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Report of the Working Group on Eels (WGEEL)

15–22 September 2016

Cordoba, Spain

International Council for the Exploration of the Sea
Conseil International pour l'Exploration de la Mer

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Executive Summary

In 2016, the WGEEL glass eel recruitment indices remain low at 2.7% of the 1960–1979 reference level in the 'North Sea' series, and 10.7% in the 'Elsewhere' series. The 'recruiting yellow eel' index was 21% of the level during the reference period.

The Eel Management Plan silver eel biomass and mortality rate estimates (reported in 2015) indicate the stock in the EU-assessed area is not within the biomass limits of the Eel Regulation and in most management units, anthropogenic mortality exceeds a level that can be expected to lead to recovery.

FAO reports the total landings from Commercial fisheries in 2014 were about 3321 t of eel. Six countries account for 73% of the FAO landings: France, Egypt, UK, Netherlands, Sweden and Denmark. Five EU Member States have a glass eel fishery (France, UK, Spain, Portugal and Italy): some non-EU countries (e.g. Morocco) also have glass eel fisheries but data from these were not available for analysis. The best estimates of the total EU catch of glass eel in 2015 and 2016 were 51.6 and 59.2 t, respectively.

About 10.6 million glass eels and 9.2 million yellow eels were stocked in 2015. Stocking is a component of many Eel Management Plans (EMPs) and in some cases the commitment could not be achieved in 2016 due to timing, market and other glass eel availability issues. Aquaculture production was about 4000–6500 t in 2015/2016 (data from FAO, FEAP and WGEEL Country Reports).

WGEEL attempts to cross-check glass eel catch with records of their fate (consumption, restocking and aquaculture) reveal major discrepancies between reporting systems. About 32% of the catch for 2015 has no recorded fate (about 36% for 2016). EuroStat trade data show France and UK declared exports of glass eel to Hong Kong in 2015/2016 despite these being 'banned' by the EU application of CITES.

The EU Eel Regulation effectively implements a Distributed Control System, in which common objectives (protection and recovery, minimal spawner production of 40% relative to the notional pristine production) are achieved by collective action (national management plans, reducing mortalities). Effective governance across the whole stock requires other areas to adopt the same approach of distributed control. Most non-EU areas have only recently joined this process, 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. Additionally, reference points, assessment procedures and feedback mechanisms will need to be agreed for the whole distribution area.

A mechanism needs to found between the EU and the ICES rules to facilitate feedback on the status of the implementation of the EMPs, as in the Eel Management Plan Evaluation workshop (WKEPEMP) in 2013 (ICES, 2013). This lack leaves a void between the formal Precautionary Advice and scientific support for the recovery plan on eel.

Knowledge gaps and research needs were identified regarding impacts of pollutants and hydropower, habitat preferences, and monitoring across environments. A recent review shows that evidence on net benefits of eel stocking is inconclusive. Emerging threats include climate change, pollution and post-release mortalities from recreational fisheries. New opportunities include research on migratory triggers and habitat use, survey methods in large waterbodies, protection for eel passing hydropower facilities, and coordinating eel management and data collection in the Mediterranean.

1 Introduction

1.1 Main tasks

The Joint EIFAAC/ICES/GFCM Working Group on Eel [WGEEL] (chaired by: Alan Walker, UK) met at the University of Cordoba, Spain, from 15th to 22nd September 2016 to address the terms of reference (ToR) set by ICES, EIFAAC and GFCM in response to the request for Advice from the EU (through the MoU between the EU and ICES), EIFAAC and GFCM.

The meeting opened at 13:00 hrs on Wednesday 15th 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	Developments in the state of the European eel (*Anguilla anguilla*) stock, the fisheries on it and other anthropogenic impacts	
	1. Assess the trends in the state of the European eel stock, and the anthropogenic impacts on the stock	Chapter 2
	2. Update and evaulate time-series of data used directly and indirectly in assessing the state of the stock	Chapter 2
	3. Produce the first draft of the ICES annual eel advice	Separate document to ICES
ToR B	Scientific basis of the advice	
	1. Suggest reference points of relevance for assessing the stock status and antropogenic impacts	Chapter 2
	2. Report on issues that affect the quality of scientific evaluation of anthropogenic impacts and ecosystems, and the effectiveness of management measures, including the timeliness, coverage and quality of data used in developing the advice	Chapter 4
	3. Provide information on research needs to improve the quality of the scientific basis of the stock assessment and advice	Chapter 4
	4. Update and extend the eel stock annex where significant changes make it necessary, to provide a full methodological description of the assessment and advisory procedure for the European eel stock	Not required
	5. Report on significant new or emerging threats to, or opportunities for, eel conservation and management	Chapter 4
ToR C	Consider the management of the stock and anthropogenic impacts	
	1. Review all management measures and options agreed in regulatory arrangements concerning the stock, fisheries and other anthropogenic mortalities, and comment on their conformity with sustainability criteria	Chapter 3
ToR D	Address the generic EG ToRs from ICES, and any requests from EIFAAC or GFCM	Annex 5

The WGEEL also re-examined its working approach and made proposals for improving efficiency of data collection and reporting, and communications in general. The findings from this work have been captured in internal working documents, including a draft WGEEL Communications Plan.

In response to the ToR, the Working Group considered 19 Country Report Working Documents submitted by participants (Annex 6); other references cited in the Report are given in Annex 1. Additional information was supplied by correspondence, by those Working Group members unable to attend the meeting. A glossary of terms and list of acronyms used within this document is provided in Annex 2.

1.2 Participants

Thirty-three experts attended the meeting, representing 18 countries, along with three experts invited by the chair and representatives of the EU Commission DG MARE and the General Fisheries Commission of the Mediterranean (GFCM). A full address list for 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 at (European Eel stock annex). 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 to assist the reader.

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 all of the 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, with time-series indices reaching minima in 2011 of less than 1% of mean 1960–1979 levels in the continental North Sea and less than 5% elsewhere in Europe (FAO and ICES, 2011). 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 of the various biomass, mortality rates and stocking 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. ΣA = ΣF + ΣH. 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. stocked (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 but no official post-evaluation has taken place.

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. For 2016, all trade into and out of the EU and Turkey is currently banned (quota 0) and Tunisia has a quota of 135 t. Other countries don't report any quota to CITES (CITES export quotas database consulted 21/09/2016). ICES (2015b) 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*". In addition, the IUCN Conservation Congress approved motion 005: Promotion of Anguillid eels as flagship species for aquatic conservation in September 2016.

In 2014, the European eel has been 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 Memorandum of Understanding between EU and ICES (2016). 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 disclosable 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. The national representatives are requested to provide this information within a series of spreadsheets and with an accompanying text explaining, e.g. management structures, data collection programmes and national assessment methods. These spreadsheets and text template were substantially updated in advance of the 2016 WGEEL meeting, and their utility reviewed during the meeting.

The status of eel production in EMUs is assessed by national or subnational fishery/environment management agencies. The setting for data collection varies considerably between countries, depending on the management actions taken, the presence or absence of various anthropogenic impacts, but also on the type of assessment procedure applied. The assessment framework varies from area to area, sometimes within a single country. Accordingly, a range of methods may be employed to establish silver eel escapement limits (40% of B_0), management targets for individual rivers, river basins, river basin districts, EMUs and nations, and for assessing compliance of current escapement ($B_{current}$) with these limits/targets. 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; 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 this year using the data reported in 2015 Progress Reports and Country Reports although there was very few updates from the data reported in 2015.

1.8 Conclusion

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. This scientific advice has to be suitable for the purposes of EIFAAC, ICES and GFCM, and to this end the advisory process is being developed to suit these multiple and varied requirements.

2 Trends in recruitment, fisheries, aquaculture and restocking

2.1 Introduction

This chapter presents collected updates, in tables and graphs, on the state of the eel stock in countries reporting to WGEEL, in response to the terms of reference set in advance of the meeting. The Country Report templates for 2016 asked reporting countries for narrative reports and completed (new for 2016) data tables presenting data and updating time-series on recruitment indices (for Glass eel and young Yellow eel), standing stock estimates, fisheries and escapement of silver eel. The chapter also includes a section on trade and trace-ability of glass eel movements to seek an understanding of these as the impact the stocks. Data on human factors outside fisheries that also contribute to mortality of eel were also requested.

Each section describes trends in the dataseries and where appropriate offers an explanation of the consequences for the status of the stock.

Note that since 2015, the bulk of the data on the longer time-series for European eel are now held in a "Stock Annex", available via the ICES website (European Eel stock annex). As such, this annual report only tabulates new data not available in the Stock Annex.

2.1.1 Extract of WGEEL 2016 Terms of Reference addressed

1) Assess the trends in the state of the European eel stock, and the anthropogenic impacts on the stock;

- 1.1) Describe the trends of recruitment, standing stock, silver eel escapement, A as biomass and mortality rates, trade (markets, traceability), eel health, predation.

2) Update and evaluate time-series of data used directly and indirectly in assessing the status of the stock;

- 2.1) Update the recruitment assessment (directly used);
- 2.2) Update (or create) time-series of standing stock, silver eel escapement, mortalities, trade, eel health, predation;
- 2.3) Evaluate whether or not the time-series are fit for purpose of assessing the status of the stock, and if not fit for purpose, make recommendations for improvements.

2.2 Trends in recruitment

This section addresses the latest trends in glass and yellow eel recruitment indices on two different areas of its distribution range. The recruitment time-series data are derived from fishery-dependent sources (i.e. catch records) and also from fishery-independent surveys across much of the geographic range of European eel. The stages are categorized as glass eel (gls.) which includes all "young of the year" eel, mixture of glass eel and yellow eel dominated by recruits from the year (gls.+ylw.) and older yellow eel (ylw.) recruiting to continental habitats (Dekker, 2002).

The glass eel recruitment time-series have also been classified according to two areas: 'continental North Sea' and 'Elsewhere Europe', as it cannot be ruled out that recruitment to the two areas have different trends (ICES, 2010b). The glass eel recruitment series are either comprised of only glass eel or of a mixture of glass eel and young yellow eel but dominated by recruits from that year.

Yellow eel series can consist of yellow eel that might be several ages (data from series in the Baltic and Ireland).

The WGEEL has collated information on recruitment from 53 time-series:

- 32 time-series were updated to 2016 (26 for glass eel and six for yellow eel Table 2.3) whereas nine time-series (four for glass eel and five for yellow eel) were updated to 2015 only (Table 2.4).
- Among the time-series based on trap indices, some have reported preliminary data for 2016 as the season is not yet finished (Lagan (SW), Kavlingeän (SW), Gota Älv (SW), Viskan (SW), Parteen(IR), Bann (GB), Bresle (FR)), while others have not yet reported (Guden Å (DK), Harte (DK)). Therefore, the indices given for 2016 must be considered as provisional, especially those for the yellow eel.
- One series (Severn HMRC) has been dropped from the list, as it was considered a double of the other Severn EA statistics, but of poorer quality. It is no longer represented in the summary but kept and updated in the database.
- There is a new glass eel time-series 'Vaccares' from the French Mediterranean: Rhone Delta (Camargue lagoons), starting in 2004.
- The whole Miño glass eel time-series (MiPo) has been reviewed and updated in 2016.

2.2.1 Recruitment series data

Calculation of the geometric mean of all time-series is presented in Figures 2.1 and 2.2.

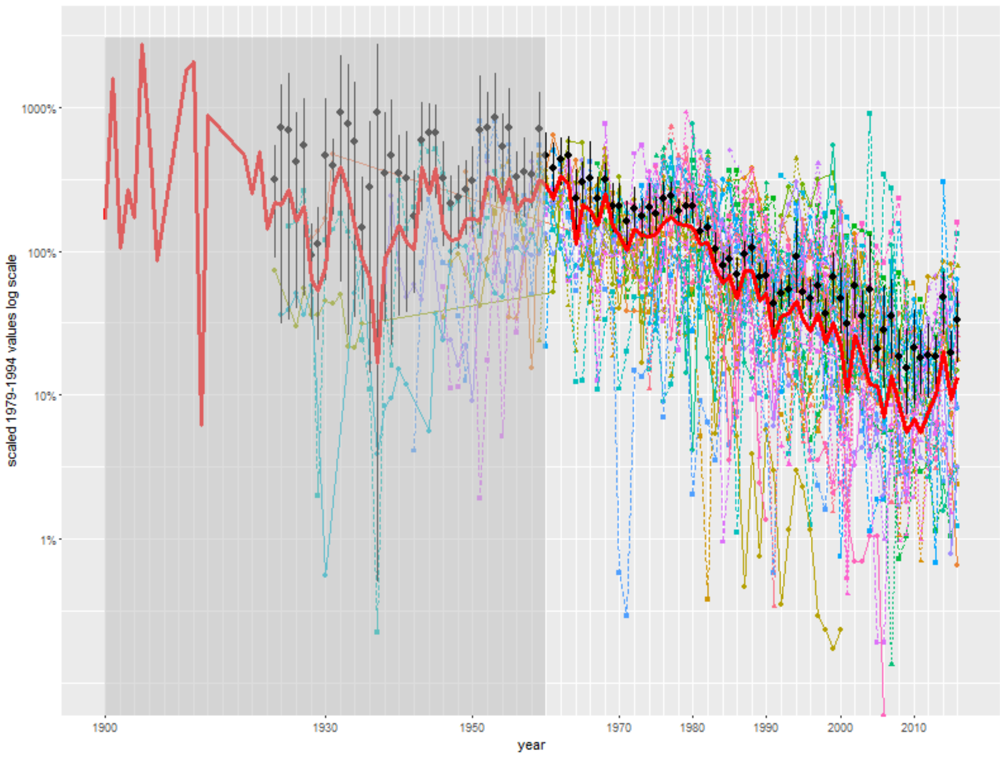

Figure 2.1. Time-series of glass eel and yellow eel recruitment in European rivers with time-series having data for the 1979–1994 period (45 sites). Each time-series has been scaled to its 1979–1994 average. Note the logarithmic scale on the y-axis. The mean values and their bootstrap confidence interval (95%) are represented as black dots and bars. Geometric means are presented in red.

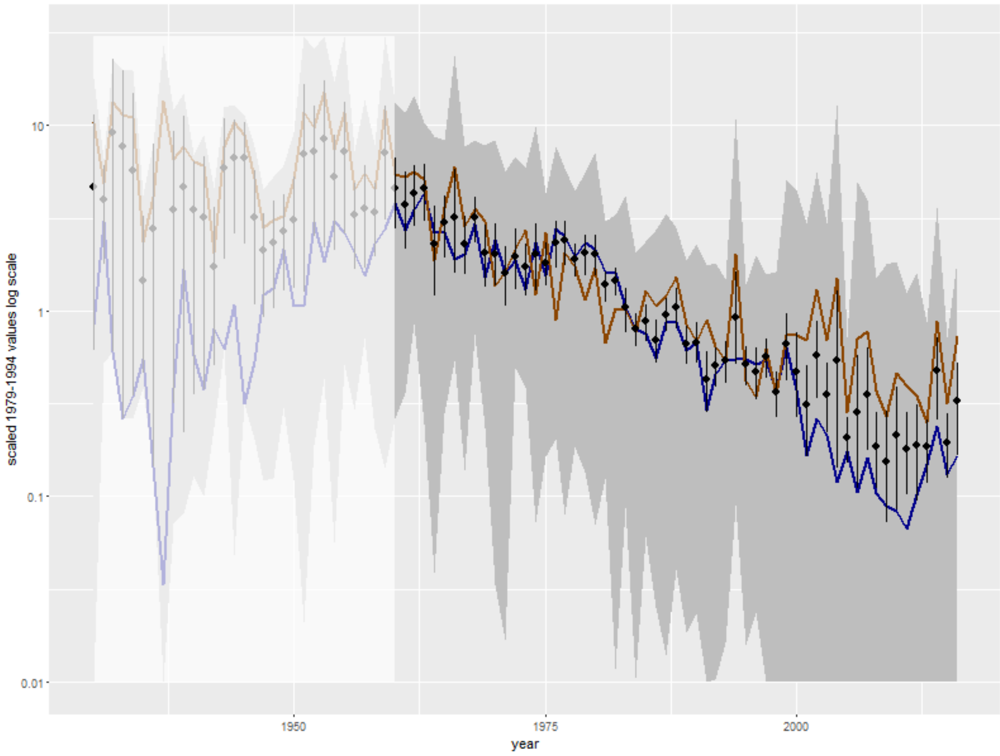

Figure 2.2. Time-series of glass eel and yellow eel recruitment in Europe with 45 time-series out of the 53 available to the working group. Each time-series has been scaled to its 1979–1994 average. The mean values of combined yellow and glass eel time-series and their bootstrap confidence interval (95%) are represented as black dots and bars. The brown line represents the mean value for yellow eel, 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 2.1 were removed to make the mean value more clear. Note also the logarithmic scale on the y-axis.

2.2.2 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 ~ year : area + site, where glass eel is individual glass eel time-series, site is the site monitored for recruitment and area is either the continental North Sea or Elsewhere Europe. In the case of yellow eel time-series, only one estimate is provided: yellow eel ~ year + site.

The trend is reconstructed using the predictions from 1949 for 33 glass eel time-series and eleven yellow eel time-series. Some zero values have been excluded from the GLM analysis: 40 for the glass eel model and three for the yellow eel model.

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 as the recruitment is usually assumed to be lognormally / Gamma distributed (Drouineau *et al.*, 2016).

After high levels in the late 1970s, there has been a rapid decreasing trend for three decades to a minimum in 2009 (Figures 2.5 and 2.6).

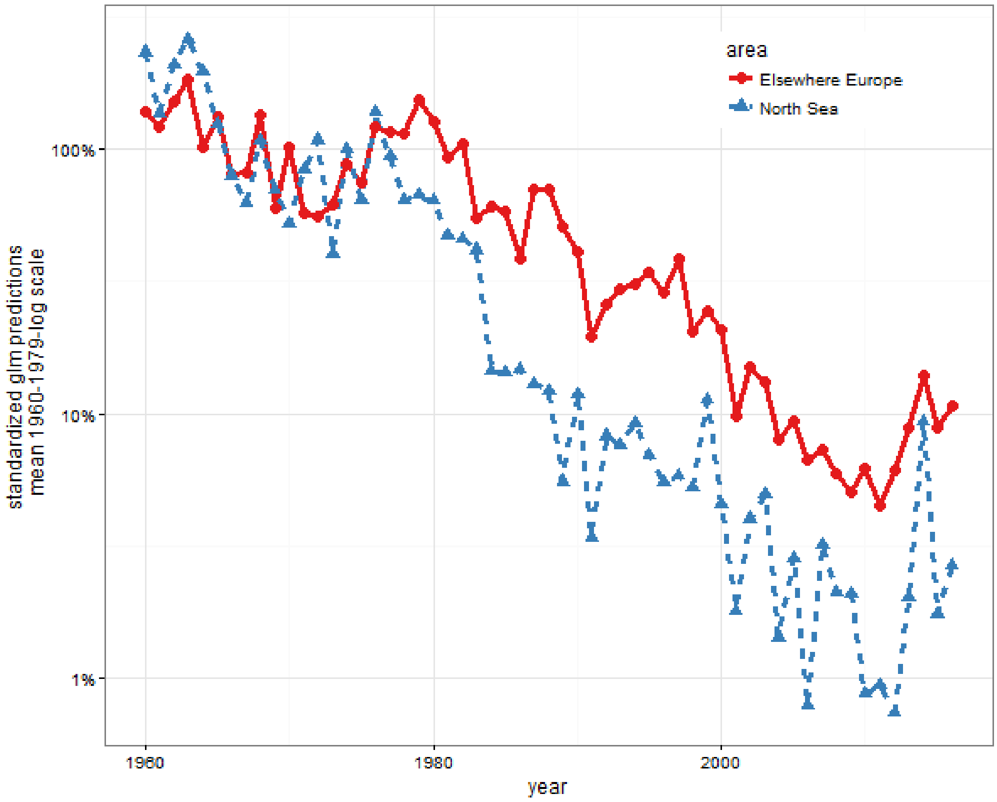

Figure 2.3. WGEEL recruitment index: geometric mean of estimated (GLM) glass eel recruitment for the continental North Sea and Elsewhere Europe series updated to 2016. The GLM (recruit~area: year + site) was fitted on 33 time-series comprising either pure glass eel or a mixture of glass eels and yellow eels and scaled to the 1960–1979 average. No time-series are available for glass eel in the Baltic area. Note the logarithmic scale on the y-axis.

The 2016 level with respect to 1960–1979 averages is 2.7% for the North Sea and 10.7% elsewhere in the distribution area (Tables 2.1 and 2.2). The increase in the Elsewhere Europe index was mainly driven by an increase in the Irish series. The yellow recruitment index was nearly double that of the previous year (Figure 2.6). This increment could be the result of the observed increase in the glass eel recruitment during previous years. However, among the 12 yellow eel series only six were updated to 2016 (Table 2.3) and, in addition, each of the series includes eels from different age, thus the available information does not allow to verify this hypothesis.

Both WGEEL recruitment indices for 2016 are lower than 2014, but modelling a breakpoint around the minima of 2011 still gives significant results when using the lower value from 2016 ($p = 2e^{-06}$ Elsewhere Europe and $p = 6e^{-04}$ North Sea (ICES, 2011).

The inclusion of the Vaccarès series, the revision of the Miño Portuguese part series (MiPo) and the updating of some of the 2015 data not updated in the previous report because the season was not finished when data were recorded, have slightly modified the recruitment indices from previous years (Tables 2.1 and 2.2). None of these are considered to have a significant influence on trends.

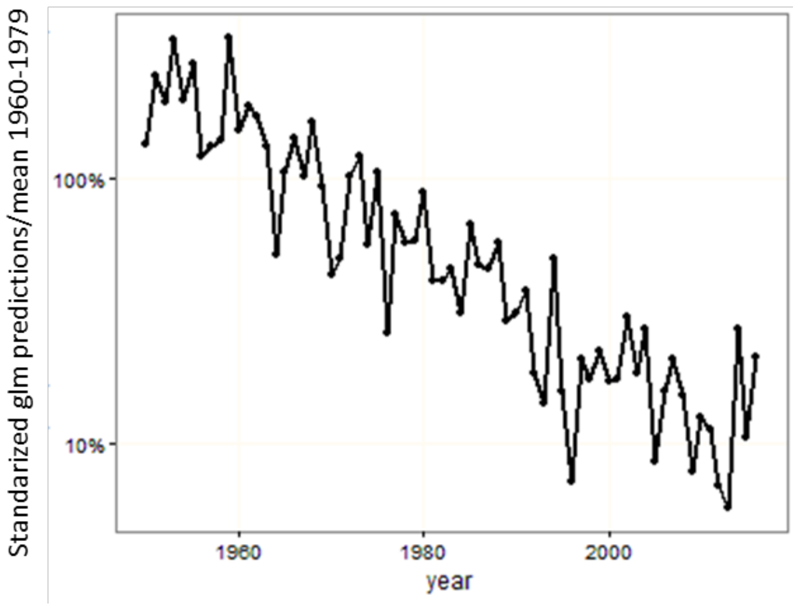

Figure 2.4. Geometric mean of estimated (GLM) yellow eel recruitment and smoothed trends for Europe updated to 2016. The GLM (recruit ~ year + site) was fitted to 12 yellow eel time-series and scaled to the 1960–1979 average. Note the logarithmic scale on the y-axis.

Table 2.1. GLM glass eel ~ year : area + site geometric means of predicted values for 40 glass eel series, values given in percentage of the 1960–1979 period. NS = North Sea, EE = Elsewhere Europe.

Year	EE	NS	Year	EE	NS	Year	EE	NS	Year	EE	NS	Year	EE	NS	Year	EE	NS
1960	138	232	1970	102	52	1980	127	64	1990	41	12	2000	20.9	4.5	2010	6.2	0.9
1961	121	135	1971	57	83	1981	93	47	1991	19	3	2001	9.8	1.8	2011	4.5	0.9
1962	151	208	1972	55	108	1982	105	46	1992	26	8	2002	15.0	4.0	2012	6.1	0.7
1963	183	259	1973	61	40	1983	55	42	1993	30	8	2003	13.1	4.9	2013	8.9	2.0
1964	102	195	1974	87	100	1984	61	15	1994	31	9	2004	8.0	1.4	2014	13.9	9.4
1965	131	124	1975	74	64	1985	58	14	1995	34	7	2005	9.4	2.8	2015	8.8	1.7
1966	80	79	1976	120	137	1986	38	15	1996	29	5	2006	6.7	0.8	2016	10.7	2.7
1967	82	63	1977	116	93	1987	70	13	1997	38	6	2007	7.3	3.2			
1968	134	107	1978	114	64	1988	71	12	1998	20	5	2008	6.0	2.1			
1969	60	70	1979	152	67	1989	51	6	1999	24	11	2009	5.1	2.1			

Table 2.2. GLM yellow eel ~ year + site geometric means of predicted values for 12 yellow eel series, values given in percentage of the 1960–1979 period.

Year	Index	Year	Index	Year	Index	Year	Index	Year	Index	Year	Index	Year	Index
1950	135	1960	153	1970	44	1980	89	1990	31	2000	17	2010	13
1951	243	1961	189	1971	50	1981	41	1991	37	2001	18	2011	11
1952	194	1962	173	1972	101	1982	41	1992	19	2002	30	2012	7
1953	331	1963	133	1973	121	1983	46	1993	14	2003	19	2013	6
1954	197	1964	52	1974	56	1984	31	1994	50	2004	27	2014	27
1955	272	1965	105	1975	106	1985	67	1995	16	2005	9	2015	11
1956	120	1966	141	1976	26	1986	48	1996	7	2006	16	2016	21
1957	132	1967	103	1977	74	1987	46	1997	21	2007	21		
1958	139	1968	164	1978	57	1988	57	1998	17	2008	15		
1959	338	1969	94	1979	58	1989	29	1999	22	2009	8		

Table 2.3. Description of the recruitment series updated to 2016 (gls: glass eel, ylw: yellow eel).

Code	Name	Survey type	Country	Area	Stage
Kavl	Kavlinge˚an	Trapping all	Sweden	Baltic	ylw.
Dala	Dalalven	Trapping all	Sweden	Baltic	ylw.
SeEA	Severn EA	Commercial catch	UK	British Isle	gls.
MiSp	Minho spanish part	Commercial catch	Spain	Atlantic Ocean	gls.
ShaA	Shannon Ardnacrusha	Trapping all	Ireland	British Isle	gls. + ylw.
Nalo	Nalon Estuary	Commercial catch	Spain	Atlantic Ocean	gls.
Feal	River Feale	Trap	Ireland	Atlantic Ocean	gls. + ylw.
Bres	Bresle	Trap	France	Atlantic Ocean	gls. + ylw.
MiPo	Minho portugese part	Commercial catch	Portugal	Atlantic Ocean	gls.
GiSc	Gironde	Scientific estimate	France	Atlantic Ocean	gls.
ShaP	Shannon Parteen	Trapping partial	Ireland	British Isle	ylw.
Bann	Bann Coleraine	Trapping partial	Northern Ireland	British Isle	gls. + ylw.
Maig	River Maigue	Trap	Ireland	Atlantic Ocean	gls.
Inag	River Inagh	Trap	Ireland	Atlantic Ocean	gls. + ylw.
Erne	Erne Ballyshannon	Trapping all	Ireland	British Isle	gls. + ylw.
Ring	Ringhals scientific survey	Scientific estimate	Sweden	North Sea	gls.
Stel	Stellendam	Scientific estimate	Netherlands	North Sea	gls.
Yser	Ijzer Nieuwpoort	Scientific estimate	Belgium	North Sea	gls.
YFS2	IYFS2	Scientific estimate	Sweden	North Sea	gls.
Laga	Lagan	Trapping all	Sweden	North Sea	ylw.
RhDO	Rhine DenOever	Scientific estimate	Netherlands	North Sea	gls.
RhIj	Rhine IJmuiden	Scientific estimate	Netherlands	North Sea	gls.
Katw	Katwijk	Scientific estimate	Netherlands	North Sea	gls.
Meus	Meuse Lixhe dam	Trapping partial	Belgium	North Sea	ylw.
Gota	Gota A¨ lv	Trapping all	Sweden	North Sea	ylw.
Visk	Viskan Sluices	Trapping all	Sweden	North Sea	gls. + ylw.
Sle	Slette A	Scientific survey	Denmark	North Sea	gls.

Code	Name	Survey type	Country	Area	Stage
Klit	Klitmoeller A	Scientific survey	Denmark	North Sea	gls.
Nors	Nors A	Scientific survey	Denmark	North Sea	gls.
Vac	Vaccares	Trapping partial	France	Mediterranean Sea	gls.
Albu	Albufera de Valencia	Commercial catch	Spain	Mediterranean Sea	gls
Ebro	Ebro delta lagoons	Commercial catch	Spain	Mediterranean Sea	gls

Table 2.4. Description of the recruitment series updated to 2015 (gls: glass eel, ylw: yellow eel).

Code	Name	Survey type	Country	Area	Stage
Hart	Harte	Trapping all	Denmark	Baltic	Ylw.
Vil	Vilaine Arzal	Trapping all	France	Atlantic Ocean	Gls.
Morr	Morrumsån	Trapping all	Sweden	Baltic	ylw.
Mota	Motala Strom	Trapping all	Sweden	Baltic	Ylw.
Imsa	Imsa Near Sandnes	Trapping all	Norway	North Sea	gls. + ylw.
Fre	Frèmur	Trap	France	Atlantic Ocean	ylw
Ronn	Rönne å	Trapping all	Sweden	North Sea	Ylw.
Lauw	Lauwersoog	Scientific estimate	Netherlands	North Sea	Gls.
AlCP	Albufera de Valencia	Commercial cpue	Spain	Mediterranean	gls.

2.3 Trends from fisheries and other stock abundance data, restocking and eel related environmental data

Introduction

This section presents and describes data from commercial fisheries, recreational and non-commercial fisheries, and other sources. Commercial landings are declining, a long-term continuing trend. Commercial landings as collated from FAO data are now down to 3321 tonnes in 2014. Six countries account for 73% of the FAO landings: France, Egypt, UK, Netherlands, Sweden and Denmark.

As a consequence of this decline, it might appear that recreational catch could be increasing as a proportion of the total catch, but good quality data on recreational fishing impacting eel over its range are not available in sufficient quantity to ascertain the full picture. Some fishery-independent data are available from yellow eel surveys, useful to describe standing stock between recruitment and silver eel escapement. The working group notes that more standing stock data may be available in individual Member States, but that the effort involved in collation to a form suitable for international use is likely to be an impediment to supply.

Restocking (Capture, translocation and stocking to new locations in the wild) of eel has increased over the period 2009 to 2013, as a result of the inclusion of this as a stock enhancement option in the EC Eel Regulation (EC 1100/2007). The activity is important in maintaining local stocks in some areas, though overall it is at a level unlikely to affect the whole stock. The scientific evidence of the impacts of this activity on the whole stock has been reviewed in a recent workshop (WKSTOCKEEL) and the reader is referred to its report (WKSTOCKEEL 20016) for further information. In essence, scientific evidence is still lacking to definitively establish whether or not stocking has a significant potential for the recovery of the stock.

2.3.1 Commercial fisheries landings, effort and fishing capacity

Landings data for commercial eel fisheries are available from the FAO statistics and from national Country Reports (CR) to the WGEEL. For some series these data sources show the same general trends, but there are problems in finding out exactly what components are grouped into national reporting to FAO. The CR, with new data tables attached in 2106, offer a potential solution to create more accuracy, but do depend on countries working to gather, verify and submit the data. Discrepancies were found between resubmitted and previous series supplied, and with the establishment of the new WGEEL Stock Annex an initial exercise is needed to make sure that its starting point is as accurate as possible.

FAO and Country Report Derived landings data

Figure 2.5 presents the FAO series up to and including 2014 (including some not WGEEL reporting countries) and Figure 2.6 presents a combination of FAO and CR data. While the resultant trends are both similar and declining, care should be taken with over-interpreting Figure 2.6, since it is not based on consistently reported time-series.

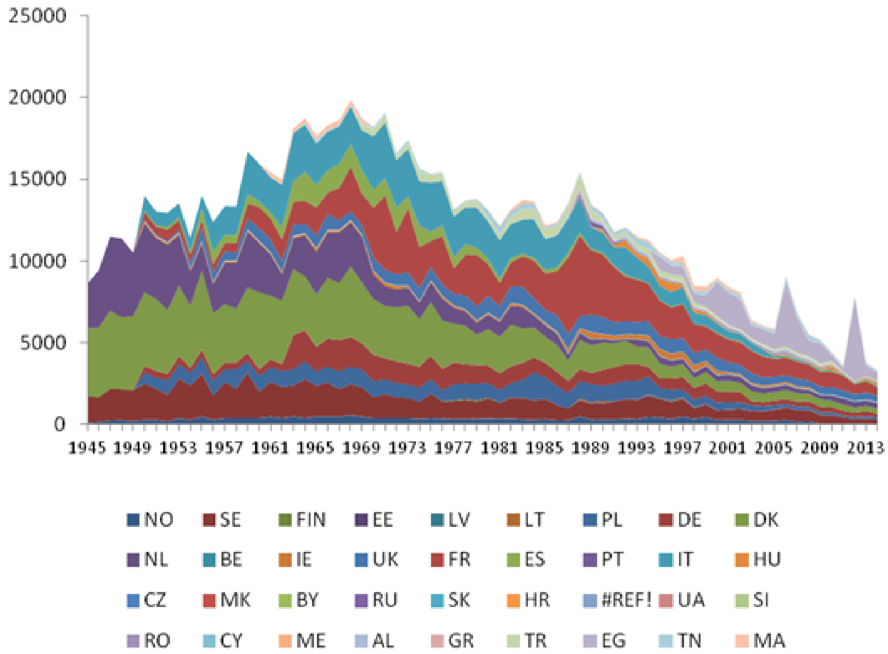

Figure 2.5. Time-series of commercial eel fishery landings, by country, as reported to FAO. Care should be taken with the interpretation of this graph, since it is not based on consistently reported time-series.

Dataseries from the Country Reports continue to be unreliable but coverage is improving, offering (slowly) increasing opportunities for assessment of the eel stock. Further improvement is supported now that the EU Data Collection Multi-Annual Programme (DC MAP) is set to offer financial support for gathering data on eel in all life phases and in both marine and freshwaters.

A review of the catches and landing reports in the CR showed a great heterogeneity in landings data reports, with countries making reference to an official system, some of which report total landings, others report landings by Management Unit or Region, and some countries haven't any centralized system. Furthermore, some countries have revised their dataseries, with extrapolations to the whole time-series, for the necessities of their Eel Management Plan compilation (Poland, Portugal). Revisiting and adjusting data prior to present years, while desirable in the interests of accuracy, has obvious potential consequences for overall long-term trend assessment. Ideally, some "track changes" analysis may be required in internationally coordinated dataseries.

Since landings data were incomplete (for CR and FAO), with some years missing for some of the countries, an estimate of the missing values is provided by simple GLM extrapolation (after Dekker, 2003), with year and countries as the explanatory factors. Combining the most recent update of the FAO data, with CR information, and a reconstruction of the remaining missing data, constitutes the best available view on the trend in landings of eel (Figure 2.6). The graph also includes FAO data for countries not reporting to WGEEL: Egypt and Morocco.

According to the CR the total eel landings in 2015 amounted to 2013 tonnes, and compared to previous years the trend is negative; note however that CR data appear incomplete. However, in the years since the implementation of the Eel Regulation, fishing restrictions in many countries appear to have reduced the catches considerably. Care should 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.

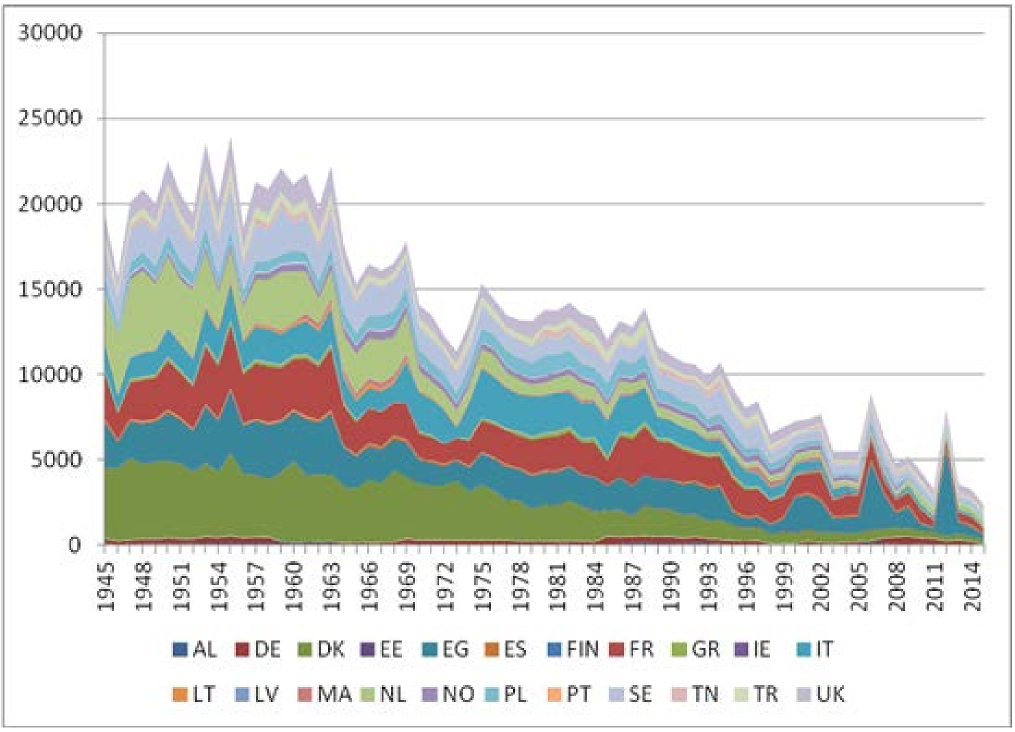

Figure 2.6. Time-series of commercial eel fishery landings, by country, combining information from the FAO database, national information sources (Country Reports) and a reconstruction of the non-reporting countries/years (see text).

Capacity and effort

Fishing capacity and effort are registered differently amongst the reporting countries. In some cases, the number of fishing licences is known but the number of gears used is unknown, or the number of licences does not reflect the number of fishermen/or gear tied as one licence may collocate different numbers of fishermen/gear. Some of the reporting countries have historic fishing rights connected to the number of licences so the fishing capacity has stayed at the same level for years but there could have been changes in fishing effort used by these licences. In some cases, the fishing capacity and/or effort has been reduced as a consequence of the implementation of the national EMPs.

Glass eel fishery

A glass eel fishery is reported from the UK, France, Spain, Portugal and Italy. There is also a glass eel fishery in Morocco but no data are available for that.

Fishing effort for glass eel in the UK has tripled since 2008, and in Spain it has doubled over a similar period. However, in France the number of glass eel fishing licences has more than halved since 2006 (from 1224 in 2006 to 540 in 2015).

Yellow/Silver eel fishery

Commercial fishing has been prohibited in the northwestern fringe of the continent (Ireland, Scotland, Norway) for almost a decade, and capacity (numbers of licences) and effort for yellow, silver and combined fisheries have declined in most European countries in recent years. These metrics have about halved in Sweden, Spain, Lithuania and Italy since 2007–2010, reduced by about 30–20% in Denmark, France and Germany, and by about 10% in Estonia. About one third of the fishery in The Netherlands was closed in 2011 due to high PCB-levels in the eel. In Greece, the yellow eel fishery has been closed.

There have been increases in some countries however, with effort increasing about one third in the UK from 2008–2010 to 2011–2013, and by about 20% in Poland from 2014 to 2015.

2.3.2 Recreational and non-commercial fisheries

Recreational and non-commercial fishing is the capture or attempted capture of living aquatic resources mainly for leisure and/or personal consumption. In a few countries, e.g. Norway, recreational fishers are allowed to sell part of their catch. Recreational and non-commercial fishing covers active fishing methods including line, spear, and hand-gathering and passive fishing methods including nets, traps, pots, and setlines.

Recreational fishing mortality of a stock may be as big or even exceed that of commercial landings. At present, recreational mortalities for most fish stocks are largely unquantified and/or lacking and are thus not included in stock assessments (with the notable exception of Baltic cod, salmon and European sea bass). This may have an impact on the ability to sustainably manage fish stocks. Therefore the need to include recreational fishery data in a stock assessment procedure should be evaluated on a case-by-case basis, according to the known magnitude of recreational catches compared with commercial catches based on previous surveys or pilot studies. This should be reviewed regularly as recreational catches can fluctuate significantly between years and recreational effort can remain high even where stocks are depleted.

It is an EU Data Collection Framework (Council Regulation (EC) No 199/2008) requirement that recreational catches of eel should be reported. In addition, Article 11.2 of the Eel Regulation (EC 1100/2007) requires Member States to regularly estimate catches of eel by recreational fishing. The obligations for MS with regard to collecting recreational fishery statistics has been emphasized in the new EU MAP. EU MAP describes the need for estimates of recreational catches (retained and released) of eel in both marine and inland waters.

To assess the potential impact of recreational fishery on eel mortality, datasets were compiled from the 2016 Country Reports.

Data deficiencies

The data reported in the Country Reports remained largely incomplete and no change was observed in the countries reporting recreational catches compared to 2015. Some updates were complete but some missed gears and/or habitats and all four lacked estimates of released eel. No MS completely covers all the different parts of its recreational fisheries: nearly all MS miss gears (angling, passive gears), areas (in-land, marine) and/or life stages (glass eel, yellow eel, silver eel). A major data gap is the nearly complete absence of MS reporting the amount of released eels and its associated release mortality. These facts make it difficult to assess the most recent total catches (catch and released) of recreational and non-commercial fisheries. Overall, the impact of recreational fisheries on the eel stock remains largely unquantified. With the implementations of the new EU MAP, it is expected that insight into the effect of recreational fish directly through extraction and indirectly by catch & release (C&R) mortality will improve in the near future.

Catch & Release (C&R) mortality of eel

In most MS it is prohibited for recreational anglers to retain eels, so all eel caught must be released. The amount of fish released by recreational anglers can be substantial (Ferter *et al*., 2013) and catch and release mortality can be high (median 11%, mean 18%, range 0–95%, n = 274 studies; Bartholomew and Bohnsack, 2005) depending on species and factors like hooking location, temperature and handling time. In the Netherlands for example, 400 000 eels were retained but an additional 1 600 000 eels were caught and released in 2012. Unfortunately, to date no C&R mortality rates are available for eel. However, several studies are being conducted in Germany to estimate this. The results of these studies will hopefully be available to MS in 2017 to be used for the 2018 evaluation of the Eel Management Plans.

2.3.3 Misreporting of data, and illegal fisheries

Although illegal glass eel trade was mentioned in some reports, interviews with Country Report authors indicate that illegal eel fishing evaluations were not provided because authorities do not collect these data. Therefore, it is not possible to determine or even guess the effect of IUU on assessments of the state of the eel stock.

2.3.4 Trends in non-fisheries impacts

The working group members were asked to report on the scale of non-fisheries impacts (hydropower including pumps, habitat loss (=barriers), predators, and indirect impacts) expressed as loss in kg for each developmental stage of eel (glass eel, yellow eel, silver eel, and silver eel equivalents).

Only Ireland reported more than one year of data for impacts of hydropower and pumps on silver eel (although Scotland indirectly estimates the impact of hydropower each year based on annual production of silver eel (kg.ha-1) with the assumption of zero silver eel escapement from the wetted area above hydropower). The impact of hydropower on silver eel (or silver eel equivalents) differed among EMU units in Ireland. The low impact of hydropower and pumps on silver eel in 2010 and 2011 in one of the EMUs of Ireland (IE_NorW) was due to closure of two turbines and low escapement of silver eels (Figure 2.7).

As most countries did not provide any quantitative impacts for more than one year, it was not possible to assess any temporal trends of impacts of habitat loss, predators or indirect impacts on any developmental stage of the eel. Thus, there is a big gap on quantitative estimates of impacts from non-fishery anthropogenic mortality factors on any developmental stage of the eel.

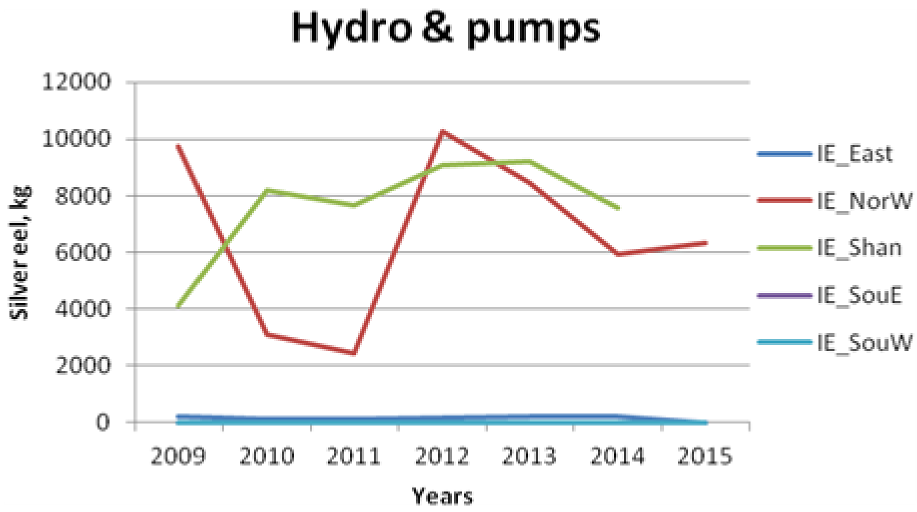

Figure 2.7. The impact of Hydropower and pumps on silver eel in five different EMUs in Ireland.

2.3.5 Silver eel Escapement biomass and mortality rate stock indicators

WGEEL has accessed and used Stock biomass and more recently mortality indicators to derive EMU and collective stock status. The Overall Stock biomass and mortality based precautionary "bubbleplots" were last comprehensively reviewed following the EU Member States reporting in 2015. WGEEL 2016 did re-examine the data and some new coverage data were available, but not sufficient to review the stock-wide picture.

It is anticipated that a full review of these stock indicators will be undertaken after the 2018 Eel Management Plan progress required by the EC Eel Regulation. By that time, it is hoped that some GFCM and other non-EU countries will also be able to report these stock indicators. Every effort should be made to encourage and assist such countries to reach that level of reporting, for the sake of increased confidence in the whole stock biomass/mortality level trend analysis.

2.3.6 Trends in restocking

Data on the amount of stocked glass eel and young yellow eel were obtained from Country Reports. As WGEEL reports in September and due to the ongoing restocking programmes in various countries, the data for the amounts of eel restocked were not completely available for 2016 and therefore the data are only presented to 2015. Note also that various countries use different size and weight classes of young yellow eels for stocking purposes.

Figure 2.8 presents the time-series of glass and yellow eel restocking from 1947 to 2015. The restocking of glass eel peaked in the 1980s, followed by a steep decline to a low in 2009. 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, in 2015, the glass eel suppliers had problems fulfilling glass eel orders placed by several countries (most notably Belgium).

The restocking of young yellow eels started rising in the 1990s reaching its peak in 2013 with almost 16 million young yellow eels restocked across EMUs (Figure 2.8). In 2015 the proportions of glass eel and young yellow eel amongst stocked eel were almost equal with 10 million and 9.2 million individuals restocked respectively. Multiple factors affect the supply and demand of eel meant for restocking so any conclusions made on the proportions of different eel restocked would be complicated.

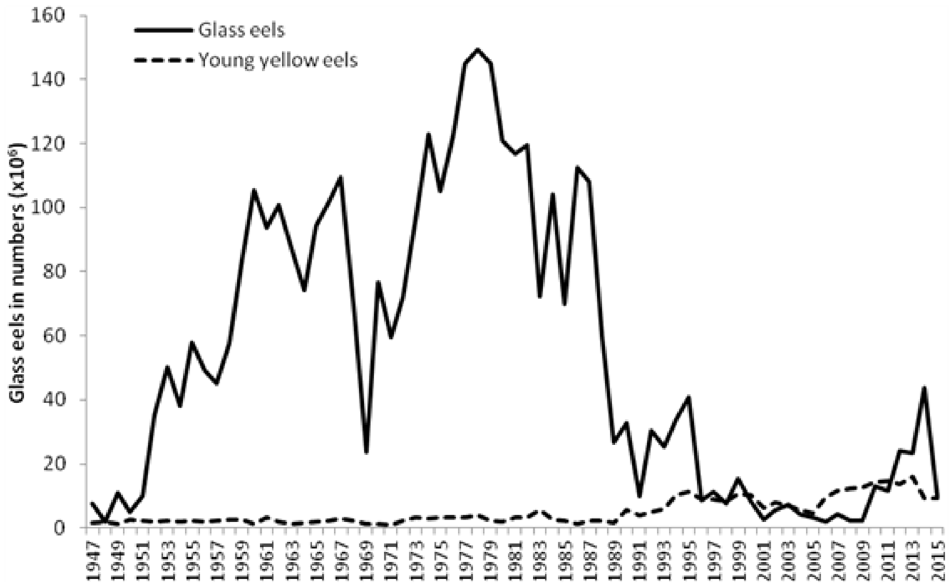

Figure 2.8. Reported stocking of glass eel and young yellow eel in Europe (Sweden, Finland, Estonia, Latvia, Lithuania, Poland, Germany, Denmark, the Netherlands, Belgium, Spain, Italy and Greece), in millions stocked (1947–2015).

Table 2.6. Stocking of glass eel (1947–2015). Numbers of glass eels (in millions) stocked in Sweden (SE), Finland (FI), Estonia (EE), Latvia (LV), Lithuania (LT), Poland (PL), Germany (DE), Netherlands (NL), Belgium (BE), United Kingdom (GB), France (FR), Spain (ES), Italy (IT) and Greece (GR).

	SE	FI	EE	LV	LT	PL	DE	NL	BE	GB	FR	ES	IT	GR	TOTAL
1947								7.6							7.6
1948								1.9							1.9
1949								11							11.0
1950								5.1							5.1
1951								10							10.0
1952						18		17							35.0
1953						26	2.2	22							50.2
1954						27	0	11							38.0
1955						31	10	17							58.0
1956			0.2		0.3	21	4.8	23							49.3
1957						25	1.1	19							45.1
1958						35	5.7	17							57.7
1959						53	11	20							84.0
1960			1	3.2	2.3	64	14	21							105.5
1961						65	7.6	21							93.6
1962			1	1.9	2	62	14	20							100.9
1963				1.5	1	42	20	23							87.5
1964			0.2	0.9	2.4	39	12	20							74.5
1965			1	0.4	2.1	40	28	23							94.5
1966		1.1			0.7	69	22	8.9							101.7
1967		3.9		1	0.5	74	23	6.9							109.3
1968		2.8	1	3.7	3	17	25	17							69.5
1969						2	19	2.7							23.7
1970			1	1.8	2.8	24	28	19							76.6
1971					1.6	17	24	17							59.6
1972			0.1	1.6	0.3	22	32	16							72.0
1973					1.4	62	19	14							96.4
1974			2		1.8	71	24	24							122.8
1975					2.2	70	19	14							105.2
1976			3	0.6	1	68	32	18							122.6
1977			2	0.5	1.4	77	38	26							144.9
1978		3.7	3		2.7	73	39	28							149.4
1979					0.8	74	39	31							144.8
1980			1		1.8	53	40	25							120.8
1981			3	1.8	3	61	26	22							116.8
1982			3		4.6	64	31	17							119.6
1983			3	1.5	3.7	25	25	14							72.2
1984			2			49	32	17		4					104.0
1985			2	1.5	1.6	36	6	12		10.9					70.0
1986			3		2.6	54	24	11		17.8					112.4
1987			3	0.3		57	26	7.9		13.8					108.0

	SE	FI	EE	LV	LT	PL	DE	NL	BE	GB	FR	ES	IT	GR	TOTAL
1988				2.2		16	27	8.4		6.32					59.9
1989						5.9	14	6.8							26.7
1990	0.8	0.1				8.6	17	6.1							32.6
1991	0.9	0.1	2			1.7	3.2	1.9							9.8
1992	1.1	0.1	3			14	6.5	3.5		2.36					30.6
1993	1	0.1				11	8.6	3.8	0.8						25.3
1994	1	0.1	2		0.1	12	9.5	6.2	0.5	2.32					33.7
1995	0.9	0.2		0.6	1	24	6.6	4.8	0.5	2.06					40.7
1996	1.1	0.1	1		0.4	2.8	0.8	1.8	0.5	0.1		0.07			8.7
1997	1.1	0.1	1			5.1	1	2.3	0.4	0.21		0.07			11.3
1998	0.9	0.1	1		0.1	2.5	0.4	2.5		0.05		0.1			7.7
1999	1	0.1	2	0.3		4	0.6	2.9	0.8	3.6		0.16			15.5
2000	0.67	0.1	1			3.1	0.3	2.8		0.45					8.4
2001	0.44	0.1				0.7	0.3	0.9	0.2			0.01			2.7
2002	0.26	0.1		0.2			0.3	1.6		3.02					5.5
2003	0.27				0.4	0.5	0.1	1.6	0.3	4.1					7.3
2004	0.18	0.1				2.3	0.2	0.3		1.28		0.04			4.4
2005	0.07	0.1		0.1			0.6	0.1		2.16				0.06	3.2
2006	0.003	0.1						0.6	0.3	0.99				0.02	2.0
2007	0.03	0.1					1	0.2		3				0.02	4.4
2008	0.12	0.2					0.5		0.3	1.28				0.01	2.4
2009	0.02	0.1					0.76	0.3	0.4	0.65				0.02	2.3
2010	0.8	0.2					4.8	2.7	0.4	3	1			0.11	13.0
2011	0.79	0.31	0.7	0.4			4.8	0.8	0.5	3.3	2.2		0.2		14.0
2012	0.77	0.18	0.9	1.0			4.0	2.4	0.6	4.0	9.3	1.07	1.3	0.01	25.5
2013	0.80	0.2	0.8		1.2		4.7	1.8	0.4	5.8	8.8		0.6	0.43	25.5
2014	0.89	0.15	3.0	1.4			1.5	7.95	1.62	8.2	18.4		1.5	0.21	44.8
2015	0.56	0.1	1.87				0.36	0.86		1.8	4.47		0.53		10.6
TOTAL	16.5	14.7	55.8	28.4	50.8	1781.2	842.8	753.9	8.5	106.6	44.2	1.5	4.1	0.9	3709.9

Table 2.7. Stocking of young yellow eel (1947–2015). Numbers of young yellow eels (in millions) stocked in Sweden (SE), Finland (FI), Estonia (EE), Latvia (LV), Lithuania (LT), Poland (PL), Germany (DE), Denmark (DK) the Netherlands (NL), Belgium (BE), Spain (ES) and Italy (IT).

	SE	FI	EE	LV	LT	PL	DE	DK	NL	BE	ES	IT	TOTAL
1947									1.6				1.6
1948									2				2.0
1949									1.4				1.4
1950							0.9		1.6				2.5
1951							0.9		1.3				2.2
1952							0.6		1.2				1.8
1953							1.5		0.8				2.3
1954							1.1		0.7				1.8
1955							1.2		0.9				2.1
1956							1.3		0.7				2.0
1957							1.3		0.8				2.1
1958							1.9		0.8				2.7
1959							1.9		0.7				2.6
1960							0.8		0.4				1.2
1961		0		1			1.8		0.6				3.4
1962		0		0.7			0.8		0.4				1.9
1963				0.4			0.7		0.1				1.2
1964		0		0.4			0.8		0.3				1.5
1965		0		0.3			1		0.5				1.8
1966		0					1.3		1.1				2.4
1967				0.8			0.9		1.2				2.9
1968							1.4		1				2.4
1969							1.4						1.4
1970				0.4			0.7		0.2				1.3
1971							0.6		0.3				0.9
1972							1.9		0.4				2.3
1973						0.2	2.7		0.5				3.4
1974							2.4		0.5				2.9
1975							2.9		0.5				3.4
1976				0.3			2.4		0.5				3.2
1977						0.1	2.7		0.6				3.4
1978							3.3		0.8				4.1
1979		0					1.5		0.8				2.3
1980							1		1				2.0
1981							2.7		0.7				3.4
1982				0.3		0.1	2.3		0.7				3.4
1983				0.4		2.3	2.3		0.7				5.7
1984						0.3	1.7		0.7				2.7
1985						0.5	1.1		0.8		0.02		2.4
1986						0.2	0.4		0.7		0.00		1.3
1987							0.3	1.58	0.4		0.00		2.3
1988			0.2	0.8		0.1	0.2	0.75	0.3		0.04		2.4

	SE	FI	EE	LV	LT	PL	DE	DK	NL	BE	ES	IT	TOTAL
1989						0.7	0.2	0.42	0.1		0.06		1.5
1990	0.7					1	0.4	3.47			0.03		5.6
1991	0.3					0.1	0.5	3.06			0.06		4.0
1992	0.3					0.1	0.4	3.86			0.06		4.8
1993	0.6						0.7	3.96	0.2	0.2	0.17		5.8
1994	1.7				0.1	0.1	0.8	7.4		0.1	0.12		10.2
1995	1.5		0.2				0.8	8.44		0.1	0.22		11.3
1996	2.4					0.5	1.1	4.6	0.2	0.1	0.11		9.1
1997	2.5					1.1	2.2	2.53	0.4	0.1	0.14		9.1
1998	2.1				0.1	0.6	1.7	2.98	0.6	0.1	0.09		8.2
1999	2.3				0.1	0.5	2.4	4.12	1.2	0.04	0.04		10.6
2000	1.4					0.8	3.3	3.83	1		0.09		10.4
2001	0.8		0.4			0.6	2.4	1.7	0.1		0.09		6.1
2002	1.7		0.4	0.2		0.6	2.4	2.43	0.1	0.01	0.16		8.1
2003	0.8		0.5			0.50	2.60	2.24	0.10	0.01	0.08		6.9
2004	1.3		0.4		0.10	0.50	2.20	0.75	0.10	0.01	0.16		5.5
2005	1		0.4			0.70	2.10	0.30		0.01	0.12		4.6
2006	1.1		0.4			1.10	5.50	1.60			0.00		9.7
2007	1		0.3		0.005	0.90	8.7	0.83			0.02		11.8
2008	1.4		0.2		0.005	1.00	8.5	0.75	0.23		0.09		12.2
2009	0.8		0.4		0.01	1.40	8.3	0.81	0.30		0.03	0.38	12.4
2010	1.9		0.2		0.03	1.40	8.2	1.55	0.10		0.06	0.36	13.8
2011	2.6		0.2	0.004	0.15	2.70	5.5	1.56	1.0		0.11	0.69	14.5
2012	2.6	0.2	0.1		0.59	1.70	6.1	1.53	0.5		0.20	0.2	13.7
2013	2.7	0.2		0.006	0.2	3.5	6.6	1.53	0.5		0.10	0.37	15.7
2014	3.0		0.2		0.4	2.3	0.4	1.6	1.09		0.04	0.38	9.3
2015	1.9				0.45	3.6	0.6	1.53	0.8			0.32	9.2
TOTAL	40.3	0.4	4.6	6.0	2.2	31.8	141.2	71.7	39.8	0.8	2.5	2.7	344.0

The potential contribution of restocking to silver eel escapement from measures taken in EMPs is difficult to measure yet, given the sometimes many years between glass eel and silver eel. However, the potential contributions can be crudely estimated by calculating 'silver eel equivalents' taking into account natural mortality rates, growth rates and size or age at silvering. Figure 2.9 presents such estimates for the restocking initiatives in German EMPs.

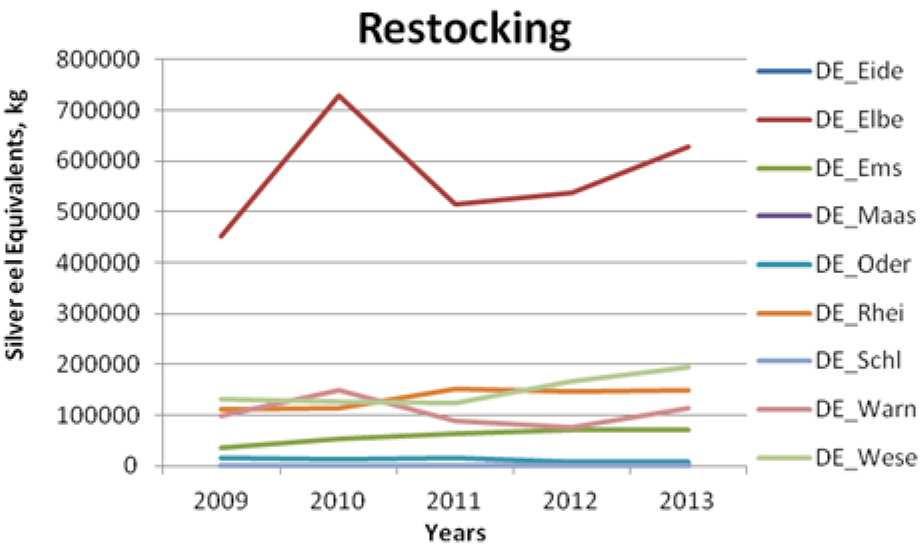

Figure 2.9. The predicted contributions of restocking in nine different EMUs in Germany expressed as silver eel equivalents.

2.3.7 Yellow eel abundance

Several Country Reports present information on long-term monitoring of yellow eel abundance in various habitats, and these values have been updated in the WGEEL database. Methodologies vary from electrofishing and traps in rivers to beach-seines, fykenets and trawls in larger waterbodies. In some cases, detailed information on catches and effort in commercial fisheries are combined to give estimates on local abundance.

The Skagerrak beach-seine surveys data from Norway since 1925 constitute the longest non-fishery dependent set of data. It is also the only potential time-series on the subpopulation of marine eels. No trend in eel abundance occurred until a sharp decrease started in the early 2000s.

The coastal fish communities on the Swedish West Coast are monitored by standardized fishing with fykenets in shallow water (2–5 m). Yellow eel is among the dominating fish species in August most years. Figure 2.10 presents time-series for Fjällbacka, Lysekil, Stenungsund, Vendelsö, Kullen and Barsebäck and Vendelsö. The trend for the longest time-series from Vendelsö in central Kattegat is significantly positive and so is the trend in average August catches for the six investigated sites. Cpue at Vendelsö and at Barsebäck was positively correlated with seawater temperature at Vendelsö in the period with available data (1988–2014). The reason for these trends and correlations are being investigated in an ongoing study.

In Irish fykenet surveys, a change in sex ratio towards female dominance was observed, and an increase in mean weight compensated for a decrease in abundance compared to the late 1960s.

Fykenet catches at Den Burg, Texel, dropped to close to zero in the 1980s and decreasing abundance along with increasing size was observed in Dutch estuaries in the last decade. In Lake IJsselmeer (Figure 2.11) and in Belgian lower Scheldt estuary, yellow eel densities decreased significantly in recent decades. However, during the same time increasing abundance was observed upstream in the same estuary in Belgium.

Finally, the catch per unit of effort in the 'eel pot' fishery in the Garonne estuary, France, has not changed significantly since 1987.

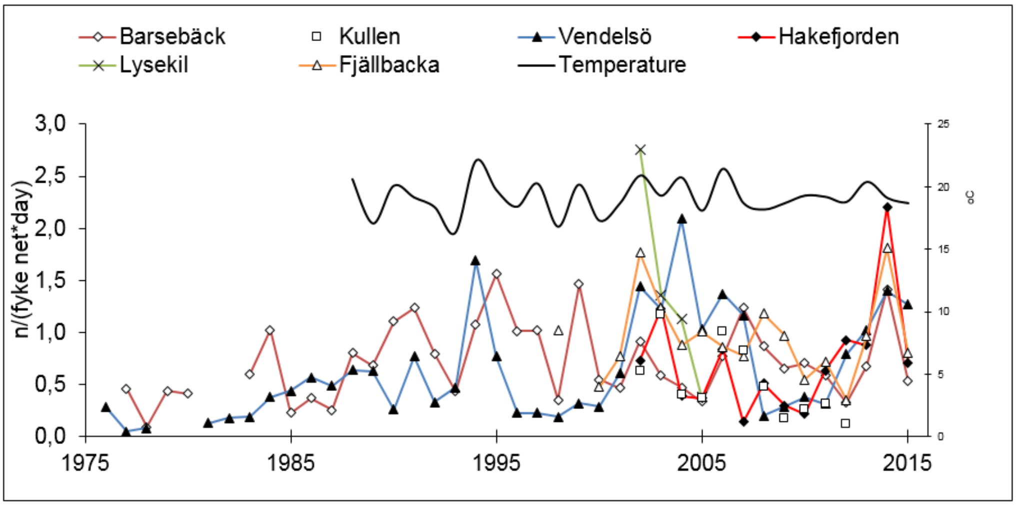

Figure 2.10. Trends in yellow eel abundance from fishery-independent surveys. Number of eels per fykenet per day in surveys along the Swedish west coast, 1976 to 2015. Temperature refers to temperature at catch at Vendelsö.

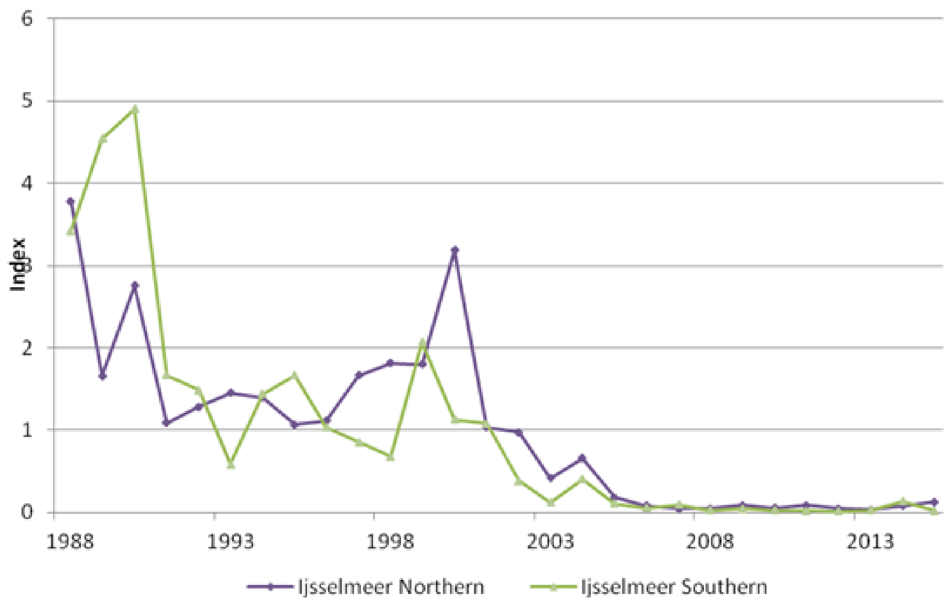

Figure 2.11. Trends in yellow eel abundance from fishery-independent surveys. data from freshwater (Ijsselmeer) in the Netherlands. Data were normalized as annual fractions of the long-term mean in each series, and updated to 2012.

In summary therefore, the available information on long-time changes in yellow eel abundance is complex but shows that the decrease in recruitment since 1980 is not necessarily reflected in a subsequent decrease in yellow biomass for some of the series. A decrease in number may be compensated for by an increase in the proportion of females, which typically grow to a heavier individual weight. In areas already dominated by females, a decrease in recruitment may result in reduced pressure for the eel to colonize distant/marginal habitats. These factors, as well as bias introduced by biotic or abiotic circumstances, have to be taken into consideration in future design and interpretation of data from a variety of different survey methods.

2.4 Glass eel trade and traceability

Chapter 2.4 addresses the following Terms of Reference:

a) Developments in the state of the European eel (*Anguilla anguilla*) stock, the fisheries on it and other anthropogenic impacts:

   i) Assess the trends in the state of the European eel stock, and the anthropogenic impacts on the stock;

   ii) Update and evaluate time-series of data used directly and indirectly in assessing the status of the stock.

This task was a development of the Trade analyses that had previously been undertaken by WGEEL (2011–2013) under similar ToR and is organized under the following headings:

1) Assess quantities of glass eel caught and their destiny:

- caught in the commercial fishery;
- internal trade between EU Countries;
- used in stocking;
- used in aquaculture for consumption;
- consumed direct;
- mortalities.
- Evidence of export to Asia;

2) Assess where possible "movement through" countries and match up import/exports;

3) Compare with the commitments to stocking in the EMP (use stocking data supplied in ICES review table).

4) Comments on illegal trade.

5) Development of methods to aid with traceability.

2.4.1 Introduction to Glass Eel Trade & Traceability

Given the decline in the eel stock, information on the trade of all stages of the European eel is necessary for a complete understanding of the fishery mortality. However, as noted previously (ICES, 2014) a complete description of eel trade was deemed to be beyond the scope of the WGEEL, and given the value and continued use of the limited resource of glass eel for consumption, aquaculture and stocking, the decision was made to re-examine the task of trade assessment by focusing on the glass eel trade.

The EC Eel Regulation (EC 1100/2007) requires that at least 60% of glass eel catch (actually eel <12 cm) "be marketed for use in restocking in eel river basins" and that Member States shall "take the measures necessary to identify the origin and ensure the traceability of all live eels imported or exported from their territory".

The provision of funding towards the purchase of glass eel for such restocking measures was made available by the EU via grant aid from the European Fisheries Fund (EFF).

So in essence this report will have been written during a time when:

- EU funding was available towards the purchase of "seed" for stocking;
- 60% of all glass eel harvested should have been made available for stocking purposes from 2013;
- The transfer of such glass eel should have been traceable for the preceding seven years.

2.4.2 Data sources

Glass eel trade data were sourced from:

- the EuroStat Database;
- WGEEL Country Reports (CR);
- A specific Glass Eel Trade questionnaire distributed by WGEEL prior to the meeting (Q.A.).

The results were compared between the years 2015 and 2016 and comparisons drawn from similar trade analysis in 2013 (ICES, 2014). The data and subsequent analyses in this chapter are based on preliminary data: many national authorities provide their data one or two years retrospectively and as observed in previous trade examinations (ICES, 2013; 2014) this can account for some glass eel trade anomalies and specific outcomes will likely change in future assessments.

2.4.3 Trade analysis

Five EU Member States have a glass eel fishery (France, UK, Spain, Portugal and Italy): some non-EU countries (e.g. Morocco) also have glass eel fisheries but data from these were not available for analysis. The best estimates of the total EU catch of glass eel in 2015 and 2016 were 51 643 and 59 256 kg, respectively (Table 2.8 and 2.9) of which 31 293 kg and 30 846 kg were declared exported.

The best recruitment year for a decade in 2014 was accompanied by relatively high glass eel catch (61 t). This figure fell by 15.4% to 51.6 t in 2015, but rose again by almost 9 t to 59.3 t in 2016. The rise in catches in 2016 was attributable principally to the French fishery (up 10 t) and to a lesser extent the UK fishery (up 1.5 t), while reported landings fell by 3 t in Spain and 1 t Portugal (Table 2.8 and 2.9).

Table 2.8. The amount of glass eel (kg) caught and exported in 2015. This table is based on preliminary data: the intention is to show the technique, but specific outcomes will certainly change in future assessments. Data from CR, EuroStat, or Q.A., but note # derived from EuroStat.

COUNTRY	CATCH KG	EXPORT KG	INTERNALLY STOCKED	DIRECT CONSUMPTION	TOTAL	UNACCOUNTED FOR %
YEAR	2015	2015	2015	2015	2015	2015
UK	2800	2022	605	100	2727	2.6
France	36 094	25 400#	1154	no data	26 404	26.8
Spain	11 079	3755	0	1730	5485	50.5
Portugal	1284	116	0	0		90.9
Italy	386	0	386	0	386	0
Total	51 643	31 293	2145	1830	35 002	32.2

Table 2.9. The amount of glass eel (kg) caught and exported in 2016. This table is based on preliminary data; the intention is to show the technique, but specific outcomes will certainly change in future assessments. Data from CR, EuroStat, or Q.A. but note # derived from EuroStat. Portugal reports on these data in retrospect and so the data were not available for 2016.

Country	catch kg	export kg	internally stocked	direct consumption	TOTAL	unaccounted for %
YEAR	2016	2016	2016	2016	2016	2016
UK	4279	3821	0	4	3825	10.6
France	46 371	26 225	3005	1761	30 991	33.2
Spain	8038	800#	2.7	1365	2168	73.1
Portugal	409	no data	0	0		100^^
Italy	159	0	159	0	159	0
Total	59 256	30 846	3167	3130	37 143	37.3

2.4.4 Difference between catch and exports

The best estimate of catch of glass eel from the various donor countries is given in Tables 2.8 and 2.9 together with the estimate of glass eel that could be accounted for through exports, internal usage in the donor country for stocking, aquaculture and/or consumption.

Of the total 2015 catch of 51.6 t, the destiny of 35 t could be accounted for. However this means that the fate of 32.2% of the catch remained unaccounted for (as highlighted by EuroStat data).

Of the total 2016 catch of 59.2 t, the destiny of 37.1 t could be accounted for. However this means that the fate of 37.3% of the catch remained unaccounted for (as highlighted by EuroStat data).

These levels of unaccounted glass eel are of a similar range to those noted in previous glass eel trade assessments in 2012 and 2013 with overall loss rates of 23% and 43% respectively.

Some of this “loss” may be accounted for by data that only become available in future (as described previously in ICES, 2013; 2014). Additional losses may be attributable to mortality and loss of weight post-capture, though such discrepancies are not believed to be significant. The major elements explaining the missing components of the glass eel harvest are more likely to be via underreporting of exports and/or through illegal activities (see Section 2.6.8).

For the UK, glass eels are caught using handnets and this is thought to account for the lower loss rate (2.6–10%) when compared with France (post fishing mortalities ranging from 2–82%: mean 42%) where most glass eel are fished using trawls (ICES, 2016).

Portugal and Spain do not have national stocking programmes, and the direct consumption of glass eel is not a culinary tradition in Portugal. However, the direct consumption of glass eel in Spain is a known use of this harvest. The UK recorded direct consumption of glass eel in both 2015 and 2016.

For Italy, the loss rate is minimal as they operate a truck and transport system with only one or two days between capture (using fykenets) and utilize their entire glass eel harvest for their national stocking programmes.

2.4.5 Destination of the catch by country

The initial destination of glass eels landed in France, Portugal, Spain and the UK are reported here via the sources described in Section 2.4.2.

The EuroStat database query was for the period September 2014–September 2016 and undertaken on 30/08/2016. The query collected export data from France (FR), Spain (ES) and the United Kingdom (UK), to BE, CZ, DE, DK, EE, EL, ES, FR, IE, IT, LT, LV, NE, PO, PT, RO, SE, SI, SK, UK, together with all 27 EU countries combined, and Morocco, Korea, Hong Kong and China. Since 2012 a distinction is now made on the EuroStat database by the type of eel consignment, allowing live juvenile eels of <12 cm to be readily identified. However, it appears from the prices charged that some of the exports are not correctly labelled. Eels that are traded for <100 EUR/kg are very unlikely to be live juvenile eels (Figure 2.13). Consequently, we excluded exports <100 EUR/kg from the further analysis. In the last step, we set the price corrected trade data in relation to the declared captures and that declared for stocking. The results are presented in Figures 2.13 and 2.14. The output has been calculated as follows: Unknown=Captures–Restocking+(Import-Export).

Figure 2.12. EuroStat price analysis for juvenile eel <12 cm (2012–2016).

Furthermore, all data in EuroStat are rounded to the nearest 100 kg (except for UK 2015), while much trading of glass eel takes place in smaller quantities: in such cases a more precise estimate of the weight of the consignment can be made by assuming that the mean price for glass eels was paid.

Tables 2.10 and 2.11 present the available EuroStat and Country Report (CR) data on imports and exports for UK, France, Spain and Portugal in 2015 and 2016, respectively.

A comparison of the two datasets (CR exports and EuroStat) for 2016 shows reasonably close correspondence for the UK and France, whereas for Portugal the discrepancy is likely only due to the rounding error involved in the 100 kg units of EuroStat. The Spanish CR did not report any exports. Additional data anomalies are discussed in Section 2.4.6.

Table 2.10. The direct destination and quantity of glass eel exported from France, Portugal, Spain and the UK in the 2014–2015 fishing season. This table is based on preliminary data; the intention is to show the technique, but specific outcomes will certainly change in future assessments. Data from C.R., EuroStat, or Q.A.

DESTINATION	QUANTITY EXPORTED (KG)											
2015	UK			France			Spain			Portugal		
	C.R. exports	EuroStat exports	C.R. imports	C.R. exports	EuroStat Exports	C.R. imports	C.R. exports	EuroStat exports	C.R. imports	C.R. exports	EuroStat exports	C.R. imports
Belgium					1200							
Bulgaria												
Czech Rep.	32											
Denmark	250	300			1700							
Estonia	250	300				562						
France	100				1154							
Germany	323	400			4200							
Greece	40					3690						
Italy												
Latvia												
Netherlands	350	400	300			4400			500			
Poland	5		150		800							
Portugal												
Slovakia												
Spain					10200	10359						563
Sweden	672	100										
UK	697	604										
Hungary							32					

Destination	Quantity exported (kg)											
2015	UK			France			Spain			Portugal		
	C.R. exports	EuroStat exports	C.R. imports	C.R. exports	EuroStat Exports	C.R. imports	C.R. exports	EuroStat exports	C.R. imports	C.R. exports	EuroStat exports	C.R. imports
Lithuania					200					26		
Luxembourg										80		
Hong Kong					1600							
Ireland												
US												40
Total	2719	2104	450	0	21054	19011	32	0	500	106	0	603

Table 2.11. The direct destination and quantity of glass eel exported from France, Portugal, Spain and the UK in the 2015–2016 fishing season. This table is based on preliminary data; the intention is to show the technique, but specific outcomes will certainly change in future assessments. Data from CR, EuroStat, or Q.A.

Destination	Quantity exported (kg)											
2016	UK			France			Spain			Portugal		
	C.R. exports	EuroStat exports	C.R. imports	C.R. exports	EuroStat exports	C.R. imports	C.R. exports	EuroStat exports	C.R. imports	C.R. exports	EuroStat exports	C.R. imports
Belgium				399	400							
Bulgaria	70											
Czech Rep.	73	100		303								
Denmark				3372	4600	4286						
Estonia	152	200				300						
France	185			4766	3500			200				
Germany	1074	1100	1568	3322	3700	4815						
Greece	600	700	350	806	900	200						
Italy				54				400				
Latvia	10			21								
Netherlands	51	100	few hundreds	3947	6600	5200		200				
Poland	127	400	300	499	400	400						
Portugal												
Slovakia	7											
Spain	460	400		9466	10200			3				
Sweden	892	900										
UK				49	800	100						
Hungary												

Destination	Quantity exported (kg)											
2016	UK			France			Spain			Portugal		
	C.R. exports	EuroStat exports	C.R. imports	C.R. exports	EuroStat exports	C.R. imports	C.R. exports	EuroStat exports	C.R. imports	C.R. exports	EuroStat exports	C.R. imports
Lithuania	120	100		415	400							
Luxembourg												
Hong Kong		200										
Ireland				2882	3600							
Unknown				15912								
Total	3821	4200	2218	43268	35100	15301	0	803	0	0	0	

2.4.6 Data anomalies

In order to assess the reliability of the glass eel traceability system among countries, a comparison has been made of import and export declarations for 2015 and 2016 as reported by donor countries vs. recipient countries.

As in previous reports a range of data anomalies/queries were noted and are annotated below: note that the frequency of occurrence, and the shipment sizes are not presented here.

Country	Comments
Belgium	Probably mislabelled in 2015 (1.2 t) while in 2016 data match well.
Bulgaria	Small export by UK (70kg) not confirmed by EuroStat in 2016.
Czech Rep.	UK export confirmed by EuroStat in 2016, no confirmation in 2015 (32 kg).
Denmark	Data missing: known to retrospectively report data (ICES, 2014) (1.7 t, 2015)
Estonia	Both years confirmed by EuroStat.
France	No country report data in 2015 and 16 t discrepancy in 2016.
Germany	Large gaps in 2015 (4.2 t but no data in CR): known to retrospectively report data (ICES, 2014)
Greece	Large declaration by CITES 2015 (3.7 t) not confirmed by other sources.
Italy	Small glass eel catches used for Italian demands and consequently does not occur in EuroStat.
Latvia	Both EuroStat and France report 21 kg exported to Latvia, not given in their CR.
Netherlands	2015 (4.4 t) not reported
Poland	EuroStat data are almost twice that as given in the CR. In 2015 800 kg only in EuroStat data in 2016, EuroStat confirmed some of the data.
Portugal	Administrative routines and the fact that the glass eel season runs over two fiscal years obstructs reporting on catch in time. Irrespective of that only a small portion of the Portugese catch is accounted for. Imports of glass eel from Spain are reported, despite Portuguese catches all being sold to Spain. Also 40 kgs imported from USA
Slovakia	Very small imports 7 kg
Spain	Only a small portion of the Spanish catch is accounted for. Large quantities directly consumed but not accounted for (data incomplete).
Sweden	In 2015 the CR records an import of 672 t from the UK (known to be correct H.Wickstrom, pers comm) while EuroStat only reports an export of 100 kg from the UK
UK	Glass eel exports match the EuroStat data but about half of the exports not confirmed by the CR imports. None of the UK catch in 2016 went to UK stocking.
Hungary	Very litle trade data
Lithuania	Imports in 2015 of 200 kg from France in EuroStat are not confirmed in the CR, and of 26 kg from Portugal from the CR are not confirmed by EuroStat. Fpr 2016, CR and EuroStat data match. 300 kg of glass eels imported by Lithuania in 2016 were unaccounted for.
Luxembourg	Small consignment in 2015 (80 kg) not confirmed.
Hong Kong	According to EuroStat 1.6 t imported from France (2015) and 200 kg from UK (2016). Neither Country recorded these shipments in their CR.

Country	Comments
Ireland	Both EuroStat and France report on an export to Ireland in 2016 (3.6 t) which is not confirmed by Irish import or export data. French authorities provided details on purpose (restocking/consumption) and considerable mortality within the consignment (~0.7 t). This would imply a possible shipment to a different destination/country (see Table 2.12).
US	Small shipment to Portugal in 2015 (40 kg).

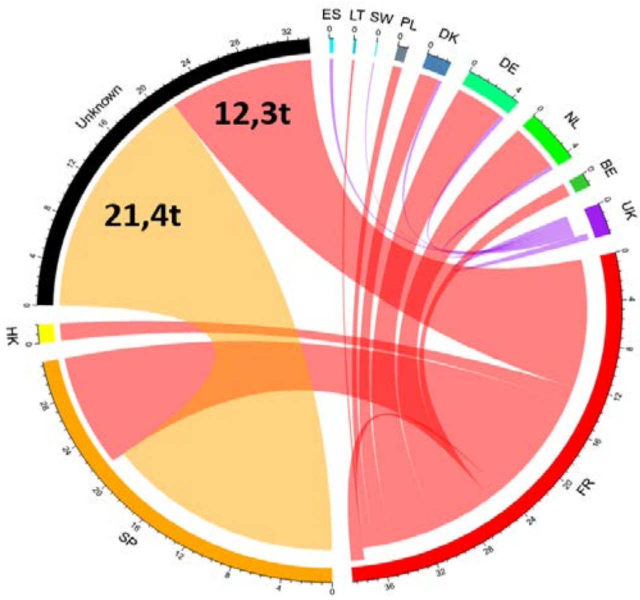

Figure 2.13. Glass eel trade flow diagram for 2015. The "Unknown" reflects the quantity of glass eel which could not be aligned to a destination.

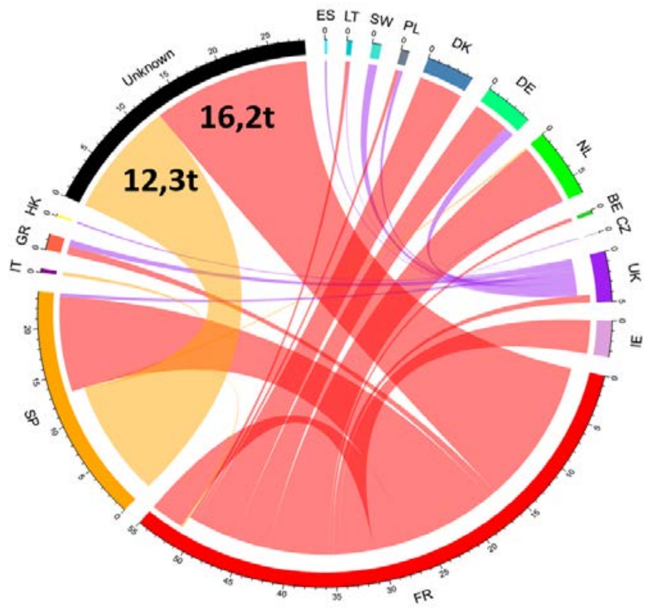

Figure 2.14. Glass eel trade flow diagram for 2016. The "Unknown" reflects the quantity of glass eel which could not be aligned to a destination.

Table 2.12. The destiny of glass eel imported by country in 2015. Data from CR or Q.A.

Country	Quantity imported (kg)				
	Total	Stocked	Aquaculture	Consumption	Unknown
Austria	0	0	0	0	0
Belgium	0	0	0	0	0
Bulgaria	na	na	na	na	na
Cyprus	na	na	na	na	na
Czech Rep	na	na	na	na	na
Denmark	2276	561	1715	0	0
Estonia	562	562	0	0	0
France	0	0	0	0	0
Germany	0	0	0	0	0
Greece	3690	369	3321	0	0
Finland	30	30	0	0	0
Hungary	0	0	0	0	0
Ireland	0	0	0	0	0
Italy	0	0	0	0	0
Latvia	0	0	0	0	0
Lithuania	160	160	0	0	0
Luxembourg	na	na	na	na	na
Malta	na	na	na	na	na
Morocco	na	na	na	na	na
Netherlands	5078	591	4487	0	0
Norway	0	0	0	0	0
Poland	600	300	300	0	0
Portugal	563*	ND	ND	ND	ND
Romania	na	na	na	na	na
Slovakia	na	na	na	na	na
Slovenia	na	na	na	na	na
Spain	10359	ND	ND	1730	ND
Sweden	672	545	76	0	20**
UK	0	605	0	100	0

***The questionnaire suggests this import is a through country transit. There are an additional 40 kg from the USA.**

****Reported mortality.**

Table 2.13. The destiny of glass eel imported by country in 2016. Data from CR or Q.A.

	Quantity imported (kg)				
Country	Total	Stocked	Aquaculture	Consumption	Unknown
Austria	8	8	0	0	0
Belgium	385	385	0	0	0
Bulgaria	na	na	na	na	na
Cyprus	na	na	na	na	na
Czech Rep	na	na	na	na	na
Denmark	4286	561	3725	0	0
Estonia	301	301	0	0	0
France	0	0	0	0	0
Germany	6853	4953	1900	0	0
Greece	550	55	495	0	0
Finland	22	22	0	0	0
Hungary	0	0	0	0	0
Ireland	2882*	1757*	0	1125*	0
Italy	0	0	0	0	0
Latvia	21**	0	0	0	0
Lithuania	99	99	0	0	0
Luxembourg	na	na	na	na	na
Malta	na	na	na	na	na
Morocco	na	na	na	na	na
Netherlands	6400	1140	5260	0	0
Norway	0	0	0	0	0
Poland	700	350	350	0	0
Portugal	ND	ND	ND	ND	ND
Romania	na	na	na	na	na
Slovakia	na	na	na	na	na
Slovenia	na	na	na	na	na
Spain	13657***	3439***	0	10218***	0
Sweden	892	813	21		35****
UK	0	0	0	3.7	

***The figures for export to Ireland come from EuroStat and are confirmed by France.**

****21 kg is declared by France to have been exported to Latvia.**

*****According to French C.R., France sold 3439 kg to Spain for stocking, and 10218 kg for direct consumption. According to Spain no stocking is conducted and the quantities ascribed to direct consumption are higher than known consumption.**

******Reported mortality.**

The use of on-grown eels for restocking may introduce some bias to these tables, e.g. if the reported weight does not refer to the original amount of imported glass eels or if the stocked fingerlings were imported the previous year (however these have been specifically corrected in the case of Germany and the Netherlands). Dubious data were checked with country representative when available, but some data may still be wrong and be explained as e.g. through country transits or illegal activities.

2.4.7 The amount of glass eel stocked by country and in relation to EMP target

In 2015 at least 10 and in 2016 at least 14 countries carried out some stocking of glass eel (Table 2.14).

In 2015, five (Belgium, Denmark, Poland, Sweden, UK) of six countries for which data were available failed to fulfil their stocking targets, with only the Netherlands achieving their target. Amongst those failing to meet their target, the percentage achieved ranged from 0% (Belgium) to 73% Sweden.

In 2016, Sweden (115%), the Netherlands (207%) and France (100%) managed to achieve their stocking targets, while the remaining five countries (Belgium, Denmark, Germany, Poland, UK) for which data were available achieved only partial success (Table 2.14).

Lack of supply and lack of funding were cited in both 2015 and 2016 by those completing the Q.A. as the principal cause of failure to meet the stocking target.

ICES identified that ~40 t yr^{-1} of glass eels were needed to meet the EMP requirements when they were first drafted (ICES, 2009). Given the total catch of glass eels was reported here as 51.6 t in 2015 and 59.3 t in 2016, and given the Eel Regulation requires that 60% of landings are to be marketed for stocking, then approximately 31 t and 36 t should have been available for stocking (minus mortalities). Thus in both years there would be expected to be some supply problems, especially in 2015, and our data reflect this: amongst those countries with available data, the EMP target has only been achieved twice (and failed 12 times) in the last two years.

Amongst the declared catch and subsequent use data for eels harvested in 2016 in the French country report, 21.4 t were sold for consumption, while 24.8 t (53.7%) were sold for stocking. As the French catch represents almost 80% of the European total it would appear likely that the Eel Regulation requirement of 60% of the catch to be made available for stocking is not yet enabling 60% of the harvest to be actually used for stocking (despite funding made available for stocking purchases by EMFF). Furthermore, we were only able to identify 11.7 t of stocking activity in 2016 (Table 2.13), representing 20% of the total known harvest, implying that the situation may be significantly more severe than the French trade data suggest. Nevertheless, the 2016 figure of 20% of total known harvest represents a small improvement over the 2013 figure of 16% (the last time this analysis was conducted: ICES, 2014). Incomplete data invalidate the same calculation for 2015.

As previously noted (FAO and ICES, 2011; ICES, 2014) we believe the true figure for total stocked may be slightly higher than our estimate, given that some glass eel listed under "Aquaculture" in Tables 2.11 and 2.12 may be ultimately destined for restocking after a period of on-growing.

Germany and Denmark subsequently released more data relating to on-grown eel relating to the 2011 calculations, allowing the analysis to be repeated, leading to an increase in the proportion of the total catch estimated to have been used for stocking from 12% to 16% in 2011 (ICES, 2014). Based on the same logic, the 2013 analysis (with 42% of the catch unaccounted for) included a speculative increase of the proportion used for stocking from 16% to 18% (ICES, 2014). A similar calculation for 2016 where the proportion of the harvest for which the fate was unknown was about 40% (Table 2.13), would lead to a speculative revision of the estimate from 20 to 22% stocked from the total catch. However, we expect this 2% increase to be an overestimate, as data relating to on-grown eels in Germany and the Netherlands have already been accounted for, leaving only Denmark's data to be updated.

Table 2.14. The total quantity of juvenile eel (<12cms) purchased by country, the % used for stocking, the % of the EMP stocking target reached and the quantity of glass eel harvested in 2015 and 2016. This table is based on preliminary data (from the buying countries unless otherwise stated) and the intention is to update this in future.

Country	Total Purchased (kg)		% used for stocking		% of EMP stocking target achieved (target in brackets (kg))		Glass eel harvest (kg)	
	2015	2016	2015	2016	2015	2016	2015	2016
Austria	0	8	-	100	-	-	0	0
Belgium	0	385	-	100	0 (2200)	18 (2200)	0	0
Bulgaria	-	-	-	-	-	-	-	-
Cyprus	-	-	-	-	-	-	-	-
Czech Rep	-	-	-	-	-	-	0	0
Denmark	2276	4286	25	13	11 (5000)	11 (5000)	0	0
Estonia	562	301	100	100	-	-	0	0
France ǂ	-	4766	-	63	-	86# (5–10% catch)	36094	46371
Germany	-	6853	-	72^^	-	80 (6228)	0	0
Greece	3690	360	11	11	-	-	-	-
Finland*	30	22	100	100	-	-	0	0
Hungary	32***	-	-	-	-	-	0	0
Ireland	0	0	-	-	-	-	0	0
Italy	385	159	100	100	-	-	385	159
Latvia	0	0	-	-	-	-	0	0
Lithuania	160	99	100	100	-	-	0	0
Luxembourg	-	-	-	-	-	-	0	0
Malta	-	-	-	-	-	-	-	-
Morocco	-	-	-	-	-	-	-	-
Netherlands	5200	5400	11^^	21^^	107 (550)	207 (550)	0	0
Norway	0	0	-	-	-	-	0	0
Poland*	600	700	50	50	8 (3900)	9 (3900)	0	0
Portugal	603	-	-	-	-	-	1284	409
Romania	-	-	-	-	-	-	-	-
Slovakia	-	-	-	-	-	-	-	-
Spain	10359*	-	-	25**	-	-	11079	8038
Sweden	672	892	81	91	73	115	0	0
UK	605	0	100	-	34 (2054)	0 (2054)	2800	4279

ǂ based on "final destination" data from French country report.

 # based on midpoint of "5–10% of catch" target.

***excluding consignments valued at <100 euro/kg.**

****according to French country report.**

*****according to Spanish ministry data ^^ includes glass eel using for subsequent stocking after a period of on-growing.**

2.4.8 Trend in the price of glass eel

The price of glass eel over a 50-year period (1961–2011) is illustrated in Figure 2.15 and Table 2.15, using data derived from EuroStat, glass eel dealers and National Customs databases, and from 2012–2016, a new data query with the average annual glass eel price consisting of purchase data from a number of different countries. Data from 2012–2016 are therefore not directly comparable with earlier data. All prices are corrected for inflation using the price index in France.

The high price noted in 1969 corresponds to buyers from the eel industry in Japan entering the French market. The general trend in average price (per kg) is towards an increasing price from 1982 (€43 per kg) to a peak of (€630 per kg) in 2005. Since the price of glass eel was last reviewed by this group in 2014, the five-year mean price has fallen from €381 for the period 2009–2013 to €357 for 2012–2016. The average annual price for the 2015 and 2016 season was €291 and €370 respectively.

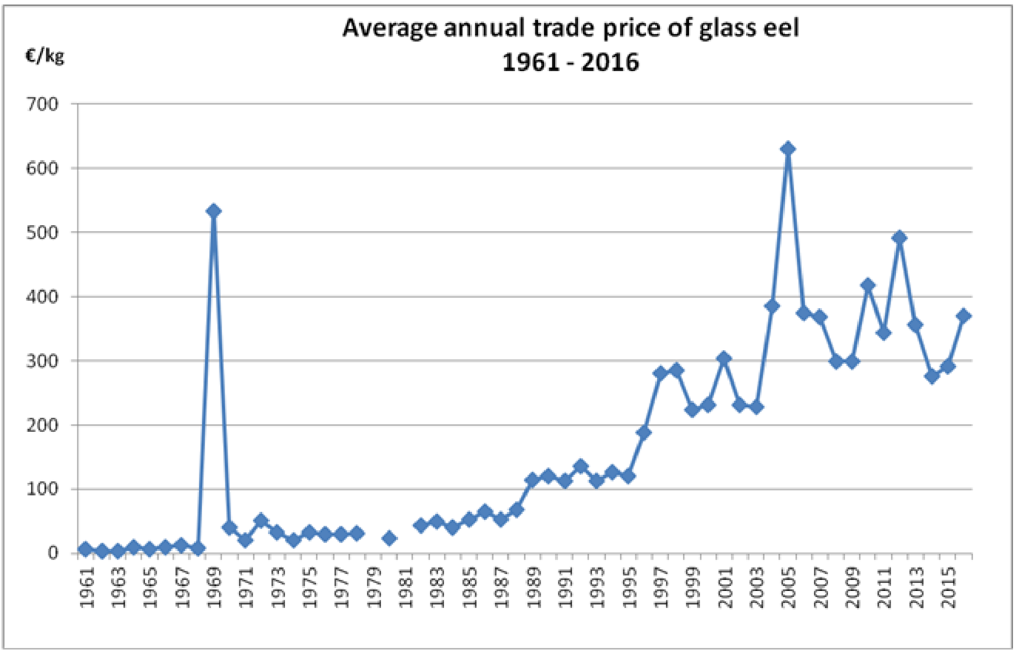

Figure 2.15. Trend in average annual price of glass eel from 1961 to 2016 derived from EuroStat, glass eel dealers and National Customs databases. The high price noted in 1969 corresponds to buyers from the eel industry in Japan entering the French market. The values from 2012–2016 are derived using a different method and are not directly comparable with preceding data.

Table 2.15. Trend in glass eel trade price 1961–2016, derived from EuroStat, glass eel dealers and National Customs databases. The high price noted in 1969 corresponds to buyers from the eel industry in Japan entering the French market. The values from 2012–2016 are derived using a different method and are not directly comparable with preceding data.

Year	French custom	French trader	Asturian (Spain) Market	EuroStat France	EuroStat Spain	EuroStat UK	Average price
1961		7					7
1962		4					4
1963		3					3
1964		10					10
1965		7					7
1966		9					9
1967		12					12
1968		8					8
1969	1055	13					534
1970	68	13					41
1971		21					21
1972	77	25					51
1973		33					33
1974		20					20
1975	42	22					32
1976	45	14					30
1977	41	19					30
1978	42	19					31
1979							
1980	24						24
1981							
1982	43						43
1983	51	43	57				50
1984	33	29	59				40
1985	50	37	70				52
1986		49	82				65
1987	63		43				53
1988	59	54	91				68
1989	108	110	128				115
1990	109	120	135				121
1991	94	109	136				113
1992	162		111				136
1993	156	86	97				113
1994	177	109	96				127
1995	135	94	90		163		120
1996	202	199	148	206	186	193	189
1997	246	366	224	260	247	344	281
1998	297	267	251	295	313	295	286
1999	213	270	174	208	214	267	224
2000	226	207	227	216	254	254	231

Year	French custom	French trader	Asturian (Spain) Market	EuroStat France	EuroStat Spain	EuroStat UK	Average price
2001	331	358	261	267	306	304	304
2002	247	252	231	220	230	202	231
2003	235	254	216	236	199	226	228
2004	496	452	432	423	282	230	386
2005	856	872	563	648	308	530	630
2006	432		374	370	297	404	375
2007			443	499	343	265	369
2008			466	316	282		299
2009			428	344	146	408	299
2010			374	588	325	341	418
2011			363	373	228	431	344
2012			368	487	411	500	492
2013			175	365	285	419	356
2014				272	301	255	276
2015				289	279	304	291
2016				354	383	374	370

2.4.9 Recent glass eel seizures and enforcement operations against illegal eel trafficking

Between 2010 and 2015, CITES authorities reported between one and seven seizures per year, conducted at international airports in Europe and Hong Kong. The transit route of four seizures went through Romania or Bulgaria (Stein *et al*., 2016). The European Commission (EC) identified additional countries which have been or were believed to be used as transit countries: Greece, Hungary, Albania, Former Yugoslav Republic of Macedonia, Morocco and Russia. Furthermore, the EC reports about several seizures, where large quantities of European glass eels where hidden in shipments of other fishery products or mislabelled (Anonymous, 2016). In 2016, 13 seizures were reported between 1 January and 8 March. They were destined for Hong Kong (twelve) or Shanghai (one). The departure location of each was Spain but the transit routes varied between Amsterdam, Paris, Madrid and Istanbul in Europe, and Dubai and Abu Dhabi in the United Arab Emirates. It remains unclear whether the relatively large number of seizures in 2016 reflects increased illegal trade activity or is a result of improved enforcement activity and collaborations between authorities (Stein *et al*., 2016).

In 2015 and 2016, the international police operation "Black Glass" uncovered a network of about 20 people who operated from a house located close to Madrid-Barajas airport. The network consisted of Spanish and Chinese citizens who collected, packed and smuggled the eels in check-in luggage via domestic flights into Hong Kong and China. 700 kg were seized but estimates provided by Guardia Civil indicate that about 2.5 tons were operated by this network. In January 2016, 109 kg of glass eels were seized at the Hong Kong International Airport and genetically identified as *A. anguilla*. This is the first documented case of illegal trade of *A. anguilla* from Europe into Hong Kong using genetic evidence (Stein *et al*., 2016).

There are indications for IUU glass eel fishing in European eel's southern part of the species natural spatial range (North Africa). Although these countries are not affected by the European eel trade ban, some committed to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and have national eel fishing bans in place. WGEEL welcomes participation of the North African countries and encourages future collaboration and coordination.

2.4.10 Traceability and the development of novel origin identification methods

Given multiple seizures of illegal exports of glass eel (Section 2.4.9) there would be clear utility in a method that could ascertain the area of origin of intercepted eels. Among the novel methods being developed are attempts to assign different otolith zero band chemical signatures (or "fingerprints") to eel from different donor systems (Evans *et al.*, 2014). The principle tested so far is that a glass eel otolith has a specific "fingerprint" derived from a unique combination of different elements in the structure of its zero band matrix, identified using Laser Ablation Inductively Coupled Plasma Mass Spectrometry (ICPMS) (Sturrock *et al.*, 2015). This elemental composition is directly linked to that of the estuary where the glass eels are caught and is likely driven by local geology, water chemistry and/or industrial activity (Campana *et al.*, 2000). Once embedded into the zero band, this elemental composition will remain stored in the otolith as additional annuli are laid down with each year's growth. As such the otoliths removed from a silver eel should have retained this "fingerprint" in the zero band and can be used to discriminate on that eel's origin based on similar analysis of glass eel otoliths. This technique can be rapidly applied and is not reliant upon the growth of chemically marked glass eel; in theory it could have a real-time application and be used on all life stages.

So far the technique has been used to successfully identify glass eels from two different UK sources (Evans *et al.*, 2014) and it is hoped to expand the study. Similar analyses examining the chemical composition or unique combinations of fatty acids and/or stable isotopes in eel flesh have been found to be representative of the environment from which they have grown (Bodles, 2016). Bodles suggested that these results could be expanded and used to discriminate between eel stocks though noted that methods of this kind required detailed knowledge of the chemical composition of the potential donor sites and prey items.

2.4.11 Conclusions to glass eel trade and traceability

The 2015 and 2016 glass eel catches are a decrease from 2014 of 9.4 t (15.4%) and 1.7 t (2.8%) respectively. Only the UK and France recorded an increase in glass eel harvests between 2015 and 2016.

Of the total 2015 catch of 51.6 t, the fate of 32.2% of the catch remained unaccounted for.

Of the total 2016 catch of 59.3 t, the fate of 37.3% of the catch remained unaccounted for.

These levels of unaccounted glass eel are of a similar range to those noted in previous glass eel trade assessments in 2012 and 2013 with overall loss rates of 23% and 43% respectively, this despite the EC Eel Regulation requiring that the transfer of such glass eel should have been traceable for the preceding seven years. These findings have implications for the fulfilment of Article 7.2 of the Regulation.

In addition to the reported glass eel seizures associated with illegal trade to Asia (Stein *et al.*, 2016), exports of glass eel (identified by commodity code and price analysis) from

Europe to Hong Kong appear in EuroStat data. France exported 1600 kg of glass eels in 2015 and the UK 200 kg in 2016.

We were able to identify 11.7 t of stocking activity in 2016 representing only 20% of the total known harvest.

Lack of supply and lack of funding were both equally cited in both 2015 and 2016 by those completing the questionnaire as the principal cause of failure to meet their country's stocking target.

The requirements for traceability within the EU Eel Regulation 1100/2007, which were to have been put in place by 2009, have still not been fully implemented across all EU Member States.

2.4.12 Recommendations

- All countries should put in place a system which fulfils the traceability requirements of the Eel Regulation, Article 12.
- The type of trade analysis conducted here should be extended to cover both yellow and silver eel and that consideration should be given to contracting an external body to undertake the analysis. Implementation of the traceability requirement of the Regulation would also benefit stock assessment.
- Further development of methods for identifying the origin of glass eel, as identified in WKSTOCKEEL, to aid in eel traceability.

2.5 Aquaculture production of European eel

Aquaculture production data for European eel limited to European countries from 2004–2015 are compiled from different sources: Country Reports to WGEEL 2016, FAO and FEAP (Federation of European Aquaculture Producers). Some discrepancies exist between FAO and FEAP databases and the Country Reports, but overall the trend in aquaculture production is decreasing from 8000–9000 tonnes in 2004 to approximately 4000–6500 tonnes in 2014–2015 (Figure 2.16). Some of the discrepancies between FAO and the Country Report data may result from the possibility that eel that is used for stocking is not being reported to the FAO.

It should be noted that eel aquaculture is based on wild recruits, and part of them is subsequently released as on-grown eel for stocking.

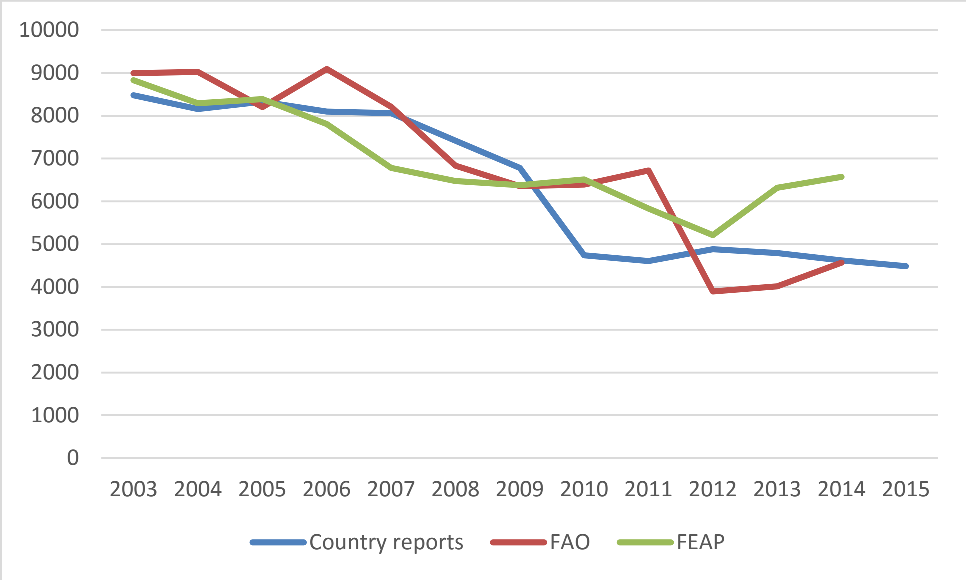

Figure 2.16. Different sources of data for aquaculture production of European eel in Europe from 2004 to 2014–2015, in tonnes.

2.6 Conclusions

Each of the above dataseries and developments towards a dataseries must be seen in the context of the overall Objective; to reach a point where there is an (annually) re-assessable check against a defined stock–recruitment relationship, to enable advice on whether or not the management actions on the component (Continental) of the eel stock directly under fishery and other management control is having the desired effect of achieving stock recovery. So far, only the collective glass eel recruitment dataseries is achieving this, and even that is subject to losing some series for a number of reasons (funding, closing fisheries, changes to infrastructure). We do now have a means of assessing Biomass and Mortality of the growing immature stock, but that requires continued and expanded efforts in EU and Non-EU eel range states to keep up the data flow and (perhaps) increase its frequency, though for a long-lived species such as eel every three years for that component is much better than the situation before the EC Regulation and its data requirement iterations. There is a real sense of encouragement in WGEEL, seeing GFCM and other countries beginning to add to the process, demonstrating the benefits of reaching out to the Mediterranean and southern regions of the eel range. As these countries come on stream, we must allow and encourage them time to catch up with established reportees, and any international programs which foster this are to be encouraged.

The lack of transparency in glass eel markets and movements is a cause for concern; far too high a proportion of the catch goes to 'unaccounted for' destinations and as such has to be considered as a total loss to the stock.

3 Scientific basis for the advice

3.1 Introduction to scientific basis for advice

This chapter addresses the following Terms of Reference:

b) Scientific basis of the advice:

iii) Suggest reference points of relevance for assessing the stock status and anthropogenic impacts;

iv) Report on issues that affect the quality of scientific evaluation of anthropogenic impacts and ecosystems […]

Additionally, this chapter has links to:

c) Consider the management of the stock and anthropogenic impacts

v) Review all management measures and options agreed in regulatory arrangements concerning the stock, fisheries and other anthropogenic mortalities, and comment on their conformity with sustainability criteria.

This chapter will first discuss the international setting of eel management, and the organisations involved. Then, the basis for advice on eel management within the context of the ICES framework for advice is discussed. Noting the gap between the ICES framework for advice and the information needs of the eel protection plans that are actually implemented, a case is made for a different management approach: distributed control. Corresponding reference points are worked out. Finally, the importance of the involvement of responsible agencies throughout the whole distribution area is stressed, and the need for quality assurance (data and methods).

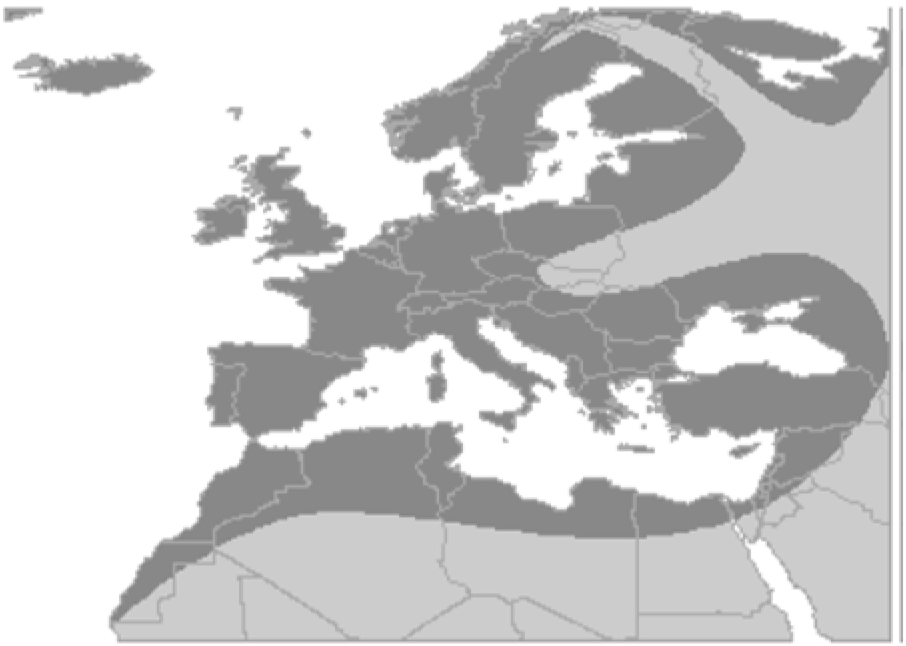

Figure 3.1. Range distribution of *Anguilla anguilla* (Source Moriarty and Dekker, 1997).

3.1.1 International management organisations involved in eel management and international legislative drivers

There are 50 countries listed as being in the geographic range of the European eel (Figure 3.1, Table 3.1). These countries are distributed across different global and regional organisations such as ICES, EIFAAC, GFCM, EU, CITES, CMS, etc. In order to get consensus on the conservation of eel there is a need for a formalised understanding at a higher level to cover all countries involved, and to identify a lead party responsible for the crucial orchestration and coordination.

ICES

The International Council for the Exploration of the Sea (ICES) is an intergovernmental organization that develops science and advice to support the sustainable use of the oceans. This is advanced through the coordination of oceanic and coastal monitoring and research, and advises international commissions and governments on marine policy and management issues. The ICES area of competence extends into the Arctic, the Mediterranean Sea, the Black Sea, and the North Pacific Ocean with 20 Member Countries (http://www.ices.dk/explore-us/who-we-are/Pages/Member-Countries.aspx).

The content of ICES scientific advice is solely the Advisory Committees (ACOM) responsibility not subject to modification by any other ICES entity. ACOM has one member from each member country, under the direction of an independent chair appointed by the Council, and works on the basis of scientific analysis prepared in the ICES expert groups and the advisory process includes peer review of the analysis before it can be used as basis for the advice.

As the ICES area of competence extends throughout the North Atlantic, and member countries include Canada and the United States of America, the competence may extend to the American eel (*A. rostrata*). However, ICES has no request for advice from countries of the natural habitat for American eel.

For more information, see link: http://www.ices.dk/

FAO

Committee on Fisheries (COFI)

The Committee currently constitutes the only global inter-governmental forum where major international fisheries and aquaculture problems and issues are examined and recommendations addressed to governments, regional fishery bodies, NGOs, fish workers, FAO and international community, periodically on a worldwide basis.

The work of the Fisheries and Aquaculture Department within FAO centres on "Sustainable management and use of fisheries and aquaculture resources" (Strategic Objective C) which embraces normative as well as operational activities whether implemented from headquarters or from the field.

GFCM and EIFAAC are regional bodies of the FAO.

EIFAAC

The role of the European Inland Fisheries and Aquaculture Advisory Commission (EIFAAC), is to promote the long-term sustainable development, utilization, conservation, restoration and responsible management of European inland fisheries and aquaculture. This should be based on the best available scientific advice, the application of an ecosystem approach, the precautionary approach and the need to safeguard biodiversity. EIFAAC seeks to support sustainable economic, social and recreational activities towards these goals through providing advice, information and coordination, encouraging enhanced stakeholder participation and communication, and the delivery of effective research. The area of competence covers all of Europe, with the exception of parts of the Balkans, together with Turkey and Israel, and has membership from most of the countries including the EU. (See http://www.fao.org/fishery/rfb/eifaac/en#Org-GeoCoverage)

For more information, see link http://www.fao.org/fishery/rfb/eifaac/en

GFCM

The General Fisheries Commission for the Mediterranean (GFCM) is a regional fisheries management organization (RFMO). The main objective of the GFCM is to ensure the conservation and the sustainable use, at the biological, social, economic and environmental level, of living marine resources as well as the sustainable development of aquaculture in the Mediterranean and in the Black Sea. The Commission has the authority to adopt binding recommendations for fisheries conservation and management in its area of application and plays a critical role in fisheries governance in the region. GFCM closely cooperates with other international organizations in matters of mutual interest and it benefits from the support of cooperation projects and programmes at the regional and sub regional level in order to enhance scientific cooperation and capacity-building among its Contracting Parties.

For more information, see link http://www.fao.org/gfcm/en/

European Union

The European Union is a politico economic union of 28 member states that are located primarily in Europe. In 2007, the EU created 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.

For more information, see link: https://europa.eu

Convention on the Conservation of Migratory Species of Wild Animals (CMS)

The CMS is an environmental treaty under the aegis of the United Nations Environment Programme. CMS provides a global platform for the conservation and sustainable use of migratory animals and their habitats. *Anguilla anguilla* was listed as Appendix II in 2014. The Convention encourages the Range States of species listed on Appendix II to conclude global or regional Agreements for the conservation and management of individual species or groups of related species. To date there is no agreement, memoranda of understanding or special species initiatives for the European eel. The first range state workshop on the European eel will take place in Ireland on the 13th to the 14th October 2016. The Workshop is being co-organized by the CMS Secretariat and the Sargasso Sea Commission. The meeting will provide a unique opportunity for the Range States to come together and take stock of eel conservation and management measures, and consider whether any additional instruments of international cooperation would be desirable or practicable.

For more information, see link: http://www.cms.int/

CITES

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. The European eel was listed in Appendix II 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 declaring a Non-Detriment Finding (NDF). All trade into and out of the EU is currently banned (decision renewed by EU CITES Scientific Review Group SRG in October 2015), but trade between non-EU countries is still permitted, subject to their own NDFs. ICES (2015b) 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).

For more information, see link: https://www.cites.org/

The International Union for the Conservation of Nature (IUCN)

The IUCN Global Species Programme working with the IUCN Species Survival Commission (SSC) has been assessing the conservation status of species, subspecies, varieties, and even selected subpopulations on a global scale for the past 50 years in order to highlight taxa threatened with extinction, and thereby promote their conservation. The IUCN has assessed the European eel as 'critically endangered' on its Red List, in 2009 and again in 2014.

For more information, see link http://www.iucnredlist.org/

OSPAR commission/convention

OSPAR is the mechanism by which 15 Governments & the EU cooperate to protect the marine environment of the Northeast Atlantic. The fifteen Governments are Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Luxembourg, The Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom. OSPAR is so named because of the original Oslo and Paris Conventions ("OS" for Oslo and "PAR" for Paris).

OSPAR started in 1972 with the Oslo Convention against dumping and was broadened to cover land-based sources and the offshore industry by the Paris Convention of 1974. These two conventions were unified, updated and extended by the 1992 OSPAR Convention. The new annex on biodiversity and ecosystems was adopted in 1998 to cover non-polluting human activities that can adversely affect the sea.

For more information, see link http://www.ospar.org/

HELCOM

HELCOM (Baltic Marine Environment Protection Commission - Helsinki Commission) is the governing body of the Convention on the Protection of the Marine Environment of the Baltic Sea Area, known as the Helsinki Convention.

For more information, see link: http://www.helcom.fi/

Table 3.1. List of countries and relevant fishery organisations involved in conservation. EMP = Eel Management Plan.

	Eel		Global organisations			Regional organisations					
Country	Range State	has EMP	CMS	CITES	FAO	EIFAAC	GFCM	EU	ICES	OSPAR	HELCOM
Albania	x		x	x	x	x	x				
Algeria	x		x	x	x		x				
Austria	x		x	x	x	x		x			
Belarus	x		x	x	x						
Belgium	x	x	x	x	x	x		x	x	x	
Bosnia & Herzegovina	x			x	x	x					
Bulgaria	x		x	x	x	x	x	x			
Croatia	x		x	x	x	x	x	x			
Cyprus	x		x	x	x	x	x	x			
Czech Republic	x	x	x	x	x	x		x			
Denmark	x	x	x	x	x	x		x	x	x	x
Egypt	x		x	x	x		x				
Estonia	x	x	x	x	x	x		x	x		x
European Union			x	x	x	x	x			x	x
Finland	x	x	x	x	x	x		x	x	x	x
France	x	x	x	x	x	x	x	x	x	x	
Georgia	x		x	x	x						
Germany	x	x	x	x	x	x		x	x	x	x
Greece	x	x	x	x	x	x	x	x			
Hungary			x	x	x	x		x			
Iceland	x			x	x	x			x	x	
Ireland	x	x	x	x	x	x		x	x	x	
Israel	x		x	x	x	x	x				
Italy	x	x	x	x	x	x	x	x			
Latvia	x	x	x	x	x	x		x	x		x
Lebanon	x			x	x		X				
Libya	x		x	x	x		x				
Liechtenstein			x	x							
Lithuania	x	x	x	x	x	x		x	x		x
Luxembourg	x	x	x	x	x	x		x		x	
Macedonia	x		x	x	x						
Malta	x		x	x	x		x	x			
Mauritania	x		x	x	x						
Monaco	x		x	x	x						
Montenegro	x		x	x	x						
Morocco	x		x	x	x		x				
Netherlands	x	x	x	x	x	x		x	x	x	

	Eel		Global organisations			Regional organisations					
Country	Range State	has EMP	CMS	CITES	FAO	EIFAAC	GFCM	EU	ICES	OSPAR	HELCOM
Norway	x	x[1]	x	x	x	x			x	x	
Poland	x	x	x	x	x	x		x	x		x
Portugal	x	x	x	x	x	x		x	x	x	
Republic of Moldova	x		x	x	x						
Romania	x		x	x	x	x	x	x			
Russian Federation	x			x[2]	x				x		x
Serbia	x		x	x[2]	x						
Slovakia	x		x	x	x	x		x			
Slovenia	x		x	x	x		x	x			
Spain	x	x	x	x	x	x	x	x	x	x	
Sweden	x	x	x	x	x	x		x	x	x	x
Switzerland	x		x	x	x	x				x	
Syrian Arab Republic	x		x	x	x		x				
Tunisia	x	x	x	x	x		x				
Turkey	x			x	x	x	x				
Ukraine	x		x	x	x						
United Kingdom	x	x	x	x	x	x		x	x	x	

3.2 Advice on eel management within the ICES framework for advice

The EU Eel Regulation sets a long-term general objective ("the protection and sustainable use of the stock of European eel"), delegating the local management, the implementation of protective measures, the monitoring, and the local post evaluation to its Member States (European Council 2007; Dekker, 2009). A long-term objective is set for the biomass of silver eel escaping from each management area, at 40% of the notional pristine biomass. Eel management plans (EMPs) have been submitted by Member States, mostly in 2008/2009. Because current recruitment is generally far below the historical level and is assumed to be so due to anthropogenic impacts, a return to this limit level is not expected within decades or centuries, even if all anthropogenic impacts are removed (FAO and ICES, 2006; ICES, 2007 (Advice); Åström and Dekker, 2007).

A corresponding mortality-based reference point $\Sigma A=0.92$ has been proposed (ICES, 2012a) that results in 40% of the pristine stock *numbers*; i.e. the sum of all anthropogenic impacts, summed over the entire continental lifespan, should not exceed a fixed value of 0.92. For reference points based on biomass rather than on numbers, the relationship

[1] Norway is not a member of the EU. Norway has a national Eel Management Plan (Anonymous, 2008), the contents of which differ from those of the EU Member States. In particular, the Norwegian plan has no specified targets, focusing on the rapid implementation of protective management measures instead.

[2] "Continuation."

between relative spawner escapement %SPR and mortality ΣA is much more complex, but numerical simulation has indicated that the relationship comes close to that specified above (Dekker, 2010).

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. 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 to use a proportional reduction in mortality reference values (i.e. a linear relation between the mortality rate advised and biomass).

For fish stocks in general, the 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.

For eel in particular, however, 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. While the decline of the stock may have forced some fishers to cease their exploitation, the side effects of other anthropogenic activities (such as hydropower generation) will not have reacted to low stock abundance, and rising prices for scarce fishing products has kept other fisheries going. Conservation measures will be required, accommodating the exceptional low stock level, as well as accommodating for the apparently depleted resilience (depensation) in stock dynamics (ICES, 2013a; 2014).

3.2.1 Recovery/Management Plan

ICES has defined procedures to evaluate the conformity of management strategies with the precautionary approach (ICES, 2012b).

A recovery plan (or an initial recovery phase within a long-term management plan) cannot be judged using the same criteria for precautionarity as a management plan. It seems more logical to judge a recovery plan according to its ability to deliver spawning biomass recovery within a certain time frame that is appropriate to that stock (e.g. for a stock with around 5–10 cohorts in the fishery five years from the start of the plan). In that case, the requirement for considering the recovery plan as precautionary would be that the probability of spawning biomass to be above B_{lim} in a prespecified year is 95%.

In the case of the eel recovery and long-term management plan the following applies:

- The status of stock-wide spawning biomass is not known;
- The time frame to recovery was not defined. (The EU Science, Technical and Economic Committee for Fisheries (STECF) recommended three generations; the EC Eel Regulation states "in the long term");
- The probability of achieving the target is undefined.

Therefore, evaluation of the national Eel Management Plans is unlikely to indicate conformity with the precautionary approach. It is also extremely unlikely that a database for the analysis of stock-wide recovery time frames and likelihoods can be compiled successfully within a reasonable time frame.

While ICES welcomed the adoption of the EC Regulation as a significant step toward the recovery of the eel population and supported the approach taken in the EC Regulation to develop management plans based on Eel River Basin Districts (ICES, 2007), a system of post-evaluation and feedback has not been established in support of its implementation. ICES noted the seriousness of the state of the stock and urged that the measures to achieve significant reductions in mortality should be implemented as soon as possible. Any delay in reducing mortality may lead to an extremely long time-scale for recovery or a collapse of the stock if that hasn't already occurred.

Member States are required under the Regulation to report updates on the implementation of the EMPs. These reports include the biomass of silver eel escaping and lifetime mortality. From a special request from the EU, ICES (2013b) undertook a technical evaluation of the 2012 implementation reports but this has not been carried through to the 2015 reporting period.

A mechanism needs to be found between the EU and the ICES rules to facilitate feedback on the status of the implementation of the EMPs, as in the Eel Management Plan Evaluation workshop (WKEPEMP) in 2013 (ICES, 2013b). Currently, this lack leaves a void between the formal PA advice and scientific support for the recovery plan on eel, which needs to be considered. Past ICES advice has been provided in the section "on provision of advice on fishing opportunities, catch and effort", giving a narrow focus on the issues involved in eel management. It is recommended to consider a formal evaluation of the Eel Regulation and/or the 2015 national post-evaluation reports, aiming for a decision before the 2018 national post-evaluations.

3.2.2 Whole stock Advice

The ICES approach to advice on fishing opportunities (ICES General Book) integrates the ecosystem and precautionary approach with the objective of achieving maximum sustainable yield (MSY). The aim is, in accordance with the aggregate of international guidelines, to inform policies for high long-term yields while maintaining productive fish stocks within healthy marine ecosystems.

The advice rule applied by ICES in developing the advice on fishing possibilities depends on management strategies agreed by relevant management bodies and the information and knowledge available for the concerned stocks.

If the relevant management authorities have agreed on a management plan or strategy and the plan/strategy has been evaluated by ICES to be consistent with the precautionary approach, ICES will provide advice in accordance with the plan/strategy.

If no management plan/strategy has been agreed by all relevant management parties or the agreed plan/strategy has been evaluated by ICES not to be consistent with the precautionary approach, ICES will provide advice applying the ICES MSY advice rule or the precautionary approach (see below for details on when to use either option).

ICES MSY advice rules requires a relative high level of data and knowledge of the dynamics of the stocks concerned. If the data and knowledge requirements are not fulfilled ICES cannot provide advice consistent with MSY: instead ICES applies an advice rule that is only based on precautionary considerations.

For the purposes of identifying the advice rule to be applied, ICES classifies the stocks into six main categories on the basis of available knowledge.

Given a quantitative assessment for the whole stock is not possible, eel falls under Category 3 rules (stocks for which survey-based assessments indicate trends) and particularly in category 3.1.4 (For extremely low biomass, a recovery plan and possibly zero catch is advised (ICES, 2012b)) according to the table page 69 from ICES (ICES, 2013c).

Given that eel has an average generation time across the whole stock in the order of ten years or more (ICES, 2014), and given the low recruitment level (1–10% of the historical level), it is probable that the indicator for eel (i.e. recruitment time-series) will not change much in the short term. Therefore, the usefulness of providing annual advice at this level is questionable, although monitoring of recruitment and catch should of course be continued and improved.

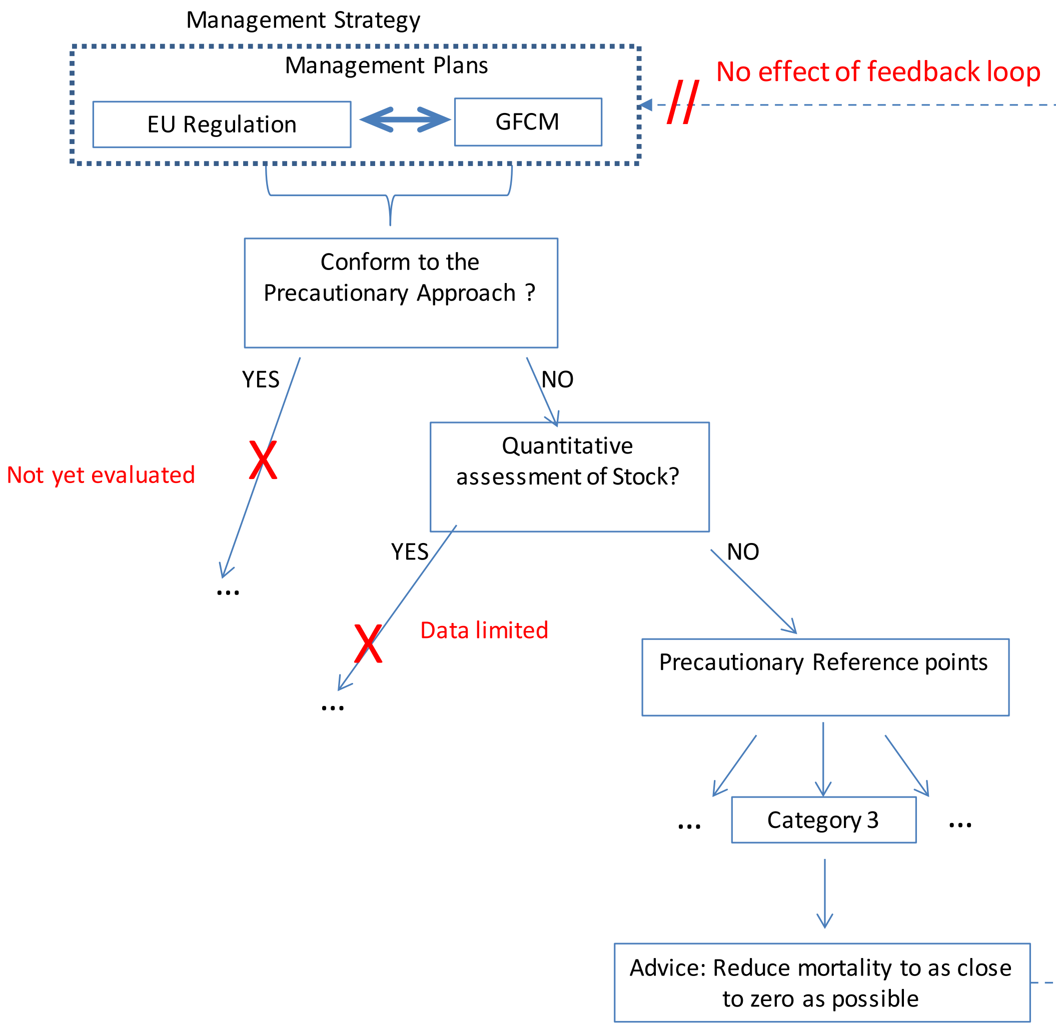

Figure 3.2. Decision tree for the ICES framework of advice, as applicable to eel.

3.2.3 Distributing control to manage the continent-wide eel stock

In a recent article, Dekker (2016) analysed the governance situation for the European eel from a socio-ecological perspective. The eel stock is distributed all over Europe and the Mediterranean, but scattered over small habitats: this includes the open ocean, high seas and sheltered coasts, large lakes and small ponds, main rivers and smallest streams. The contrast between the extremely large distribution area vs. the tiny scale of most continental habitats complicates the management of this shared resource. Local management (uncoordinated Collective Action) has proven ineffective, as indicated by the decadal decline of the stock in history. A conventional top–down management, based on a stock-wide assessment and focused on stock-wide management decisions, is not feasible either, due to the incomplete information on the status of the stock and the anthropogenic impacts in the multitude of fragmented habitats.

Hence, the EU Eel Regulation (EC 1100/2007) has adopted a governance structure conforming to a Distributed Control System, under the supervision of international orchestration (Dekker, 2004; 2009). This encompasses:

- setting global objectives and targets at the international level;
- obliging EU Member States to develop national/regional Eel Management Plans to implement measures to achieve those objectives/targets;
- reporting indicators on the stock status and on anthropogenic impacts for each management unit on a tri-annual basis;
- post-evaluating the overall achievements and providing feedback on the achievements of each unit on the basis of this reporting.

Obviously, the areas not covered by the EC Eel Regulation (the GFCM initiative on eel management, Norway, Russia, etc.) face the same governance problem (neither uncoordinated local action, nor centralised top–down management likely to be effective), and they will benefit from the same solution (distributing control, orchestration and coordination). Therefore, it is recommended that all responsible management bodies involved adopt a Distributed Control System approach, and that orchestration between all areas is worked out and implemented.

3.2.4 Reference points for a distributed control management framework

For the eel management units in the EU member states, the Eel Regulation sets a minimum limit for the escapement of silver eel biomass (say B_{MGT}) 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". In this, it is implicitly assumed that at that biomass level, recruitment would not have been impaired. This management limit was based on scientific advice by ICES (2002), based on a meta-analysis of stock–recruitment relations across unrelated fish stocks. It is proposed to expand this management limit to the whole distribution area of European eel. First, it would be a science-based reference point for those areas too, and secondly, it would align the objectives of the different regions facilitating the stock-wide orchestration.

The anthropogenic mortality rate for the eel lifespan (say ΣA_{MGT}) corresponding to B_{MGT} is 0.92 for each eel management unit, considering a similar contribution of each unit to the reproduction success and without any consideration of possible density-dependence mechanisms (ICES, 2010a). Notice that a biomass-reference point applies to the long term, and that mortality-reference points are manageable in the short term.

Below B_{MGT}, it is recommended to reinforce the mortality limit. The design of this reduction is under political decision and reflects the ambition level to restore the stock. Clearly, the lower the mortality level achieved, the faster recovery of the stock can be expected and the lower the risk of further deterioration (Figure 3.3), though multiple generation times might be required to achieve full recovery (Åström and Dekker, 2007; FAO and ICES, 2011). Notice that the reduction in mortality target proportional to the reduction of spawning biomass corresponds to the harvest control rule advised by ICES protocol.

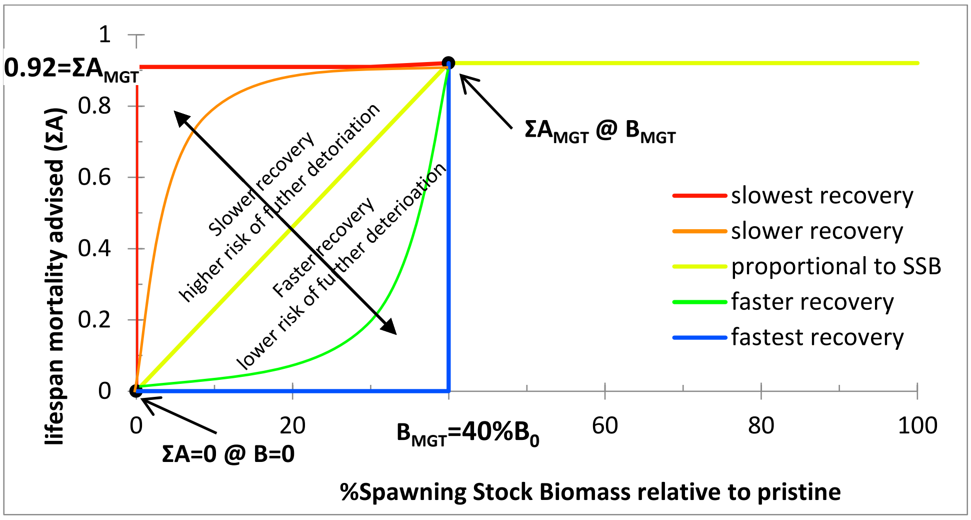

Figure 3.3. Schematic overview of different control rules. B_{MGT} is the escapement biomass management target fixed at 40% of the escapement to the sea of the silver eel biomass relative to the best estimate of escapement in pristine conditions. ΣA_{MGT} is the corresponding lifespan mortality rate. Below B_{MGT} different control rules are possible that lead to more or less fast recovery speed with more or less risk of further deterioration.

3.2.5 Expansion of the spatial coverage of management plans

Not all EU Member States have reported the obligatory stock indicators to the EC, thereby contributing to a reduction in the spatial coverage compared to that that should have been achieved by the implementation of all EMPs. However, there has been an improvement. In 2012, 63% of the EMUs reported biomass indicators and 46% reported mortality indicators, whereas in 2015, the results increased to 83% and 80% of the EMUs respectively. The lack of spatial coverage was considered an obstacle to progress from a trend-based assessment (recruitment) to an advice framework based on the precautionary approach (ICES, 2015a).

While the spatial coverage within the EU countries is sufficient to make an assessment within their geographical boundaries, the widespread distribution of the species together with the global international economic interest that goes beyond the borders of the distribution area requires a wider framework for action. The participation of GFCM in the Joint EIFAAC/ICES/GFCM WGEEL since 2014 has contributed to strengthening collaboration with ICES and EIFAAC experts and significant progress has been made since then. In 2015, during the WGEEL meeting, the participants in the GFCM used a model to provide stock indicators for 13 countries that covered the Mediterranean area of distribution, contributing for a wider overview of the stock.

Because the European eel constitutes a single stock, a reinforcement of organizations and governance systems that are capable of covering the natural distribution range of the species is required. The formal inclusion of other countries like Norway that has been in the WGEEL since 1985, and Iceland, located in the outer fringe of the western distribution range require an approach that needs to be addressed for a full assessment of the international stock, which might be discussed at the next CMS workshop.

3.2.6 Quality assurance of reported national stock indicators

The international assessment of a stock like the European eel requires that the biomass and mortality indicators (3Bs& ΣA) present a good quality assurance. ICES (2015a) showed that the 2012 evaluation of the eel stock revealed some problems regarding the quality assurance of the indicators reported by Member States. Those concerns included quality of data and the diversity of methods and models to derive stock indicators, concluding they should be: 1) reviewed and rationalized to ensure the quality of methods; 2) inter-calibrated and refined to eliminate redundancy; and 3) evaluated for their sensitivity against input data.

Although it is acknowledged by the Regulation that there are diverse needs and conditions, which might require different approaches and that EMPs should be adjusted to regional and local conditions, the need to evaluate the effectiveness of measures at the national level, and to assess the stock at the international level, require a more efficient approach. There is an urgent requirement to test and improve the quality of data and analyses used in deriving national stock indicators. We recommend a benchmarking process for quality assessment of stock assessments.

3.3 Forward focus on the scientific basis for advice

In this and previous reports of WGEEL, a framework of reference points and post-evaluation procedures has been developed, along the lines of the ICES framework for advice, that is adapted to the peculiarities of the eel (Dekker, 2010; 2016; ICES, 2010a). This framework has been used for the reporting by EU Member States to the EU Commission and the international post-evaluation in 2012 and 2015 (ICES, 2013a; 2013b; 2015). The use of this eel-specific assessment framework within the EU-area has shown that this framework is fit for implementation. Most non-EU areas have only recently been involved in this joint process, 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. Additionally, reference points, assessment procedures and feedback mechanisms will need to be agreed upon for the whole distribution area.

4 Issues that affect the quality of evaluations: research needs and significant new or emerging threats and opportunities

4.1 Introduction

This chapter addresses the following parts of the ToRs:

b) Scientific basis of the advice

2 Report on issues that affect the quality of scientific evaluation of anthropogenic impacts and ecosystems, and the effectiveness of management measures, including the timeliness, coverage and quality of data used in developing the advice;

3 Provide information on research needs to improve the quality of the scientific basis of the stock assessment and advice;

4 Update and extend the eel stock annex where significant changes make it necessary, to provide a full methodological description of the assessment and advisory procedure for the European eel stock;

5 Report on significant new or emerging threats to, or opportunities for, eel conservation and management.

Data collection and monitoring for eels were discussed and an initial outline methodology for assessing data quality and confidence was put forward. As a starting point, a work flow was suggested, including two new scorecards on data quality and confidence. It was recommended that this subject requires further elaboration and should be addressed at a future workshop. Due to the previous lack of standards for data quality, there was not much information available regarding the quality and confidence of data in the 2016 Country Reports.

Based on the country reports, some research needs were identified, with regards to pollutants, hydropower, monitoring, and habitat preferences. A recent review has showed that evidence on net benefits of eel stocking is inconclusive.

Emerging threats were the same as those identified in previous reports, and some relevant recent findings on these subjects were added. Likewise, emerging opportunities were similar to those in previous reports, and related research is ongoing. This section concludes with a report on recent developments in efforts to coordinate eel assessment and management throughout the Mediterranean region.

No significant changes were required to the Stock Annex because the assessment method remains the same as 2015. However, a series of minor improvements have been identified and these will be addressed in 2017 so that an updated Stock Annex is available for the 2017 meeting.

4.2 Data quality, standards and deficiencies

This chapter concerns data quality standards, data quality and deficiencies. WGEEL (ICES, 2014) reviewed the data requirements for international stock assessment, the data available and the gaps in those data. They were updated by WGEEL (2015a) with minor changes. The Working Group considered the 2014 and 2015 reviews again at the 2016 meeting, in light of developments in the past year. Those that remain outstanding are summarized below.

Several reports relating to data quality and confidence standards were reviewed, including all 2016 Country Reports (CR). The ICES Data Policy was revised in 2012 and concerns marine data and information. The 2016 CR and the present report largely abide by the policy, although there are instances when data could be supplemented by a reference. In some CR, data are provided without a reference, implying that the authors are the data providers. WGCATCH (2016) expressed the intention of developing guidelines for data collection in small-scale fisheries. The fishPi (2016) report has a focus on marine coastal fisheries, and is primarily relevant to countries which currently lack reporting systems on marine eel landings. The PGDATA (2016) suggested that a cost–benefit framework should be implemented as a component of all data collection programmes to ensure that these are closely aligned with end-user needs, deliver data of sufficient quality to meet these needs, and make most efficient use of available human resources and funding. The costs of scientific monitoring and the fishery regulatory system also have to be considered in relation to the value of the fishery and the short and long-term risks to the stocks.

There is very little reporting on data quality and confidence in the CR, probably because data quality and confidence standards have hitherto been lacking.

It was concluded that ICES needs to develop data quality and confidence standards for all relevant species, including eel. One option is a special ICES workshop assigned to defining data quality and confidence standards and to suggesting how standards can be improved. Some starting points are given below.

High data quality and confidence are characterised by:

- Validity (of methods);
- Consistency (meaning that methods have not changed);
- Representativeness (of the EMU);
- Accuracy (low uncertainty).

These four points go into one of the two suggested scorecards. The suggested workflow is:

1) Make data available;
2) Describe the methods;
3) Fill in two scorecards (see below).

The first scorecard (Table 4.1) was proposed by WGEEL (2012a) and has been modified in the present report. An example of how this scorecard should be filled in is given in Table 4.2.

Table 4.1. Scorecard 1. List of key parameters that should be scored to evaluate potential bias in data used for eel stock assessment (modified from WGEEL, 2012). For each parameter, there is a list of categories to which one can assign their data. Three tables: glass eel/yellow eel/silver eel. Red (confirmed bias), amber (risk of bias), green (no bias).

	EMU 1	EMU …	EMU 10	Comments
Species identification				
Commercial landings weight				
Recreational landings weight				
Effort (commercial)				
Effort (recreational)				
Abundance				
Length structure (spatial and temporal coverage; selectivity)				
Age structure (spatial and temporal coverage and methodology)				
Weight structure (spatial and temporal coverage; selectivity)				
Sex-ratio				
Life stage				
B_0				
B_{best}				
$B_{current}$				
ΣA				
Escapement (silver eel only)				

Table 4.2. Example of a scorecard completion for "species identification".

A – Species identification	NO BIAS	RISK OF BIAS	CONFIRMED BIAS
1 - Species subject to confusion & trained staff	Staff trained and experienced OR Easily defined species	Any other situation	Species difficult to identify AND novice staff
2 - Species misreporting	Checked and no problem OR checked and corrected	Any other situation	Checked + not corrected
3 – Glass eel stocking	Genetic tests performed before stocking	No genetic testing	Glass eel tested + non-A. anguilla detected
Final indicator	All green	List of potential bias	List of confirmed bias

The second scorecard should also be given in red, amber and green and should specify validity, consistency, accuracy and representativeness (Table 4.3).

Table 4.3. Scorecard 2. This scorecard should indicate four scores for each spreadsheet in the Country Report Tables. The scores have three categories: red (low), amber (moderate) and green (high).

Spreadsheet	Validity	Consistency	Accuracy	Representativeness
1.1				
1.2				
...				
n.n				

The following sections were selected to highlight data deficiencies that were obvious to the working group. This analysis relates to the ToR as defined at the beginning of this chapter (issues that affect the quality of scientific evaluation of anthropogenic impacts and ecosystems, and the effectiveness of management measures).

4.2.1 Recruitment

The working group has over recent years continued to raise concerns about the consistency and coverage of recruitment data. The EU Water Framework Directive requires an inter-calibration of methodologies across Member States to ensure the consistency of WFD monitoring data across Europe. There is no such legislative requirement for the inter-calibration of methods of eel data collection or analysis. An example of the complications this poses is that at some sites, pigmented elvers, glass eels and older migrating juvenile eels are not separated in the counting. This may be confusing regarding the estimation of the yearly recruitment but it was expressed that what needs to be reported is the number of young-of-the-year irrespective of pigmentation.

WGEEL (ICES, 2013a) encouraged the development of additional recruitment monitoring time-series, especially in the Mediterranean basin, preferable by methods that were not dependent on commercial fisheries. However, the criteria under which new time-series are included in the analyses remain to be set. The Netherlands are working on a combined recruitment index including data from several sites, also including long-term and short-term trends. Such a combined index may on one hand increase the certainty, but it may on the other hand conceal the spatial variability.

The time-series already used in the analyses also have some inherent challenges. WGEEL (FAO and ICES, 2011; ICES, 2012a; 2013a; 2015a) noted that some of the glass eel recruitment series have been stopped. However, there are new activities to re-activate the previously discontinued time-series in the River Ems (Germany).

There is a recurrent problem with local conditions such as extreme weather events, construction work, or removal of artificial barriers according to the WFD, disturbing data collection or damaging equipment at several sites. For instance, in the Yzer, Belgium, construction work obstructed monitoring of the young-of-the year eels. The most recent yellow eel index recording in the Scottish EMU was destroyed in winter floods in 2015. In the Netherlands, the recruitment series were disturbed by lack of monitoring staff or assistants. Poland reported complications with data recording because of the risk of double counting stocked eels and natural recruits.

This raises the question how we can manage the resilience of the eel recruitment dataseries across Europe. There should be a risk register for the existing recruitment indices, mapping important time-series under real risk to be discontinued in future.

4.2.2 Commercial and recreational fisheries data

The working group has repeatedly requested improvements concerning the quality of eel fisheries data. For example:

1) Even basic data of catch and effort and the main fishery indicators: catch total (landings/fishing mortality), total effort, and abundance index (generally catch per unit of effort (cpue)) for eel may be underestimated, or even missing in the Country Reports. For instance, in Sweden, there have been several reports in the media of the Coastal Guard discovering and removing illegal and unmarked fykenets along the coast. Moreover, data are not clearly reported by biological stages (glass eel, yellow, silver), by fishing categories or by appropriate management unit, also omitting marine or inland waters. For instance, in the UK, the catch effort for landings of yellow and silver eels cannot be separated and thus the only reliable data that can be recorded is the cpue for a combined catch. The need for new columns in the data table to record a combined catch was expressed.
2) Differences in catch size limits hampers comparison of landings in total numbers.
3) In some countries, recreational landings are underestimated or not even reported.

A decreasing number of fishermen in many countries makes it more costly to collect Catch, Effort, and cpue data, both in real terms of coordinating a potentially more dispersed fishery and in relative terms when compared to the value of the fishery. This means that those EMUs with poor datasets in such aspects should instead invest in fishery-independent monitoring and seek EU-MAP funding as appropriate.

The inaccuracy and poor representativeness of these indicators have so far made it impossible to assess stock-wide plausible total commercial landings as well as catches of recreational and non-commercial fisheries. The forthcoming EU-MAP funding programme presents an opportunity for each EU country to review their monitoring programme in terms of the size of the programme, and whether it is fit for purpose (including aspects of its data quality).

4.2.3 Reporting of indicators for stock assessment

Reported commercial landings from countries that have not implemented Eel Management Plans (because they are not subject to the EC Eel Regulation) accounted for about 27 to 39% of the total reported eel catch in recent years (ICES, 2015a). However, despite the fact the Eel Regulation puts upon Member States clear and significant reporting obligations, progress reports are still incomplete and inconsistent. Some stock and mortality indicators are lacking. In recently published or preliminary findings from Dutch and German research, recreational fisheries may constitute a greater risk than previously thought. For example, in the UK, a zero mortality is reported for recreational fisheries, yet there are angling related mortalities that have not been factored into the assessments. Total fishing mortality (ΣF) is better known, albeit with some remaining data quality issues. Other anthropogenic impacts, such as loss of habitat, pollution, barriers, and turbines (ΣH) are quantified in uncertain terms at best, as is the impact from top predators, diseases, parasites, and other components of natural mortality.

4.2.4 Evaluation of stocking measure and life cycle mortality

To be able to distinguish stocked eels from natural recruits and to facilitate the evaluation of stocking measures, it is recommended that all stocked eels be marked, for example by chemical methods. Preferably this would be done in a way that allows the separation between eels stocked within different countries' management plans. This implies the need for an internationally coordinated programme (ICES, 2015a).

Earlier in 2016, there was a WKSTOCKEEL meeting in Northern Ireland. In short, the key findings (ICES, 2016) of this meeting were inconclusive regarding the net benefits of glass eel or elver stocking on total stock size or escapement. The following are recommended research needs to address the identified knowledge gaps:

Glass eel/elver/juvenile eel

- Assessments of carrying capacity estimates of glass eel donor estuaries are absent; these are fundamental in denoting any "surplus".
- A whole eel distribution approach to assessing, lifetime mortality, stocking and determining net benefit to the stock (such as a current French project mentioned in the report). Studies must incorporate:
  - Appropriate experimental controls;
  - Evaluation of the mortality of the stocked fish;
  - Evaluation of the mortality of the cohort left *in situ*;
  - Development and growth of both cohorts over time.
- Detailed mortality estimates within the commercial stocked eel trade channels.

Silver eel

- Further research into silver eel migration including:
  - Observe and measure actual spawning;
  - Assess the reproductive fitness and spawning contribution of silver eels from stocking programs and those of native-origin;

- Further development of origin identification methods to assist with the above.

4.2.5 Improving data quality and certainty

ICES (2010b, 2014) highlighted the following issues for improved data quality:

- the reporting on stock status by countries should be standardized;
- the minimal information on stock status required is $B_{currrent}$, B_{best} and B_0 and ΣA, commonly referred to as the "3Bs & ΣA";
- quality criteria for national stock assessments should be considered, and implemented;
- intercalibration between assessment methods should be executed to standardize results.

Under the current review these issues are still relevant and need addressing. For instance, some countries do not report the "3Bs & ΣA" at all. For example, the UK only assesses and reports them every three years because that is the reporting schedule of the EC Eel Regulation, and Sweden only reports them for inland waters and the Baltic Sea coastal waters but not for its North Sea (the Skagerrak and Kattegat) coastal waters. France has reported these data for eight EMUs for the period 2007–2012. Other countries, such as the Netherlands and Ireland, report these data annually for every EMU. And of course, the EU Eel Regulation does not apply to non-EU countries so they collect and report stock indicators on a voluntary basis.

A separate workshop could evaluate the extent to which the four issues mentioned above are being dealt with. In addition, the Country Report Tables for 2017 and onwards could contain the two scorecards suggested at the beginning of this chapter.

4.3 Research needs

4.3.1 Hydropower and pumping station driven mortalities

Hydropower and pumping stations constrain eel survival in most countries. Fish that pass water management or hydropower structures either through turbines, pumps, pipework or other deep pathways can experience rapid decreases in pressure that can result in barotrauma. Such injuries can include emboli in the gills, haemorrhaging, ruptured swimbladder, and eye damage. Recent work by Brown *et al.* (2016) has highlighted the challenges faced in achieving good experimental design to evaluate these issues. More research work is required to better understand the potential impacts that barotrauma injuries can have on eels passing through pumping stations and hydroelectric power installations.

To summarise, some research needs here are:

- Identifying measures that mitigate against the impact of hydropower on silver eel migration (ICES, 2010b), and their net benefit as mitigations.
- Clarifying the fish-friendliness of current designs of hydroelectric turbines and pumps. This includes evaluating direct impacts (blade strikes) and indirect impacts such as barotrauma. It also includes testing and developing novel designs of hydropower installations in European waters in terms of fish-friendliness and electric output.
- Make a thorough effort to design and evaluate efficient and scalable behavioural guiding methods. In a first step, an in-depth understanding of fine

scale downstream migration/-navigation/-choice of path in eel should be built in, and reaction to elements under natural non-disturbed conditions. In a second step, guiding means to specifically address natural fish behaviour and memory and decision-making should be carefully tailored (as opposed to applying artificial stimuli with little biological significance).

4.3.2 Predator-driven mortalities

Predators such as seals, cormorants and other mammals and seabirds consume eel. The extent varies geographically as well as temporarily. Research needs are:

Quantifying predator–prey relationships (e.g. cormorants; ICES, 2008) in order to inform application of predation mortalities in assessments where desired, and to put losses from predation in context of other losses.

Improving the knowledge of (lifetime) natural mortalities, including its spatial and temporal variation and the relationship with case-specific (local) conditions.

4.3.3 Contaminant driven mortalities

Eel quality refers to how high are the chances for an eel to successfully migrate to the Sargasso Sea and reproduce effectively. Therefore, it includes the quantification of pollution and fat level, parasite load and diseases so that these can be including in quantitative stock assessments. There are research needs involving all of these aspects.

Analysing historical samples of eels (pre-1980s) to confirm the role of contaminants in the decline of eels (ICES, 2016-WGBECEEL report in preparation).

Investigating effects of contaminants on different aspects of eel reproduction (maternal transfer, egg quality, larval deformities) and particularly through ecotoxicological studies on artificially induced sexually mature eels.

Investigating the relationship between eel fat content and environmental variables (changing temperature, changing trophic status, and food availability; ICES, 2008).

Obtaining knowledge of synergistic effects of contaminant and infection levels of diseases and parasites.

Investigating methods to quantify the effects of contaminants on the reproductive success of the European eel and defining thresholds for integration in stock-wide assessments (ICES, 2013a).

4.3.4 Marine life-history strategies

At present, the proportion of eels that have a marine residency is unknown and is not included in most local stock assessments. This contingent may be especially important at higher latitudes where marine residency may be a dominant trait.

There is a need for research on the marine habitats of eels in terms of their use of depth, hydrodynamics and benthic substrate. Knowledge is also needed to understand the proximate drivers (environmental and biological) of migration between freshwater and salt water.

4.3.5 Sociology and economics

Sociological and economic research on eel is generally scarce in the context of the ecosystem approach to fish management. However, the consideration of the socio-economic dimension of the eel management is a key element for the successful development of conservation strategies. Some suggestions of such research that would strengthen the ecosystem approach to eel management would be:

- Analysing the marginal value of bringing glass eel recruitment back to its 1960–1979 level.
- Quantifying the total value of commercial or recreational eel fisheries.
- Mapping social aspects of the commercial and recreational eel fishery.
- Ecosystem services provided by eel in various countries, e. g. the societal benefit of the eel in maintaining foodweb functions and as a food source for other protected species.

Further socio-economic studies should address the willingness of stakeholders to adapt their behaviour for eel conservation or the economic welfare change of alternative eel management regulations. As shown by Dorow (2015) such studies can help to predict the acceptance of altered management regulations by stakeholder groups and provide therefore information to balance/compare biological and socio-economic outcomes management scenarios.

4.3.6 Recommendations on data quality and research needs

- A workshop should be convened to devise standards for data quality and confidence.
- Until then, apply the standards suggested in the present report.
- Data providers to improve data quality, confidence and coverage wherever needed.
- The best practice regarding the measures within eel manage plans should be identified, including the net benefits of eel stocking.
- Knowledge needs to be developed on fish-friendly hydropower, turbines and pumps, as well as on predators, contaminants, life-history strategies and socio-economic aspects on the eel decline and eel fisheries.

4.4 New and emerging threats and opportunities

Due to its complex life history as a diadromous species, the eel is exposed to a multitude of risks. For many of them the impact on the stock is difficult to assess and largely unknown. However, based on a literature review of recent publications (publication years 2015, 2016), some emerging opportunities (4.4.1–4.4.8) and potential threats (4.4.9–4.4.12) are discussed.

4.4.1 Threat: Changing environment, further ongoing climate change

Changes in ocean currents and productivity in the Sargasso Sea and the larval migration routes are likely to impact the early life stages of eels. Given that we have little access to the leptocephalus life stage, we can only speculate on the magnitude of their impact but as summarized in ICES (2015a) there have been studies which have correlated numbers of glass and yellow eel abundance to oceanic factors in the Sargasso Sea and in the Atlantic more generally.

Díaz *et al.* (2016) analysed the relation between oceanic and climatic factors and glass eel recruitment, using the historic glass eel catches series since the fifties as a proxy, in two Mediterranean (La Albufera and Delta del Ebro) and two Atlantic (Nalón and Miño) estuaries. Preliminary results indicated that the predicted evolution of the variables significantly related to glass eel recruitment would negatively affect eel population in future.

4.4.2 Threat: Effects of contaminants

In 2016, ICES updated the literature and elaborated in depth on the status and potential effects of contaminants in the eel. This was the result of a workshop of the Working Group on Eel and the Working Group on Biological Effects of Contaminants (WKBECEEL), held in Os, Norway (WKBECEEL report, under preparation). Although, contaminant levels (such as PCBs and DDTs) have been banned 40 years ago, contaminated wastes and equipment are still a cause for concern in the environment. Other pesticides, metals and other emerging contaminants are at very high levels in eels with certain substocks being unfit for human consumption. Direct evidence of the contribution of chemical contamination to the decline of eels however is still unavailable. The major limitation in understanding the impact of contaminants is that naturally spawning adults have never been found and that possibilities of rearing eel larvae in a laboratory are still very limited. Nevertheless, the report highlights that contaminants probably contributed to the collapse of eel stocks. Impacts have been reported at subcellular, organ, individual and even population levels. Based on the many documented cases of impaired reproductive capacities related to toxicants in fish, there are reasons to suspect negative biological effects of contaminants during eel reproduction. Among the different disturbances are fertility, endocrine disruption and larval deformities after maternal transfer causes for concern in eel. During migration, as eels fast and lipid reserves are depleted, lipophilic contaminants will reach high concentrations in the blood and will attain vital organs and gonads (Belpaire *et al.,* 2016).

Historical samples should be analysed. Other research fields include relationships between contaminants and lipids, main effects expected on reproduction and maternal transfer, and more eco-toxicological studies on dose and effect of contaminants on eels.

A new study on brain tissues was carried out on female eels caught in Belgium (Bonnineau *et al.*, 2016). Levels of organochlorine compounds (OCs) were compared to levels in liver and muscle tissues. Eel brain contained very high amounts of OCs, superior to those found in the two other tissues. Several of these pollutants could affect functioning of the nervous system. The results indicate that eel brain is an important target for organic and, to a lesser extent, for inorganic neurotoxic pollutants. To what extent this affects fitness of the eel stock remains unknown.

4.4.3 Threat: Endocrine disruption (from WKBECEEL)

Endocrine disruptors are exogenous chemicals or chemical mixtures that can interfere with any aspect of hormone action. They can act directly on any number of proteins that control the delivery of a hormone to its normal target cell or tissues (WHO, 2012). Endocrine disrupting compounds (EDC) include natural hormones and phytoestrogens, synthetic hormones (e.g. 17-alpha ethynylestradiol (EE2), and industrial/commercial compounds (such as alkylphenols, POPs (persistent organic pollutants; e. g. PCBs, chlorinated pesticides, brominated compounds and PFOS), pharmaceuticals, and phthalates) (http://toxics.usgs.gov/regional/emc/endocrine_disruption.html; WHO, 2012).

Exposure to endocrine-active contaminants can cause endocrine disruption, which can have severe impacts on fish populations. Intersex, the presence of both male and female characteristics within the same fish, is one manifestation of endocrine disruption in fish and has now been reported from many places and in many freshwater and marine fish species (Jobling *et al.*, 1998). However, endocrine disruption can also result in adverse effects on the development of the brain and nervous system, the growth and function of the reproductive system, and the response to stressors in the environment (ICES, 2016-WKBECEEL under preparation). Given that the eel is prone to bioaccumulating a wide range of chemicals, it is likely that eels living in polluted habitats are also affected by endocrine disruption.

Blanchet-Letrouvé *et al.* (2016) investigated whether European eel from the Loire estuary were still the subject of estrogenic disruption by quantifying the hepatic Vg gene expression according to gender and maturity stage. Results demonstrated the responsiveness of exposed silver male eels, since hepatic mRNA Vg induction was observed in E2 treated males compared to control specimens. In the field, results of female silver eels reflected large inter-individual differences in the activation of hepatic Vg at silvering.

In another French study on wild eel in the river Loire (Couderc *et al.*, 2016) the thyroid endocrine status of eel was assessed in relation to organic contaminants body burdens. Overall, several organic contaminants, mainly dl-, ndl-PCBs and PBDEs, could be associated with changes in thyroid homeostasis in these fish, via direct or indirect metabolic and hormonal interactions.

4.4.4 Threat: Recreational fishing

In many countries regulations to reduce angling-induced eel mortality have been implemented. These regulations are likely to increase the release of eels. However, data are missing to assess the mortality associated with catch and release in the case of eel. Accordingly, Weltersbach *et al.* (2016) studied the hook shedding and post-release fate of deep-hooked eel by considering different hook sizes. The presented results of the study indicate that the regulatory forced release of deep-hooked eels can cause substantial mortality rates, which is in contrast to the generally expected high survival rate. For a deeper understanding of the eel angling hooking mortality additional studies have been conducted in Germany (Malte Dorow, pers. communication).

4.4.5 Opportunity: Advances in glass eel migration triggers

Studies in both the American eel (*Anguilla rostrata*) and European eel have demonstrated that olfaction is critical to anguillid behaviour and that glass eels are attracted to conspecific washings, that the effects last several weeks and that conspecific cueing is an important component of migration coordination among juvenile American eels (Schmucker *et al.*, 2016).

4.4.6 Opportunity: Behaviour and habitat use

For the first time silver eels were observed migrating southward in the North Sea (Huisman *et al.*, 2016). Therefore, at least part of the Western European population of eels migrates towards the English Channel, in contrast to the Nordic migration route hypothesis. These findings are also supported by Simon and Dorow (2015). This different migratory route may affect the energy reserve available for spawning and therefore the contribution of these eels to the population. As such, increasing our knowledge of marine eel migrations contributes to the goal of achieving sustainable eel stock management. In Denmark, trapped silver eels are tagged annually with PIT tags and released during autumn. Downstream movements are monitored by detection stations (Ingemann Pedersen, 2016). These data will be used evaluating silver eel escapement, including anthropogenic mortality due to fishing and turbines.

In Norway, a knowledge gap on the biology (growth rates, lengths at silvering) and behaviour (migration time, home range, depth) of eels is being addressed in a research proposal regarding marine resident eels vs. eels that spend some part of their life cycle in freshwater (Durif and Thorstad, 2016). As part of the research, yellow and silver eels (eleven) were tagged with acoustic transmitters and monitored for almost two years. These data are being analysed and will provide more knowledge of the behaviour of eels living in the sea. Furthermore, a research proposal (MAREEL) was submitted to explore the drivers of catadromy vs. marine residency in the Norwegian subpopulation of eel (Durif and Thorstad, 2016).

4.4.7 Opportunity: Advances in stock assessment

A new method has been tested in Estonia regarding yellow eel abundance and density related studies in large waterbodies (Bernotas *et al.*, 2016). A 100x100 m enclosure fykenet system of Ubl and Dorow (2015) is being tested in L. Võrtsjärv since earlier in 2016. The efficiency of the enclosure system is currently under evaluation in Germany.

In Norway and Ireland, scientific fisheries were initiated to obtain local biomass estimates. Findings may increase data availability for modelling eel production (see the 2016 Country Reports of Norway and Ireland).

4.4.8 Opportunity: Advances in using environmental DNA

The Working Group acknowledged the presence of numerous reports showing potential applications of using environmental DNA methods (e-DNA) in assessing natural fish populations (ICES, 2015a). The presence of eel can be detected by this method in both marine and freshwater environments (Thomson *et al.*, 2012; Herder *et al.*, 2014a). In the Netherlands a higher detection rate was observed for eel when using eDNA (87.5%) compared to using traditional fishing methods (60%), e.g. electrofishing (Herder and Kranenbarg, 2016). A relatively new approach is the use of eDNA metabarcoding, to attain whole fish stock assemblage detection (Herder *et al.*, 2014b; Valentini *et al.*, 2016). Using this technique, it is possible to read relative eDNA ratio between species, indicating a level of abundance of each species (Valentini *et al.*, 2016; Herder and Kranenbarg, 2016). Quantification of species abundance or biomass is normally not possible by eDNA meta-barcoding, because eDNA concentrations in natural environments are often below the limit of quantification (Tréguier *et al.*, 2014). A future challenge is to obtain better understanding of (eel) stock dynamics by using eDNA methods, however on population dynamics (e.g. life stage, age, fitness) eDNA will most likely not provide any information (Herder *et al.*, 2014a).

4.4.9 Opportunity: Advances in techniques for reproducing eel

Significant advances have been made in recent years in the artificial reproduction of anguillids (see e.g. Masuda *et al.* (2012) for *A. japonica* and Butts *et al.* (2014) for *A. anguilla*). Future developments in the production of eel larvae in captivity hold new possibilities for experimental work in many areas, including toxicology, as researchers may be able to test the effect of pollutants in reproduction experiments (Brinkmann *et al.*, 2015; Sühring *et al.*, 2015; Belpaire *et al.*, 2016).

4.4.10 Opportunity: Advances in understanding of eel health

Over the past year, the Environment Agency's fish laboratory at Brampton in England has been working on Eel Health protocols (EHP) as an EU standard for monitoring contamination and diseases in eels. A paper is due for publication on this subject shortly (see the UK Country Report 2016).

ICES (ICES, 2015c) advised on defining methods for the harmonisation of eel quality, and discussed general issues on sampling for eel quality assessments. Best practices to sample, analyse, report and visualize contaminants in the eel were described. The disease sections focus on parasitic diseases (including the swimbladder parasite *Anguillicoloides*), and on viral and bacterial diseases. Possible ways to integrate data and to implement them into eel quality indices were suggested. The workshop also discussed the future perspectives of using biomarkers of effects to assess eel health. The report concluded describing the international context and future perspectives in eel health assessments, and its implications for international stock assessment.

In Northern Ireland the health status of eel was examined in Lough Neagh for the presence of a range of eel viruses (UK Country Report 2016). The study found no evidence of anguillid herpes virus in any life-history stage of the wild eel population. Eel virus European (EVE) and Eel virus European X (EVEX) were found but at a very low prevalence, suggesting that the presence of these diseases has not reached levels of concern to the population's health status. In Lough Neagh the wild eel population was believed to be in good health (UK Country Report 2016).

4.4.11 Opportunity: New findings in relation to stocking

The WKSTOCKEEL convened to update knowledge of the net benefit of stocking (the practice of adding eels to a recipient EMU from a donor source), to the recovery of the eel stock, and to make proposals for research to fill any crucial knowledge gaps that prevent a definitive advice on stocking as a stock conservation measure (ICES, 2016). The definition of the net benefit of stocking was taken as "where the stocking results in a higher silver eel escapement biomass than would have occurred if the glass eel seed had not been removed from its natural (donor) habitat in the first place". The conclusions from WKSTOCKEEL echo many of those from the most recent reviews and the latest advice and recommendations from ICES (2015a) given that many of their concerns remain unaddressed. Studies were found to lack controls and/or a simultaneous assessment of the life history of those glass eel left *in situ*. This in effect means that, while a local benefit may be apparent, an assessment of net benefit to the wider eel stock is unquantifiable. The contribution of stocking derived silver eel to the spawning stock is still not quantifiable and is limited by the lack of knowledge of the spawning of any eel (ICES, 2016).

4.4.12 Opportunity: New hydropower developments

In WGEEL (ICES, 2015a), new hydropower initiatives in Turkey, the Balkans and Belgium were discussed. In 2016, the UK has reported an interest in applications for large-scale tidal lagoon hydropower schemes. The potential effects of such schemes on eels have yet to be established.

In the UK, research was undertaken to quantify the level of protection screens at a hydropower plant provided to silver eels (Inglis *et al.*, 2016). An overall deflection efficiency of at least 89.5% (95% confidence) for a 12.5 mm aperture screen was measured for silver eels.

Earlier in 2016, the Environment Agency (UK-England only) updated its guidance on hydropower application requirements. This guidance is a compilation of previous reports and includes flow and abstraction management, screening requirements, fish passage, impoundments, nature conservation and flood risk (Environment Agency, 2016).

"Fish friendliness" is the focus of some recent hydropower research. A few hydropower technologies such as the Alden turbine (Čada *et al.*, 2006; Dixon and Hogan, 2015) and traditional Archimedes screws (Waters and Aggidis, 2015) offer a fairly safe downstream passage for eel. A recent improvement (Archimedes Double Screw; Hydroconnect, 2016) also includes an upstream passage, which may enhance motivation for installation in additional streams. However, "fish-friendliness" in hydropower turbines and pumps is not enough since all turbines in a plant will not be promptly replaced by better ones. Fish must therefore for a long time ahead be led to, and use, a better turbine or conventional passage. Efficient techniques for guiding eels are thus indispensable. Mechanical solutions such as louvers or bar racks are useful in many situations, although improvements can be made (Poletto *et al.*, 2015).

4.4.13 Opportunity: developing the coordination of eel management and data collection in the Mediterranean

Introduction

This section addresses specifically the emerging opportunity of coordination in the Mediterranean region. As such, this section addresses ToR B Scientific basis of Advice, under points 5 Emerging opportunities, and 2 Coverage of data used in developing advice.

The necessity for the integration of Mediterranean countries within the stock-wide coordination of actions for the European eel is apparent.

The GFCM Transversal Workshop on European Eels, held in Salammbô, Tunisia, 23–25 September 2010, recommended the development of management plans for the European eel covering all subregions of the Mediterranean. The workshop also recommended the selection of the European eel as one of the seven case studies for the development of GFCM multiannual management plans.

The FAO hosted the first meeting of the joint EIFAAC/ICES/GFCM Working Group on Eel (WGEEL) in Rome, November 2014. At that meeting, a plan for a pilot action, starting in November 2014, was drafted to assist countries in collecting the basic data for setting up a methodology for assessment and a preliminary evaluation of reference points (biomass and mortality parameters) for Mediterranean eel local subpopulations. Results of this preliminary exercise were presented at the joint EIFAAC/ICES/GFCM Working Group on Eel (WGEEL) in Antalya, December 2015, and represented the first joint effort for an assessment of the eel local stocks for the Mediterranean area.

Here we describe developments in 2016, and plans for the near future.

2016 Liaison Action between GFCM and WGEEL

The GFCM supported a Liaison Action in 2016 with the aim of implementing harmonization among GFCM countries and supporting the coordinated participation of Mediterranean countries to the WGEEL.

Countries nominated national experts and GFCM established a 'liaison' to coordinate the preparation of the technical work to complete the national Country Reports (CR) for the WGEEL. Eleven countries nominated national experts, and seven prepared CR (Spain, France, Italy, Albania, Greece, Turkey and Tunisia).

CR were circulated in advance of the 2016 WGEEL meeting, to facilitate sharing of information on the situation in the Mediterranean area for the eel local stocks. For the EU countries already obliged to develop and implement eel management plans for the EC Eel Regulation, the amount of information available is substantial, and fulfils the requirements of the ICES format of the CR. For non-EU countries however, important information on eel habitat, local stock assessment and targets for eel recovery is lacking.

One of the key deliverables of the Liaison Action is to propose draft ToR for a GFCM Workshop towards preparation of a Mediterranean management plan for European eel. Therefore, National Experts from the Mediterranean countries, and the EU representative Ms Evangelia Georgitsi, met as a subgroup to consider and discuss the following:

1) An evaluation of the possibility to gain sufficient background information on the local stocks, on exploitation patterns, on present catch and effort, on historical trends, to be used for the identification of reference points (targets) and stock assessment;
2) Discuss the upcoming implementation of the Data Collection Reference Framework (DCRF), the GFCM instrument for fisheries data collection in the Mediterranean, for eel as well as for other marine resources, as a tool for collecting data for eel to be used for the resource characterization and assessment;
3) Eventually, the identification of the key reference points for a Mediterranean Management Plan aimed at sustainable management of European eel, considering Country specificities, including the existing management plans for EU Member States.

The following section summarizes the situation for Spain, France, Italy, Greece, Turkey and Tunisia. Albania did not attend the WGEEL and were not discussed.

In Spain, seven EMUs out of 12 are part of the Mediterranean region. Most management measures in Mediterranean EMUs target rivers. The most important river flowing into the Mediterranean is the Ebro. The rest of the rivers are short, have a low and irregular flow with seasonal flooding and very dry summers. In fact, there are some water courses that remain dry most of the year. There are lagoons in the Mediterranean (Albuferas). Eel assessment is made at the autonomous region level, according to monitoring and analytical methods of the autonomies. Each autonomous government is in charge of the control, regulation and management of eel fishery and stock. Therefore, fisheries for glass eel, yellow and/or silver eel fisheries are allowed in some autonomies but banned in others.

The measures implemented differ between the Atlantic and the Mediterranean area. In the Atlantic area, fishing effort is reduced by up to 50% compared to the reference periods, as the main measure to comply with the objectives of the EU regulation. In the Mediterranean area, the main focus is on restocking measures and maintaining the fishing management measures already set in their legislation. In certain cases, these Mediterranean EMUs also propose measures to reduce fishing effort or to ban certain fisheries, i.e. a stricter control and catch monitoring measures to control illegal fishing or poaching.

A regional framework at the Mediterranean level could thus be particularly interesting to improve data collection/availability and assessment and management for coastal lagoons that are important habitat for eels in the Mediterranean Spanish region.

France has already set up a national management plan (NMP) complying with requirements of EC regulation 1100/2007. This NMP includes eel management units (EMUs) in the Mediterranean part of the country (two out of nine) and a range of specific measures. No glass eel fishery is allowed. Coastal lagoons are the main eel habitat (productive habitats with rapid growth and short generation time eels). Yellow and silver eel fisheries exist mainly in lagoons and represent an important economic activity in the region, especially in its western continental part lying from the river Rhône to the border with Spain. The main management measures in the region are:

- glass eel fishery ban;
- restricted fishing seasons and areas, as well as effort control through quotas of licences established in order to guarantee a level of activity less than that before the NMP;
- silver eels release programme.

Moreover, most of the lagoons have local management measures set up by State local services in dialogue with fishermen organisations, and these measures are sometimes more restrictive than the one required at the national level.

France provides landing data for the national stock assessment under the NMP but some data and relative assessment are still unsatisfactory for the Mediterranean part, and data collection improvement and research programmes could be encouraged and better deployed under a management plan dealing with lagoon habitats under a regional framework.

The French administration demonstrated its interest by nominating a focal point for WGEEL 2015 and 2016. The French administration is ready to take part in the framework of a Mediterranean management plan but wishes that this plan be consistent with the EU Eel Recovery Plan (EC 1100/2007) and therefore calls for a dialogue with the European Commission (EC).

The French National Expert indicated that one of the first steps in developing a Mediterranean regional management plan should be an inventory of management measures existing in countries of the GFCM outside the EU. After this there should be a dialogue with the EC to evaluate how the Mediterranean plan could be articulated with the existing framework that includes marine and freshwater eel habitats of the EU MS concerned. The National Expert opinion is that from a scientific point of view, such a framework is a necessary step in order to be able to assess the state of the stock at its distribution scale, and therefore to propose adapted management measures to enhance recovery and sustainable use of the stock.

In Italy a similar situation occurs as Spain, where the Eel Management Units are the Administrative Regions. There are nine EMUs, and in each one different habitat typologies (such as coastal lagoons, with or without fish barriers, lakes and rivers) have been considered. The coastal lagoons habitat constitutes the most important typology for eel in Italy, for wetted area as well as eel production. Italy has a Management Plan in place that envisages a recovery plan for eel, with a National framework and nine coordinated Regional Plans. The National Expert from Italy reports that the possibility to frame the current Management Plan within a wider framework at the Mediterranean level, in particular if this would be focused to management in coastal lagoons habitats, would be welcome because it would enhance coordination and functioning of the existing Plan. In fact, habitat management and restoration of coastal lagoons in Italy is an environmental priority that could take advantage of a sustainable management framework aimed at restoration of local eel stocks.

In Greece, the Ministry of Rural Development and Food implemented and submitted to EU an Eel Management Plan in 2009, declaring in this way its commitment to protect the local eel stock. Note however that measures taken for the protection of eel were put into force back in 1971, by prohibiting glass and yellow eel fisheries except in the case of restocking, in addition to the total ban of fisheries in rivers. Today, the total eel landings come from the coastal lagoons, which are managed by local fishing cooperatives and target only migrating silver eels.

Eel landings time-series for each fishing cooperative are not for the same period and thus there is a difficulty to identify the pristine condition of the stock before the collapse of the eel stock. Also, in the framework of EU Data Collection Framework (DCF), Greece collects and submits to EU all available data on eel landings and assesses the condition of the local stock. These data are used also for the preparation of the Country Report submitted to WGEEL, and for the post-evaluation of the EMP progress.

In this framework it will be of benefit for Greece to participate in a Mediterranean Eel Management Plan, which will assist Greece to meet the requirements for the eel stock recovery and to coordinate its work with the other Mediterranean countries, within EU or not. It is with this objective that Greece has verified its commitment to finalize the stock assessment also towards the implementation of a Mediterranean EMP, by taking part in the nominating a focal point for the WGEEL meetings in 2014, 2015 and 2016, but its further commitment should be verified.

Turkey has not compiled a National Eel Management Plan, thus no EMUs have been delimited. However, there are efforts to finalize a National EMP, following the same motivation that has driven Tunisia, i.e. look out on the export market for eel, and therefore be able to address the limitations imposed by CITES requirements. The administrator acts cautiously in the regulation of eel exporting quota. For this, at the national level an effort is currently made to explore all possible issues for data gathering in Turkey. The administrator attempts to collect some scientific data for stock assessment to achieve sustainable eel fisheries. For this reason, actions on the assessment of potential stock and life-history traits are assessed in a coastal lagoon system in a pilot study. Some long time-series data on Koycegiz lagoon are currently being collected by a national working group on eel supported by the Turkish Government, in order to estimate potential stock on a model lagoon. This is a first important step towards the setting up of a work for an Eel Management Plan at the National level. In this sense, the National Expert feels a coordination and a support by GFCM to those countries that do not have a frame similar to the one provided by the EU regulation would be welcome.

Tunisia is a country where most of the eel production occurs in coastal lagoons habitats. These habitats suffer from a number of restraints, some linked to socio-economic problems, some due to environmental constraints such as drought, that all concur to a loss of efficiency and expertise in coastal lagoon management for fishery purposes. This has as a consequence a loss of habitat quality for eel. Tunisia has set up an Eel Management Plan, between 2009 and 2010, in order to comply with requirements set by CITES, and to align with EU measures in the development and submission of the management plan for possible export resumption eels to the EU countries.

The database to build such a plan requires more development. This is why the National Experts have strongly appreciated GFCM initiative to support the Mediterranean countries in participating to the WGEEL meetings. They have also pointed the attention to the importance of taking advantage of the work of the previous WGEEL meetings, and of other relevant workshops organized by GFCM. The Tunisian National Experts therefore strongly support the idea of setting up a Management Plan at the Regional Scale that would allow to better structure the existing Management Plan and to strengthen it.

In conclusion, all participating countries, at least for what concerns the commitment of National Experts, seem strongly interested in considering a Mediterranean framework for eel management, and are willing to contribute to the preparation of such a plan. They request on the other hand for a full engagement of the other Mediterranean countries, so that the coverage for such a management framework can be adequate.

The group then considered point 2, if the information available is such that a Management Plan for eel at the Mediterranean scale can be drafted.

The situation differs between EU Member States and non-EU countries. This is because those countries obliged to have Management Plans under the EC Regulation have a bulk of information available, and target reference points already identified and quantified, methodologies available, and a clear management framework, even if in some cases incomplete for some EMUs or parts. Other countries (non-EU) have not yet committed with Management Plans under coordinated frameworks and nor do they have the same amount of information nor methodologies available for stock assessment nor clear targets for eel recovery.

In this context, the group discussed the DCRF, the GFCM instrument for fisheries data collection in the Mediterranean, as a possible tool for collecting data for eel to be used for resource characterization and assessment. Most National experts were not aware of its potential, and some of them expressed doubts at its applicability within their national contexts for eel, for example Tunisia, this being due to internal constraints and limitations. All National Experts agreed that DCRF is the tool that could enable a framework for collecting data for eel with a coordinated methodology at the Mediterranean scale, also enforcing existing DCF (now EU-Map) and have agreed to follow its implementation at their National level. National Experts have agreed to make efforts to implement coordination in data collection on eel in all existing frameworks.

Further discussion points included:

i) The main habitat which is of importance for eel in most countries in the Mediterranean is represented by coastal lagoons.

ii) For all countries, there is a noticeable interest in establishing an Eel Management Plan for the Eel in the Mediterranean, especially if such a Plan is going to deal primarily with management of eel in Mediterranean coastal lagoons. However, the plan should also take into account freshwater systems in future.

iii) Such Management Plan should act in synergy with a framework for the sustainable management of coastal lagoons, giving priority to such action as lagoon hydraulic and landscape management, biodiversity protection, enhancement of natural recruitment, habitat restoration.

iv) National experts agree that a sustainable management framework for the eel local stocks in Mediterranean lagoons could offer an important opportunity to promote the protection of the environment and living resources in such habitats. This contributes to ensure the survival and persistence of coastal lagoons that represent important drivers for regional economies.

Finally, the discussion focused on the identification of some key points for a Mediterranean Management Plan. In particular, Experts focused on directing the discussion towards the drafting of Specific ToR for a GFCM Workshop towards the elaboration and implementation of a Mediterranean management plan for European eel, whose date, venue and participants should have to be defined by the GFCM.

Notwithstanding the good amount of information existing for some countries, gaps remain concerning some areas and countries of the Mediterranean. A coordinated project or concerted action in order to widen the knowledge base necessary to build an adaptive management plan specifically tailored for the Mediterranean eel subpopulations and situations is required. National experts expressed their commitment to find the opportune framework for such a project within research funding opportunities at the Mediterranean level (e.g. INTERREG Calls, MED calls).

Terms of Reference are proposed for the GFCM Workshop:

a) Review background information on eel habitat distribution, eel stock state (exploitation – catch/effort, time-series, existing assessment, anthropogenic impacts) in the Mediterranean area, also based on previous work done within the GFCM Eel Pilot Action (2014; ICES, 2015a).

b) Identify the distinctive features of the eel life cycle for subpopulations in the Mediterranean.

c) Review exploitation typologies in the main habitat where eel is present, identifying the main strengths and weaknesses of such exploitation patterns.

d) Review the frameworks for eel management in the Mediterranean area, by examining all management measures and assessing their suitability. The need to harmonize existing management plans such as those within EU Regulation 1100/2007 or other existing frameworks will be also taken into account if possible.

e) Review the provisions for data collection on European eel according to the GFCM-DCRF.

f) Identify the key issues for a sustainable management of eel local stocks in the Mediterranean, also by listing possible management measures to be considered for each issue, within a comprehensive Management plan.

g) Identify management targets towards which the Mediterranean Management Plan shall focus.

h) Define requirements to evaluate the effectiveness of management measures to be put in place.

It is clear that the success of such an initiative shall rely on adequate planning, and shall require a certain amount of preparatory work. A key point will be the participation of National Experts and Administration Representative from most Mediterranean Countries, as well as some invited experts chosen among eel scientists dealing with issues relevant to management.

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Annex 2: Acronyms and Glossary

ACRONYMS	DEFINITION
ACFM (ICES)	Advisory Committee on Fisheries Managment
ACOM (ICES)	Advisory Committee on Management
ADGEEL (ICES)	Advice drafting group on eel, for ICES
AngHV-1	Anguillid herpesvirus 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 Commission
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 Managment Plan
EMU	Eel Management Unit
EFF	European Fisheries Fund
EQD	Eel Quality Database
EROD	Ethoxyresorufin-O-deethylase
ESAM	Eel Stock Assessment Model
EU	European Union
EU MAP	the European Union Multi Annual Plan (EU MAP).
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	Hydropower 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	Poly aromatic 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 stocking. The exact size of the eels may vary considerably. Thus, it is a confusing term.
Depensation	
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
Ongrown eels	Eels that are grown in culture facilities for some time before being stocked.
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.
Stocking (restocking)	Stocking (formerly called 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 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, corressponding 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 stocking, corressponding 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 Blim.
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 (Bpa)	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
R2	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.
three 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.

Annex 3: Participants list

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Annex 4: Meeting agenda

Thursday 15th Sept

- 13:00–13:30 Welcome, Intro to Working Group, agenda, ToR.
- 13:30–14:30 Tour de table; Introduce tasks with short discussion
- 14:30–15:00 Brainstorming on WG communications plan
- 15:00–15:30 Coffee break
- 15:30–16:00 Feedback on new Country Report format
- 16:00–17:00 Choose tasks and Breakout to plan work
- 17:00–17:30 Plenary to outline task plans

Friday

- 09:00–13:00 Presentations Country Report updates (maximum 10 minutes)
- 13:00–14:00 Lunch
- 14:00–15:00 WK updates (WKBECEEL, WKSTOCKEEL, WGRECORDS, EU, GFCM)
- 15:00–17:30 All Task Groups breakout

Saturday

- 09:00–10:00 Plenary for discussion of any urgent matters
- 10:00–13:30 All Task Groups breakout

Sunday, Monday

- 10:30–11:00 Plenary for discussion of any urgent matters
- 11:00–17:00 All Task Groups breakout
- 17:00–17:30 Plenary for tasks to report progress

Tuesday

- 09:00–10:00 Plenary for discussion of any urgent matters
- 10:00–17:00 All Task Groups breakout
- 17:30 Report drafts submitted for collation

Wednesday

- 09:00–12:00 Reading the report
- 12:00–13:30 Agreeing the report – summary, advice, etc.
- 15:00–18:00 Agreeing the report chapters

Thursday

- 09:00–14:00 Final corrections
- 14:00 Close Working Group

Annex 5: WGEEL responses to recommendations from other Expert Groups

The WGEEL did not receive any recommendations from other expert groups for the attention of the 2016 meeting and therefore nothing further is reported against ToR d here.

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 table below.

Annex 6: WGEEL responses to the generic ToRs for Regional and Species Working Groups

GENERIC TOR QUESTIONS	WGEEL RESPONSE
a) Consider and comment on ecosystem overviews where available.	*Anguilla anguilla* is a catadromous species and therefore occupies marine, transitional and freshwater environments during its life cycle. The ecosystem function (role) of *A. anguilla* in each of these environments is not well understood. A brief ecosystem overview is provided in the initial WGEEL stock annex developed in this report (European eel stock annex). Environmental influences on the stock are incorporated in the annual advice and may address a wide range of factors affecting eels at different stages of their life cycle. Consideration has and will be given to possible ecosystem drivers in both freshwater and the marine environment, but at present it is not possible to incorporate such drivers in the assessment process.
b) For the fisheries considered by the working group consider and comment on: i) Descriptions of ecosystem impacts of fisheries where available ii) Descriptions of developments and recent changes to the fisheries iii) Mixed fisheries overview iv) Emerging issues of relevance for the management of the fisheries	i) The current commercial fishery is prosecuted with fixed and mobile traps, longlines, fine mesh trawls and handnets, and the recreational fishery is mostly rod-and-line, small traps and nets. The operation of these gears probably has little direct impact on aquatic ecosystems, with the possible exception of local bycatch issues. However, the eel is an important and frequently dominating species in the ecosystem, and its substantial reduction, whether due to fisheries or other causes, may have had a more profound effect. There is limited knowledge of the magnitude of these effects. ii) There have probably not been any substantial changes in fishing gears and their operation in recent years. Many eel fisheries have been subject to management controls and closures, with resulting reductions in exploitation rates. This has resulted in increasing sensitivity of assessment procedures to these values. iii) Most eels are caught in targeted fisheries in coastal waters, transitional (brackish) and freshwater. Some mixed fisheries do occur (e.g. German freshwater fykenet fisheries). Eels may be captured as bycatch in commercial and recreational fisheries. There is limited information on number of eels captured as bycatch, or on their survival when there are regulations requiring the release of eel captured in other fisheries (for instance by recreational angling). There are few data on bycatch of other species in targeted eel fisheries. iv) See Chapter 4 of this report for more details.

GENERIC TOR QUESTIONS	WGEEL RESPONSE
c) Conduct an assessment to update advice on the stock(s) using the method (analytical, forecast or trends indicators) as described in the stock annex and produce a brief report of the work carried out regarding the stock, summarising where the item is relevant: i) Input data (including information from the fishing industry and NGO that is pertinent to the assessments and projections) ii) Where misreporting of catches is significant, provide qualitative and where possible quantitative information and describe the methods used to obtain the information iii) For relevant stocks estimate the percentage of the total catch that has been taken in the NEAFC regulatory area by year in the recent three years iv) The developments in spawning–stock biomass, total-stock biomass, fishing mortality, catches (wanted and unwanted landings and discards) using the method described in the stock annex. v) The state of the stocks against relevant reference points vi) Catch options for next year vii) Historical performance of the assessment and catch options and brief description of quality issues with these	Most of the questions posed in this section of the generic ToR are addressed routinely in the WGEEL report. However, iii) and iv) are not applicable to eel. See Stock Annex and Chapter 2. However, no information from the fishing industry and NGOs is passed on to WGEEL from ICES. Knowledge of misreporting of catches is poor. The WG 2016 was not aware of any methods used to obtain this information. Not applicable. Described in Chapter 2. See annual advice. Total landings and effort data are incomplete and therefore ICES does not have the information needed to provide a reliable estimate of total catches of eel. Furthermore, the understanding of the stock dynamic relationship is not sufficient to determine/estimate the impact of any catch above zero (at glass, yellow, or silver eel stage) on the reproductive capacity of the stock. There is no historical assessment of the assessment and catch options.
d) Produce a first draft of the advice on the fish stocks and fisheries under considerations according to ACOM guidelines.	Advice is drafted annually by the WG and redefined by the ADGEEL. A draft advice was delivered to ICES from the WG in September 2016.
e) With reference to the Frequency of Assessment criteria agreed by ACOM (see Section 5.1 of WGCHAIRS document 03): (1) Complete the calculation of the first set of criteria, by calculating Mohn's rho index for the final assessment year F; (2) Comment on the list of stocks initially identified as candidates for less frequent assessment from the first set of criteria (adding stocks to the list or removing them would require a sufficient rationale to be provided).	Not relevant to eel. There is currently reporting on a triannual basis in line with the EU regulation. Annual advice on recruitment trends is in line with category 3 long-lived species.
f) Estimate precautionary reference points for all the category 1 stocks with undefined PA reference points, following the Technical Guidelines document on reference points developed by ACOM and the WKMSYREF4 report.	Eel is not a category 1 stock at the moment.

GENERIC TOR QUESTIONS	WGEEL RESPONSE
g) Review progress on benchmark processes of relevance to the expert group.	A benchmark type stock annex has not yet been developed for eel. Work on an initial stock annex describing the assessment methods was started in 2015 (Stock Annex).
h) Propose specific actions to be taken to improve the quality and transmission of the data (including improvements in data collection).	For improvements to data quality, see Chapter 4 of this report. For improvements to data transmission, see Chapter 4 of this report.
i) Prepare the data calls for the next year update assessment and for the planned data compilation workshops.	These preparations will be conducted outside the WGEEL annual meeting. A workshop has been proposed to ICES to address this topic.
j) Update, quality check and report relevant data for the stock: i) Load fisheries data on effort and catches into the INTERCATCH database by fisheries/fleets ii) Abundance survey results iii) Environmental drivers	See Chapter 4 of this report and the Stock Annex. Eel data are not currently in ICES databases, because these databases are not structured in a way that is appropriate to European eel. Data are reported using annual Country Reports, and WGEEL maintains relevant databases used consistently in the advice, such as recruitment and silver eel time-series and the Eel Quality Database. Abundance survey results are provided in some Country Reports, but at present the WG does not collate and analyse these data. Environmental drivers are relevant at the local level for individual catchment assessments, but these are not relevant at the international scale, with the possible exception of oceanic environmental influences on spawning stock and larval migrations. Global environmental drivers are not currently incorporated, or maybe even relevant, to the international assessment.
k) Produce an overview of the sampling activities on a national basis based on the InterCatch database or, where relevant, the regional database.	The InterCatch database is not used by WGEEL (see above). A series of workshops have been proposed to ICES for development or modification of a database and to make recommendations for future data management.
l) Identify research needs of relevance for the working group.	See Chapter 4 of this report.

Annex 7: Country Reports 2015–2016: 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 are presented. These Country Reports aim at presenting the best information which does not necessarily coincide with the official status.

Participants from the following countries provided an updated report to the 2016 meeting of the Working Group on Eels:

- Albania
- Belgium
- Denmark
- Estonia
- Finland
- France
- Germany
- Greece
- Ireland
- Italy
- Latvia
- Lithuania
- Netherlands
- Norway
- Poland
- Portugal
- Spain
- Sweden
- Tunisia
- Turkey
- 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 2015/2016 will be available ASAP.