REPORT OF THE JOINT EIFAAC/ICES/GFCM WORKING GROUP ON EELS (WGEEL)

VOLUME 05 | ISSUE 98

ICES SCIENTIFIC REPORTS

RAPPORTS SCIENTIFIQUES DU CIEM

ICES INTERNATIONAL COUNCIL FOR THE EXPLORATION OF THE SEA
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International Council for the Exploration of the Sea
Conseil International pour l'Exploration de la Mer

H.C. Andersens Boulevard 44-46
DK-1553 Copenhagen V
Denmark
Telephone (+45) 33 38 67 00
Telefax (+45) 33 93 42 15
www.ices.dk
info@ices.dk

ISSN number: 2618-1371

ICES Scientific Reports

Volume 05 | Issue 98

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Recommended format for purpose of citation:

ICES. 2023. Report of the Joint EIFAAC/ICES/GFCM Working Group on Eels (WGEEL). ICES Scientific Reports. 05:98. 138 pp. https://doi.org/10.17895/ices.pub.24420868

Editors

Caroline Durif • Jan-Dag Pohlmann

Authors

Elsa Amilhat • Tea Bašic • Marouene Bdioui Beaulaton • Claude Belpaire • Clarisse Boulenger • Cedric Briand • Karin Camara • Rui Catarino • Eleonora Ciccotti • Estibaliz Diaz • Tomas Didrikas • Isabel Domingos • Hilaire Drouineau • Caroline Durif • Derek Evans • Marko Freese • Jason Godfrey • Matthew Gollock • Edmond Hala • Reinhold Hanel • Jani Helminen • Per Holiland • Andrzej Kapusta • Michael Ingemann Pedersen • Katarzyna Janiak • Janis Kolangs • Linas Lozys • Lasse Marohn • Jonathan McDowell • Tomasz Nermer • Ciara O'Leary • Jan-Dag Pohlmann • Russell Poole • Argyrios Sapounidis • Torbjörn Säterberg • Josefin Sundin • Ayesha Taylor • Paul Teesalu • Eva Thorstad • Jeroen Van Wichelen • Tessa van der Hammen • Rob van Gemert • Sami Vesala • Jack Wootton • Sukran Yalcin Ozdilek

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i Executive summary

The Joint EIFAAC/ICES/GFCM Working group on eels (WGEEL) met in a split meeting from 4–8 September (online) and 25 September–02 October 2023 (hybrid meeting) in Helsinki, Finland, to provide the scientific basis for the ICES advice on fishing opportunities and conservation aspects for the European eel and address requests from EIFAAC and GFCM.

WGEEL assessed the state of the European eel and its fisheries, collated and analysed biometric data, reviewed the implementation of the WKFEA (Workshop on the future of eel advice) roadmap, examined available recruitment data from coastal and marine habitats, reported on any updates to the scientific basis of the advice, new and emerging threats or opportunities, including developments in the Mediterranean region.

After high levels in the late 1970s, the recruitment declined dramatically in the 1980s and remains low. Compared to 1960–1979, the recruitment in the "North Sea" was 0.4% in 2023 (provisional) and 0.7 % in 2022 (final). In the "Elsewhere Europe" index series was 8.8 % in 2023 (provisional) and 11.3% in 2022 (final). For the yellow eel data series, recruitment for 2022 was 9% (final). Time-series from 1980 to 2023 show that glass eel recruitment remains at a very low level, with an historical minimum value in the North Sea.

Silver eel time series have been analysed to identify patterns in abundance trends. These analyses are exploratory and have enabled us to test certain statistical methods and their limitations for analysing temporal series on silver eels. Although they give us an initial idea of trends in silver eel abundance, their results should be treated with caution. In fact, several problems have been identified and these points need to be improved in order to be able to interpret the results.

The trend of reported commercial landings shows a long-term continuing decline, from a level of around 10,000 t in the 1960s, reported commercial landings have now dropped to 2028 (glass eel + yellow eel + silver eel) in 2022. The commercial glass eel fishery in 2022 was 60.1 t and 53.6 t in 2023. Reported landings from yellow and silver eel commercial fisheries (Y, S, YS) add up to 2914 t in 2021 and 2437 t in 2022. Spain was the only country allowing a recreational catch of glass eel, with landings estimated at 0.72 t in 2022 and 1.32 t in 2023. Reported recreational landings for yellow and silver eel combined were 240 t for 2021 (11 countries reporting) and 249 t for 2022.

Progress with regards to the 'road map' developed within WKFEA was evaluated. The returns from the three questionnaires distributed by WKSMEEL to WGEEL members were summarised. In relation to the progress of the WKFEA roadmap, item 1; the inclusion of biological data is advanced with biometry data included in the annual data call. Item 2 relates to the reconstruction of the landings data and a workshop will take place in December 2023. Items 3 and 4 are also in progress, the Spatial database and Model for Eel (WKSMEEL) workshop was held in June 2023 with a follow up workshop planned for October 2023. A questionnaire for 3 topics (electrofishing, hydrographic network, and river obstructions & hydropower) was circulated to WGEEL members in August 2023. Of the 21 countries who responded, a large majority carry out electrofishing, have available hydrographic networks and hold some information of obstructions to migration. However, it was recognised that considerable effort and resources will be required before the available data could be collated.

ii Expert group information

Expert group name	Joint EIFAAC/ICES/GFCM Working Group on Eels (WGEEL)
Expert group cycle	Annual
Year cycle started	2023
Reporting year in cycle	1/1
Chair(s)	Caroline Durif, Norway
	Jan-Dag Pohlmann, Germany
Meeting venue(s) and dates	4-8 September 2023, digital, 21 participants
	25 September – 2 October 2023, Helsinki, Finland (hybrid), 46 participants

1 Introduction

1.1 Main Tasks

The **Joint EIFAAC/ICES/GFCM Working Group on Eels** (WGEEL), chaired by Caroline Durif, Institute of Marine Research, Norway & Jan-Dag Pohlmann, Thünen Institute, Germany, met in a split meeting from 4–8 September (online) and 25 September–02 October 2023 (hybrid meeting) in Helsinki, Finland, 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 2023 (from 24 countries) and 15 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

Thirty-three experts attended the meeting, representing 22 countries, along with an observer from the European Commission DG MARE.

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 2023 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. Two members from the UK mentioned a potential CoI due to their involvement in drafting a non-detriment finding (https://cites.org/eng/prog/ndf/index.php) concerning eel trade between the UK and 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 2023 and is due for another revision latest in 2026. 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 development into the "silver eel" stage, maturation and spawning migration. 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'). 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. Eel fisheries in EU waters are further regulated in Council Regulation (EU) No 2023/194 'Fishing Opportunities' and in the Commission Implementing Decision (EU) No 2018/1986 'Specific Control and Inspection Programme', amended by Commission Implementing Decision (EU) 2020/1320. Other EU legislation that has specific relevance to the European eel, in the context of ICES are Directive 2000/60/EC and 2008/56/EC, known as the Water Framework Directive (WFD) and Marine Strategy Framework Directive (MSFD), and Council Regulation (EC) No 338/97 which relates to trade in CITES-listed species. For details see the Stock Annex.

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" (RP) took place between September 2020 and February 2022, and involved nine Countries in the Mediterranean area. The programme's general objective has been 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. Scientific advice based on the RP outcomes were presented at WKMEASURES-EEL 2022, and at 23rd GFCM Scientific Advisory Committee for fisheries (SAC) in 2022. Recommendation GFCM/45/2022/1[1] was adopted in 2022, that acknowledged that SAC recommended strengthening existing transitional measures in 2022 while continuing work towards informing future long-term management measures for 2023.

Across 2022 and 2023, two workshops were held in the framework of the Small–Scale Fishers' Forum (SSF), one held in Sète, France (14 April 2022), within the International Year of Artisanal Fisheries and Aquaculture (IYAFA), and one in Orbetello, Italy (28 February – 2 March 2023)[2]. The aim of these workshops, "Connecting scientists and fishers in the process towards data collection and management of European eel in the Mediterranean", was to enhance the interactions between scientists and fishers for European eel in the Mediterranean, and dissemi-nate the scientific advice emerging from the GFCM research programme on European eel (RP) and the GFCM scientific advisory committee (SAC). Among the outcomes of the workshop in Orbetello, GFCM Secretariat explained that, while the first phase of the research programme on European eel had ended, a second phase had been foreseen. This second phase foresees carrying out, among other things, a socio-economic survey in 2023 to capture a snapshot of the economic status of the European eel fishery in the Mediterranean, prior to the entry into force of the latest GFCM Recommendation. The information collected through this socioeconomic study is fore-seen to serve as baseline information, facilitating understanding of the socioeconomic impacts of the management measures and facilitating consideration of economic issues by fishery manag-ers when taking decisions. In 2023, the study was piloted in a few select sites with select fishing cooperatives, in order to better refine and adapt the methodology to the realities of eel fisheries in the region.

Following the meeting of the GFCM Expert Group on European eel in the Mediterranean (EGE-Med) (FAO headquarters, Rome, Italy, 8–9 June 2023), some activities were proposed, presented at and approved at 24th GFCM Scientific Advisory Committee for fisheries (SAC) in 2023.

The activities proposed are a) advances towards the implementation of a "Socioeconomic study of European eel fisheries in the Mediterranean Sea", stressing the importance of producing a baseline of regional socioeconomic indicators (e.g. revenue and costs, employment, profitability, debts, subsidies, investments and demographic information) to capture the status of the fishery prior to the entry into force of the GFCM long-term management measures. b) a "Roadmap

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[1] Recommendation GFCM/45/2022/1 on a multiannual management plan for European eel in the Mediterranean Sea, amending Recommendation GFCM/42/2018/1

[2] GFCM. 2022. Small-Scale Fisheries' Forum: Workshop "Connecting scientists and fishers in the process towards data collection and management of European eel in the Mediterranean" (Sète, France, 14 April 2022) - Conclusions. (https://www.fao.org/gfcm/activities/fisheries/small-scale-fisheries/ssfforum/en/

GFCM, 2023. Small-Scale Fisheries' Forum: Connecting scientists and fishers in the process towards data collection and management of European eel in the Mediterranean (Orbetello, Italy, 28 February – 2 March 2023) - Conclusions. (https://www.fao.org/gfcm/activities/fisheries/small-scale-fisheries/ssfforum/en/

2023-2024 to inform a long-term management plan for eel in the Mediterranean", aiming at identify-ing a possible toolbox or suite of potential management measures to ensure the conservation of European eel while maintaining some level of fisher employment/revenue.

From the methodological point of view, the approach employed to identify potential measures will follow the one used in the first phase Research Programme (RP), that resulted in an appraisal of contribution of different existing or potential management scenarios to the recovery of European eel stock for the Mediterranean area. In the 2023-2024 Roadmap, such model-based appraisal of management scenarios will be further explored by a multi-objective assessment aiming at performing a Management Strategy Evaluation (MSE), with the prospect of providing the 25th SAC in 2024 with elements to inform future long-term measures for European eel in the Mediterranean.

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 (CITES, 2022a). 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 (IUCN, 2022). 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 (CMS, 2018). 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 (OSPAR, 2014). The status of European eel was reassessed within OSPAR in 2022 (OSPAR, 2022). The Baltic Sea Action Plan (BSAP) of the **Baltic Marine Environment Protection Commission (HELCOM**) contains several targets for the European eel (HELCOM, 2007, updated in 2021). The overarching objectives of the **Ramsar Convention on Wetlands** of International Importance (the international treaty for the conservation and sustainable use of wetlands) are to stem the loss and progressive encroachment on **wetlands - an important European eel habitat** - now and in the future (UN, 1976). Most EU Member States are Contracting Parties, hence the wetlands protected under this Convention will benefit eel population. 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 for 2022 (ICES and EU, 2022a, b). 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 2023, 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 UK exited the EU, 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.

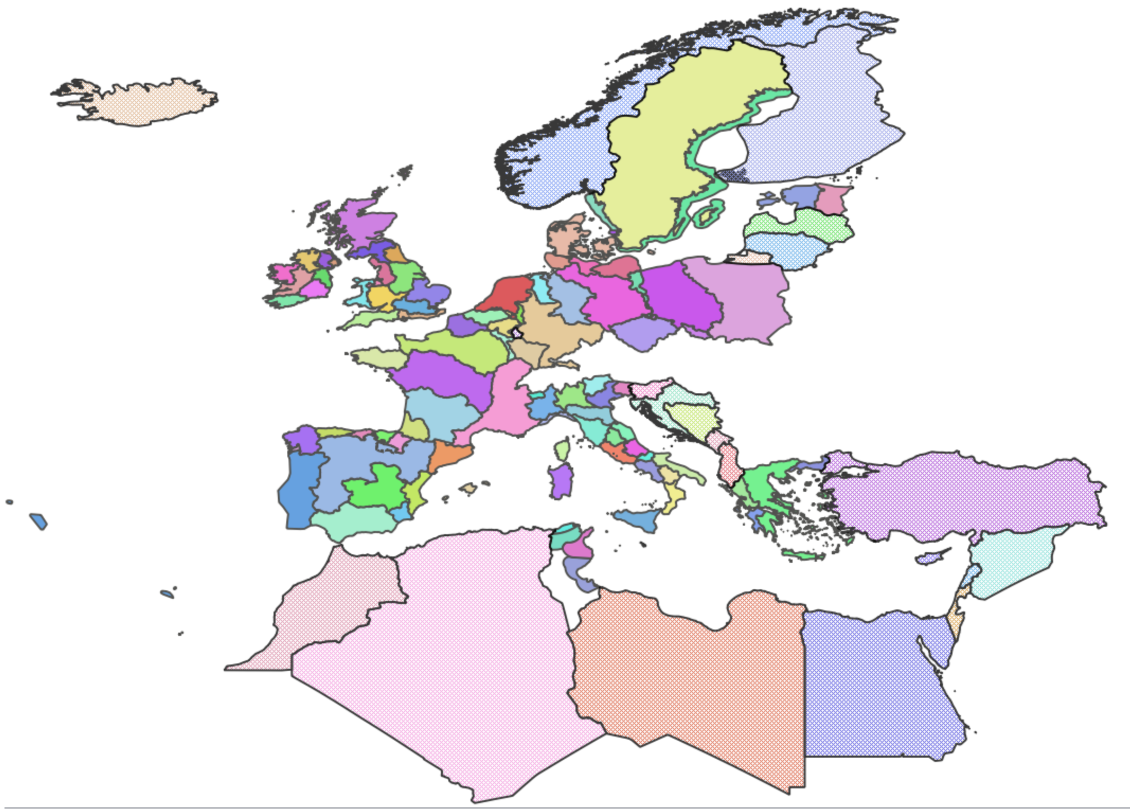


Figure 1.1. Current map of Eel Management Units (EMUs) as reported by countries or corresponding to national entities where no EMU is described at the national level.

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.

A description of data collection and methods used establish silver eel escapement and mortality is further detailed in the report on the technical evaluation of EU member states' progress reports for submission in 2021(WKEMP 3; ICES, 2022a).

The ICES Study Group on International Post-Evaluation of Eel (SGIPEE) (ICES, 2010; 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, 2021a) 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 2023 Data Call, data on recruitment up to 2023, and fishery landings, recreational landings, aquaculture production, restocking, yellow eel abundance and silver eel escapement time-series and up to 2022, including biometry were requested. The call also required the provision of metadata associated with all data.

The Data Call consists of excel spreadsheets that are further incorporated in the WGEEL database using the shiny data integration tool. It first comprises time series. Recruitment series (Data Call Annex 1) include series made of glass eel (G), a mixture of glass eel and young yellow eel series (GY) and yellow eel migrant (Y) series. Yellow eel (Y) standing stock time series (as opposed to migrant (Y) time series in Data Call Annex 1) are collected in Data Call Annex 2. Silver eel annual time series are collected in Data Call Annex 3. Data Call Annexes 1, 2 and 3 collect annual numbers but also gather information about annual metrics collected for the series (group metrics like average length and weight) and individual data on biometry, contamination, parasites and pathogens.

The Data Call also collects information on commercial landings (Data Call Annex 4), recreational landings (Data Call Annex 5), and other landings (Data Call Annex 6). 'Other landings' are used to gather information about eel collection prior to their subsequent release. For instance, eel can be caught or trapped in one EMU and then released in another EMU. Since the release of those eels will be used in the national and foreseen international assessment of the stock, they are also removed from the stock in another place, and Data Call Annex 6 is the place for those eels when the collection is not covered by the commercial landings (which remains the source of most glass eel releases). Data call Annexes 4, 5, 6 cover different stages, glass (G), yellow(Y), a mixture of yellow and silver eel (YS) and silver eel data (S).

Release (Data Call Annex 7) covers data about eel releases, the range of stages available is wider than in previous annexes and can cover G, QG (quarantined glass eel), OG (ongrown eel), GY (mixture of glass and yellow), Y (yellow), YS (yellow and silver) and S (silver). Aquaculture data are covered in Data Call Annex 8 and analysed by WGEEL because eels are first collected from the stock before going to aquaculture.

Data Call Annex 9 was not reported this year. It comprises information about biomass and mortality indicators.

Data Call Annex 10 reports data on sampling either from the DCF or other sources. The format of group and individual metrics is the same as in Data Call Annex 1 to 3 (time series) but the location of each fish collection, and information of the date (possibly rounded to year when not available) and details about the sampling scheme are provided.

1.9 Address the generic TORs from ICES, and any requests from EIFAAC or GFCM

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

A detailed review of ecosystem and fisheries overviews with a list of comments was provided in 2020. There are 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 impacts on fisheries

See 'Emerging threats' in Chapter 3

ii) descriptions of developments and recent changes to the fisheries

*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 North East Atlantic and the Mediterranean Sea and was rolled over to 2020, 2021, and to 2022 with some specifications (e.g. EU Council 2022a,b). Under the 2023 rules the closure period for commercial eel fisheries in marine and brackish waters have been extended from 3 to 6 months and the recreational fisheries have been prohibited (*Council Regulation (EU) No 2023/194*). Each Member State concerned needed to determine the closure period according to the rules specified in the Regulation to ensure that the prohibition is consistent with the conservation objectives set out in Regulation (EC) No 1100/2007, with national management plans in place and with the temporal migration patterns of European eel at the respective life stage in the Member State concerned.*

iii) mixed fisheries considerations, and

No new information is available for eel as a bycatch in marine fisheries. And in addition in general not considered a significant issue.

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

In November 2022 ICES advised that given the uncertainties and potential harmful effects (ICES 2016), and following the precautionary approach, any catch for restocking should not be allowed.

c) Conduct an assessment on the stock(s) to be addressed in 2022 using the method (assessment, forecast or trends indicators) as described in the stock annex; - complete and document an audit of the calculations and results; 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.

See report 2022

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

See report 2022

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 2021.

There is no eel fishing in the NEAFC area. 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.

iv) For category 3 and 4 stocks requiring new advice in 2023, implement the methods recommended by WKLIFE X (e.g. SPiCT, rfb, chr, rb rules) to replace the former 2 over 3 advice rule (2 over 5 for elasmobranchs). MSY reference points or proxies for the category 3 and 4 stocks

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, 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;

see Chapter 2 (ICES,2021b) and ICES (2022a).

1) for category 1 and 2 stocks, in addition to the other relevant model diagnostics, the recommendations and decision tree formulated by WKFORBIAS (see Annex 2 of https://www.ices.dk/sites/pub/Publication%20Reports/Expert%20Group%20Report/Fisheries%20Resources%20Steering%20Group/2020/WKFORBIAS_2019.pdf) should be considered as guidance to determine whether an assessment remains sufficiently robust for providing advice.

2) If the assessment is deemed no longer suitable as basis for advice, consider whether it is possible and feasible to resolve the issue through an interim benchmark. If this is not possible, consider providing advice using an appropriate Category 2 to 5 approach.

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 for 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.

No reference points are defined for eel. For the time being, the 1960-1979 recruitment is considered as a likely limit reference point (R_{lim}; e.g. chapter 2 & ICES, 2023).

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;

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 and will conclude in 2024.

viii) Historical and analytical performance of the assessment and catch options with a succinct description of associated quality issues. For the analytical performance of categories 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.

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 using a different analytical approach (GEREM; ICES, 2019). No catch options have been proposed so there is nothing to review.

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

i. In the section 'Basis for the assessment' under input data match the survey names with the relevant "SurveyCode" listed ICES survey naming convention *(restricted access)* and add the "SurveyCode" to the advice sheet.

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 in SID;
ii) review progress on benchmark issues and identify potential benchmarks to be initiated in 2023 for conclusion in 2024;

iii) determine the prioritization score for benchmarks proposed for 2023–2024;
iv) as necessary, document generic issues to be addressed by the Benchmark Oversight Group (BOG)

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. An earlier benchmark for the current assessment will be explored intersessionally.

f) Prepare the data calls for the next year's update assessment;

A workshop will be held in 2024 to develop the data call.

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

See chapter 4 (ICES, 2021a) and ICES (2021b). In this report see chapter 3 & 4.

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

Information was updated according to WKFEA roadmap.

h) 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.

A spreadsheet was provided in 2020.

2 Stock assessment

This section of the report also relates to ToRs A, D & 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 yellow eel (dominated by recruits from the current year) and yellow eel series.
- The application of a GLM to describe trends in recruitment.
- Updated Trends in Fisheries and landings.
- Information on Releases of eel (restocking activity and assisted migrations).
- Trends in aquaculture.
- Silver eel time series analysis to identify patterns in abundance's trends

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

2.1 Recruitment

2.1.1 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 :

- G: glass eel recruiting to continental waters, corresponding to the 0+ cohort age group but also including some pigmented eel.
- GY: a mixture of glass eel and yellow eel dominated by recruits from the same year
- Y: yellow eel recruiting to continental habitats. The yellow eel series might consist of yellow eel of several ages. This is 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: 'continental North Sea' (NS) and 'Elsewhere Europe' (EE) (Fig. 2.1). Previous analyses by the working group (ICES, 2010, p19, Bornarel et al. (2017) have shown a different trend between the two sets. This is mostly due to 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 103 time-series (Fig. 2.1). 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 81 have been selected to calculate the WGEEL recruitment indices; see details on data selection and processing below. Depending on the standardization period, the number of series used can be lower and is given for each analysis.

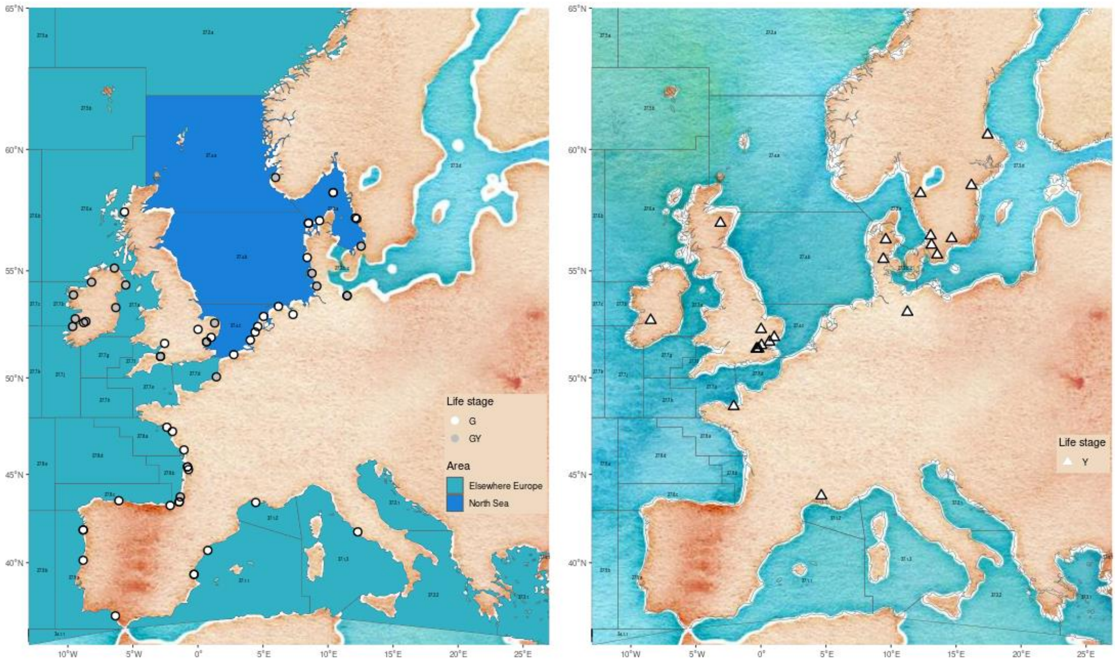


Figure 2.1. Map of recruitment sampling stations currently used to build the GLM trend models: G and GY model on the left (that includes an Area effect), Y model on the right.

2.1.2 Details on data selection and processing

Out of the 103 series that were compiled in the Data Call, 81 meet the required conditions to be used in the analysis to calculate the recruitment indexes. 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 data series will be included when the total number of "good" years of data meets the 10-year criterion. 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, it was decided to discard recruitment series that were obviously biased by restock- ing (e.g. Farpener Bach in Germany).

The following series have been left out due to the reasons mentioned above: InagG (IE), PogoG (IT), PovoG (IT), EmsBGY (DE), SeHMG (GB), ShiFG (GB), MiScG (PT), MondG (PT), TibnG (IT), EmsHG (DE), WaSG (DE), VeAmG (BE), BroGY (GB), CorGY (IE), EmsBGY (DE), FarpGY (DE), FlaGY (GB),HHKGY (DE), HoSGY (DE), LangGY (DE), BroGY (GB), FlaGY (GB), MeusY (BE), VeAmY (BE),MiSpY (ES), VeAmY (BE) and WaSEY (DE). See Annex 10, table 3 for the reasons for which the series have been excluded for the recruitment analysis.

Number of series available (details can be found in Annex 10):

The WGEEL has collated information on recruitment from 103 time-series (Table 2.1. fig. 2.2). Among those series, 81 have been selected for further analysis. For the calculation of the glass eel recruitment index, 60 series have been retained (39 glass eel series and 21 glass and yellow eel mixed series), from which 34 came from NS and 26 from EE (see Annex 10, table 1). For the calculation of the yellow eel recruitment index, 21 yellow eel series have been retained, most of the retained yellow eel series (18) coming from the North and Baltic Sea regions (see Annex 10 table 2).

Twenty time-series were updated to 2023 (3 for glass eel 7 for glass + yellow eel and 10 for yellow eel) and 2 yellow time-series were updated to 2022.

In 2023, four new series were added to the recruitment trend analysis: two GE (MondG (PT), ShiMG (GB)) and two GY OatGY(GB), SousGY(FR)) series.

Among the time-series based on trap indices, some have reported preliminary data for 2023 as their trapping season had not finished. As usual, the indices given for 2023 must be considered as provisional, especially those for the yellow eel.

Twelve glass eel time series have been stopped or not updated beyond 2016 but are still included in the analysis. Some have stopped reporting either because of a lack of recruits in the case of the fishery-based surveys (Ems in Germany, stopped in 2001; Vidaa in Denmark, stopped in 1990), a lack of financial support (the Tiber in Italy, 2006) or the introduction of quota from 2008 to 2011 that has disrupted the five fishery-based French time-series..

Table 2.1: Summary of the number of series that have been received (2023 Data Call) and incorporated (kept) for the determination of the recruitment index by area and stage. Life stage: GY = glass eel and yellow eel, G = glass eel, Y = yellow eel Area: EE = Elsewhere Europe, NS =North Sea

Life-stage	Area	Submitted	Kept
G	EE	29	22
	NS	20	17
	Total	49	39
GY	EE	13	12
	NS	16	9
	Total	29	21
Y	Total	25	21
TOTAL		**103**	**81**

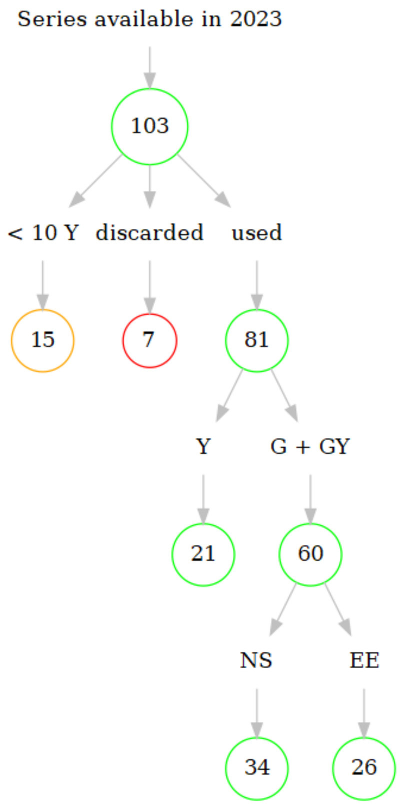


Figure 2.2. Schematic showing the recruitment series available by type and region, and numbers selected for analysis. Y = Yellow eel, G = Glass eel, GY = mixed Glass and yellow eel. NS = North Sea (including Baltic), EE = Elsewhere Europe regions.

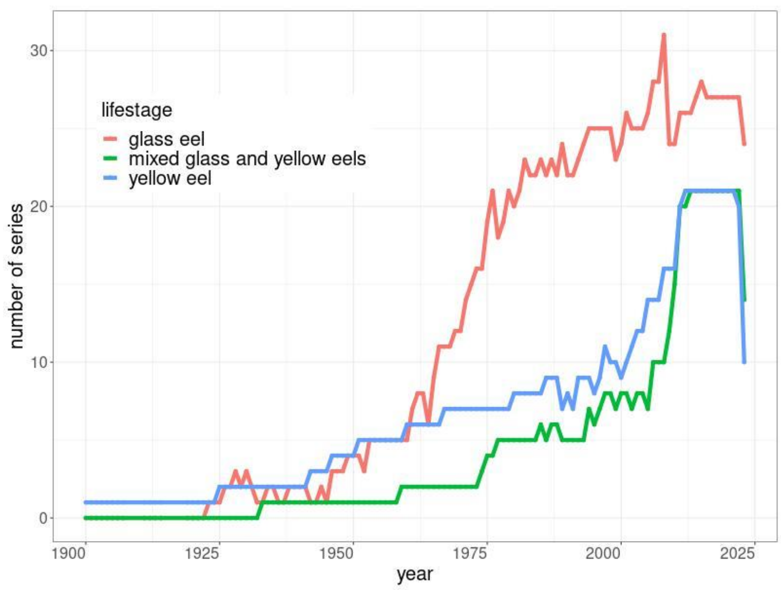


Figure 2.3. Temporal trends in the number of series that have been kept to perform the recruitment analysis per stage. Note that the number of 2023 series is not final as the year has not yet ended and there are still series to be reported.

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 (Figure 2.3 & 2.4). Thus, most of the glass eel series come from the Atlantic while the yellow eel series come from the Baltic and the North Sea.

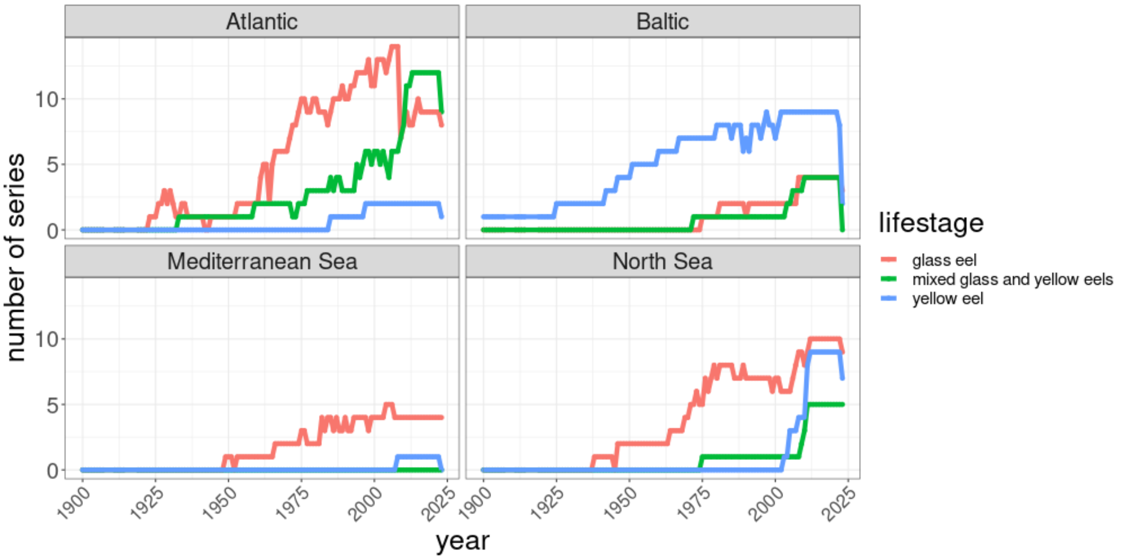


Figure 2.4. Temporal trends in the number of series that have been kept to perform the recruitment analysis per stage and area. Note that the number of 2023 series is not final as the year has not yet ended and there are still series to be reported.

2.1.3 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* is the individual glass eel time-series, including both pure G series and those identified as a mixture of glass and yellow eel (GY),
- *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 60 glass eel time-series and from 1950 onwards for 21 yellow eel time-series. Some zero values have been excluded from the GLM analysis: 21 for the glass eel model and 42 for the yellow eel model. This treatment has been tested and 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 data series on glass and yellow eel recruitment are not complete for this year at the date of submission to WGEEL. Therefore, each year the recruitment index is updated when the complete data from the previous year is available. Thus, in the case of the glass eel series, the recruitment of 2022 has been recalculated from 9.7% to 11.3% in the Elsewhere Europe series (Table 2.2). For the North Sea, recruitment for 2022 has been recalculated from 0.5 % to 0.7.%

Analyses of provisional 2023 data show recruitment as a percentage of 1960-1979 levels at 0.4 % in the North Sea, reaching its historical minimum, and 8.8 % in elsewhere Europe. (Figure 2.5; Table 2.2).

Table 2.2. Annual WGEEL recruitment index for the continental North Sea (NS) and Elsewhere Europe (EE). The index was estimated using a GLM (glasseel ~ area : year + site) fitted on 60 time-series comprising either pure glass eel or a mixture of glass eels and yellow eels.

	1960		1970		1980		1990		2000		2010		2020	
year	EE	NS	EE	NS	EE	NS	EE	NS	EE	NS	EE	NS	EE	NS
0	153.5	207.6	101.5	96.4	112.7	84.4	35.2	14.0	19.0	4.3	4.6	0.7	7.9	0.8
1	132.1	116.4	55.4	84.3	88.3	61.3	17.3	3.1	8.4	0.9	3.7	0.5	6.0	0.6
2	151.3	177.7	50.0	108.0	90.9	31.2	22.0	7.1	12.9	2.3	5.0	0.5	11.3	0.8
3	194.8	222.7	55.3	46.5	48.6	25.6	24.1	6.4	12.5	1.7	7.3	1.7	8.8	0.4
4	121.8	116.0	82.6	129.5	53.9	9.8	23.5	6.3	7.1	0.6	11.4	2.4		
5	135.3	76.8	71.2	53.3	52.1	8.1	31.0	4.5	7.7	1.0	6.8	0.8		
6	75.8	87.0	116.2	96.9	33.7	7.9	24.6	4.6	5.6	0.5	10.0	1.6		
7	80.9	95.8	114.2	77.5	58.4	9.7	40.5	4.0	6.4	1.2	10.7	1.1		
8	128.4	122.6	109.4	60.0	68.7	8.9	16.1	2.7	5.6	1.1	9.7	1.7		
9	67.4	88.3	144.1	102.9	43.6	4.0	20.1	5.5	4.3	0.8	5.9	1.3		

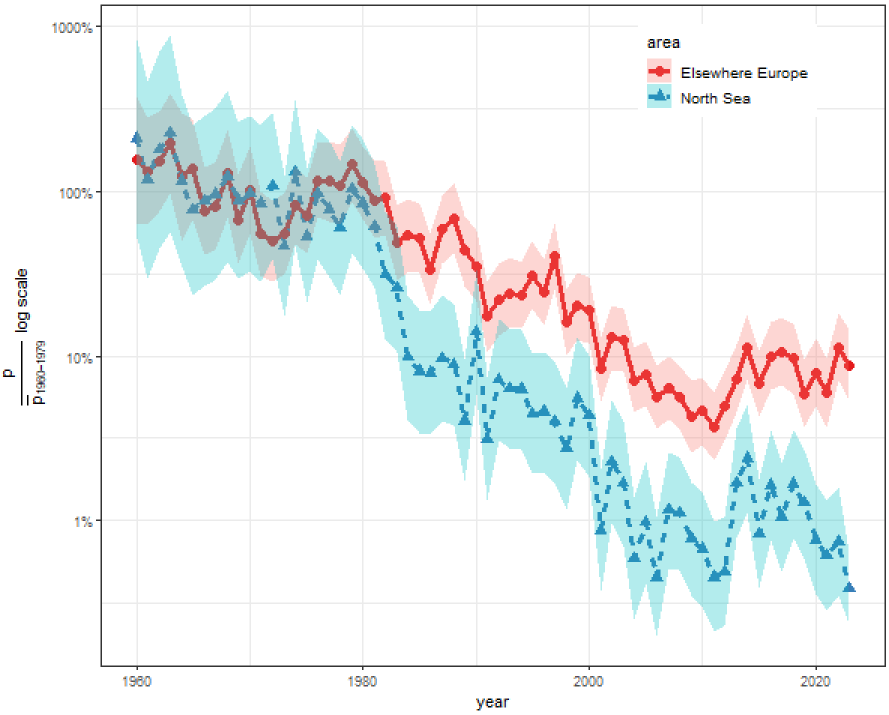


Figure 2.5. WGEEL glass eel recruitment index for the continental North Sea and Elsewhere Europe series with 95 % confidence intervals updated to 2023. The index was estimated using a GLM (*glasseel ~ area* : *year* + *site*) fitted on 60 time-series comprising either pure glass eel or a mixture of glass eels and yellow eels. Note the logarithmic scale on the y-axis. Number of series Elsewhere Europe = 34, North Sea = 26.

For yellow eel series, the autumn ascent has not been recorded yet and most of the series have only reported data till the middle of the summer. The 2022 yellow eel index is at 9% of the 1960-1979 baseline (Fig. 2.6).

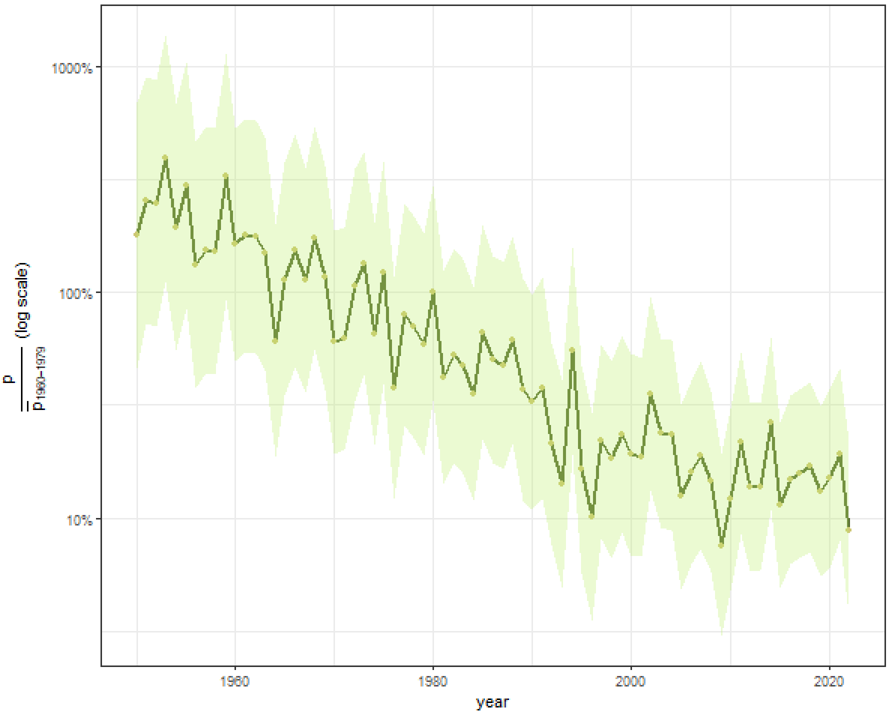


Figure 2.6. Geometric mean of of estimated yellow eel recruitment for Europe updated to 2023. The yellow recruitment was estimated using a GLM (*yellow eel ~ year*) fitted to 21 yellow eel time-series *p* scaled to the 1960-1979 average $p_{1960-1979}$. Note the logarithmic scale on the y-axis.

Table 2.3. Annual geometric mean of estimated yellow eel recruitment for Europe updated to 2023. The yellow recruitment was estimated using a GLM (*yellow eel ~ year)* fitted to 21 yellow eel time-series *p* and scaled to the 1960-1979 average $p_{1960-1979}$.

year	1950	1960	1970	1980	1990	2000	2010	2020
0	179	164	60	100	33	19	12	15
1	257	179	62	42	38	19	22	19
2	248	176	108	53	21	36	14	9
3	393	149	135	47	14	24	14	
4	194	61	65	35	55	23	26	
5	300	114	123	67	17	12	11	
6	133	154	38	51	10	16	15	
7	154	113	79	48	22	19	16	
8	152	173	70	62	18	15	17	
9	329	116	59	37	24	8	13	

2.1.4 Conclusion

The status of European eel remains critical. Indices of both glass and yellow eel recruitment strongly declined from 1980 to 2011. Index values correspond to the recruitment as a percentage of the 1960–1979 geometric mean. Glass eel recruitment in the "North Sea" index area was 0.4% in 2023 (provisional) and 0.7% in 2022 (final). In the "Elsewhere Europe" index series it was 8.8% in 2023 (provisional) and 11.3% in 2022 (final). The yellow eel recruitment index for 2022 was 9% (final) of the 1960–1979 geometric mean. Time-series from 1980 to 2023 show that eel recruitment remains at a very low level.

2.2 Trend in fisheries

This section presents and describes data from commercial, recreational and non-commercial fisheries of eel. Data can be reported by eel life stage (glass, yellow, silver), habitat type (freshwater, transitional, coastal) and by eel management unit (EMU) where available. 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 2023 Data call, in Country Reports, or integrated in previous WGEEL data calls.

2.2.1 Commercial fisheries landings

Landings data come from the 2023 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, 2003I), 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.

Care should be taken with the interpretation of landings as stock indicators since the catch statistics now reflect the status of reduced fishing activity as well as stock levels. In summary, reported commercial landings are declining, a long-term continuing trend, from a level of around 10,000 t in the 1960s, reported commercial landings have now dropped to 2028 t (glass eel + yellow eel + silver eel) in 2022.

2.2.1.1 Glass eel

Figure 2.7 presents the time-series up to and including 2023 for total commercial glass eel landings as reported by five countries in the Eel data call (GB, FR, PT, ES, IT).

Glass eel landings have declined since 1980, from 1500 t to approximately 50 t from 2009 onwards. The commercial glass eel fishery in 2022 was 60.1 t and decreased to 53.6 t in 2023 (GB, FR, PT, ES). The mean glass eel commercial fisheries landings for the previous five years (2017–2021) was 59.1 t.

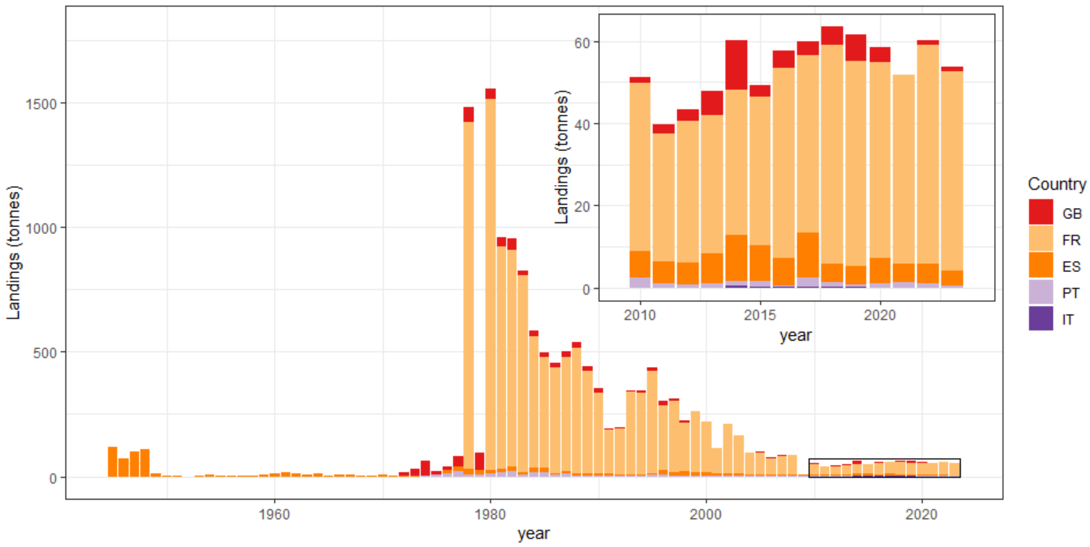


Figure 2.7. Time-series of reported commercial glass eel fishery landings (tonnes), by country. United Kingdom (GB), France (FR), Spain (ES), Portugal (PT) and Italy (IT) are included combining information from the Data call 2023 and the WGEEL database updated to 2023. The Portuguese catches correspond to glass eel catches from the Portuguese side of the Miño river. Catches from the Spanish side of the Miño river are included in the Spanish catches.

2.2.1.2 Yellow and silver eel

Figure 2.8. presents data for yellow and silver eels aggregated coming from 23 countries and Figure 2.9 presents the time-series including reconstructed data to fill the gaps. The proportion of "corrected" landings was as high as 50% in the 1950s, but rather low since the mid-1980s. The total landings (including reconstructed) of yellow and silver eels decreased from 18000–20000 t in the 1950s to 2000–3500 t since 2009. Reported landings from yellow and silver eel commercial fisheries (Y, S, YS) add up to 2202 t in 2021 and 1968 t in 2022. Yellow and silver eel commercial fisheries averaged 2663 t over the previous five years (2016–2020). There are a number of fisheries data series that are not included in the landings presentations e.g. Morocco glass eel catch (CITES, 2022). As such, there is an opportunity to make the landings data more comprehensive.

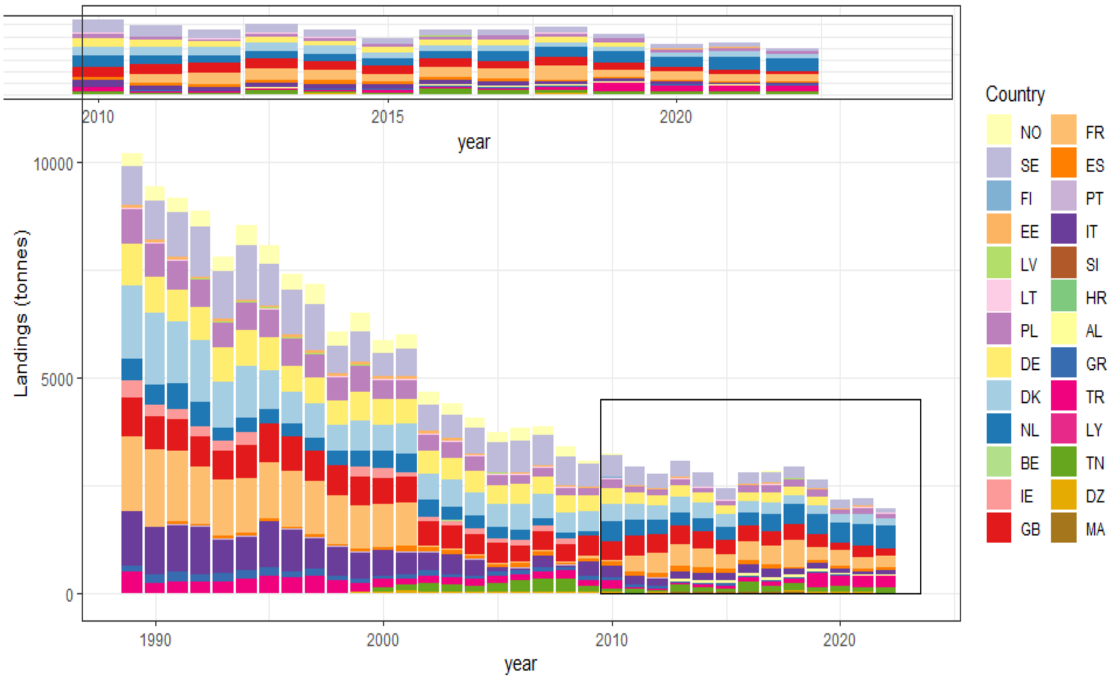


Figure 2.8. Time-series of reported commercial yellow (Y), silver (S) and yellow-silver (YS) eel fishery landings (tonnes) 1908-2022, by country, Norway (NO), Sweden (SE), Finland (FI), Estonia (EE), Latvia (LV), Lithuania (LT), Poland (PL), Germany (DE), Denmark (DK), Netherlands (NL), Ireland (IE), United Kingdom (GB), France (FR), Spain (ES), Portugal (PT), Italy (IT), Slovenia (SI), Croatia (HR), Albania (Al), Greece (GR), Türkiye (TR), Libya (LY), Tunisia (TN) ,Algeria (DZ), and Morocco (MA) combining information from the 2023 Data call and the WGEEL database updated until 2022.

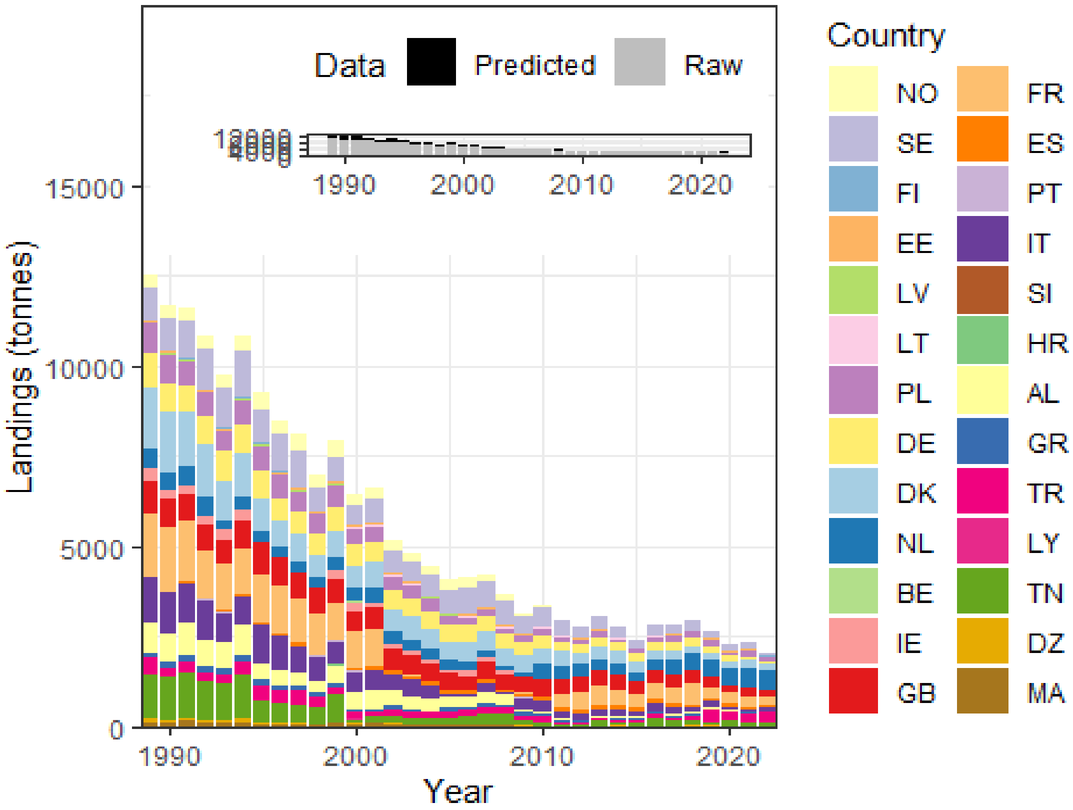


Figure 2.9. Time-series of reported or reconstructed commercial yellow and silver eel fishery landings (tonnes), by country, Norway (NO), Sweden (SE), Finland (FI), Estonia (EE), Latvia (LV), Lithuania (LT), Poland (PL), Germany (DE), Denmark (DK), Netherlands (NL), Ireland (IE), United Kingdom (GB), France (FR), Spain (ES), Portugal (PT), Italy (IT), Slovenia (SI), Croatia (HR), Albania (Al), Greece (GR), Türkiye (TR), Libya (LY), Tunisia (TN) ,Algeria (DZ), and Morocco (MA) combining information from the Data call 2023 and the WGEEL database updated to 2022 and a reconstruction of the non-reported countries/years combinations. The inset box shows the proportion of reconstructed landings per year.

2.2.2 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 popular while in others, passive gear, such as fyke nets, may be used to catch eel for personal consumption (e.g. Denmark). In other countries (e.g. UK, Portugal, Sweden, Norway), this is forbidden and all accidently caught eels must be returned alive. Recreational fisheries for glass eel continue to exist in Spain, while the former recreational glass eel fisheries in France were forbidden in 2010.

Figure 2.10 presents data available to the WGEEL on recreational landings for glass eel from two countries: Spain and France. Spain is currently the only country allowing a recreational catch of glass eel, with landings estimated at 0.72 t in 2022 and 1.32 t in 2023.

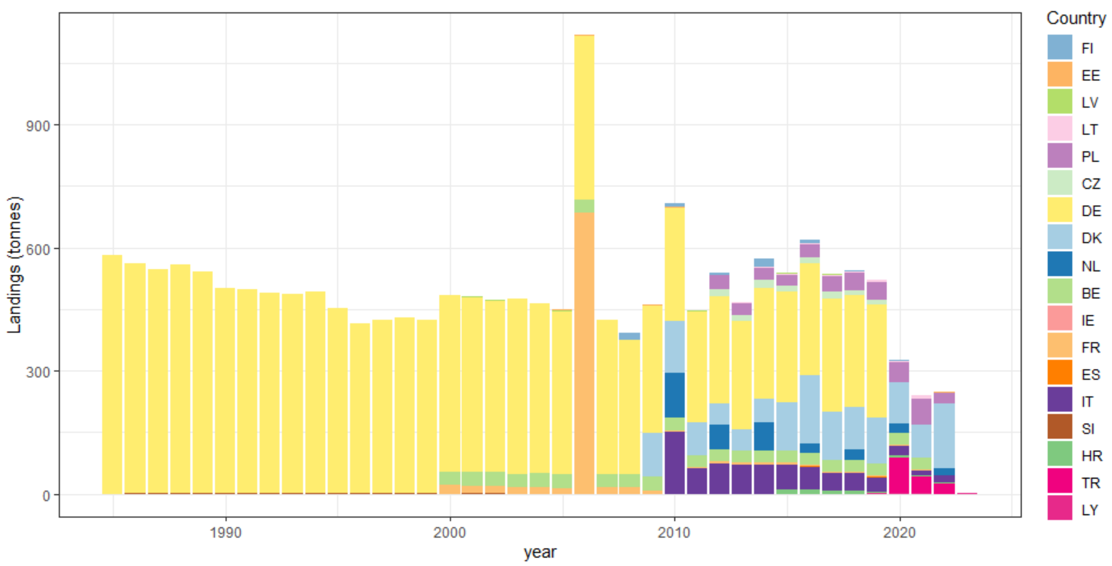


Figure 2.11. Time-series of reported or reconstructed recreational yellow and silver eel fishery landings (tonnes), by country. Finland (FI), Estonia (EE), Latvia (LV), Lithuania (LT), Poland (PL), Czech Republic (CZ) Germany (DE), Denmark (DK), Netherlands (NL), Belgium (BE), Ireland (IE), France (FR), Spain (ES), Italy (IT), Slovenia (SI), Croatia (HR), Türkiye (TR) and Libya (LY).

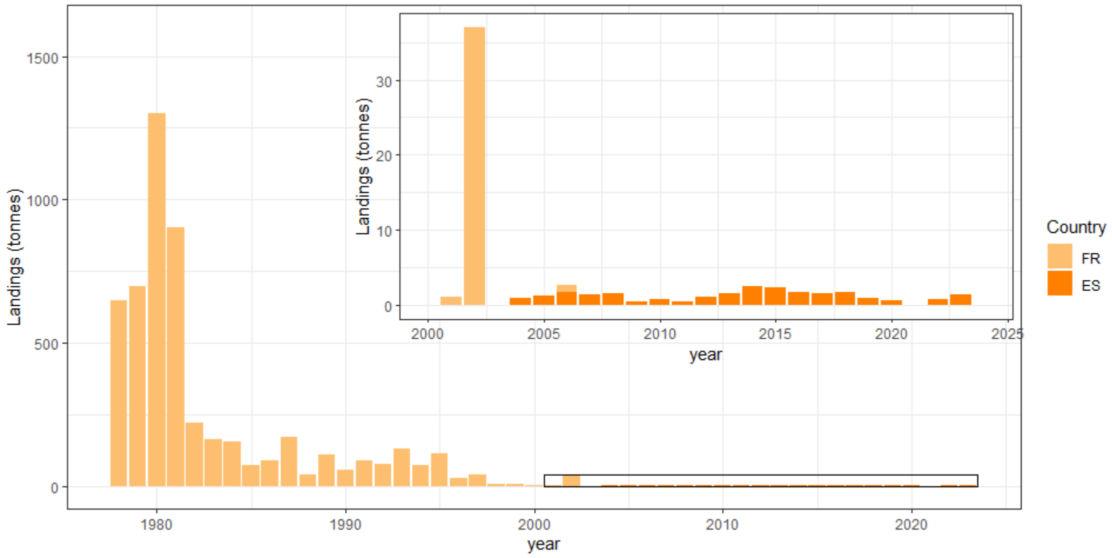


Figure 2.10. Time-series of reported recreational glass eel fishery landings (tonnes), 1978-2023, by country France (FR) and Spain (ES)

Figure 2.11 presents the data available on recreational landings of yellow and silver eel combined. Recreational landings for yellow and silver eel combined were 240 t for 2021 (11 countries reporting) and 247 t for 2022 (18 countries reported). FR has provided estimation for all freshwater recreational fisheries in 2006, while for other years FR provided 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 (2016–2020) was 509 t.

2.2.3 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. 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 many news reports during recent years. In addition, illegal eel trade from range states is an issue of concern for CITES (https://cites.org/sites/default/files/documents/SC/77/agenda/E-SC77-66.pdf). 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.

2.3 Releases

2.3.1 Releases (G + QG) and other landings (G)

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). To futher complicate the matter, displacements of eel can range from a few metres within the same waterbody (i.e. assisted migration to bypass an obstacle), to eel being moved between waterbodies and/or EMUs.

There are still inconsistencies and variations in how countries report these displacements. Therefore, the WGEEL broadly categorizes them as "releases", though the term "restocking" is still used here in some circumstances.

Restocking of glass eel peaked during 1980s and was followed by a decline to a low level in 2009 (Figures 2.12 & 2.13). The amount of restocked glass eels has increase since 2010 with high numbers in 2014, 2018 and 2019 when the lower market prices guaranteed a larger number of glass eels could be purchased for fixed restocking budgets. The number of glass eels (G, QG) released in 2021 = 19.78 million (Number of countries reporting: 10). The number of yellow eels (Y) released in 2020 = 0.09 million (1 country reporting). The number of silver eels (S) released in 2022 = 0.35 million (7 countries reporting).

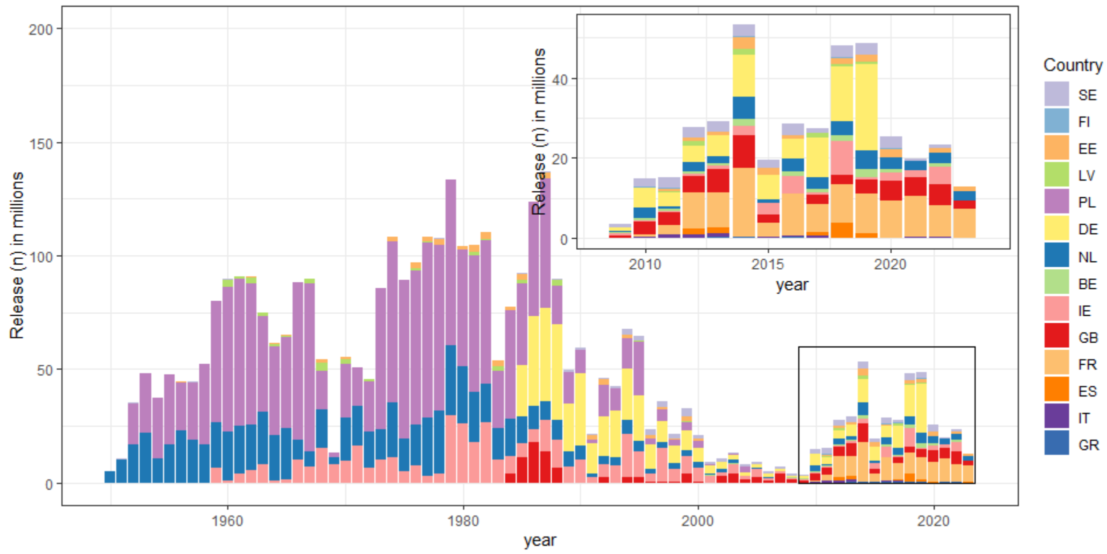


Figure 2.12. Reported releases of glass eel (G) in millions per country: Finland (FI), Sweden (SE), Estonia (EE), Latvia (LV), Poland (PL), Germany (DE), Netherlands (NL), Belgium (BE), Ireland (IE), United Kingdom (GB), France (FR), Spain (ES), Italy (IT) and Greece (GR). Inset shows years since 2009 at greater resolution.

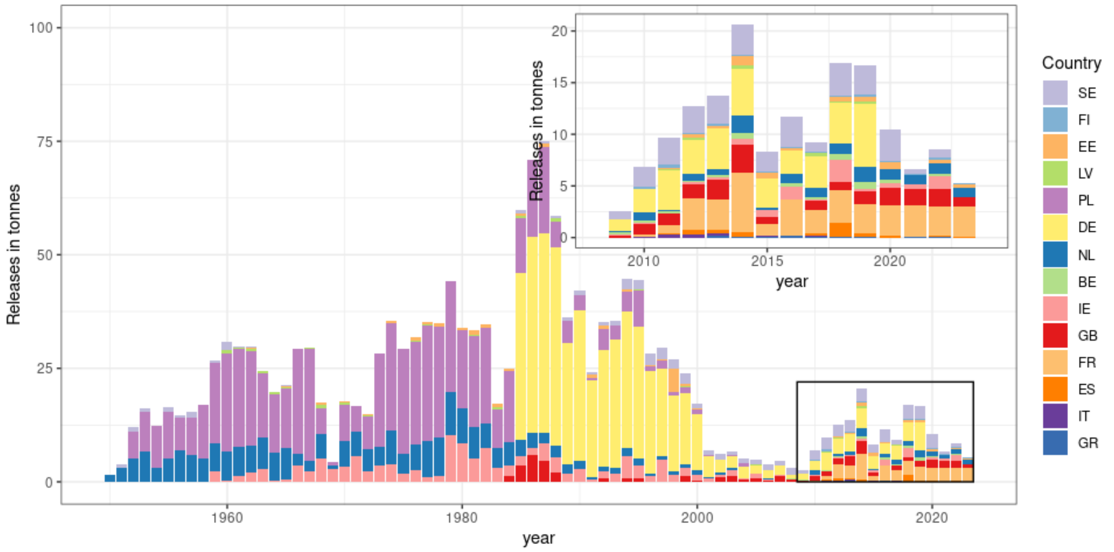


Figure 2.13. Reported releases of glass eel (G) in tonnes per country: Sweden (SE), Estonia (EE), Latvia (LV), Poland (PL), Germany (DE), Netherlands (NL), Belgium (BE), Ireland (IE), United Kingdom (GB), France (FR), Spain (ES), Italy (IT) and Greece (GR). Inset shows years since 2009 in greater resolution.

Translocation within an EMU to mitigate the impact of barriers to migration (Fig 2.14 & 2.15). were only reported by Ireland (since 1959, by numbers and mass) and the United Kingdom (since 1996, by mass only).

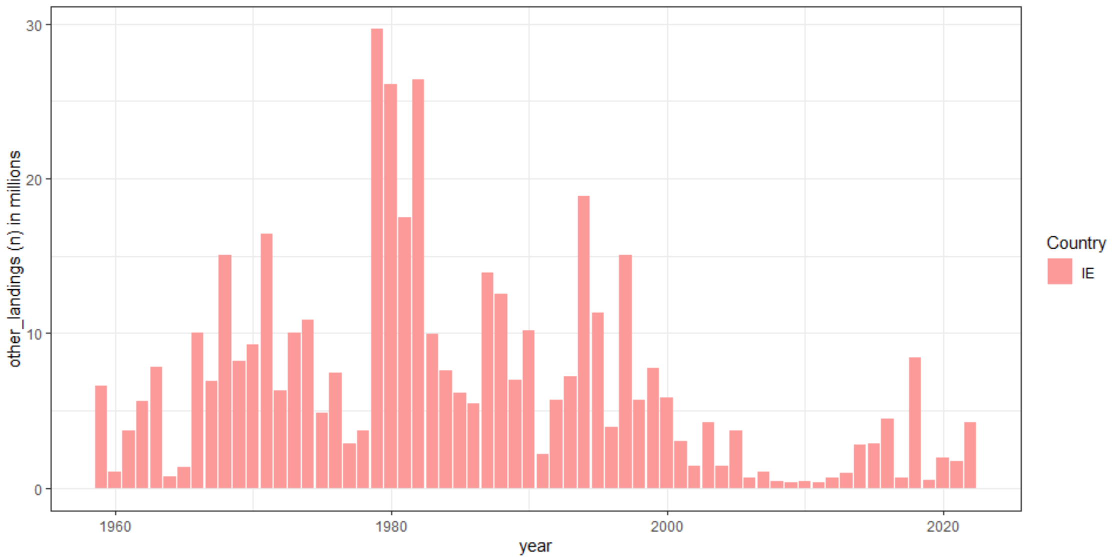


Figure 2.14. Other landings of glass eel (glass eel caught for transport operations, so not in formerly reported commercial or recreational fisheries) by number in Ireland (values in numbers not provided for UK).

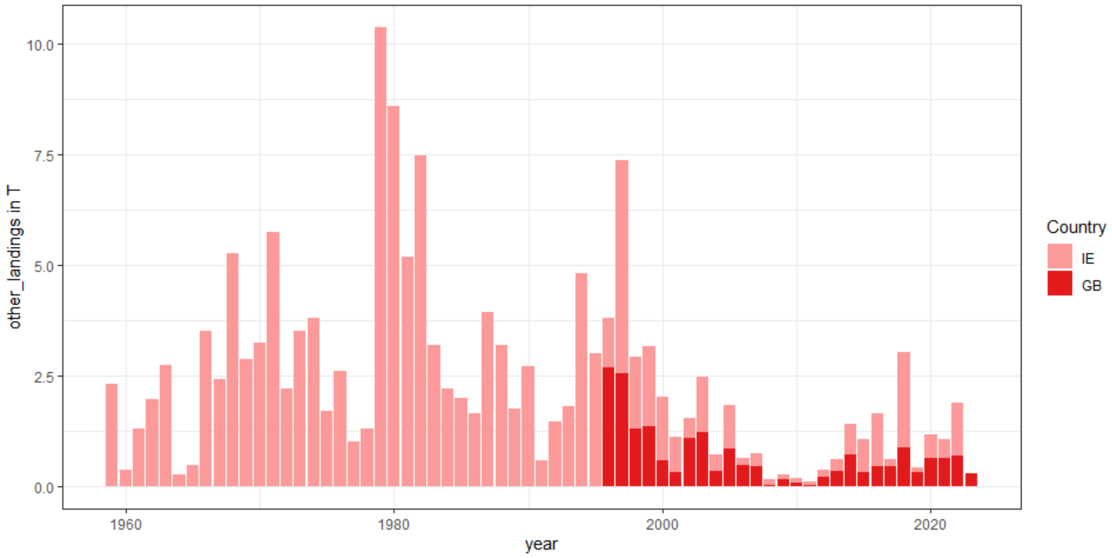


Figure 2.15. Other landings of glass eel (glass eel caught for transport operations, so not in formerly reported commercial or recreational fisheries) by mass in Ireland (IE) and the UK (GB).

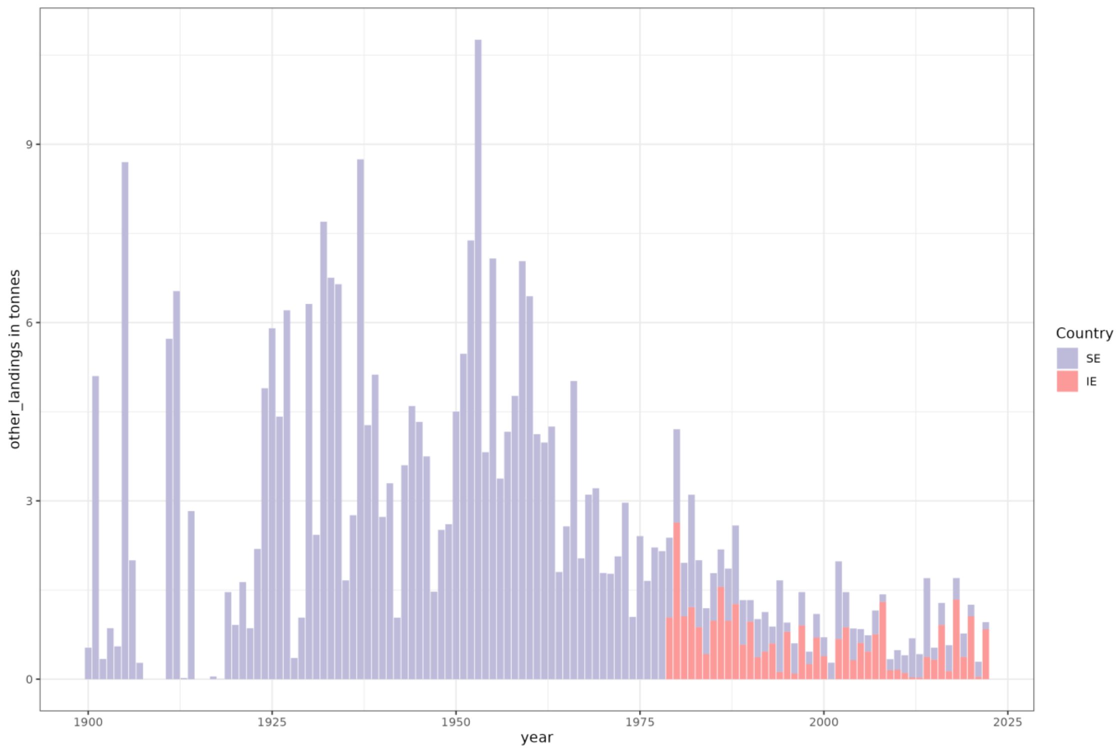


Figure 2.20. Reported other_landings (used for assisted migration) of yellow eel (in tonnes) per country: Sweden (SE) and Ireland (IE). The number of sites where data are collected may vary between years. For example in Sweden, it has varied from 1 to 26 and is currently 8.

2.3.2 Yellow eel and ongrown eel releases and other landings

Releases of yellow eel are represented in Figure 2.18 and 2.19. Sweden has recorded yellow eel release activity since 1900. On top of a continuous assisted migration programme for yellow eel, Sweden had a restocking programme for yellow eel from the early 20th century up to 2009. Germany started to stock yellow eels in 1985. Activity declined somewhat after 2005 and in recent years has been much reduced.

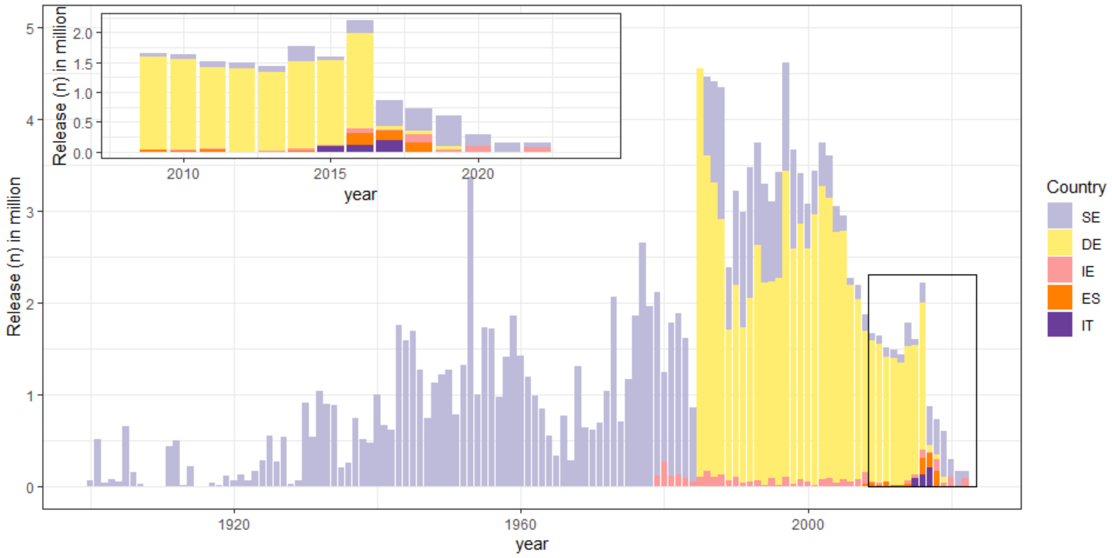


Figure 2.18 Reported releases of yellow eel (in millions) per country, Sweden (SE) Germany (DE), Ireland (IE), Spain (ES) and Italy (IT). Inset shows the last 13 years in more detail. Data for recent years are provisional or incomplete and may change in future data calls.

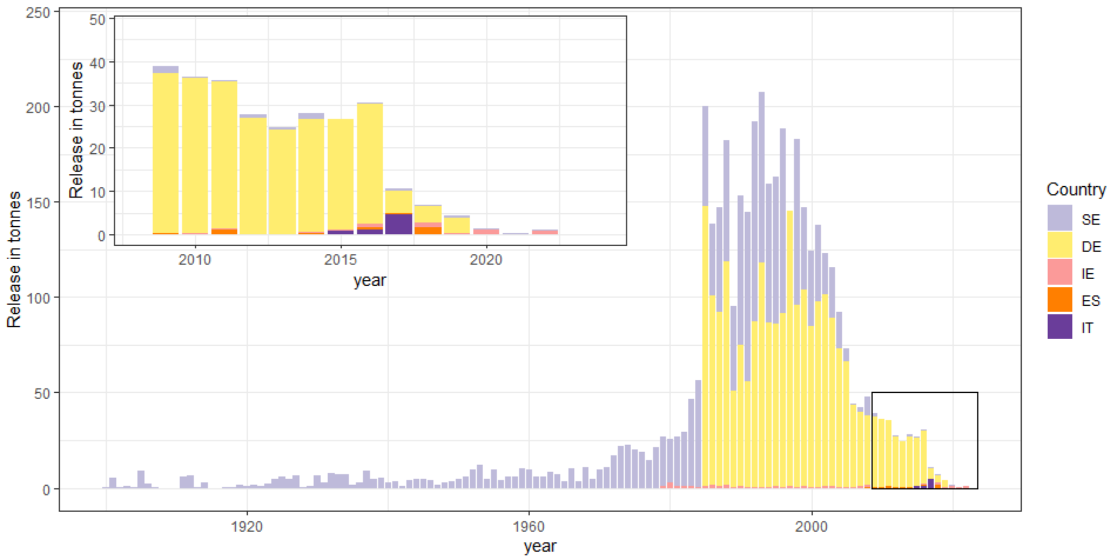


Figure 2.19. Reported releases of yellow eel (in tonnes) per country: Sweden (SE) Germany (DE), Ireland (IE), Spain (ES) and Italy (IT). Inset shows the last 13 years in more detail. Data for recent years are provisional or incomplete and may change in future data calls.

The restocking of on-grown eels has constantly increased since 2000 and reached a maximum in 2014 (Figure 2.21).

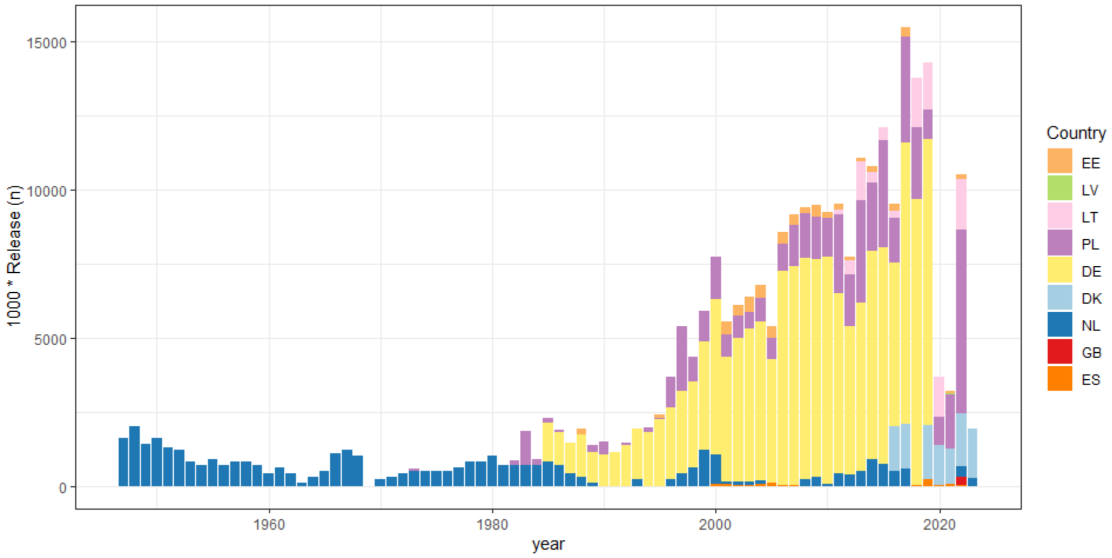


Figure 2.21. Reported releases of ongrown glass eel (in thousands) per country, Estonia (EE), Latvia (LV), Lithuania (LT), Poland (PL), Germany (DE), Denmark (DK) and Spain (ES).

2.3.3 Release and other landings silver eels

A certain percentage of silver eels caught by the fishery, and therefore recorded as landings, are later released in the Mediterranean outside the lagoons in Greece (30% of caught silver eels) and France. These are reported as released silvers (Figure 2.22, Figure 2.23). Spain has made anecdotal releases of silver eels from farms. In Ireland, the Netherlands, Finland and Sweden Trap and Transport (T&T, also called 'assisted migration') of silver eels from upstream to downstream sites in rivers have been implemented (Figure 2.22, Figure 2.23, Figure 2.24, Figure 2.25), and they will also be reported as other landings (not landings) and release.

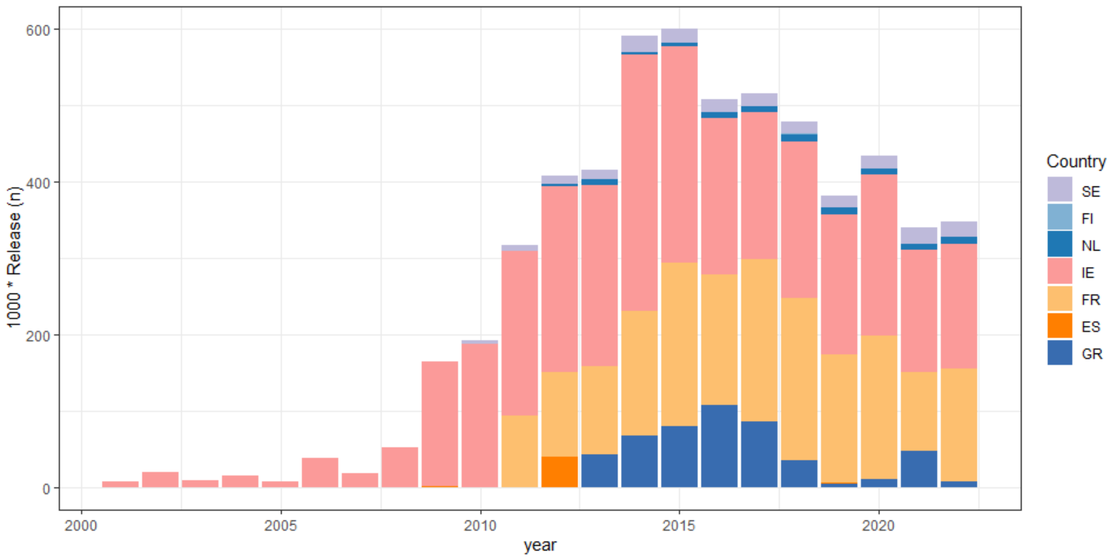


Figure 2.22. Reported releases of silver eel (in thousands) per country, Sweden (SE), Finland (FI), Netherlands (NL), Ireland (IE), France (FR), Spain (ES), and Greece (GR). Data for recent years are provisional or incomplete and may change in future data calls.

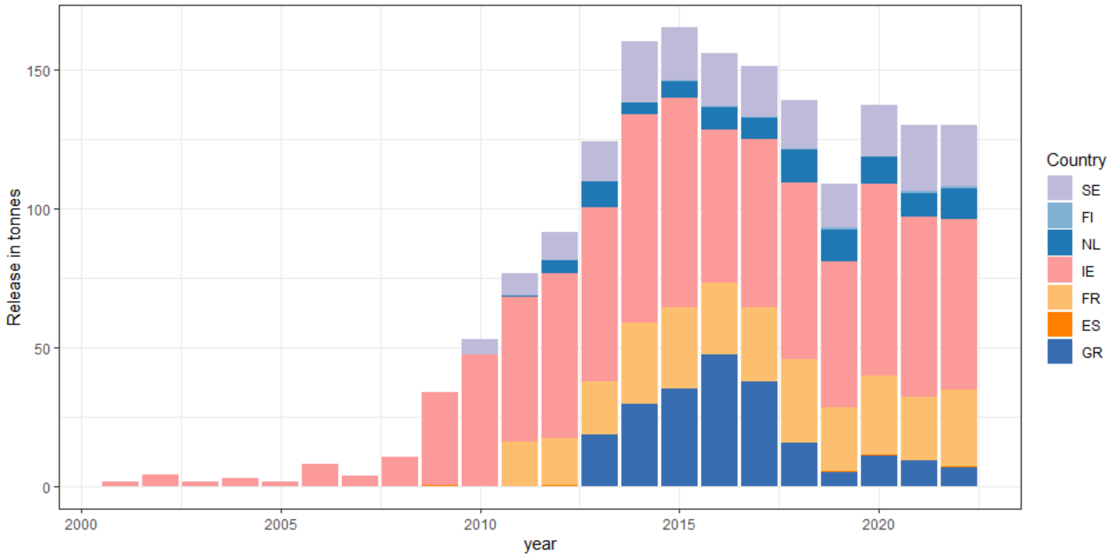


Figure 2.23. Reported releases of silver eel (in tonnes) per country, Sweden (SE), Finland (FI), Netherlands (NL), Ireland (IE), France (FR), Spain (ES), and Greece (GR). Data for recent years are provisional or incomplete and may change in future data calls.

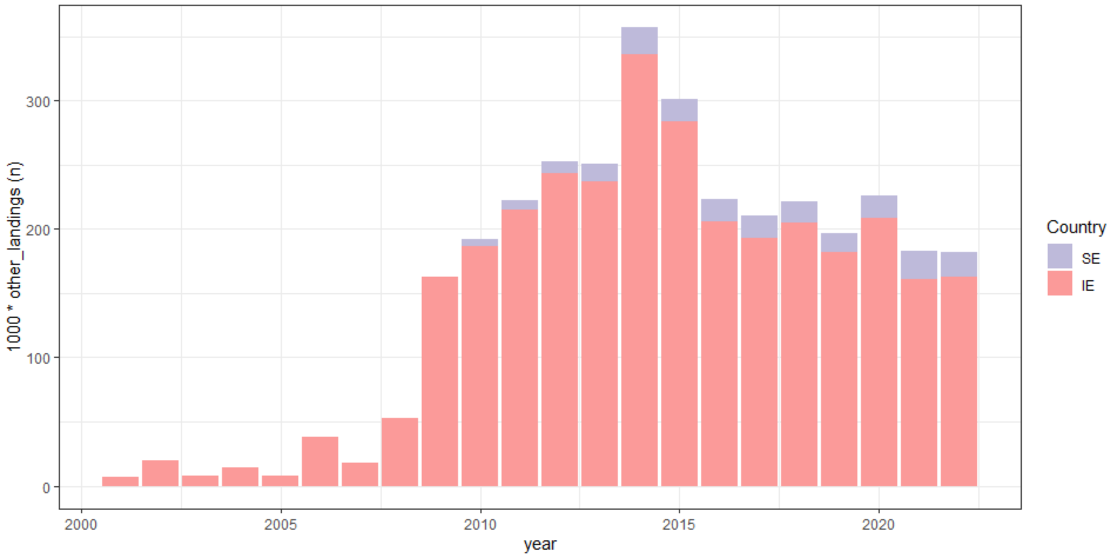


Figure 2.24. Other silver eel landings by number of individuals (n), comprising silver eel caught for the purpose of assisting their seaward migration past obstacles (Ireland and Sweden).

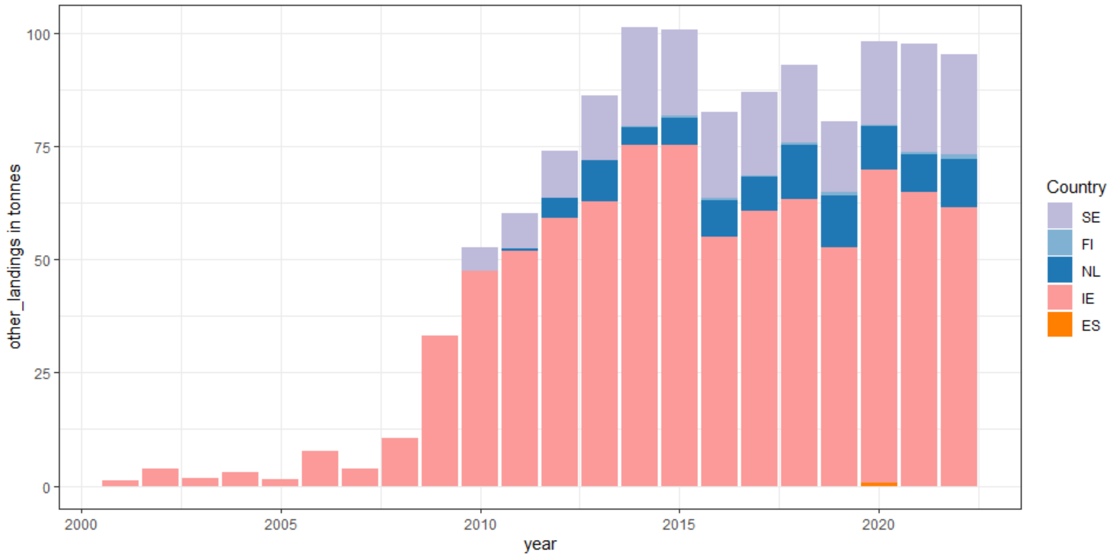


Figure 2.25. Other silver eel landings (in tonnes) including silver eel caught for the purpose of assisting their seaward migration past obstacles . Sweden (SE), Finland (FI), Netherlands (NL), Ireland (IE), and Spain (ES).

2.4 Aquaculture

All aquaculture for eel currently depends upon wild eel for seeding. Aquaculture production data are derived from responses to the data call 2023.

Aquaculture production increased from the 1980s, peaking in 2004 at just under 8,600 t. Since then it has steadily declined to approximately 5,000 t by 2020. In 2021, total aquaculture production was reported as 4412 t (countries reporting: 7) (Figure 2.26). Lithuania had only a single farm in operation from 2017 to 2021 and therefore cannot report production for that period for reasons of confidentiality. This was also true for Spain after 2022. The mean aquaculture production for the 5-year period (2017-2021) is 5387 t.

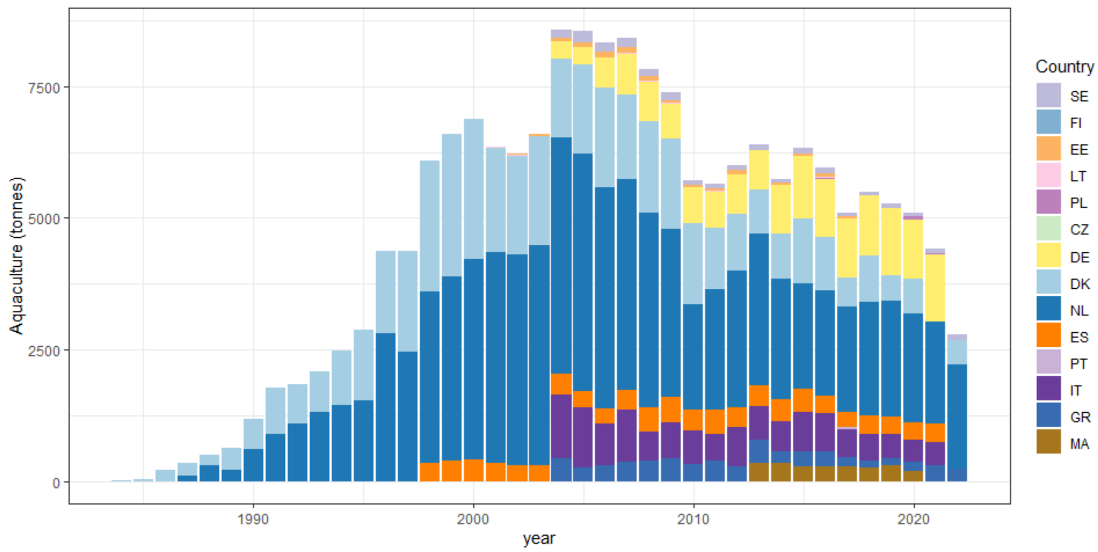


Figure 2.26. Reported aquaculture production of European eel in Europe from 1984 onwards, in tonnes, in Sweden (SE), Finland (FI), Estonia (EE), Lithuania (LT), Poland (PL), Germany (DE), Denmark (DK), Netherlands (NL), Ireland (IE), Spain (ES), Portugal (PT), Italy (IT) and Greece (GR).

2.5 Glass eel exploitation rates

By dividing glass eel reported commercial landing by the time series of abundance, a relative indicator of glass eel mortality exploitation rate that can inform on trends in glass eel fishing mortality was estimated (Figure 2.27). The analysis was restricted to Elsewhere Europe since no commercial glass eel fisheries took place in the North Sea area in the last years. Moreover, we restricted the analysis to the post 2000 period since recent ICES data calls have focused on those decades. the diagram suggests that the exploitation rate for glass eels has decreased after the implementation of the Eel Regulation in 2009. Data for 2009 were removed as France, which accounts for a significant part of the landings, did not report in that year . The exploitation rate has remained at this level since then despite an increase from 2017 to 2019. The upcoming landing workshop aiming at reconstructing time series of landings could enable us to go further back in time and to improve. This exercise is currently only feasible for glass eel recruitment: while landings data are available for other stages, we are still missing abundance indices at the stock level for yellow eel standing stock and silver eel abundance.

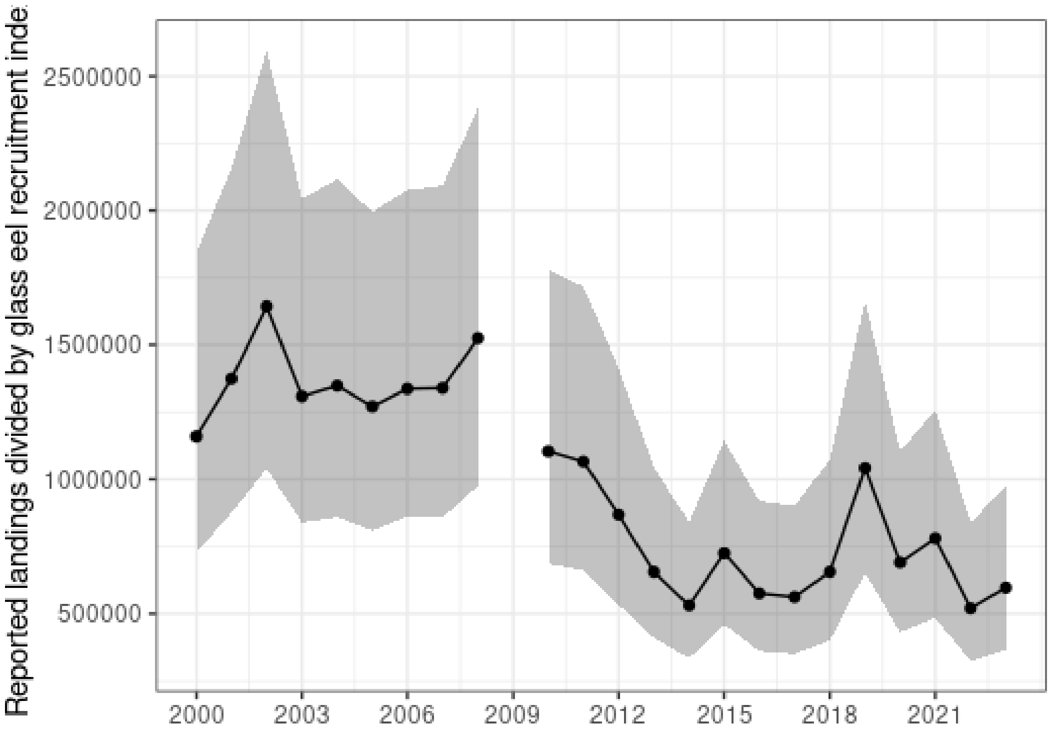


Figure 2.27. Reported G and GY commercial landings divided by recruitment index for EE (including landings reported in EMUs ES_Astu, ES_Cant, ES_Cata, ES_Minh, ES_Mino, ES_Vale, FR_Adou, FR_Arto, FR_Bret, FR_Garo, FR_Loir, FR_Sein, FR_total, GB_Dee, GB_NorW, GB_Seve, GB_SouE, GB_SouW, GB_Wale, GB_total, IT_Lazi, IT_Tosc, IT_Vene). The resulting ratio is a relative proxy of the exploitation rate that inform on trends in fishing mortality. Landings data from 2000 are not available for GB. Year 2009 was removed since France, which accounts for a significant part of the landings, did not report data for this year.

2.6 Silver eel time series

2.6.1 Introduction

Glass eel recruitment shows a common trend in all areas across the European eel distribution which results in an overall recruitment index. There is no common trend in silver and yellow eel time series. Some of these reasons include, but are not limited to, differences in silver eel characteristics such as individual eel size, age at maturation/silvering, differences in sex ratio, and varying natural and anthropogenic mortalities.

We herewith provide a preliminary analysis examining silver eel time series, following from previous data exploration undertaken in 2021 and 2022. Silver eels can be considered a proxy for future spawner biomass/abundance. Analysis of the yellow eel time series will be taken in the future once a method is developed for the silver eel time series.

The two overarching objectives are to (i) find common trends among the series or identify groups of series that share similar trends; (ii) assess the conservation status of future spawners (i.e. silver eel) by determining whether their numbers are sufficiently high to avoid extinction. Achieving the first objective will also be useful in establing a spatial model for the European eel (ICES, 2021a).

Patterns can be explored using different metrics such as abundance, mean length, sex ratio. The work presented here focuses on abundance and biomass, as these metrics are related to conservation status. Furthermore, the primary output of these analyses will be used in a spatial model. This section describes the potential methods taking into account the ecological and biological assumptions needed so that the correct analysis and predictors can be chosen in the future.

2.6.2 Data selection

In the 2023 data call, 57 silver eel time series were available, located in 15 countries (**Error! Reference source not found.**). The majority of these series are from Lithuania (9 series), Netherlands (7 series), United Kingdom (6 series) and France (6 series). Four time series (BI1S, BI4S, NSIS, PanS) are international trawling surveys, data on these four silver eel time series have been added to the WGEEL database in the past, but as these international series have no dedicated reporting country, their data have not been updated by any country in the database since 2011.

Table 2.1 Summary of data availability in the silver eel time series, showing availability of series with at least 10 years of data; and the number of series that do or do not have available information on series quality ID, habitat type, sampling type, effort, gear type, restocking influence, and distance to sea.

Category	Available data	Missing data
Nb of series >=10 years	30	27
Nb of series with quality id	36	21
Nb of series with habitat data	57	0
Nb of series with sampling type	53	4

Category	Available data	Missing data
Nb of series with effort data	23	34
Nb of series with gear	56	1
Nb of series with restocking data	56	1
Nb of series with distance to sea	52	5

A summary of the type of data available in the silver eel time series is given in **Error! Reference source not found.** and **Error! Reference source not found.**, and a detailed summary of all the series see ICES (2022b). From all available silver eel time series, 30 series have 10 or more years of available data. Only 23 of the 57 series have effort data submitted. Most silver eel series were collected in freshwaters via traps and fyke nets. In terms of sampling type, 14 series were from commercial catches, 5 series were reported as commercial CPUE, 10 were assigned as full trapping series, 18 as partial trapping series, and 26 were classified as scientific estimate, with 4 series missing this information. When it comes to the series quality ID, 38 series had a quality ID of 1, indicating good quality, 40 had a quality ID of 0, indicating that it had been previously decided that the series should not be used in an analysis (usually because there were not enough years of data), and 21 series were missing a series quality ID. For the next WGEEL meeting, these series quality IDs should be reconsidered, given the large amount of series without a series quality ID, and the fact that some series with a quality ID of 0 now have at least 10 years of data. Almost all series had information on the potential impacts of restocking, with 21 series classified as being influenced by restocking and 35 as not being influenced by restocking.

The trend analysis was performed with only silver eel time series that had at least 10 years of data available. After examining the 57 available silver eel time series, only 28 were kept for the trend analysis (**Error! Reference source not found.**). From the 29 time series that were excluded, 2 showed inconsistencies in data and 27 were excluded because they did not have 10 consecutive years of effort data (**Error! Reference source not found.**).

The 28 silver eel time series which were used in the analysis represented six ICES ecoregions (**Error! Reference source not found.**). The Western Mediterranean Sea and Aegean-Levantine Sea only had one time series. The most represented areas were the Greater North Sea with 8 time series and the Baltic Sea with 7 time series. 11 ecoregions (Adriatic Sea, Arctic Ocean, Azores, Barents Sea, Black Sea, Faroes, Greenland Sea, Icelandic Waters, Ionian Sea and the Central Mediterranean Sea, Norwegian Sea, Oceanic Northeast Atlantic) did not have silver eel time series which were used in the trend analysis. All coastal time series used in the analysis are located in the Baltic Sea ecoregion. Freshwater series are located across 4 different ecoregions (Baltic Sea, Bay of Biscay and the Iberian Coast, Celtic Seas, Greater North Sea) and the transitional series are located in 2 ecoregions (Aegean-Levantine Sea, Western Mediterranean Sea).

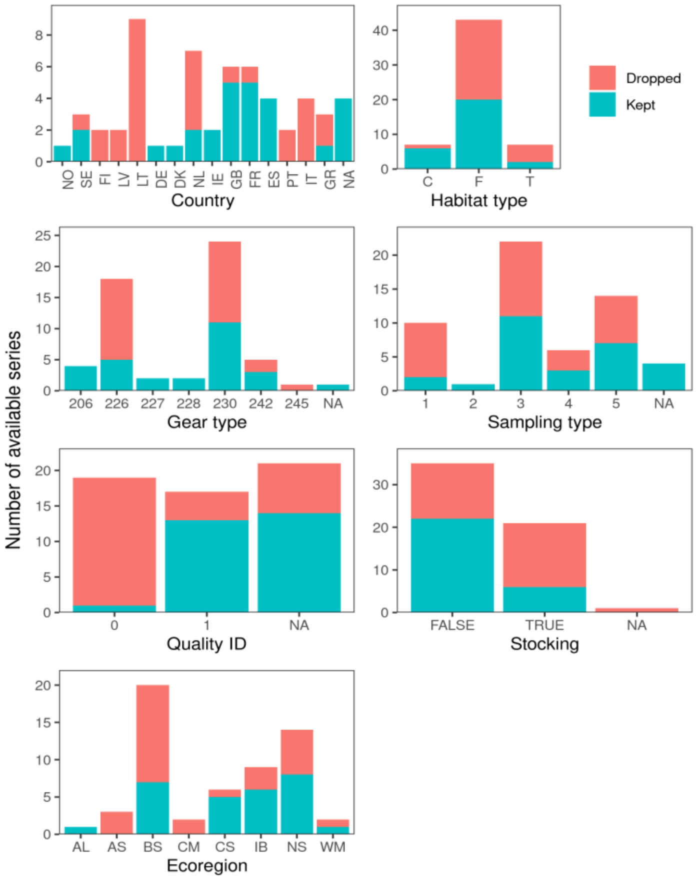


Figure 2.18 Summary of available silver eel time series per country, habitat, gear, sampling type, quality ID, stocking status and ecoregion. The summary includes whether times series were kept or dropped for the trend analysis. Habitat: C = coastal water, F = freshwater, MO = marine water (open sea), T = transitional water (according to WFD); gear: 226 = fyke nets, 227 =stow nets, 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: 0 = series has ended and no future data will become available, 1 = good quality data; stocking: FALSE = no impacts of stocking, TRUE = impacts of stocking; and ecoregion: WM = Western Mediterranean Sea, BS = Baltic Sea, NS = Greater North Sea, IB = Bay of Biscay and the Iberian Coast, CS = Celtic Seas, AL = Aegean-Levantine Sea, CM = Ionian Sea and the Central Mediterranean Sea, AS = Adriatic Sea. For all, NA means not available (no information provided).

Table 2.2 Available silver eel time series that were kept for the analysis. Listed is also whether the silver eel time series data was first divided by provided effort data, before it was used in the analysis. A reason for dividing by effort is that the data in the series is effort-dependent. Reasons for not first dividing by effort data include for instance the provided data already being a CPUE index, or effort being constant (e.g. whole year full-river coverage).

Country	Series name	Years (n)	Series type	Divided by effort data	Comments
	BI1S	16	Index	No	
	BI4S	20	Index	No	
	NSIS	22	Index	No	
	PanS	16	Index	No	

Country	Series name	Years (n)	Series type	Divided by effort data	Comments
NO	ImsaS	48	Constant effort	No	
SE	NkaS	41	Index	No	
SE	SosS	41	Index	No	
DE	WarS	14	Model estimate	No	
DK	RibS	22	Model estimate	No	
NL	HVWS	10	Index	No	
NL	NiWS	11	Index	No	
IE	BurS	51	Constant effort	No	
IE	KilS	23	Effort-dependent	Yes	
GB	BaBS	17	Constant effort	No	
GB	FowS	12	Constant effort	No	
GB	GiBS	32	Constant effort	No	
GB	LevS	21	Constant effort	No	
GB	ShiS	20	Constant effort	No	
FR	BreS	37	Effort-dependent	Yes	
FR	FreS	27	Constant effort	No	
FR	LoiS	34	Index	No	
FR	SeNS	10	Constant effort	No	

Country	Series name	Years (n)	Series type	Divided by effort data	Comments
FR	SouS	10	Model estimate	No	
ES	AlCS	68	Effort-dependent	No	Commercial catches, but assumed that representative of abundance.
ES	BidS	13	Constant effort	No	
ES	NalS	11	Constant effort	No	
ES	OriS	16	Index	No	
GR	EamtS	11	Constant effort	No	

Table 2.3 Available silver eel time series that were dropped from the analysis, including the reason for being dropped.

Country	Series name	Years (n)	Drop reason	Comments
SE	KavlS	4	Number of years fewer than 10	
FI	KotkS	6	Number of years fewer than 10	
FI	VaakS	9	Number of years fewer than 10	
LV	DaugS	4	Number of years fewer than 10	
LV	LilS	3	Number of years fewer than 10	

Country	Series name	Years (n)	Drop reason	Comments
LT	AlauS	4	Number of years fewer than 10	Next year double check for available effort data on all similar Lithuanian series, and check if only silver eel are reported
LT	CurlS	5	Number of years fewer than 10	Next year double check for available effort data on all similar Lithuanian series, and check if only silver eel are reported
LT	KertS	4	Number of years fewer than 10	Next year double check for available effort data on all similar Lithuanian series, and check if only silver eel are reported
LT	KreS	1	Number of years fewer than 10	Next year double check for available effort data on all similar Lithuanian series, and check if only silver eel are reported
LT	LakS	2	Number of years fewer than 10	Next year double check for available effort data on all similar Lithuanian series, and check if only silver eel are reported
LT	RieS	1	Number of years fewer than 10	Next year double check for available effort data on all similar Lithuanian series, and check if only silver eel are reported
LT	RubS	2	Number of years fewer than 10	Next year double check for available effort data on all similar Lithuanian series, and check if only silver eel are reported
LT	SiesS	3	Number of years fewer than 10	Next year double check for available effort data on all similar Lithuanian series, and check if only silver eel are reported
LT	ZeiS	1	Number of years fewer than 10	Next year double check for available effort data on all similar Lithuanian series, and check if only silver eel are reported
NL	BRWS	8	Number of years fewer than 10	
NL	DoijS	8	Number of years fewer than 10	

Country	Series name	Years (n)	Drop reason	Comments
NL	IjsS	8	Number of years fewer than 10	
NL	NZKS	7	Number of years fewer than 10	
NL	ZMaS	9	Number of years fewer than 10	
GB	StrS	6	Number of years fewer than 10	
FR	VilS	9	Number of years fewer than 10	
PT	MinS	5	Number of years fewer than 10	
PT	MonS	6	Number of years fewer than 10	
IT	PobeS	1	Number of years fewer than 10	
IT	PogoS	1	Number of years fewer than 10	
IT	PolsS	1	Number of years fewer than 10	
IT	TibeS	1	Number of years fewer than 10	
GR	NorwS	10	Inconsistencies in data	Recent years reported as 0, but actually no information available

Country	Series name	Years (n)	Drop reason	Comments
GR	WepeS	10	Inconsistencies in data	Recent years reported as 0, but actually no information available

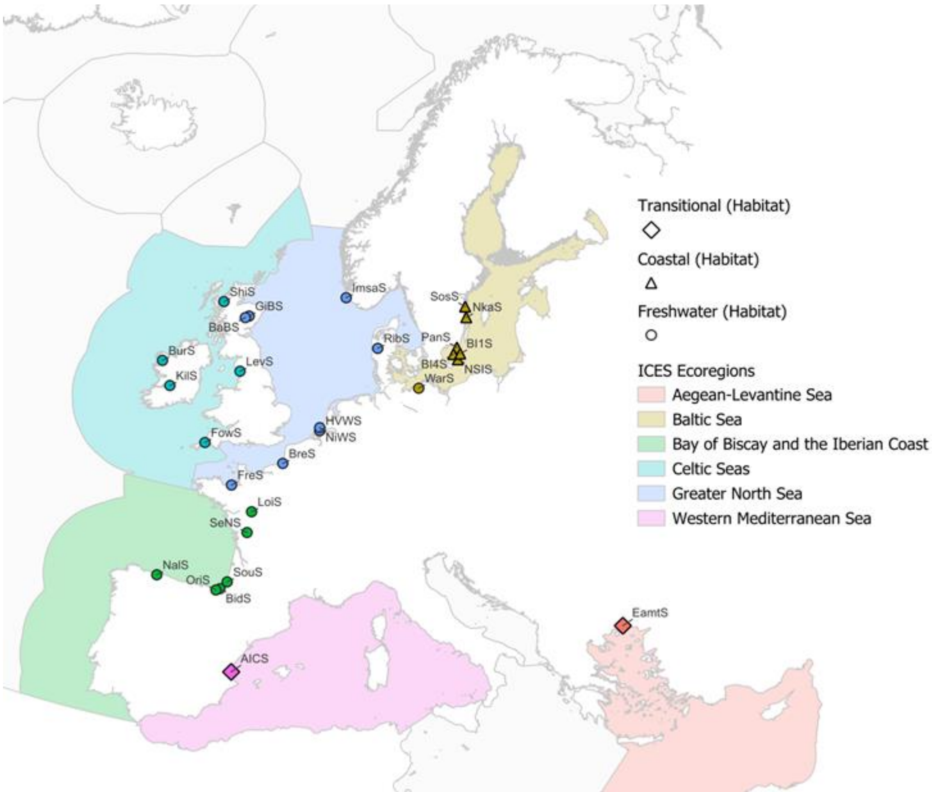


Figure 2.29 Map of silver eel time series used in the trend analysis, shown by ICES ecoregion and habitat.

Error! Reference source not found. gives an overview of the reported data for each silver eel time series that were kept for the trend analysis. Among the kept series, the number of available data points was highest between 2010 and 2021, with the peak in 2013-2017 (**Error! Reference source not found.**). The majority of the kept time series did not have 2023 data ready at the time of writing this report. Given the scarcity of data before 1980, analyses were carried out excluding data before that date.

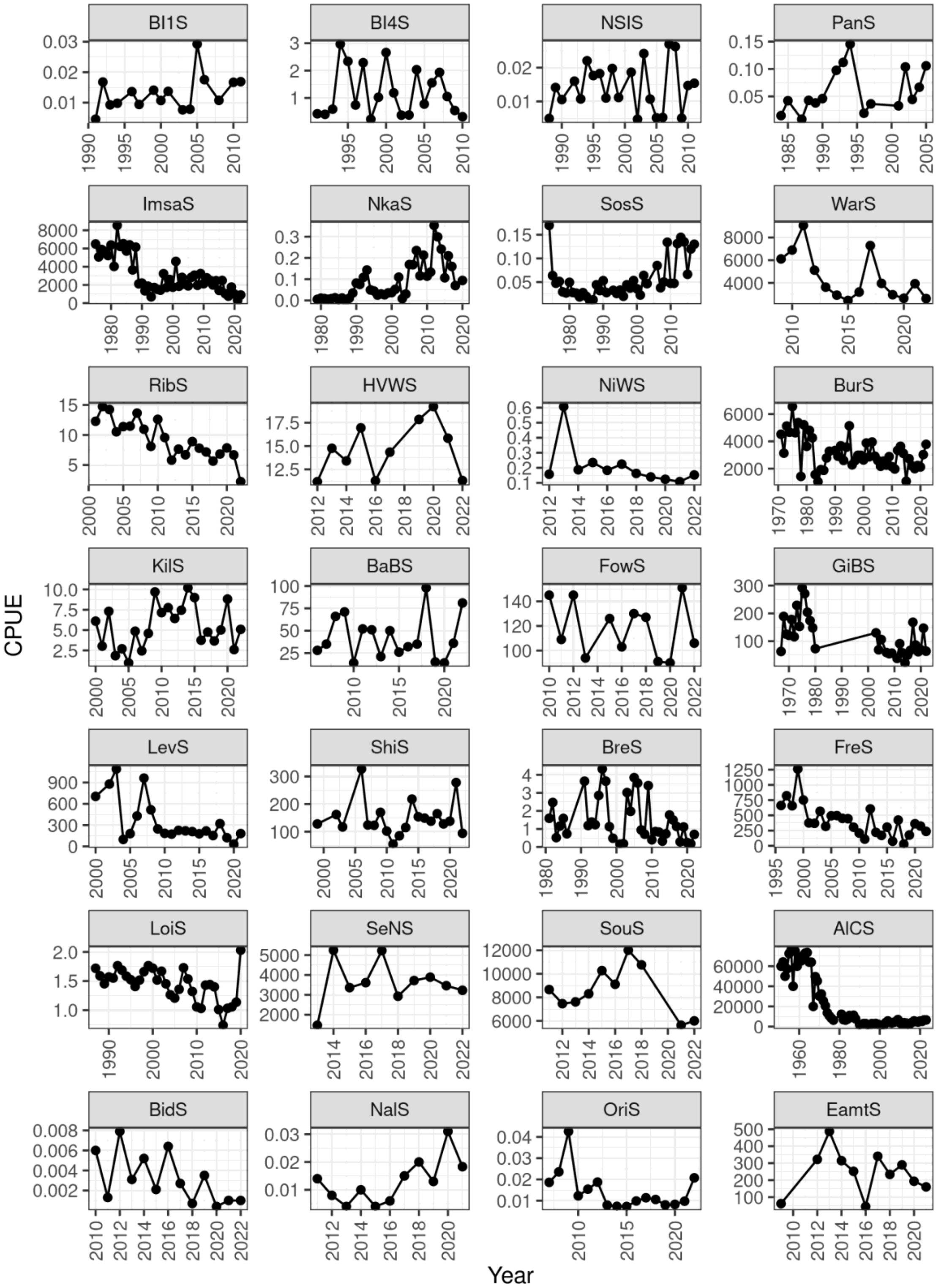


Figure 2.30 Silver eel time series that were used in the trend analysis.

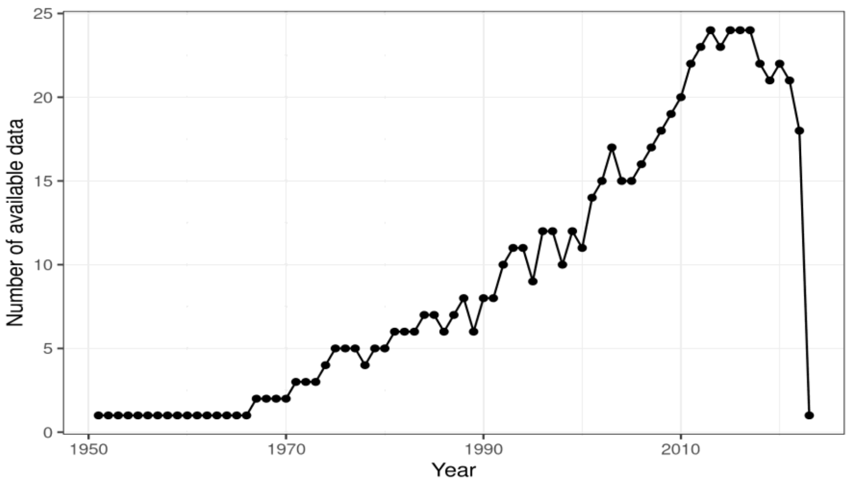


Figure 2.31 Number of available datapoints from silver eel time series over time, shown only for those time series that were used in the trend analysis.

2.6.3 Model description

Through a literature review, we have identified two possible types of analyses. These models both use multivariate auto-regressive state-space (MARSS) models. MARSS model are a family of state-space models (Hinrichsen and Holmes, 2009). They have been implemented through the MARSS package (Holmes *et al.*, 2021).

MARSS models include a state process (1) and an observation process (2) (adapted from Holmes *et al.*, 2021).

$$X_{i,t} = X_{i,t-1} + U_i + w_{i,t} \qquad \text{with } \{w_{i,t}\} \sim N(0, Q_t) \qquad (1)$$

$$Y_{j,t} = A_j + \sum_{i=1}^{n} Z_{i,j} \cdot X_{i,t} + v_{j,t} \qquad \text{with } \{v_{j,t}\} \sim N(0, R_t) \qquad (2)$$

In these equations:

- t is the year
- X is the matrix of the m trends
- U is the linear trend
- $w_{i,t}$ is the process error
- Y is the matrix of the n (silver eel) time series
- Z relates the n time series to the m trends
- A is the offset of each time series
- $v_{j,t}$ is the observation error

The DFA method is a special case of MARSS models and is described in full detail in (Zuur *et al.*, 2003). The basic idea is to connect each time series into a weighted sum (through Z) of a few (m) common trends and a noise factor. The method allows both to extract the common trends through the estimates of X, but also to see the importance of each trend in each series through Z. Thus, this method does not assume any *a priori* structure in the data and allows each individual time series to be related to any of the m common trends.

Another alternative is to define *a priori* structures of times series (e.g. spatial structure)(Ward *et al.*, 2010). In that case each individual series belongs to one and only one trend.

Error! Reference source not found. gives the details of the configuration of the MARSS model for both type of model.

Table 2.4 Model summary. DFA: Dynamic Factor Analysis.

	DFA	Spatial structure
U	0	Unequal
Q	Identity	Diagonal and equal
m	1 to 5	Determined by spatial structure
A	0	Zero or unequal
Z	Full n x m matrix	Spatial structure (0 & 1 matrix)
R	Diagonal and equal or inequal	Diagonal and unequal

2.6.4 Dynamic factor analysis (DFA)

2.6.4.1 DFA using all the data available from the selected series

The best model selected based on Akaike information criterion for small sample size (AICc) has two trends and an R diagonal and equal, meaning that each time series have the same variability. The two trends are shown in the **Error! Reference source not found.**.

They both show a decline since 2000. The first trend shows a strong increase during the two first decades, while the second is rather stable during that period. The second trend shows a increase over the last decade.

When the factor loading is positive (respectively negative) the given time series is positively (resp. negatively) related to the given trend (**Error! Reference source not found.**). If factor loading crosses the 0, the given time series is not significantly related to the given trend.

In the following we give example on how these results should be interpreted. 'AICS' series is negatively correlated to trend 1 and not to trend 2. This time series indeed shows a sudden drop in the late 1980s and a slow increase afterward. \`WarS\` is positively correlated to trend 1 and not to trend 2. This time series do not have any data before the 2010s. Since that date the trend is inded decreasing like in trend 1. For this time series the DFA fit before that date is only due to the fact that this times series correlated well with trend 1 for the recent period. This extrapolation (period before 2010) should not be interpreted as a prediction of what \`Wars\`should have been in older period. \`LoiS\` is positively correlated to trend 2 and not to trend 1. It indeed show a decline since 2000 after two decades with a relative stability.

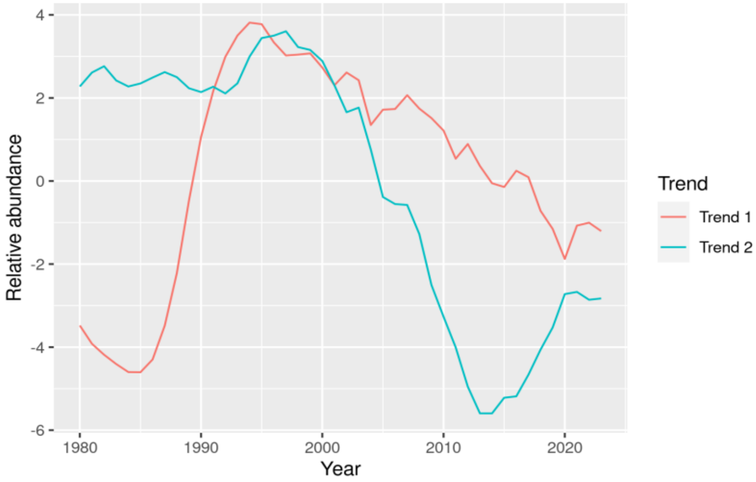


Figure 2.32 Estimated common trends in silver eel time series using the data set since 1980.

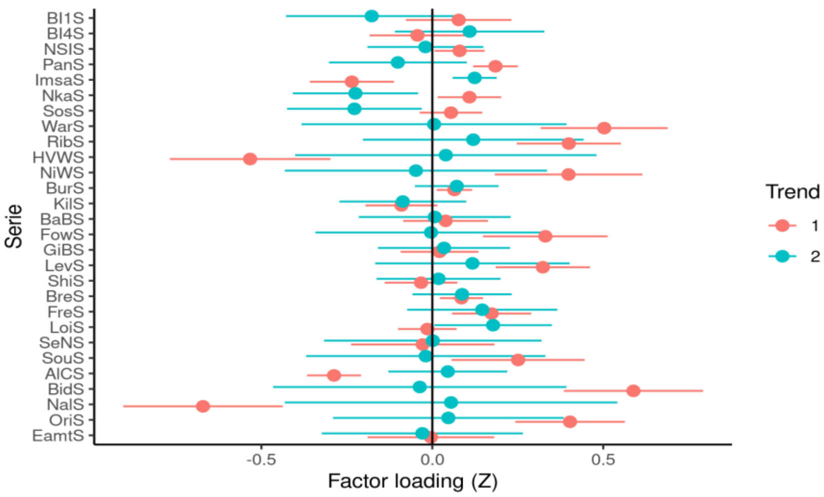


Figure 2.33 Factor loadings (Z) for each time series for DFA using the dataset since 1980.

DFA fits to data are presented in **Error! Reference source not found.**.

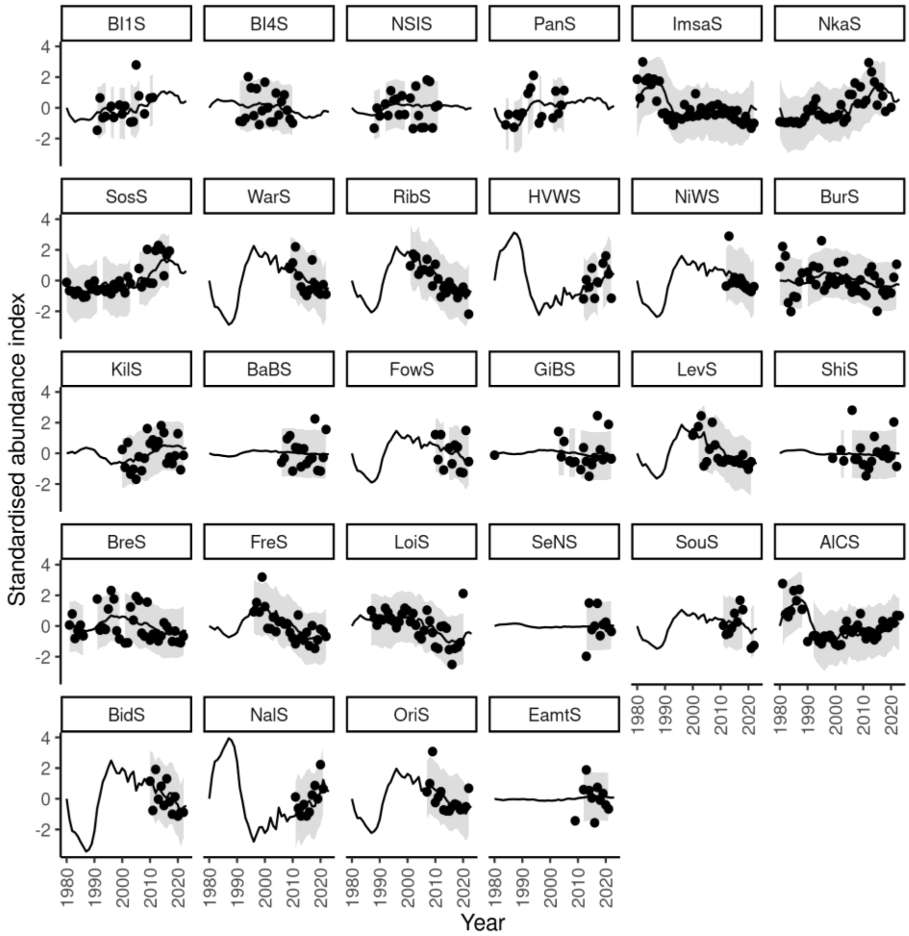


Figure 2.34 DFA fits to time series using the data set since 1980.

This DFA analysis makes it possible to describe common trends over the long term (since 1980). The analysis revealed two common trends. This general picture shows very contrasted situations (increase/decrease, more correlated to one and/or the other trends, etc.). However, the results should be taken with caution given the limited number of series that provided data for the period of 1980-1990 (8/28 series) and for the period of 1990-2000 (12/28). The lack of data for the earliest period may have an impact on trend analysis. To limit this impact and make it easier to interpret the results, a second DFA analysis has been carried out for the most recent years (since 2007).

2.6.4.2 DFA using data available from the selected series since 2007

For this analysis on the data since 2007, the best model selected based on AICc has one trend and an *R* diagonal and equal. This trend was represented in **Error! Reference source not found.**. The factor loadings (importance of each trend in each time series) are displayed in **Error! Reference source not found.**. Nearly all factor loadings encompass the zero, meaning a weak support to the common trend. This can be due to a high variability in each individual time series compared to a low number of time series. DFA fits to data are presented in Fig 2.37.

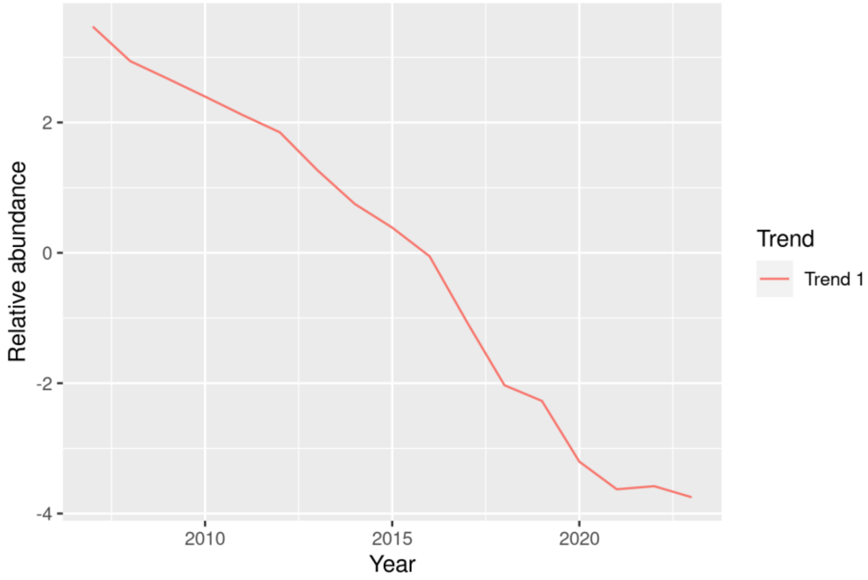


Figure 2.35 Estimated common trend in silver eel time series using the dataset since 2007

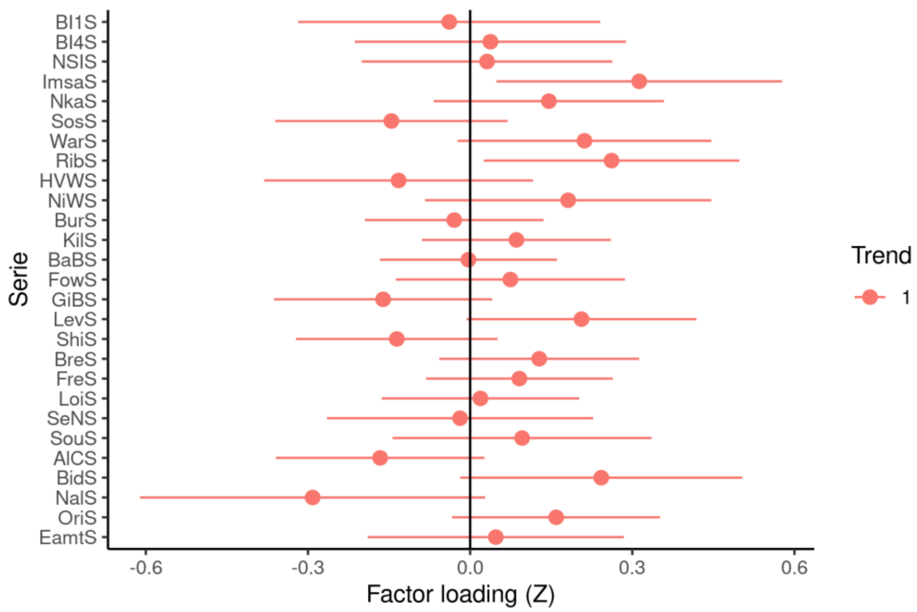


Figure 2.36 Factor loadings (Z) for each time series for DFA using the dataset since 2007

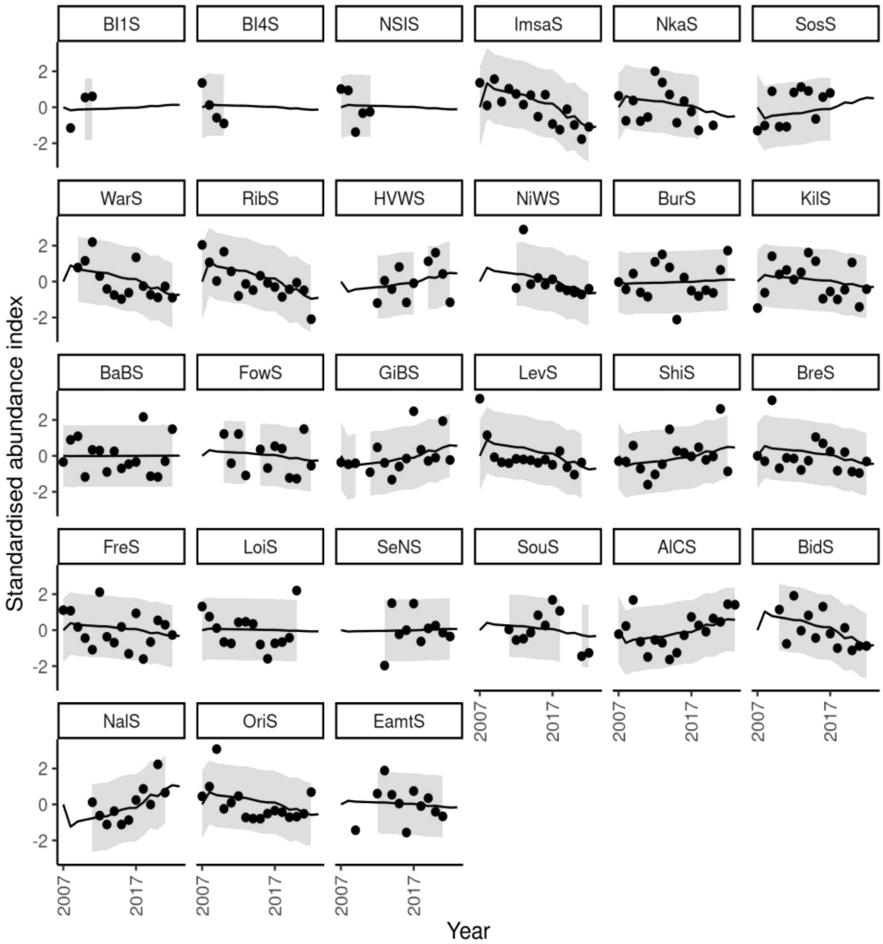


Figure 2.37 DFA fits to time series using the data set since 2007. Points = raw data, black line = DFA fit, grey zone = confidence interval.

The contrasted results (positively/negatively/none correlated to the trend) are likely related to different conditions (environmental conditions, anthropogenic pressures, management practices) among river basins but this analysis does not allow us to go any further into the factors that may affect the correlation with one or more of the trends.

2.6.5 Spatially structured models

Time series where grouped based on six different hypotheses on potential sub-population structure (common trends within sub-populations) among the silver eel time series. The mapping between individual time series and the different groupings are shown in **Error! Reference source not found.**.

Table 2.5 Mapping between silver eel time series and different hypothesis on sub-population structure. Hypotheses being tested refer to: H1 – panmictic population, i.e. all time series share the same trend; H2 – Habitat type (C – Coastal, T – Transitional, F- Freshwater); H3 – Restocking (indicator of whether the time series is affected by restocking (TRUE) or not affected by 47estocking (FALSE)); H4 – ICES ecoregions; H5 – Whether a series is sampled in the North Sea region or elsewhere in Europe; H6 – Size of the catchment area (Small, Medium, Large or Sea)

ser_nameshort	H1	H2	H3	H4	H5	H6
BI1S	pan	C	TRUE	Baltic Sea	Elsewhere Europe	Sea
BI4S	pan	C	TRUE	Baltic Sea	Elsewhere Europe	Sea
NSIS	pan	C	TRUE	Baltic Sea	Elsewhere Europe	Sea
ImsaS	pan	F	FALSE	Greater North Sea	North Sea	Sea
NkaS	pan	C	FALSE	Baltic Sea	Elsewhere Europe	Sea
SosS	pan	C	FALSE	Baltic Sea	Elsewhere Europe	Sea
WarS	pan	F	TRUE	Baltic Sea	Elsewhere Europe	Medium
RibS	pan	F	FALSE	Greater North Sea	North Sea	Small
HVWS	pan	F	FALSE	Greater North Sea	North Sea	Large
NiWS	pan	F	FALSE	Greater North Sea	North Sea	Large
BurS	pan	F	FALSE	Celtic Seas	Elsewhere Europe	Small
KilS	pan	F	FALSE	Celtic Seas	Elsewhere Europe	Large
BaBS	pan	F	FALSE	Greater North Sea	North Sea	Small
FowS	pan	F	FALSE	Celtic Seas	Elsewhere Europe	Small

ser_nameshort	H1	H2	H3	H4	H5	H6
GiBS	pan	F	FALSE	Greater North Sea	North Sea	Small
LevS	pan	F	FALSE	Celtic Seas	Elsewhere Europe	Small
ShiS	pan	F	FALSE	Celtic Seas	Elsewhere Europe	Small
BreS	pan	F	FALSE	Greater North Sea	North Sea	Small
FreS	pan	F	FALSE	Greater North Sea	North Sea	Small
LoiS	pan	F	TRUE	Bay of Biscay and the Iberian Coast	Elsewhere Europe	Large
SeNS	pan	F	FALSE	Bay of Biscay and the Iberian Coast	Elsewhere Europe	Small
SouS	pan	F	FALSE	Bay of Biscay and the Iberian Coast	Elsewhere Europe	Small
AlCS	pan	T	FALSE	Western Mediterranean Sea	Elsewhere Europe	
BidS	pan	F	FALSE	Bay of Biscay and the Iberian Coast	Elsewhere Europe	Sea
NalS	pan	F	FALSE	Bay of Biscay and the Iberian Coast	Elsewhere Europe	Medium
OriS	pan	F	FALSE	Bay of Biscay and the Iberian Coast	Elsewhere Europe	Small
EamtS	pan	T	FALSE	Aegean-Levantine Sea	Elsewhere Europe	Small

The most parsimonious model (based on AICc) of the tested models (**Error! Reference source not found.**) was the model mapping silver eel time series to habitat type (H2). This model had three sub-population trends (**Error! Reference source not found.**; sub-population trends per series and eco-region are shown in 2.39 & 2.40). For coastal habitat the model suggests an increasing trend, and for transitional and freshwater habitats decreasing trends. It is important to note that the coastal time series are only coming from the Baltic Sea. Hence, the increasing trend observed for coastal habitat may be due to an increase of silver eels from the Baltic Sea. However, this increasing trend observed for the coastal habitat should be interpreted cautiously as two of the longest time series come from fisheries data.

Table 2.6 Model comparison between MARSS models. H refers to the hypothesis on sub-population structure being tested, logLik – Total Log-likelihood of the model, AIC - Akaikes information criteria with a correction for small sample sizes, num.param – number of parameters in the model, m – number of subpopulations for the model, num.param – number of parameters in the model, converged – an indicator of whether the model converged (TRUE) or not (FALSE)

H	num.param	m	converged	logLik	AICc
H1: Panmictic	31	1	TRUE	-851.7524	1,768.920
H2: Habitat type	35	3	TRUE	-807.9328	1,690.233
H3: Restocking	33	2	TRUE	-851.5265	1,772.929
H4: Ecoregion	41	6	TRUE	-817.0205	1,722.073
H5: North Sea vs. Elsewhere Europe	33	2	TRUE	-840.1077	1,750.091
H6: Catchment Size	37	4	TRUE	-843.2801	1,765.451
H6: Catchment Size	37	4	TRUE	-843.2801	1,765.451

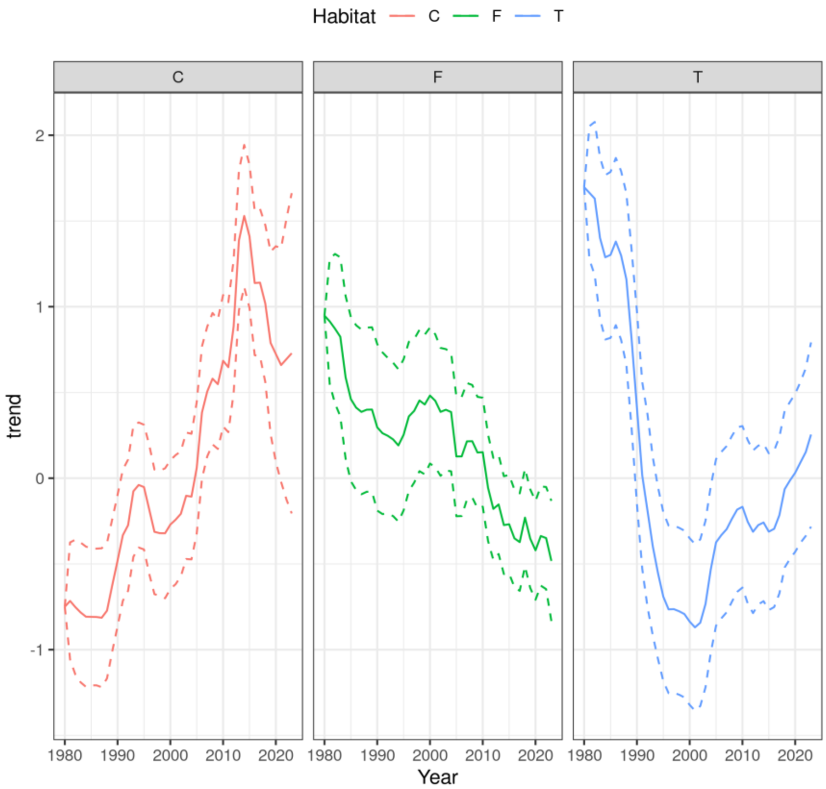


Figure 2.38 : Sub-population trends for the most parsimonious MARSS model (H2: Habitat type). The figure shows estimated sub-population trends for time series sampled in coastal (C; red), freshwater (F; green) and transitional waters (T; blue). Lines show mean estimates and dash lines represent 95 % confidence intervals

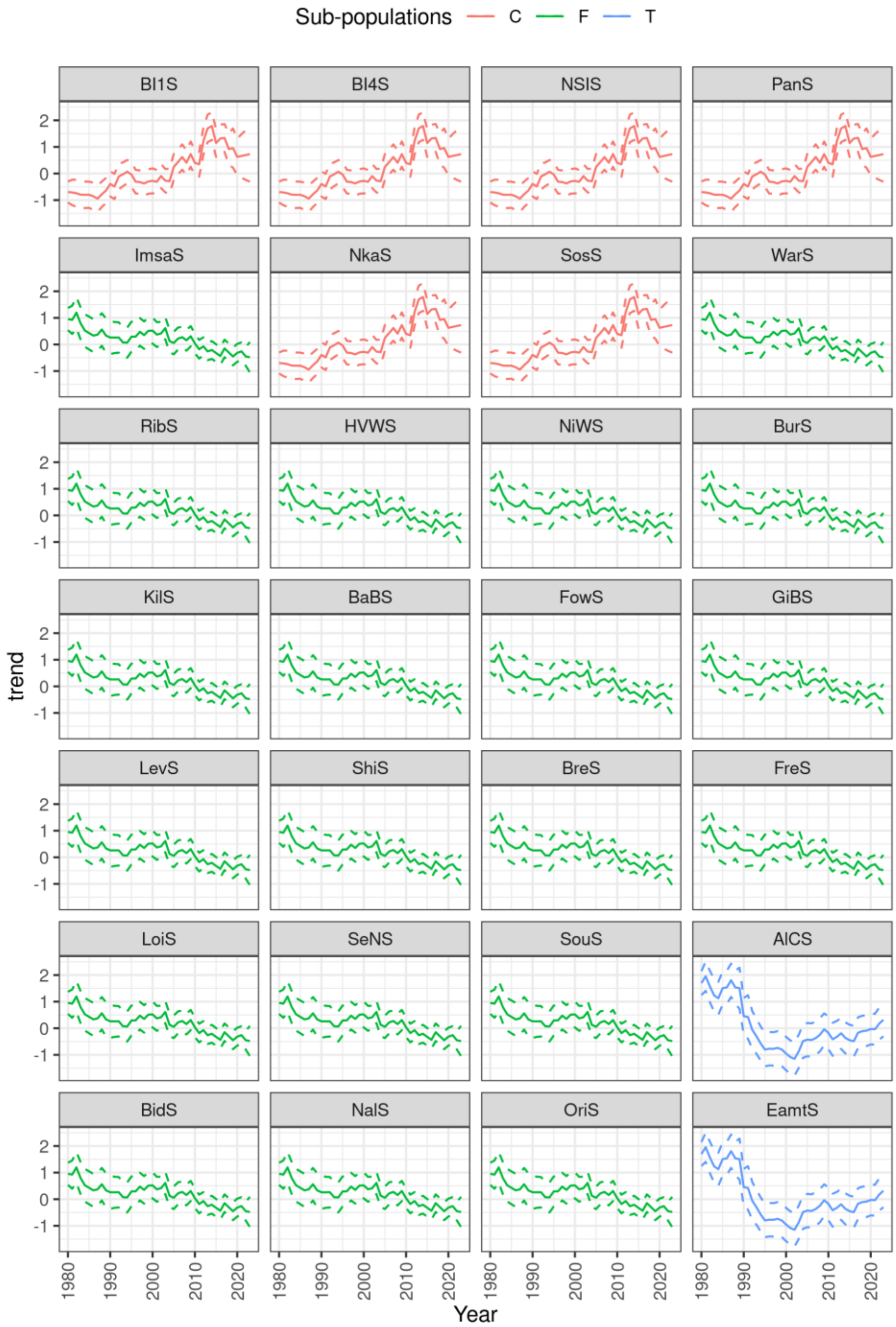


Figure 2.39 MARSS model predictions of silver eel time series. Lines represent mean estimates and dashed lines represent 95 % confidence intervals. Colors display time series from coastal waters (red), freshwaters (green) and transitional waters(blue)

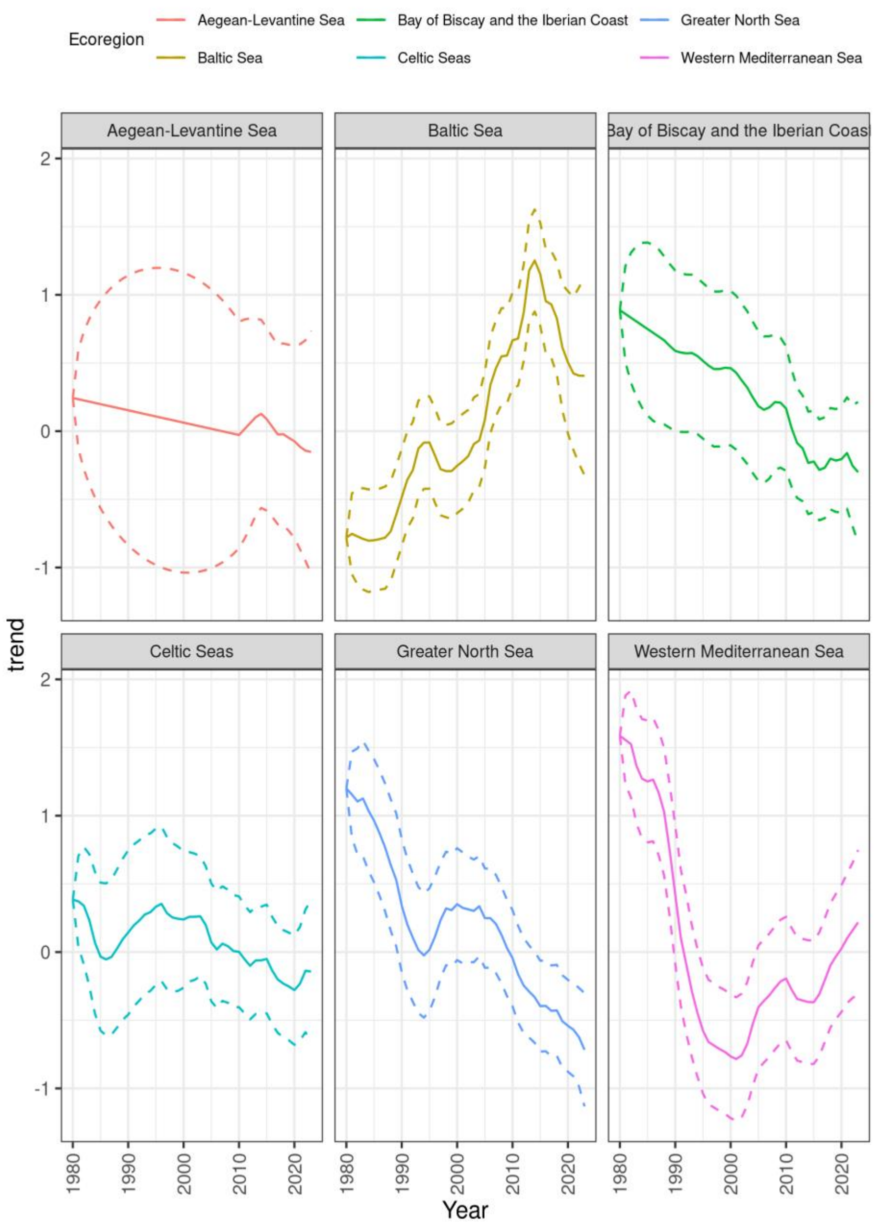


Figure 2.40 Sub-population trends for the ecoregion MARSS model. The figure shows estimated sub-population trends for series sampled in Aegean-Levantine Sea (red), Baltic Sea (orange), Bay of Biscay and the Iberian Coast (green), Celtic Sea (cyan), Greater North Sea (blue) and Western Mediterranean Sea (pink). Lines represent mean estimates and dash lines represent 95 % confidence intervals

2.6.6 Conclusion on yellow and silver eel time series

These analyses are strictly exploratory and enable us to test certain statistical methods and their limitations for analysing temporal series on silver eel abundance.Thus, results should be treated with caution. Several problems have been identified and these points need to be improved to interpret the outputs.

- More data should be collected in underrepresented ecoregions, especially in the Mediterranean.

- Abundance data are given in numbers or in weight. However giving the dimorphism (female being older, larger and heavier) and the environmental sex determism for European eel, changes in abundance may be reflected differently in numbers or in weight. Mixing time series in both unity may be misleading.
- In the Baltic Sea, international trawl survey data has not been updated since 2011. These series should be made available for WGEEL, if they are still being collected. Additionally, freshwater silver eel series are needed from the Northern/Northeastern Baltic Sea.
- In the WGEEL data call, the data providers should consult the ReadMe-file especially regarding the fishing/sampling season. Additionally, the definition of fishing/sampling season should be discussed in WKEELDATA and be based on available data.
- To have more series available for analyses, the conditions for accepting the series for analysis should be re-evaluated (quality, number of years needed, etc.). In addition, series that are marked as low quality should be re-evaluated.
- A more detailed review of the statistical methods that can be used should also be carried out to identify new ones.

Although these analyses of silver eel time series are exploratory, they provide a first step towards benchmarking using these data to assess European eel stocks. They enabled us to identify the limitations of dataset and how we can improve future data collection.

3 Review the implementation of the WKFEA roadmap

3.1 Introduction

The purpose of the WKFEA workshop (ICES 2021-FEA) was to discuss the current ICES advice framework, consider options for future assessment and advice needs and draft a roadmap towards recommendations for a new or adapted advice framework for fishing opportunities and potentially other anthropogenic pressures on European eel. The future of eel assessment and advice was addressed through a roadmap (Figure 3.1) that targets two major improvements: 1) to improve the data that should be part of a stock analysis, and 2) to provide more holistic advice by taking the whole ecosystem into greater account and looking in more detail at the impacts of the different types of pressures affecting the eel population.

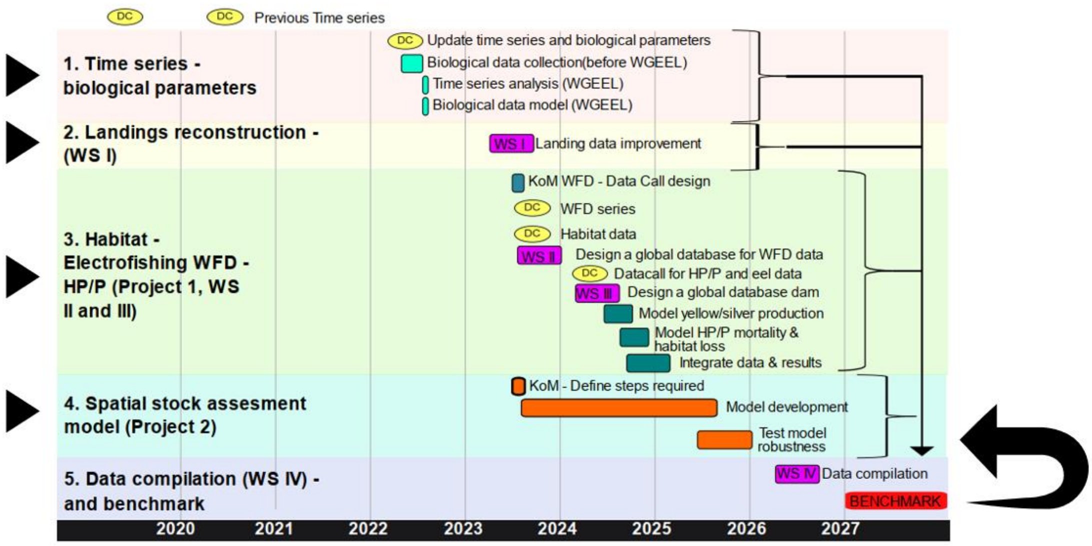


Figure 3.1 Roadmap from WKFEA

In relation to the Roadmap (Figure 3.1) item 1 relates to the inclusion of time series – biological parameters. Since 2020 the WGEEL data call has included biological (biometry) data for the following files: time series data (recruitment, yellow and silver) and for 'other sampling data'. The analysis of this data is required. Item 1 has been advanced but remains in progress.

Item 2 relates to a workshop on landings and is in progress. This workshop (WKLANDEEL) will meet in December 2023 and again in early April 2024. The aim of this workshop is to reconstruct the available commercial landings data from the range states in a standardised manner. This will then facilitate the inclusion of landings data into the population assessments and future spatial models (item 4 on WKFEA roadmap).

In order to progress item 4 for a spatial model we need to ensure Item 3 is complete. This relates to Water Framework Directive (WFD) and environmental data which includes information on dams/obstacle/HEPs, required at the range level. The spatial model will also require detailed information on the geographic information system used in individual member states.

In 2023 a workshop on the development of a Spatial database and Model for Eel 2023 (WKSMEEL) was initiated. In June the group met to discuss the terms of references and create a number of questionnaires in order to understand the scope of data available. Three questionnaires were created on the topics of Electrofishing; Hydrographic network; and River obstructions & Hydropower. The questionnaires were circulated by ICES secretariat to the WGEEL mailing list. The 2nd part of the workshop will be held in October 2023. As a result of this, item 3 and 4 of the WKFEA roadmap are now in progress.

In addition to the ICES workshops a project entitled DIASPARA (DIAdromous Species: new PARadigms in scientific Advice) has recently been submitted as a response to the recent EMFAF Call for Proposals for Scientific Advice on Fisheries (https://cinea.ec.europa.eu/funding-opportunities/calls-proposals/emfaf-call-proposals-scientific-advice-fisheries_en). Bringing together experts from WGNAS, WGEEL and WGBAST, DIASPARA aims to address several deadlocks that had been identified in the WKFEA roadmaps as well as by salmon experts (e.g. WKSALMODEL and WKSALMON2), to move forward towards more holistic and regionalised scientific advice supporting EAFM. More specifically, the project will focus on the spatial and temporal variations in key life history traits, which are crucial parameters of stock productivity. DIASPARA will aim to ensure that collected data are suitable to feed spatial stock assessment models and will benchmark ways forward to integrate such variability into stock assessment models. This is critical to account for regional variations in species productivity in large-scale models, but also to explore the potential future impacts of climate change. Secondly, DIASPARA will develop database structures to store all data supporting the stock assessment, as well as electrofishing data, dams data, and potentially other impact data. This would allow moving forward the current situation of WGEEL and WGNAS using home-made databases stored in their local servers, but also to handle the diversity of human impacts and the complexity of spatial scales which are not well handled by traditional databases. Lastly, DIASPARA will focus on spatial stock assessment models themselves, enhancing their performances to facilitate more in-depth explorations during expert working group meetings. This is critical to provide more comprehensive advice based on broader ranges of scenarios and datasets. To conclude, DIASPARA aims to develop tools to promote a more coherent and internationally coordinated framework from data collection to assessment, scientific assessment process, a more transparent and secure assessment framework, and to move forward a regionalised and holistic EAFM.

3.2 Questionnaire Results

We present a summary of the three WKSMEEL questionnaires below.

3.2.1 Electrofishing

There were 28 respondents to the electrofishing questionnaire, relating to 21 different countries, 18 of which reported that they collected electrofishing data. Estonia, Albania and Tunisia reported that there was no electrofishing in their countries. The earliest available electrofishing data are from the late 1950's in France, earliest data elsewhere are from the 1970's (UK), 1980's (Finland, Norway, Spain, Sweden), 1990's (Belgium, Ireland), 2000's (Germany, Greece, Netherlands), 2010's (Denmark, Latvia, Lithuania, Poland, Portugal, Türkiye). Italy was not able to specify when their data collection began. Eleven countries were able to specify an approximate number of multipass electrofishing sites fished annually (Figure 3.2).

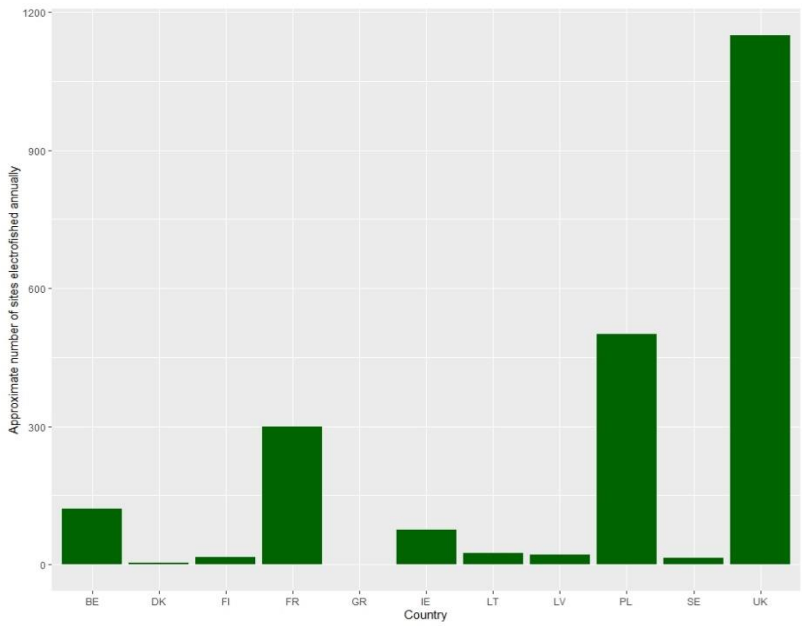
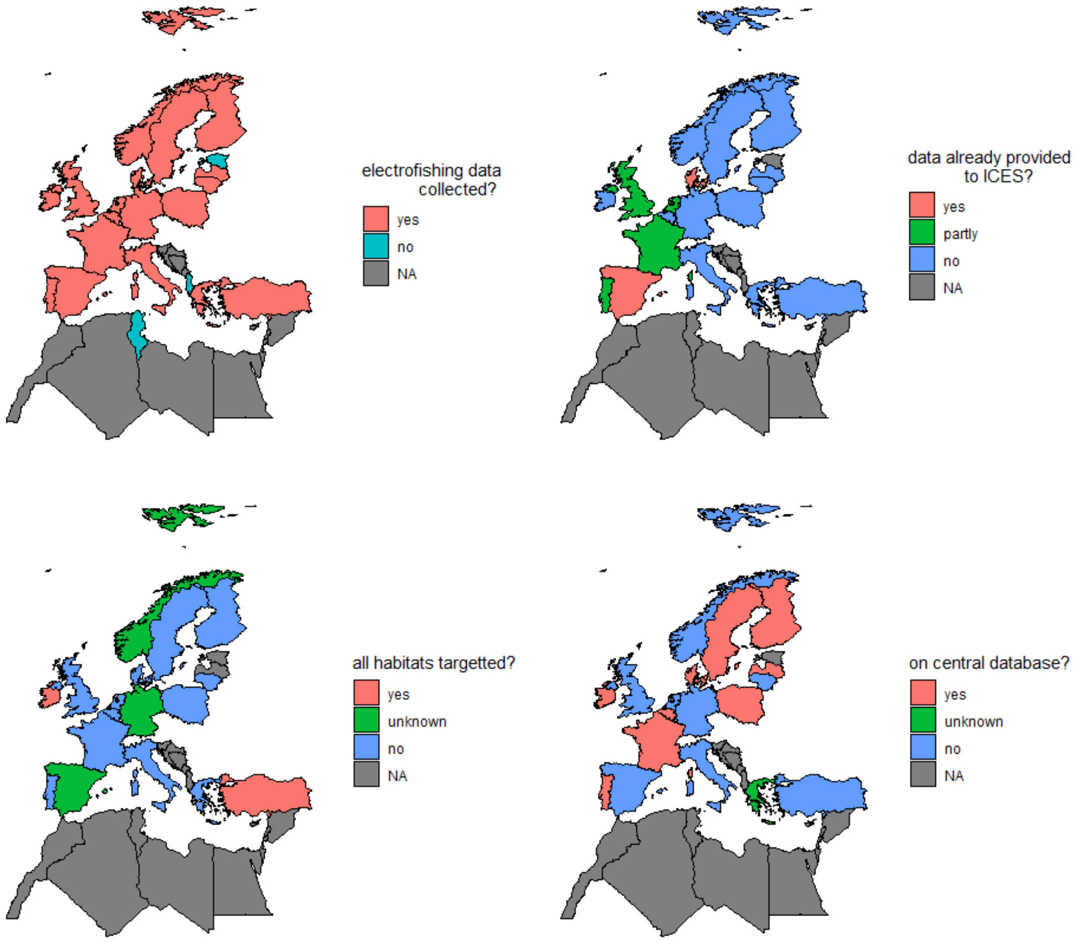
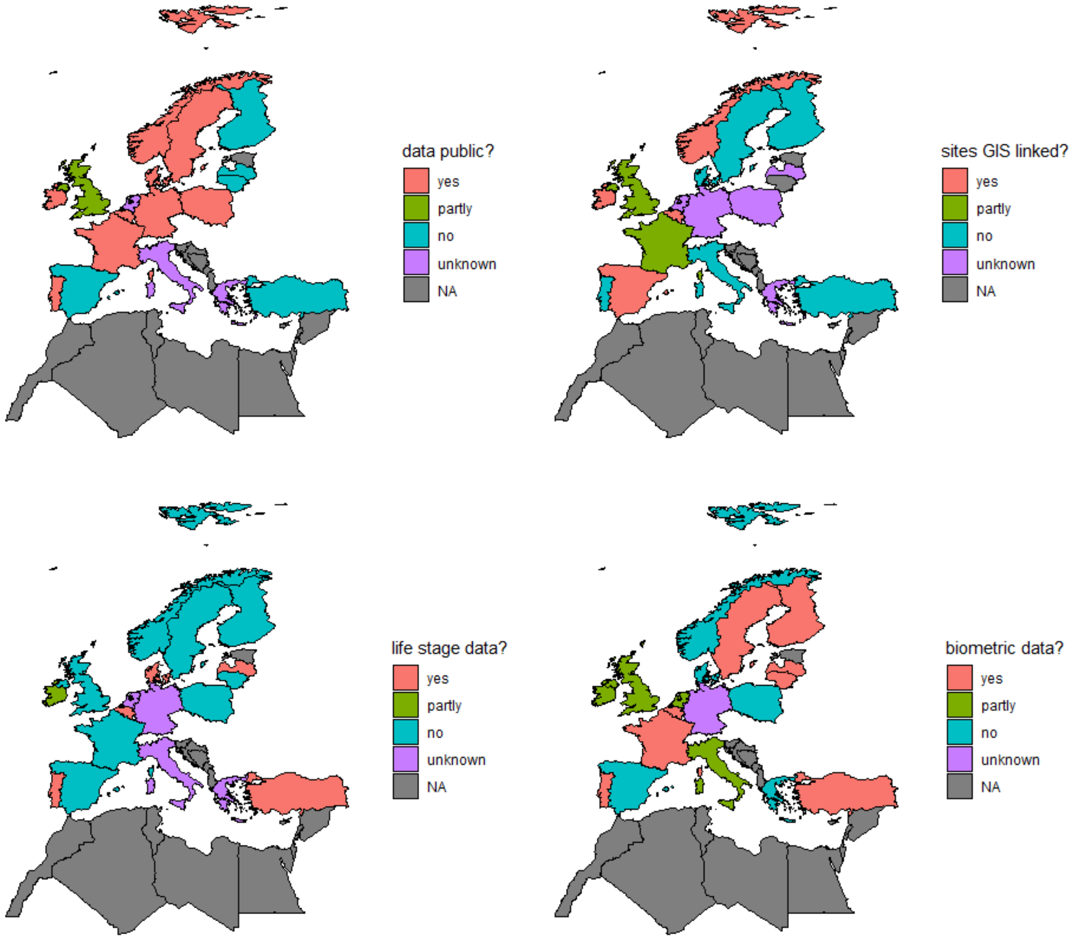


Figure 3.2 The approximate number of multipass sites electrofished annually, for the eleven countries presently able to specify this metric.

Overall, the accessibility of data, even where they do exist, can be described as mixed (Figure 3.3a&b). Little of these data are presently held by ICES: only two countries (Denmark and Spain) reported that their data have already been provided to ICES, with four other countries having supplied a portion of their data, the remainder having provided none. Only Ireland and Türkiye regarded their electrofishing as targeting all eel specific habitats, with most countries reporting under-representation of lakes, large rivers and estuarine habitat. However, some caution is needed here because not all respondents may have interpreted this question in the same way. An alternative interpretation is that all eel habitat that can be targeted by electrofishing is being done, accepting that large water bodies and transitional waters are not surveyed with this method. About half of the countries hold their data on a central database (Figure 3.3a). Similarly about half described their data as public. Six countries reported that all or some of their electrofishing sites were linked to a GIS network, five countries did not know about GIS linkage, and six reported no link. At least 11 countries (one returned 'unknown') collect at least some biometric data with their electrofishing, while at least six countries (three returned 'unknown') collect life stage information (Figure 3.3b).



a)



b)

Figure 3.3 Abbreviated country level responses to the electrofishing questionnaire: a) whether there is any electrofishing, whether the data are already provided to ICES, whether all eel specific habitats are targeted, if the data are stored on a central database, b) whether the data are public, if sites are GIS-linked, whether life-stage and biometric data are recorded. Note, the countries displayed in the map are intended as representative of the range of the European eel: an NA value does not imply nil return.

The foregoing suggests that considerable effort will be required before the existing data could be rendered in a state useful for the spatial modelling task. At least one respondent noted that additional funding will have to be secured to gather and release the data they hold.

3.2.2 Hydrographic Network

There were 26 respondents to the hydrographic network questionnaire, relating to 21 different countries, 17 of which reported that they have the hydrographic network (one country reported using CCM) and associated metadata (one country was unsure on the metadata) (Figure 3.4). Germany, Denmark and Tunisia had no information available at the time of reporting, and Türkiye reported that there was no hydrographic network in their country (Figure 3.4).

Of the 17 countries that have the hydrographic network, over half of them had information on the network being chained as well the if it included bifurcation, while the rest did not have that information available at the time (Figure 3.4).

Regarding the existence of the surface water polygon layer linked to the line layer of rivers, 76% of the countries with the hydrographic network had that information available (yes, no, probably), while the rest were uncertain (Figure 3.4). Of the countries that had the knowledge of their hydrographic network, the majority have indicated it was an improvement compared to the Catchment Characterisation and Modelling network (CCM).

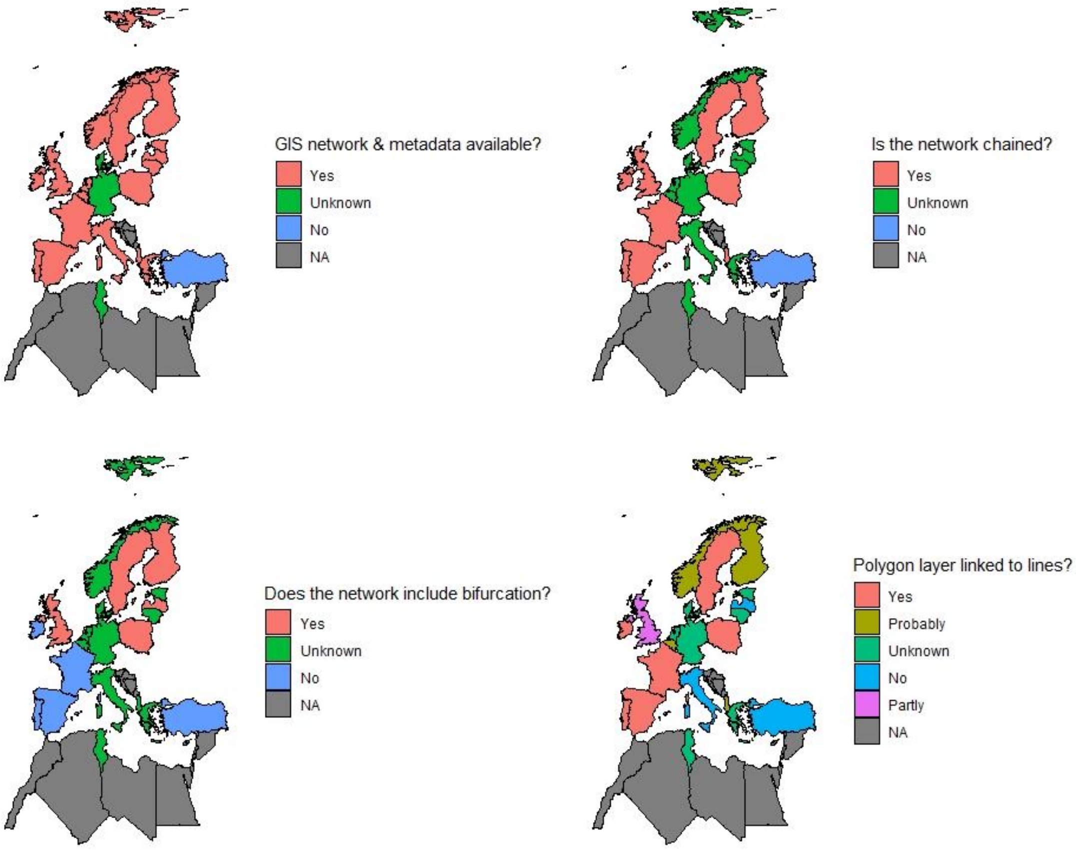


Figure 3.4 Abbreviated country level responses to the hydrographic network questionnaire on whether there is an existing hydrographic network and associated metadata (up left); whether the network is chained (up right) or includes bifurcation (bottom left); and weather there is a surface water polygon layer associated with the river lines (bottom right). Note, the countries displayed in the map are intended as representative of the range of the European eel: an NA value does not imply nil return.

In relation to the available data linked to the hydrographic networks of countries that had responded, the majority of the specific features were unknown (Figure 3.5). Most data seem to be available on segment length, name, starting and ending nodes, basin and distance to the sea, while other data were either unavailable or unknown (Figure 3.5). This suggests considerable effort and resources will be required before all the unknowns are answered, the available data are collated, and processed to be used in the spatial model.

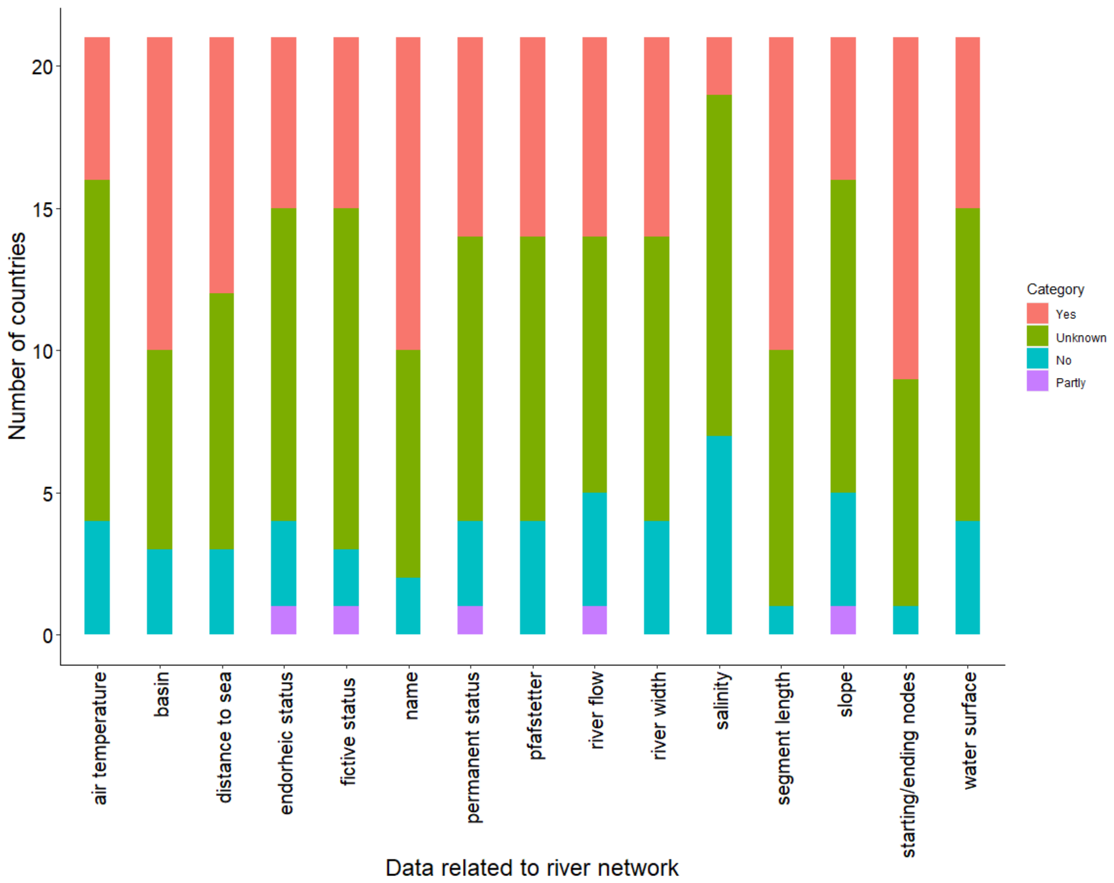


Figure 3.5 Abbreviated country level responses in regards to the availability of specific data linked to the hydrographic network. Note, only countries that have responded to the questionnaire are included.

3.2.3 River Obstructions & Hydropower

Twenty one countries replied to the questionnaire, and only three countries reported that they did not have data on river obstructions and hydropower. Of the 18 countries that have data on dams, 12 countries have all or most of their data collated and centrally stored, four countries have part of their data collated and centrally stored, and two respondents didn’t know (Figure 3.6).

Data points on dams from 10 countries are related to a hydrographic network, and from one country is not. Five respondents did not know. Data on dams from 10 countries are publicly available but from three countries they are not. Five respondents did not know (Figure 3.6).

Fourteen countries reported that they have information on hydropower stations, four reported ‘don’t know’. Seven countries had dam height data available; 3 had 25% of data available for dam height and 3 reported that this data is not available (Figure 3.6).

Seven countries reported that information on the presence of bypasses is available, or partly available. One country does not have information on bypasses and eight respondents did not know whether this information was available..

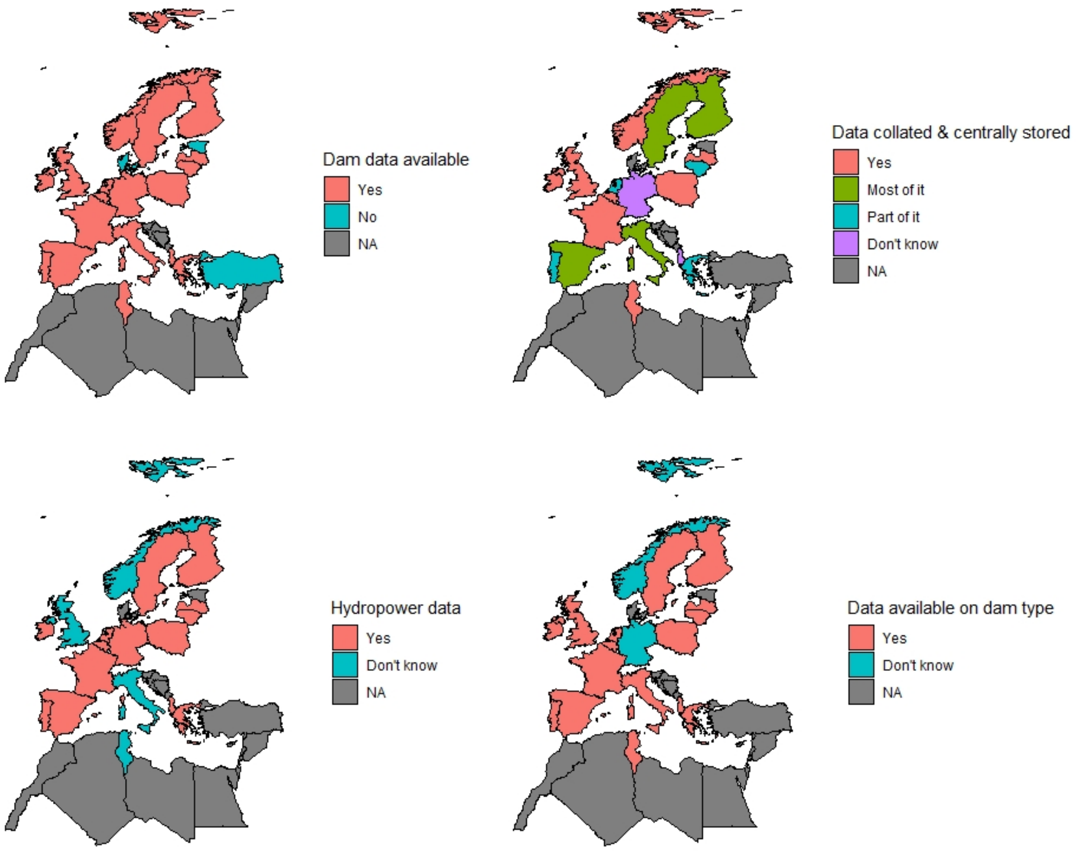


Figure 3.6 Abbreviated country level responses to the River Obstruction and Hydropower questionnaire:

Most countries reported on the type of dams present these included weirs, dams, culverts etc. (Figure 3.7).

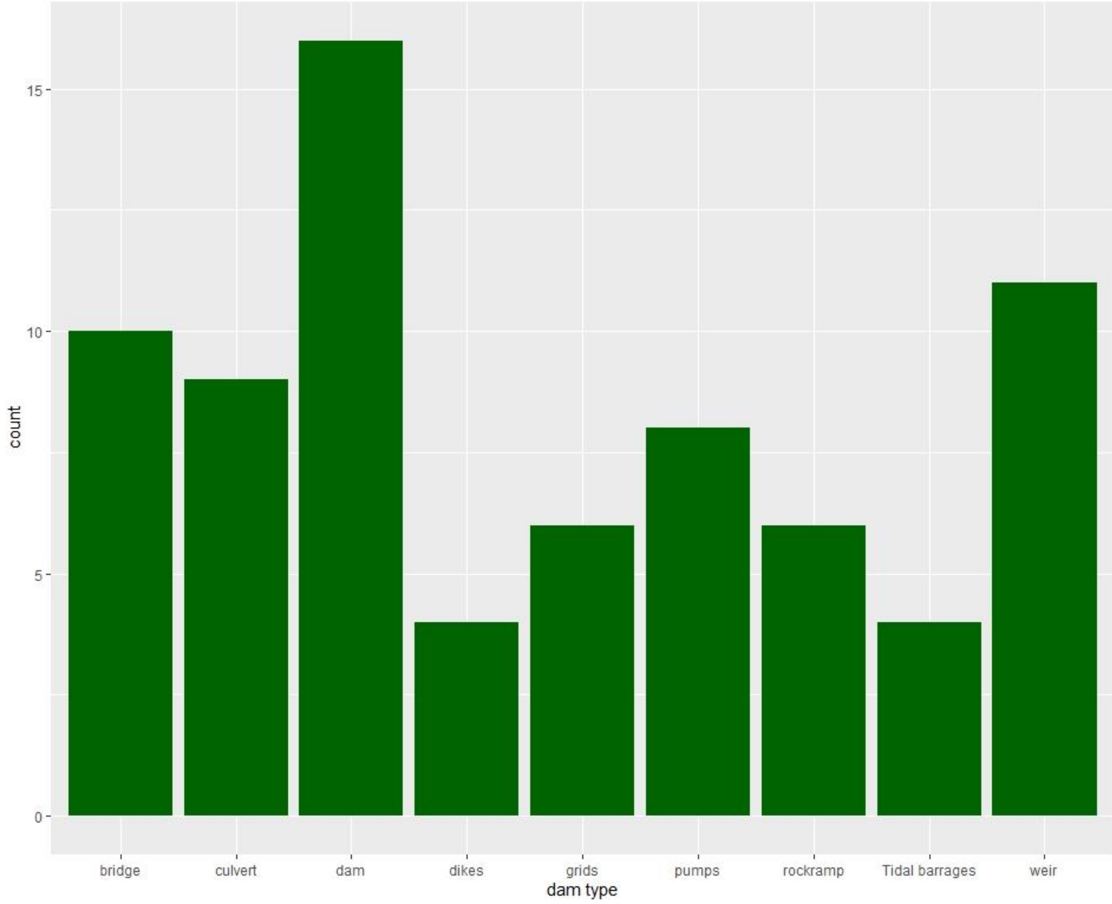


Figure 3.7 Breakdown of the obstruction types reported in the questionnaire

Some additional comments included in the questionnaire are:

- only large dams recorded in database
- fords and sluice gates (additional dam types)
- few redundant databases present in MS
- compiling data will require resources
- turbine information not available
- some complex structures have multiple barrier types; difficult to categorise
- Need to get the experts for hydropower companies to participate

3.2.4 Suggestions

An issue raised in the questionnaires is the requirement for funding in order to collate this information into a standardised dataset. The data required is potentially available but in disparate locations and it will take time and resources to compile it.

4 Updates on the scientific basis for the advice

This chapter discusses updates in science, relevant for 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 refreshing advice and based on the availability of new information.

Additionally, it was assessed if areas within the European eel's distribution range are under-represented in the recruitment indices and/or show significantly divergent trends from in order to identify potential regions and habitats that might not be well covered by the current assessment.

4.1 New or emerging threats and opportunities

Only recent publications on new and emerging threats were reviewed to answer terms of reference (ToR C). At the time of writing 14 country reports were available to WGEEL with additional inputs originating from in person contributions at the meeting.

Due to a change of Country Report format post 2016, resulting in the removal of the *New and Immerging Threats* section 5 (yet remaining a continuing ICES generic ToR), the subgroup review of this section was noted as more difficult and less streamlined.

The combination of topics included with this rolling ToR such as new information, projects, and publications under one heading resulted in a reduced collating efficiency. A suggestion from the reviewing group is to include section 5 to the country report formatting from the 2016 format.

4.1.1 New or emerging threats

- **4.1.1.1 Research or Sampling Fatigue**

Research fatigue occurs when an individual or population of interest tires of engaging with research, consequently avoiding further participation, and frequently linked to misrepresentation of findings and/or reduced belief in outcomes Patel et al., (2020).

Practically all of the Countries at WGEEL described this as a common and growing theme, with stakeholders regularly questioning the validity of assessments, the continued application of monitoring (often alleged as flawed) and stating that further sampling of eel from Europes largest fishery was no longer a "financially sustainable"objective. Many of the scientists described scenarios wherein fisheries stakeholders would question how can it be "*a drop in recruitment issue here, whilst it's a habitat loss issue there yet there's a supposed problem with silver eel migration everywhere*".

But eel communities are not unique in this difficulty which has been recognised by ICES who will host ICES Workshop on accounting for fishers and other stakeholders' perceptions of the dynamics of fish stocks in ICES advice in October 2023 (section 4.1.1.2). In a similar light some of the members of WGEEL (Norway, Netherlands and UK) have established initiatives, whereby outputs from eel science is distributed in a more user friendly fashion for a wider stakeholder use and interpretation. The positive experiences from these outputs have been grabbed by the group as a possible route to re-engage with commercial fisher communities and believe the production and distribution of a similar type of summary distilled from the annual WGEEL report would be a useful recommendation for a way forward.

- **4.1.1.2 Changing demographics of commercial fisher communities**

Some countries contributing to WGEEL, commented that the age demographic of eel fishers is advancing with many fishing communities now based around fishers of an average age 60-65+. With a lack of young, interested fishers, (due to uncertain future prospects, unsociable working hours and lower pay associated with eel fishing compared to other industry sectors), fishing fleets and the skills and abilities linked to these are in decline or are already lost. Reduced fleet sizes coupled with the advancing age of fishers, will be a contributing factor for the knock-on effect of lowered catch availability for sampling programmes from the range of eel habitats. Conversely, it will ultimately lead to a significant reduction in the quantity of fishers, who are providers of on-field observations which have greatly contributed to monitor the situation of the species in different regions (e.g. Evans 2022), including by providing the first signs of the declines in the 1990s/early 2000s (ICES, 2002). The risk associated with the loss of fishery-based indices was analysed by ICES (2019) which highlighted among others a potential risk of increased noise in the assessment. It is therefore increasingly important to establish ways to monitor systems and insure scientific sampling independently of commercial fisheries. It's important to note, however, that in many countries, such decline in fishing fleet is part of the intended management measures to reduce fishing impact (i.e., eel fishing permits are personal and no new permits are issued).

- **4.1.1.3 Seasons closures and policing**

Seasonal closures of eel fisheries on a regional, national, and/or EU-wide basis are a viable measure to immediately reduce eel mortality and are therefore of great/increasing interest for stock managers to achieve management goals. To be effective, however, regional and national policing and enforcement measures must be appropriately adapted in order to deter violations of new or extended fishing bans. The extension of closed seasons, like implemented in 2023 for marine, coastal and transitional waters in EU Member States (Council Regulation (EU) No 2023/94), must therefore be accompanied by appropriate control measures to prevent an increase of illegal fishing.

- **4.1.1.4 Restocking – Glass Eel Quality**

ICES advises zero catch, which includes glass eel for restocking, whilst aware of restocking as part of National EMPS in a number of member states. Within the German framework of the scientific monitoring of various stocking measures, indications emerged that the quality of glass eels for restocking measures available on the European market might have declined in recent years. For example, random follow-up inspections of various eel deliveries under EFF/EMFF-funded eel projects by the federal state of North Rhine-Westphalia (Germany) found that health certificates supplied with the animals in 2018-2022 did not reliably reflect the actual quality of the stocked animals. Despite the health certificates supplied with the restocked animals claiming that the animals examined in each case were free of eel viruses, random follow-up inspections found that they were positive for infection with eel viruses (i. e. HVA, EVEX).

In contrast, comparable follow-up inspections from the previous years (2010-2017) confirmed the accompanying health certificates which claimed that the eels were free of viruses. For those systems where stocking occurs the results underline the importance of quality controls to ensure stocking quality.

- **4.1.1.5 Illegal eel trade**

Proof that operations against illegal glass eel trade are gaining ground in protecting the European eel stock was provided in 2022 and 2023:

A joint operation coordinated by Europol, involving law enforcement authorities across the globe, has dealt a major blow to organised crime groups engaged in international glass eel trafficking. From October 2022 to June 2023 "Operation LAKE VII" led to the arrest of 256 persons responsible for the illegal trafficking of 25 tonnes of live eels worth around EUR 13 million. Up to date seizure data from the CITES illegal trade database can be found at: https://cites.org/sites/default/files/documents/SC/77/agenda/E-SC77-66.pdf

During the period from 2016 to 2023, the following parties participated in the operation: Albania, Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Canada, Colombia, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Greece, Georgia, Germany, Hungary, Italy, Latvia, Lithuania, Luxembourg, Moldova, Morocco, Netherlands, North Macedonia, Poland, Portugal, Romania, Serbia, Slovakia, Spain, Sweden, Switzerland, the United Kingdom and the United States, EUROPOL, OLAF, DG SANTE, EUROJUST, EFCA, EU CITES enforcement group, INTERPOL.

4.1.2 Opportunities

4.1.2.1 Project Development

Several new opportunities which support funding and project development initiatives aimed at enhancing eel restoration were presented during WGEEL, (summaries below). In addition opportunities for improved stakeholder awareness/understanding of ICES advice and suggestions towards improved dissemination were presented and discussed.

- **Presentation 1; Joël Vigneau (and Maria Hansson)**

Title: Regional workplans concepts and contents presentation to WGEEL

Regarding: Regional Work Plans (RWPs) in the EU-Multi Annual Plan (EUMAP) of the European Union Data Collection Framework (DCF)

Data collection requirements for diadromous species (eel and salmon) under DCF were introduced in 2007 and improved in 2012 following the WKESDCF workshop. While for salmon and sea trout there are hundreds of separate stocks in the NANS&EA and BALTIC regions, there is one single stock (panmictic species, however with regional differences) for the European eel. Here, the relevant species distribution covers NANSEA, BALTIC and the MEDITERRANEAN/BLACK SEA RCGs. Assessment models (and data needs) differ by species and region and are still under active development. Currently, Data collection under the DCF is supposed to follow mandatory requirements as defined in the respective legal acts published by the European Union and formulated in line with multiannual national workplans, that EU member states develop in order to cover all (international and national) end-user needs.

In order to proceed with improved regional coordination and work towards regional work plans for eel, WGEEL touched the topic for the first time during the 2023 meeting after a presentation on the concept of RWP by **Joël Vigneau**. Developing regional workplans (RWPs) that overarch National workplans (NWPs) and set and define common methodologies, required data and standard procedures in the future are meant to improve quality and comparability of DCF-collected data in the respective regions. Regional Work Plans (RWPs) can thus replace or supplement relevant parts of national work plans of each Member State.

The concept of RWPs has been discussed over many years. The current goal is to have RWPs (to be reviewed by STECF in October 2023) publicly available in early 2024 so that Member States developing their NWP 2025-2027 would complement the RWPs with their own National specificities. This means that a developed RWP for eels would be the first one of its kind.

At the moment, Text Box 2.3: "*Diadromous species data collection in freshwater*" states that "*No regional sampling is planned*". It is however still possible to add information, until June 2024.

In the discussions that followed the presentation, it was suggested that WGEEL could write some guidelines for how to collect data that we are already using for the glass eel recruitment series, and potentially for some of the data that we know will be needed for a spatial model.

- **Presentation 2; Katarzyna Janiak**

Title: Marine Action Plan and eel-related actions

EU COMM presented the key elements of the EU Marine Action Plan adopted by the European Commission in February 2023, and focused on the actions relevant for the conservation and management of European eel stock. This Action Plan of non-legally binding nature, stemming from the EU Biodiversity Strategy for 2030, calls on EU Member States to improve the protection of sensitive species and sensitive habitats, enhance a collaboration between fisheries and environment stakeholders, improve scientific knowledge base for better decision making, strengthen the enforcement of the implementation, while enabling a fair and just transition of the sectors impacted. As European eel is a critically endangered migratory species and commercially fished, further efforts are needed to help its recovery based on a more holistic approach. Specifically, the Commission calls on Member States to revise their national eel management plans or adopt the new ones by end of June 2024 in full coherence with relevant environmental legislation and to strengthen a transboundary cooperation. A first meeting of the Special Group under the Marine Action Plan (with Member State representatives as members and the stakeholders as observers) takes place on 6 October 2023 and will provide a forum for a dialogue on the effective implementation of this Plan.

- **Presentation 3; Hilaire Drouineau**

Title: DIASPARA: DIAdromous Species: moving towards new PARadigms to achieve holistic scientific Advice This project has recently been submitted as a response to the recent EMFAF Call for Proposals for Scientific Advice on Fisheries (https://cinea.ec.europa.eu/funding-opportunities/calls-proposals/emfaf-call-proposals-scientific-advice-fisheries_en). Bringing together experts from WGNAS, WGEEL and WGBAST, DIASPARA aims to address several deadlocks that had been identified in the WKFEA roadmaps as well as by salmon experts (e.g. WKSALMODEL and WKSALMON2), to move forward towards more holistic and regionalised scientific advice supporting EAFM. More specifically, the project will focus on the spatial and temporal variations in key life history traits, which are key parameters of stock productivity. DIASPARA will ensure that collected data are suitable to feed spatial stock assessment models and will benchmark way forwards to integrate such variability into stock assessment models. This is critical to account for regional variations in species productivity in large-scale models, but also to explore the potential future impacts of climate change. Secondly, DIASPARA will develop database structures to store all data supporting the stock assessment, as well as electofishing data, dams data, and potentially other impact data. This would allow moving forward the current situation of WGEEL and WGNAS using home-made databases stored in their local servers, but also to handle the diversity of human impacts and the complexity of spatial scales which are not well handled by traditional databases. Lastly, DIASPARA will focus on spatial stock assessment models themselves, enhancing their performances to facilitate more in-depth explorations during expert working group meetings. This is critical to provide more comprehensive advice based on broader ranges of scenarios and datasets. To conclude, DIASPARA aims to develop tools to promote a more coherent and internationally coordinated framework from data collection to assessment, scientific assessment process, a more transparent and secure assessment framework, and to move forward a regionalised and holistic EAFM.

- **Presentation 4; Ross McGill**

Title: STRAITS Strategic Infrastructure for Improved Animal Tracking. This is a four-year (Jan 2023 – Dec 2026) EU-funded infrastructure project that will instrument all four corners of Europe to monitor the movements of aquatic animals at a pan-European scale. STRAITS will deploy infrastructure to monitor animal movements using acoustic telemetry at four key locations in Europe: 1) the Danish Straits, 2) the North Channel, 3) the Strait of Gibraltar, and 4) the Strait of Bosporus and Dardanelles. STRAITS will leverage ongoing acoustic telemetry tracking projects, expand efforts to connect tracking initiatives from across Europe, develop data management plans and networking to promote synergy and deliver data to national and international governing bodies. The STRAITS team consists of 10 world-leading organisations in the study of animal movement. Together, they will advance our understanding of aquatic animal movements in Europe and abroad and change the way biodiversity is monitored in European waters.

The infrastructure is very relevant for studying “single migration” species such as European eel and the project welcomes collaboration with any trackers interested in coordinating efforts. By registering with the project and the European Tracking Network researchers will be able to access any detections of their tagged animals on the STRAITS (and associated) arrays. Anyone interested in the STRAITS infrastructure or has a project that they think would benefit from STRAITS should email the project’s communications manager (Kim Birnie-Gauvin) at kbir@aqua.dtu.dk to find out how to get involved.

4.1.2.2 Stakeholder Engagement

- **Better understanding of ICES Advice for Stakeholders**

ICES Workshop on accounting for fishers and other stakeholders’ perceptions of the dynamics of fish stocks in ICES advice (WKAFPA) WKAFPA will meet Tuesday 10th - Thursday 12th October 2023 at ICES headquarters, Copenhagen, under the Chair of Steven Mackinson (UK) and Niels Hintzen (Netherlands). WGEEL will be represented at this Workshop by Derek Evans (UK), with the report fed back to WGEEL in due course.

Terms of reference for this workshop are:

a. Synthesize the findings of WKRRMAC, WKRRCOD, WKENSURE and other relevant reports on using knowledge of fishers and other stakeholders’ perceptions of fish and fisheries dynamics in the process of sense-checking ICES assessment and resulting advice on fishing opportunities.

b. Identify where in ICES assessment and advisory process, the knowledge of perceptions of fish stock dynamics could usefully be applied.

c. Describe a process for reflection and reasoning on identified similarities and differences in ICES assessments and fishers and other stakeholders' perceptions of fish stock dynamics.

d. Provide the key elements of a mechanism to systematically monitor and collate information from fishers and other stakeholders on fish stock status (and relation to reference points) and trends, and fishing patterns, which may be useful to evidence and understand any similarities and differences in their perceptions compared to ICES assessments. e. Suggest key fisheries and stock assessments to test the sense-checking processes.

- **Improved dissemination of "tailored" ICES advice to stakeholders**

Production of a WGEEL pictorial/figures summary (section 4.1.1.1) .

- **The UK Eel Forum**

A presentation was given on the progress and the development of a mechanism over the past year to provide consistent communications on a number of key conservation and management topics was shared. The Forum aims to engage stakeholders on the following four areas in the context of eels:

ICES Advice, CITES, CMS, and EU Exit

As well as offering a platform for stakeholders to bring other issues to the attention of those in the Forum, for discussion outside of the quarterly meetings. While attendance had been encouraging to begin with, it has waned over the first twelve months and a questionnaire will be circulated in order to gather feedback on how to meet the needs of stakeholders. Additional uptake for attendance from non-fisheries interests such as energy and water companies was noted. It was considered whether changes in the frequency of meetings and adjustments to the agenda items might help to attract a wider and greater attendance.

- Presentation - REDEEM screening PhD

A presentation on the updates from a new REDEEM PhD was provided. Specific focus was given to the first study to be carried out - *The influence of temperature on juvenile European eel (Anguilla anguilla) behaviour at a physical screen in a flow-controlled flume*. This presentation highlighted the work carried out to date and potential for collaboration from partners within WGEEL and wider associated network. See new PhD for more information.

- **Eel conservation**

A number of discussions were held on the conservation impacts and corresponding measures during the 2023 WGEEL meeting. A questionnaire was drafted to request expert judgement on the key non-fishery anthropogenic impacts and whether any measures are being implemented (Appendix 9). This questionnaire will be kept as a working document for the time being and the inclusion of a sub-task on conservation measures will be discussed ahead of the creation of Terms of Reference for WGEEL 2024.

4.1.3 New scientific outputs

From the annual reviews of the updates of the scientific basis for the advice a rolling programme of topics was adopted, with a specifically tasked subgroup examining one theme per year beginning in 2019. This subgroup would make use of the most uptodate data and new scientific publications presented at WGEEL relevant to the specific theme.

So far, the following topics have been reviewed:

- 2019: Impacts of hydropower and pumping stations
- 2020: Habitat loss
- 2021: Effects of contaminants and parasites
- 2022: Eel quality

By way of revisiting this themed topic in 2024, WGEEL agreed that they had found the previous exercise useful and the outputs of direct application. As such they were asked for considered ideas/suggestions as to what they felt would be a relevant topic, which could be undertaken with sufficient rigour and in time given the additional EMP Review reporting constraints on the horizon for 2024. Two suggestions were given:

1. a thematic session on the level of scientific eel sampling (by way of assessing impact on the eel stock) and the use or application of alternative non-invasive sampling methods
2. Elaboration of an information sheet destined to inform non-scientists and stakeholders on the status of the eel population

In general, the overall review of recent publications (outside of the selected topics) is based on what is reported in the WGEEL Country Reports, on literature searches (non-systematic), and by asking WGEEL participants to provide recent publications. Systematic literature searches are not performed. Given the great increase in scientific publications, it can be difficult to map all yearly relevant contributions whilst minimizing bias and/or the risk of accidentally missing papers. Review tools, such as Rayyan (Ouzzani et al. 2016), could be utilized to enable easier and more time efficient systematic literature review. During the last 10 years (2013-2022), 220 papers have been published per year (on average) that includes the word “European eel” (data from a Web of Science Core Collection search on 29 September 2023, using the search term “European eel” for all fields).

4.1.3.1 New publications

A significant number of research outputs developed from publications, projects and newly devised PhD’s were included in Country Reports and are listed in ANNEX 8

4.1.3.2 New Scientific updates of previous themed topics

- **Hydropower and screening**

The risk of impingement and entrainment due to the increased development and implementation of hydropower and associated habitat fragmentation is of significant concern for diadromous species and in particular eel. Although this threat has been highlighted previously, increasing research is being undertaken to understand the effects migration barriers have on successful glass eel and silver eel migration. This work consists of, but is not limited to, route selection and type of barrier (van Keeken et al., 2023) as well as screening techniques and fish-friendly pump design (see new PhDs). Incorporation of diadromous species behaviours into management of flood and hydropower operations are also prevalent to support eel migration for both glass and silver eels (Huisman et al., 2023; Norman et al., 2023; Van Wichelen et al., 2023). In addition, screening of associated freshwater infrastructure is being studied within the REDEEM cluster as part of a new PhD. Screening work continues from previous studies (Carter et al., 2023) within REDEEM, predominantly focusing on eel. Updated guidance documents concerning screening have been recently publish in the UK and NZ, see below.

Recent screening guidance documents

- EA (2021) - Eel Screening for Flood and Coastal Erosion Risk Management FCERM Mobile Pumps - Results of Field Trials
- EA (2022) - Screening at intakes: measures to protect eel and elvers
- NIWA (2023) - Toward national guidance for fish screen facilities to ensure safe passage for freshwater fishes

- **Evaluation of eel population models**

The robust assessment of eel stock indicators is of crucial importance for the management of the stock. Given that data on eel is notoriously difficult to assess, empiric site-specific evaluations of results are of great importance. A mark-recapture study in the German North Sea river Ems showed that the annual escapement of silver eels is considerably lower than calculated by the German Eel Model (GEM III) (Höhne et al. 2023). GEM III is a demographic model and is used to estimate silver eel escapement from EMUs. It relies on high-quality, site-specific and often difficult to assess input data. The current study supports former findings showing that the GEM tends to higher silver eel escapement. Whether this is caused by functions applied in the model eg natural mortality or by input data not covering spatial and or temporal variability remains unclear. Nonetheless, an overestimation of escapement numbers has huge implications for eel management as it leads to an overoptimistic assessment of the stock and might hinder the implementation of additional protection measures. The results highlight the need for site-specific model calibrations throughout the distribution area.

- **Chemicals of emerging concern**

The presence of PFAS related compounds in the environment was discussed in depth previously but remains of rising concern. These compounds seem to be ubiquitous, and have been detected in (ground) water, air, river sediments, terrestrial and aquatic biota. After discovery of local PFAS pollution, Flanders started a PFAS Action Plan (Vrancken, 2022). In this context, INBO recently started a 3 years programme to assess the presence of PFAS compounds in eel (and some other species). Apart from PFAS also other chemicals will be analysed, both in new samples and in older frozen samples from ca 20 years ago.

A new study shows worrying levels of pollutants in eels in the Mar Menor lagoon, some of them surpassing the maximum levels authorized by the EC for human consumption (Martinez-Gomez et al., 2023). The findings show that lagoon eels were exposed to high levels of legacy organochlorine contaminants, recently banned pesticides (chlorpyrifos), and some emerging chemicals. Some individuals surpassed the maximum levels of CBs authorized by the European Commission for human consumption. In this species, residuals of chlorpyrifos, pendimethalin, and chlorthal dimethyl have been reported for the first time.

In Flanders (Belgium) a vast monitoring network on perch and eel has been in place since 2015. During the first sampling campaign (2015-2018) fish from 44 locations, covering the main Flemish water bodies, were analysed for POPs and mercury (included in the current EU Environmental Quality Standards for biota – EQSbiota). The same locations were resampled during the second campaign (2019-2021). These allowed for a first look at temporal trends of chemical pollution in both perch and eel muscle tissue. For this we focussed on Hg, PBDEs, PFOS, dioxins and PCBs, the compounds showing the highest concentrations and highest frequency of exceedance of the current EQSbiota. This revealed general decreasing trends for Hg, PFOS, dioxins and PCBs, while PBDEs showed stagnating or even increasing trends. In general, even though these data show some promising progress, additional effort might be needed to reduce environmental concentrations and reach below the safe levels.

Continued concern has been noted for the bioconcentration of pharmaceuticals observed within glass eels. Building on a previous study (Alvarez-Mora et al., 2022) highlighting higher bioaccumulation of pharmaceutical originating chemicals in exposed glass eels Alvarez-Mora et al., (2023) concluded mixtures of diazepam and irbesartan had the most severe effect on glass eels with alteration of several lipids and providing a broad overview of the effects of exposure on glass eels and highlighting the need for further development of wastewater treatment programs. Bouchard et al. (2023) found glass eel exposed to diazepam in a concentration typical for waste water treatment plants effluents to show increased boldness in combination with a lower activity level and a reverse of the preferred swimming direction of unexposed glass eel against the current. Consequently, chemical burdens and their potential impact on eel need to be explored with a broader scope. Preliminary data from analyses of eel tissue samples from three lakes in Sweden show presence of 36 different pharmaceutical compounds (Sundin et al. In preparation). The pharmaceuticals detected include, but are not limited to, painkillers, antihistamines, antidepressants, antibiotics, and muscle relaxants. The highest bioaccumulation levels were detected for antibiotics and painkillers.

- **Silver eel migration**

In August 2019, DTU Aqua initiated a study with acoustic telemetry that will investigate silver eel migration behaviour and determine when and where out-migrating eels leave the Baltic Sea and estimate the efficiency of coastal based commercial silver eel fisheries in Denmark. For the study, silver eels were tagged with an acoustic tag that emits a unique ID. The study attempts to have full acoustic receiver coverage at transects across the exits from the Baltic Sea to see when and where each individual eel leaves the Baltic Sea. To investigate the efficiency of commercial fisheries, receivers have also been mounted at four commercial fisheries located close to the receiver transects. The study has been joined by research institutions from Sweden (SLU Aqua), Estonia (Estonian University of Life Sciences), Germany (Thünen-Institute), Belgium (Ghent University), Lithuania (Lithuanian Nature Research Centre), Finland (Luke Natural Resources Institute) and Latvia (Institute of Food Safety, Animal Health and Environment). DTU Aqua is working on making the receiver transects in the belts and sounds permanent, which will allow future research on eel migration behaviour with this infrastructure. Together with receivers installed by the STRAITS project in the Strait of Gibraltar, the North Channel, and the Strait of Bosporus and Dardanelles, these networks provide the unique opportunity to study the migration behaviour of silver eels in different locations and geographical bottlenecks of the distribution area.

An investigation recently published by Verhelst et al. (2023) analysed the timing and pattern of vertical movement and activity of silver eels during their migration. It showed a complex behavioural repertoire that included classical diel vertical migration (DVM), reverse DVM and vertical movement behaviours that synchronized with tidal patterns. In addition, a higher horizontal migration speed was observed when the current in the favourable direction was stronger and a higher vertical movement range at night compared to daytime was detected. The results suggest that eels adopt selective tidal stream transport. A study investigating the effects of temperature and pressure on the oxygen consumption rate of migrating silver eels showed a significant increase of metabolic rate with temperature, whereas pressure reduced oxygen consumption, albeit only at higher temperatures (Pohl-mann et al. 2023). Average oxygen consumption rates highlight the remarkably high swimming efficiency of this species and, more importantly, indicating that past evaluations of the cost of transport are potentially overestimates as they are often based on experiments con-ducted at atmospheric pressure at higher temperatures.

- ***Anguillicola crassus*** **health Indicators and non-invasive techniques (eDNA/PCR)**

Infection from *A. crassus* is well known as a potential driver of eel stock declines with reduced migration and reproduction abilities significantly reduced (**see updates in the WGEEL report 2021)**. A recent study (Myrenås et al., 2023), investigated this further, and arrived at similar findings of ICES (2022a) concluded swim bladder damage due to *A. crassus* prevalence should be considered in future eel monitoring programmes, providing information on past and future problems arising from infection.

The need for non-invasive sampling methods is becoming more prevalent in order to reduce the number of mortalities required for sampling and quality assessment studies. Assessing the prevalence of *A. crassus* is one such methodology which requires attention of non-invasive techniques. PCR (De Noia et al., 2022) and qPCR (Berger et al., 2023) techniques have been developed for a more sensitive and in some cases more in depth technique for analysing parasitic burden when compared to visual screening. These methodologies if assessed further may have a rightful place within veterinary and fisheries management applications for eel stocking and early detection programmes. Non-invasive techniques and advances in technology, such as eDNA, also have wider application for supplementing fish monitoring programmes and quantifying effects of fragmentation (Griffiths et al., 2023). These techniques, not only enhance current sampling protocols but may also provide a preferable quantification and management methodology to further reduce disturbance within wild eel populations in differing aquatic habitats if progressed further (Fernandez et al., 2023; Halvorsen et al., 2023; VUCIĆ et al., 2023)

AZORES Project – paper update

Following the brief description of the Azores eel project in WGEEL 2022, the recently published study associated with this work (Wright et al., 2022) highlighted migration speeds of tagged silver eels travelling to spawning grounds from the Azores. These tagged eels presented slow travel speeds suggesting energy conservation, enhanced maturation, and reduced mortality risk being preferred to rapid migration to spawning grounds. This work presented the first direct evidence of mature European eel reaching presumed spawning grounds within the Sargasso Sea after several previous attempts to understand eel migratory behaviours whilst also providing avenues for future research.

Climate change

Changes in climate, and in particular, temperature have 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 from the range of potential impacts 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 concerns and reasons behind those concerns remain the same:-

- changes in ocean conditions having an impact between silver eel marine phase migration, reproduction and glass eel return to the coast – the oceanic "black box".
- factors in freshwater impacting silver eel production and their onward capacity to migrate downstream in riverine habitats and breed successfully.

As already highlighted before, climate change might affect the eel stock on many levels which are not all negative (see ICES 2022b), with increasing water temperatures and extreme weather events (e.g. droughts) potentially further degrading eel habitats. In this context, early data for 2023 suggests a sustained increase in eel specific mortalities over the last 2 years in England, most associated with AngHV-1 (UK Country Report). It is considered likely that the increase in eel specific mortalities observed in recent years may in part be due to recent environmental conditions, including warm temperatures and prolonged dry weather exacerbating low flows, eel aggregations and conditions for disease emergence (see Stock Annex).

4.2 Eel recruitment trends in data poor habitats

Yellow eel abundance has increased in coastal habitats in the German Baltic (Dorow et al. 2023). An increase in yellow eel abundance could be the result from restocking or changes in mortality and does not necessarily reflect an increase in natural recruitment. However, since the possibility of increased recruitment in coastal habitats cannot be excluded, this chapter aims at investigating whether there are any available time-series which could indicate a risk of bias in the recruitment indices by missing signals from coastal and marine habitats.

The working group objectives therefore were i) to check which habitat types (fresh-, transitional-, coastal- or marine open waters) are represented in the recruitment indices, ii) to investigate whether there are indications of a difference in recruitment trends from different habitats and discuss the implications for the recruitment indices.

4.2.1 General considerations

Facultative catadromy

There is now clear evidence that catadromy in European eel is facultative (Marohn et al. 2013, Durif et al. 2023) and that restocked glass eels move between water bodies. Since eels move between fresh and marine waters and/or remain in coastal habitats and since the proportions of glass eel that remain in downstream or coastal habitats vary though time, a time series collected in freshwater habitats might not represent overall recruitment in the area. In other words: There is a risk that time series collected too far upstream might not encompass recruitment variations in an area. As a general rule, recruitment indeces are better if they can be collected at sea from the youngest stage. Recruitment series collected far inland, and at later stages will have a higher probability of being biased.

Restocking

Restocking influences eel density in a water body. For this reason, one of the inclusion criteria for the index series is that they should not be influenced by restocking (see Chapter 2). Water bodies that are connected to areas where restocking has taken place can also be influenced by this restocking: Rohthla et al., (2021) reported that 1% of the yellow eels caught and examined in coastal waters in Estonia came from restocking in inland waters, and 8.5% for the coast of Finland (personal communication Rohthla). Rohthla et al. (2021) explain the low percentage for the coast of Estonia by the fact that a dam separates the Narva catchment area from the offshore coastal waters. Shiao et al. (2006) report that stocked eels accounted for 20% of eels in the Curonian Lagoon (Lithuania), and 2% of eels sampled in Lithuanian coastal waters.

This aspect is addressed in the current assessment by specifically checking if series are impacted by restocking. Since it requires detailed knowledge on the respective system and monitoring approach, it is requested from national data providers to assess the quality of each year of each recruitment time series to avoid the use of data points that are affected by restocking (or other factors, e.g. samping reduced due to COVID).

4.2.2 Is there a risk of bias in the recruitment indices due to unsuitable habitat representation?

The WGEEL stock assessment is based on time series of recruitment, defined as the arrival of glass-eels in coastal/continental habitats, used as a proxy of reproduction outcome, and under the rationale that glass-eel abundance is less impacted by local environmental and anthropogenic conditions than latter stages. As such, time-series used in the analysis must be as representative as possible of overall recruitment in the region, and not that of arrival in a particular habitat, and be as little influenced as possible by local conditions.

Representation of different habitats in the current recruitment indices was checked. The North Sea index corresponds to 12 series from fresh water (6 glass eel and 6 glass eel + yellow eel) and 15 series from saline water (2 open water; 12 transitional and 1 coastal water) (Table 4.1). The “Europe Elsewhere” series corresponds to 11 series from fresh water (2 glass eel series and 9 glass eel + yellow eel series) and 9 from saline water (transitional). The yellow eel series all series (7) all come from freshwater.

Table 4.1 Number of series per index trend (NE =North sea; EE= Europe Elsewhere) , life stage (G =glass eel Y= yellow eel; GY = mixed glass and yellow) and habitat type (F =freshwater; T = transitional zone; Mo= Marine open; C = Coastal), in 2023.

Trend	life_stage	habitat_type	No. series 2023	No. series total
EE	G/GY	F	11	15
EE	G	T	9	19
NS	G/GY	F	9	11
NS	G	MO	1	2
NS	G/GY	T	5	12
NS	G	C	1	1
Y	Y	F	7	21

In both, North Sea and Elsewhere Europe index, saline (i.e. transitional, coastal or marine open) and freshwater habitats are represented almost equally. Saline habitats in both indices correspond mostly to transitional waters, whereas data from coastal and marine waters is scarce. For the yellow eel index, the time series included are exclusively in freshwater. This might bias the resulting index if the proportions of eels settling in saline habitats vary through time.

The core issue is, however, that direct and reliable estimates of recruitment in coastal and marine habitats are scarce (otherwise they would be included in the indices). Therefore, in the following sections, both direct and indirect information on recruitment (e.g. abundance of yellow eel linked to recruitment) were reviewed to check if there are any indications of differing recruitment trends among habitats.

4.2.3 Direct information on recruitment in coastal and marine open habitats

Recruitment data from fully marine habitats are available from two Swedish time series (Fig 4.1):

1. The Ringhals scientific survey (RingG), using a modified stationary Isaacs-Kidd-Midwater trawl (IKMT) to sample glass eel in coastal waters (intake channel of cooling water, corrected for variations in water flow depending on the operation of the nuclear power plant). Note, that from 2012 sampling was restricted to March and April (prior it was not restricted, but the peak usually occurred during this time).
2. The IYFS scientific estimate (IYFS), sampling glass eels in marine open waters (Skagerrak/Kattegat). Technically these are two series: Prior to 1990 a regular IKMT was used (IYFS1G) and after 1991 a modified Method-Isaac-Kidd-Midwater trawl (MIKMT) was used (IYFS2G).

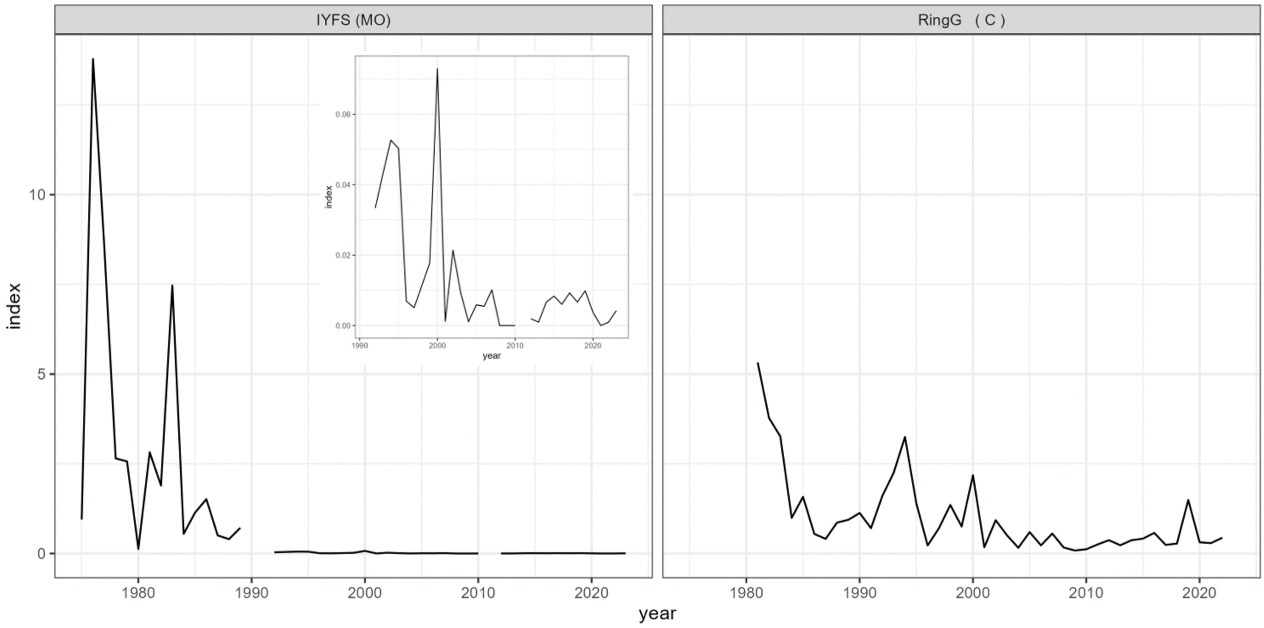


Fig 4.1: Time series of glass eel abundance from the IYFS scientific survey in marine open waters in the Skagerrak/Kattegat area (left; method changed in 1990; the small plot in the top right corner shows a zoom in on data after 1990 (i.e. different y-axis scale)) and time series of glass eel abundance from the Ringhals scientific survey (right; Ringhals nuclear power plant, Swedish east coast, Kattegat; sampling from 2012 restricted to March/April). Series are standardized to the percentage (1 = 100%) of the respective series mean over all years.

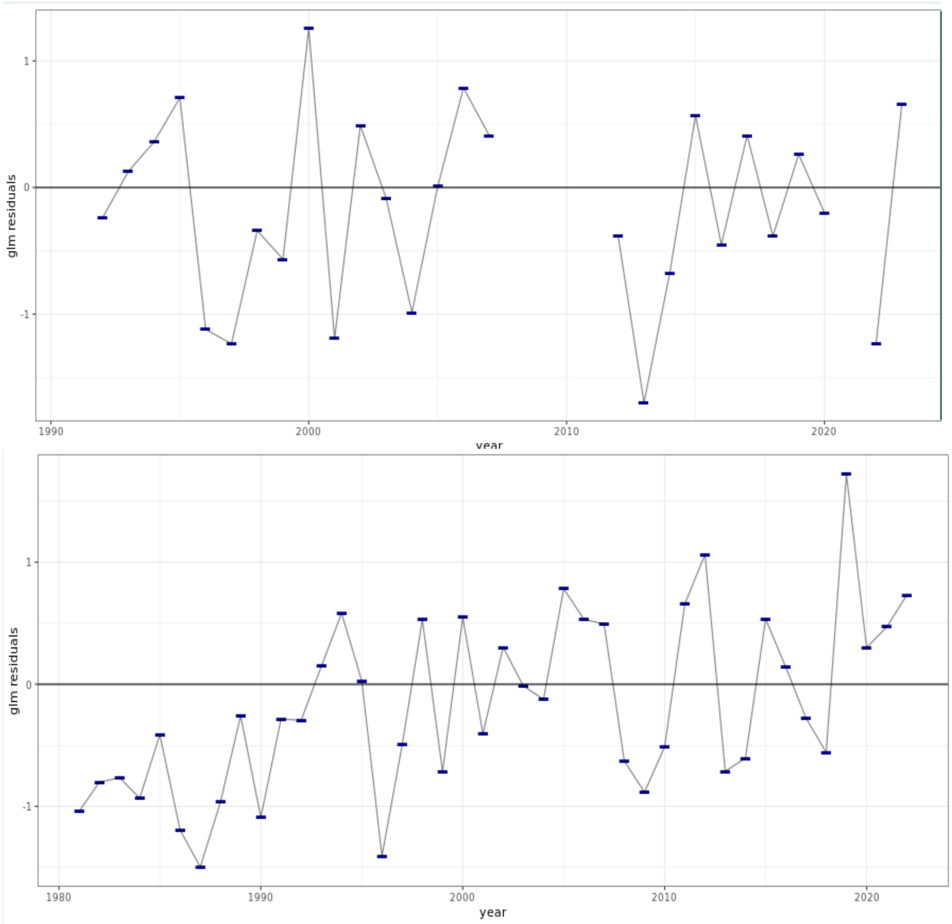


Fig 4.2: Residuals between the observed value (data points) from time series and recruitment index (North Sea; GLM, see 2.1.3) for each year, for the IYFS series (top) and RingG (bottom).

With only one time series each (coastal and marine open), both coming from the same geographic region, it cannot be said with certainty whether recruitment trends from these habitats generally deviate from those in freshwater. However, neither of the time series (Fig. 4.1) show a notable increase over the past decade. Further, in the residual plots (Fig. 4.2) a clear pattern is visible before 1993 in RingG (model overestimated recruitment) but no clear pattern after. This is, however, not necessarily an effect of habitat since a similar pattern can be observed in other series from the region, including sites upstream (e.g. LagaY). No obvious pattern is visible for IYFS.

In summary, the examples presented here demonstrate the importance of relying on multiple time series to draw any further conclusion.

4.2.4 Indirect indicators of recruitment trends in coastal and marine open habitats

Given the scarcity of direct recruitment data in coastal and marine habitats, this section looks at indirect information on recruitment trends. Several time series on the yellow eel standing stock are available, which can be seen as an indirect measure of natural recruitment if they are not impacted by other factors, such as changes in natural/anthropogenic mortalities, facultative catadromy or restocking (see 4.2.1). Therefore, information derived from yellow eel series are only relevant if a sound link to changes natural recruitment can be established, which will be addressed case by case in the following.

Southern Baltic Sea

A recent study found an increase in yellow eel standing stock in some coastal sites in the German Baltic (Dorow et al. 2021, Dorow et al. 2023), based on analyses of three independent time series of yellow eel abundance (2009-2020). This increase in yellow eel density was observed in four out of eight reference areas (one significant decrease) and it is concluded that this was possibly an effect of an increased natural recruitment. However, as discussed by the authors of the study the trend may result from several other factors, such as changes in natural mortality.

Swedish East Coast

In Sweden (east coast), yellow eel standing stock is monitored as part of biological monitoring programs at two nuclear powerplants (Forsmark and Oskarshamn). The Forsmark data is influenced by a large targeted restocking event and is therefore not discussed here. Test fishing with fyke nets is conducted yearly from March to June in Hamnefjärden (Fig. 4.3), which is the recipient of the cooling water, the fykes are emptied twice weekly (Franzén *et al*, 2023). Eels were restocked in the area during 1982-1983 as part of investigations on the effects of restocking eels in warmer water areas (Andersson, 1991). No other restocking events are mentioned in any reports, and data from the restocking database (held by SLU Aqua) show that the most recent restocking in the vicinity was in 2018, approximately 60 km north of the site.

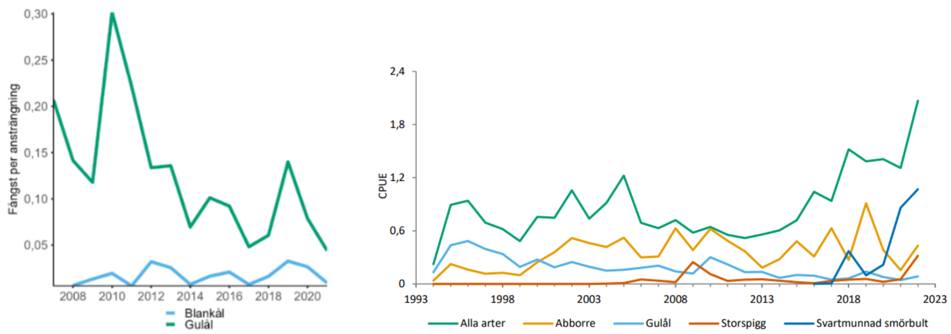


Figure 4.3. Left: CPUE of yellow eel (green line) and silver eel (blue line) in a fyke net test fishing survey in Hamnefjärden at Oskarshamn nuclear powerplant, Sweden. The figure is from the Swedish national report of the condition and trends of fish and shellfish in Swedish waters website (Fiskbarometern: *https://www.fiskbarometern.se*). Right: CPUE of yellow eel in a fyke net test fishing survey in Hamnefjärden at Oskarshamn nuclear powerplant (light blue line, the other lines show other species of fish). The graph shows the same dataseries as A but from the start of the survey in 1993. Figure from Franzén et al. 2023. Gulål: yellow eel, Blankål: silver eel, Alla arter: all species, Abborre: perch, Storspigg: Three-spined stickleback, Svarmunnad smörbult: Round Goby.

The CPUE data is owned by the powerplant company, but the results are reported annually and published (publicly) by the Swedish University of Agricultural Sciences (SLU), Department of Aquatic Resources (SLU Aqua) as part of the Swedish national report of the condition and trends of fish and shellfish in Swedish waters (Fiskbarometern: https://www.fiskbarometern.se). The CPUE is generally low, at the highest about 0.5 eels per fyke net per night in the early 1990's, and roughly 0.1 in 2014-2020 (Figure 4.3) giving no indication for an increase in natural recruitment in this coastal habitat.

Denmark

In Denmark recording eel catches (CPUE) in a standard way along the coast has taken place since 2002. The recordings are done by recreational fishers that have volunteered to participate. These "Key fishers" fish during the period from 1. April till 10. November. They use three standard fykenets and register catches after 48 hours. The last report (Støttrup et al 2020) conclude the following: *There is an increase in catches in several areas in the southern Danish waters from Bornholm to Funen Archipelago as well as in Great Belt and Kerteminde Fjord, Sejerø Bay and in the fjords facing east (the area includes Mariager Fjord, Randers Fjord and Horsens Fjord). This progress may have been caused by increasing water temperatures and potentially poor oxygen conditions, especially in the warm summer of 2018, which may have resulted in the eel being easier to catch. Steadily increasing catches of eel in Præstø Fjord since 2014 indicate an increase locally* (Støttrup et al 2020). Hence, the authors of the report do not establish a link to an increase in natural recruitment but link it to other factors influencing CPUE.

Netherlands

In the Netherlands there are signals that the eel biomass in some water bodies is increasing. Increasing trends are observed in LPUE (Landings per unit of effort) in Lake Ijsselmeer/Markermeer, CPUE (in biomass) in the scientific survey in lake Ijsselmeer/Markermeer, in the fyke monitoring in the Waddensea and the trap and transfer in the Nederrijn. The increase is only apparent in CPUE in biomass and not in number. This increase is consistent with an increase in average eel size, as well as a shift in sex ratio towards a larger proportion of females. In addition, in the Netherlands, there are hardly any areas where there is either no restocking or where the water body is not connected to a water body where there is restocking. For example, there is no restocking in lake Ijsselmeer, but there is in the connected lakes Markermeer and Randmeren.

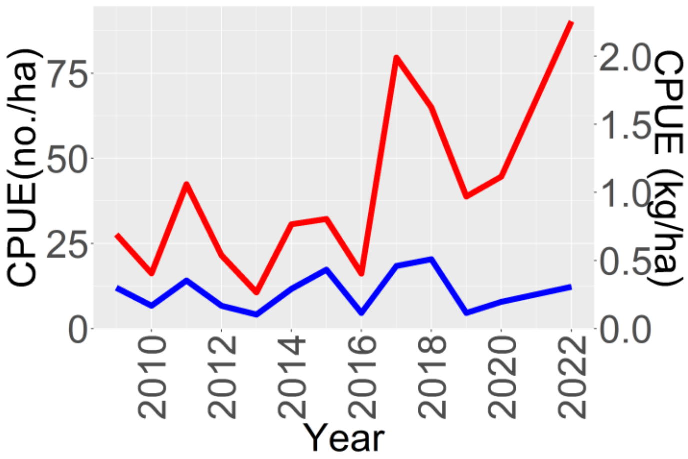


Figure 4.4 CPUE in numbers (blue) and in biomass (red) in lake IJsselmeer in the electric beam trawl monitoring.

4.2.5 Conclusions

ICES acknowledges that recruitment data in coastal and marine open habitats are scarce and it is currently not possible to conclude whether recruitment trends are different according to habitat. Therefore, it is strongly encouraged to establish new or report exisiting time series from coastal and marine open habitats. However, preliminary examination of the few direct estimates of recruitment and readily available time series from older life stages, do not indicate notably different trends from freshwater systems and therefore do not raise concerns about the suitability of the ICES recruitment indices for the assessment of the European eel stock.

4.3 Suggestions

1. Inclusion of Section 5 Scientific updates (new and emerging threats) from the 2016 Country Report format.
2. Thematic session under emerging opportunities on the level of scientific eel sampling undertaken for ICES and the use or application of alternative non-invasive sampling methods
3. Elaboration of an information sheet destined to inform non-scientists and stakeholders on the status of the eel population, i.e Development of a WGEEL pictorial/figures/simplified summary for dissemination aimed specifically for fishers/interested parties in line with current ICES output initiatives.
4. It is encouraged to establish new or report exisiting time series from coastal and marine open habitats
5. Assess to what extent these data series from the International Bottom Trawl Survey-(IBTS), similar to the Swedish recruitment index in marine water may be used to strengthen the set of recruitment indices in marine/brackish habitats

5 Update on developments in the Mediterranean region

For what concerns aspects of the eel lyfe cycle in the Mediterranean, advances have been made on issues of key interest, that confirmed and clarified some basic questions concerning the European eel subpopulation in the Mediterranean, including Atlantic reproduction in the Sargasso Sea, the genetic structure and panmixia, emigration of spawners from the Mediterranean and the transport of larvae from the Atlantic Ocean across the Mediterranean. Several studies have also focused on local stocks throughout the Mediterranean, contributing to knowledge on eel biology in its continental stages (for example, growth, differentiation, reproductive biology, population structure, ecology), as well as papers on recruitment, spawner quality and assessment of local stocks. These aspects have been reviewed in Kara and Quignard (2019), in a comprehensive book chapter dedicated to European eel in the Mediterranean region, also including a section on glass eel recruitment. Nevertheless, there still persists a common perception that scarce information is available, particularly for the Mediterranean.

The amount of information available on eel in the Mediterranean from different past and present sources has provided the foundations for the work of he "GFCM Research programme on European eel: towards coordination of European eel stock management and recovery in the Mediterranean" (RP), mentioned in paragraph 1.6.2. , whose final report is now available as a GFCM publication (Ciccotti & Morello 2023). This publication includes the quantitative and qualitative study of eel habitats in their various components (Chapters 1 through 4) and continues with the study of recruitment (Chapter 5) and the characterization of local stocks from the point of view of their biology and quality (Chapters 6 through 8). The qualitative and quantitative description of exploitation methods employed by fisheries and aquaculture follows in Chapters 9 through 12. Chapter 13 provides the results of a thorough review of all management measures relevant to European eel in the context of different frameworks, both those within eel-specific management plans and those relevant to the species within fishery regulations and habitat protection frameworks. All the information gathered for this review, collected at the highest possible resolution (site level), and analysed at various levels (at the site, eel management unit or local level and by country, habitat typology, region), provided the basis for a model-based evaluation of alternative management strategies, which is reported in Chapter 14. The last important task of the research programme dealt with an in-depth analysis of the current tools used for the collection of data on European eel stocks through current monitoring in different countries and under different frameworks (including research, assessment, European Union obligations and national requirements) (Chapter 15) and on eel fishery-related data collection under DCRF Task VII.6 "European eel" (Chapter 16). Apart from the availability of a large amount of information and data on European eel, as well as an established network of relevant contacts. an important outcome of the research programme was to devise a coordinated framework for the collection and analysis of data, as well as for the assessment and management of the resource, with the common goal of sustainable exploitation of eel resources and the restoration and conservation of the stock at the global level. In this sense, perspective work at the Mediterranean level will enable the formulation and implementation of a management strategy at the Regional level, also joining the stock-wide process of data collection and data sharing for assessment caiiued out within the WGEEL.

A comprehensive description of recruitment in the Mediterranean was developed for the first time (Ciccotti, Prisco & Leone, 2023), based on past and present information and an exhaustive search of available data (130 papers dating from 1913 to 2021, integrated by a specific data collection of annual data on glass eel abundance from any monitoring and commercial fisheries records). Recruitment was documented at 79 sites across the Mediterranean, with all transitional eel habitats included. Past and present levels of abundance were compared for the four timeframes (pre-1950, pre-1980, pre-2009 and post-2009), and twenty-three recruitment times series from seven countries in the Mediterranean area were reconstructed and covered varying time intervals from 1910 to 2020. The overall picture emerging from the available time series confirms that for these European eel fisheries in the Mediterranean, landings over the period pre-2009 saw a marked decline throughout the 1990s, with the lowest recruitment levels occurring at all sites in the most recent years of this timeframe. In the period following the implementation of eel management plans in European countries, the time series show a further decrease in abundance at all sites, even if for some sites (for example, the Spanish rivers and the French site in Camargue Lagoon) signs of recovery were observed in the middle of this period. However, no information is available or has been validated on changes in fishing effort at specific sites, and this partial recovery has not been confirmed for the most recent years. Therefore, the trend in recruitment described for the Mediterranean area seems consistent with the trend described for the rest of Europe. As new time series are now available for the Mediterranean, potential areas of exploration, at the moment underway, include the analysis of time trends in the Mediterranean compared to recruitment trends observed in the rest of Europe, considering these new series in recalculations of recruitment indices, while also performing trend analyses to separate the Mediterranean area from the North Sea and the “Elsewhere Europe”.

Within the work of the GFCM RP, data and information Mediterranean collected at the highest possible resolution (site level), and analysed have allowed to fill gaps on many aspects of eel and its habitats in the Region, and provided the basis for the assessment and model-based evaluation of alternative management strategies.

The common basis for the assessment and management appraisal of European eel (Capoccioni, 2023) across the Mediterranean relied on the Eel Stock Assessment Model (ESAM), an age- and sex-structured population dynamics model based on the early development of the DemCam model for French lagoons, was selected. This choice was made due to the model’s suitability for transitional waters (i.e. lagoons and river deltas or estuaries) and the possibility of its application to both data-rich and data-poor conditions. This model’s strength lies in the possibility of embedding a set of default parameters in order to run simulations under all data availability conditions, producing outputs of time series for landings and silver eel escapement. The ESAM model was selected for use because of its flexibility and easy adaptability to data-poor case studies, and it was developed specifically for lagoons, which represent highly productive habitats for European eel in the Mediterranean area. The ESAM model builds on early work on European eel demography and management by De Leo and Gatto (1995, 1996, 2001) for Comacchio Lagoons in Italy, on subsequent developments by Bevacqua et al. (2007) for the Camargue lagoons in France and on a generalization at the European scale by Andrello et al. (2011), which was followed by a further improvement from Schiavina et al. (2015) for European eel stock assessment. Assessments were performed at the site level for 122 locations with information available on fisheries (minimum eight years of landings and effort data), biological data (size and age) and habitat (wetted area, sea connectivity and water temperature) (“data-rich” sites). Specific sites from which historical (pre-1990) or long time series of landings from fishing barriers were available (forming their own “super subset” of sites) were used to evaluate the range of the carrying capacity (kg/ha of potential settlers) and to estimate the potential biomass each site could produce in the absence of anthropogenic pressures. Results were extended to another 135 sites that did not provide data fulfilling minimum requirements (“data-poor” sites). Finally, the model was used to foresee the effects of some current or feasible management scenarios on European eel potential spawning biomass at the country level, including different fishing closure periods at the site or habitat level, minimum landing size for European eel, or gear restrictions.

Data on chemical contamination levels (heavy metals, organic pollutants) and biological infections (parasites, viruses, bacteria) in European eel were also collected from the nine partner countries participating in the GFCM RP, analysed and described in the Final report (Derouiche, Bensaâd-Bendjedid & Rouidi, 2023). The data were used to evaluate the quality of local European eel stocks, using the eel quality index (EQI) (ICES, 2016). Despite the disparities in the availability of data between different partner countries, habitat typologies and specific parameters, results, although partial, highlighted that local eel stocks in Mediterranean lagoons are relatively healthy overall and could therefore effectively and successfully contribute towards stock recovery.

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Annex 1: List of participants

Name	Institute	Country (of institute)	Email
Elsa Amilhat	University of Perpignan Centre of Education and Research on Mediterranean Environments	France	elsa.amilhat@univ-perp.fr
Tea Bašić	Centre for Environment, Fisheries and Aquaculture Science Cefas Lowestoft Laboratory	United Kingdom	tea.basic@cefas.gov.uk
Marouene Bdioui	Institut National des Sciences et Technologies de la Mer	Tunisia	bdioui.marouene@gmail.com
Laurent Beaulaton	French Agency for Biodiversity / Management of Diadromous Fish in their Environment, OFB, INRAE, Institut Agro, UNIV PAU and PAYS ADOUR/E2S UPPA	France	laurent.beaulaton@ofb.gouv.fr
Claude Belpaire	Research Institute Nature and Forest	Belgium	Claude.Belpaire@inbo.be
Clarisse Boulenger	French Agency for Biodiversity / Management of Diadromous Fish in their Environment, OFB, INRAE, Institut Agro, UNIV PAU and PAYS ADOUR/E2S UPPA	France	clarisse.boulenger@ofb.gouv.fr
Cedric Briand	EPTB Vilaine	France	cedric.briand@eptb-vilaine.fr
Karin Camara	North Rhine Westfalian State Agency for Nature, Environment and Consumer Protection Department of Fishery Ecology	Germany	Karin.Camara@lanuv.nrw.de
Rui Catarino	International Council for the Exploration of the Sea	Denmark	rui.catarino@ices.dk
Eleonora Ciccotti	University of Rome Tor Vergata Department of Biology	Italy	ciccotti@uniroma2.it
Estibaliz Diaz	AZTI-Tecnalia/ AZTI Sukarrieta	Spain	ediaz@azti.es
Tomas Didrikas	Fisheries Service under Ministry of Agriculture	Lithuania	tomas.didrikas@zuv.lt
Isabel Domingos	University of Lisbon Faculty of Sciences	Portugal	idomingos@fc.ul.pt
Hilaire Drouineau	INRAE EABX/ Management of Diadromous Fish in their Environment OFB, INRAE, Institut Agro, UNIV PAU and PAYS ADOUR/E2S UPPA	France	Hilaire.Drouineau@inrae.fr
Caroline Durif (Chair)	Institute of Marine Research Austevoll Aquaculture Research Station	Norway	caroline.durif@hi.no

Name	Institute	Country (of institute)	Email
Derek Evans	AFBI Fisheries and Aquatic Ecosystems Branch	United Kingdom	derek.evans@afbini.gov.uk
Marko Freese	Thuenen Institute for Fisheries Ecology	Germany	marko.freese@thuenen.de
Jason Godfrey	Marine Scotland Science Freshwater Laboratory	United Kingdom	JasonGodfrey@gov.scot
Matthew Gollock	Institute of Zoology	United Kingdom	matthew.gollock@zsl.org
Edmond Hala	Agricultural University of Tirana, Department of Aquaculture and Fisheries	Albania	hiedmo@upt.edu.al
Reinhold Hanel	Thuenen Institute Institute for Fisheries Ecology	Germany	reinhold.hanel@thuenen.de
Jani Helminen	Natural Resources Institute Finland	Finland	jani.helminen@luke.fi
Per Holiland	Swedish University of Agricultural Sciences SLU Department of Aquatic Resources	Sweden	per.holliland@slu.se
Andrzej Kapusta	Inland Fisheries Institute	Poland	a.kapusta@infish.com.pl
Michael Ingemann Pedersen	DTU Aqua - Silkeborg	Denmark	mip@aqua.dtu.dk
Katarzyna Janiak	European Commission Directorate General for Maritime Affairs and Fisheries	Belgium	Katarzyna.JANIAK@ec.europa.eu
Janis Kolangs	Institute of Food Safety Animal Health and Environment	Latvia	janis.kolangs@bior.lv
Linas Lozys	Nature Research Centre	Lithuania	linas.lozys@gamtc.lt
Lasse Marohn	Thuenen Institute for Fisheries Ecology	Germany	lasse.marohn@thuenen.de
Jonathan McDowell	Queen’s University of Belfast	Northern Ireland	jmcdowell39@qub.ac.uk
Tomasz Nermer	National Marine Fisheries Research Institute	Poland	nermer@mir.gdynia.pl
Ciara O'Leary	Inland Fisheries Ireland	Ireland	ciara.oleary@fisheriesireland.ie
Jan-Dag Pohlmann (Chair)	Thuenen Institute for Fisheries Ecology	Germany	jan.pohlmann@thuenen.de
Russell Poole	Marine Institute Fisheries Ecosystem Advisory Services	Ireland	russell.poole@marine.ie
Argyrios Sapounidis	Fisheries Research Institute	Greece	asapoun@inale.gr

Name	Institute	Country (of institute)	Email
Torbjörn Säterberg	University of Agricultural Sciences SLU Department of Aquatic Resources-SLU Aqua	Sweden	torbjorn.saterberg@slu.se
Josefin Sundin	University of Agricultural Sciences SLU Department of Aquatic Resources-SLU Aqua	Sweden	josefin.sundin@slu.se
Ayesha Taylor	Environment Agency Northwest Regional Office	United Kingdom	ayesha.taylor@environment-agency.gov.uk
Paul Teesalu	Estonian University of Life Sciences	Estonia	paul.teesalu@emu.ee
Eva Thorstad	Norwegian Institute for Nature Research	Norway	eva.thorstad@nina.no
Jeroen Van Wichelen	Research Institute Nature and Forest	Belgium	jeroen.vanwichelen@inbo.be
Tessa van der Hammen	Wageningen Marine Research	Netherlands	tessa.vanderhammen@wur.nl
Rob van Gemert	Swedish University of Agricultural Sciences SLU Department of Aquatic Resources SLU Aqua	Sweden	rob.van.gemert@slu.se
Sami Vesala	Natural Resources Institute Finland	Finland	sami.vesala@luke.fi
Jack Wootton	Forth Rivers Trust	United Kingdom	j.wootton@forthriverstrust.org
Sukran Yalcin Ozdilek	Canakkale Onsekiz Mart University	Türkiye	syalcinozdilek@gmail.com

Annex 2: Resolutions

2022/2/FRSG11 The J**oint EIFAAC/ICES/GFCM Working Group on Eels** (WGEEL), chaired by Jan-Dag Pohlmann, Thünen Institute, Germany and Caroline Durif, Norway will meet, in a split meeting from 11–16 September (virtually) and 25 September–02 October in TBD 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) Identify and address Mediterranean-specific issues on European eel
e) Implement the roadmap proposed by WKFEA
f) Review and update the stock annex

Material and data relevant for the meeting must be available to the group on the dates specified in the 202 ICES data call.

WGEEL will report by Date, 16 October 2023 for the attention of ACOM, WGDIAD, FRSG and FAO, EIFAAC and GFCM.

Supporting Information

Priority	1. The status of the European eel stock remains outside safe biological limits and continuing and further management actions are required to recover the stock. 2. 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 the 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. 3. 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. 4. 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, 2018 and 2021. 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

Only experts appointed by national Delegates or appointed in consultation with the national Delegates of the expert's country can attend this Expert Group

Annex 3: Recruitment series tables

Table 1: Short description of the 60 Glass and Glass and eel yellow mixed series that have been used in the recruitment index calculation in 2023. EE: Elsewhere Europe, NS: North Sea. 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: G = glass eel and GY = glass eel and yellow eel, G. 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).

Serie	Area	Country	min	max	duration	missing	life_stage	sampling_type	unit	habitat_type
AlbuG	EE	ES	1949	2023	75	6	G	commercial catch	kg	F
AlCPG	EE	ES	1982	2023	42	7	G	commercial CPUE	kg/boat/d	F
EbroG	EE	ES	1966	2023	58	3	G	commercial catch	kg	T
GuadG	EE	ES	1998	2007	10	0	G	scientific estimate	index	T
MiSpG	EE	ES	1975	2023	49	0	G	commercial catch	kg	T
NaloG	EE	ES	1953	2023	71	0	G	commercial catch	kg	T
OriaG	EE	ES	2006	2023	18	6	G	scientific estimate	nr/m3	T
AdCPG	EE	FR	1928	2008	81	40	G	commercial CPUE	kg/boat/d	T
AdTCG	EE	FR	1986	2008	23	0	G	commercial catch	t	T
GiCPG	EE	FR	1961	2008	48	1	G	commercial CPUE	kg/boat/d	T
GiScG	EE	FR	1994	2023	30	0	G	scientific estimate	index	T
GiTCG	EE	FR	1923	2008	86	28	G	commercial catch	t	T
LoiG	EE	FR	1924	2008	85	6	G	commercial catch	kg	T
SevNG	EE	FR	1962	2008	47	25	G	commercial CPUE	kg/boat/d	T
VacG	EE	FR	2004	2023	20	0	G	trapping partial	nr	T
VilG	EE	FR	1971	2015	45	3	G	trapping all	t	T
SeEAG	EE	GB	1972	2020	49	2	G	commercial catch	t	T
ShiMG	EE	GB	2014	2023	10	0	G	trapping partial	nr	T
MaigG	EE	IE	1994	2022	29	5	G	trapping all	kg	F
TibeG	EE	IT	1975	2006	32	0	G	commercial catch	t	T
MiPoG	EE	PT	1974	2023	50	0	G	commercial catch	kg	T
MondG	EE	PT	1989	2023	35	28	G	scientific estimate	nr/h	T
YserG	NS	BE	1964	2022	59	3	G	scientific estimate	kg	T
EmsG	NS	DE	1946	2001	56	0	G	commercial catch	kg	T
KlitG	NS	DK	2008	2023	16	0	G	scientific estimate	nr/m2	F
NorsG	NS	DK	2008	2023	16	0	G	scientific estimate	nr/m2	F
SleG	NS	DK	2008	2023	16	0	G	scientific estimate	nr/m2	F
VidaG	NS	DK	1971	1990	20	0	G	commercial catch	kg	T

Serie	Area	Country	min	max	duration	missing	life_stage	sampling_type	unit	habitat_type
BeeG	NS	GB	2006	2023	18	0	G	trapping partial	nr	F
BroG	NS	GB	2011	2023	13	2	G	trapping partial	nr	F
FlaG	NS	GB	2007	2023	17	1	G	trapping partial	nr	F
KatwG	NS	NL	1991	2023	33	2	G	scientific estimate	index	T
LauwG	NS	NL	1976	2023	48	6	G	scientific estimate	nr/h	T
RhDOG	NS	NL	1938	2023	86	1	G	scientific estimate	index	T
RhIjG	NS	NL	1969	2022	54	5	G	scientific estimate	index	T
StelG	NS	NL	1971	2023	53	0	G	scientific estimate	index	T
RingG	NS	SE	1981	2022	42	0	G	scientific estimate	index	C
YFS1G	NS	SE	1975	1989	15	0	G	scientific estimate	index	MO
YFS2G	NS	SE	1992	2023	32	1	G	scientific estimate	index	MO
BresGY	EE	FR	2003	2023	21	0	GY	trapping partial	nr	F
SousGY	EE	FR	2013	2022	10	0	GY	trapping all	nr	F
BannGY	EE	GB	1933	2023	91	11	GY	trapping partial	kg	F
GreyGY	EE	GB	2009	2023	15	0	GY	trapping partial	nr	F
OatGY	EE	GB	2013	2023	11	2	GY	trapping partial	nr	F
StraGY	EE	GB	2012	2023	12	0	GY	trapping partial	nr	F
BurrGY	EE	IE	1987	2023	37	18	GY	trapping partial	kg	F
ErneGY	EE	IE	1980	2023	44	0	GY	trapping all	kg	F
FealGY	EE	IE	1985	2017	33	14	GY	trapping all	kg	F
InagGY	EE	IE	1996	2022	27	5	GY	trapping all	kg	F
LiffGY	EE	IE	2012	2023	12	0	GY	trapping partial	kg	F
ShaAGY	EE	IE	1977	2023	47	0	GY	trapping all	kg	F
BrokGY	NS	DE	2012	2022	11	0	GY	trapping partial	nr	T
VerlGY	NS	DE	2010	2023	14	0	GY	trapping partial	nr	T
WiFG	NS	DE	2006	2022	17	0	GY	trapping partial	nr	T
WisWGY	NS	DE	2004	2022	19	0	GY	trapping partial	nr	F
HellGY	NS	DK	2010	2022	13	0	GY	scientific estimate	nr	T
BeeGY	NS	GB	2011	2023	13	0	GY	trapping partial	nr	F
NmiGY	NS	GB	2009	2023	15	0	GY	trapping partial	nr	F
ImsaGY	NS	NO	1975	2023	49	0	GY	trapping all	nr	F
ViskGY	NS	SE	1972	2022	51	0	GY	trapping all	kg	F

Table 2: Short description of the 21 yellow series that have been used in the recruitment index calculation in 2023. 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. 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).

Series	Area	Country	min	max	duration	missing	sampling_type	unit	habitat_type
FreY	EE	FR	1997	2022	26	0	trapping all	nr	F
RhoY	EE	FR	2008	2022	15	0	trapping partial	nr	F
ShaPY	EE	IE	1985	2023	39	0	trapping partial	kg	F
DoElY	NS	DE	2003	2022	20	2	trapping partial	nr	F
GudeY	NS	DK	1980	2022	43	0	trapping all	kg	F
HartY	NS	DK	1967	2022	56	0	trapping all	kg	F
BeeY	NS	GB	2011	2023	13	0	trapping partial	nr	F
BroY	NS	GB	2011	2023	13	2	trapping partial	nr	F
FlaY	NS	GB	2012	2023	12	0	trapping partial	nr	F
GirnY	NS	GB	2008	2022	15	1	trapping partial	nr	F
MertY	NS	GB	2012	2023	12	0	trapping partial	nr	F
MillY	NS	GB	2011	2022	12	1	trapping partial	nr	F
MolY	NS	GB	2005	2023	19	1	trapping partial	nr	F
RodY	NS	GB	2005	2023	19	2	trapping partial	nr	F
DalaY	NS	SE	1951	2022	72	3	trapping all	kg	F
GotaY	NS	SE	1900	2017	118	14	trapping all	kg	F
KavlY	NS	SE	1992	2022	31	0	trapping all	kg	F
LagaY	NS	SE	1925	2021	97	0	trapping all	kg	F
MorrY	NS	SE	1960	2016	57	0	trapping all	kg	F
MotaY	NS	SE	1942	2022	81	0	trapping all	kg	F
RonnY	NS	SE	1946	2018	73	9	trapping all	kg	F

Table 3: Short description of the sampling sites for European eel recruitment data that have been excluded in the recruitment index calculation in 2023. Kept: 0 = excluded because the series was < 10 years, 3 = not used due to poor quality, EE: Elsewhere Europe, NS: North Sea. 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).

Series	Area	Country	min	max	duration	missing	life_stage	sampling_type	unit	habitat_type	series_kept
InagG	EE	IE	2017	2022	6	0	G	trapping all	kg	F	0
MiScG	EE	PT	2018	2023	6	0	G	scientific estimate	nr/h	T	0
PogoG	EE	IT	2022	2022	1	0	G	trapping partial	index	T	0
PovoG	EE	IT	2022	2022	1	0	G	trapping partial	index	T	0
ShiFG	EE	GB	2017	2022	6	1	G	trapping partial	nr	F	0
TibnG	EE	IT	2022	2022	1	0	G	trapping partial	index	T	0
EmsHG	NS	DE	2014	2022	9	0	G	trapping partial	nr	T	0
VeAmG	NS	BE	2017	2022	6	1	G	trapping all	kg	T	0
WaSG	NS	DE	2015	2021	7	0	G	scientific estimate	nr	T	0
CorGY	EE	IE	2017	2022	6	0	GY	trapping partial	kg	F	0
HoSGY	NS	DE	2010	2010	1	0	GY	trapping partial	nr	T	0
LangGY	NS	DE	2015	2023	9	0	GY	trapping partial	nr	T	0
MiSpY	EE	ES	2019	2020	2	0	Y	trapping all	kg	T	0
VeAmY	NS	BE	2017	2022	6	1	Y	trapping all	nr	T	0
WaSEY	NS	DE	2015	2022	8	0	Y	scientific estimate	nr	T	0
SeHMG	EE	GB	1979	2020	42	4	G	commercial catch	t	T	3
BroGY	NS	GB	2011	2023	13	2	GY	trapping partial	nr	F	3
EmsBGY	NS	DE	2013	2022	10	0	GY	trapping all	nr	F	3
FarpGY	NS	DE	2007	2022	16	0	GY	trapping all	nr	F	3
FlaGY	NS	GB	2007	2023	17	2	GY	trapping partial	nr	F	3
HHKGY	NS	DE	2010	2013	4	0	GY	trapping partial	nr	T	3
MeusY	NS	BE	1992	2019	28	3	Y	trapping partial	nr	F	3

Annex 4: Recruitment series: series reported up to 2023

Table 1: Series updated to 2023. 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	Divi-sion	Kept
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
BeeG	Beeleigh_Glass_<80mm	GB	G	NS	27.4.c	1
BroG	Brownshill_Glass_<80mm	GB	G	NS	27.4.c	1
FlaG	Flatford_GE_<80mm	GB	G	NS	27.4.c	1
SeEAG	Severn EA commercial catch	GB	G	EE	27.7.f	1
ShiMG	Shieldaig river mouth scientific estimate	GB	G	EE	27.6.a	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
MondG	Mondego estuary	PT	G	EE	27.9.a	1
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
LiffGY	Liffey	IE	GY	EE	27.7.a	1
BurrGY	Burrishoole	IE	GY	EE	27.7.b	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

Site	Name	Coun.	Stage	Area	Divi-sion	Kept
StraGY	Strangford	GB	GY	EE	27.7.a	1
GreyGY	Greylake_Elvers/Yellow (mainly yellow>120mm with 20-25% elvers <120mm)	GB	GY	EE	27.7.g	1
BeeGY	Beeleigh_Elver_81-120mm	GB	GY	NS	27.4.c	1
OatGY	Oath Lock predominantly glass eel and elvers (<120mm)	GB	GY	EE	27.7.d	1
BannGY	Bann Coleraine trapping partial	GB	GY	EE	27.6.a	1
NmiGY	New Mills Elvers/Yellow >80mm	GB	GY	NS	27.4.c	1
BresGY	Bresle	FR	GY	EE	27.7.d	1
RonnY		SE	Y	NS	27.3.a	1
MorrY	Mörrumsån trapping all	SE	Y	NS	27.3.d	1
ShaPY	Shannon Parteen trapping partial	IE	Y	EE	27.7.b	1
BeeY	Beeleigh_Yellow_121mm+	GB	Y	NS	27.4.c	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
RodY	Thames - Roding	GB	Y	NS	27.4.c	1
FlaY	Flatford Yellow eel >120mm	GB	Y	NS	27.4.c	1

Annex 5: Recruitment series: series reported up to 2022

Table 2: Series updated to 2022 see table XXX for codes. Series ordered from North to South

Site	Name	Coun.	Stage	Area	Division
RingG	Ringhals scientific survey	SE	G	NS	27.3.a
YserG	IJzer Nieuwpoort scientific estimate	BE	G	NS	27.4.c
MaigG	River Maigue	IE	G	EE	27.7.b
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
InagGY	River Inagh	IE	GY	EE	27.7.b
FealGY	River Feale	IE	GY	EE	27.7.j
SousGY	Souston glass and yellow eel trap	FR	GY	EE	27.8.b
KavlY	Kävlingeån trapping all	SE	Y	NS	27.3.b, c
DalaY	Dalälven trapping all	SE	Y	NS	27.3.d
MotaY	Motala Ström trapping all	SE	Y	NS	27.3.d
GotaY		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 AA. Tange trapping all	DK	Y	NS	27.3.a
GirnY	Girnock Burn trap scientific estimate	GB	Y	NS	27.4.b
FreY	Fremur	FR	Y	EE	27.7.e
RhoY	Rhone_Beaucaire	FR	Y	EE	37.1.2

Annex 6: Recruitment series: series stopped, with no report after 2022

Table 3: table_serieslost

Site	Name	Coun.	Stage	Area	Division	Last Year
YFS1G	IYFS scientific estimate	SE	G	NS	27.3.a	1,989
VidaG	Vidaa Hoejer sluice commercial catch	DK	G	NS	27.4.b	1,990
EmsG	Ems Herbrum commercial catch	DE	G	NS	27.4.b	2,001
TibeG	Tiber Fiumara Grande commercial catch	IT	G	EE	37.1.3	2,006
GuadG	Guadalquivir scientific monitoring	ES	G	EE	27.9.a	2,007
AdCPG	Adour Estuary (CPUE) commercial CPUE	FR	G	EE	27.8.b	2,008
AdTCG	Adour Estuary (catch) commercial catch	FR	G	EE	27.8.b	2,008
GiCPG	Gironde Estuary (CPUE) commercial CPUE	FR	G	EE	27.8.b	2,008
GiTCG	Gironde Estuary (catch) commercial catch	FR	G	EE	27.8.b	2,008
LoiG	Loire Estuary commercial catch	FR	G	EE	27.8.a	2,008
SevNG	Sevres Niortaise Estuary commercial CPUE	FR	G	EE	27.8.a	2,008
VilG	Vilaine Arzal trapping all	FR	G	EE	27.8.a	2,015
LagaY	Lagan trapping all	SE	Y	NS	27.3.a	2,021

Annex 7: Recruitment series reported in 2022 and 2023 having problem at the level of individual year

Table 10: Data in 2023 and 2022 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 is used, but there are warnings on its quality

Name	Stage	Coun-try	Divi-sion	Year	Kept	Comment
NaloG	G	ES	27.8.c	2,022	4	Glass eel fishing
RhIjG	G	NL	27.4.c	2,022	4	
SeEAG	G	GB	27.7.f	2,022	3	Updated 0.473 to 1.114. following reciept and analysis of further catch returns from provisional data provided in 2022
SeHMG	G	GB	27.7.f	2,022	3	
BeeG	G	GB	27.4.c	2,023	4	Provisional data to end June
BroG	G	GB	27.4.c	2,023	4	Provisional data to end June
FlaG	G	GB	27.4.c	2,023	4	Provisional data to end June
GiScG	G	FR	27.8.b	2,023	4	Provisional data
RhIjG	G	NL	27.4.c	2,023	0	
SeEAG	G	GB	27.7.f	2,023	3	Effort highly restricted due to market forces
SeHMG	G	GB	27.7.f	2,023	3	Effort highly restricted due to market forces
ShiFG	G	GB	27.6.a	2,023	0	NP trap site discontinued
VacG	G	FR	37.1.2	2,023	4	Provisional data
HHKGY	GY	DE	27.4.b	2,022	0	no monitoring. Series ended in 2013
OatGY	GY	GB	27.7.d	2,022	4	Count was not available for the last data call, but still considered as provisional as some checks are needed.

Table 11: Table continued. Data in 2023 and 2022 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 is used, but there are warnings on its quality

Name	Stage	Coun-try	Divi-sion	Year	Kept	Comment
OatGY	GY	GB	27.7.d	2,022	4	Count was not available for the last data call, but still considered as provisional as some checks are needed.
SousGY	GY	FR	27.8.b	2,022	4	Provisional data
WisWGY	GY	DE	27.3.b, c	2,022	4	
BeeGY	GY	GB	27.4.c	2,023	4	Provisional data to end June
BresGY	GY	FR	27.7.d	2,023	4	Provisional data
BroGY	GY	GB	27.4.c	2,023	4	Provisional data to end June
BrokGY	GY	DE	27.4.b	2,023	3	Strange data. Possibly caused by change of operator. Must be checked.
FlaGY	GY	GB	27.4.c	2,023	4	Provisional data to end June
GreyGY	GY	GB	27.7.g	2,023	4	Provisional data to end of April
LangGY	GY	DE	27.4.b	2,023	4	
LiffGY	GY	IE	27.7.a	2,023	4	Still trapping; data up to 24/08/2023
NmiGY	GY	GB	27.4.c	2,023	4	Provisional data to end June
OatGY	GY	GB	27.7.d	2,023	4	Provisional data (March and April only)
VerlGY	GY	DE	27.4.b	2,023	4	
GotaY	Y	SE	27.3.a	2,022	0	This eel pass is not running
MorrY	Y	SE	27.3.d	2,022	0	This eel-trap is closed

Table 12: Table 11 continued. Data in 2023 and 2022 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 is used, but there are warnings on its quality

Name	Stage	Coun-try	Divi-sion	Year	Kept	Comment
MorrY	Y	SE	27.3.d	2,022	0	This eel-trap is closed
RonnY	Y	SE	27.3.a	2,022	0	This eel-trap is closed
BeeY	Y	GB	27.4.c	2,023	4	Provisional data to end June
BroY	Y	GB	27.4.c	2,023	4	Provisional data to end June
FlaY	Y	GB	27.4.c	2,023	4	Provisional data to end June
MertY	Y	GB	27.4.c	2,023	4	Provisional data to end June
MillY	Y	GB	27.4.c	2,023	0	NP; This series was discontinued in 2023 and will not be re-instated.
MolY	Y	GB	27.4.c	2,023	4	Provisional data to end June
MorrY	Y	SE	27.3.d	2,023	0	
RodY	Y	GB	27.4.c	2,023	4	Provisional data to end of June
RonnY	Y	SE	27.3.a	2,023	0	

Annex 8: Additional graphs and analyses for recruitment

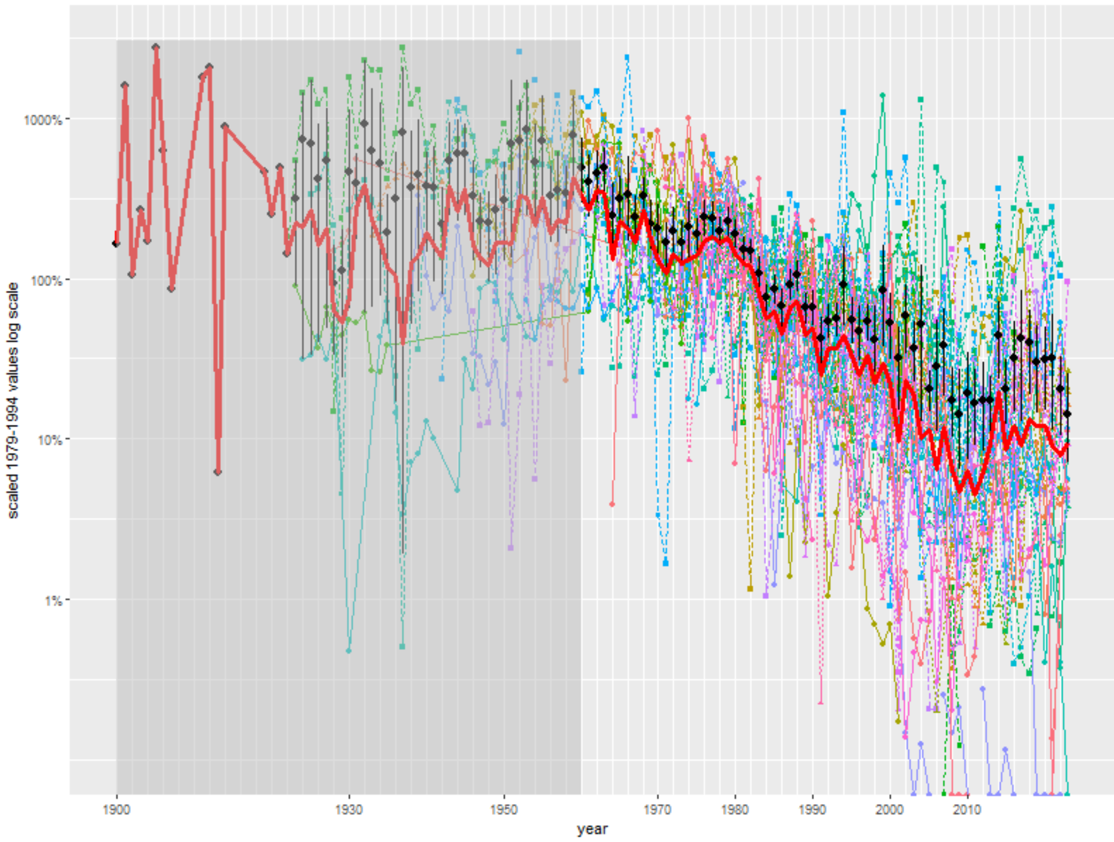

Figure 1. Time-series of glass eel and yellow eel recruitment in European rivers with time-series having data for the 1979-1994 period (45 sites). Each time-series has been scaled to its 1979-1994 average. Note the logarithmic scale on the y-axis. The mean arithmetic values and their bootstrap confidence interval (95%) are represented as black dots and bars. Geometric means are presented in red.

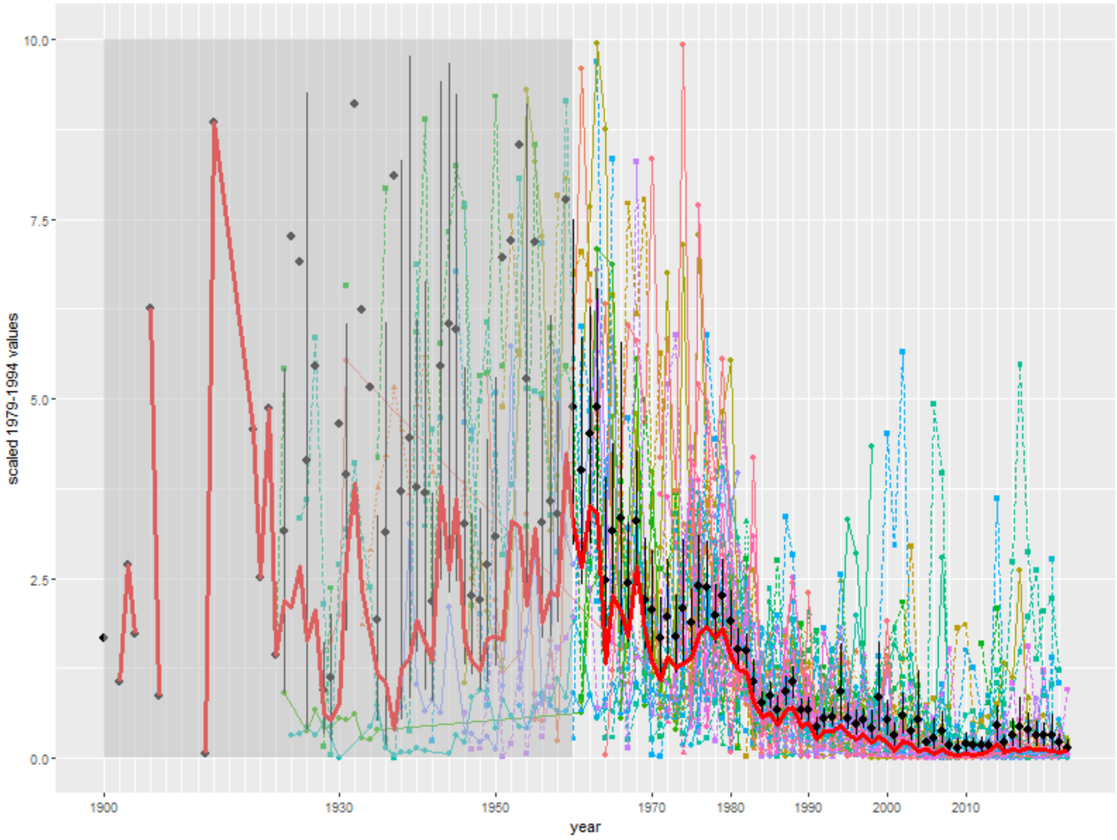

Figure 2. Time-series of glass eel and yellow eel recruitment in European rivers with time-series having data for the 1979-1994 period (45 sites). Each time-series has been scaled to its 1979-1994 average. The mean arithmetic values and their bootstrap confidence interval (95%) are represented as black dots and bars. Geometric means are presented in red. Same Figure as 1 but with a natural scale.

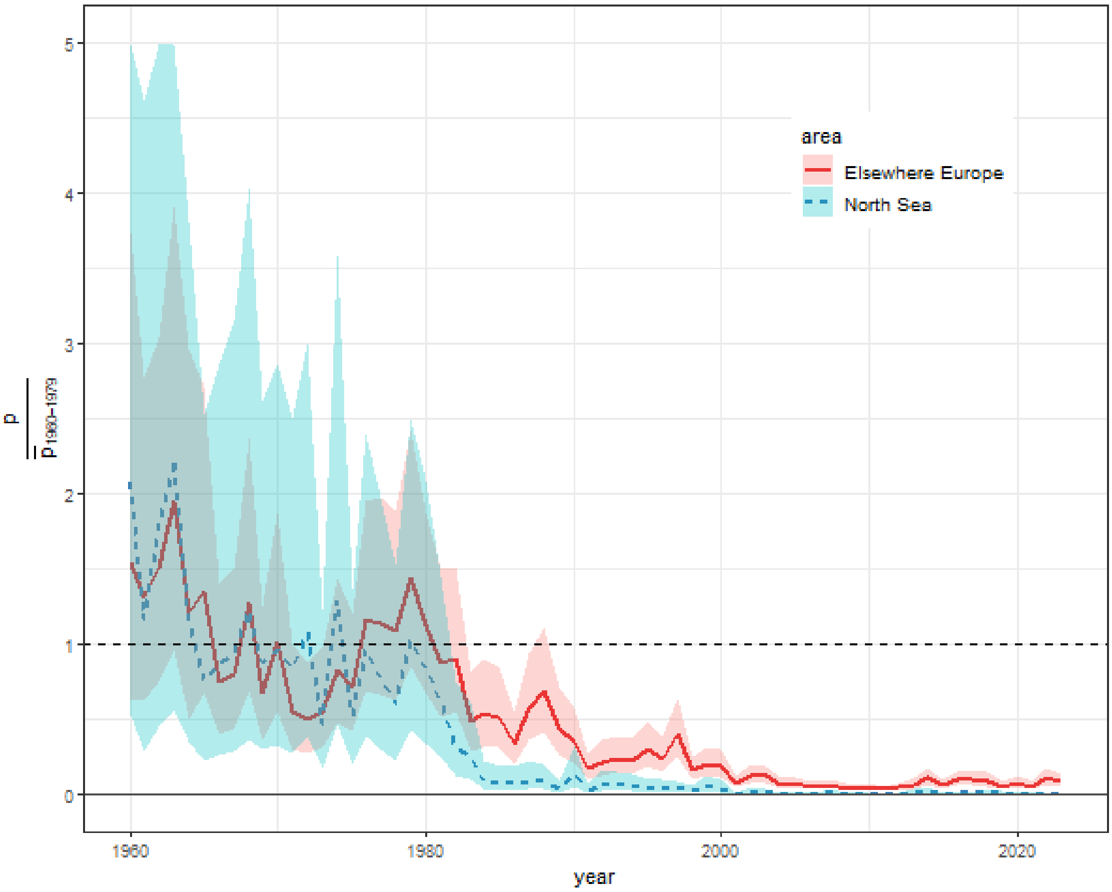

Figure 3. WGEEL glass eel recruitment index for the continental North Sea and Elsewhere Europe series with 95 % confidence intervals updated to 2023. The index was estimated using a GLM (*glasseel* ~ *area* : *year* + *site*) fitted on 58 time-series comprising either pure glass eel or a mixture of glass eels and yellow eels. The predictions *p* have been scaled to the 1960-1979 average $\bar{p}_{1960-1979}$. Number of series Elsewhere Europe = 34, North Sea = 26. Same Figure as 2.6 but with a natural scale.

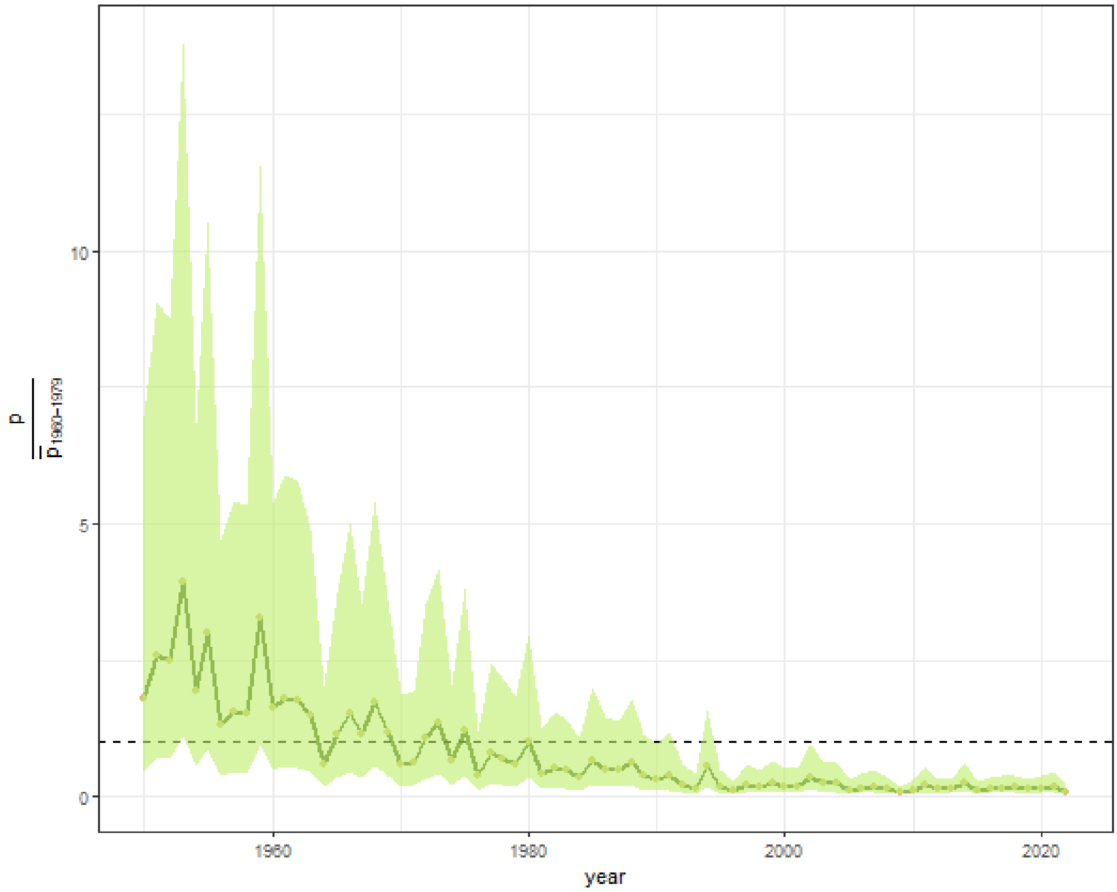

Figure 4. Geometric mean of of estimated yellow eel recruitment for Europe updated to 2021. The yellow recruitment was estimated using a GLM (*yelloweel ~ year*) fitted to 21 yellow eel time-series *p* scaled to the 1960-1979 average $\bar{p}_{1960-1979}$. Note the logarithmic scale on the y-axis. Same Figure as 2.7 but with a natural scale.

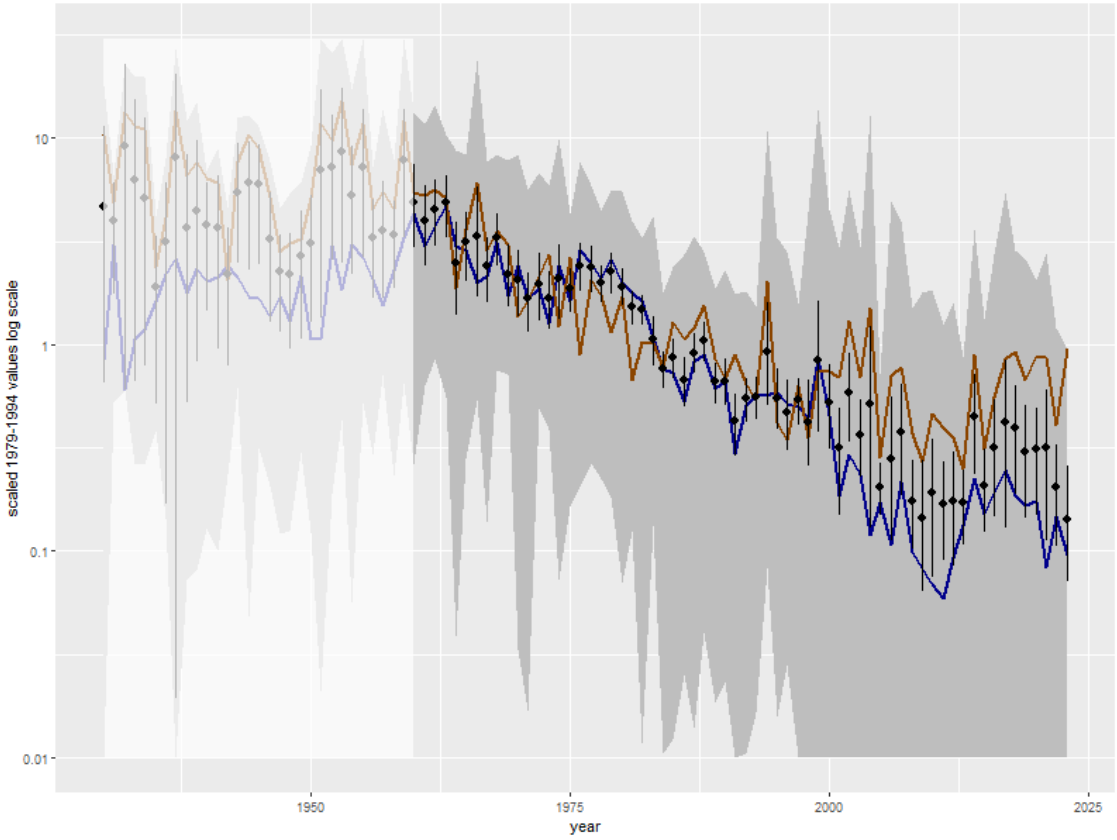

Figure 5. Time-series of glass eel and yellow eel recruitment in Europe with 81 time-series out of the 103 available to the working group. Each time-series has been scaled to its 1979-1994 average. The mean aritmetic values of the combined yellow and glass eel time-series and their bootstrap confidence interval (95%) are represented as black dots and bars. The brown line represents the mean value for yellow eel, and 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 5 were removed to make the mean value more clear. Also note the logarithmic scale o

Annex 9: Trends in landings, releases and aquaculture

Table 1. European eel. Commercial landings (tonnes) of glass eel (1945–2023), as reported to ICES by EU Member States (France [FR], Spain [ES], Portugal [PT], and Italy [IT]) and United Kingdom (GB), combining information from the 2023 data call and the WGEEL database. Empty cell = no data, data not collected, or data not pertinent.

Year	GB	FR	ES	PT	IT	Total
1945			119.2			119.2
1946			71.9			71.9
1947			100.1			100.1
1948			110.6			110.6
1949			9.3			9.3
1950			3.8			3.8
1951			2.1			2.1
1953			2.5			2.5
1954			5.9			5.9
1955			0.9			0.9
1956			0.9			0.9
1957			2.8			2.8
1958			0.4			0.4
1959			6.6			6.6
1960			9.5			9.5
1961			16.7			16.7
1962			11.1			11.1
1963			8			8
1964			11			11
1965			4			4
1966			6			6
1967			5			5
1968			4			4
1969			4			4
1970			5			5
1971			1			1
1972	16.7		1			17.7
1973	28.2		1			29.2
1974	57.5		2	1.6		61.1
1975	10.5		2.6	5.6		18.7
1976	13.1		11.6	12.5		37.2
1977	38.6		17.5	22.6		78.7
1978	61.2	1393	21.6	7.3		1483.1
1979	67	1850	17.3	8.8		1943.1
1980	40.1	1491	15.4	10.1		1556.6
1981	36.9	890	13	18.1		958
1982	48	866	19.3	22.2		955.5
1983	16.9	791	10.3	6.7		825
1984	25	528	16.4	16.1		585.5
1985	20	444	18.3	14.8		497.1
1986	19	423	6.4	7		455.4
1987	21.3	461	9.4	9.5		501.2
1988	21.4	504	9.9	2.6		537.8
1989	20.6	410	9.9	2.8		443.3

Year	GB	FR	ES	PT	IT	Total
1990	20.9	325	5.3	4.5		355.7
1991	1.1	179	6.8	2.8		189.7
1992	5	183	3.7	4.5		196.1
1993	5.7	329	5.2	3.6		343.6
1994	9.5	329	2.4	2.9		343.8
1995	11.9	413	4.9	5.3		435.1
1996	18.8	262	14.5	8.7		304
1997	8.7	287	12	4.4		312.1
1998	11.2	195	14.1	4.5		224.8
1999		242	13.9	3.6		259.5
2000		206	11	3		220
2001	0.8	101	12	1.1		115
2002	0.5	202	8.6	0.8		211.9
2003	1.7	151	10	1.5		164.1
2004	1	89	5.1	0.8		95.9
2005	1.7	89	6.4	1.2		98.3
2006	1.3	67	4.1	2.7		75.2
2007	2.1	77	5.2	0.9		85.2
2008	0.8	79	5.1	0.8		85.7
2009	0.3		3.7	1.4		5.3
2010	1.3	41	6.5	2.4		51.2
2011	2.3	31.3	5.2	1.1		39.8
2012	2.8	34.3	5.3	0.8		43.2
2013	5.9	33.6	7.2	1.1		47.8
2014	12	35.3	11.3	1.2	0.4	60.3
2015	2.8	36.1	8.8	1.3	0.2	49.1
2016	4	46.4	6.6	0.4	0.1	57.5
2017	3.3	43.2	11.1	2.2	0.1	59.9
2018	4.2	53.4	4.5	1	0.2	63.4
2019	6.6	50	4.3	0.6	0.2	61.7
2020	3.4	47.8	6.3	0.9		58.4
2021	0.1	46	4.5	1.2		51.9
2022	1.1	53.4	4.7	0.9		60.1
2023*	0.9	48.6	3.6	0.5		53.6

***Preliminary Data**

Table 2a. European eel. Official commercial landings (tonnes) of yellow and silver eel (1908–2022) in Norway (NO), Sweden (SE), Finland (FI), Estonia (EE), Latvia (LV), Lithuania (LT), Poland (PL), Germany (DE), Denmark (DK), Netherlands* (NL), and Belgium (BE), combining information from the 2023 data call and the WGEEL database. Empty cell = no data, data not collected, or data not pertinent.

Year	NO	SE	FI	EE	LV	LT	PL	DE	DK	NL	BE
1908	268.1										
1909	326.6										
1910	303.1										
1911	383.8										
1912	187.3										
1913	212.7										
1914	282	1460.6									
1915	143	996.9									
1916	117	1078.2									
1917	44	1283.6									

Year	NO	SE	FI	EE	LV	LT	PL	DE	DK	NL	BE
1918	35	884.4									
1919	64	1145.4									
1920	80	969.6							3413		
1921	79	1072.4							3443		
1922	94	925.9							3760		
1923	140	947.7							3396		
1924	290	1201.1							4130		
1925	325	1714.2							4880		
1926	341	1707.3							4726		
1927	354	2011.5							4648		
1928	325	1040.1							4117		
1929	425	1393.7							4375		
1930	450	1528.8							4773		
1931	329	1794.8							4195		
1932	518	1588.7							5088		
1933	694	1494							5014		
1934	674	1768.7							5171		
1935	564	1950.9							4316		
1936	631	1654.5							4332		
1937	603	1725.1							4329		
1938	526	1870.5							3849		
1939	434	1774.4							4662		
1940	143	1625.7							3709		
1941	174	1821.8							3717		
1942	131	1226.5							3140		
1943	136	1827.8							3917		
1944	150	2319.8							4245		
1945	102	1906.1							4169	2668	
1946	167	1744.6							4269	3492	
1947	268	2346.8			10	8			4784	4502	
1948	293	2211.9			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	

Year	NO	SE	FI	EE	LV	LT	PL	DE	DK	NL	BE
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	
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	644.7		3656	823	
1974	368	1034		51.1	20	86	691.1		2977	840	
1975	407	1391		82.1	19	114	809.7		3485	1000	
1976	386	935		71.6	24	88	760.5		3054	1172	
1977	352	989		65.8	16	68	867.8		2502	783	
1978	347	1076		63.2	18	70	910.4		2492	719	
1979	374	954		28.5	21	57	978.9		1904	530	
1980	387	1112		25.7	9	45	1214		2288	664	
1981	369	887		21.9	10	27	943.5		2227	722	
1982	385	1161		13.9	12	28	911.3		2541	842	
1983	324	1212		28.8	9	23	868		2119	937	
1984	310	963		72.2	12	27	819.4		1871	691	
1985	352	1029		75.1	18	29	1022.5	1096.7	1630	679	
1986	272	827.7		61.1	19	32	920.7	1118.7	1672	721	
1987	282	699.4		66.7	25	20	886.6	1031	1279	538	
1988	513	932.7		109.7	15	23	943.3	1018	1878	425	
1989	313	902		54.8	13	21	812.8	963.6	1696	526	
1990	336	916.2		61.3	13	19	768.1	829.7	1675	472	
1991	323	1058.5		52.4	14	16	669.7	724.7	1465	573	
1992	372	1152.5		39.4	17	12	638.2	761.7	1451	548	
1993	340	1119.4		59.2	19	10	568	790.1	1080	293	
1994	472	1262		46.9	19	12	635.1	833.1	1200	330	
1995	454	948		45.4	38	9.4	641.9	777.9	892	354	
1996	353	1053.3		55.1	24	8.6	629	603	751.5	300	
1997	467	1065		59.1	25	10.7	526	616.2	797	285	
1998	331	646.4		44.2	30	17.1	544.4	566.9	597	323	
1999	447	701.6		64.8	26	17.9	599.1	645.1	717	357	
2000	281	530.9		67	13.7	22	443.6	591.2	628	370.1	2.9
2001	304	643.2		67	17.4	23	434.5	569	707	439.5	2.9
2002	311	591.4		49.9	9.6	25.6	372.9	543.9	614	370.2	2.9
2003	240	565.1		48.6	10.3	23.5	365.5	497.9	648	309.8	2.9
2004	237	583.2		39.2	11.3	32	337.2	475.3	546	310.2	2.9
2005	249	675.8		30.7	10.3	44.6	219.9	454.8	534	255.2	2.9
2006	293	732.3		33.4	7.9	31.6	184.4	472.2	596	240.3	
2007	194	702.5		31.1	9.6	29.8	180.7	423.6	537	197	

Year	NO	SE	FI	EE	LV	LT	PL	DE	DK	NL	BE
2008	211	671.4	1	30.6	12.9	27	159.7	406.1	466	147.6	
2009	69	514.1	1.8	22.1	4.9	17.2	160.6	374.6	467	108	
2010	32	525.1	2.3	18.9	8.9	37.6	173.2	367.1	422	445	
2011	0	450.4	1.5	16.2	6	22.6	118.8	278.9	370	370.6	
2012	0	340	1.5	17.7	6.3	15.8	119.3	245.4	317	351.7	
2013	0	374.4	1.3	17.4	4.7	28.4	137.4	264.8	356	318.9	
2014	0	324.2	1	16.7	4.4	15.4	116.8	232.9	346	320.3	
2015	0	246.5	0.6	14.2	5.2	11.8	102.4	226.1	282	293	
2016	3	279.5	1.3	15.2	4.2	28.4	138.4	206.8	265	312.5	
2017	10.9	245	1.1	15.7	8.6	24.3	172.6	241.7	257.3	421.3	0
2018	3.4	251	1.1	18.3	5.8	20.3	146.5	226.9	181.8	476.9	
2019	4	188.2	0.4	21.7	6.1	4.6	167.5	209.1	183.3	484	
2020	4	194.4	0.4	38.8	6.7	6.8	103.6		182.2	475.5	
2021	5	170.5	0.4	47.9	6.4	9.9	126.6		232.8	523.7	
2022	4	114.6	0.3	1.6	6.1	11.6	115.3		163.1	538.1	

*** Landings from the Netherlands are incomplete before 2010.**

Table 2b. European eel. Official commercial landings (tonnes) of yellow and silver eel (1951–2022, no data before 1951 for the countries listed here) in Ireland (IE), United Kingdom (GB), France (FR), Spain (ES), Portugal (PT), Italy (IT), and Slovenia (SL), combining information from the 2023 data call and the WGEEL database. Empty cell = no data, data not collected, or data not pertinent.

Year	IE	GB	FR	ES	PT	IT	SI	HR	AL	GR	TR
1951				90							
1952				102.2							
1953				80.2							
1954				97.7							
1955				102.9							
1956				106.1							
1957				80							
1958				115							
1959				100							
1960		771.7		98							
1961		768.4		153.8							
1962		696.1		114.9							
1963		787.8		136.9							
1964		548.9		91.5							
1965		783.8		130.4							
1966		881		191.5						14.9	
1967		568.7		163.8						19	
1968		585.6		175.6						4.9	
1969		605.6		136.4		2469				2.9	342
1970	200	752.1		119.4		2300				0	441
1971	200	842.2		107.4		2113				0	460
1972	200	632.6		119.4		1997				4.3	220
1973	91	723.2		100.2		588				15.5	315

Year	IE	GB	FR	ES	PT	IT	SI	HR	AL	GR	TR
1974	67	765		93.4		2122				129.8	588
1975	79	762.2		78		2886				133.8	448
1976	150	621.7		82.7		2596				158.7	499
1977	108	690.5		79.9		2390				89.2	282
1978	76	823.6		67		2172				225.3	283
1979	110	1045		96.8		2354				185.5	396
1980	75	912.2		89.8		2198				226.9	224
1981	94	907.1		97.7		2270				250.6	374
1982	144	942.5		19.9		2025	0.8			255.2	424
1983	117	866.4		18.4		2013	0.7			200.8	588
1984	88	973.4		11		2050	1.2			285.4	616
1985	87	750		16.5		2135	2.5			189.6	583
1986	87	650.8	1944	13.4		2134	2.7			151.6	517
1987	230	684.1	2062	21.2		2265	1.6			266.3	543
1988	215	933.6	2265	13.9		2027	1.5			268.1	756
1989	400	874.7	1746	5.3	13.5	1243	1.3			155.6	472
1990	256	783.9	1778	8.7	13	1088	1.9			194.2	230
1991	245	736.9	1645	49.8	23.5	1097	1.4			209.4	262
1992	234	715.4	1321	54.3	29.7	1084	0.1			184.8	245
1993	260	670.7	1280	66.5	33.9	782	0.1			181.9	261
1994	300	777.8	1280	50.7	26.6	771	0.7			200.5	329
1995		899.6	1280	69.4	23.7	1047	0			201.4	390
1996		805.2	1280	61.7	25.6	953	0			151.3	342
1997		730.7	1223	61.5	24.7	727	0			136.5	400
1998		693.4	1150	43.6	23.3	666	0			87.6	300
1999	250	667.8	1005	48.3	23.1	634				80.7	200
2000	250	587.2	1008.8	55.3	21.8	588	0			88.1	176
2001	98	582.7	1024.1	130.2	15	520	0			93.4	122
2002	123	551.1	30.4	105.6	26.9	415	0			136.3	147
2003	111	552.3	21.4	95.6	10.6	446				76.5	158
2004	136	471.7	12.5	85.3	8.8	379				58.1	165
2005	101	477.2	7.8	88	7	75	0			116.1	176
2006	133	383.5	15	115.6	10.1	56	0			77.1	162
2007	114	450.4	26.1	82.1	10.5	277	0			89.7	179
2008	108.3	400.6	31.4	65.6	7	56	0			71.1	171
2009	0	462.4	42	89.2	8.2	329.9	0			78.5	158
2010	0	461.1	20.2	104.6	11	265.1	0			58.6	182
2011	0	455.9	368	93.6	5.9	189.7	0			83.2	28.3
2012	0	415.1	472.6	121.6	3.8	182.4	0			55.2	38
2013	0	426.5	504.1	132.7	2.7	172.2	0		47	38	48.2
2014	0	392.8	434.4	130.4	3.3	184.6	0	0.5	43	58.3	56
2015	0	341	356.9	92	2.9	170.3	0	0.1	50	60.2	71
2016	0	347.2	442.6	115.1	2.4	205	0	0.6	41	60.9	75
2017	0	321.8	434.1	98.2	1.5	213.8		0.6	47	48.3	81
2018	0	366.9	617.4	57.8	3.6	123.5		0.6	60	42.8	111

Year	IE	GB	FR	ES	PT	IT	SI	HR	AL	GR	TR
2019	0	295.6	312.7	58	1.9	126.6		0.4	70	20.4	330
2020	0	182.2	347.9	81.8	3.2	89.5		0.4	40	27.9	232.8
2021	0	244	293.6	69.6	2.4	50		0.4	22	19.2	267.3
2022	0	166.7	265.4	66.1	1.7	95.7		0.3	17	17.5	275.8

Table 2c. European eel. Official commercial landings (tonnes) of yellow and silver eel (1908–2022) in Croatia (HR), Albania (AL) Greece (GR), Turkey (TR), Libya (LY), Tunisia (TN), Algeria (DZ), and Morocco (MA), combining information from the 2022 data call and the WGEEL database. Empty cell = no data, data not collected, or data not pertinent. Total refers to the total of tables 2a-c.

Year	HR	AL	GR	TR	LY	TN	DZ	MA	total
1908									268.1
1909									326.6
1910									303.1
1911									383.8
1912									187.3
1913									212.7
1914									1742.6
1915									1139.9
1916									1195.2
1917									1327.6
1918									919.4
1919									1209.4
1920									4462.6
1921									4594.4
1922									4779.9
1923									4483.7
1924									5621.1
1925									6919.2
1926									6774.3
1927									7013.5
1928									5482.1
1929									6193.7
1930									6751.8
1931									6318.8
1932									7194.7
1933									7202
1934									7613.7
1935									6830.9
1936									6617.5
1937									6657.1
1938									6245.5
1939									6870.4
1940									5477.7
1941									5712.8
1942									4497.5

Year	HR	AL	GR	TR	LY	TN	DZ	MA	total
1943									5880.8
1944									6714.8
1945									8845.1
1946									9672.6
1947									11918.8
1948									11713.9
1949									10979
1950									11601
1951									10816
1952									10055.2
1953									10764.2
1954									9544.7
1955									11277.9
1956									8425.1
1957									9917
1958									9354
1959									12189
1960									12075.7
1961									11142.2
1962									9762
1963									10623.7
1964									10414.4
1965									10000.5
1966			14.9						11133.3
1967			19						10381.2
1968			4.9						11211
1969			2.9	342					13420.9
1970			0	441					11168
1971			0	460					10694.1
1972			4.3	220					10005.7
1973			15.5	315					8793.6
1974			129.8	588					9832.4
1975			133.8	448					11694.8
1976			158.7	499					10599.2
1977			89.2	282					9283.2
1978			225.3	283					9342.5
1979			185.5	396					9034.7
1980			226.9	224					9470.6
1981			250.6	374					9200.8
1982			255.2	424					9705.6
1983			200.8	588					9325.1
1984			285.4	616					8790.6
1985			189.6	583					9694.9
1986			151.6	517					11144.7
1987			266.3	543					10900.9

Year	HR	AL	GR	TR	LY	TN	DZ	MA	total
1988			268.1	756					12337.8
1989			155.6	472					10213.6
1990			194.2	230					9444
1991			209.4	262					9166.3
1992			184.8	245					8860.1
1993			181.9	261					7814.8
1994			200.5	329					8546.4
1995			201.4	390					8071.7
1996			151.3	342					7396.3
1997			136.5	400					7154.4
1998			87.6	300					6063.9
1999			80.7	200			20.4		6504.8
2000			88.1	176		109.9	17.2		5852.7
2001			93.4	122		144.1	44.5		5981.5
2002			136.3	147		204.4	25.4		4656.5
2003			76.5	158		171.7	25.2		4379.9
2004			58.1	165		132.5	29		4052.2
2005			116.1	176		197	7.6		3729.9
2006			77.1	162		266.3	2.7		3812.4
2007			89.7	179		296.5	14.6		3845.2
2008			71.1	171		316.7	13.9		3374.9
2009			78.5	158		122.2	14.2		3043.9
2010			58.6	182		92.6	3.4		3230.7
2011			83.2	28.3		79.6			2939.2
2012			55.2	38		55	0.4		2758.8
2013		47	38	48.2		149.6	3	23	3050.3
2014	0.5	43	58.3	56		83.6	6	23	2793.6
2015	0.1	50	60.2	71		81.4	3	4	2414.6
2016	0.6	41	60.9	75		250.4	2	7	2803.5
2017	0.6	47	48.3	81		153	10.6	2	2810.4
2018	0.6	60	42.8	111		166.3	33	2	2916.9
2019	0.4	70	20.4	330	1.3	107	25.2		2618
2020	0.4	40	27.9	232.8	1.9	129.9	18		2167.9
2021	0.4	22	19.2	267.3	0.2	105.3	4.7		2201.9
2022	0.3	17	17.5	275.8	2.1	105			1968

Table 3 European eel. Recreational landings (tonnes) of glass eel (1978–2023) in countries where fisheries exist, i.e. France (FR) and Spain (ES), combining information from the 2023 data call and the WGEEL database. Empty cell = no data, data not collected, or data not pertinent.

Year	FR	ES	Total
1978	647		647
1979	697		697
1980	1303		1303
1981	904		904
1982	219		219
1983	161		161

Year	FR	ES	Total
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		0.9	0.9
2005	0	1.2	1.2
2006	1	1.7	2.7
2007	0	1.3	1.3
2008	0	1.6	1.6
2009	0	0.4	0.4
2010	0	0.8	0.8
2011	0	0.4	0.4
2012	0	1.1	1.1
2013	0	1.6	1.6
2014	0	2.4	2.4
2015	0	2.3	2.3
2016	0	1.7	1.7
2017	0	1.5	1.5
2018	0	1.7	1.7
2019	0	0.9	0.9
2020	0	0.7	0.7
2022		0.7	0.7
2023*		1.3	1.3

***Preliminary data**

Table 4a. European eel. Recreational landings (tonnes) of yellow and silver eel (1980–2023) in Finland (FI), Estonia (EE), Latvia (LV), Lithuania (LT), Poland (PL), Czechia (CZ), Germany (DE), Denmark (DK), Netherlands (NL), Belgium (BE), and Ireland (IE), combining information from the 2023 data call and the WGEEL database. Countries omitted in tables 7a and 7b include those where recreational landings are prohibited as well as those that have not reported.

Year	FI	EE	LV	LT	PL	CZ	DE	DK	NL	BE	IE
1980											
1981											
1982											
1983											
1984											

Year	FI	EE	LV	LT	PL	CZ	DE	DK	NL	BE	IE
1985							582				
1986							563				
1987							546				
1988							559				
1989							543				
1990							501				
1991							498				
1992							489				
1993							486				
1994							493				
1995							452				
1996							416				
1997							424				
1998							431				
1999							425				
2000			2				429			34	
2001			1				426			34	
2002			1				417			34	
2003			0				428			34	
2004			1				414			34	
2005		2	3				398			34	
2006		1	0				399			34	
2007		1	0				375			34	
2008	17	1	0				326			34	
2009		1	1				310	108		34	
2010	10	1	0				277	126	111	30	
2011		1	0				272	79.5		30	
2012	5	1	0	1	32	17	263	52.3	59	30	
2013		1	1	3	27	15	265	50.3		30	
2014	20	1	1	2	30	19	270	57	70	30	
2015		1	1	5	27	12	271	118		30	
2016	8	1	0	2	34	12	275	164	24	30	
2017		1	1	3	40	17	276	117		30	
2018	2	1	0	1	45	12	271	105	24	30	
2019		1	0	6	42	12	276	110		30	
2020	2	1	1	1	50			98.9	24	30	
2021		1	0	7	65			79		30	
2022		0	0		26			160	16		0

Year	FI	EE	LV	LT	PL	CZ	DE	DK	NL	BE	IE
2023*											0

*** Preliminary data**

Table 4. European eel. Recreational landings (tonnes) of yellow and silver eel (1980–2023) in France (FR), Spain (ES), Italy (IT), Slovenia (SL), and Turkey (TR), combining information from the 2023 data call and the WGEEL database. Countries omitted in tables 7a and 7b include those where recreational landings are prohibited as well as those that have not reported. Empty cell = no data, data not collected, or data not pertinent.

Year	FR	ES	IT	SI	HR	TR	LY	Total
1980				0				0
1981				0				0
1982				0				0
1983				0				0
1984				0				0
1985				0				581.6
1986				0.1				562.9
1987				0.1				546.4
1988				0.1				558.6
1989				0.1				542.6
1990				0.1				501.4
1991				0.1				498.2
1992				0.1				488.6
1993				0.1				485.7
1994				0				492.9
1995				0				452.2
1996				0.1				416.4
1997				0.2				423.9
1998				0.1				430.6
1999				0				424.8
2000	20.9			0				485.1
2001	19.9			0				480.6
2002	19			0				471
2003	14.7			0				476.6
2004	16.8			0				465
2005	12.9			0				448.9
2006	683.9			0				1117.9
2007	14.6			0				424.9
2008	14.9			0				393.2
2009	7.1			0				460.6
2010	4.9		149.5	0				709

Year	FR	ES	IT	SI	HR	TR	LY	Total
2011	3.2		60.6	0				446.5
2012	4.6		73.6	0				539
2013	4.7	1	69.7	0				467.3
2014	4.3	1	69.8	0				573.3
2015	3.5	1	60.2	0	10.1			538.2
2016	3.1	0.8	56.8	0	8.9			619
2017	2.9	0.1	41.3		7.6			535.1
2018	3.3	0.9	42.3		6.8			543.3
2019	3.2	2.2	33.7		5.7		0.1	521.9
2020	1.5		24.5		5	87.2	0.1	325.5
2021	1.8		12.6		1.9	41.7	0	239.6
2022	1.3		17.1		1.9	24.2		247
2023*							0.1	0.1

* PRELIMINARY DATA.

Table 5a. Release of glass eel (G) and quarantined glass eel (QG) in millions from 1950 to 2023), 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).

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

Year	SE	FI	EE	LV	PL	DE	NL
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
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
2002	1.393			0.251		2.858	1.6
2003	0.702				0.506	1.994	1.6
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
2007	0.959			0.015		1.001	0.216
2008	1.377					0.51	0
2009	0.76					0.789	0.3
2010	1.937	0.153				5.009	2.714
2011	2.624	0.306	0.68	0.304		3.403	0.529
2012	2.566	0.177	0.91	1.03		4.033	2.287
2013	2.658	0.197	0.89			5.08	1.895
2014	2.953	0.147	3	1.386		10.449	5.698
2015	1.866	0.102	1.87			6.116	0.863
2016	2.871	0.079	0.9			5.027	3.042
2017	0.947	0.12		1.03		9.879	3.044
2018	3.109	0.082	1.424	0.715		13.545	3.577

Year	SE	FI	EE	LV	PL	DE	NL
2019	2.872	0.134	1.58	0.69		21.512	4.677
2020	3.091	0.13	2.029	0			2.93
2021	0.443	0.154		0			2.39
2022	0.796	0.106	1.054				2.736
2023*		0.093	1.071				2.257

***Preliminary data**

Table 5b. Release of glass eel in millions from 1950 to 2023), reported by countries: IE Ireland, GB United Kingdom, FR France, ES Spain, IT Italy, GR Greece.

Year	BE	IE	GB	FR	ES	IT	GR	total
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
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

Year	BE	IE	GB	FR	ES	IT	GR	total
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
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	0.162	3.03	0					9.039
2002		1.412	3					10.514
2003	0.324	4.224	3.9					13.25
2004		1.396	1.2					7.967
2005		3.71	2.4					9.236
2006	0.33	0.616	1					4.929
2007		1.027	3.6					6.818
2008	0.351	0.418	1.3					3.956
2009	0.456	0.375	0.719			0		3.399
2010	0.429	0.444	3.149	0.627		0.3		14.762
2011	0.48	0.318	3.255	2.35	0.014	0.9		15.163
2012	0.618	0.647	3.968	9.258	1.338	0.9		27.732

Year	BE	IE	GB	FR	ES	IT	GR	total
2013	0.432	0.972	5.763	8.775	1.259	0.9	0.419	29.24
2014	1.62	2.166	8.297	17.037	0.245		0.204	53.202
2015		2.885	1.864	3.464	0.045	0.366	0.017	19.458
2016	1.155	4.462	0.053	10.347	0.003	0.21	0.471	28.62
2017	0.727	0.685	2.481	6.986	0.767	0.437	0.149	27.252
2018	1.59	8.407	2.313	9.498	3.762		0.094	48.116
2019	2.028	0.476	3.758	9.703	1.22		0.046	48.696
2020	0.9	1.956	5.142	9.174	0.04			25.392
2021	0	1.705	4.611	10.252		0.188	0.035	19.778
2022	0.855	4.193	5.305	7.953	0.044	0.188	0.019	23.249
2023*			2.008	7.342	0.045			12.816

***Preliminary data**

Table 6. Releases for yellow eel from 1900 to 2022 in millions, reported by countries DE Germany, NL Netherlands, IE Ireland, ES Spain, IT Italy.

Year	SE	DE	IE	ES	IT	total
1900	0.053					0.053
1901	0.51					0.51
1902	0.034					0.034
1903	0.065					0.065
1904	0.041					0.041
1905	0.652					0.652
1906	0.15					0.15
1907	0.021					0.021
1909	0					0
1911	0.43					0.43
1912	0.49					0.49
1913	0.004					0.004
1914	0.212					0.212
1917	0.03					0.03
1918	0.004					0.004
1919	0.113					0.113
1920	0.062					0.062
1921	0.128					0.128
1922	0.06					0.06
1923	0.166					0.166
1924	0.275					0.275
1925	0.551					0.551
1926	0.258					0.258
1927	0.536					0.536
1928	0.017					0.017
1929	0.052					0.052

Year	SE	DE	IE	ES	IT	total
1930	0.903					0.903
1931	0.53					0.53
1932	1.037					1.037
1933	0.897					0.897
1934	0.876					0.876
1935	0.198					0.198
1936	0.249					0.249
1937	0.736					0.736
1938	0.505					0.505
1939	0.471					0.471
1940	0.99					0.99
1941	0.655					0.655
1942	0.608					0.608
1943	1.758					1.758
1944	1.589					1.589
1945	1.693					1.693
1946	1.266					1.266
1947	0.743					0.743
1948	1.122					1.122
1949	1.213					1.213
1950	1.271					1.271
1951	0.772					0.772
1952	1.317					1.317
1953	3.368					3.368
1954	0.998					0.998
1955	1.731					1.731
1956	1.72					1.72
1957	0.968					0.968
1958	1.402					1.402
1959	1.856					1.856
1960	1.423					1.423
1961	1.186					1.186
1962	0.979					0.979
1963	0.843					0.843
1964	0.542					0.542
1965	0.329					0.329
1966	0.761					0.761
1967	0.279					0.279
1968	1.306					1.306
1969	0.632					0.632
1970	0.608					0.608
1971	0.683					0.683
1972	1.03					1.03
1973	2.064					2.064
1974	0.705					0.705

Year	SE	DE	IE	ES	IT	total
1975	1.159					1.159
1976	1.851					1.851
1977	2.652					2.652
1978	1.965					1.965
1979	2.003		0.105			2.108
1980	0.976		0.265			1.241
1981	1.677		0.107			1.784
1982	1.762		0.122			1.884
1983	1.519		0.088			1.607
1984	0.811		0.042			0.853
1985	1.599	4.449	0.099			6.147
1986	0.862	3.441	0.156			4.459
1987	1.095	3.213	0.099			4.407
1988	1.436	2.783	0.127			4.346
1989	0.685	1.642	0.058			2.385
1990	1.019	2.098	0.098			3.215
1991	1.251	1.696	0.037			2.984
1992	1.422	2.002	0.047			3.471
1993	1.116	2.565	0.061			3.742
1994	1.078	2.202	0.013			3.293
1995	0.876	2.148	0.08			3.104
1996	1.154	2.259	0.01			3.423
1997	1.183	3.35	0.091			4.624
1998	1.075	2.568	0.026			3.669
1999	0.552	2.786	0.071			3.409
2000	0.486	2.551	0.039			3.076
2001	0.483	2.959	0			3.442
2002	0.47	3.207	0.068			3.745
2003	0.461	3.056	0.088			3.605
2004	0.284	2.733	0.032			3.049
2005	0.174	2.712	0.066			2.952
2006	0.074	2.14	0.047			2.261
2007	0.153	1.963	0.076			2.192
2008	0.174	1.544	0.131	0.016		1.865
2009	0.071	1.544	0.015	0.03		1.66
2010	0.09	1.524	0.016	0.013		1.643
2011	0.107	1.359	0.011	0.039		1.516
2012	0.1	1.386	0.003	0		1.489
2013	0.093	1.333	0.003	0.004		1.433
2014	0.261	1.457	0.038	0.021		1.777
2015	0.068	1.412	0.033		0.085	1.598
2016	0.217	1.596	0.092	0.183	0.122	2.21
2017	0.429	0.076	0.014	0.15	0.2	0.869
2018	0.374	0.055	0.135	0.156		0.72
2019	0.507	0.054	0.038			0.599

Year	SE	DE	IE	ES	IT	total
2020	0.203		0.092			0.295
2021	0.159		0.004			0.163
2022	0.074		0.085			0.159

Table 7. Releases for silver eel from 2001 to 2022 in millions, reported by countries SE Sweden, FI Finland, IE Ireland, Fr France, ES Spain, GR Greece.

Year	SE	FI	NL	IE	FR	ES	GR	total
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	0.215	0.094			0.317
2012	0.01		0.004	0.243	0.111	0.039		0.407
2013	0.013		0.008	0.238	0.116		0.042	0.417
2014	0.021	0	0.003	0.336	0.164		0.067	0.591
2015	0.018	0	0.005	0.284	0.214		0.079	0.6
2016	0.017	0	0.007	0.206	0.17		0.108	0.508
2017	0.017	0	0.006	0.193	0.213		0.086	0.515
2018	0.016	0	0.01	0.205	0.212		0.035	0.478
2019	0.015	0	0.01	0.182	0.169	0.001	0.004	0.381
2020	0.018	0	0.008	0.211	0.187	0.001	0.01	0.435
2021	0.022	0	0.007	0.161	0.103		0.047	0.34
2022	0.019	0.001	0.009	0.163	0.149	0	0.006	0.347

Table 8. Releases for quarantined glass eel from 2010 to 2023 in millions, reported by countries SE Sweden, FI Finland.

Year	SE	FI
2010		0.15
2011		0.31
2012		0.18
2013		0.2
2014		0.15
2015		0.1
2016		0.08
2017		0.12
2018		0.08
2019		0.13
2020		0.13

2021		0.15
2022	0.8	0.11
2023*		0.09

***Preliminary data**

Table 9. Releases for ongrown glass eel from 1947 to 2023 in millions, reported by countries: EE Estonia, LV Latvia, LT Lithuania, PL Poland, DE Germany, DK Denmark, ES Spain.

Year	EE	LV	LT	PL	DE	DK	NL	GB	ES
1947							1.6		
1948							2		
1949							1.4		
1950							1.6		
1951							1.3		
1952							1.2		
1953							0.8		
1954							0.7		
1955							0.9		
1956							0.7		
1957							0.8		
1958							0.8		
1959							0.7		
1960							0.4		
1961							0.6		
1962							0.4		
1963							0.1		
1964							0.3		
1965							0.5		
1966							1.1		
1967							1.2		
1968							1		
1969							0		
1970							0.2		
1971							0.3		
1972							0.4		
1973				0.06			0.5		
1974				0.01			0.5		
1975							0.5		
1976							0.5		
1977				0.01			0.6		
1978							0.8		
1979							0.8		
1980				0			1		
1981							0.7		
1982				0.14			0.7		
1983				1.13			0.7		

Year	EE	LV	LT	PL	DE	DK	NL	GB	ES
1984				0.2			0.7		
1985				0.14	1.33		0.8		
1986				0.05	1.12		0.7		
1987				0	1.03		0.4		
1988	0.18			0.01	1.42		0.3		
1989				0.25	1.02		0.1		
1990				0.44	1.04		0		
1991				0.03	1.12		0		
1992				0.06	1.37		0		
1993				0	1.74		0.2		
1994				0.14	1.82		0		
1995	0.15			0.04	2.23		0		
1996				1.02	2.46		0.2		
1997				2.21	2.79		0.4		
1998				0.85	2.9		0.6		
1999				1.02	3.66		1.2		
2000				1.43	5.26		1		0.04
2001	0.44			0.75	4.19		0.1		0.05
2002	0.36			0.75	4.88		0.1		0.02
2003	0.54			0.56	5.15		0.1		0.03
2004	0.44			0.81	5.38		0.1		0.06
2005	0.37			0.74	4.14		0		0.11
2006	0.38			0.92	7.25		0		0
2007	0.33			1.39	7.39		0		0.02
2008	0.19			1.52	7.45		0.23		
2009	0.42			1.4	7.36		0.3		
2010	0.21			1.29	7.66		0.06		
2011	0.2		0.15	2.67	6.06		0.41		
2012	0.12		0.49	1.75	4.98		0.39		
2013	0.13		1.3	3.48	5.65		0.51		
2014	0.19		0.38	2.29	7.01		0.9		
2015			0.45	3.63	7.29		0.74		
2016	0.22		0.27	1.51	5.49	1.53	0.49		
2017	0.31		0	3.58	9.47	1.52	0.57		
2018		0	1.65	2.44	9.65				0.01
2019			1.59	0.98	9.68	1.81			0.22
2020			1.37	0.95		1.34			0.03
2021	0.08	0.03	0	1.82		1.23			0.04
2022	0.15	0.02	1.7	6.18		1.79	0.36	0.26	0.03
2023*						1.68	0.26		

*** Data for 2023 incomplete.**

0 = No catch.

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

Table 10a. Aquaculture for all stages in tonnes from 1998 to 2022 (data before 1998 not available from shown countries) 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	CZ	DE
1998				2			
1999				2			
2000				1			
2001				5			
2002			20	17			
2003			40	20			
2004	158		50	9			328
2005	222		80	8			329
2006	191		100	12			567
2007	175		100	13			774
2008	124.4		90	10.6			749.4
2009	142.6		60	12			667
2010	92.8		40	8.3			681
2011	91.4		50	12.6			692
2012	93.4		70	3.5		0.54	744
2013	91.7	0		3.45		0.42	758
2014	64.4	0.5	55.65	7.15		0.24	926
2015	104.3	0.5	52.45	0.2	0.6	4.91	1176
2016	117.1	0	60.91	36.4	0.98	2.33	1099
2017	75	0	50		2.81	0.41	1111
2018	64.6				3.09	0.7	1132
2019	81					1.1	1286
2020	73.9				61.8		1125
2021	89.2				7.84		1285
2022	95.7						

Table 10b. Aquaculture for all stages in tonnes from 1984 to 2022 reported by countries: NL Netherlands, IE Ireland, ES Spain, PT Portugal, IT Italy, GR Greece.

Year	DK	NL	ES	PT	IT	GR	MA	total
1984	18							18
1985	40							40
1986	200							200
1987	240	100						340
1988	195	300						495
1989	430	200						630
1990	586	600						1186
1991	866	900						1766

Year	DK	NL	ES	PT	IT	GR	MA	total
1992	748	1100						1848
1993	782	1300						2082
1994	1034	1450						2484
1995	1324	1540						2864
1996	1568	2800						4368
1997	1913	2450						4363
1998	2483	3250	347.1					6082.1
1999	2718	3500	383.09					6603.09
2000	2674	3800	411.08					6886.08
2001	2000	4000	339.07					6344.07
2002	1880	4000	295.06					6212.06
2003	2050	4200	292.05					6602.05
2004	1500	4500	377.04		1220	429		8571.04
2005	1700	4500	321.03		1131	261		8552.03
2006	1900	4200	275.02		807	290		8342.02
2007	1617	4000	369.01		1000	365		8413.01
2008	1740	3700	460		550.74	396		7821.14
2009	1707	3200	493		677.4	428		7387
2010	1537	2000	392	0.28	647.19	320		5718.57
2011	1156	2300	468	0.56	509.3	377.05		5656.91
2012	1093	2600	373	0.89	736.98	281		5996.31
2013	824	2900	393	1.38	642.14	432	340	6386.09
2014	842	2300	406	0.92	571.9	220	350	5744.76
2015	1234	2000	454	0.89	750	270.86	280	6328.71
2016	1033	2000	330	1.06	710.1	289.46	282	5962.34
2017	549.61	2005	292.26	32.96	528.6	184.26	274	5105.91
2018	893.94	2155	346.17	0.46	509.35	128	257.41	5490.72
2019	490.26	2200	318.91	0.77	464.04	146.42	289.17	5277.67
2020	659	2065	338.05	0.12	406.55	184.41	183.03	5096.86
2021		1950	339.7	0.04	443.1	297.11		4411.99
2022	462.74	2000				221.23		2779.67

Annex 10: Recruitment analysis using the GEREM model

Introduction

GEREM is a Bayesian model aiming at estimating glass eel recruitment at different nested spatial scales (overall recruitment, sub-regions/zone, river basins) through the analysis of available recruitment time series (Drouineau *et al.*, 2016). The model has already been applied in France (Drouineau *et al.*, 2016), to a large part of Europe (Bornarel *et al.*, 2018) and a specific application was carried out in the context of the Sudoang Interreg project (Drouineau *et al.*, 2021). It had been used by WGEEL few years ago (ICES, 2020) and was updated during WGEEL last year. It was decided to renew the exercise since GEREM is a candidate to feed the spatial assessment model promoted in the WKFEA roadmap (ICES, 2021) and is a good example of the hierarchy of spatial scales on which would be based such as spatial model. The model assumes that each year, the overall recruitment $R(y)$ is distributed among various zones (i.e. subregions) which receive recruitment $R_z(y)$. Then, zone recruitment is distributed among river catchments as a function of their surface, leading to recruitment $R_{c,z}(y)$. Basically, GEREM is a mixing of a Dynamic Factor Analysis (DFA) (Zuur *et al.*, 2003) and a "rule of three". Similarly to a DFA model, GEREM is state-space model based on a random walk structure, which estimates common trends in a set of time series. The rule of three is used to extrapolate absolute recruitment estimates in a river basin to recruitment in other basins in the same zone, stating that the recruitment in each basin is a simple function of its surface. After having inventoried available time series and listed their characteristics, it is necessary to define zones. In each zone:

- river catchments should have similar trends in recruitment
- the rule of three must apply, i.e. it should be possible to extrapolate recruitment in a basin to another basin of the same zone as a simple function of their relative surfaces
- time series of recruitment should be available. Morevover, there should be at least on time series of absolute recruitment. If not available, it is possible to use time series such as trapping or commercial catch from which absolute recruitment can be inferred by introducing additional information on the scaling factors (trap efficiency and exploitation rate).

The model is detailed in (Drouineau *et al.*, 2016) and (Bornarel *et al.*, 2018). The current exercise is mainly an update from (Bornarel *et al.*, 2018). We will use the same zone and the nearly the same time series but with updated values.

Material and Methods

Zone definition

We used the same zones as Bornarel *et al.* (2018) 1:

- a North Sea zone (NS)
- a Channel zone which covers Southwestern Great Britanny and NorthWestern France
- ATL_F which covers the French coast along the Bay of Biscay
- ATL_IB which extends from the Cantabrian Sea to the Gibraltar Strait
- Med which extends from the Gibraltar Strait to Sicilia
- A zone that covers Ireland and the Northwestern part of Great Britain (INWGB)

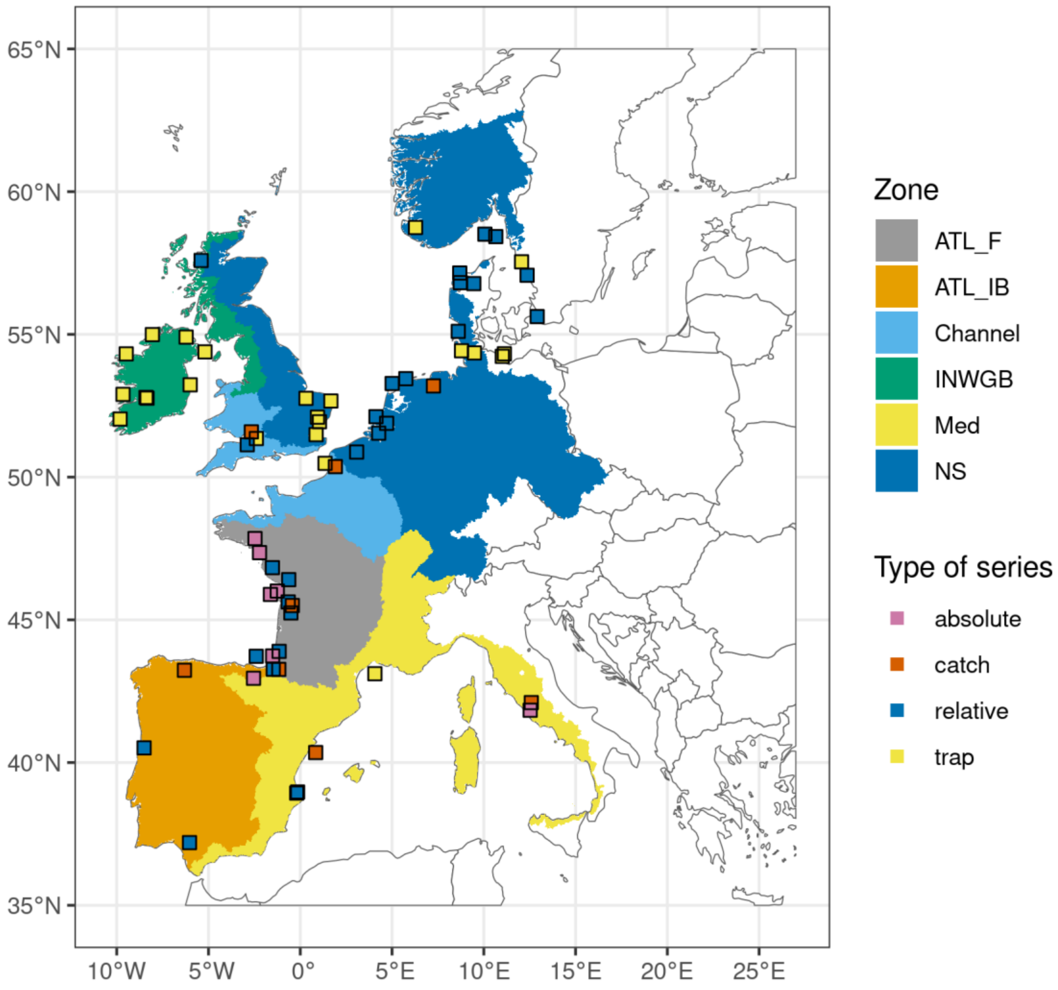

Figure 1: Zone definition and available data

Available Data

Table 1 summarises the data used to fit the model. Basically, we used the exact same dataset as for the GLM analysis. This includes the 4 newly integrated time series: MondG (PT), ShiMG (GB), OatGY(GB) and SousGY. As last, year, the dataset was supplemented with some absolutes estimates of recruitment following ICES (2020). While time series are available in all zones, most absolute estimates come from ATL_F. In other zones, trap monitoring and commercial catches can inform on absolute estimates given but this requires making assumption on trapping efficiency or on exploitation rates. We also note that the number of time series is limited in the Channel area. Conversely, there are many time series in ATL_F, but most of them ended after the implementation of the French Eel Management Plan (Minist'ere de l'Ecologie, de l'Energie, du Developpement durable et de l'Am'enagement du Territoire *et al.*, 2010) and presently, there is only one still updated time series. We also note that the Mediterranean zone is large with only four available time series.

Table 1: Available time series of recruitment

Series	Type	Zone	Surface (km²)	First Year	Last Year	Nb data
AdCPG	relative	ATL_F	16,860.9	1,966	2,008	37
AdGERMA	absolute	ATL_F	16,860.9	1,999	2,005	7
AdTCG	catch	ATL_F	16,860.9	1,986	2,008	23
ChGEMAC	absolute	ATL_F	9,526.1	2,007	2,008	2
GiCPG	relative	ATL_F	79,605.1	1,961	2,008	47
GiGEMAC	absolute	ATL_F	79,605.1	1,999	1,999	1
GiScG	relative	ATL_F	79,605.1	1,994	2,023	30
GiTCG	catch	ATL_F	79,605.1	1,961	2,008	47
LoGERMA	absolute	ATL_F	116,981.0	2,004	2,006	3
LoiG	relative	ATL_F	116,981.0	1,960	2,008	49
SeGEMAC	absolute	ATL_F	754.6	2,007	2,010	4
SevNG	relative	ATL_F	3,398.4	1,962	2,008	22
SousGY	relative	ATL_F	312.1	2,013	2,022	10
VilG	absolute	ATL_F	10,490.4	1,971	2,015	42
GuadG	relative	ATL_IB	57,052.5	1,998	2,007	10
MondG	relative	ATL_IB	6,662.5	1,989	2,023	7
NaloG	catch	ATL_IB	4,886.5	1,960	2,023	64
Oria	absolute	ATL_IB	4,886.5	2,006	2,018	7
OriaG	relative	ATL_IB	863.4	2,006	2,023	12
BeeGY	trap	Channel	993.9	2,011	2,023	13
BresGY	trap	Channel	743.0	1,994	2,023	30
GreyGY	trap	Channel	1,574.0	2,009	2,023	15
OatGY	relative	Channel	1,574.0	2,013	2,023	11
SeEAG	catch	Channel	11,381.5	1,972	2,023	50
Somme	catch	Channel	6,223.4	1,991	2,012	18
BannGY	trap	INWGB	5,810.9	1,960	2,023	64
BurrGY	trap	INWGB	108.1	1,987	2,023	19
ErneGY	trap	INWGB	4,338.7	1,960	2,023	62
FealGY	trap	INWGB	1,166.2	1,985	2,017	19
InagGY	trap	INWGB	252.6	1,996	2,017	17
LiffGY	trap	INWGB	1,208.1	2,012	2,023	12
MaigG	trap	INWGB	1,080.5	1,994	2,017	19

Series	Type	Zone	Surface (km²)	First Year	Last Year	Nb data
ShaAGY	trap	INWGB	11,618.6	1,977	2,023	47
ShiMG	relative	INWGB	14.2	2,014	2,023	10
StraGY	trap	INWGB	2.5	2,012	2,023	12
AlbuG	catch	Med	886.3	1,960	2,023	60
AlCPG	relative	Med	886.3	1,982	2,023	36
EbroG	catch	Med	85,611.8	1,966	2,023	55
TibeG	catch	Med	17,861.0	1,975	2,006	32
Tiber	absolute	Med	17,861.0	1,991	2,005	7
VacG	trap	Med	456.0	2,004	2,023	20
BeeG	trap	NS	993.9	2,006	2,023	18
BroG	trap	NS	8,442.7	2,011	2,023	13
BrokGY	trap	NS	3,404.6	2,012	2,023	12
EmsG	catch	NS	12,185.1	1,960	2,001	42
FlaG	trap	NS	877.9	2,007	2,023	16
HellGY	relative	NS	7.9	2,011	2,022	11
ImsaGY	trap	NS	127.0	1,975	2,023	49
KatwG	relative	NS	160,221.4	1,977	2,023	42
KlitG	relative	NS	85.2	2,008	2,023	16
LauwG	relative	NS	160,221.4	1,976	2,023	42
NmiGY	trap	NS	3,017.2	2,009	2,023	15
NorsG	relative	NS	85.2	2,008	2,023	16
RhDOG	relative	NS	160,221.4	1,960	2,023	64
RhIjG	relative	NS	160,221.4	1,969	2,022	45
RingG	relative	NS	36.7	1,981	2,022	42
SleG	relative	NS	25.8	2,008	2,023	16
StelG	relative	NS	160,221.4	1,988	2,023	36
VerlGY	trap	NS	1,386.7	2,010	2,023	14
VidaG	relative	NS	1,386.7	1,971	1,990	20
ViskGY	trap	NS	2,373.0	1,972	2,022	51
WiFG	trap	NS	148.8	2,006	2,022	17
WisWGY	trap	NS	148.8	2,004	2,022	19
YFS1G	relative	NS	21,330,000,000,000,000.0	1,975	1,989	15
YFS2G	relative	NS	21,330,000,000,000,000.0	1,992	2,023	31

Series	Type	Zone	Surface (km²)	First Year	Last Year	Nb data
YserG	relative	NS	1,485.8	1,964	2,022	57

Available time series are assumed to be proportional to real abundance in the river basin with a scaling factor constant through time (otherwise the time series would not be a recruitment abundance index). For absolute estimates, this scaling factor is set to 1 by definition (e.g. absolute estimates provide direct estimates of real abundance in average). For traps, we use vague priors on trap efficiency to give an insight on the possible recruitment (Figure 2), we used a vague prior between 0 and 0.35. Indeed, fishway passabilities are often estimated around 1/3 (Jessop, 2000; Briand *et al.*, 2005; Noonan *et al.*, 2012; Drouineau *et al.*, 2015), therefore our prior assumes that the observed abundance, corrected for the passability (e.g. multiplied by 3) is a minimum bound for the overall recruitment. For commercial time series, the scaling factor corresponds to the exploitation rate and we used a uniform prior between 0 and 1 (e.g. commercial catch is a minimum value for recruitment), except for the Somme River, in which, based on expert knowledge and following Bornarel *et al.* (2018), we assumed a large exploitation rate.

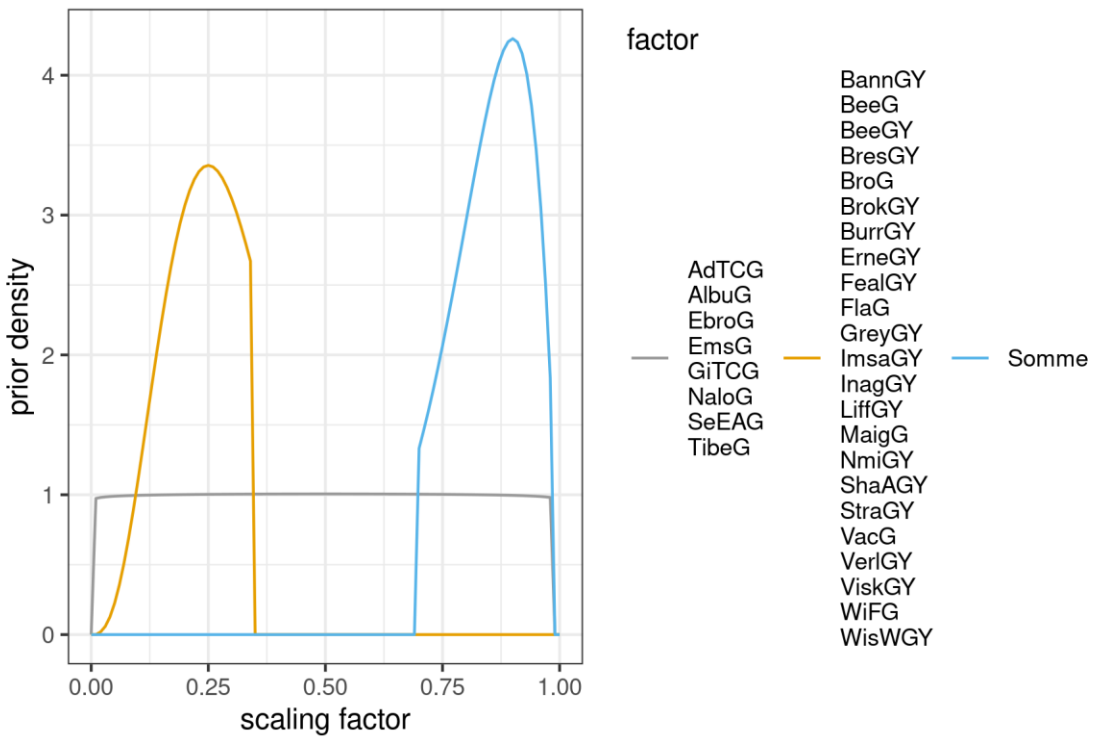

Figure 2: Priors for exploitation rates and trap efficiency. Exploitation rate and trap efficiency make make the link between observed data and models predictions of absolute recruitments

Running the model

Three independent MCMC chains are run in parallel using JAGS (Plummer, 2003) through R package runjags (Denwood, 2016). Chains were run 50000 iterations, with a thinning of 50 iterations, after an initial burnin period of 100000 iterations. Gelman and Rubin diagnostics were used to check model convergence (Gelman and Rubin, 1992).

Results

Gelman R hat statistics was below 1.05 for 78.9% of the parameters, demonstrating a good convergence of the model though not perfect for all parameters 3. In the future, it might be necessary to run the model for a longer number of iterations to achieve a perfect convergence.

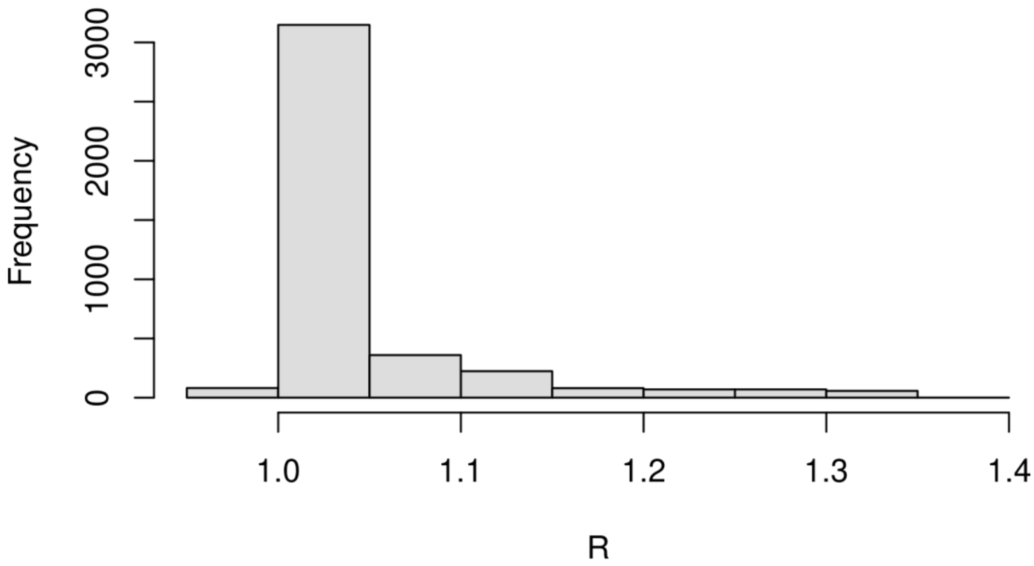

Figure 3: Distribution of Gelman R statistics

Overall recruitment and zone recruitment

Unsurprisingly, overall recruitment (Figure 4) shows a steep decline since the early 1980s, despite some oscillations. More recently, we observe a period of increase in the early 2010s but it seems to stabilise or slightly decrease after this. Credibility intervals are rather large at the end of the period partly because many time series (especially French fishery based time series) ended after the implementation of the Eel Regulation. The 2023 recruitment is estimated to be 4.77% (credibility interval [3.27%-7.12%]), while it was 5.25% (credibility interval [3.66%-7.66%]) in 2022.

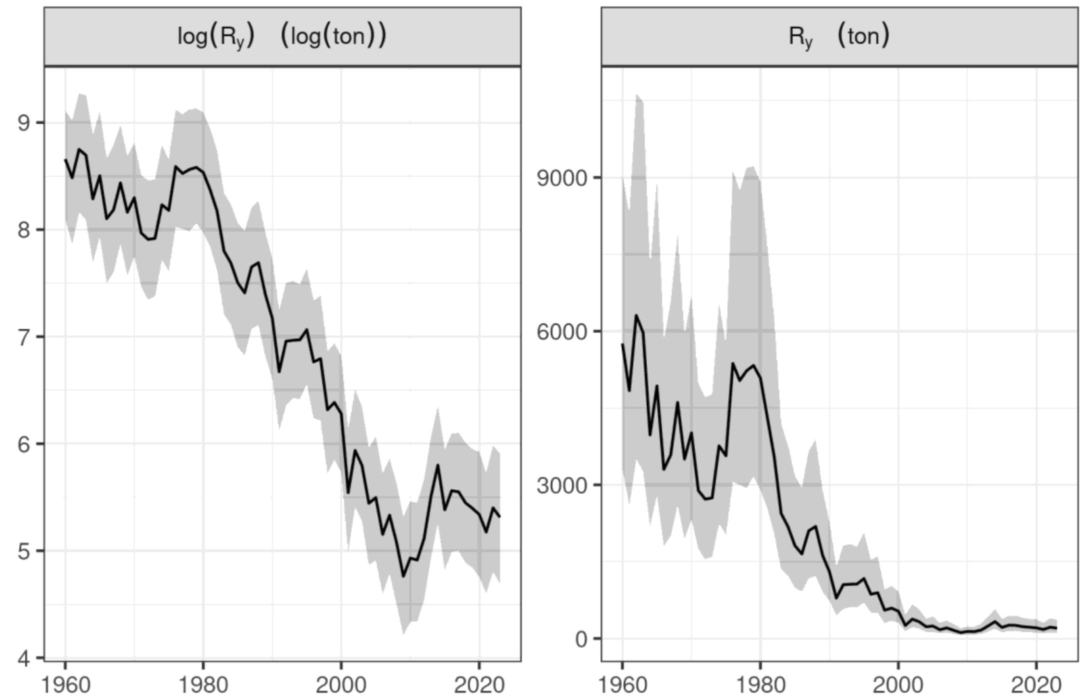

Figure 4: Overall trend in recruitment: median of the posterior distribution (solid line) and corresponding 95% credibility interval (shaded area)

At the zone level (Figure 5), all zones display a decrease of recruitment since 1960. As already observed by WGEEL, which provides separated estimates for the North Sea and Elswhere Europe series, the decline in North Sea started earlier than ATL_F and ATL_IB. In very recent years, the recruitment seems to displayed a slightly better trend in Mediterranean and especially in the INWGB regions compared to other regions. This had a limited impact on the overall recruitment.

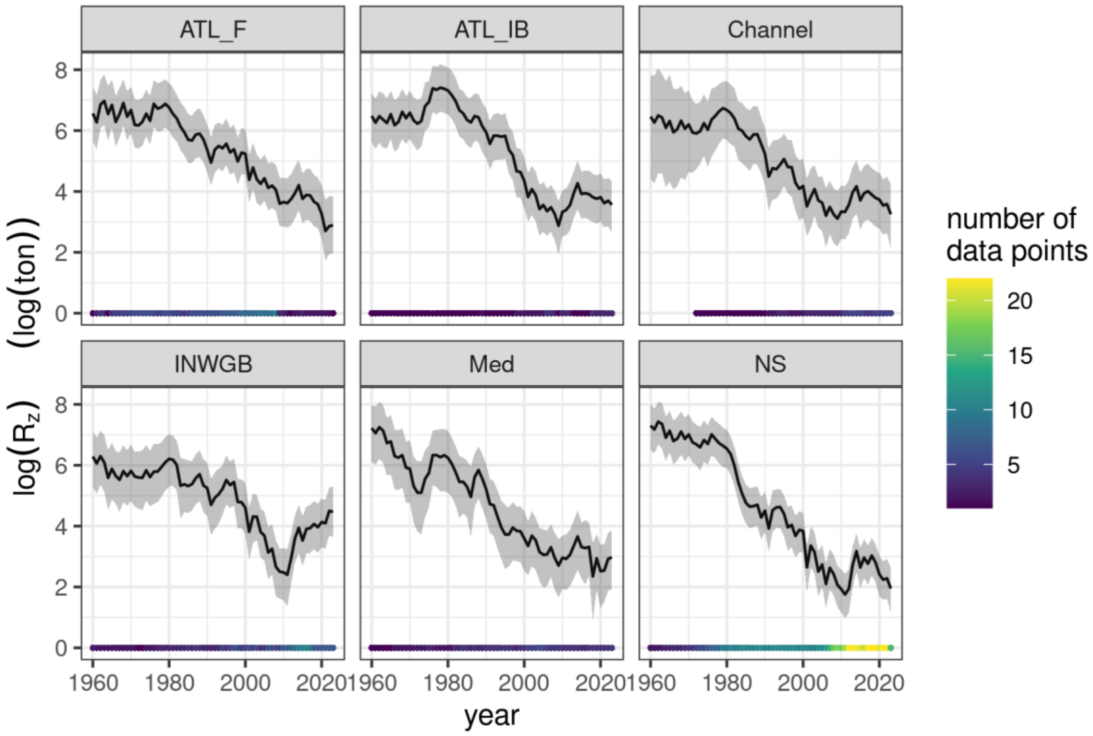

Figure 5: Trend in recruitment in each zone of the model: median of the posterior distribution (solid line) and corresponding 95% credibility interval (shaded area). The colour of the points on the x-axis indicates the number of available data series for the corresponding zone and year

It is also possible to analyse the proportions of recruitment arriving in each zone of the model (Figure 6). However, these results should be taken with great care: credibility intervals are large and some zones estimates are based on few absolute (or trap/commercial catch) time series. The proportions of recruitment in ATL_F appeared to decrease since the late 2000s, but these estimates are based on the single still updated time series in this zone, plus SousGY in recent years, so they should be taken with care. The share of recruitment in INWGB is well visible.

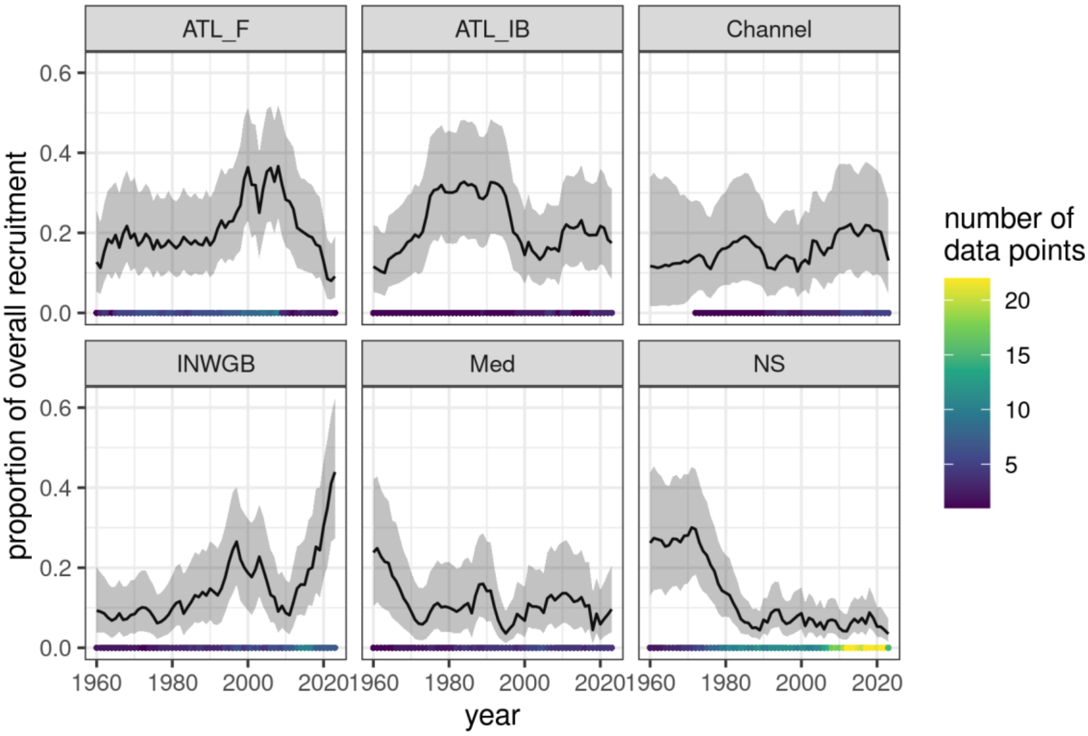

Figure 6: Proportions of overall recruitment arriving in each zone: median of the posterior distribution (solid line) and corresponding 95% credibility interval (shaded area)

Discussion

The use of GEREM does not change the overall image of the recruitment as provided by the GLM analysis. It confirms the decline of recruitment since the 1980s and the currently very low level of recruitment. However, it raises additional questions regarding some potential differences in trends among zones, such as the recent decline in the recruitment received in ATL_F. While definitive conclusions cannot be drawn, this result shows the importance of establishing new monitoring time series in areas where data are missing. As such, the monitoring network implemented in Sudoang appears to be an interesting opportunity. Regarding absolute recruitment, as already mentioned, results should be taken with great care since the number of time series is limited, the estimates are sensitive to some parameters and biases are observed in the model fits.

More importantly, the use of GEREM illustrates the potential benefit of a spatial assessment model for the European eel stock: combining data series from different regions without accounting for their relative importance in terms of biomass can bias the assessment, especially in the current situation in which data are not evenly distributed all other the distribution area.

Conclusion

The idea of presenting this modelling exercise was not to replace the GLM exercise nor to conduct a benchmark exercise of models but to provide an additional tool that provides complementary information. The two modelling approaches have two different levels of complexity and provide similar general picture of the trend of recruitment. While GEREM does not provide any definitive conclusions, it raises interesting complementary questions and highlights the need for new data in some regions and of new types. More importantly, it shows that combining time-series without weighting them according to the local level of abundance can potentially bias the results.