

Report on the eel stock, fishery and other impacts, in:

Portugal

2023/24

Note to the reader - this document accompanies a series of spreadsheet tables that provide the bulk of the data in a format most suitable for the working practices of the WGEEL. Summaries of these data are provided in this document.

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1 Updates to the previous report

All tables and figures have been updated with the latest available data.

The tables showing landings of glass eel and yellow eel have been replaced by figures.

2 Stock status summary

The most recent (2021-2023) stock indicators of silver eel escapement biomass, mortality rates, and assessed habitat area, for the two Eel Management Units (EMUs) reported by Portugal: PT_Port and ES_Minh, are presented in Table 2.1.

Table 2.1. Stock indicators of silver eel escapement biomass and mortality rates, and assessed habitat area for two EMUs, PT_Port and ES_Minh (transboundary EMU shared with Spain), by year, from 2017 to 2023.

EMU_code	Year	Assessed Area (ha)	B ₀ (kg)	B _{curr} (kg)	B _{best} (kg)	B _{curr} /B ₀ (%)	ΣF	ΣH	ΣA
PT_Port	2017	135487	1625215	210336	537604	12.94	0.94	0.00	0.94
	2018	135487	1625215	423682	1008549	26.07	0.87	0.00	0.87
	2019	135487	1625215	1018614	1289054	62.68	0.24	0.00	0.24
	2020	135487	1625215	856344	1336535	52.68	0.30	0.00	0.30
	2021	135487	1625215	980632	1125018	60.34	0.14	0.00	0.14
	2022	135487	1625215	263072	536536	16.19	0.71	0.00	0.71
	2023	135487	1625215	368406	658786	22.67	0.58	0.00	0.58
ES_Minh	2017	1823,69	36474	4278	36474	11.7	2.73	0.00	2.73
	2018	1823,69	36474	831	34400	2.28	3.72	0.00	3.72
	2019	1823,69	36474	2816	35564	7.72	2.54	0.00	2.54
	2020	1823,69	36474	5008	27221	13.73	1.69	0.00	1.69
	2021	1823,69	36474	2633	42146	6.25	2.77	0.00	2.77
	2022	1823,69	36474	2976	18739	15.88	1.84	0.00	1.84
	2023	1823,69	36474	2320	63275	3.67	3.31	0.00	3.31

Key:

EMU_code = Eel Management Unit code

B₀ = the amount of silver eel biomass that would have existed if no anthropogenic influences had impacted the stock (kg).

B_{curr} = The amount of silver eel biomass that currently escapes to the sea to spawn (in the assessment year) (kg).

B_{best} = The amount of silver eel biomass that would have existed if no anthropogenic influences had impacted the current stock (kg).

ΣF=mortality due to fishing, summed over the age groups in the stock (rate)

ΣH=anthropogenic mortality excluding the fishery, summed over the age groups in the stock (rate)

ΣA=all anthropogenic mortality summed over the age groups in the stock (rate)

Assessed area (ha) = combined area total (ha) of transitional (combining estuaries and coastal lagoons), and inland waters.

3 Overview of the stock and its management

3.1 Describe the eel stock and its management

3.1.1 EMUs, EMPs

In accordance with Council Regulation (EC) No 1100/2007, Portugal has considered **two EMUs** in accordance with Article 2 of the Eel Regulation: one covering the whole country (mainland), and another covering the International River Minho. Therefore, Portugal submitted **2 EMPs**: a **national EMP** and a **transboundary EMP**, shared with Spain, for the river Minho.

The **Portuguese Eel Management Plan (PT_Port)** was submitted in December 2008. This EMP was approved by the European Commission on 5 April 2011, following the submission of the last revised version on the 19 November 2010.

Despite the existence of 5 river basins extending beyond Portugal (Minho, Lima, Douro, Tagus, and Guadiana) (Figure 3.1a), and included in three different river basin districts (Figure 3.1b), it was agreed between both countries that the only Transboundary Eel Management Plan to be considered should be for the River Minho, as it is the only international river where the estuary mouth is shared by both countries and where there is a strong interest in glass eel fisheries. Due to delays in coordination between the two countries, it was not possible to take this into account when submitting the Portuguese Eel Management Plan in December 2008.

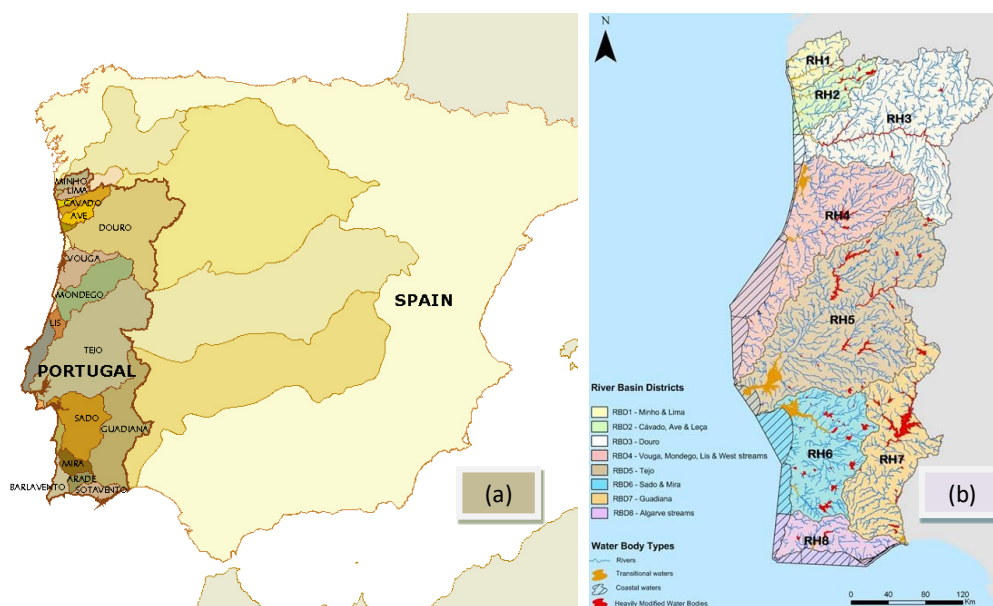


Figure 3.1. Map showing Portuguese River basins including the catchment area extending to Spain (a), and limits of the 8 Portuguese River Basin Districts defined according to the Directive 2000/60/EC (b). RBD is labelled as RH in the map.

A first version of the **Transboundary EMP** for the **River Minho (ES_Minh)**, was sent to the European Commission in June 2011, followed by a revised version in November of the same year. The Transboundary EMP was approved by the European Commission on 21 May 2012.

Because the EMP for the River Minho was not submitted on time, Portugal had to reduce fishing effort in that river until the EMP was implemented. Several measures were therefore taken to comply with the provisions of Article 4, number 4, *i.e.* to reduce fishing effort by at least 50%

compared to the average effort deployed between 2004 and 2006. These measures included a reduction in the number of glass eel fishing licences, a reduction in the glass eel fishing area, a reduction in the fishing season and a ban on fishing for other eel stages (yellow and silver).

3.1.2 Management authorities

The eel fishery is managed by the **DGRM** (General Directorate of Natural Resources, Maritime Safety and Services), which is responsible for coastal waters, and the **ICNF** (Institute of Conservation of Nature and Forests), which is responsible for inland waters. These institutions depend on two ministries: the first, on the Ministry of Agriculture and Fisheries, and the second on the Ministry of Environment and Energy. The exception is River Minho because it is an international river with a common section bordering the two countries, and therefore jointly managed by a Commission (**Standing Transboundary Commission of the River Minho**), which includes representatives from both countries and establishes specific rules applicable to fishing in the international section of this river basin. Licences to fish in inland waters are issued by the ICNF, while licences to fish in transitional and coastal waters are issued by the DGRM. Licences for Portuguese fishermen to fish for glass eels in the River Minho are issued by the **Capitania do Porto de Caminha**.

The management of water bodies is the responsibility of the **APA** (Portuguese Environment Agency) and 5 regional administration authorities for inland waters, which are under the Ministry of Environment and Energy. These authorities are responsible for the implementation of the Water Framework Directive, and therefore, for obstacles in water basins.

Finally, the ICNF is also the **National Authority for the CITES Convention**, which implies that it also has a role in the implementation of the EMPs.

3.1.3 Fishery regulations

Glass eel fishery is forbidden in all river basins since 2000 (*Decreto Regulamentar no 7/2000*), except for the international River Minho where it is still permitted (*Decreto Lei no 316, artº 55 of 26/11/81*).

Yellow eel fishery is ruled by 11 specific byelaws applied to 11 fishing areas in coastal waters (estuaries and coastal lagoons) and 9 other byelaws that are applied to specific fishing areas designated ZPPs (Zonas de Pesca Profissional / Professional Fishing Zones) (See Figure 3.2a), which are the only areas where professional eel fishery is allowed in freshwater. These byelaws set the number of fishermen, the rules for types and characteristics of fishing gears permitted, and in most cases, limit the maximum number of gears per fishing licence. Although professional fishing in freshwater is regulated by Decree-Law 112/2017 (6 September 2017), this legislation applies to the stretches represented in green, while in sections represented in yellow (ZPPs) the fishery is ruled by the 9 above mentioned byelaws (Figure 3.2b).

In the fisheries managed by the DGRM landing reports are mandatory because eels are sold at fish auctions, while in inland waters, there are no auctions. According to Decree-Law 112/2017, professional fishermen must hold a special licence to fish for eels and are obliged to report their catches. If these catches are not reported, their fishing licence will not be renewed for the following year. The minimum legal size is 22 cm in both jurisdictions. The yellow fishery is permitted from 1 January to 30 September.

To promote **silver eel** escapement, a three-month closure was implemented from October to December. This prohibition to fish eels (yellow and silver) was first set in 2010 for waters within the jurisdiction of DGRM, *i.e.*, estuaries and coastal lagoons (*Portaria nº 928/2010, from 20 September*) and in 2012 for waters under the jurisdiction of ICNF, *i.e.*, inland waters (*Portaria nº 180/2012, from 6 June*). In River Minho the yellow and silver eel fishery is forbidden since the fishing season 2011-2012.

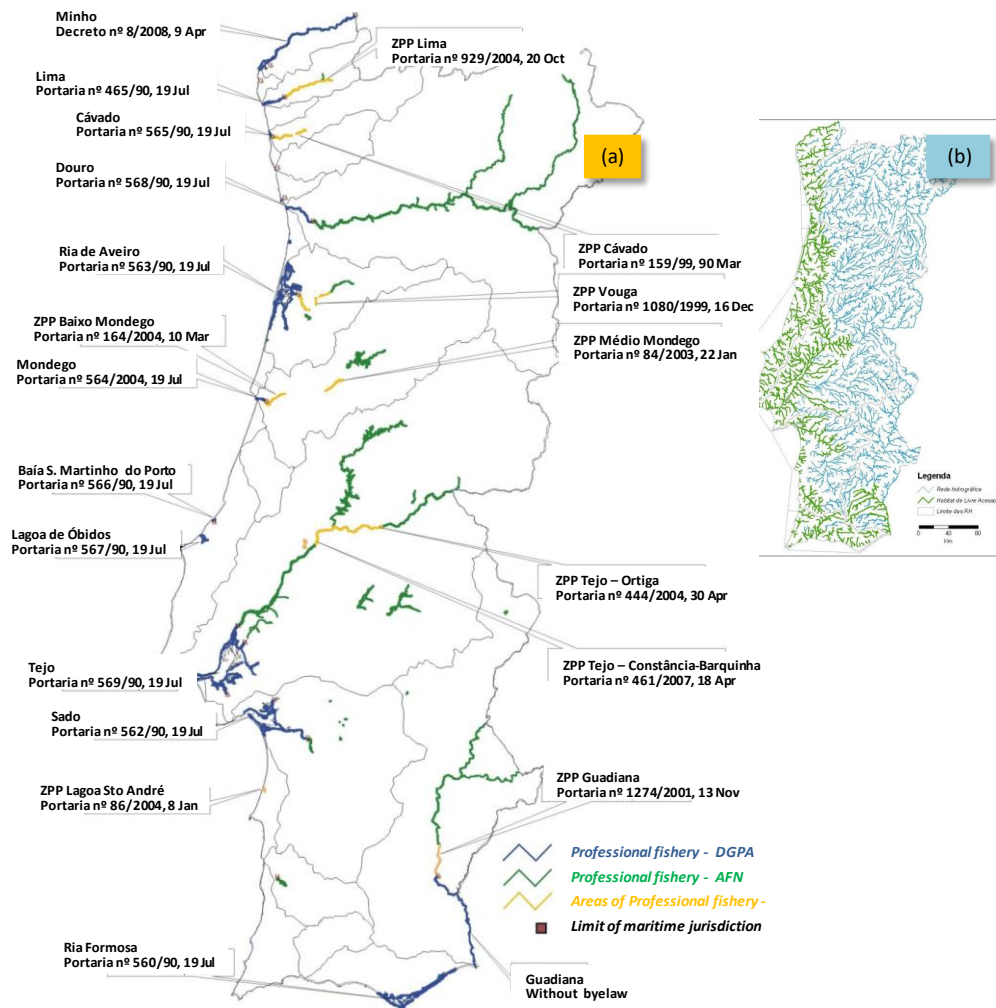


Figure 3.2. Map showing areas where professional fisheries can be conducted both in estuaries and coastal lagoons (jurisdiction of DGRM) and in inland waters (jurisdiction of ICNF) (a). The limit of maritime jurisdiction and the byelaws that rule the fisheries at each area are presented in the map (a). (Source: ICNF). The habitat that is accessible for the eel is also represented in green (b).

3.1.4 Management actions

The main objective of the Portuguese Eel Management Plan (PT_Port EMU), which considered the entire country as one Eel Management Unit (EMU), was to establish a series of measures to be applied at the national level that could contribute to reduce mortality and increase silver eel escapement as requested by Regulation (EC) N° 1100/2007. These measures can be classified into 4 categories:

- Fisheries restrictions
- Mitigation of obstacles to upstream migration
- Reinforcing police control on glass eel poaching
- Data collection (Habitat/stock assessment)

An overview of the measures foreseen in the Portuguese EMP is presented in Table 3.1.

Table 3.1. List of the management measures foreseen within the scope of the Portuguese EMP (PT_Port) and state of implementation. 😊 - Fully implemented; 😞 - Partially implemented.

MEASURE TYPE	MEASURE DESCRIPTION	LIFE STAGE	PLANNED	PROGRESS	DATE
Commercial fishery	Prohibit the eel fishery outside the professional fishing areas in freshwater jurisdiction	Y	After 2011	😊	Decree-Law 112/2017
	Set maximum number of fishing gears and licences per professional fishing area, in freshwater	Y	After 2011	😊	2017
	Introduce obligation to report catches in freshwater to obtain a licence the following year	Y	After 2011	😊	2017
	Introduce a specific annual licence for eel fishery in freshwater jurisdiction	Y	After 2011	😊	2017
	Introduce closed fishing season (1 October to 31 December) in freshwater jurisdiction	Y/S	After 2011	😊	Portaria n° 180/2012
	Introduce closed fishing season (1 October to 31 December) in marine jurisdiction	Y/S	until 2012	😊	Portaria n° 928/2010
	Reduce the number of licences for marine water jurisdiction	Y	2009-	😊	ongoing
Recreational fishery	Prohibit recreational eel fishery in marine (M) jurisdiction	Y	After 2011	😊	Portaria n° 14/2014
	Prohibit recreational eel fishery in freshwater (F) jurisdiction	Y	After 2011	😊	Portaria n° 108/2018
Hydropower & Pumps	Mitigate the impact of existing obstacles (upstream migration)	G/Y	After 2011	😞	ongoing
Restocking	0	na	na	na	na
Scientific monitoring	Collect data and conduct studies on the stock (Recruitment/Production/Escapement)	All	Until 2012	😊	DCF 2017-ongoing
Illegal fishery	Monitoring and control of glass eel poaching	G	2009-	😊	ongoing

In general, all measures related to fisheries have already been implemented. These measures focused on reducing the fishing capacity and effort, but also on prohibiting fishing during the most intensive period of silver eel migration. In addition, to control the eel fishery in freshwater and reduce fishing effort where necessary, a special licence for the eel fishery was introduced in 2018, under the designation of species of relevant interest for professional fishing (Decree-Law No. 112/2017).

With the approval of the Portuguese EMP, measures to reduce poaching have been stepped up, both in the aquatic systems where fishing takes place and on land during the transport of catches. Several actions have been carried out by the authorities both in the marine jurisdiction (National Maritime Police) and in the freshwater jurisdiction (SEPNA, a special unit of the GNR, the National Republican Guard). These authorities have made great efforts to control the situation, but the nets seized are quickly replaced by new ones. SEPNA is responsible for monitoring illegal fishing activities and can also act on land. However, another special unit of the GNR, the

UCC (Coastal Control Unit) operates close to the coast and has also been involved in these operations.

In recent years, there has been a strong cooperation between the Portuguese control forces as well as the criminal police with the pressure on the international illegal trade generated by the listing of *Anguilla anguilla* in CITES, the Portuguese Food and Economic Security Authority (ASAE) together with the CITES authority have been involved in joint actions that resulted in the seizure of glass eels as well as dismantling of trafficking of glass eels at several Portuguese airports, on several occasions. Cooperation with the Spanish authorities, as well as with Europol and Interpol, have also been improved within the scope of the illegal trade on glass eels.

With the pressure on international illegal trade generated by the listing of *Anguilla anguilla* in CITES, the Portuguese control forces and the criminal police together with the CITES authority have been involved in joint actions that resulted in the seizure of glass eels and dismantling of international criminal networks involved in the trafficking of glass eels. Cooperation with the Spanish authorities, as well as Europol and Interpol, have also been improved within the scope of the illegal trade on glass eels.

A joint operation - Operation CAVIAR - revealed that glass eels caught in various national estuaries were temporarily stored in facilities available to the suspects and then transported to Spain and France, where they were finally illegally exported by air to countries in Southeast Asia. The investigation, which began in January 2023, and led to the dismantling of part of this structure with international implications in northern Spain in March 2023, was led by the direction of the Department of Investigation and Criminal Action of Porto (DIAP) and aimed to dismantle the facilities of a group of highly organised individuals dedicated to fishing, storing and transporting this protected species without complying with legal formalities. During the operation, which ended in June 2024, it was possible to collect evidence and seize the means linked to the criminal activity, namely vehicles, boats and other objects used for fishing and packaging live specimens. The operation was carried out with the operational support of EUROPOL and the collaboration of the SEPRONA service of the Spanish Guardia Civil and the French customs authorities. (More information on the operation can be found at <https://regiaodecoimbra.sapo.pt/noticias/operacao-caviar-desmantelamento-de-rede-organizada-de-pesca-ilegal-de-meixao.>)

Another mega-operation carried out by police investigation units in Portugal and Spain has led to the dismantling of a major international criminal network involved in the trafficking of glass eels in May 2024. The operation, which took place over two years, resulted in the arrest of 21 people of various nationalities in *flagrante delicto* and the seizure of approximately 420 kg of glass eels by air and 293 kg by land, bringing the total seizure of glass eels in the investigation to over 800 kg. (More information on the operation can be found at <https://observador.pt/2024/05/25/megaoperacao-da-policia-portuguesa-e-espanhola-desmantela-rede-criminosa-de-traffic-de-meixao/>)

The most difficult measures to implement are related to restoring longitudinal connectivity for fish migration because there are numerous obstacles, and their impact has not been evaluated. As for the need to collect data on the stock (recruitment/production and escapement), vital to accomplish the objectives set by the Eel Regulation, it was finally started in 2017, under the EU MAP obligations.

The implementation of the Transboundary EMP for the River Minho has been more successful, mostly because it includes a smaller area and the measures were all focused on the fishing activity, which is easier to implement. The results are presented in Table 3.2.

Table 3.2. List of the management measures foreseen within the scope of the Transboundary Eel Management Plan for the River Minho (ES_Minh) and state of implementation. 😊 - Fully implemented.

MEASURE TYPE	MEASURE DESCRIPTION	LIFE STAGE	PLANNED	OUTCOME
Commercial fishery	Prohibit the eel fishery	Y/S	EMP	😊
	Reduce fishing effort	G	EMP	😊
	Introduce obligation to fill in logbooks	G	After approval	😊
Recreational fishery	Prohibit the eel fishery in marine jurisdiction	Y/S	EMP	😊
Hydropower & Pumps	0	na	na	na
Restocking	0	na	na	na
Other	0	na	na	na

In the international hydrographic basin of River Minho, and within the scope of the MigraMiño-Minho project (<http://migraminho.org/>) some actions were undertaken to improve the connectivity for migratory fish in two of its Portuguese tributaries.

3.2 Significant changes since last report

There have been no significant changes in the status of eel and management of human impacts since the last country report.

4 Impacts on the stock

4.1 Fisheries

4.1.1 Glass eel fisheries

There has never been recreational glass eel fishery in Portugal. The glass eel fishery is prohibited in all rivers in Portugal (*Decreto Regulamentar* nº 7/2000 of May 30), except in the River Minho (*Decreto-Lei* 316 artº 55 of 26/11/81). It was after the fishing season 2000/2001 that the fishery became prohibited in all other Portuguese rivers, except for aquaculture and restocking programmes. The official Portuguese fishery statistics from Minho are kept by the responsible local Authority – Capitania do Porto de Caminha. Total annual statistics have been recorded since 1974.

The total landings and the number of licences issued annually to fish for glass eels, between 2005 and 2024, are presented in Figure 4.1. There have been some changes in the number of licences throughout time, as well as in the extension of the fishing season and the fishing area.

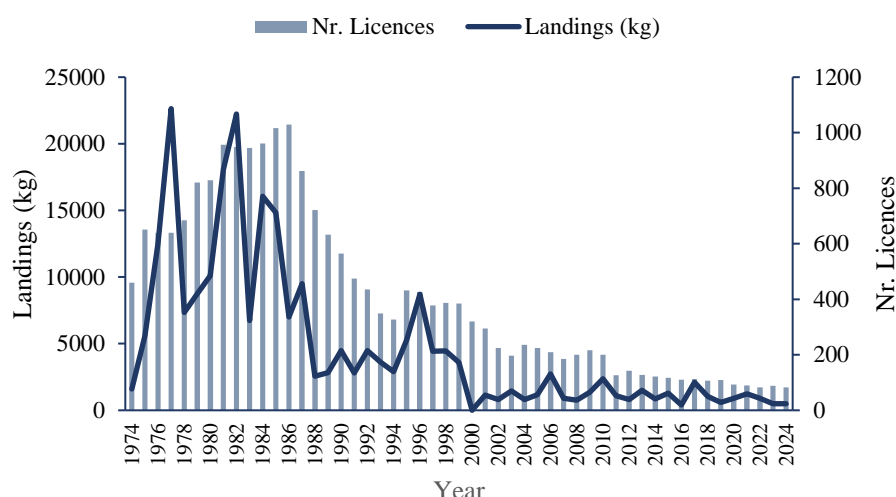


Figure 4.1. Commercial catches (kg) of glass eel caught in the Portuguese part of the River Minho and number of fishing licences issued from 2005 to 2024. (Source: Capitania do Porto de Caminha).

To reduce fishing pressure, the Standing Transboundary Commission of the River Minho decided that from the 2010/2011 fishing season onwards, the maximum number of fishing licences to be issued by each country would be 200, and that the fishing area of the glass eel fishery would decrease by 25 km in the river length. In the same year a new change was introduced in the licensing process, and licences started to be issued to the owners of the boats and not to fishermen, implying that the drop to 126 licences in 2011 is a consequence of these changes rather than a real reduction in fishing pressure. However, the number of fishermen is generally the same, with two men per boat.

Glass eel fishery in the river Minho was permitted between November and April for many years, but after the fishing season 2005/06, mostly due to the eel population decline and the high fishing pressure, an agreement between the Portuguese and Spanish authorities, started to gradually reduce the fishing period. After this period, the fishing season included four new moons (the most profitable period), but fishing could only take place 8 days before and 8 days after each new moon, for a total of ≈ 60 fishing days. A daily **fishing quota** was set for this fishery. The maximum catch of glass eel in 2023/24 was: 2Kg/fisherman/night. A new restrictive measure has been introduced for the 2023/24 fishing season, allowing only 30 fishing days, spread over the months of November and January. In the 2023/24 fishing season, fishing took place between 9 November and 15 January, with one week of fishing around each new moon.

4.1.2 Yellow eel fisheries

Fishing capacity in freshwater is not known, and under current legislation, it is not possible to estimate the number of fishermen and the gear they use. Professional fishermen must obtain a licence issued by the ICNF to fish in these waters and they are obliged to report their catches. Professional fishing is regulated by 9 byelaws, which define the river sections where fishermen are allowed to fish, establish the number of fishermen for each fishing season and the rules for fishing (fishing gear and mesh size, species size limit, hour restrictions and species restriction).

Fishing licences issued by the DGRM for local fishing in estuarine and coastal waters are linked to fishing boats. The same fishing boat may be licensed to fish with more than one type of fishing gear. In some areas under the jurisdiction of the DGRM, there is a policy on the

maximum number of fishing gears permitted by licence. This does not mean that fishermen use them all, but the number they use is unknown. The type, number and characteristics of eel fishing gears vary between fishing areas. There are 11 specific byelaws that lay down the rules for 11 fishing areas. However, for certain areas and/or fishing gears there is no limit on the number allowed per licence. These different rules and the lack of records on the actual number of fishing gears used by fishermen add to the difficulties in estimating fishing capacity.

The use of fyke nets in the River Minho was banned by Decree 8/2008 (9 April) and its application started with the 2008/2009 fishing season. However, longlines are still allowed in the international part of the river (80 Km) and eels are caught as by-catch (maximum 10% allowed) in other fisheries.

Landings from coastal fisheries (estuaries and coastal lagoons) are shown in Figure 4.2. A decline in catches was observed after 2010 and has continued until today. However, it should be noted that a three-month ban (October, November and December), implemented in 2010 (Portaria n° 928/2010, from 20 September), could explain the observed decline. In addition, the closure of the fishery has been extended until 28 February 2024 (*Despacho No 15/DG/23, from 28 March*) in a total of six months. The changes in fishing regulations resulting from the implementation of the EMP make it even more difficult to assess the trend of the stock on the basis of landings.

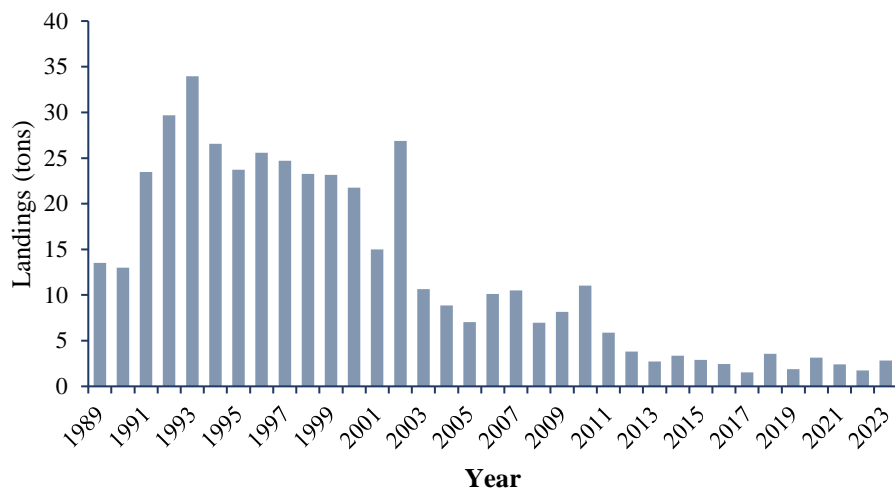


Figure 4.2. Annual landings from the yellow eel fishery in coastal waters (estuaries and coastal lagoons) from 2005 to 2023. (Source: DGRM). (A ban on eel fishing between October and December was introduced in 2011 to increase the silver eel escapement).

4.1.3 Silver eel fisheries

There has never been a silver eel fishery in Portugal. With the implementation of the EMP eel fishing has been closed during the main spawning migration period, *i.e.* from 1 October to 31 December in both marine (Portaria n° 928/2010) and freshwater (Portaria n° 180/2012) jurisdictions. In addition, in a professional fishing zone of freshwater jurisdiction, fishermen who catch silver eels outside the national closure period (October to December) are obliged to return them to the water.

4.2 Restocking

There is no stocking of eels in Portugal.

4.3 Aquaculture

Aquaculture production of European eel is not significant in Portugal as there are no eel aquaculture units in Portugal. In brackish water systems, eel production is a by-product of aquaculture systems dedicated to extensive and semi-intensive seabass (*Dicentrarchus labrax*) and seabream (*Sparus aurata*) culture. Eel production in these systems is shown in Table 4.1. The increase in eel production recorded in 2017 was due to an eel farming facility that only produced in 2017, but that facility is now closed.

Table 4.1. Aquaculture production of eels (Kg) between 2010 and 2022 from the EMU PT_Port (Source: DGRM)

YEAR	PRODUCTION
2010	285
2011	562
2012	886
2013	1383
2014	917
2015	890
2016	1060
2017	32963
2018	456
2019	765
2020	121
2021	42
2022	45

4.4 Entrainment

Anthropogenic impacts identified in the two Eel Management Plans (PT_Port and ES_Minh EMU) were mainly related to fisheries and obstacles to migration that have reduced the habitat available for growth. Although turbine activity is usually a major mortality factor especially for silver eels, in Portugal there is no passage for eels in the hydroelectric dams, which implies that there is no mortality associated with turbines. Furthermore, as these EMPs do not include stocking of upriver sections inaccessible to eels, these facilities do not pose a problem for silver eels escaping from continental waters to spawn. As for pumps or diversions, they may become a problem, particularly for glass eels, which can be easily entrained by the pumps, but this impact has not been considered and is not being assessed.

4.5 Habitat Quantity and Quality

Habitat quality and quantity have been considered in the PT_Port EMU. The improvement of water quality was a measure set in the Portuguese EMP to be achieved by the implementation of WFD, but it has never been identified as a problem. However, because there are many obstacles in the water courses, the quantity of habitat available for eels to grow, required a list of needs to be implemented in the short, medium, and long run. The quantity of habitat free of obstacles has also increased in River Mondego. A project entitled “Rehabilitation of habitats for diadromous fish in the River Mondego” funded by Programa Operacional Pesca 2007-2013 (PROMAR) (Reference 31-03-02-FEP-5), which aimed to remove obstacles allowed to install an eel pass in the first dam that was hampering the colonization of the watershed. The result

was an effective increase of 30 km of river completely free of obstacles. The monitoring of the eel pass is under course.

In River Minho, the presence of the Frieira dam prevents eels from migrating upstream. As such, there is a high concentration of juvenile eels (elvers) just below this obstacle, which has driven the authorities to release these individuals in tributaries located below the dam to reduce mortality derived from high densities. In total, there was a redistribution of 3.9 tonnes of eels between 2011 and 2024 (Table 4.2). Under the MigraMiño-Minho project there was intervention at 2 obstacles in the Gadanha River and 1 obstacle in the Mouro River, both tributaries of the Minho River, to improve river connectivity for migratory fish. However, there is no monitoring of eel passage.

Table 4.2. Quantity of eels (kg) captured below the Frieira dam both in the salmonid ladder and in the ramp between 2011 and 2024 (Source: Conselleria del Medio Ambiente)

YEAR	Ramp	Ladder	TOTAL
2011	187.52	0	187.52
2012	243.18	0	243.18
2013	98.86	658.45	757.31
2014	136.01	426.65	562.66
2015	103.75	652.3	756.05
2016	70.76	104.28	175.05
2017	82.7	915.44	998.145
2018	0	0	0
2019	0	216	216
2020	0	232.94	232.94
2021	14.41	12.45	26.87
2022	0	55.35	55.35
2023	0	0	0
2024	0	571	571
TOTAL	937.19	3844.86	4782.05

4.6 Others

Nothing to report.

5 National stock assessment

5.1 Description of Method

5.1.1 Data collection

Surveys to estimate stock parameters are currently carried out under the DCF, which started to include the eel in 2017. A combination of methods including the commercial fisheries and independent surveys, is used as a proxy to estimate stock indicators. Where there is a fishery, it is monitored, but where there is no fishery, experimental fishing is carried out.

These data are used to estimate the biomass of silver eel escaping from each EMU.

Data collected from electrofishing surveys and fyke nets are used to estimate silver eel production. The index river chosen to represent the PT_Port EMU was the River Mondego (estuary and freshwater) to compare with data from the 1990s. The selection of this river is in line with the recommendations from the WKESDCF (ICES, 2012). However, as this EMU covers the whole country and eel production is influenced by the type of aquatic system, a coastal lagoon (Santo André Lagoon) was also included in the data collection to represent the diversity of aquatic systems (river + estuary + coastal lagoon). These surveys include experimental fishing to estimate recruitment (monthly from November to May) and surveys of yellow and silver eels in the Mondego River. Moreover, biological sampling is also carried out within the framework of the DFC. Each year, a sample of eels is taken for length, weight, sex, and age determination.

As for the other EMU, ES_Minh, the same surveys and biological sampling are carried out under the DCF. Fishing for yellow eel is prohibited, which means that biological sampling is carried out by experimental fishing.

5.1.2 Analysis

EMU PT_Port

Estimates of the silver eel biomass were improved compared to the estimated biomass provided in the Portuguese EMP (**EMU PT_Port**) presented in 2008, in which calculations were done by extrapolating data from watersheds of France. The biomass estimates herein presented are based on the densities of yellow eel surveys conducted in the Mondego River, using electrofishing in freshwater and fyke nets in the estuary. Additionally, sampling of yellow and silver eels that has been conducted between 2014 and 2016 within the framework of the Project “Rehabilitation of habitats for diadromous fish in the River Mondego” funded by PROMAR, provided data to determine the mean silvering age, the mean weight (yellow and silver eels), and the silvering rate. Data from scientific surveys conducted in 1988-90 (Domingos, 2003 and unpublished data) were used to improve estimates of the pristine biomass of silver eels.

The stock indicators were calculated for the PT_Port EMU, extrapolating the silver eel production obtained in the river Mondego, according to the following expressions:

$$B_0 = [(YE \text{ densities } 1988) * (\text{silvering rate})] * \text{mean SE weight} * \text{wetted area}$$

$$B_{\text{current}} = [(YE \text{ densities } \text{YEAR}) * (\text{silvering rate})] * \text{mean SE weight} * \text{wetted area}$$

$$B_{\text{best}} = B_{\text{current}} + \text{Anthropogenic mortality in Silver Eel Equivalents (SEE)}$$

The silvering rate and mean silver eel weight were obtained by conducting surveys in the river Mondego during the Autumn period when silver eels can be distinguished morphologically. The silvering rate was estimated calculating the ratio between these individuals and the non-migrating ones (Durif *et al.*, 2009), being 2.8%, and the mean weight considered was 109g.

The wetted area is the natural habitat of eel in the PT_Port EMU, which was considered unchanged since 1988, because all the anthropogenic obstacles present in 2017 already existed in 1988. Therefore, the pristine habitat (referred to the period 1988) in the EMU is the same as the current habitat and amounts to a total of 1625215 ha (see Table 2.1).

Anthropogenic mortality in SEE was calculated using the method proposed by the WGEEL taking into account the generation time, based on the age determined for silver eels from the Mondego. Catches of glass and yellow eel (silver eel fishing is forbidden) were used, and an 80% mortality in glass eel settlement (Briand, 2009) and annual mortality of 0.138 were

considered (Dekker, 2000); the yellow eel weight of yellow and silver eel considered each year is presented in Table 5.1.

Since glass eel fishery is forbidden in the PT_Port EMU, the catches from the Minho River (fishery allowed) were used to estimate the illegal catches in the EMU by extrapolation. It was therefore considered that the main river basins (Lima, Cávado, Ave, Douro, Vouga, Mondego, Tejo, Sado, Mira, Guadiana) from the PT_Port EMU had the same amount of illegal fishing as the legal fishing that occurs in the Minho river, and the total of illegal catches estimated by this method was considered to represent illegal catches of glass eel throughout the whole EMU.

Table 5.1. Data used to estimate the anthropogenic mortality in SEE for the PT_Port EMU in the 2024 EMP Progress Report

Year	Glass eel mean weight (g)	Yellow eel mean weight (g)	Silver eel mean weight (g)	Yellow eel mean age	Silver eel mean age	Glass eel settlement mortality	Eel natural mortality
2021	0.30	17.8	95.7	3	5	80%	0.138
2022	0.29	15.3	64.8	3	4	80%	0.138
2023	0.33	16.9	88.5	2	5	80%	0.138

The only anthropogenic mortality considered was the mortality derived from the fisheries, which was estimated using the following expression:

$$\text{SumF} = -\ln(B_{\text{current}}/(B_{\text{current}} + \text{kg SEE})).$$

In the 2021 and 2024 post evaluation reports, the stock indicators were calculated for the PT_Port EMU, extrapolating the silver eel production obtained for the River Mondego, but splitting densities into freshwater density and estuary density, according to the following expressions:

$$B_0 = [((\text{YE estuarine density 1988}) * (\text{silvering rate})) * \text{mean SE weight}] * \text{wetted area}] + [((\text{YE freshwater density 1988}) * (\text{silvering rate})) * \text{mean SE weight}] * \text{wetted area}]$$

$$B_{\text{current}} = [((\text{YE estuarine density YEAR}) * (\text{silvering rate})) * \text{mean YEAR SE weight}] * \text{wetted area}] + [((\text{YE freshwater density YEAR}) * (\text{silvering rate})) * \text{mean YEAR SE weight}] * \text{wetted area}]$$

$$B_{\text{best}} \text{ YEAR} = B_{\text{current}} \text{ YEAR} + \text{YEAR Anthropogenic mortality in Silver Eel Equivalents (SEE)}$$

EMU ES_Minh

For the calculation of B_0 in the Minho River (**ES_Minh**), an average area production rate (20kg/ha) (ICES, 2001) has been applied to the pristine habitat. The pristine habitat has been estimated using order number of tributaries of international catchment area adding area of international main river. Only the international area was considered due to the presence of an impassable dam $B_{\text{current}} = \text{Extrapolation of the Silver eel productivity per hectare obtained in electrofishing surveys in tributaries and extrapolated to available wet area. The eel density, available wet area, silvering rate, mean weight at silvering, were also considered for the estimate. } B_{\text{best}} = B_{\text{current}} + \text{Anthropogenic mortality in SEE. A likely error is associated with the new } B_{\text{current}} \text{ calculation and that will need to be mitigated in the future because only Portuguese tributaries have been considered and the eel length classes have been reduced due to translocations of eels 12-15 cm from Frieira dam over the last few years. Although CPUE data for yellow and silver eels are available for the main river (fyke nets) they were not considered. The mortality was calculated}$

on the basis of biological data from yellow and silver eels caught by electrofishing surveys in tributaries (average weight) and glass eels caught by experimental fishing (average weight). The assigned age for this system was 5 years for yellow eels and 8 years for silver eels. For the calculation of F glass eel in SEE (Kg) the fishing mortality of glass eels recorded 8 years ago was considered.

5.1.3 Reporting

Estimates of stock indicators are included in the EMP progress reports (PT EMU and PT Minho EMU), as required by the EU Eel Regulation (1100/2007).

The data used, which started to be collected recently (from 2017 onwards) under the DCF is used/included in the annual ICES data call from the WGEEL and the country reports. It strongly contributes to estimate the indicators and to improve the stock assessment.

5.1.4 Data quality issues and how they are being addressed

As it refers to PT_Port, the following quality issues need to be addressed in a near future:

- Anthropogenic mortality indices, i.e. illegal glass eel fishing, are extrapolated from landings in the Minho River;
- Density from the Mondego estuary was used to extrapolate for all transitional waters (estuaries + coastal lagoons) for the most recent estimates of biomass indicators (2017-2023). DCF data from Santo André coastal lagoon will be used in a near future to improve production estimates in transitional waters throughout this EMU;
- Silver eel biomass indicators represent total production and not actual escapement. As silver eel fishery is forbidden, silver eel escapement was measured for two consecutive years (2014-16) in the River Mondego using telemetry. In total, 42% silver eels escaped successfully to the sea, but the success increased to 90% when only the estuary was considered (Monteiro *et al.*, 2020). A less cost-effective solution needs to be found.

5.2 Assessment results

The assessment results presented in chapter 2 covers only 7 years, making it difficult to report changes or trends over time. However, there is a difference between PT_Port and ES_Minh, with the first EMU showing compliance with the EU target of 40% of the pristine biomass in some years.

6 Other data collection

6.1 Recruitment time series

The recruitment time series that has been used by the WGEEL to analyse the trends in recruitment is the commercial glass eel fishery in the River Minho. There have been some changes in the number of licences over time (Figure 4.1), as well as in the extension of the fishing season.

There are no other recruitment series, but within the scope of the DCF, two new fishery-independent series were started in 2017: one in the Minho River and another in the Mondego River. The methodology and sampling location used in the Mondego estuary are the same as those used by Domingos (1992), which will make it possible to compare current recruitment with data from the late 1980s, when recruitment started to decline.

6.2 Yellow eel abundance surveys

Yellow eel surveys have been carried out in the Mondego River and the Santo André Lagoon, as part of two projects funded by PROMAR. The same was done in River Minho tributaries and River Mondego, under the SUDOANG project, following a common sampling protocol. The surveys on the abundance of yellow eel, initiated in 2017 under the DCF, are still ongoing.

6.3 Silver eel escapement surveys

Scientific surveys on silver eel escapement have been conducted within the scope of two projects funded by PROMAR: one in the River Mondego and the other in Santo André Lagoon. In both cases, receivers were installed in the aquatic systems studied along the water course until the river mouth (Mondego River) and in the coastal area close to the opening of the lagoon (Santo André Lagoon) to measure escapement. The results of 42% silver eel escapement obtained for the Mondego River (Monteiro *et al.*, 2020) from a total of 36 male silver eels tagged indicates some silver eels are lost on their downstream migration.

Scientific surveys on silver eel abundance in River Minho basin have been conducted within the scope of SUDOANG and MigraMinho projects using electrofishing surveys in tributaries and fyke-nets in the river Minho.

6.4 Biological parameters

Biological parameters have been collected under the DCF since 2017. River Mondego, River Minho and Santo André Lagoon have been selected as representative of all habitat types present in the PT_Port EMU, which covers the whole country. The River Minho was also included to sample biological parameters from the ES_Minh EMU. Since 2017, a total of 100 eels per habitat type have been sampled annually.

Biological parameters collected include: - For yellow/silver eels: total length, total weight, sex, life stage, age and *Anguillicola crassus* infection. Silver stage is being identified according to Durif *et al.* (2009). - For glass eels: total length, total weight and pigmentation stage.

In eel age studies carried out in Portugal, sagittal otoliths were removed, cleaned with water, stored dry, and cleared in 70% alcohol (Vollestad, 1985) for 10 minutes before being examined under a stereomicroscope. Otoliths were read by more than one person (Gordo & Jorge, 1991), or by the same person twice (Costa, 1989; Domingos, 2003; Lopes 2013, Monteiro 2015, Santos 2016; Correia *et al.*, 2021). If there was disagreement between the two readings, a third reading was performed and if inconsistent, the otoliths were excluded from the analyses.

Within SUDOANG, otoliths from the Mondego pilot basin have been prepared according to the protocol established within the project, which followed the recommendations from ICES (2009; 2020).

Moura *et al.* (2022) investigated the age structure of European eel in the Minho River, including freshwater and estuarine habitats. The techniques used for age reading involved a combination of clearing and embedding the otoliths in epoxy resin and grinding them (for eels older than 5 years), following the recommendations from ICES (2009; 2020).

Stock assessment requires the collection of stock indicators to meet the objectives of the Eel Regulation (mortality and biomass indicators). A combination of methods including commercial fisheries and independent surveys, are used to estimate these indicators in both EMUs.

6.5 Parasites & Pathogens

There is not a national programme to monitor parasites or pathogens. *Anguillicola crassus* is however spread throughout the country. Although not mandatory, the assessment of the infection by the parasite *A. crassus* is being carried out under the DCF and includes several river basins. Preliminary results from the Mondego basin show that the prevalence in freshwater and brackish water, i.e., the estuary, is similar, with 50% and 40%, respectively. A summary of the infection in previous years is given below.

In a study conducted in 2008 in five brackish water systems (Aveiro Lagoon, Óbidos lagoon, Tagus estuary, Santo André Lagoon and Mira estuary) it was concluded that *A. crassus* was spread in all systems except in Óbidos lagoon, which was probably related to the higher salinity observed in this lagoon, similarly to what happens in one sampling site (Barreiro) (Neto *et al.*, 2010) located in the lower part of the Tagus estuary. Prevalence values ranged from 0 to 100 % and intensity values ranged from 0.4 to 5.8. The presence of the parasite had already been reported for the River Minho (Antunes, 1999) and River Mondego (Domingos, 2003), which suggests the parasite is probably widespread in Portugal. In River Minho, the presence of the parasite was reported for the entire international section of the river and prevalence ranged between 23% and 100% (Braga, 2011). New information on the parasite infection in the Minho (Pereira *et al.*, 2022) showed that 99% of the eels had signs of damage to the swimbladder.

6.6 Contaminants

There is no routine sampling for contaminant analysis in eel. No new data are available, but existing information from previous years is presented below.

Samples of eels caught in five brackish water systems (Aveiro Lagoon, Óbidos Lagoon, Tagus estuary, Santo André Lagoon and Mira estuary), were analysed for some trace metals (Hg, Pb, Zn, Cu, Cd), showing low contamination levels compared to their European counterparts (Passos, 2008; Neto, 2008; Neto *et al.* 2011a). The most contaminated eels were obtained from the Tagus estuary. However, in this estuary no clear relationships could be established between contaminant concentrations in eel tissues (liver and muscle) and in the sediment, probably due to the general heterogeneity of environmental conditions (Neto *et al.*, 2011b). In the River Minho, significant increases in metal concentrations (Zn, Pb and Cr) were found when comparing glass eels with muscle of yellow eels between 15 and 30 cm. However, the whole sample of yellow eels (muscle and liver) showed low levels of contamination (Braga, 2011).

A comparative study of the effects of pollution on glass and yellow eels from the estuaries of the Minho, Lima and Douro rivers was developed by Gravato *et al.* (2010). The Fulton condition index and several biomarkers indicated that eels from polluted estuaries had a worse health status than those from a reference estuary, and that the adverse effects became more pronounced after several years of residence in polluted estuaries.

6.7 Predators

NO AVAILABLE DATA.

7 New Information

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