

## EU request on temporal migration patterns of European eel (*Anguilla anguilla*)

### Advice summary

ICES compiled data and information on European eel (*Anguilla anguilla*) migration to assess the seasonality of European eel migration patterns in EU waters.

Seasonal patterns of recruit arrivals (glass eel and older stages) and silver eel emigration vary geographically.

European eel recruit all year round in Portugal, Spain, and the Bay of Biscay. Typically, glass eel immigration to the Atlantic area starts in October along the coasts of Iberia and progressively later in the northeastern parts of the continent in February–March. The main migration season lasts four to five months, with arrival peaking around the third month, and with the month of the onset of the migration being different between the regions. The temporal pattern of arrivals to the shores of the western and central Mediterranean Sea is similar, although more uncertain. Recruitment to coastal Mediterranean lagoons may occur all year round, with seasonal peaks due to local factors.

The migration of silver eels starts earlier and extends over a longer period of time from areas of greater distance to the Sargasso Sea. Migration typically starts in early autumn, stalls during the cold winter months, and may resume in early spring. In the Baltic Sea, the spring peak can be more pronounced than elsewhere.

The yellow eel does not typically undertake discrete migrations. Seasonal redistributions in some waters may occur, including gradual upstream movements, but without obvious latitudinal patterns.

ICES detected no substantial change in migration patterns of eels since the implementation of the EU Eel Regulation (EU, 2007).

The seasonality of glass and silver eel passage through the narrow straits of the Baltic and Mediterranean seas, and of the English Channel, is consistent with migration patterns of nearby areas.

Data limitation and associated complexity did not allow for assessment of whether closure periods set up under the national eel management plans prior to the EU temporal closure are consistent with the periods established following the EU closure.

### Request

*In order to support the European Commission in assessing the effectiveness of the fishing closure periods set up by the Member States and in view of deciding on possible future measures to further enhance the protection and recovery of the stock of European eel, ICES is requested to give – to the extent possible – advice per relevant geographical area on the temporal migration patterns of European eel, namely:*

- 1) The period of arrival of European glass eel on the different EU shores and the peak time, and whether this has changed substantially since before 2007; Ideally the information would be provided by eel management unit (EMU), if not possible then at the next higher aggregate level; areas outside the EU are not to be covered.*
- 2) The period of escapement of European silver eel from the different relevant regions in the EU towards the Sargasso Sea and the peak time, and whether this has changed substantially since before 2007; Ideally the information would be provided by EMU, if not possible then at the next higher aggregate level; areas outside the EU are not to be covered.*
- 3) The period of migration of the yellow eel, when relevant, through different relevant regions in the EU and the peak time (when, and from and to where yellow eels migrate), and whether this has changed substantially since before 2007; Ideally the information would be provided by EMU, if not possible then at the next higher aggregate level; areas outside the EU are not to be covered (Idem as question 1). This question is not directly linked to the EU marine fisheries closure but more generally to the Eel Regulation and eel fisheries.*
- 4) In the relevant cases, the period when migrating eels need to pass through narrow passages (e.g. such as the exits of the Baltic and Mediterranean) on the way to their destination, and whether this has changed substantially since before 2007.*

- 5) Furthermore, ICES is requested to assess whether the closure periods set up under the national Eel Management Plans prior to the EU temporal closure are consistent (in terms of time periods of the closures) with the periods established following the EU closure. ICES is therefore requested for glass/silver, yellow and silver eel fisheries, to describe (i) the fishery closure periods per EMU area in place from 2000 to 2007, (ii) any changes introduced through EMPs, and (iii) in response to the EU closures in 2018 and 2019.

ICES is requested to coordinate its work with the GFCM so as to avoid possible overlaps or contradictions with the upcoming GFCM research programme.

### Elaboration on the advice

Even though European eel (mostly glass eel) recruit all year round in Portugal, Spain, and the Bay of Biscay, a seasonal pattern of migration is more pronounced in the Atlantic area than in the Mediterranean Sea. Typically, recruitment in the Atlantic area starts in October along the coasts of Portugal and Spain, in November along the coast of France, and progresses later on to the English Channel and the North Sea. The main migration season lasts four to five months, with most fisheries landings taken in the middle three-month period. However, it is challenging to define the migration pattern in the Mediterranean Sea. According to the literature and landings data, recruitment in the western and central Mediterranean Sea starts in November–December, peaks in January, and lasts until January–March. In contrast, recruitment to coastal lagoons may occur all year round, with seasonal peaks influenced by local environmental factors.

Silver eel migration starts earlier and extends over a longer period of time from areas of greater distance to the spawning grounds in the Sargasso Sea (i.e. from the northern and eastern parts of the European continent as opposed to the southern parts). However, a broad range of environmental factors influences this migration which typically starts in early autumn, stalls during the coldest winter months, and may resume in early spring. The spring peak can be particularly pronounced in the Baltic Sea compared to the autumn peak.

A proportion of yellow eels complete their continental growth phase in coastal and estuarine waters, while others migrate into freshwater. The remaining yellow eels shift irregularly between fresh and salt water during their yellow phase. Migratory movements increase the likelihood of capture in monitoring or fishing gear; however, catchability can also be altered by factors other than migration (e.g. temperature, seasonality of feeding). For this reason, the available data do not provide a clear or reliable image of the seasonal timing of yellow eel migrations.

With limited data available, no evidence was found that patterns of glass eel, silver eel, or yellow eel migrations have changed from before the implementation of the EU Eel Regulation (EU, 2007).

Extrapolating from movements in the Baltic Sea and adjoining rivers, silver eel passage through the straits from the Baltic Sea occurs from early autumn to the following spring.

No direct information is available on the timing of glass eel transit through the Gibraltar Strait. Glass eel landings occur all year round in some Spanish and Portuguese rivers near the strait. Because of the extremely limited evidence, it is not feasible to evaluate the timing of silver eel emigration through the Gibraltar Strait. The only available tracking study (from one river in southern France) suggested that three silver eels, having left the river in December, passed through the strait in March.

Recent tagging experiments indicate that some silver eels migrate through the English Channel to the Sargasso Sea. In view of the extremely limited evidence, it is not possible to evaluate the timing of eel emigration through the English Channel.

Before 2017, seasonal closures were implemented in some countries in the context of their national eel management plans. In 2018 and in 2019, the EU promulgated some measures to restrict eel fishing seasons. Closures in these three time periods differed widely in timing and duration, and also with regards to different eel life stages, fishing types, habitat types, and implementation in the whole or only part of an EMU. These differences were not further analysed.

## Suggestions

In case seasonal closures will be a significant tool for eel conservation and management, reporting landings by month should be included in routine data calls.

ICES faced challenges in data availability, coverage, and representativeness of the available dataset in addressing the request. Data (including from EU MAP) for recruits, yellow eel, and silver eel indices/monitored rivers should be analysed for representativeness of their EMU (or other relevant area). Such analyses should consider, *inter alia*, the proportion of the freshwater outflow that was covered/sampled for the monitoring (for transition habitat), the proportion in habitat surface, and the proportion of abundance.

The comprehensive compilation of seasonal migration patterns prepared for this advice shall be used to quantify both the present and the future effects of seasonal closures, which should be related to precautionary management targets and reference points.

## Basis of the advice

### Background

In its request the EU stated that:

*The stock of the European eel (*Anguilla anguilla*) has been in critical condition for at least two decades. ICES has advised that all anthropogenic pressures that decrease production and escapement of silver eels should be reduced to or kept as close to zero as possible.*

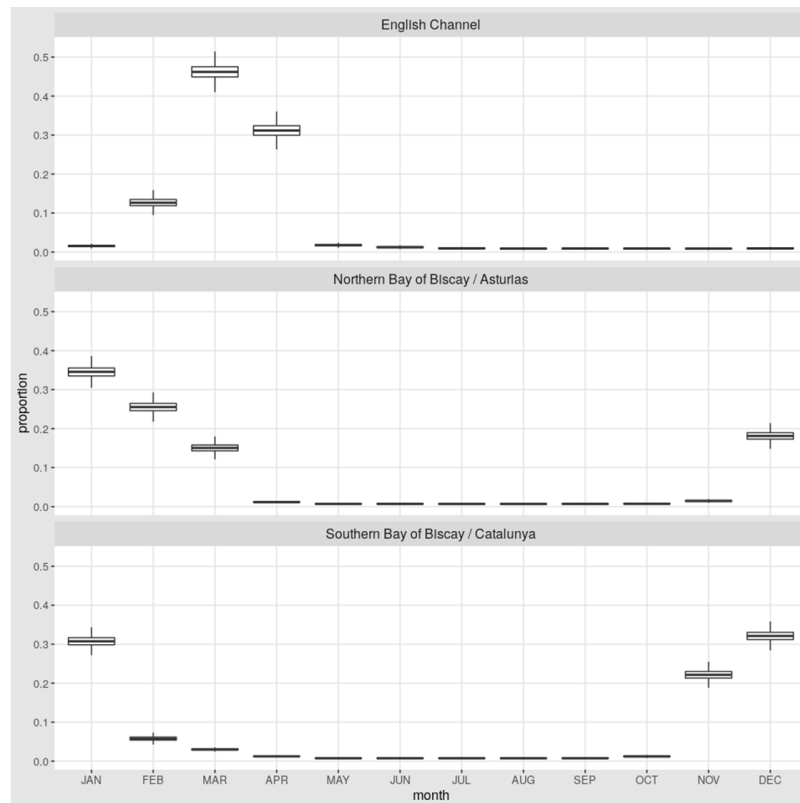
*In order to support the protection of the stock, the EU adopted Regulation 1100/2007 in 2007, establishing measures for the recovery of the eel stock. The regulation has been evaluated. Furthermore, to increase protection efforts beyond measures taken at national levels, since 2018 the EU has introduced closure periods for three consecutive months via the annual "TAC and quota regulation" (Regulation 2018/120 for the 2018 fishing season, and Regulation 2019/124 for the 2019 fishing season). In 2018, the closure covered the commercial marine catches of eels longer than 12 cm in EU waters of ICES area; the three-month closure was to be introduced by each Member State between 1 September 2018 and 31 January 2019. In 2019, the scope of the closure was extended to cover catches in transitional waters, recreational catches, and eels at all life stages (i.e. including glass eels and elvers). Moreover, the TAC and quota regulation for 2019 transposes the closures decided in the GFCM Recommendation for a multiannual management plan for European eel in the Mediterranean Sea GFCM/42/2018/1<sup>1</sup>. The consecutive three-month closure was to be set by the Member States between 1 August 2019 and 29 February 2020 for EU waters of the ICES area, and in accordance with the conservation objectives of the Recommendation and migration patterns of eel in waters of the Contracting Parties (CPCs) to the GFCM in the Mediterranean. For the Mediterranean, the closures were adopted as transitional measures, pending the results of an EU-funded GFCM research programme. The latter will aim *inter alia* at examining the management measures implemented in the CPCs, including the closure dates, and propose additional or alternative long-term management measures, if appropriate.*

### Results and conclusions (not advice)

The available information on migration seasons identifies the typical seasonality, its variability and variants. The considerable amount of new data on seasonality of eel migration confirms existing views overall. Typical seasonality can be summarized thus: glass eel recruitment in the Atlantic area starts in October along the coasts of Portugal and Spain, in November in France, and progresses later into the English Channel and the North Sea (Figure 1).

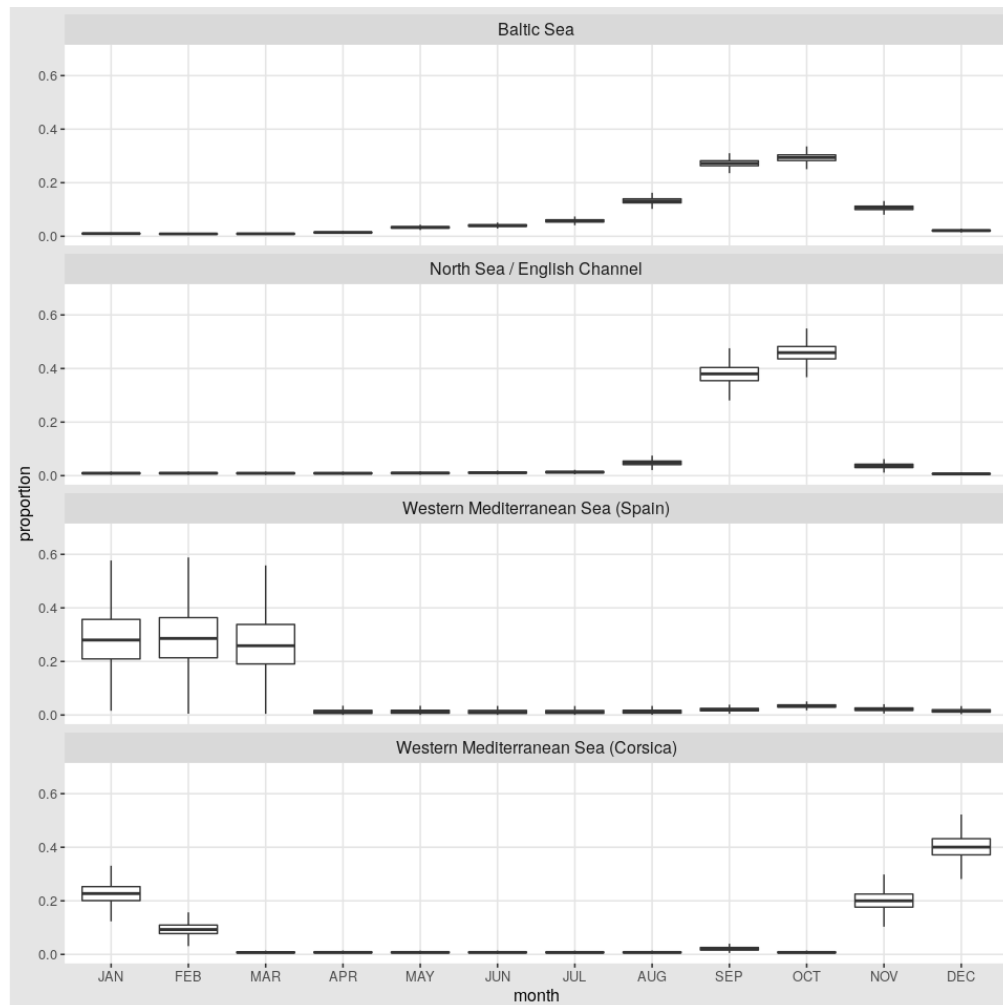
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<sup>1</sup> <http://www.fao.org/gfcm/decisions/en/>



**Figure 1** Seasonal distribution of glass eel landings for southern latitude (bottom panel), medium latitude (middle panel), and northern latitude (upper panel). For details see Figure 4.1 in the WKEELMIGRATION report (ICES, 2020).

Silver eel migration starts in early autumn, stalls during the coldest winter months, and may resume in early spring. The spring peak in the Baltic Sea can be very pronounced, compared to the autumn peak (Figure 2).



**Figure 2** Seasonal distribution of silver eel landings in different coastal, transitional, and marine open waters. For details see Figure 5.1 in the WKEELMIGRATION report (ICES, 2020).

## Methods

The data analysed for the present advice come from the following sources: (i) fisheries landings data, (ii) monitoring data, and (iii) the literature. The first two datasets were obtained from a dedicated data call published by ICES on 14 November 2019. Countries were requested to provide the following (by month, EMU, and eel life-history stage):

- Data on landings from commercial fisheries, from 2000 to 2019 (inclusive);
- Data on eel migration from fishery-independent sources (monitoring);
- Information on the timing and geographical scale of commercial and recreational fishery closures, from 2000 to 2019; and
- Relevant associated metadata.

Regarding the literature, other relevant information (including published as well as grey literature) was requested in the same data call. In addition, ICES carried out a literature search using the following search term combinations: (i) escapement, (ii) recruitment, (iii) settlement or colonization, (iv) seasonality, and (v) peak. Scientific experts were also contacted to seek relevant published and unpublished material.

### Data analysis

The request asked for comparisons in seasonality of eel migrations before and after 2007 in order to appraise the effect of the Eel Management Plans (EMPs) set by Council Regulation EC 1100/2007 (EU, 2007). However, this regulation required

the implementation of EMPs in 2009; some of these were only implemented later or gradually. Therefore, the fishery landings and scientific monitoring time-series were analysed for differences between the periods 2000–2009 and 2010–2019. The literature was reviewed for the same periods.

To assess trends by geographical area and counteract local signals (e.g. resulting from local factors in a particular water catchment), seasonal patterns of landings and abundance were clustered by area using a Bayesian model. The analysis was conducted separately for each life stage (i.e. glass eels, yellow eels, and silver eels), habitat type (i.e. freshwater, transitional, coastal, and marine open), and time period (2000–2009 and 2010–2019). For each series (life stage/habitat/period) the clustering analysis was performed with the predefined number of 2 to 7 geographical clusters and the number of clusters best suited to the data was then selected to present the resulting distributions of landings and abundance per series.

An assessment of the spatial and temporal complexities of fishery closures implemented across the EU, as requested, was deemed overly complicated. Instead, it was decided to evaluate whether or not EU Member States followed the Closure Regulation obligations set by the EU and the GFCM for 2018/2019 and 2019/2020. Based on the information supplied, one fishery did not follow the Closure Regulation for the period 2018/2019, whereas 35 did not for 2019/2020.

### Additional information

There is no additional information available.

### Sources and references

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