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Joint EIFAAC/ICES/GFCM Working Group on Eels (WGEEL)

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Contents

i Executive summary

The Joint EIFAAC/ICES/GFCM Working group on eels (WGEEL) met by correspondence and video conference from September 7 – 10 September and 27 September – 4 October in 2021 to assess the state of the European eel and its fisheries, investigate the effects of contaminants on the reproductive capacity of the eel stock, discuss the findings of WKFEA, further identify issues specific to the Mediterranean region and report on any updates to the scientific basis of the advice, new and emerging threats or opportunities.

For a better integration of the Mediterranean area, new members joined WGEEL, providing data and support as regional experts. This is considered an important step in a continuous process to identify and address Mediterranean-specific issues and harmonize the efforts of WGEEL and the recent 'GFCM research Programme on European Eel'.

The recruitment of European eel strongly declined from 1980 to 2011. The glass eel recruitment compared to that in 1960–1979 in the "North Sea" index area was 0.6% in 2021 (provisional) and 0.9 % in 2020 (final). In the "Elsewhere Europe" index series it was 5.4 % in 2021 (provisional) and 7.1% in 2020 (final), based on available dataseries. For the yellow eel dataseries, recruitment for 2020 was 16% (final) of the 1960–1979 level; the 2021data collection for yellow eel is ongoing. Time-series from 1980 to 2021 show that recruitment has stopped decreasing in 2011 but the trend thereafter is rather unclear.

Preliminary analyses of 160 dataseries on yellow or silver eel abundance show the potential of the yellow and silver eels' series to improve the stock assessment. A comprehensive framework of analyses of the yellow and silver stocks through these series will, however, require many iterations of data collection, analyses and further data needs.

Mortality and biomass indicators have been reviewed and visualized, preparing for a future workshop on the evaluation of eel management plans (WKEMP). Spatial overviews and temporal trends show a lack of data for many regions and no evidence yet of a general improvement in stock status for regions with data. Overall silver eel escapement remains low and mortalities high. Doubts remain about the consistency of indicators across countries. The information provided on data and methods used for assessment are not available or sufficiently detailed to ensure transparency and reproducibility of estimates. These limitations and the incomplete reporting impair the use of these data to inform on the status of the stock at a larger scale.

A review on the effects of contaminants (in a broader sense: spawner quality) on the reproductive capacity of eel highlighted this as an important, but a frequently lacking, aspect of stock assessment. Monitoring of silver eel quality should be considered as part of new or existing programmes.

WGEEL supports the findings WKFEA and the suggested roadmap and agreed to implement the necessary steps towards achieving it. This implies further exploration and analyses of existing as well as the systematic collection of additional data. Implementation will require concerted data collection and assessment, which will require additional support.

In summary, the working group has focused on exploring and analysing the data collected in the WGEEL database for their potential use in stock assessment. This included identifying gaps in the available data, defining data requirements for specific analyses in future and developing procedures for the analysis of these data. Furthermore, the group reviewed the effects of contamination on the reproductive potential of eels and renewed their recommendation to consider these in the assessment of effective spawning-stock biomass.

ii Expert group information

Expert group name	Joint EIFAAC/ICES/GFCM Working Group on Eels (WGEEL)
Expert group cycle	Annual
Year cycle started	2021
Reporting year in cycle	1/1
Chair(s)	Jan-Dag Pohlmann, Germany
Meeting venue(s) and dates	7-10 September 2021, Online meeting, 33 Participants
	27 September to 4 October 2021, Online meeting, 46 Participants

1 Introduction

1.1 Main Tasks

The **Joint EIFAAC/ICES/GFCM Working Group on Eels** (WGEEL), chaired by Jan-Dag Pohlmann, Thünen Institute, Germany, met virtually, in a split meeting from 7–10 September and 27 September–4 October to address the ToRs in the EG resolution (Annex 2):

The Working Group used data and information provided in response to the Eel data call 2021 (from 24 countries) and 16 Country Report Working Documents submitted by participants (Annex 6); other references cited in the Report are given in Annex 3. A list of acronyms and glossary of terms used within this document is provided in Annex 4.

1.2 Participants

52 experts attended the meeting, representing 25 countries, along with an observer from the European Commission DG MARE and one from the Chuo University, Japan. A list of the meeting participants is provided in Annex 1.

1.3 ICES Code of Conduct

In 2018, ICES introduced a Code of Conduct that provides guidelines to its expert groups on identifying and handling actual, potential or perceived Conflicts of Interest (CoI). It further defines the standard for behaviours of experts contributing to ICES science. The aim is to safeguard the reputation of ICES as an impartial knowledge provider by ensuring the credibility, salience, legitimacy, transparency, and accountability in ICES work. Therefore, all contributors to ICES work are required to abide by the ICES Code of Conduct.

At the 2021 WGEEL meeting, the chair raised the ICES Code of Conduct with all attending member experts. In particular, they were asked if they would identify and disclose an actual, potential or perceived CoI as described in the Code of Conduct. After reflection, three members from the UK raised a potential COI since they are involved in drafting a non-detriment finding concerning eel trade between the UK and the EU. The group, in consultation with the secretariat, however concluded that it did not challenge the scientific independence, integrity, and impartiality of these members and therefore ICES.

1.4 The European eel: Stock Annex

The Stock Annex has been reviewed and updated in 2020 and is due for another revision latest in 2023. See Annex 7.

1.5 The European eel: life history and reproduction

During its continental phase the European eel (*Anguilla anguilla*) is distributed across the majority of coastal countries in Europe and North Africa, with its southern limit in Morocco (30°N), its northern limit situated in the Barents Sea (72°N) and spanning the entire Mediterranean basin.

The European eel life history is complex, being a long-lived semelparous and widely dispersed stock. The shared single-stock is considered genetically panmictic and data indicate that the spawning area is in the southwestern part of the Sargasso Sea. The newly hatched leptocephalus larvae drift with the ocean currents to the continental shelf of Europe and North Africa, where they metamorphose into glass eels and enter continental waters. The growth stage, known as yellow eel, may take place in marine, brackish (transitional), or freshwaters. This stage may last typically from two to 25 years (and can exceed 50 years) prior to metamorphosis to the "silver eel" stage, maturation and spawning migration. Strong sexual dimorphism occurs in eels with males maturing at a younger age and smaller size. For details on the eel life cycle see Stock Annex; Annex 7.

The abundance of glass eel arriving in continental waters declined dramatically in the early 1980s to a low in 2011 (and remaining on a low level since). The reasons for this decline are uncertain but anthropogenic impacts and oceanic factors are assumed to have major impacts on the stock. For a detailed description of factors affecting the eel stock see Stock Annex. These factors will likely affect local production differently throughout the eel's range. In the planning and execution of measures for the recovery, protection and sustainable use of the European eel, management must therefore account for the diversity of regional conditions.

1.6 The management framework for European eel

1.6.1 EU Member state waters

Within EU Member State waters, the stock, fisheries and other anthropogenic impacts, are currently managed in accordance with Council Regulation (EC) No 1100/2007, "*establishing measures for the recovery of the stock of European eel*" (so-called 'Eel Regulation', EU Council, 2007). This regulation sets a framework for the protection and sustainable use of the stock of European eel in EU Waters, coastal lagoons, estuaries, and rivers and communicating inland waters of Member States that flow into the seas in ICES areas 3, 4, 6, 7, 8, 9 or into the Mediterranean Sea. For details see the Stock Annex. Eel fisheries in EU waters are further regulated in Council Regulation (EU) No 2019/124 'Fishing Opportunities' (EU Council, 2021a, b) and in the Commission Implementing Decision (EU) No 2018/1986 'Specific Control and Inspection Programme' (EC, 2018). Other EU legislation that has specific relevance to the European eel, in the context of ICES are Directive 2000/60/EC, known as the Water Framework Directive (WFD) (EU, 2000), and Council Regulation (EC) No 338/97 (EU Council, 1996) which relates to trade in CITES-listed species.

1.6.2 General Fisheries Commission of the Mediterranean (GFCM) state waters

Specifically, for the Mediterranean region, work is ongoing towards the development of an adaptive regional management plan for eel in the Mediterranean Region under the auspices of the GFCM. The GFCM Commission approved recommendation GFCM/42/2018/1 on a multiannual management plan, in the Mediterranean Sea, also promoting a specific research programme (FAO, 2019). The GFCM Research programme on European eel: towards coordination of European eel stock management and recovery in the Mediterranean has started officially in September 2020, and involves nine Countries in the Mediterranean area. The programme's general objective is to deal with issues relevant to the setting up of a coordinated framework for management, through data and information collation, collection, and analysis as well as the creation of a network of experts and institutions. Final results are expected in 2022. For details see Stock Annex.

1.6.3 Other countries

WGEEL receives data from EU and non-EU countries and GFCM supports more countries to achieve this. The Eel Regulation only applies to EU Member States – although other states may engage in the case of transboundary management plans. Some non-EU countries are involved in the provision of data for many years (e.g. Norway, UK). Others have only recently been involved and further development of assessment procedures and feedback mechanisms might be required to involve them in future standardisation processes. For details see Stock Annex.

1.6.4 Other international actors

The European eel was listed in Appendix II of the **Convention on International Trade in Endangered Species of Wild Fauna and Flora** (**CITES**) in 2007. Since 2009 when the listing came into force, any international trade in this species needs to be accompanied by an export permit supported by a Non-Detriment Finding (NDF). Since 2010, export out of, and import to, the EU is not allowed. The **International Union for the Conservation of Nature** (**IUCN**) listed the European eels as Critically Endangered in 2008. It was reassessed in both 2013 and 2018, and the status remains unchanged. In 2014, the European eel was added to Appendix II of the **Convention on the Conservation of Migratory Species of Wild Animals** (**CMS**), whereby signatories call for cooperative conservation actions to be developed among Range States. The European eel *Anguilla anguilla* was included on the OSPAR List of threatened and/or declining species and habitats in 2008. In 2014, the **Convention for the Protection of the Marine Environment of the North-East Atlantic** (**"OSPAR Convention"**) issued a recommendation to strengthen the protection of the European eel at all life stages in order to recover its population and to ensure that it was effectively conserved. The Baltic Sea Action Plan (BSAP) of the **Baltic Marine Environment Protection Commission (HELCOM**) contains several targets for the European eel. For details see the Stock Annex.

1.7 Assessment to meet management needs

The European Commission obtains both recurring and ad hoc scientific advice from ICES on the state of the eel stock, the management of the fisheries and other anthropogenic factors that impact it, as specified in the Administrative Agreement between European Commission and ICES (EU and ICES, 2021). In support of this advice, ICES is asked to provide the European Commission with: estimates of catches; fishing mortality; recruitment and spawning stock; relevant reference points for management; information about the level of confidence in parameters underlying the scientific advice and the origins and causes of the main uncertainties in the information available (e.g. data quality, data availability, gaps in methodology and knowledge). The Commission Implementing Decision (EU) No 2019/909 (Data Collection Framework, DCF; EC, 2019), requires Member States data, collected through this framework, to be made available to end-users, such as ICES.

ICES requests information from national representatives to the WGEEL on stock parameters, landings, restocking, and time-series (e.g. recruitment, yellow eel abundance, silver eel escapement). In May 2021 ICES issued a Data Call to collect this information; this call was also advertised by EIFAAC and GFCM to their memberships (see below for further details).

The status of eel production in EU and non-EU Eel Management Units (Figure 1.1) is assessed by national or sub-national fishery and/or environment management agencies. The terminology Eel Management Unit (EMU) has been used by WGEEL and others for several years now but with various and unrecorded definitions leading to some confusion. It most often represents a management area for eel, corresponding to a river basin district (RBD) as defined in the WFD (EU, 2000). However, in cases of stock assessments at other spatial scales, and for stock parts lying outside the EU, EMUs have also been defined, either as being the management units used by the country (e.g. Tunisia) or as the whole country. In practice, data provision from some EMUs can be divided into further geographical subunits. This is, for instance, the case for Sweden where the EMU is national, but data can be provided to the WGEEL according to Inland, West and East coasts subunits. The catch from coastal areas does include eels migrating from other countries or parts of the Baltic.

Since EU exit and becoming an independent coastal state, UK has signed a Memorandum of Understanding (MoU) with ICES, effective as of start of 2021, which recognises UK obligations to provide relevant data for ICES to undertake stock assessment and provide advice to the UK relating to the North Atlantic and its adjacent seas, including advice on fishing opportunities for the European eel.

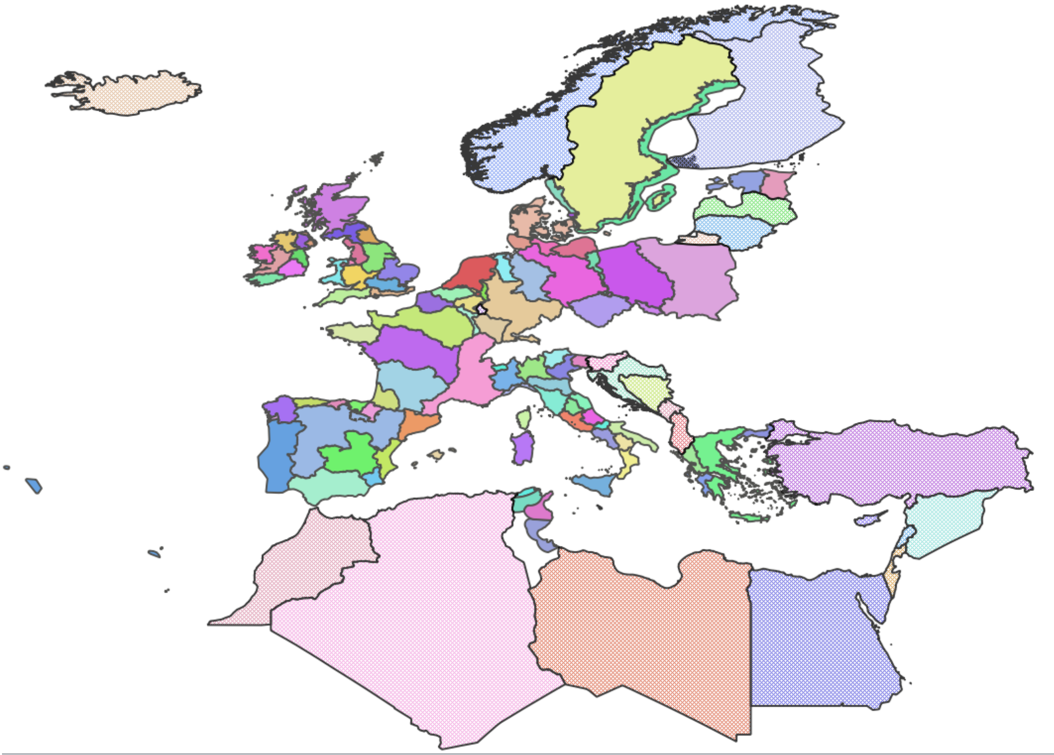


Figure 1.1. Current map of Eel Management Units (EMUs) as reported by countries or corresponding to national entities where no EMU is described at the national level.

The setting for data collection varies considerably between, and sometimes within, countries, depending on the management actions taken, the presence or absence of various anthropogenic impacts, but also on the type of assessment procedure applied. Accordingly, a range of methods may be employed to establish silver eel escapement limits (e.g. the Eel Regulation's ≥40% of B_0), management targets for individual rivers, river basins, RBDs, EMUs and nations, and for assessing compliance of current escapement with these limits/targets (e.g. for the Eel Regulation comparing $B_{current}$). These methods require various combinations of data on e.g. landings, recruitment length/age structure, restocking, abundance (as biomass and/or density) or maturity ogives, in order to estimate silver eel biomass, fishing and other anthropogenic mortality rates.

The ICES Study Group on International Post-Evaluation of Eel (SGIPEE) (ICES, 2010b; 2011) and WGEEL (FAO and ICES, 2010; 2011) derived a framework for *post hoc* combination of EMU / national 'stock indicators' of silver eel escapement biomass and anthropogenic mortality rates to an international total.

In 2020/2021, WKFEA (ICES, 2021b) addressed issues with the current advice, consider options for future assessment/advice and drafted a roadmap towards potential new or additional advice on fishing opportunities for the European eel to better suit the management needs. The roadmap provides detailed information on the future approach, acknowledging the complexity of the issue and the required efforts, this is, however, merely the first step in a long process which is aiming at a first benchmark in 2027; though this will largely depend on the realization (e.g. personnel, funding) of a model development project.

1.8 Data Call

The WGEEL annually collates data on eel in support of its work. A dedicated Data Call hosted by ICES, EIFAAC and GFCM and covering all natural range states of the European eel was first initiated in 2017 and is considered an effective mechanism to significantly improve the situation of data provision and use. For details see the Stock Annex.

In the 2021 Data Call, data on recruitment, fishery landings, recreational landings, aquaculture production, restocking, yellow eel abundance and silver eel escapement time-series, including biometry was requested. Following a triannual cycle, harmonized with the reporting of EU member states reporting on the progress of EMPs, data on biomass and mortality indicators were requested in 2021 as well. The call also required the provision of metadata associated with all data.

The data call further requested data on the number of recreational fishers, effort, methodological aspects on data collection and modelling in the EMUs, glass eel utilization and the implementation of management measures. These are, however, collected for the "Workshop for the Technical evaluation of EU Member States' Progress Reports", which will be held late 2021 and early 2022, to avoid having multiple separate calls.

In response to the 2019 Data Call, all national representatives gave their consent to the public use of the data stored in the database and used in the report, until revoked.

2 ToR A: Address the generic TORs from ICES, and any requests from EIFAAC or GFCM

2.1 ICES Generic ToRs for Expert (Working) Groups

a) Consider and comment on Ecosystem and Fisheries overviews where available;

WGEEL – A detailed review of ecosystem and fisheries overviews with a list of comments was provided in 2020, no further updates at this time.

b) For the aim of providing input for the Fisheries Overviews, consider and comment on the following for the fisheries relevant to the working group:

i) descriptions of ecosystem impact on fisheries

WGEEL – no new descriptions are available at this time

ii) descriptions of developments and recent changes to the fisheries

WGEEL – Since 2018, a closure of three consecutive months for eel commercial fishing has been in place at the EU level for eels above 12 cm in Union waters of ICES area, including in the Baltic Sea. This closure has been extended in 2019 to cover commercial and recreational fisheries for all eel life stages in EU marine and brackish waters in the Northeast Atlantic and the Mediterranean Sea and was rolled over to 2020 & 2021 (EU Council 2021a,b).

The EU exit of the UK has implications for eel trade and possibly entails changes to fisheries or restocking practices. The exact impacts are, however, not known and will further depend on a possible NDF between the EU and the UK concerning eel trade.

In 2018, Article 10 of Council Regulation (EU) 2018/120 relating to 'Measures on European eel fisheries', which specifically applied to ICES waters (EU Council, 2018). Later in 2018, the GFCM adopted, in Recommendation GFCM/42/2018/1, the establishment of an annual fishing closure of three consecutive months where landing European eel shall be prohibited, which came in to force as of 01/01/19 (ICES, 2020a). According to WKEELMIGRATION, the responses to the WK's data call revealed the establishment of 155 closures, as concerns the year 2018, of which one was excluded as it didn't seem to follow the relevant legislation (ICES, 2020a).

In 2019, the total number of declared closures were increased to 161 closures of which, however, only 126 appeared to follow the updated EU (ICES Region) and GFCM (Mediterranean basin) legislation. Those that were excluded were due to closures being outside of the required date range, not having consecutive months and/or only being partial temporal/spatial closures (ICES, 2020a).

What must be noted though is the fact that all the above data were provided from European countries and there weren't any data from the Non-EU Mediterranean countries. Following the GFCM Recommendation 42/2018/1 on a multiannual management plan for European eel in the Mediterranean and the results of the Working Group on the management of European eel (WKMEASURES – EEL; FAO HQ, April 2019), a research programme was funded by GFCM aiming at the achievement of a coordinated framework for eel monitoring, assessment and management in the Mediterranean.

A part of the project (Working Package) was dedicated in "Listing of all current management and protection measures in place for eel, and/or of relevance to eel" *established in the participant countries (EU and Non-EU Mediterranean countries).*

Through the data call forwarded to the participant countries, information on the closures that each country has established, were requested. It was observed that fisheries closures are established in almost all Mediterranean countries, except from Egypt, with these observations being provisional until the completion of the data validation process. As for the rest of the countries, again with the data being provisional, the period of closure depends on the species life stage, the period of migration (towards to mainland or towards the Sargasso Sea), but also by the Region. It is notable that in EU Med countries, apart from regions with completely closure of fisheries for life stages or for some of them, the closure period ranges from one month up to 9.5 months (not always consecutive), targeting glass eels, yellow or silver only, all of them or combination of them. Noteworthy, the existence of fisheries prohibitions, even closure of fisheries, in areas that are part of specific network, such as MPAs, NATURA 2000 or Ramsar.

iii) mixed fisheries considerations, and

WGEEL – data on bycatch of eel in marine fisheries targeting other species in the Norwegian Sea are reported in the Fisheries Overview for that ecoregion. This is not believed to be a concern. While recognizing that these data are valuable, it is not considered a priority for WGEEL at this time and therefore no further efforts were undertaken to collect additional data on eel bycatch.

iv) emerging issues of relevance for management of the fisheries;

WGEEL – Chapter 4 deals with emerging issues in detail; Following the triennial plan established in 2018 this report focuses on contaminants and their potential to reduce the reproductive success. In addition, potential new and updates to previously identified threats/opportunities are provided.

c) Conduct an assessment on the stock(s) to be addressed in 2021 using the method (assessment, forecast or trends indicators) as described in the stock annex and produce a **brief** report of the work carried out regarding the stock, providing summaries of the following where relevant:

i) Input data and examination of data quality; in the event of missing or inconsistent survey or catch information refer to the ACOM document for dealing with COVID-19 pandemic disruption and the linked template that formulates how deviations from the stock annex are to be reported.

WGEEL – see Chapter 3

ii) Where misreporting of catches is significant, provide qualitative and where possible quantitative information and describe the methods used to obtain the information;

WGEEL – see Chapter 3

iii) For relevant stocks (i.e. all stocks with catches in the NEAFC Regulatory Area), estimate the percentage of the total catch that has been taken in the NEAFC Regulatory Area in 2020.

WGEEL – NEAFC stretches from southern tip of Greenland, east to the Barents Sea and south to Portugal (from their website) but the map shows that it is only outside the national waters. There is no eel fishing in the NEAFC area.

iv) Estimate MSY reference points or proxies for the category 3 and 4 stocks

WGEEL – it is not possible to estimate MSY proxy reference points for the European eel; WGEEL considers that the establishment of an appropriate and effective framework for the advice under the principles of the precautionary approach is a matter of urgency. WKFEA has addressed the issue and provided a roadmap towards a benchmark in 2027, adopted by WGEEL, where reference points could be defined.

v) Evaluate spawning-stock biomass, total-stock biomass, fishing mortality, catches (projected landings and discards) using the method described in the stock annex;

WGEEL – see Chapter 3

vi) The state of the stocks against relevant reference points;

Consistent with ACOM's 2020 decision, the basis for Fpa should be Fp.05.

1) 1. Where Fp.05 for the current set of reference points is reported in the relevant benchmark report, replace the value and basis of Fpa with the information relevant to Fp.05

2) 2. Where Fp.05 for the current set of reference points is not reported in the relevant benchmark report, compute the Fp.05 that is consistent with the current set of reference points and use as Fpa. A review/audit of the computations will be organized.

3) 3. Where Fp.05 for the current set of reference points is not reported and cannot be computed, retain the existing basis for Fpa.

WGEEL – no reference points are defined for eel, for further information see chapter 3

vii) Catch scenarios for the year(s) beyond the terminal year of the data for the stocks for which ICES has been requested to provide advice on fishing opportunities;

WGEEL – Historical total landings and effort data are incomplete. In addition, there was a great heterogeneity among the time-series of landings due to inconsistencies in reporting by, and between, countries. However, there has been a considerable improvement in both data consistency and area

coverage since the introduction of a standardised eel Data Call in 2017. Changes in eel management practices have also affected commercial and non-commercial/recreational fisheries and the reporting of these fisheries. Therefore, ICES does not have the information needed to provide a reliable retrospective time-series of eel catch across the species' range, and as such, it is not used for the Advice. Furthermore, the understanding of the stock dynamic relationship is not sufficient to determine/estimate the level of impact that fisheries or non-fisheries anthropogenic factors (at the glass, yellow, or silver eel stage) have on the reproductive capacity of the stock. Hence, no catch scenarios can be provided.
To address issues with landings data and facilitate their use in the advice, WKFEA suggested a dedicated workshop which is planned in 2023.

NOTE: In response to the Eel Regulation, stock and mortality indicators were reported at the EMU level every three years since 2012; however, they don't cover the whole species' range.
NOTE: The impact of recreational fisheries on the eel stock remains largely unquantified although landings can be thought to be at a similar order of magnitude to those of commercial fisheries.

viii) Historical and analytical performance of the assessment and catch options with a succinct description of associated quality issues. For the analytical performance of category 1 and 2 age-structured assessments, report the mean Mohn's rho (assessment retrospective bias analysis) values for time-series of recruitment, spawning-stock biomass, and fishing mortality rate. The WG report should include a plot of this retrospective analysis. The values should be calculated in accordance with the "Guidance for completing ToR viii) of the Generic ToRs for Regional and Species Working Groups - Retrospective bias in assessment" and reported using the ICES application for this purpose.

WGEEL – As a category 3 stock, there is no analytical assessment of the eel stock. The performance of the current assessment has not been formally reviewed. However, the trends in recruitment indices have been validated in the past using a different analyticial approach (GEREM). No catch options have been proposed so there is nothing to review.

d) Produce a first draft of the advice on the stock under considerations according to ACOM guidelines.

WGEEL – A first draft of the advice on the European eel stock has been provided to ICES as a separate document.

e) Review progress on benchmark issues and processes of relevance to the Expert Group.
i) update the benchmark issues lists for the individual stocks;
ii) review progress on benchmark issues and identify potential benchmarks to be initiated in 2022 for conclusion in 2023;
iii) determine the prioritization score for benchmarks proposed for 2022–2023;
v) as necessary, document generic issues to be addressed by the Benchmark Oversight Group (BOG)

WGEEL – The European eel has not been benchmarked and this is not scheduled on the ICES calendar in the next few years. However, WKFEA proposed a roadmap towards a benchmark in 2027 and further a list of issues and potential of the collected and potentially collected data which is further explored WGEEL.

f) Prepare the data calls for the next year's update assessment and for planned data evaluation workshops;

WGEEL – see chapter 3.7; A dedicated workshop will be needed to prepare the data call.

g) Identify research needs of relevance to the work of the Expert Group.

WGEEL – see chapters 3 and 4 as well as WKFEA report (ICES, 2021b)

h) Review and update information regarding operational issues and research priorities on the Fisheries Resources Steering Group SharePoint site.

WGEEL – information was updated according to WKFEA roadmap

i) If not completed in 2020, complete the audit spread sheet 'Monitor and alert for changes in ecosystem/fisheries productivity' for the new assessments and data used for the stocks. Also note in the benchmark report how productivity, species interactions, habitat and distributional changes, including those related to climate-change, could be considered in the advice.

WGEEL – spread sheet was provided in 2020

2.2 Additional requests from EIFAAC or GFCM

No additional requests.

3 ToR B: Report on developments in the state of the European eel (*Anguilla anguilla*) stock, the fisheries on it and other anthropogenic impacts

This section of the report also relates to ToRs A, D and E, including examinations of data quality, and preparations for the data call next year.

The chapter presents:

- the current analysis of trends in recruitment, for both glass eel and young yellow eel (dominated by recruits from the current year) and older yellow eel series
- The application of a GLM to describe trends in recruitment
- Data on trends in Yellow and silver eel data,
- Updated Trends in Fisheries and landings
- Information on Biomass and Mortality indicators
- Information on Releases of eel (restocking activity and assisted migrations)
- Trends in aquaculture
- Preparation for next year's data call.

The methodology is further described in the Stock Annex (see Annex 7).

3.1 Recruitment

3.1.1 Data sources

In this section, the latest trends in glass and yellow eel recruitment are addressed. The time-series data are derived from fishery-dependent sources (i.e. catch records) and also from fishery-independent surveys across much of the geographic range of European eel. The stages are categorized as:

- glass eel (G), continental age 0 years,
- a mixture of glass eel and young yellow eel dominated by recruits from the same year (GY), and
- yellow eel (Y) recruiting to continental habitats. The yellow eel series might consist of yellow eel of several ages. This is certainly the case for all series from the Baltic (mean age up to 6), some Irish sites, and sites located far upstream.

The glass eel recruitment time-series have been grouped into two geographical areas: 'North Sea' (NS) which for our trend analysis, includes the Baltic, and 'Elsewhere Europe' (EE) (Figure 3.1). Previous analyses (ICES, 2010b, p19; Bornarel et al. 2017) have shown different trends between the two sets. This is mostly reflected as a more pronounced decline of the North Sea series compared to the Elsewhere Europe area during the 1980s.

The WGEEL has collated information on recruitment from 97 time-series. Some time-series date back to the beginning of 20th century (yellow eel, Göta Älv, Sweden) or 1920 (glass eel, Loire, France). Among those series, 77 (glass and yellow eel series) have been selected for further analysis in the WGEEL indices; see details on data selection and processing below. Depending on the standardisation period, the number of series used can be lower and is given for each analysis.

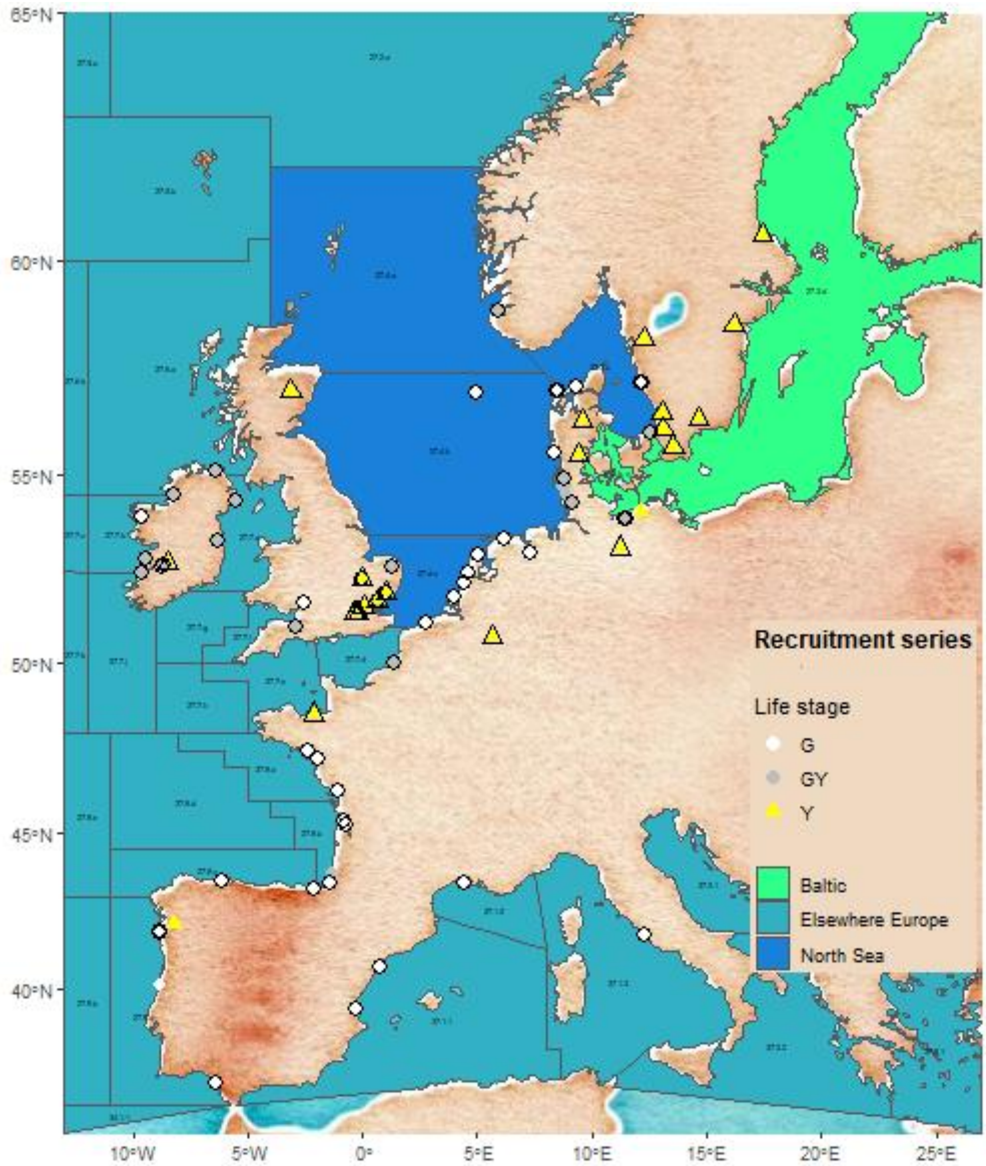


Figure 3.1. Map of recruitment sampling stations, colour according to stage (grey = G and GY) yellow = Y. Full circles represent recruitment series currently used to build the GLM trend.

3.1.2 Details on data selection and processing

Out of 97, 56 glass eel and 21 yellow eel series were used in the analysis. Three rules have been used for this selection procedure.

1. First, if there are two or more series from the same location, i.e. they are not independent, only one series is kept. For instance, the longer of two series has been kept for the Severn (Severn EA, a total of all the glass eel fisheries for England and Wales) while the second series (Severn HMRC) has been dropped from the list, as it was considered a duplicate being based on the same fishery.

2. The second rule is to exclude a series from the analysis when it is less than ten years long. The series are, however, still updated in the database until they are long enough to be included. If

there are missing years, or years excluded for data quality reasons, the dataseries will be included when the total number of “good” years of data meets the 10 year criterion.

In 2021, seven new recruitment series were added to the recruitment trend analysis because these series now reached the agreed limit value of at least ten years of observations. Five of these seven series were from the United Kingdom, one from Ireland and one from Germany. The seven series were *Beeleigh elver* (abbreviation: BeeGY, country: GB), *Beeleigh yellow* (BeeY, GB), *Broklandsau river mouth* (BrokGY, DE), *Liffey* (LiffGY, IE), *Merton Abbey Mills – River Thames* (MertY, GB), *Hogsmill Middle Mill – River Thames* (MillY, GB), and *Strangford* (StraGY, GB).

Within any series, individual annual data point or points can be excluded from the analysis where a one-off problem is identified which negates the value as an index for that year, such as a major reduction in effort (e.g. Covid or other effort related restriction).

3. Finally, the final rule is to discard recruitment series that were obviously biased by restocking.

3.1.3 Number of series available

Six Glass eel and glass eel + young yellow eel time-series were available 2021. The number of older yellow eel time-series has increased to 21 in 2020. Few yellow eel time-series were reported in 2021 and this data year was not used in the indices (Figure 3.2 and 3.3). A specific analysis of the influence of including new series over time has been made this year. This factor was not considered to be of concern - the analysis is presented in annex 12. None of the series reported for 2021 had any data losses associated with Covid.

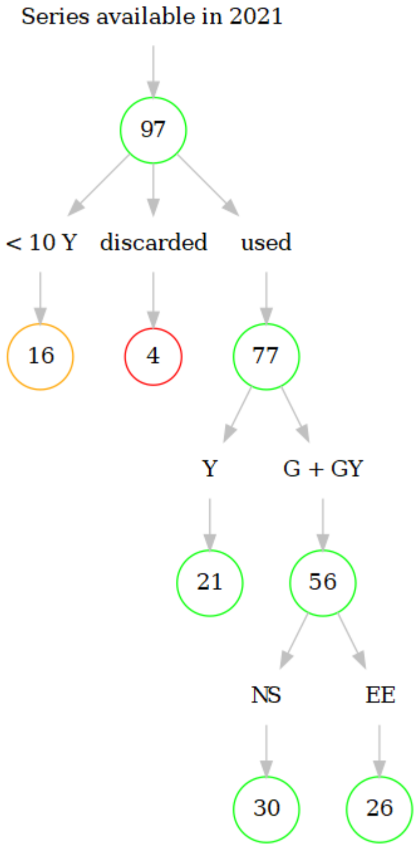


Figure 3.2. Schematic showing the recruitment series available by type and region, and numbers selected for analysis. Y = Yellow eel, G = Glass eel, GY = mixed Glass and yellow eel. NS = North Sea (included Baltic) EE = Elsewhere Europe regions (See figure 3.1 above)

The number of time-series available between regions and life stages is not an even distribution, influenced by factors including variation in the behaviour of eel, traditions of fishery and usage of eel, and the history of scientific investigation and eel management. The result of this variation, as it impacts number of series available for analysis, is shown in Figure 3.3.

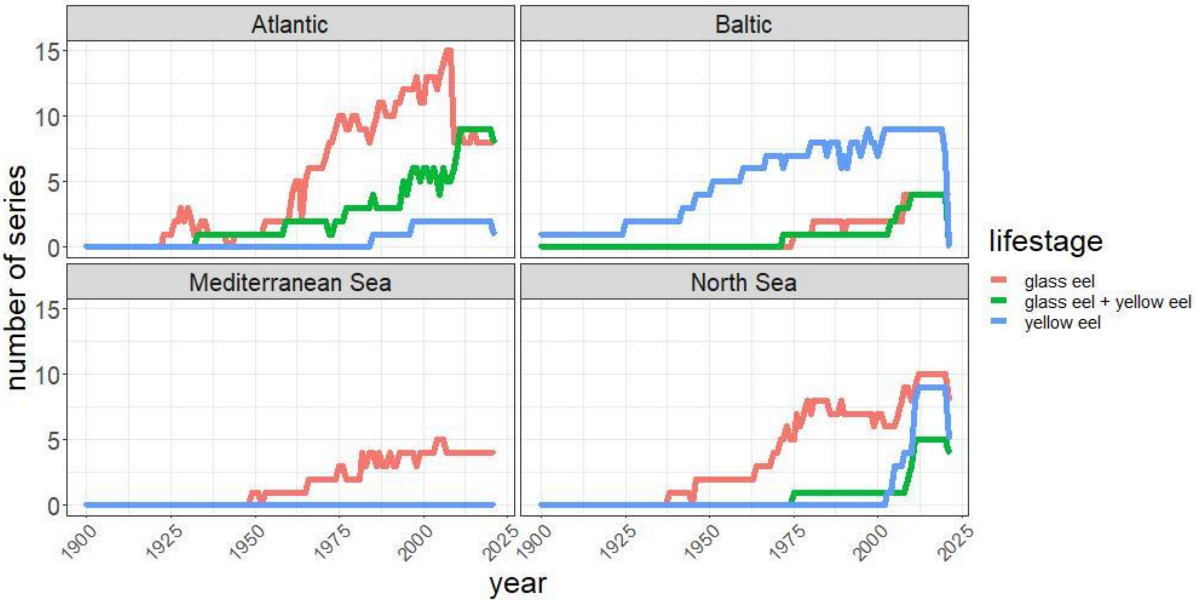


Figure 3.3. The Number of dataseries available for recruitment analyses for different life stages and regions

3.1.4 GLM based trend

The WGEEL recruitment index used in the ICES Annual Stock Advice is fitted using a GLM with a Gamma distribution and a log link: glass eel ~ year : area + site, where glass eel are the individual glass eel time-series, including both pure G series and those identified as a mixture of glass and yellow eel (G+Y), site is the site monitored for recruitment, area is either the continental 'North Sea' (NS) or 'Elsewhere Europe' (EE), and year is the year coded as a categorical value. For yellow eel time-series, only one estimate is provided: yellow eel ~ year + site.

The trend is hindcast using the predictions from 1960 onwards for 56 glass eel time-series and from 1950 onwards for 21 yellow eel time-series. Some zero values have been excluded from the GLM analysis: 19 for the glass eel model and 29 for the yellow eel model. This treatment is parsimonious and tests show that it has no effect on the trend (ICES, 2017).

The reconstructed values are then aggregated using geometric means of the two reference areas (Elsewhere Europe EE, and North Sea NS). The predictions are given in reference to the geometric mean of the 1960-1979 period.

As for previous working groups, data call and meeting timing means that some dataseries on glass and yellow eel recruitment are not complete for year at the date of submission to WGEEL. Where previous years' data were finalised or revised by reporting countries, changes were made retrospectively. Thus, recruitment as reported in any one year includes adjustments to recruitment levels reported in the previous year. 2020 recruitment, as a percentage of 1960-1979 levels, is adjusted up from 0.5% to at 0.9% (North Sea) and from 6.1% to 7.1% (elsewhere Europe). Analyses of provisional 2021 data show recruitment as a percentage of 1960-1979 levels at 0.6 % (North Sea) and 5.4% (elsewhere Europe). Recruitment therefore remains among the lowest points on record. (Figure **3.4** Tables **3.1**).

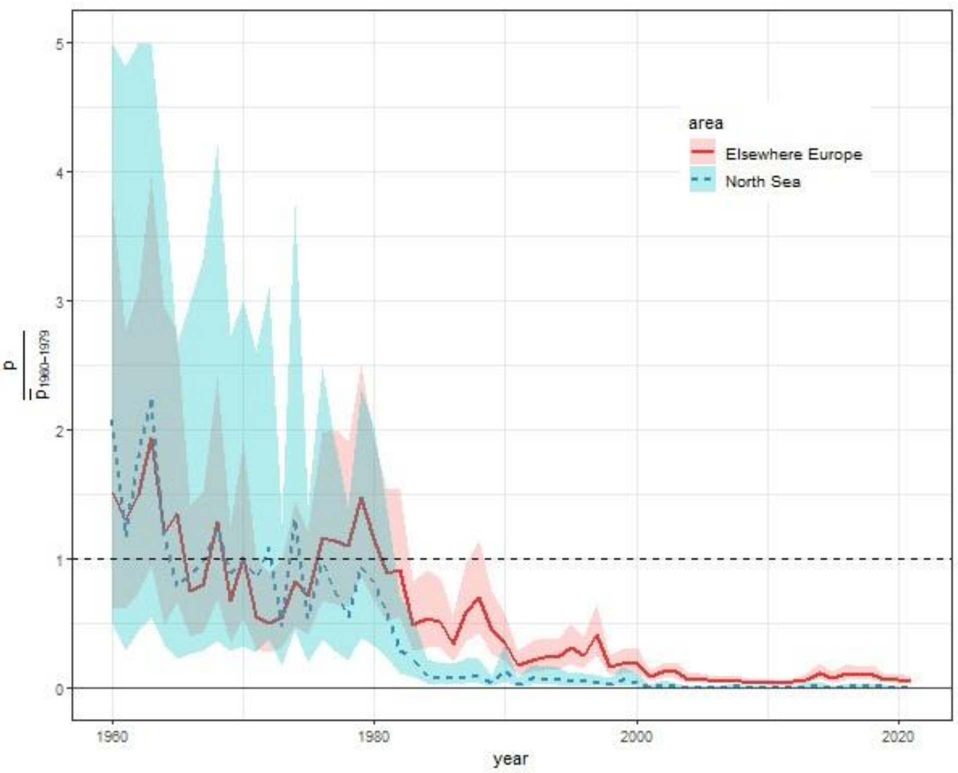


Figure 3.4. WGEEL recruitment index: estimated (GLM) glass eel recruitment for the continental North Sea and Elsewhere Europe series with 95 % confidence intervals updated to 2021. The GLM (*glasseel ~ area: year + site*) was fitted on 56 time-series comprising either pure glass eel or a mixture of glass eels and yellow eels. The predictions *p* have been scaled to the 1960-1979 average $\bar{p}_{1960–1979}$. Number of series Elsewhere Europe = 30, North Sea = 26.

For yellow eel series, autumn ascent has not been recorded yet and most of the series have only reported data till the middle of summer. The completed 2020 yellow eel index is 16% of the 1960-1979 baseline (Figure 3.5 and Table 3.2).

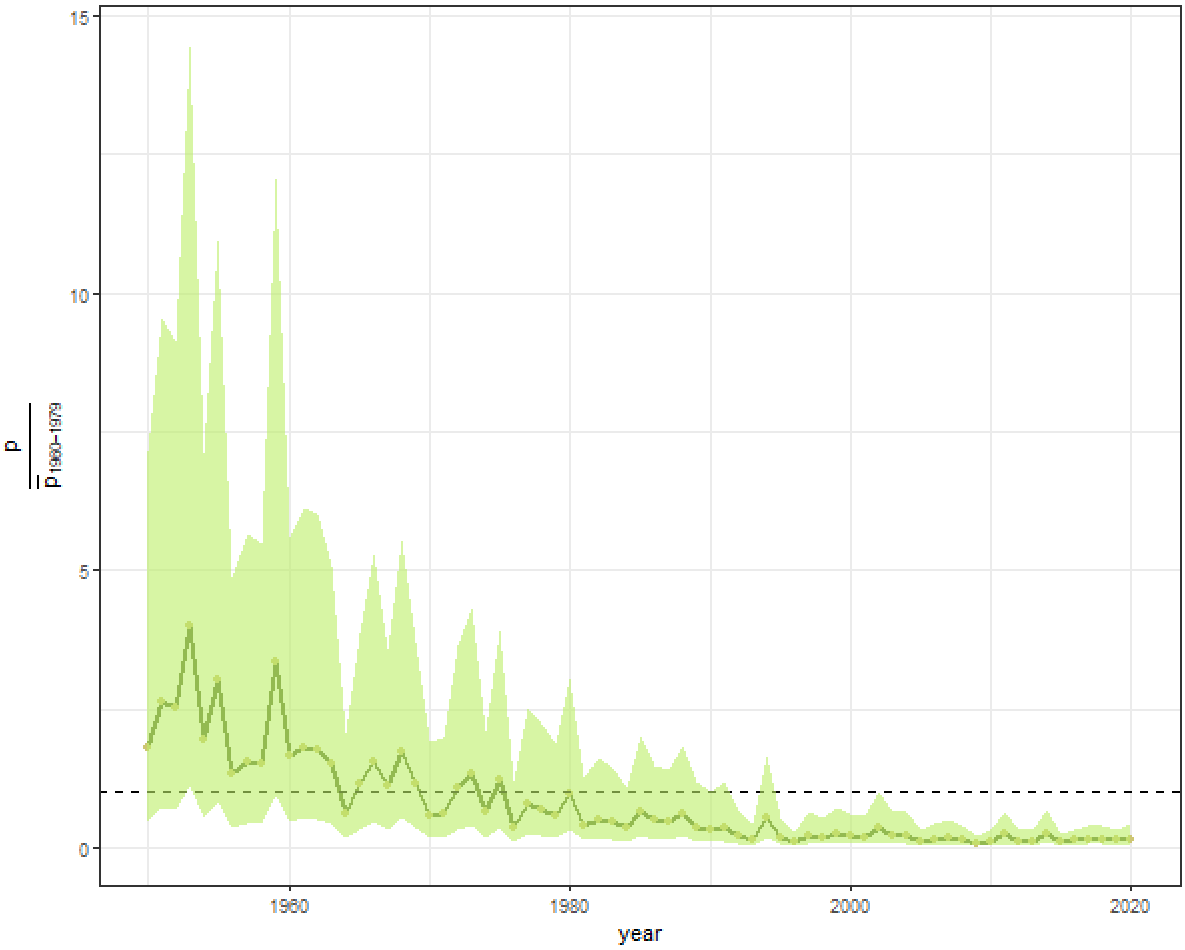


Figure 3.5. Geometric mean of estimated (GLM) yellow eel recruitment for Europe updated to 2020. The GLM (*yelloweel ~ year + site*) was fitted to 21 yellow eel time-series *p* and scaled to the 1960-1979 average $p_{1960–1979}$.

Table 3.1. GLM *glass eel ~ year: area+site* geometric means of predicted values for 56 glass eel series, values given in percentage of the 1960-1979 period.

	1960		1970		1980		1990		2000		2010		2020	
	EE	NS	EE	NS	EE	NS	EE	NS	EE	NS	EE	NS	EE	NS
0	152	208	101	99	115	81	35	15	19	4.7	4.8	0.7	7.1	0.9

	1960		1970		1980		1990		2000		2010		2020	
1	130	117	55	85	89	58	17	3	8.8	1	3.7	0.5	5.4	0.6
2	151	180	50	109	92	29	22	8	12	2.6	4.9	0.5		
3	195	225	56	47	49	23	24	7	13	1.9	7.1	1.7		
4	120	116	83	131	54	10	24	7	7.3	0.6	12	2.5		
5	135	79	71	54	52	8	31	5	7.4	1.1	7.6	0.9		
6	76	88	116	98	34	8	25	5	6.0	0.5	12	1.7		
7	81	98	115	74	59	9	41	4	6.4	1.3	11	1.1		
8	129	124	110	55	70	9	16	3	5.7	1.2	10	1.8		
9	67	90	147	95	45	4	19	7	4.3	0.8	6.2	1.4		

Table 3.2. GLM *yellow eel ~ year+site* geometric means of predicted values for 21 yellow eel series, values given in percentage of the 1960-1979 period.

	1 950	1960	1 970	1980	1 990	2000	2 010	2020
0	181	166	59	99	32	21	12	16
1	265	181	62	41	38	20	24	
2	253	178	108	52	24	37	13	
3	401	150	134	47	14	24	13	
4	197	61	65	35	56	24	27	
5	304	115	122	66	18	12	10	
6	135	157	37	50	10	16	14	
7	157	112	79	47	23	19	16	
8	152	173	70	62	20	15	17	
9	334	116	58	37	25	8	14	

3.1.5 Conclusion

After high levels in the late 1970s, the recruitment declined and has been very low for all years after 2000. WGEEL 2021 analysis records an annual recruitment data point for 2020 among the lowest on record. Recruitment remains low at 0.9% (North Sea) and 7.1% (Elsewhere Europe) of pre-1980s levels.

3.2 Yellow and silver eel series

3.2.1 Introduction

Current ICES advice for eel is based on recruitment trend analysis. In the past, landings have been used as a proxy for stock, for example in stock-recruitment analysis (Dekker 2003, Astrom & Dekker 2007). However, since about 2008 and throughout the implementation of the Eel Management Plans and the CITES listing, e.g. landings restrictions, the link between landings and local stock has become much less clear. This means that an approach independent of commercial and recreational landings is required for evaluating levels and changes in local stocks.

Collecting and analysing time-series on yellow and silver eels and their associated biological parameters in addition to recruitment data can provide a different insight into the trend of the population. Such trends will be influenced by local management, and anthropogenic and environmental impacts, and relate to different subunits of the stock. Therefore, on one hand, their use as a global index will be challenging; whilst, on the other hand they provide the opportunity to look at local and / or regional effects and variations therein (ICES, 2021b). Such a global analysis, especially of the silver eel series, in conjunction with the reported biomass indicators, will also give insight into the future spawning stock.

3.2.2 Existing Yellow and Silver Eel Series Data

3.2.2.1 WKESDCF 2012

The ICES Workshop on Eel and Salmon DCF Data (WKESDCF; ICES, 2012) considered the data requirements for the assessment of standing stock of the European eel and made a number of recommendations for the data collection that should be supported by DC-MAP. These included the requirement for at least one “Eel Index River” per EMU, in which information on the number of recruits, the abundance of the standing stock, and the number, weight and sex ratio of silver eel should be collected. In addition, it called for information on anthropogenic impact on all stages of the stock for each index river.

WKESDCF (ICES, 2012) also proposed that “a coordinated programme of work should be undertaken to address the assessment of densities of standing stock of eels in large open water bodies, such as lakes, deep rivers, transitional and coastal waters”.

3.2.2.2 WGEEL Data Calls

Silver eel time-series were first included in the ICES Eel data call in 2019 (ICES, 2018). Data requested included numbers, biomass, mean weight, mean length and sex ratio. The stated use for the data (ICES draft data call Letter) was to examine trends over time, and cross-calibrate / validate of aggregated data. However, in the official data call letter (2019), yellow eel abundance indices were also requested, noting, that these do not refer to yellow eel recruitment time-series, but only to those that provide a measure of the standing stock.

The stated justification in the data call was that "WGEEL requires data on time-series of yellow eel abundance (i.e. standing stock) as an independent measure in order to confirm reported local trends in the standing stock. Data should be based on empirical observations in a specific location, such as scientific surveys or fisheries-based surveys of yellow eel abundance (e.g. based on CPUE)." Biological information (average length, weight and age of yellow eels) related with the time-series of yellow eel abundance was also requested.

In 2021, historical time-series, and updates or new data, including information on associated upstream factors, such as stocking, for both yellow eel standing stock (Annex 2) and silver eel (Annex 3) time-series were requested by data call. However, the reasoning for gathering those data were not explained in the data call letter.

3.2.2.3 GFCM Data Collection Reference Framework

The GFCM Data Collection Reference Framework (DCRF) places obligations on Contracting Parties to collect and report fishery-related data on eel, specific guidance is detailed in a DCRF manual (available online at http://www.fao.org/gfcm/data/dcrf/en/). At present, the ongoing project "GFCM Research Programme on European eel: towards coordination of European eel (*Anguilla anguilla*) stock management and recovery in the Mediterranean" is assessing current methodologies, aiming to attain a better standardization with a view to reforming Table VII.6 Eel.

3.2.3 Types of Analysis that could be performed

The analysis of the index yellow eel and silver eel data may be undertaken to carry out a number of functions, some of which are only in the proof of concept stage (e.g. the stock assessment in SUDOANG) or in the planning stage such as the road map for advice including a spatial stock assessment model (ICES, 2021b). We have identified three possible types of analyses and uses for these data as follows.

3.2.3.1 Trend Analyses

The analyses of time-series data on yellow standing stock and silver eel production or relative abundance and their associated biological parameters should provide an independent view of the current status and changing trends of the stock, separate from the trend in recruitment and/or the bio-indicators reported as a requirement of the EU Regulation.

Independent analyses of yellow eel stock trends and silver indices, along with the recruitment time-series, the reported silver eel Biomass indicators and other spawner quality indicators might also help to untangle the impacts of anthropogenic pressures and changes in the ocean that influence recruitment e.g. clarifying the relationships between yellow eel abundance, spawner escapement and recruitment.

Analyses of time-trends in silver eel production will require additional information such as age profile and sex ratio, especially where a stock – recruitment relationship, or a recruit to stock analysis is performed. Considerable differences in growth, length-at-age and sex ratio occur throughout the range. For example, age at maturity is significantly lower in the southern end of the range compared to its northern end of the range while female eel predominates with increasing latitude resulting in larger eel sizes and slower growth (ICES, 2018; Poole et al. 2018; Vøllestad, 1992). These differences would need to be considered when combining datasets or series.

Further, local silver eel time-series could be used as an independent verification of modelled estimates of Bcurrent (compare with trends in Bbest) while noting that those silver eel trends may have been used in the estimation of biomass in the first place. Trend analysis of index time-series may facilitate a cross-validation/verification of aggregated or derived data, provided those index data are not part of the estimate being validated. Further, an examination of yellow eel standing stock trends may provide a more immediate measure of effectiveness of management actions than waiting for silver eel escapement

(Bcurrent) to react in years or decades to come, either by the countries at the local level or by WGEEL at the international level.

Trends in direction of standing stock of yellow eel, and in silver eel production, or escapement, could be compared with previous recruitment history and combined in a lifetime model to cross-check silver eel reporting, and to provide additional information on the status of the stock for either ICES Advice, or for other parties to avail of, such as OSPAR's evaluation of the global status of the eel stock. This could be done on a local basis using reliable fisheries independent time-series, or aggregated at a country, regional or species level to give a wider overview.

3.2.3.2 Data for supporting a "global" stock assessment model

The collection of independent time-series data on yellow eel standing stock and silver eel production could be used in a wide-scale spatial model, such as EDA (Briand *et al.* 2018), or MED Eel/ESAM/DEMCAM (Bevacqua *et al.* 2007) for a stock-wide assessment for advice, or at more local level for models such as SMEPII (Aprahamian *et al* 2007) and GEM (Oeberst & Fladung 2012; Prigge *et al.* 2013). This type of assessment and modelling approach has been trialled in the three year SUDOANG project (https://sudoang.eu/en/). This "proof of concept" developed in SUDOANG has been proposed as a possible roadmap for applying a similar approach to the broadening of the Advice on eel (ICES, 2021b).

The SUDOANG project (https://sudoang.eu/en/) developed a spatially explicit model of eel production, EDA, taking into account current local recruitment, yellow-eel standing stock and pre-migratory silvering eels, together with habitat characteristics including the location of barriers to migration, and the flow conditions that influence mortality at such barriers (https://sudoang.eu/en/task-groups/). The standing stock survey was conducted in rivers only, using electrofishing. Length and weight were collected for each eel caught, together with assessment of the silvering status of larger eels, and some details of the electrofishing site. However, due to the issue of a lack of assessment methodologies for large waterbodies including lakes, lagoons and deep rivers s, theses have not been included in the overall assessment and remain to be addressed.

The WKFEA (ICES, 2021b) road map (Figure 3.7) for strengthening the advice considers some complex preparatory tasks, such as hydrographic modelling, and a silver eel production model along with improved spatial data and the need for collating individual site and individual eel data into a new database. Such tasks will require both international coordination and research time to build the tools and the different models necessary to build the final **Spatial Stock Assessment Model** to be used in the ICES advice. As a consequence, the road map time frame is just indicative. The following steps are identified in the WKFEA report:

1. Time-series of yellow and silver eels and biological parameters (2022)

2. Landing reconstruction workshop (2023)

3. Habitat assessment, WFD data and HP/P mortality–Project 1 (2023–2025)

4. Design a population model–Project 2 (2023–2026)

5. Data compilation meeting and benchmark (2026–2027)

To complete this development process, a **Data Compilation Workshop** should take place in 2026 in order to review, discuss and quality-check the data gathered so far (recruitment time-series, yellow and silver eel series, biological parameters, spatial abundance of yellow and silver eel, hydropower and pumping station mortality and habitat data). The approved data will be used in the final **benchmark** in 2027 to evaluate the candidate Spatial Stock Assessment Models.

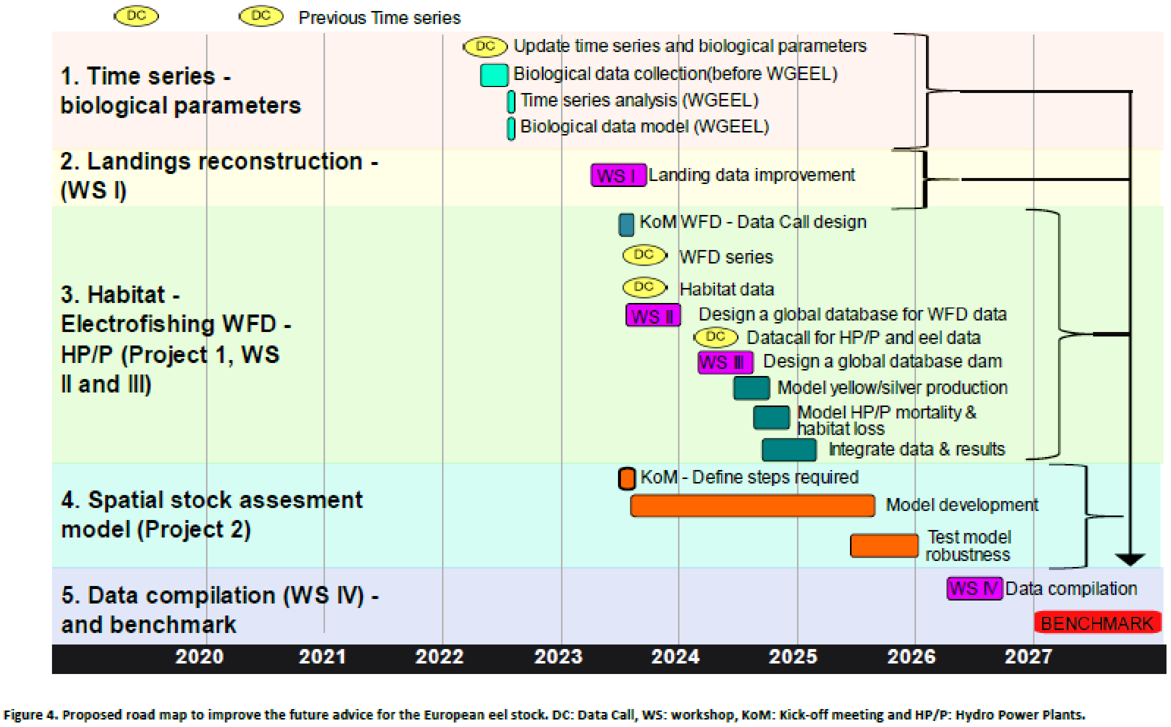


Figure 3.7. Proposed road map for future advice, reproduced from WKFEA (ICES, 2021b)

3.2.3.3 Assessment of the relative impact of different management measures

Analysis of the index series data, and their associated biological parameters may provide an independent insight into the effectiveness of applied management measures. The trends, especially in yellow eel standing stock series, can be compared with changes in ΣA as an independent means of verifying the effectiveness of applied management measures. However, the changing recruitment, and especially the recent low levels of recruitment will introduce an interaction term in these analyses.

The data may also be useful in investigating the rebuilding of local stocks when fisheries measures are put in place, provided recruitment is not impaired. A similar insight into the effectiveness of stocking in silver eel production may also be elucidated by some series.

The examination of a time-series of size frequencies may assist in tracking change in the population dynamics such as the rebuilding of the stock with recruiting and growing small eel increasing in abundance. However, if recruitment is slow and outstripped by maturation and departure as silver eels, the shape of the size frequency may change in a different direction over time.

Note: the current data call does not include individual data required for this type of analysis.

3.2.4 Summary of collected data

3.2.4.1 Abundance data

3.2.4.1.1 Yellow eel time-series

data call 2021 reported on 108 yellow eel time-series from 15 countries and 38 EMUs (Table 3.3, Figure 3.9). Most of the series are located in the United Kingdom (49 series) and France (19 series) (Figure 3.8 and 3.9).

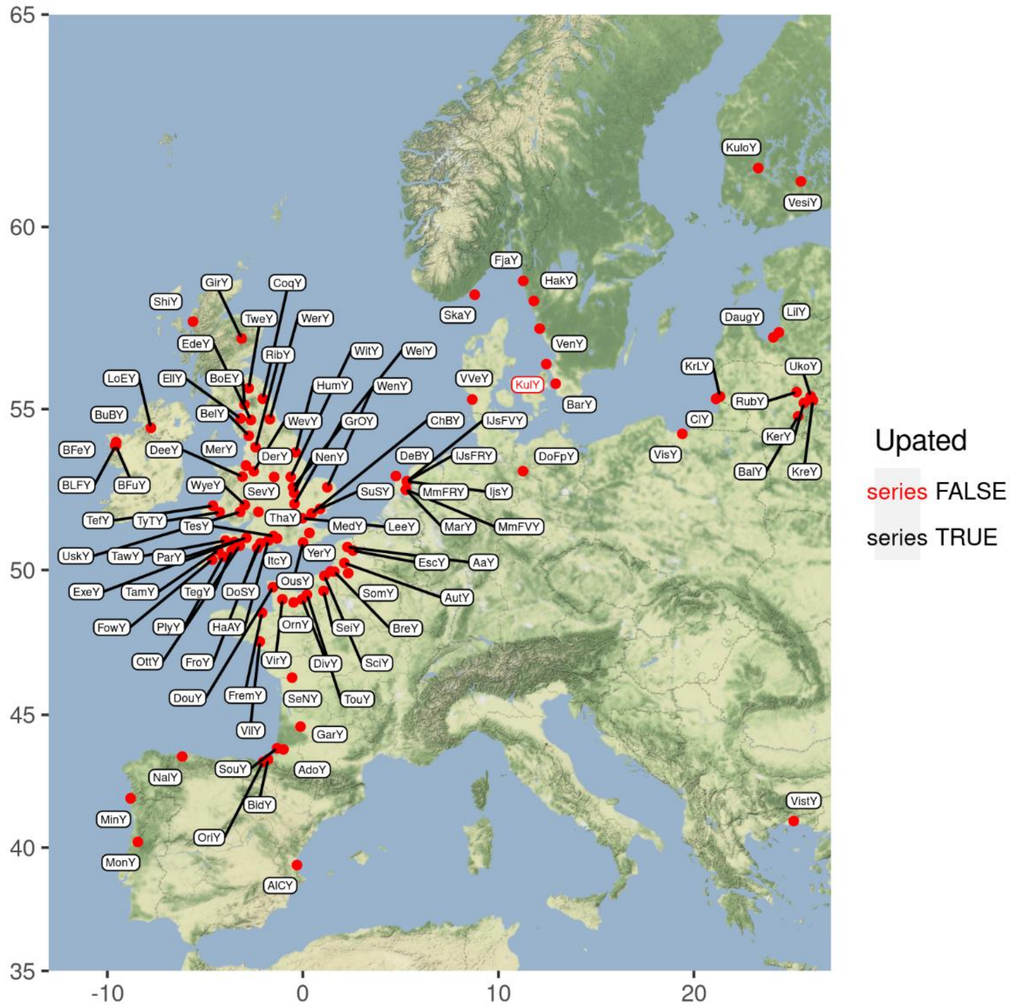


Figure 3.8. Map of available yellow time-series (standing stock). Updated time-series: TRUE = time-series for which at least one value was provided in the three last years, FALSE = not one value provided in the last three years. Not all series names are displayed on the map, for details see Annex 13.

The majority of the data from the yellow eel series were collected in freshwater habitats by electrofishing gear and are reported as scientific estimates (Figure 3.9). Some series were missing quality information, but those with this information available were mainly described as of good quality (Figure 3.9; Table 3.3). Equally, each data entry was of good quality in majority of the cases, but quality id was missing for 130 data entries. Only seven data points were classified as being of bad quality, two were of questionable quality and 80 data entries were considered missing (i.e. not reported). Only one series was missing information on the influence of restocking, while 19 series were classified as being influenced by restocking and 88 as not being influenced by restocking (Figure 3.9, Table 3.3). Seven series were missing information on effort and 48 series were missing data on distance to sea (Table 3.3). For more information on the total number of available series per each category and missing information per category please see Table 3.3.

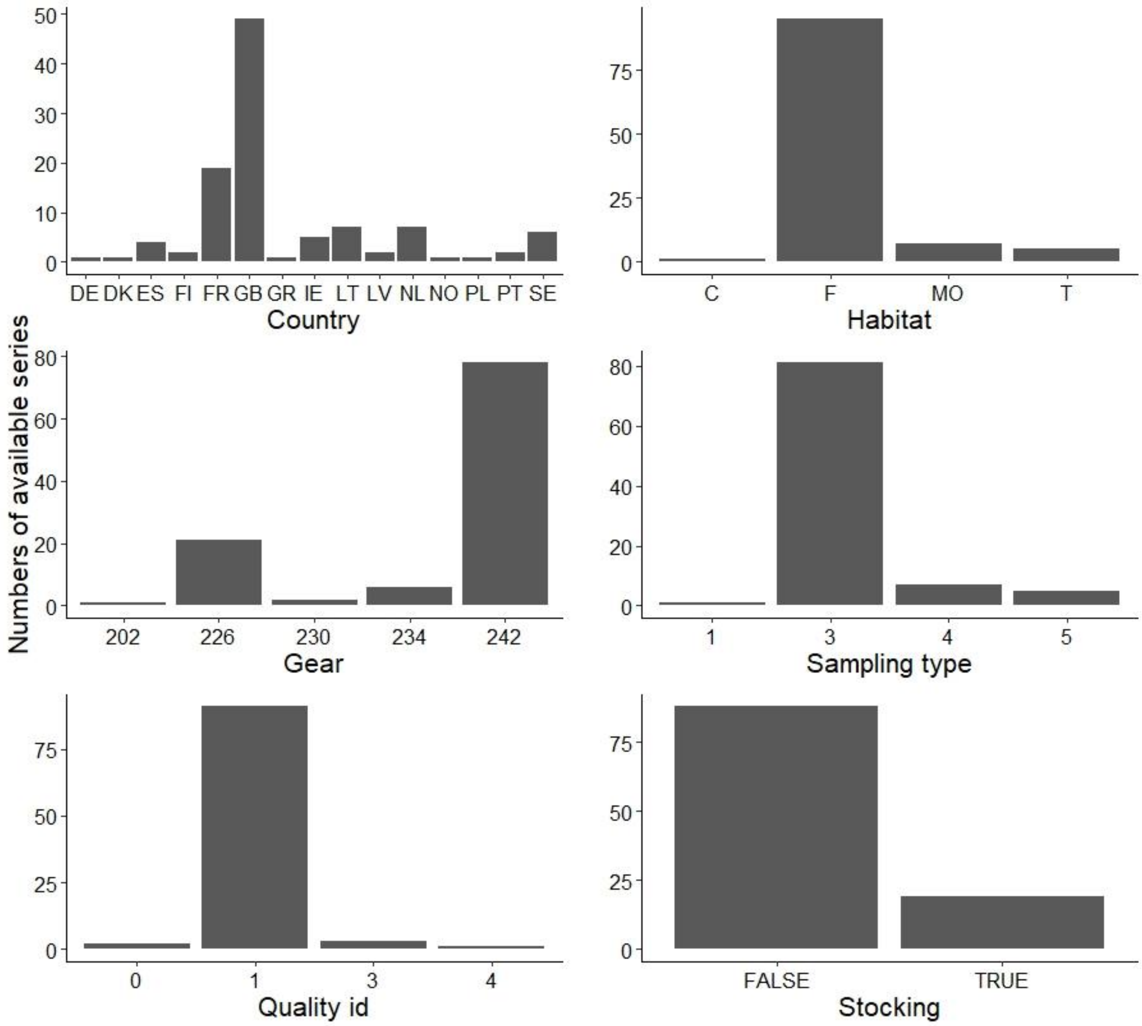


Figure 3.9. Summary of available yellow eel series per country; habitat: C = coastal water, F = freshwater, MO = marine water (open sea), T = transitional water (according to WFD); gear: 202 = beach-seines, 226 = fykenets, 230 = traps, 234 = longlines; 242 = electric fishing; sampling type: 1 = commercial catch, 3 = scientific estimate, 4 = trapping all, 5 = trapping partial; quality id: 0 = missing data, 1 = good quality data, 3 = bad quality data, 4 = data used but with warnings; and stocking: FALSE = no impacts of stocking, TRUE = impacts of stocking.

Table 3.3. Summary of available yellow eel series with more than 5 years of data, and with available quality id, habitat, sampling type, effort, gear, restocking and distance to sea information before and after updates. Missing information for each category is also indicated before and after these updates. N/A means not applicable.

Category	Initial available data	Initial missing data	Available data after updates	Missing data after updates
Nb of series >5 years	87	21	N/A	N/A
Nb of series with quality id	38	70	97	11

Category	Initial available data	Initial missing data	Available data after updates	Missing data after updates
Nb of series with habitat data	108	0	108	0
Nb of series with sampling type	47	61	94	14
Nb of series with effort data	93	15	101	7
Nb of series with gear	105	3	108	0
Nb of series with restocking data	105	3	107	1
Nb of series with distance to sea	58	50	60	48

More than 30 series were available since 2001, with the constant increase in the numbers of series until the peak in 2018 (Figure 3.10). Many series did not have data reported in 2020 due to COVID-19 restrictions (most English and Welsh series). In addition, only two series had 2021 data reported at the time of writing this report (Figure 3.10). This is to be expected due to the timing of most yellow and silver series data in relation to the timing of the data call, and as a consequence any analysis can at best only include data up to the previous year. Two series in the data call had no data reported for any of the years. Eighty-seven series had more than 5 years of data and 70 series more than ten years of data, but the continuity of each of those time-series needs to be further inspected (Table 3.3). A detailed summary of all the series is presented in Annex 13.

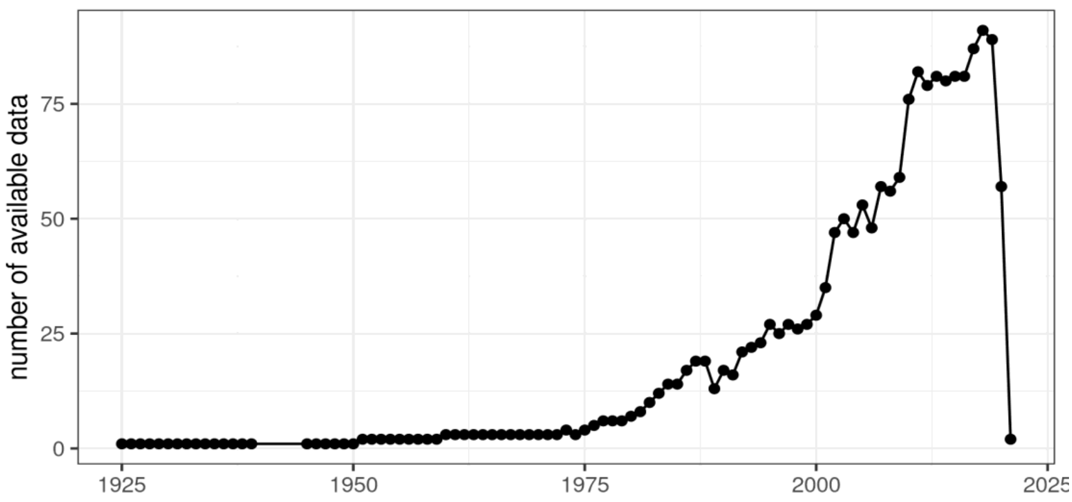


Figure 3.10. Number of yellow eel time-series with available data per year.

3.2.4.1.2 Silver eel time-series

In the 2021 data call, 52 silver eel time-series were available, located in 14 countries and 29 EMUs (Figure 3.11). The majority of these series are from Lithuania (8 series), Netherlands (7 series), United Kingdom (6 series) and France (6 series) (Figure 3.11 and 3.12). Four older time-series were missing information on majority of the investigated parameters, including the country.

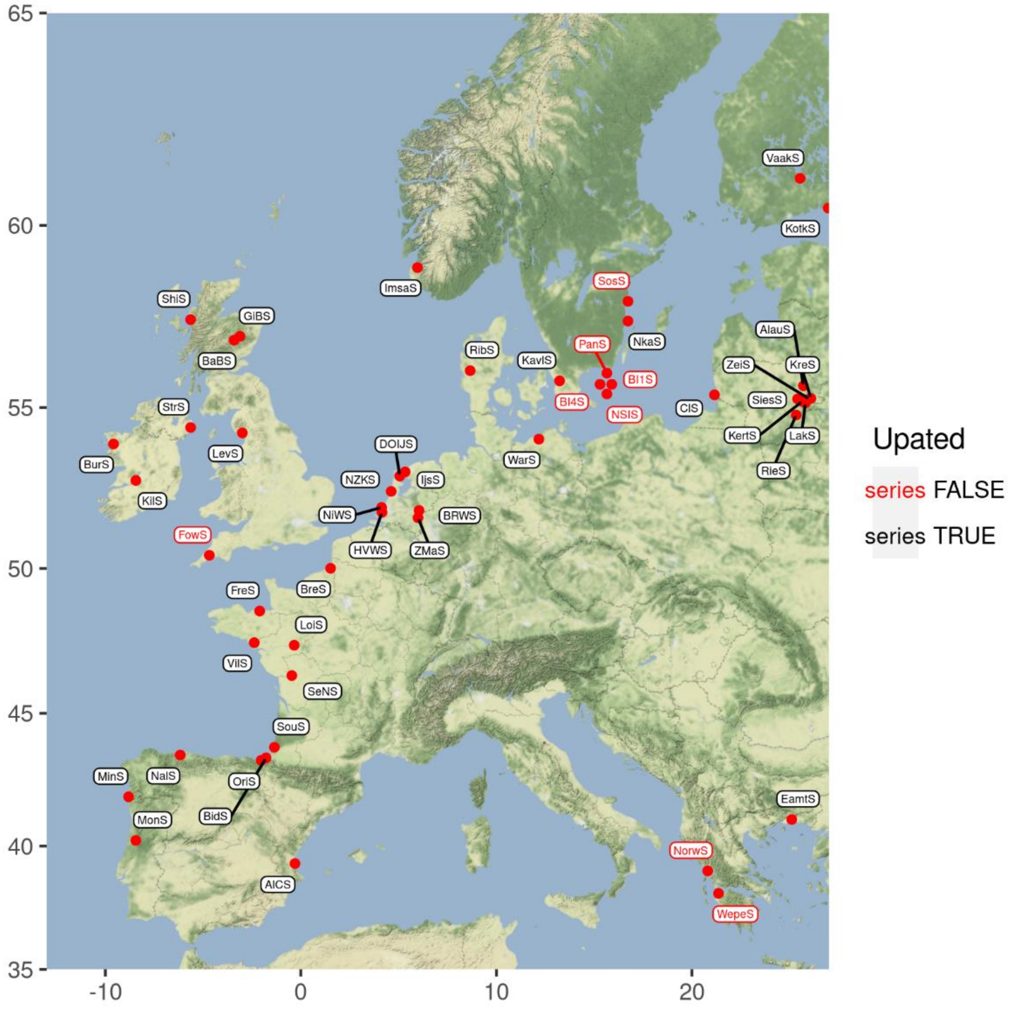


Figure 3.11. Map of available silver eel time-series. Updated time-series: TRUE = time-series for which at least one value was provided in the three last years, FALSE = not one value provided in the last three years.

Most silver eel series were collected in freshwaters via traps and fykenets (Figure 3.12). In terms of sampling type, five series were from commercial catches, one series was reported as

CPUE, six were assigned as full trapping series, 10 as partial trapping series and the rest was classified as scientific estimate, with 16 series missing this information (Figure 3.12, Table 3.4). Half of the series were missing quality information, but those with this information available were mainly described as of good quality (Figure 3.12, Table 3.4). Similarly, quality id describing the data were missing for almost half of the data, with 346 data entries assigned a good quality value. Only eight data points were classified as being of bad quality, 15 were of questionable quality and 13 data entries were considered missing (i.e. not reported). Ten series were missing information on the potential impacts of restocking, with 16 series classified as being influenced by restocking and 26 as not being influenced by restocking (Figure 3.12, Table 3.4). Ten series were missing information on distance to sea and effort data were missing for 28 series (Table 3.4). For more information on the total number of available series per category and missing data please see Table 3.4.

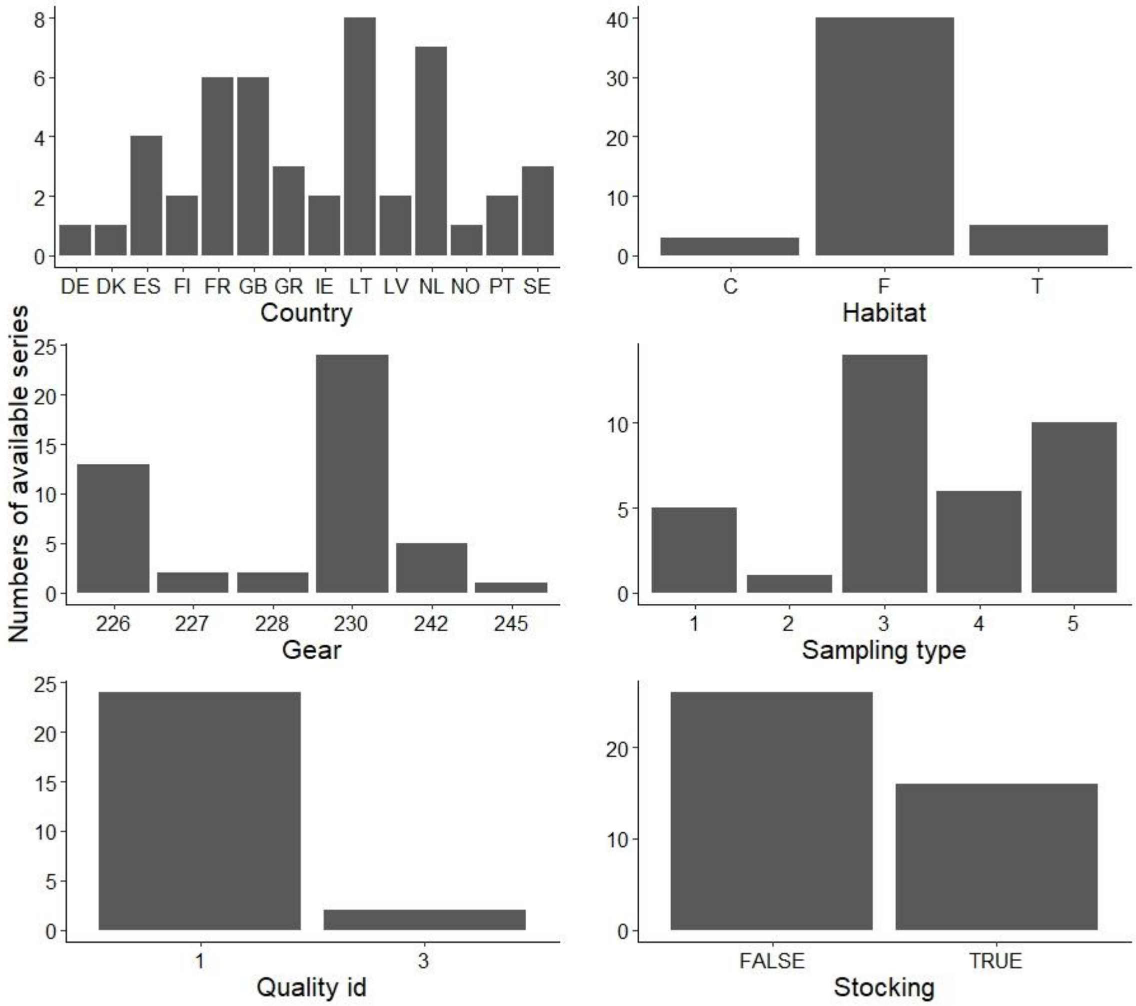


Figure 3.12. Summary of available silver eel series per country; habitat: C = coastal water, F = freshwater, MO = marine water (open sea), T = transitional water (according to WFD); gear: 226 = fykenets, 227 =stownets, 228 = barriers, fences, weirs, etc., 230 = traps, 234 = longlines, 242 = electric fishing, 245 = gear unknown; sampling type: 1 = commercial catch, 2 = commercial

CPUE, 3 = scientific estimate, 4 = trapping all, 5 = trapping partial gear; quality id: 1 = good quality data, 3 = bad quality; and stocking: FALSE = no impacts of stocking, TRUE = impacts of stocking.

Table 3.4. Summary of available silver eel series with more than 5 years of data, and with available quality id, habitat, sampling type, effort, gear, restocking and distance to sea information before and after updates. Missing information for each category is also indicated before and after these updates. N/A means not applicable.

Category	Initial available data	Initial missing data	Available data after updates	Missing data after updates
Nb of series >5 years	36	16	N/A	N/A
Nb of series with quality id	23	29	26	26
Nb of series with habitat data	48	4	48	4
Nb of series with sampling type	36	16	36	16
Nb of series with effort data	24	28	24	28
Nb of series with gear	46	6	47	5
Nb of series with restocking data	42	10	42	10
Nb of series with distance to sea	42	10	42	10

The total number of series per year was highest between 2011 and 2020, with the peak in 2020, but the majority of the series did not have 2021 data ready at the time of writing this report (Figure 3.10). Thus, these data have been excluded from the analysis this year. Thirty-six series had more than five years of data and 21 series more than ten years of data. A detailed summary of all the series is presented in Annex 13.

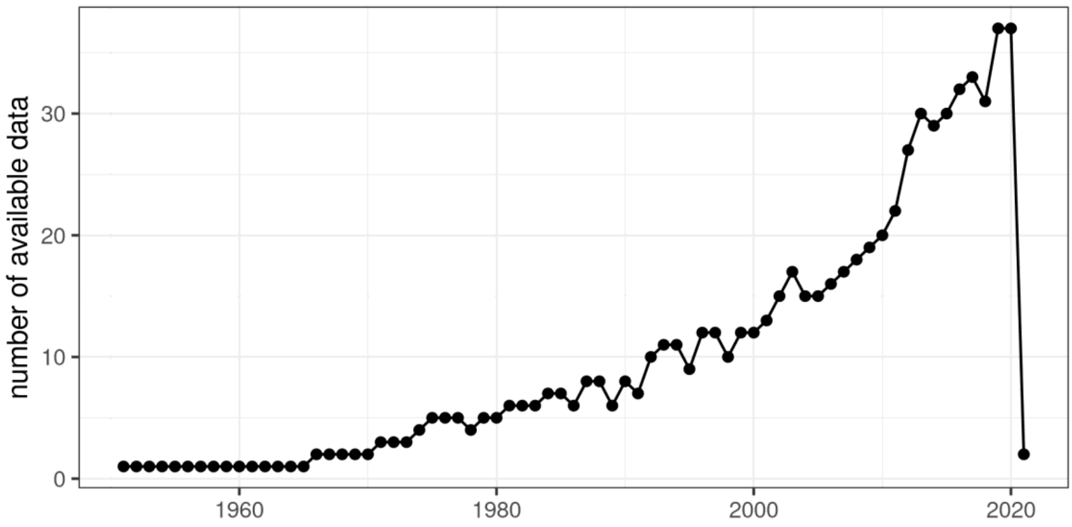


Figure 3.13. Number of silver eel time-series with available data per year.

3.2.4.2 Biometrics series

The biometry section includes the description of the available data on yellow eel standing stock and silver eel, as well as on the recruitment series. The recruitment series include glass eel, mixed glass eels and yellow eel, and yellow eel series. However, these stages have very different sizes, thus any biometric analysis will not be suitable for series with mixed stages. Therefore, in the case of biometry, separate descriptive analyses will be carried out for:

- Glass eel
- Yellow eel (recruitment)
- Yellow eel (standing stock)
- Silver eel

3.2.4.2.1 Glass eel

Of the 23 glass eel time-series recorded, 7 have provided data on glass eel length and 9 for weight of glass eels (table 3.5). Three and 6 of the series have at least 5 years of data for length and weight respectively.

The series with glass eel biometry data come from 8 countries. Two of these series are from the Mediterranean and the rest are for the Atlantic.

3.2.4.2.2 Recruitment yellow eel series

Of the 20 yellow eel recruitment series 3 have provided data on length and 12 for weight (Annex 13). Three and 11 of these series have at least 5 years of data for length and weight respectively. The series come from 6 countries, mostly from the northern part of the range and are located in freshwaters.

3.2.4.2.3 Standing Stock yellow eel series

Of the 108 standing stock yellow eel series 96 have provided data on length, 86 on weight and 16 for age (Annex 13). Seventy-seven and 65 of these series have at least 5 years of data for length and weight respectively. None of the series has at least 5 years of data for age. The series come from 6 countries, mostly from the northern part of the range and are located in freshwaters.

3.2.4.2.4 Silver eel series

Of the 52 silver eel series, 37 have provided data on length and 27 on weight of silver eel (both sexes included) and 8 series have provided silver age data. Nineteen and 10 of the series have at least 5 years of data for length and weight data respectively. None of the age series contains at least 5 years of data. 28 series have provided sex ratio data but none of those contains at least 5 years of data.

Twenty-two series have provided the length and weight and 12 the age of females. Nine, 10 and 1 of the series have at least 5 years of data for length, weight and age respectively. 17 series have provided the length and weight and 5 the age of males. Seven of those series have at least 5 years of data for length and weight and none for age.

The silver eel series with biometry data come from 14 countries, again the northern part of the range and are located in freshwaters. Only one of these series is from the Mediterranean, and it only contains data from one year.

3.2.4.2.5 General overview of the biometry time-series

The information described in the previous sections is summarised in Table 3.5:

- Most of the series containing biometry data come from the northern countries and few series in the Mediterranean provide biometry data. There is also a lack of series in transitional and coastal waters.
- There is little information on biometrics at the earliest stages comparing to the later stages.
- The stage for which the most information exists is the resident yellow eel stage.
- There is very little information on age.
- Many series are too short at present but may be incorporated as soon as they reach five years.
- The problems detected in the previous sections (see chapter 3.2.4.1) also apply to the case of biometrics (methods, lack of information, etc.). Moreover, in the case of biometrics, these problems are compounded by the lack of information on the number of individuals measured, which makes it difficult to assess the quality of the dataseries provided and to compare the different series.

Table 3.5. Number of series with more than five years of data for different parameters. G: glass eel series, YR: recruitment yellow series, Y standing stock yellow series, S silver eel series

									Female						Male					
	Length		Weight		Age		% female		Length		Weight		Age		Length		Weight		Age	
	Total	≥5	Total	≥5	Total	≥5	Total	≥5	Total	≥5	Total	≥5	Total	≥5	Total	≥5	Total	≥5	Total	≥5
G	7	3	9	6																
YR	3	3	12	11	16	0														
Y	96	77	86	65	16	0	28	0	22	9	22	10	12	1	17	7	17	7	5	0
S	35	18	27	10	8	1	29	13	23	12	23	11	12	2	18	9	17	9	5	1

3.2.4.3 Mediterranean data

Only Spain and Greece provided non-empty time and biometry series on yellow and silver eel from the Mediterranean. France also provided time-series but not for its Mediterranean EMUs. In 2021 seven other countries (Italy, Turkey, Tunisia, Egypt, Algeria and Albania) provided data to the WGEEL, but no yellow and silver time-series with related biometry data were ever provided.

In perspective, the ongoing work undertaken within the GFCM Eel project, from which results are foreseen in 2022, should allow to fill some of these gaps. The GFCM Eel Project also foresee a revision of the GFCM Data Collection Reference Framework (DCRF), which places obligations on Contracting Parties to collect and report data on eel fishery-related data. A reforming of Table 'VII.6 Eel' within the DCRF may incorporate data collecting time-series on yellow and silver eels and their associated biological parameters with an independent approach to commercial fishery. This will allow to provide more data from that part of the stock in the near future.

3.2.5 Update and correction during the WGEEL

In order to improve the available data for the analyses of yellow and silver eel time-series, missing data were identified and requested from national data providers and, if available, integrated into the WGEEL Database via the shiny app (table 3.3 and 3.4). Besides the completion of the database, this extensive exercise specifically aimed at obtaining information on the quality of time-series and single data points thereof with regards to further analyses (e.g. trend analysis) to allow for a better selection of suitable series and to prevent the use of inconsistent and biased series in the analyses. Most requested data were obtained and integrated during the working group, while for a small number of series, data were not available at short notice or were never collected.

3.2.6 Trend analyses

Yellow and silver eel series were previously analysed in ICES (2020b). During the current working group we have redone this analysis trying to improve the overall process and to go further into the analysis. Among all the types of analyses that can be done (see chapter 3.2.3), only trend analysis is explored here. Major changes compared to the yellow eel series 2020 analysis will be shown here as an illustrative example. As regards to the state of the dataset (see chapter 3.2.2) there is no point in presenting a comprehensive analysis yet as we anticipate additional data and improved quality in the reporting of data in forth coming data calls and workshops.

Following the 2020 report, the first step has been to analyse the recent trend (2000-2020) with dataseries that have at least 10 observations in the period and having less than 10% of zero values. This leaves 62 time-series. A simple General Additive Model (GAM) smoother on standardised series show an overall decreasing trend. This can be further explored by separating the trends by country (figure 3.14), which explained 14.5% (note that DK and NO trends are not significant) of the deviance or by any other factors available in the data call like habitat (figure 3.15), which explained 6.4% (note that the coastal trend is not significant), restocking, sampling gear, distance to the sea etc. However, those factors are not randomly distributed, e.g. series on open water are currently only available for Sweden.

Using country in this preliminary analysis is a convenient explanatory variable as a proxy for geolocation. It is also a geo-political variable that may include differences in eel management (that might influence the series), data collection and/or data handling. These will require further investigation.

In the 2020 report (ICES, 2020b) the long-term analysis indicates generally higher level of abundance in the past. This should be kept in mind when interpreting the short-term analysis.

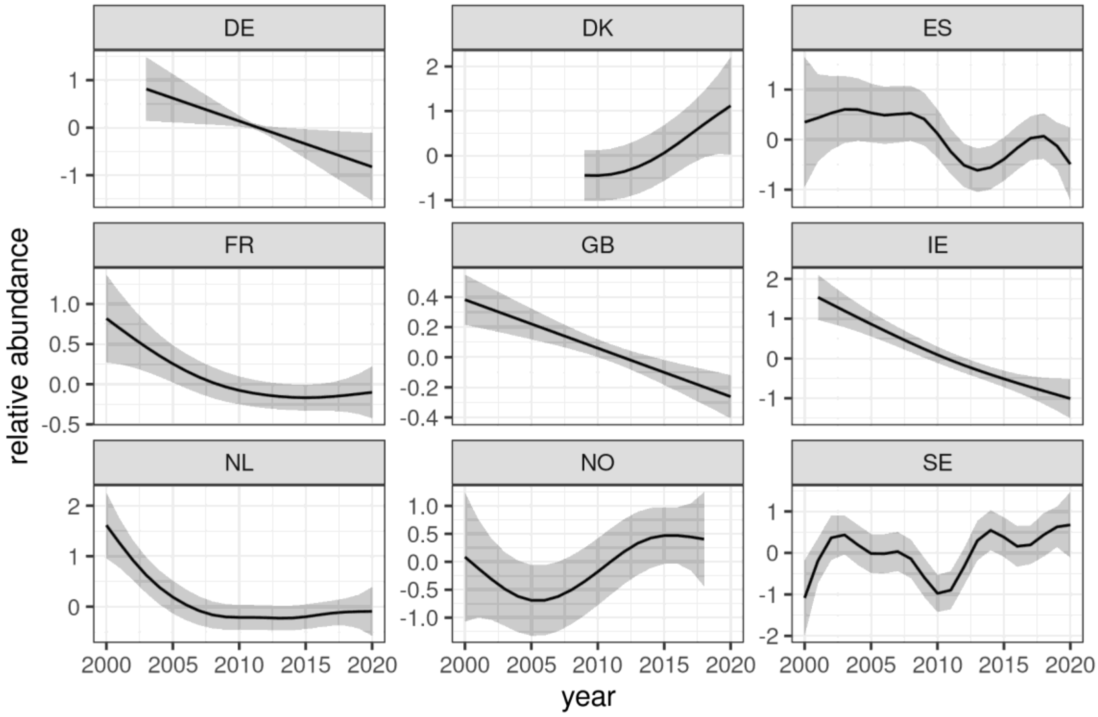


Figure 3.14. Trends per country in yellow eel abundance estimated by a GAM. Note that DK, DE, NO have only 1 series and trends for DK and NO are not significant.

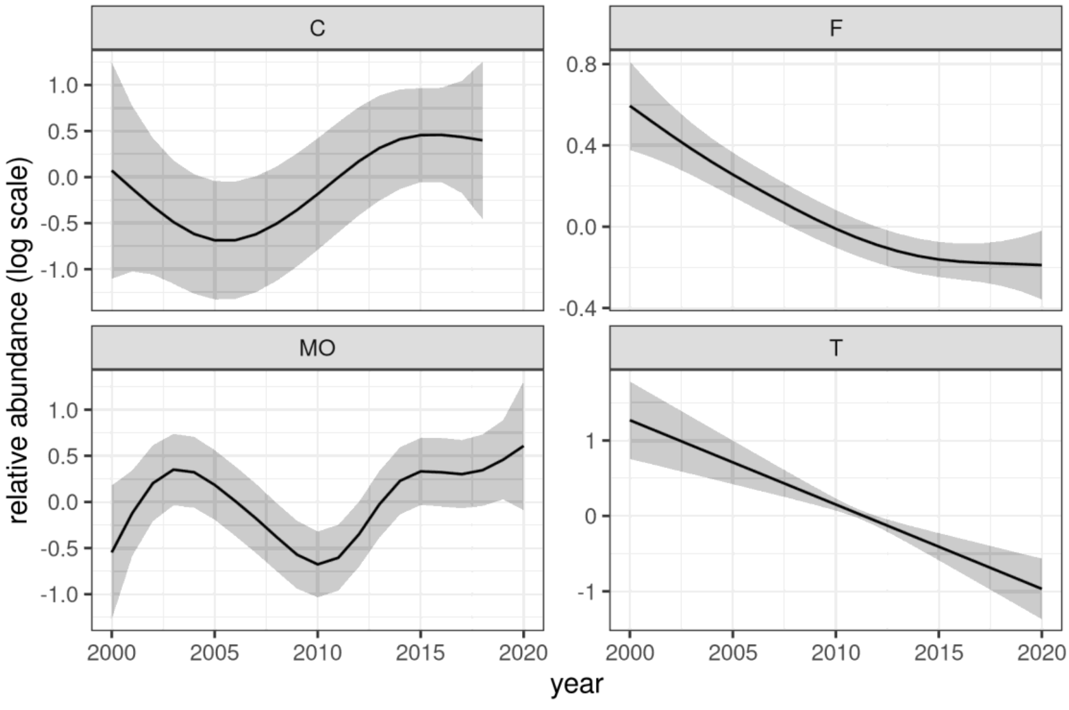


Figure3.15. Trends per habitat in yellow eel abundance estimated by a GAM. Note trend for C is not significant. MO: open sea, C: coastal water, T: transitional water, F: freshwater.

A dynamic factor analysis (DFA) analysis (Zuur et al., 2003) can help in extracting common trends for the whole dataset. We have used the 2020 procedure (ICES, 2020b) and selected, via AIC, a two trends model with the variance-covariance matrix being diagonal and equal (figure

3.16). The first trend shows a decrease, a stabilization and an increase while the second trend shows an increase followed by a decrease. Factors loading from the DFA give the importance of each trend for each series. We can test the correlation between these factor loadings, with some explanatory variables. We have tested both trends in a GLM with the following explanatory variables used simultaneously: restocking, habitat, sampling gear and the distance to sea. Given the number of missing data (chapter 3.2.4.1), only 33 series (out of 62) can be included. For the first trend, only restocking is significant (series with restocking have a higher factor loading) and for the second trend habitat is significant (T > F > C > MO).

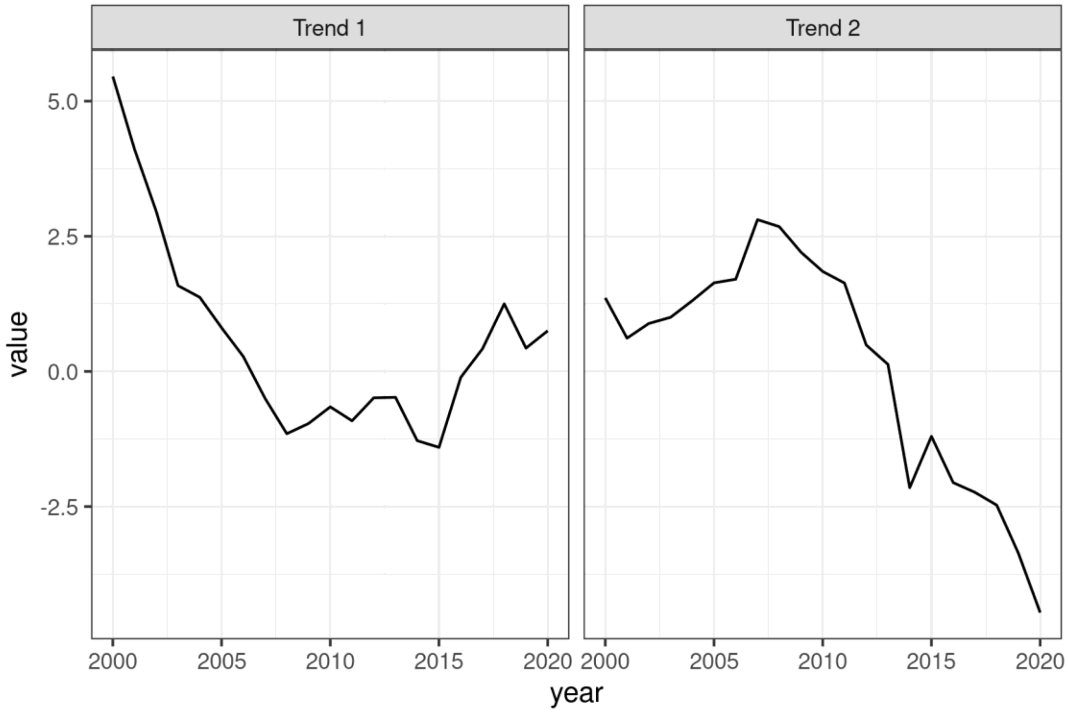


Figure 3.16. Estimated common trends in yellow eel time-series from a DFA analysis.

3.2.7 data call diagnostic and improvement proposal

3.2.7.1 Quality issues

During the review of the eel time-series, a number of problems have been detected that make it difficult to analyse them reliably:

- The existence of particular series is unlikely to be accidental; indeed, some may have been initiated to investigate specific local management actions or as a consequence of historical data collection, and only some of these reasons may be explicitly accounted for in the compiled data. Furthermore, only time-series that meet the necessary conditions for obtaining year on year data collection will survive to be analysed, while more taxing environments (for example, lakes) may be under-sampled. As such careful consideration of biases inherent in the dataset obtained by ICES will be necessary.
- Some countries have not reported all the information required in the series description, which limits the usefulness of these series (e.g. whether there is associated restocking that influence stock, or distance to sea).

- Sometimes there is a lack of information on the sampling methods that makes it difficult to interpret the information because these differences in methods can cause differences in the catchability of the different stages and therefore in the biometrics obtained (i.e. within methods of electrofishing, or compared with fykenet lake data).
- Series from the same life history stage may contain data obtained using very different methodologies. e.g. countries have reported silver series: 1) using summer electrofishing of local sites to determine silver eel density; silver eel are identified and quantified from a mixed catch of yellow and pre, or fully silver eels using a silvering classification (e.g. Durif et al. 2009); 2) targeted sampling of downstream migrating silver eels collected in traps or fixed fishing stations. It will be necessary to determine whether each of them is a reliable source of data and whether they can be appropriately identified and analysed together.
- There is a lack of series in the south and the Mediterranean and in transitional and coastal waters. This can lead to biases in the interpretation of the data across habitats.
- Some in-river aggregations of the data are already occurring within the reporting of individual time-series (i.e. average abundance of different sampling points within a river) and the reliability of these aggregations within an index needs to be tested.
- In most cases when averages of biometrics are provided, the number of individuals measured is not reported (and n may be different for the length, weight, sex ratio and age metrics). Thus, the same weighting could be given to a series in which a single eel has been measured as to a series in which 500 eels have been measured.
- Series mixing different stages cannot be used in biometric analysis (i.e. GY series)
- Restocking impacts are only assessed at series level, but the level and its intensity can change per year and affect the series with variable intensity over time.
- A quality index is assigned to the series in a general way. However, a series can change its quality from one year to the next, for example catch-based recruitment series may have been used in the past and may no longer be of good quality due to the introduction of a quota. The ser_qal_id field in the data call should help identify such inconsistencies in the data, particularly when combined with the annual das_qal_id. However, it is not clear how consistently these are applied across countries. In addition, there may be a risk that the originally reported ser_qal_id ends up being sticky, even when the quality of the series has changed.
- We lack information on other influences, such as fishing quota, upstream impacts such as variable rates of stocking, fishing, trap and transport activities etc. Depending on the analysis, these activities may invalidate the use of individual series.
- Abundance and biometric characteristics can change throughout the year. Lack of information on the date of sampling can cause difficulties in interpreting the data.
- Some countries have included commercial catch data as trapping, as one of their method included trapping. However, it might be useful to have a separate column indicating if data come from fishery-dependent or independent sources.
- Some countries have identified effects of COVID-19 on fisheries. However, this effect is not quantified, so the data of the 2020 and 2021 in this case should be used with caution and the quality for these years should be rated adequately.
- Some commercial catch series are missing data on effort.
- Information on fishery management measures, such as quota, that might bias time-series when certain analyses are applied, have not been asked for and may be useful.

- Some series change the sampling method over the years and/or specific sites inside the same river. The reliability of these series should be assessed. It may be more appropriate to create different series.
- The structure of the Data Call is complex and might lead to errors and misunderstanding during data entry.

3.2.7.2 Proposed improvement for the data call

- The columns “ser_locationdescription” and “ser_method” are text boxes that leave the provider free to choose the information they put in. Sometimes this information is difficult to locate for the person who has to evaluate the series or does not include parameters of interest. For this reason, it is proposed that the information that is relevant when evaluating the series is included in columns that include specific values. For example, in the case of the “ser_locationdescription”, size of the basin, and in the case of “ser_method”, number of passes, number of sampling points included in case of an average.
- Information on the methods of capturing should be more complete in order to be able to interpret the biometric information correctly:
    - Time period in which the sampling was carried out
    - number of samples (divided by sex where applicable) from which the average of each biometric was obtained.
    - Series where trapping is considered, selectivity of the gear should be noted as a value instead of a comment to simplify data analyses

- Consideration should be given in the biometry time-series data to requesting information on a disaggregated basis for each eel, or at least the length structure should be provided.
- The number of series should be increased for transitional and coastal waters.
- The number of series should be increased in the southern part of the range and more specifically in the Mediterranean.
- Guidelines are required for the provision of the time-series, on the use of aggregated data and on the use of pre-silver classification.
- The implementation of the WKFEA roadmap contemplates the collection of different biological parameters. The level of disaggregation required by this roadmap must be considered when collecting data in the data call
- The importance of providing effort information should be stressed.
- If possible, countries should be asked to quantify the effect of COVID-19 on the series.
- The effect of restocking should be considered at the annual level for each series. The possibility of providing a level of influence (not only yes/no) should also be considered.
- In case of changing the sampling method in a given series, the effect this could have on the series should be reported. When appropriate different series should be provided.
- It is recommended that the responsibility for quality rating of the data are clarified.
- If it is not possible to report biometry data in a more disaggregated way, the number of individuals measured for each of the parameters should be provided.
- Given the fact that the structure of the data call is already complex and that the inclusions of the above mentioned recommendations would make it even more complicated, it is important to improve the precision of the data requests (e.g. improvement of

the explanations in readme and in some definition, like how to calculate distance to the sea, clear list of eligible units for each parameter and a reduction of requested parameters and information to the necessary minimum).

3.2.8 Conclusion and recommendation

Current and past data calls allow the working group to gather a growing number of dataseries, many supported by the DCF or other directives (e.g. WFD). Currently 160 dataseries on yellow or silver eel abundance and for some of them corresponding biometric data have been gathered. As with many data collecting systems undergoing development, this collection is not mature and can be further improved. This includes a better understanding by the data provider on what data they need to provide and the importance of improving the quality of the data reported (e.g. filling out all the requested data fields). The previous sub-chapter (3.7.2.2) gives also some proposals on new or modified data to be collected.

Preliminary analyses done in 2020 and in this report (see chapter 3.2.6) illustrated how these data may be used to identify and understand changes in trends, which is one of the uses and outputs possible from these data (see chapter 3.2.3). While many explanatory variables are still missing (see chapter 3.2.4 and 3.2.5) these analyses allow the identification of some common trends and the testing of some preliminary explanatory variables. This shows the potential of the yellow and silver eel series to improve our understanding of the population dynamics and ultimately to improve the stock assessment.

A comprehensive framework of analyses of the yellow and silver stocks through these series will require many iterations of data collection – analyses – further data needs. One way to ease and accelerate that process is to conduct a series of workshops gathering data providers and biostaticians to study the details of each dataseries. Reports of projects, like glass eel monitoring (Dekker 2002), have been the basis of development of the glass eel recruitment index. Materials from the country reports can be a good basis setting up such a project on yellow and silver eel data collection and analysis. This should however be planned within the overall framework of the roadmap proposed at WKFEA.

3.3 Trend in fisheries

This section presents and describes data from commercial, recreational and non-commercial fisheries, aquaculture production and restocking of eel. Data can be reported by eel life stage (glass, yellow, silver), habitat type (freshwater, tidal, marine) and by eel management unit (EMU) where possible. Historical series for which these details are not available are reported by country. The current database structure will allow aggregation by country or region if necessary. The landings data presented are those reported to the WGEEL, either through responses to the 2021 data call, in Country Reports, or integrated by the WGEEL during data calls.

Within the Concerted Action promoted by GFCM, still ongoing and due to be completed in February 2022, work has been done already in 2021 in order to implement involvement to WGEEL 2021 of Mediterranean countries participating to the Programme. Further, this will coordinate data submission to the Joint Data Call, at least for landings and Aquaculture data (Annex 4 and 5) already available and checked for quality within specific tasks of the Programme.

Within the WGEEL, up to now 6 Mediterranean countries (4 EU: Spain, France, Italy, Greece and 2 Non-EU countries: Turkey and Tunisia) over time, have provided historical series of eel landings, recruitment and data on aquaculture. In 2021, the number of the Mediterranean countries that provided data through responses to the 2021 EIFAAC/ ICES/GFCM WGEEL data call increased to 9, with 3 new countries (Egypt, Algeria and Albania) being able to provide data for commercial and recreational landings, releases and fishing effort.

3.3.1 Commercial fisheries landings

Landings' data come from the Eel data call and the WGEEL database data for commercial fisheries. When data are absent and presumed missing for a country/year, a predicted catch is used. This "correction" is based on a simple GLM extrapolation of the log-transformed landings (after Dekker, 2003), with year and countries as the explanatory factors. This is applied as one means to account for non-reporting, but it is not a complete solution. Note that for glass eel as well as for yellow and silver eels, some countries have not always reported their landings. Thus, even with the corrected version of the figures the total given here should be considered as a minimum. Care should also be taken with the interpretation of the landings as indicators of the stock, since the catch statistics now reflect the status of reduced activity as well as of stock levels.

All Med participants (Al, DZ, EG, ES, GR, IT, TN, TR) has provided commercial landing data for WGEEL 2021 report. The overall yellow-silver landings starting from 1951 until 2021, have been taking into account and considered by the WGEEL jointly with the other series in Europe this year, one series provided by Egypt being discarded to the moment, waiting for a further check. Within the activities of the GFCM Programme, a revision of all available data, especially fishery-related data, is ongoing, with a quality check currently underway that will be finally acknowledged in 2022 for all data under the National frameworks, that will provide further dataseries to WGEEL from 2022.

3.3.1.1 Glass eel

Figure 3.17 presents the time-series up to and including 2021 for total commercial glass eel landings as reported by 5 countries in the Eel data call and additional data provided via the Country Reports.

Figure 3.18 presents the same time-series but corrected for missing data (see above), with an inset box showing the proportion of data corrected per year. This proportion is rather low, except for 2009. Glass eel landings show a sharp decline since 1980 from 2,000 tonnes to around 40–60 tonnes since 2009 onwards (Annex 14). The commercial glass eel fisheries in 2020 and 2021 are 59 t for 4 countries (ES, PT, FR, GB) and 52 t for 3 countries (FR, ES, PT), respectively. The mean glass eel commercial fisheries for the previous five years (2015–2019) is reported as 59 t.

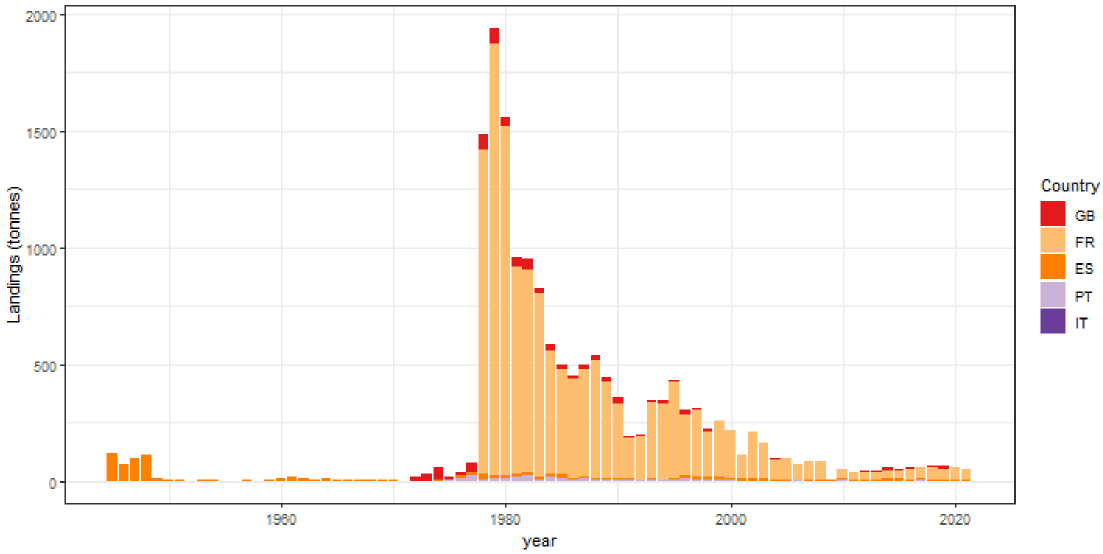


Figure 3.17. Time-series of reported commercial glass eel fishery landings (tonnes), by country. United Kingdom (GB), France (FR), Spain (ES), Portugal (PT) and Italy (IT) are included combining information from the data call 2020 and the WGEEL database.

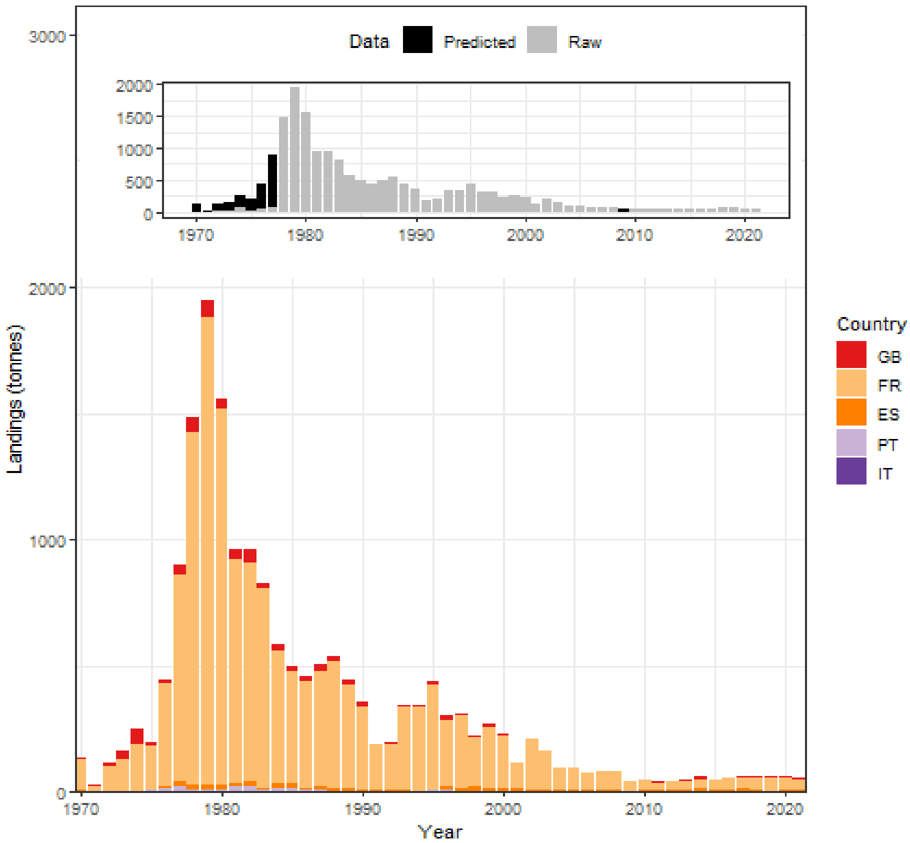


Figure 3.18. Time-series of reported or reconstructed commercial glass eel fishery landings (tonnes), 1970-2020, by country. United Kingdom (GB), France (FR), Spain (ES), Portugal (PT) and Italy (IT) combining information from the data call 2020 and the WGEEL database, and a reconstruction of the non-reported countries/years combinations (see text). The inset box shows the proportion of data reconstructed per year.

3.3.1.2 Yellow and silver eel

Figure 3.19 presents data but for yellow and silver eels aggregated coming from 25 countries, including those from the Mediterranean, and Figure 3.20 presents the time-series including reconstructed data to fill the gaps (Annex 14). The proportion of "corrected" landing was as high as 50% in the 1950s, but rather low since the mid-1980s. Annex 14 presents the raw data for yellow and silver eel combined, Annex 14 presents the raw and corrected data for yellow and silver eel landings data. The total landings of yellow and silver eels decrease from 18,000–20,000 t in the 1950s to 2,000–3,000 t since 2009. Landings from yellow and silver eel commercial fisheries (Y, S, YS) add up to 2,219 t in 2019 and 2,263 t in 2020. Yellow and silver eel commercial fisheries averaged 3,273 t over the five previous years (2015–2019).
Reconstructed yellow and silver eel commercial fisheries (Y, S, YS) in 2020 is 2,919 t.

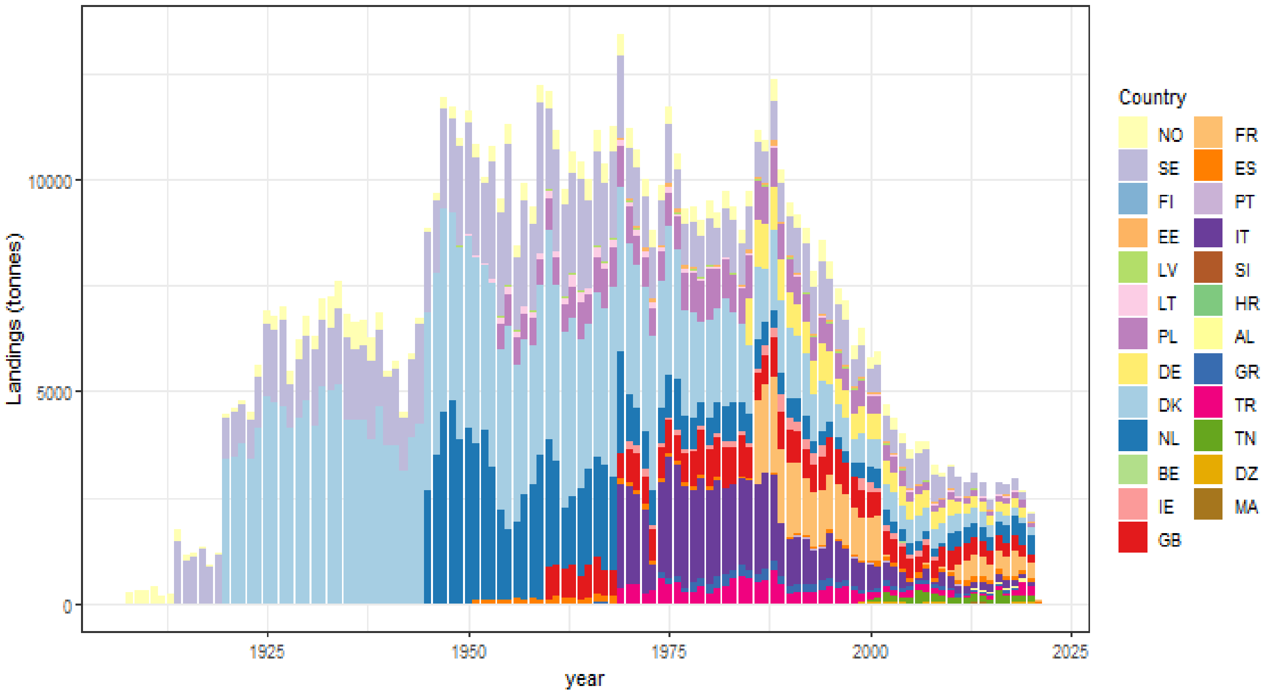


Figure 3.19. Time-series of reported commercial yellow (Y), silver (S) and yellow-silver (YS) eel fishery landings (tonnes) by country, Norway (NO), Sweden (SE), Finland (FI), Estonia (EE), Latvia (LV), Lithuania (LT), Poland (PL), Germany (DE), Denmark (DK), Netherlands (NL), Belgium (BE), Ireland (IE), United Kingdom (GB), France (FR), Spain (ES), Portugal (PT), Italy (IT), Slovenia (SI), Croatia (HR), Albania (AL), Greece (GR), Turkey (TR), Tunisia (TN), Algeria (DZ) and Morocco (MA) combining information from the data call and the WGEEL database.

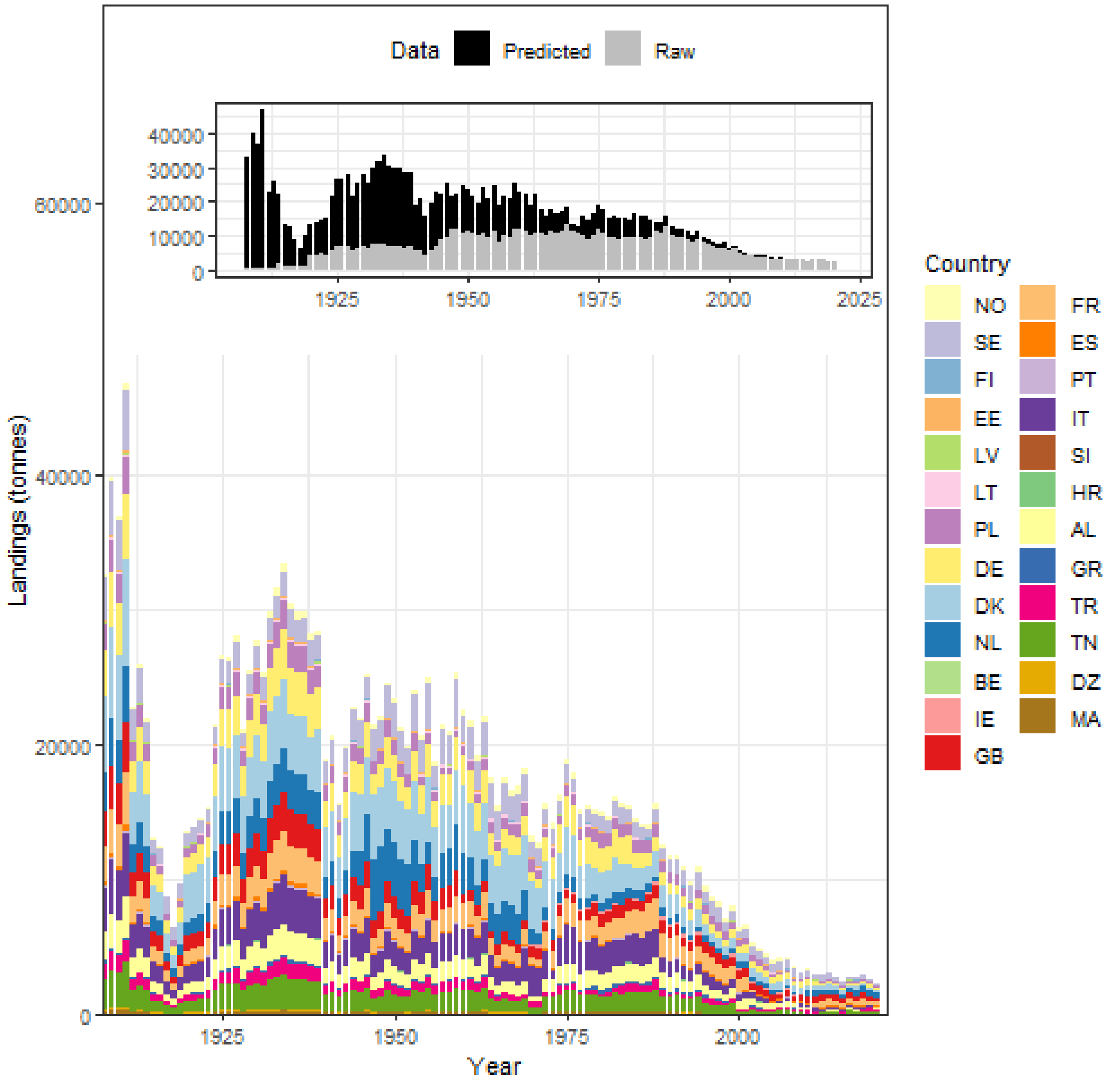


Figure 3.20. Time-series of reported or reconstructed commercial yellow and silver eel fishery landings (tonnes), by country, Norway (NO), Sweden (SE), Finland (FI), Estonia (EE), Latvia (LV), Lithuania (LT), Poland (PL), Germany (DE), Denmark (DK), Netherlands (NL), Belgium (BE), Ireland (IE), United Kingdom (GB), France (FR), Spain (ES), Portugal (PT), Italy (IT), Slovenia (SI), Croatia (HR), Albania (AL), Greece (GR), Turkey (TR), Tunisia (TN), Algeria (DZ) and Morocco (MA) combining information from the data call, the WGEEL database and a reconstruction of the non-reported countries/years combinations. Inset box shows the proportion of reconstructed landings, per year.

Regarding the COVID-19 pandemic impact on commercial fisheries, only 2 Countries (UK-NI, IT) out of 18 reported or mentioned in the Country Reports a potential COVID impact on eel fishery in the last two years. Effects are identified especially in fishing effort restrictions - in terms of limitation of fishing season and reductions of the number of gears and boats - as a result of a loss of market and opportunity for sales. Only IT mentioned specific action (i.e. a questionnaire) to evaluate the impact on the fishery both from the productions and from socio-economic point of view. However, no sufficient information is available for dealing with COVID-19 pandemic disruption, and no data are missing due to the COVID-19 pandemic.

3.3.2 Recreational fisheries landings

Recreational and non-commercial fishing is the capture or attempted capture of living aquatic resources mainly for leisure and/or personal consumption. Recreational and non-commercial fishery covers active fishing methods including rod and line, spear, and hand–gathering and passive fishing methods including nets, traps, pots, and setlines. In some countries, recreational angling for yellow and silver eel is a popular outdoors activity. Passive gear, such as fyke nets, in some countries are used to catch eel for house consumption (e.g. Denmark). In other countries (e.g. UK, Portugal, Sweden), it is forbidden and all accidently caught eels must be returned alive. Recreational fisheries for glass eel have existed in France and Spain – it has been forbidden in France since 2010.

Figure 3.21 presents the data available to the WGEEL on recreational landings for glass eel from 2 countries Spain and France. Spain is the only country allowing a recreational catch of glass eel, with landings estimated as 0.87 t and 0.66 t for 2019 and 2020, respectively (Annex 14). The mean glass eel recreational fisheries of the previous five years (2015–2019) is 1.63 t.

Figure 3.22 presents the data available on recreational landings of yellow and silver eel combined (Annex 14). Recreational landings for yellow and silver eel combined were 489 t for 2019 (10 countries reporting) and 272 t for 2020 (9 countries reporting). FR has provided estimation for all freshwater recreational fisheries in 2006, while for other years FR provides declared catch by recreational fishers with gear in public rivers. The available data have been considered by the WGEEL jointly with the other series in Europe. The mean yellow and silver eel recreational fisheries for the previous five years (2015–2019) is 520 t.

Covid related effects

In 2021 Belgium reported a significant increase in the number of licensed anglers in Flanders, the increase amounted up to 18.5% compared to the mean number of the five previous years (period 2015-2019). This significant rise was most probably due to COVID-19. Angling was very popular as an individual COVID-safe outdoor activity.

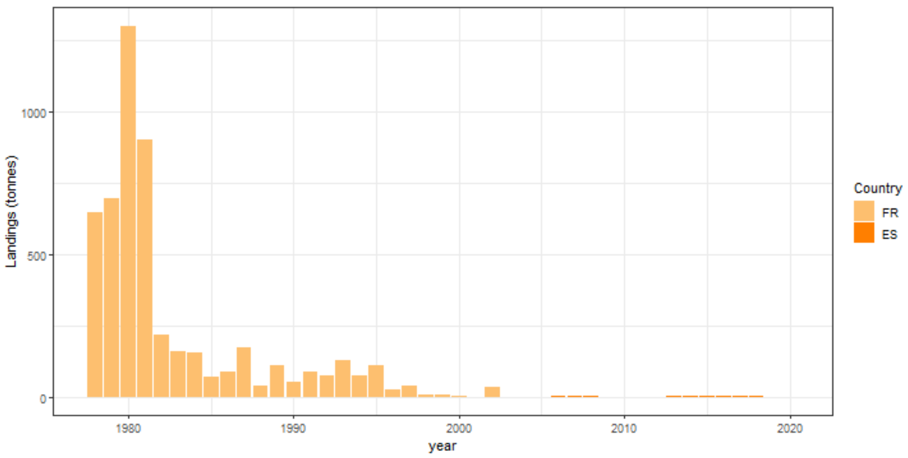


Figure 3.21. Time-series of reported recreational glass eel fishery landings (tonnes), by country France (FR) and Spain (ES) combining information from the data call and the WGEEL database. Data for recent years are provisional or incomplete and may change in future data calls. For more details, see Annex 14.

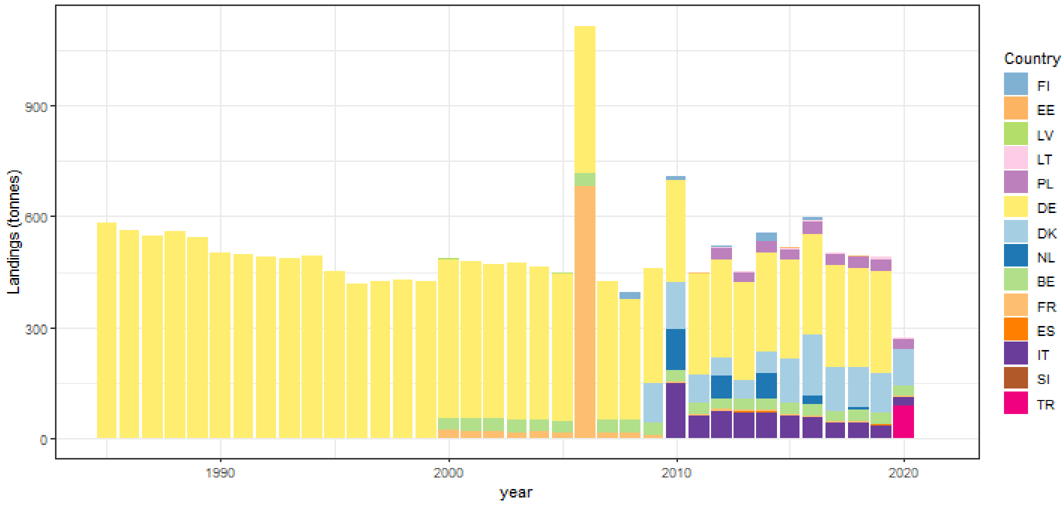


Figure 3.22. Time-series of reported recreational yellow and silver eel fishery landings (tonnes), by country, Finland (FI), Estonia (EE), Latvia (LV), Lithuania (LT), Poland (PL), Germany (DE), Denmark (DK), Netherlands (NL), Belgium (BE), France (FR), Spain (ES), Italy (IT), Slovenia (SI) and Turkey (TR) combining information from the data call. Note, in 2006 FR has provided estimation for all freshwater recreational fisheries, while for other years FR provides declared catch by recreational fishers with gear in public rivers. Reporting is not considered complete in recent years and particularly before 2000 where DE is the only country reporting landings estimates (extrapolation based on regional studies and number of licenses). For more details, see Annex 14.

3.3.3 Illegal, unreported and unregulated landings

Illegal, unreported, and unregulated fishing (IUU) is by its nature very difficult to quantify, and misreporting may therefore be substantial. Most countries did not report any IUU in their Country Reports. However, seizure of illegal gears, or other legal measures were reported in Country Reports. Organised illegal glass eel trade is supplied by legally caught and IUU caught eel. This trade is considered high priority by Europol (the European Union's law enforcement agency) among environmental crimes, due to its economic significance, the poor status of the eel stock, and the large number of organisms affected. Related police action and court decisions have been covered by a large number of news reports during the past year. In addition, illegal eel trade from range states is an issue of concern for CITES. To summarize, while IUU fisheries certainly exist for glass, yellow and silver eel, there are insufficient data available to quantify their effect on the total stock size or status with any level of certainty.

3.4 Overview of Biomass and Mortality indicators

3.4.1 Introduction

In June 2021, ICES issued a data call, in which countries were asked to provide several stock indicators for their EMUs:

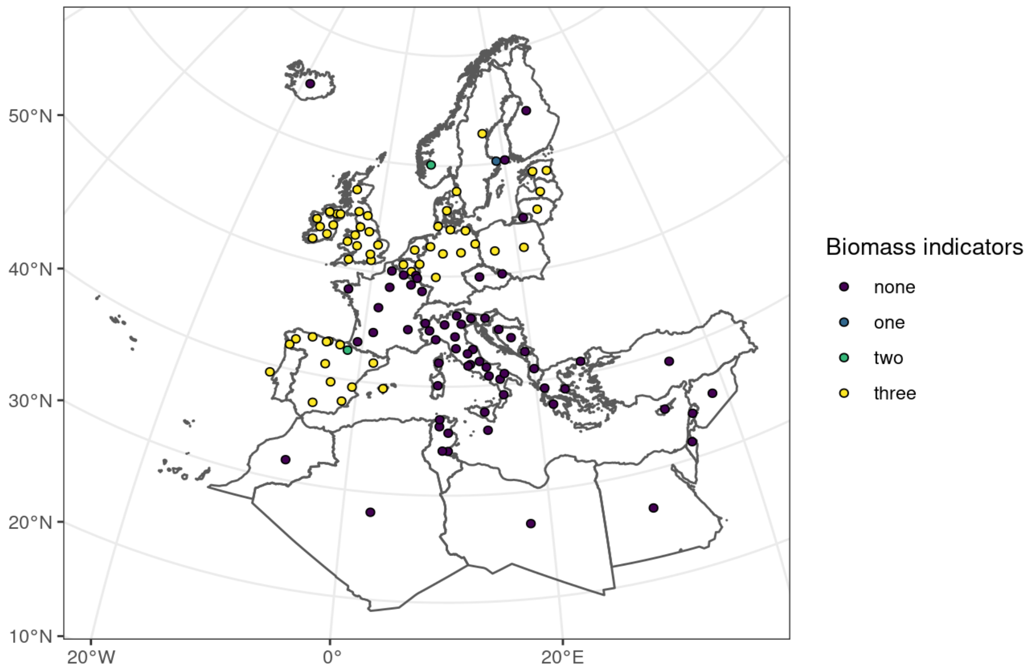
- estimates of fishing lifespan mortality, denoted ΣF
- estimates of other anthropogenic lifespan mortality, denoted ΣH

- estimates of total lifespan anthropogenic mortality, denoted ΣA
- estimates of current escapement, denoted $B_{current}$
- estimates of the best estimates that would have occurred given the current level of recruitment in the absence of any anthropogenic influence (restocking being mentioned as an anthropogenic influence), denoted B_{best}
- estimates of the pristine escapement, B_0, defined as the escapement that would have occurred in the absence of any anthropogenic influence.

As such, $B_{current}$ and B_0 can be used to assess the compliance with the Regulation aim (defined as 40% of the pristine escapement). Similarly, the mortality indicators can be used to assess the compliance with the aim of the Regulation (40% pristine escapement implies a maximum ΣA of 0.92).

Based on feedbacks from previous data call, detailed recommendations were made in different WGEEL reports (ICES 2018, 2020b), WKEELDATA3 data reports (ICES, 2021a) and in the template files sent to countries (Annexes 9 and 10 of the data call). Recommendations aimed to improve the consistency in the way countries estimate these indicators, and compliance with those recommendations, is assessed in subsequent sections. In addition to these estimates, EU Member State countries were asked to provide additional information on the method used to estimate the indicators through a specific template file (Annex 13 of the data call).

A detailed inventory of the estimates provided by the countries is presented in Annex 15, and summarised in Figure 3.23.



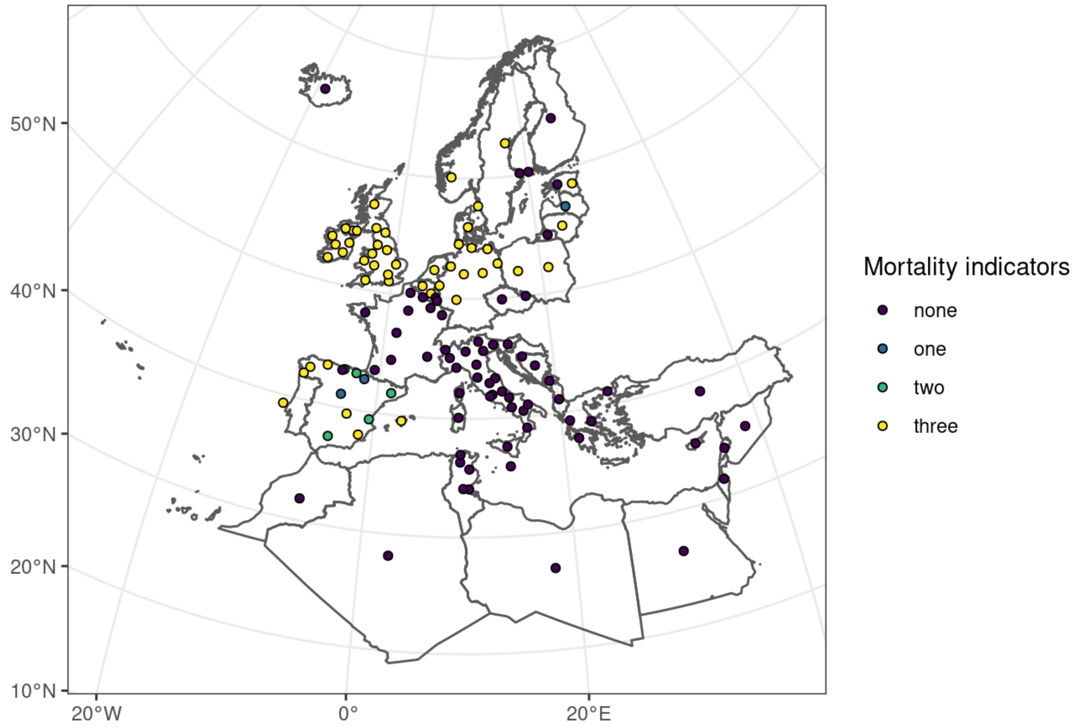


Figure 3.23. Amount of biomass (top panel) and mortality (bottom panel) indicators provided in each EMU. The colour of the points indicates the number of distinct indicators for which estimates were provided (for at least for one year out of all reported years). Where countries report mortality as non-pertinent (NP), this is treated as a reported indicator of zero.

Overall, 14 countries of 40 have, at least partially, answered this call (Annexes 9 and 10 of the data call), with data for 63 EMUs of 120. Most Mediterranean countries, except Spain, have not answered, though it should be noted that some of them are not ICES countries, nor EU Member States, and as such are not committed to the data call. Contrary to the 2018 data call, countries were not asked to provide estimates disaggregated at the habitat scale, but to provide a single estimate at the EMU scale. However, they were asked to quantify the proportion of each habitat that was indeed accounted for in their computation. A table detailing these proportions is presented in Annex 15, and clearly highlights that both marine and coastal habitats are almost never accounted for in the reported indicators, and that a large proportion of transitional waters across the species range are not considered. Similarly, in the absence of data on the surface of available habitat, except for a few range States, it is difficult to quantify the impact of not taking these habitats into account, but this should be kept in mind when looking at the results.

3.4.1.1 Data quality check

To check quality of data and detect possible inconsistencies or errors with reported indicators, the indicators $B_{current}$, B_{best}, and $\sum A$ were re-estimated for all countries that provided them, using two of the three indicators to estimate the third. The underlying assumption for the alternative estimates is that, if the currently-reported value for $\sum A$ were to be applied to the currently-reported value for B_{best}, you would end up with the currently-reported value for $B_{current}$, at least in the absence of restocking. Thus, the alternative estimations were performed as follows:

$$\sum A = -\ln \frac{B_{\text{current}}}{B_{\text{best}}}$$

$$B_{\text{current}} = B_{\text{best}} e^{-\sum A}$$

$$B_{\text{best}} = \frac{B_{\text{current}}}{e^{-\sum A}}$$

The results show that especially Germany, Poland, and Sweden have reported indicator values which deviate from the ones estimated using the above formulae, and with at least some years in at least one EMU where the alternative estimate of $\sum$A is actually negative (Figure). These negative $\sum$A values can only be the result of reported $B_{current}$ being larger than B_{best}. This is consistent with this year's data call recommendations, in which it was requested that the estimate of $B_{current}$ include the effect of restocking, but that the estimates of B_{best} and B_0 do not. Thus, if restocked silver eel account for a significant fraction of current escapement ($B_{current}$), then that $B_{current}$ value could be larger than the estimate of B_{best} which should not include restocking.

Some countries that have reported restocking in the estimates of either/both $B_{current}$ and B_{best} show little difference in their reported value of $\sum$A and our new estimate (Figure). This also warrants further investigation, because larger discrepancies would be expected.

Annual reported landings of yellow and silver eel were compared with reported $B_{current}$ values to check for inconsistencies (Figure). Most EMUs show no cause for concern, but several large outliers can be observed. $B_{current}$ represents silver eel escapement, so after all anthropogenic removals have taken place. Therefore, it is not unexpected to observe values of landings that exceed $B_{current}$. However, several EMUs show outliers of years where landings are over five times as high as $B_{current}$.

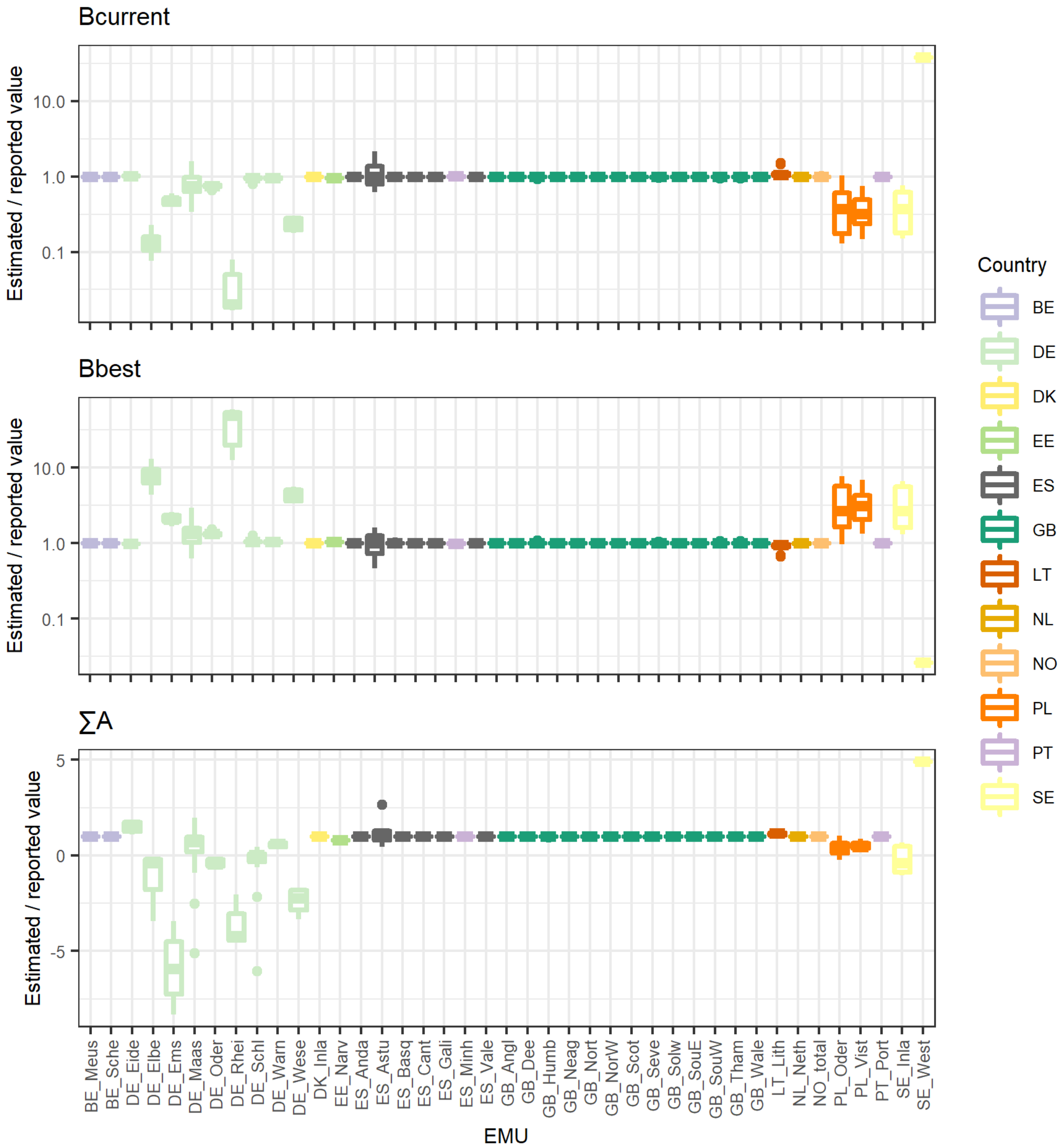


Figure 3.24. Ratio of estimated and reported values of three reported indicators: $B_{current}$ (top), B_{best} (middle), and ∑A (bottom). One boxplot is shown for each EMU with data on these indicators, with the boxplot containing all years with indicators available. Note the logarithmic y-axis for the biomass indicators, and the linear y-axis for the ∑A indicator. Data reported for Ireland are not displayed in the figure since an error in the data were discovered during this working group; it will be fixed for the upcoming WKEMP.

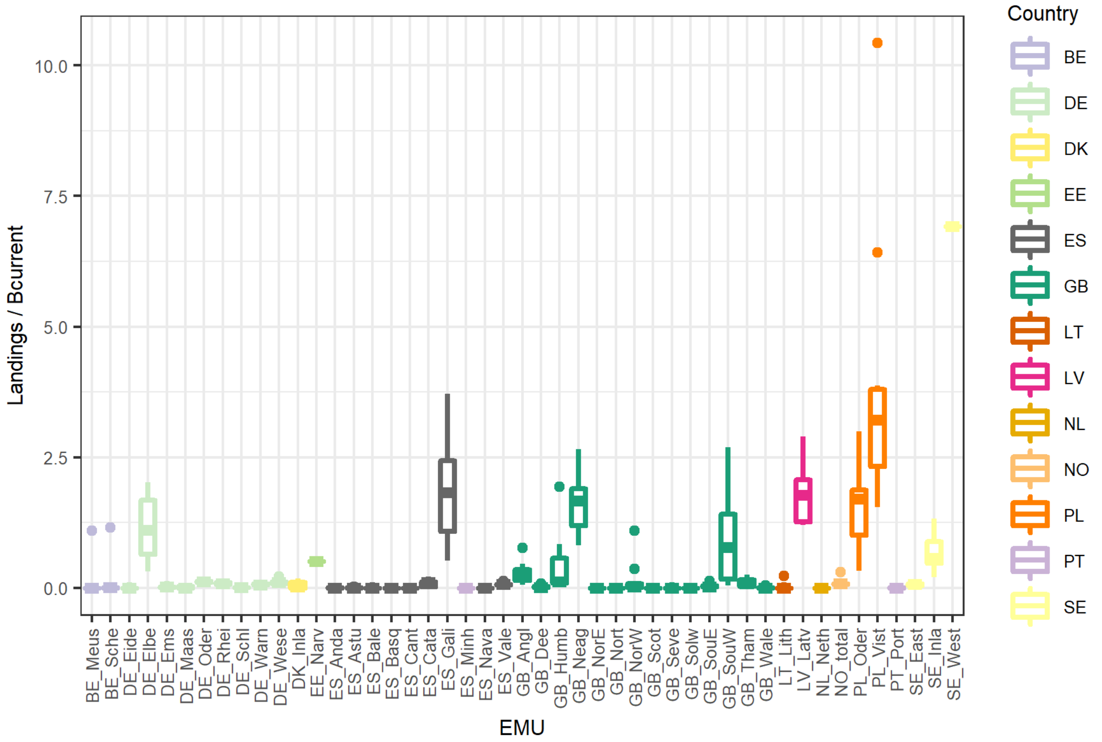


Figure 3.25. Ratio between annual reported total landings and that year's reported value of $B_{current}$, shown for all EMUs with available data. Here, total landings are the sum of a given year's landings of yellow and silver eel (by weight). Data reported for Ireland are not displayed in the figure since an error in the data were discovered during this working group; it will be fixed for the upcoming WKEMP.

Another approach used to identify the EMUs that provided inconsistent or potentially wrong estimates for biomass and mortality indicators, in support of the coming WKEMP evaluation, was to sort EMUs under the following checks:

- Is pristine biomass (B_0) smaller than potential escapement (B_{best})?
- Is current biomass ($B_{current}$) larger than potential escapement (B_{best})?
- Is the ratio $B_{current}/ B_0 > 1$?
- Is $\Sigma A = \Sigma F + \Sigma H$?

These checks would allow for the detection of errors: In cases where there is no restocking the 3 Bs should follow a gradient of magnitude: $B_0 > B_{best} > B_{current}$. A list of EMUs was identified as having potential errors and/or inconsistencies in estimates reported for biomass indicators and anthropogenic mortality rates.

The results of this analysis indicated that there are eight EMUs, from six countries, where the reported potential biomass (B_{best}) has been reported as greater than pristine biomass (B_0) for at least one year in the dataseries. The causes include: 1) changes in methods to calculate stock indicators, which hinder comparability with previous reported indicators; 2) use of restocking to estimate B_{best}, contrary to the recommendation from ICES (2020b) that clearly indicated restocking should not be included in this estimate. This needs to be checked with data providers.

The analysis of the ratio between $B_{current}$ and B_0 showed that four EMUs from four countries have reported at least one year where ratios were larger than 1. From some responses obtained it was concluded that this is a consequence of restocking being included in $B_{current}$, as was requested in this year's data call.

As for anthropogenic mortality (ΣA), inconsistencies were found in only two EMUs from one country: in one case mortality data were provided for ΣF and ΣH, but ΣA excluded ΣH from the estimate, and in the other case, ΣA is always smaller than ΣF + ΣH. This could not be checked during the WGEEL meeting because the data providers were not present.

Data providers who were attending this WGEEL meeting were contacted to clarify any inconsistencies and/or errors found. Some corrections have been provided and inserted in the database during this meeting, but most inconsistencies remain, and this work must be done during the next WKEMP meeting. A table was drawn up summarizing the inconsistencies found and the possible causes (after consulting Annex 13 of the 2021 ICES data call, if available), and delivered to the chair of the meeting.

3.4.1.2 Methods for Assessments

Data from Annex 13 from the 2021 data call was examined to quantify a number of questions in relation to the reporting for the Eel Regulation. These include the transboundary element of EMUs, the treatment of restocking in assessments, and direct and indirect methods of assessments. Eleven countries provided data at the EMU level (relating to 42 EMU's) and three countries reported at the country level. In total fourteen countries reported the overview of methods table in 2021, a decline from the 20 countries who completed the overview table in the 2018 data call.

While direct methods were reported by every country who reported in Annex 13 of the data call, there were individual EMU's where direct methods were not available. The direct methods include mark-recapture studies, counters, traps and electrofishing.

Thirteen countries reported on indirect assessments using models and extrapolation. The models mentioned include GEM-III (Oeberst et al., 2012), SMEP II (Aprahamian et al., 2007), IMESE (Ireland National EMP; Anonymous, 2008), with other reporting extrapolations and generic modelling.

In some countries, models differ according to main habitat typology (freshwater or transitional) and data available (stock-reconstructive models). While most countries apply the same model in each EMU, in some instances different approaches are applied. This can happen where EMUs are created to divide freshwater and coastal water in some countries or to account for data poor EMUs where direct assessments are not possible. This is a result of the variation in data availability and quality across EMU's. Thus, we recommend that countries build-up knowledge in the data poor areas using EUMAP if available.

Method inconsistencies among EMUs of the same country impair the comparison among them, especially in the absence of details on the methods. It may also explain why, in a same country, all EMUs have not necessarily responded the same indicator. This makes the aggregation at the country level from data at the EMU scale prone to misinterpretation.

Table 3.6. Summary of stock assessment methods information provided by reporting countries in Annex 13 of the 2021 data call (na = not-available, Y = yearwise, C = cohort, MK = mark and recapture).

Country	Same approach in all EMUs	changes in B_0 since 2018	changes in B_{best} since 2018	changes in $B_{current}$ since 2018	Mortality	Change in Assessment Method since 2018	Assessment methods
BE	N	N	Y	Y	na		indirect (model)
CZ	na	na	na	na	na		electrofishing
DE	Y	Y	Y	Y	Y	Data & Methods & Habitats	indirect (model) & extrapolation, direct (MK, other in some EMU's)
DK	Y	N	N	N	na		direct (MK & Traps) & extrapolation
EE	Y/N	N	Y	Y	Y	Method	direct (traps) & extrapolation
FI	na	N	N	N	na	No	na
GB	N	N	Y	Y	C	Method	direct (MK & counters & traps) & extrapolation & indirect (model)
IE	Y	N	N	N	C	no	direct (counters & MK) & indirect(model) & extrapolation
LV	Y	N	N	N	Y	no	indirect (model) + electrofishing data
LT	Y	Y	Y	Y	Y	no	indirect (model)
NL	Y	N	Y	Y	Y	Method	indirect(model)
PL	Y	Y	Y	Y	Y	Data Source	indirect(model)
PT	Y	Y	Y	Y	C	Data Source & Habitat	direct (electrofishing) & extrapolation
SE	N	N	Y	Y	na	No	direct (MK) & indirect(model)

3.4.1.3 Changes since 2018 Data Call

Eleven EMUs reported changes in the B_0 indicator since the 2018 reporting. Thirty-one EMU's reported changes in B_{best} since 2018. Thirty-two EMUs reported a change in $B_{current}$ since 2018. Twenty-eight EMUs reported no change to the time-series data while sixteen EMUs reported changes ranging from changes to the data sources, methods used and habitat assessed.

3.4.1.4 Restocking

Restocking constitutes an anthropogenic impact on the stock, but unlike all other impacts, it could contribute positively to the abundance and silver eel escapement in recipient areas, which sets it in contrast to all other detrimental impacts. One country indicated that restocking is used in the calculation of B_0. Twenty-five EMUs use restocking in the calculation of B_{best} and $B_{current}$. Twelve EMUs use restocking in the calculation of fishing mortality, though it is unclear on how it was considered and whether double-banking was prevented as recommended by WGEEL. Twenty-three EMU's use restocking in the calculation of Hydropower mortality. Restocking is used to offset mortality (in either fishing, hydropower or both) as it is a positive element when calculating mortality but does not reflect the actual mortality experienced in an EMU. To reduce this ambiguity, it is recommended for the next WGEEL data call to ask for B_{best} with influence of restocking and without restocking so WGEEL can calculate ∑A in a standardised manner. Furthermore, it is recommended to ask for the use of restocking in B_{best} and $B_{current}$ separately in Annex 13 of the data call.

In order for the WGEEL to carry out assessments at the European level, WGEEL need raw data to make calculations for mortality for all countries. The information required for this analysis includes $B_{current}$, landings, time generation, lifespan, estimate of silvering age, and restocking values. This will allow the calculation of mortality in a standardised way for comparison and will ensure restocking assumptions are the same across range states.

3.4.1.5 Mortality: cohortvs. Year wise estimation

The 2018 WGEEL report highlighted an issue over the estimation of mortality, some countries operate a cohort analysis whereas others calculate mortality in the year of migration only. These two approaches are: either summing up values of mortalities experienced by all year classes in that particular year (year-wise also called pseudo-cohort analysis) or summing up values of mortalities experienced by the final cohort (silver eels) during their entire life (cohort-wise analysis). WGEEL 2020 report section 3.7.3 (ICES, 2020b) reported an example to illustrate the two approaches. On the one hand, for countries using cohort-wise assessment, interpretation of mortality estimates will not consider recent modifications or management measures, which could be problematic for countries in the northern latitudes with long eel lifespans. On the other hand, countries using year-wise assessment do not show the 'true' value of ∑A, but rather a hypothetical one that reflects the current management regime and informs on the mortality that the last cohort would experience during its lifespan under a *status quo* scenario. SGIPEE (ICES, 2011) noticed that the year-wise analyse is in line with the conventional ICES procedures and the standard Precautionary Diagram to show the full effect of management measures taken although the effect on biomass has not yet fully occurred. However, recognising the current practices and work to be done to converge toward a common practice, the 2021 data call allowed for reporting with either approach, provided the approach was clearly specified.

Twenty-two EMUs reported mortality at the cohort level with 16 reporting year-wise mortality, 7 did not report or put not pertinent. This highlights the constraints around comparing mortality values reported across the eel's range.

Within the 2021 data call there was a recommendation that a mortality rate using eel number as opposed to weight is reported, however some countries reported an inability to follow this recommendation, further highlighting the need for a workshop on stock assessment methods. This was a recommendation by WGEEL in 2018 (ICES, 2018) and was reiterated as part of the WKFEA time frame to benchmark (ICES, 2021b).

3.4.1.6 Transboundary element

Fifteen EMUs indicated there was a transboundary element. In some instances, countries created the EMUs based on the WFD River Basin Districts, however in other scenarios larger areas were grouped together which means these EMUs are connected on an upstream and/or a downstream basis along the river network within countries and across country borders.

If EMUs are connected in an upstream/downstream direction within countries, how are biomass indicators accounted for, e.g. do escapement indicators in the downstream EMU include escapement biomass originating from the upstream EMU? Conversely, do mortality indicators in upstream EMU include the mortality that eel will suffer while migrating through the downstream EMU? We accept that in some instances larger numbers are present in the downstream areas for rivers with free connectivity for natural recruitment, however for areas with restocking into inland waters the impact could be greater.

Examples of issues are:

- Are silver eels caught and released (untagged) in upstream EMU's double banked in the next EMU when caught for a 2nd time? This will not be a problem for commercial fishing sampling sites where eels are removed from the system, but could be an issue if scientific fisheries are present. Or yellow eel studies extrapolating to silver eel escapement
- If $B_{Current}$ is used to rebuild $\sum A$, escapees can come from other EMU's with different mortalities.
- That silver eels have escaped at the sea or at the border, highlighting the difference between production and escapement within an EMU.
- Examples include Rivers running from Germany to Netherlands, from France to Belgium, Germany to Poland

Clarity is needed on this point to ensure an accurate representation of biological indicators to ensure double banking is not masking a greater decline in current biomass levels across Europe. This topic needs to be discussed at the Data Assessment Methods workshop as recommended.

Czech Republic, Germany and Ireland indicated that there were agreements in place for transboundary water bodies across multiple EMUs.

3.4.2 Analysis of reported values

3.4.2.1 Precautionary diagram

The precautionary diagrams allow for comparisons between EMUs (%-wise SSB; lifetime summation of anthropogenic mortality) and comparisons of the status to limit/target values, while at the same time allowing for the integration of local stock status estimates by country into status indicators for larger geographical areas (ultimately: population wide).

The 3Bs and ΣA framework of stock indicators and the Precautionary Diagram used by WGEEL quantify the status of the stock (in individual management units) on the horizontal axis, and the human impacts (in individual management units) on the vertical axis. For the horizontal axis, a biomass limit B_{mgt} is set at 40% of the pristine biomass B_0, corresponding to the objectives of the Eel Regulation (Anonymous, 2007). For the vertical axis, a limit anthropogenic mortality ΣA_{mgt} is set at $\Sigma A=-\ln(40\%)=0.92$, corresponding to the 40% biomass limit. At low biomass, however, the anthropogenic mortality advised is reduced, to reinforce the tendency for the stock to rebuild.

The precautionary diagrams below include the 3Bs and ΣA indicators per EMU in Figure 3.26, and aggregated per country in Figure 3.27, as provided by EU Member States in their responses to the ICES 2021 data call, against the background of the generic reference points according to the 40% biomass aim of the EU Eel Regulation, the corresponding mortality limit of ΣA=0.92 and taking the 40% biomass aim as a trigger point below which the mortality is reduced to zero in proportion to the actual biomass of the escapement. From the data available to the WG, out of a total of 39 EMUs that most recently reported $B_{current}$, 8 (21%, representing six countries) are reaching or exceeding the 40% aim and 31 EMUs are below target. The aggregation per country corresponds to the sum of $B_{current}$ divided by the sum of B_0 from EMUs of the country that have reported both values (EMUs that have reported only a single value are not accounted for, for example in Sweden, aggregated B_0 and $B_{current}$ are only based on EMU SE-Inla). For ΣA, following ICES (2010b), aggregated ΣA corresponds to the weighted average of survivals from national EMUs, with weights corresponding to B_{best}. As such, only EMUs that have provided estimates for both B_{best} and ΣA were accounted for.

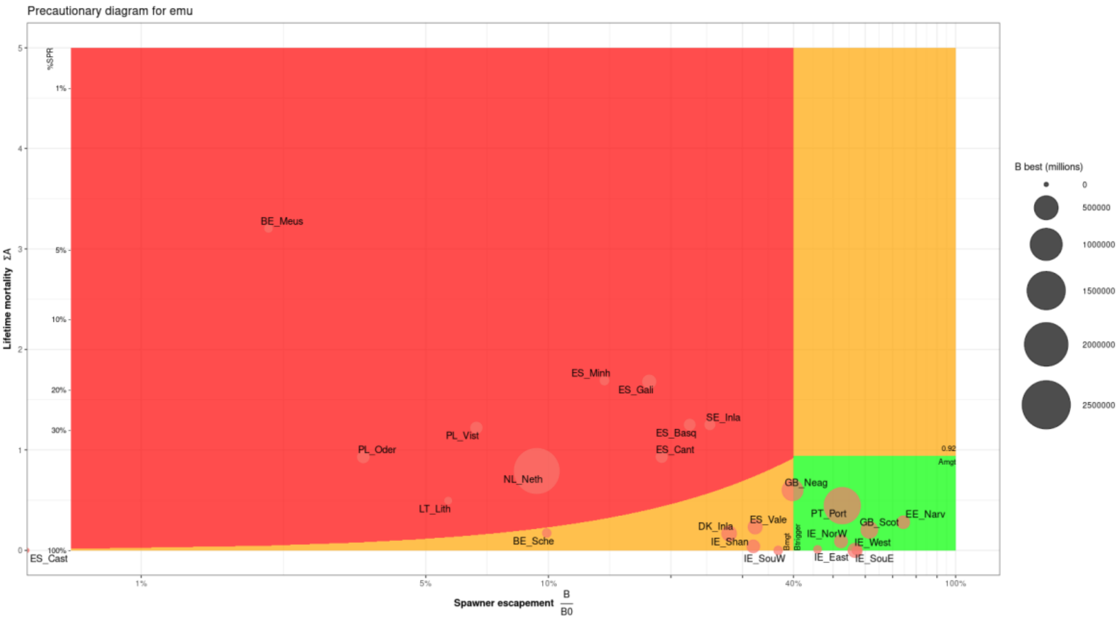


Figure 3.26. Precautionary Diagram for Eel Management Units, presenting the reported data for the 2020 (plots for 2018 and 2019 can be found in Annex 15) status of the stock (horizontal, spawner escapement ($B_{current}$) expressed as a percentage of the pristine escapement (B_0)) and the anthropogenic impacts (vertical, expressed as lifetime mortality ΣA, resp. lifetime survival %SPR). The limit anthropogenic mortality (A_{mgt}) was set as 0.92, corresponding to the 40% biomass limit (B_{mgt}). Data from the 2021 data call provided to WGEEL. Due to an error during the data call, ΣA in Irish EMUs may be slightly biased.

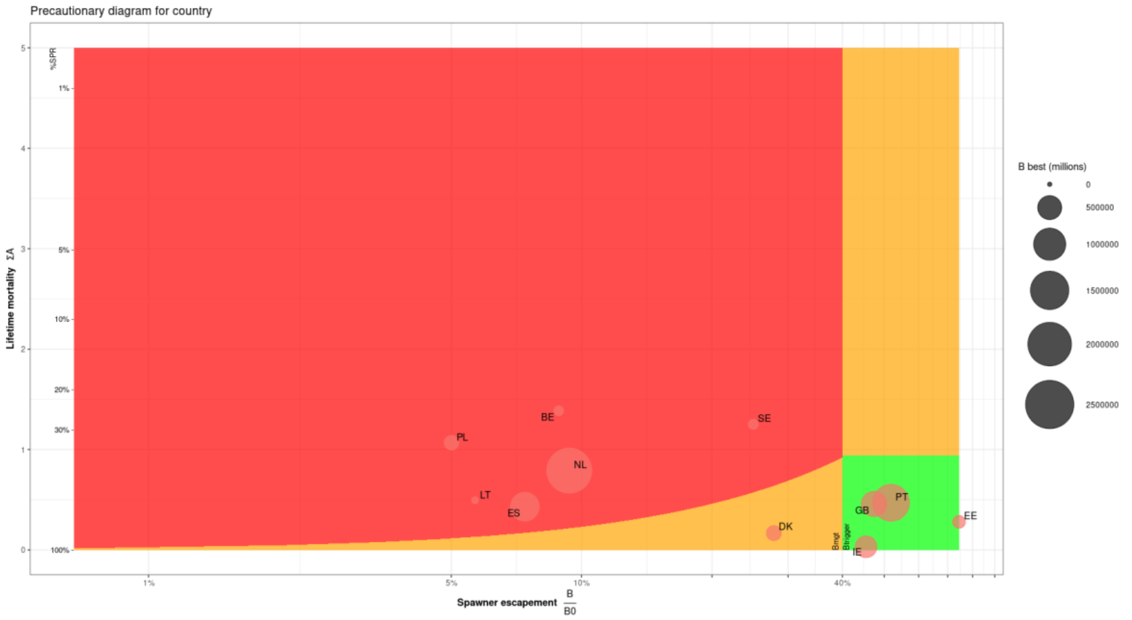


Figure 3.27. Precautionary Diagram for country level presenting the reported data for the 2020 (plots for 2018 and 2019 can be found in Annex 15) status of the stock (horizontal, spawner escapement ($B_{current}$) expressed as a percentage of the pristine escapement (B_0)) and the anthropogenic impacts (vertical, expressed as lifetime mortality ΣA, resp. lifetime survival %SPR). The limit anthropogenic mortality (A_{lim}) was set as 0.92, corresponding to the 40% biomass limit (B_{lim}). Only EMUs that have provided both $B_{current}$ and B_0 have been used to derive a country-aggregated indicator. Thus, the overview in this figure may not include all provided data and care should be taken in its interpretation. Data from the 2021 data call provided to WGEEL. Due to an error during the data call, ΣA in Irish EMUs may be slightly biased.

3.4.2.2 A modification to the Precautionary Diagram: 50 shades of orange

According to the FAO Technical Guidelines for Responsible Fisheries, policy makers are expected to "*Establish a recovery plan that will* ***rebuild the stock over a specific time period*** *with reasonable certainty*" (FAO 1996, point 48.b, formatting added). When a rebuilding target has been specified, and an appropriate period has been selected, a corresponding level of anthropogenic mortality can be deduced (using a scientific model of stock dynamics and anthropogenic impacts). While the ultimate rebuilding target gives no guidance for taking imm :tions (it describes an ultimate goal, far into the future; Dekker 2016), the correspondi ›pogenic mortality level directly translates into contemporary protective actions (which can be implemented and evaluated immediately). Hence, stock management is generally evaluated in two dimensions: the stock status itself in relation to the ultimate target (in biomass, horizontal), and the immediate impacts (as mortality rate, vertical) – as in a Precautionary Diagram. This then allows evaluating current management, by comparing the actual mortality level to the mortality level needed for recovery within the specified period. Given an ultimate rebuilding target and a specified aspiration level (formulated as a specific period until recovery), a corresponding mortality level can be calculated. Current management is then evaluated, depending on whether the actual mortality is above or below that reference mortality level. Based on this line of reasoning, Dekker (2019) pleaded for the adoption of a time-period (as number of generations) by the relevant policy makers. No such time-period has been adopted in the Eel Regulation (EU Council, 2007), and recent ICES advice (ICES, 2020c) has been based on minimising mortality, minimising the time until recovery, maximising the aspiration level.

We note that the (tri-annual) assessment in any particular management area results in an estimate of $B_{current}$ and ΣA for that area. In the absence of an agreed period until recovery, these estimates cannot be evaluated against the aim to recover. Following Dekker et al (2021), however, we note that this line of reasoning can be reversed. Instead of defining a recovery target (biomass) and a period for recovery (resulting in an estimate of mortality), we can use the actual mortality as assessed and the recovery target (biomass) to derive an estimate of the period (expressed in number of generations) it will take to recover to that target. In Figure , these are represented by shades of orange, representing the number of generations.

In reversing this line of reasoning on restoration targets, period and mortality limits, we circumvent the problem that neither the Eel Regulation, nor current ICES advice, indicate a time frame for the recovery of the stock (ICES, 2019). Whether that number of generations, and hence any actual level of anthropogenic mortality, is considered acceptable or not, is left open. This approach has the additional advantage, that we do not suggest there is a sharp boundary between acceptable (recovery within the specified period) and unacceptable – which there is not. The shades of orange (Figure) represent a continuous range of feasible aspiration levels.

For further technical details see Annex 15.

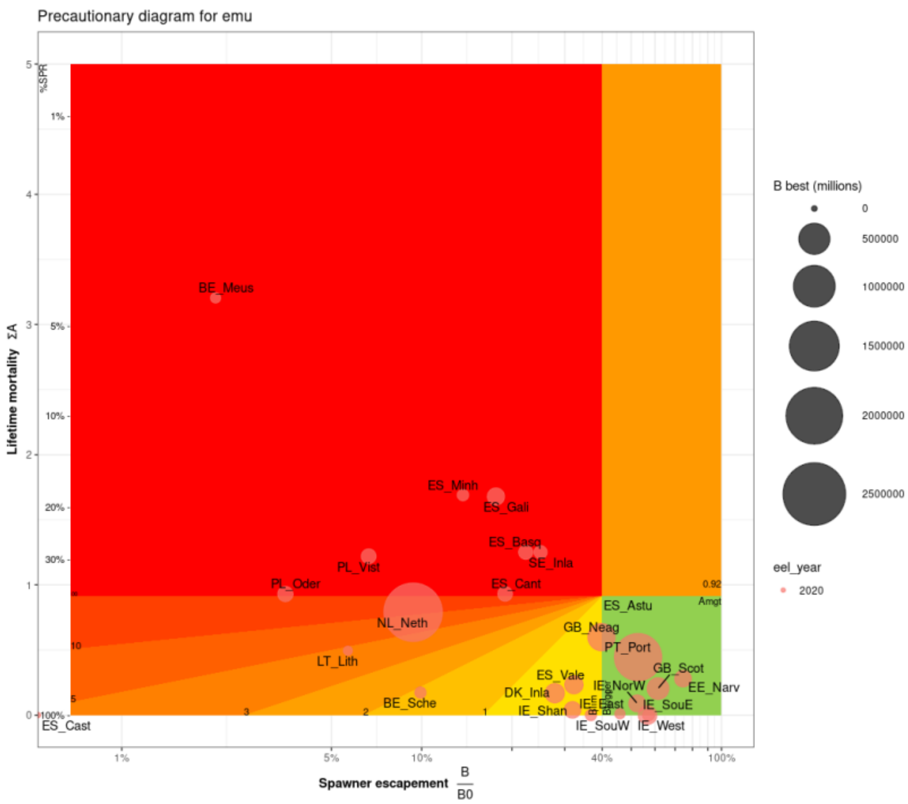


Figure 3.28. Precautionary Diagram, presenting reported data for the 2020 status of the stock (horizontal) and the level of anthropogenic impacts (vertical). The left axis shows the lifetime anthropogenic mortality (rate), while the right axis shows the corresponding survival rate. Note the logarithmic scale of the horizontal and right axis, corresponding to the inherently logarithmic nature of the left axis. The numbers on the borders between the shades of orange, in the lower-left quadrant, provide an approximate indication of the number of generations needed until full recovery to the management aim (40%), under the assumption that all EMUs would behave the same. Data from the 2021 data call provided to WGEEL. Due to an error during the data call, ΣA in Irish EMUs may be slightly biased.

3.4.2.3 Spatial overview

Given all the pre-mentioned caveats on those indicators, *great caution should be taken when comparing their values among countries or EMUs*. The two maps (Figures 3.29 and 3.30) illustrate the spatial patterns in biomass and mortality indicators. Some large escapements are estimated in Northern Europe (e.g. Sweden, the Netherlands, Germany). In some cases, this could be partly due to restocking, which could also explain the high values of the ratio $B_{current}$ (which includes restocking) / B_0 (which does not) for these EMUs.

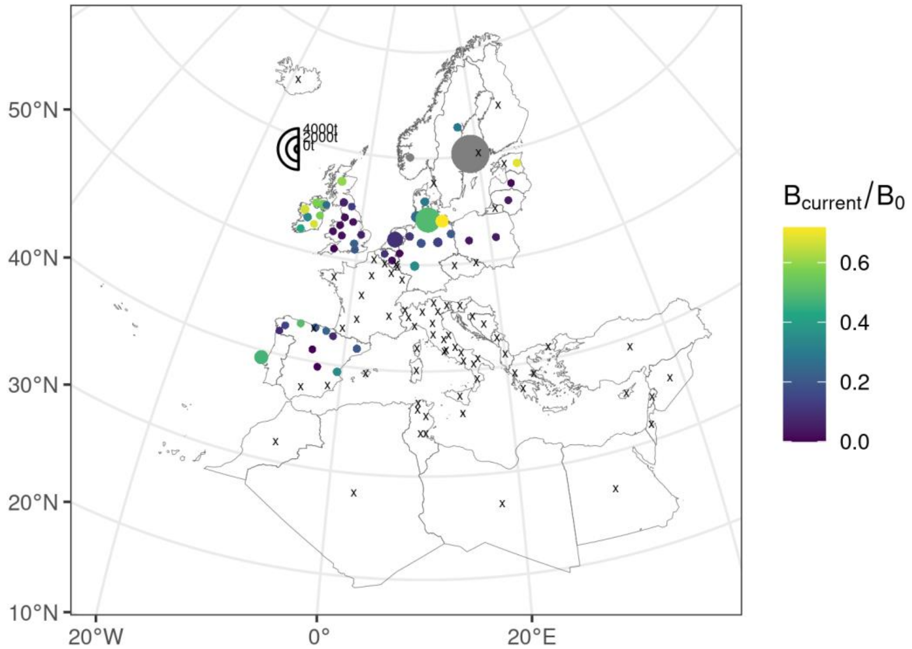


Figure 3.29. Map of biomass indicators per EMU (average from 2018 to 2020). The size of the circle stands for $B_{current}$ while the colour stands for the ratio between $B_{current}$ and B_0. A cross indicates that no data were available. When only $B_{current}$ is available, the circle is grey (e.g. Sweden).

For mortality indicators (Figure 3.30), the map shows that the relative weights of fishery and other mortalities vary a lot among EMUs. However, this might be partially biased by the lack of data available on turbines or pumping induced mortality in many countries (see previous section) and by the fact that, even when pumping and turbine mortalities are assessed, they generally do not account for indirect mortalities such as delayed mortality due to habitat loss/fragmentation or contamination, that are difficult to quantify.

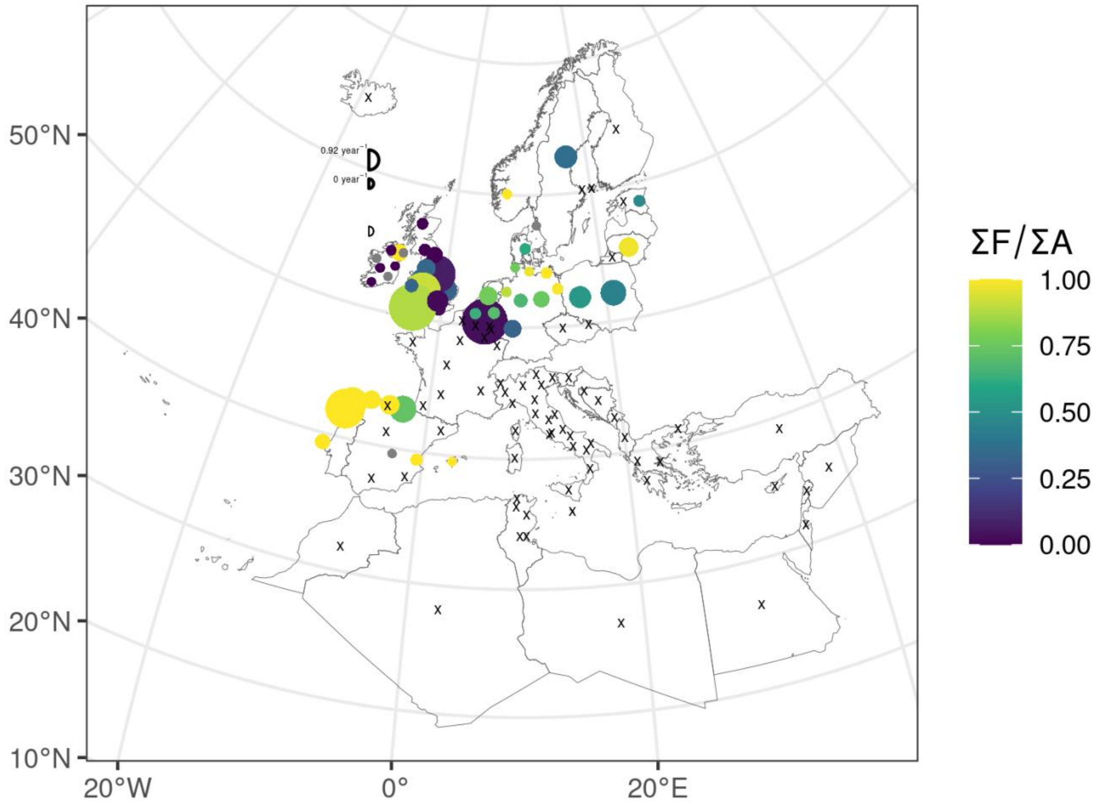


Figure 3.30. Maps of mortality indicators per EMU (average from 2018 to 2020). The size of the circle stands for ΣA while the colour stands for the ratio between ΣF and ΣA. A cross indicates that no data were available. When only ΣA is available, the circle is grey (e.g. Northern UK). A grey circle indicates that ΣA was equal to 0 (e.g. Irish EMUs). Due to an error during the data call, non-null ΣA in Irish EMUs may be slightly biased.

The same maps aggregated at the country scale are presented in Annex 15.

3.4.2.4 Trend

While spatial comparison is impaired by inconsistencies among countries, temporal trends within EMUs should be more robust since data providers were asked to report any changes in their estimation methods.

Results (Figure 3.31) do not indicate an increase in the silver eel escapement in the last decade since the implementation of EMPs. This might be due to the still low level of recruitment and to the fact that some management measures require time to have an effect on the escapement given the lifespan of the eel in some areas.

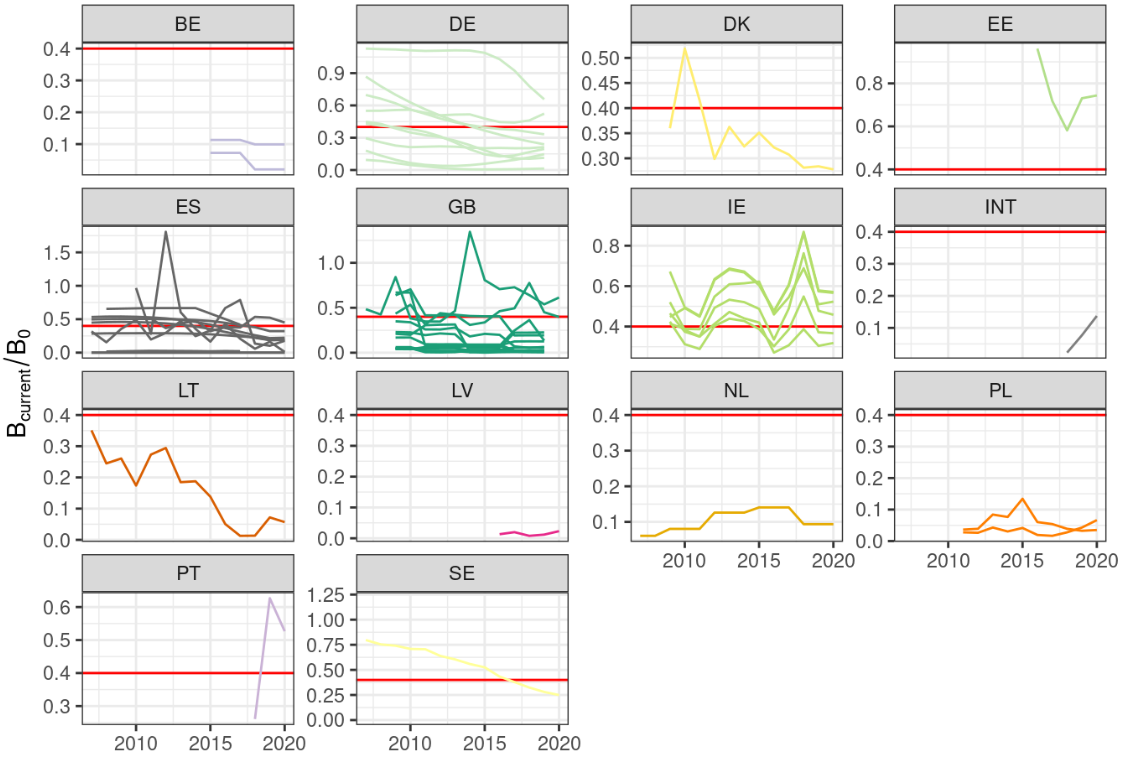


Figure 3.31. Trends in the $B_{current}/B_0$ ratio. Each panel stands for the country and each line for a specific EMU. Red horizontal lines stand for the EU Regulation target (Bcurrent/B0=0.4). The INT panel stands for international EMU (here the Minho transboundary EMU shared by Spain and Portugal). An error was detected in the data reported for Ireland in 2008 so the point was removed, this will be fixed before the upcoming WKEMP. Belgian data before 2015 were not considered in the analysis due to a change in the estimation model.

However, the temporal trends in ΣA (Fig 3.32) indicate that anthropogenic mortality has not decreased in many EMUs. Details for fishing mortality and other anthropogenic mortalities are presented in Annex 15.

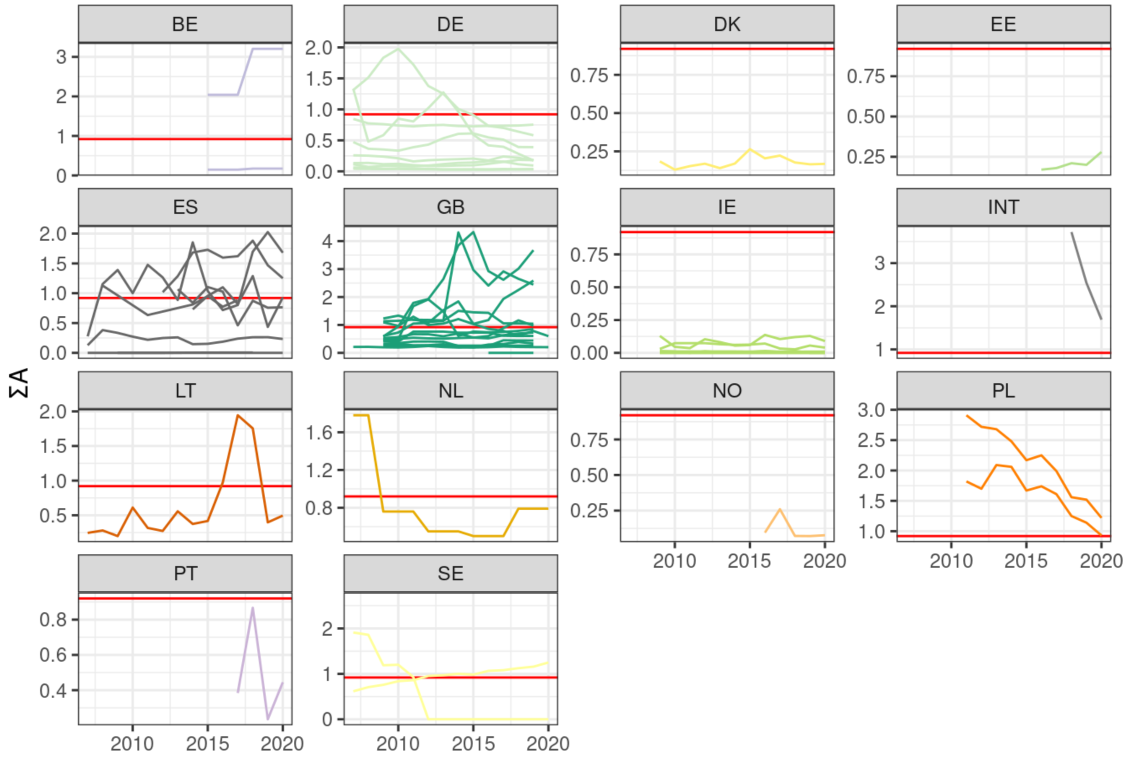


Figure 3.32. Trends in the ΣA (total lifespan anthropogenic mortality). Each panel stands for the country and each line for a specific EMU. Red horizontal lines stand for a total lifespan mortality of 0.92, which would correspond to a reduction of escapement of 60% due to anthropogenic mortality compared to a situation without any anthropogenic mortality. An error was detected in the data reported for Ireland in 2008 so the point was removed, this will be fixed before the upcoming WKEMP. Moreover, ΣA might be slightly biased in IE due to an error in the estimation procedure. Belgian data before 2015 were not considered in the analysis due to a change in the estimation model.

3.4.3 Conclusions and recommendations

The data quality check showed that despite efforts to clarify and standardise the way indicators are estimated, some doubts remain on the consistency among countries. The way restocking is accounted for is one of the main caveats, but others have been identified (e.g. year-wise versus cohort-wise, reference period for pristine situation, quality of data) and should be acknowledge for the next WKEMP. Some suspicious data have been listed, data providers have been contacted to address these issues and potentially fixed these before WKEMP commences.

In addition to these data consistency problems, it should be noted that currently, data and methods used are not available or detailed enough to ensure transparency and reproducibility of estimates, as would be requested in a traditional stock assessment. Since WGEEL collect data on landings, restocking, it might be worthwhile for the group to provide harmonised guidance on stock assessment indicators to ensure consistency. As a minimum, biometric data and data on other sources of mortality that are used by data providers to carry out the estimation but are not collected by WGEEL, should be asked in the future to ensure traceability and facilitate the validation of the indicators.

The recommended workshop on Data Assessment methods will potentially ensure an increase in countries providing data, including the Mediterranean countries under the GFCM remit who are working on the biomass indicator assessments in parallel, and will improve the consistency across countries.

Given all these elements, comparisons among EMUs or with respect to management target should be made with great care. However, of concern, the data indicate that silver eel escapement remains low and mortalities high in many EMUs, and shows no evidence yet of an improvement.

It should be noted that in most countries, fishing mortality is restricted to commercial fisheries and that other anthropogenic mortalities are restricted to pumping and turbine mortality, not accounting for other impacts such as contamination, climate change, and habitat loss. As such, ΣA only gives a partial view of total anthropogenic impacts affecting the population.

3.5 Releases

Data have been reported on restocking comprising eels released at the glass eel phase, either directly (G), or after a quarantine (QG), after a period of some months of growth in aquaculture (OG), at the yellow eel (Y) or silver eel (S) stage or mixed life stages: Glass + Yellow eel (G+Y) and Yellow + Silver eel (Y+S). There is also a spatial element that complicates matters, ranging from the capture and movement of eel only a few metres within the same waterbody to bypass an obstacle (assisted migration), to eel being moved between waterbodies and/or EMU.

As there is still some inconsistency or variation in the way that countries report some of these actions, the WGEEL broadly categorizes them as “releases”, though the term “restocking” is still used here for some circumstances. However, in future, releases related to assisted migration helping eels to bypass an obstacle should be clearly separated from releases for restocking purposes.

Data on the amount of restocked eel were obtained from the responses to the data call in 2021; however, the data for 2020 and 2021 for restocking are incomplete due to the delayed data availability.

The data call requires the provision of both numbers and weights per EMU to evaluate the average weight of each line of data entered. As the database is not structured to handle two different columns for quantities, the initial checks on the consistency are done during data integration.

The restocking of glass eel peaked in the 1980s but part of the decrease is not showing as German data are lacking for the period before 1980, Lithuanian before 2011, followed by a steep decline to a low in 2009 (**Error! Reference source not found.**Figure 3.33 and 3.34; Annex 14). The amount of glass eels restocked increased until 2014 when the lower market prices guaranteed a larger number of glass eels could be purchased for fixed restocking budgets. However, glass eel restocking has decreased since then.

Denmark reported some effect of Covid-19 on eel restocking measures in 2021.

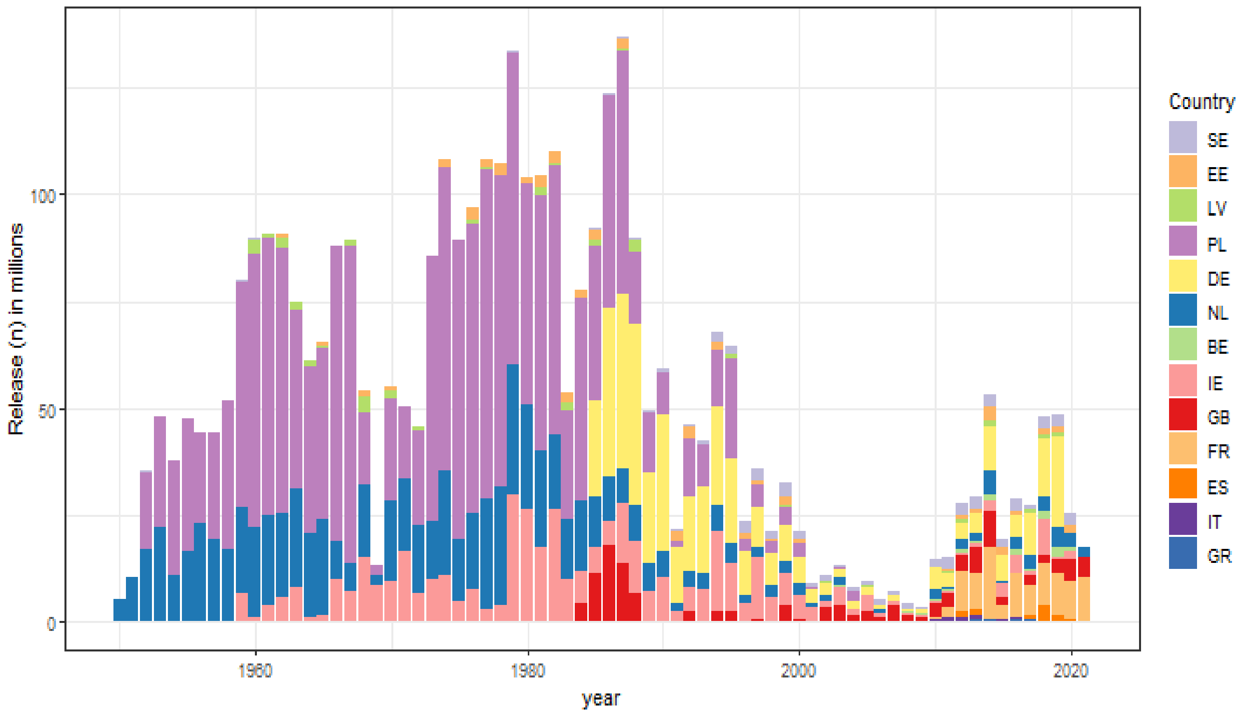


Figure 3.33. Reported releases of glass eel (in millions) per country, Sweden (SE), Estonia (EE), Latvia (LV), Poland (PL), Germany (DE), Netherlands (NL), Belgium (BE), Ireland (IE), United Kingdom (GB), France (FR), Spain (ES), Italy (IT) and Greece (GR).

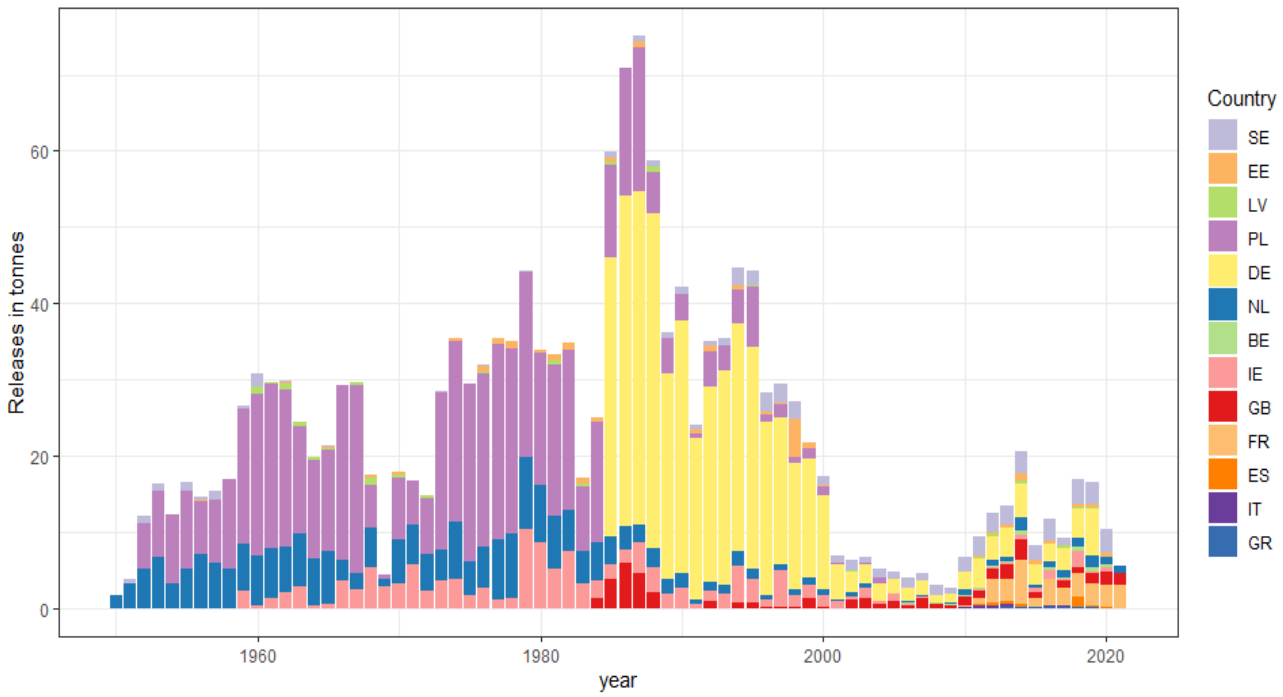


Figure 3.34. Reported releases of glass eel (in tonnes) per country Estonia (EE), Latvia (LV), Poland (PL), Germany (DE), Netherlands (NL), Belgium (BE), Ireland (IE), United Kingdom (GB), France (FR), Spain (ES), Italy (IT) and Greece (GR).

During the 1940–1960 period, Sweden had a large restocking programme for yellow eel. The activity decreased in the 1970s and increased again in the 1980s. Germany started to stock yellow eels in 1985 (Annex 14). In the Netherlands stocking with young yellow eel has been performed since pre-war time. First with wild origin fish and later with eels raised in aquaculture. No yellow eel releases were reported by any Mediterranean country.

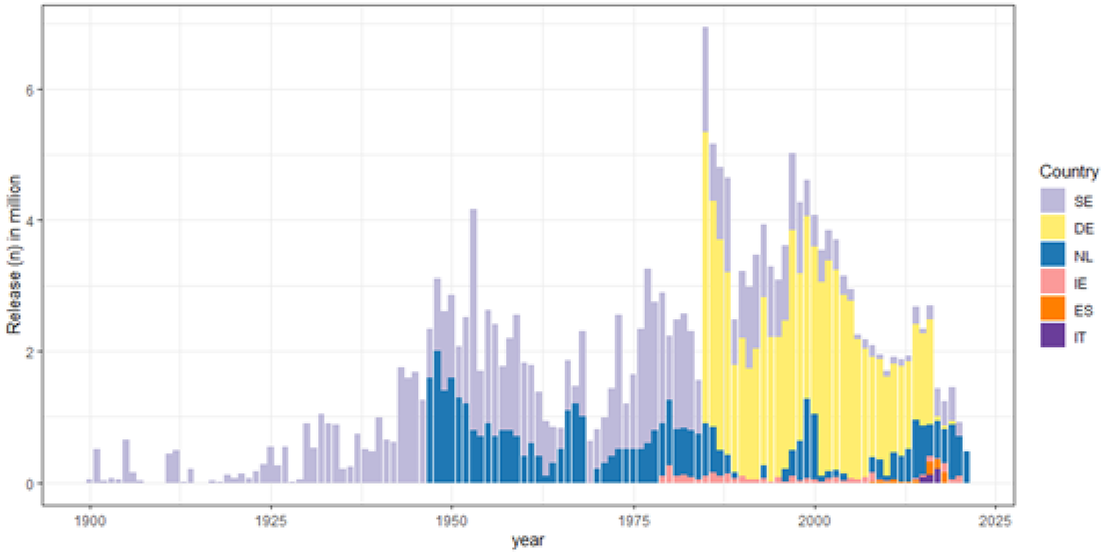


Figure 3.35. Reported releases of yellow eel (in millions) per country, Sweden (SE) Germany (DE), Netherlands (NL), Ireland (IE), Spain (ES) and Italy (IT).

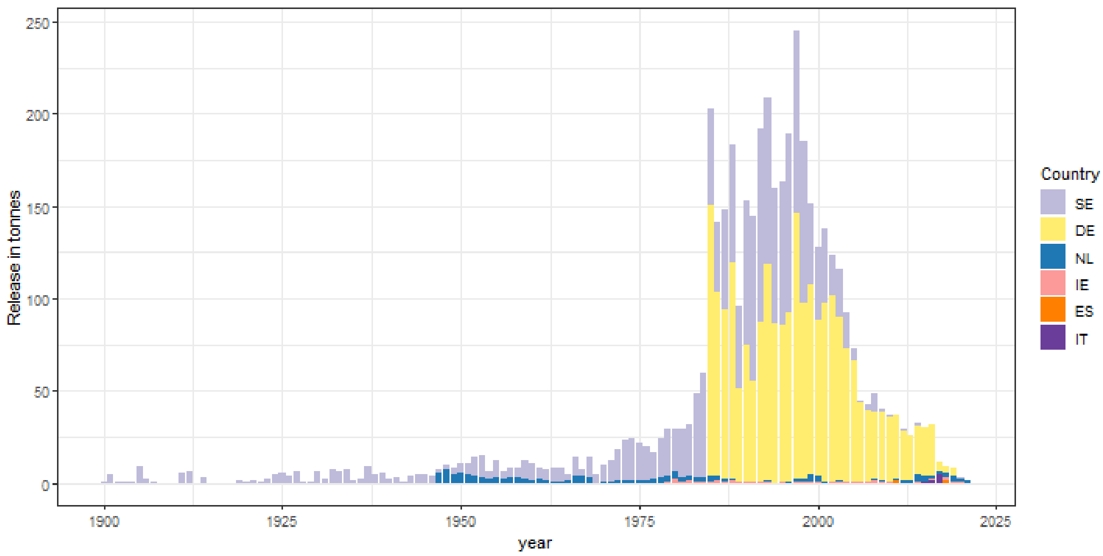


Figure 3.36. Reported releases of yellow eel (in tonnes) per country: Sweden (SE) Germany (DE), Netherlands (NL), Ireland (IE), Spain (ES) and Italy (IT).

In contrast, some silver eels (0.198 million) caught by the fishery and therefore recorded as landings, are later released in the Mediterranean outside the lagoons in Greece and France, and they are reported as released silvers (Figure 3.37 and Figure 3.38; Annex 14). In Ireland and Sweden Trap and Transport (TandT) of silver eels from upstream to downstream sites in rivers have been implemented.

In Sweden within the TandT-program, approximately 119,000 kg silver eels were cumulatively transported downstream by road between 2013 and 2019.

In Ireland within the TandT-program, approximately 705,721 kg silver eels were cumulatively transported downstream by road between 2009 and 2020.

In Finland, eels are trapped on the river Vääksynjoki running from Lake Vesijärvi in the upper reaches of the Kymijoki watercourse, 150 km from the sea. The eels caught in this trap are tagged and released into the sea at Kymijoki estuary below hydropower dams.

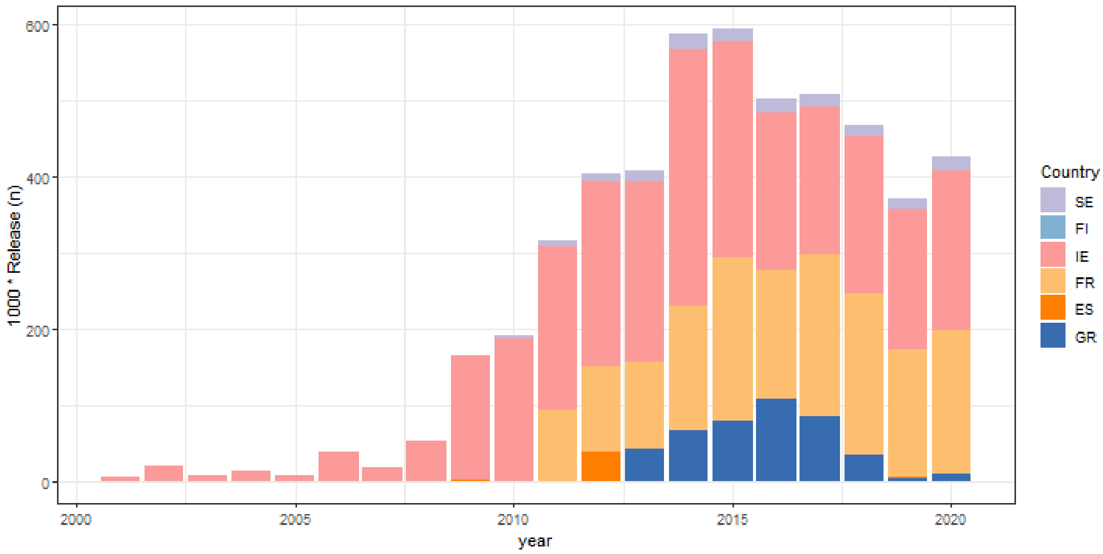


Figure 3.37. Reported releases of silver eel (in thousands) per country, Sweden (SE), Finland (FI), Ireland (IE), France (FR), Spain (ES), and Greece (GR). Data for recent years are provisional or incomplete and may change in future data calls. For more details, see Annex 14.

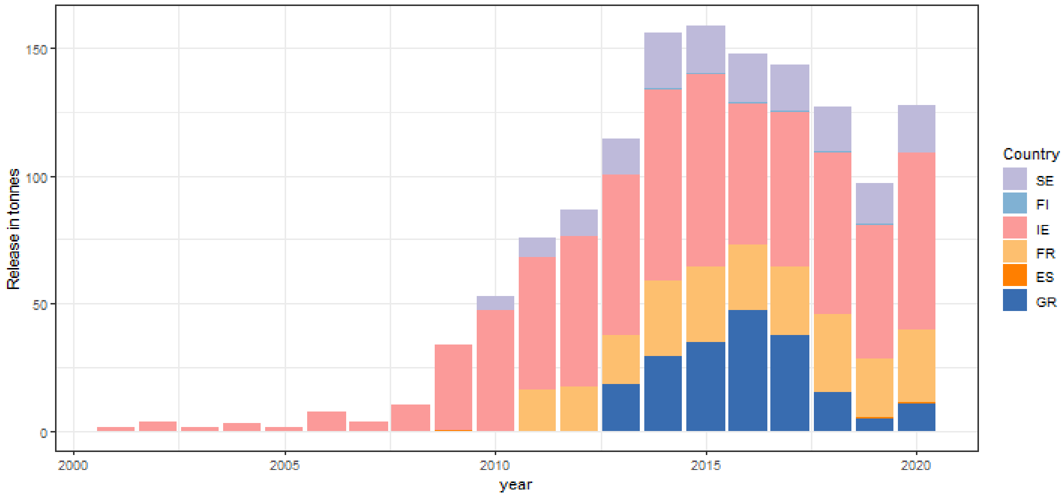


Figure 3.38. Reported releases of silver eel (in tonnes) per country, Sweden (SE), Finland (FI), Ireland (IE), France (FR), Spain (ES), and Greece (GR).

Only Sweden and Finland have reported quarantined glass eel restocking. However, Sweden is in the process to validate all data regarding the quarantined glass eels releases, therefore Swedish data are omitted from the current report (Figure 3.39; Annex 14). Quarantined glass eel restocking peaked in the 1990s, decreased in the early 2000s and increased again after the implementation of the Eel Regulation.

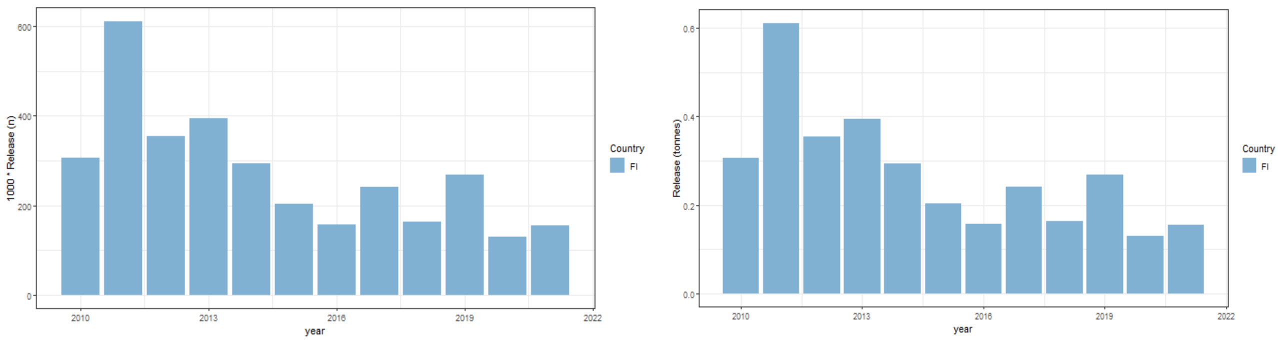


Figure 3.39. Reported releases of Quarantined glass eel (in thousands and tonnes) in Finland (FI). Data for recent years are provisional or incomplete and may change in future data calls. For more details, see Annex 14.

The restocking of on-grown eels has constantly increased since 2000 and reached a maximum in 2014 (Figure 3.40-3.41; Annex 14). Since the mid-1980s, Germany has restocked the most on-grown eels.

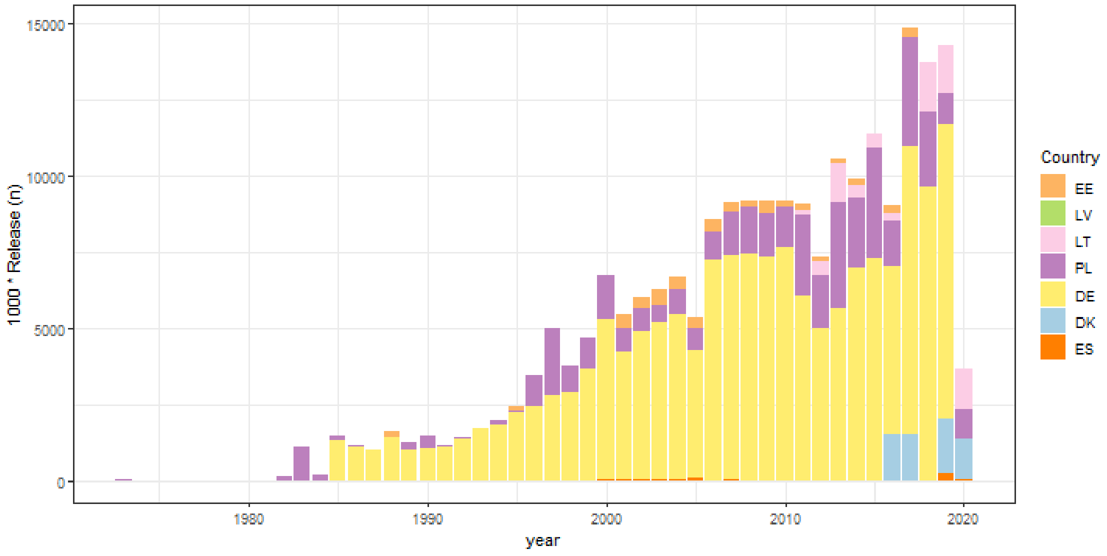


Figure 3.40. Reported releases of on-grown eel (in thousands) per country, Estonia (EE), Latvia (LV), Lithuania (LT), Poland (PL), Germany (DE), Denmark (DK) and Spain (ES). Data for recent years are provisional or incomplete and may change in future data calls. For more details, see Annex 14.

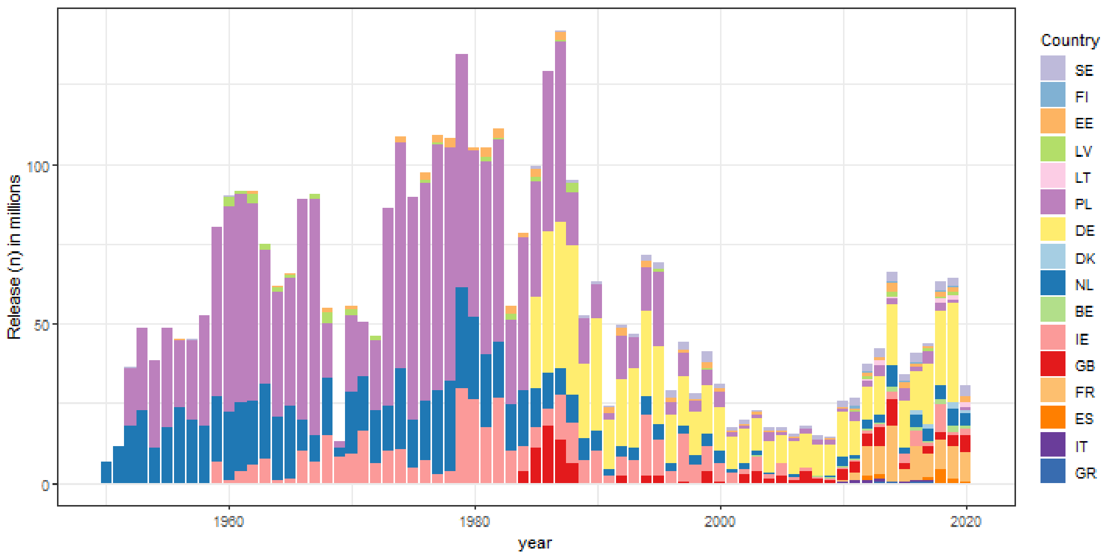


Figure 3.41. Reported releases of all stages (Y, YS, OG, S, QG) (in millions) per country, Sweden (SE)[1], Finland (FI), Estonia (EE), Latvia (LV), Lithuania (LT), Poland (PL), Germany (DE), Denmark (DK), Netherlands (NL), Belgium (BE), Ireland (IE),

[1] NOTE DATA FOR SWEDEN ARE INCOMPLETE IN NUMBER.

United Kingdom (GB), France (FR), Spain (ES), Italy (IT) and Greece (GR). Data for recent years are provisional or incomplete and may change in future data calls. For more details, see Annex 14.

3.6 Aquaculture

Aquaculture production data are derived from responses to the data call 2021.

The aquaculture production increased until the end of the 1990s. It started to decline from the mid-2000s from 8,000–9,000 t to approximately 4,000-5,000 t now. In 2020, aquaculture production was reported as 4628 t (countries reporting: 7; Figure 3.42; Annex 14). In 2020, only ES and GR provided aquaculture data for all stages, for a total of 522.46 t. For IT and FR, the data on aquaculture are expected to be available by the end of 2021.

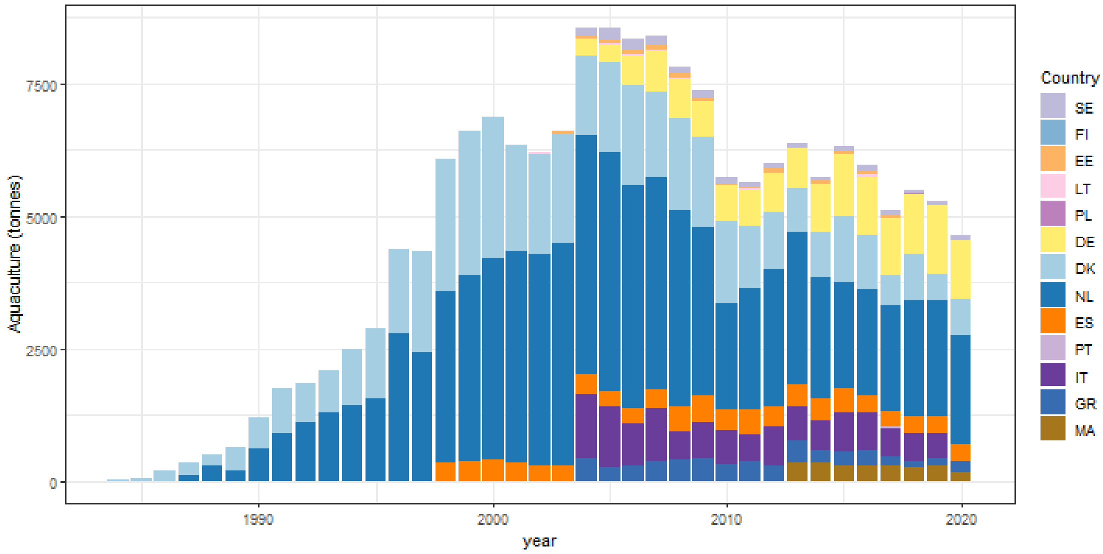


Figure 3.42: Reported aquaculture production of European eel in Europe from 1984 onwards, in tonnes, in Sweden (SE), Finland (FI), Estonia (EE), Lithuania (LT), Poland (PL), Germany (DE), Denmark (DK), Netherlands (NL), Spain (ES), Portugal (PT), Italy (IT), Greece (GR) and Morocco (MA). Data for recent years are provisional or incomplete and may change in future data calls. For more details, see Annex 14.

Regarding Covid-19 impact, it should be noted that there was no significant decline in aquaculture production since the beginning of the pandemic. Also, there were no mentions in Country Reports of 2021 about Covid-19 affecting aquaculture production activities and no data were missing due to Covid-19 pandemic.

3.7 Preparation of Data Call 2022

The data call in 2022 will largely resemble Annexes 1-8 of the 2021 data call. Following the roadmap provided by WKFEA, the collection of biological data (biometry) is planned in 2022, and in response to the suggestions in Chapters 3 and 5, further changes to the current call need to be addressed.

Given the necessary changes/developments in the database and shiny application this task is outside the scope of this EG and requires a dedicated workshop. It is therefore recommended to organize a workshop on designing the eel data call in 2022.

4 ToR C: Report on updates to the scientific basis of the advice, including any new or emerging threats or opportunities

This chapter discusses updates in science, relevant to the management and protection of the eel. In 2018, WGEEL identified a need to review scientific studies and new data on non-fishery factors contributing to direct and indirect losses of eel, at a frequency appropriate to updating advice and based on the availability of new information. A rolling programme of reviews was adopted with a specifically tasked subgroup examining one theme per year. This started in 2019 with an extensive review of the impacts of hydropower and pumping stations and was followed by a focus on habitat loss in 2020. In 2021, the subgroup specifically reviewed the effects of contaminants and parasites on eels. Later in the chapter, an overview of recent publications on new and emerging threats is given to answer to the ToRC c).

4.1 Understanding the effects of contaminants

4.1.1 Introduction

Contamination can be defined as the presence of elevated concentrations of a substance or form of energy above the natural background level for the respective area and organism. Pollution, however, describes the introduction of a constituent such as chemical or biological matter or energy (e.g. heat, light or noise) into natural environments (Longcore & Rich 2004; Geissen et al. 2015; Goines & Hagler 2007).

Many scientific studies and literature reviews have focused on chemical pollution with emphasis on its effects and interactions on whole ecosystems or on specific organisms in detail (Jones & de Voogt 1999; Zala & Penn 2004; Halpern et al. 2008; Diamond et al. 2015).

WGEEL considers contaminants and their associated effects on reproductive potential of eel as one factor contributing to recruitment decline and non-fishery mortality with potential for quantitative assessment. In a recent comprehensive review paper by Belpaire et al. (2019), the authors give a broad overview of the state of knowledge; knowledge gaps and research needs regarding contaminants, potential impacts on the species at population and stock levels, and discuss implications for management of the species.

A variety of contaminants have been associated with population or stock declines of biota including insects (Sánchez-Bayo & Wyckhuys, 2019), birds (Koemann et al. 1972), mammals (Atkinson et al. 2008) and fish (Hamilton et al. 2016). While many of these substances have already been banned, many chemicals persist in the environment for decades and continue to accumulate in wildlife (e.g. PCBs and Dioxins). Banning hazardous substances, however, does not always help to eliminate the issue, as also newly introduced substitutes often share similar chemical properties due to the nature of their application (e.g. chlorinated flame retardants substituted by brominated flame retardants) and thus presumably cause similar issues. Often the persistent and lipophilic nature of contaminants cause them to accumulate through bioaccumulation, bioconcentration and biomagnification in living organisms.

Freshwater eels of the genus *Anguilla* represent lipid-rich, high trophic-level predatory animals, that are particularly prone to the accumulation of lipophilic pollutants due to their biology and life history. Research on mechanisms of contaminant uptake and its effects in the European eel *A. anguilla* and in the American eel *A. rostrata* developed slowly but steadily from the early 1980s in Europe and North America, and further increased through the 90s (Lopez et al. 1981a; Lopez et al. 1981b; Hodson et al. 1994; Ferrando et al. 1987; Bruslé 1991; de Boer et al. 1994a, 1994 b). Larsson et al. were probably the first authors to directly link the decline in recruitment to possible effects from chemical contamination (Larsson et al. 1990). Research on contaminant effects on eels has focused on traits affecting their fitness to complete their life cycle, including the ability to swim, accumulate energy reserves, develop healthy oocytes and reproduce.

In 2006, Palstra et al. further elaborated on this hypothesis and were the first to directly investigate effects of organochlorine toxicity in eel embryos. They concluded that environmental concentrations of Dioxin-Like contaminants (DLCs) could impair recruitment. A further study in 2009 suggested impairment of lipid metabolism caused by chemical burdens, and thus presented realistic mechanisms linking contamination to impaired reproduction in eels (Van Ginneken et al. 2009).

WGEEL (ICES, 2010a) estimated that more than half (>60%) of all European eels from eight different countries were at risk of reproductive impairment based on toxicity thresholds for PCB effects on reproduction of other fish species. Tissue concentrations of DLCs in American and European eels compared to threshold concentrations affecting lake trout reproduction lead to similar conclusions (Byer et al. 2015). Yet, compared to other fish species, assessment of pollutant effects in American and European eels can be seen as particularly difficult, since large parts of their life cycles, including aspects of the reproductive biology, are still not fully understood.

4.1.2 Thresholds

Many scientific studies and literature reviews have focused on chemical pollution with emphasis on its effects and interactions on whole ecosystems or on specific organisms in detail (Jones & de Voogt 1999; Zala & Penn 2004; Halpern et al. 2008; Diamond et al. 2015). A large variety of different contaminants are known to cause adverse health effects. Especially since World War II, synthetic chemical pollutants have accumulated in the environment, which affects food webs on a global scale, posing a direct hazard to environmental, as well as human health (Thornton 2000; El-Shahawi et al. 2010).

Known effects of contaminants can be acute, such as direct physiological impairment, intoxication or poisoning, or chronic effects, which are caused due to exposure over an extended time frame. Toxic effects associated with POPs include endocrine disruption, reproductive impairment, damage to the immune system, behavioural effects and carcinogenicity (Bosveld & van den Berg 1994; Safe 1994; De Swart et al. 1994; Ross et al. 1995; Van den Berg et al. 1998). At present, most countries have rules, restrictions or even bans on their use, trade or production.

Threshold values for acute and chronic toxicity - such as lethal dose (LD50) values or consumer thresholds - exist for a variety of different compounds and species. Threshold values are valuable to differentiate between problematic and non-problematic contamination levels in eels with regards to their health and reproductive capacity. However, the absence of relevant threshold values remains a substantial issue connected to the lack of quantification of the effects of pollutants on the eel stock. Brinkmann et al. (2015) underlined the lack of relevant threshold values for most lipophilic contaminants in combination with knowledge gaps regarding physiological consequences for eel gonadal development and bioenergetics. Based on experiments on artificially matured and spawned eels, Palstra et al. (2006) suggested a threshold of 4 pg TEQ / g (TCDD Equivalents per g wet weight gonadal mass) for dioxin-like contaminants, above which disrupting effects may occur in eel embryos (e.g. yolk-sac oedema, deformed head region and absence of heartbeat). Freese et al. (2017) used this threshold to derive a simple prediction, based on concentrations measured in muscle, gonads and eggs of artificially matured silver eels, in order to estimate whether or not wild eels from different German management units were able to successfully reproduce. Even based on rather conservative estimates as the fish in this experiment did not migrate and spend energy on locomotion, the study indicated that female eels from some of the industrial central European rivers would produce eggs largely exceeding Palstra's threshold values for disrupting effects. Furthermore, values may even reach known threshold values for direct embryo mortality recorded in other fish species.

Given the remaining difficulties relating to artificial reproduction of anguillid eels, effect-concentrations, such as lethal dose concentrations of specific chemicals, have never been experimentally obtained in a satisfactory state. This is due to *A. anguilla* egg and embryonic survival under controlled conditions being unstable, even without exposure to any chemicals. Doering et al (2018) published a promising approach in order to estimate direct dioxin contamination effects by utilizing species-level derived Aryl-Hydrocarbon Receptor (AHR) activity, the main physiological pathway responsible for dioxin toxicity. This, and prior investigations, demonstrated that sensitivity to activation of the species-specific AHR isoforms - AHR1 and AHR2 - in an *in vitro* AHR transactivation assay is predictive of early life stage mortality among birds and fishes, as experimental lethal-dose concentrations were in significant positive correlation with results of the assay in various species. As a result, the suggested assay investigating sensitivity to activation in the eel specific AHR could finally lead to valid threshold values needed to estimate the probability of successful reproduction both in individual eels and at the population level.

Table 4.1. Various threshold values for different effects, caused by different contaminants in different matrices and species.

Contaminant	Known effect on (migration and reproduction)	species	organ	Threshold - concentration	reference
ΣPCB	impairment of reproductive success Embryonic malformations	whiting	Ovaries	> 200 µg/kg ww*	von Westernhagen *et al.* 2006
ΣDDT	impairment of reproductive success	whiting	ovaries	> 20 µg/kg ww	von Westernhagen *et al.* 2006
dieldrin	impairment of reproductive success	whiting	ovaries	> 10 µg/kg ww	von Westernhagen *et al.* 2006

Contaminant	Known effect on (migration and reproduction)	species	organ	Threshold - concentration	reference
Dioxin-like contaminants (PCBs and PCDDs/PCDFs)	negative correlation between embryo survival time and TEQ (toxic equivalent) levels in the gonads implying TEQ-induced teratogenic effects.	Eel	gonad	>4 pg TEQ/g wet weight gonad,	Palstra et al., 2006
Cd	oocyte atresia and eel mortality	Eel	Liver	>1.7 µg/g dry weight	Pierron et al. (2008)

4.1.3 Effect of contaminants in other fish species which might be relevant to eels

Compared to mammals and birds, little is known about contaminant impacts in fish (Dietz et al 2019). Most information concerns the biological effects of PCBs and Mercury. In other species, contaminants reduce fecundity, hatching success and egg quality, induce larval malformation and/or disrupt the endocrine system. Concentrations usually increase with age and size and also with piscivory, compared to invertivory. However, pollution state of the respective growth habitat obviously has significant effect on the contaminant status of the inhabiting fish. Freese et al. (2016) and Sühring (2013 a, b) showed how DLC and BFR concentrations in eels magnified through different life stages from glass to silver eels. However, magnitude and composition differed when looking at different origins, underlining earlier results by Belpaire et al. (2008) and Kammann et al. (2014). Results of these studies suggest that rural river systems tend to produce less contaminated silver eels than industrial river systems. Concentrations of mercury increase with growth rates and temperature (Dietz et al. 2019). Foekema et al. published a model based on reported tissue concentrations, which predicts that, depending on eel sensitivity, maternally transferred dioxin-like contaminants at realistic levels currently found in wild-caught eels could cause up to 50% larval mortality (Foekema et al. 2016). Predictions based on field and experimental maturation -derived data by Freese et al. (2017) also suggested concentrations in eels from some European river systems may exceed thresholds for direct embryonic mortality.

Besides eel, many reports propose that a diversity of contaminants may have an impact on lipid levels in fish (see for a review: Adams et al. 2012). Some other examples of an overall decrease in fat levels in fish have been reported

- Reduced lipid stores and decreased energy for growth (McMaster et al. 1991; Neff et al. 2012)
- Smaller gonads, impaired reproduction (McMaster et al. 1991,)
- Decline in lipids both in muscle and liver

4.1.4 Can we quantify the effect of contaminants?

The term "contaminant" thus stands for a range of compounds, that may cause effects and even interact in different ways, as they can activate, amplify or impede each other. Therefore, quantification of contaminant effects in biota is complicated and needs to be a best possible estimate under certain (known) conditions.

4.1.5 Data required to quantifying the effects of eel quality on stock dynamics and integrating these in stock assessment methods

ICES 2014 (WKPQMEQ report) recommended that harmonised methods for eel quality assessments and reporting should be implemented by the Member States and recommended to take up an obligation of the Member States for the realization of routine monitoring of lipid levels, contamination and diseases in the Eel Regulation. More specifically WGEEL 2013 (ICES, 2013) defined a set of basic requirements for assessing the quality of the silver eels (the mean size (mm), percentage lipid and the sum of PCB28, PCB52, PCB101, PCB138, PCB153 and PCB180 (Σ 6 PCBs) (ng/g wet weight)) and for the yellow eels (the mean size (mm), total wet weight of PCB28, PCB52, PCB101, PCB138, PCB153 and PCB180 (Σ 6 PCBs), p,p′-DDD, p,p′- DDT, p,p′-DDE (Σ DDTs), cadmium, lead and mercury), and for both life stages the prevalence (%) and abundance (n) of *Anguillicola crassus*. Ongoing research projects or monitoring programmes such as DCF should make maximal use of sacrificed eels, to collect data on contaminants and pathogens.

To simplify and standardize future assessments, WGEEL could make use of the existing national data and monitoring frameworks on aquatic contaminants, as provided by EU member states to meet EU WFD requirements. This Directive requires member states to monitor and report on pollutants in surface waters and fish (chemical status). In general, chemical pollutants can be measured in water or sediment samples, however some strongly lipophilic chemicals are difficult to measure in water due to their poor solubility. On the other hand, they are prone to bioaccumulate and significant concentrations can be reached in taxa at higher trophic levels, such as fish. As such, the EU defined environmental quality standards for biota (biota EQS) for 11 priority compounds and their derivatives in fish or bivalves (EU, 2013). The priority substances to be measured in fish are: hexachlorobenzene (HCBz), hexachlorobutadiene (HCBd), mercury (Hg), brominated diphenyl ethers (PBDE), hexabromo-cyclododecane (HBCD), perfluoro-octanesulfonate (PFOS), dicofol, heptachlor and heptachlor epoxide, and dioxins and dioxin-like compounds (Teunen et al., 2020). For those compounds, EQS were defined in order to specifically protect top predators such as piscivorous birds and mammals. These are based on calculations of ecotoxicological risks of secondary poisoning through consumption of contaminated prey. EQS also aim to protect human health from deleterious effects resulting from the consumption of food (fish, molluscs, crustaceans, oils, etc.) contaminated by chemicals (Deutsch et al., 2014). While this list of compounds is rather limited, it includes substances known to be harmful for eel, such as dioxins, mercury, and brominated flame retardants. Collection of these data will generate important knowledge of the spatial distribution of chemical pressure on the eel in Europe. As European nations may use different fish species to monitor the trend, intercalibration exercises will be required. Some countries, such as Belgium, use the eel, among other species, which gives direct indications to its quality with respect to reproduction potential. Results indicate a status of high concern. For example, Figure 4.1 shows the proportion of exceedances of the EQS in eel analysed in Flanders (Belgium, N = 44 sites) in the period 2015-2018 (Teunen et al., 2020). In 60-100% of the studied sites, the body burden of eel for Hg, PBDEs, PFOS and dioxins exceed the EQS, quite often to a large extent.

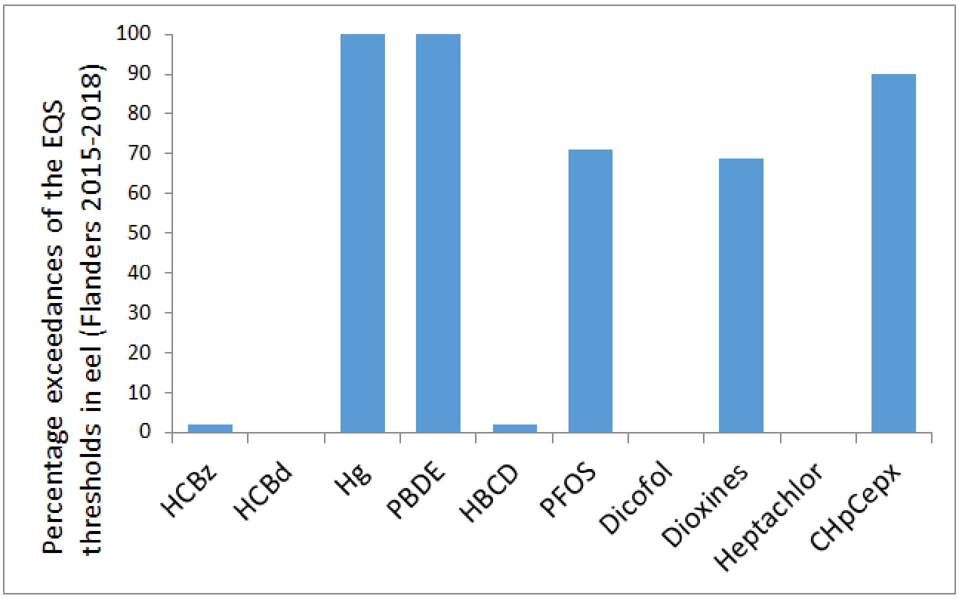


Figure 4.1. Percentage exceedance of measurements of 10 priority chemicals in eel compared to the Environmental Quality Standard (Flanders, 44 sites, 2015-2018) (Teunen et al., 2020). HCBz-hexachlorobenzene, HCBd-hexachlorobutadiene, Hg-mercury, PBDE-brominated diphenyl ethers, HBCD-hexabromo-cyclododecane, PFOS-perfluoro-octaansulfonate, CHpCepx - heptachloorepoxide).

4.2 *Anguillicola crassus* update

4.2.1 Introduction

Among the multi-factorial causes considered to have impacted the European eel stock, the presence of the non-native nematode *Anguillicola crassus* is recognised as one of the most harmful parasitic infections in eel (Kirk, 2003; Kennedy, 2007) (Figure 4.2). It was first documented in the early 1980s (Koops & Hartmann, 1989) in *A. anguilla* populations after being imported to Europe in its native host, *A. japonica,* and is now considered to have spread across the majority of the European eel's range (Kennedy, 2007). The parasite was subsequently identified in *A. rostrata* (Barse *et al.*, 2001).

In addition, there are indications of other infection routes in which a type of hyperparasitism (a parasite within a parasite) plays a role: In the Rhine, *A. crassus* was found abundantly in *Pomphorhynchus* sp. cysts of parasitized round gobies (*Neogobius melanostomus*) (> 30%). This led to the hypothesis that the invasive round goby, due to its high population density and the large number of infestations, is another decisive factor for the spread and persistently high infection rates of swimbladder nematodes in European eels (Emde et. al 2014). Now, successful infection attempts support this assumption (Hohenadler et al. 2018). Since *Pomphorhynchus laevis* and *A. crassus* both represent non-native parasites, this is considered as the first evidence of an invasional meltdown in parasites.

Being haematophagous and causing damage to the swimbladder wall during the infection process, *A. crassus* infection has been identified as having a range of impacts on eels. As a naïve host to this non-native parasite, *A. anguilla* appears to exhibit more pronounced cortisol release than *A. japonica* after lab-infection with *A. crassus* indicating that host-parasite adaptations affect the stress response (Honka and Sures, 2021). Presence of *A. crassus* can also cause reduced haematocrit values (Lefebvre et al., 2013). Laboratory research indicates that infected eels show a more pronounced stress response when exposed to hypoxic conditions (Gollock, Kennedy, & Brown, 2005); that infected silver eels may have delayed downstream movement in rivers (Newbold *et al*. 2015) and may not be able to reach the spawning area due to the metabolic impacts of the parasite (Lefebvre et al. 2002; Palstra *et al.* 2007); and physiological modelling suggests that the transoceanic migration would be significantly affected (Barry *et al.,* 2014). The parasites also cause inflammation on the swimbladder (Würtz & Taraschewski, 2000), and can damage the gas glands which may affect its function and also on blood oxygen exchange (Würtz et al., 1996; Würtz & Taraschewski, 2000). Field evidence from silver eels migrating along the Swedish Baltic coast confirmed adverse effects on the swimming abilities and survival prospects of *A. crassus* infected eels (Sjöberg *et al.* 2009), although other studies have not come to the same conclusion (Simon *et al.* 2018). Use of molecular techniques has revealed that there is a relationship between expression of genes related to silvering processes and the presence of the nematode (Fazio et al., 2009; Schneebauer).

As such, it seems certain that an infection with this parasite alone (Pelster, 2015), or associated with other impacts, will affect the ability of eels to migrate and reproduce effectively, but more work is needed to understand the impacts of *A. crassus,* how these might interact cumulatively and/or synergistically, and how eels are adapting (or not) to infestation.

It is important to recognize that these effects can have acute impacts on the host eel e.g. stress responses, blood loss and more chronic effects e.g. swimbladder damage and dysfunction. These may be experienced by infected fish simultaneously depending on the infection history and potentially have impacts on condition, migration and survival.

Figure 4.2. Silver eel sampled from commercial fishing from Lake Bolmen in Sweden in 2020. This individual eel had 88 A. crassus in its swimbladder. Note that this image does not show the multitude of scars in the swimbladder wall that are created when the parasites enter the swimbladder.

4.2.2 Collection of *A. crassus* data

4.2.2.1 Previous WGEEL comments in relation to *A. crassus*

The distribution and pathogenicity of *A. crassus* through eel populations has been mentioned by WGEEL since 1985, and its associated infection parameters were some of the metrics recorded for eel across Europe. These data were submitted as additional criteria within the WGEEL Eel Quality Database (EQD) up until 2014. Previous attempts by WGEEL to document the infection parameters and distribution of *A. crassus* resulted in the submission of these data to the EQD (developed by WGEEL (Belpaire et al., 2011). As data were added to the database, it provided some indication of the extent of the distribution of *A. crassus* across the more northerly regions of Europe. Specific recommendations by WGEEL to investigate *A. crassus* parameters and their effects on eel have featured in previous ICES reports:

- WGEEL (ICES, 2006): Member Countries should set up a national program on RBD scale to evaluate the quality of emigrating spawners. This should include at least body burden of PCBs, BFRs, infestation levels with *Anguillicola*, EVEX. It should be included in the national management plans. Special emphasis should be given to standardisation and harmonisation of results (units and methods). In order to facilitate this a concerted action is strongly recommended.
- WGEEL (ICES, 2008): The effects of specific contaminants and parasites on fat metabolism and a possible relationship between eel fat content and environmental variables (changing temperature, changing trophic status, and food availability).
- WGEEL (ICES, 2010b): The contaminant and infection levels of diseases and parasites from large parts of the distribution area.

During the current WGEEL, presentation of data by representatives of GFCM highlighted that their investigations into eel populations around the Mediterranean basin had recorded *A. crassus* in yellow and silver eel from southern European, north African and eastern Mediterranean countries. These new data served to confirm previous suspicions that a parasitic infection, unknown in *A. anguilla* prior to the early 1980s, is now near-ubiquitous throughout the natural range of the species.

4.2.2.2 Under other frameworks

Given the impacts of *A. crassus* on the European eel it is important to determine prevalence to evaluate potential effects. Collection of data on *A. crassus* is included within some National programmes, however there are variations in the precision between member states. Some may collect data on the number of parasites per eel (e.g. Sweden and N. Ireland for eel in freshwater), others only indicate presence/absence (e.g. Sweden for eel in coastal waters).

Detection of *A. crassus* necessitates examination of the swimbladder and therefore data are currently collected using lethal methods. To date, a number of non-invasive methods have been tested, such as morphological changes (Crean et al. 2003), molecular tests (De Noia et al. 2020; Jousseaume et al. 2021), X-ray (Székely et al. 2005), computed tomography, magnetic resonance imaging and ultrasound (Frisch et al. 2016). While presence and, in some cases, worm load, can be identified, all these methods have limitations and terminal sampling hence offers the best option for a full assessment of the swimbladder. Continued development into effective non-invasive methods are encouraged, but currently, member states wishing to establish, or continue, data collection on *A. crassus* should consider opportunities where eel mortalities occur. A standardised protocol and template for data collection has been developed by the SUDOANG project which can be downloaded from https://sudoang.eu/en/task-groups/

4.2.2.3 WGEEL Country reports 2021

Of the 14 Country Reports available to WGEEL at the writing of this section, all contained reference to data on *A. crassus* burdens, which confirms that metrics are being collected in relation to the infection parameters associated with this parasite. While reporting/compilation of these data into the EQD have ceased, there is scope that they could be submitted as part of the annual ICES eel data call such that analyses into the incidence, prevalence and distribution of *A. crassus* are undertaken. Concurrently with the known impacts listed above, a more complete understanding as to the negative effects across the eel's range could be possible and would form the basis of a special themed study within WGEEL in 2022.

4.2.3 Perspectives

While the group recognise that the arrival of *A. crassus* into Europe in the early 1980s (Koops & Hartmann, 1989) post-dates the known timelines around declining eel stocks and the elver crash of 1983, there is a considered expert opinion from WGEEL that a synergism of the known impacts surrounding infection with this nematode can impair silver eel migration and reproduction. Such impacts are considered as negatively affecting/influencing stock recovery. As such, *A. crassus* is a recognised concern, and we suggest this matter should be a focus for next year's WGEEL reporting.

Additionally, we make the following recommendations, based on expert opinion:

- *A. crassus* infection parameters (presence/absence, mean prevalence per EMU) should be submitted as part of the annual ICES eel data call;
- Conclusive experiments on the biological impact of *A. crassus* are needed;
- It is important to quantify the prevalence, the intensity, and the functionality of the swimbladder to evaluate the combined effects with other anthropogenic factors in the context of infections;
- Because *A. crassus* mainly occurs in freshwater systems, eels from marine coastal habitats are expected to have best spawning/migratory capacities.

4.3 New and emerging threats and opportunities

The information was drawn from Country Reports and/or brought to the attention of WGEEL by those attending the 2021 virtual meeting.

4.3.1 Advances eel in reproduction

The latest results from research on the possibility of rearing eel larvae from broodstock were presented by Dr Jonna Tomkiewicz (DTU Aqua, Denmark) during the 2021 WGEEL meeting. For over 10 years, Dr Tomkiewicz's laboratory has aimed at breeding European eel (*A. anguilla*) in captivity to expand the current knowledge of the eel reproduction and develop standardized protocols for production of high-quality gametes (egg and sperm), viable embryos and feeding larvae of European eel (Tomkiewicz 2019). The primary bottlenecks in a controlled reproduction of eels, concern deficiencies in knowledge of their reproductive physiology and treatments applied to induce and finalise gamete development. New methods were developed to produce viable eggs and larvae from broodstock. Details of the methods are commercially confidential, but it was clear that Dr Tomkiewicz's team has made significant advances in the development of enhanced broodstock feeds for females and males, has improved egg and sperm quality from farm-raised broodstock, fertilisation procedures and protocols for gamete development. The team has managed to raise larvae to a feeding stage. Although some larvae are feeding in captivity, mortalities are still of significance. The oldest larva reached 150 days. These new results represent new perspectives to study the effects of stressors on the early life stages of eels.

4.3.2 Diseases

Before 1980, there were only a few papers on eel diseases in Europe. This changed with the advent of eel farming, as more eels were then offered for diagnosis to fish disease labs. This, in turn developed into specific and sensitive diagnostic tests to detect virus and bacteria (Haenen et al., 2002). Moreover, eel farmers using stock other than European elvers from the coast of SW Europe to seed their farms introduced other and new sources of pathogens by utilizing Japanese eel juveniles.

In wild eels, there is generally low infection pressure with regard to pathogens, such as bacteria, viruses and parasites. Ordinarily, such native pathogens contribute to the normal faunal composition of a balanced environment, and within these habitats, eels can sustain a low number of natural parasites or a small background level of endemic viral/bacterial infection without becoming diseased (Evans et al., 2018). As with other diseases, eel diseases may develop from the interaction of a fish with a low resistance and a suboptimal environment, especially when water quality is the suboptimal limiting step. The eel is then particularly vulnerable to opportunistic viral and bacterial infections (Lewin et al., 2019).

The impact of viral infections on the natural eel population is still largely unexplored and the impact on the eel stock is still unclear. However, there is scientific evidence that the spread of viral infections is contributing to the decline of the European Eel (Delrez et al., 2021). Eels infected by the EVEX virus (EEL Virus European X) developed haemorrhage and anaemia after trials in swim tunnels; they eventually died after having swum 1000-1500 km (van Ginneken et al., 2005). Several other viruses occur naturally in wild eel populations. These include the viral Anguillid herpesvirus 1 (AngHV 1), aquabirnavirus Eel virus European (EVE), and Eel-Picornavirus (EPV-1).

The previously unknown EPV-1 was detected in a diseased eel caught in Lake Constance (Fichtner et al., 2013). Currently, a study provided first evidence of the distribution of EPV-1 in the Rhine system in the North Rhine Westphalia (NRW) State of Germany (Danne et al., 2021).

In Sweden, AngHV-1 was commonly found in yellow eels along the Swedish west coast in 2020, as well as in lake Bolmen and lake Hjälmaren in 2018. In England the AngHv-1 has been detected in 17 fishery sites. In Northern Germany, AngHV 1 infection was investigated in eels from the Schlei Fjord and 68% of the eels were found to be virus positive (Kullmann et al., 2017). In Northern Ireland, there has been no evidence of anguillid herpes virus in the wild European eel population of Lough Neagh. EVE and EVEX were found but at a very low prevalence, suggesting that the presence of these diseases has not reached levels of concern to the population's health status (Evans *et al*., 2018).
Mortality of elvers from an East Anglian river catchment was attributed to AngHV-1 alongside co-infections of the potentially zoonotic bacterium *Vibrio vulnificus.* This case highlighted the

potential for disease in all freshwater life stages of eel and the complexity of determining the root cause of mortality with multiple infections. A review of AngHv-1 disease outbreaks (as mentioned in the previous WGEEL Country Report) is underway to better understand the triggers for disease and the distribution of the virus within wild eels.
In summer 2018, EVEX was detected for the first time during an eel-specific mortality in a river catchment in East Anglia. Co-infections with Ang-Hv1, eel birnavirus and *Vibrio anguillarum* further complicated the cause of these losses. This case represented the first detection of EVEX during a mortality event of wild eels in England.
The Schlei Fjord in northern Germany is the recipient water of a comprehensive European eel stocking programme, and Kullmann *et al*., (2017) concluded to the urgent need for a disease contaminant strategy for eel stocking programmes. It is crucial that restocking measures should not introduce infectious diseases into the local eel stocks of rivers and connected lakes.

4.3.3 Climate change

Changes in climate, and in particular, temperature have affected, and will continue to affect, fish at all levels of biological organization: cellular, individual, population, species, community and ecosystem, influencing physiological and ecological processes in a number of direct, indirect and complex ways (Harrod, 2016). The response of fishes and of other aquatic taxa will vary according to their tolerances and life stage and are complex and difficult to predict. Eel may respond directly to climate-change-related shifts in environmental processes or indirectly to other influences, such as community-level interactions with other taxa (Heino et al., 2015).

The threat of climate change on eel populations continues to be a consistent feature in Country Reports and ICES reports since this specific ToR was first included in 2015. The reasons for those concerns remain the same:

- changes in ocean conditions having an impact on the oceanic "black box", that is reproduction and larval migration.
- factors in freshwater impacting silver eel production and their capacity to migrate downstream in riverine habitats and breed successfully.

Much of the current discussions into the effects of climate change are directed towards the marine environment but freshwater habitats require similar consideration given the likelihood of dual impacts on migratory animals such as diadromous fish. The most recent EU River Flow Indicator assessment is already showing an increasing variability between summer/winter splits and streamflow, with flows rising in the North and West, while decreasing in South and East (European Environment Agency, 2021). The wider range of likely impacts for freshwater fish and their associated fisheries, including eel, are reviewed in Harrod (2016) and Heino et al., (2015).

While the general elements of climate change impacts remained the same as those discussed in previous WGEEL meetings, specific comment was made in relation to severe episodic floods in central Europe and the unforeseen consequences of these on local habitats. In July 2021 extreme rainfall events produced simultaneous heavy floods throughout Belgium, the Netherlands and Germany causing many human casualties and enormous structural damage. The situation in Flanders (Belgium) was less catastrophic compared to the Walloon region, however the floods had enormous impact on several water courses in Flanders. By the end of July, the river Demer and tributaries had suffered from almost complete anoxia over a 50 km stretch covering a 2-3-week period, during which 80-90% of their fish populations are assumed to have died, among which thousands of dead eels were observed. Significant fish mortalities were also reported in The Netherlands. In Germany, more than 150 l/m^2 of rain fell in 24 hours in some places in North-

Rhine Westfalia and Rhineland Palatinum. The recovery time of such an event was estimated >100 years. Many Rhine tributaries were severely impacted. In the flooded industrial regions, various pollutants were mobilized, which could have negative effects on the local eel and fish populations.

Additional environmental effects included risk of elevated exposure to contaminants as high quantities of chemicals of very different nature entered some rivers. Although a short term impact of floods on residents was obvious, the quality of eels produced after local stock recovery might also be jeopardized in the long term by the additional contaminant exposure after flooding. Indirect effects may be expected because of changes in local ecosystems affecting prey abundance, by shifting sediments, and the destruction of invertebrate populations due to flooding, pollution or anoxia.

Increase periods of droughts are also predicted with global warming. A drought is an unusually dry period when groundwater and stream levels are low, and which is long enough to cause severe hydrological imbalance. The Mediterranean is therefore experiencing longer, more frequent and more intense episodes of drought, with major repercussions on various socio-economic sectors, including fishing. Droughts obviously result in habitat loss for eels, but even before habitat disappearance can have repercussions on recruitment and catches. An example comes from Tunisia, where annual catches of eels from Ichkeul Lake and Ghar el Melh lagoon were linked to the ecological phenomena that these hydrosystems undergo (Hizem-Habbechi, 2014). Indeed, periods of high catches alternated with periods of low catches which matched periods of difficult hydrological conditions. These fluctuations could be explained by rainfall, since heavy rainfall facilitates migration of glass eels and elvers entering the lagoon.

In addition, elevated summer temperatures leading to strong evaporation and consequently an increase in salinity, led to significant eel mortality during August 2016 and 2017 in Ichkeul Lake. Finally, the record temperatures of summer 2021 led to water distress in dams such as Bni Mtir, Mellegue, Lebna or Oued Abid, whose reservoirs shelter eels and we could expect a drop, or a stop of eel catches, in addition to other fish species in these reservoirs.

In discussion the group agreed, as in previous WGEEL meetings (ICES, 2018 and 2020b), that this "*established threat*" requires a specific themed workshop on climate change and its impacts on European eel.

4.3.4 Invasion of the American blue crab

There is growing concern regarding the expansion of the American blue crab *Callinectes sapidus* Rathbun, 1896, *in* the Mediterranean region. It has been included among the 100 worst Invasive Alien Species in the Mediterranean Sea (Streftaris and Zenetos 2006). *C. sapidus* is native to the estuaries and coastal waters of the western Atlantic. It was introduced in the Mediterranean probably through ballast waters (Holthuis and Gottlieb 1955) and it first colonized the eastern part (Galil 2011). Recently, different scientific papers and communications reported its arrival in several places in the western Mediterranean Sea (see below the updated map from Falsone et al. 2020). It develops differently depending on location and in some places, the invasion led to the development of a commercial fishery (Spain, Greece, Egypt). In the Golf du Lion in France, it was first recorded in 2017 in Canet-Saint-Nazaire lagoon (Labrune, 2019) where its population increased rapidly and now reaches a level where the eel fishery stopped due to the blue crab invasion. It is now the only species caught in the nets, in impressive large quantities. It adapts easily to a wide range of environments; *C. sapidus* grows rapidly and tolerates wide ranges of temperatures and salinities. This species occurs also along the Northern African coasts, in Algeria (Benabdi et al. 2019; Hamida and Kara, 2021); Morocco (Chartosia et al. 2018; Taybi and

Mabrouki 2020) and Tunisia, where a Lessepsian blue crab species, *Portunus segnis* is also present along the coast (Shaiek et al. 2021). *C. sapidus* is known to be aggressive and feeding on a large variety of species. In Algeria, according to local fishers of Mellah lagoon, *C. sapidus* severely impacts the shrimp fishery but this hasn't been verified.

In Greece, the main fishing grounds for *C. sapidus* were identified to be Vistonikos Gulf and Thermaikos Gulf where it was first recorded in 1935 (Kevrekidis & Antoniadou, 2018). During '60s the population collapsed and blue crab catches were very low or even rare. After 2007 and until 2019 the landings increased but there were fluctuations in the landings ranging from 1t to 84t (source: Fisheries Cooperation of Vistonis Lake and Vistonikos Gulf).

Although there is a regional research programme on blue crab stock assessment and fisheries (Recommendation GFCM/42/2018/7), there are actually no known studies looking specifically at the impact of *C. sapidus* on the eel population. Studies on this topic should be encouraged, as blue crabs may have an important impact on eel management in the Mediterranean.

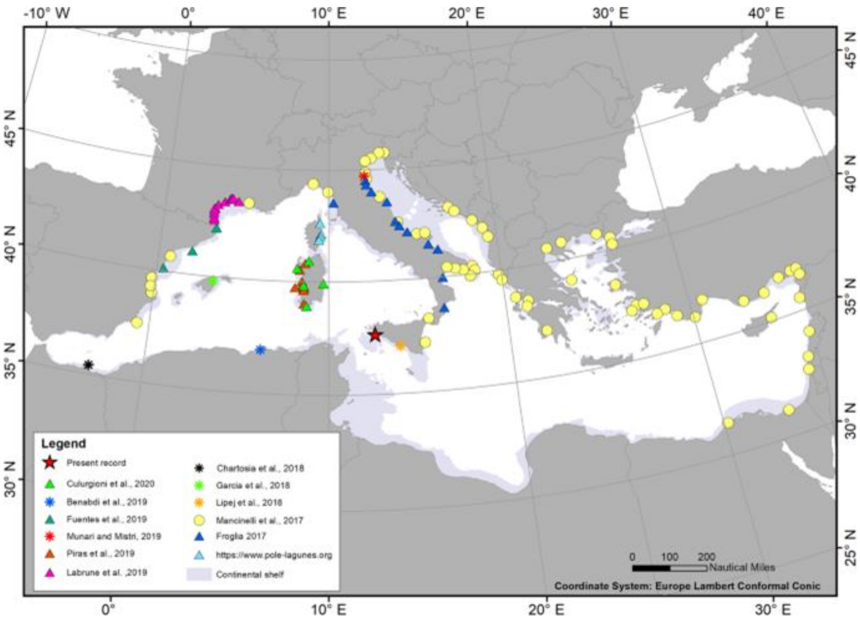


Figure 4.3. Records of presence of the blue crab (*Callinectes sapidus)* in the Mediterranean basin (from Falsone et al 2020). Recently, Recently, the species was also recorded along the Tunisian coast.

4.3.5 Microplastics

Plastic pollution is an emerging global issue. Microplastics (MPs) are found in a wide range of aquatic ecosystems including marine, transitional and freshwaters (Simon-Sanchez et al. 2019; Constant et al. 2020; Quesadas-Rojas et al. 2021). More than 700 species of marine organisms have been found with traces of plastics in their digestive content, from zooplankton to fish (Foekema et al. 2013; Abidli et al. 2021).

However, the potential effects of plastic ingestion are largely dependent on particle size. While ingestion of larger plastic debris is repeatedly reported to be potentially lethal in different species (rarely in fish), microplastic particles in the range of 20 to 1000 µm were shown to be excreted, with T50 values (time for 50% of particles to be evacuated) ranging from 12.1 hr for 42.7 µm particles to 4.0 hr for 1,086 µm particles in Rainbow trout (Roch et al. 2021). In contrast, the differences observed between sizes in common carp were considerably smaller, with T50 ranging from 7.3 hr for 42.7 μm particles to 4.6 hr for 1,086 μm particles. Nevertheless, nanoplastic particles smaller than <5 μm were reported to pass the gastrointestinal tract wall and bioaccumulation could arise when uptake exceeds release or when particles are assimilated in tissues or organs (Roch et al. 2021). Pirsaheb et al. (2020) also describe obstructions of the digestive tract, decreased feeding and nutrition as potential effects of the ingestion of microplastics. MPs can also absorb hazardous substances from seawater, making them potentially much more harmful to wildlife (Blair Crawford and Quinn, 2016). However, there is currently no consensus on whether MPs represent a significant exposure pathway to chemicals in contaminated habitats (Bour et al. 2020).

Only one study has so far mentioned the ingestion of MPs by eels, among other fish larvae. One blue fragment of Polyamide-polypropylene was found in the gut of one specimen of *A. anguilla* in the western English Channel (Steer et al 2017). Therefore, more evidence is needed to understand if contamination by MPs can affect the early stages of this species. Other research projects are currently underway in Italy, Belgium and the Netherlands and could provide other indications in the near future.

It is yet unclear if MP pollution may be added to the list of threats for eels. Special attention should be given to this issue and studies should be encouraged throughout the range of the species to get an idea about MPs contamination in the first place and investigate the potential risk for the eel population.

4.3.6 Offshore wind farms

Offshore wind farms are an alternative to fossil fuels. Power generated by these systems is carried over long distances through submarine power cables (SPC). These are used worldwide, also to supply power to islands, marine platforms or subsea observatories (Taormina et al. 2018). In 2015, the total length of cables laid down on the seabed reached 106 km, 8000 of which represented HVDC (High Voltage Direct Current) power cables (Ardelean and Minnebo, 2015). One of the consequences of underwater electrical cables is the emission of an electromagnetic field due to the current flow passing through them which causes local deviation from the natural geomagnetic field (Taormina et al., 2018). This may disturb marine organisms that are magnetosensitive, such as species that use the Earth’s magnetic field to orient and/or navigate (Taormina et al. 2018; Nyqvist et al. 2020). Magnetic orientation has been demonstrated in eels at several stages of their life cycle (Durif et al. 2013; Cresci et al. 2019). A study carried out in the Baltic Sea only showed minor effects on adult eels. Migrating silver eels passing over an electric cable, inducing magnetic field strengths of 5000 nT at 60 m distance, deviated from their migration route, but resumed their migration direction after only a short average delay of 30 min (Westerberg and Langenfelt, 2008). No such studies have been carried out on juveniles.

4.4 Conclusion

4.4.1 Eel quality

While the quantification of escapement is a key metric in assessing the state of the stock, as a proxy for SSB, it is also important to examine how silver eels may be compromised in their ability to successfully migrate and/or breed, due to sublethal impacts they are exposed to during their continental stages. Exposure to contaminants and parasites/diseases will undoubtedly compromise their condition, and ultimately the quality of potential spawners. This was also referred to in WGEEL 2019, in reference to unassessed sublethal injury from hydropower facilities and pumping stations.

To date, spawner quality has been highlighted as an important, but frequently lacking, aspect of stock assessment, both in the context of specific threats, and in more holistic perspectives. For example, in relation to chemical contaminants, Belpaire et al. (2016) stated 'Assessing the quality of maturing silver eels leaving continental waters towards their spawning grounds is of vital importance not only for the assessment of the stocks, but also in order to understand how pollution affects eels and what consequences it has on the life cycle of the species.' More broadly, eel quality was discussed in the WGEEL report in 2015 and stated, 'The Working Group therefore recommended that monitoring of silver eel quality should be introduced as part of new or existing programmes.'

The establishment of the EQD (Belpaire et al. 2011) has already been referenced, and while there were concerns that harmonised procedures were lacking, this could act as a starting point to establish the monitoring of eel quality in the long term to complement quantitative metrics of eel abundance. As recognised in the recent WKFEA report (ICES, 2021b), it may be possible to draw on existing datasets - e.g. chemical pollution data collected as part of the WFD requirements - to inform development of consolidated eel quality assessments.

4.4.2 Recommendations

Following the 2021 session of the EIFAAC/ICES/GFCM Working Group on Eel, we reiterate and update previous recommendations concerning improvements to the assessment of eel quality and the effects of non-fishery anthropogenic impacts:

- Areas producing high quality spawners (large sized females, low contaminant and parasite burdens, unimpacted by hydropower stations) should be identified in order to maximise protection for these areas;
- We recommend that monitoring of silver eel quality should be introduced as part of new or existing programmes (DCF/DCMAP). Eels that are killed for scientific purposes and in DCF monitoring programs should be screened for contaminants and *Anguillicola crassus* detection;
- We recommend the initiation of an internationally coordinated and multidisciplinary (aquaculture, ecotoxicology) research project aiming to improve the basis for introduction of eel quality into eel stock assessment and more specifically the estimation of the spawning stock;
- We recommend a detailed analysis of *Anguillicola crassus* effects and distribution derived from the infection parameter data supplied as part of the 2022 data call.

5 ToR D: Address the findings of WKFEA, consider their consequences for data collection, stock assessment and advice and make amendments to the current approach of the WG where necessary

The findings of WKFEA have been presented and discussed and there was a general consensus in the group to follow the suggested roadmap. Hence, the group focused on further exploring and analysing available data and time-series and recommends a data call workshop in 2022 to facilitate the tasks planned for WGEEL in 2022. Furthermore, the group amended the advice draft according to the suggestions made by WKFEA to improve the advice.

While the aims of the WKFEA roadmap partly depend on the financing and supervision of a multiyear assessment model development project, which is supported by WGEEL, the suggested improvements in the data collection will certainly allow for more reliable and informative trend-based analyses for the European eel stock and provide results/develop tools that are of interest to diadromous species in general.

6 ToR E: Identify and address Mediterranean-specific issues on European eel

The critical status of the European eel stock was acknowledged for the Mediterranean since 2010, and this has led to specific initiatives, under the auspices of the General Fisheries Commission for the Mediterranean (GFCM), since 2014, when the WGEEL became a Joint ICES/ EIFAAC/GFCM Working Group. Since then, work has been carried out in to integrate the Mediterranean Region within the stock-wide coordination of actions for the European eel, that finally resulted in the approval at the 42nd GFCM Commission in 2018 of the Recommendation GFCM/42/2018/1 on a multiannual management plan for European eel in the Mediterranean Sea countries. The Recommendation established a set of transitional management measures while preparing the ground for a future management plan for the European Eel in the Mediterranean. A specific request of GFCM/42/2018/1 also led to the to the start of a specific Research Project to establish the knowledge base to support the coordinated management plan, to be carried out as a Concerted Action. The "GFCM Research Programme on European eel: towards coordination of European eel (*A. anguilla*) stock management and recovery in the Mediterranean" started in September 2020, and it will end in February 2022. The Programme structure and some preliminary results were presented to WGEEL 2021 with a presentation given jointly by all Partners involved in the Project.

Among the many Work Packages and tasks, the Programme envisages also actions to ensure a better integration of actions and Mediterranean Partners in initiatives at the international level, also to strengthen the Joint ICES/ EIFAAC/GFCM Working Group and the interactions between ICES and GFCM. To this end, a specific *ToR e) Identify and address Mediterranean-specific issues on European eel* was added this year. This was addressed in WGEEL 2021 by discussing the specific issues contemplated in the Subgroups also paying attention to the Mediterranean perspective, including present state of data availability, data analyses and assessment, and also taking account needs for further integration of perspectives work in the WGEEL.

The outcomes relative to *ToR e)* are therefore included in Chapters 2 and 3 and represent a first step for a better integration of the Mediterranean area in the Joint ICES/ EIFAAC/GFCM WGEEL, that in the future will also allow to include more specific issues in the ToRs.

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Annex 2: Resolutions

WGEEL – Joint EIFAAC/ICES/GFCM Working Group on Eels

2020/2/FRSG12 The **Joint EIFAAC/ICES/GFCM Working Group on Eels** (WGEEL), chaired by Jan-Dag Pohlmann, Thünen Institute, Germany, will meet virtually, in a split meeting from 7–10 September (virtually) and 27 September–4 October (virtually) to:

a) Address the generic EG ToRs from ICES, and any requests from EIFAAC or GFCM;
b) Report on developments in the state of the European eel (*Anguilla anguilla*) stock, the fisheries on it and other anthropogenic impacts;
c) Report on updates to the scientific basis of the advice, including any new or emerging threats or opportunities;
d) Address the findings of WKFEA, consider their consequences for data collection, stock assessment and advice and make amendments to the current approach of the WG where necessary.
e) Identify and address Mediterranean-specific issues on European eel

Material and data relevant for the meeting must be available to the group on the dates specified in the 2021 ICES data call.

WGEEL will report by Date, 11 October 2021 for the attention of ACOM, WGDIAD, FRSG and FAO, EIFAAC and GFCM.

Supporting Information

Priority	The status of the European eel stock remains outside safe biological limits and continuing and further management actions are required to recover the stock. The present stock status assessment is based on recruitment time-series, which have no predictive power and therefore cannot be used to identify the most effective way to recover to stock nor the time-scale over which recovery might be achieved. Therefore, the development and application of further status assessment methods are urgently required. Therefore, the findings of WKFEA require particular attention. The Council Regulation (EC) 1100/2007 obliges EU Member States to report national stock indicators, to take management measures and to report progress. Non-EU countries have no such legal obligation, but the same aspirations are necessary to provide a whole-stock assessment and management. The Working Group continues to provide EIFAAC, ICES and the GFCM countries with support in implementing and improving such actions. The EU has requested annually recurring scientific advice on the European eel. Specifically, for eel, the advice is sought in support of the Eel Regulation (EC 1100/2007).
Scientific justification	European eel life history is complex and atypical among aquatic species. The stock is genetically panmictic and data indicate random arrival of adults in the spawning area. The continental eel stock is widely distributed and there are strong local and regional differences in population dynamics and local stock structures. Fisheries on all continental life stages take place throughout the distribution area. Local impacts by fisheries vary from almost nil to heavy overexploitation. Other forms of anthropogenic mortality (e.g. hydropower, pumping stations) also impact on eel and vary in distribution and local relevance.

	Most but not all EU Member States reported quantitative estimates of the required stock indicators to the EU in 2012, 2015 and 2018. The reliability and accuracy of these data have not yet been fully evaluated, but the ICES WKEMP will examine this. Furthermore, the stock indicators of some non-European countries within the natural range are lacking.
Resource requirements	SharePoint, WebEx
Participants	EIFAAC, ICES and GFCM Working Group Participants, Invited Country Administrations, Client representative
Secretariat facilities	Support to organize the logistics of the meeting.
Financial	At countries expense
Linkages to advisory committees	ACOM
Linkages to other committees or groups	WGDIAD, SCICOM, FRSG
Linkages to other organizations	FAO EIFAAC, GFCM, EU DG-MARE, EU DG-ENV

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Annex 4: Acronyms and Glossary

Acronyms

Acronyms	Definition
AA	Administrative Agreement, typically the recurring agreement between ICES and the EC
ACFM (ICES)	Advisory Committee on Fisheries Management
ACOM (ICES)	Advisory Committee on Management
ADGEEL	Advice drafting group on eel, for ICES
AIC	Akaike Information Criterion
AngHV-1	Anguillid herpes virus 1
ANCOVA	Analysis of Covariance
ANOVA	Analysis of Variance
BERT	Bayesian Eel Recruitment Trend model
BIC	Bayesian Information Criterion
CCM	Catchment Characterisation and Modelling
CITES	Convention on International Trade in Endangered Species of Flora and Fauna
CMS	Convention on the Conservation of Migratory Species of Wild Animals
COMM	European Commission, also EC is used.
CPUE	Catch per unit of effort
CR	Country Report
C&R	Catch and release
CUSUM	Cumulative Sum Control Chart
DAERA	Department of Agriculture, Environment and Rural Affairs (N. Ireland)
DBEEL	Database on Eel (from EU POSE project)
DCF	Data Collection Framework of the European Union
DEMCAM	Demographic Camargue Model
DG-MARE	Directorate-General for Maritime Affairs and Fisheries, European Commission
DLS	Data-Limited Stocks

Acronyms	Definition
EC	European Commission, also COMM is used.
e-DNA	Environmental DNA
EDA	Eel Density Analysis (model, France)
EIFAAC	European Inland Fisheries and Aquaculture Advisory Commission
EIFAC	European Inland Fisheries Advisory Commission – became EIFAAC in 2008
EMP	Eel Managment Plan
EMU	Eel Management Unit
EFF	European Fisheries Fund
EQD	Eel Quality Database
EROD	Ethoxyresorufin-O-deethylase
ESAM	Eel Stock Assessment Model
EU	European Union
EU MAP	The European Multi-Annual Plan, previously the DCF
EVEX	Eel Virus European X
FAO	Food and Agriculture Organisation
FEAP	The Federation of European Aquaculture Producers
GAM	Generalised Additive Model
GEM	German Eel Model
GFCM	General Fisheries Commission of the Mediterranean
GIS	Geographic Information Systems
GLM	Generalised Linear Model
GlobAng	French Model of Eel Population Dynamics
GST	Glutathione-S-transferase
HPS	Hydropower Station
ICES	International Council for the Exploration of the Sea
IMESE	Irish model for estimating silver eel escapement
IUCN	International Union for the Conservation of Nature
IUU	Illegal, Unreported and Unregulated fisheries

Acronyms	Definition
LAM	Lifetime anthropogenic mortalities
LHT	Life History Trait
LVPA	Length-based Virtual Population Assessment
L50	L50 = the length (L) at which half (50%) of a fish species may be able to spawn
MS	Member State, typically used in reference to EU Member States but not only
MSY	Maximum Sustainable Yield
NAO	North Atlantic Oscillation
NA	Not applicable
NC	Not collected, code to explain an empty data value cell
ND	No data, code to explain an empty data value cell
NDF	Non-detriment Finding
NP	Not pertinent, code to explain an empty data value cell
NR	Not recorded, code to explain an empty data value cell
POSE	Pilot projects to estimate potential and actual escapement of silver eel (EU project)
RBD	River Basin District, typically as defined according to the EU Water Framework Directive
RGMAREEL	Workshop on Fisheries Related Impacts on Silver eels 2017
RG-TEMPP	Review of the Trans-border management plan for European eel, *Anguilla anguilla*, in the Polish-Russian zone of the Pregola River basin and Vistula Lagoon
RS_EMP	Review Service – Evaluation of Eel management Plans 2010
SAC	The GFCM Scientific and Advisory Committee on Fisheries
SCICOM	The Science Committee of ICES
SGAESAW	Study Group on anguillid eels in saline waters 2009
SGIPEE	Study Group on International Post-Evaluation on Eels 2010, 2011
SLIME	Restoration the European Eel population; pilot studies for a scientific framework in support of sustainable management (EU project)
SMEP II	Scenario-based Model for Eel Populations, vII (model applied in England and Wales, UK)
SPR	Estimate of spawner production per recruiting individual.
SQL	Special purpose programming language for managing data
SRG	Scientific Review Group of the European Commission

Acronyms	Definition
SSB	Spawning–Stock Biomass
STECF	Scientific, Technical and Economic Committee for Fisheries, European Commission
ToR	Terms of Reference
VPA	Virtual Population Analysis
WG	Working Group
WFD	Water Framework Directive, European Directive
WGEEL	Joint EIFAAC/ICES/GFCM Working Group on Eels
WKBALTEEL	Workshop on Baltic Eel 2010
WKBECEEL	Working Group on Biological Effects of Contaminants in Eel 2016
WKEELCITES	Workshop on Eel and CITES 2015
WKEELDATA	Workshop on Designing an Eel Data Call 2017
WKEELDATA2	Second Workshop on designing an Eel Data Call 2019
WKEELMIGRATION	Workshop on the Temporal Migration patterns of European Eels 2020
WKEMP	Workshop on Evaluating Management Plans – 2018
WKEPEMP	The Workshop on Evaluating Progress with Eel Management Plans 2013
WKESDCF	Workshop on Eels and Salmon in the Data Collection Framework 2012
WKFEA	Workshop on the future of eel advice 2021
WKLIFE	Workshop on the Development of Assessments based on Life history traits and Exploitation Characteristics
WKPGMEQ	Workshop of a Planning Group on the Monitoring of Eel Quality under the subject “Development of standardized and harmonized protocols for the estimation of eel quality”
WKSTOCKEEL	Workshop on Eel Stocking 2016
WKTEEL	Workshop on Tools for Eel 2018
WGRFS	Working Group on Recreational Fisheries Surveys
YFS1	Young Fish Survey: North Sea Survey location
IYFS	International Young Fish Survey

Glossary

Anthropogenic	**Caused by humans.**
Assisted migration	The practice of trapping and transporting juvenile eel within the same river catchment to assist their upstream migration at difficult or impassable barriers, without significantly altering the production potential (B_{best}) of the catchment
Bootlace, fingerling	Intermediate sized eels, approx. 10–25 cm in length. These terms are most often used in relation to restocking. The exact size of the eels may vary considerably. Thus, it is a confusing term.
Carrying Capacity	The average maximum biomass of eel that can be supported by a given habitat.
Catch	The WGEEL uses the term catch(es) to mean fish that are caught but not necessarily landed. See landings below
Depensation	The effect on a population when a decrease in spawners leads to a faster decline in the number of offspring than in the number of adults.
Eel River Basin or Eel Management Unit	"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. If appropriate justification is provided, a Member State may designate the whole of its national territory or an existing regional administrative unit as one eel river basin. In defining eel river basins, Member States shall have the maximum possible regard for the administrative arrangements referred to in Article 3 of Directive 2000/60/EC [i.e. River Basin Districts of the Water Framework Directive]." EC No. 1100/2007.
Elver	Young eel, in its first year following recruitment from the ocean. The elver stage is sometimes considered to exclude the glass eel stage, but not by everyone. To avoid confusion, pigmented 0+cohort age eel are included in the glass eel term.
Escapement	The amount of eel that leaves (escapes) a water body, after taking account of all natural and anthropogenic losses. Most commonly used with reference to silver eel – silver eel escapement.
Glass eel	Young, unpigmented eel, recruiting from the sea into continental waters. WGEEL consider the glass eel term to include all recruits of the 0+ cohort age group, including some pigmented eel.
Index river	To be defined
Landings	The WGEEL uses the term Landings to mean fish that are brought ashore.
Leptocephalus	Flat and transparent marine larval stage of eel, on migration from spawning ground to continental waters, between pre-Leptocephalus and metamorphosis to glass eel
Lifestage	Defined stage in the life cycle of eel, whether leptocephalus, glass eel, yellow eel, or silver eel.
Limit reference point	A Limit Reference Point indicates a state of a fishery and/or a resource which is considered to be undesirable and which management action should avoid.
Non-detriment finding (NDF)	In relation to CITES, the competent scientific authority has advised in writing that the capture or collection of the specimens in the wild or their export will not have a harmful effect on the conservation status of the species or on the extent of the territory occupied by the relevant population of the species.

Anthropogenic	**Caused by humans.**
Ongrown eels	Eels that are grown in culture facilities for some time before being restocked. Whether the time is to meet quarantine requirements, for the receiving environment conditions to be suitable, or as part of the culture and grading purpose.
Pre-leptocephalus	First larval stage of eel, between hatching from ovum and leptocephalus
Production	The amount of fish produced from a waterbody. Sometimes referred to for silver eel in terms as escapement + anthropogenic losses, or production – anthropogenic losses = escapement.
River Basin District (RBD)	The area of land and sea, made up of one or more neighbouring river basins together with their associated surface and groundwaters, transitional and coastal waters, which is identified under Article 3(1) of the Water Framework Directive as the main unit for management of river basins. The term is used in relation to the EU Water Framework Directive.
Restocking	The practice of adding fish [eels] to a waterbody from another source, to supplement existing populations or to create a population where none exists
Silver eel	Migratory phase following the yellow eel phase. Eel in this phase are characterized by darkened back, silvery belly with a clearly contrasting black lateral line, enlarged eyes. Silver eel undertake downstream migration towards the sea, and subsequently westwards. This phase mainly occurs in the second half of calendar years, although some are observed throughout winter and following spring.
Target reference point	A Target Reference Point indicates to a state of fishing and/or a resource which is considered to be desirable and at which management action, whether during development or stock rebuilding, should aim. FAO, 1995.
To silver (silvering)	Silvering is a requirement for downstream migration and reproduction. It marks the end of the growth phase and the onset of sexual maturation. This true metamorphosis involves a number of different physiological functions (osmoregulatory, reproductive), which prepare the eel for the long return trip to the Sargasso Sea. Unlike smoltification in salmonids, silvering of eels is largely unpredictable. It occurs at various ages (females: 4 – 20 years; males 2 – 15 years) and sizes (body length of females: 50 – 100 cm; males: 35 – 46 cm) (Tesch, 2003).
Trap and Transport	Capturing downstream migrating silver eel for transportation around hydropower turbines
Yellow eel	Life-stage resident in continental waters. Often defined as a sedentary phase, but migration within and between rivers, and to and from coastal waters occurs and therefore includes young pigmented eels ('elvers' and bootlace).

Stock Reference Points and Data Call Terms

Age	**The age of eel in years., with part years as plus growth (e.g, 0+, 1+), starting at recruitment to coastal waters. Glass eel are defined as 0+.**
Aggregate habitat (AL)	Data Call term for aggregrated habitats where data are commined across habitat categories
A_{lim}	Limit anthropogenic mortality: Anthropogenic mortality, above which the capacity of self-renewal of the stock is considered to be endangered and conservation measures are requested (Cadima, 2003).

Age	**The age of eel in years., with part years as plus growth (e.g, 0+, 1+), starting at recruitment to coastal waters. Glass eel are defined as 0+.**
A_{pa}	Precautionary anthropogenic mortality: Anthropogenic mortality, above which the capacity of self-renewal of the stock is considered to be endangered, taking into consideration the uncertainty in the estimate of the current stock status.
Aquaculture production	The biomass of eel harvested in aquaculture during a time frame; e.g. a year.
Baltic region	The countries bordering the Baltic Sea; sometimes other countries in the catchment are also included.
bio_age	mean age
bio_g_in_gy	proportion (in %) of glass eel [100 for only glass eel ; 0 for only yellow eel ; the proportion if mix of glass and yellow eel]
bio_length	mean length in mm
bio_sex_ratio	sex ratio express as a proportion of female; between 0 (all males) and 100 (all females)
bio_year	year during which biological samples where collected
bio_weight	mean individual weight in g
$B_{current}$ or B_{curr}	The Current escapement biomass: The amount of silver eel biomass that currently escapes to the sea to spawn, corressponding to the assessment year.
B_{best}	The amount of silver eel biomass that would have existed if no anthropogenic influences had impacted the current stock, included re-stocking practices, hence only natural mortality operating on stock. The Best achievable escapement biomass under present conditions: escapement biomass corresponding to recent natural recruitment that would have survived if there was only natural mortality and no restocking, corressponding to the assessment year.
B_0	The amount of silver eel biomass that would have existed if no anthropogenic influences had impacted the stock. Reference point for the theoretical maximum quantity of silver eel expressed as biomass that would have escaped from a defined eel producing area, in the absence of any anthropogenic impacts.
B_{lim}	Limit spawner escapement biomass, below which the capacity of self-renewal of the stock is considered to be endangered and conservation measures are requested (Cadima, 2003).
B_{MSY}	Spawning-stock biomass (SSB) that is associated with the Maximum Sustainable Yield.
$B_{MSY-trigger}$	Value of spawning–stock biomass (SSB) which triggers a specific management action, in particular: triggering a lower limit for mortality to achieve recovery of the stock.
B_{pa}	Precautionary spawner escapement biomass: The spawner escapement biomass, below which the capacity of self-renewal of the stock is considered to be endangered, taking into consideration the uncertainty in the estimate of the current stock status.
Commercial Fisheries	Fisheries with sale of catch for commercial gain
Coastal waters	WFD coastal waters
das_comment	Comment (including comments about data quality for this year)

Age	**The age of eel in years., with part years as plus growth (e.g, 0+, 1+), starting at recruitment to coastal waters. Glass eel are defined as 0+.**
das_effort	Effort (if used)
das_value	Value
das_year	Year
Eel mannagement unit (EMU)	Eel management unit defined in an Eel Management plan under the Eel Regulation 1100/2007.
F	Fishing mortality rate
FAO areas	See http://www.fao.org/fishery/area/search/en
F_{lim}	F_{lim} is the fishing mortality which in the long term will result in an average stock size at B_{lim}.
F_{pa}	ICES applies a precautionary buffer F_{pa} to avoid that true fishing mortality is above F_{lim}.
F-rec	recreational fishing mortality, per reporting year, in kg
Freshwaters	Waters with zero salinity
F_{MSY}	F_{MSY} is estimated as the fishing mortality with a given fishing pattern and current environmental conditions that gives the long term maximum yield.
G	Code in Data Call for data comprising Glass eel only as defined in Glossary
G+Y	Code in Data Call for data comprising a Glass eel with yellow eel mix
GEE-n	Glass eel equivalents in numbers – the quantity of eel expressed as equivalent number of glass eel. Method provided in ICES (2013) report p103.
Glass eel recruitment series	Time-series enumerating glass eel recruiting from the sea into continental waters.
GLM	Generalized linear model (used by ICES to predict and fill in gaps in the data)
Habitat	Waters occupied by eel, whether fresh, transitional, coastal or marine
ICES statistical rectangles	See http://gis.ices.dk/sf/index.html?widget=StatRec
Inland waters	Freshwaters, not under the jurisdiction of Marine fisheries management (i.e. the CFP).
Landings from fisheries	Commercial landings include any eel taken from the water and landed on the market. Recreational landings include any eel taken from the water by recreational fisheries. Other landings include eel caught for assisted migration, translocation,
Length in mm	Total length measured from tip of nose to tip of tail (TL)
Longitude	x (longitude) EPSG:4326. WGS 84 (Google it)
Latitude	y (latitude) EPSG:4326. WGS 84 (Google it)
M	Natural Mortality

Age	**The age of eel in years., with part years as plus growth (e.g, 0+, 1+), starting at recruitment to coastal waters. Glass eel are defined as 0+.**
North Sea	For the purposes of ICES eel management, taken as ICES sea areas IV_a, IV_b, IV_c and inflowing freshwater systems
Marine waters	(Abbreviated MO) Open marine waters
q_aqua_kg	Aquaculture production (kg) in reporting year
q_aqua_n	Aquaculture production (number of eel) in reportng year
Fisheries - Recreational	Recreational (= non-commercial) fishing is the capture or attempted capture of living aquatic resources mainly for leisure and/or personal consumption.
Releases	Eel released to the wild after capture
R_{target}	The Geometric Mean of observed recruitment between 1960 and 1979, periods in which the stock was considered healthy.
R(s)	The amount of eel (<20 cm) restocked into national waters annually
S	Code in Data Call for data comprising Silver eel
Sea region (division)	ICES Sea area statisitical rectangle. Where required for freshwater eel habitats, is the sea area the River basin drains to.
SEE–n	Silver eel equivalents in numbers – the quantity of eel expressed as equivalent number of silver eel
SEE_com	Commercial fishery silver eel equivalents
SEE rec	Recreational fishery silver eel equivalents)
SEE_hydro	Mortility in hydropower, pumps and water intakes etc expressed as Silver eel equivalents
SEE_habitat	Silver eel equivalents relating to anthropogenic influences on habitat (quantity/quality)
SEE_release	Silver eel equivalents relating to release activity
SEE_other	Silver eel equivalents from `other` sources
Silver eel abundance series	Time-series of abundance of silver eel determined by consistent regular count or survey (usually by capturing migrating silver eel)
ser_nameshort	short name of the recruitment series, this must be 4 letters + stage name, e.g. VilG, LiffGY, FremS, the first letter is capitalised and the stage name too.
ser_namelong	long name of the recuitment series e.g. `Vilaine estuary` for the Vilaine;
ser_typ_id	type of series 1= recruitment series, 2 = yellow eel standing stock series, 3 silver eel series
ser_effort_uni_code	unit used for effort, it is different from the unit used in the series, for instance some of the Dutch series rely on the number hauls made to collect the glass eel to qualify the series, see units sheet.

Age	**The age of eel in years., with part years as plus growth (e.g, 0+, 1+), starting at recruitment to coastal waters. Glass eel are defined as 0+.**
ser_comment	This comment should at least include a short description of the methods, give an idea on the size of the eels and the proportion of glass eel, whether it is mixed (e.g. glass and yellow) or not, possible biases (e.g. by restocking) and a mention if the series is special in any way (e.g. very old/long) Note that this text will be displayed as a description of the series in the shiny app, thus consider the "readability".
ser_uni_code	Units used in the series, see tr_units_uni sheet
ser_lfs_code	Lifestage see tr_lifestage_lfs sheet
ser_hty_code	Habitat type see tr_habitattype_hty (F=Freshwater, MO=Marine Open,T=transitional, AL=aggregate...)
ser_locationdescription	This should provide a description of the site, e.g. if ist far inland, in the middle of a river, near a dam etc. Also please specify the adjectant marine region (Baltic, North Sea) etc. (e.g. "Bresle river trap 3 km from the sea" or IYFS/IBTS sampling in the Skagerrak-Kattegat" Note that this text will be displayed as a description of the site in the shiny app, thus consier the "readability".
ser_emu_nameshort	The codes of the emu (emu_nameshort) in sheet tr_emu_emu. In case you provide data for each EMU separately then you don't need to fill in for AL and vice versa
ser_cou_code	The cou_code in the tr_country_cou table
ser_area_division	Fao code of sea region (division level) see tr_fao_area (column division)(https://github.com/ices-e.g./WGEEL/wiki). These codes are for use only in the case of Coastal and Marine Open waters – otherwise you can leave it blank. ICES statistical rectangles (http://gis.ices.dk/sf/index.html?widget=StatRec) and FAO areas map (http://www.fao.org/fishery/area/search/en)
ser_tblcodeid	This should refer to the id of the series once inserted in ICES station table, currently void : ignore
ser_x	x (longitude) EPSG:4326. WGS 84
ser_y	y (latitude) EPSG:4326. WGS 84
ser_sam_id	The sampling type corresponds to trap partial, trap total, see tr_samplingtype_sam (sam_id)
Silver eel abundance series	Time-series of abundance of silver eel determined by consistent regular count or survey (usually by capturing migrating silver eel)
Skagerrak-Kattegat	For the purposes of ICES eel management, taken as ICES Sea areas III_{b}, III_{c} and inflowing freshwater systems
SPR	Spawner per recruit: estimate of spawner production per recruiting individual.
%SPR	Ratio of SPR as currently observed to SPR of the pristine stock, expressed in percentage. %SPR is also known as Spawner Potential Ratio.
Standing stock	The total stock of eel present in a waterbody at a point in time, expressed as a number of individuals or total biomass

Age	**The age of eel in years., with part years as plus growth (e.g, 0+, 1+), starting at recruitment to coastal waters. Glass eel are defined as 0+.**
sumA	total Anthropogenic mortality, per reporting year , in kg
sumF	total Fishing Mortality per reporting year, in kg
sumH	total non fishing Anthropogenic mortality, per reporting year in kg
sumF_com	Mortality due to commercial fishery, summed over age groups in the stock.
SumF_rec	Mortality due to recreational fishery, summed over age groups in the stock .
SumH_hydro	Mortality due to hydropower (plus water intakes etc) summed over the age groups in the stock (rate)
SumH_habitat	Mortality due to anthropogenic influence on habitat (quality/qauntity) summed over the age groups in the stock (rate)
SumH_other	Mortality due to other anthropogenic influence summed over the age groups in the stock (rate)
SumH_release	Mortality due to release summed over the age groups in the stock (rate: negative rate indicates positive effect of release)
Transitional waters	WFD transitional waters, implies reduced salinity
Transport/relocation operations	When eels have been collected somewhere in traps and transported to other places where they appear as “release” for the purposes of data recording
ΣF	The fishing mortality rate, summed over the age groups in the stock.
ΣH	The anthropogenic mortality rate outside the fishery, summed over the age groups in the stock.
ΣA	The sum of anthropogenic mortalities, i.e. ΣA = ΣF + ΣH.
Y	Code in Data Call for data comprising yellow eel only
Yellow eel abundance series	Time-series of abundance of yellow eel determined by consistent regular count or survey
Yellow eel recruitment series	Time-series enumerating yellow eel where this life stage is first observed at a site or is the stage at which eel enter freshwaters
Yellow eel standing stock series	Time-series of abundance of yellow eel determined by consistent regular count or survey
“3Bs & ΣA”	Refers to the 3 biomass indicators (B_0, B_{best} and $B_{current}$) and anthropogenic mortality rate (ΣA).
40% EU Target	From the Eel regulation (1100/2007): “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 relative to the best estimate of escapement that **would have existed if no** anthropogenic influences had impacted the stock”. The WGEEL takes the EU target to be equivalent to a reference limit, rather than a target.

Annex 5: Meeting Agenda

<u>All times in CEST, Paris time</u>

Part 1

Tuesday 7th September

10:00-11:00 Welcome & Introduction (all data providers)

11:00-13:00 Demonstration of the integration process (all data providers)

13:00-13:45 Lunch

13:45-16:15 Breakout: Data integration (solo sessions)

Wednesday 8th September

10:00-13:00 Breakout: Data integration (solo sessions)

13:00-13:45 Lunch

13:45-16:45 Breakout: Data integration (solo sessions)

Thursday 9th September

10:00-13:00 Breakout: Data integration (solo sessions)

13:00-13:45 Lunch

13:45-16:45 Breakout: Data integration (solo sessions)

Friday 10th September

10:00-13:00 Breakout: Data integration (solo sessions)

13:00-13:45 Lunch

13:45-15:45 Closing Session (everyone)

Additional explanations:

Solo sessions: Data providers will integrate their data via the online tool with the help of an operator. A schedule will be agreed at the start of the meeting and attendance of the data provider is only required at the countries scheduled date/time.

All data providers: These sessions will inform on the integration process and only the attendance of members participating in the integration process is required. Other members are welcome to join.

Everyone: Session which is of general interest to the WG. If possible, this session should be attended by all members planning to participate in the 2nd part of the 2021 WGEEL as well.

Part 2

Monday 27th September

10:00-11:15 Welcome and Introduction / Agree on agenda

11:15-12:00 Reporting: WKFEA

12:00-12:15 SG Assignments

12:15-13:00 SG Breakouts: Concepts

13:00-13:45 Lunch

13:45-15:30 SG Breakouts: Concepts

15:30-17:30 Scientific Exchange and CR Highlights

17:30-18:00 Plenary

Tuesday 28th September

10:00-11:30 Reporting: GFCM

11:30-13:00 SG Breakouts

13:00-13:45 Lunch

13:45-17:30 SG Breakouts: Tasks / Assignments

16:30-18:00 Plenary: Concepts

Wednesday 29th September

10:00-10:45 Reporting: SUDOANG

10:45-11:15 Plenary

11:15-13:00 SG Breakouts: Content

13:00-13:45 Lunch

13:45-17:30 SG Breakouts: Create Content

17:30-18:00 Plenary

Thursday 30th September

10:00-11:30 Plenary

11:30-13:15 SG Breakouts: Create Content

13:15-14:00 Lunch

14:00-14:30 Reporting: Larval development

14:30-14:45 Reporting: Spawning grounds

14:45-16:00 Plenary advice (Room 1, parallel)

14:45-17:30 SG Breakouts: Create Content

17:30-18:00 Plenary

Friday 1st October

10:00-13:00 Plenary: Final chapter content

13:00-13:45 Lunch

13:45-17:30 SG Breakouts: Writing / Changes / Proof reading

17:30-18:00 Plenary

Saturday 2nd October

10:00-13:00 SG Breakouts

13:00-13:45 Lunch

13:45- 15:00 Advice agreement

15:00-17:00 SG Breakouts **– 17:00 DEADLINE TO SUBMIT CHAPTER**

Sunday 3rd October

10:00-18:00 Reading

Monday 4th October

10:00-18:45 Report agreement session

Annex 6: Country reports 2020-2021: Eel stock, fisheries and habitat reported

In preparation for the Working Group, participants of each country have prepared a Country Report, in which the most recent information on eel stock and fishery is presented. These Country Reports aim at presenting the best information that does not necessarily coincide with the official status.

Participants from the following countries provided an updated report to the 2021 meeting of the Working Group on Eels:

- **Belgium**
- **Denmark**
- **Estonia**
- **Finland**
- **Germany**
- **Greece**
- **Italy**
- **Latvia**
- **Lithuania**
- **Netherlands**
- **Norway**
- **Poland**
- **Portugal**
- **Spain**
- **Sweden**
- **The United Kingdom of Great Britain and Northern Ireland**

For practical reasons, this report presents the Country Reports in electronic format only (URL).

Country Reports 2020/2021

Annex 7: Stock Annex

The table below provides an overview of the WGEEL Stock Annex. Stock Annexes for other stocks are available on the ICES website Library under the Publication Type “Stock Annexes”. Use the search facility to find a particular Stock Annex, refining your search in the left-hand column to include the *year*, *ecoregion*, *species*, and *acronym* of the relevant ICES expert group.

Stock ID	Stock name	Last updated	Link
Anguilla anguilla	European eel	September 2020	*Anguilla anguilla*

Annex 8: Recruitment series tables

Table 1: Short description of the sampling sites for European eel recruitment data for Elsewhere Europe. Min and max indicate the first year and last year in the records, and the values are given in the n+ and n- columns, indicate the number of years with values and the number of years when there are missing data within the series. Life stage: GY = glass eel and yellow eel, G = glass eel, Y = yellow eel. Unit for the data collected is given (nr = number; index = calculated value following a specified protocol, nr/m2 = number per square metre, nr/h = number per hour, kg/boat/d = kg per boat per day). Habitat: C = coastal water (according to the EU Water Framework Directive, WFD), F = freshwater, MO = marine water (open sea), T = transitional water with lower salinity (according to WFD). Kept = 1 means that the dataseries is used in recruitment analyses, 4 that there are warnings about the use of the series but it is still used in the analysis.

code ea	ar	min	max	n+	n-	life stage	sampling type	unit	habitat	kept
BurrG	EE	1987	2021	35	18	G	trap	kg	F	1
MaigG	EE	1994	2021	28	4	G	trap	kg	F	1
SeEAG	EE	1972	2021	50	2	G	com. catch	t	T	1
SeHMG	EE	1979	2021	43	4	G	com. catch	t	T	3
ShiFG	EE	2011	2021	11	0	G	trap	nr	F	0
ShiMG	EE	2011	2021	11	0	G	trap	nr	T	0
AdCPG	EE	1928	2008	81	40	G	com. cpue	kg/boat/d	T	1
AdTCG	EE	1986	2008	23	0	G	com. catch	t	T	1
GiCPG	EE	1961	2008	48	1	G	com. cpue	kg/boat/d	T	1
GiScG	EE	1992	2021	30	0	G	sci. surv.	index	T	1
GiTCG	EE	1923	2008	86	28	G	com. catch	t	T	1
LoiG	EE	1924	2008	85	6	G	com. catch	kg	T	1
SevNG	EE	1962	2008	47	25	G	com. cpue	kg/boat/d	T	1
VacG	EE	2004	2021	18	0	G	trap	nr	T	1
VilG	EE	1971	2015	45	3	G	trap	t	T	1
AlbuG	EE	1949	2021	73	5	G	com. catch	kg	F	1
AlCPG	EE	1982	2021	40	5	G	com. cpue	kg/boat/d	F	1
EbroG	EE	1966	2021	56	3	G	com. catch	kg	T	1
GuadG	EE	1998	2007	10	0	G	sci. surv.	index	T	1
MiSpG	EE	1975	2021	47	0	G	com. catch	kg	T	1
NaloG	EE	1953	2021	69	0	G	com. catch	kg	T	1

code ea	ar	min	max	n+	n-	life stage	sampling type	unit	habitat	kept
OriaG	EE	2006	2021	16	0	G	sci. surv.	nr/m3	T	1
MiPoG EE		1974	2021	48	0	G	com. catch	kg	T	1
MiScG EE		2018	2021	4	0	G	sci. surv.	nr/h	T	0
MondG EE		1989	2021	33	28	G	sci. surv.	nr/h	T	0
TibeG	EE	1975	2006	32	0	G	com. catch	t	T	1
RingG	NS	1981	2021	41	0	G	sci. surv.	index	C	1
YFS1G NS		1975	1989	15	0	G	sci. surv.	index	MO	1
YFS2G NS		1991	2021	31	0	G	sci. surv.	index	MO	1
EmsG	NS	1946	2001	56	0	G	com. catch	kg	T	1
EmsHG NS		2011	2020	10	0	G	trap	nr	T	0
WaSG	NS	2011	2020	10	0	G	sci. surv.	nr	T	0
KlitG	NS	2008	2021	14	0	G	sci. surv.	nr/m2	F	1
NorsG	NS	2008	2021	14	0	G	sci. surv.	nr/m2	F	1
SleG	NS	2008	2021	14	0	G	sci. surv.	nr/m2	F	1
VidaG NS		1971	1990	20	0	G	com. catch	kg	T	1
KatwG NS		1977	2021	45	5	G	sci. surv.	index	T	1
LauwG NS		1976	2021	46	4	G	sci. surv.	nr/h	T	1
RhDOGNS		1938	2021	84	1	G	sci. surv.	index	T	1
RhIjG	NS	1969	2021	53	5	G	sci. surv.	index	T	1
StelG	NS	1971	2021	51	0	G	sci. surv.	index	T	1
VeAmG NS		2017	2021	5	0	G	trap	kg	T	0
YserG	NS	1964	2021	58	1	G	sci. surv.	kg	T	1
BeeG	NS	2006	2020	15	0	G	trap	nr	F	1
BroG	NS	2011	2021	11	0	G	trap	nr	F	1
FlaG	NS	2007	2020	14	0	G	trap	nr	F	1
ImsaGYNS		1975	2021	47	0	GY	trap	nr	F	1
ViskGY NS		1972	2020	49	0	GY	trap	kg	F	1

code ea	ar	min	max	n+	n-	life stage	sampling type	unit	habitat	kept
BrokGYNS		2011	2021	11	0	GY	trap	nr	T	1
EmsBGYNS		2011	2020	10	0	GY	trap	nr	F	0
FarpGYNS		2007	2020	14	0	GY	trap	nr	F	3
HHKGYNS		2010	2021	12	0	GY	trap	nr	T	0
HoSGY NS		2010	2010	1	0	GY	trap	nr	T	0
LangGYNS		2011	2021	11	0	GY	trap	nr	T	0
VerlGY NS		2010	2021	12	0	GY	trap	nr	T	1
WiFG	NS	2006	2020	15	0	GY	trap	nr	T	1
WisWGYNS		2004	2020	17	0	GY	trap	nr	F	1
HellGY NS		2010	2020	11	0	GY	sci. surv.	nr	T	1
ErneGYEE		1959	2021	63	2	GY	trap	kg	F	1
FealGY EE		1985	2021	37	14	GY	trap	kg	F	1
InagGY EE		1996	2021	26	4	GY	trap	kg	F	1
LiffGY EE		2011	2021	11	0	GY	trap	kg	F	1
ShaAGYEE		1977	2021	45	0	GY	trap	kg	F	1
BannGYEE		1933	2021	89	0	GY	trap	kg	F	1
BeeGY NS		2011	2020	10	0	GY	trap	nr	F	1
BroGY NS		2011	2021	11	0	GY	trap	nr	F	3
FlaGY NS		2007	2020	14	0	GY	trap	nr	F	3
GreyGYEE		2009	2020	12	0	GY	trap	nr	F	1
NmiGY NS		2009	2021	13	0	GY	trap	nr	F	1
OatGY EE		2011	2021	11	0	GY	trap	nr	F	0
StraGY EE		2011	2021	11	0	GY	trap	nr	F	1
BresGY EE		1994	2021	28	0	GY	trap	nr	F	1
SousGYEE		2013	2021	9	0	GY	trap	nr	F	0

code a	are	min	max	n+	n-	life stage	sampling type	unit	habitat	kept
DalaY	NS	1951	2020	70	3	Y	trap	kg	F	1
GotaY NS		1900	2020	121	12	Y	trap	kg	F	1
KavlY	NS	1992	2020	29	0	Y	trap	kg	F	1
LagaY NS		1925	2020	96	0	Y	trap	kg	F	1
MorrY NS		1960	2019	60	0	Y	trap	kg	F	1
MotaY NS		1942	2020	79	0	Y	trap	kg	F	1
RonnY NS		1946	2019	74	9	Y	trap	kg	F	1
DoElY NS		2003	2020	18	0	Y	trap	nr	F	1
WaSEY NS		2011	2020	10	0	Y	sci. surv.	nr	T	0
GudeY NS		1980	2020	41	0	Y	trap	kg	F	1
HartY	NS	1967	2020	54	1	Y	trap	kg	F	1
MeusY NS		1992	2020	29	3	Y	trap	nr	F	4
VeAmY NS		2017	2021	5	0	Y	trap	nr	T	0
ShaPY EE		1985	2021	37	0	Y	trap	kg	F	1
BeeY	NS	2011	2020	10	0	Y	trap	nr	F	1
BroY	NS	2011	2021	11	0	Y	trap	nr	F	1
FlaY	NS	2012	2020	9	0	Y	trap	nr	F	1
GirnY	NS	2008	2021	14	0	Y	trap	nr	F	1
MertY NS		2011	2021	11	0	Y	trap	nr	F	1
MillY	NS	2011	2021	11	0	Y	trap	nr	F	1
MolY	NS	2005	2021	17	0	Y	trap	nr	F	1
RodY	NS	2005	2020	16	0	Y	trap	nr	F	1
FreY	EE	1997	2020	24	0	Y	trap	nr	F	1
MiSpY EE		2019	2020	2	0	Y	trap	kg	T	0

Annex 9: Recruitment series: data not reported in 2020 and 2021

Table 1: Data in 2021 and 2020 having problems causing the data in the specific year to be excluded from the analysis. Codes for stages are G = glass eel, GY = glass eel + yellow eel, Y = yellow eel, Division = FAO marine division. Kept: 0 = missing, 1 = good quality, 2 = wgeel has modified the data, 3 = not used due to poor quality, 4 = data are used, but there are warnings on its quality.

Name	Stage	Country	Division	Year	Kept	Comment
BeeG	G	GB	27.4.c	2020	4	Provisional data as of June 2020 - comment updated 2021 and confirmed as a final count for 2020. Das value updated from 7446 to 8303. Monitoring impacted by COVID19.
BroG	G	GB	27.4.c	2020	4	Comment updated from "Provisional data as of June 2020" to "Final count for 2020". Monitoring impacted by COVID19.
FlaG	G	GB	27.4.c	2020	4	Value updated 2021 from 93 to 1136. Underestimate due to impact of Covid restrictions.
NaloG	G	ES	27.8.c	2020	4	In March (allowed from 20 to 27) only a few fishers were active because of the reduced price of glass eel due to the COVID-19.
SeEAG	G	GB	27.7.f	2020	4	.
SeHMG	G	GB	27.7.f	2020	4	Note that UK trade of glass eel has been impacted by COVID19- elver station closure within season will have impacted upon effort
ShiFG	G	GB	27.6.a	2020	0	Covid-19 prevented collection
VacG	G	FR	37.1.2	2020	4	due to COVID19, the glass eel monitoring was stop since mid-march then one month of monitoring was not made at the end of the migration period
VeAmG	G	BE	27.4.c	2020	3	Monitoring started on 3 March and stopped on 19 March. Since 19 March monitoring was not allowed any more due to Covid 19.
YserG	G	BE	27.4.c	2020	3	Monitoring started on 3 February and stopped on 5 March. On 6 March there was a malfunction at the sluice, after that water level was too high to perform the monitoring and on 19 March monitoring was not allowed any more due to Covid 19.
BroG	G	GB	27.4.c	2021	4	Provisional data up to July 2021. Trap flooded out May and June.
GiScG	G	FR	27.8.b	2021	4	Provisional data

SeEAG	G	GB	27.7.f	2021	3	This is a provisional figure, with approx. 60% of returns processed to date, Because of Brexit we shouldn't be using the 2021 series at all.
SeHMG	G	GB	27.7.f	2021	4	0.52 was restocked to the ghomeh rivers; remaining 0.06t exported to Northern Ireland within UK also for restocking
VacG	G	FR	37.1.2	2021	4	Provisional data

Table 1 continued.

Name	Stage	Country	Division	Year	Kept	Comment
VacG	G	FR	37.1.2	2021	4	Provisional data
BeeGY	GY	GB	27.4.c	2020	4	Comment and value updated in 2021. Das value from 758 to 3479 and comment from ”Provisional data as of June 2020. Two weeks at the start of the run- end of March/early April monitoring impacted by COVID19. Trap not monitored within this period” to ”Two weeks at the start of the run- end of March/early April monitoring impacted by COVID19- trap not monitored within this period”.
BroGY	GY	GB	27.4.c	2020	4	Value and comment updated 2021. ”Two weeks at the start of the run- end of March/early April monitoring impacted by COVID19. Trap not monitored within this period.” Das value changed from 3795 to 3794.
GreyGY	GY	GB	27.7.g	2020	4	Das value updated from to 2367 to 15098. Monitoring impacted by COVID19 monitoring did not start until 19th May 2020 so is a significant underestimate missing the early part of the migration period.
HHKGY	GY	DE	27.4.b	2020	0	No monitoring. Series ended in 2013
NmiGY	GY	GB	27.4.c	2020	4	Das value updated 2021 from 3464 to 4459 (0 G, 4280 GY and 179 Y). No monitoring April May due to Covid-19 restrictions.
OatGY	GY	GB	.	2020	4	Partial count for 2020 (until end of June 2020).
SousGY	GY	FR	27.8.b	2020	4	Provisional data.
BannGY	GY	GB	27.6.a	2021	4	As of 10th July Derek Evans; provisional; not affected by Covid-19.
BresGY	GY	FR	27.7.d	2021	4	Provisional data.
BroGY	GY	GB	27.4.c	2021	4	Provisional data up to July 2021. Trap flooded out May and June.
HHKGY	GY	DE	27.4.b	2021	0	No monitoring. Series ended in 2013.

NmiGY	GY	GB	27.4.c	2021	4	Provisional data up to end of July 2021. Combined glass eel, elvers and yellow eel count. (if separated 280 G, 5495 GY and 2019 Y).
OatGY	GY	GB	.	2021	4	Provisional data up to end of June.
SousGY	GY	FR	27.8.b	2021	4	Provisional data.
StraGY	GY	GB	27.7.a	2021	4	Provisional data; Individual glass eel counted; not affected by Covid-19.

Name	Stage	Country	Division	Year	Kept	Comment
StraGY	GY	GB	27.7.a	2021	4	Provisional data; Individual glass eel counted; not affected by Covid-19.
BeeY	Y	GB	27.4.c	2020	4	Comment and value updated in 2021. Das value from 7 to 297 and comment from 'Provisional data as of June 2020. Two weeks at the start of the run- end of March/early April monitoring impacted by COVID19- trap not monitored within this period' to 'Two weeks at the start of the run- end of March/early April monitoring impacted by COVID19- trap not monitored within this period'.
BroY	Y	GB	27.4.c	2020	4	Comment updated in 2021 from" Provisional data as of June 2020" to" Final count for 2020. Monitoring impacted by COVID19."
FlaY	Y	GB	27.4.c	2020	4	New series added. Underestimate due to impact of COVID19 restrictions.
GotaY	Y	SE	27.3.a	2020	0	This eel pass is not running.
MertY	Y	GB	27.4.c	2020	4	Provisional count as of July 2020.
MeusY	Y	BE	27.4.c	2020	3	In 2020 up to 17 August, 84 eels were caught (biomass 2352.2 g). Sizes of eels caught ranged from 12.4 cm to 67.3 cm (median 22.8 cm). Maximum CPUE was 40 individuals per day. This observed number of eels caught has been impacted by the COVID-19 pandemic and includes both wild and restocked eels. Updated 2021: effort (nr days) added.
MillY	Y	GB	27.4.c	2020	0	NC; No sampling due to COVID19 restrictions.
MiSpY	Y	ES	27.9.a	2020	4	Provisional data.
RodY	Y	GB	27.4.c	2020	0	NC; Not monitored due to COVID19.
VeAmY	Y	BE	27.4.c	2020	3	Monitoring started on 3 March and stopped on 19 March. Since 19 March monitoring was not allowed any more due to COVID19.
BroY	Y	GB	27.4.c	2021	3	Provisional data up to July 2021. Trap flooded out May and June.

GirnY	Y	GB	27.4.b	2021	4	NR; Updated during wgeeltemporarily removed from the analmysis in 2021 (only two series for yellow eel) PUT BACK das qal id TO 1 next year.
MertY	Y	GB	27.4.c	2021	4	Provisional data up to mid July.
MillY	Y	GB	27.4.c	2021	4	Provisional data up to mid July.
MolY	Y	GB	27.4.c	2021	3	Provisional data up to mid July
ShaPY	Y	IE	27.7.b	2021	4	Additional new traps captured a further 6.6 kg. Data up to 20/8/2021 - trap still operationaltemporarily removed from the analmysis in 2021 (only two series for yellow eel) PUT BACK das qal id TO 1 next year.

Annex 10: Recruitment, series reported in 2020, 2021 and with no reporting

Table 1: Series updated to 2021. Codes for stages are G = glass eel, GY = glass eel + yellow eel, Y = yellow eel, Area NS = North Sea, EE = Elsewhere Europe, Division = FAO marine division. Series ordered by stage and from North to South.

Site	Name	Coun.	Stage	Area	Division	Kept
RingG	Ringhals scientific survey	SE	G	NS	27.3.a	1
YFS2G	IYFS2 scientific estimate	SE	G	NS	27.3.a	1
KlitG	Klitmoeller A	DK	G	NS	27.3.a	1
NorsG	Nors A	DK	G	NS	27.3.a	1
SleG	Slette A	DK	G	NS	27.4.b	1
RhIjG	Rhine Ijmuiden scientific estimate	NL	G	NS	27.4.c	1
KatwG	Katwijk scientific estimate	NL	G	NS	27.4.c	1
StelG	Stellendam scientific estimate	NL	G	NS	27.4.c	1
LauwG	Lauwersoog scientific estimate	NL	G	NS	27.4.b	1
RhDOG	Rhine DenOever scientific estimate	NL	G	NS	27.4.c	1
YserG	IJzer Nieuwpoort scientific estimate	BE	G	NS	27.4.c	1
MaigG	River Maigue	IE	G	EE	27.7.b	1
BurrG	Burrishoole	IE	G	EE	27.7.b	1
BroG	Brownshill Glass <80mm	GB	G	NS	27.4.c	1
SeEAG	Severn EA commercial catch	GB	G	EE	27.7.f	1
VacG	Vaccares	FR	G	EE	37.1.2	1
GiScG	Gironde scientific estimate	FR	G	EE	27.8.b	1
OriaG	Oria scientific monitoring	ES	G	EE	27.8.b	1
MiSpG	Minho spanish part commercial catch	ES	G	EE	27.9.a	1
AlbuG	Albufera de Valencia commercial catch	ES	G	EE	37.1.1	1
NaloG	Nalon Estuary commercial catch	ES	G	EE	27.8.c	1
EbroG	Ebro delta lagoons	ES	G	EE	37.1.1	1
AlCPG	Albufera de Valencia commercial CPUE	ES	G	EE	37.1.1	1

Site	Name	Coun.	Stage	Area	Division	Kept
MiPoG	Minho portuguese part commercial catch	PT	G	EE	27.9.a	1
ImsaGY	Imsa Near Sandnes trapping all	NO	GY	NS	27.4.a	1
VerlGY	Verlath Pumping Station	DE	GY	NS	27.4.b	1
BrokGY	Broklandsau Pumping Station	DE	GY	NS	27.4.b	1
InagGY	River Inagh	IE	GY	EE	27.7.b	1
FealGY	River Feale	IE	GY	EE	27.7.j	1
LiffGY	Liffey	IE	GY	EE	27.7.a	1
ShaAGY	Shannon Ardnacrusha trapping all	IE	GY	EE	27.7.b	1
ErneGY	Erne Ballyshannon trapping all	IE	GY	EE	27.7.b	1
StraGY	Strangford	GB	GY	EE	27.7.a	1
NmiGY	New Mills Elvers/Yellow >80mm	GB	GY	NS	27.4.c	1
BannGY	Bann Coleraine trapping partial	GB	GY	EE	27.6.a	1
BresGY	Bresle	FR	GY	EE	27.7.d	1
ShaPY	Shannon Parteen trapping partial	IE	Y	EE	27.7.b	1
BroY	Brownshill Yellow >120mm	GB	Y	NS	27.4.c	1
MertY	Thames - Wandle - Merton Abbey Mills	GB	Y	NS	27.4.c	1
MillY	Thames - Hogsmill Middle Mill	GB	Y	NS	27.4.c	1
MolY	Thames-Molesey weir	GB	Y	NS	27.4.c	1
GirnY	Girnock Burn trap scientific estimate	GB	Y	NS	27.4.b	1
BeeG	Beeleigh Glass <80mm	GB	G	NS	27.4.c	
FlaG	Flatford GE <80mm	GB	G	NS	27.4.c	
ViskGY	Viskan trapping all	SE	GY	NS	27.3.a	
WiFG	Frische Grube	DE	GY	NS	27.3.b, c	
WisWGY	Wallensteingraben	DE	GY	NS	27.3.b, c	
HellGY	Hellebaekken	DK	GY	NS	27.3.a	
BeeGY	Beeleigh Elver 81-120mm	GB	GY	NS	27.4.c	

Site	Name	Coun.	Stage	Area	Division	Kept
GreyGY	Greylake Elvers/Yellow (yellow>120mm with 10-15% <120mm) mainly elvers	GB	GY	EE	27.7.g	
KavlY	Kavlingean trapping all	SE	Y	NS	27.3.b, c	
LagaY	Lagan trapping all	SE	Y	NS	27.3.a	
DalaY	Dalalven trapping all	SE	Y	NS	27.3.d	
MotaY	Motala Strom trapping all	SE	Y	NS	27.3.d	
GotaY	Gota Alv trapping all	SE	Y	NS	27.3.a	
DoElY	Dove Elde eel ladder	DE	Y	NS	27.4.b	
HartY	Harte trapping all	DK	Y	NS	27.3.b, c	
GudeY	Guden AAc Tange trapping all	DK	Y	NS	27.3.a	
BeeY	Beeleigh Yellow 121mm+	GB	Y	NS	27.4.c	
RodY	Thames - Roding	GB	Y	NS	27.4.c	
FlaY	Flatford Yellow eel >120mm	GB	Y	NS	27.4.c	
FreY	Fremur	FR	Y	EE	27.7.e	

Table 2: Series stopped or not updated to 2020 see table ?? for codes. Series ordered by last year

Site	Name	Coun.	Stage	Area	Division	Last Year
YFS1G	IYFS scientific estimate	SE	G	NS	27.3.a	1989
VidaG	Vidaa Hoejer sluice commercial catch	DK	G	NS	27.4.b	1990
EmsG	Ems Herbrum commercial catch	DE	G	NS	27.4.b	2001
TibeG	Tiber Fiumara Grande commercial catch	IT	G	EE	37.1.3	2006
GuadG	Guadalquivir scientific monitoring	ES	G	EE	27.9.a	2007
AdCPG	Adour Estuary (CPUE) commercial CPUE	FR	G	EE	27.8.b	2008
AdTCG	Adour Estuary (catch) commercial catch	FR	G	EE	27.8.b	2008
GiCPG	Gironde Estuary (CPUE) commercial CPUE	FR	G	EE	27.8.b	2008

Site	Name	Coun.	Stage	Area	Division	Last Year
GiTCG	Gironde Estuary (catch) commercial catch	FR	G	EE	27.8.b	2008
LoiG	Loire Estuary commercial catch	FR	G	EE	27.8.a	2008
SevNG	Sevres Niortaise Estuary commercial CPUE	FR	G	EE	27.8.a	2008
VilG	Vilaine Arzal trapping all	FR	G	EE	27.8.a	2015
MorrY	Morrumsan trapping all	SE	Y	NS	27.3.d	2019
RonnY	Ronne A trapping all	SE	Y	NS	27.3.a	2019

Annex 11: Recruitment series in the Mediterranean

ToR E: Identify and address Mediterranean-specific issues on European eel → *Recruitment*

Premise

Recruitment in the Mediterranean has been dealt with in a number of documents and publications along the last decades, mainly addressing glass eel behaviour and local dynamics of recruitment. "Historical" literature, even if often anecdotal (description of the "cordon" ascending lagoon tidal channels, sporadic records of catches, biological features of glass eels), documents a past abundance of recruitment in specific sites around the Mediterranean. Glass eel ascent provided the natural process of recruitment to coastal lagoons, and sporadic or erratic fisheries provided seed for lagoon stocking to enhance local production (extensive aquaculture), intensive aquaculture or other purposes (including, in the past, direct consumption and export). Organized official authorized fisheries on a continuative basis in specific sites were therefore scarce, and this has hampered the possibility to obtain time-serieslong time-series and to evaluate the time-trend of recruitment specifically for the Mediterranean region.

Specific studies from the end of the 1990s up to recent years have focused on understanding the role of local factors in different habitats (coastal lagoons, river estuaries) on glass eel migration, its dynamics and colonization, but provide scarce or sporadic information about abundance. These studies have been revised and used to describe temporal patterns of recruitment in the Mediterranean (ICES 2020 -WKEEL Migration). The migration patterns are thought to be more complex than in Atlantic estuaries, probably because of the different role of local drivers on migration. Besides different weights of the influence of the tide in driving migration by Selective Tidal Stream Transport with respect to Atlantic estuaries, because of reduced tidal excursion, other factors probably play a more prominent role (attraction due to outflow of river or channel, temperature differences between sea and inland water body, lagoon connectivity with the sea). These differences are also reflected in the different fishing modalities used in the Mediterranean with respect to large Atlantic estuaries.

Present state of data available to the WGEEL

Based on the information above, up to three time-series on an ongoing basis of catches from glass eel fisheries and a fourth from a specific monitoring are now available for the Mediterranean, and are already used by the WGEEL.

Two series are from Spain; the ES Albufera de Valencia time-series, label AlbuG , 73 years long (1949-2021), fishery(com. catch, kg), habitat classified as Freshwater (F), updated to the year 2021, and the ES Ebro, label EbroG, 56 years long, (1966-2021), fishery (com. catch, kg), habitat classified as Transitional (T) as it refers to Ebro Delta, updated to the year 2021. A third series is from an ongoing monitoring in France, FR Vaccares, label VacG, 18 years long (2004-2021), trap (number), habitat classified as Transitional (T) as it refers to the Camargue lagoons, in the La Fourcade station. Also, this series is updated to the year 2021.

In contrast, a series from Italy from the local glass fishery at the Tiber estuary has been discontinued since 2006 because of the closure of the fishery, yields were no longer sustainable for the fishers, with too small and discontinuous catches. These series, IT Tiber, label TibeG, 32 ears long (1975-2006), fishery (com. catch, kg), habitat classified as Transitional (T) estuary, has been kept, albeit discontinued. These four series up to now have always been included in WGEEL recruitment assessment, merged with the series of Elsewhere Europe (EE), and therefore no specific information on recruitment trends specifically for the Mediterranean are available.

So far, no yellow eel time-series have been considered informative of recruitment for the Mediterranean, and was therefore never used by WGEEL. This issue might be explored by revising available time-series in specific sites across the Region.

For recruitment there is a need to assess absolute recruitment at specific sites, as well as for the whole Mediterranean region and in the different Mediterranean zones (Western, Eastern, Southern) would be necessary, but the availability of time-series only for the Western area seems a limitation. Some efforts have been made applying the GEREM model using available Mediterranean time-series, along with time-series form the North Sea and from the rest of Europe (Drouineau et al. 2016, Bornarel et al., 2018). In Drouineau et al., 2016, which developed this model to estimate annual absolute glass eel recruitment at different spatial scales in France, the Vaccares 11-years time-serieslong time-series was used for estimates relative to the French EMU Rhone Mediterranean-Corsica along with the other Atlantic French EMUs. Bornarel et al. (2018) extended the use of the model to estimate a recruitment index across the eel distribution range, and the 4 Mediterranean time-series were used for application to the ICES ecoregion corresponding to the Western Mediterranean Sea. Results showed a decrease of recruitment slightly anticipated with respect to other zones, and not completely consistent with the recruitment index trend evaluated for Elsewhere in Europe in the decades 1990-2010. The reduced number of series used for estimation, and the scarce data for the period prior to 1980, suggested caution in interpretation of results, and evidences the need to apply this or other models for recruitment to a larger number of time-series, possibly longer. Therefore, a further quality check of the available time-trends should be made, to evidence if catch data might be biased, for instance by changes in fishing effort.

Further insights might be attained by data from monitoring schemes at specific sites. Following the concerns for the eel stock and the evidence of recruitment decline, ascertained also for the Mediterranean, at the end of the 1990s, specific monitoring for recruitment began, and some followed the implementation of Eel Management Plans for the Eel Regulation. The monitoring scheme in Camargue (Vaccares lagoon) mentioned above, based on a trap on a fish-pass on the sea-channel of the lagoon, implemented on a continuative basis since 2004, many other glass-eel specific monitoring for recruitment have been set up in many sites in the Mediterranean. At present, glass eel monitoring in 12 additional sites is ongoing in Italy (IT CR). Some monitoring has been resumed since 2013 at the Tiber estuary, the same site where the glass eel fishery occurred in the past. Other sites are tidal channels of lagoons, and some other river estuaries. In France the monitoring in the Camargue lagoons has been implemented with additional stations. In Spain within the SUDOANG project, an attempt has been made to study recruitment in two estuaries in the Spanish Mediterranean area (the estuary of the Ter River and the estuary of the Guadiaro River). In the Ter River at the mouth of the estuary monthly sampling were carried out at new moon from November to April 2019. The sampling method was based on deployment of fyke nets placed on the shore for six hours from sunset, checking the nets every two hours. A similar sampling methodology was used for monitoring the Guadiaro River. Due to the scarcity of catches in the first month (< 10 individuals), the monitoring in this river was intensified with a larger number of nets and exploring other stations, but catches were always extremely low (< 5 indiv.), so the recruitment study was suspended for this river within the SUDOANG programme. Similar sampling schemes are at the moment in place in the monitoring in Italy. Results are still to be evaluated on a comparative basis, but preliminary observations confirm what was highlighted in SUDOANG, that not all sites give good results, and that sampling schemes have to take into account the hydro-morphological features of the sites and local environmental conditions.

Conclusions

This brief overview allows to outline some specific needs for increasing knowledge of recruitment in the Mediterranean, to better understand long term dynamics over the years, in the short term (intra-annual) and any dynamics at the spatial scale.

1) There is a need to perform a separate evaluation at the regional level for Mediterranean recruitment trends, working further on the existing time-series and eventually trying to integrate with additional series. This should also entail a further quality-check of the available time-trends, and eventually the identification of suitable yellow eel time-series possibly informative of recruitment in specific sites.

2) There is a need to perform a comparative evaluation of recruitment trends in the Mediterranean against the rest of the distribution area, eventually with a comparison against some specific time series used by WGEEL, choice being based on similar latitudes or similar habitats, and against the rest of Europe and the North Sea.

3) There is a need to obtain assessment of absolute recruitment at specific sites, at the zone level across the Mediterranean and for the whole region. This could rely on a further use of the GEREM model, on revised and implemented datasets, following work already done by WGEEL and in the SUDOANG project.

4) There is a need to progress in the monitoring implementation in the Mediterranean. This should rely on a comprehensive analysis of data available from the present networking of monitoring sites across the Mediterranean, implemented by some countries also based on the needs of EU Regulations (Eel Regulation, EU-MAP) and national frameworks.

5) There is a need to evaluate the suitability of single sites for recruitment monitoring, and a need of protocols that, although standardized, should consider specificity of sites, based on their habitat typology and environmental settings.

Perspectives

Many of the points mentioned above are already included in the goals of the ongoing GFCM Eel Project, which within the different work-packages includes a specific task addressing recruitment. The ongoing work has already allowed to achieve a revision of the recruitment time series and a quality check, and foresees work on the monitoring data, by a comprehensive analysis at the spatial scale and eventually of short-term time dynamics. A collaboration with the WGEEL could be envisaged to work on the assessment of absolute recruitment, integrating work already done and strengthening collaborations.

The GFCM eel project also envisages to give guidelines for the establishment of long-term monitoring for the eel stock, also including recruitment monitoring. Within this specific work-package of the project, a detailed analysis of monitoring schemes and methodologies for glass eel monitoring is ongoing, and will provide a possible framework for future monitoring. This will imply a commitment of all Countries at different levels, both administrative and scientific, but will be an important tool for the future management and recovery of the eel stock.

Annex 12: Additional graphs and analyses for recruitment

Additional figures (log scale)

Here the same figures as in the main text (Figures 3.4 and 3.5) are provided but on a log scale.

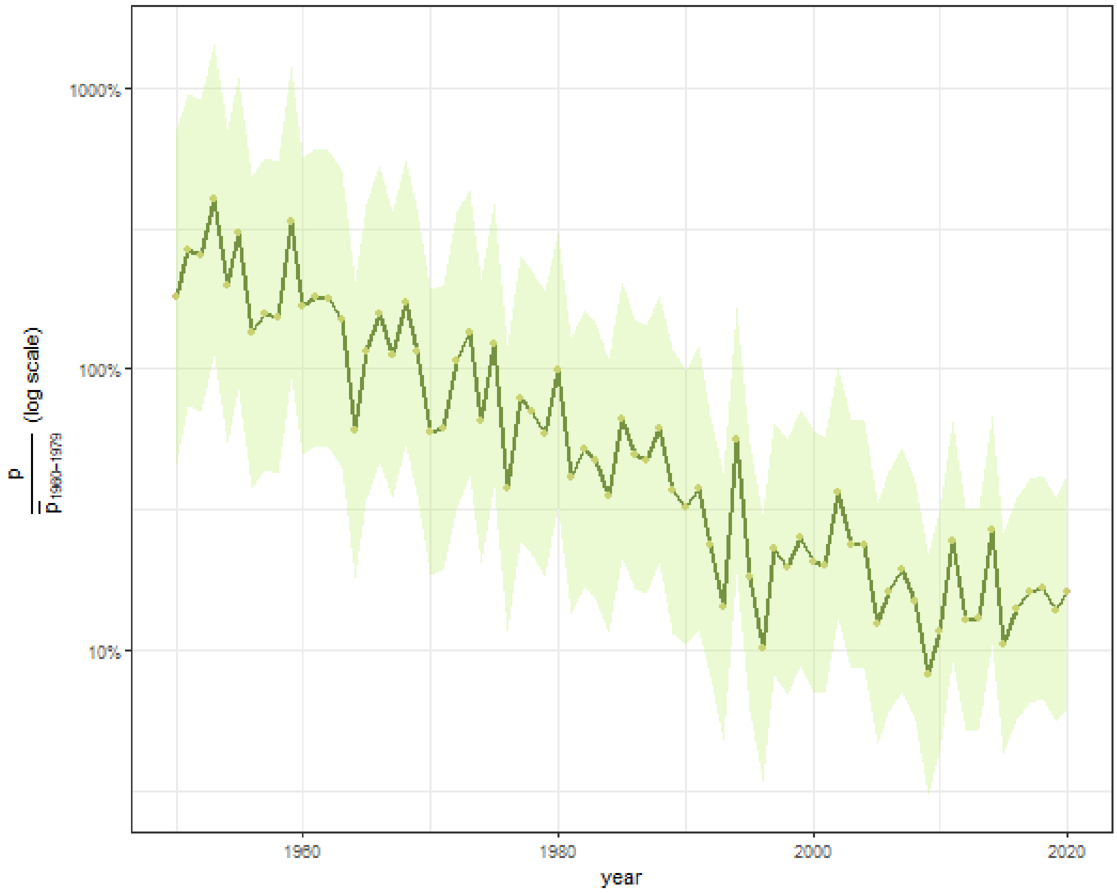

Figure 1: Same as figure 3.5 but on a log scale.

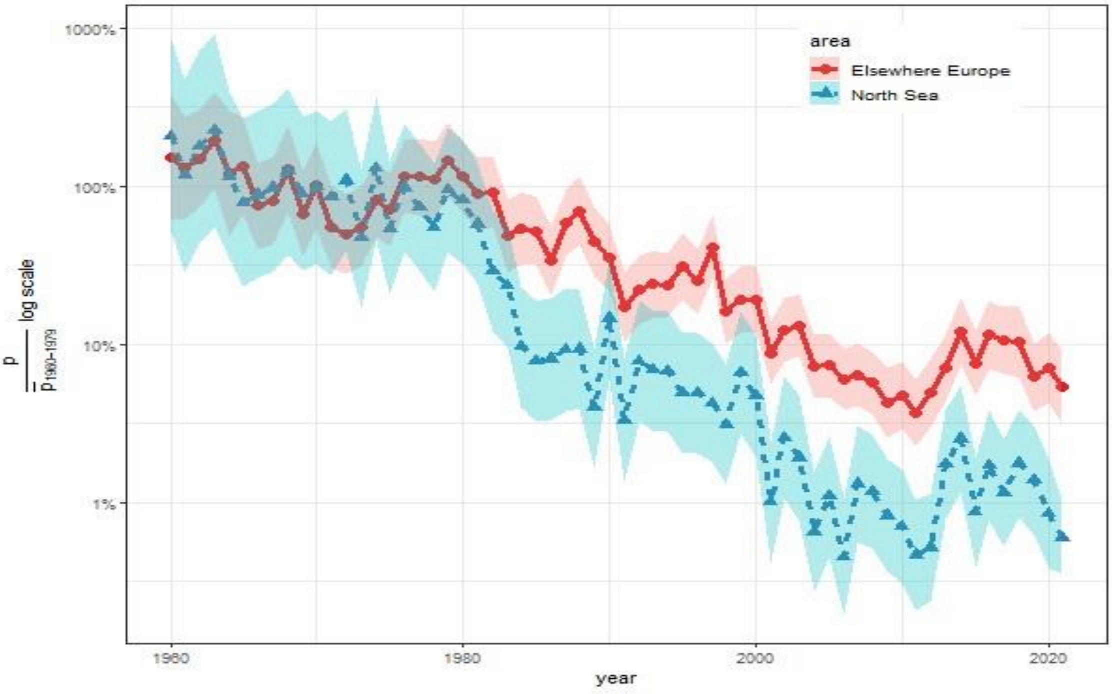

Figure 2: Same as figure 3.4 but on a log scale.

Reference to older period

Series are currently scaled to the years 1960 - 1979 (included limits) predictions from the GLM. During WKFEA the question was raised as to why the reference was not extended farther back in time. Using 1950 as a historical limit instead of 1960 was considered in the following analysis.

Concerning the number of series, within years 1960 – 1970 20 glass eel series, 5 glass eel and young yellow eel series and 16 yellow eel series are available. Only 7 glass eel or glass and young eel series are available in the 1950-1960, and the number of yellow eel series drops from 16 to 5.

For yellow eel older recruits, changing the reference period from 1960-1979 to 1950 – 1979 results in lowering the recruitment indices in the recent years (all points lowered, current point 17% in 2020 lowered to 13%). This is because the trend in recruitment reported from yellow eel series have diminished in the 1950's so the historical reference becomes higher when the reference is extended back in time.

For glass eel recruitment indices, the reverse effect is obtained. From 1950 to 1960 the recruitment indices provided by glass eel series are lower. So, including a 1950s reference period would increase the recent recruitment index (2021 EE increases from 5.4 % to 6.6%, NS increases from 0.6% to 0.7%).

There is however a good reason to think that the lower numbers reported during the 1950's are the consequence of a lower fishing effort or efficiency of the fisheries: 4 series out of 6 in Elsewhere Europe are total catch in a context of increasing glass eel price during the 1950's. The numbers to derive the indices on are too low and for the North Sea there is just on series available.

To conclude with, the effect of moving the baseline back to the 1950's would have different effect on the yellow and glass eel series. The current reason for not putting it in the 1950's is that the number of series available at that time is too low. This change wouldn't make any change in the perceived level of recruitment.

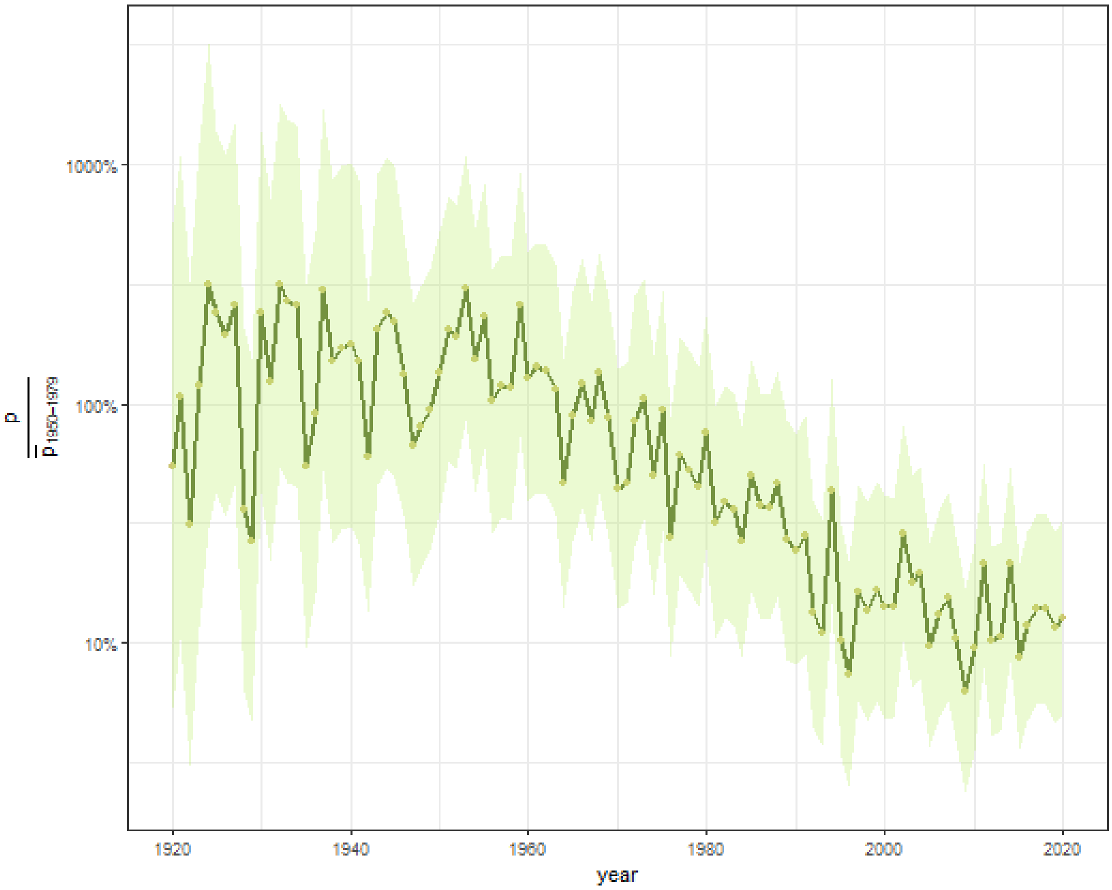

Figure 3. GLM predictions of eel recruitment. Same as figure 1 but with a reference period of 1950-1979.

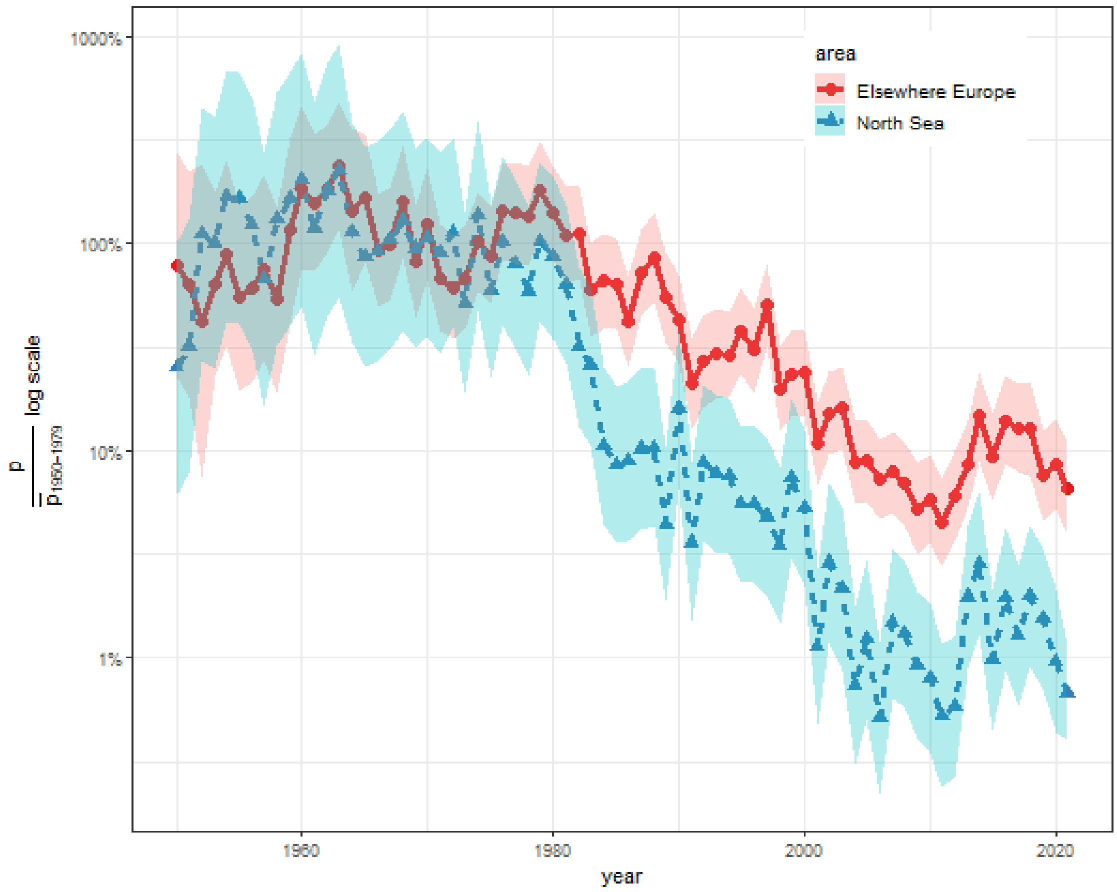

Figure 4. Recruitment trend to the North Sea and Elsewhere Europe. Same as figure 2 but with a reference period of 1950-1979.

Raw data graphs with different historical scaling

The trend given can simply be expressed as the geometric mean of all time-series. The scaling can be done either on historic data (the 1979-1994 average provided by WGEEL from 2002 to 2006) given as it consistent with the trend.

When a scaling is performed on the 1979-1994 average of each time-series, then 32 time-series without data during that period are excluded from the analysis. The time-series left out are : BeeG, BeeGY, BeeY, BresGY, BroG, BrokGY, BroY,DoElY, FlaG, FlaY, FreY, GirnY, GreyGY, GuadG, HellGY, InagGY, KlitG, LiffGY, MaigG, MertY, MillY,MolY, NmiGY, NorsG, OriaG, RodY, SleG, StraGY, VacG, VerlGY, WiFG, WisWGY

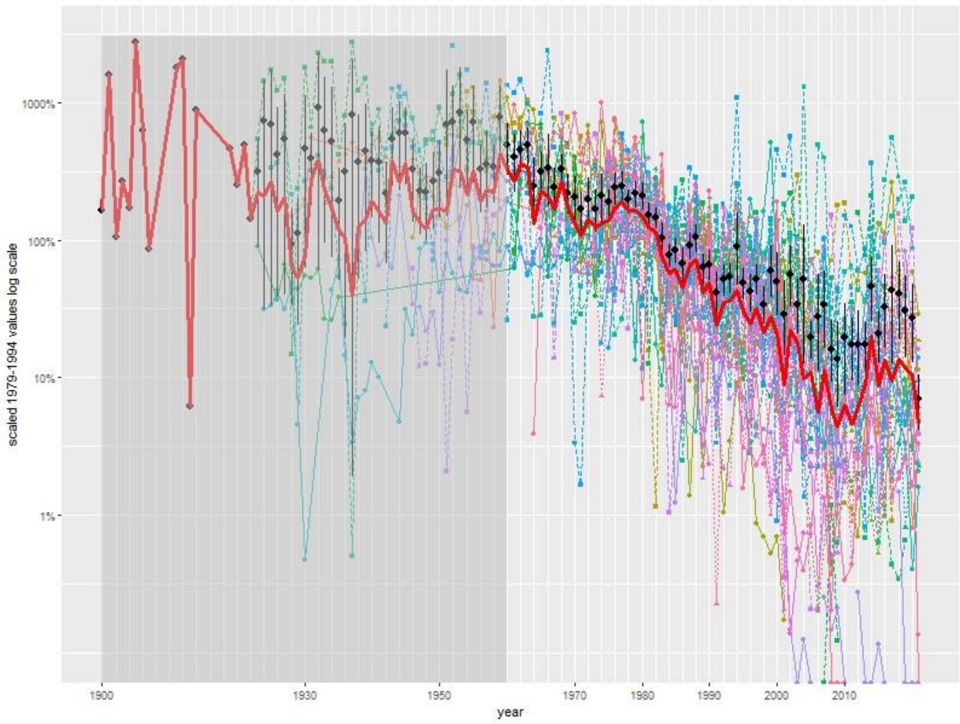

Figure 5: Time-series of glass eel and yellow eel recruitment in European rivers with time-series having data for the 1979-1994 period (44 sites). Each time-series has been scaled to its 1979-1994 average. Note the logarithmic scale on the y-axis. The mean values and their bootstrap confidence interval (95%) are represented as black dots and bars. Geometric means are presented in red.

The same figure is given below, but the "range" of all series is given instead of individual series as a shading, and glass eel (glass eel + glass and young yellow eel series) and yellow (older yellow eel series) are shown as two separate graphs. It should be noted that the most recent year is to be considered with particular caution for glass eel and not at all for yellow eel.

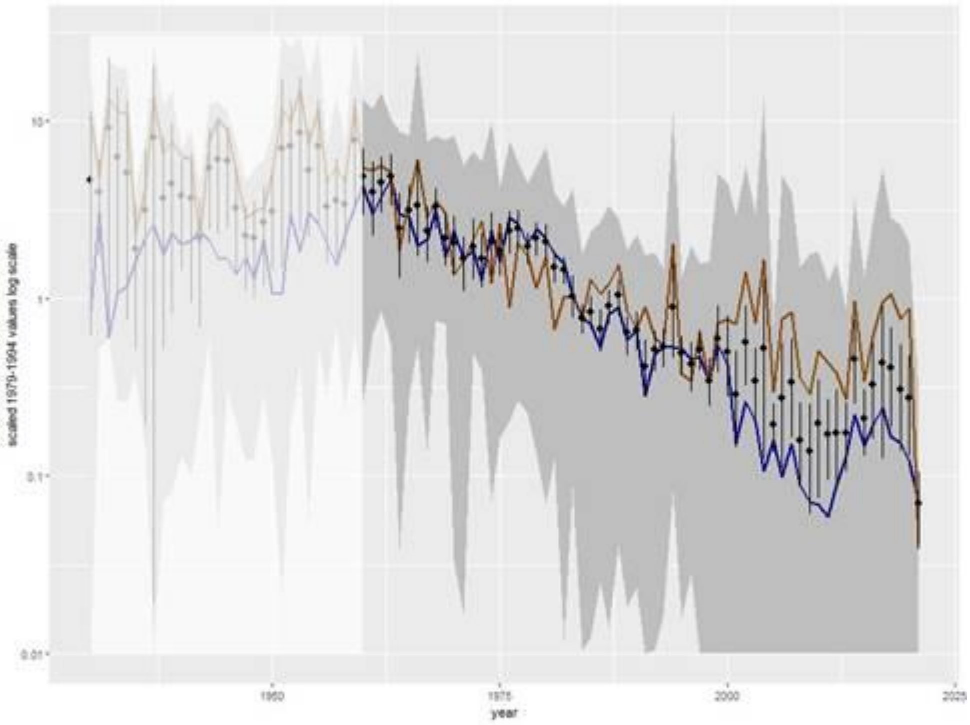

Figure 6: Time-series of glass eel and yellow eel recruitment in Europe with 44 time-series out of the 97 available to the working group. Each time-series has been scaled to its 1979-1994 average. The mean values of combined yellow and glass eel time-series and their bootstrap confidence interval (95%) are represented as black dots and bars. The brown line represents the mean value for yellow eel, while the blue line represents the mean value for glass eel time-series. The range of these time-series is indicated by a grey shade. Note that individual time-series from Figure 2.3 were removed to make the mean value clearer. Note also the logarithmic scale on the y-axis.

The scaling can also be done on more recent years (2000-2009) prior to the implementation of the eel management plan. This excludes series with no data during this period.

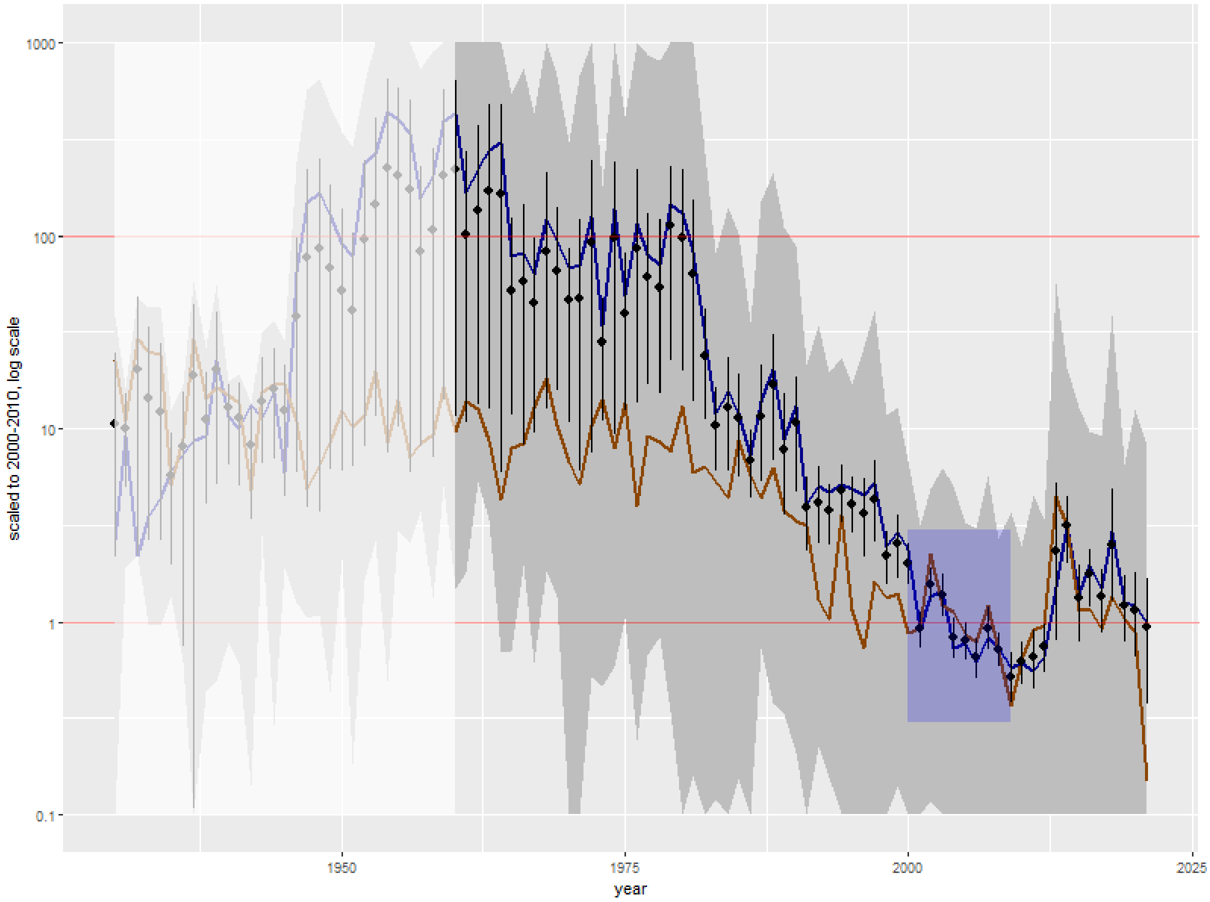

Figure 7: Time-series of glass eel and yellow eel recruitment in Europe with 62 time-series out of the 97 available to the working group. Each time-series has been scaled to its 2000-2009 average (square in blue). The mean values of combined yellow and glass eel time-series and their bootstrap confidence interval (95%) are represented as black dots and bars. The brown line represents the mean value for yellow eel, the blue line represents the mean value for glass eel time-series. The range of these time-series is indicated by a grey shade. Note that individual time-series were removed to make the mean value more clear. Note also the logarithmic scale on the y-axis.

Consequence of including new series in the analysis

The data call and annual updataing of the database allows the inclusion include of new series of recruitment data as they become available. New series are only integrated in the analysis when 10 years of data are available in the database (see main text, rules for introducing new series). A substantial number of new series have been added over time to the glass eel (21 series) and yellow eel recruitment series (7 series). Inevitably, several series have been stopped It is therefore important to collect data at new sites and integrate those in the analysis of recruitment. However, it is important to check that this inclusion might influence the overall trends. An analysis was carried out in 2021 to check the effect of including new series on the recruitment trend, and this is reported here.

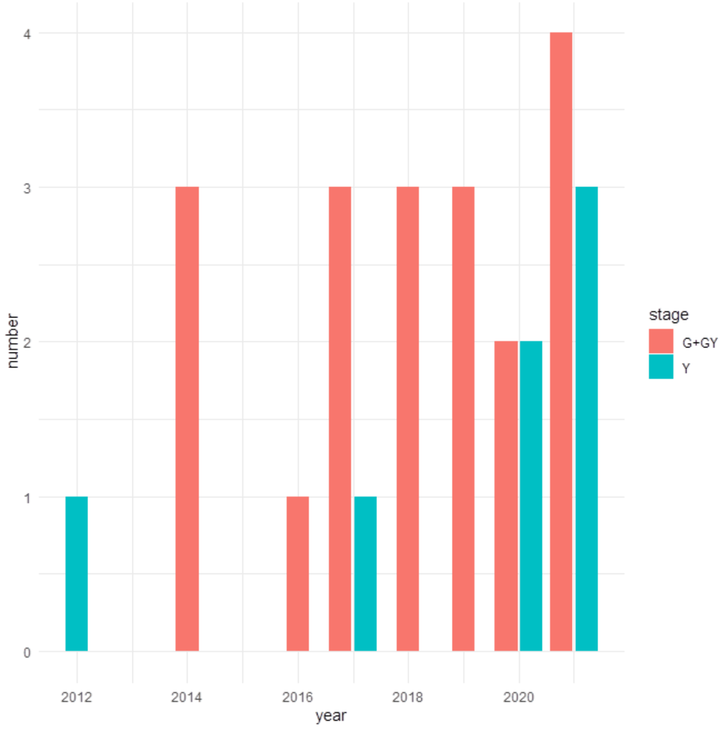

Figure 8: Number of series introduced after 2010.

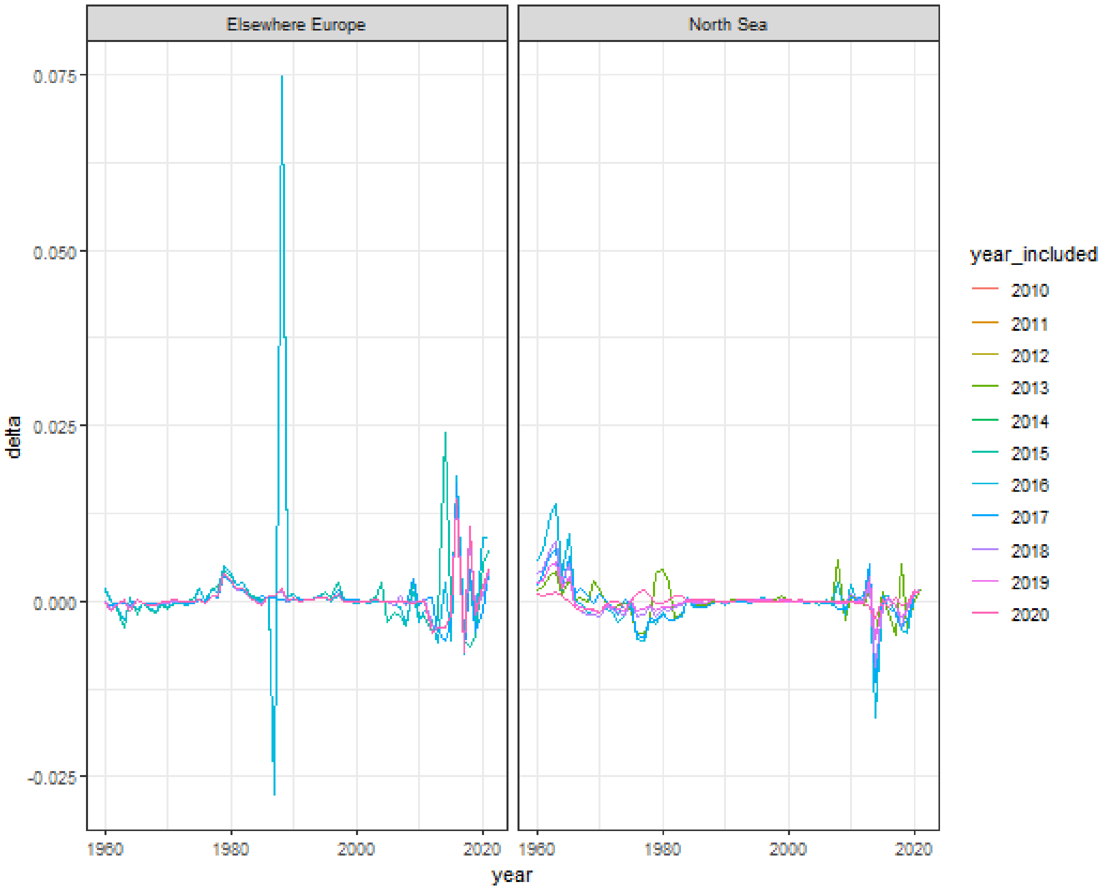

Figure 9 Variation in the recruitment indices over years expressed as the 2021 trend minus modified trend computed without series introduced after a year of inclusion. Same as previous figure but relative number. The numbers presented are percentages of recruitment,

The wgeel has introduced a new field in its database recording on which year new series were included for analysis. From this field, recruitment trends have been computed by removing series that have been added over time. For instance, the trend shown as "year included" =2012 shows the effect of removing all series introduced after 2012 in the analysis. The results are shown both as absolute trend comparison (figure 10) and the difference with the 2021 trends (figure 11).

Several conclusions can be drawn from the analysis of the trends obtained by this method. First it can be stated that there is no real change in the perceived state of recruitment level. All reference historical values remain unchanged, and the drop-in recruitment reflects the drop in historical series. There is however a change in the recruitment absolute value perceived for specific years. Variations as large as 2.5 % can be explained by introducing new series for some years, though the change in the recruitment peak from 14 % (ICES, 2018) to 12 % (current report) is explained by corrections made in three series where actual numbers were corrected. Overall, correcting some historical values, or dropping some historical series to avoid duplicates (ICES, 2018) may have a larger influence on the overall recruitment indices than the introduction of new series.

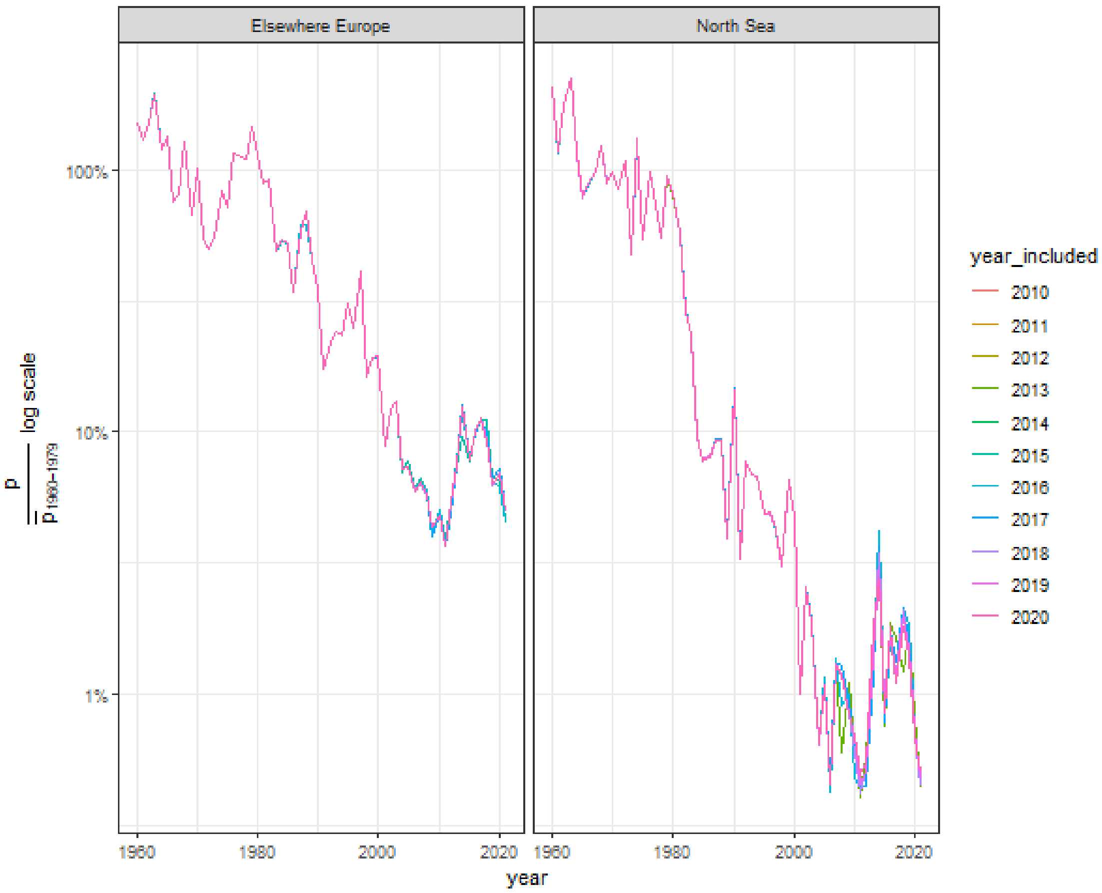

Figure 10. Variation in recruitment indices as more series were added over years. Value expressed as absolute recruitment trend.

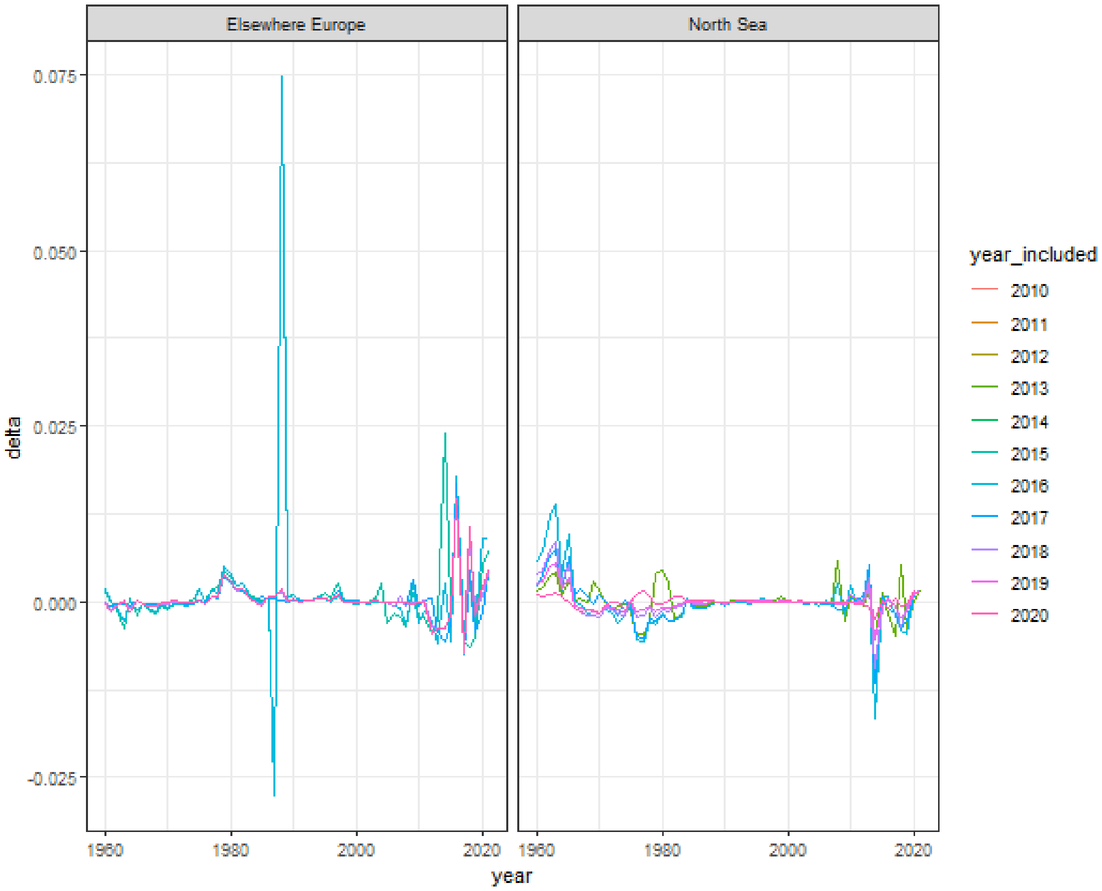

Figure 11 Variation in the recruitment indices over years expressed as the 2021 trend minus modified trend computed without series introduced after a year of inclusion. Same as previous figure but relative number. The numbers presented are percentages of recruitment,

Introducing new series does explain most of the change in series over time. For instance introducing new series in 2014 gives a positive delta value (see figure 11) for 2014 and has in practice subtracted 2.5% from the 2014 peak. This value was 14.6% so this value would been lowered to 12 % by introducing new series. However, at that time, the 2015 series were already introduced. In fact, a specific check on the series indicates that three series were strongly corrected downwards for that year, and this explains why now the peak of 2014 appears lower than around 2018

Annex 13: Additional Information on Yellow and Silver eel Time Series

Abundance series

Table 1. Short description of the series of European eel yellow standing stock, where Habitat: C = coastal water, F = freshwater, MO = marine water (open sea), T = transitional water with lower salinity (according to WFD); gear: 202 = beach-seines, 226 = fyke nets, 230 = traps, 234 = longlines; 242 = electric fishing; sampling type: 1 = commercial catch, 3 = scientific estimate, 4 = trapping all, 5 = trapping partial; quality id: 0 = missing data, 1 = good quality data, 3 = bad quality data, 4 = data used but with warnings; Unit for the data collected: kg = kilograms, nr = number; index = calculated value following a specified protocol, nr/m2 = number per square metre, nr/haul= number per haul, nr/net/d = number per net per day); Dist_sea is distance to sea (m); Restocking: FALSE = no restocking impacts, TRUE = there are potential restocking impacts; First year and Last year indicate the first year and last year in the time-series; n+ and n- columns indicate the number of years with values (n+) and the number of years when there are missing data (n-) within the series.

Series	EMU	Country	Habitat	Samp_typ	Unit	Dist_sea	Restocking	First year	Last year	n+	n-
DoFpY	DE_Elbe	DE	F	5	nr	224	TRUE	2003	2020	18	1
VVeY	DK_Inla	DK	F	3	nr/m2	NA	FALSE	2009	2021	13	0
NalY	ES_Astu	ES	F	3	nr/m2	NA	FALSE	2011	2020	10	0
OriY	ES_Basq	ES	F	3	nr/m2	NA	FALSE	2004	2020	17	0
BidY	ES_Nava	ES	F	3	nr/m2	28.777	FALSE	2010	2020	11	0
AlCY	ES_Vale	ES	T	1	kg	0	FALSE	1951	2021	66	0
KuloY	FI_Finl	FI	F	5	nr	120	TRUE	2017	2019	3	0
VesiY	FI_Finl	FI	F	5	nr	170	TRUE	2017	2020	4	0
AdoY	FR_Adou	FR	F	3	index	78.8	FALSE	2010	2020	11	0
SouY	FR_Adou	FR	F	3	index	10.5	FALSE	2010	2020	11	0

Series	EMU	Country	Habitat	Samp_typ	Unit	Dist_sea	Restocking	First year	Last year	n+	n-
AaY	FR_Arto	FR	F	3	index	33	FALSE	2010	2020	9	0
AutY	FR_Arto	FR	F	3	index	51.9	FALSE	2010	2019	8	0
EscY	FR_Arto	FR	F	3	index	204.4	FALSE	2011	2020	7	0
SomY	FR_Arto	FR	F	3	index	66.3	FALSE	2010	2020	11	0
FremY	FR_Bret	FR	F	3	nr/m2	13.8	FALSE	1995	2020	26	0
VilY	FR_Bret	FR	F	3	nr/m2	12	FALSE	1998	2020	18	0
GarY	FR_Garo	FR	F	3	nr/m2	167.4	FALSE	2010	2018	9	0
SeNY	FR_Loir	FR	F	3	index	68.2	FALSE	2002	2020	19	0
BreY	FR_Sein	FR	F	3	index	29.3	FALSE	2012	2020	9	0
DivY	FR_Sein	FR	F	3	index	46.4	FALSE	2012	2020	7	0
DouY	FR_Sein	FR	F	3	index	43.6	FALSE	2011	2020	7	0
OrnY	FR_Sein	FR	F	3	index	61.8	TRUE	2010	2020	11	0
SciY	FR_Sein	FR	F	3	index	15.7	FALSE	2010	2020	10	0
SeiY	FR_Sein	FR	F	3	index	157.8	TRUE	2010	2020	11	0
TouY	FR_Sein	FR	F	3	index	37.2	FALSE	2011	2020	7	0
VirY	FR_Sein	FR	F	3	index	65.2	FALSE	2010	2020	11	0
YerY	FR_Sein	FR	F	3	index	14.4	FALSE	2010	2020	10	0

Series	EMU	Country	Habitat	Samp_typ	Unit	Dist_sea	Restocking	First year	Last year	n+	n-
ChBY	GB_Angl	GB	F	3	nr/m2	NA	FALSE	1983	2020	33	0
GrOY	GB_Angl	GB	F	NA	nr/m2	NA	FALSE	1986	2020	35	1
NenY	GB_Angl	GB	F	NA	nr/m2	NA	FALSE	1979	2020	32	5
SuSY	GB_Angl	GB	F	NA	nr/m2	NA	FALSE	1980	2020	33	1
WelY	GB_Angl	GB	F	NA	nr/m2	NA	FALSE	1982	2020	32	1
WenY	GB_Angl	GB	F	NA	nr/m2	NA	FALSE	1986	2020	28	0
WitY	GB_Angl	GB	F	NA	nr/m2	NA	FALSE	1985	2020	34	1
DeeY	GB_Dee	GB	F	3	nr/m2	NA	FALSE	2002	2020	13	1
HumY	GB_Humb	GB	F	3	nr/m2	NA	FALSE	1981	2020	40	1
KilY	GB_NorE	GB	F	3	nr	3	FALSE	2011	2020	10	9
LagY	GB_NorE	GB	F	3	nr	20	FALSE	2011	2020	10	9
CoqY	GB_Nort	GB	F	3	nr/m2	NA	FALSE	1993	2020	24	2
WerY	GB_Nort	GB	F	3	nr/m2	NA	FALSE	1995	2020	22	1
BelY	GB_NorW	GB	F	3	nr/m2	NA	FALSE	1992	2020	13	4
DerY	GB_NorW	GB	F	3	nr/m2	NA	FALSE	1991	2020	22	1
EllY	GB_NorW	GB	F	3	nr/m2	NA	FALSE	2005	2020	14	6
MerY	GB_NorW	GB	F	3	nr/m2	NA	FALSE	1994	2020	21	1

Series	EMU	Country	Habitat	Samp_typ	Unit	Dist_sea	Restocking	First year	Last year	n+	n-
RibY	GB_NorW	GB	F	3	nr/m2	NA	FALSE	1984	2020	35	1
WevY	GB_NorW	GB	F	3	nr/m2	NA	FALSE	1994	2020	23	4
BadY	GB_Scot	GB	F	3	nr/m2	122.7	FALSE	2009	2020	12	0
GirY	GB_Scot	GB	F	3	nr/m2	3.2	FALSE	2009	2020	12	0
ShiY	GB_Scot	GB	F	3	nr/m2	89.1	FALSE	2010	2020	11	0
SevY	GB_Seve	GB	F	3	nr/m2	NA	FALSE	1976	2020	44	0
UskY	GB_Seve	GB	F	3	nr/m2	NA	FALSE	2010	2020	11	1
WyeY	GB_Seve	GB	F	3	nr/m2	NA	FALSE	1985	2020	33	1
BoEY	GB_Solw	GB	F	3	nr/m2	NA	FALSE	1985	2020	22	1
EdeY	GB_Solw	GB	F	3	nr/m2	NA	FALSE	1975	2020	24	1
TweY	GB_Solw	GB	F	3	nr/m2	NA	FALSE	2009	2020	11	7
ItcY	GB_SouE	GB	F	3	nr/m2	NA	FALSE	2001	2020	20	2
OusY	GB_SouE	GB	F	3	nr/m2	NA	FALSE	1998	2020	21	1
TesY	GB_SouE	GB	F	3	nr/m2	NA	FALSE	2001	2020	20	0
DoSY	GB_SouW	GB	F	3	nr/m2	NA	FALSE	2001	2020	20	1
ExeY	GB_SouW	GB	F	3	nr/m2	NA	FALSE	1995	2020	25	1
FowY	GB_SouW	GB	F	3	nr/m2	NA	FALSE	1977	2020	34	1

Series	EMU	Country	Habitat	Samp_typ	Unit	Dist_sea	Restocking	First year	Last year	n+	n-
FroY	GB_SouW	GB	F	3	nr/m2	NA	FALSE	2003	2020	18	2
HaAY	GB_SouW	GB	F	3	nr/m2	NA	FALSE	2002	2020	19	1
OttY	GB_SouW	GB	F	3	nr/m2	NA	FALSE	1998	2020	16	1
ParY	GB_SouW	GB	F	3	nr/m2	NA	FALSE	1990	2020	26	1
PlyY	GB_SouW	GB	F	3	nr/m2	NA	FALSE	1982	2020	25	1
TamY	GB_SouW	GB	F	3	nr/m2	NA	FALSE	1984	2020	30	1
TawY	GB_SouW	GB	F	3	nr/m2	NA	FALSE	1996	2020	21	1
TegY	GB_SouW	GB	F	3	nr/m2	NA	FALSE	1996	2020	20	1
LeeY	GB_Tham	GB	F	3	nr/m2	NA	FALSE	1987	2020	22	0
MedY	GB_Tham	GB	F	3	nr/m2	NA	FALSE	1993	2020	27	2
ThaY	GB_Tham	GB	F	3	nr/m2	NA	FALSE	1985	2020	36	0
ClwY	GB_Wale	GB	F	3	nr/m2	NA	FALSE	2011	2020	10	10
TefY	GB_Wale	GB	F	3	nr/m2	NA	FALSE	2010	2020	11	1
TyTY	GB_Wale	GB	F	3	nr/m2	NA	FALSE	2010	2020	11	1
WniY	GB_Wale	GB	F	3	nr/m2	NA	FALSE	2011	2020	10	10
VistY	GR_EaMT	GR	F	5	kg	NA	NA	2019	2019	1	0
LoEY	IE_NorW	IE	F	3	index	25	FALSE	2011	2020	5	0

Series	EMU	Country	Habitat	Samp_typ	Unit	Dist_sea	Restocking	First year	Last year	n+	n-
BFeY	IE_West	IE	F	3	nr/net/day	2.5	FALSE	1973	2020	19	0
BFuY	IE_West	IE	T	3	nr/net/day	0	FALSE	1987	2020	17	0
BLFY	IE_West	IE	T	3	nr/net/day	0	FALSE	1987	2019	12	0
BuBY	IE_West	IE	F	3	nr/net/day	2.5	FALSE	1987	2019	16	0
BalY	LT_total	LT	F	NA	nr	440	TRUE	2020	2020	1	0
ClY	LT_total	LT	T	NA	nr	0	TRUE	2019	2020	2	0
KerY	LT_total	LT	F	NA	nr	560	TRUE	2020	2020	1	0
KreY	LT_total	LT	F	NA	nr	570	TRUE	2019	2020	2	0
KrLY	LT_total	LT	F	NA	nr	60	TRUE	2020	2020	1	0
RubY	LT_total	LT	F	NA	nr	268	TRUE	2020	2020	1	0
UkoY	LT_total	LT	F	NA	nr	305	TRUE	2019	2020	2	0
DaugY	LV_total	LV	F	5	kg	2.5	TRUE	2015	2020	6	0
LilY	LV_total	LV	F	4	kg	1.5	TRUE	2017	2020	4	0
DeBY	NL_Neth	NL	MO	3	index	0	FALSE	1960	2019	60	0
IJsFRY	NL_Neth	NL	F	3	index	30	TRUE	2007	2020	14	0
IJsFVY	NL_Neth	NL	F	3	index	30	TRUE	2007	2020	14	0
IjsY	NL_Neth	NL	F	3	nr/m2	30	FALSE	1989	2020	32	0

Series	EMU	Country	Habitat	Samp_typ	Unit	Dist_sea	Restocking	First year	Last year	n+	n-
MarY	NL_Neth	NL	F	3	nr/m2	60	TRUE	1989	2020	32	0
MmFRY	NL_Neth	NL	F	3	index	60	TRUE	2007	2020	14	0
MmFVY	NL_Neth	NL	F	3	index	60	FALSE	2007	2020	14	0
SkaY	NO_total	NO	C	3	nr/haul	0	FALSE	1925	2018	94	5
VisY	PL_Vist	PL	T	NA	nr	0	TRUE	2017	2020	4	0
MinY	ES_Minh	PT	F	3	nr/m2	40	FALSE	2018	2020	3	0
MonY	PT_Port	PT	F	3	nr/m2	35	FALSE	2017	2020	4	0
BarY	SE_East	SE	MO	4	nr	0	FALSE	1977	2020	42	0
FjaY	SE_West	SE	MO	4	nr	0	FALSE	1998	2020	22	0
HakY	SE_West	SE	MO	4	nr	0	FALSE	2002	2020	19	0
KulY	SE_West	SE	MO	4	nr	0	FALSE	2002	2012	11	0
LysY	SE_West	SE	MO	4	nr	0	FALSE	2002	2005	4	0
VenY	SE_West	SE	MO	4	nr	0	FALSE	1976	2020	43	0

Table 2. Short description of the series of European eel silver data, where Habitat: C = coastal water, F = freshwater, MO = marine water (open sea), T = transitional water with lower salinity (according to WFD); Gear: 226 = fyke nets, 227 =stownets, 228 = barriers, fences, weirs, etc., 230 = traps, 234 = longlines, 242 = electric fishing, 245 = gear unknown; Samp_typ is sampling type: 1 = commercial catch, 2 = commercial CPUE, 3 = scientific estimate, 4 = trapping all, 5 = trapping partial; Unit for the data collected: kg = kilograms, nr = number; index = calculated value following a specified protocol, nr/m2 = number per square metre, nr/haul= number per haul, nr/net/d = number per net per day); Dist_sea is distance to sea (m); Restocking: FALSE no restocking impacts, TRUE there are potential restocking impacts; First year and Last year indicate the first year and last year in the time-series; n+ and n- columns indicate the number of years with values (n+) and the number of years when there are missing data (n-) within the series.

Series	EMU	Country	Habitat	Samp_typ	Unit	Dist_sea	Restocking	First year	Last year	n+	n-
WarS	DE_Warn	DE	F	3	nr	17	TRUE	2009	2020	12	0
RibS	DK_Inla	DK	F	2	kg/ha	0.5	NA	2001	2020	20	0
NalS	ES_Astu	ES	F	NA	nr/m2	NA	FALSE	2011	2020	10	0
OriS	ES_Basq	ES	F	NA	nr/m2	NA	FALSE	2007	2020	14	0
BidS	ES_Nava	ES	F	3	nr/m2	28.777	FALSE	2010	2020	11	0
AlCS	ES_Vale	ES	T	1	kg	0	FALSE	1951	2021	66	0
KotkS	FI_Finl	FI	C	1	nr	0	TRUE	2017	2020	4	0
VaakS	FI_Finl	FI	F	4	nr	170	TRUE	2014	2020	7	0
SouS	FR_Adou	FR	F	5	nr	6.78	FALSE	2011	2020	10	2
FreS	FR_Bret	FR	F	4	nr	5.35	FALSE	1996	2020	25	0
VilS	FR_Bret	FR	F	5	nr	10	TRUE	2012	2019	8	0
LoiS	FR_Loir	FR	F	5	index	114.74	TRUE	1987	2019	33	0
SeNS	FR_Loir	FR	F	5	nr	85.4	FALSE	2013	2020	8	0
BreS	FR_Sein	FR	F	5	nr	15.65	FALSE	1982	2021	35	0

Series	EMU	Country	Habitat	Samp_typ	Unit	Dist_sea	Restocking	First year	Last year	n+	n-
StrS	GB_NorE	GB	F	4	nr	3	FALSE	2011	2020	10	6
LevS	GB_NorW	GB	F	3	nr	1.8	FALSE	2000	2020	20	0
BaBS	GB_Scot	GB	F	5	nr	120.1	FALSE	2006	2020	15	0
GiBS	GB_Scot	GB	F	5	nr	85.7	FALSE	1966	2020	35	3
ShiS	GB_Scot	GB	F	5	nr	85.7	FALSE	1999	2020	22	4
FowS	GB_SouW	GB	F	3	nr	3	TRUE	2010	2020	11	5
EamtS	GR_EaMT	GR	T	1	kg	NA	NA	2009	2019	9	0
NorwS	GR_NorW	GR	T	1	kg	NA	NA	2012	2017	5	0
WepeS	GR_WePe	GR	T	1	kg	NA	NA	2015	2015	1	0
KilS	IE_Shan	IE	F	3	kg	20	FALSE	2000	2020	21	0
BurS	IE_West	IE	F	4	nr	0	FALSE	1971	2020	50	1
AlauS	LT_Lith	LT	F	NA	nr	300	TRUE	2019	2020	2	0
KertS	LT_Lith	LT	F	NA	nr	300	TRUE	2019	2020	2	0
LakS	LT_Lith	LT	F	NA	nr	300	TRUE	2019	2020	2	0
SiesS	LT_Lith	LT	F	NA	nr	300	TRUE	2019	2020	2	0
ClS	LT_total	LT	T	NA	nr	0	TRUE	2018	2020	3	0
KreS	LT_total	LT	F	NA	nr	570	TRUE	2020	2020	1	0

Series	EMU	Country	Habitat	Samp_typ	Unit	Dist_sea	Restocking	First year	Last year	n+	n-
RieS	LT_total	LT	F	NA	nr	440	TRUE	2020	2020	1	0
ZeiS	LT_total	LT	F	NA	nr	550	TRUE	2020	2020	1	0
DaugS	LV_total	LV	F	5	nr	2.5	TRUE	2015	2020	6	0
LilS	LV_total	LV	F	4	nr	1.5	TRUE	2017	2020	4	0
BRWS	NL_Neth	NL	F	3	index	160	FALSE	2013	2020	7	1
DOIJS	NL_Neth	NL	F	3	index	0	FALSE	2013	2020	6	0
HVWS	NL_Neth	NL	F	3	index	7	FALSE	2012	2020	8	0
IjsS	NL_Neth	NL	F	3	index	0	FALSE	2012	2020	9	3
NiWS	NL_Neth	NL	F	3	index	3	FALSE	2012	2020	9	0
NZKS	NL_Neth	NL	F	3	index	5	FALSE	2012	2020	8	0
ZMaS	NL_Neth	NL	F	3	index	160	FALSE	2012	2020	7	0
ImsaS	NO_total	NO	F	4	nr	NA	NA	1975	2021	47	1
MinS	ES_Minh	PT	F	NA	nr/m2	8	FALSE	2018	2020	3	0
MonS	PT_Port	PT	F	NA	nr/m2	21	FALSE	2017	2020	4	0
NkaS	SE_East	SE	C	3	index	0	FALSE	1979	2020	41	0
SosS	SE_East	SE	C	3	nr	0	FALSE	1974	2018	45	4
KavlS	SE_Inla	SE	F	5	nr	16	NA	2019	2020	2	0

Series	EMU	Country	Habitat	Samp_typ	Unit	Dist_sea	Restocking	First year	Last year	n+	n-
BI1S				NA	index	NA	NA	1991	2011	16	0
BI4S				NA	index	NA	NA	1991	2010	20	0
NSIS				NA	index	NA	NA	1988	2011	22	0
PanS				NA	index	NA	NA	1984	2005	16	0

Biometry Annex

This annex details the number of years for which countries have provided data on biometrics in their time series for each of the parameters.

Table 3. number of years for which the glass eel series have length or weight data

Seeri	Country	habitat	length	weight
KlitG	DK	F	0	10
NorsG	DK	F	0	10
SleG	DK	F	0	10
VidaG	DK	T	0	10
AlbuG	ES	F	1	1
OriaG	ES	T	6	6
VacG	FR	T	18	18
BeeG	GB	F	0	0
FlaG	GB	F	0	0
SeEAG	GB	T	0	0
ShiMG	GB	T	7	0
SeHMG	GB	T	0	0
ShiFG	GB	F	4	0
BurrG	IE	F	0	0
KatwG	NL	T	0	0
LauwG	NL	T	0	0
RhDOG	NL	T	0	0
StelG	NL	T	0	0
RhIjG	NL	T	0	0
MiScG	PT	T	4	4
MondG	PT	T	4	4
RingG	SE	C	0	0
YFS2G	SE	MO	0	0
KlitG	DK	F	0	10
NorsG	DK	F	0	10
SleG	DK	F	0	10

RhIjG	NL	T	0	0
MiScG	PT	T	4	4
MondG	PT	T	4	4
RingG	SE	C	0	0
YFS2G	SE	MO	0	0
Series with data			**7**	**9**
Series ≥ 5 years			**3**	**6**

Table 4. number of years for which the yellow eel recruitment series have length, weight or age data.

Serie	Country	habitat	length	weight
MeusY	BE	F	26	26
GudeY	DK	F	0	10
HartY	DK	F	0	10
FreY	FR	F	24	0
BeeY	GB	F	0	0
BroY	GB	F	0	0
FlaY	GB	F	0	0
GirnY	GB	F	12	12
MertY	GB	F	0	0
MillY	GB	F	0	0
MolY	GB	F	0	0
RodY	GB	F	0	0
ShaPY	IE	F	2	1
DalaY	SE	F	0	66
GotaY	SE	F	0	74
KavlY	SE	F	0	28
LagaY	SE	F	0	5
MorrY	SE	F	0	22
MotaY	SE	F	0	51
RonnY	SE	F	0	17

series with biometry	3	12
series ≥ 5	3	11

Table 5 number of years for which the yellow eel series have length, weight or age data.

ser_nameshort	Habitat	bio_length	bio_weight	bio_age
VVeY	F	DK	0	10
AlCY	T	ES	1	1
BidY	F	ES	11	11
NalY	F	ES	10	10
OriY	F	ES	17	17
KuloY	F	FI	3	3
VesiY	F	FI	4	4
AaY	F	FR	9	9
AdoY	F	FR	11	11
AutY	F	FR	8	8
BreY	F	FR	9	8
DivY	F	FR	7	0
DouY	F	FR	7	0
EscY	F	FR	7	7
FremY	F	FR	26	24
GarY	F	FR	9	9
OrnY	F	FR	11	0
SciY	F	FR	10	9
SeiY	F	FR	11	11
SeNY	F	FR	19	19
SomY	F	FR	11	11
SouY	F	FR	11	11
TouY	F	FR	7	1
VirY	F	FR	11	0
YerY	F	FR	10	8

ser_nameshort	Habitat	bio_length	bio_weight	bio_age
BadY	F	GB	12	10
BelY	F	GB	7	7
BoEY	F	GB	19	19
ChBY	F	GB	17	17
ClwY	F	GB	0	0
CoqY	F	GB	11	11
DeeY	F	GB	12	12
DerY	F	GB	18	18
DoSY	F	GB	15	15
EdeY	F	GB	18	18
EllY	F	GB	8	8
ExeY	F	GB	14	14
FowY	F	GB	32	32
FroY	F	GB	16	16
GirY	F	GB	12	10
GrOY	F	GB	24	24
HaAY	F	GB	16	16
HumY	F	GB	29	29
ItcY	F	GB	15	15
KilY	F	GB	1	1
LagY	F	GB	1	1
LeeY	F	GB	20	20
MedY	F	GB	16	16
MerY	F	GB	18	18
NenY	F	GB	12	12
OttY	F	GB	13	13
OusY	F	GB	19	19
ParY	F	GB	25	25
PlyY	F	GB	22	22

ser_nameshort	Habitat	bio_length	bio_weight	bio_age
RibY	F	GB	28	28
SevY	F	GB	40	40
ShiY	F	GB	11	3
SuSY	F	GB	18	18
TamY	F	GB	23	23
TawY	F	GB	13	13
TefY	F	GB	10	10
TegY	F	GB	12	12
TesY	F	GB	15	15
ThaY	F	GB	35	35
TweY	F	GB	4	4
TyTY	F	GB	10	10
UskY	F	GB	10	10
WelY	F	GB	14	14
WenY	F	GB	16	16
WerY	F	GB	13	13
WevY	F	GB	14	14
WitY	F	GB	15	15
WniY	F	GB	0	0
WyeY	F	GB	14	14
VistY	F	GR	1	1
BFeY	F	IE	18	17
BFuY	T	IE	17	17
BLFY	T	IE	12	12
BuBY	F	IE	16	11
LoEY	F	IE	5	5
BalY	F	LT	1	1
ClY	T	LT	2	2
KerY	F	LT	1	1

ser_nameshort	Habitat	bio_length	bio_weight	bio_age
KreY	F	LT	2	2
KrLY	F	LT	1	1
RubY	F	LT	1	1
UkoY	F	LT	2	2
DaugY	F	LV	4	4
LilY	F	LV	4	4
IJsFRY	F	NL	14	0
IJsFVY	F	NL	14	0
IjsY	F	NL	32	0
MarY	F	NL	31	0
MmFRY	F	NL	14	0
MmFVY	F	NL	14	0
SkaY	C	NO	20	0
VisY	T	PL	3	3
MinY	F	PT	3	3
MonY	F	PT	4	4
Series with data		**96**	**86**	**16**
Series with ≥ 5y		**77**	**65**	**0**

Table 6. number of years for which the silver eel series have length, weight or age data aggregated or disaggregated per sex.

Series	Country	**Female and male**			% female	**Female**			**Male**		
		length	weight	age		length	weight	age	length	weight	age
WarS	DE	0	0	0	12	0	0	0	0	0	0
RibS	DK	2	2	0	2	0	0	0	0	0	0
AlCS	ES	1	1	0	0	0	0	0	0	0	0
BidS	ES	0	0	0	11	10	10	0	11	11	0
NalS	ES	0	0	0	0	1	1	0	10	10	0
OriS	ES	0	0	0	14	14	14	0	14	14	0

Series	Country	Female and male			% female	Female			Male		
		length	weight	age		length	weight	age	length	weight	age
KotkS	FI	0	0	0	4	4	4	3	0	0	0
VaakS	FI	0	0	0	7	7	7	7	0	0	0
BreS	FR	29	0	0	0	0	0	0	0	0	0
FreS	FR	25	25	0	25	25	25	0	25	25	0
SeNS	FR	8	8	0	8	8	7	0	8	7	0
SouS	FR	9	9	0	2	0	0	0	0	0	0
BaBS	GB	18	16	0	18	17	14	0	18	18	0
GiBS	GB	35	19	0	35	30	14	0	35	19	0
ShiS	GB	20	15	0	20	20	15	0	20	17	0
StrS	GB	4	4	0	4	4	4	0	4	4	0
EamtS	GR	9	9	3	0	9	9	3	0	0	0
NorwS	GR	5	5	0	0	0	0	0	0	0	0
WepeS	GR	1	1	0	0	0	0	0	0	0	0
BurS	IE	34	34	10	37	34	34	10	34	34	10
KilS	IE	6	1	0	7	5	0	0	4	0	0
AlauS	LT	1	1	1	1	1	1	1	0	0	0
ClS	LT	3	3	3	3	3	3	3	2	2	2
KertS	LT	1	1	1	1	1	1	1	0	0	0
KreS	LT	1	1	0	1	0	0	0	0	0	0
LakS	LT	2	2	0	1	1	1	0	1	1	0
RieS	LT	1	1	0	1	0	0	0	0	0	0
SiesS	LT	2	2	2	2	2	2	2	1	1	1
ZeiS	LT	1	1	0	1	0	0	0	0	0	0
DaugS	LV	3	3	3	3	2	2	1	3	3	3
LilS	LV	4	4	4	4	3	3	3	4	4	4
DOIJS	NL	6	0	0	0	0	0	0	0	0	0
HVWS	NL	8	0	0	0	0	0	0	0	0	0
IjsS	NL	6	0	0	0	0	0	0	0	0	0

Series	Country	**Female and male**			% female	**Female**			**Male**		
		length	weight	age		length	weight	age	length	weight	age
NiWS	NL	9	0	0	0	0	0	0	0	0	0
NZKS	NL	8	0	0	0	0	0	0	0	0	0
ImsaS	NO	9	9	0	9	9	9	4	0	0	0
MinS	PT	3	3	0	3	0	0	0	3	3	0
MonS	PT	4	4	0	4	4	4	0	4	4	0
KavlS	SE	2	0	0	0	0	2	2	0	0	0
SosS	SE	18	0	0	18	0	0	0	0	0	0
series con datos		**35**	**27**	**8**	**29**	**23**	**23**	**12**	**18**	**17**	**5**
series ≥ 5 años		**18**	**10**	**1**	**13**	**12**	**11**	**2**	**9**	**9**	**1**

Annex 14: Trends in fisheries: Landings, releases, Aquaculture

Table 1: Glass eel commercial fisheries landings (in tonnes) from 1984 to 2021, reported by countries: GB United Kingdom, FR France, ES Spain, PT Portugal, IT Italy.

Year	GB	FR	ES	PT	IT	sum
1945			119.246			119.246
1946			71.931			71.931
1947			100.09			100.09
1948			110.624			110.624
1949			9.319			9.319
1950			3.828			3.828
1951			2.093			2.093
1953			2.535			2.535
1954			5.91			5.91
1955			0.906			0.906
1956			0.884			0.884
1957			2.833			2.833
1958			0.402			0.402
1959			6.637			6.637
1960			9.453			9.453
1961			16.731			16.731
1962			11.088			11.088
1963			7.997			7.997
1964			11			11
1965			4			4
1966			6			6
1967			5			5
1968			4			4
1969			4			4
1970			5			5

Year	GB	FR	ES	PT	IT	sum
1971			1			1
1972	16.7		1			17.7
1973	28.2		1			29.2
1974	57.5		2	1.596		61.096
1975	10.5		2.6	5.578		18.678
1976	13.1		11.6	12.548		37.248
1977	38.6		17.5	22.637		78.737
1978	61.2	1393	21.6	7.344		1483.144
1979	67	1850	17.3	8.758		1943.058
1980	40.1	1491	15.4	10.11		1556.61
1981	36.9	890	13	18.05		957.95
1982	48	866	19.309	22.235		955.544
1983	16.9	791	10.34	6.74		824.98
1984	25	528	16.387	16.064		585.451
1985	20	444	18.28	14.843		497.123
1986	19	423	6.402	7		455.402
1987	21.3	461	9.384	9.51		501.194
1988	21.4	504	9.855	2.571		537.826
1989	20.6	410	9.872	2.834		443.306
1990	20.9	325	5.283	4.485		355.668
1991	1.1	179	6.822	2.8		189.722
1992	5	183	3.665	4.471		196.136
1993	5.73	329	5.248	3.626		343.604
1994	9.5	329	2.371	2.9		343.771
1995	11.9	413	4.9	5.3		435.1
1996	18.8	262	14.545	8.7		304.045
1997	8.7	287	11.978	4.44		312.118
1998	11.2	195	14.119	4.46		224.779
1999		242	13.869	3.6		259.469

Year	GB	FR	ES	PT	IT	sum
2000		206	10.987	3		219.987
2001	0.809	101	12.044	1.149		115.002
2002	0.521	202	8.577	0.804		211.902
2003	1.715	151	9.974	1.45		164.139
2004	0.97	89	5.12	0.814		95.904
2005	1.704	89	6.425	1.174		98.303
2006	1.274	67	4.143	2.736		75.153
2007	2.074	77	5.241	0.905		85.22
2008	0.817	79	5.148	0.75		85.715
2009	0.291		3.655	1.35		5.296
2010	1.324	41.018	6.466	2.36		51.168
2011	2.239	31.258	5.206	1.085		39.788
2012	2.773	34.296	5.326	0.808		43.203
2013	5.907	33.616	7.155	1.081		47.759
2014	11.772	35.341	11.28	1.176	0.425	59.994
2015	2.696	36.094	8.763	1.284	0.159	48.996
2016	4.04	46.371	6.668	0.409	0.06	57.548
2017	3.53	43.191	11.09	2.178	0.146	60.135
2018	4.66	53.405	4.501	1.048	0.243	63.857
2019	6.95	50.009	4.245	0.587	0.243	62.034
2020	3.417	48.738	6.28	0.891		59.326
2021		46.071	4.459	1.236		51.766

Table 2a: Commercial fisheries landings (in tonnes) for yellow eel and silver eel from 1908 to 2021 (part 1), reported by countries: NO Norway, SE Sweden, FI Finland, EE Estonia, LV Latvia, LT Lithuania, PL Poland, DE Germany, DK Denmark, NL Netherlands, BE Belgium (to be continued for other countries in next table).

Year	NO	SE	FI	EE	LV	LT	PL	DE	DK	NL	BE
1908	268.145										
1909	326.558										
1910	303.064										

Year	NO	SE	FI	EE	LV	LT	PL	DE	DK	NL	BE
1911	383.821										
1912	187.325										
1913	212.749										
1914	282	1460.605									
1915	143	996.92									
1916	117	1078.247									
1917	44	1283.643									
1918	35	884.351									
1919	64	1145.353									
1920	80	969.609							3413		
1921	79	1072.376							3443		
1922	94	925.85							3760		
1923	140	947.739							3396		
1924	290	1201.069							4130		
1925	325	1714.229							4880		
1926	341	1707.254							4726		
1927	354	2011.481							4648		
1928	325	1040.056							4117		
1929	425	1393.667							4375		
1930	450	1528.797							4773		
1931	329	1794.757							4195		
1932	518	1588.748							5088		
1933	694	1493.965							5014		
1934	674	1768.74							5171		
1935	564	1950.935							4316		
1936	631	1654.478							4332		
1937	603	1725.109							4329		
1938	526	1870.504							3849		
1939	434	1774.362							4662		

Year	NO	SE	FI	EE	LV	LT	PL	DE	DK	NL	BE
1940	143	1625.714							3709		
1941	174	1821.767							3717		
1942	131	1226.46							3140		
1943	136	1827.842							3917		
1944	150	2319.761							4245		
1945	102	1906.104							4169	2668	
1946	167	1744.632							4269	3492	
1947	268	2346.809			10	8			4784	4502	
1948	293	2211.86			10	14			4386	4799	
1949	214	2329			50	21			4492	3873	
1950	282	2628			10	29			4500	4152	
1951	312	2311			10	32			4400	3661	
1952	178	1848			10	39			3900	3978	
1953	371	2756			20	80			4300	3157	
1954	327	2459			20	147	609		3800	2085	
1955	451	3338			40	163	732		4800	1651	
1956	293	1702			20	131	656		3700	1817	
1957	430	2494			20	168	616		3600	2509	
1958	437	2024			20	149	635		3300	2674	
1959	409	3522			24	155	566		4000	3413	
1960	430	1905			37	165	733		4937	2999	
1961	449	2387			43	139	640		4110	2452	
1962	356	2171			41	155	663		4122	1443	
1963	503	2334			56	260	762		4166	1618	
1964	440	2612		3	37	225	884		3505	2068	
1965	523	2051		0.3	35	125	682		3402	2268	
1966	510	2219		1.9	33	238	804		3901	2339	
1967	491	1835		2.7	39	153	906		3679	2524	
1968	569	2052		2.9	28	165	943		4476	2209	

Year	NO	SE	FI	EE	LV	LT	PL	DE	DK	NL	BE
1969	522	1922		49	36	134	935		3878	2389	
1970	422	1209		61.5	29	118	847		3558	1111	
1971	415	1391		59.5	29	124	722		3378	853	
1972	422	1204		73.4	25	126	696		3429	857	
1973	409	1212		69	27	120	644.707		3656	823	
1974	368	1034		51.1	20	86	691.129		2977	840	
1975	407	1391		82.1	19	114	809.665		3485	1000	
1976	386	935		71.6	24	88	760.519		3054	1172	
1977	352	989		65.8	16	68	867.806		2502	783	
1978	347	1076		63.2	18	70	910.375		2492	719	
1979	374	954		28.5	21	57	978.932		1904	530	
1980	387	1112		25.7	9	45	1214.035		2288	664	
1981	369	887		21.9	10	27	943.503		2227	722	
1982	385	1161		13.9	12	28	911.289		2541	842	
1983	324	1212		28.84	9	23	867.978		2119	937	
1984	310	963		72.2	12	27	819.414		1871	691	
1985	352	1029		75.1	18	29	1022.467	1096.653	1630	679	
1986	272	827.689		61.1	19	32	920.661	1118.657	1672	721	
1987	282	699.389		66.7	25	20	886.569	1031.004	1279	538	
1988	513	932.679		109.7	15	23	943.271	1018.002	1878	425	
1989	313	901.969		54.8	13	21	812.85	963.611	1696	526	
1990	336	916.204		61.3	13	19	768.095	829.743	1675	472	
1991	323	1058.467		52.4	14	16	669.686	724.738	1465	573	
1992	372	1152.483		39.4	17	12	638.191	761.654	1451	548	
1993	340	1119.366		59.2	19	10	567.994	790.061	1080	293	
1994	472	1261.954		46.9	19	12	635.126	833.051	1200	330	
1995	454	948.031		45.4	38	9.4	641.863	777.853	892	354	
1996	353	1053.309		55.1	24	8.6	628.986	602.967	751.5	300	
1997	467	1064.963		59.1	25	10.7	525.997	616.185	797	285	

Year	NO	SE	FI	EE	LV	LT	PL	DE	DK	NL	BE
1998	331	646.377		44.2	30	17.1	544.371	566.948	597	323	
1999	447	701.611		64.8	26	17.9	599.12	645.112	717	356.962	
2000	281	530.879		67	13.669	21.986	443.649	591.233	628	370.11	2.879
2001	304	643.153		67	17.404	22.968	434.509	569.024	707	439.494	2.879
2002	311	591.366		49.9	9.58	25.609	372.911	543.918	614	370.235	2.879
2003	240	565.089		48.6	10.347	23.532	365.522	497.903	648	309.765	2.879
2004	237	583.18		39.2	11.337	32.001	337.199	475.279	546	310.153	2.879
2005	249	675.817		30.7	10.267	44.563	219.91	454.761	534	255.176	2.879
2006	293	732.285		33.4	7.88	31.604	184.448	472.196	596	240.327	
2007	194	702.458		31.1	9.561	29.769	180.7	423.634	537	196.963	
2008	211	671.354	1	30.6	12.86	26.989	159.7	406.098	466	147.63	
2009	69	514.079	1.8	22.1	4.873	17.246	160.6	374.585	467	108.029	
2010	32	525.123	2.3	18.9	8.915	37.562	173.2	367.055	422	445.011	
2011	0	450.431	1.549	16.2	5.993	22.613	118.8	278.884	370	370.593	
2012	0	339.986	1.539	17.7	6.264	15.791	119.3	245.371	317	351.733	
2013	0	374.384	1.307	17.4	4.698	28.423	137.4	264.843	356	318.852	
2014	0	324.234	1.021	16.7	4.405	15.409	116.8	232.92	346	320.271	
2015	0	246.486	0.609	14.15	5.19	11.774	102.423	226.127	282	292.978	
2016	3	279.532	1.326	15.215	4.159	28.4	138.393	206.828	265	312.479	
2017	10.898	244.978	1.081	15.686	8.645	24.287	172.618	241.698	257.267	421.255	0
2018	3.403	250.993	1.095	18.319	5.784	20.279	146.49	226.936	181.806	476.864	
2019	4	188.198	0.394	21.731	6.088	4.62	167.535	209.122	183.257	483.972	
2020	4	194.431	0.202	38.8	6.676	6.841	103.632		182.2	475.462	
2021											

Table 2b: Commercial fisheries landings (in tonnes) for yellow eel and silver eel from 1908 to 2021 (part 2), reported by countries and all countries: IE Ireland, GB United Kingdom, FR France, ES Spain, PT Portugal, IT Italy, Sl Sovenia, HR Croatia, GR Greece, sum.

Year	IE	GB	FR	ES	PT	IT	SI	HR	AL	GR	TR	TN	DZ	MA	sum
1908															268.145

Year	IE	GB	FR	ES	PT	IT	SI	HR	AL	GR	TR	TN	DZ	MA	sum
1909															326.558
1910															303.064
1911															383.821
1912															187.325
1913															212.749
1914															1742.605
1915															1139.92
1916															1195.247
1917															1327.643
1918															919.351
1919															1209.353
1920															4462.609
1921															4594.376
1922															4779.85
1923															4483.739
1924															5621.069
1925															6919.229
1926															6774.254
1927															7013.481

Year	IE	GB	FR	ES	PT	IT	SI	HR	AL	GR	TR	TN	DZ	MA	sum
1928															5482.056
1929															6193.667
1930															6751.797
1931															6318.757
1932															7194.748
1933															7201.965
1934															7613.74
1935															6830.935
1936															6617.478
1937															6657.109
1938															6245.504
1939															6870.362
1940															5477.714
1941															5712.767
1942															4497.46
1943															5880.842
1944															6714.761
1945															8845.104
1946															9672.632
1947															11918.809

Year	IE	GB	FR	ES	PT	IT	SI	HR	AL	GR	TR	TN	DZ	MA	sum
1948															11713.86
1949															10979
1950															11601
1951				90											10816
1952				102.2											10055.2
1953				80.2											10764.2
1954				97.7											9544.7
1955				102.9											11277.9
1956				106.12											8425.12
1957				80											9917
1958				115											9354
1959				100											12189
1960		771.655		98											12075.655
1961		768.37		153.837											11142.207
1962		696.1		114.941											9762.041
1963		787.819		136.853											10623.672
1964		548.918		91.5											10414.418
1965		783.816		130.444											10000.56
1966		881.045		191.518						14.9					11133.363

Year	IE	GB	FR	ES	PT	IT	SI	HR	AL	GR	TR	TN	DZ	MA	sum
1967		568.717		163.826						19					10381.243
1968		585.615		175.601						4.904					11211.02
1969		605.628		136.356		2469				2.932	342				13420.916
1970	200	752.141		119.396		2300				0	441				11168.037
1971	200	842.231		107.37		2113				0	460				10694.101
1972	200	632.599		119.414		1997				4.307	220				10005.72
1973	91	723.24		100.198		588				15.496	315				8793.641
1974	67	765.03		93.403		2122				129.768	588				9832.43
1975	79	762.162		78.002		2886				133.776	448				11694.705
1976	150	621.718		82.729		2596				158.741	499				10599.307
1977	108	690.508		79.867		2390				89.214	282				9283.195
1978	76	823.576		67.034		2172				225.269	283				9342.454
1979	110	1045.034		96.823		2354				185.479	396				9034.768
1980	75	912.167		89.797		2198				226.933	224				9470.632
1981	94	907.102		97.706		2270				250.648	374				9200.859
1982	144	942.547		19.871		2025	0.795			255.244	424				9705.646
1983	117	866.413		18.394		2013	0.67			200.757	588				9325.052
1984	88	973.392		10.972		2050	1.154			285.437	616				8790.569
1985	87	750.036		16.504		2135	2.456			189.569	583				9694.785
1986	87	650.76	1944	13.448		2134	2.705			151.55	517				11144.57

Year	IE	GB	FR	ES	PT	IT	SI	HR	AL	GR	TR	TN	DZ	MA	sum
1987	230	684.122	2062	21.225		2265	1.595			266.306	543				10900.91
1988	215	933.554	2265	13.913		2027	1.535			268.088	756				12337.742
1989	400	874.679	1746	5.308	13.532	1243	1.303			155.618	472				10213.67
1990	256	783.908	1778	8.696	13	1088	1.943			194.214	230				9444.103
1991	245	736.922	1645	49.818	23.486	1097	1.399			209.4	262				9166.316
1992	234	715.355	1321	54.285	29.665	1084	0.061			184.846	245				8859.94
1993	260	670.679	1280	66.481	33.943	782	0.066			181.902	261				7814.692
1994	300	777.838	1280	50.741	26.553	771	0.718			200.505	329				8546.386
1995		899.576	1280	69.401	23.706	1047	0.01			201.386	390				8071.626
1996		805.237	1280	61.732	25.566	953	0.012			151.339	342				7396.348
1997		730.722	1223	61.452	24.707	727	0.002			136.506	400				7154.334
1998		693.373	1150	43.592	23.277	666	0.003			87.585	300				6063.826
1999	250	667.772	1005	48.298	23.143	634				80.72	200		20.386		6504.824
2000	250	587.224	1008.842	55.321	21.772	588	0.004			88.068	176	52.825	17.216		5795.677
2001	98	582.715	1024.128	130.156	15.003	520	0.019			93.428	122	93.251	44.495		5930.626
2002	123	551.139	30.392	105.596	26.863	415	0.009			136.333	147	250.669	25.393		4702.792
2003	111	552.333	21.425	95.634	10.63	446				76.503	158	137.046	25.203		4345.411
2004	136	471.689	12.512	85.253	8.848	379				58.056	165	95.436	29		4015.022
2005	101	476.057	7.774	87.96	7.022	75	0.002			116.128	176	106.693	7.594		3638.303

Year	IE	GB	FR	ES	PT	IT	SI	HR	AL	GR	TR	TN	DZ	MA	sum
2006	133	382.804	14.976	115.583	10.131	56	0.014			77.097	162	288.404	2.652		3833.801
2007	114	450.155	26.136	82.073	10.512	277	0.009			89.653	179	256.772	14.6		3805.095
2008	108.323	399.372	31.398	65.611	6.954	56	0.031			71.068	171	193.739	13.95		3250.677
2009	0	460.347	42.044	89.225	8.169	329.924	0.002			78.468	158	140.585	14.2		3060.276
2010	0	460.635	20.2	104.557	11.031	265.052	0.003			58.632	182	113.532	3.4		3251.108
2011	0	455.857	368	93.598	5.866	189.68	0			83.229	28.3	122.017			2981.61
2012	0	415.06	472.581	121.551	3.814	182.427	0			55.207	38	140.724	0.4		2844.448
2013	0	426.512	504.054	132.721	2.736	172.213	0.001		46.98	37.96	48.2	179.912	3	23	3080.596
2014	0	405.936	434.359	130.384	3.348	184.612	0	0.516	43.01	58.271	56	136.75	6	23	2859.946
2015	0	340.972	356.891	91.977	2.885	170.254	0	0.149	49.99	60.238	71	95.2	3	4	2428.293
2016	0	347.178	442.602	115.058	2.435	205.028	0	0.595	40.97	60.889	75	298.993	2	7	2852.08
2017	0	321.775	434.105	98.174	1.539	213.82		0.559	47.02	48.316	81	148.65	10.6	2	2805.971
2018	0	366.913	617.355	92.899	3.572	123.513		0.61	59.95	42.797	111	153.012	32.962	2	2938.552
2019	0	295.628	309.638	64.055	1.894	126.628		0.562	70	20.439	330	129.252	25.19		2642.203
2020	0	182.247	330.283	96.958	3.157	89.466				27.871	232.75	140.371	18		2133.347
2021	0		18.485	52.904											71.389

Table 3: Raw recreational landings (tonnes) for glass eels (1978 - 2020) for ES,FR.

Year	FR	ES	sum
1978	647		647
1979	697		697
1980	1303		1303
1981	904		904
1982	219		219
1983	161		161
1984	156		156
1985	71		71
1986	87		87
1987	172		172
1988	40		40
1989	110		110
1990	54		54
1991	87		87
1992	77		77
1993	130		130
1994	74		74
1995	113		113
1996	25		25
1997	39		39
1998	6		6
1999	6		6
2000	2		2
2001	1		1
2002	37		37
2004		0.858	0.858
2005	0	1.181	1.181
2006	1	1.656	2.656

Year	FR	ES	sum
2007	0	1.339	1.339
2008	0	1.563	1.563
2009	0	0.439	0.439
2010	0	0.821	0.821
2011	0	0.389	0.389
2012	0	1.104	1.104
2013	0	1.555	1.555
2014	0	2.414	2.414
2015	0	2.316	2.316
2016	0	1.73	1.73
2017	0	1.511	1.511
2018	0	1.725	1.725
2019	0	0.865	0.865
2020	0	0.662	0.662

Table 4a: Recreational fisheries landings (in tonnes) for yellow eel and silver eel from 1980 to 2021 (part 1), reported by countries: NO Norway, SE Sweden, FI Finland, EE Estonia, LV Latvia, LT Lithuania, PL Poland, DE Germany, DK Denmark,NL Netherlands, BE Belgium (to be continued for other countries in next table).

Year	FI	EE	LV	LT	PL	DE	DK	NL	BE	FR	ES
1980											
1981											
1982											
1983											
1984											
1985						581.602					
1986						562.815					
1987						546.318					
1988						558.477					
1989						542.533					
1990						501.281					

Year	FI	EE	LV	LT	PL	DE	DK	NL	BE	FR	ES
1991						498.119					
1992						488.506					
1993						485.559					
1994						492.858					
1995						452.21					
1996						416.32					
1997						423.748					
1998						430.477					
1999						424.756					
2000			1.663			428.91			33.6	20.91	
2001			1.241			425.86			33.6	19.893	
2002			1.133			417.336			33.6	19.043	
2003			0.418			427.86			33.6	14.702	
2004			0.655			413.941			33.6	16.813	
2005		1.692	2.612			398.097			33.6	12.933	
2006		1.024	0.326			399.088			33.6	683.894	
2007		0.958	0.34			375.39			33.6	14.646	
2008	17	1.061	0.183			326.352			33.6	14.858	
2009		1.393	0.69			309.824	108		33.6	7.134	
2010	10	1.104	0.348			276.669	125.5	111	30	4.89	
2011		0.98	0.383			271.796	79.5		30	3.209	
2012	5	0.612	0.415	1.4	32.4	262.586	52.3	59	30	4.587	
2013		0.589	0.738	3	26.7	265.222	50.3		30	4.664	1.029
2014	20	0.536	0.503	1.8	29.5	270.144	57	70	30	4.299	1.028
2015		0.744	0.45	5	26.5	270.48	118.3		29.523	3.541	0.993
2016	8	0.634	0.17	1.638	34.216	274.614	164.3	24	29.523	3.144	0.814
2017		0.579	0.45	2.973	30.851	275.515	117.1		29.523	2.873	0.103
2018	2	0.565	0.166	0.587	30	271.054	105	10	29.723	2.547	0.876
2019		0.615	0.258	6.038	30.4	275.981	110		29.723	1.67	2.162

Year	FI	EE	LV	LT	PL	DE	DK	NL	BE	FR	ES
2020		1.092	0.519	1.158	27.7		98.9		29.723	1.032	
2021										0.182	

Table 4b: Recreational fisheries landings (in tonnes) for yellow eel and silver eel from 1980 to 2021 (part 2), reported by countries and all countries: IE Ireland, GB United Kingdom, FR France, ES Spain, PT Portugal, IT Italy, Sl Sovenia, HR Croatia, GR Greece, sum .

Year	IT	SI	TR	sum
1980		0		0
1981		0		0
1982		0		0
1983		0		0
1984		0		0
1985		0		581.602
1986		0.07		562.885
1987		0.14		546.458
1988		0.134		558.611
1989		0.11		542.643
1990		0.06		501.341
1991		0.058		498.177
1992		0.092		488.598
1993		0.078		485.637
1994		0.036		492.894
1995		0.029		452.239
1996		0.143		416.463
1997		0.207		423.955
1998		0.088		430.565
1999		0.023		424.779
2000		0.004		485.087
2001		0.02		480.614
2002		0.033		471.145

Year	IT	SI	TR	sum
2003		0.004		476.584
2004		0.006		465.015
2005		0		448.934
2006		0.004		1117.936
2007		0		424.934
2008		0		393.054
2009		0		460.641
2010	149.504	0		709.015
2011	60.623	0		446.491
2012	73.623	0		521.923
2013	69.653	0		451.895
2014	69.816	0		554.626
2015	60.195	0		515.726
2016	56.84	0		597.893
2017	41.26			501.227
2018	42.3			494.818
2019	33.66			490.507
2020	24.531		87.25	271.905
2021				0.182

Table 5a. European eel. Release of glass eel in millions from 1950 to 2021, reported by countries SE Sweden, EE Estonia, LV Latvia, PL Poland, DE Germany, NL Netherlands, BE Belgium (to be continued for other countries in next table). Combining information from the 2021 data call and the WGEEL database.

Year	SE	EE	LV	PL	DE	NL	BE
1950						5.1	
1951	0.107					10.2	
1952	0.147			18		16.9	
1953	0.164			26		21.9	
1954				27		10.5	

Year	SE	EE	LV	PL	DE	NL	BE
1955	0.174			31		16.5	
1956	0.07	0.2		21		23.1	
1957	0.197			25		19	
1958	0.011			35		16.9	
1959	0.1			53		20.1	
1960	0.259	0.06	3.189	64		21.1	
1961	0.007		1	65		21	
1962	0.021	0.9	2.644	62		19.8	
1963			1.901	42		23.2	
1964	0.004	0.2	1.302	39		20	
1965	0.041	0.7	0.693	40		22.5	
1966				69		8.9	
1967			1.768	74		6.9	
1968		1.4	3.57	17		17	
1969				2		2.7	
1970	0.002	1	1.797	24		19	
1971				17		17	
1972	0.001	0.1	1.134	22		16.1	
1973	0.01			61.922		13.6	
1974		1.8		70.989		24.4	
1975				69.977		14.4	
1976	0.184	2.6	0.851	67.95		18	
1977		2.1	0.52	76.977		25.8	
1978	0.284	2.7		73.012		27.7	
1979	0.23			73.027		30.6	
1980	0.138	1.3		51.784		24.8	
1981		2.7	1.8	60.036		22.3	
1982	0.02	3	0.29	63.173		17.2	
1983		2.5	1.927	25.103		14.1	

Year	SE	EE	LV	PL	DE	NL	BE
1984		1.8		47.6		16.6	
1985	0.633	2.4	1.481	36.278	22.561	11.8	
1986	0.08			50.213	39.544	10.5	
1987	0.648	2.5	0.26	56.891	41.38	7.9	
1988	0.637		2.906	16.66	42.445	8.4	
1989	0.914			13.962	20.951	6.8	
1990	1.089			10.174	31.92	6.1	
1991	0.586	2		1.67	13.156	1.9	
1992	0.681	2.5		13.798	17.464	3.5	
1993	0.987			9.743	20.545	3.8	
1994	2.347	1.9		13.117	22.822	6.2	
1995	2.022		0.572	23.721	19.915	4.8	
1996	2.517	1.4		2.766	10.726	1.8	
1997	2.505	0.9		5.106	9.453	2.3	
1998	2.154	0.5		2.496	7.851	2.5	
1999	3.246	2.3	0.294	3.982	8.5	2.9	
2000	1.574	1.1		3.116	6.065	2.8	
2001	0.908			0.701	3.338	0.9	0.162
2002	1.393		0.251		2.858	1.6	
2003	0.702			0.506	1.994	1.6	0.324
2004	1.118		0.06	2.25	1.643	0.3	
2005	1.037		0.12		1.869	0.1	
2006	1.314		0.003		1.084	0.582	0.33
2007	0.959		0.015		1.001	0.216	
2008	1.377				0.51	0	0.351
2009	0.76				0.789	0.3	0.456
2010	1.937				5.009	2.714	0.429
2011	2.624	0.68	0.304		3.403	0.529	0.48
2012	2.566	0.91	1.03		4.033	2.287	0.618

Year	SE	EE	LV	PL	DE	NL	BE
2013	2.658	0.89			5.08	1.895	0.432
2014	2.953	3	1.386		10.449	5.698	1.62
2015	1.866	1.87			6.116	0.863	
2016	2.871	0.9			5.027	3.042	1.155
2017	0.947		1.03		9.879	3.044	0.727
2018	3.109	1.424	0.715		13.545	3.577	1.59
2019	2.872	1.58	0.69		21.512	4.677	2.028
2020	3.091	2.029	0			2.93	0.9
2021						2.39	0

Table 5b. European eel. Release of glass eel in millions from 1950 to 2021, reported by countries: IE Ireland, GB United Kingdom, FR France, ES Spain, IT Italy, GR Greece, combining information from the 2021 data call and the WGEEL database.

Year	IE	GB	FR	ES	IT	GR	sum
1950							5.1
1951							10.307
1952							35.047
1953							48.064
1954							37.5
1955							47.674
1956							44.37
1957							44.197
1958							51.911
1959	6.586						79.786
1960	1.02						89.628
1961	3.711						90.718
1962	5.566						90.931
1963	7.791						74.892
1964	0.743						61.249
1965	1.3						65.234

Year	IE	GB	FR	ES	IT	GR	sum
1966	10.017						87.917
1967	6.866						89.534
1968	15.029						53.999
1969	8.163						12.863
1970	9.277						55.076
1971	16.42						50.42
1972	6.309						45.644
1973	10.017						85.549
1974	10.854						108.043
1975	4.823						89.2
1976	7.42						97.005
1977	2.857						108.254
1978	3.714						107.41
1979	29.637						133.494
1980	26.079						104.101
1981	17.473						104.309
1982	26.407						110.09
1983	9.926						53.556
1984	7.573	4					77.573
1985	6.136	11					92.289
1986	5.445	17.8					123.582
1987	13.888	13.7					137.167
1988	12.546	6.3					89.894
1989	6.949	0					49.576
1990	10.177	0					59.46
1991	2.185	0					21.497
1992	5.693	2.4					46.036

Year	IE	GB	FR	ES	IT	GR	sum
1993	7.209	0					42.284
1994	18.86	2.3					67.546
1995	11.291	2.1					64.421
1996	3.918	0.1					23.227
1997	15.003	0.2					35.467
1998	5.698	0.052					21.251
1999	7.708	3.6					32.53
2000	5.792	0.45					20.897
2001	3.03	0					9.039
2002	1.412	3					10.514
2003	4.224	3.9					13.25
2004	1.396	1.2					7.967
2005	3.71	2.4					9.236
2006	0.616	1					4.929
2007	1.027	3.6					6.818
2008	0.418	1.3					3.956
2009	0.375	0.719			0		3.399
2010	0.444	3.149	0.627		0.3		14.609
2011	0.318	3.255	2.35	0.014	0.9		14.857
2012	0.647	3.968	9.258	1.338	0.9		27.555
2013	0.972	5.763	8.775	1.259	0.9	0.419	29.043
2014	2.166	8.297	17.037	0.245		0.204	53.055
2015	2.885	1.864	3.464	0.045	0.366	0.017	19.356
2016	4.462	0.053	10.347	0.003	0.21	0.471	28.541
2017	0.685	2.481	6.986	0.767	0.437	0.149	27.132
2018	8.407	2.313	9.498	3.762		0.094	48.034
2019	0.476	3.758	9.703	1.22		0.046	48.562
2020	1.956	5.142	9.174	0.34			25.562

Year	IE	GB	FR	ES	IT	GR	sum
2021		4.611	10.252				17.253

*** Data for 2020 and 2021 incomplete.**

0 = No catch.

Empty cell = No data or Not Collected or Not Pertinent.

Table 6. European eel. Releases for yellow eel from 1947 to 2020 in millions, reported by countries DE Germany, DK Denmark, NL Netherlands, IE Ireland, ES Spain, IT Italy, combining information from the 2021 data call and the WGEEL database.

Year	DE	NL	IE	ES	IT	sum
1947		1.6				1.6
1948		2				2
1949		1.4				1.4
1950		1.6				1.6
1951		1.3				1.3
1952		1.2				1.2
1953		0.8				0.8
1954		0.7				0.7
1955		0.9				0.9
1956		0.7				0.7
1957		0.8				0.8
1958		0.8				0.8
1959		0.7				0.7
1960		0.4				0.4
1961		0.6				0.6
1962		0.4				0.4
1963		0.1				0.1
1964		0.3				0.3
1965		0.5				0.5
1966		1.1				1.1
1967		1.2				1.2
1968		1				1
1969		0				0
1970		0.2				0.2
1971		0.3				0.3
1972		0.4				0.4

Year	DE	NL	IE	ES	IT	sum
1973		0.5				0.5
1974		0.5				0.5
1975		0.5				0.5
1976		0.5				0.5
1977		0.6				0.6
1978		0.8				0.8
1979		0.8	0.105			0.905
1980		1	0.265			1.265
1981		0.7	0.107			0.807
1982		0.7	0.122			0.822
1983		0.7	0.088			0.788
1984		0.7	0.042			0.742
1985	4.449	0.8	0.099			5.348
1986	3.441	0.7	0.156			4.297
1987	3.213	0.4	0.099			3.712
1988	2.783	0.3	0.127			3.21
1989	1.642	0.1	0.058			1.8
1990	2.098	0	0.098			2.196
1991	1.696	0	0.037			1.733
1992	2.002	0	0.047			2.049
1993	2.565	0.2	0.061			2.826
1994	2.202	0	0.013			2.215
1995	2.148	0	0.08			2.228
1996	2.259	0.2	0.01			2.469
1997	3.35	0.4	0.091			3.841
1998	2.568	0.6	0.026			3.194
1999	2.786	1.2	0.071			4.057

Year	DE	NL	IE	ES	IT	sum
2000	2.551	1	0.039			3.59
2001	2.959	0.1	0			3.059
2002	3.207	0.1	0.068			3.375
2003	3.056	0.1	0.088			3.244
2004	2.733	0.1	0.032			2.865
2005	2.712	0	0.066			2.778
2006	2.14	0	0.047			2.187
2007	1.963	0	0.076			2.039
2008	1.544	0.23	0.131	0.016		1.921
2009	1.544	0.3	0.015	0.03		1.889
2010	1.524	0.062	0.016	0.013		1.615
2011	1.359	0.408	0.011	0.039		1.817
2012	1.386	0.392	0.003	0		1.781
2013	1.333	0.506	0.003	0.004		1.846
2014	1.457	0.903	0.038	0.021		2.419
2015	1.412	0.742	0.033		0.085	2.272
2016	1.596	0.49	0.092	0.183	0.122	2.483
2017	0.076	0.574	0.014	0.15	0.2	1.014
2018	0.055	0.517	0.135	0.156		0.863
2019	0.054	0.851	0.038			0.943
2020		0.619	0.092			0.711
2021		0.472				0.472

*** Data for 2020 incomplete.**

0 = No catch.

Empty cell = No data or Not Collected or Not Pertinent.

Table 7. European eel. Releases for silver eel from 2001 to 2020 in millions, reported by countries SE Sweden, FI Finland, IE Ireland, Fr France, ES Spain, GR Greece. Combining information from the 2020 data call and the WGEEL database.

Year	SE	FI	IE	FR	ES	GR	sum
2001			0.006				0.006
2002			0.02				0.02
2003			0.008				0.008
2004			0.015				0.015
2005			0.007				0.007
2006			0.038				0.038
2007			0.018				0.018
2008			0.052				0.052
2009			0.163		0.001		0.164
2010	0.005		0.187				0.192
2011	0.008		0.215	0.094			0.317
2012	0.01		0.243	0.111	0.039		0.403
2013	0.013		0.238	0.116		0.042	0.409
2014	0.021	0	0.336	0.164		0.067	0.588
2015	0.018	0	0.284	0.214		0.079	0.595
2016	0.017	0	0.206	0.17		0.108	0.501
2017	0.017	0	0.193	0.213		0.086	0.509
2018	0.016	0	0.205	0.212		0.035	0.468
2019	0.015	0	0.182	0.169	0.001	0.004	0.371
2020	0.018	0	0.211	0.187	0.001	0.01	0.427

*** Data for 2019 and 2020 incomplete.**

0 = No catch.

Empty cell = No data or Not Collected or Not Pertinent.

Table 8. European eel. Releases for quarantined glass eel from 2010 to 2021 in millions, reported by countries SE Sweden, FI Finland. Combining information from the 2020 data call and the WGEEL database.

Year	FI
2010	0.31
2011	0.61
2012	0.35
2013	0.39
2014	0.29
2015	0.2
2016	0.16
2017	0.24
2018	0.16
2019	0.27
2020	0.13
2021	0.15

Table 9. European eel. Releases for on-grown glass eel from 1973 to 2020 in millions, reported by countries: EE Estonia, LV Latvia, LT Lithuania, PL Poland, DE Germany, DK Denmark, ES Spain. Combining information from the 2021 data call and the WGEEL database.

Year	EE	LV	LT	PL	DE	DK	ES	sum
1973				0.06				0.06
1974				0.01				0.01
1977				0.01				0.01
1980				0				0
1982				0.14				0.14
1983				1.13				1.13
1984				0.2				0.2
1985				0.14	1.33			1.47
1986				0.05	1.12			1.17
1987				0	1.03			1.03
1988	0.18			0.01	1.42			1.61
1989				0.25	1.02			1.27
1990				0.44	1.04			1.48
1991				0.03	1.12			1.15
1992				0.06	1.37			1.43
1993				0	1.74			1.74
1994				0.14	1.82			1.96
1995	0.15			0.04	2.23			2.42
1996				1.02	2.46			3.48
1997				2.21	2.79			5
1998				0.85	2.9			3.75
1999				1.02	3.66			4.68
2000				1.43	5.26		0.04	6.73
2001	0.44			0.75	4.19		0.05	5.43
2002	0.36			0.75	4.88		0.02	6.01

Year	EE	LV	LT	PL	DE	DK	ES	sum
2003	0.54			0.56	5.15		0.03	6.28
2004	0.44			0.81	5.38		0.06	6.69
2005	0.37			0.74	4.14		0.11	5.36
2006	0.38			0.92	7.25		0	8.55
2007	0.33			1.39	7.39		0.02	9.13
2008	0.19			1.52	7.45			9.16
2009	0.42			1.4	7.36			9.18
2010	0.21			1.29	7.66			9.16
2011	0.2		0.15	2.67	6.06			9.08
2012	0.12		0.49	1.75	4.98			7.34
2013	0.13		1.3	3.48	5.65			10.56
2014	0.19		0.38	2.29	7.01			9.87
2015			0.45	3.63	7.29			11.37
2016	0.22		0.27	1.51	5.49	1.53		9.02
2017	0.31		0	3.58	9.47	1.52		14.88
2018		0	1.65	2.44	9.65		0.01	13.75
2019			1.59	0.98	9.68	1.81	0.22	14.28
2020			1.37	0.95		1.34	0.03	3.69

*** Data for 2019 and 2020 incomplete.**

0 = No catch.

Empty cell = No data or Not Collected or Not Pertinent.

Table 10a: Aquaculture for all stages in tonnes from 1984 to 2020 reported by countries: SE Sweden, FI Finland, EE Estonia, LT Lithuania, PL Poland, DE Germany, DK Denmark. (to be continued for other countries in next table)

Year	SE	FI	EE	LT	PL	DE	DK
1984							18
1985							40
1986							200
1987							240
1988							195
1989							430
1990							586
1991							866
1992							748
1993							782
1994							1034
1995							1324
1996							1568
1997							1913
1998				2			2483
1999				2			2718
2000				1			2674
2001				5			2000
2002			20	17			1880
2003			40	20			2050
2004	158		50	9		328	1500
2005	222		80	8		329	1700
2006	191		100	12		567	1900
2007	175		100	13		774	1617
2008	124.4		90	10.6		749.4	1740
2009	142.6		60	12		667	1707
2010	92.8		40	8.3		681	1537
2011	91.4		50	12.6		692	1156

Year	SE	FI	EE	LT	PL	DE	DK
2012	93.4		70	3.5		744	1093
2013	91.7	0		3.45		758	824
2014	64.4	0.5	55.65	7.15		926	842
2015	104.3	0.5	52.45	0.2	0.6	1176	1234
2016	117.1	0	60.91	36.4	0.98	1099	1033
2017	75	0	50		2.81	1111	549.61
2018	64.6				3.09	1132	893.94
2019	81					1286	490.26
2020	73.9					1125.4	659

Table 10b: Aquaculture for all stages in tonnes from 1984 to 2020 reported by countries: NL Netherlands, IE Ireland, ES Spain, PT Portugal, IT Italy, GR Greece.

Year	NL	ES	PT	IT	GR	MA	sum
1984							18
1985							40
1986							200
1987	100						340
1988	300						495
1989	200						630
1990	600						1186
1991	900						1766
1992	1100						1848
1993	1300						2082
1994	1450						2484
1995	1540						2864
1996	2800						4368
1997	2450						4363
1998	3250	347.1					6082.1
1999	3500	383.09					6603.09
2000	3800	411.08					6886.08
2001	4000	339.07					6344.07
2002	4000	295.06					6212.06
2003	4200	292.05					6602.05
2004	4500	377.04		1220	429		8571.04
2005	4500	321.03		1131	261		8552.03
2006	4200	275.02		807	290		8342.02
2007	4000	369.01		1000	365		8413.01
2008	3700	460		550.74	396		7821.14
2009	3200	493		677.4	428		7387
2010	2000	392	0.28	647.19	320		5718.57
2011	2300	468	0.56	509.3	377.05		5656.91

Year	NL	ES	PT	IT	GR	MA	sum
2012	2600	373	0.89	736.98	281		5995.77
2013	2900	393	1	642.14	432	340	6385.29
2014	2300	406	0.92	571.9	220	350	5744.52
2015	2000	454	0.89	750	270.86	280	6323.8
2016	2000	330	2	710.1	289.46	282	5960.95
2017	2005	292.26	33	528.6	184.26	274	5105.54
2018	2155	346.17	0.46	509.35	128	257.41	5490.02
2019	2200	318.91	0.77	464.04	146.42	289.17	5276.57
2020	2065	338.05			184.41	183.03	4628.79

Annex 15: Additional information Biomass/Mortality

Table 1 Summary of the biomass indicators provided for each EMU. For B_0, the columns indicate whether an estimate was provided or not. For B_{best} and $B_{current}$, both the range of years and number of years for which estimates were provided has been listed. For Belgium, data before 2015 were not considered in the analysis due to a change in the estimation model. For Ireland, errors were detected for the year 2008, which was therefore not considered in the analysis. Non-reporting countries are not listed.

	B_0	B_{best}		$B_{current}$	
EMU		Range (min - max)	Number of years	EMU	
BE_Meus	yes	2009-2020	12	2009-2020	12
BE_Sche	yes	2009-2020	12	2009-2020	12
DE_Eide	yes	2007-2019	13	2007-2019	13
DE_Elbe	yes	2007-2019	13	2007-2019	13
DE_Ems	yes	2007-2019	13	2007-2019	13
DE_Maas	yes	2007-2019	13	2007-2019	13
DE_Oder	yes	2007-2019	13	2007-2019	13
DE_Rhei	yes	2007-2019	13	2007-2019	13
DE_Schl	yes	2007-2019	13	2007-2019	13
DE_Warn	yes	2007-2019	13	2007-2019	13
DE_Wese	yes	2007-2019	13	2007-2019	13
DK_Inla	yes	2009-2020	12	2009-2020	12
EE_Narv	yes	2016-2020	5	2016-2020	5
EE_West	yes	2016-2020	5	2016-2020	5
ES_Anda	yes	2008-2017	6	2008-2017	6
ES_Astu	yes	2008-2017	7	2011-2020	10
ES_Bale	yes	2008-2017	4	2008-2017	4
ES_Basq	yes	2012-2020	9	2007-2020	14
ES_Cant	yes	2014-2020	7	2007-2020	14
ES_Cast	yes	2007-2020	14	2007-2020	14
ES_Cata	yes	2007-2020	14	2007-2020	14

	B_0	B_{best}		$B_{current}$	
ES_Gali	yes	2007-2020	14	2007-2020	14
ES_Inne	yes	2007-2020	14	2007-2020	14
ES_Minh	yes	2018-2020	3	2018-2020	3
ES_Mino	yes	2007-2020	14	2007-2020	14
ES_Murc	yes	2007-2020	14	2007-2020	14
ES_Nava	yes			2010-2020	11
ES_Spai	yes	2007-2020	14	2007-2020	14
ES_Vale	yes	2018-2020	3	2007-2020	14
GB_Angl	yes	2009-2019	11	2009-2019	11
GB_Dee	yes	2009-2019	11	2009-2019	11
GB_Humb	yes	2009-2019	11	2009-2019	11
GB_Neag	yes	2009-2020	12	2009-2020	12
GB_NorE	yes	2016-2019	4	2016-2019	4
GB_Nort	yes	2009-2019	11	2009-2019	11
GB_NorW	yes	2009-2019	11	2009-2019	11
GB_Scot	yes	2007-2020	14	2007-2020	14
GB_Seve	yes	2009-2019	11	2009-2019	11
GB_Solw	yes	2009-2019	11	2009-2019	11
GB_SouE	yes	2009-2019	11	2009-2019	11
GB_SouW	yes	2009-2019	11	2009-2019	11
GB_Tham	yes	2009-2019	11	2009-2019	11
GB_Wale	yes	2009-2019	11	2009-2019	11
IE_East	yes	2008-2020	13	2008-2020	13
IE_NorW	yes	2008-2020	13	2008-2020	13
IE_Shan	yes	2008-2020	13	2008-2020	13
IE_SouE	yes	2008-2020	13	2008-2020	13
IE_SouW	yes	2008-2020	13	2008-2020	13
IE_West	yes	2008-2020	13	2008-2020	13
LT_Lith	yes	2007-2020	14	2007-2020	14

	B_0	B_{best}		$B_{current}$	
LT_total	yes	2007-2020	14	2007-2020	14
LV_Latv	yes	2016-2020	5	2016-2020	5
NL_Neth	yes	2006-2020	15	2006-2020	15
NO_total		2016-2020	5	2016-2020	5
PL_Oder	yes	2007-2020	14	2011-2020	10
PL_Vist	yes	2007-2020	14	2011-2020	10
PT_Port	yes	2017-2020	4	2010-2020	5
SE_East				2000-2020	21
SE_Inla	yes	1986-2020	35	1986-2020	35
SE_West	yes	2011-2011	1	2011-2011	1

Table 2 Summary of the mortality indicators provided for each EMU. For each indicator, both the range of years for which estimates are provided and the number of years are provided. For Belgium, data before 2015 were not considered in the analysis due to a change in the estimation model. For Ireland, errors were detected for the year 2008, which was therefore not considered in the analysis. Non-reporting countries are not listed.

	ΣA		ΣF		ΣH	
EMU	Range (min - max)	Number of years	Range (min - max)	EMU	Range (min - max)	Number of years
BE_Meus	2009-2020	12	2009-2020	12	2009-2020	12
BE_Sche	2009-2020	12	2009-2020	12	2009-2020	12
DE_Eide	2007-2019	13	2007-2019	13	2007-2019	13
DE_Elbe	2007-2019	13	2007-2019	13	2007-2019	13
DE_Ems	2007-2019	13	2007-2019	13	2007-2019	13
DE_Maas	2007-2019	13	2007-2019	13	2007-2019	13
DE_Oder	2007-2019	13	2007-2019	13	2007-2019	13
DE_Rhei	2007-2019	13	2007-2019	13	2007-2019	13
DE_Schl	2007-2019	13	2007-2019	13	2007-2019	13
DE_Warn	2007-2019	13	2007-2019	13	2007-2019	13
DE_Wese	2007-2019	13	2007-2019	13	2007-2019	13
DK_Inla	2009-2020	12	2009-2020	12	2009-2020	12
EE_Narv	2016-2020	5	2016-2020	5	2016-2020	5

	ΣA		ΣF		ΣH	
ES_Anda	2008-2017	6	2008-2017	6		
ES_Astu	2013-2020	8	2011-2020	10	2013-2020	8
ES_Bale	2009-2018	4	2010-2019	4	2009-2020	12
ES_Basq	2012-2020	9	2012-2020	9		
ES_Cant	2014-2020	7	2014-2020	7		
ES_Cast	2007-2020	14	2007-2020	14	2007-2020	14
ES_Cata	2007-2020	14	2007-2020	14		
ES_Gali	2007-2020	14	2007-2020	14	2007-2020	14
ES_Inne					2007-2020	14
ES_Minh	2018-2020	3	2018-2020	3	2007-2020	14
ES_Mino					2007-2020	14
ES_Murc	2007-2020	14	2007-2020	14	2007-2020	14
ES_Nava			2007-2020	14		
ES_Vale	2007-2020	14	2007-2020	14		
GB_Angl	2009-2019	11	2009-2019	11	2009-2019	11
GB_Dee	2009-2019	11	2009-2019	11	2009-2019	11
GB_Humb	2009-2019	11	2009-2019	11	2009-2019	11
GB_Neag	2009-2020	12	2009-2020	12	2009-2020	12
GB_NorE	2016-2019	4	2007-2020	14	2016-2019	4
GB_Nort	2009-2019	11	2009-2019	11	2009-2019	11
GB_NorW	2009-2019	11	2009-2019	11	2009-2019	11
GB_Scot	2007-2020	14	2007-2020	14	2007-2020	14
GB_Seve	2009-2019	11	2009-2019	11	2009-2019	11
GB_Solw	2009-2019	11	2009-2019	11	2009-2019	11
GB_SouE	2009-2019	11	2009-2019	11	2009-2019	11
GB_SouW	2009-2019	11	2009-2019	11	2009-2019	11
GB_Tham	2009-2019	11	2009-2019	11	2009-2019	11
GB_Wale	2009-2019	11	2009-2019	11	2009-2019	11
IE_East	2008-2020	13	2008-2020	13	2008-2020	13

	ΣA		ΣF		ΣH	
IE_NorW	2008-2020	13	2008-2020	13	2008-2020	13
IE_Shan	2008-2020	13	2008-2020	13	2008-2020	13
IE_SouE	2008-2020	13	2008-2020	13	2008-2020	13
IE_SouW	2008-2020	13	2008-2020	13	2008-2020	13
IE_West	2008-2020	13	2008-2020	13	2008-2020	13
LT_Lith	2007-2020	14	2007-2020	14	2007-2020	14
LT_total	2007-2020	14	2007-2020	14	2007-2020	14
LV_Latv			2016-2020	5		
NL_Neth	2006-2020	15	2006-2020	15	2006-2020	15
NO_total	2016-2020	5	2016-2020	5	2016-2020	5
PL_Oder	2011-2020	10	2011-2020	10	2011-2020	10
PL_Vist	2011-2020	10	2011-2020	10	2011-2020	10
PT_Port	2017-2020	4	2017-2020	4	2007-2020	14
SE_Inla	1986-2020	35	1986-2020	35	1986-2020	35
SE_West	2001-2020	20	2001-2020	20	2007-2020	14

Table 3: Table summarizing the frequencies with which habitats (F: freshwater, T: transitional, C: coastal, MO: marine open) were said to be fully accounted for or not accounted for at all in the estimates of indicators.

	Not accounted at all				Fully accounted for			
	F	T	C	MO	F	T	C	MO
biomass	9	21	81	99	90	79	19	1
mortality	6	17	74	100	93	83	26	0

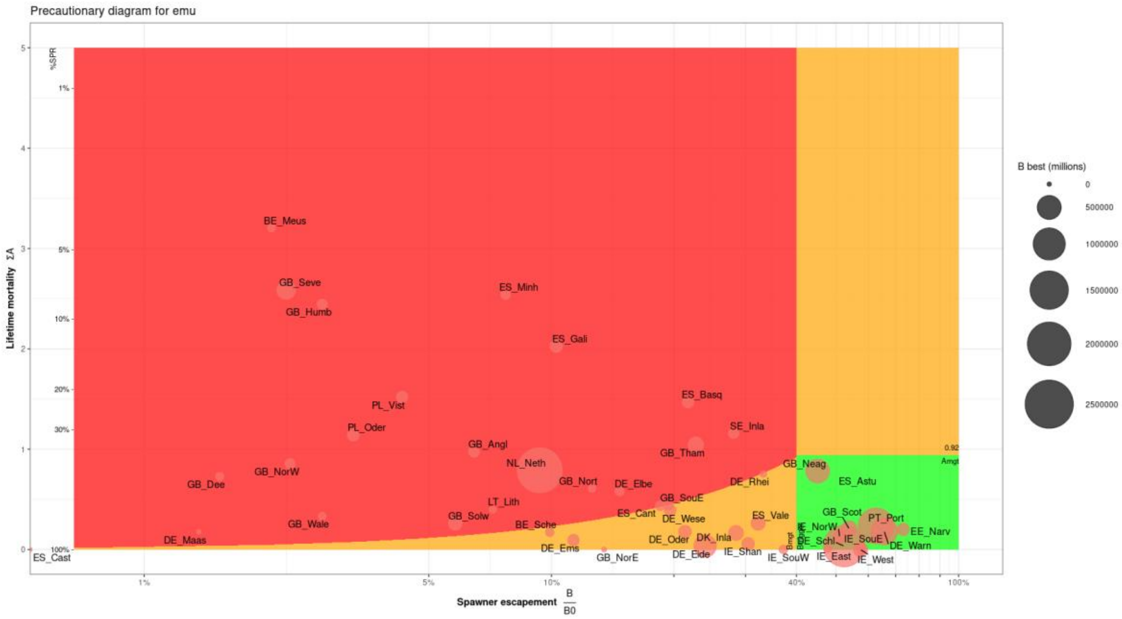

Figure 1: Precautionary Diagram for Eel Management Units, presenting the status of the stock (horizontal, spawner escapement ($B_{current}$) expressed as a percentage of the pristine escapement (B_0)) and the anthropogenic impacts (vertical, expressed as lifetime mortality ΣA, resp. lifetime survival %SPR). The limit anthropogenic mortality (A_{mgt}) was set as 0.92, corresponding to the 40% biomass limit (B_{mgt}). Data from the 2021 data call provided to WGEEL. Due to an error during the data call, ΣA in Irish EMUs may be slightly biased.

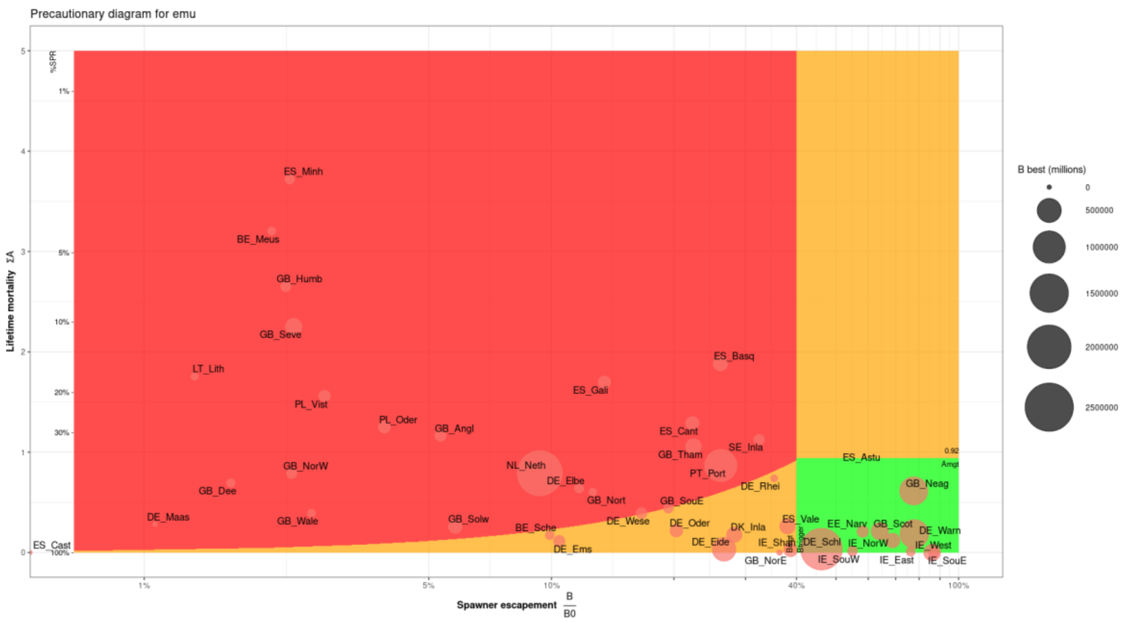

Figure 2: Precautionary Diagram for Eel Management Units, presenting the 2018 status of the stock (horizontal, spawner escapement ($B_{current}$) expressed as a percentage of the pristine escapement (B_0)) and the anthropogenic impacts (vertical, expressed as lifetime mortality ΣA, resp. lifetime survival %SPR). The limit anthropogenic mortality (A_{mgt}) was set as 0.92, corresponding to the 40% biomass limit (B_{mgt}). Data from the 2021 data call provided to WGEEL. Due to an error during the data call, ΣA in Irish EMUs may be slightly biased.

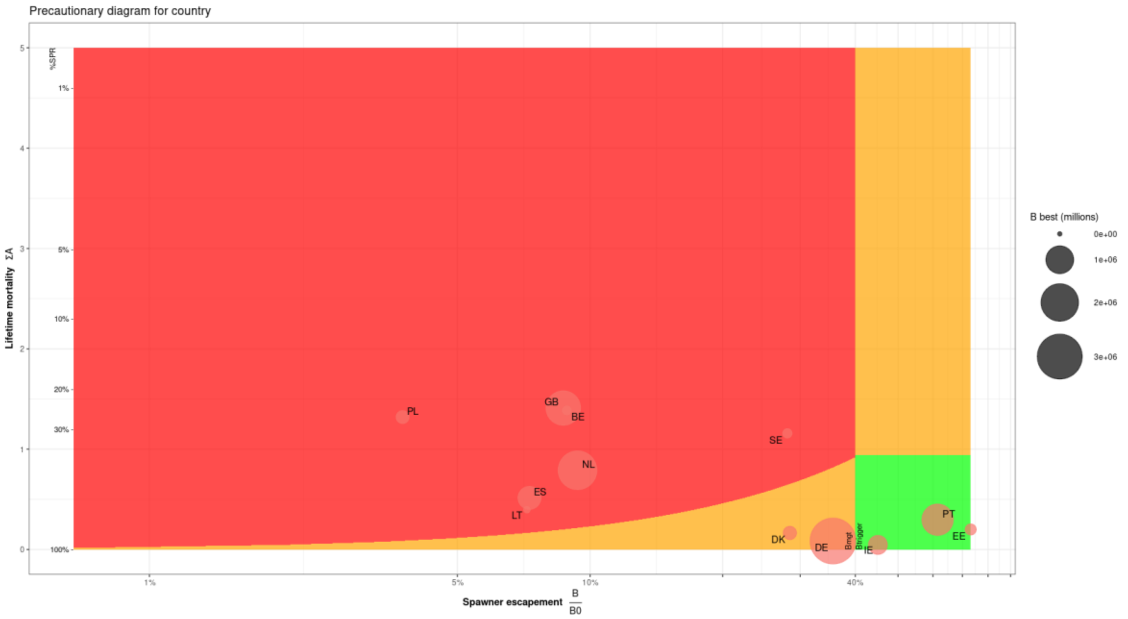

Figure 3: Precautionary Diagram for country level presenting the reported data for the 2019 status of the stock (horizontal, spawner escapement ($B_{current}$) expressed as a percentage of the pristine escapement (B_0)) and the anthropogenic impacts (vertical, expressed as lifetime mortality ΣA, resp. lifetime survival %SPR). The limit anthropogenic mortality (A_{lim}) was set as 0.92, corresponding to the 40% biomass limit (B_{lim}). Only EMUs that have provided both $B_{current}$ and B_0 have been used to derive a country-aggregated indicator. Thus, the overview in this figure may not include all provided data and care should be taken in its interpretation. Data from the 2021 data call provided to WGEEL. Due to an error during the data call, ΣA in Irish EMUs may be slightly biased.

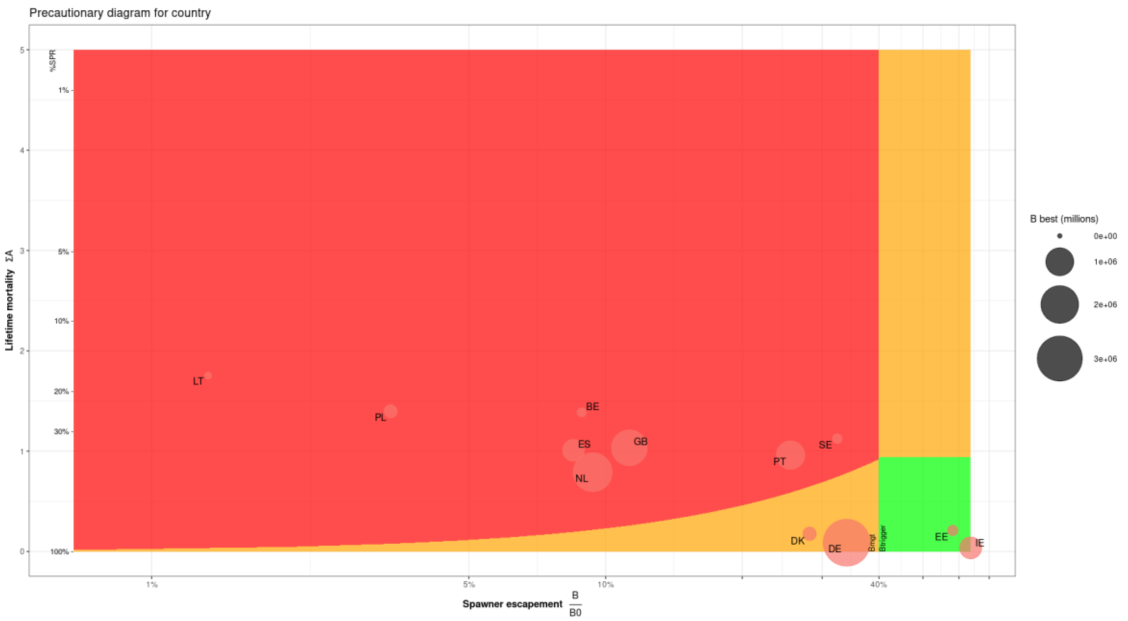

Figure 4: Precautionary Diagram for Eel Management Units, presenting the 2018 (plots for 2018 and 2019 can be found in annex XX) status of the stock (horizontal, spawner escapement ($B_{current}$) expressed as a percentage of the pristine escapement (B_0)) and the anthropogenic impacts (vertical, expressed as lifetime mortality ΣA, resp. lifetime survival %SPR). The limit anthropogenic mortality (A_{mgt}) was set as 0.92, corresponding to the 40% biomass limit (B_{mgt}). Data from the 2021 data call provided to WGEEL. Due to an error during the data call, ΣA in Irish EMUs may be slightly biased.

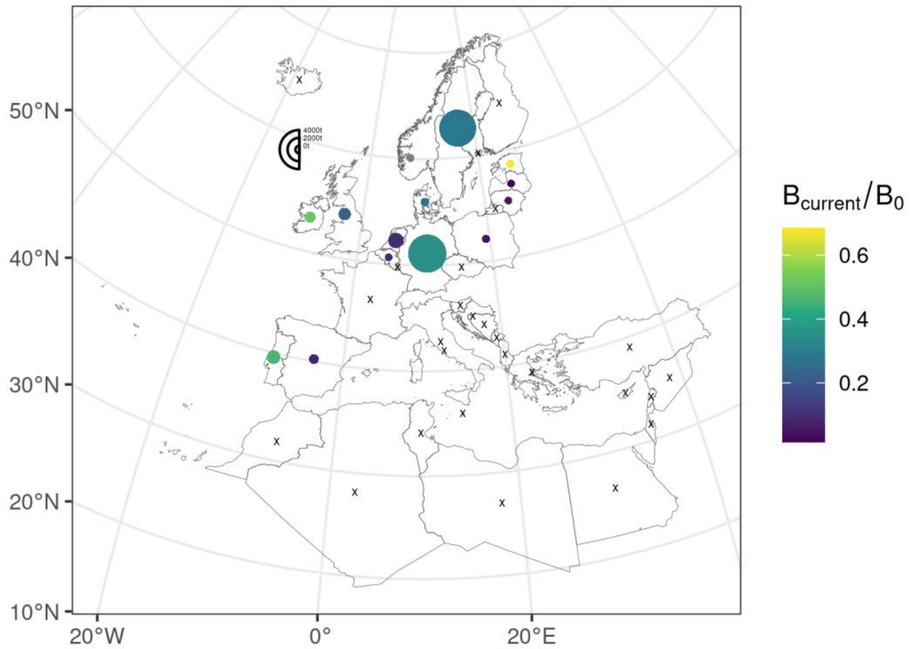

Figure 5: Maps of biomass indicators aggregated per country (average from 2018 to 2020). The size of the circle stands for $B_{current}$ while the colour stands for the ratio between $B_{current}$ and B_0. A cross indicates that no data were available. For $B_{current}$, all reported values were summed up. For the ratio of $B_{current}$ over B_0, only EMUs that have reported both values were accounted for.

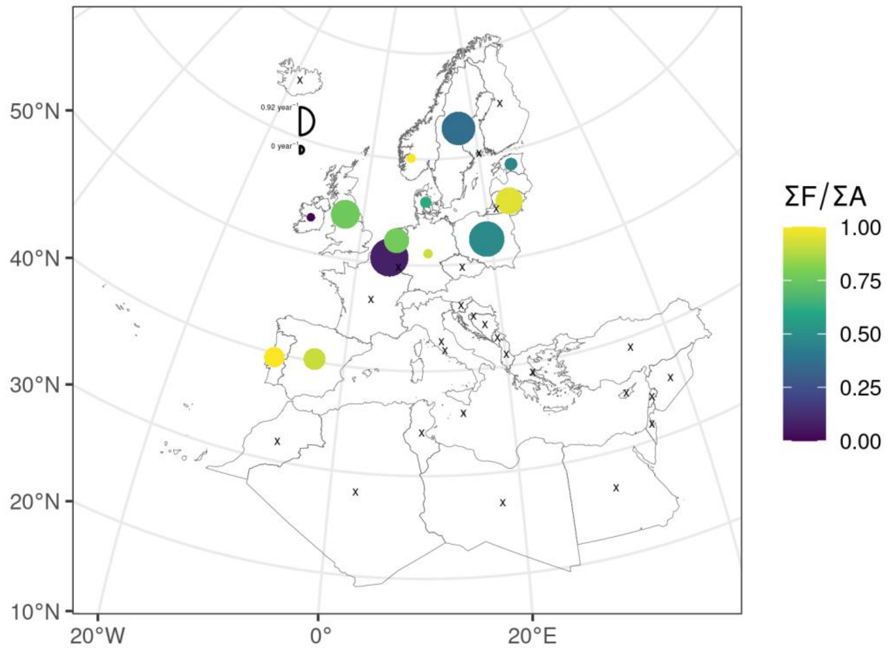

Figure 6: Maps of mortality indicators aggregated per country (average from 2018 to 2020). The size of the circle stands for ΣA while the colour stands for the ratio between ΣF and ΣA. For ΣA, the value corresponds to a weighted mean of reported survival at the EMU scale, weighted by corresponding B_{best} (ICES 2010b), as such only EMUs that have reported both B_{best} and ΣA were accounted for. For the ratio between ΣF and ΣA, both were weighted averages of EMUs (weighted by B_{best}), where only EMUs that have provided ΣF, ΣA, and B_{best} were accounted for. ΣA for Ireland may be slightly biased due to a minor error in the estimation procedure.

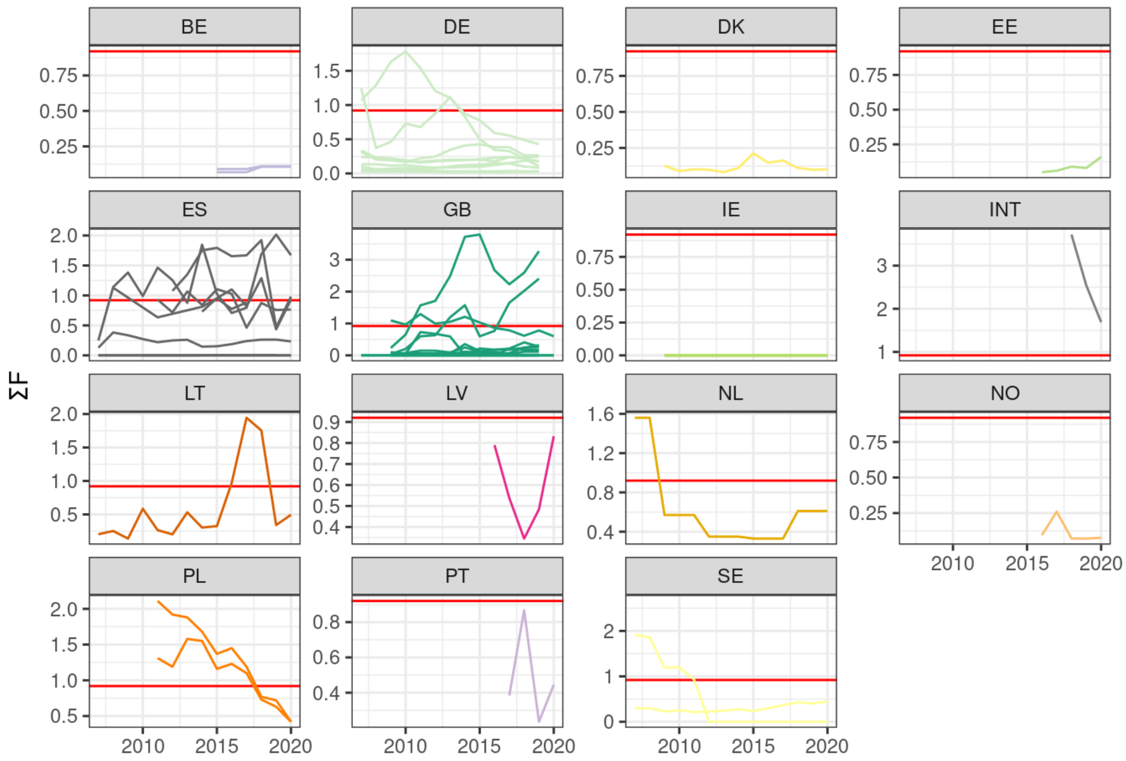

Figure 7: Trends in ΣF (lifespan fishing mortality). Each panel stands for the country and each line for a specific EMU. Red horizontal lines stand for a total lifespan mortality of 0.92, which would correspond to a reduction of escapement of 60% due to anthropogenic mortality compared to a situation without any anthropogenic mortality. Irish data for 2008 was removed due to an error in the estimated value. Belgian data before 2015 were not considered in the analysis due to a change in the estimation model.

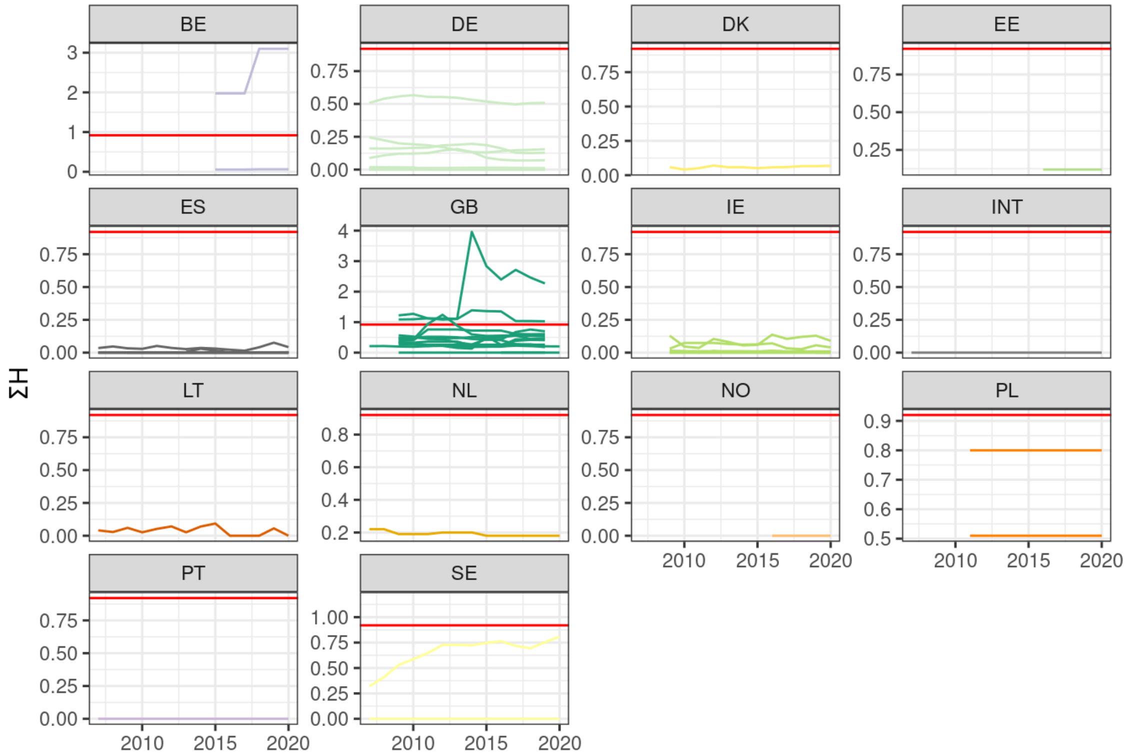

Figure 8: Trends in the ΣH (lifespan other anthropogenic mortality). Each panel stands for the country and each line for a specific EMU. Red horizontal lines stand for a total lifespan mortality of 0.92, which would correspond to a reduction of escapement of 60% due to anthropogenic mortality compared to a situation without any anthropogenic mortality. Irish data for 2008 was removed due to an error in the estimated value, recent values may be slightly biasied due to a minor error in the estimation procedure. Belgian data before 2015 were not considered in the analysis due to a change in the estimation model.

Technical derivation of the 50 shades of orange

For any biomass $B_{current}$ (where $B_{current}$ is below B_{mgt}=40%), resulting from a lifetime mortality of $\Sigma A_{current}$, a reduction in mortality over that lifetime to $\Sigma A_1 = \Sigma A_{current} - \ln\left(\frac{B_{mgt}}{B_{current}}\right)$ would have led to the current biomass $B_{current}$ to have increased to $B_1 = B_{current} * exp^{\ln\left(\frac{B_{mgt}}{B_{current}}\right)} = B_{mgt}$. That is: $\Sigma A_1 = \Sigma A_{current} - \ln\left(\frac{B_{mgt}}{B_{current}}\right)$ defines the mortality limit that would have recovered the stock to B_{mgt} if that mortality had been applied over the past lifetime.

Likewise, a reduction in lifetime mortality to $\Sigma A_n = \Sigma A_{current} - {\ln\left(\frac{B_{mgt}}{B_{current}}\right)}\big/_{n}$, if applied during n generations, could have led to a recovery of the biomass to $B_n = B_{current} * exp^{{n*\ln\left(\frac{B_{mgt}}{B_{current}}\right)}\big/_{n}} = B_{mgt}$, assuming a linear relationship between biomass and recruitment below B_{mgt} (i.e. hockey-stick relationship). Obviously, for any particular management area, the development over more than a generation time depends crucially on the contribution from other management areas (Dekker 2016), and a multi-generational mortality limit therefore defines a theoretical expectation for a situation where all management areas would act in synchrony, but not a realistic prognosis of the actual future developments. However, ΣA_n can be used to quantify over what order of time the stock can be expected to recover to B_{mgt}, and indirectly, to quantify the apparent aspiration level implied by the current mortality level.

Note that $\boldsymbol{\Sigma A_n}$ can be re-written as $\boldsymbol{\Sigma A_n} = \boldsymbol{\Sigma \mathrm{A}_{current}} - {}^{\mathbf{ln}\left(\frac{B_{mgt}}{B_{current}}\right)}\!/_{\boldsymbol{n}} = \boldsymbol{\Sigma \mathrm{A}_{current}} - {}^{\mathbf{ln}(\boldsymbol{B_{mgt}})}\!/_{\boldsymbol{n}} + {}^{\mathbf{ln}(\boldsymbol{B_{current}})}\!/_{\boldsymbol{n}}$. From that, it follows that $\boldsymbol{\Sigma A_n}$ is a linear function of ln ($B_{current}$), for any particular value of *n*, thus showing up as a straight line on the Precautionary Diagram plotting $B_{current}$ on a logarithmic scale.