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

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Executive Summary

The recruitment of European eel from the ocean remained low in 2018. The glass eel recruitment compared to the 1960–1979 was only 2.1% in the North Sea and 10.1% in the Elsewhere Europe series, based on available dataseries. For the yellow eel dataseries, recruitment was provisionally 29% (not all series fully reported) of the level during the reference period.

Landings data were updated according to those reported to the WGEEL, either through responses to the 2018 Data call or in Country Reports, or integrated by the WGEEL using data from its previous reports. As some countries have not reported all their landings, even the raised versions reported here should be considered as minima.

Glass eel fisheries within the EU take place in France, UK, Spain, Portugal and Italy. Glass eel landings have declined sharply from 1980, when reported landings were larger than 2000 tonnes to 58.6 t in 2018.

Yellow and silver eel landings are not always reported separately, so are combined here. The total landings of yellow and silver eels decreased from 18 000–20 000 tonnes in the 1950s to 2000–3000 tonnes since 2009, and a reported 2224 tonnes in 2017 (mostly Sweden, Poland, Germany, Denmark, The Netherlands, United Kingdom, France, Italy and Tunisia).

Recreational catches and landings are poorly reported so amounts must be treated as a minimum but were estimated as 2 t for glass eel in 2018 (Spain only), and 161 t for yellow and silver eel combined in 2017 (mostly Denmark and Italy) (2018 data not available at time of writing). Overall, the impact of recreational fisheries on the eel stock remains largely unquantified although landings can be thought to be at a similar order of magnitude to those of commercial fisheries.

Aquaculture production of eel increased until the end of the 1990s but started to decline from the mid-2000s from about 8000–9000 t, and in 2017 the reported quantities of eels produced in aquaculture was 4 546 t, mostly in The Netherlands and Germany. It should be noted that eel aquaculture is based on wild recruits, and part of the production is subsequently released as on-grown eel for stocking (around 10 million eels, which if assuming a mean weight of 20 g would equate to about 200 t).

Restocking data for 2018 were incomplete at time of writing because some restocking programmes were ongoing. An update of the restocking amounts for 2017 suggests about 15 million glass eel, 14 million yellow eels and about 0.5 million silver eels were restocked in 2017, though these amounts include eel moved in the same river basin from where they were first caught (sometimes called assisted migration) and eel on grown in aquaculture.

The WGEEL compiled the biomass and mortality rate stock indicators reported in response to the 2018 eel data call. The ICES Workshop on Eel Management Plans (WKEMP) will examine these stock indicators in more detail. However, a preliminary analysis by the WGEEL of the data reported by EU Member States found that out of a total of 76 EMUs that most recently reported escapement biomass as a percentage of pristine biomass, 16 (21%, representing six EU countries) are reaching or exceeding the 40% target whereas 60 EMUs are below target.

The WG has made substantial progress in developing the use of the data call and database to refine data submission, checking, analyses and reporting. This was the first year of complete data reporting, and the data checking created a large but very worthwhile task. Two workshops are proposed for 2019 to further improve the data call and use of the reported data, and to standardize the analytical approaches used to estimate stock indicators. The data call for 2019 will request updates for recruitment, landings, aquaculture and stocking.

An overview was made of the methods countries use to respond to the data call. Some misinterpretations, inconsistencies and incomplete reporting (life stages, habitats, geographical areas, etc.) were uncovered. The first workshop in 2019 will address these issues.

The WG reviewed developments in previously specified emerging threats and opportunities, noting that most of these remained issues to address. New threats included (in no particular order) the effects of high summer water temperature/poor water quality as eel mortalities and disease outbreaks were reported across the UK, Sweden and Estonia; uncertainties over the supply of some glass eel for restocking after the UK leaves the EU; increasing reports of illegal fishing and/or eel trade; increased risk of misreading the age of restocked eel because of artificial 'annuli' and its impact on age-based cohort models; and further concern over disease transfer through restocking programmes. New opportunities included technologies to monitor eel behaviour in rivers and at sea; and a new multidisciplinary research project (Sudoang) between Spain, Portugal and France to provide tools and implement joint methods to support conservation of eel and habitats in this region.

The WG recognised that fishing impacts have received most attention in relation to quantifying impacts and effects of management measures. While this will continue, the WG will establish a standing annual activity taking forward quantification of the impacts of non-fishery factors, and to review methods for reducing these mortalities. In 2019, the WG will focus on impacts of hydropower facilities and water pumps.

The Working Group reviewed and trimmed the structure and content of the Country Report, in light of the further refined data call process.

The ToRs for 2019 were drafted according to the multiyear plan proposed in 2016.

1 Introduction

1.1 Main tasks

The Joint EIFAAC/ICES/GFCM Working Group on Eel [WGEEL] (chaired by: Alan Walker, UK) met in Gdańsk, Poland, from 5th to 12th September 2018 to address the terms of reference (ToR) set by ICES, EIFAAC and GFCM.

The meeting opened at 14:00 hrs on Wednesday 5th September. The agenda for the meeting is provided in Annex 4. The terms of reference were met.

The report chapters are linked to ToR, as indicated in the table below.

ToR A	Report on developments in the state of the European eel (*Anguilla anguilla*) stock, the fisheries on it and other anthropogenic impacts, based on the responses to the Data call 2018 and the WGEEL Country Reports	Chapter 2
ToR B	Produce the first draft of the ICES annual eel advice, and other advisory documents as requested	Chapter 3
ToR C	Report on updates to the scientific basis of the advice, including any new or emerging threats or opportunities	Chapter 4
ToR D	Address the generic EG ToRs from ICES, and any further requests from ICES, EIFAAC or GFCM	Chapter 5

In response to the ToR, the Working Group used data and information provided in response to the Eel Data call 2018 (from 16 countries) and 19 Country Report Working Documents submitted by participants (Annex 5); other references cited in the Report are given in Annex 1. A list of acronyms and glossary of terms used within this document is provided in Annex 2.

1.2 Participants

Thirty-nine experts attended the meeting, representing 19 countries, along with a representative of the EU Commission DG MARE and a representative of the ICES Workshop on Evaluating Eel Management Plans 2018 (WKEMP). A list of the meeting participants is provided in Annex 3.

1.3 The European eel: Stock Annex

A Stock Annex for the European eel was drafted by the WGEEL 2015 meeting, and is available from the ICES website here. This Stock Annex is intended as a reference document providing the background to the European eel. It describes the eel stock, the development of eel advice, the management frameworks for eel and the analysis of the recruitment for the provision of ICES Stock Advice. In principle, information contained in the Stock Annex should not be repeated in the annual reports of the WGEEL. However, some information is reported here where the WGEEL considered it appropriate.

1.4 The European eel: life history and production

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

European eel life history is complex, being a long-lived semelparous and widely dispersed stock. The shared single stock is genetically panmictic and data indicate the spawning area is in the southwestern part of the Sargasso Sea and therefore outside Community Waters. 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 could exceed 50 years) prior to metamorphosis to the "silver eel" stage and maturation. Age-at-maturity varies according to temperature (latitude and longitude), ecosystem characteristics, and density-dependent processes. The European eel life cycle is shorter for populations in the southern part of their range compared to the north.

The amount of glass eel arriving in continental waters declined dramatically in the early 1980s and has been very low in all years after 2000. The reasons for this decline are uncertain but may include overexploitation, pollution, non-native parasites, diseases, migratory barriers and other habitat loss, mortality during passage through turbines or pumps, and/or oceanic-factors affecting migrations. These factors will affect local production differently throughout the eel's range. In the planning and execution of measures for the protection and sustainable use of European eel, Management must therefore take into account the diversity of regional conditions.

1.5 Anthropogenic impacts on the stock

Anthropogenic mortality may be inflicted on eel by fisheries (including where catches supply aquaculture for consumption), hydropower turbines and pumps, pollution and indirectly by other forms of habitat modification and obstacles to migration.

Fisheries exploit all continental life phases: glass eel recruiting to continental waters, the immature growing yellow eel and the maturing silver eel. There are multiple commercial and recreational fisheries: with registered and non-registered vessels using nets and/or longlines; without vessels using fixed traps and nets; with mobile (bank-based) net gears, and rod and line. The exploited life stage and the gear types employed vary between local habitat, river, country and international regions.

1.6 The management framework of eel

1.6.1 EU and Member State waters

The European eel is a panmictic stock with widespread distribution. Within EU and Member State waters, the stock, fisheries and other anthropogenic impacts, are currently managed in accordance with the European Eel Regulation EC No 1100/2007, "*establishing measures for the recovery of the stock of European eel*" (European Council, 2007). This regulation sets a framework for the protection and sustainable use of the stock of European eel of the species *Anguilla anguilla* in Community Waters, in coastal lagoons, in estuaries, and in 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.

EU Member States must adopt national objectives, set out in Eel Management Plans (EMPs) in accordance with Article 2.4 of the Regulation to "*reduce anthropogenic mortalities so as to permit with high probability the escapement to the sea of at least 40% of the silver eel biomass relative to the best estimate of escapement that would have existed if no anthropogenic influences had impacted the stock*…. (The EMPs)… *shall be prepared with the purpose of achieving this objective in the long term.*" Each EMP constitutes a management plan adopted at national level within the framework of a Community conservation measure.

Under Article 9 of the Regulation, Member States must report on the monitoring, effectiveness and outcomes of EMPs, including: the proportion of silver eel biomass (relative to the target level of escapement) that escapes to the sea to spawn or leaves the national territory; the level of fishing effort that catches eel each year; the level(s) of anthropogenic mortality outside the fishery; the amount of eel less than 12 cm in length caught; and the proportions utilized for different purposes. These reporting requirements were further developed by the Commission in 2011/2012 and published as guidance for the production of the 2012 reports. This guidance adds the requirement to report fishing catches (as well as effort) and explains the various biomass, mortality rates and restocking metrics using the following definitions:

- Silver eel production (biomass):
  - B_0 The amount of silver eel biomass that would have existed if no anthropogenic influences had impacted the stock;
  - $B_{current}$ The amount of silver eel biomass that currently escapes to the sea to spawn;
  - B_{best} The amount of silver eel biomass that would have existed if no anthropogenic influences had impacted the current stock, included restocking practices, hence only natural mortality operating on stock.
- Anthropogenic mortality (impacts):
  - ΣF The fishing mortality rate, summed over the age groups in the stock;
  - ΣH The anthropogenic mortality rate outside the fishery, summed over the age groups in the stock;
  - ΣA The sum of anthropogenic mortalities, i.e. $\Sigma A = \Sigma F + \Sigma H$. It refers to mortalities summed over the age groups in the stock.
- Stocking requirements:
  - R(s) The amount of eel (<20 cm) restocked into national waters annually. The source of these eel should also be reported, at least to originating Member State, to ensure full accounting of catch vs. restocked (i.e. avoid 'double banking'). Note that R(s) for stocking is a new symbol devised by the Workshop to differentiate from "R" which is usually considered to represent Recruitment of eel to continental waters.

In July 2012, Member States first reported on the actions taken, the reduction in anthropogenic mortalities achieved, and the state of their stock relative to their targets. In May 2013, ICES evaluated these progress reports in terms of the technical implementation of actions

(ICES, 2013a). In October 2014, the European Commission reported to the European Parliament and the Council with a statistical and scientific evaluation of the outcome of the implementation of the Eel Management Plans. EU Member States again reported on progress with implementing their EMPs in 2015 and most recently in 2018. ICES is in the process of evaluating these progress reports at the time of writing.

1.6.2 Non-EU states

The EC Eel Regulation only applies to EU Member States, but the eel distribution extends much further than this. Some non-EU countries provide data to the WGEEL and more countries are being supported to achieve this through efforts of the General Fisheries Commission of the Mediterranean (GFCM). Most non-EU areas have only recently been involved in this data provision, and further development - of reference points, assessment procedures, and feedback mechanisms - might be required, to cope with unforeseen complications and/or to familiarise local experts and involve them in future standardisation processes.

1.6.3 Other international drivers

The European eel was listed in Appendix II of the Convention on International Trade in Endangered Species (CITES) in 2007, although it did not come into force until March 2009. Since then, any international trade in this species needs to be accompanied by a permit. ICES (2015a) recently advised the EU CITES SRG on criteria and thresholds that might be used in forming a future application for a Non-Detriment Finding (NDF).

The International Union for the Conservation of Nature (IUCN) has assessed the European eel as 'critically endangered' and included it on its Red List in 2009. It renewed this listing in 2014 but recognised that: "*if the recently observed increase in recruitment continues, management actions relating to anthropogenic threats prove effective, and/or there are positive effects of natural influences on the various life stages of this species, a listing of Endangered would be achievable*" and therefore "*strongly recommend an update of the status in five years*". The Red List assessments of all Anguillid eels will be reviewed by IUCN in late 2018.

In 2014, the European eel was added to Appendix II of the Convention on Migratory Species (CMS), whereby Parties (covering almost the entire distribution of European eel) to the Convention call for cooperative conservation actions to be developed among Range States.

1.7 Assessments to meet management needs

The European Commission obtains recurring 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 EU and ICES (2018). In support of this advice, ICES is asked to provide the EU 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 EU is required to arrange, through Member States or directly, for any data collected through the Data Collection Framework (DCF) and legally discloseable for scientific purposes to be available to ICES.

ICES requests information from national representatives to the WGEEL on the status of national eel production each year. ICES issued a Data call to request some of this information in July 2018, and this call was also advertised by EIFAAC to its membership (see below for further details).

The status of eel production in EU-EMUs and non-EU Eel Assessment 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 mostly represents the management area corresponding to the "eel river basin" as defined in the EU Eel Regulation (EC No 1100/2007). But 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 to the whole country. In practice, geographical units have also been provided that refer to more consistent geographical areas, with the objective of providing consistent spatial units to assess shared stock 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.

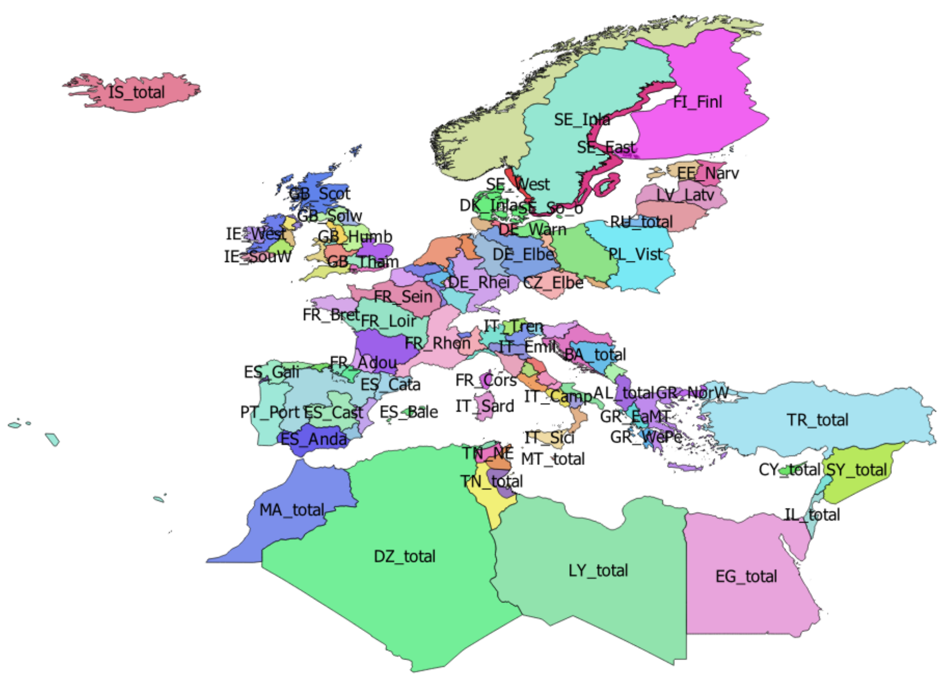

Figure 1.1. Current map of Eel Management Units (EMUs) as reported by EU countries or corresponding to national entities when no EMU is described at the national level.

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 EC Eel Regulation's 40% of B_0), management targets for individual rivers, river basins, river basin districts, EMUs and nations, and for assessing compliance of current escapement with these limits/targets (e.g. for the EC Eel Regulation comparing $B_{current}$). These methods require data on various combinations of catch, recruitment indices, length/age structure, recruitment, abundance (as biomass and/or density), maturity ogives, to estimate silver eel biomass, fishing and other anthropogenic mortality rates.

The ICES Study Group on International Post-Evaluation of Eel (SGIPEE) (ICES, 2010a; 2011a) and WGEEL (ICES, 2010b; FAO and ICES, 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. This approach was first applied by WGEEL in 2013 based on the national stock indicators reported by EU Member States in 2012 in their first EMP Progress Reports and has been applied again here using the data reported in 2018 Data call and Country Reports.

1.8 Data call

The WGEEL annually collates data on recruitment, landings from commercial and recreational fisheries, restocking, aquaculture production, etc. Prior to 2017, these data have been provided by countries attending the WGEEL in many complex spreadsheets. Reporting is far from complete at present. A Data call hosted by ICES, EIFAAC and GFCM is considered an effective mechanism to significantly improve the situation of data provision and use.

The Data call 2017 (Part 1 of the two-year plan) requested data describing: recruitment; fishery catches; fishery landings (killed); aquaculture production and restocking. These data were requested for as far back as available, to form a starting point for the creation of a database. The call also required the provision of metadata associated with all data.

The WGEEL 2017 meeting, and a subsequent Workshop on Tools for Eels (WKTEEL), (chaired by: Laurent Beaulaton, France), met in Rennes, France, from 2 to 6 June 2018 developed Part 2 of the Data call, requesting data on the stock indicators (biomass) and mortality estimates, wetted area and silver eel time-series, as well as the annual update on recruitment data, landings (not catch), aquaculture production and restocking, and the data integration, analysis and visualisation tools to be used by WGEEL to automate this process.

1.9 Concluding remarks

This report of the Joint EIFAAC/ICES/GFCM Working Group on Eel is a further step in an ongoing process of documenting the stock of the European eel, associated fisheries and other anthropogenic impacts and developing methodologies for giving scientific advice on management to effect a recovery in the international, panmictic stock. Scientific advice has traditionally been issued by ICES under the Administrative Agreement (AA) with the EU, and that advice has been given on a stock-wide basis. In addition to this, WGEEL are considering an additional advisory framework aimed at the EMU/Country level in support of the management targets set in the EU Regulation. To this end the advisory process is being developed to suit these multiple and varied requirements of a wide-ranging fragmented stock exposed to many and varied pressures and management practices.

2 Tor A: Developments in the state of the stock, the fisheries and other anthropogenic impacts

Updates on the state of the eel stock in countries reporting to WGEEL are presented in this chapter, in response to Term of Reference A: *Report on developments in the state of the European eel (Anguilla anguilla) stock, the fisheries on it and other anthropogenic impacts*.

Countries were asked to report time-series of recruitment, catches and landings, aquaculture production, quantities restocked, and stock indicators of biomass and mortality rates through the Eel Data call 2018, which was distributed through ICES, EIFAAC and GFCM. Each of the sections below describes trends in the dataseries, comments on any issues with the quality of the data and, where appropriate, explains the consequences for the status of the stock.

2.1 Data sources

2.1.1 Data call treatment and quality assurance

The Data call files have been processed with R in a two-step process. First all files placed in a folder, with a subfolder structure (one folder per country) have been read into R. A function was programmed to issue structural warning regarding the files (number of column, column names, etc.) and a series of check utilities (click here for github files) have been programmed to ensure that the data returned were consistent with the dictionaries, did not contain text instead of number, and qualified all the lines with missing data, etc. The check was done file by file with corrections made in the original excel files until all the warnings could be safely ignored.

As a second step, the contents of the database were checked at the file insertion: including checking that there were no double entries for the same year for the same kind of data, nor the inconsistencies with the dictionary tables (as set by foreign keys in the database). The process was repeated for three Data call file input: landings, aquaculture, and restocking.

As a result, three csv files were then produced for the WGEEL for inspection, quality check, and control.

For recruitment data, a different procedure was applied as these data are already in a database used by the WGEEL. Data from the previous years were sent to users using a script for recruitment which generates excel files. Those files were checked, filled in by national correspondents, and then returned with a flagging of changes values. They were then integrated manually using a database interface.

2.1.2 Application development (Shiny)

WGEEL now uses the GitHub areas CES provided by ICES to facilitate scientific collaboration. GitHub is an open source version control system. It permits the WGEEL members to have access to the R and SQL scripts that are useful for recurring WGEEL activity.

Currently, there are scripts:

- To create the WGEEL database structure with georeferenced information (SIG layers).

- To export the spreadsheets to be fill in for recruitment data call.
- To upload the data from Data call spreadsheets for recruitment, aquaculture, landings and restocking with primary quality checks.
- For the shiny application that proposes a user-friendly interface to visualize the data in the database.
- For the analyses and graphs used in WGEEL report:
- to integrate the biomass and mortalities, habitat wetted areas, and the silver eel time-series from the 2018 Data call (See Data integration details below);
- to improve the shiny application (Figure 2.1) with new visualization tools useful for quality check by the national delegates;
- to identify and solve duplicate problems.

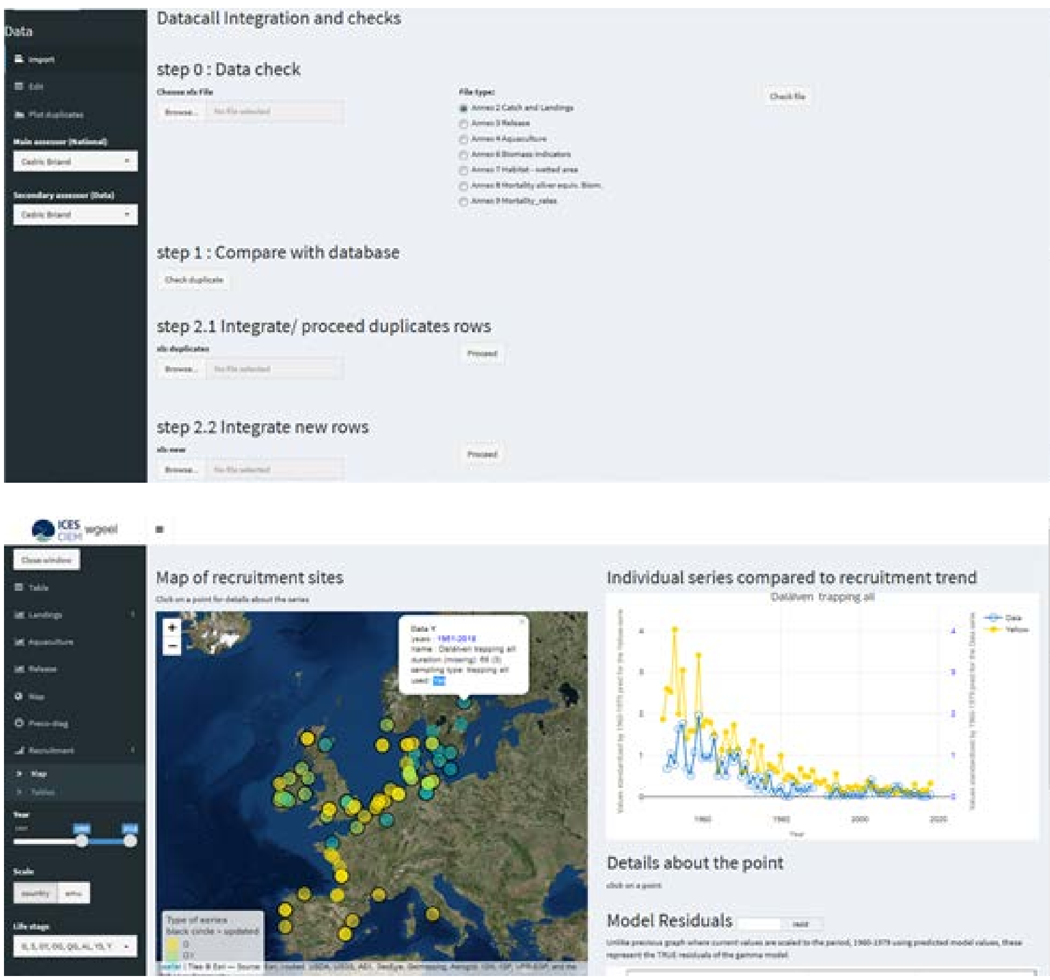

Figure 2.1. Screen-print example of the Shiny application, showing the data integration webpage and data visualization webpage.

The relevant data (landings, restocking, mortality rates, biomass indicators) provided through the 2018 data call were integrated into the existing WGEEL database using a shiny application. The basic idea is (1) to let WGEEL experts carry out checks on the new files,

(2) help national correspondents to qualify their data for quality (3) compare the new data with the existing data in the database and check for duplicates. There are two applications, one to edit data straight into the database (data integration, Figure 2.1 upper panel), and display graphs to check for duplicates once data are submitted (Figure 2.1 lower panel). Detailed information can be found on the website https://github.com/ices-eg/wg_WGEEL/tree/master/R/shiny_data_integration.

The second shiny application was used to visualize and analyse the data supplied. Detailed information on how to start the app can be found at: https://github.com/ice-seg/wg_WGEEL/tree/master/R/shiny_data_visualisation

2.2 Trends in Recruitment

In this section, the latest trends in glass and yellow eel recruitment are addressed. The time-series data on recruitment are derived from fishery-dependent sources (i.e. catch records) and fishery-independent surveys across much of the geographic range of European eel (locations of the sampling stations, differentiating according to eel stage and duration of time-series, are shown in Figure 2.2). The stages are categorized as glass eel (G), which includes all "young of the year" eel, mixture of glass eel and yellow eel dominated by recruits from the year (G+Y) and older yellow eel (Y) recruiting to continental habitats (Dekker, 2002). The yellow eel series might consist of yellow eel of several ages. This is certainly the case for all series from the Baltic, Ireland (ShaP) and sites located well into freshwater.

The glass eel recruitment time-series have been grouped into two geographical areas: 'North Sea' and 'Elsewhere Europe' (see Figure 2.2) (after ICES, 2010b).

Extract from the 2010 report of the WGEEL (ICES, 2010b, p19) explaining the split into two recruitment indices: it was demonstrated that a sharper decrease occurred in the North Sea recruitment series. Repeatedly, new analyses have been done to check this, and it was decided to keep that split. The variability within each geographical unit is high, and there is no clear pattern in the trend of recruitment between the series, except for the North Sea which stands apart with series demonstrating a much more pronounced declining trend, as demonstrated by the GLM analysis (Figures 2.7–2.8). This sharper decline in recruitment is observed for series in the Kattegat (YFS2), a scientific young fish survey, on the Dutch coast (Ems, Rhine IJmuiden, Stellandam) and in Denmark (Vidaa) and Norway (Imsa). Surprisingly, this sharper decline is not observed in the Baltic area. The decline might, in some places, be explained by diminishing fishing effort (Ems, Vidaa) but not for the scientific estimates (YFS2, Rhine IJmuiden, Ijser, Stellendam). It must also be noted that other stations, geographically close to the other Dutch recruitment stations (Lauwersoog, Katwijk) and the Ringhals nuclear power station series, have similar trends to the mean of the other European series (Figures 2.7–2.8; Table 2.2). An alternative model was tested using log(x+α) transformed values, ε as a gaussian error, and identity link, with a negligible when compared with the minimum value yields almost no difference in the results. Also an analysis on a more limited time frame 1975–2009 yielded similar results with the North Sea stations standing apart from the others.

Bornarel *et al.* (2017) adapted the Glass Eel Recruitment Estimation Model (GEREM) to estimate annual recruitment (i) at the river catchment level, a scale for which data are available, (ii) at an intermediate scale (6 European regions), and (iii) at a larger scale (Europe). Results confirmed an overall recruitment decline and confirmed a more pronounced decline in the North Sea area compared to the Elsewhere Europe area (after ICES, 2010b).

The WGEEL has collated information on recruitment from 81 time-series (Table 2.1). Some time-series date back to the beginning of the 20th century (yellow eel, Göta Älv, Sweden) or 1920 (glass eel, Loire, France). Among those series, 60 have been selected for further analysis in the WGEEL indices, see details on data selection and processing below). Depending on the period on which we standardized, the number of series really used can be lower and are given for each analysis.

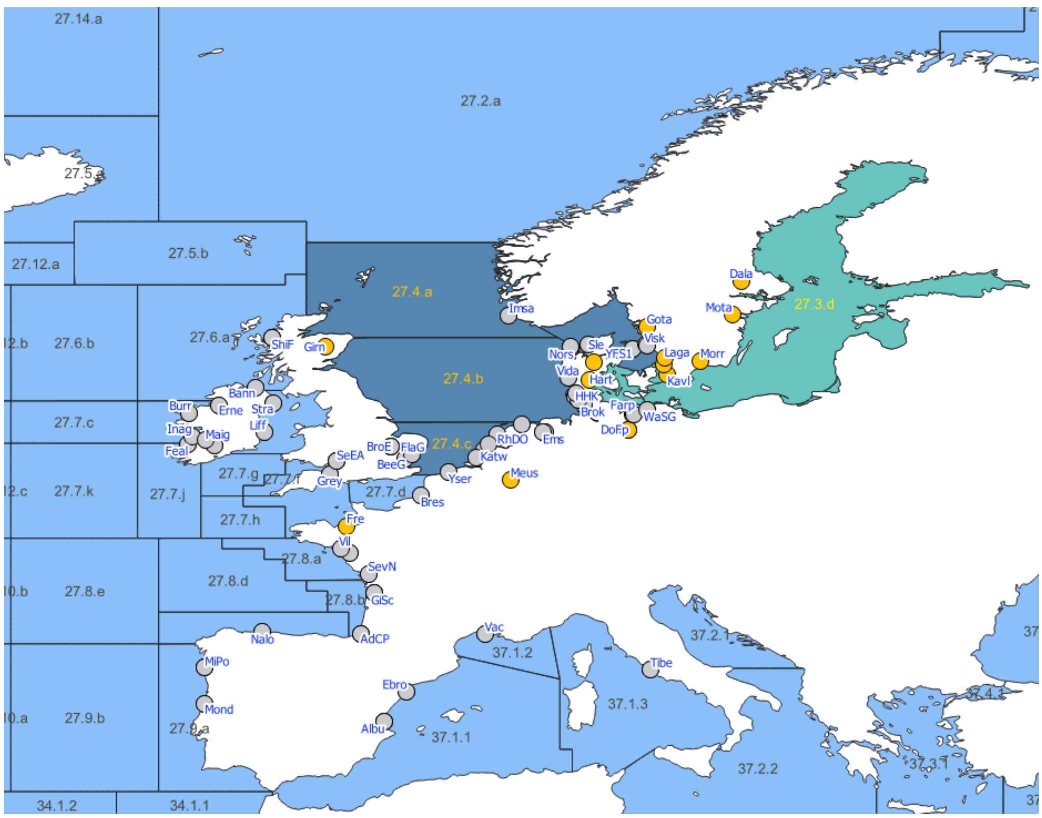

Figure 2.2. Map showing the sampling stations of European eel recruitment. Sampling stage colour shows life stage (grey = glass eel and yellow eel, yellow = yellow eel). The ICES rectangles (e.g.27.4.c etc.) are shaded grey for the North Sea, green for the Baltic, and blue for the Elsewhere Europe index areas.

2.2.1 Details on data selection and processing

Out of 81, 21 series were not selected for the analysis (Table 2.1). Three rules have been used for this selection procedure:

1) The first rule is to keep only one series at one location when two series for that location (from different sources) display different information. For instance, the longest series has been kept for the England and Wales glass eel (EA) while the

other (HMRC) has been dropped from the list, as it was considered a double, being based on the same fishery.

2) The second rule is to not include a series when it is too short. It was decided in 2018 to include the practical rule that series of less than ten years, should not be kept. They are still updated in the database until they can be included.

3) Finally, it was also decided to discard recruitment series that were obviously biased by restocking, e.g. Farpener Bach in Germany.

Among the time-series based on trap indices, some have reported preliminary data for 2018 as their trapping season had not finished. **As usual, the indices given for 2018 must be considered as provisional, especially those for the yellow eel.**

Eight new historical data time-series have been collected in the UK and one in Portugal. Most of those are not yet included in the analysis as they are too short in time.

Table 2.1. Short description of the sampling sites for European eel recruitment data. Area: NS = North Sea, EE = Elsewhere Europe. Min and max indicate the first year and last year in the records, and the values are given in the n+ and n- columns, indicate the number of years with values and the number of years when there are missing data within the series. Life stage: GY = glass eel and yellow eel, G = glass eel, Y = yellow eel (see Annex 8 Table 13 for more details). 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, see Annex 8 Table 16 for more details). Habitat: C = coastal water (according to the EU Water Framework Directive, WFD), F = freshwater, MO = marine water (open sea), T = transitional water with lower salinity (according to WFD). Kept = 1 means that the dataseries is used in recruitment analyses.

code	area	min	max	n+	n-	life stage	sampling type	unit	habitat	kept
Imsa	NS	1975	2017	43	0	GY	trap	nr	F	1
YFS2	NS	1991	2018	28	0	G	sci. surv.	index	MO	1
Ring	NS	1981	2018	38	0	G	sci. surv.	index	C	1
Visk	NS	1972	2018	47	0	GY	trap	kg	F	1
Sle	NS	2008	2018	11	0	G	sci. surv.	nr/m²	F	1
Klit	NS	2008	2018	11	0	G	sci. surv.	nr/m²	F	1
Nors	NS	2008	2018	11	0	G	sci. surv.	nr/m²	F	1
Bann	EE	1933	2018	86	0	GY	trap	kg	F	1
Erne	EE	1959	2018	60	2	GY	trap	kg	F	1
Liff	EE	2012	2018	7	0	GY	trap	kg	F	0
Burr	EE	1987	2018	32	18	G	trap	kg	F	1
Feal	EE	1985	2018	34	14	GY	trap	kg	F	1
Maig	EE	1994	2018	25	4	G	trap	kg	F	1
Inag	EE	1996	2018	23	4	GY	trap	kg	F	1
ShaA	EE	1977	2018	42	0	GY	trap	kg	F	1
SeEA	EE	1972	2018	47	2	G	com. catch	t	T	1
SeHM	EE	1979	2017	39	4	G	com. catch	t	T	0
Girn	NS	2008	2018	11	0	Y	trap	nr	F	1
ShiM	EE	2014	2018	5	0	G	trap	nr	T	0
ShiF	EE	2017	2018	2	0	G	trap	nr	F	0
FlaG	NS	2007	2016	10	0	G	trap	.	F	0
FlaE	NS	2007	2016	10	0	GY	trap	.	F	1
BeeG	NS	2006	2016	11	0	G	trap	.	F	1
BroG	NS	2011	2018	8	0	GY	trap	.	F	0
BroE	NS	2011	2018	8	0	GY	trap	.	F	0
Grey	EE	2009	2018	10	0	GY	trap	.	F	1
Stra	EE	2012	2018	7	0	GY	trap	.	F	0
Vidaa	NS	1971	1990	20	0	G	com. catch	kg	T	1
Ems	NS	1946	2001	56	0	G	com. catch	kg	T	1
Verl	NS	2010	2017	8	0	GY	trap	nr	T	0
HHK	NS	2010	2013	4	0	GY	trap	nr	T	0
HoS	NS	2010	2010	1	0	GY	trap	nr	T	0

code	area	min	max	n+	n-	life stage	sampling type	unit	habitat	kept
Brok	NS	2012	2017	6	0	GY	trap	nr	T	0
Lang	NS	2015	2017	3	0	GY	trap	nr	T	0
WaSG	NS	2015	2017	3	0	G	sci. surv.	nr	T	0
WaSE	NS	2015	2017	3	0	Y	sci. surv.	nr	T	0
Farp	NS	2007	2017	11	0	GY	trap	nr	F	0
WiFG	NS	2006	2017	12	0	GY	trap	nr	T	1
WisW	NS	2004	2017	14	0	GY	trap	nr	F	1
DoFp	NS	2003	2017	15	0	Y	trap	nr	F	0
DoEl	NS	2003	2017	15	0	Y	trap	nr	F	1
EmsH	NS	2014	2017	4	0	G	trap	nr	T	0
EmsB	NS	2013	2016	4	0	GY	trap	nr	F	0
Lauw	NS	1976	2018	43	4	G	sci. surv.	nr/h	T	1
RhDO	NS	1938	2018	81	1	G	sci. surv.	index	T	1
RhIj	NS	1969	2018	50	5	G	sci. surv.	index	T	1
Katw	NS	1977	2018	42	5	G	sci. surv.	index	T	1
Stel	NS	1971	2018	48	0	G	sci. surv.	index	T	1
Yser	NS	1964	2018	55	1	G	sci. surv.	kg	T	1
Bres	EE	1994	2018	25	0	GY	trap	nr	F	1
Vil	EE	1971	2015	45	3	G	trap	t	T	1
Loi	EE	1924	2008	85	6	G	com. catch	kg	T	1
SevN	EE	1962	2008	47	25	G	com. cpue	kg/boat/d	T	1
GiSc	EE	1992	2018	27	1	G	sci. surv.	index	T	1
GiTC	EE	1923	2008	86	28	G	com. catch	t	T	1
GiCP	EE	1961	2008	48	1	G	com. cpue	kg/boat/d	T	1
AdTC	EE	1986	2008	23	0	G	com. catch	t	T	1
AdCP	EE	1928	2008	81	40	G	com. cpue	kg/boat/d	T	1
Nalo	EE	1953	2018	66	0	G	com. catch	kg	T	1
MiSp	EE	1975	2018	44	0	G	com. catch	kg	T	1
MiPo	EE	1974	2018	45	0	G	com. catch	kg	T	1
Mond	EE	1988	2017	30	28	G	sci. surv.	kg/d	T	0
Albu	EE	1949	2017	69	5	G	com. catch	kg	T	1
Ebro	EE	1966	2018	53	3	G	com. catch	kg	T	1
AlCP	EE	1982	2018	37	5	G	com. cpue	kg/boat/d	T	1
Vac	EE	2004	2018	15	0	G	trap	nr	T	1
Tibe	EE	1975	2006	32	0	G	com. catch	t	T	1
YFS1	NS	1975	1989	15	0	G	sci. surv.	index	MO	1
Dala	NS	1951	2018	68	3	Y	trap	kg	F	1
Mota	NS	1942	2017	76	0	Y	trap	kg	F	1
Morr	NS	1960	2018	59	0	Y	trap	kg	F	1
Kavl	NS	1992	2018	27	0	Y	trap	kg	F	1
Ronn	NS	1946	2018	73	9	Y	trap	kg	F	1

code	area	min	max	n+	n-	life stage	sampling type	unit	habitat	kept
Laga	NS	1925	2018	94	0	Y	trap	kg	F	1
Gota	NS	1900	2018	119	12	Y	trap	kg	F	1
ShaP	EE	1985	2018	34	0	Y	trap	kg	F	1
BroY	NS	2011	2018	8	0	Y	trap	.	F	0
Gude	NS	1980	2018	39	0	Y	trap	kg	F	1
Hart	NS	1967	2017	51	1	Y	trap	kg	F	1
Meus	NS	1992	2018	27	3	Y	trap	nr	F	1
Fre	EE	1997	2017	21	0	Y	trap	nr	F	1

2.2.2 Number of valid series available

The number of glass eel and glass eel + young yellow eel time-series available for a given year has declined from a peak of 40 in 2008 to 30 in 2018. The maximum number of yellow eel time-series increased to 14 in 2017 but declined to ten in 2018 (Figure 2.3).

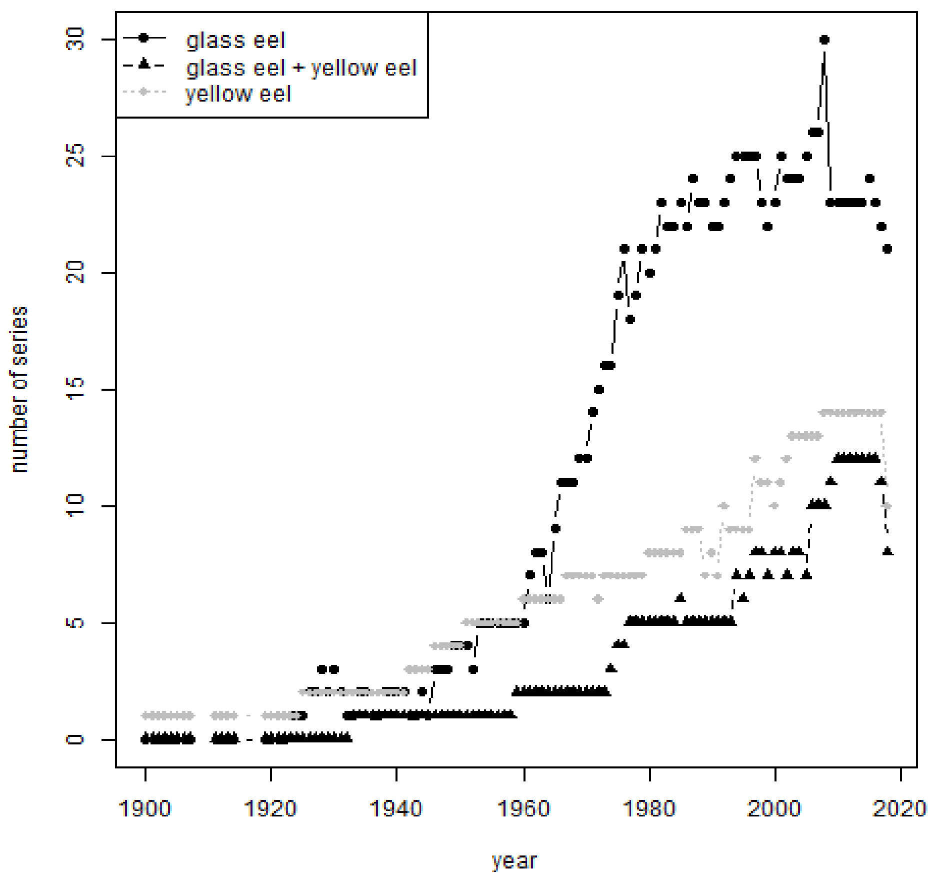

Figure 2.3. Trends in number of glass (black circle), glass+young yellow eel (grey triangle) and older yellow eel (black triangle) time-series giving a report in any specific year.

2.2.3 Checks on updates of series for the 2018 analyses

Thirty-seven time-series were updated to 2018 (20 for glass eel, seven for glass+yellow and ten for yellow eel (Table 2.2). Ten time-series (two for glass eel, four for glass+yellow and 4 for yellow eel) were updated to 2017 only (Table 2.3).

Thirteen time-series have been stopped or not updated beyond 2016 (12 for glass eel, one for glass+yellow and 0 for yellow eel, Table 2.4), 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. The two English series (FlaE and BeeG) are still operating but data have not been updated since 2016.

Table 2.2. Recruitment series updated to 2018. Codes for stages are G = glass eel, GY = glass eel + yellow eel, Y = yellow eel (see Annex 8 Table 13 for more details), Area NS = North Sea, EE = Elsewhere Europe, Division = FAO marine division.

Site	Name	Coun.	Stage	Area	Division
Imsa	Imsa Near Sandnes trapping all	NO	GY	NS	27.4.a
YFS2	IYFS2 scientific estimate	SE	G	NS	27.3.a
Ring	Ringhals scientific survey	SE	G	NS	27.3.a
Visk	Viskan trapping all	SE	GY	NS	27.3.a
Sle	Slette A	DK	G	NS	27.4.b
Klit	Klitmoeller A	DK	G	NS	27.4.a
Nors	Nors A	DK	G	NS	27.4.a
Bann	Bann Coleraine trapping partial	GB	GY	EE	27.6.a
Erne	Erne Ballyshannon trapping all	IE	GY	EE	27.7.b
Burr	Burrishoole	IE	G	EE	27.7.b
ShaA	Shannon Ardnacrusha trapping all	IE	GY	EE	27.7.b
SeEA	Severn EA commercial catch	GB	G	EE	27.7.e
Girn	Girnock burn trap scientific estimate	GB	Y	NS	27.4.b
Grey	Greylakes_Elvers (<120mm)	GB	GY	EE	27.7.f
Lauw	Lauwersoog scientific estimate	NL	G	NS	27.4.b
RhDO	Rhine DenOever scientific estimate	NL	G	NS	27.4.c
RhIj	Rhine IJmuiden scientific estimate	NL	G	NS	27.4.c
Katw	Katwijk scientific estimate	NL	G	NS	27.4.c
Stel	Stellendam scientific estimate	NL	G	NS	27.4.c
Yser	Ijzer Nieuwpoort scientific estimate	BE	G	NS	27.4.c
Bres	Bresle	FR	GY	EE	27.7.d
GiSc	Gironde scientific estimate	FR	G	EE	27.8.b
Nalo	Nalon Estuary commercial catch	ES	G	EE	27.8.c
MiSp	Minho spanish part commercial catch	ES	G	EE	27.9.a
MiPo	Minho portugese part commercial catch	PT	G	EE	27.9.a
Ebro	Ebro delta lagoons	ES	G	EE	37.1.1
AlCP	Albufera de Valencia commercial cpue	ES	G	EE	37.1.1
Vac	Vaccares	FR	G	EE	37.1.2
Dala	Dalalven trapping all	SE	Y	NS	27.3.d
Morr	Morrumsan trapping all	SE	Y	NS	27.3.d
Kavl	Kavlingean trapping all	SE	Y	NS	27.3.b, c
Ronn	Ronne A trapping all	SE	Y	NS	27.3.a
Laga	Lagan trapping all	SE	Y	NS	27.3.a
Gota	Gota Alv trapping all	SE	Y	NS	27.3.a
ShaP	Shannon Parteen trapping partial	IE	Y	EE	27.7.b
Gude	Guden A Tange trapping all	DK	Y	NS	27.3.a
Meus	Meuse Lixhe dam trapping partial	BE	Y	NS	27.4.c

Table 2.3. Recruitment series updated to 2017 only. Codes are as in Table 2.2.

Site	Name	Coun.	Stage	Area	Division
WiFG	Frische Grube	DE	GY	NS	27.3.b, c
WisW	Wallensteingraben	DE	GY	NS	27.3.b, c
DoEl	Dove Elde eel ladder	DE	Y	NS	27.4.b
Albu	Albufera de Valencia commercial catch	ES	G	EE	37.1.1
Mota	Motala Strom trapping all	SE	Y	NS	27.3.d
Hart	Harte trapping all	DK	Y	NS	27.3.b, c
Fre	Fremur	FR	Y	EE	27.7.e
Feal	River Feale	IE	GY	EE	27.7.j
Maig	River Maigue	IE	G	EE	27.7.b
Inag	River Inagh	IE	GY	EE	27.7.b

Table 2.4. Recruitment series not updated to 2017, or stopped in recent years. Codes are as in Table 2.2.

Site	Name	Coun.	Stage	Area	Division	Last Year
YFS1	IYFS scientific estimate	SE	G	NS	27.3.a	1989
Vidaa	Vidaa Hojer sluice commercial catch	DK	G	NS	27.4.b	1990
Ems	Ems Herbrum commercial catch	DE	G	NS	27.4.b	2001
Tibe	Tiber Fiumara Grande commercial catch	IT	G	EE	37.1.3	2006
AdCP	Adour Estuary (cpue) commercial cpue	FR	G	EE	27.8.b	2008
AdTC	Adour Estuary (catch) commercial catch	FR	G	EE	27.8.b	2008
GiCP	Gironde Estuary (cpue) commercial cpue	FR	G	EE	27.8.b	2008
GiTC	Gironde Estuary (catch) commercial catch	FR	G	EE	27.8.b	2008
Loi	Loire Estuary commercial catch	FR	G	EE	27.8.a	2008
SevN	Sevres Niortaise Estuary commercial cpue	FR	G	EE	27.8.a	2008
Vil	Vilaine Arzal trapping all	FR	G	EE	27.8.a	2015
BeeG	Beeleigh_Glass_<80 mm	GB	G	NS	27.4.c	2016
FlaE	Flatford_Elvers_>80<120 mm	GB	GY	NS	27.4.c	2016

2.2.4 Recruitment series data

The geometric mean of all time-series[1] is presented in Figures 2.4 and 2.5.

[1] This figure is given as it consistent with the trend provided by WGEEL from 2002 to 2006. The scaling is performed on the 1979–1994 average of each time-series, and 15 time-series without data during that period are excluded from the analysis. The time-series left out are: BeeG, Bres, DoEl, FlaE, Fre, Girn, Grey, Inag, Klit, Maig, Nors, Sle, Vac, WiFG, WisW.

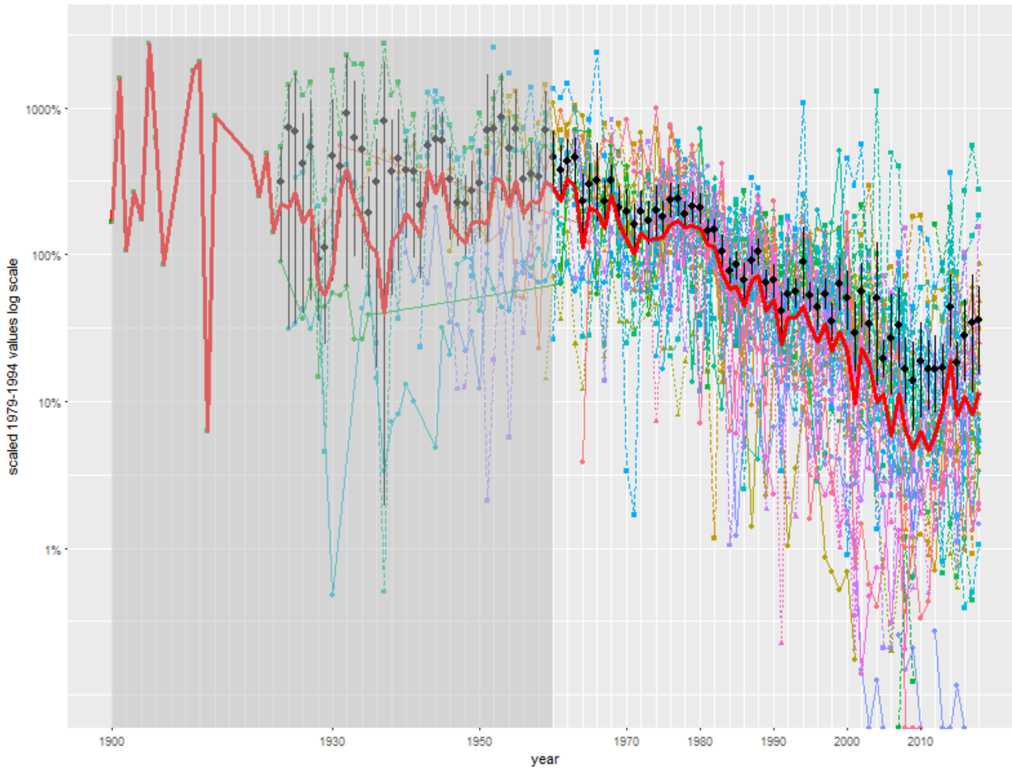

Figure 2.4. Time-series of glass eel/glass+yellow (46 time-series) and yellow eel (14 time-series) recruitment in European rivers with time-series having data for the 1979–1994 period. Each time-series has been scaled to its 1979–1994 average. The mean values and their bootstrap confidence interval (95%) are represented as black dots and bars. Geometric means are presented as a red line. Note the logarithmic scale on the y-axis.

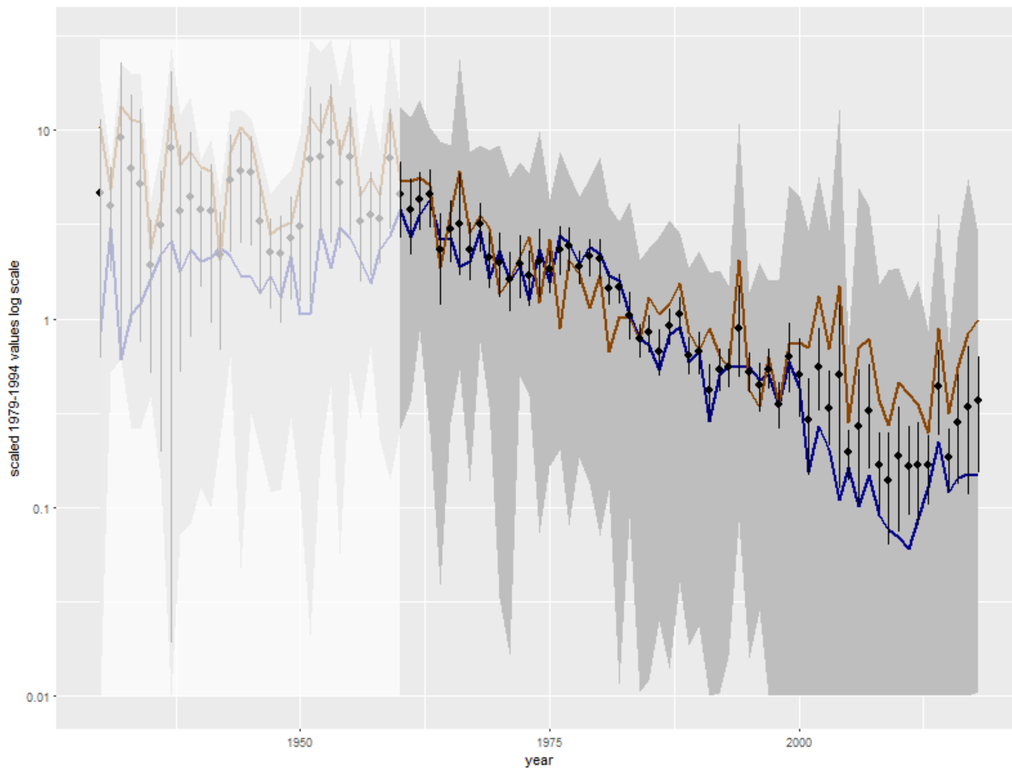

Figure 2.5. Time-series of glass eel and yellow eel recruitment in Europe with 46 time-series for glass eel/glass+yellow and 14 time-series for yellow eel. Each time-series has been scaled to its 1979–1994 average. The mean values of combined yellow and glass eel time-series and their bootstrap confidence interval (95%) are represented as black dots and bars. The brown line represents the mean value for yellow eel, the blue line represents the mean value for glass eel time-series. The range of these time-series is indicated by a grey shade. Note that individual time-series from Figure 2.4 were removed to emphasize the mean value. Note also the logarithmic scale on the y-axis.

2.2.5 GLM based trend

The WGEEL recruitment index used in the ICES Annual Stock Advice is a reconstructed prediction using a GLM (Generalised Linear Model) with gamma distribution and a log link: $glass\ eel \sim year{:}area + site$, where $glass\ eel$ is individual glass eel time-series, including both pure G series and those identified as a mixture of glass and yellow eel (G+Y), $site$ is the site monitored for recruitment and area is either the continental North Sea or Elsewhere Europe. For yellow eel time-series, only one estimate is provided: $yellow\ eel \sim year + site$.

The trend is reconstructed using the predictions from 1960 onwards for 46 glass eel plus glass+yellow eel time-series and from 1950 onwards for 14 yellow eel time-series. Some zero values have been excluded from the GLM analysis: 15 for the glass eel model and 12 for the yellow eel model. This treatment is parsimonious, and tests shows it has no effect on the trend (ICES, 2017a).

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. Note that the shift from arithmetic to geometric means was done this year because *post hoc* model checking confirmed that lognormal (or Gamma Distribution) and geometric means are the preferred choice.

After high levels in the late 1970s, the recruitment declined and has been very low for all years after 2000. As some of the values were not complete the 2017 level of European eel recruitment compared to the 1960–1979 average is now a bit higher, 1.4% for the North Sea and 9.6% for the Elsewhere Europe area. For 2018, provisional data give estimates at 2.1% for the North Sea and 10.1% for the Elsewhere Europe area, but some of the series are not yet complete (Figure 2.6, Table 2.5).

For yellow eel series, the autumn ascent has not been recorded yet and most of the series have reported data till the middle of summer. The 2017 yellow eel index is confirmed at 15% of the 1960–1979 baseline. The 2018 provisional value is 29% and (Figure 2.7, Table 2.6).

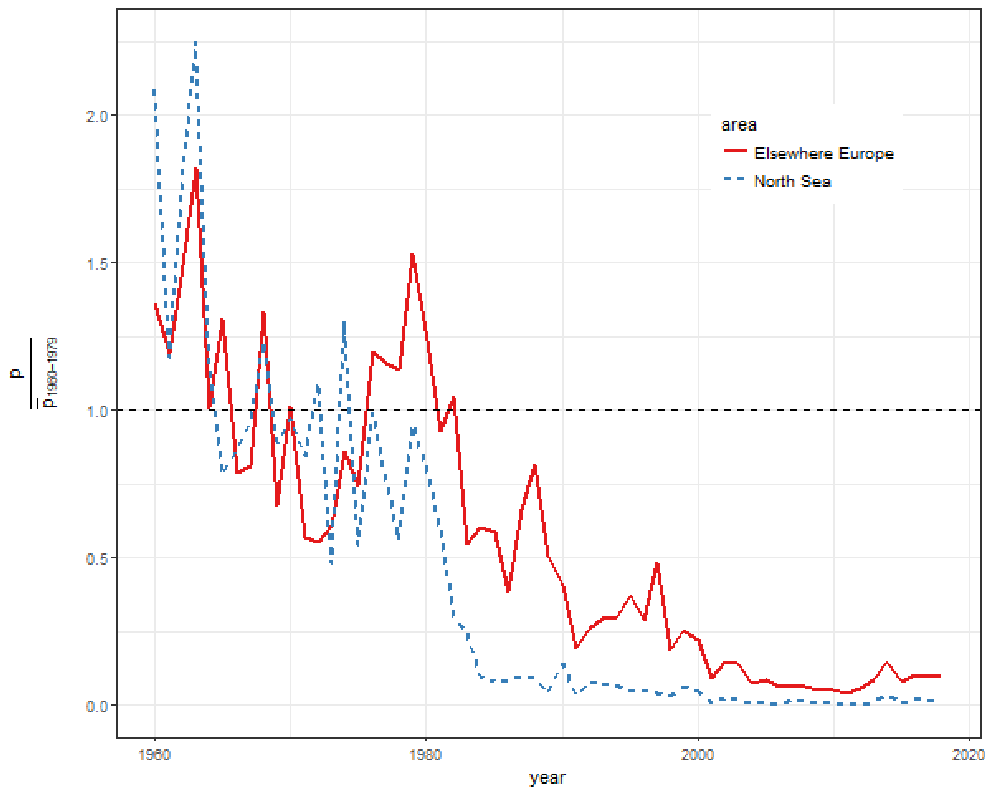

Figure 2.6. WGEEL recruitment index: geometric mean of estimated (GLM) glass eel recruitment for the continental North Sea and Elsewhere Europe series updated to 2018. The GLM (glass eel~area: year + site) was fitted on 46 time-series comprising either pure glass eel or a mixture of glass eels + yellow eels and the predictions were scaled to the 1960–1979 average. In the Baltic area, recruitment occurs in the yellow eel stage only.

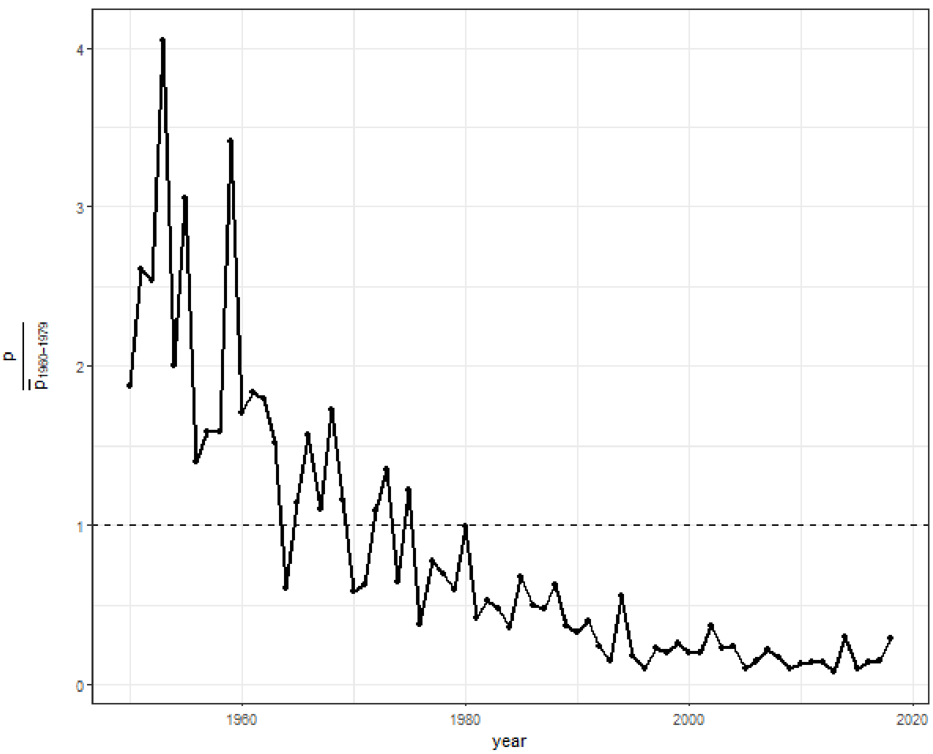

Figure 2.7. Geometric mean of estimated (GLM) yellow eel recruitment and smoothed trends for Europe updated to 2018 data. The GLM (yellow eel ~ year + site) was fitted to 14 yellow eel time-series and scaled to the 1960–1979 average.

Table 2.5. GLM glass eel ~ year : area + site geometric means of predicted values for 46 dataseries on glass eel recruitment. Values are given as percentage of the 1960–1979 period. EE = Europe elsewhere dataseries and NS = North Sea dataseries. The rerun of the analysis after adding most recent years or correcting old data, means that all index values may change from those reported previously. These changes are however all small and do not affect previous or present advice.

	1960		1970		1980		1990		2000		2010	
	EE	NS	EE	NS	EE	NS	EE	NS	EE	NS	EE	NS
0	136	209	101	97	127	81	41	14	21.9	4.8	5.1	0.6
1	119	117	57	85	93	59	19	3	9.1	1.0	4.1	0.4
2	149	180	55	109	104	30	26	8	14.7	2.6	5.9	0.4
3	182	225	61	48	55	24	29	7	14.3	2.0	8.4	1.5
4	101	117	86	130	60	10	29	7	7.7	0.6	14.6	3.3
5	131	78	74	54	58	8	37	5	8.8	1.2	8.0	0.9
6	79	87	120	99	38	8	29	5	6.2	0.5	10.2	1.8
7	81	96	116	76	67	10	48	4	7.2	1.7	9.6	1.4
8	133	123	114	56	81	9	19	3	6.3	1.1	10.1	2.1
9	68	89	153	95	51	4	26	6	5.0	0.8		

Table 2.6. GLM *yellow eel ~ year + site* geometric means of predicted values for 14 yellow eel dataseries. Values are given as percentage of the 1960–1979 period.

	1950	1960	1970	1980	1990	2000	2010
0	187	170	59	99	32	20	13
1	261	183	62	41	39	20	14
2	253	179	109	52	24	37	14
3	405	152	135	47	14	23	8
4	200	61	64	35	55	24	30
5	306	114	122	67	18	10	10
6	140	156	37	50	10	15	14
7	159	110	77	48	23	22	15
8	158	172	70	63	20	17	29
9	341	116	59	37	25	9	

2.3 Trends in fisheries

This section presents and describes data from commercial, recreational and non-commercial fisheries, aquaculture production and restocking of eel. Data can be reported by eel life stage (glass, yellow, silver), habitat type (freshwater, tidal, marine) and by eel management unit (EMU) where possible. Historical series for which these details are not available are reported by country. The current database structure will allow aggregation by country or region if necessary. The landings data presented are those reported to the WGEEL, either through responses to the 2018 Data call, in Country Reports, or integrated by the WGEEL in 2017 using data from its previous reports. Note that in 2017, FAO data that could have been used for Morocco, Turkey or Egypt was not integrated.

Note that some countries have not reported all their landings (see Figure 2.8). **Thus, even with the corrected version of the figures the total given here should be considered as a minimum.**

Care should also be taken with the interpretation of the landings as indicators of the stock, since the catch statistics now reflect the status of reduced activity as well as of stock levels.

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 2291 t in 2017.

2.3.1 Commercial fisheries landings

Landings data for commercial eel fisheries are available from the Eel Data call and from the WGEEL database. When data are absent and presumed missing for a country/year, a predicted catch is used. This “correction” is based on a simple General Linear Model (GLM) extrapolation of the log-transformed landings (after Dekker, 2003a), with year and countries as the explanatory factors. This is applied to account for non-reporting, but it is not a complete solution.

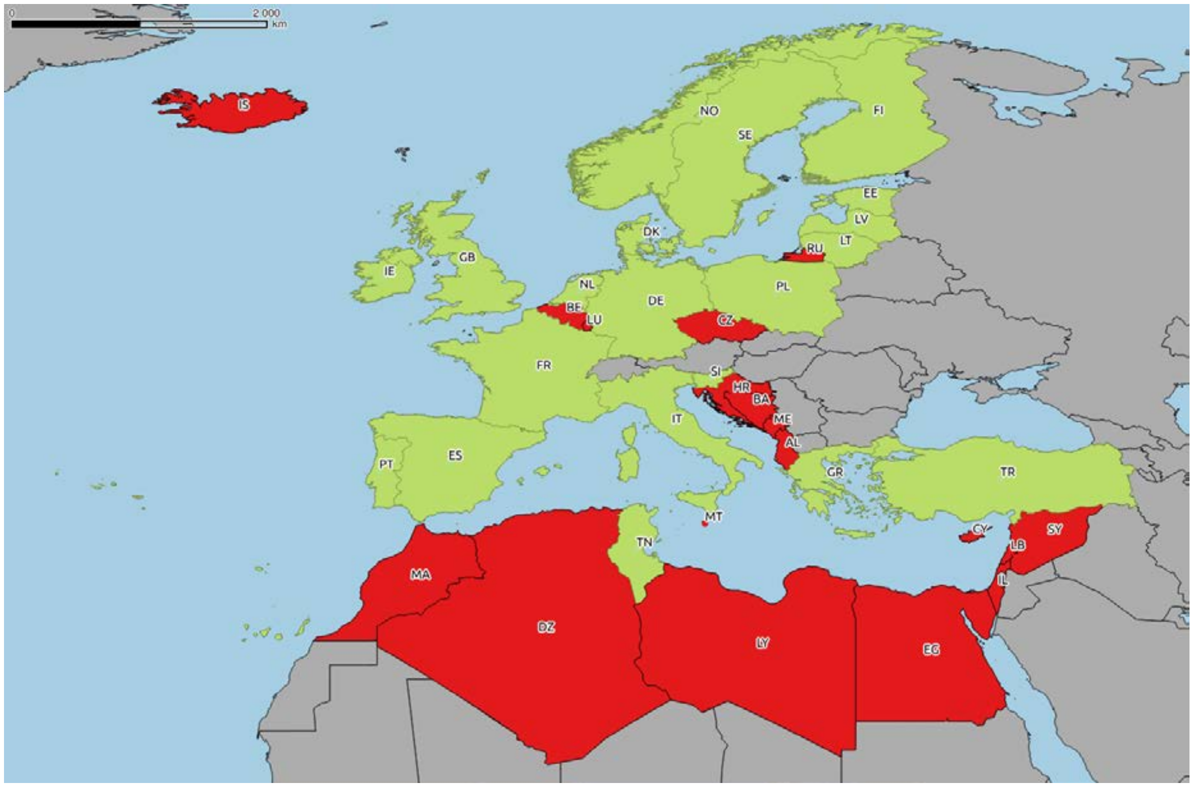

Figure 2.8. Map representation of the countries reporting commercial yellow and silver eel landings to the WGEEL (green shading) vs. not reporting (red shading). Note that the 'not reporting' countries might not have fisheries to report, but this is not certain.

Figure 2.9 presents the time-series up to and including 2018 (though some 2018 data are provisional) for total glass eel landings as reported by five countries in the Eel Data call and from the WGEEL database. Figure 2.10 presents the same time-series but corrected for missing data (see above), with an inset box showing the proportion of data corrected per year. Glass eel landings show a sharp decline since 1980 from 2 000 tonnes to around 40–60 tonnes since 2009 onwards. In 2018, the raw (uncorrected) landings data for glass eels is 58.6 t (Annex 8 Table 1 for raw data and Table 2 for raw and corrected data).

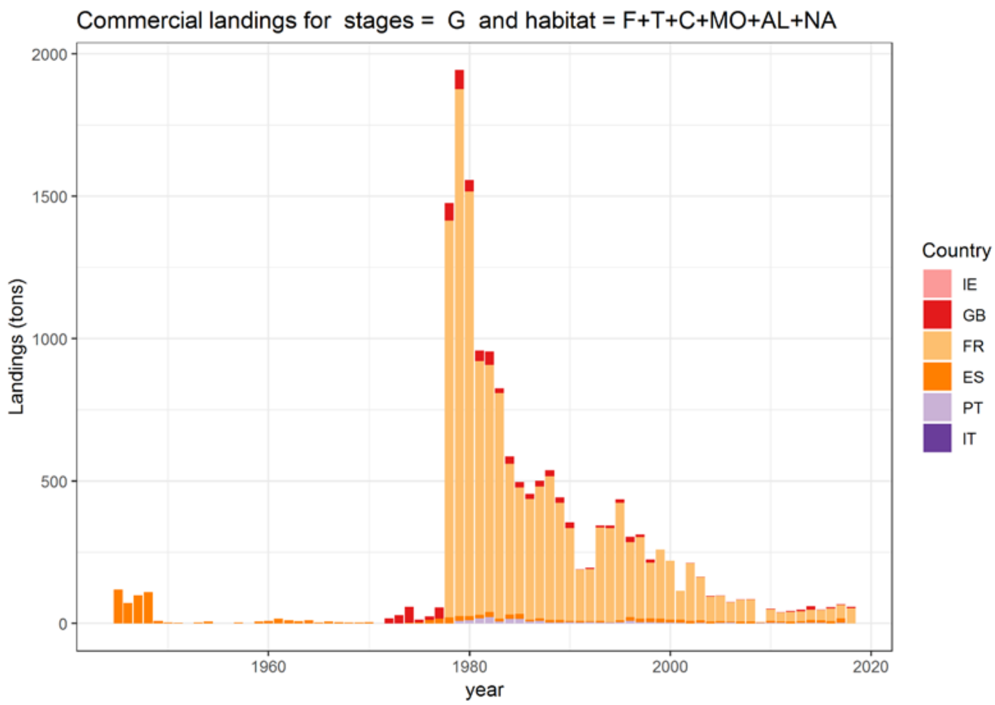

Figure 2.9. Time-series of reported commercial glass eel fishery landings (tonnes) 1945–2018, by country, Ireland (IE) (included in error, no fishery), Great Britain (GB), France (FR); Spain (ES), Portugal (PT) and Italy (IT) combining information from Data call 2018 and WGEEL database (see text).

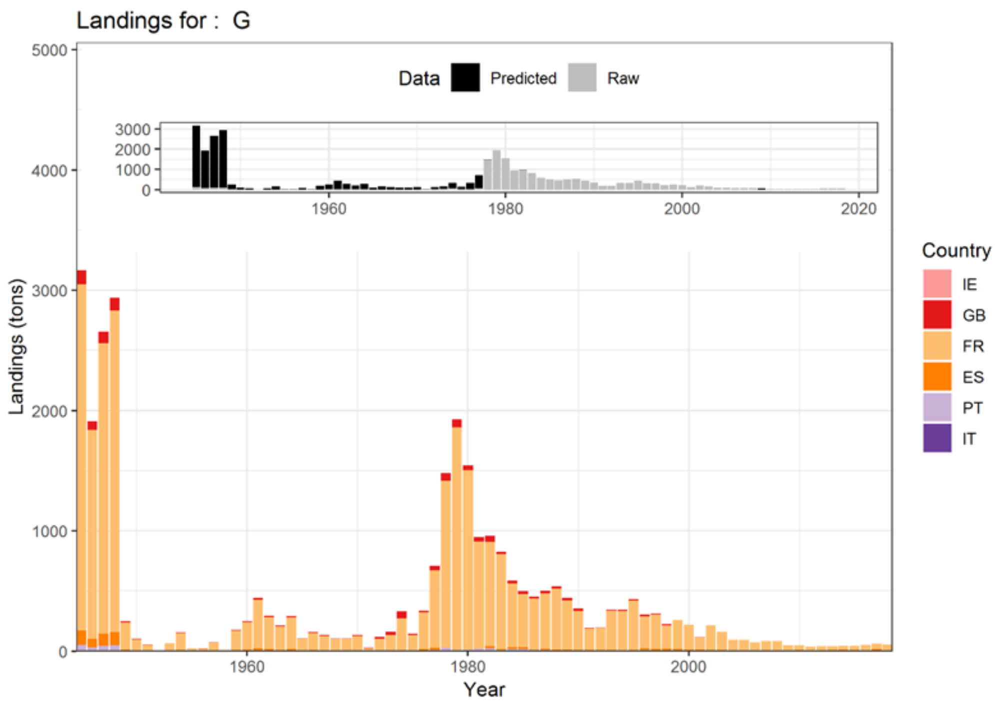

Figure 2.10. Time-series of reported commercial glass eel fishery landings (tonnes) 1945–2018, by country Ireland (IE, included in error, no fishery), Great Britain (GB), France (FR); Spain (ES), Portugal (PT) and Italy (IT), combining information from Data call 2018 and WGEEL database and a reconstruction of the non-reported countries/years combinations (see text). The inset box shows the proportion of data reconstructed per year.

Figure 2.11 presents data but for yellow and silver eels aggregated coming from 20 countries, and Figure 2.12 presents the time-series including reconstructed data to fill the gaps. The proportion of "corrected" landing was as high as 50% in the 1950s, but rather low since the mid-1980s. Annex 8 Table 3 presents the raw data for yellow and silver eel combined, Annex 8 Table 4 presents the raw and corrected data for yellow and silver eel landings data. The total landings of yellow and silver eels decrease from 18 000–20 000 tonnes in the 1950s to 2000–3000 tonnes since 2009. In 2017, the amount was 2224 t for yellow and silver landings, combined.

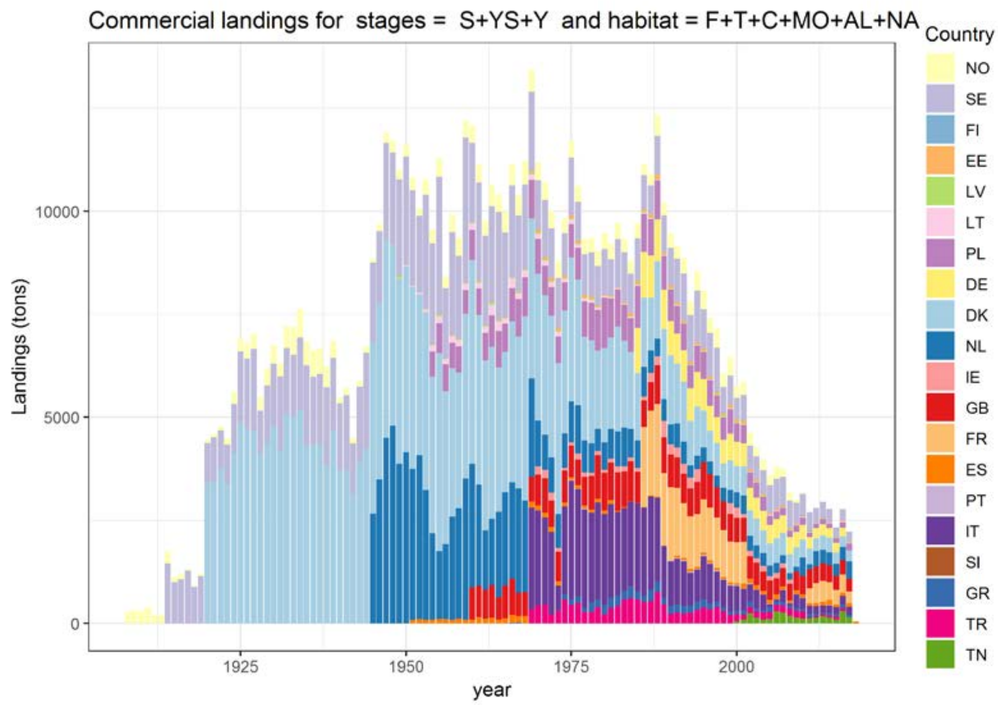

Figure 2.11. Time-series of reported commercial yellow (Y) and silver (S) eel fishery landings (tonnes) 1908–2018, by country, Norway (NO), Sweden (SE), Finland (FI), Estonia (EE), Latvia (LV), Lithuania (LT), Poland (PL), Germany (DE), Denmark (DK), Netherlands (NL), Ireland (IE), Great Britain (GB), France (FR), Spain (ES), Portugal (PT), Italy (IT), Slovenia (SI), Greece (GR), Turkey (TR) and Tunisia (TN), combining information from the Data call and WGEEL database (see text).

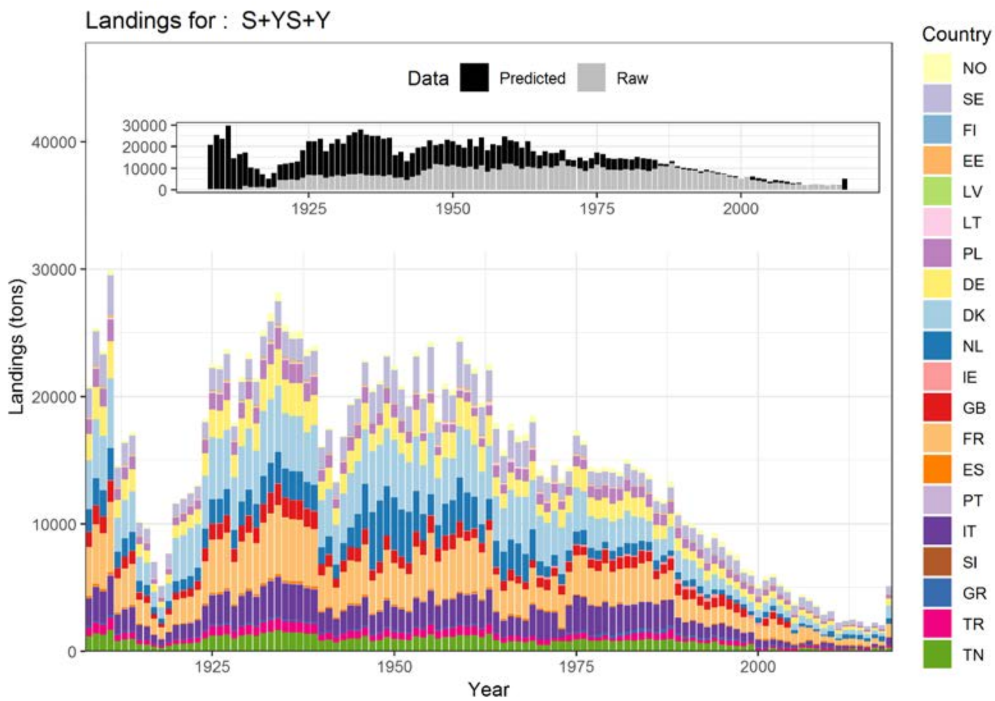

Figure 2.12. Time-series of reported or reconstructed commercial yellow and silver eel fishery landings (tonnes) 1908–2018, by country, Norway (NO), Sweden (SE), Finland (FI), Estonia (EE), Latvia (LV), Lithuania (LT), Poland (PL), Germany (DE), Denmark (DK), Netherlands (NL), Ireland (IE), Great Britain (GB), France (FR), Spain (ES), Portugal (PT), Italy (IT), Slovenia (SI), Greece (GR), Turkey (TR) and Tunisia (TN) combining information from the Data call, the WGEEL database and a reconstruction of the non-reported countries/years combinations (see text). Inset box shows the proportion of reconstructed landings, per year.

2.3.1.1 Commercial fisheries: capacity and effort

To date, there is no standardised reporting of capacity and fishing effort to accompany the landings data requested by the WGEEL. Information on fishing effort and the capacity of the fisheries, is necessary to correctly interpret the changes to the landings data over the years. The WGEEL is developing approaches to include and analyse fishing effort and capacity data in coming years.

2.3.2 Recreational / non-commercial fisheries

Recreational / 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&line, spear, and hand-gathering and passive fishing methods including nets, traps, pots, and setlines. Recreational fisheries for glass eel used to exist in France and Spain but have been forbidden in France from 2010.

Figure 2.13 and Annex 8 Table 5 present the data available to the WGEEL on recreational landings for glass eel; Figure 2.14 and Annex 8 Table 6 present the data available on recreational landings of yellow and silver eel combined. The data call in 2018 resulted in an increase in recreational data submitted to the WGEEL and therefore the catches reported in previous years have been adjusted. Recreational landings were estimated as 2 t for glass eel in 2018, and 161 t for yellow and silver eel combined in 2017 (2018 data not available at time of writing).

Data deficiencies were described by the WGEEL 2016 report (ICES, 2016), and improvements have been evidenced since then. In summary, some countries do not include surveys of all gears and/or habitats and lack estimates of released eel. Overall, the impact of recreational fisheries on the eel stock remains largely unquantified although landings can be thought to be at a similar order of magnitude to those of commercial fisheries.

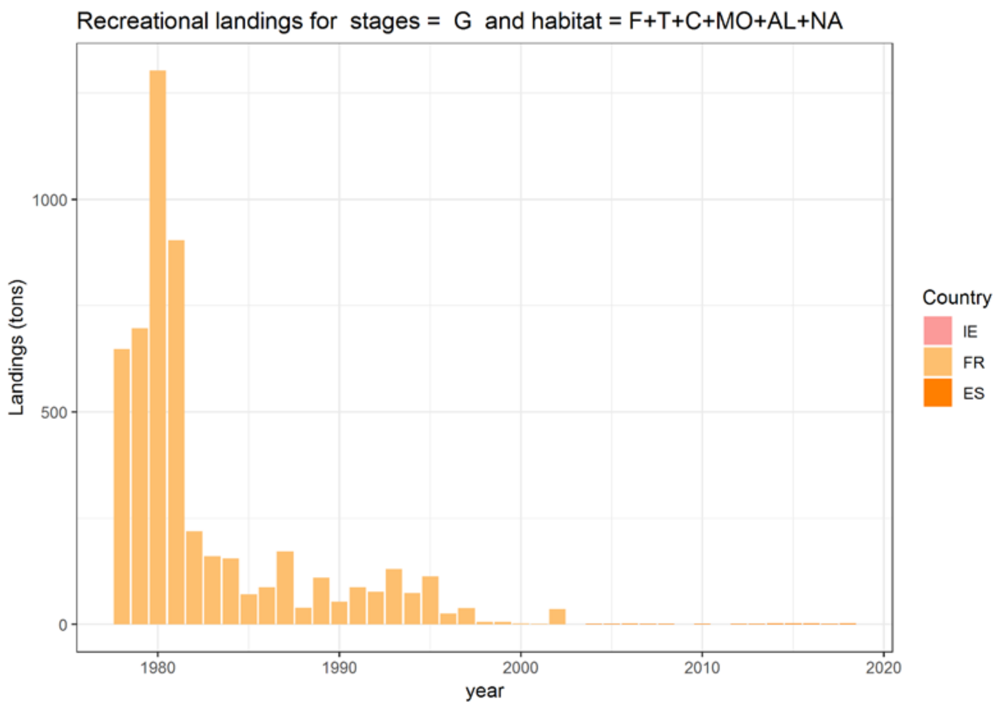

Figure 2.13. Time-series of reported recreational glass eel fishery landings (tonnes) 1978–2018, by country, Ireland (IE), France (FR), Spain (ES), combining information from the Data call and WGEEL database.

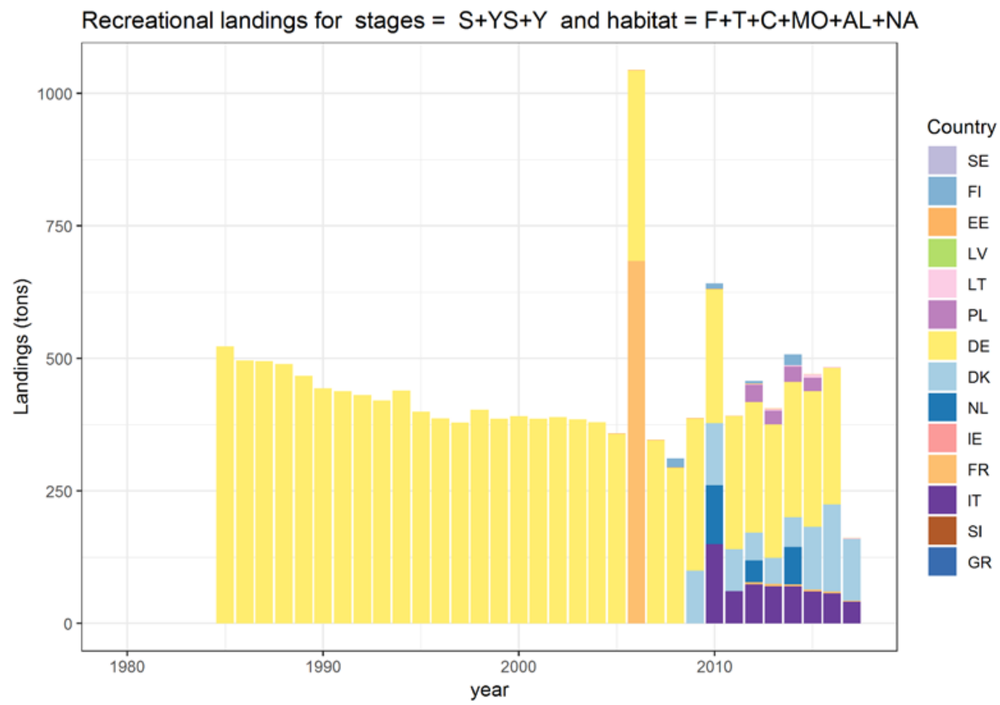

Figure 2.14. Time-series of reported recreational yellow and silver eel fishery landings (tonnes) 1980–2018, by country, Sweden (SE), Finland (FI), Estonia (EE), Latvia (LV), Lithuania (LT), Poland (PL), Germany (DE), Denmark (DK), Netherlands (NL), Ireland (IE), Great Britain (GB), France (FR), Italy (IT), Slovenia (SI) and Greece (GR) combining information from the Data call and WGEEL database.

2.3.3 Illegal, unreported and unregulated landings

Most countries did not report the level of misreporting and illegal fisheries in their Country Reports. Illegal activities have been noted in some Country Reports however, with seizure of illegal nets reported for Sweden, Belgium, Ireland, Portugal and Spain, and illegal trade of glass eels in Spain and Portugal. Despite the existence of illegal practices, no data are available to quantify their impact at the stock level. Therefore, it is not possible to determine or even guess the effect of IUU on assessments of the state of the eel stock currently.

2.4 Aquaculture production

Aquaculture production data are derived from either responses to the Data call or from the Country Reports. Compared to previous WGEEL reports, all the data available to WGEEL are presented here (>20 years), even if data are only complete from 2004 onwards. Data are provided for ten countries (Annex 8 Table 7).

The aquaculture production increased until the end of the 1990s. It clearly starts to decline since the mid-2000s from 8000–9000 tonnes to approximately 5000–6000 tonnes now (Figure 2.15). In 2017, the reported quantities of eels used in aquaculture is 4546 tonnes.

It should be noted that eel aquaculture is based on wild recruits, and part of them is subsequently released as on-grown eel for restocking (around 10 million eels, making a mean weight of 20 g, 200 t).

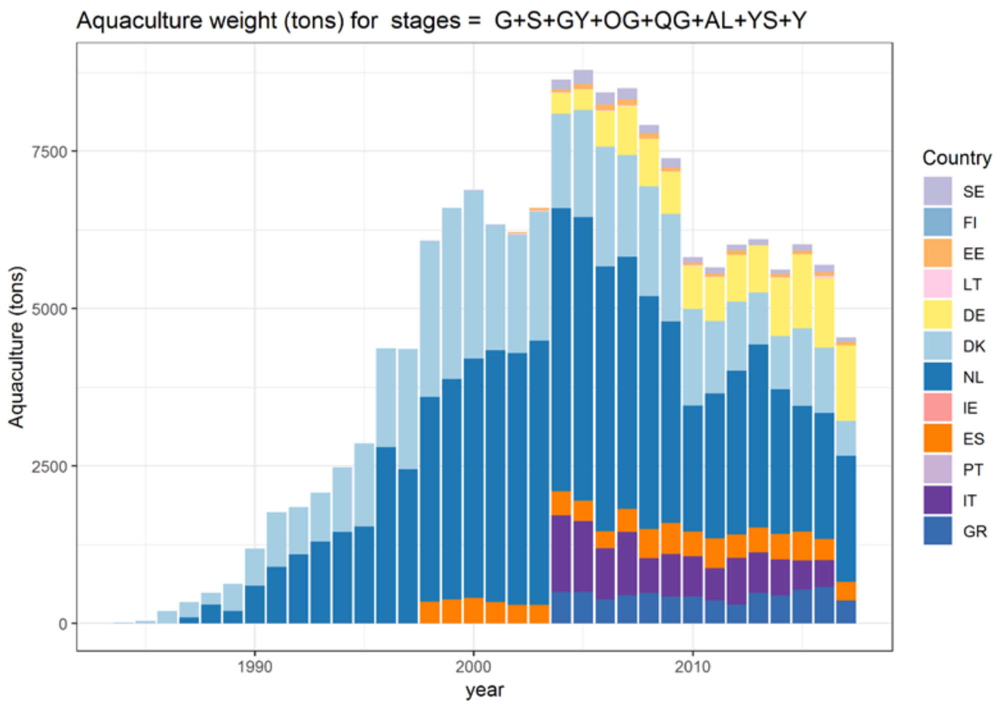

Figure 2.15. Reported aquaculture production of European eel in Europe from 1984 onwards, in tonnes, in Sweden (SE), Finland (FI), Estonia (EE), Lithuania (LT), Germany (DE), Denmark (DK), Netherlands (NL), Ireland (IE), Spain (ES), Portugal (PT), Italy (IT) and Greece (GR).

2.5 Restocking and Releases

Restocking (the process of capture, translocation and restocking to new locations in the wild) of eel increased after the implementation of the management plan in 2009, because of the inclusion of this as a stock enhancement option in the EC Eel Regulation (EC 1100/2007). Restocking reached it maximum in 2014 and has decreased after (Figure 2.16). Scientific evidence is still lacking to definitively establish whether restocking has a significant potential for the recovery of the stock (ICES, 2016).

Data on the amount of restocked eel were obtained from the responses to the Data call. The 2018 data call for restocking is incomplete as (i) restocking programmes in various countries are still underway for the year, and (ii) information from countries (such as Belgium), known to have restocking programmes but which did not reply to the Data call, was not included.

Countries use a varied and broad definition of restocking, more varied than the definition in the Data call 2018. Data have been reported on restocking comprising eels restocked 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 a mixed life stages: Glass + Yellow eel (G+Y) and Yellow + Silver eel (Y+S). These differing definitions cause inconsistencies in the data reported. This is an element of the Data call and analysis that will be addressed in 2019 (see Chapter 4.2). Some countries have changed the stage they have assigned, i.e. eels classified as on-grown in the 2017 Data call have been classified as yellow in the 2018 Data call. The result is that the series in the current report (Table 2.7) are not consistent with those of the 2017 WGEEL report: The countries that have provided data for on-grown eels (OG) and quarantined glass eels (QG) have decreased, and those providing data for glass (G), yellow (Y) and silver eels (S) have increased.

We have analysed the present Data call values using the following assumptions about individual weights: 0.3 g for a glass eel, 1 g for a quarantined eel, 20 g for an on-grown eel, 50 g for a yellow eel and 200 or 250 g for a silver eel in France and 440 g in Greece, respectively.

Table 2.7. Countries providing release data provided per life stage in the 2018 data call.

	Data call 2018
Glass eel (G)	DE, EE, ES, FR, GB, IE, GR, IT, LT, LV, NL, PL
Glass + yellow eel	IE, ES
Yellow (Y)	SE, LT, DE, DK, IE, GB, FR, ES, PT, IT
Yellow + Silver eel	ES
Silver (S)	SE, IE, FR, ES, GR
Quarantined Glass eel (QG)	FI, SE
On-grown (OG)	EE, LT, PL, DK

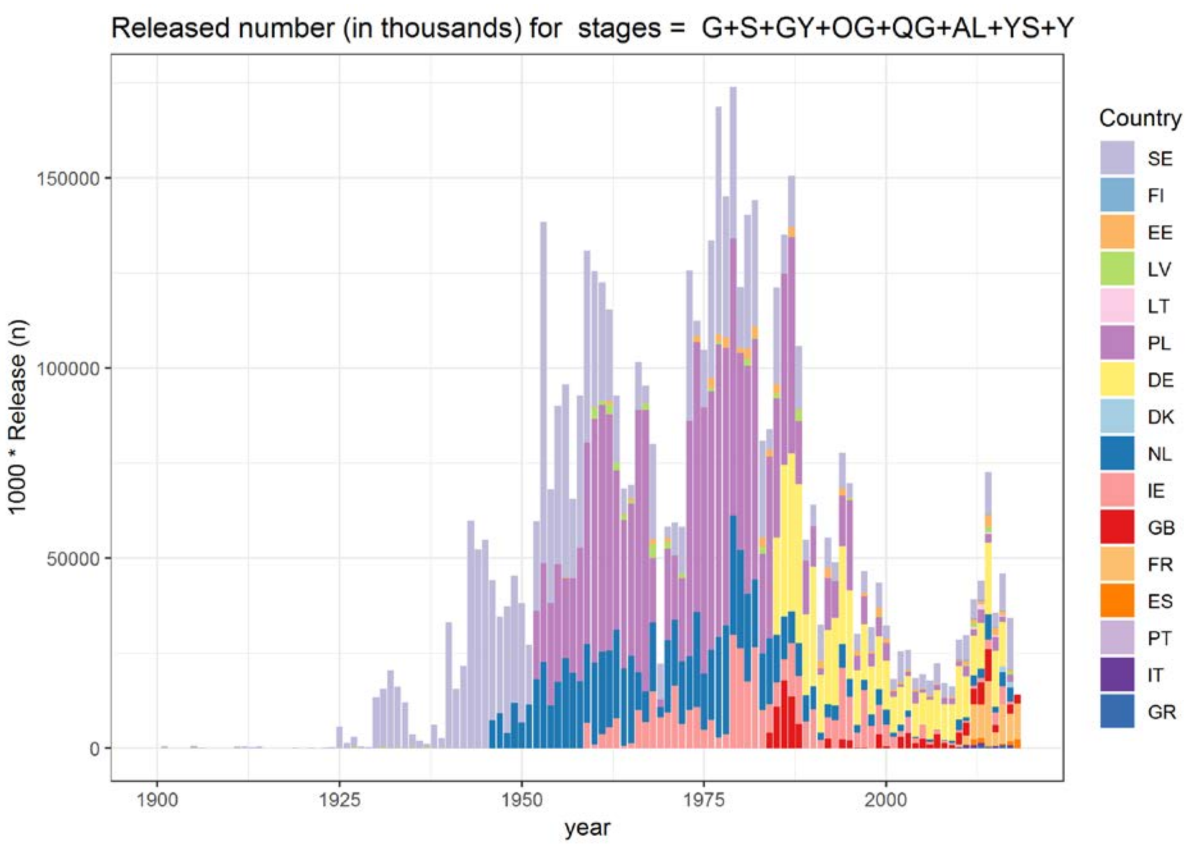

Figure 2.16. Total annual amounts of eel restocked (thousand) per country (1900–2018) Norway (NO), Sweden (SE), Finland (FI), Estonia (EE), Latvia (LV), Lithuania (LT), Poland (PL), Germany (DE), Denmark (DK), Netherlands (NL), Ireland (IE), Great Britain (GB), France (FR), Spain (ES), Portugal (PT), Italy (IT), Slovenia (SI), Greece (GR), Turkey (TR) and Tunisia (TN).

The restocking of glass eel peaked in the 1990s, followed by a steep decline to a low in 2009 (Figure 2.17, Annex 8 Table 8). The amount of glass eels restocked increased in 2014 when the lower market prices guaranteed a larger number of glass eels could be purchased for fixed restocking budgets. However, glass eel restocking has decreased since then.

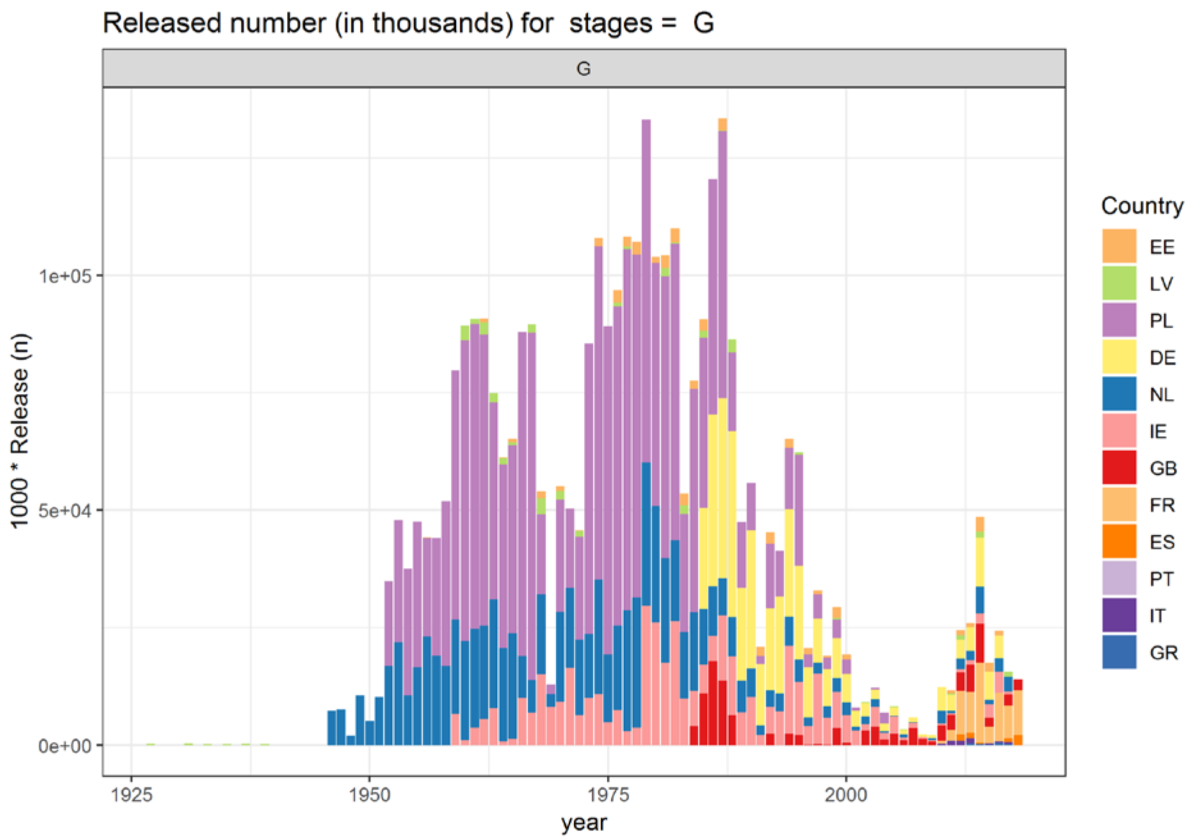

Figure 2.17. Reported restocking of glass eel not including those in quarantine by country (in thousands). 1927–2018, Estonia (EE), Latvia (LV), Poland (PL), Germany (DE), Netherlands (NL), Ireland (IE) United Kingdom (GB), France (FR), Spain (ES), Italy (IT) and Greece (GR).

Since the implementation of the EMP, Ireland has been assisting migration of glass and yellow eel and Spain has restocked with a mixture of these stages (Table 2.8).

Table 2.8. Release of glass eel + yellow eel mixture (2009–2017) in Ireland (IE) and Spain (ES) (in million). Empty cell = No data or NC or Not pertinent.

Year	IE	ES
2009		0.025
2010	0	0.005
2011	0.008	
2012	0.004	
2013	0.001	
2014	0	
2015	0	0.015

2016	0	0.026
2017	0.002	0.043

During the 1940–1960 period Sweden had a large restocking programme for yellow eel (Figure 2.18, Annex 8 Table 9). The activity decreased in the 1970s and increased again in the 1980s. Germany started to stock yellow eels in 1985 and was responsible for the restocking of large quantities of yellow eels until 2016 when they stopped restocking yellow eel.

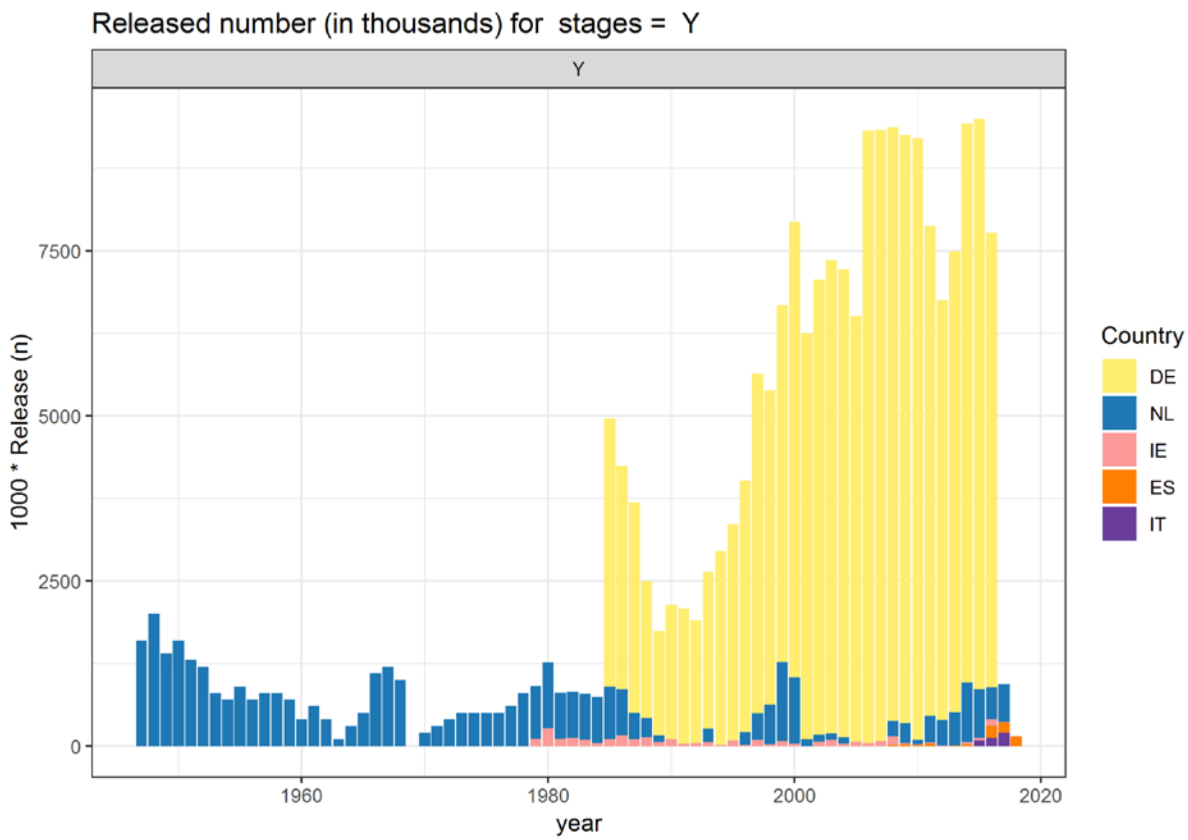

Figure 2.18. Reported restocking of yellow eel by country (in thousands) from 1947–2018, in Germany (DE), Netherlands (NL), Ireland (IE), Spain (ES), and Italy (IT).

Only Spain has reported Yellow + Silver eel restocking (Table 2.8).

Table 2.8. Released Yellow and silver eel (n) in Spain.

Year	ES
2014	2631
2015	889
2016	4313
2017	3931

Some silver eels, caught by the fishery and therefore recorded as landings, are then released in the Mediterranean outside the lagoons in Greece and France. They are reported as "restocked" silvers (Figure 2.19; Annex 8 Table 10).

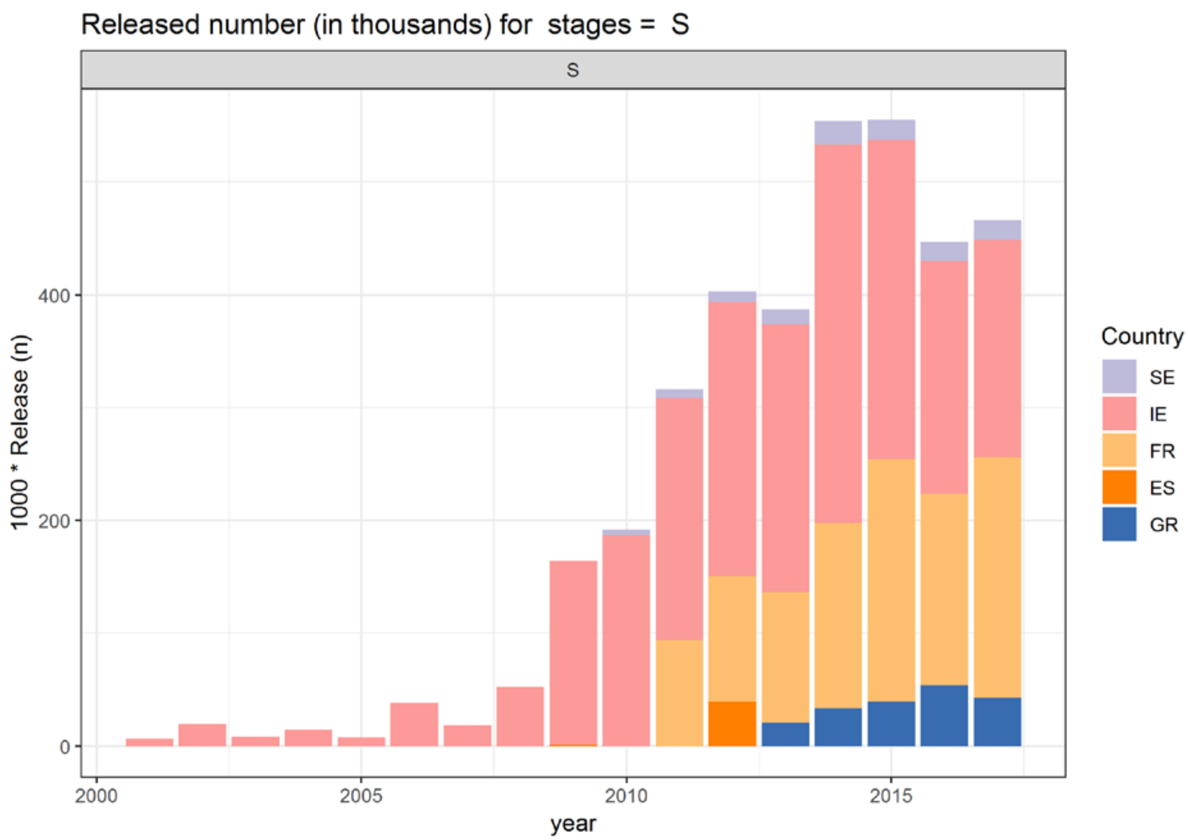

Figure 2.19. Reported released silver eel by country (in thousands) 2001–2018 restocked in Sweden (SE) Ireland (IE), France (FR), Spain (ES), Italy (IT) and Greece (GR).

Only Sweden and Finland have reported quarantined glass eel restocking (Figure 2.20, Annex 8 Table 11). Quarantined glass eel restocking peaked in the 1990s, decreased in the early 2000s and increased again after the implementation of the EC Eel Regulation.

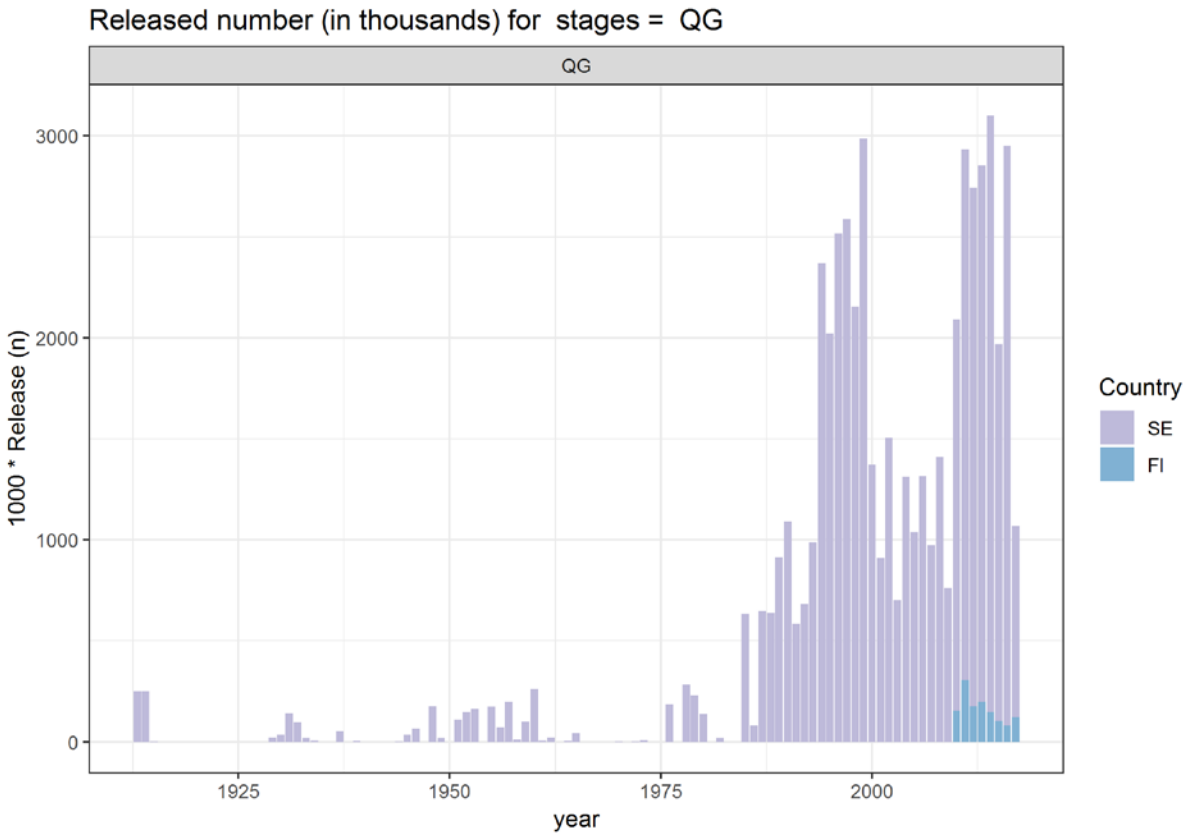

Figure 2.20. Reported restocking of quarantined glass eel by country (in thousand) 1913–2018 Sweden (SE) and Finland (FI).

The restocking of on-grown eels has constantly increased since 2000 and reached a maximum in 2014 (Figure 2.21, Annex 8 Table 12). Poland was the country that restocked more on-grown eels until 2016 when Denmark started to report on-grown eels.

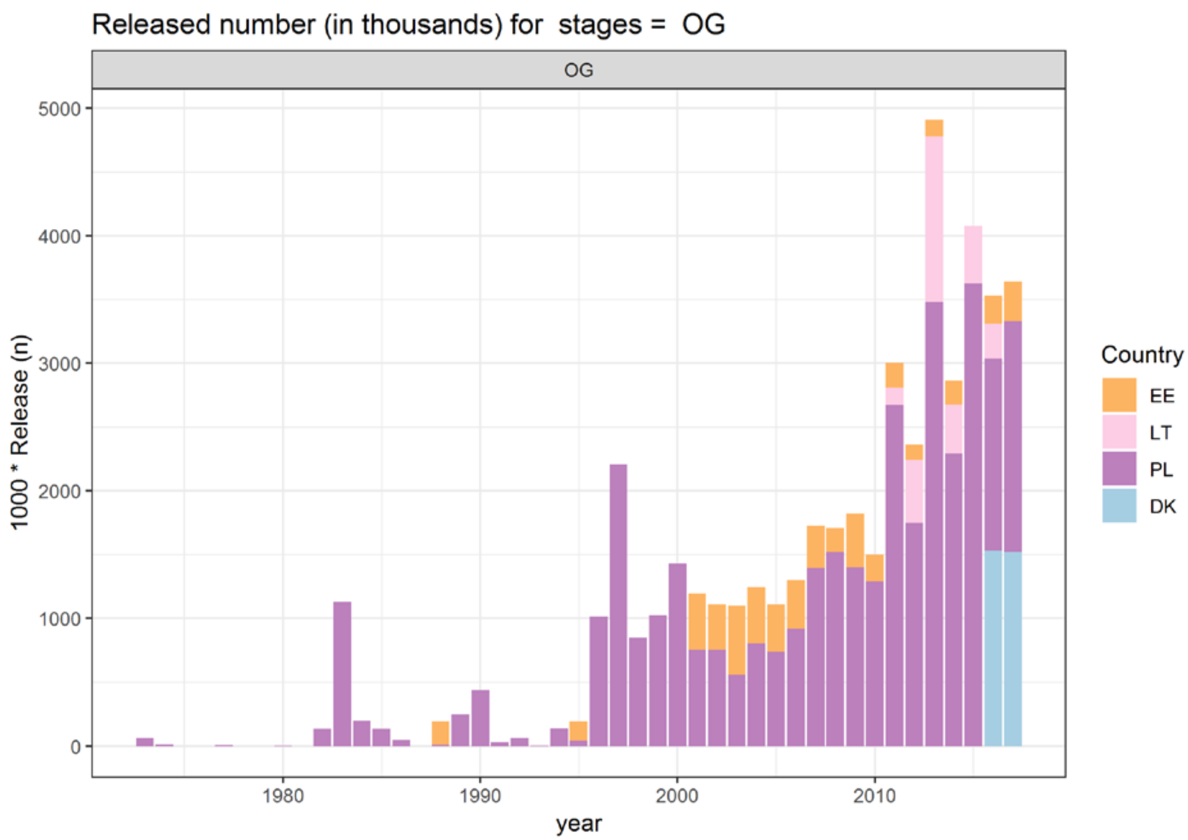

Figure 2.21. Restocking of on-grown eel by country (in thousand). (1973–2018), Estonia (EE), Lithuania (LT), Poland (PL) and Denmark (DK).

2.6 Stock indicators from 2018 ICES Data call and Country Reports

In July 2018, ICES issued a Data call concerning the eel stocks in countries of ICES, EIFAAC and GFCM. This included estimates of the stock indicators (3B & ΣA). In addition, Country Reports (Annex 5), national assessments and some 2018 progress reports under the Eel Regulation were available to the meeting.

The 3B & ΣA framework of stock indicators and the Modified Precautionary Diagram used by WGEEL quantify the status of the stock (in individual management units) on the horizontal axis, and the human impacts (in individual management units) on the vertical axis. For the horizontal axis, a limit biomass B_{lim} is set at 40% of the pristine biomass B_0, corresponding to the objectives of the Eel Regulation. For the vertical axis, a limit anthropogenic mortality ΣA_{lim} is set at ΣA=-ln(40%)=0.92, corresponding to the 40% biomass limit. At low biomass, however, the anthropogenic mortality advised is reduced, to reinforce the tendency for the stock to rebuild. For long-lived species in general, ICES advice applies a proportional reduction in limit mortality values (i.e. a linear relation between the mortality rate advised and biomass) below a biomass of $B_{MSY\text{-}trigger}$. For eel, no $B_{MSY\text{-}trigger}$ has been specified in particular; WGEEL has used $B_{MSY\text{-}trigger} = B_{lim} = 40\%*B_0$, in accordance with the Eel Regulation. The proportional reduction (i.e. the linear relation) shows as a downward sloping curve, on the logarithmic biomass-axis used by WGEEL. For further details, see Dekker (2010; 2016) and ICES (2010a; 2015b).

The modified Precautionary Diagrams shown below plot the 3Bs & ΣA-indicators as provided by EU Member States in their responses to the ICES Data call, against the background of the generic reference points according to the 40% biomass target of the EU Eel Regulation, the corresponding mortality limit of ΣA=0.92 and taking the 40% biomass limit as a trigger point below which the mortality is reduced to zero in proportion to the actual biomass of the escapement.

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

All these indicators have been taken at face value. No quality evaluation of the data or assessments has been undertaken by WGEEL, but that will feature in the work of the ICES Workshop on Evaluating Eel Management Plans (WKEMP) that will report later in 2018. However, preliminary inspection of the data (see Section 4.1) revealed several misinterpretations, inconsistencies and incomplete reporting (life-stages, habitats, geographical areas; etc.). This applied in particular to the mortality estimates. While the Working Group is working on the completion and quality control of the database (Section 4.1), it was decided to compile and present a preliminary analysis of the stock indicators reported in 2018. **Clearly, the results presented here are preliminary, and data quality processing and further analyses should continue.** Because of this, the Working Group decided to restrict the presentation to the latest data year, i.e. 2017 or the latest reported year before that. While some countries reported annual stock indicators for a continuous range of years, others reported only for the years preceding the tri-annual reporting years (2011, 2014 and 2017, respectively) or multiyear averages; consistency was achieved by selecting only the triannual indicators or corresponding multiyear averages. However, this approach may obscure considerable interannual variation in indicators, that might be due to, for example, unusual environmental conditions such as particularly wet or dry periods of silver eel escapement.

The diagrams below present the indicators per EMU (or country) as reported; Figure 2.22 also contains the Sum of the reported areas. Since not all EU Member States have reported (and not for all years from 2009 onwards), the presented stock-wide sum represents the reporting countries; not all countries within the distribution area, and not even all countries within the EU. From the data available to the WG out of a total of 76 EMUs that most recently reported %SSB, 16 (21%, representing six countries) are reaching or exceeding the 40% target and 60 EMUs are below target. The evaluation group will examine this in more detail.

Figure 2.23 presents the stock indicators of each EMU in a map, where data-deficient areas have been shown by a ☹. Additionally, the stock indicators per EMU are listed in Table 2.9. Given the shortage of time available to the WGEEL 2018 because of competing priorities, it was not possible to compare the 2018 indicators to those reported in 2015 and 2012.

Not all EMUs/countries have reported, or they have reported inconsistently/contradictorily. Reported indicators, as provided by EU Member States in response to the Data call, indicate that the stock in many reporting countries/areas was not within the biomass limits of the Eel Regulation and in most management units, anthropogenic mortality is not at a level that can be expected to lead to recovery, in many cases even exceeding the level that would sustain a healthy stock (%SSB≥40%*B_0, $\Sigma A_{lim} \leq 0.92$).

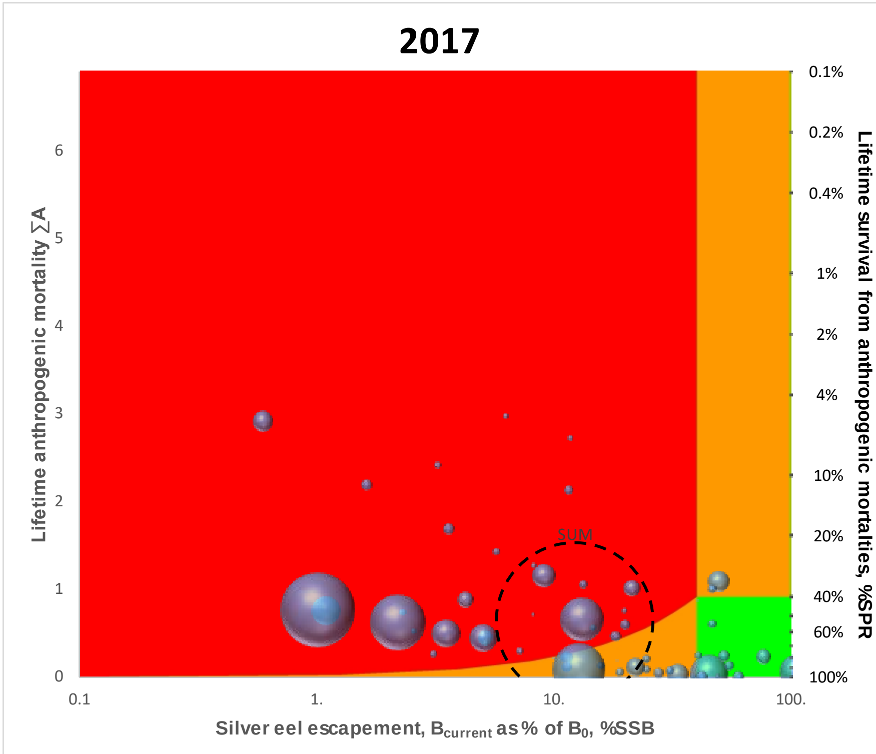

Figure 2.22. Modified Precautionary Diagram for Eel Management Units, presenting the status of the stock (horizontal, spawner escapement ($B_{current}$) expressed as a percentage of the pristine (B_0) escapement) and the anthropogenic impacts (vertical, expressed as lifetime mortality ΣA, resp. lifetime survival %SPR). Data from the 2018 Data call or from Country Reports provided to WGEEL. Note that all indicators have been used as reported, despite some inconsistencies and errors.

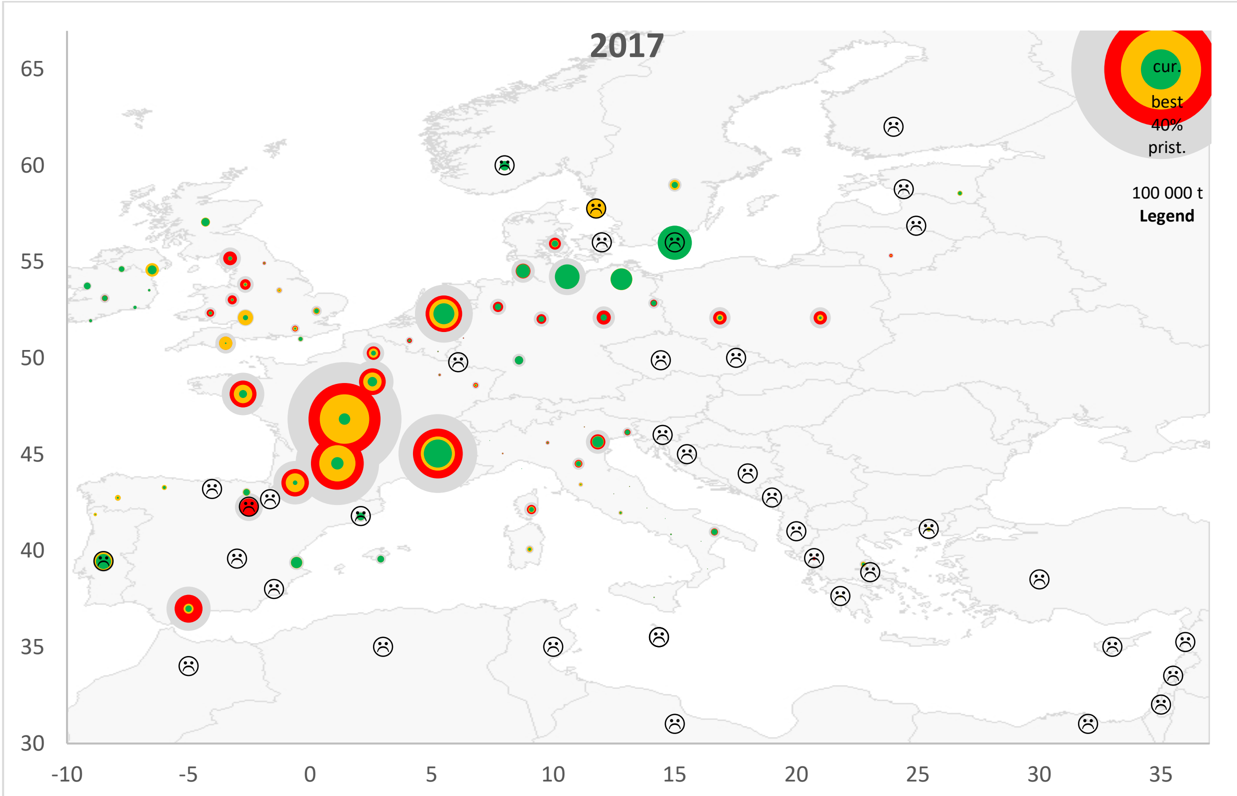

Figure 2.23. Stock biomass indicators plotted on the location of the EMU they refer to. For each area/country, estimates of the current escapement ($B_{current}$), the potential escapement (B_{best}), the limit of the Eel Regulation (40% of B_0) and the pristine escapement (B_0) are shown. For non-reporting and incompletely reported EMUs/countries, a ☹ of arbitrary size is plotted. Note that all indicators have been used as reported, despite some inconsistencies and errors. For the non-EU countries, no formal reporting obligation exists.

Table 2.9. Stock indicators for 2017 or the latest data year before, as reported by EU Member States and some other eel-producing countries. Note that all indicators have been used as reported, despite some inconsistencies and errors. For each area, the columns %SSB (Biomass) and %SPR (total anthropogenic mortality) indicate whether the indicators are (green) or not (red) within the limits set/implied by the 40% limit of the Eel Regulation. Data from 2018 ICES Data call.

Country	Management unit	Pristine escapement	Potential escapement	Actual escapement	Lifetime mortality	Limit mortality	Stock status	Lifetime survival
	EMU	B_0	B_{best}	$B_{current}$	ΣA	ΣAlim	%SSB	%SPR
Norway	NO_total		281	277				
Sweden	SE_East			3627				
	SE_Inla	564	314	120	1.02	0.49	21	36
	SE_West	1154	1154		0			100
Finland	FI_total							
Estonia	EE_Narv	90	77	42	0.61	0.92	46	54
	EE_West							
Latvia	LV_total							
Lithuania	LT_total	87	9	0	1	0	0	37
Poland	PL_Oder	1426	150	52	1.69	0.08	4	18
	PL_Vist	1386	125	23	2.19	0.04	2	11
Czech republic	CZ_Elbe							
	CZ_Oder							
Germany	DE_Eide	1708	590	571	0.03	0.77	33	97
	DE_Elbe	1553	33	127	1.27	0.19	8	28
	DE_Ems	820	71	129	0.13	0.36	16	88
	DE_Maas	9	0	0	0.73	0.02	1	48
	DE_Oder	373	82	91	0.21	0.56	24	81
	DE_Rhei	532	8	214	0.87	0.92	40	42
	DE_Schl	4205	1856	1892	0.04	0.92	45	96
	DE_Warn	1367	1488	1445	0.06	0.92	106	94
	DE_Wese	730	41	106	0.57	0.33	15	57
Denmark	DK_Coast							
	DK_Inla	1110	169	125	0.22	0.26	11	80
Netherlands	NL_total	10 400	2647	1365	0.66	0.3	13	52

Country	Management unit	Pristine escapement	Potential escapement	Actual escapement	Lifetime mortality	Limit mortality	Stock status	Lifetime survival
	EMU	B_0	B_{best}	$B_{current}$	ΣA	ΣAlim	%SSB	%SPR
Belgium	BE_Meus	12	3	2	0.19	0.42	18	83
	BE_Sche	184	25	21	0.15	0.27	12	86
Luxembourg	LU_total							
Ireland	IE_East	35	17	17	0.01	0.92	49	99
	IE_NorW	171	104	93	0.13	0.92	54	87
	IE_Shan	285	90	87	0.07	0.7	31	93
	IE_SouE	53	32	32	0	0.92	61	100
	IE_SouW	66	26	26	0.01	0.88	39	99
	IE_West	230	139	139	0	0.92	60	100
Great Britain	GB_Angl	341	124	68	0.6	0.46	20	55
	GB_Dee	636	28	16	0.52	0.06	3	59
	GB_Humb	138	50	4	2.41	0.07	3	9
	GB_Neag	500	570	247	1.09	0.92	49	34
	GB_NorE	4	1	1	0	0.57	25	100
	GB_Nort	61	10	5	0.72	0.19	8	49
	GB_NorW	865	48	20	0.74	0.05	2	48
	GB_Scot	268	256	204	0.23	0.92	76	79
	GB_Seve	900	708	81	1.16	0.21	9	31
	GB_Solw	1474	59	46	0.26	0.07	3	77
	GB_SouE	121	63	49	0.25	0.92	40	78
	GB_SouW	1328	549	8	2.92	0.01	1	5
	GB_Tham	252	60	14	1.43	0.13	6	24
	GB_Wale	430	44	31	0.3	0.16	7	74
France	FR_Adou	5874	1102	64	0.75	0.02	1	47
	FR_Arto	1418	269	73	0.45	0.12	5	64
	FR_Bret	5627	1059	197	0.5	0.08	4	61
	FR_Cors	663	125	75	0.11	0.26	11	90
	FR_Garo	21 658	4082	475	0.62	0.05	2	54

Country	Management unit	Pristine escapement	Potential escapement	Actual escapement	Lifetime mortality	Limit mortality	Stock status	Lifetime survival
	EMU	B_0	B_{best}	$B_{current}$	ΣA	ΣAlim	%SSB	%SPR
	FR_Loir	40 337	7598	405	0.77	0.02	1	46
	FR_Meus	40	7	4	0.21	0.23	10	81
	FR_Rhin	176	33	9	0.39	0.12	5	68
	FR_Rhon	19 279	3628	2453	0.09	0.29	13	91
	FR_Sein	5541	1054	278	0.45	0.11	5	64
Spain	ES_Anda	6058	311	128	0.88	0.05	2	42
	ES_Astu	63	81	29	1.01	0.92	46	36
	ES_Bale	331	139	139	0	0.92	42	100
	ES_Basq	245	162	127	0.24	0.92	52	79
	ES_Cant	10	7	2	1.34			26
	ES_Cast	23	0	0				
	ES_Cata	365	196	191				
	ES_Gali	111	104	13	2.14	0.26	12	12
	ES_Inne	2420	0	0				
	ES_Murc	26	0	0				
	ES_Nava	5	0	1				
	ES_Vale	698	419	385	0.09	0.92	55	91
Portugal	PT_Minho	36	36	4	2.73	0.27	12	7
	PT_Port	1365	1026	699				
Italy	IT_Abru	2	1	0	0.15	0.46	20	86
	IT_Basi	2	1	1	0.25	0.69	30	78
	IT_Cala	2	1	0	0.22	0.46	20	80
	IT_Camp	14	6	6	0.08	0.92	43	92
	IT_Emil	458	114	83	0.31	0.42	18	73
	IT_Frio	293	73	71	0.02	0.56	24	98
	IT_Lazi	71	31	14	0.79	0.45	20	45
	IT_Ligu	2	1	1	0.13	0.69	30	88
	IT_Lomb	66	12	7	0.57	0.24	11	57

Country	Management unit	Pristine escapement	Potential escapement	Actual escapement	Lifetime mortality	Limit mortality	Stock status	Lifetime survival
	EMU	B_0	B_{best}	$B_{current}$	ΣA	ΣAlim	%SSB	%SPR
	IT_Marc	4	1	1	0.32	0.34	15	73
	IT_Moli	1	0	0	0.3	0.51	22	74
	IT_Piem	16	3	1	1.58	0.09	4	21
	IT_Pugl	400	124	110	0.12	0.63	28	89
	IT_Sard	210	89	28	1.16	0.31	13	31
	IT_Sici	8	3	3	0.13	0.86	38	88
	IT_Tosc	75	32	5	1.9	0.15	7	15
	IT_Tren	7	1	0.1	2.5	0.03	1	8
	IT_Umbr	4	0.6	0		0	0	
	IT_Vall	1	0.2	0		0	0	
	IT_Vene	1773	441	389	0.13	0.5	22	88
Malta	MT_total							
Slovenia	SI_total							
Croatia	HR_total							
Greece	GR_CeAe							
	GR_EaMT	72	2	3				
	GR_NorW	100	53	22				
	GR_WePe	5	22	9				
	GR_total	178	78	34	0.06	0.43	19	94
Cyprus	CY_total							

3 ToR B: Provide a draft of the ICES Advice

This chapter addresses ToR B: *Produce the first draft of the ICES annual eel advice, and other advisory documents as requested*.

3.1 Draft advice

The WG is asked to provide a first draft of updates to the ICES Advice. As this is a draft, it is supplied to the Advice Drafting Group as a "stand-alone" document, separate from this report.

3.2 Proposal for new Advisory framework for eel

Note there is some repetition between this sub-Chapter and Chapter 2, but this is preferred because this subsection may be used as a stand-alone document.

In 2016 and 2017, prompted by various discussions within WGEEL and between ACOM and DG MARE in relation to the MoU (now Administrative Agreement), the lack of coordination and feedback on the performance of the EU Regulation in its aim to recover the stock, and the absence of scientific advice within the framework of the EU Regulation at the more local level (Dekker, 2016), the WGEEL drafted a possible addition/change to the standard eel annual advice incorporating commentary on the performance of the Eel Management Plans (EMPs) measured against the limits set in the EU Regulation. This could take the form of triennial supplementary advice in line with the reporting time line laid out in the EU Regulation; 2012, 2015, 2018 and every three years thereafter as agreed at the December Council of Fisheries in 2017.

The EC Regulation of 2007 (European Council, 2007), establishing measures for the recovery of the stock of European eel, has not been evaluated by ICES for its conformity with the precautionary approach and has for this reason not been used as the basis for the whole stock advice.

In 2013, ICES provided information on the progress of the EMPs and the performance of the local stocks in relation to their biomass and mortalities with respect to the limits set in the Regulation (ICES, 2013a). At time of writing, another workshop to evaluate EMPs is in progress (WKEMP).

ICES would be able to provide advice based on the EU Recovery Plan once it has been evaluated for its conformity with the precautionary approach.

3.2.1 EU Regulation 1100/2007

The EC Regulation (Council Regulation 1100/2007) for the recovery of the eel stock required Member States to establish eel management plans for implementation in 2009. Under the EC Regulation, MSs should monitor the eel stock, evaluate current silver eel escapement and post-evaluate implemented management actions aimed at reducing eel mortality and increasing silver eel escapement. Under the Regulation, each Member State was to report to the Commission every third year until 2018 and subsequently every six years, but the Joint Declaration during the December 2017 Council of Fisheries agreed to continue this 3-year reporting period.

3.2.2 Non-EU Countries

The Eel Regulation 1100/2007 only applies to EC Member States, but the eel distribution extends much further than this. The whole-stock (international) assessment requires data and information from both EU and non-EU countries producing eels. Some non-EU countries provide such data to the WGEEL and more countries are being supported to achieve this through efforts of the General Fisheries Commission of the Mediterranean (GFCM). Recent progress has been made towards the development of an adaptive regional management plan for eel in the Mediterranean Region under the auspices of the GFCM.

3.2.3 ICES Advice on Reference Limits

The objective of each EMP shall be to reduce anthropogenic mortalities to permit with high probability the escapement to the sea of at least 40% of the silver eel biomass relative to the best estimate of escapement that would have existed if no anthropogenic influences had impacted the stock. That is: a limit is set at an escapement ($B_{current}$) of 40% of B_o, in between the universal level (30%) and the more precautious level advised (50%). It is noted that neither an explicit time frame for recovery nor a short-term mortality limit were set in the Regulation.

Because current recruitment is generally far below the historical level, a return to the limit level is not to be expected within a short range of years, even if all anthropogenic impacts are removed (Åström and Dekker, 2007). The Eel Regulation indeed expects to achieve its objective "in the long term", but it does not specify an order of magnitude for that duration. Noting the general objective to protect <u>and recover</u> the European eel stock, it will be consistent for ICES to provide advice in line with its general framework for long-lived species (see Section 3.2.5, below).

The 40% biomass limit of the Eel Regulation applies to all management units, without differentiation between the units. Whether or not that implies that the corresponding mortality limit ($\Sigma A = 0.92$) also applies to all units, is unclear. However, since it is unknown whether all areas contribute to successful spawning, a uniform mortality limit for all areas will constitute a risk-averse approach (Dekker, 2010).

3.2.4 Eel Reporting/Stock Indicators

The Regulation sets reporting requirements (Article 9) such that Member States must report on the monitoring, effectiveness and outcomes of EMPs, including the proportion of silver eel biomass that escapes to the sea to spawn, or leaves the national territory, relative to the target level of escapement; the level of fishing effort that catches eel each year; the level of mortality factors outside the fishery; and the amount of eel less than 12 cm in length caught and the proportions utilized for different purposes.

These reporting requirements were further developed by Dekker (2010), SGIPEE (ICES, 2011a) and then published by the Commission in 2011/2012 as guidance to produce the 2012 reports. This guidance added the requirement to report fishing catches (as well as effort), and provides explanations of the various biomass, mortality rates and restocking metrics required for international assessment and post-evaluation, as follows:

- Silver eel production (biomass)

  B_0 The amount of silver eel biomass that would have existed if no anthropogenic influences had impacted the stock;

  $B_{current}$ The amount of silver eel biomass that currently escapes to the sea to spawn;

B_{best} The amount of silver eel biomass that would have existed if no anthropogenic influences had impacted the current stock, included restocking practices, hence only natural mortality operating on stock.

- Anthropogenic mortality (impacts)

ΣF The fishing mortality rate, summed over the age groups in the stock;

ΣH The anthropogenic mortality rate outside the fishery, summed over the age groups in the stock;

ΣA The sum of anthropogenic mortalities, i.e. $\Sigma A = \Sigma F + \Sigma H$. It refers to mortalities summed over the age groups in the stock.

Mortality-based indicators and reference points routinely refer to mortality levels assessed in (the most) recent years. ICES (2011a) noted that the actual spawner escapement will lag, because cohorts contributing to current spawner escapement have experienced different mortality levels earlier in their life. Consequently, stock indicators based on assessed mortalities do not match with those based on measured spawner escapement. The time-lag applies to mortality-based indicators as well as to %SPR-based indicators. It will be in line with the conventional ICES procedures and the standard Precautionary Diagram to focus on immediate effects ($\sum A$), ignoring the inherent time-lag in spawner production. This will show the full effect of management measures taken (on the vertical mortality axis) although the effect on biomass (horizontal) has not yet fully occurred.

3.2.5 The Derivation of ΣA_{lim} and the Harvest Control Rule

The Eel Regulation specifies a limit reference point (40% of pristine biomass B_0) for the biomass of the spawning stock. For long-lived species (such as the eel) with a low fecundity (unlike the eel), biological reference points are often formulated in terms of numbers, rather than biomass. Though numbers-based and biomass-based reference points will differ slightly, a mortality-based reference point will be derived here, that results in 40% of the pristine stock *numbers*.

If no substantial density-dependent processes affect the stock abundance in the continental phase, the number of silver eels escaping to the ocean equals[2]:

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[2] Notation in these equations:

X* parameter X as applied in the silver eel stage. Hence: A* is the anthropogenic mortality (A) in the silver eel stage.
Esc silver eel escapement. The number of silver eels leaving the area towards the ocean.
t time, in years.
a age, in years since recruitment to the continent.
%SPR ratio of spawner per recruit (SPR), the current SPR as a percentage of SPR in the pristine state.
A anthropogenic mortality (fishing F & other anthropogenic mortality H).
M natural mortality.
N number of eels in the stock; N* is the number of silver eels produced (before mortality).
R recruitment.
S instantaneous rate of the silvering process, i.e. the silvering process expressed as a rate.

$$Esc_t^* = N_t^* \times \exp^{-Z_t^*} = N_t \times \exp^{-Z_t^* - S_t} = R_{t-a} \times \exp^{-S_t - \sum_{i=0}^{a} M_{t-a+i,i}} \times \exp^{-Z_t^* - \sum_{i=0}^{a} A_{t-a+i,i}}$$

Without anthropogenic mortality, the last factor ($\exp^{-Z_t^* - \sum_{i=0}^{a} A_{t-a+i,i}}$) vanishes. Hence, the number of silver eels escaping, as a percentage of the number that would have escaped without anthropogenic impacts is

$$\%SPR_t = \exp^{-Z_t^* - \sum_{i=0}^{a} A_{t-a+i,i}} \quad (\times 100\%)$$

This is independent of the number of recruits and the natural mortality (unless density-dependence is significant). If the limit reference point on the *number* of silver eels escaping is set at 40%, it follows that

$$Z_t^* + \sum_{i=0}^{a} A_{t-a+i,i} = -\ln(\%SPR) \leq -\ln(40\%) = 0.92$$

i.e. the sum of all anthropogenic impacts, summed over the entire continental lifespan, should not exceed a fixed value of 0.92.

ICES provides fisheries advice that is consistent with the broad international policy norms of the Maximum Sustainable Yield (MSY) approach, the precautionary approach, and an ecosystem approach while at the same time responding to the specific needs of the management bodies requesting advice (ICES, 2009; 2010c).

For long-lived stocks with population size estimates, ICES bases its advice on attaining an anthropogenic mortality rate at or below the mortality that corresponds to long-term biomass targets using a ***Harvest Control Rule***. However, $B_{MSY\text{-}trigger}$ is a biomass level triggering a more cautious response. Below $B_{MSY\text{-}trigger}$, the anthropogenic mortality advised is reduced, to reinforce the tendency for stocks to rebuild. Below $B_{MSY\text{-}trigger}$, ICES suggests using a proportional reduction in mortality reference values (i.e. a linear relation between the mortality rate advised and biomass).

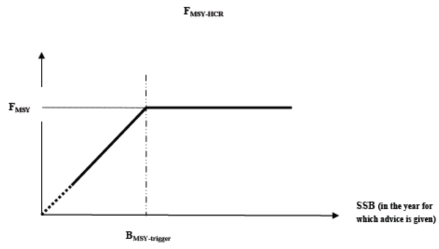


Figure 1.2.4 MSY approach shown in Harvest Control Rule.

For general fish stocks, the normal tendency to recover may break down at very low spawning stock levels. In these cases, the advised fishing mortality rate is likely to be so low that fishing may cease anyway. When stock size is so low that recruitment failure is a concern (e.g. at or below B_{lim}), additional conservation measures may be recommended for the stock to prevent a further decline. This special consideration at low stock sizes is depicted by a dotted line in the diagram.

For eel in particular, current stock and recruitment are historically low, and indications are that the conventionally assumed mechanisms (e.g. a compensatory stock–recruitment relation) might not hold. The decline of the stock will have forced some fishers to cease their exploitation, but side effects of other anthropogenic activities (such as hydropower generation) will not have reacted to low stock abundance. Exceptional conservation measures will be required, accommodating the exceptional low stock level, as well as accommodating for the apparently depleted resilience in stock dynamics.

3.2.6 Mortality Control Rule

For eel stocks, a standard approach of controlling fishing mortality ($\sum F$) using a Harvest Control Rule does not apply. Other anthropogenic mortality ($\sum H$) (such as hydropower, pumping stations, barriers and pollution) is known to inflict considerable additional mortality on the eel stock. In many instances, both *F* and *H* may occur in the same river basin with *H* offsetting gains made from reductions in *F.*

Figure 3.1 and Table 3.1 show a derivation of the mortality (control) limit at various levels of % Biomass as they relate to the current eel escapement $B_{current}$ relative to the pristine biomass (B_o).

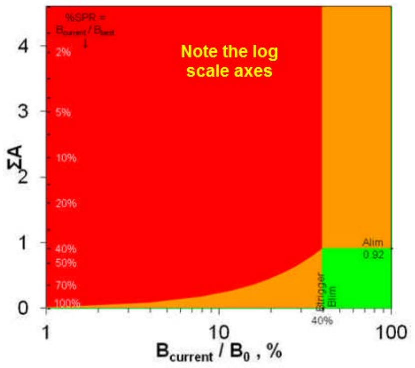


Figure 3.1. Illustration of the Modified Precautionary Diagram for Eel, reflecting the application of the Mortality Control Rule (see Table 3.1 for 'data').

Table 3.1. Values used to create the illustrative Modified Precautionary Diagram for Eel reflecting the application of the Mortality Control Rule in Figure 3.1.

Biomass % of pristine	Mortality limit	Survival limit
%SSB	ΣAlim	%SPR
100	0.92	40
90	0.92	40
80	0.92	40
70	0.92	40
60	0.92	40
50	0.92	40
40	0.92	40
38	0.87	42
36	0.82	44
34	0.78	46
32	0.73	48
30	0.69	50
28	0.64	53
26	0.60	55
24	0.55	58
22	0.50	60
20	0.46	63
18	0.41	66
16	0.37	69
14	0.32	73
12	0.27	76
10	0.23	80
8	0.18	83
6	0.14	87
4	0.09	91
2	0.05	96
1	0.02	98
0.5	0.01	99
0	0.00	100

3.2.7 Demonstration of analysis of the Reported Stock Indicators

Noting that at this stage, this is a demonstration of a concept rather than actual conclusions.

In July 2018, ICES issued a Data call concerning the eel stocks in countries of ICES, EIFAAC and GFCM. This included estimates of the stock indicators (3B & ΣA). In addition, Country Reports (Annex 5), national assessments and some 2018 progress reports under the Eel Regulation were available to the meeting.

The WGEEL compiled the reported indicators in support of the ICES Workshop on Evaluating Eel Management Plans (WKEMP). All these indicators have been taken at face value. The WGEEL did not undertake a quality evaluation of the data or assessments because these will feature in the work of the WKEMP. However, preliminary inspection of the indicators (see Section 4.2) revealed several misinterpretations, inconsistencies and incomplete reporting (life stages, habitats, geographical areas; etc.). This applied in particular to the mortality estimates. While the Working Group is working on the completion and quality control of the database (Section 4.2), it was decided to present a preliminary analysis of the stock indicators reported in 2018, noting that the WKEMP will soon make a more complete analysis. **Clearly, the results presented here are preliminary, and data quality processing and further analyses should continue.** Because of this, the Working Group decided to restrict the presentation to the latest data year, i.e. 2017 or the latest reported year before that. While some countries reported annual stock indicators for a continuous range of years, others reported only for the years preceding the tri-annual reporting years (2011, 2014 and 2017, respectively) or multiyear averages; consistency was achieved by selecting only the triannual indicators or corresponding multiyear averages. However, this approach may obscure considerable interannual variation in indicators, that might be due to, for example, unusual environmental conditions such as particularly wet or dry periods of silver eel escapement.

The diagrams below present the indicators per EMU (or country) as reported, against the background of the reference points according to the 40% biomass target of the EU Eel Regulation, the corresponding mortality limit of ΣA=0.92 (taking the 40% biomass limit as a trigger point below which the mortality is reduced to zero in proportion to the actual biomass of the escapement). Figure 3.2 presents stock biomass indicators across the distribution of the European eel. Additionally, the stock indicators per EMU are listed in Table 3.2.

Not all EMUs/countries have reported, or they have reported inconsistently/contradictorily. Disparities have been noted in data reporting and assessments under the EC Eel Regulation, such as the derivation of B_0, and the inclusion of restocking in some estimates of mortality to offset the impacts of fishing. All efforts should be made to standardise these to ensure better quality of the data and the Working Group assessment. The WGEEL recommends, and will continue to support, a process of data quality assurance and standardisation.

Reported indicators, as provided by EU Member States in response to the Data call, indicate that the stock in many reporting countries/areas was below the biomass limits of the Eel Regulation and in most management units, anthropogenic mortality is above a level that can be expected to lead to recovery, in many cases even exceeding the level that would sustain a healthy stock ($\%SSB \geq 40\% * B_0$, $\Sigma A_{lim} \leq 0.92$). Due to the recent decline in recruitment, spawner production is expected to decline further in the near future (Åström and Dekker, 2007) and therefore further reductions in mortality may be required.

3.2.8 Concluding statement

Recruitment remains low across the geographical range of the stock and the stock status remains critical.

85 EMUs (84%) have either not reported biomass indicators or are below the 40% threshold target.

62 EMUs (62%) have either not reported mortality indicators or are above the desired mortality limit at their current escapement.

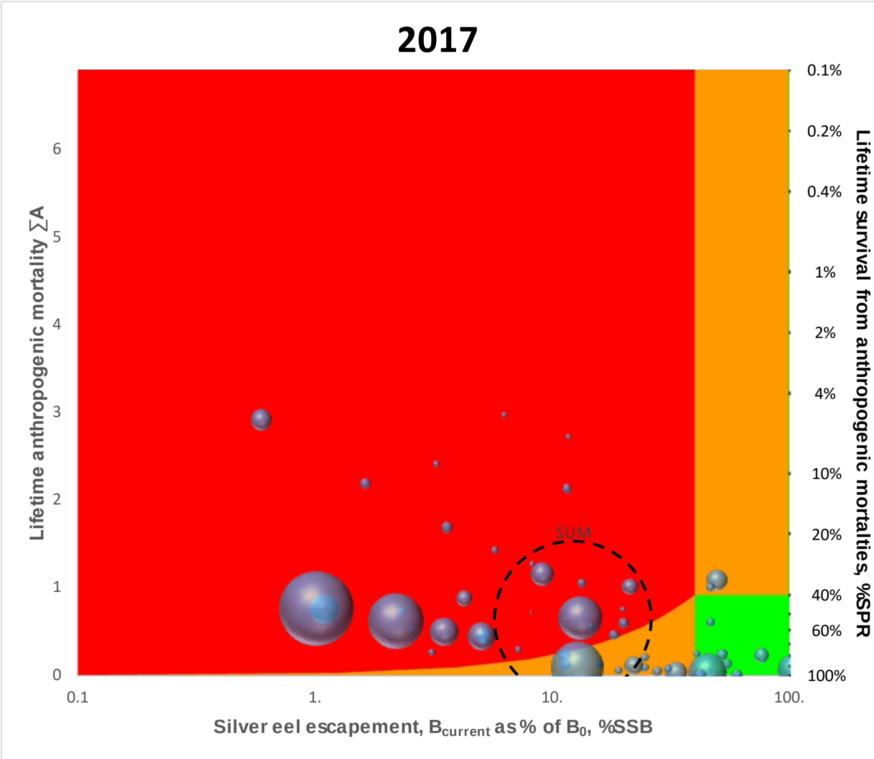


Figure 3.2. Modified Precautionary Diagram for Eel Management Units, presenting the status of the stock (horizontal, spawner escapement ($B_{current}$) expressed as a percentage of the pristine (B_0) escapement) and the anthropogenic impacts (vertical, expressed as lifetime mortality ΣA, resp. lifetime survival %SPR). Data from the 2018 Data call or from Country Reports provided to WGEEL. Note that all indicators have been used as reported, despite some inconsistencies and errors.

Table 3.2. Stock indicators for 2017 or the latest data year before, as reported by EU Member States and some other eel-producing countries. Note that all indicators have been used as reported, despite some inconsistencies and errors. For each area, the columns %SSB (Biomass) and %SPR (total anthropogenic mortality) indicate whether the indicators are (green) or not (red) within the limits set/implied by the 40% limit of the Eel Regulation. Data from 2018 ICES Data call.

Country	Management unit	Pristine escapement	Potential escapement	Actual escapement	Lifetime mortality	Limit mortality	Stock status	Lifetime survival
	EMU	B_0	B_{best}	$B_{current}$	ΣA	ΣAlim	%SSB	%SPR
Norway	NO_total		281	277				
Sweden	SE_East			3627				
	SE_Inla	564	314	120	1.32	0.49	21	16
	SE_West	1154	1154		0			100
Finland	FI_total							
Estonia	EE_Narv	90	77	42	0.61	0.92	46	54
	EE_West							
Latvia	LV_total							
Lithuania	LT_total	87	9	0	1	0	0	37
Poland	PL_Oder	1426	150	52	1.03	0.08	4	36
	PL_Vist	1386	125	23	2.10	0.04	2	11
Czech republic	CZ_Elbe							
	CZ_Oder							
Germany	DE_Eide	1706	590	571	0.03	0.77	33	97
	DE_Elbe	1553	33	127	1.27	0.19	8	28
	DE_Ems	820	71	129	0.13	0.36	16	88
	DE_Maas	9	0	0	0.70	0.02	1	49
	DE_Oder	373	82	91	0.21	0.56	24	81
	DE_Rhei	532	8	214	0.87	0.92	40	42
	DE_Schl	4205	1856	1892	0.04	0.92	45	96
	DE_Warn	1367	1488	1445	0.06	0.92	106	94
	DE_Wese	730	41	106	0.93	0.33	15	40
Denmark	DK_Coast							
	DK_Inla	1110	169	125	0.22	0.26	11	80
Netherlands	NL_total	10 400	2647	1365	0.66	0.3	13	52
Belgium	BE_Meus	12	3	2	0.19	0.42	18	83
	BE_Sche	184	25	21	0.15	0.27	12	86
Luxembourg	LU_total							
Ireland	IE_East	35	17	17	0.01	0.92	49	99
	IE_NorW	171	104	93	0.13	0.92	54	87
	IE_Shan	285	90	87	0.07	0.7	31	93
	IE_SouE	53	32	32	0	0.92	61	100
	IE_SouW	66	26	26	0.01	0.88	39	99
	IE_West	230	139	139	0	0.92	60	100
Great Britain	GB_Angl	341	124	68	0.6	0.46	20	55
	GB_Dee	636	28	16	0.52	0.06	3	59
	GB_Humb	138	50	4	2.41	0.07	3	9
	GB_Neag	500	570	247	1.03	0.92	49	36
	GB_NorE	4	1	1	0	0.57	25	100
	GB_Nort	61	10	5	0.72	0.19	8	49
	GB_NorW	865	48	20	0.74	0.05	2	48
	GB_Scot	268	256	204	0.23	0.92	76	79
	GB_Seve	900	708	81	1.16	0.21	9	31
	GB_Solw	1474	59	46	0.26	0.07	3	77
	GB_SouE	121	63	49	0.25	0.92	40	78
	GB_SouW	1328	549	8	2.92	0.01	1	5
	GB_Tham	252	60	14	1.43	0.13	6	24
	GB_Wale	430	44	31	0.3	0.16	7	74
France	FR_Adou	5874	1102	64	0.75	0.02	1	47
	FR_Arto	1418	269	73	0.45	0.12	5	64
	FR_Bret	5627	1059	197	0.5	0.08	4	61
	FR_Cors	663	125	75	0.11	0.26	11	90
	FR_Garo	21 658	4082	475	0.62	0.05	2	54
	FR_Loir	40 337	7598	405	0.77	0.02	1	46
	FR_Meus	40	7	4	0.21	0.23	10	81
	FR_Rhin	176	33	9	0.39	0.12	5	68
	FR_Rhon	19 279	3628	2453	0.09	0.29	13	91
	FR_Sein	5541	1054	278	0.45	0.11	5	64
Spain	ES_Anda	6058	311	128	0.88	0.05	2	42
	ES_Astu	63	81	29	1.01	0.92	46	36
	ES_Bale	331	139	139	0	0.92	42	100
	ES_Basq	245	162	127	0.24	0.92	52	79
	ES_Cant	10	7	2	1.34			26
	ES_Cast	23	0	0				
	ES_Cata	365	196	191				
	ES_Gali	111	104	13	2.14	0.26	12	12
	ES_Inne	2420	0	0				
	ES_Murc	26	0	0				
	ES_Nava	5	0	1				
	ES_Vale	698	419	385	0.09	0.92	55	91
Portugal	PT_Minho	36	36	4	2.73	0.27	12	7
	PT_Port	1365	1026	699				
Italy	IT_Abru	2	1	0	0.15	0.46	20	86
	IT_Basi	2	1	1	0.25	0.69	30	78
	IT_Cala	2	1	0	0.22	0.46	20	80
	IT_Camp	14	6	6	0.08	0.92	43	92
	IT_Emil	458	114	83	0.31	0.42	18	73
	IT_Frio	293	73	71	0.02	0.56	24	98
	IT_Lazi	71	31	14	0.79	0.45	20	45
	IT_Ligu	2	1	1	0.13	0.69	30	88
	IT_Lomb	66	12	7	0.57	0.24	11	57
	IT_Marc	4	1	1	0.32	0.34	15	73
	IT_Moli	1	0	0	0.3	0.51	22	74
	IT_Piem	16	3	1	1.58	0.09	4	21
	IT_Pugl	400	124	110	0.12	0.63	28	89
	IT_Sard	210	89	28	1.16	0.31	13	31
	IT_Sici	8	3	3	0.13	0.86	38	88
	IT_Tosc	75	32	5	1.9	0.15	7	15
	IT_Tren	7	1	0.1	2.5	0.03	1	8
	IT_Umbr	4	0.6	0		0	0	
	IT_Vall	1	0.2	0		0	0	
	IT_Vene	1773	441	389	0.13	0.5	22	88
Malta	MT_total							
Slovenia	SI_total							
Croatia	HR_total							
Greece	GR_CeAe							
	GR_EaMT	72	2	3				
	GR_NorW	100	53	22				
	GR_WePe	5	22	9				
	GR_total	178	78	34	0.06	0.43	19	94
Cyprus	CY_total							

4 ToR C: Updates on the scientific basis of the advice, new and emerging threats and opportunities

This chapter answers ToR C and Generic ToR g: *Report on updates to the scientific basis of the advice, including any new or emerging threats or opportunities.* The information is drawn from that provided in Country Reports plus that brought to the attention of WGEEL by all those attending the 2018 meeting.

Prior to WGEEL in 2018, a subgroup of WGEEL met as WKTEEL to identify the data needed for the 2018 stock assessments, re-design data templates, and create tools to standardise and improve reporting of data and derivation of stock parameters. This section presents the requirement of the data call arising from the process and the data delivered to WGEEL: collating the methods used to gather stock assessment data; mortality indicators, and the effect on mortality rate indicators of restocking activity.

4.1 Data call

4.1.1 Overview of the Data call

Up until 2016, the data and information were supplied to WGEEL through a Country Report text with associated figures and tables. They are now requested in the form of excel files, associated with a Data call, which have been formatted to ensure direct upload into the WGEEL eel database. The aim of the eel Data call is to harmonise and officialise the data requirements across ICES, EIFAAC and GFCM countries.

The Covering Letters describing the Data call in 2018 is provided in Annex 6.

The process of designing and implementing an Eel Data call was improved based on the feedback received by data providers and by discussions during the WGEEL 2018 meeting.

4.1.2 Problems found during the data integration from Data call 2018

Data from the 2018 Data call were integrated into the Shiny application during the WGEEL meeting 2018. There were some data formatting and inconsistency problems that hampered the process, including:

1) Duplicate data:
   1.1) When reporting the same data if something was changed comparing to the 2017 data call (i.e.: habitat type, life stage…) the app treats this as new data and the information will be duplicated.
   1.2) Some EMUs have included more than one row per year/ habitat/stage (i.e.: each time they made a release they included a row.
   1.3) Human error issues i.e. typos and mistakes.
2) Many countries inputted ICES division area for freshwater and "All" habitat that had to be removed.
3) Use of wrong/non-existing codes.
4) There is still some confusion with the use of missing values codes.
5) Some EMUs have used periods (covering multiple years) instead of individual years.
6) Some EMUs have included both: values per EMU and totals for the country; thus, values are duplicated.

7) In Recruitment tables, methods are asked in the metadata section (which is not actually used), while methods are not explicitly asked for in the series_info tab; thus, the methods are sometimes missing here or are not well described.

8) Some countries reported a lot of decimal spaces e.g. in Biomass or Mortalities, thus the visualisation displays them respectively.

4.1.3 Recommendations for the data integration procedure

To make the integration process more efficient during the forthcoming years, some recommendations to avoid the above-mentioned problems are:

a) Going forwards, only report new or revised data.

b) Do not use any code that does not appear in the Data call sheet.

c) Use the codes exactly as they have been provided in the sheets of the data call: upper/low case, spaces, hyphens, etc. The more convenient is to copy/paste them from the sheets in the Data call.

d) Be consistent with the habitats you have assessed through time. For example, if you provide information on the biomass indicators for ALL the habitats for 2015, and you provide information for the biomass indicators for each of the habitats in the next call, the application process will duplicate the data. Thus, add a comment explaining the change, and then check the data after data integration to make sure that they haven't been duplicated.

e) Do not include information from the same year, habitat, stage ICES/FAO area in more than one row. In case you have information from different sources, add it in a single row. The application only allows one row per year, stage, habitat. Before submitting you can make a dynamic table to check you only have one row per year, stage, habitat, ICES/FAO area.

f) Regarding the use of NP (Not Pertinent): if you have a fishery that was there before and has been stopped use "0". If you have never had a fishery use NP (do not report 0 catches for a glass eel fishery if you have never had one).

g) Only include one year per row, periods are not allowed (i.e.: 2008–2011; pre-1980).

h) If you provide landings in yellow (Y) and silver (S) separately for a given year, don´t report Y+S; otherwise they will be doubled and landings by individual life stage is better for the WG where such data are available.

i) Do not include totals for different habitats, EMUs or countries, only provide raw data.

j) Review the Data call before submission to make sure you have met the above-mentioned requirements, this will avoid delay in analysing the data at the WG meeting.

k) For the next data call, in recruitment table modify/delete metadata and change the column names in series_info to clarify what is asked here (e.g. ser_habitat_name could be ser_method). Further extract the series_info from recruitment data for each country from the database and ask countries to provide methods where necessary; then reintegrate the updated data.

l) Reported numbers should be rounded to XY decimal places (need to clarify how many spaces).

4.1.4 Recommendations for the Data call cover letter

i) It was decided to drop the silver eel equivalents due to the difficulties in accurately calculating these values.

ii) The section "Landings" should be renamed to "Catches".

iii) On Section "6. Landings": The catches should include all landings, also those later released, except for eels that are (more or less) immediately released in the same EMU and don't have notable mortalities (e.g. assisted migration, trap and transport.) There must be a clear definition about the exceptions. There might be significant releases in recreational fisheries, which are associated with mortalities (see Weltersbach *et al.*, 2016; 2018 for recreational eel fishing).

iv) On Section "7. Releases":

A) All releases of wild-caught eels that are reported in catches <u>must</u> also be reported here.

B) Clarify if reporting of all three values is preferred or which ones are essential (kg, numbers, glass eel equivalents).

C) Specify which stages are needed and clearly define those (e.g. glass eel, on-grown glass eel, yellow eel, glass plus yellow eel).

4.1.5 Further developments towards a systematic treatment of data for the Data call

Several stock parameters are required by WGEEL to analyse the effect of measures applied in the various EMUs. These parameters have been made available by MS in their triennial progress reports, as well as in response to the annual data call conducted through ICES. Definitions of the parameters to be delivered have been given repeatedly in WGEEL reports (e.g. ICES 2013b, p.170) as well as with instructions that accompany the progress reporting and data calls. In addition to a few inconsistencies which have been highlighted above, for some of the requested parameters there are different options on how to estimate their values. This refers to how restocking is handled when calculating the three biomass indicators and how this affects estimation of anthropogenic mortality rates and precautionary reference point values (ΣA, ΣA_{lim}).

To improve spatial and temporal comparability of values reported for EMU`s as well as to foster approaches in assessing the status and development of the European-wide stock beyond single EMU-boundaries, the following issues were addressed during the meeting.

4.1.5.1 Stock indicators and Restocking

Since the mid-1800s, young eels (glass eels) have been transported from areas of highest abundance (estuaries, predominantly from rivers flowing into the Bay of Biscay) to areas of lesser abundance (further upstream, less-densely populated areas in central and northern Europe). This so-called 'restocking' (repeuplement, Aussetzung) aimed to mitigate the decline of the stock and/or to sustain/expand the fisheries (Dekker and Beaulaton, 2016). With the decline in glass eel abundance since 1980, and the parallel increase in prices (due to extensive export to Asia), restocking as a fishery management measure had declined. The Eel Regulation (European Council, 2007), however, adopted restocking as a potential measure for the conservation of the stock.

Whether or not restocked eel successfully contributes to the spawning stock is a matter of debate (ICES, 2016a); this section/report does not elaborate on that discussion.

In addition to this, it has been argued that transport of glass eel from the donor area to the recipient area might increase the amount of silver eel escaping from the continent ("the net benefit of restocking"). ICES (2016a) analysed this, concluding that transport from areas of high mortality to areas of low mortality will indeed result in a net benefit to the silver eel run from the whole continent, if the mortality in the donor area exceeds that in the recipient area. This would be the case if there was a strong density-dependent mortality in the donor areas, and no density-dependent mortality in the recipient areas. However, ICES (2016b) felt unable to reach a decisive conclusion, due to uncertainties in the existing assessments of donor and recipient areas. This section/report will not elaborate on the comparison between donor and recipient area.

Restocking obviously constitutes an anthropogenic impact on the stock, but unlike all other impacts, it could contribute positively to the abundance and silver eel escapement in recipient areas, which sets it in contrast to all other detrimental impacts. This section discusses the way restocking is/can be incorporated into the stock indicators used to evaluate the status of the stock and the effect of human impacts.

4.1.5.2 Management targets and stock indicators, and their relation to restocking

According to the Eel Regulation (European Council, 2007), restocking is pursued 'to increase the numbers of eels released into European waters … for the purpose of increasing escapement levels of silver eels' (Preamble 12) and 'Restocking shall be deemed to be a conservation measure … provided that … it contributes to the achievement of the 40% target level of escapement' (Art. 7.8).

Over the decades, restocking has been practised with various objectives in mind (Dekker and Beaulaton, 2016): to support/extend a fishery, to mitigate the effect of migration barriers, to compensate for other anthropogenic mortalities, or to support the recovery of the stock. Some of the historical objectives align with the aims of the Eel Regulation, but others do not. To evaluate the achievements of national EMPs under the Eel Regulation, the stock indicators, used in national assessments as well as in the international evaluation by ICES, should reflect the effect of restocking in the sense of the Eel Regulation. That is, they should reflect a.) the status of the stock (horizontal, %SSB), b.) the human impacts (vertical, ΣA), and c.) the reduction in ΣA_{lim} at low stock abundance (the sloping line below %SSB=40%). These issues will be discussed here.

4.1.5.3 The effect of restocking on the B's, the stock status indicators

The estimation of $B_{current}$ is relatively straightforward: eels of restocked origin contribute to the actual escapement (if and where), and therefore, $B_{current}$ should include the contribution from restocking. But this was not the case for all assessments reported in the 2018 Data call (see Section 4.2), so there is a lack of consistency between EMUs.

B_0 represents the biomass of the silver eel run, if a.) no human action would have had an impact on the stock (no fishery, no barriers, no habitats lost, etc.), and b.) recruitment had been at its historical (high) level. Adding eels to the water, i.e. restocking, being a (beneficial) human impact, the estimate of B_0 should not contain any contribution from eels of restocked origin. This was the case for all 2018 assessments (except for Sweden that presented both scenarios).

For B_{best}, the biomass of silver eels that would escape if the present production was not impacted by human factors, it is noted that this quantity does not affect the Modified Precautionary Diagram directly. However, some countries reported B_{best} *with*, others *without* the (potential) contribution from restocking (and Sweden reported both), creating some risk for confusion or inconsistencies. In many assessments, however, ΣA

was calculated as ΣA=-ln($B_{current}$/B_{best}), which means that inconsistencies in the derivation of B_{best} (with/out restocking) carry over to ΣA. We consider that ΣA should preferably represent a true mortality, not corrected for the (beneficial) effect of restocking; it is therefore recommended, to handle $B_{current}$ and B_{best} consistently, so that their ratio truly reflects mortality; and therefore to include the restocking contribution in both $B_{current}$ and B_{best} when using -ln($B_{current}$/B_{best}) to estimate ΣA.

4.1.5.4 The effect of restocking on ΣA, the anthropogenic impacts indicator

In the assessments reported in the 2018 Data call, some countries reported ΣA as representing the true lifetime mortality, regardless of the origin of the eels (natural recruitment or restocking), and regardless of the beneficial effect from restocking on the production of silver eel escapement ($B_{current}$). Other countries considered the effect of restocking as a beneficial impact, a negative mortality (included in the non-fisheries impacts, ΣH; and indirectly in ΣA=ΣF+ΣH too). Earlier discussions of this (ICES, 2010b) had indicated that both options could work, but failed to identify a preferred option, and the Data call did not clarify the situation.

If the estimate of ΣA does *not* account for the (beneficial) effect of restocking (i.e. calculating $B_{current}$ and B_{best} while including the amount of eel restocked), a higher value for ΣA will be reported. This greater mortality estimate then corresponds to the true mortality, experienced by naturally immigrated and restocked eel in the stock. In cases where the limit mortality is exceeded (ΣA>ΣA_{lim}), a further reduction in impacts will be required. Increasing the amount restocked will not affect ΣA, and hence will not change the evaluation that ΣA>ΣA_{lim} (except through the relation between ΣA_{lim} and restocking, as discussed in the next section).

If, in contrast, the estimate of ΣA *does* account for the (beneficial) effect of restocking (i.e. calculating $B_{current}$ with, but B_{best} without the amount of eel restocked), a lower value for ΣA will be reported (in the Modified Precautionary Diagram, restocking would shift the indicator down). This lower mortality rate *does not* correspond to the mortality actually experienced by the eels in the water, but represents the combined effect of restocking (beneficial, positive) and negative impacts on the stock. In cases where the limit mortality is exceeded (ΣA>ΣA_{lim}), a smaller reduction in impacts will be required. Increasing the amount of restocked eel *will* affect this, through a lower value of ΣA (as well as through the relation between ΣA_{lim} and restocking, discussed in the next section). This might lead to situations where large quantities of eel are restocked into areas of high mortality: any impact on the stock in the recipient area could be compensated by (large) restocking programmes. In this case, adding extra restocking actually *increases* the permissible impact on the stock, and in particular, *increases* the permissible impact on the naturally recruited part of the stock. This appears to be counter-intuitive, and not fitting into a precautionary approach.

4.1.5.5 The effect of restocking on ΣA_{lim}, the limit mortality

The objective of the Eel Regulation is to restore the silver eel escapement to a level of 40% of the pristine level; the corresponding mortality limit is ΣA_{lim} = -ln(40%) = 0.92. Below a certain biomass ($B_{current}$< $B_{MSY\text{-}trigger}$), however, the limit mortality ΣA_{lim} is reduced (proportional to $B_{current}$), to reinforce the tendency for the stock to rebuild. As indicated above, WGEEL has used $B_{MSY\text{-}trigger}$ = B_{lim} = 40%*B_0 for this. Restocking increases $B_{current}$. When/where the actual biomass is below the limit ($B_{current}$ < 40%*B_0), restocking will shift the indicator to the right in the Modified Precautionary Diagram, and this would result in a higher permissible mortality, a higher value for ΣA_{lim}. That is: restocking would lead to a higher permissible impact (on both the natural and the restocked part of the stock). However, at high biomass ($B_{current} > 40\%*B_0$), the maximum permissible anthropogenic mortality would remain at $\Sigma A_{lim} = 0.92$; that is: extra restocking would possibly lead to a higher limit mortality, but applying extra restocking, one would not be able to increase ΣA_{lim} beyond the limit of 0.92.

4.1.5.6 Conclusion on restocking and stock indicators

The above sections reviewed the effects of restocking (the release of young eels, introduced from elsewhere) on the stock indicators and the evaluation of the stock status in any management area.

First, it is noted that some inconsistencies occurred between the analytical approach applied in management areas, in that different calculation procedures for the indicators were applied regarding restocking. This should obviously be standardised as soon as possible.

Secondly, options have been sketched to include the effects of restocking into either the biomass indicators (shifting the position horizontally in the precautionary diagram), and/or into the mortality indicator (shifting position vertically). While under both options, restocking would possibly permit a somewhat higher anthropogenic mortality than without restocking, it would be undesirable to apply both options, since that would constitute a case of "double-banking". Applying neither of these two options would be most precautious, but it would not be in line with the Eel Regulation, in which restocking is considered as a viable option to contribute to the restoration of the stock. Contrasting the two options: inclusion of restocking into the biomass indicators (horizontal shift) may lead to an increase in the limit mortality ΣA_{lim}, but only in as far as $\Sigma A_{lim} <0.92$, that is: the 40% target of the Eel Regulation (and the corresponding mortality limit $\Sigma A_{lim}=0.92$) would not be compromised. Inclusion of restocking into the mortality indicator, however, (a vertical shift) could in theory lead to unlimited restocking enabling an unlimited exploitation, while keeping the (restocking-corrected) ΣA below the limit mortality ($\Sigma A < \Sigma A_{lim}$). This is obviously undesirable, and it is therefore recommended to include the effects of restocking into the biomass indicators (horizontal shift) only, and not in the mortality estimates (vertical).

4.1.5.7 Estimating anthropogenic mortality rates based on the ratio of B_{curr}/B_{best}

According to instructions given in WGEEL report from 2013 (ICES, 2013b), ΣA (same applies to F, H) shall be estimated by definition as "… *the anthropogenic mortality* *rate*, *summed over the age groups in the stock*". Nevertheless, because several MS were not able to perform an age-class based calculation, for practical reasons an oversimplified proxy ($\Sigma A = –\ln(B_{current}/B_{best})$) was introduced to estimate the sum of anthropogenic mortalities.

The Pros and Cons of including restocking into the calculation of B_{best} and how this affects anthropogenic mortality estimates when based on $–\ln(B_{current}/B_{best})$ were discussed in the previous sub chapter. In addition to this, $B_{current}$ as well as B_{best} are both biomass estimates (tonnes) by definition.

When calculating the sum of mortality rates (ΣA) on their basis, a transformation of biomass values into numbers becomes essential. Due to the different size of silver eel over the distribution area, a biomass-based calculation would result in values for ΣA which are bound to a regional/temporal average size of silver eel. This would be problematic when comparing between regions and for the overall stock assessment. For the EMU Elbe as an example, using biomass or numbers when estimating ΣA via $B_{current}/B_{best}$ for the year 2016 results in values of 1.27 (numbers) as compared to 1.40 (biomass).

Using –ln($B_{current}$/B_{best}) is a very rough and oversimplified proxy for estimating ΣA in EMU, where no stock assessment based on age classes/cohorts can currently be applied. According to the definitions repeatedly given in WGEEL documents, Σ values should be calculated by summing up values cohort-wise over the age groups in the stock. In principle, there are two approaches existing on how to perform this procedure (see Figure 4.1):

1) Summing up mortality values experienced by age groups within the stock in the year of interest/concern (year-wise approach).

2) Starting with all stock parameters modelled for the year of interest/concern, locking all variables of the stock (recruitment, growth, natural mortality, escapement) and perform a forward projection. Sum up the mortalities experienced each year by the very cohort which had formed age group 0 in the year of interest, until it is 'escaped' from the managed stock.

In addition, summing up values over age groups can be performed in different ways as well, e.g. with or without weighting of age-group values according to cohort strength. This again affects the value estimates.

Concerning the different principle approaches mentioned above, results will not only differ in terms of value but also regarding their interpretation. Using approach 1) provides mortality values which were experienced by the cohorts forming the stock in the year of interest. They can be summed up over EMU to inform the current management. In contrast, approach 2) results in estimates of mortality rates which will be experienced by a cohort over a life time if stock variables and mortality values will remain as they are (were) in the first year this cohort entered the stock. Resulting rates will quantify the effects of measures applied in the respective year on mortality when compared to cohorts from years before a measure (e.g. installing a bypass for descending eel at a power plant) was applied.

To clarify the issues raised here, and to improve comparability and quality of reported stock indicators, a workshop on methods to be applied when estimating stock parameters both for progress reporting as well as serving data calls will be organized by WGEEL.

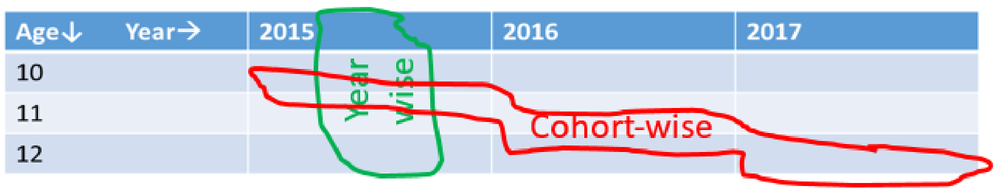
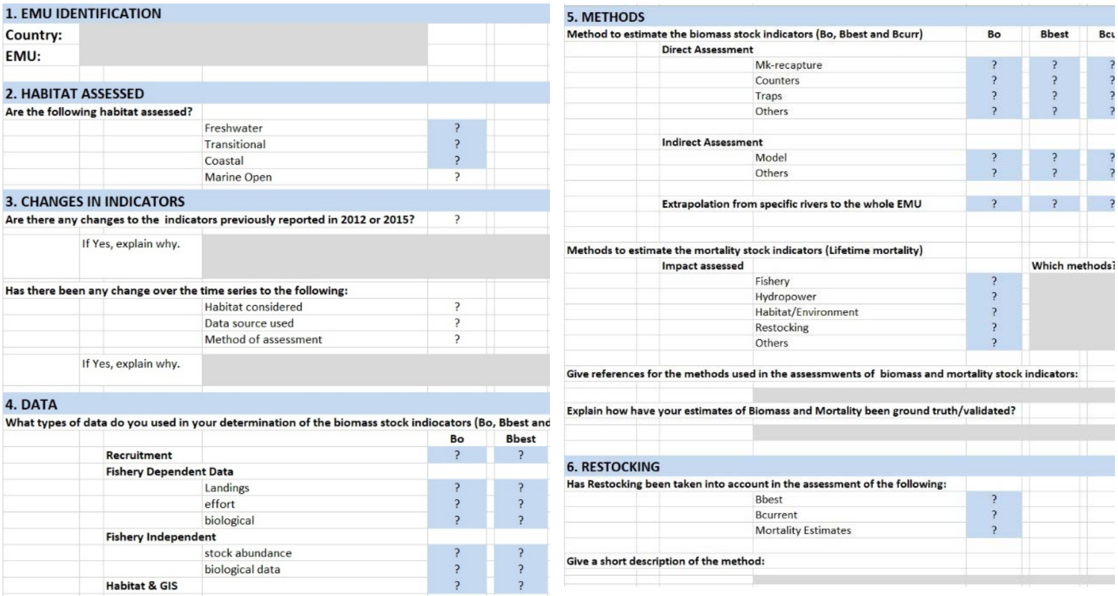


Figure 4.1. Schematic illustrating the two principle options on how to estimate mortality rates over the age groups in the stock.

4.2 Overview of assessment methods used by Countries responding to ICES data call

This section summarizes the information contained in the ICES Data call "Annex 5 - Overview" (Figure 4.2) and in the Country Reports concerning the assessment methods used in the 3-years period 2015–2017. The tables highlight the main characteristics of the methodology used by each country for the estimation of spawner biomass indicators (i.e. B_0, B_{best}, B_{curr}) and anthropogenic mortality rates (i.e. fishery, hydropower, habitat, restocking or others).


1. EMU IDENTIFICATION
Country:
EMU:

2. HABITAT ASSESSED
Are the following habitat assessed?
Freshwater ?
Transitional ?
Coastal ?
Marine Open ?

3. CHANGES IN INDICATORS
Are there any changes to the indicators previously reported in 2012 or 2015? ?
If Yes, explain why.
Has there been any change over the time series to the following:
Habitat considered ?
Data source used ?
Method of assessment ?
If Yes, explain why.

4. DATA
What types of data do you used in your determination of the biomass stock indocators (Bo, Bbest and

	Bo	Bbest
Recruitment	?	?
Fishery Dependent Data		
Landings	?	?
effort	?	?
biological	?	?
Fishery Independent		
stock abundance	?	?
biological data	?	?
Habitat & GIS	?	?

5. METHODS

Method to estimate the biomass stock indicators (Bo, Bbest and Bcurr)	Bo	Bbest	Bcu
Direct Assessment			
Mk-recapture	?	?	?
Counters	?	?	?
Traps	?	?	?
Others	?	?	?
Indirect Assessment			
Model	?	?	?
Others	?	?	?
Extrapolation from specific rivers to the whole EMU	?	?	?

Methods to estimate the mortality stock indicators (Lifetime mortality)

Impact assessed		Which methods?
Fishery	?	
Hydropower	?	
Habitat/Environment	?	
Restocking	?	
Others	?	

Give references for the methods used in the assessmwents of biomass and mortality stock indicators:
Explain how have your estimates of Biomass and Mortality been ground truth/validated?

6. RESTOCKING
Has Restocking been taken into account in the assessment of the following:
Bbest ?
Bcurrent ?
Mortality Estimates ?
Give a short description of the method:

Figure 4.2. ICES eel Data call template "Annex 5 – Overview".

Table 4.1 reports (i) the homogeneity of approaches used among countries' EMUs, (ii) comparisons between current and previous years, (iii) where pre-2017 stock indicators were recalculated for the last report, and (iv) the methods used for the estimation of stock indicators.

Two countries didn't provide any data (Finland and the Czech Republic). Three countries (Estonia, Portugal and Norway) provided estimates for the first time.

In general, there is homogeneity in the types of methods applied among the EMUs within a country with only Belgium, United Kingdom and Sweden using different approaches for the stock assessment among their EMUs.

Methods vary widely between the countries: about half of the countries used 'direct methods' to estimate the biomass stock indicators (Mk-recapture, counters, traps, electrofishing, etc.), while the others applied an 'indirect method' (models, differing according to main habitat typology (freshwater or transitional) and data available (EDA, ESAM, GEM-II, SMEP or stock-reconstructive models)).

Three countries (Belgium, Germany and Lithuania) reported a variation of the methodology used with a consequent recalculation of all indicators for pre-2017 (2015–2017). Four countries (France, Italy, the Netherland and Poland) recalculated the pre-2017 indicators according to the new data collected.

Table 4.2 summarizes which mortality rates were assessed in each country and if spawner biomasses provided are affected by restocking practices.

Table 4.1. Summary of stock assessment methods information provided by reporting country (na = not-available, MK = mark and recapture).

Country	Same approach in all EMUs	Change in assessment method	Recalculation of pre-2017 indicators	Assessment methods
BE	N	Y	Y	indirect (model)
CZ	Na	na	na	na
DE	Y	Y	Y	indirect (model) & extrapolation
DK	Y	N	N	direct (MK & Traps) & extrapolation
EE	Y	(first)	Y	direct (traps) & extrapolation
ES	Y	N	N	direct assessment (electrofishing) & extrapolation
FI	na	na	na	na
FR	Y	N	Y	direct (all) & extrapolation & indirect (model)
GB	N	N	N	direct (MK & counters & traps) & extrapolation & indirect (model)
GR	Y	N	Y	direct (traps)
IE	Y	N	N	direct (counters & MK) & indirect(model) & extrapolation
IT	Y	N	Y	indirect (model)
LV	Y	N	N	indirect (model)
LT	Y	Y	Y	indirect (model)
NL	Y	N	Y	indirect(model)
NO	Y	(first)	Y	direct (MK) & extrapolation
PL	Y	N	Y	indirect(model)
PT	Y	(first)	N	direct (electrofishing) & extrapolation
SE	N	N	N	direct (MK) & indirect(model)
TN	Y	N	N	indirect (model)

Table 4.2. Mortality indicators assessed and restocking effects inclusion in stock indicators.

Countries	Mortality estimation					Restocking effect		
	Fishery	Hydropower	Habitat/ Environment	Restocking	Others	B_{best}	B_{curr}	ΣA
BE	Y	Y	N	Y	N	Y	Y	Y
CZ	na	na	na	na	na	na	Na	na
DE	Y	Y	N	Y	N	N	Y	Y
DK	Y	Y	N	Y	N	N	N	N
EE	Y	Y	N	Y	N	Y	Y	Y
ES	Y	Y	N	Y	N	N	N	Y
FI	na	na	na	na	na	na	na	na
FR	Y	N	Y	N	N	N	N	N
UK	Y	Y	Y	Y	N	N	Y	Y
GR	Y	Y	N	N	N	N	N	N
IE	Y	Y	N	N	Y	N	N	N
IT	Y	Y	Y	Y	N	N	Y	N
LV	N	N	N	N	N	na	na	na
LT	Y	Y	Y	Y	N	Y	Y	Y
NL	Y	Y	N	N	N	N	N	Y
NO	Y	N	N	N	N	N	N	N
PL	Y	Y	N	Y	Y	N	Y	Y
PT	Y	Y	N	N	Y	N	N	N
SE	Y	Y	N	Y	N	N	Y	Y
TN	Y	Y	N	N	N	N	N	N

Results are also represented in two histograms (Figure 4.3). Figure 4.3a shows which mortality indicators were assessed and whether restocking effects were included in stock indicators, as reported either in ICES data call tables or Country Reports. Almost all countries estimated fishery mortality rate (but some reported it as a %, not a rate).

Hydropower mortality has not been quantified in France, Latvia and Norway. As there is no hydropower in Greece, Portugal or Tunisia such mortality rate is irrelevant it has been reported as 0.

Ten countries assessed restocking (positive) within their mortality rate. In Greece, Ireland, Norway, Portugal and Tunisia restocking doesn't take place, while in France, Latvia and Netherlands its mortality effect has not been assessed.

Only four countries investigated the effect of habitat loss: France, United Kingdom, Italy and Lithuania.

Among countries where restocking takes place, Figure 4.3b illustrates the proportion of countries that did or did not include the effect of restocking on their estimates for each biomass indicator and overall anthropogenic mortality. In general, except for two countries (Estonia and Lithuania), the estimates of potential spawner biomass (B_{best}) do not include an effect of restocking. A slightly larger proportion of countries considered the restocking effect in current spawner biomass (B_{curr}) and overall anthropogenic mortality (ΣA).

Portugal reported a mortality rate from illegal catches, and Poland reported a mortality rate due to cormorant predation.

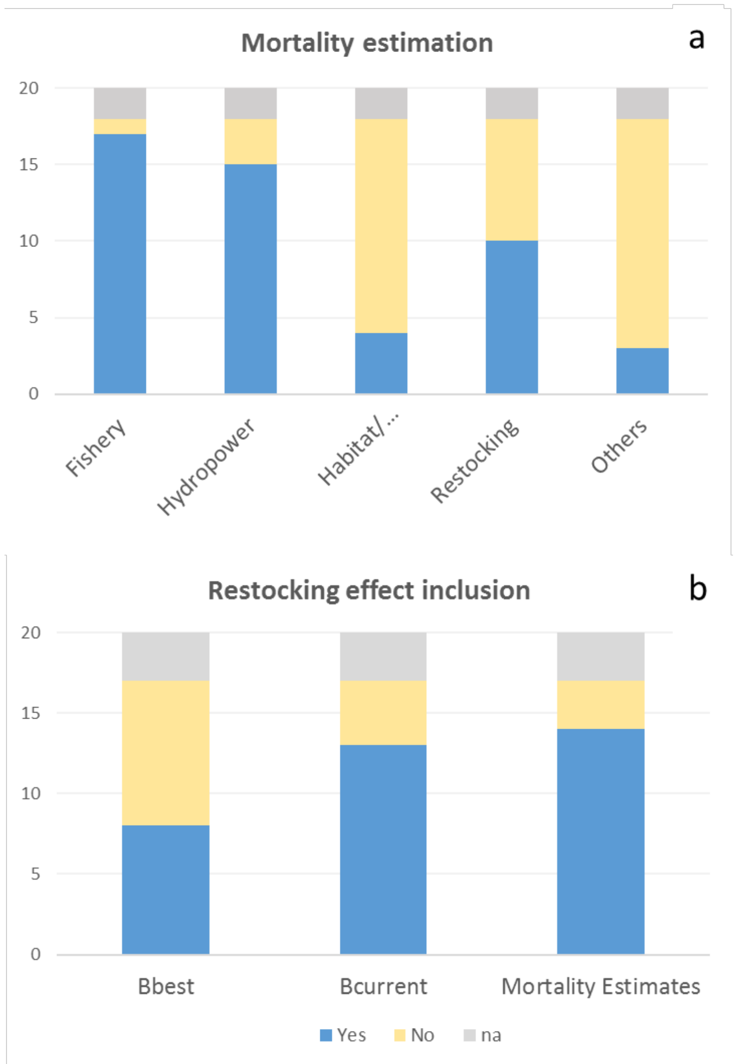


Figure 4.3. Schematic representation of data provided by countries: (a) mortality indicators assessed and (b) restocking effect inclusion in stock indicators.

4.3 New and emerging threats and opportunities

4.3.1 Revisiting the non-fishing impacts on the European eel stock

The current WGEEL annual stock assessment exercise has evolved to meet the needs of ICES to advise the EU and others on conservation measures for eel. Decline in recruitment became a concern at EIFAC meetings and symposia from the early 1980s. The concept of an international agreement for countries to each contribute towards the total spawning stock arose when an ICES stock assessment exercise joined the then biannual EIFAC symposia on eel in the mid-1990s. Lacking any immediate prospect of managing eel using standard stock–recruitment models and control of mortality rates, this concept became formalised as the “40% of pristine biomass” silver eel escapement target set in the EU regulation of 2007 (European Council, 2007).

WGEEL has since been primarily involved in application of a scientific approach to implementation of the 40% biomass and associated quantification of mortality, while periodically noting, without being able to quantify the many other anthropogenic factors affecting stock levels. This section reviews the list of additional factors, examines their perceived importance in Country Reports to WGEEL, and makes a proposal to revisit the quantification of high priority non-fishing impacts with a view to advising on the prospects for Ecosystem Based Management for eel.

When the need for stock recovery action first emerged, a list of factors and emerging threats thought to contribute to the overall stock decline were listed in reports from the EIFAC/ICES meetings, and included, (in no particular order):

- Loss of eel habitat through land reclamation and drainage of eel holding waters;
- Increasing numbers of barriers to migration through development of water control and exploitation infrastructure including dams, other barriers, abstractions, flow regulation, locks and hydropower and pumps;
- Fishing or overfishing on glass eel, yellow eel, silver eel - fishing for consumption at all three phases throughout the population range and fishing of glass eel to supply aquaculture;
- Effects of new pathogens and parasites (particularly the Japanese swimbladder parasite *Anguillicola crassus*);
- Climate change and potentially associated changes in ocean conditions having an impact between silver eel departure, reproduction and glass eel return to the coast - the oceanic "black box";
- Factors in freshwater potentially affecting silver eel reproductive capacity - including the contaminants burden;
- Increased predation arising from recovery of predator populations.

While this list still stands, with no wholly new categories added over the past 20 years, the initial stock recovery focus has been predominantly on regulation and control of fisheries. This has been driven initially within the EU, with common targets accepted and adopted by other ICES members and now extending into the GFCM area.

Experts of WGEEL and associated workshops have led the process by developing the current biomass-based stock indicators and indices. EU Member States and other countries report progress in stock management actions in terms of these stock indicators.

While actions taken by contributing states to comply with the Eel Regulation Stock Recovery target include non-fishery management options (e.g. opening new habitat, restocking) in addition to closing or regulating fisheries, fishery controls remain the principal focus of current action.

This is a clear response to the fact that actions on fisheries can:

- offer immediate results;
- often be carried out under existing legislation; and
- be administratively straightforward.

Fisheries powers vested within the EU Commission were crucial to establishing the international action. The current focus on fishery-based control, with established frameworks for annual reporting of the activity could easily lead to a general view that this internationally agreed and structured process will eventually lead to stock recovery. However, this is at the risk of overlooking the remaining large list of other factors contributing to eel stock decline (Figure 4.4). While taking immediate action to regulate and control eel fishing has been the obvious thing to do and an essential emergency first step to (hopefully) stabilising the situation and arresting decline, it is clear that eel stocks may not be recoverable to historical maxima by fishery management action alone. In addition, the scope for further fishery control/reduction will at some point be limited.

Furthermore, unless substituted by fishery-independent surveys, there is an argument for retaining fisheries at a scale and coverage to maintain the supply of data (which feeds the ICES indicators) and monitor the results of management actions taken.

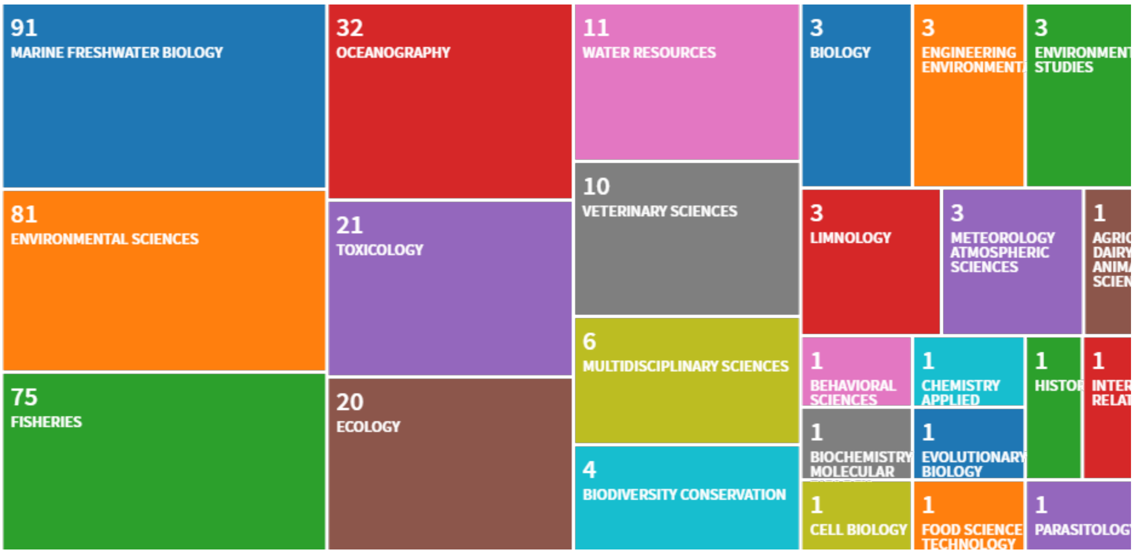


Figure 4.4. Treemap showing the general topics of the journals which published the stated number of research articles on the factors of the decline in eel. This figure is based on a literature search (Web of Science) related to the causes of the decline of eels. The initial search included the following keywords: *Anguilla* OR eel AND decline AND factor OR cause. The period covered is 1986–2018 (search performed on June 6, 2018).

Given the importance of collective non-fishery impacts, it is probable that ecosystem-based management (EBM) will be required to achieve current long-term objectives for conservation and management of the European eel stock (see http://www.ices.dk/explore-us/Documents/ICES%20and%20EBM.pdf). While some non-fishery impacts are currently estimated in some countries in quantitative terms, such as the direct impact of hydropower turbines, most non-fishery impacts are not quantified in enough coverage or detail for advice on the value of population level mitigative actions. Hence, further and more detailed quantification continues to be an essential step toward proposing directed actions to restore the capacity of the environment to support eel.

Data were extracted from the Country Reports (*Stock Status Summary*) submitted to the 2018 WGEEL. Only 75 EMUs (from a total of 116 in the reports examined) had data on both total fisheries mortality rates (∑F) and total non-fishing mortalities rates (∑H).

38 EMUs (50.7%) had total non-fisheries mortality rates (∑H) greater than total fishing mortalities rates (∑F). This simplistic analysis highlighted two main issues.

- Several countries did not report any information on total non-fisheries mortality rates (∑H);
- Almost half of all EMUs (with full datasets) have significant non-fishing mortality pressure.

The above findings suggest that management options to consider these pressures are potentially of equal importance to those addressing fishing pressures in contributing to the aim of restoring these EMUs to sustainable levels.

Further analysis of the subcomponents used to calculate non-fisheries mortality rates (∑H) would be useful to identify the specific key pressures that these EMUs face. Such information could be implemented in the development of more specific/tailored management options to restore eel populations in these catchments.

Over the past two decades, numerous studies on individual components of the collective environmental pressure have been published within a rapidly growing publication trail for eel science. A Web of Science search returned 210 articles dealing with the causes of the decline of eels (Figure 4.5). Articles referenced in the Web of Science on the causes of the decline of eels were first published during 1980s and their numbers increased significantly after the publication of the Quebec Declaration of Concern (Dekker *et al.*, 2003b). The topics of the journals in which they were published are highly varied, due in part to the diadromous life cycle of the eel. The first articles (in 1986) dealt with the occurrence of the swimbladder parasite *Anguillicola crassus*. The role of contaminants in the decline of eels has been the most published research topic since the early 1990s.

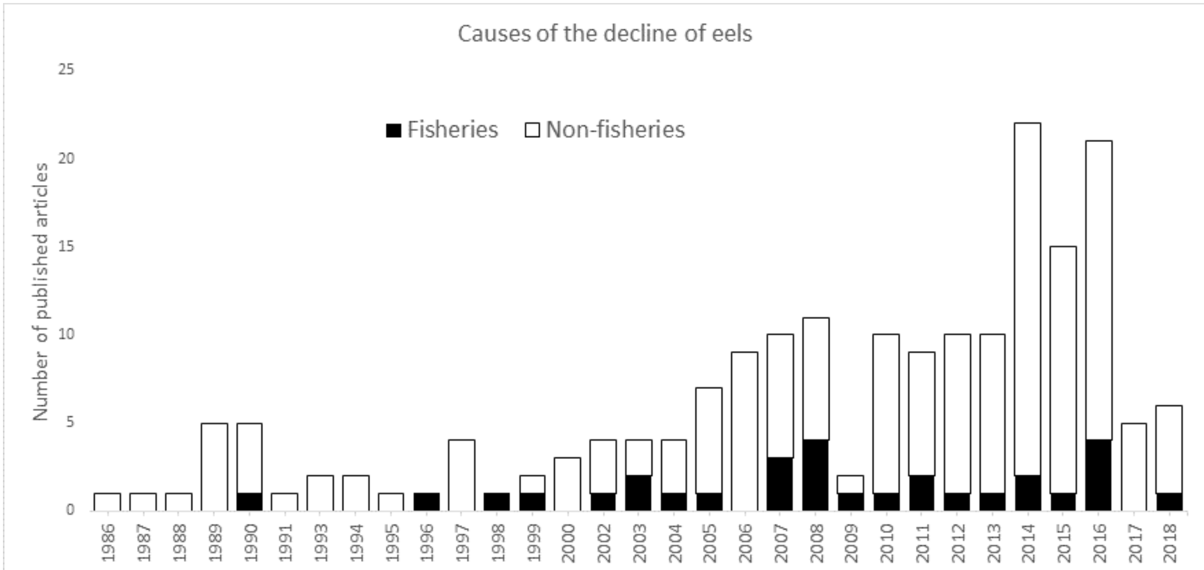


Figure 4.5. Number of research article published on the causes of the decline of eels divided into fishery and non-fishery pressures. This figure is based on a literature search (Web of Science) including the following keywords: *Anguilla* AND eel AND decline AND factor OR cause. The period covered is 1986–2018 (search performed on June 6, 2018). Note the numbers for 2017 and 2018 are incomplete.

Moving to an ecosystem-based management approach will inevitably take time, just as it has taken almost 20 years from the first consensus of serious decline to putting in place international fishery management frameworks and a stock reporting system. There is perhaps no obvious route to understanding the contribution of changes in the oceanic phase, but there is clear scope to further quantify non-fishery impacts and the benefits of further action on the continental phase, building for example on action forced by compliance with the requirements of the Water Framework Directive (WFD) and Marine Strategy Framework Directive (MSFD) within the EU.

It is therefore proposed that WGEEL establish a standing annual activity/subgroup package tasked with taking forward QUANTIFICATION of the non-fishery impacts, and to review methods for assessing and reducing these mortalities. This would indicate the potential additional benefits of conservation measures (both ongoing, e.g. in WFD and MSFD, and potentially new) beyond fisheries management actions. A new dedicated section in future country reports, changing annually, would facilitate this task.

4.3.2 Threats and opportunities raised in previous WGEEL reports

The eel is exposed to a multitude of risks because of its diadromy and complex life history. For many of these risks the impact on the stock is difficult to assess and largely unknown.

WGEEL have reported on emerging threats and opportunities in each of the previous three years (ICES, 2015; 2016; 2017). The general threat types highlighted in the each of the years are summarised in Table 4.3. The threat posed by Contaminants appears in all three years, Diseases and Climate Change in two years whilst the remainder (Hydropower, Marine Renewable Energy, Predators, Recreational Fishing, Parasites) appear in a single year. While some of these reported threats are newly emerging (e.g. a newly identified contaminant), there is the danger of overlooking the fact that these summary headings refer to threats that, once identified, should be regarded as current and ongoing. In many cases these areas of threats have a relatively long history (decades) yet the mitigation measures that have been implemented have tended to be minor and incremental rather than decisive, and thus scope for action may remain.

Table 4.3. Summary of threats identified by WGEEL 2015, 2016, 2017. Commercial fisheries are dealt with in Chapter 2.

THREAT	2015	2016	2017
Contaminants	y	y	y
Parasites			y
Diseases	y		y
Hydropower	y		
Marine renewable energy	y		
Predators	y		
Invasive species	y		
Climate change	y	y	

A range of perceived opportunities were also identified in the respective reports in conjunction with the threats listed above (Table 4.4). These are somewhat harder to categorise, tending to be more specific in nature as they often relate to individual studies providing new information, and are perhaps more accurately described as advances in a scientific process/method rather than a novel opportunity (e.g. new local stock assessment improvements, new migration studies, new restocking information). Exceptions to this have been developments of new techniques with widespread potential application (Environmental DNA, telemetry advances, new artificial reproduction techniques) or new political or management initiatives (development of the GFCM, CITES action). Accordingly, the opportunities identified have tended only to be reported in a single year, usually the year of project inception.

Table 4.4. Opportunities identified by WGEEL 2015, 2016 and 2017.

Opportunity	2015	2016	2017
Invasive species	y		
Advances in telemetry	y		
Environmental DNA	y		
Advances in artificial reproduction	y	y	
Advances in genetic/bio- markers	y		
New restocking info	y	y	
Stock assessment advance		y	
New migration info		y	y
New habitat use info		y	y
New hydropower mitigation measures		y	
GFCM development		y	
Convention on migratory species proposal			y
Improved GE catch reporting			y
New study of minimum size limits			y
New GE estimation model			y
New larval feeding info			y
New restocking info			y

4.3.3 New and emerging threats

Country Reports and expert comments on new or emerging threats were discussed in conjunction with a review of ongoing/current threats where recent improvements in methodologies or knowledge has increased awareness of their importance for the stock.

Predators (Cormorants): Hansson *et al*. (2017) have shown that the mortality due to cormorant predation in the Baltic Sea may be of the same order of magnitude as from the commercial fishery in the Baltic. Additional data are given in Lundström *et al*. (2010) and Östman *et al*. (2013). There are also similar data from some lakes in Sweden, where cormorants consumed more eels than were landed by the fishery (Ovegård, 2017).

Climate change/high water temperatures: The summer of 2018 was unusually warm and dry for a long period in many European countries. This climate or weather situation resulted in high water temperatures and low oxygen levels that may have stressed eels and/or favoured some bacterial and viral diseases. In addition, some habitats may have disappeared due to drought. Sweden reported on frequent findings of diseased and dead eels from several lakes (Axén, SVA, pers. comm.). Estonia also experienced eel mortalities in connection to high water temperatures, and several incidences of unexplained eel mortalities were reported in the UK.

EU Exit of UK (Trade Issues): Several countries rely on restocking in their EMPs, with UK glass eels amongst those used. The imminent exit of the UK from the EU may result in an eel export ban because of the CITES Regulation in relation to European Eel Trade. Any such ban could have severe implications for several Member States EMP compliance.

Illegal fishing/trafficking: Dwindling eel recruitment and stock drive a demand for eels, mainly for aquaculture in Asia, which in turn drives a black market in glass eel, breaching CITES-regulations and the export ban from EU, see Outhwaite and Brown (2018). Because of demand for seed material for aquaculture, several, if not all, tropical eel species are also now exploited (Crook, 2014; Gollock *et al*., 2018).

Hydropower, intakes, pumps and water infrastructure: Mortalities in relation to hydropower production (intake screens, turbines, pressure drops, etc.) have grown in importance as a proportion of total anthropogenic impact as fisheries have decreased. Delays related to downstream passage at weirs are stressed by France and UK. Timing of operation of weirs and sluices linked to differences in migration period could affect males and females differently resulting in an unsynchronized arrival to the spawning area.

Biased ageing: A recent paper by Kullmann *et al*. (2018) demonstrates that ages in eel originating from restocking are overestimated, resulting in underestimated growth rates. The reason behind the overestimated age is that cultured eels often show supernumerary checks that can be difficult to distinguish from true annuli. The authors show that an underestimated growth rate strongly affects the outcome of age-based cohort models.

Contaminants: Eels represent one of the most intriguing examples of how toxic stress may impact a species at the population level. Benefitting from new scientific evidence, pollution has received increasing attention as a possible cause for the decline of the eel. Apart from legacy pollutants like e.g. PCBs and DDTs, other compounds have also been reported bioaccumulating in wild or exposed eels, for example carcinogenic dyes such as Malachite Green (Belpaire *et al*., 2015) and even drugs such as cocaine (Capaldo *et al.,* 2012). A variety of these contaminants affect eels and the effects were reported at several levels of biological organization, from subcellular, organ, individual up to even population level. Ecotoxicogenomic and transcriptomic studies provide evidence of evolutionary and genotoxic effects. Reports documented disturbances of the immune system, the reproduction system, the nervous system and the endocrine system. Lipophilic pollutants can impact reproduction through direct damage to organs after their remobilization from fat, inducing embryotoxic effects in larvae. Alternatively, pollutants may affect the eel stock through interaction with lipid physiology, while establishing enough lipid energy is essential to fulfil their life cycle. The silvering process, the subsequent downstream and transoceanic reproductive migration, as well as gonad maturation, can only take place if enough quantity of energy is stored as lipids (Belpaire *et al*., 2016).

Effects of parasite burden: While increasing efforts are undertaken to increase the quantity of silver eel escaping to their spawning grounds, there is concern that a substantial proportion might not be able to contribute to reproduction due to significant body burden of *A crassus*, other parasites and pathogens.

Microplastics: The occurrence of tiny particles in the food chain, including in fish stomachs have been much discussed in recent years. Whether eel and eel larvae are affected is not yet known, though some preliminary unpublished studies did not find any plastic particles in eel larvae from the Sargasso Sea (Ogonowski *et al*., 2018; Ogonowski, pers. com.).

Disease transfer via restocking: WGEEL has previously highlighted the risk of spreading diseases via restocking of glass eel out with their catchment of origin. During the quarantine period in Sweden in 2017, a batch of glass eel imported from France was discovered to be infected with the rhabdovirus EVEX. Van Ginneken *et al.* (2015) have shown that European eel infected with EVEX (Eel Virus European X) virus developed haemorrhage and anaemia during simulated migration in large swim tunnels and died after 1000–1500 km (in contrast to disease free animals). They concluded that eel virus infections may adversely affect the spawning migration of eels. The Swedish authorities elected to destroy the batch (of about 1 t) of infected eel, representing a substantial loss for eel restoration. This example illustrated that lack of any progress toward effective quality assessment which comprised a veterinary health inspection that included viral assessment of eels used for restocking, remains an important risk for disease transfer. Not all countries restocking glass eel have quarantine and fish health inspection procedures, thus infected eels from similar origin may have been restocked elsewhere.

4.3.4 New and emerging opportunities

Several opportunities supporting eel restoration were raised at the WGEEL and are described briefly below.

Telemetry developments: Recent applications of tracking technology such as acoustic telemetry (Belgium) in combination with listening stations and/or the use of acoustic cameras (Ireland, Sweden) illustrate the opportunities in improving the monitoring of seaward migrating silver eels. Greece reported ongoing work with pop-up satellite tags examining migration patterns of eels released in the Aegean Sea. With some tags still to pop up in September 2018 the furthest eels have reached is the Adriatic Sea, apparently heading west into the Mediterranean Sea.

New Collaborative Projects: SUDOANG (https://www.azti.es/es/ficha/sudoang/) is an Interreg Sudoe project which aims to provide tools and to implement joint methods in support of the conservation of the eel and its habitat. More specifically, the Eel Density

Analysis model (EDA) will be implemented, which allows the prediction of yellow eel densities and silver eel escapement from electrofishing survey networks. Also, the project will allow quantification of the impacts of hydropower facilities on downstream-migrating silver eels. Hence, the project has the potential to improve estimations of the stock indicators for the next post evaluation report.

Improvements in eel passage: New sea sluice management facilitating inward and outward migration open opportunities for eel restoration is being introduced in the Scheldt EMU. The potential for the ongoing development of fish-friendly passage technology (through turbines, pumps, etc.) represents an opportunity for widespread mitigation of hydropower-related mortalities, but it should be noted that the advantages of such technologies remain largely unproven.

Trafficking data: WGEEL has accessed and used data from monitoring of trafficking, cross checked with reported fishery data to show the extent of missing information on trade in eel.

4.3.5 Conclusions – improving quantification of non-fisheries impacts on eel

The process of identifying threats and opportunities in previous WGEEL reports, and again here, illustrates that while trends in published research themes come and go (Figure 4.6), the areas of concern once highlighted often remain current and unaddressed. Now, as the scope for further reduction of fisheries mortality is decreasing and the relative impact of non-fisheries mortality has been shown to be correspondingly increasing, it may be time for a raised focus on non-fisheries impacts on eel. The goal should be to further integrate these non-fishery impacts into the wider quantitative stock assessment.

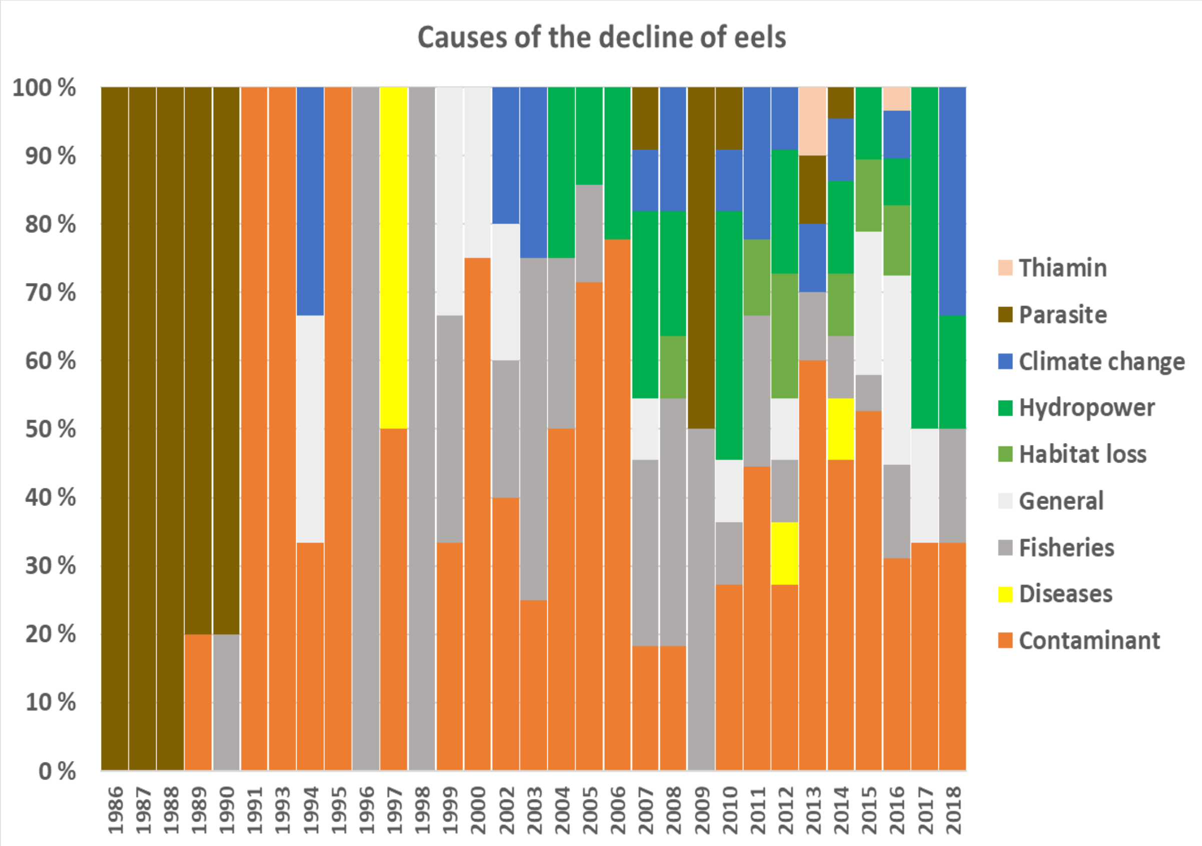


Figure 4.6. Proportion of the articles dealing with research topics listed on the right side of the figure. This is based on a literature search (Web of Science) including the following keywords: *Anguilla* AND eel AND decline AND factor OR cause. The period covered is 1986–2018 (search performed on June 6, 2018).

Progress to a better understanding of these identified threats may be best achieved by adding a rolling programme of scientific reviews aimed at reporting work toward QUANTIFICATION of at least one of the identified components of the non-fishery impacts listed above within each annual WGEEL meeting. This process should be accompanied by a specific pre-meeting call for information from contributors, with a specific section in the Country Report, while keeping a focus on how each fits into the ecosystem approach. Inviting specialists to address and contribute to particular topics could assist in this progress.

Regular revisiting of non-fishery impacts will thus provide the means of incremental improvement in estimated time to recovery and noting of changes in threat level of non-fishery factors as new information becomes available.

4.3.6 Recommendations

WGEEL therefore proposes establishing a standing annual activity/subgroup package tasked with taking forward QUANTIFICATION of the non-fishery impacts and therefore the potential additional benefits of conservation measures (both ongoing, e.g. in WFD and MSFD, and potentially newly identified impacts) beyond fisheries management actions.

The WGEEL suggest that three factors contributing to non-fishery mortality offer prospects for quantitative assessment, and would be considered during 2019–2021:

- Impacts of hydropower turbines and pumping stations;

- Impacts of barriers to migration on habitat availability to eel;
- Effects of contaminants on reproductive potential.

5 ToR D: Respond to the ICES Generic ToRs and other requests

5.1 In response to the ICES Generic ToRs

The Working Group was asked, where relevant, to consider the questions posed by ICES under their generic ToRs for regional and species Working Groups. WGEEL responses to the generic ToR are given in the respective sections throughout the report No responses were given for generic ToRs considered not relevant to WGEEL.

5.2 In response to the recommendations of the Regional Coordination Groups (RCGs)

The ICES Diadromous species subgroup (DSG) met as a pan-regional group within the regional coordination group (RCG) meeting for the Baltic in 2017 and made several requests to WGEEL for information. This section reports these Recommendations (in italics) and then WGEEL 2018 considerations.

- WGEEL to consider and report any benefits to eel assessment of regional coordination of data collection in the North Sea and Eastern Arctic, and North Atlantic RCG region.
- WGEEL to consider and report any benefits to eel assessment of regional coordination of data collection in the Mediterranean.

For the use of data collected at national and regional levels, clear definitions of the assessed parameters are required. It should be coordinated and standardized on international level whether e.g. restocking is treated as negative mortality, assisted up- and downstream migration is reported in landing and/or release data, which area is included in the assessment of B_0, and whether numbers or weight should be used for the calculation of mortalities.

It is of great benefit and necessity to have a standardized procedure of data collection and analyses in all countries where the species exists. Especially in “closed environments” like the Baltic Sea and the Mediterranean, with similar habitats, fisheries and environmental conditions, the regional coordination of data collection and analyses and implementation of management measures can improve eel assessment. There should be a coordinated strategy of regional data collection to ensure high data quality and comparable data. A pan-Baltic or pan-Mediterranean approach would help to avoid problems like the identification of the origin of migrating silver eels in coastal waters. Common measures could be enforced and increasing spawner escapement from a region rather than from single EMUs or countries.

The comparability of results should be ensured by regional coordination of data collection and analytical standards also in the North Sea and the North Atlantic regions.

- WGEEL to advise on data quality indicators, the quality of data supplied by MS, the effect of these qualities on the assessments, and therefore identify any significant improvements in data quality required.

Data collection methods applied by the Member States vary widely and standardization is lacking. Quality checks should be applied to the data collection and to the outputs of the assessments, i.e. stock indicators, for the consistancy of the results.

In 2017, WGEEL established a data quality index that ensures that data of low quality are flagged in the database (albeit that the data providers make a qualitative determination of this data quality) (See Annex 8 Table 17). This allows for exclusion of data with low quality from analyses if desired and enables their replacement as soon as better data/methods are available. This procedure improves the quality of the data used for the stock assessment.

- WGEEL to work out the optimal approach for selecting the appropriate index rivers in the Baltic.

For eel, the recommendation of WKESDCF (ICES, 2012) on Eel Index River selection remains relevant. The WKESDCF report defined the Eel Index Rivers as "basins where intensively monitored systems are employed to produce census and other biological data for pertinent life stages (glass, yellow, silver)". Moreover, the WKESDCF recommended that ICES should approve the selection of index river systems.

WGEEL does not have a system for naming rivers or deciding on number of rivers at this time, but anticipates some analyses to support this.

- The Regional Database can be modified to better incorporate the data for eels under the DCF. The WGEEL are asked to list the data types that should be incorporated in the RDB to achieve this.

For WGEEL there is no pressing need to incorporate the data for eels collected under the DCF into the RDB, since a separate eels database is well developed to store the data that the countries provide through the ICES data calls. However, the new eel database has taken into account, where possible, the ICES guidelines, structures and definitions in order to ease the transfer of the eel database across into an already established system. If the incorporation of eel into the RDB is desired, modifications are required to include eel habitats (freshwater, transitional; rivers, lakes, estuaries, lagoons and canals) and development stages (glass eel, yellow eel, silver eel). Further modification is needed to include fishing gears used in eel fisheries.

- Examine the RCG 2018 ToR and consider how to support any ahead of the Kavala meeting.

Regarding RCG 2018 ToR 1.3. WGEEL-feedback on the recommendations and requests is given below (points 1–5). Supporting information for ToR 2.1 on the report on compliance with the Eel data call 2018 and possible modifications for 2019 is given in Chapter 4. The eel database development is documented in Chapter 3 and possible modifications of the RDB (ToR 3.2.) are presented above (recommendations).

In addition, as the EU MAP Regulation (2017/1004) specifies some regional coordination requirements for eel data collection, these were considered by the WGEEL.

1) For commercial fisheries in Union waters, advise on the selection of stocks for which variables (sex-ratio, maturity, fecundity) have to be collected in support of scientific advice, and the temporal frequency of data collection.

The European eel is panmictic and therefore consists of a single stock. As assessment and management are usually applied at national level, data collection should be supportive of this. The requirements set in EU MAP Regulation 2017/1004 are consistent with the recommendations of the ICES Workshop on Eel and Salmon in the DCF (ICES, 2012) and remain relevant to date. Therefore, information should be collected in each Eel Management Unit (EMU). Each Member State should have completed the data collection within the time frame set by EU-MAP.

Although fecundity is not used in any stock assessments for eel now, it may become important in future if more refined models become available for the stock assessment.

A coordinated pilot study is therefore required. Information on maturity is not required, providing that life stage (i.e. glass, yellow or silver) is specified.

2) For commercial fisheries in freshwaters, specify stock-related variables to be collected for individual specimens, on age, length, weight, sex, maturity and fecundity, by life stage. Noting that the requirement to collect annual catch quantities by age class or life stage is obligatory.

Data on age, length, weight and sex for yellow and silver eel are necessary to perform assessments. The collection of the data should be performed on a periodic basis (e.g. every three years). Although fecundity is not used in any stock assessments for eel now, it may become important in future if more refined models become available for stock assessment. It might therefore be considered to assess fecundity on a regular basis. Information on maturity is not required, providing that life stage (i.e. glass, yellow or silver) is specified.

3) For recreational fisheries in all waters, advice on the end-user needs for age or other biological data, noting the requirement to collect annual volume (numbers and weights or length) of catches and releases is obligatory.

The WGEEL was not able to form a complete answer to this question.

4) Define the rivers to be monitored for eel at regional level, noting that 'rivers' in the Legal Text is interpreted to represent 'water bodies' (STECF, 2017).

For eel, the recommendation of ICES WKESDCF 2012 on Eel Index River selection remains relevant, that information should be collected at least in one river within each EMU. WGEEL does not have a system for naming rivers or deciding on number of rivers at this time, but anticipates some analyses to support this.

5) Coordinate, at regional level, the selection of stocks from which eel variables (recruits, standing stock and silver eel) have to be collected.

According to Regulation (EU) No 1380/2013, Member States shall coordinate their data collection activities. For eel, the recommendation of ICES, WKESDCF 2012 on Eel Index River selection remains relevant. Moreover, WKESDCF 2012 recommended that ICES should approve the selection of index river systems.

6 Considerations on the future work of the WGEEL

This chapter is not part of the response to the ToR, but documents discussions and developments on the future work plans of the WGEEL. Section 6.1 functions as a description of the future of the Country Reports (CR), if the CRs are needed and if so whether the structure should be changed. Section 6.2 entails the future science focus and how the WGEEL might address a wider audience and exposure of the results and research conducted in connection to annual meetings.

6.1 Country Report content

To decide whether the Country Report (CR) is still needed or whether the format needed any change, almost every attending member of WGEEL 2018 Gdańsk, Poland, was interviewed. Questions that were asked included whether the CR is needed, who reads the CR and what should be removed/added? The outcomes of these interviews were simplified and presented below.

6.1.1 Should member countries still deliver the Country Report?

Most members wanted to keep the CR (33 out of 37 members) and four members did not want to keep the CR (Figure 6.1).

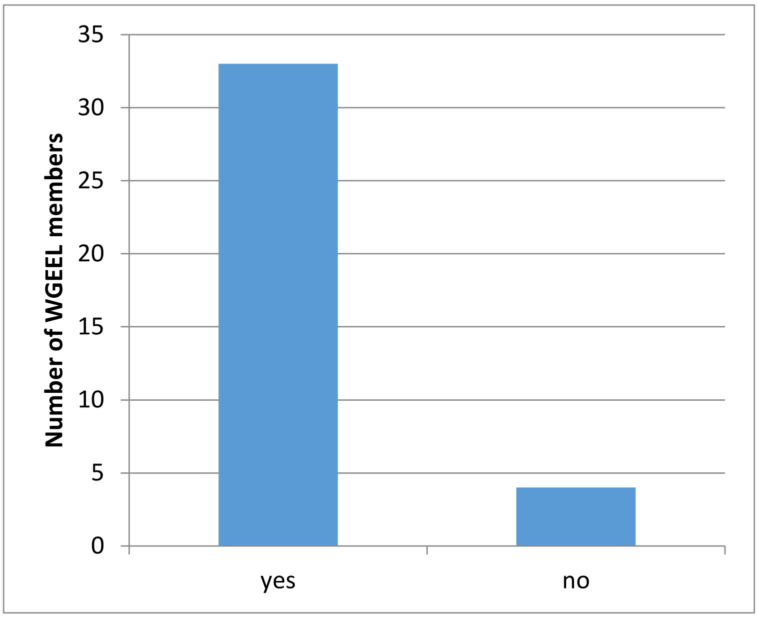


Figure 6.1. Outcome of replies to the question whether the country report should still be produced or not.

It should be noted that six members of WGEEL who did want to keep the CR only wanted to keep it, if the format of the report would change. Suggested changes were: condensing the report (e.g. by using a word limit), keep the wording to a minimum, only report significant changes and refer to previous CR for unchanged sections, and that (parts of) the report should be optional (e.g. Chapter 5).

6.1.2 CR attention by WGEEL members

The CR were found to be frequently read by other member countries. In total, 30 out of 37 members attending the WGEEL 2018 answered that they read the CR of other member countries. Seven answered no, where three of these explained that they only read the CR of other member countries at the WGEEL. This was considered as a no. Two people answered that they only read the supplied datasets (Figure 6.2).

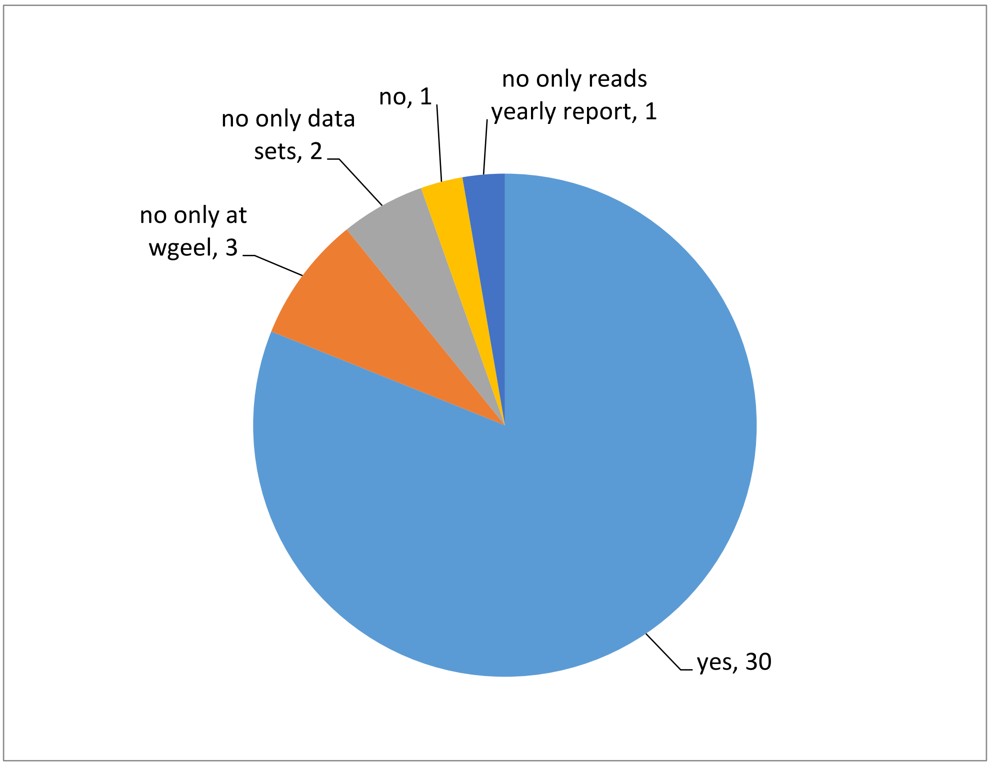


Figure 6.2. Pie chart of replies to the question whether the CR from other member countries are read by the people attending the WGEEL. Numbers in the pie chart represent the number of replies.

6.1.3 CR usage

The usages of the CR were found to be numerous. The most common usage was by the ministry, the public, reference in other work, other scientists and NGO´s. Less common usage includes internal use by colleagues, managers, stakeholders and as a motivational factor for getting regional work done. A few CR were also getting attention by national authorities, students, news and media (Figure 6.3).

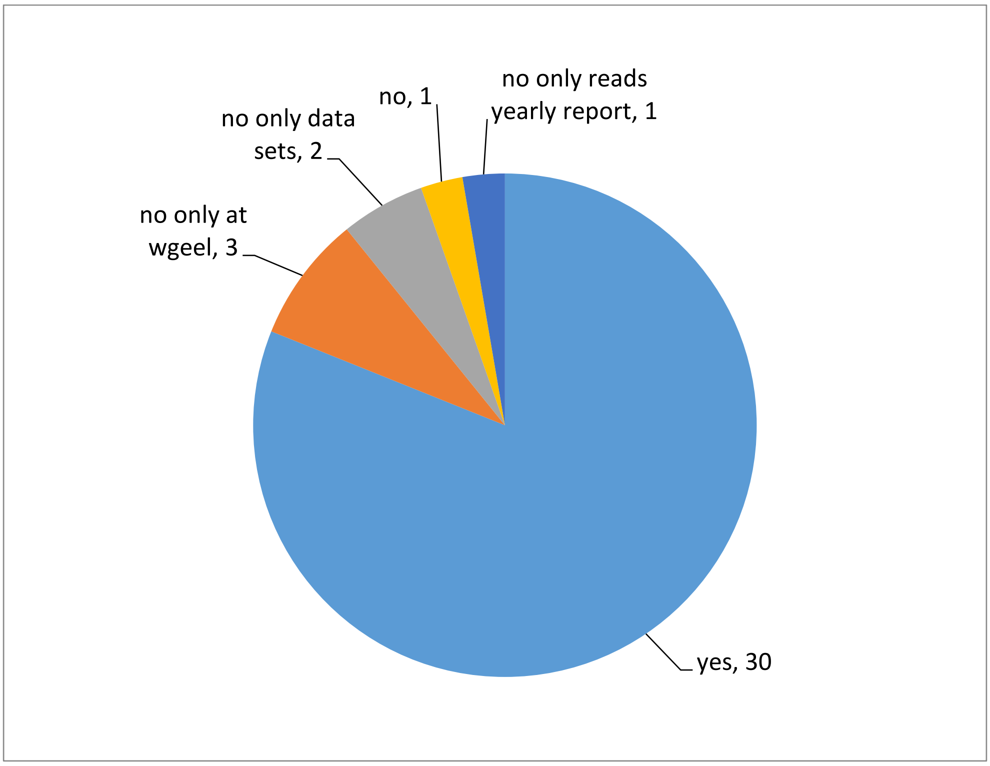


Figure 6.3. Pie chart of replies to the question of what usage the CR has besides being used at the WGEEL. Numbers in the pie chart represent the number of replies.

6.1.4 What could be removed from the CR?

In total, 16 members offered suggestions concerning what to remove from the CR, the other 21 members either had no suggestions or were satisfied with the current content. The suggested changes that were mentioned were the removal of data tables (as they are already included in the Data call), shortening of the word use and keeping significant changes only (Figure 6.4). Others suggestions included deciding on the target audience first and restructure the report based on that, remove the section on habitat quality and quantity (as these often do not change on an annual basis according to the member), remove the section on predation (as there is no known predation according to the member), and remove the Sections 5.2–5.7 (other data collection) or make this section optional as they are not being used according to the member. However, other members expressed their concern about the data quality if this section was made optional.

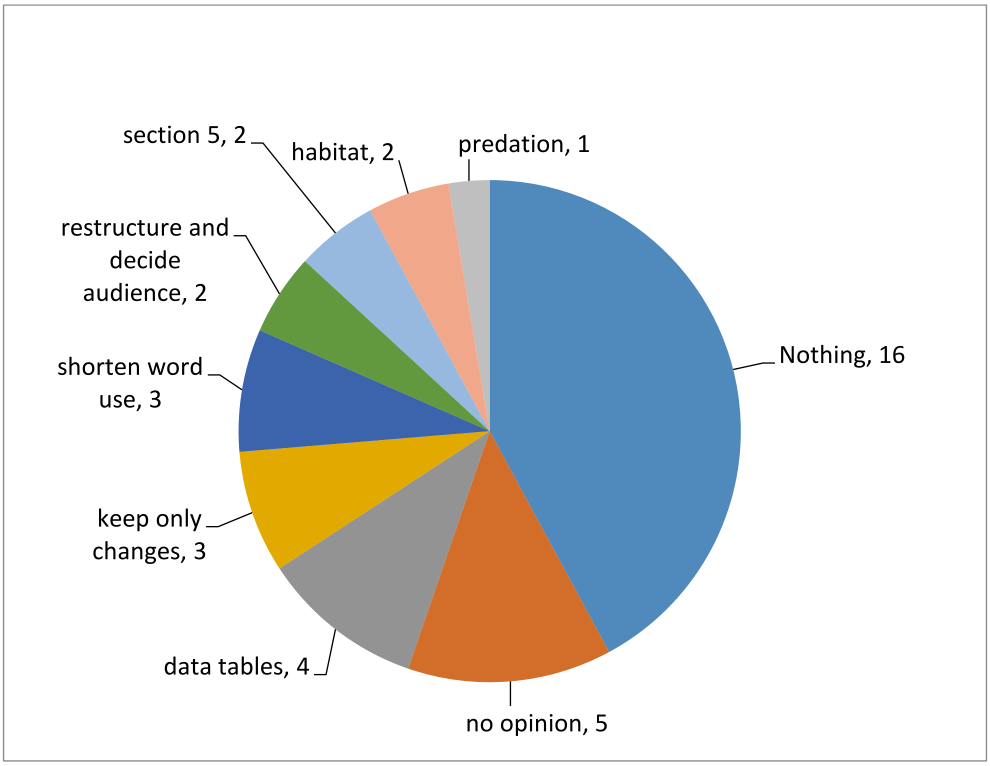


Figure 6.4. Pie chart of replies to the question whether anything needs to be removed from the CR. Numbers in the pie chart represent the number of replies.

6.1.5 What could be added to the CR?

In total, 24 members answered that nothing should be added to the CR or had no opinion, the other 13 members suggested either changes or additions to the CR. Four suggestions were mentioned more than once: add a section on illegal fishing activity, make sure all the reports are in the same format to increase readability, list current threats, and list a section with new/planned projects (although Section 6 in the CR is already available for that purpose). Other suggestions were mentioned only once and are listed in Figure 6.5.

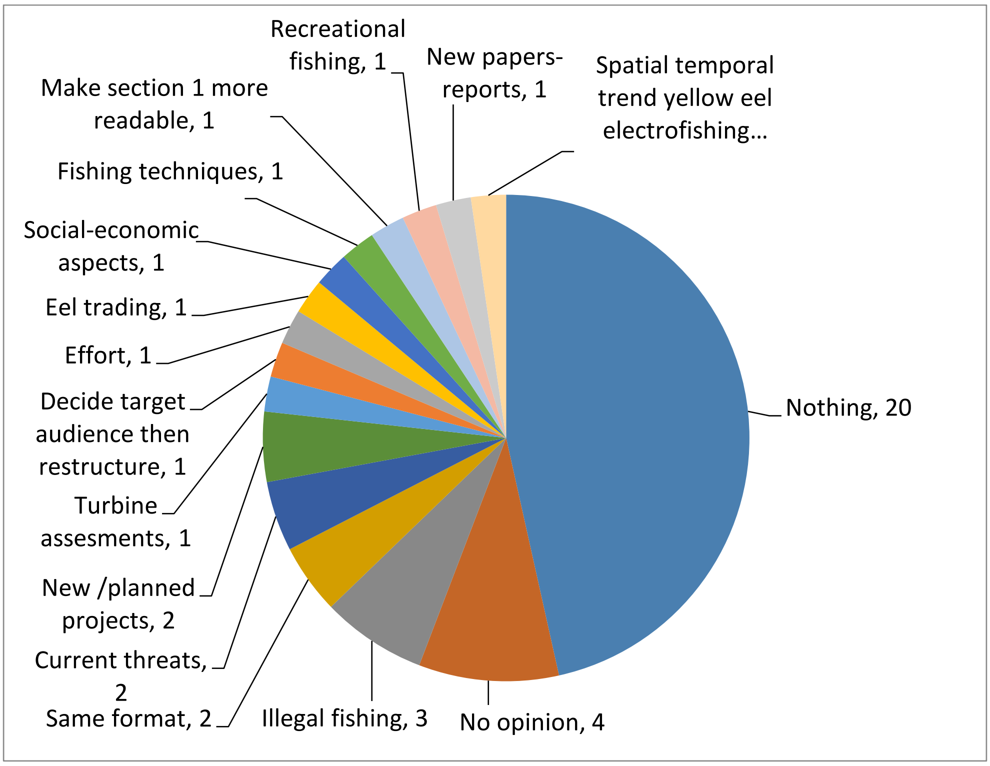


Figure 6.5. Pie chart of replies to the question whether anything needs to be added to the CR. Numbers in the pie chart represent the number of replies.

6.1.6 Comments and suggestions on the CR

Some members had additional suggestions regarding the CR. These included that the target audience should be decided upon and only then decisions should be made on the format and the content of the report; that (parts of) the CR should be optional; that the report or at least the figures should be automated e.g. by using the recently developed shiny app; whether the current figure templates are used by members or not and if they could be made more user-friendly; and that the recruitment figure should be moved up in the CR to the first section.

6.1.7 Conclusions

Based on the above-mentioned results we conclude that the CR should still be produced by each country as it is read by a variety of stakeholders. There are several valuable suggestions made by the attending members of WGEEL that should be considered and discussed. Especially it was pointed out that (i) since data tables are now provided through the ICES data call, the WGEEL has no need for them in the CR (providing that the CR can link to the Data call tables). It should therefore be considered if they could be removed from the CR, (ii) moving the recruitment part which is one of the most essential parts of the CR forwards from Section 5.3, and (iii) in line with plans to make the WGEEL work more accessible, the CR structure and content could be standardized, for example using the ICES figure and table templates.

6.2 Wider science delivery

A science delivery plan was considered at the 2016 WGEEL in Cordoba, Spain (see Section 6.2.2 below). This year, the subject was once again addressed. The methods presented in Section 6.1.2 below cover all the methods used by WGEEL members to communicate their research output and activities. It was concluded that communication with the public should be reinforced to disseminate the results of the annual report of the WGEEL. Therefore, the WGEEL proposes to use the ICES website dedicated to the eel to highlight the annual meeting.

6.2.1 Questionnaire on science communication at WGEEL 2018

The questionnaire at the 2018 WGEEL in Gdańsk, Poland indicated that the members of the WGEEL belong to management institutions (6%) and research institutes (94%), of which only 6% is private. Among these members, 74% participate in outreach activities through diverse communication methods that can be grouped in three categories:

- Written material;
- Oral communications/seminars;
- Activities at specific event days.

The target groups include local government, fishermen, students, and the public in general. The communication method is therefore, adjusted to the target audience.

Written material includes articles in fishermen's magazines, newsletters produced by the parent institution, news in the institutional website, press releases and news in social media (twitter, Facebook and Instagram). Press releases, which are done by 34% of the WGEEL members, have the potential to enlarge communication to other media, such as TV and radio.

Oral communications and seminars are the most commonly used to reach fishermen, local government and the public in general. Special events like the "Open Day" (popular in some institutions) as well as the "World Fish Migration Day" are also used to disseminate the information and call the attention of the audience to the problems related to the conservation of the eel. It is during the World Fish Migration Day that activities are commonly developed with children at school and several WGEEL members join the event.

Despite being involved in rolling out science, the contents of the dissemination actions conducted by most WGEEL members is focused on the eel, but not specifically on the results from the annual report of the WGEEL. It should however, be noted that WGEEL reports are often "works in progress" used to communicate with the parent agencies (ICES, EIFAAC, GFCM). Reaching all stakeholders and the public in general requires a different approach and the use of appropriate communication.

6.2.2 Communication plan from WGEEL 2016

The overall aim of the communication plan developed at the WGEEL 2016, Cordoba, Spain was to expand publicity and use of the scientific outputs and advice of WGEEL to a larger and more diverse audience.

Subgoals

1) Increase the awareness that the group and report exist;
2) Further the dissemination of the report and its main contents;
3) Improve the readability of the report and its main contents.

Target groups

Stakeholders, managers, politicians, journalists, scientists, students and the public on international, national and local levels.

Subgoals 1 and 2 can be achieved by similar actions:

Recommended action	Responsible
Broad e-mail dissemination of report Broad dissemination of the report to target groups when it is published, within the network of each of the working group members. This can be done by forwarding an e-mail with the pdf of the report, with a short description of what the group and report is in the e-mail itself, together with the short summary of the report (see below). It should be a possibility to register e-mail for subscription of updates from the WGEEL, like release of the report. Links to the WGEEL website and report should be provided on the FAO and EIFAAC websites.	Chair or ICES personnel provide the e-mail text and distributes it to e-mail list. Those responsible for the Country Reports deliver an e-mail list of important stakeholders in their country (key persons in government, public sector, commercial sector, media etc.). EIFAAC members have an e-mail list that can be used for different countries as well. Updating this list can be a task during the WGEEL meeting.
Scientific publishing Develop method descriptions, reviews and data analyses from the report into international publications in scientific journals.	Various members of WGEEL
News release Press releases and news releases in different countries based on the short summary of the report. News releases on group members' own institution websites can also be done by releasing the short summary.	ICES communication team and WGEEL members from different countries. Annual press release can also be included as specific generic task during the annual meeting (text + photo)
Inform local press of the meeting?	Local coordinator of annual meeting
Fact sheets Develop and distribute fact sheets on selected methods used by the WGEEL, and on results, advice and reviews from the report A sub task of this is to create a list showing what is in each WGEEL report, because some people do not know that we have detailed description of methodology and tagging, etc. This will work as a way of archiving the reports and should make finding the data contained inside easier, until we get the fact sheets and relevant chapters published. (See ICES popular advice fact sheets: http://ices.dk/publications/library/Pages/default.aspx#k=popular%20advice)	Chair, task group leaders and selected WGEEL members. Include as specific generic terms of reference for each annual meeting.
Social media Social media - Facebook, twitter, etc.	Include as specific generic task in each annual meeting. Updates between meetings by appointed working group members.
Wikipedia Check if WGEEL is on Wikipedia. If not add a description of the working group and its work.	English version and translations to other languages. Include as specific generic task in annual meeting 2017

Recommended action	Responsible
	and include as tasks for each following meeting to update it.
ICES Communication team Initiate increased use of the ICES communication team. As a start, discuss with them how and with what they can contribute. Does FAO have a communication team that we can use?	Chair, or someone appointed by the chair.
ICES and WGEEL websites Direct others to the ICES and WGEEL websites	All

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Annex 2: Acronyms and Glossary

ACRONYMS	DEFINITION
ACFM (ICES)	Advisory Committee on Fisheries Management
ACOM (ICES)	Advisory Committee on Management
ADGEEL	Advice drafting group on eel, for ICES
AngHV-1	Anguillid herpes virus 1
BERT	Bayesian Eel Recruitment Trend model
CAGEAN	The Catch-at-Age Analysis Model
CITES	Convention on International Trade in Endangered Species
CMS	Convention on Migratory Species
cpue	Catch per unit of effort
C&R	Catch and release mortality
DD	Density-dependent
DCF	Data Collection Framework
DEMCAM	Demographic Camargue Model
DG MARE	Directorate-General for Maritime Affairs and Fisheries, EU
DNA	Deoxyribonucleic acid
DPMA	Direction des Pêches Maritimes et de l'Aquaculture, France
e-DNA	Environmental DNA
EC	European Commission
EDA	Eel Density Analysis (modelling tool)
EIFAAC	European Inland Fisheries & Aquaculture Advisory Commission
EIFAC	European Inland Fisheries Advisory Commission
EMP	Eel Management Plan
EMU	Eel Management Unit
EFF	European Fisheries Fund
EQD	Eel Quality Database
EROD	Ethoxyresorufin-O-deethylase
ESAM	Eel Stock Assessment Model
EU	European Union
EU MAP	The European Union Multi Annual Plan
EVEX	Eel Virus European X
FAO	Food and Agriculture Organisation
FEAP	The Federation of European Aquaculture Producers
GEM	German Eel Model
GFCM	General Fisheries Commission of the Mediterranean
GIS	Geographic Information Systems
GLM	Generalised Linear Model
HPS	Hydroelectric power Station
ICES	International Council for the Exploration of the Sea
IMESE	Irish model for estimating silver eel escapement
IUCN	The International Union for the Conservation of Nature
GST	Glutathione-S-transferase
LAM	Lifetime anthropogenic mortalities
MS	Member State

ACRONYMS	DEFINITION
MSY	Maximum Sustainable Yield
MoU	Memorandum of Understanding
NAO	North Atlantic Oscillation
NC	"Not Collected", activity / habitat exists but data are not collected by authorities (for example where a fishery exists but the catch data are not collected at the relevant level or at all).
NDF	Non-Detriment Finding
NP	"Not Pertinent", where the question asked does not apply to the individual case (for example where catch data are absent as there is no fishery or where a habitat type does not exist in an EMU).
ONEMA	Office National de l'Eau et des Milieux Aquatiques, France (ex-CSP)
PAH	Polyaromatic hydrocarbons
PBDE	Polybrominated diphenyl ether
PCB	Polychlorinated biphenyl
PFOS	Perfluorooctane sulfonate
POSE	Pilot projects to estimate potential and actual escapement of silver eel
RBD	River Basin District
RGEEL	Review Group on Eel (ICES)
SAC	The GFCM Scientific and Advisory Committee on Fisheries
SCICOM	The Science Committee of ICES
SGIPEE	Study Group on International Post-Evaluation on Eels
SLIME	Restoration the European Eel population; pilot studies for a scientific framework in support of sustainable management
SMEP II	Scenario-based Model for Eel Populations, vII
SPR	Estimate of spawner production per recruiting individual.
SRG	Scientific Review Group
SSB	Spawning–Stock Biomass
ToR	Terms of Reference
WG	Working Group
WGEEL	Joint EIFAAC/ICES/GFCM Working Group on Eel
WGRFS	The Working Group on Recreational Fisheries Surveys
WKAREA	Workshop on Age Reading of European and American Eel
WKBECEEL	Working Group on Biological Effects of Contaminants in Eel
WKEPEMP	The Workshop on Evaluating Progress with Eel Management Plans
WKESDCF	Workshop on Eels and Salmon in the Data Collection Framework
WKPGMEQ	The Workshop of a Planning Group on the Monitoring of Eel Quality
WFD	Water Framework Directive
WKLIFE	Workshop on the Development of Assessments based on LIFE-history traits and Exploitation Characteristics
WKPGMEQ	Workshop of a Planning Group on the Monitoring of Eel Quality under the subject "Development of standardized and harmonized protocols for the estimation of eel quality"
WGRFS	Working Group on Recreational Fisheries Surveys
YFS1	Young Fish Survey: North Sea Survey location
IYFS	International Young Fish Survey

Glossary

Bootlace	Intermediate sized eels, approx. 10–25 cm in length (fingerlings). These terms are most often used in relation to restocking. The exact size of the eels may vary considerably. Thus, it is a confusing term.
Depensation	The effect on a population when a decrease in spawners leads to a faster decline ' in the number of offspring than in the number of adults.
Eel Management Unit (Eel River Basin)	"Member States shall identify and define the individual river basins lying within their national territory that constitute natural habitats for the European eel (eel river basins) which may include maritime waters. If appropriate justification is provided, a Member State may designate the whole of its national territory or an existing regional administrative unit as one eel river basin. In defining eel river basins, Member States shall have the maximum possible regard for the administrative arrangements referred to in Article 3 of Directive 2000/60/EC [i.e. River Basin Districts of the Water Framework Directive]." EC No. 1100/2007.
Elver	Young eel, in its first year following recruitment from the ocean. The elver stage is sometimes considered to exclude the glass eel stage, but not by everyone. To avoid confusion, pigmented 0+ cohort age eel are included in the glass eel term.
Escapement (silver eel)	The amount of silver eel that leaves (escapes) a water body, after taking account of all natural and anthropogenic losses.
Glass eel	Young, unpigmented eel, recruiting from the sea into continental waters. WGEEL consider the glass eel term to include all recruits of the 0+ cohort age. In some cases, however, also includes the early pigmented stages.
Non-detriment finding (NDF)	the competent scientific authority has advised in writing that the capture or collection of the specimens in the wild or their export will not have a harmful effect on the conservation status of the species or on the extent of the territory occupied by the relevant population of the species
On-grown eels	Eels that are grown in culture facilities for some time before being restocked.
Silver eel production	The amount of silver eel produced from a water body. Sometimes referred to as escapement + anthropogenic losses, or production-anthropogenic losses = escapement.
River Basin District	The area of land and sea, made up of one or more neighbouring river basins together with their associated surface and groundwaters, transitional and coastal waters, which is identified under Article 3(1) of the Water Framework Directive as the main unit for management of river basins. The term is used in relation to the EU Water Framework Directive.
Silver eel	Migratory phase following the yellow eel phase. Eel in this phase are characterized by darkened back, silvery belly with a clearly contrasting black lateral line, enlarged eyes. Silver eel undertake downstream migration towards the sea, and subsequently westwards. This phase mainly occurs in the second half of calendar years, although some are observed throughout winter and following spring.
Restocking	Restocking is the practice of adding fish [eels] to a waterbody from another source, to supplement existing populations or to create a population where none exists.
To silver (silvering)	Silvering is a requirement for downstream migration and reproduction. It marks the end of the growth phase and the onset of sexual maturation. This true metamorphosis involves a number of different physiological functions (osmoregulatory, reproductive), which prepare the eel for the long return trip to the Sargasso Sea. Unlike smoltification in salmonids, silvering of eels is largely unpredictable. It occurs at various ages (females: 4–20 years; males 2–15 years) and sizes (body length of females: 50–100 cm; males: 35–46 cm) (Tesch, 2003).

Yellow eel (Brown eel)	Life-stage resident in continental waters. Often defined as a sedentary phase, but migration within and between rivers, and to and from coastal waters occurs and therefore includes young pigmented eels ('elvers' and bootlace). Sometimes yellow eel is also called 'brown eel'.
EEL REFERENCE POINTS/POPULATION DYNAMICS	
$B_{current}$ or B_{curr} (Current escapement biomass)	The amount of silver eel biomass that currently escapes to the sea to spawn, corresponding to the assessment year.
B_{best} (Best achievable biomass)	Spawning biomass corresponding to recent natural recruitment that would have survived if there was only natural mortality and no restocking, corresponding to the assessment year.
B_0 (Pristine biomass)	Spawner escapement biomass in absence of any anthropogenic impacts.
B_{lim} (Limit spawner escapement biomass)	Spawner escapement biomass, below which the capacity of self-renewal of the stock is considered to be endangered and conservation measures are requested (Cadima, 2003).
B_{MSY}	Spawning–stock biomass (SSB) that is associated with Maximum Sustainable Yield (MSY)
B_{pa} (Precautionary spawner escapement biomass)	The spawner escapement biomass, below which the capacity of self-renewal of the stock is considered to be endangered, taking into consideration the uncertainty in the estimate of the current stock status.
F	Fishing mortality rate
F_{lim}	F_{lim} is the fishing mortality which in the long term will result in an average stock size at B_{lim}.
F_{pa}	ICES applies a precautionary buffer F_{pa} to avoid that true fishing mortality is above F_{lim}.
F_{MSY}	F_{MSY} is estimated as the fishing mortality with a given fishing pattern and current environmental conditions that gives the long-term maximum yield.
M	Natural mortality
MSY	Maximum Sustainable Yield
MSY $B_{trigger}$	Value of spawning–stock biomass (SSB) which triggers a specific management action, in particular: triggering a lower limit for mortality to achieve recovery of the stock.
Precautionary spawner escapement biomass (B_{pa})	The spawner escapement biomass, below which the capacity of self-renewal of the stock is considered to be endangered, taking into consideration the uncertainty in the estimate of the current stock status.
Pristine	Conditions not affected by humans
R(s)	The amount of eel (<20 cm) restocked into national waters annually
R^2	Determination coefficient
Spawner per recruitment (SPR)	Estimate of spawner production per recruiting individual.
%SPR	Ratio of SPR as currently observed to SPR of the pristine stock, expressed in percentage. %SPR is also known as Spawner Potential Ratio.
ΣF	The fishing mortality rate, summed over the age groups in the stock

ΣH	The anthropogenic mortality rate outside the fishery, summed over the age groups in the stock
	EEL REFERENCE POINTS/POPULATION DYNAMICS
ΣA	The sum of anthropogenic mortalities, i.e. ΣA = ΣF + ΣH. It refers to mortalities summed over the age groups in the stock.
3 Bs & ΣA	Refers to the three biomass indicators (B_0, B_{best} and $B_{current}$) and anthropogenic mortality rate (ΣA).

Definition: 40% EU Target: "The objective of each Eel Management Plan shall be to reduce anthropogenic mortalities so as to permit with high probability the escapement to the sea of at least 40% of the silver eel biomass relative to the best estimate of escapement that would have existed if no anthropogenic influences had impacted the stock". The WGEEL takes the EU target to be equivalent to a reference limit, rather than a target.

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Name	institution	country	e-mail
Alan Walker Chair	Centre for Environment, Fisheries and Aquaculture Science-Cefas Lowestoft Laboratory	UK	alan.walker@cefas.co.uk
Håkan Wickström	Swedish University of Agricultural Sciences Department of Aquatic Resources Institute of Freshwater Research	Sweden	hakan.wickstrom@slu.se

Annex 4: Meeting agenda

Agenda

Wednesday 5th

14:00–14:15 Welcome and Introductions, reminder of ToR, adopting the agenda.

14:15–14:45 Chair's report on activities in last year.

14:45–15:30 WKTEEL report (Laurent).

16:00–16:30 Overview of status based on data call (Cedric)

16:30–17:30 Introduce tasks

Task a finalising stock status descriptors

Task b Produce the first draft of the ICES annual eel advice, and other advisory documents as requested

Task c(i) Report on scientific basis of the advice (includes considering effect on advice of new management measures, e.g. fishery closures or TACs)

Task c(ii) Report on any new and emerging threats and opportunities

Task c(iii) Consider what does the WGEEL want to do with science in future? (theme sessions, projects, papers, etc?)

Task d address other requirements from ICES, EIFAAC, GFCM, EU (DGs or RCGs)

Task e WGEEL operating procedures

17:30–18:00 Assign people to tasks, and schedule the CR presentations

Thursday 6th

09:00–10:00 Presentations of six Country Reports

10:00–10:15 Management plans in GFCM area (Chiara)

10:15–13:00 All Task Groups breakout

14:00–16:00 All Task Groups breakout

16:00–18:00 Plenary to review progress and urgent actions

Friday 7th

09:00–10:00 Presentations of 6 Country Reports

10:00–13:00 All Task Groups breakout

14:00–18:00 All Task Groups breakout

Saturday 8th

09:00–13:00 All Task Groups breakout

14:00–15:00 Presentations of 6 Country Reports

15:00–18:00 All Task Groups breakout

18:00	Report drafts submitted for collation

Sunday 9th

All day	Group visits
09:00–17:00	All Task Groups breakout

Monday 10th

09:00–13:00	Reading the report
14:00–18:00	Discussing the report, identifying any changes

Tuesday 11th

09:00–18:00	Updating the report and tying up loose ends

Wednesday 12th

09:00–11:00	Finalising the report and plans, close the Working Group

Annex 5: Country Reports 2017–2018: Eel stock, fisheries and habitat reported by country

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

Participants from the following countries provided an updated report to the 2018 meeting of the Working Group on Eels:

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

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

Country Reports 2017/2018

Annex 6: Data call 2018 covering letter

1. Rationale

This Data call is intended to formalize data reporting across all countries with natural production of European eel.

Much of the historic eel data are available to WGEEL already, but often in multiple versions, some with subtle differences and with limited information from which to identify the most up-to-date version. Furthermore, the descriptions of methods used to collect and process the data are often held separately in some Country Reports, and without the contact details of data stewards. These associated 'metadata' should be held alongside the 'eel data'.

Recognizing that the collection and provision of all eel and metadata is a huge task, the Data call has been split over two years (2017 and 2018), giving time to clarify the process for those providing the data and for the WGEEL and ICES to organize the data in the most efficient manner. In 2017, the Data call focused on data directly required to achieve the annual stock assessment in support of the ICES Advice published in 2017.

The Data call 2018 includes the request for the data on silver eel stock indicators, biomass production and escapement and anthropogenic mortality rates, etc., as specified by the Eel Regulation 1100/2007 and EMPs.

Output

The data and metadata provided for the Data call 2018 will be used as the basis for the annual stock assessment in support of the advice for the eel stock. Ultimately, the output from these Data calls will be an electronic database for European Eel stock, held in a single repository and complying with data quality standards. This database will be used as a basis for timely and efficient drafting of stock status reports for ICES, the European Commission including fisheries and trade matters, and the provision of regional and whole stock advice across the natural range of the European eel.

Legal framework

The legal framework for the Data call is as follows, though noting that these don't all apply to every eel producing country:

- Council Regulation (EC) No 2017/1004 concerning the establishment of a Union framework for the collection, management and use of data in the fisheries sector and support for scientific advice regarding the Common Fisheries Policy.
- Council Regulation (EU) No 1380/2013 on the Common Fisheries Policy, amending Council Regulations (EC) No 1954/2003 and (EC) No 1224/2009 and repealing Council Regulations (EC) No 2371/2002 and E(EC) No 639/2004 and Council Decision 2004/585/EC.
- REC.DIR-GFCM/40/2016/2 on the progressive implementation of data submission in line with the GFCM Data Collection Reference Framework (DCRF).
- Council Regulation (EC) No 1100/2007 of 18 September 2007 establishing measures for the recovery of the stock of European eel.

2. Scope of the Data call

This Data call is addressed to those countries within the geographic range of the European eel, though a separate Data call will be made to GFCM countries. These countries are distributed across different global and regional management organisations such as those represented in WGEEL (EIFAAC, ICES, GFCM).

Table 1. List of species.

Common name	Code	Scientific name
European eel	ele.2737.nea	*Anguilla anguilla*

In this 2018 Data call we ask for submission of all available 'eel data', including historical data and previously submitted data for European eel on:

- Silver eel production (biomass)
- Anthropogenic mortality (impacts: silver eel equivalent biomass, and lifetime mortality rates)
- Potential wetted area habitat
- Silver eel time-series

In addition to the annual update on:

- Recruitment
- Landings
- Stocking
- Aquaculture production

Alongside each of these eel data, we request the following 'metadata':

- Data Steward: name and e-mail address of a person who can be contacted about the dataset.
- Method used: short description of the method used to collect the data.

These metadata are further described in the data input sheets of Annexes 1 to 10. The call also includes Annex 0 where you should record any suggestions for how this data call process might be improved in future. Annex 5 requests additional information pertaining to the Stock Indicators (Annexes 6–9). Annex 5 should have a separate sheet filled out for each reported Eel Management Unit, or area assessed.

3. Deadlines

ICES requests the data to be delivered to provide enough time for additional quality assurance prior to the WGEEL meeting. Therefore, data should be submitted by e-mail to the WGEEL stock coordinator (to be appointed) by 6th August, 2018. This deadline is set according to the ICES standards. Missing the reporting deadline will compromise the indispensable data quality checking (on a stock basis) before the use of that data to update assessments.

4. Data submission

The data should be submitted using the templates supplied in Annexes 0–10 to this Data call, along with an accompanying checklist confirming that all sheets have been completed. Suggestions for improvements to the process should be recorded in Annex 0. A detailed list of data formats, instructions and codes (e.g. treatment of nil values) to be used in the database can be found in Annexes 1–10. Note that once the database is developed, we would hope to make the data reporting process more efficient using an online system. This will come in future years.

5. Feedback on the process (Annex 0)

- List any comments here, especially any requiring attention for clarification or improvement in future Data calls.

6. Recruitment (Annex 1)

- Recruitment data are defined as the quantities of eel caught at specific (index) locations as they 'recruit' to the local vicinity. These captures can be either by fisheries or fishery-independent studies, which include handnets, fykenets or trapping ladders.
- The WGEEL uses these time-series data to calculate the Recruitment Indices, relative to the reference period of 1960–1979, and the results form the basis of the annual Single-stock Advice reported to the EU Commission. These recruitment indices are also used by the EU CITES Scientific Review Group in their annual review of the Non-Detriment Finding position.
- Data should be provided as annual total values.
- The units of data are either numbers or weight (kg) of eel, or indices.
- Those recruitment dataseries used in the Recruitment Indices are described in detail in the ICES European eel Stock Annex: (http://ices.dk/sites/pub/Publication%20Reports/Stock%20Annexes/2015/Anguilla_anguilla_S A.pdf). However, the Data call also seeks new dataseries not listed in the Stock Annex.
- The recruitment series are categorized as glass eel, young eel, and larger yellow eel recruiting to continental habitats. The glass eel recruitment series are either comprised only of glass eel (i.e. zero age cohort) or a mixture of glass and young yellow eel. The young or larger yellow eel may consist of multiple year classes of eel but they are all 'recruiting' to the stock past the survey point in the same year.

7. Landings (Annex 2)

- Landings are defined as the quantity of eel that are retained after capture (defined by the FAO as the Retained Catch), or to put it another way, removed from the water basin or management unit. So, Landings should not include any eels subject to assisted migration within the same river basin, or scientific studies where they are returned alive to the waters where they were caught.
- The WGEEL uses these data to report trends in landings in the ICES Single-stock Advice. This information is requested by the Administrative Agreement between ICES and the EU Commission.

- Data should be provided as annual total values, according to life stage (glass, yellow, silver) and fishing activity type (commercial or recreational).
- The units of data are kg.
- The Stock Annex notes that there is a great heterogeneity among time-series of landings (also catches) because of inconsistencies in reporting by, and between, countries, as well as incomplete reporting of non-commercial and recreational fisheries.

8. Stocking (Annex 3)

- Stocking data are defined as the quantity of eel that are released alive into waters of a basin or management unit other than the basin/management unit where they were caught (i.e. NOT including assisted upstream migration).
- The WGEEL uses these data to check against eel production estimates and anthropogenic mortality rates reported by countries.
- Data must be provided in annual totals both in weight (kg) and numbers, per eel management unit. If you do not have either one of the two values, calculate an estimate based on an average eel weight.
- The units of data are numbers and kg of eel when they are stocked.
- Note that a potential consequence of stocking could be that estimates of silver eel production for the stocked basin could be higher than those of historic production.

9. Aquaculture production (Annex 4)

- Aquaculture production data are defined as the quantity of eel produced on an annual basis from aquaculture facilities.
- The WGEEL uses these data in addressing its remit to report annually on the state of the stock, associated fisheries and other anthropogenic impacts.
- Data should be provided as annual total weights per country.
- The units of data are kg.
- Some aquaculture production data have previously been included in official landings statistics but this must be avoided.
- Some eels are grown in aquaculture for periods of time and then released alive to waters not necessarily those from where they were caught. This can be done for a variety of reasons. Such eels should be registered as stocked and not as aquaculture production.

10. Overview of Stock Indicators (Annex 5)

The WGEEL require this sheet describing the methods used for assessing the biomass and anthropogenic mortalities in each EMU. The sheet should also indicate any changes made to the data, or the assessments, over the time period and whether stocking has been taken into account in the derivation of the stock indicators. The overview also supports the initial quality review of the data supplied.

11. Biomass indicators (Annex 6)

- B_0 The amount of silver eel biomass that would have existed if no anthropogenic influences had impacted the stock;

- $B_{current}$ The amount of silver eel biomass that currently escapes to the sea to spawn;
- B_{best} The amount of silver eel biomass that would have existed if no anthropogenic influences had impacted the current stock, included restocking practices, hence only natural mortality operating on stock.

12. Mortality as Silver Eel Equivalents Biomass (Annex 7)

Biomass all measured in kg.

- SEE_com Commercial fishery silver eel equivalents.
- SEE rec Recreational fishery silver eel equivalents.
- SEE_hydro Silver eel equivalents relating to hydropower and water intakes, etc.
- SEE_habitat Silver eel equivalents relating to anthropogenic influences on habitat (quantity/quality).
- SEE_stocking Silver eel equivalents relating to stocking activity.
- SEE_other Silver eel equivalents from `other` sources.

13. Anthropogenic mortality Sigma (Annex 8)

- ΣF The fishing mortality rate, summed over the age groups in the stock;
- ΣH The anthropogenic mortality rate outside the fishery, summed over the age groups in the stock; sum of ∑F, ∑Hydro, ∑Restock, ∑Habitat, ∑Other;
- ΣA The sum of anthropogenic mortalities, i.e. $\Sigma A = \Sigma F + \Sigma H$. It refers to mortalities summed over the age groups in the stock.

14. Habitat Wetted Area (Annex 9)

- The Habitat_Wetted_Area is used for indicating the potential available area used as a habitat for the eels.
- It is used to provide data on the available areas of all possible habitat types, such as Freshwater (F), Marine open sea (MO), WFD Transitional (T), WFD Coastal (C) and an aggregate of all the above).
- This value is important for the calculation of the biomass indicators.
- The unit of area should be the hectare (ha).

15. Silver Eel Time-series (Annex 10)

This will be used for examining trends over time, and cross-calibration/validation of aggregated data.

- Number of emigrating eels;
- Total weight;
- Mean weight;
- Sex ratio;
- And associated upstream mortalities, (landings, stocking, etc.).

16. Contacts

The national response to the Data call should be sent to:

- Jon-Dag Pohlmann. WGEEL Stock Coordinator. E-mail: jan.pohlmann@thuenen.de

For support concerning issues about the data call please contact:

- Cédric Briand. WGEEL Stock Assessor. E-mail: Cedric.Briand@eptb-vilaine.fr

For support concerning other data issues, please contact:

- Alan Walker, chair of WGEEL. E-mail: Alan.walker@cefas.co.uk

For questions about the content of the data call, please contact: advice@ices.dk

For questions on data submission, please contact: accessions@ices.dk

Annex 7: Stock Annex for the European Eel

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

Stock ID	Stock name	Last updated	Link
Anguilla anguilla	European eel	September 2016	*Anguilla anguilla*

Annex 8: Data tables for Chapter 2

Table 1. Commercial landings (tonnes) of glass eel (1945–2018) in Spain (ES), France (FR), United Kingdom (GB) and Portugal (PT). 0 = No restocking. Empty cell = No information, Not collected or Not pertinent.

Year	GB	FR	ES	PT	IT
1945			119		
1946			72		
1947			100		
1948			111		
1949			9		
1950			4		
1951			2		
1952					
1953			3		
1954			6		
1955			0.9		
1956			0.9		
1957			3		
1958			0.4		
1959			7		
1960			9		
1961			17		
1962			11		
1963			8		
1964			11		
1965			4		
1966			6		
1967			5		
1968			4		
1969			4		
1970			5		
1971			1		
1972	17		1		
1973	28		1		
1974	58		2		
1975	10		3		
1976	13		12		
1977	39		18		
1978	61	1393	22		
1979	67	1850	17	9	
1980	40	1491	15	10	
1981	37	890	13	18	
1982	48	866	19	22	

Year	GB	FR	ES	PT	IT
1983	17	791	10	7	
1984	25	528	16	16	
1985	20	444	18	15	
1986	19	423	6	7	
1987	21	461	9	10	
1988	21	504	10	3	
1989	21	410	10	3	
1990	21	325	5	4	
1991	1	179	7	3	
1992	5	183	4	4	
1993	6	329	5	4	
1994	10	329	2	3	
1995	12	413	5	5	
1996	19	262	15	9	
1997	9	287	12	4	
1998	11	195	14	4	
1999		242	14	4	
2000		206	11	3	
2001	0.8	101	12	1	
2002	0.5	202	9	0.8	
2003	2	151	10	1	
2004	1	89	5	0.8	
2005	2	89	6	1	
2006	1	67	4	3	
2007	2	77	5	0.9	
2008	0.8	79	5	0.8	
2009	0.3		4	1	
2010	1	41	6	2	
2011	2	31	5	1	
2012	3	34	5	0.8	
2013	6	34	7	1	
2014	12	35	11	1	0.4
2015	3	36	9	1	0.2
2016	4	46	7	0.4	0.1
2017	3	46	16	2	0.1
2018	4	54	0.6		

Table 2. Raw and corrected commercial landings (tonnes) of glass eel (1945–2018) in Spain (ES), France (FR), United Kingdom (GB) and Portugal (PT). 0 = No restocking. or Empty cell = No information, Not collected or Not pertinent.

Year	GB	FR	ES	PT	IT
1945	123	3175	119	51	5
1946	74	1915	72	31	3
1947	103	2665	100	43	5
1948	114	2945	111	47	5
1949	10	248	9	4	0.4
1950	4	102	4	2	0.2
1951	2	56	2	0.9	0.1
1952					
1953	3	67	3	1	0,1
1954	6	157	6	3	0,3
1955	0.9	24	0.9	0.4	0
1956	0.9	24	0.9	0.4	0
1957	3	75	3	1	0.1
1958	0.4	11	0.4	0.2	0
1959	7	177	7	3	0.3
1960	10	252	9	4	0.4
1961	17	445	17	7	0.8
1962	11	295	11	5	0.5
1963	8	213	8	3	0.4
1964	11	293	11	5	0.5
1965	4	106	4	2	0.2
1966	6	160	6	3	0.3
1967	5	133	5	2	0.2
1968	4	106	4	2	0.2
1969	4	106	4	2	0.2
1970	5	133	5	2	0.2
1971	1	27	1	0.4	0
1972	17	107	1	2	0.2
1973	28	139	1	2	0.2
1974	58	281	2	4	0.5
1975	10	137	3	2	0.2
1976	13	323	12	5	0.5
1977	39	681	18	11	1
1978	61	1393	22	17	2
1979	67	1850	17	9	2
1980	40	1491	15	10	1
1981	37	890	13	18	1
1982	48	866	19	22	2
1983	17	791	10	7	0.8
1984	25	528	16	16	1
1985	20	444	18	15	1
1986	19	423	6	7	0.6

Year	GB	FR	ES	PT	IT
1987	21	461	9	10	0.7
1988	21	504	10	3	0.6
1989	21	410	10	3	0.5
1990	21	325	5	4	0.5
1991	1	179	7	3	0.2
1992	5	183	4	4	0.3
1993	6	329	5	4	0.3
1994	10	329	2	3	0.3
1995	12	413	5	5	0.5
1996	19	262	15	9	0.7
1997	9	287	12	4	0.5
1998	11	195	14	4	0.5
1999	11	242	14	4	0.5
2000	9	206	11	3	0.4
2001	0.8	101	12	1	0.1
2002	0.5	202	9	0.8	0.1
2003	2	151	10	1	0.2
2004	1	89	5	0.8	0.1
2005	2	89	6	1	0.1
2006	1	67	4	3	0.1
2007	2	77	5	0.9	0.1
2008	0.8	79	5	0.8	0.1
2009	0.3	47	4	1	0.1
2010	1	41	6	2	0.1
2011	2	31	5	1	0.1
2012	3	34	5	0.8	0.1
2013	6	34	7	1	0.1
2014	12	35	11	1	0.4
2015	3	36	9	1	0.2
2016	4	46	7	0.4	0.1
2017	3	46	16	2	0.1
2018	4	54	0.6	0.7	0.1

Table 3. Commercial landings (tonnes) of yellow and silver eel (1908–2017) in 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), Greece (GR), Turkey (TR) and Tunisia (TN). 0 = no catch, Empty cell = No data or Not Collected or Not Pertinent.

Year	NO	SE	FI	EE	LV	LT	PL	DE	DK	NL	IE	GB	FR	ES	PT	IT	SI	GR	TR	TN
1908	268																			
1909	327																			
1910	303																			
1911	384																			
1912	187																			
1913	213																			
1914	282	1461																		
1915	143	997																		
1916	117	1078																		
1917	44	1284																		
1918	35	884																		
1919	64	1145																		
1920	80	970							3413											
1921	79	1072							3443											
1922	94	926							3760											
1923	140	948							3396											
1924	290	1201							4130											
1925	325	1714							4880											
1926	341	1707							4726											
1927	354	2011							4648											
1928	325	1040							4117											
1929	425	1394							4375											

Year	NO	SE	FI	EE	LV	LT	PL	DE	DK	NL	IE	GB	FR	ES	PT	IT	SI	GR	TR	TN
1930	450	1529							4773											
1931	329	1795							4195											
1932	518	1589							5088											
1933	694	1494							5014											
1934	674	1769							5171											
1935	564	1951							4316											
1936	631	1654							4332											
1937	603	1725							4329											
1938	526	1871							3849											
1939	434	1774							4662											
1940	143	1626							3709											
1941	174	1822							3717											
1942	131	1226							3140											
1943	136	1828							3917											
1944	150	2320							4245											
1945	102	1906							4169	2668										
1946	167	1745							4269	3492										
1947	268	2347			10	8			4784	4502										
1948	293	2212			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				90						
1952	178	1848			10	39			3900	3978				102						
1953	371	2756			20	80			4300	3157				80						
1954	327	2459			20	147	609		3800	2085				98						

Year	NO	SE	FI	EE	LV	LT	PL	DE	DK	NL	IE	GB	FR	ES	PT	IT	SI	GR	TR	TN
1955	451	3338			40	163	732		4800	1651				103						
1956	293	1702			20	131	656		3700	1817				106						
1957	430	2494			20	168	616		3600	2509				80						
1958	437	2024			20	149	635		3300	2674				115						
1959	409	3522			24	155	566		4000	3413				100						
1960	430	1905			37	165	733		4937	2999		772		98						
1961	449	2387			43	139	640		4110	2452		768		154						
1962	356	2171			41	155	663		4122	1443		696		115						
1963	503	2334			56	260	762		4166	1618		788		137						
1964	440	2612		3	37	225	884		3505	2068		549		92						
1965	523	2051		0,3	35	125	682		3402	2268		784		130						
1966	510	2219		2	33	238	804		3901	2339		881		192				15		
1967	491	1835		3	39	153	906		3679	2524		569		164				19		
1968	569	2052		3	28	165	943		4476	2209		586		176				5		
1969	522	1922		49	36	134	935		3878	2389		606		136		2469		3	342	
1970	422	1209		62	29	118	847		3558	1111	200	752		119		2300		0	441	
1971	415	1391		60	29	124	722		3378	853	200	842		107		2113		0	460	
1972	422	1204		73	25	126	696		3429	857	200	633		119		1997		4	220	
1973	409	1212		69	27	120	645		3656	823	91	723		100		588		15	315	
1974	368	1034		51	20	86	691		2977	840	67	765		93	2	2122		130	588	
1975	407	1391		82	19	114	810		3485	1000	79	762		78	6	2886		134	448	
1976	386	935		72	24	88	761		3054	1172	150	622		83	13	2596		159	499	
1977	352	989		66	16	68	868		2502	783	108	691		80	23	2390		89	282	
1978	347	1076		63	18	70	910		2492	719	76	824		67	7	2172		225	283	
1979	374	954		28	21	57	979		1904	530	110	1045		97		2354		185	396	

Year	NO	SE	FI	EE	LV	LT	PL	DE	DK	NL	IE	GB	FR	ES	PT	IT	SI	GR	TR	TN
1980	387	1112		26	9	45	1214		2288	664	75	912		90		2198		227	224	
1981	369	887		22	10	27	944		2227	722	94	907		98		2270		251	374	
1982	385	1161		14	12	28	911		2541	842	144	943		20		2025	0.795	255	424	
1983	324	1212		29	9	23	868		2119	937	117	866		18		2013	0.67	201	588	
1984	310	963		72	12	27	819		1871	691	88	973		11		2050	1	285	616	
1985	352	1029		75	18	29	1022	1097	1630	679	87	750		17		2135	2	190	583	
1986	272	829		61	19	32	921	1119	1672	721	87	651	1944	13		2134	3	152	517	
1987	282	700		67	25	20	887	1031	1279	538	230	684	2062	21		2265	2	266	543	
1988	513	933		110	15	23	943	1018	1878	425	215	934	2265	14		2027	2	268	756	
1989	313	903		55	13	21	813	964	1696	526	400	875	1746	5	14	1243	1	156	472	
1990	336	918		61	13	19	768	830	1675	472	256	784	1778	9	13	1088	2	194	230	
1991	323	1060		52	14	16	670	725	1465	573	245	737	1645	50	23	1097	1	209	262	
1992	372	1154		39	17	12	638	762	1451	548	234	715	1321	54	30	1084	0.061	185	245	
1993	340	1121		59	19	10	568	790	1080	293	260	671	1280	66	34	782	0.066	182	261	
1994	472	1265		47	19	12	635	833	1200	330	300	778	1280	51	27	771	0.718	201	329	
1995	454	950		45	38	9	642	778	892	354		900	1280	69	24	1047	0.01	201	390	
1996	353	1053		55	24	9	629	603	752	300		805	1280	62	26	953	0.012	151	342	
1997	467	1065		59	25	11	526	616	797	285		731	1223	61	25	727	0.002	137	400	
1998	331	646		44	30	17	544	567	597	323		693	1150	44	23	666	0.003	88	300	
1999	447	702		65	26	18	599	645	717	332	250	668	1005	48	23	634		81	200	
2000	281	531		67	15	11	444	591	628	382	250	588	986	55	22	588	0.004	88	176	53
2001	304	643		67	19	12	435	569	707	440	98	584	1002	130	15	520	0.019	93	122	93
2002	311	591		50	11	13	373	544	614	371	123	551		106	27	415	0.009	136	147	251
2003	240	565		49	11	12	366	498	648	311	111	552		96	11	446		77	158	137
2004	237	583		39	11	16	337	475	546	311	136	472		85	9	379		58	165	95

Year	NO	SE	FI	EE	LV	LT	PL	DE	DK	NL	IE	GB	FR	ES	PT	IT	SI	GR	TR	TN
2005	249	676		31	12	22	220	455	534	256	101	476		88	7	75	0.002	116	176	107
2006	293	732		33	8	16	184	472	596	241	133	382		116	10	56	0.014	77	162	288
2007	194	702		31	10	15	181	424	537	197	114	451		82	11	277	0.009	90	179	257
2008	211	671	1	31	13	14	160	408	466	148	108	393		66	7	56	0.031	71	171	194
2009	69	514	2	22	5	9	161	374	467	109	0	460		89	8	330	0.002	78	158	141
2010	32	525	2	19	9	19	173	366	422	447	0	455		76	11	265	0.003	59	182	114
2011	0	450	2	16	6	11	119	279	370	127	0	456	368	61	6	190	0	83	28	122
2012	0	340	2	18	6	8	119	245	317	354	0	414	473	84	4	182	0	55	38	141
2013	0	374	1	17	5	14	137	265	356	321	0	427	504	86	3	172	0.001	38	48	180
2014	0	324	1	17	4	8	117	232	346	321	0	406	434	124	3	192	0	58	56	137
2015	0	246	0.609	14	5	6	102	224	282	293	0	341	357	60	3	170	0	60	71	95
2016	3	279	1	15	4	14	138	205	265	313	0	347	443	83	2	205	0	84	75	299
2017		244	1	16	9	14	173		257	422	0	321	280	75	1	200		62		149

Table 4. Raw and Corrected commercial landings (tonnes) of yellow and silver eel (1908–2017) in 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), Greece (GR), Turkey (TR) and Tunisia (TN). 0 = no catch, Empty cell = No data or Not Collected or Not Pertinent.

Year	NO	SE	FI	EE	LV	LT	PL	DE	DK	NL	IE	GB	FR	ES	PT	IT	SI	GR	TR	TN
1908	268	3059	47	124	54	114	1787	3149	5398	2604	14	2060	6340	269	61	3264	0.06	184	1010	2025
1909	327	3726	57	151	65	139	2176	3835	6573	3172	17	2509	7721	328	75	3975	0.073	225	1229	2466
1910	303	3458	53	140	61	129	2019	3559	6100	2944	16	2329	7166	304	69	3689	0.068	208	1141	2288
1911	384	4379	67	178	77	164	2557	4507	7726	3728	20	2949	9075	385	88	4672	0.086	264	1445	2898
1912	187	2137	33	87	37	80	1248	2200	3771	1819	10	1439	4429	188	43	2280	0.042	129	705	1414
1913	213	2427	37	99	43	91	1418	2498	4282	2066	11	1635	5030	213	49	2590	0.048	146	801	1606
1914	282	1461	33	88	38	81	1266	2231	3825	1846	10	1460	4493	191	43	2313	0.043	131	715	1435
1915	143	997	20	52	22	48	745	1313	2250	1086	6	859	2643	112	26	1361	0.025	77	421	844
1916	117	1078	18	49	21	45	701	1235	2117	1021	5	808	2486	105	24	1280	0.024	72	396	794
1917	44	1284	12	33	14	30	469	826	1416	683	4	541	1664	71	16	856	0.016	48	265	531
1918	35	884	9	24	10	22	347	612	1048	506	3	400	1232	52	12	634	0.012	36	196	393
1919	64	1145	14	37	16	34	534	941	1613	779	4	616	1895	80	18	976	0.018	55	302	605
1920	80	970	18	49	21	45	699	1231	3413	1018	5	806	2479	105	24	1276	0.023	72	395	792
1921	79	1072	19	50	22	46	722	1272	3443	1052	6	832	2561	109	25	1318	0.024	74	408	818
1922	94	926	20	52	22	48	750	1321	3760	1093	6	865	2661	113	26	1370	0.025	77	424	850
1923	140	948	22	58	25	53	834	1470	3396	1216	6	962	2960	126	29	1524	0.028	86	471	945
1924	290	1201	32	85	37	79	1228	2165	4130	1790	9	1416	4359	185	42	2244	0.041	127	694	1392
1925	325	1714	40	106	46	97	1519	2676	4880	2214	12	1751	5389	229	52	2774	0.051	157	858	1721
1926	341	1707	40	106	46	97	1525	2687	4726	2222	12	1758	5410	230	52	2785	0.051	157	861	1728
1927	354	2011	42	113	49	104	1622	2858	4648	2364	12	1870	5754	244	56	2962	0.055	167	916	1838
1928	325	1040	32	84	36	78	1215	2141	4117	1771	9	1401	4311	183	42	2219	0.041	125	686	1377
1929	425	1394	39	104	45	96	1495	2634	4375	2179	11	1723	5303	225	51	2730	0.05	154	844	1694

Year	NO	SE	FI	EE	LV	LT	PL	DE	DK	NL	IE	GB	FR	ES	PT	IT	SI	GR	TR	TN
1930	450	1529	42	112	49	103	1617	2850	4773	2357	12	1865	5739	243	55	2954	0.054	167	914	1833
1931	329	1795	39	102	44	94	1472	2594	4195	2146	11	1698	5224	222	50	2689	0.049	152	832	1668
1932	518	1589	46	122	53	112	1754	3091	5088	2556	13	2022	6223	264	60	3204	0.059	181	991	1987
1933	694	1494	49	131	57	121	1885	3322	5014	2748	14	2174	6689	284	65	3443	0.063	194	1065	2136
1934	674	1769	52	139	60	128	1995	3516	5171	2908	15	2301	7079	300	68	3644	0.067	206	1127	2261
1935	564	1951	48	127	55	117	1829	3223	4316	2666	14	2109	6490	275	63	3341	0.061	189	1033	2073
1936	631	1654	47	125	54	115	1799	3171	4332	2623	14	2075	6385	271	62	3287	0.06	186	1017	2039
1937	603	1725	47	125	54	115	1797	3167	4329	2619	14	2072	6376	271	62	3282	0.06	185	1015	2036
1938	526	1871	44	118	51	108	1696	2989	3849	2472	13	1956	6018	255	58	3098	0.057	175	958	1922
1939	434	1774	44	116	50	107	1666	2936	4662	2429	13	1921	5912	251	57	3043	0.056	172	941	1888
1940	143	1626	27	72	31	66	1036	1825	3709	1510	8	1194	3675	156	35	1892	0.035	107	585	1174
1941	174	1822	30	80	34	73	1149	2025	3717	1675	9	1325	4078	173	39	2099	0.039	119	649	1302
1942	131	1226	23	60	26	55	866	1526	3140	1263	7	999	3074	130	30	1582	0.029	89	489	982
1943	136	1828	28	75	32	69	1078	1901	3917	1572	8	1244	3827	162	37	1970	0.036	111	609	1222
1944	150	2320	32	86	37	79	1239	2184	4245	1806	10	1429	4397	187	42	2264	0.042	128	700	1404
1945	102	1906	31	82	35	75	1176	2072	4169	2668	9	1356	4172	177	40	2148	0.04	121	664	1332
1946	167	1745	37	97	42	90	1400	2467	4269	3492	11	1614	4967	211	48	2557	0.047	144	791	1586
1947	268	2347	23	62	10	8	891	1570	4784	4502	7	1027	3161	134	31	1627	0.03	92	503	1009
1948	293	2212	26	68	10	14	979	1725	4386	4799	8	1129	3474	147	34	1788	0.033	101	553	1109
1949	214	2329	33	88	50	21	1270	2238	4492	3873	10	1464	4506	191	43	2320	0.043	131	718	1439
1950	282	2628	29	77	10	29	1108	1953	4500	4152	9	1278	3932	167	38	2024	0.037	114	626	1256
1951	312	2311	26	70	10	32	1003	1768	4400	3661	8	1157	3560	90	34	1833	0.034	104	567	1137
1952	178	1848	24	65	10	39	935	1647	3900	3978	7	1078	3316	102	32	1707	0.031	96	528	1059
1953	371	2756	33	89	20	80	1274	2245	4300	3157	10	1469	4521	80	44	2327	0.043	131	720	1444
1954	327	2459	31	81	20	147	609	2054	3800	2085	9	1344	4137	98	40	2129	0.039	120	659	1321

Year	NO	SE	FI	EE	LV	LT	PL	DE	DK	NL	IE	GB	FR	ES	PT	IT	SI	GR	TR	TN
1955	451	3338	38	100	40	163	732	2528	4800	1651	11	1654	5090	103	49	2620	0.048	148	811	1626
1956	293	1702	28	75	20	131	656	1906	3700	1817	8	1247	3838	106	37	1976	0.036	112	611	1226
1957	430	2494	32	85	20	168	616	2150	3600	2509	9	1407	4329	80	42	2229	0.041	126	689	1383
1958	437	2024	32	85	20	149	635	2166	3300	2674	9	1417	4360	115	42	2245	0.041	127	694	1392
1959	409	3522	36	96	24	155	566	2421	4000	3413	11	1584	4874	100	47	2509	0.046	142	776	1557
1960	430	1905	34	91	37	165	733	2298	4937	2999	10	772	4627	98	45	2382	0.044	135	737	1478
1961	449	2387	35	92	43	139	640	2343	4110	2452	10	768	4717	154	46	2428	0.045	137	751	1506
1962	356	2171	31	81	41	155	663	2062	4122	1443	9	696	4152	115	40	2138	0.039	121	661	1326
1963	503	2334	37	100	56	260	762	2521	4166	1618	11	788	5077	137	49	2614	0.048	148	808	1621
1964	440	2612	24	3	37	225	884	1588	3505	2068	7	549	3197	92	31	1646	0.03	93	509	1021
1965	523	2051	18	0,3	35	125	682	1236	3402	2268	5	784	2490	130	24	1282	0.024	72	396	795
1966	510	2219	22	2	33	238	804	1448	3901	2339	6	881	2916	192	28	1501	0.028	15	464	931
1967	491	1835	21	3	39	153	906	1401	3679	2524	6	569	2820	164	27	1452	0.027	19	449	901
1968	569	2052	19	3	28	165	943	1270	4476	2209	6	586	2557	176	25	1316	0.024	5	407	817
1969	522	1922	23	49	36	134	935	1523	3878	2389	7	606	3067	136	30	2469	0.029	3	342	980
1970	422	1209	9	62	29	118	847	604	3558	1111	200	752	1215	119	12	2300	0.012	0	441	388
1971	415	1391	9	60	29	124	722	588	3378	853	200	842	1184	107	11	2113	0.011	0	460	378
1972	422	1204	24	73	25	126	696	1625	3429	857	200	633	3271	119	32	1997	0.031	4	220	1045
1973	409	1212	23	69	27	120	645	1565	3656	823	91	723	3151	100	30	588	0.03	15	315	1006
1974	368	1034	22	51	20	86	691	1509	2977	840	67	765	3038	93	2	2122	0.029	130	588	970
1975	407	1391	27	82	19	114	810	1830	3485	1000	79	762	3684	78	6	2886	0.035	134	448	1176
1976	386	935	29	72	24	88	761	1934	3054	1172	150	622	3894	83	13	2596	0.037	159	499	1244
1977	352	989	25	66	16	68	868	1675	2502	783	108	691	3373	80	23	2390	0.032	89	282	1077
1978	347	1076	24	63	18	70	910	1620	2492	719	76	824	3261	67	7	2172	0.031	225	283	1041
1979	374	954	26	28	21	57	979	1772	1904	530	110	1045	3568	97	34	2354	0.034	185	396	1139

Year	NO	SE	FI	EE	LV	LT	PL	DE	DK	NL	IE	GB	FR	ES	PT	IT	SI	GR	TR	TN
1980	387	1112	24	26	9	45	1214	1603	2288	664	75	912	3227	90	31	2198	0.031	227	224	1031
1981	369	887	24	22	10	27	944	1593	2227	722	94	907	3207	98	31	2270	0.03	251	374	1024
1982	385	1161	28	14	12	28	911	1881	2541	842	144	943	3787	20	37	2025	0.795	255	424	1209
1983	324	1212	27	29	9	23	868	1823	2119	937	117	866	3671	18	35	2013	0.67	201	588	1172
1984	310	963	29	72	12	27	819	1933	1871	691	88	973	3893	11	38	2050	1	285	616	1243
1985	352	1029	30	75	18	29	1022	1097	1630	679	87	750	4061	17	39	2135	2	190	583	1297
1986	272	829	27	61	19	32	921	1119	1672	721	87	651	1944	13	35	2134	3	152	517	1163
1987	282	700	28	67	25	20	887	1031	1279	538	230	684	2062	21	37	2265	2	266	543	1216
1988	513	933	30	110	15	23	943	1018	1878	425	215	934	2265	14	40	2027	2	268	756	1313
1989	313	903	23	55	13	21	813	964	1696	526	400	875	1746	5	14	1243	1	156	472	997
1990	336	918	22	61	13	19	768	830	1675	472	256	784	1778	9	13	1088	2	194	230	967
1991	323	1060	25	52	14	16	670	725	1465	573	245	737	1645	50	23	1097	1	209	262	1062
1992	372	1154	20	39	17	12	638	762	1451	548	234	715	1321	54	30	1084	0.061	185	245	873
1993	340	1121	19	59	19	10	568	790	1080	293	260	671	1280	66	34	782	0.066	182	261	843
1994	472	1265	23	47	19	12	635	833	1200	330	300	778	1280	51	27	771	0.718	201	329	1011
1995	454	950	15	45	38	9	642	778	892	354	4	900	1280	69	24	1047	0.01	201	390	653
1996	353	1053	14	55	24	9	629	603	752	300	4	805	1280	62	26	953	0.012	151	342	595
1997	467	1065	12	59	25	11	526	616	797	285	4	731	1223	61	25	727	0.002	137	400	537
1998	331	646	11	44	30	17	544	567	597	323	3	693	1150	44	23	666	0.003	88	300	488
1999	447	702	16	65	26	18	599	645	717	332	250	668	1005	48	23	634	0.021	81	200	711
2000	281	531	12	67	15	11	444	591	628	382	250	588	986	55	22	588	0.004	88	176	53
2001	304	643	13	67	19	12	435	569	707	440	98	584	1002	130	15	520	0.019	93	122	93
2002	311	591	13	50	11	13	373	544	614	371	123	551	1786	106	27	415	0.009	136	147	251
2003	240	565	12	49	11	12	366	498	648	311	111	552	1570	96	11	446	0.015	77	158	137
2004	237	583	11	39	11	16	337	475	546	311	136	472	1468	85	9	379	0.014	58	165	95

Year	NO	SE	FI	EE	LV	LT	PL	DE	DK	NL	IE	GB	FR	ES	PT	IT	SI	GR	TR	TN
2005	249	676	9	31	12	22	220	455	534	256	101	476	1220	88	7	75	0.002	116	176	107
2006	293	732	10	33	8	16	184	472	596	241	133	382	1376	116	10	56	0.014	77	162	288
2007	194	702	10	31	10	15	181	424	537	197	114	451	1388	82	11	277	0.009	90	179	257
2008	211	671	1	31	13	14	160	408	466	148	108	393	1099	66	7	56	0.031	71	171	194
2009	69	514	2	22	5	9	161	374	467	109	0	460	339	89	8	330	0.002	78	158	141
2010	32	525	2	19	9	19	173	366	422	447	0	455	382	76	11	265	0.003	59	182	114
2011	0	450	2	16	6	11	119	279	370	127	0	456	368	61	6	190	0	83	28	122
2012	0	340	2	18	6	8	119	245	317	354	0	414	473	84	4	182	0	55	38	141
2013	0	374	1	17	5	14	137	265	356	321	0	427	504	86	3	172	0.001	38	48	180
2014	0	324	1	17	4	8	117	232	346	321	0	406	434	124	3	192	0	58	56	137
2015	0	246	0.609	14	5	6	102	224	282	293	0	341	357	60	3	170	0	60	71	95
2016	3	279	1	15	4	14	138	205	265	313	0	347	443	83	2	205	0	84	75	299
2017	10	244	1	16	9	14	173	119	257	422	0	321	280	75	1	200	0.002	62	38	149

Table 5. Recreational landings (tonnes) of glass eel (1978–2018) in Spain (ES) and France (FR). 0 = no catch, Empty cell = No data or Not Collected or Not Pertinent.

Year	FR	ES
1978	647	
1979	697	
1980	1303	
1981	904	
1982	219	
1983	161	
1984	156	
1985	71	
1986	87	
1987	172	
1988	40	
1989	110	
1990	54	
1991	87	
1992	77	
1993	130	
1994	74	
1995	113	
1996	25	
1997	39	
1998	6	
1999	6	
2000	2	
2001	1	
2002	37	
2004		0.858
2005	0	1
2006	1	2
2007	0	1
2008	0	2
2009	0	0.439
2010	0	0.821
2011	0	0.389
2012	0	1
2013	0	2
2014	0	2
2015	0	2
2016	0	2
2017	0	2
2018	0	2

Table 6. Recreational landings of yellow and silver eel (1980–2017) (tonnes) in Finland (FI), Estonia (EE), Latvia (LV), Lithuania (LT), Poland (PL), Germany (DE), Denmark (DK), Netherlands (NL), Ireland (IE), France (FR), Italy (IT), and Slovenia (SI). 0 = No fishing or No information.

Year	FI	EE	LV	LT	PL	DE	DK	NL	IE	FR	IT	SI
1980												0
1981												0
1982												0
1983												0
1984												0
1985						523						0
1986						496						0.07
1987						495						0.14
1988						490						0.134
1989						467						0.11
1990						444						0.06
1991						438						0.058
1992						432						0.092
1993						421						0.078
1994						439						0.036
1995						400						0.029
1996						387						0.143
1997						378						0.207
1998						403						0.088
1999						386						0.023
2000						391						0.004
2001						386						0.02
2002						389						0.033
2003						385						0.004
2004						380						0.006
2005		2				357						0
2006		1				359				684		0.004
2007		0.958				346						0
2008	17	1				293						0
2009		1				286	100					0
2010	10	1				253	118	111			150	0
2011		0.98				251	80				61	0
2012	5	0.612		1	32	246	52	41		5	74	0
2013		0.589	0.037	3	27	251	50			5	70	0
2014	20	0.536	0.038	2	30	254	57	70		4	70	0
2015		0.744	0.007	5	26	256	118			4	60	0
2016		0.634	0.009	2		258	164			3	57	0
2017		0.579	0.01	0.8			117		0	1	41	

Table 7. Reported aquaculture production of European eel in Europe from 1984 onwards, in tonnes, in Norway (NO), Sweden (SE), Finland (FI), Estonia (EE), Latvia (LV), Germany (DE), Denmark (DK), Netherlands (NL), Ireland (IE), Spain (ES), Portugal (PT), Italy (IT), and Greece (GR). 0 = No fishing or No information.

Year	NO	SE	FI	EE	LT	DE	DK	NL	IE	ES	PT	IT	GR
1984							18						
1985							40						
1986							200						
1987							240	100					
1988							195	300					
1989							430	200					
1990							586	600					
1991							866	900					
1992							748	1100					
1993							782	1300					
1994							1034	1450					
1995							1324	1540					
1996							1568	2800					
1997							1913	2450					
1998					2		2483	3250		348			
1999					2		2718	3500		383			
2000	0.123				1		2674	3800		411			
2001					5		2000	4000		339			
2002				20	17		1880	4000		295			
2003				40	20		2050	4200		292			

Year	NO	SE	FI	EE	LT	DE	DK	NL	IE	ES	PT	IT	GR
2004		158		50	9	328	1500	4500		377		1220	500
2005		222		80	8	329	1700	4500		321		1131	500
2006		191		100	12	567	1900	4200		275		807	385
2007		175		100	13	774	1617	4000		369		1000	454
2008		124		90	11	749	1740	3700		460		551	489
2009		143		60	12	667	1707	3200	0	493		677	428
2010		93		40	8	681	1537	2000	0	392		641	428
2011		91		50	13	692	1156	2300	0	469		510	372
2012		93		70	4	744	1093	2600	0	373		737	304
2013		92	0		3	758	824	2900	0	393		642	491
2014		64	0.5	56	7	926	842	2300	0	405		572	446
2015		104	0.5	52	0.205	1176	1234	2000	0	454		460	542
2016		117	0	61	36	1099	1042	2000	0	330	1	432	580
2017		77	0	50		1202	550	2005	0	293			369

Table 8. Release of glass eel (1927–2018). Numbers of glass eels (in millions) restocked in Estonia (EE), Latvia (LV), Poland (PL), Germany (DE), Netherlands (NL), Ireland (IE), United Kingdom (GB), France (FR), Spain (ES), Portugal (PT), Italy (IT) and Greece (GR). 0 = No restocking or No information.

Year	EE	LV	PL	DE	NL	IE	GB	FR	ES	PT	IT	GR
1927		0.308										
1931		0.344										
1933		0.222										
1935		0.156										
1937		0.255										
1939		0.206										
1946					7							
1947					8							
1948					2							
1949					10							
1950					5							
1951					10							
1952			18		17							
1953			26		22							
1954			27		10							
1955			31		16							
1956	0.2		21		23							
1957			25		19							
1958			35		17							
1959			53		20	7						
1960	0.06	3	64		21	1						
1961		1	65		21	4						
1962	0.9	3	62		20	6						
1963		2	42		23	8						
1964	0.2	1	39		20	0.743						
1965	0.7	0.693	40		22	1						
1966			69		9	10						
1967		2	74		7	7						
1968	1	4	17		17	15						
1969			2		3	8						
1970	1	2	24		19	9						
1971			17		17	16						
1972	0.1	1	22		16	6						
1973			62		14	10						

YEAR	EE	LV	PL	DE	NL	IE	GB	FR	ES	PT	IT	GR
1974	2		71		24	11						
1975			70		14	5						
1976	3	0.851	68		18	7						
1977	2	0.52	77		26	3						
1978	3		73		28	4						
1979			73		31	30						
1980	1		52		25	26						
1981	3	2	60		22	17						
1982	3	0.29	63		17	26						
1983	2	2	25		14	10						
1984	2		48		17	8	4					
1985	2	1	36	22	12	6	11					
1986			50	37	10	5	18					
1987	2	0.26	57	38	8	14	14					
1988		3	17	40	8	13	6					
1989			14	20	7	7	0					
1990			10	29	6	10	0					
1991	2		2	13	2	2	0					
1992	2		14	17	4	6	2					
1993			10	21	4	7	0					
1994	2		13	23	6	19	2					
1995		0.572	24	20	5	11	2					
1996	1		3	11	2	4	0.1					
1997	0.9		5	9	2	15	0.2					
1998	0.5		2	8	2	6	0.052					
1999	2	0.294	4	9	3	8	4					
2000	1		3	6	3	6	0.45			0.003		
2001			0.701	3	0.9	3	0					
2002		0.251		3	2	1	3					
2003			0.506	2	2	4	4					
2004		0.06	2	2	0.3	1	1					
2005		0.12		2	0.1	4	2					
2006		0.003		1	0.582	0.616	1					
2007		0.015		1	0.216	1	4					
2008				0.51	0	0.418	1					
2009				0.787	0.3	0.375	0.719				0	
2010				5	3	0.444	3	0.627			0.3	

YEAR	EE	LV	PL	DE	NL	IE	GB	FR	ES	PT	IT	GR
2011	0.68	0.304		3	0.529	0.318	3	2	0.014		0.9	
2012	0.91	1		4	2	0.647	4	9	1		0.9	
2013	0.89			5	2	0.972	6	9	1		0.9	0.419
2014	3	1		10	6	2	8	17	0.245			0.204
2015	2			6	0.863	3	2	3	0.045		0.366	0.017
2016	0.9			5	3	4	0.053	10	0.003		0.21	0.471
2017		1			3	0.685	2	7	0.767		0.437	0.149
2018							2	9	2			

Table 9. Restocking of yellow eel (1985–2017). Numbers of yellow eels (in millions) restocked in Sweden (SE), Germany (DE), Denmark (DK), Netherlands (NL), Ireland (IE), Spain (ES), and Italy (IT) - note these include eels that were restocked or the subject of assisted migration via trap and transport. 0 = No restocking, Empty cell = No information.

YEAR	SE	DE	NL	IE	ES	IT
1900	0.053					
1901	0.51					
1902	0.034					
1903	0.065					
1904	0.041					
1905	0.652					
1906	0.15					
1907	0.021					
1909	0					
1911	0.43					
1912	0.49					
1913	0.004					
1914	0.212					
1917	0.03					
1918	0.004					
1919	0.113					
1920	0.062					
1921	0.128					
1922	0.06					
1923	0.166					
1924	0.275					
1925	6					
1926	1					
1927	3					
1928	0.456					
1929	0.26					
1930	13					
1931	15					
1932	20					
1933	16					
1934	12					
1935	4					
1936	2					
1937	0.768					
1938	6					
1939	2					
1940	33					
1941	16					
1942	22					
1943	60					
1944	52					

YEAR	SE	DE	NL	IE	ES	IT
1945	55					
1946	37					
1947	25		2			
1948	33		2			
1949	34		1			
1950	32		2			
1951	16		1			
1952	23		1			
1953	90		0.8			
1954	30		0.7			
1955	41		0.9			
1956	51		0.7			
1957	21		0.8			
1958	40		0.8			
1959	50		0.7			
1960	35		0.4			
1961	31		0.6			
1962	24		0.4			
1963	18		0.1			
1964	7		0.3			
1965	4		0.5			
1966	13		1			
1967	5		1			
1968	25		1			
1969	9		0			
1970	3		0.2			
1971	9		0.3			
1972	12		0.4			
1973	40		0.5			
1974	4		0.5			
1975	15		0.5			
1976	36		0.5			
1977	60		0.6			
1978	37		0.8			
1979	40		0.8	0.105		
1980	16		1	0.265		
1981	35		0.7	0.107		
1982	33		0.7	0.122		
1983	25		0.7	0.088		
1984	5		0.7	0.042		
1985	25	4	0.8	0.099		
1986	10	3	0.7	0.156		
1987	13	3	0.4	0.099		
1988	16	2	0.3	0.127		
1989	5	2	0.1	0.058		

YEAR	SE	DE	NL	IE	ES	IT
1990	5	2	0	0.098		
1991	9	2	0	0.037		
1992	7	2	0	0.047		
1993	4	2	0.2	0.061		
1994	7	3	0	0.013		
1995	2	3	0	0.08		
1996	2	4	0.2	0.01		
1997	3	5	0.4	0.091		
1998	4	5	0.6	0.026		
1999	4	5	1	0.071		
2000	2	7	1	0.039		
2001	2	6	0.1	0		
2002	7	7	0.1	0.068		
2003	4	7	0.1	0.088		
2004	2	7	0.1	0.032		
2005	3	6	0	0.066		
2006	3	9	0	0.047		
2007	5	9	0	0.076		
2008	2	9	0.23	0.131	0.016	
2009	2	9	0.3	0.015	0.03	
2010	3	9	0.062	0.016	0.013	
2011	4	7	0.408	0.011	0.039	
2012	2	6	0.392	0.003	0	
2013	2	7	0.506	0.003	0.004	
2014	8	8	0.903	0.038	0.021	
2015	2	9	0.742	0.033		0.085
2016	7	7	0.49	0.092	0.183	0.122
2017	13		0.574	0.014	0.15	0.2
2018					0.148	

Table 10. Releases of silver eel (2001–2017). Numbers of released silver eels (in million) in Sweden (SE), Ireland (IE), France (FR), Spain (ES) and Greece (GR) – note releases include eels that were restocked or the subject of assisted migration via trap and transport. Empty cell = No data or NC or Not pertinent.

YEAR	SE	IE	FR	ES	GR
2001		0.006			
2002		0.02			
2003		0.008			
2004		0.014			
2005		0.008			
2006		0.038			
2007		0.018			
2008		0.052			
2009		0.163		0.001	
2010	0.005	0.187			
2011	0.008	0.215	0.094		
2012	0.01	0.243	0.111	0.039	
2013	0.013	0.238	0.116		0.021
2014	0.021	0.336	0.164		0.033
2015	0.018	0.284	0.214		0.04
2016	0.017	0.206	0.17		0.054
2017	0.017	0.193	0.213		0.043

Table 11. Restocking of glass eel that have been held in quarantine (1913–2017). These are eels for which a holding and quarantine phase of eight to ten weeks is added, instead of restocking them directly after catch and transport. Numbers of restocked eels that have been in quarantine (in millions) in Sweden (SE) and Finland (FI). Empty cell = No data or NC or Not pertinent.

YEAR	SE	FI
1913	0.25	
1914	0.25	
1915	0.002	
1929	0.023	
1930	0.035	
1931	0.14	
1932	0.096	
1933	0.02	
1934	0.006	
1937	0.052	
1939	0.003	
1944	0.001	
1945	0.035	
1946	0.065	
1948	0.177	
1949	0.018	
1951	0.107	
1952	0.147	
1953	0.164	
1955	0.174	
1956	0.07	
1957	0.197	
1958	0.011	
1959	0.1	
1960	0.259	
1961	0.007	
1962	0.022	
1964	0.004	
1965	0.041	
1970	0.002	
1972	0.001	
1973	0.01	
1976	0.184	
1978	0.284	

Year	SE	FI
1979	0.23	
1980	0.138	
1982	0.02	
1985	0.634	
1986	0.08	
1987	0.648	
1988	0.637	
1989	0.914	
1990	1	
1991	0.586	
1992	0.681	
1993	0.987	
1994	2	
1995	2	
1996	3	
1997	3	
1998	2	
1999	3	
2000	1	
2001	0.908	
2002	2	
2003	0.702	
2004	1	
2005	1	
2006	1	
2007	0.972	
2008	1	
2009	0.763	
2010	2	0.153
2011	3	0.306
2012	3	0.177
2013	3	0.197
2014	3	0.147
2015	2	0.102
2016	3	0.079
2017	0.947	0.12

Table 12. Restocking of on-grown eel (1973–2017). Numbers of on-grown eels (in millions) restocked in Estonia (EE), Lithuania (LT), Poland (PL) and Denmark (DK). Empty cell = No data or NC or Not pertinent.

YEAR	EE	LT	PL	DK
1973			0.064	
1974			0.014	
1977			0.008	
1980			0	
1982			0.135	
1983			1	
1984			0.199	
1985			0.135	
1986			0.048	
1987			0	
1988	0.18		0.01	
1989			0.247	
1990			0.441	
1991			0.03	
1992			0.064	
1993			0.001	
1994			0.138	
1995	0.15		0.043	
1996			1	
1997			2	
1998			0.848	
1999			1	
2000			1	
2001	0.44		0.753	
2002	0.36		0.751	
2003	0.54		0.558	
2004	0.44		0.806	
2005	0.37		0.74	
2006	0.38		0.918	
2007	0.33		1	
2008	0.19		2	
2009	0.42		1	
2010	0.21		1	
2011	0.2	0.134	3	
2012	0.12	0.494	2	

YEAR	EE	LT	PL	DK
2013	0.13	1	3	
2014	0.19	0.38	2	
2015		0.45	4	
2016	0.22	0.273	2	2
2017	0.31	0	2	2

Table 13. Reference table of life stages used in the WGEEL database. OG and QG are reserved for tables detailing aquaculture and release (restocking). GY is a special type used to identify recruitment series made of a mixture of glass and yellow eel. Constraints have been added to the database to prevent insertion of the wrong stages in the wrong context. click here for description on the use of this table within the database.

CODE	NAME	DEFINITION
AL	All stages	All stages combined
G	glass eel	Young, unpigmented eel, recruiting from the sea into continental waters. WGEEL consider the glass eel term to include all recruits of the 0+ cohort age. In some cases, however, also includes the early pigmented stages.
GY	glass eel + yellow eel	A mixture of glass and yellow eel. Some traps have a historical set of data where amounts of glass eel and yellow eel were not separated, but they were dominated by glass eel.
OG	On-grown eel	Eel that have been held in water tanks for some days or months between first capture and then release to a new water basin, and they have been fed and grown during that time.
QG	quarantined eel	On-grown eel (see definition above) that have been held in isolation between capture and restocking.
S	silver eel	Migratory phase after the yellow eel phase. Eel in this phase are characterized by a darkened back, silvery belly with a clearly contrasting black lateral line, and enlarged eyes. Silver eel undertake downstream migration towards the sea, and subsequently across the ocean. This phase mainly occurs in the second half of the year, although some are observed throughout the following spring.
Y	yellow eel	Life-stage resident in continental waters. Often defined as a sedentary phase, but migration within and between rivers, and to and from coastal waters, occurs and therefore includes young pigmented eels (may be called 'elvers' or bootlace eels). Sometimes is also called Brown eel.
YS	yellow eel+ silver eel	Yellow and Silver eel as defined above

Table 14. Reference table of data source, identifying at what stage data have been entered in the database. click here for description on the use of this table within the database.

DATASOURCE	DESCRIPTION
dc_2017	Joint ICES, EIFAAC and GFCM Data call: Data submission for advice for European eel under WGEEL – Part 1: 2017
dc_2018	Joint ICES, EIFAAC and GFCM Data call: Data submission for advice for European eel under WGEEL – Part 2: 2018
wgeel_2016	Data provided by WGEEL 2016
wgeel_2017	Data provided by WGEEL 2017

Table 15. Reference table of datatype, these codes are used in the t_eelstock_eel table, click here for description on the use of this table within the database.

ID	Name	Description	Unit code
1	Recruitment index	Index of recruitment	
2	Yellow eel index	Index of standing stock abundance	
3	silver eel series	Index of silver eel	
4	com_landings_kg	Commercial landings (kg)	kg
5	com_catch_kg	Commercial catch (kg) DEPRECATED	kg
6	rec_landings_kg	Recreational landings kg)	kg
7	rec_catch_kg	Recreational catch (kg) DEPRECATED	kg
8	q_release_kg	Released quantity (kg)	kg
9	q_release_n	Released numbers (number)	nr
10	gee_n	Glass eel equivalents (n)	nr
11	q_aqua_kg	Aquaculture production (kg)	kg
12	q_aqua_n	Aquaculture production (number)	nr
13	B0_kg	Pristine spawning of silver eel B0 (kg)	kg
14	Bbest_kg	Maximum potential biomass of silver eel (sumA=0) (kg)	kg
15	Bcurrent_kg	Current biomass of silver eel (kg)	kg
16	Potential_availabe_habitat_production_ha	Wetted area (ha)	ha
17	SumA	Lifetime anthropogenic mortality	
18	SumF	Lifetime fishing mortality	

ID	NAME	DESCRIPTION	UNIT CODE
19	SumH	Lifetime mortality hydro and pumps	
20	sumF_com	Mortality due to commercial fishery, summed over age groups in the stock.	
21	SumF_rec	Mortality due to recreational fisher, summed over age groups in the stock	
22	SumH_hydro	Mortality due to hydropower (plus water intakes etc.) summed over the age groups in the stock (rate)	
23	SumH_habitat	Mortality due to anthropogenic influence on habitat (quality/quantity) summed over the age groups in the stock (rate)	
24	SumH_release	Mortality due to releases (restocking, assisted migration, Trap & Transport) summed over the age groups in the stock (rate: negative rate indicates positive effect of restocking)	
25	SumH_other	Mortality due to other anthropogenic influence summed over the age groups in the stock (rate)	
26	SEE_com	Commercial fishery silver eel equivalents	kg