WGEEL Country Reports

Report on the eel stock and fishery in Belgium 2013/2014

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Reporting Period: This report was completed in October 2014, and contains data up to 2014.

1. Introduction

This report is written in preparation of the EIFAAC/ICES Working Group on Eel meeting at Copenhagen (4–10 September 2013). Extensive information on the eel stock and fishery in Belgium has been presented in the previous Belgian country reports (i.e. Belpaire *et al.*, 2006; 2007; 2008; 2009; 2010, 2011, 2012 and 2013), in the Belgian Eel Management Plan (EMP), in the first report submitted in line with Article 9 of the eel Regulation 1100/2007 (Vlietinck *et al.*, 2012). This report should thus be read in conjunction with those documents.

Four international RBDs are partly lying on Belgian territory: the Scheldt (Schelde/Escaut), the Meuse (Maas/Meuse), the Rhine (Rijn/Rhin) and the Seine. For description of the river basins in Belgium see the 2006 Country Report (Belpaire *et al.*, 2006). All RBDs are part of the North Sea ICES ecoregion.

In response to the Council Regulation CE 1100/2007, Belgium has provided a single Eel Management Plan (EMP), encompassing the two major river basin districts (RBD) present on its territory: the Scheldt and the Meuse RBD.

Given the fact that the Belgian territory is mostly covered by two internationals RBDs, namely the Scheldt and Meuse, the Belgian Eel Management Plan was prepared jointly by the three Regional entities, each respectively providing the overview, data and measures focusing on its larger RBDs. The Belgian EMP thus focuses on the Flemish, Brussels and Walloon portions of the Schelde/Escaut RBD, and the Walloon and Flemish portions of the Meuse/Maas RBD.

The Belgian EMP has been approved by the European Commission on January 5th, 2010.

The three Belgian authorities (Flanders, Wallonia or Brussels Regions) are responsible for the implementation and evaluation of the proposed EMP measures on their respective territory.

In the next years, all eel-related measures proposed in the Belgian EMP will be fine-tuned according to the existing WFD management plans and implemented in such manner by the responsible regional authorities.

The Belgian EMP focuses on:

For the Flemish region

- the ban of fyke fishing on the lower Scheldt in 2009;
- making up an inventory of the bottle necks for upstream eel migration (priority and timing for solving migration barriers).

Specific action in 2010–2014: In Flanders, 38 fish migration bottlenecks of high priority were identified. 90% has to be solved at the end of 2015 and the remaining part by 2021. Until mid-2013, eight of the 38 bottlenecks were remediated and for several of them remediations are planned. In addition, a number of bottlenecks of moderate priority were remediated. In 2013, a study was started at the sea sluices of Leopold Canal and Schipdonk Canal to optimize management of the sluices in order to allow glass eel migration.

For downward migration

Specific action in 2012–2014: In the fall of 2013 a research will start on the Albert Canal to estimate the damage and mortality causes by the combined pump/hydropower installations. Also downstreaming silvers eels will be equipped with transmitters in order to study their behaviour at the pump/hydropower installations and in order to determine to which amount they use the Albert Canal as downstream migration route.

Controlling poaching

Specific action in 2012–2014: actions have been focused and will be continued specifically on the Scheldt estuary, on the Nete catchment and in the polders. Illegal fishing equipment was seized.

Glass eel restocking programme

Specific action in 2012–2014: In Flanders 156 kg, 140 kg and 500 kg were stocked respectively in 2012, 2013 and 2014.

achieving WFD goals for water quality

Specific action in 2010–2015: Flanders continues to work to the development of water treatment infrastructure to achieve the good ecological status and ecological potential for the WFD.

Eel stock monitoring

Specific action in 2012–2014:

Glass eel: the monitoring of the glass eel recruitment at Nieuwpoort (River IJzer) has been continued in 2013 and 2014, and will be continued in upcoming years.

Yellow eel/silver eel: A new report (Stevens *et al*., 2013) discusses the methodology for calculating the escapement of silver eel in Flanders. The suitability of the new Monitoring Network Freshwater Fish for the European Eel Regulation reporting is discussed and recommendations are made to improve the methodology and validate the model results.

Eel quality monitoring

Specific action in 2012–2014: Flanders has contributed to the scientific work about the status and effects of hazardous substances on the eel (see abstracts under subchapter 11.3). Flanders continues to coordinate the Eel Quality Database (Belpaire *et al*., 2011b), for which a new application has been developed. A pilot programme to monitor eel and perch quality with respect to their levels of contaminants for reporting to the WFD has been finalised.

General status

The European eel is categorized as 'Critical Endangered' on the new Red List of Fishes in Flanders.

For the Walloon region

No updated information was made available by the Walloon region. We repeat here the information provided in the 2012 report.

- avoiding mortality at hydropower stations;
- sanitation of migration barriers on main waterways (especially in the Meuse catchment);
- Glass eel restocking programme.

No information was provided by the Walloon Region.

Controlling poaching

Specific action in 2010–2012: actions have been focused specifically on the river Meuse and in the canals during the night. Numerous illegal fishing equipment was seized.

In the coming years, Belgium will pursue with its neighbouring countries the development and implementation of cross boundary eel management plans. These coordination activities will take place within the International Scheldt Commission (ISC) and the International Meuse Commission (IMC).

In June 2012 Belgium submitted the first report in line with Article 9 of the eel Regulation 1100/2007. This report outline focuses on the monitoring, effectiveness and outcome of the Belgian Eel Management Plan.

2. Time-series data

2.1. Recruitment

2.1.1 Glass eel recruitment

2.1.1.1 Commercial

There are no commercial glass eel fisheries.

2.1.1.2 Recreational

There are no recreational glass eel fisheries.

2.1.1.3 Fishery independent

Glass eel recruitment at Nieuwpoort at the mouth of River Yser (Yser basin)

In Belgium, both commercial and recreational glass eel fisheries are forbidden by law. Fisheries on glass eel are carried out by the Flemish government. Former years, when recruitment was high, glass eels were used exclusively for restocking in inland waters in Flanders. Nowadays, the glass eel caught during this monitoring are returned to the river.

Long-term time-series on glass eel recruitment are available for the Nieuwpoort station at the mouth of the river Yser. Recently new initiatives have been started to monitor glass eel recruitment in the Scheldt basin (see below).

For extensive description of the glass eel fisheries on the river Yser see Belpaire (2002, 2006).

Figure 1 and Table 1 give the time-series of the total annual catches of the dipnet fisheries in the Nieuwpoort ship lock and give the maximum day catch per season. Since the last report the figure has been updated with data for 2014.

Fishing effort in 2006 was half of normal, with 130 dipnet hauls during only 13 fishing nights between March 3rd, and June 6th. Catches of the year 2006 were extremely low and close to zero. In fact only 65 g (or 265 individuals) were caught. Maximum day catch was 14 g. These catches are the lowest record since the start of the monitoring (1964).

In 2007 fishing effort was again normal, with 262 dipnet hauls during 18 fishing nights between February 22nd, and May 28th. Catches were relatively good (compared to former years 2001–2006) and amounted 2214 g (or 6466 individuals). Maximum day catch was 485 g. However this 2007 catch represents only 0.4% of the mean catch in the period 1966–1979 (mean = 511 kg per annum, min. 252–max. 946 kg).

In 2008 fishing effort was normal with 240 dipnet hauls over 17 fishing nights. Fishing was carried out between February 16th and May 2nd. Total captured biomass of glass eel amounted 964.5 g (or 3129 individuals), which represents 50% of the catches of 2007. Maximum day catch was 262 g.

In 2009 fishing effort was normal with 260 dipnet hauls over 20 fishing nights. The fishing was carried out between and February 20th and May 6th. Total captured biomass of glass eel amounted 969 g (or 2534 individuals), which is similar to the catches of 2008). Maximum day catch was 274 g.

In 2010 fishing effort was normal with 265 dipnet hauls over 19 fishing nights. The fishing was carried out between and February 26th and May 26th. Total captured biomass of glass eel amounted 318 g (or 840 individuals). Maximum day catch was 100 g. Both total captured biomass, and maximal day catch is about at one third of the quantities recorded in 2008 and 2009. Hence, glass eel recruitment at the Yser in 2010 was at very low level. The 2010 catch represents only 0.06% of the mean catch in the period 1966–1979 (mean = 511 kg per annum, min. 252–max. 946 kg).

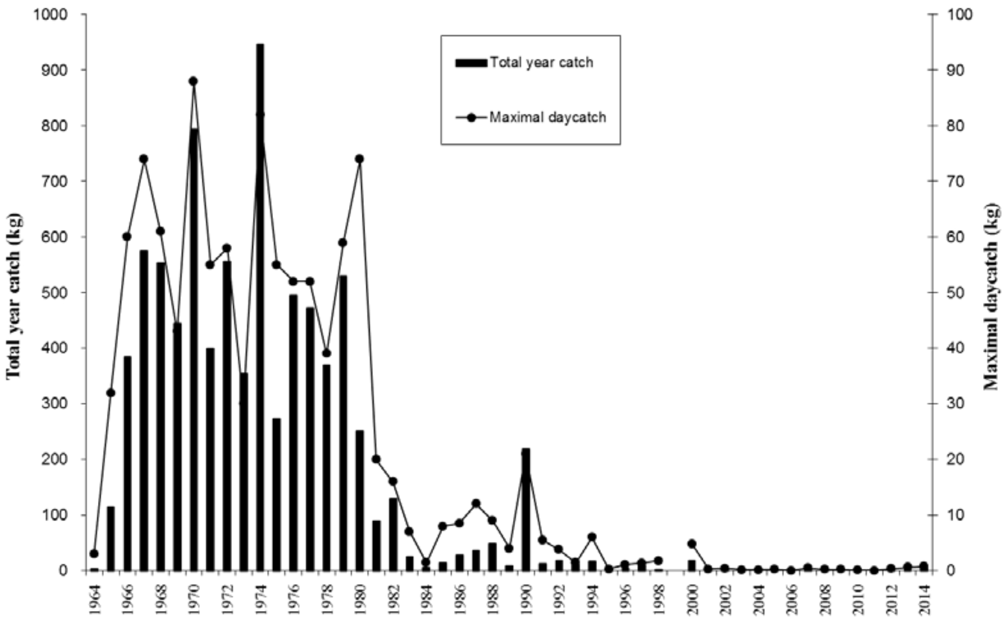
In 2011 fishing effort was normal with 300 dipnet hauls over 20 fishing nights. The fishing was carried out between and February 16th and April 30th. Compared to 2010, the number of hauls was ca. 15% higher, but the fishing period stopped earlier, due to extremely low catches during April. Total captured biomass of glass eel amounted 412.7 g (or 1067 individuals). Maximum day catch was 67 g. Total captured biomass is similar as the very low catches in 2010. Maximal day catch is even lower than data for the four previous years (2007–2010). Overall, the quantity reported for the Yser station should be regarded as very low, comparable to the 2010 record. The 2011 catch represents only 0.08% of the mean catch in the period 1966–1979 (mean = 511 kg per annum, min. 252–max. 946 kg).

In 2012 fishing effort was higher than previous years with 425 dipnet hauls over 23 fishing nights. The fishing was carried out between and March 2nd and May 1st. Compared to 2010, the number of hauls was 42% higher. Total captured biomass of glass eel amounted 2407.7 g (or 7189 individuals). Maximum day catch was 350 g. Both, the total captured biomass and the maximum day catch are ca. six times higher than in 2010. Overall, the quantity reported in 2012 for the Yser station increased significantly compared to previous years and is similar to the 2007 catches. Still, the 2012 catch represents only 0.47% of the mean catch in the period 1966–1979 (mean = 511 kg per annum, min. 252–max. 946 kg).

In 2013 fishing effort included 410 dipnet hauls over 23 fishing nights. The fishing was carried out between 20 February and 6 May. Total captured biomass of glass eel amounted 2578.7 g (or 7368 individuals). Maximum day catch was 686 g. So compared to 2012, similar fishing effort (number of hauls), and similar year catches, but higher maximum day catch.

In 2014 fishing effort included 460 dipnet hauls over 23 fishing nights. The fishing was carried out between 24 February and 25 April. Total captured biomass of glass eel amounted 6717 g (or 17 815 individuals). Maximum day catch was 770 g. So compared to 2013, same number of fishing nights, but 12% more hauls (increased fishing effort in number of hauls), and a 2.6 fold increase of the total year catches. Maximum day catch increased with 12% compared to the 2013 value.

See below under 7.1 for cpue data for the period 2002–2014.



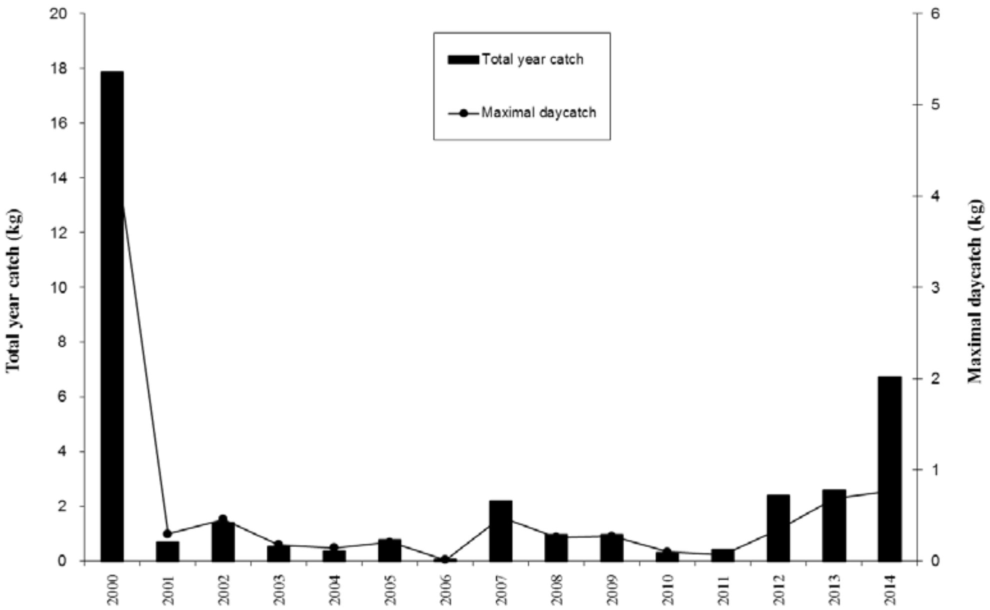


Figure 1 and Table 1. Annual variation in glass eel catches at river Yser using the dipnet catches in the ship lock at Nieuwpoort (total year catches and maximum day catch per season). Figure 1A represents the data for the period 1964–2014; Figure 1b shows the data for the period 2000–2014.

In Table 1 the presented data are the total year catches between 1964 and 2014. Data Provincial Fisheries Commission West-Vlaanderen.

Decade						
Year	1960	1970	1980	1990	2000	2010
0		795	252	218.2	17.85	0.318
1		399	90	13	0.7	0.413
2		556.5	129	18.9	1.4	2.408
3		354	25	11.8	0.539	2.579
4	3.7	946	6	17.5	0.381	6.717
5	115	274	15	1.5	0.787	
6	385	496	27.5	4.5	0.065	
7	575	472	36.5	9.8	2.214	
8	553.5	370	48.2	2.255	0.964	
9	445	530	9.1		0.969	

Other glass eel recruitment studies

The glass eel recruitment-series for the Schelde estuary which was reported in the 2011 Country Report (See Belpaire *et al*., 2011) for the period 2004–2011 has been stopped.

2.1.2 Yellow eel recruitment

2.1.2.1 Commercial

There is no commercial fishery for yellow eel in inland waters in Belgium. Commercial fisheries for yellow eel in coastal waters or the sea are negligibly small.

2.1.2.2 Recreational

No data available.

2.1.2.3 Fishery independent

On the Meuse, the University of Liège is monitoring the amount of ascending young eels in a fish-pass. From 1992 to 2014 upstream migrating eels were collected in a trap (0.5 cm mesh size) installed at the top of a small pool-type fish-pass at the Visé-Lixhe dam (built in 1980 for navigation purposes and hydropower generation; height: 8.2 m; not equipped with a ship-lock) on the international River Meuse near the Dutch–Belgium border (290 km from the North Sea; width: 200 m; mean annual discharge: 238 m^3 s^{-1}; summer water temperature 21–26°C). The trap in the fish-pass is checked continuously (three times a week) over the migration period from March to September each year, except in 1994. A total number of 37302 eels was caught (biomass 2445 kg) with a size from 14 cm (1992 and 2001) to 88 cm (2012) and an increasing median value of 28.5 cm (1992) to 40 cm (2012) corresponding to yellow eels. The study based on a constant year-to-year sampling effort revealed a regular decrease of the annual catch from a maximum of 5613 fish in 1992 to minimum values of 423–758 in 2004–2007) (Figure 2, Table 2). In 2008 2625 eels were caught. This sudden increase might be explained by the fact that a new fish pass was opened (20/12/2007) at the weir of Borgharen-Maastricht, which enabled passage of eels situated downward the weir in the uncanalized Grensmaas. Nevertheless the number of eels were very low again in 2009 (n=584) and 2010 (n = 249). The figure for 2011 (n=208) is the lowest ever recorded since the start of the controls (1992, n = 5613). The figure for 2012 (n= 317) is a bit more than the two previous years. In 2013, 265 eels were caught (size range 19.6–76.5 cm, median 39.1 cm), the data for 2014 (incomplete data, situation September 2014) are similar with 255 individuals. The decreasing trend in the recruitment of young eels in this part of the Meuse was particularly marked from 2004 onwards. The University of Liège (Ovidio *et al.*, 2012) is continuing a research program financed by EFF-EU to follow the upstream migration of yellow eels at Lixhe and to analyse the historical trends. Since 2011, every individual yellow eel is pit-tagged and its upstream migration has been followed along detection stations placed at fish-passes located upstream in the Meuse and in the lower course of the river Ourthe (main tributary of River Meuse). A preliminary report has been published (Nzau Matondo *et al.*, 2014). Note that some small changes have been made to the figure as presented in last years' reports.

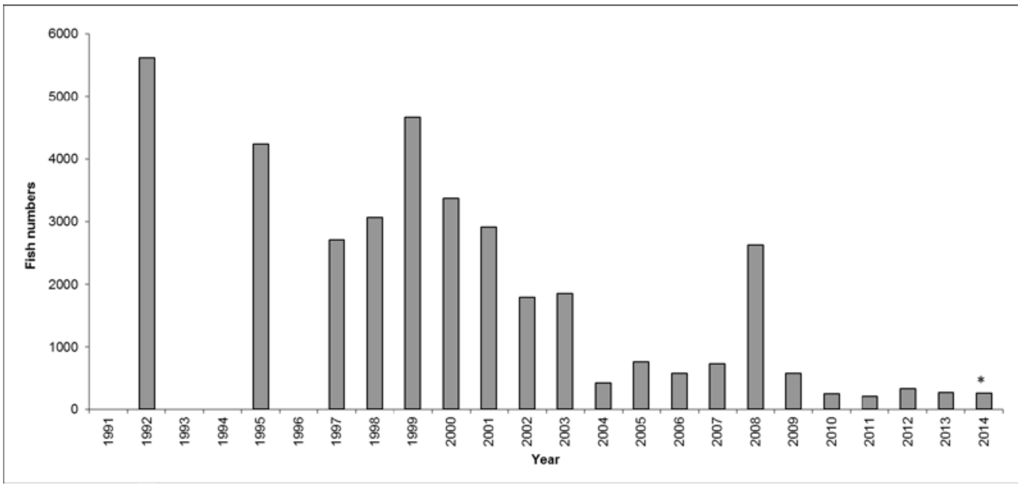


Figure 2. Variation in the number of ascending young yellow eels trapped at the fish trap of the Visé-Lixhe dam between 1992 and 2014. Data from University of Liège (J.C. Philippart) in Philippart and Rimbaud (2005), Philippart (2006) and Ovidio (pers. comm. 2014). * Data for 2014 are incomplete (situation 1/9/2014).

Table 2 Variation in the number of ascending young yellow eels trapped at the fish trap of the Visé-Lixhe dam between 1992 and 2013. Data from University of Liège (J.C. Philippart) in Philippart and Rimbaud (2005), Philippart (2006) and Ovidio (pers. comm., 2014). * Data for 2014 are incomplete (situation 1/9/2014).

Decade			
Year	1990	2000	2010
0		3365	249
1		2915	208
2	5613	1790	324
3		1842	265
4		423	255*
5	4240	758	
6		575	
7	2709	731	
8	3061	2625	
9	4664	584	

2.2 Yellow eel landings

2.2.1 Commercial

No time-series available. Currently there is no commercial yellow eel fisheries.

2.2.2 Recreational

No time-series available.

Based on an inquiry by the Agency for Nature and Forest in public waters in Flanders in 2008, recreational anglers harvest on a yearly basis 33,6 tons of eel (Vlietinck, 2010). In 2010 a small restriction of eel fishing was aimed by a new regulation (Besluit van de Vlaamse Regering 5/3/2010). Between April 16th and May 31th, and during the night, eels may not be taken home. This results in a roughly estimate of 10% reduction of eel harvest. Hence estimates for 2010 and later are an annual eel harvest of 30 tons (Vlietinck, pers. comm.). There is no distinction between the catch of yellow eel and silver eel, but due to the specific behaviour of silver eel, it is considered that these catches are mainly composed of yellow eel.

Only eels above the size limit of 30 cm are allowed to be taken home. In 2013 a new legislation on river fisheries went into force (Agentschap voor Natuur en Bos, 2013). The total number of fish (all species, including eel) which an angler is allowed to take with him on a fishing occasion is now limited to five. There is no indication to what extent this will have an impact on the total recreational biomass of eel retrieved by recreational fisheries.

2.3 Silver eel landings

2.3.1 Commercial

There is no commercial fishery for silver eel in inland waters in Belgium. Commercial fisheries for silver eel in coastal waters or the sea are negligibly small.

2.3.2 Recreational

No time-series available. Due to the specific behaviour of silver eel catches of silver eel by recreational anglers are considered low.

2.4 Aquaculture production

There is no aquaculture production of eel in Belgium.

2.4.1 Seed supply

2.4.2 Production

2.5 Stocking

2.5.1 Amount stocked

Stocking in Flanders

Glass eel and young yellow eels were used for restocking inland waters by governmental fish stock managers. The origin of the glass eel used for restocking from 1964 onwards was the glass eel catching station at Nieuwpoort on river Yser. However, due to the low catches after 1980 and the shortage of glass eel from local origin, foreign glass eel was imported mostly from UK or France.

Also young yellow eels were restocked; the origin was mainly the Netherlands. Restocking with yellow eels was stopped after 2000 when it became evident that also yellow eels used for restocking contained high levels of contaminants (Belpaire and Coussement, 2000). So only glass eel is stocked from 2000 on (Figure 3). Glass eel restocking is proposed as a management measure in the EMP for Flanders.

In some years the glass eel restocking could not be done each year due to the high market prices. Only in 2003 and 2006 respectively 108 and 110 kg of glass eel was stocked in Flanders (Figure 3 and Table 3). In 2008 117 kg of glass eel from U.K. origin (rivers Parrett, Taw and Severn) was stocked in Flemish waterbodies. In 2009 152 kg of glass eel originating from France (Gironde) was stocked in Flanders. In 2010 (April 20th, 2010) 143 kg has been stocked in Flanders. The glass eel was originating from France (area 20–50 km south of Saint-Nazaire, small rivers nearby the villages of Pornic, Le Collet and Bouin). A certificate of veterinary control and a CITES certificate were delivered.

In 2011 (21 April 2011) 120 kg has been stocked in Flemish waters. The glass eel was originating from France (Bretagne and Honfleur). A certificate of veterinary control and a CITES certificate were delivered.

In 2012 156 kg has been stocked in Flemish waters. The glass eel was supplied from the Netherlands but was originating from France.

In 2013 140 kg has been stocked in Flemish waters. The glass eel was supplied via a French company (SAS Anguilla, Charron, France).

In 2014 the lower market price allowed a higher quantity of glass eel to be stocked. 500 kg has been stocked in Flemish waters. The glass eel was supplied via a French company (Aguirrebarrena, France).

The cost of the glass eel per kg (including transport but without taxes) is presented in Table 2.

Table 2. Prices of restocked glass eel in Belgium (2008–2014).

Year	Cost (€/kg)
2008	510
2009	425
2010	453
2011	470 (Flanders) 520 (Wallonia)
2012	416 (Flanders) 399 (Wallonia)
2013	460 (Flanders) 400 (Wallonia)
2014	128 (Flanders) ??(Wallonia)*

***No information was provided by the Walloon region about the glass eel stocking in Wallonia in 2014.**

Glass eel restocking activities in Flanders are not taking account of the variation in eel quality of the restocking sites.

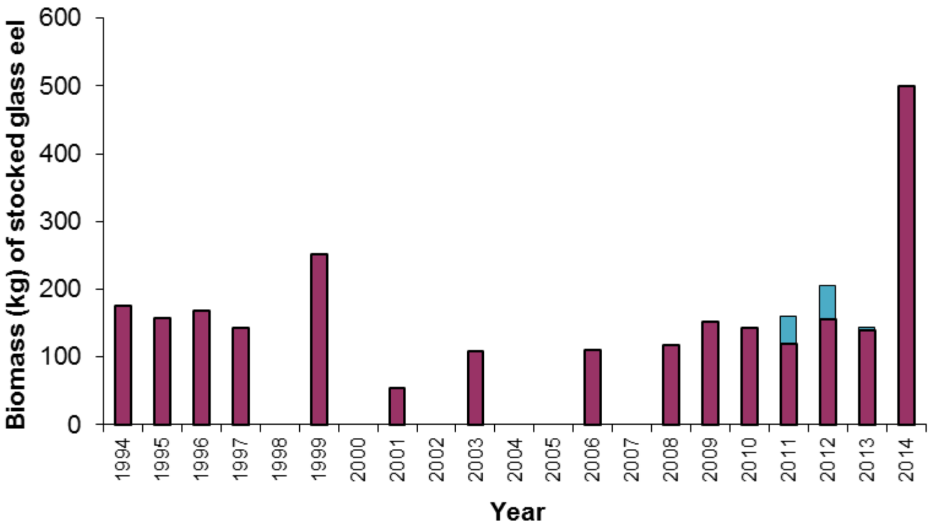


Figure 3 and Table 3. Restocking of glass eel in Belgium (Flanders and Wallonia) since 1994, in kg of glass eel. Flanders is represented in red and Wallonia in blue in the figure. * left Flanders/right Wallonia.

Decade	1980	1990	2000	2010
Year				
0			0	143
1			54	120/40*
2			0	156/50*
3			108	140/4*
4		175	0	500/?**
5		157,5	0	
6		169	110	
7		144	0	
8		0	117	
9		251,5	152	

****No information was provided by the Walloon region about the glass eel stocking in Wallonia in 2014.**

Stocking in Wallonia

In Wallonia, glass eel restocking was initiated in 2011, in the framework of the Belgian EMP. In March 2011 40 kg of glass eel was restocked in Walloon rivers and lakes, in 2012 the amount stocked was 50 kg.

In 2013, for financial reasons no stocking was carried out in Wallonia, except for some restocking in three small rivers in the context of a research program led by the University of Liège. This research program is financed by EFF (project code 32-1102-002) to test the efficiency of glass eel restocking in waterbodies of diverse typology. In May 2013 in total 4 kg of glass eel was stocked (1,5 kg in La Burdinale, 1,5 kg in d'Oxhe and 1 kg in Mosbeux). (price per kg was 400 Euros). The origin of these glass eels was UK glass eels Ldt, UK Survival, dispersion, habitat and growth will be followed from September on, to assess to what extent glass eel stocking is a valuable management measure to restore Walloon eel stocks.

See under for more details on this restocking survey.

More information on stocking details for Wallonia is presented in Table 4 (Cost of the glass eel) and Table 5 (origin). No information was provided by the Walloon region about the glasseel stocking in Wallonia in 2014.

2.5.2 Catch of eel <12 cm and proportion retained for restocking

There are no glass eel fisheries in Belgium. As the glass eel caught for monitoring purposes by the Flemish authorities at the sluices at the mouth of River Yzer is so low, these glass eel are released directly above the sluices.

2.5.3 Reconstructed time-series on stocking

Stocking in Flanders

Table 5. Source and size of eel restocked in Flanders between 1994 and 2014.

	Local Source				Foreign Source			
Year	Glass Eel	Quarantined Glass Eel	Wild Bootlace	On-grown cultured	Glass Eel	Quarantined Glass Eel	Wild Bootlace	On-grown cultured
1994					175		5394	
1995					157,5		4880	
1996					169		4168	
1997					144		5517	
1998					0		5953	
1999					251,5		5208	
2000					0		4283	
2001					54			
2002					0			
2003					108			
2004					0			
2005					0			
2006					110			
2007					0			
2008					117			
2009					152			
2010					143			
2011					120			
2012					156			
2013					140			
2014					500			

Stocking in Wallonia

Table 5. Source and size of eel restocked in Wallonia between 1994 and 2014.

Information to update this table has not been provided by the Walloon region.

	Local Source				Foreign Source			
Year	Glass Eel	Quarantined Glass Eel	Wild Bootlace	On-grown cultured	Glass Eel	Quarantined Glass Eel	Wild Bootlace	On-grown cultured
1994								
1995								
1996								
1997								
1998								
1999								
2000								
2001								
2002								
2003								
2004								
2005								
2006								
2007								
2008								
2009								
2010								
2011					40			
2012					50			
2013					4			
2014					?*			

***No information was provided by the Walloon region about the glass eel stocking in Wallonia in 2014.**

All glass eel used for the Flemish and Walloon restocking programmes are purchased from foreign sources (usually UK or France). There are no quarantine procedures. Nowadays, no bootlace eels, nor ongrown cultured eels are restocked.

Table 5. Origin and amounts of glass eel restocked in Belgium (Flanders and Wallonia) between 2008 and 2013.

Year	Region	Origin	Amount (kg)
2008	Flanders	UK	125
2009	Flanders	France	152
2010	Flanders	France	143
2011	Wallonia	UK	40
2011	Flanders	France	120
2012	Flanders	France	156
2012	Wallonia	France	50
2013	Flanders	France	140
2013	Wallonia	UK	4
2013	Flanders	France	500
2013	Wallonia*	?	?

***No information was provided by the Walloon region about the glass eel stocking in Wallonia in 2014.**

2.6 Trade in eel

Information on the trade of the eel in Belgium is currently not available, but will be integrated in next year's report.

3 Fishing capacity

3.1 Glass eel

Commercial nor recreational fishery for glass eels is allowed in Belgium.

3.2 Yellow eel

Professional coastal and sea fisheries

Marine eel catches through professional and coastal fisheries are negligible.

Estuarine fisheries on the Scheldt

The trawl fisheries on the Scheldt was focused on eel, but since 2006 boat fishing has been prohibited, and only fyke fishing was permitted until 2009. Since 2009 no more licences are issued, which is as a measure of the Eel Management Plan of Flanders to reduce catches. In 2010 a Decree (Besluit van de Vlaamse Regering van 5 maart 2010) was issued to regulate the prohibition of fyke fishing in the lower Seascheldt.

For a figure of the time-series of the number of licensed semi-professional fishermen on the Scheldt from 1992 to 2009 (Data Agency for Nature and Forests) we refer to Belpaire *et al.*, 2011 (Belgian Eel Country Report 2011).

Recreational fisheries in the Flemish region

The number of licensed anglers was 60 520 in 2004, 58 347 in 2005, 56 789 in 2006, 61 043 in 2007, 58 788 in 2008, 60 956 in 2009, 58 338 in 2010, 61 519 in 2011, 62 574 in 2012 and 64 643 in 2013. The time-series shows a general decreasing trend from 1983 (Figure 6). However in 2007 there was again an increase in the number of Flemish anglers (+7.5% compared to 2006). From an inquiry of the Agency for Nature and Forests in 2008 among 10 000 recreational anglers (36% feedback) it appeared that ca. 7% fishes for eel.

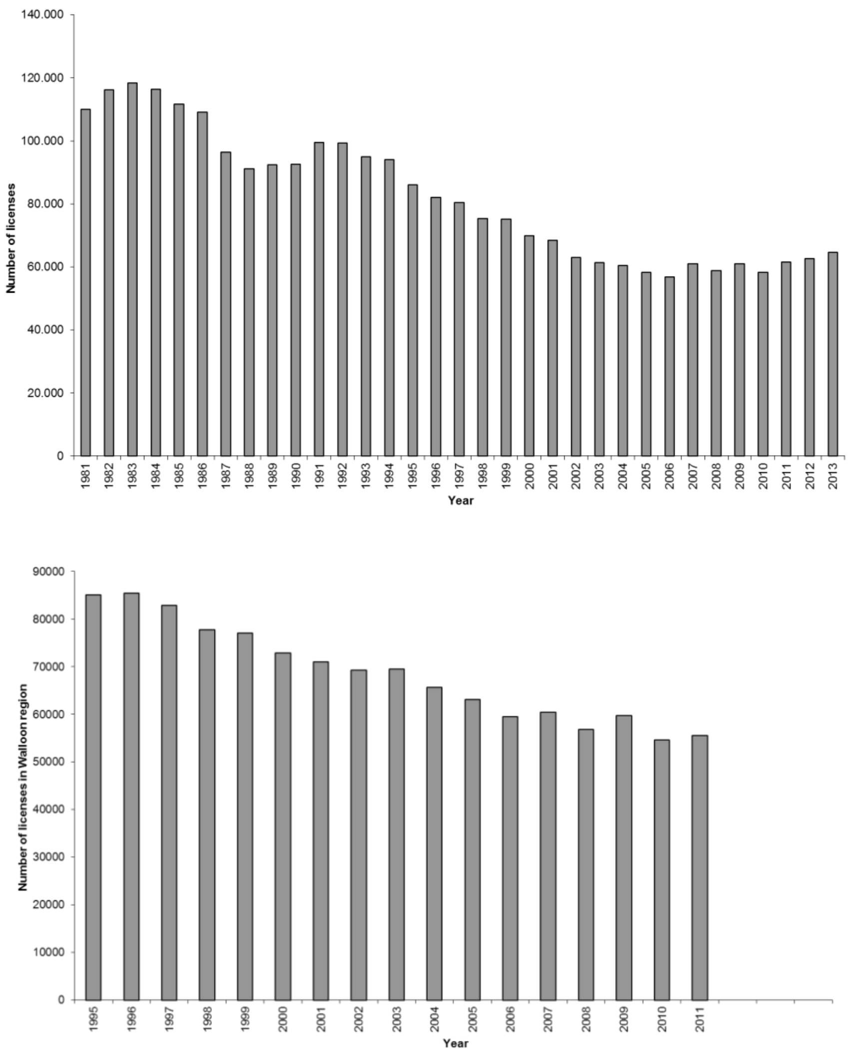


Figure 4. Time-series of the number of licensed anglers in Flanders (above) and Wallonia (below) since 1980 and 1995 respectively (Data Agency for Nature and Forests and Nature and Forestry Division (DNF) of the Walloon Environment and Natural Resources DG (DGRNE). 2012 and later data not updated for Walloon region.

Recreational fisheries in the Walloon Region

Although in constant decline since the nineties, fishermen are still a well-represented community in the Walloon region. The number of licensed anglers was 65 687 in 2004, 63 145 in 2005, 59 490 in 2006, and 60 404 in 2007. Since then, numbers have decreased with 56 864 in 2008, 59 714 in 2009, 54 636 in 2010 and 55 592 in 2011 (Figure 4). The data for 2012 and later were not updated for the Walloon region.

Recreational fisheries in the Brussels capital

The number of licensed anglers is approximately 1400 (Data Brussels Institute for Management of the Environment).

3.3 Silver eel

See Sections 3.3.1 and 3.3.2.

3.4 Marine fishery

Marine eel catches through professional and coastal fisheries are negligible.

4 Fishing effort

4.1 Glass eel

There is no professional or recreational fisheries on glass eel.

4.2 Yellow eel

See Section 4.2 for the number of recreational fishermen and the proportion of eel fishermen.

4.3 Silver eel

There are no professional or recreational fisheries on silver eel.

4.4 Marine fishery

Marine fisheries on eel are not documented and are assumed to be negligible.

5 Catches and landings

5.1 Glass eel

Commercial nor recreational fishery for glass eels is allowed in Belgium.

5.2 Yellow eel

Catches and landings–estuarine fyke fisheries on river Scheldt

Fyke fishing for eel on the lower Scheldt estuary is prohibited now. Since 2009 no more licences for fyke fisheries on the river Scheldt are issued, which is as a measure of the Eel Management Plan of Flanders to reduce fishing capacity. Before 2009 annual catches of eel by semi-professional fyke fishermen was estimated between 2.8 and 12.4 tons. This is thus reduced to zero in 2009 and later.

Catches and landings–recreational fisheries in Flanders

Based on an inquiry by the Agency for Nature and Forest in public waters in Flanders in 2008, recreational anglers harvest on a yearly basis 33,6 tons of eel (Vlietinck, 2010). This figure holds for 2009 too (Vlietinck, pers. comm.). In 2010 a small restriction of eel fishing was aimed by a new regulation (Besluit van de Vlaamse Regering 5/3/2010). Between April 16th and May 31th, and during the night, eels may not be taken home. This results in a roughly estimate of 10% reduction of eel harvest. Hence estimate for 2010, 2011 and 2012 is an annual eel harvest of 30 tons (Vlietinck, pers. comm.). There is no distinction between the catch of yellow eel and silver eel, but due to the specific behaviour of silver eel, it is considered that these catches are mainly composed of yellow eel.

Other earlier estimates were 121 tonnes per annum and 43 tonnes per annum (Belpaire *et al.*, 2008).

In 2000 a catch and release obligation for the recreational fishing of eel was issued due to high contaminant concentrations, however this law was abolished in 2006. This resulted in an increase in yield of yellow eel by recreational fisheries from nihil to the actual 30 tons.

It is worth mentioning that based on the 2008 inquiry in a population of recreational anglers (Vlietinck, 2010), the majority (77%) of anglers are in favour of a restriction in the fishing or the harvest of eel (in the framework of the protection of the eel). 27% of the respondents are in favour of (among other options) the obligatory release of caught eel as management option (Figure 5).

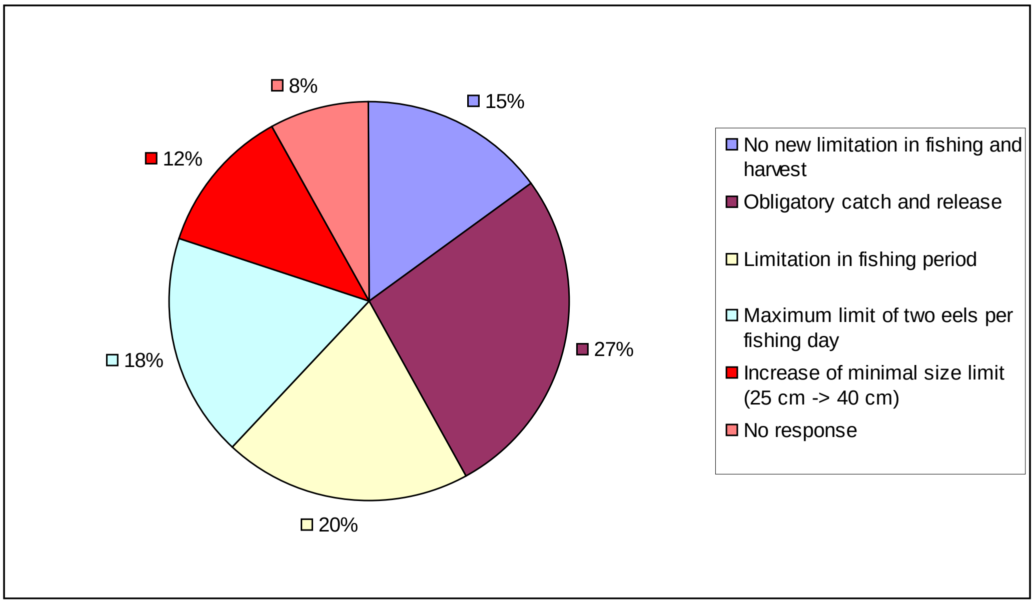


Figure 5. Results of a 2008 inquiry among 10 000 Flemish recreational anglers for their preference in management options for restoring the eel stock. 36% (N = 3627 anglers) responded (Vlietinck, 2010).

Only eels above the size limit of 30 cm are allowed to be taken home.

In 2013 a new legislation on river fisheries went into force (Agentschap voor Natuur en Bos, 2013). The total number of fish (all species, including eel) which an angler is allowed to take with him on a fishing occasion is now limited to five. There is no indication to what extent this will have an impact on the total recreational biomass of eel retrieved by recreational fisheries.

Currently (2014), in Flanders the eel is classified as "Critically Endangered" in the new Flemish Red List of Freshwater Fishes and Lampreys (Verreycken *et al*., 2014). It is not known if in the future this will have some implications on further restrictions on fishing and taking home eel by recreational fishermen.

Catches and landings–recreational fisheries in Wallonia

No new data available for recreational fisheries in the Walloon Region. See Belpaire *et al*. (2008) for an overview. In the Walloon region, fishing of eels is prohibited since 2006 (Walloon Government, 2006). By modification of the 1954 law on fishing activities, there is an obligation to release captured eels whatever their length. So from 2006 on, recreational catches of eel in Wallonia should be zero.

Recreational fisheries in Brussels capital

No information on eel catches.

5.3 Silver eel

There are no professional or recreational fisheries on silver eel.

5.4 Marine fishery

Marine fisheries on eel are negligible and not documented.

5.5 Recreational fishery

See under 6.2 and 7.2 for the information available on recreational fisheries.

No further data available.

Recreational Fisheries: Retained and Released Catches.

	Retained				Released			
	Inland		Marine		Inland		Marine	
Year	Angling	Passive Gears	Angling	Passive gears	Angling	Passive gears	Angling	Passive gears

Provide the catch and release mortality (%) used in your country for angling in marine and inland waters.

Recreational Fisheries: Catch and Release Mortality.

	Released			
	Inland		Marine	
	Angling	Passive gears	Angling	Passive gears
Year				

5.6 Bycatch, underreporting, illegal activities

Bycatch through exploitation of marine fish stocks is not reported and is considered low.

From time to time illegal activities have been observed. Fishing using illegal gears, and illegal selling of catches might be the illegal activities with most impact on the eel stock. Quantitative information is not available.

Table 6-x. Estimation of underreported catches in Country, per EMU and Stage.

		Glass eel				Yellow eel				Silver Eel				Combined (Y + S)			
Year	EMU_code	Reported catches (kg)	Underrept. %	Underrept. (kg)	Total catches (kg)	Reported catches (kg)	Underrept. %	Underrept. (kg)	Total catches (kg)	Reported catches (kg)	Underrept. %	Underrept. (kg)	Total catches (kg)	Reported catches (kg)	Underrept. %	Underrept. (kg)	Total catches (kg)
2013	EMU_a																
	EMU_b																
	EMU_c																
	EMU_d																
	EMU_e																
	EMU_f																
	Total/mean (%)																

AIM: Determine the % of the underreporting and the total catches of the Country per stage.

NOTE: Please indicate in the text whether the percentage underreported catch is a direct measurement or a guess using the estimate to calculate the underreported kgs and Total catches.

Table 6-y. Existence of illegal activities, its causes and the seizures quantity they have caused.

		Glass eel			Yellow eel			Silver Eel			Combined (Y +S)		
Year	EMU	Y/N/?	Cause	Seizures (kg)	Y/N/?	Seizures (kg)	Cause	Y/N/?	Seizures (kg)	Cause	Y/N/?	Seizures (kg)	Cause
2013	EMU_a												
	EMU_b												
	EMU_c												
	EMU_d												
	EMU_e												
	EMU_f												

AIM: Identify the illegal fishing activities and in case it is possible its causes and the seized kgs in case they were seizures.

NOTES:

-Y/N/?:

- Y: you know for sure they have been illegal activities;
- N: illegal activities are considered negligible / not significant;
- ?: You do not know whether they have been illegal activities or not.

-Cause: One of the followings:

- Fishing out of the season;
- Fishing without licence;
- Fishing using illegal gears;
- Retention of eel below or above any size limit;
- Illegal selling of catches.

6 Catch per unit of effort

6.1 Glass eel

Commercial nor recreational fishery for glass eels is allowed in Belgium.

There is some information available on the cpue trend in the governmental glass eel monitoring at Nieuwpoort (River Yzer) (Table 6).

Table 6. Temporal trend in catch per unit of effort for the governmental glass eel monitoring by dipnet hauls at the sluices in Nieuwpoort (River Yzer, 2002–2014). Cpue values are expressed as Kg glass eel caught per fishing day with catch and as Kg glass eel per haul.

Year	Total year catch	Max daycatch	Total year catch/Number of fishing days with catch (Kg/day)	Total year catch/Number of hauls per season (Kg/haul)
2002	1,4	0,46	0,140	0,0081
2003	0,539	0,179	0,034	0,0040
2004	0,381	0,144	0,042	0,0029
2005	0,787	0,209	0,056	0,0044
2006	0,065	0,014	0,006	0,0005
2007	2,214	0,485	0,130	0,0085
2008	0,964	0,262	0,060	0,0040
2009	0,969	0,274	0,057	0,0037
2010	0,318	0,1	0,017	0,0012
2011	0,412	0,067	0,021	0,0014
2012	2,407	0,35	0,105	0,0057
2013	2.578	0.686	0.112	0.0063
2014	6.717	0.770	0.292	0.0146

6.2 Yellow eel

There are only rough estimates about the catches of eel by recreational fishing. These data are based on an inquiry (N=3627 responses) by the Agency for Nature and Forest in public waters in Flanders in 2008 (Vlietinck, 2010). At that time recreational anglers harvest on a yearly basis 33,6 tons of eel. 6.6% of the recreational fishermen (N=58 788) are eel fishermen. So 3880 eel fishermen are catching 33.6 tons, or an average eel fishermen is fishing 8.7 kg eel per year.

6.3 Silver eel

There are no professional or recreational fisheries on silver eel.

6.4 Marine fishery

Marine fisheries on eel are negligible and not documented.

7 Other anthropogenic and environmental impacts

In Belgium, the eel stock is considerably impacted by an overall poor water quality (especially for Flanders), and by a multitude of migration barriers (draining pumps, sea sluices, dams, weirs, impingement by power stations and hydropower units).

Water quality

Improvement of water quality by installing purification units is an on-going process (within the objectives of the Water Framework Directive). As an example the installation of an important purification unit in 2007 on the River Senne (north of Brussels) purifying the waste waters of the capital, has led to an impressive increase in the eel population in river Senne and Rupel during 2008 and 2009. Due to a temporary closure of the water treatment plant (for technical reasons) at the end of 2009 all eels disappeared, subsequent monitoring showed that the eel population restored approximately six months after restart of the plant.

Restoring migration possibilities

On April 26, 1996, the Benelux Decision about free fish migration was adopted. The Decision sets that the Member States should guarantee free fish migration in all hydrographic basins before January 1, 2010. Recently, the 1996 Benelux decision has been evaluated. The general conclusion is that a lot of barriers have been removed, but also that the timing is not achievable and that the focus should be on the most important watercourses. On June 16, 2009 a new Benelux Decision (Benelux, 2009) was approved. According to this new Decision, Member States commit themselves to draw up a map indicating the most important watercourses for fish migration. Hereto, the Research Institute for Nature and Forest (INBO) drew up a proposal for this prioritization map based on ecological criteria (Figure 6).

The proposal for the new prioritization map accounts for both the distribution of EU Habitat Directive species and the recommendations of the eel management plan. In addition, the Benelux Decision allows accounting for regionally important fishes. Therefore, we also accounted for the distribution of the rheophilic species for which Flanders has developed a restoration program (dace, chub and burbot).

The total length of the prioritization network of Flemish water courses is 3237 km (almost 15% of the total length of the watercourses in Flanders). Besides the barriers on the selected watercourses, also pumping stations and hydro turbines on unselected water courses should be taken into account. Depending on their location and functioning, pumping stations and hydro turbines may have a significant impact on the survival of downstream migrating fish and eel in particular. The results of a survey of pumping stations in Flanders will be used to draw up a list of the most harmful pumping stations. This list will then be added to the prioritization map.

The prioritization map gives an overview of the water courses that should be barrier-free in order to preserve the populations of the target species. Hereto a distinction is made between obstacles of first and second priority. Obstacles of first priority are those located on the main rivers of the major river basins (Scheldt and Meuse). 90% of these barriers should be eliminated by 2015, the remaining 10% by 2021. In Flanders, the highest priority is given to the obstacles on the River Scheldt and to the obstacles that should be removed first according to the eel management plan. The remaining obstacles on the water courses of the prioritization map are assigned to the second priority. These obstacles will be divided into three groups. 50% of these should be removed before December 31, 2015. 75% should be removed before December 31, 2021 and 100% by December 31, 2027.

Additionally, water courses of special attention were selected. These are water courses that have important fish habitat, but where the removal of migration barriers is not a priority. These water courses are important for the restoration of the eel stock, have an ecologically valuable structure or are located in a sub-basin where Habitat Directive species occur. They are not part of the prioritization map and have no timing for the removal of existing migration barriers. However, downstream migration should be guaranteed in these water courses and if an opportunity arises, the existing fish migration barriers should be removed.

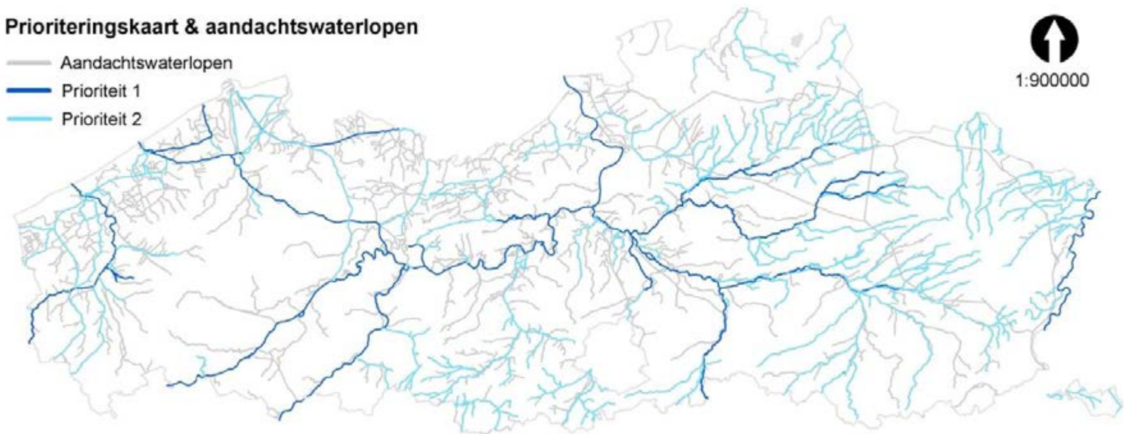


Figure 6. Fish migration prioritization network of Flemish water courses (blue) and water courses of special attention (grey) following the Benelux Decision "Free migration of fish" M(2009)1.

An update of the anthropogenic impacts has recently been made in the framework of the report of the evaluation of the Belgian EMP (Vlietinck *et al*., 2012). We refer to this document for a more complete description of the anthropogenic impacts on the stock.

In summary following management measures are foreseen:

Table 7. Status of measures of habitat restoration as reported in the evaluation of the Belgian EMP (Vlietinck *et al*., 2012).

Measures	region	status	timing
Resolving migration barriers for upstream migration	Flanders	In progress	2027
Resolving migration barriers for upstream migration	Wallonia	In progress	2027
Measures to protect eels from impingment (by industries using cooling water) during their downward migration.	Wallonia	In progress	To be defined

Measures to protect eels from hydropower installations during their downward migration.	Wallonia	In progress	To be defined
Measures to protect eels from hydroturbines and pumping stations during their downward migration.	Flanders	In progress	To be defined
Measures to attain good ecological status or good ecological potential of water bodies.	Belgium	In progress	2027
Measures for sanitation of polluted sediments	Flanders	To be started	To be defined
	Wallonia	In progress	To be defined

Although numerous pumping stations have been used by water managers for numerous applications on rivers, canals and other waterbodies, their impact on fish populations is poorly understood. Buysse *et al.* (2014) investigated European eel mortality after natural downstream passage through a propeller pump and two Archimedes screw pumps at two pumping stations on two lowland canals in Belgium. Fykenets were mounted permanently on the outflow of the pumps during the silver eel migration periods. Based on the condition and injuries, maximum eel mortality rates were assessed. Mortality rates ranged from 97 ± 5% for the propeller pump to 17 ± 7% for the large Archimedes screw pump and 19 ± 11% for the small Archimedes screw pump. Most injuries were caused by striking or grinding. The results demonstrate that pumping stations may significantly threaten escapement targets set in eel management plans (Buysse *et al.*, 2014).

Research in progress into the possibilities for glass eel migration to the Diversion Canal of the Leie (DCL) and the Leopold Canal (LC) in Zeebrugge

Previous research conducted by INBO (commissioned by W&Z) near the Ganzepoot in Nieuwpoort and the Sas Slijkens in Ostend showed that reverse drain management significantly increases the upstream migration of glass eels from the sea to fresh water. Hence this study investigated the applicability of this reverse drain management on another fresh water/sea transition of the Diversion Canal of the Leie and that of the Leopold Canal in Zeebrugge. These two canals with a sharp salt/fresh water transition are two potentially important land inwards routes for glass eels in Flanders.

We looked at how many glass eels migrated upstream in the LC by applying the reverse lock management. In this study the arriving glass eels were quantified when doors were 'slightly opened'. Quantification was done by sampling at one of the LC lock slides with a glass eel net which is inserted into the groove of the lock orifice.

The goal of this research was also to assess whether the measures taken are efficient, i.e. do the glass eels that enter via reversed drain management grow and spread in the LC?

Therefore, we examined whether the glass eels that were admitted by modified drain management also lead to a significant increase in the eel population. In a relatively well-sealed trajectory of the LC between the lock slide in Zeebrugge and the weir in St Laureins, eels will be sampled in at least two consecutive years with different methods (electrofishing, fykenetting). This study should provide an answer to the following research question: Is there a significant increase in eel density in the LC between Zeebrugge and St Laureins by applying the reverse lock management?

9 Scientific surveys of the stock

9.1 Glass eel

See Section 3.1.1.3 Glass eel recruitment at Nieuwpoort at the mouth of River Yser (Yser basin).

Evaluation of the efficiency of the glass eel restoking and dispersal and habitat use of glass eel

The University of Liege is carrying out a research project on the efficiency of restocking glass eel in three small rivers of Wallonia, affluents of rivers Méhaigne, Meuse and Vesdre, in order to increase our knowledge about the potential of restocking programmes in the framework of the international eel management. Preliminary results are reported by Tarrago-Bes (2014).

9.2 Yellow eel

Fish stock monitoring network in Flanders

Since 1994, INBO runs a freshwater fish monitoring network consisting of ca. 1500 stations in Flanders. These stations are subject to fish assemblage surveys on regular basis (on average every two to four years depending of the typology of the station). This network includes all water types, head streams as well as tributaries (stream width ranging from 0.5 m to 40 m), canals, disconnected river meanders, water retaining basins, ponds and lakes, in all of the three major basins in Flanders (Yser, Scheldt and Meuse). Techniques used for analysing fish stocks are standardized as much as possible, but can vary with water types. In general electrofishing was used, sometimes completed with additional techniques, mostly fyke fishing. All fish are identified, counted and at each station 200 specimens of each species were individually weighed and total length was measured. As much as possible biomass (kg/ha) and density (individuals/ha) is calculated. Other data available are number (and weight) of eels per 100 m electrofished river bank length or number (and weight) of eels per fyke per day. The data for this fish monitoring network are available via the website http://vis.milieu-info.be/.

This fish monitoring network is now been further developed to cope with the guidelines of the Water Framework Directive.

A temporal trend analysis has been performed based on a dataset including fish stock assessments on locations assessed during the periods 1994–2000, 2001–2005 and 2006–2009. 334 locations were assessed in those three periods (30 on canals and 304 on rivers). These results have been reported in the 2011 Country Report; see Belpaire *et al.* (2011) for further details.

In 2012–2013 a new data-analysis has been carried out for the most recent period, in the framework of updating the Red List status of Flanders' fresh water fishes. In the new Flemish Red List of Freshwater Fishes and Lampreys (Verreycken *et al.*, 2014), eel was placed in the Critically Endangered category. The number of eel individuals, steeply decreased with 75% between the periods 1996–2003 and 2004–2011 and this despite the yearly restocking with glass eel.

Reporting for the Eel Regulation and the Fish stock monitoring network in Flanders

According to the EU Eel Regulation, each Member State has to report every three years on the progress of the implementation of the eel management plans. One of the things that need to be reported is the effective escapement of silver eels to sea. Both the calculations for the eel management plan and the first interim report are based on data on yellow eel abundances collected by the Flemish Fish Monitoring Network Freshwater. However, the current Monitoring Network for Freshwater Fish was evaluated and merged into a new monitoring network for the Water Framework Directive (Stevens *et al.*, 2013). This report discusses the methodology for calculating the escapement of silver eel in Flanders. The suitability of the new Monitoring Network Freshwater Fish for the European Eel Regulation reporting is discussed and recommendations are made to improve the methodology and validate the model results.

It was concluded that the new Monitoring Network Freshwater Fish covers satisfactorily the watercourses of the eel management plan and is suitable for reporting on the distribution of eel in Flanders. However, the number of sampling points in the new monitoring network is strongly reduced. As a result, the estimators for the calculation of the density of yellow eel will be based on a limited number of measurements, resulting in a lower reliability of these estimators. The new monitoring network can be used to calculate estimators per basin and per stratum (instead of current classification per basin and typology). This limits the number of combinations and avoids the double spatial component for the small streams in the ecological typology. Possibly a number of combinations can be grouped to increase the number of points per estimator. An analysis of the data from the Monitoring Network Freshwater Fish is necessary to determine which classification of watercourses is best suited to determine these estimators.

Large rivers, canals and estuaries represent a significant portion of the surface area of watercourses in the eel management plan. However, electric fishing is less efficient or impossible (brackish waters) in these watercourses, as a result of which the density estimators are less reliable. Therefore a method should be developed to improve the density estimators for these watercourses and for the Scheldt estuary in particular.

The methodology for calculating the escapement of silver eel is sufficiently suitable for reporting to Europe (see Stevens *et al.*, 2009). However, the method and model parameters need to be refined to reduce the uncertainty in the model output and the results of the model should be validated with real data on the escapement of silver eels.

The report suggests two approaches:

- First, desk studies can be used (1) to improve the calculations of eel mortality and (2) to refine the classification of the freshwater eel habitat (analysis of the habitat and fish data from the Monitoring Network Freshwater Fish). In addition, the habitat analysis is also important to underpin the conversion of eel cpue to eel density.

- On the other hand, field studies are necessary to calibrate the conversion of eel cpue to eel density, to improve the model parameters and to validate the model results.

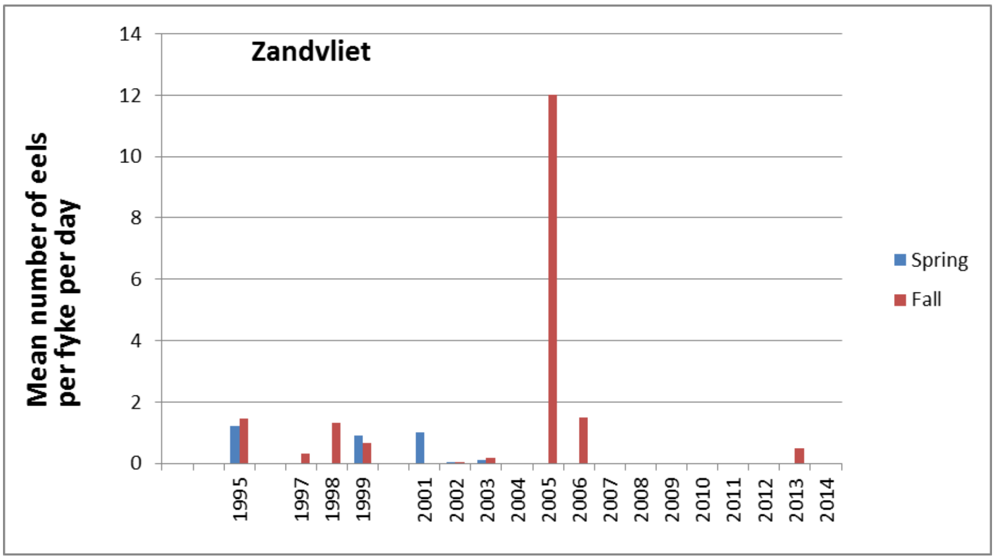
Finally, supporting research can be used to evaluate the effectiveness of measures in the management plan and to improve the model (e.g. research on the impact of eel quality and on the contribution of the Scheldt estuary in the production and migration of silver eels in Flanders) (Stevens *et al.*, 2013).

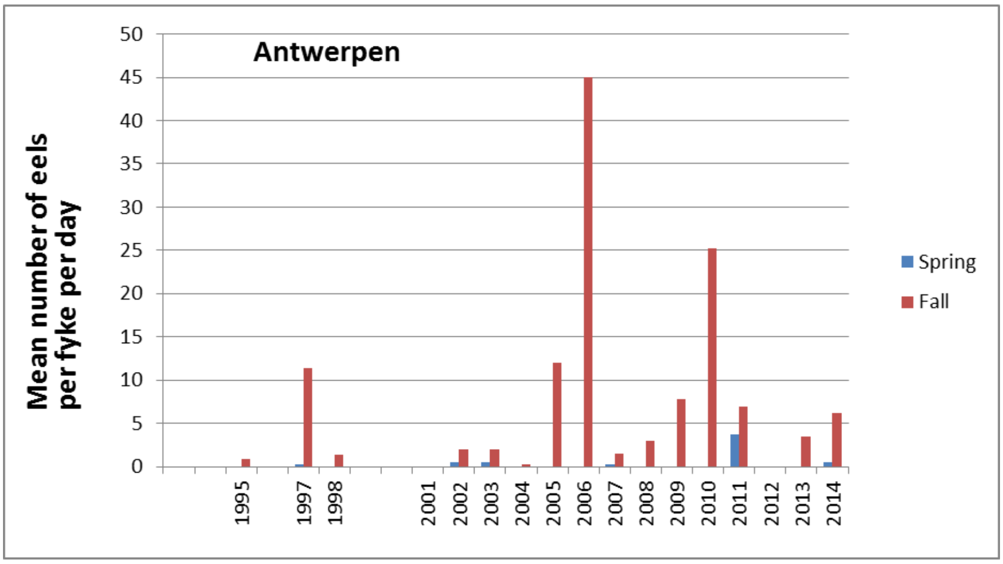
River Scheldt fish monitoring at the power station of Doel

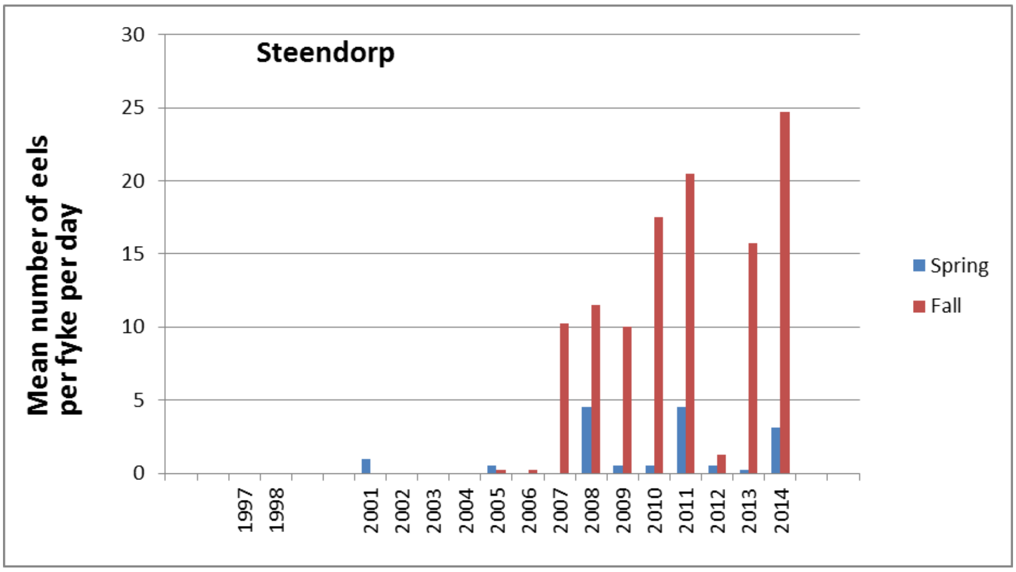
Between 1991 and 2012, INBO has been following the numbers of impinged fish at the nuclear power station of Doel on the Lower Scheldt. We refer to the 2012 Country Report (Belpaire *et al.*, 2012) for a presentation of results and trends. Unfortunately, due to a shortness of means this monitoring series has been stopped in 2012.

Estuarine fish monitoring by fykes

A fish monitoring network has been put in place to monitor fish stock in the Scheldt estuary using paired fykenets. Campaigns take place in spring and autumn. At each site, two paired fykenets were positioned at low tide and emptied daily; they were placed for two successive days. Data from each survey per site were standardized as number of fish per fyke per day. Figure 8 gives the time trend of eel catches in four locations along the Scheldt (Zandvliet, Antwerpen, Steendorp and Kastel). In the mesohaline zone (Zandvliet) catches are generally low. This could be due to the applied methodology. However, a decline is apparent as no eel was caught in Zandvliet since 2007 (except for fall 2013). Catches in 2012 were very low, but at the more upstream sites in 2013 and 2014 catches are increasing towards normal levels (Data Jan Breine, INBO).


Zandvliet
Mean number of eels per fyke per day
14
12
10
8
6
4
2
0
1995
1997
1998
1999
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Spring
Fall


Antwerpen
Mean number of eels per fyke per day
50
45
40
35
30
25
20
15
10
5
0
1995
1997
1998
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Spring
Fall


Steendorp
Mean number of eels per fyke per day
30
25
20
15
10
5
0
1997
1998
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Spring
Fall

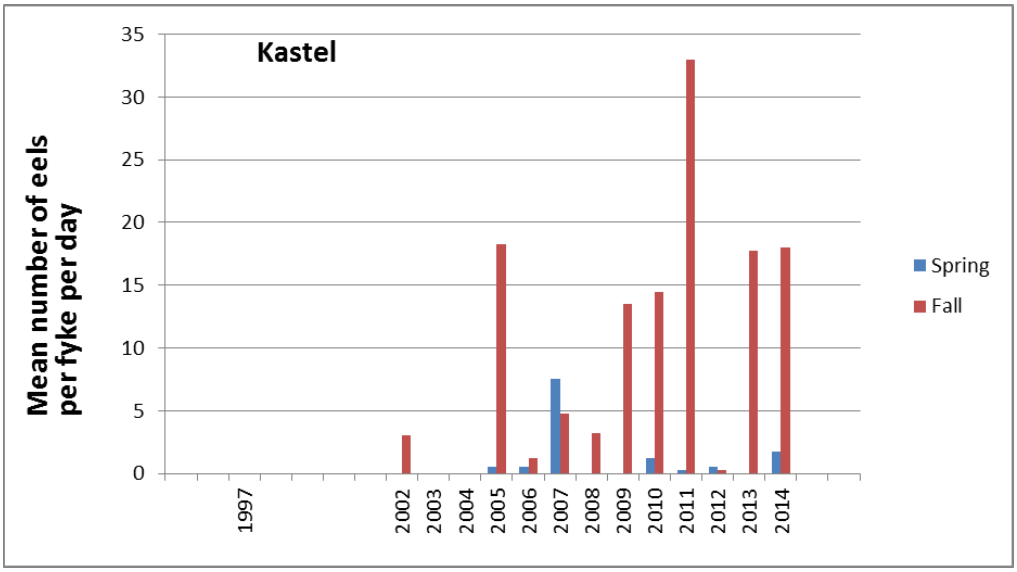


Figure 8. Time trend of fyke catches of eel along the River Scheldt estuary. Numbers are expressed as mean number of eels per fyke per day. Data are split up in spring catches and fall catches. Years without monitoring data are excluded from the X-axis. Data Jan Breine, INBO.

Yellow eel telemetry study in the Méhaigne (Meuse RBD)

In 2009, University of Liège started up a telemetry study on 50–80 cm yellow eels in the Méhaigne, tributary of the river Meuse. The objectives are the evaluation of home range, mobility, habitat choice, impact of alterations of water regime by hydropower stations and the assessment of up and downstream migration. This study aims to study habitat choice of eels in support of the management of river habitat in Walloon rivers.

The movements and habitat use of resident yellow eels were studied in a stream stretch having both natural and minimum flow zones. N = 12 individuals (total length 505–802 mm) were surgically tagged with radio transmitters and released at their capture sites. They were located using manual radio receivers during the daytime from 2 to 5 days/week over periods ranging from 200 to 329 days, for a total of 1098 positions. Eels showed home ranges ranging from 33 to 341 m (median value, 62 m), displayed strong fidelity to sites and demonstrated a great degree of plasticity in habitat use. Eels were slightly mobile throughout the year, but their movements were season and temperature dependent, with a maximum during the spring (mean water temperature, 12°C) and a minimum in winter (3°C). Stones and roots (utilization rate greater than 50% of eels for more than 30% of location days) were significantly the most frequently used habitats. Between the two flow zones, the natural flow was the most occupied, with a significantly higher proportion of resident eels (66.7% of radio-tagged yellow eels) and longer occupation (81% of location days) than the minimum flow zone with less suitable habitats (Ovidio *et al*., 2013).

Eel population study in the Lesse (Meuse RBD)

An ongoing research program financed by the Fonds Européen pour la Pêche (FEP) and the Service Public de Wallonie (SPW), aims to estimate the resident stock of eels in the Lesse River, sub-basin of the Belgian river Meuse. The stock is estimated by the method of capture–recapture sampling and densities are calculated according to the Petersen method. On each sampling site, electrofishing is performed and fykenets are placed. The eels captured are individually tagged with passive integrated transponders. Morphometric measurements such as total length, weight, length of pectoral fins and eye diameters allowed to determine the stages of eels. As their migration can be compromised by their health state, eel blood samplings are also made on each fish in order to evaluate the physiological and immunological state of the stock. The results of thyroïd hormones (T3 and T4), growth hormone (GH) and Insulin Like Growth Factor 1 (IGF1) measurements will be compared with the stages previously defined. Lysozyme and complement activities measurements will give us some indications on the health state of fish individuals. The detection of herpes virus (HVA) is also done in each fish (Roland and Kestemont, 2014).

9.3 Silver eel

Verbiest *et al*. (2012) published the results of a study on the downstream migration of female silver eel by remote telemetry in the lower part of the River Meuse (Belgium and the Netherlands) using a combination of nine detection stations and manual tracking. N = 31 eels (LT 64–90 cm) were implanted with active transponders and released in 2007 into the River Berwijn, a small Belgian tributary of the River Meuse, 326 km from the North Sea. From August 2007 till April 2008, 13 eels (42%) started their downstream migration and were detected at two or more stations. Mean migration speed was 0.62 m/s (or 53 km/day). Only two eels (15%) arrived at the North Sea, the others being held up or killed at hydroelectric power stations, caught by fishermen or by predators or stopped their migration and settled in the river delta. A majority (58%) of the eels classified as potential migrants did not start their migration and settled in the River Berwijn or upper Meuse as verified by additional manual tracking. More details are to be found in the paper.

See under 9.2 for information on a starting FEP research project assessing downstream migration of silver eel at the confluence of the Lesse and the Meuse.

De Canet *et al*. (2014) estimated the actual and historical eel stock and escapement to the sea estimated for French and Belgium Meuse by applying the EDA.2.0 model (Jouanin *et al*., 2012, Eel Density Analysis). A total of 19 980 yellow eels and 1000 silver eels was estimated in 2013 in the Belgian part of the Meuse. This number is 5.8 times lower than the estimated number in 1980. Eel presence and abundance are decreasing linearly with the distance to the sea and the cumulative height of dams. As part of this work, a first attempt to estimate the anthropogenic mortality and biomass according to a pristine state has provided some results. However the lack of data and proper biological parameters limited the results to plots used to illustrate the possible outputs. The numbers estimated by the model are fairly lower than previous estimates for this area, and the reasons for this result are discussed.

9 Data collected for the DCF

Not applicable for Belgium as there are no commercial catches in inland waters. Commercial catches of eel in coastal waters or marine fisheries are not reported to DCF.

See Section 11.1 for data on length and weight gained from research sampling.

There are no routine surveys on age of eels. Some silver eels from Flanders have been aged in the framework of the Eeliad program.

10 Life history and other biological information

10.1 Growth, silvering and mortality

Von Bertalanffy parameters: Linf, K, t0

L50 = the length at which 50% of the population has silvered (my interpretation of 50% maturity)

Length and age at silvering

Fecundity

Weight-at-age

Length–weight relationship

Length and weight and growth (DCF)

Flemish Region

Length and weight data of individual eel collected through the freshwater fish monitoring network are available via the website http://vis.milieuinfo.be/.

An analysis of the length of yellow eels per catchment has been made for the EMP and is presented there.

Verreycken *et al*. (2011) describe the length–weight relationship ($W = aL^b$) in eel (and other species) from Flanders. Nearly 263 000 individual length–weight (L/W) data, collected during 2839 fish stock assessments between 1992 and 2009, were used to calculate L/W relationships of 40 freshwater fish species from Flanders. Those stock assessments were performed by INBO in the framework of the Flemish Freshwater Fish Monitoring Network. The study area includes 1426 sampling locations characterized as lacustrine as well as riverine habitats, including head streams, tributaries, canals, disconnected river meanders, water retaining basins, ponds and lakes. Eel was the fifth most abundant species in our surveys. The equation was based on 17 586 individual eels recorded for total length and weight (Figure 9).

Following equation was found:

$$W = 0.0011\ L^{3.130}$$
$$r^2 = 0.98$$

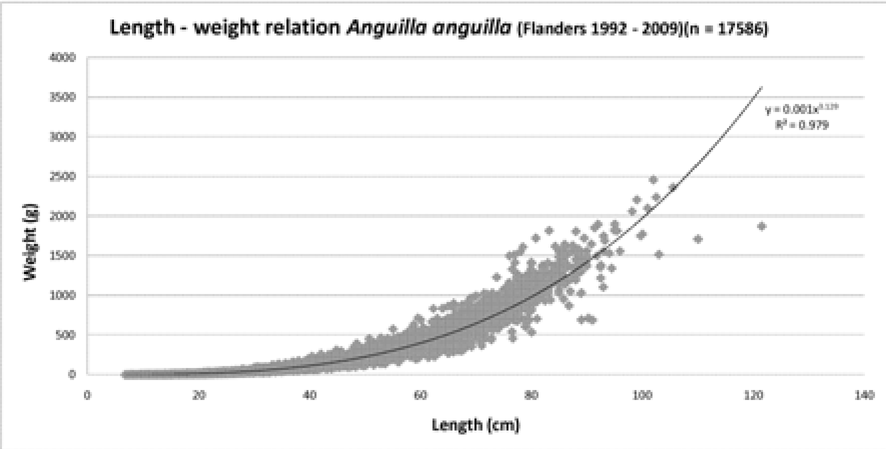


Figure 9. Length–weight relation of European eel (n = 17 586) sampled over Flanders in the period 1992–2009.

In order to ascertain to what extent the log10a and b values calculated for the Flemish populations fell within the range available from other studies, we compared the Flemish values with the values available in FishBase (Froese and Pauly, 2010) from other countries. Flemish *a* and *b* values both fell within the 95% CL of the mean European *a* and *b* values (Figure 10).

Our data originate from over almost two decades, irrespective of sampling sites, dates and seasons. Because of the dense sampling network in a small geographic area over a long sampling period, extremes are balanced out. Therefore and through the fact that Flanders is situated centrally in Europe, our *a* and *b* values may be applicable as reference marks for an European L/W relation for eel. Moreover, our TL range covered the whole range between minimum and maximum length in sufficient numbers, making *a* and *b* values valid as mean values for all length ranges (Verreycken *et al*., 2011).

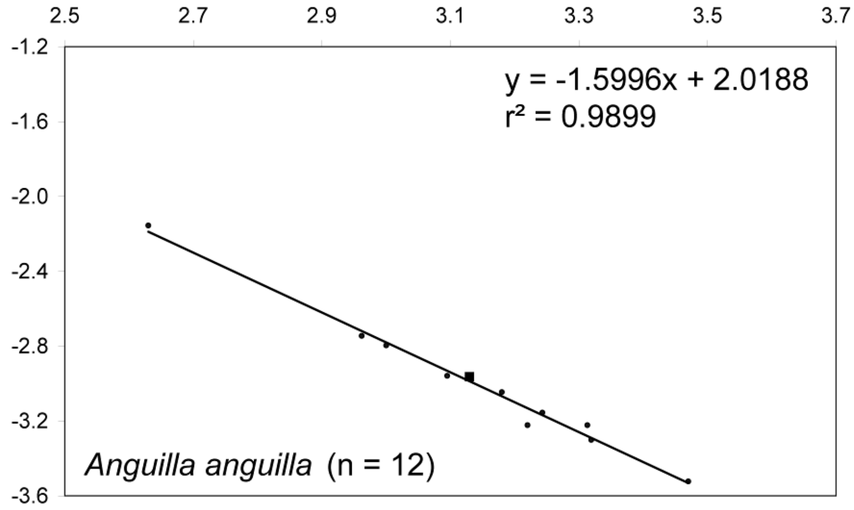


Figure 10. Estimated intercepts (log10a; Y-axis) versus estimated slope (b; X-axis) for the log10 transformed L/W regression and regression line for European eel from European datasets, as available in Fishbase (Froese and Pauly, 2010), compared to the Flemish populations (■ 2009). Linear regression equation and r² are given (n = number of L/W relationships, including Flanders). (Vereycken *et al.*, 2011).

Results from a study on head dimorphism (Ide *et al.*, 2011) are presented in the 2011 Country Report (See Belpaire *et al.*, 2011) for details).

Walloon Region

An analysis of the length of yellow eels in some rivers of the Meuse catchment has been made for the EMP and is presented there.

Head shape dimorphism in glass eel

Recently (De Meyer *et al.*, under review) studied head shape dimorphism in glass eel (*A. anguilla*). Two phenotypes are present in the yellow eel stage, broadheads and narrowheads. While this has been linked to dietary differences, with broadheads feeding on harder and larger prey than narrowheads, very little is known about how and when this dimorphism arises during their ontogeny. Therefore, the authors examined head shape variation at an earlier ontogenetic stage, the glass eel stage, as at this stage, the eels are considered to be non-feeding. Head shape was studied in glass eels from different sampling sites (Leopold Canal and the rivers Yser, Severn, Trent and Parret) by both taking measurements and using an outline analysis. We found that there's already considerable variation in head broadness and bluntness, but no unambiguous support for head shape dimorphism at the glass eel stage was found. Variation in head width/head length ratios in non-feeding glass eels had, however, a similar range as in feeding yellow eels, indicating that head shape in European eel might be at least partially determined through other mechanisms than trophic segregation.

10.2 Parasites and pathogens

Flemish Region

See for results on a pan European survey on the actual status of *Anguillicola* in silver eels (Faliex *et al*., 2012), 2012 Country Report (Belpaire *et al*., 2012).

Walloon Region

No new information compared to earlier reports.

10.3 Contaminants

Some recent work (recently published papers and contributions to international meetings) is summarized below.

In order to meet the requirements of the European Commission, De Jonghe *et al*. (2014) measured bioaccumulation of hydrophobic micropollutants in muscle tissue of eel (*Anguilla anguilla*) and perch (*Perca fluviatilis*) from Flemish waterbodies. Quantified pollutants included mercury (Hg), hexachlorobenzene (HCB), hexachlorobutadiene (HCBd), Polybrominated diphenyl ethers (PBDE), Hexabromocyclododecane (HBCDD), perfluorooctane sulfonate (PFOS) and its derivates, dicofol, heptachlor and heptachlorepoxide. Measured Hg and HCB concentrations were compared between species and in time, based on historical data of eel pollutant monitoring in Flanders. In addition two polycyclic aromatic hydrocarbons (PAH), fluoranthene and benzo(a)pyrene, were measured in zebra mussels (*Dreissena polymorpha*), which were caged for six weeks. At all sample sites eel could be captured, however this was not possible for perch. For perch only (too) small individuals could be captured. An exceeding of the biota environmental quality standard (EQS) was observed for HCB, HBCDD and PFOS at some sample sites. For Hg and PBDE, biota-EQS were exceeded at all sample sites. EQS evaluation for HCB depended on fish species, since more elevated HCB concentrations were measured in eel compared to roach. Measured Hg concentrations were dependent on fish size, and strong relations were observed between Hg accumulation in eel and perch. HCB concentrations in eel were found to decrease in time. In contrast, Hg concentrations seem to increase, although measured Hg bioaccumulation was comparable with levels found in other European studies. Based on results from the present study and data from literature, biota EQS for both Hg and PBDE seem unrealistically low for Flemish and European watercourses. This study recommends eel as the most suitable species to monitor bioaccumulation of hydrophobic micropollutants in Flanders. The latter is based on both practical aspects (spatial distribution and amount of biomass) and species-specific aspects of the immature eel related to biomonitoring (sedentary, no gender issues, no reproduction). Furthermore, this study also highlights the need for intercalibration studies relating pollutant concentraties between different species (De Jonghe *et al*., 2014).

Van Ael *et al*. (2014) investigated the relationships between the presence of PCBs, OCPs and metals in aquatic ecosystems and the ecological water quality by combining datasets of long-term monitoring of chemicals in European eel (*Anguilla anguilla*, N = 1156) in Flanders (Belgium) and the Ecological Quality Ratio (EQR), based on the assessment of fish assemblages at 185 locations. For most pollutants, EQR scores were lower when pollutant levels were higher. Threshold concentrations for a good quality could be formulated for PCB's, most metals and OCPs. Mixed models suggested that the ecological water quality was significantly correlated with the presence of PCBs. However, the low R2 indicates that other environmental pressures may significantly influence the biotic integrity of fish communities. Empirical data and their analyses are essential to enable defining threshold values of bioaccumulated levels to allow better protection of the aquatic environment and its biota through associated food webs as demanded by the Water Framework Directive.

In a study by Malarvannan *et al*. (2014), pooled yellow European eel (*Anguilla anguilla* (L.)) samples, consisting of 3–10 eels, collected between 2000 and 2009 from 60 locations in Flanders (Belgium) were investigated for persistent contaminants, such as polybrominated diphenyl ethers (PBDEs), hexabromocyclododecanes (HBCDs), polychlorinated biphenyls (PCBs) and dichlorodiphenyltrichloroethane and its metabolites (DDTs). The current study expands the knowledge regarding these contaminant concentrations, their patterns and distribution profiles in aquatic ecosystems. PBDEs, HBCDs, PCBs, and DDTs were detected in all eel samples and some samples had high concentrations (up to 1400, 9500, 41 600 and 7000 ng/g lw, respectively). PCB levels accounted for the majority of the contamination in most samples. The high variability in PBDE, HBCD, PCB and DDT concentrations reported here is likely due to the variety in sampling locations demonstrating variable local pollution pressures, from highly industrialised areas to small rural creeks. Among PBDEs, BDE-47 (57% contribution to the sum PBDEs), −100 (19%) and −99 (15%) were the predominant congeners, similar to the composition reported in the literature in eel samples. For HBCDs, α-HBCD (74%) was predominant followed by γ-(22%) and β-HBCD (4%) isomers in almost all eel samples. CB-153 (19%) was the most dominant PCB congener, closely followed by CB-138 (11%), CB-180 (9%), CB-187 (8%) and CB-149 (7%). The contribution to the total human exposure through local wild eel consumption was also highly variable. Intake of PBDEs and HBCDs, through consumption of wild eel, was below the RfD values for the average population (consuming on average 2.9 g eel/day). At 16 out 60 sites, eels exceeded largely the new EU consumption threshold for PCBs (300 ng/g ww for the sum of six indicator PCBs). The current data show an on-going exposure of Flemish eels to PBDEs, HBCDs, PCBs and DDTs through indirect release from contaminated sediments or direct releases from various industries.

10.4 Predators

Flemish Region

Information on the occurrence and distribution of the cormorant has been provided for Flanders in the Belgian EMP.

It was estimated that the yearly consumption of eels by cormorants amounts 5.6–5.8 tonnes for Flanders.

Walloon Region

For the Walloon region, no new data were available. See 2008 report and the Belgian Eel Management Plan.

11 Other sampling

Information on habitat, water quality, migration barriers, turbines is available in the Belgian Eel Management Plan.

12 Stock assessment

This section does not contain new information compared to the 2013 Country Report. Information from last year is copied here.

12.1 Method summary

12.2 Summary data

12.2.1 Stock indicators and targets

Note that not all targets may be available, for example the Reg does not set a mortality rate target. The mortality rate target from WGEEL 2012 corresponds to (0.92 if '$B_{current}/B_0$' >40%, or 0.92 * $B_{current}/(40\%*B_0)$ if '$B_{current}/B_0$'<40%).

EMUcode	Indicator	biomass (T)	Mortality (rate)				Target		
	B0	Bbest	Bcurr	∑A	∑F	∑H	Source	Biomass (t)	∑A (rate)
BE_Scheldt	169	45	33	0.3101	0.2879	0.02218	EMP		
	187	41	34	0,1872	0.1788	0.00841	EU Reg (Progress report)		
							WGEEL		
BE_Meuse	53	41	16	0.9409	0.1520	0.78896	EMP		
	54	39	14	1.0245	0.11242	0.91209	EU Reg (progress Rep)		
							WGEEL		

12.2.2 Habitat coverage

Area corresponds to the wetted area of eel-producing habitat. "A'd" asks whether or not eel are assessed in that habitat type.

EMU code	River		Lake		Estuary		Lagoon		Coastal	
	Area (ha)	A'd Y/N)	Area (ha)	A'd Y/N)	Area (ha)	A'd Y/N)	Area (ha)	A'd Y/N)	Area (ha)	A'd Y/N)
BE_Scheldt	8978	Y	3505*	Y	4130**	Y	/	N	/	N
BE_Meuse	987	Y	452*	Y	0	/	/	N	/	N

*** Lake = WFD waterbodies type 'lake', including the docks of the ports of Antwerp and Zeebrugge.**

**** Estuary = Scheldt estuary + IJzer estuary**

12.2.3 Impact

For each EMU, provide an overview of the assessed impacts per habitat type or for 'All' habitats where the assessment is applied across all relevant habitats. Barriers includes habitat loss. Indirect impacts are anthropogenic impacts on the ecosystem but only indirectly on eel (e.g. eutrophication).

A = assessed, MI = not assessed, minor, MA = not assessed major, AB = impact absent.

EMU code	Habitat	Fish com	Fish rec	Hydro & pumps	Barriers	Restocking	Predators	Indirect impacts*
BE-Scheldt	Riv	AB	A	A	A	A	A	Nr/MA
	Lak	AB	A	Nr	Nr	A	A	Nr/MA
	Est	AB	A	Nr	A	A/Nr	A	Nr/MA
	Lag	Nr	Nr	Nr	Nr	Nr	Nr	Nr
	Coa	Nr	Nr	Nr	Nr	Nr	Nr	Nr
	All							
BE-Meuse	Riv	AB	A	A	A	A	A	Nr/MA
	Lak	AB	A	Nr	Nr	A	A	Nr/MA
	Est	Nr	Nr	Nr	Nr	Nr	Nr	Nr
	Lag	Nr	Nr	Nr	Nr	Nr	Nr	Nr
	Coa	Nr	Nr	Nr	Nr	Nr	Nr	Nr
	All							

*** indirect impacts were not assessed as such, but the calculated eel densities implicitly account for the current habitat conditions. I.e. the eel density in rivers is the result of water quality and habitat structures.**

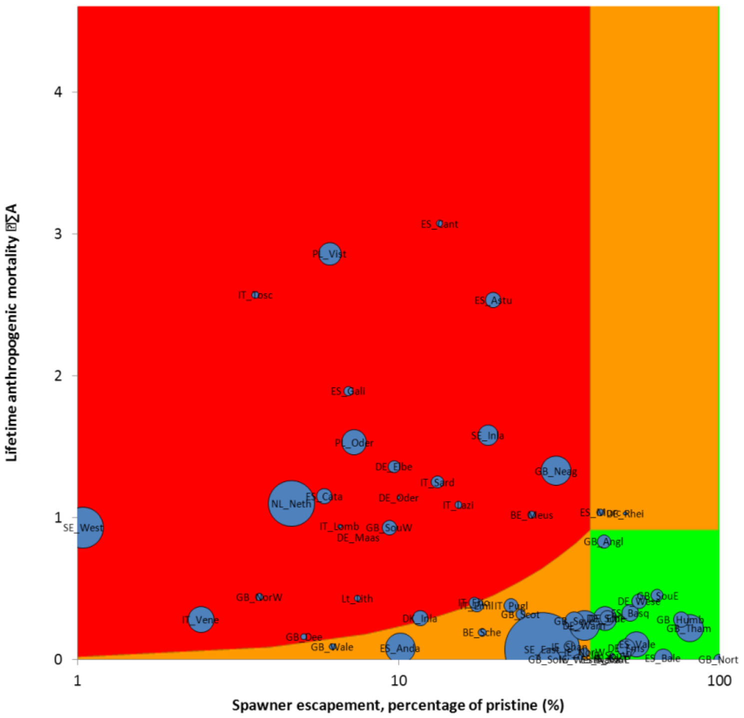
Express the loss in tonnes (t) for each impact per developmental stage or MI = not assessed, minor, MA = not assessed major, AB = impact absent. Where available, also report the total loss as silver eel equivalents, and explain the method used to calculate equivalents in Section 13.1.

EMU code	Stage	Fish com	Fish rec	Hydro & pumps	Barriers	Restocking	Predators**	Indirect impacts*
BE_Scheldt	Glass	AB	MI	AB	MA	MA ?	MI ?	
	Yellow	AB	27	MI ?	MA	MI	5.2	
	Silver	AB	6	1.27	MI	MI	1.51	
	Silver EQ	AB						
BE_Meuse	Glass	AB	MI	AB	MA	MA ?	MI ?	
	Yellow	AB	3	MI ?	MA	MI	0.58	
	Silver	AB	0.7	0.24	MI	MI	0.18	
	Silver EQ	AB						

*** See previous table.**

**** Predation by cormorants. Scheldt = 90% of total silver eel biomass in Flanders → impact of predation calculated for Meuse & Scheldt together and then divided over both basins according to their contribution to overall biomass.**

12.2.4 Precautionary diagram



France-total is in this plot as a bubble without color. It influences the scaling.

12.2.5 Management measures

No new information compared to last year's report.

12.3 Summary data on glass eel

See Chapters 3.1.1 and 3.5.1.

13 Sampling intensity and precision

No new data available.

14 Standardisation and harmonisation of methodology

No new data available.

14.1 Survey techniques

14.2 Sampling commercial catches

14.3 Sampling

14.4 Age analysis

14.5 Life stages

14.6 Sex determinations

14.7 Data quality issues

15 Overview, conclusions and recommendations

Recent (2011–2014) data from recruitment-series or other scientific stock indicators in Belgium indicate a further decrease of the stock, although the glass eel recruitment at Nieuwpoort (River Yzer) showed an increase with recent years.

Special fisheries management actions to restore the stocks in Flanders are confined to the prohibition of the semi-professional fyke fisheries in the Lower Scheldt. In the Walloon region eel fishing is prohibited to avoid human consumption of contaminated eels. In Flanders the eel has been listed as *Critically Endangered* on the Red List of Fishes.

In Flanders, restocking practises with glass eel are going as in former years. Glass eel restocking activities are not taking account of the variation in eel quality (diseases/contamination) of the restocking sites. A significant higher quantity has been restocked in 2014 compared to the years before, due to the lower prices. In the Walloon Region restocking with glass eel has been initiated in 2011 and in 2012, but was temporarily stopped in 2013 for financial reasons. The Walloon region did not indicate if glass eel was restocked in Wallonia during 2014.

In Belgium, habitat and water quality restoration is a (slow) ongoing process within the framework of other regulations, especially the Water Framework Directive and the Benelux Decision for the Free Migration of Fish (which has been reformulated in 2009). Numerous migration barriers, pumps and hydropower stations still affect the free movement of eels and many rivers and brooks still have an insufficient water quality to allow normal fish life.

Specific programs for eel sampling and other biological sampling for stock assessment purposes of eel as required in the context of the Belgian EMP have been initiated in Wallonia under co-financing of EFF.

Some research programs focusing on habitat, migration and eel quality are being initiated or ongoing. Several scientific results have been published. A pilot project to monitor contamination in eel and perch for reporting about the chemical status of water bodies within the WFD has been reported in Flanders.

Recommendations

It is recommended that the sampling programmes as required in the Belgian EMP and the European restoration plan is initiated asap.

Considering further downward trend of most stock indicators, additional protection of the local stock is required. In the Walloon Region the harvest of eels by recreational fishermen is prohibited for human health considerations (as the eels are contaminated).

Similarly Flanders could envisage the same management option. Eels from many places in Flanders are considerably contaminated and their consumption presents risks for human health. Furthermore apparently recreational fishermen are not reluctant for a limitation in eel fishing. Putting in place a catch and release obligation in Flanders would save 30 tons of eel on annual basis.

16 Literature references

Agentschap voor Natuur en Bos. 2013. Officieuze coördinatie van de visserijreglementering. 19 April 2013.

Belpaire C., Breine J., Ovidio M., Stevens M., Rollin X and Vlietinck K. 2012. Report on the eel stock and fishery in Belgium 2011/12. In FAO European Inland Fisheries Advisory Commission; International Council for the Exploration of the Sea, 2012. Report of the Joint EIFAAC/ICES Working Group on Eels (WGEEL), 3–9 September 2012, Copenhagen, Denmark. ICES CM 2012/ACOM:18, pp. 202–240.

Belpaire, C. 2002. Monitoring of glass eel recruitment in Belgium. In: Dekker W. (Ed.) Monitoring of glass eel recruitment. Netherlands Institute of Fisheries research, report C007/02-WD, Volume 2B, pp. 169–180.

Belpaire, C. 2006. Report on the eel stock and fishery in Belgium 2005. In FAO European Inland Fisheries Advisory Commission; International Council for the Exploration of the Sea. Report of the 2006 session of the Joint EIFAC/ICES Working Group on Eels. Rome, 23–27 January 2006. EIFAC Occasional Paper. No. 38, ICES CM 2006/ACFM:16. Rome, FAO/Copenhagen, ICES. 2006. 352p., 217–241.

Belpaire, C. and Coussement, M. 2000. Nota omtrent het uitzetten van paling in de Vlaamse openbare waters. [Note on the restocking of glass eel in Flandrian public waters]. Advice for the High Fisheries Council (March 20, 2000). Institute for Forestry and Game Management, Vlaamse Vereniging van Hengelsport Verbonden, IBW.Wb.V.ADV.2000.070 (in Dutch).

Belpaire, C., Adriaens, D., Breine, J., Buysse, D., Geeraerts, C., Ide, C., Lebel, A., Philippart, J.C., Stevens, M., Rollin, X., Vlietinck, K. 2011. Report on the eel stock and fishery in Belgium 2010/'11. 44 pages.

Belpaire, C., Stevens, M., Breine, J., Verreycken, H., Ovidio, M., Nzau Matondo, B., Roland, K., Rollin, X., and Vlietinck, K. 2013. Report on the eel stock and fishery in Belgium 2012/’13. In: ICES. 2013. Report of the Joint EIFAAC/ICES Working Group on Eels (WGEEL), 18–22 March 2013 in Sukarietta, Spain, 4–10 September 2013 in Copenhagen, Denmark. ICES CM 2013/ACOM:18. 851 pp.

Belpaire, C., Buysse, D., Coeck, J., Geeraerts, C.,Ovidio, M., Philippart, J.C., Reyns, T., Stevens, M., Van Thuyne, G., Vlietinck, K., and Verreycken, H. 2010. Report on the eel stock and fishery in Belgium 2009/’10. In FAO European Inland Fisheries Advisory Commission; International Council for the Exploration of the Sea. Report of the 2010 Session of the Joint EIFAC/ICES Working Group on Eels, Hamburg, 9–14 September 2010, EIFAC Occasional Paper No. 41, ICES CM 2010/ACOM: 18. Rome, FAO/Copenhagen, ICES. 2010. 721p. (Online).

Belpaire, C., Geeraerts, C., Verreycken, H., Van Thuyne, G., Cuveliers, E., Stevens, M., Coeck, J., Buysse, D., Gomes da Silva, S., Demol, T., Vlietinck, K., Rollin, X., Guelinckx, J. and Philippart, J.C. 2008. Report on the eel stock and fishery in Belgium 2007. In FAO European Inland Fisheries Advisory Commission; International Council for the Exploration of the Sea. Report of the 2008 Session of the Joint EIFAC/ICES Working Group on Eels, Leuven, 3–9 September 2008, EIFAC Occasional Paper No. 43, ICES CM 2009/ACOM: 15. Rome, FAO/Copenhagen, ICES. 2009. 192p. (Includes a CD-ROM).

Belpaire, C., Gomes da Silva, S., Demol, T., Vlietinck, K., Van Thuyne, G., Goemans, G., Geeraerts, C., Cuveliers, E. and Philippart, J.C. 2007. Report on the eel stock and fishery in Belgium

2006. In FAO European Inland Fisheries Advisory Commission; International Council for the Exploration of the Sea. Report of the 2007 Session of the Joint EIFAC/ICES Working Group on Eels, Bordeaux, 3–7 September 2007, EIFAC Occasional Paper No. 39, ICES CM 2007/ACFM: 23. Rome, FAO/Copenhagen, ICES. 2008. 138p. (Includes a CD-ROM).

Belpaire, C., Vlietinck, K., Stevens, M., Buysse, D. and Philippart, J.C. 2009. Report on the eel stock and fishery in Belgium 2008/'09. In FAO European Inland Fisheries Advisory Commission; International Council for the Exploration of the Sea. Report of the 2009 Session of the Joint EIFAC/ICES Working Group on Eels, Göteborg, 7–12 September 2009, EIFAC Occasional Paper No. 45, ICES CM 2009/ACOM: 15. Rome, FAO/Copenhagen, ICES. 2010. 540p. (Online).

Benelux. 2009. Beschikking van het Comité van Ministers van de Benelux Economische Unie tot opheffing en vervanging van Beschikking M (96) 5 van 26 april 1996 inzake de vrije migratie van vissoorten in de hydrografische stroomgebieden van de Beneluxlanden (16 juni 2009).

Buysse, D., A. M. Mouton, M. Stevens, T. Van den Neucker, J. Coeck, 2014. Mortality of European eel after downstream migration through two types of pumping stations. Fisheries Management and Ecology, 21, 13-21 online doi: 10.1111/fme.12046.

de Canet, L., Briand, C., Beaulaton, L., Roland, K., Kestemont, P. 2014. Eel density analysis (EDA 2.0), Silver eel (*Anguilla anguilla*) escapement in the Meuse basin (DRAFT). Draft Report Université de Namur, EPTB-Vilaine, ONEMA.

De Jonge M., Belpaire C., Verhaert V., Dardenne F., Blust R. en Bervoets L. 2014. Veldstudie naar de monitoring van biota in het kader van de rapportage van de chemische toestand voor de Kaderrichtlijn Water. Universiteit Antwerpen (UA) in samenwerking met het Instituut voor Natuur- en Bosonderzoek (INBO), in opdracht van de Vlaamse Milieumaatschappij (VMM). Antwerpen, België.

De Meyer J., Ide C., Belpaire C., Goemans G. and Adriaens D. 2014. Head shape dimorphism in European glass eels (*Anguilla anguilla*). Under review.

Eel Management Plan for Belgium. 2009. 172 pages.

Malarvannan, G., Belpaire, C., Geeraerts, C., Eulaers, I., Neels, H., Covaci, A. 2014. Assessment of persistent brominated and chlorinated organic contaminants in the European eel (*Anguilla anguilla*) in Flanders, Belgium: Levels, profiles and health risk. Science of the Total Environment 482–483 (2014) 222–233.

Nzau Matondo, B., Benitez, J-P., Dierckx, A., Philippart, J-C., Ovidio, M. 2014. Arrival of European eel in Belgian part of the Meuse: who and how are they? Proceedings of the 10th International Conference on Ecohydraulics, Trondheim, Norway http://hdl.handle.net/2268/170392.

Ovidio, M., A. Seredynski, J-C Philippart, B. N. Matondo. 2013. A bit of quiet between the migrations: the resting life of the European eel during their freshwater growth phase in a small stream. Aquat Ecol 47:291–301. DOI 10.1007/s10452-013-9444-1.

Ovidio, M., Nzau Matondo, B., Philippart, J.C. 2012. Estimation de l'abondance du stock des anguilles recrutées dans la Meuse en Wallonie et réalisation des essais de repeuplement en juvéniles (civelles et anguillettes). Projet 32-1102-002 du Fonds Européen pour la pêche de l'Université de Liège, Laboratoire de Démographie des Poissons et d'Hydroécologie.

Philippart, J.C and Rimbaud G. 2005. L'efficacité de la nouvelle grande échelle à poissons du barrage de Visé-Lixhe sur la Meuse. Eléments du suivi scientifique 1999–2004. [Efficiency of the new large fish pass at the Visé-Lixhe dam on the river Meuse. Follow-up 1999–2004]. Draft report: 50 years of Fonds Piscicole.

Philippart, J-C. 2006. *L'érosion de la biodiversité: les poissons*. Dossier Scientifique réalisé dans le cadre de l'élaboration du rapport analytique 2006–2007 sur l'état de l'environnement Wallon. Université de Liège. 306 pp.

Roland, K., Kestemont, P. 2014. Estimation of the resident European eel stock in the Lesse river, sub-basin of the Belgian river Meuse, and evaluation of the physiological and immunological state of fish using non-invasive methods. FEP Project research abstract. Research Unit in Environmental and Evolutionary Biology (URBE), Narilis (Namur Research Institute for Life Sciences), University of Namur, Belgium.

Stevens M, Van Daele T, Belpaire C, Mouton A, Geeraerts C, De Bruyn L, Bauwens D, Coeck J, Pollet M 2013. Evaluatie van de methodologie voor de berekening van het ontsnappingspercentage zilverpaling ten behoeve van de rapportage voor de Palingverordening. Rapporten van het Instituut voor Natuur- en Bosonderzoek 2013 (32). Instituut voor Natuur- en Bosonderzoek, Brussel.

Stevens M., Coeck J. and van Vessem J. 2009. Wetenschappelijke onderbouwing van de palingbeheerplannen voor Vlaanderen. Rapporten van het Instituut voor Natuur- en Bosonderzoek 2009 (INBO.R.2009.40). Instituut voor Natuur- en Bosonderzoek, Brussel.

Tarrago-Bes, F. 2014. Evaluation de l'efficacité du repeuplement en civelles (*Anguilla anguilla* L.) dans trois rivières du Sud de la Belgique; Université de Bordeaux, Unité de Formation Biologie, Master Sciences de la Terre, Ecologie, Environnement.

Van Ael, E., Belpaire, C., Breine, J., Geeraerts, C., Van Thuyne G., Eulaers, I., Blust, R., Bervoets, L. 2014. Are persistent organic pollutants and metals in eel muscle predictive for the ecological water quality? Environmental Pollution 186 (2014) 165–171.

Verbiest, H., A. Breukelaar, M. Ovidio, J.-C. Philippart and C. Belpaire. 2012. Escapement success and pattern of downstream migration of female silver eel *Anguilla anguilla* in the River Meuse. Ecology of Freshwater Fish, 21, 395–403 doi :10.1111/j.1600-0633.2012.00559.x.

Verreycken, H., Belpaire, C., Van Thuyne, G., Breine, J., Buysse, D., Coeck, J., Mouton, A., Stevens, M., Van den Neucker, T., De Bruyn, L., Maes, D. 2014. An IUCN Red List of freshwater fishes and lampreys in Flanders. Fisheries Management and Ecology, 21, 122–132.

Verreycken, H., Van Thuyne, G., Belpaire, C. 2011. Length–weight relationships of 40 freshwater fish species from two decades of monitoring in Flanders (Belgium). Journal of Applied Ichthyology doi: 10.1111/j.1439-0426.2011.01815.x.

Vlietinck, K. 2010. Agentschap voor Natuur en Bos – Resultaten van de enquête bij hengelaars op openbaar water in 2008.

Vlietinck, K. Nature and Forest Agency, Groupe de travail pour l'anguille européenne coordonné par le Service de la pêche du Service public de Wallonie. Council Regulation (EC) No 1100/2007 of 18 September 2007 establishing measures for the recovery of the stock of European eel. Eel Management Plan for Belgium. First report to be submitted in line with Article 9 of the eel Regulation 1100/2007. June 2012.

Walloon Government. 2006. Walloon Government Order of 15th June 2006 modifying the Walloon Regional Executive Order of 11th March 1993 concerning angling, in order to impose no-kill practices for the European eel.

Report on the eel stock and fishery in Denmark 2013/2014

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Reporting Period: This report was completed in August 2014, and contains data up to 2013 and some provisional data for 2014.

2 Introduction

The Danish EMU belong to the NORTHSEA ecoregion.

From 1st July 2009 the eel is managed according to the EU regulation, aiming at 40% (relative to the prestine) silver eel escapement in freshwater and 50% effort reduction in the marine waters. The Danish territory is managed as one freshwater EMU excluding two small transboundary river basins named Kruså and Vidå shared with Germany. Intermediate and coastal waters are treated together with community waters constituting the entire marine area.

From 1st July 2009, professional fishing operations are based on licences and landings and number and type of gear must be registered with the Danish AgriFish Agency. The professional fishermen in saline areas are given a licence to use a limited number of gear in order to meet the 50% reduction within five years following the EU eel regulation.

Recreational fishermen operating in the marine may use six fykenets or six hooklines but in a reduced period of the year. Fishing is closed from the 10th of May to 31th of July to reduce effort by 50%.

In freshwater a few professional fishermen have a licence to use a limited number of gears. For landowners and recreational fishermen the fishing season has been limited to a period of 2.5 month and fishing is closed from 16 October–31 July.

The escapement target of 40% in freshwater has been calculated to be achieved after ca. 85 years if a total ban on freshwater fisheries will commence. Licences are provisionally issued until 31st December 2013. The Ministry of Food, Agriculture and Fisheries may implement further reductions pending the development in the eel stock.

3 Time-series data

3.1 Recruitment series and associated effort

No data.

3.1.1 Glass eel

3.1.1.1 Commercial

No data; glass eel fishery is forbidden.

3.1.1.2 Recreational

No data.

3.1.1.3 Fishery independent

Silver eels

Data from a silver eel trap, active every year from ca. 1 September–15 December at Vestbirk Hydropower station in River Gudenå. The trap takes 2/3 of the eels coming down the stream. This is likely to be constant every year!

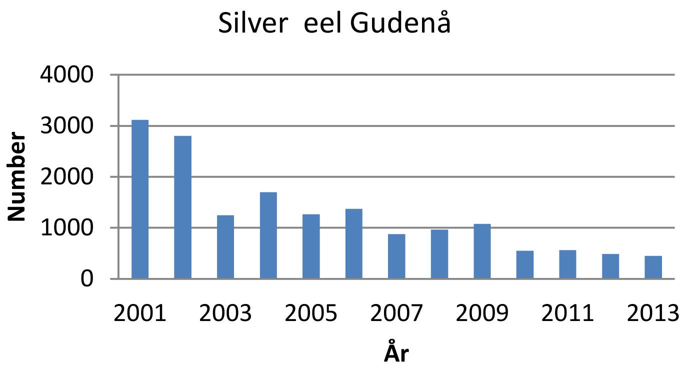


Figure and Table 3.1.1.3. Silver eel trap catch since 2001.

Year	Number	Year	Number	Year	Number
2001	3117	2006	1370	2011	562
2002	2802	2007	875	2012	490
2003	1248	2008	961	2013	451
2004	1697	2009	1076	2014	NR
2005	1267	2010	549		

3.1.2 Yellow eel recruitment

The recruitment of young eels to Danish freshwater is currently monitored in pass traps at Harte Hydropower Station in river Kolding Å and at Tange Hydropower Station in river Guden Å. Both rivers empty into Kattegat on the east coast of Jutland. On the west coast of Jutland no passive trapping facilities are available. Here the recruitment is monitored in Vester Vedsted brook a small brook by the Wadden Sea. See also Section 9.1 for further information on glass eel monitoring by electrofishing.

In **Vester Vedsted brook** an annual population surveys is made by electrofishing four sections of the brook three times a year (further details in Pedersen, 2002).

At **Harte Hydropower Station** the condition for monitoring recruitment has changed. As part of a river restoration project in River Kolding Å, the water supply to Harte Hydropower station has been reduced by 60% since spring/summer 2008. The effect of lower water supply to the trapping site is a marked decrease in recruitment at Harte hydropower station from 2008. This is the second time a major change of eel monitoring in River Kolding Å has taken place since monitoring started in 1967. The first change was in 1991, a bypass stream was made at the Stubdrup Weir allowing eels to bypass and the trapping facility was terminated in 1990. This is also reflected in the recruitment data (Table 3.1.2).

At **Tange Hydropower Station**. Eel ladder trap. The local staff at the station is responsible for the daily maintenance of the trap and registration of data.

Table 3.1.2. Recruitment data from Tange and Harte Hydropower Stations and Vester Vedsted brook. Mean density during the year and maximum density at any electrofishing occasion.

YEAR	TANGE	HARTE	VESTER VEDSTED BROOK DENSITY EEL/M²		YEAR	TANGE	HARTE	VESTER VEDSTED BROOK DENSITY EEL/M²		YEAR	TANGE	HARTE	VESTER VEDSTED BROOK DENSITY EEL/M²	
Year	Kg	Kg	Mean	Max (season)	Year	Kg	Kg	Mean	Max (season)	Year	Kg	Kg	Mean	Max (season)
1967		500	-	-	1984	84	172	-	-	2000	88	18	0.6	0.7
1968		200	-	-	1985	315	446	-	-	2001	239	11	0.6	0.8
1969		175	-	-	1986	676	260	-	-	2002	278	17	0.5	0.6
1970		235	-	-	1987	145	105	-	-	2003	260	9	0.6	0.7
1971		59	-	-	1988	252	253	-	-	2004	246	9	0.3	0.4
1973		117	-	-	1989	354	145	-	-	2005	88	7	0.5	0.5
1974		212	-	-	1990	367	101	-	-	2006	123	7	0.3	0.7
1975		325	-	-	1991	434	44	-	-	2007	62	7	0.4	0.5
1976		91	-	-	1992	53	40	-	-	2008	131	0.9	0.2	0.2
1977		386	-	-	1993	93	26	-	-	2009	20	1.3	0.2	0.2
1978		334	-	-	1994	312	35	-	-	2010	14	5	0.2	0.4
1979		291	2.8	6.5	1995	83	23	2.6	2.6	2011	84.6	3.6	0.3	0.3
1980	93	522	7	13	1996	56	6	4.6	6.8	2012	-	4.1	0.1	0.2
1981	187	279	7.8	13	1997	390	9	0.7	1	2013	47	1.4	0.1	0.1
1982	257	239	-	-	1998	29	18	0.3	0.4	2014	NR	NR	0.1	0.1
1983	146	164	-	-	1999	346	15	0.4	0.5	2015				

3.1.2.1 Commercial

No data.

3.1.2.2 Recreational

No data.

3.1.2.3 Freshwater independent

No data.

3.2 Yellow eel landings

3.2.1 Commercial

The time-series on Yellow eel landing below (see 3.3.1).

3.2.2 Recreational

Available information is reported below (see 3.3.2 recreational).

3.3 Silver eel landings

3.3.1 Commercial

Data on separate landings of yellow and silver eel in fresh and salt water are given below. Data origin is catch reports by commercial fishermen reported to the ministry. From medio-2009 catches are only reported from those given a licence to fish for eel.

Table 3.3.1.1. Freshwater landings (ton) of yellow and silver eels.

Year	Silver	Yellow	Total	Year	Silver	Yellow	Total	Year	Silver	Yellow	Total
1960	-	-	214	1979	-	-	78	1998	-	-	40
1961	-	-	235	1980	-	-	147	1999	-	-	30
1962	-	-	215	1981	-	-	140	2000	4	24	28
1963	-	-	238	1982	-	-	163	2001	2	34	36
1964	-	-	223	1983	-	-	116	2002	5	27	27
1965	-	-	205	1984	-	-	126	2003	2	21	24
1966	-	-	211	1985	-	-	111	2004	4	12	15
1967	-	-	243	1986	-	-	120	2005	3	10	14
1968	-	-	258	1987	-	-	90	2006	7	8	14
1969	-	-	254	1988	-	-	119	2007	5	6	11
1970	-	-	249	1989	-	-	114	2008	5	4	9
1971	-	-	183	1990	-	-	107	2009	8	5	13
1972	-	-	200	1991	-	-	99	2010	10	3	13
1973	-	-	201	1992	-	-	109	2011	11	4	15
1974	-	-	163	1993	-	-	57	2012	9	4	13
1975	-	-	260	1994	-	-	60	2013	10	3	13
1976	-	-	178	1995	-	-	52	2014	NR		
1977	-	-	179	1996	-	-	34				
1978	-	-	157	1997	-	-	39				

Table 3.3.1.2. Marine landings (ton) of yellow and silver eels.

Year	Silver	Yellow	Total	Year	Silver	Yellow	Total	Year	Silver	Yellow	Total
1960	2756	1967	4509	1978	1187	1148	2178	1996	381	336.5	684
1961	2098	1777	3640	1979	887	939	1748	1997	375	383	719
1962	2132	1775	3692	1980	911	1230	1994	1998	306	251	517
1963	1837	2091	3690	1981	897	1190	1947	1999	380	307	657
1964	1417	1865	3059	1982	1003	1375	2215	2000	382	218	572
1965	1498	1699	2992	1983	884	1119	1887	2001	446	225	635
1966	1829	1861	3479	1984	830	915	1619	2002	365	217	555
1967	1673	1763	3193	1985	793	726	1408	2003	437	188	601
1968	2063	2155	3960	1986	818	734	1432	2004	343	187	516
1969	1552	2072	3370	1987	538	651	1099	2005	372	149	506
1970	1470	1839	3060	1988	799	960	1640	2006	427	154	567
1971	1490	1705	3012	1989	785	797	1468	2007	411	115	515
1972	1662	1567	3029	1990	834	734	1461	2008	364	93	448
1973	1697	1758	3254	1991	724	642	1267	2009	367	87	454
1974	1378	1436	2651	1992	687	655	1233	2010	304	105	409
1975	1534	1691	2965	1993	523	500	966	2011	271	84	355
1976	1477	1399	2698	1994	509	631	1080	2012	226	78	304
1977	1141	1182	2144	1995	408	432	788	2013	243	100	343

3.3.2 Recreational

Marine

An interview survey among recreational marine fishermen revealed landings of a 100 tonne of eel in 2009. Recreational fishermen are only allowed to use fykenets and the catch supposedly consists mostly of yellow eels**.** The reduction in recreational fishery in marine waters is estimated to have been reduced from approximately 100 tonne in 2009 to approximately 80 tonne in 2011 and 52 tons in 2012 and 50 tons in 2013.

Freshwater

The reduction in recreational fishery in freshwater is estimated to have been reduced by 50% from approximately 16 tonne to 8 tonne.

3.4 Aquaculture production

3.4.1 Seed supply

Glass eels to Danish aquaculture are imported from France and England. The eel farmers have reported to the Danish AgriFish Agency that 2.5 ton of glass eel was imported during 2013. The glass eel are used as seed stock for the production presented in Table 3.4.1.

3.4.2 Production

Aquaculture production of eel in Denmark started in 1984. The production takes place at eight indoor, heated aquaculture systems, Table. 3.4.

Table. 3.4. Annual aquaculture eel production.

Year	Production Units	Production [ton]	Year	Production units	Production [ton]
1984	??	18	1999	27	2718
1985	30	40	2000	25	2674
1986	30	200	2001	17	2000
1987	30	240	2002	16	1880
1988	32	195	2003	13	2050
1989	40	430	2004	9	1500
1990	47	586	2005	9	1700
1991	43	866	2006	9	1900
1992	41	748	2007	9	1617
1993	35	782	2008	9	1740
1994	30	1034	2009	9	1707
1995	29	1324	2010	9	1537
1996	28	1568	2011	8	1156
1997	30	1913	2012	8	1093
1998	28	2483	2013	8	824

Table 3.4.1. Usage of aquaculture production 2013 (Source: Danish AgriFish Agency).

	Glass eel used (kg)	Number	Kg	Kg
Imported glass eel		7.556.900	2519	
Young eel exported (5 g)	134	344.253		1721
Young eel exported stocking (5 g)	2.021	5.181.629		25908
Young eel stocked in Dk (3.5g)	625	1.602.000		5607
Large eel consumption	1.714			791013
Total	4.494			824249

Import and export of young eel (in 2013) is reported in numbers. Large eel for consumption is reported in kilo. To convert numbers to kilo it is assumed that one kilo of glass eel is equal to 3000 individuals. Thus, the import of glass eel in 2013 is equal to 2,5 tonne. The weight of an exported young eel is assumed to be 5 gram and a young eel stocked in Danish waters is known to average 3.5 gram. The average weight of a large eel for consumption is 0.18 kg. Mortality of glass eel in the farm is assumed to be 17% no matter what size of the end product.

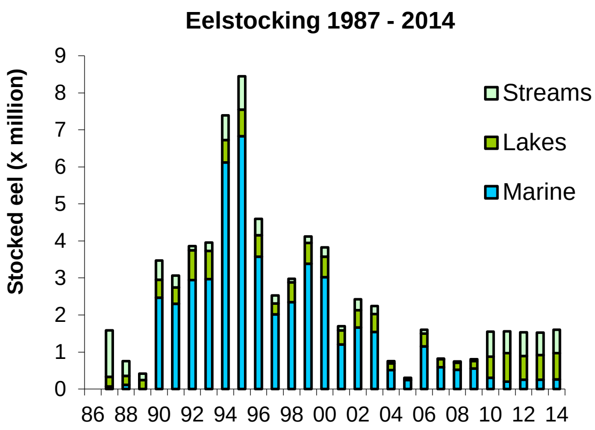
It should be noted that the amount of glass eel imported to the farm is not the same as the amount of eel exported from the farm the same year. Eel for consumption are about 18 months of age.

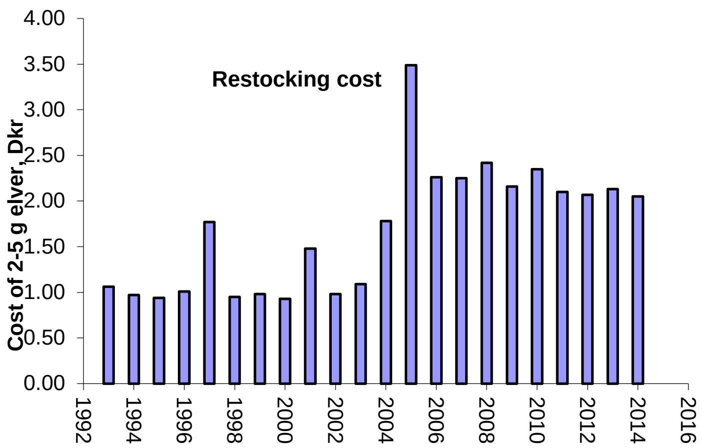
3.5 Stocking

3.5.1 Amount stocked

In 2014 a total of 1.6 million 2–5 gram eels are stocked. In freshwater 1.34 million eel of size 2–5 gram were stocked in lakes and rivers as a management measure and 0.26 million were stocked in marine waters (Table 3.5.1 below).

The eels stocked are **foreign source** imported from France and England grown to a weight of 2–5 gram in heated culture. The price for SEG certified eels for stocking (DKK 2.05) were only slightly more expensive than for non-certified 2–5 gram eel (DKK 2.0).





Figures 3.5.1. Restocking of elvers (2–5 g) in marine and fresh waters from 1987–2014 (numbers in millions) and cost per stocked eel.

Table 3.5.1. Restocking of elvers (2–5 g) in marine and fresh waters from 1987–2013. Numbers of eels stocked (in millions).

YEAR	MARINE	LAKE	RIVER	TOTAL	YEAR	MARINE	LAKE	RIVER	TOTAL
1987	0.07	0.26	1.26	1.58	**2001**	1.2	0.38	0.12	1.7
1988	0.11	0.24	0.4	0.75	**2002**	1.66	0.47	0.3	2.43
1989	0	0.24	0.17	0.42	**2003**	1.54	0.49	0.22	2.24
1990	2.46	0.49	0.51	3.47	**2004**	0.52	0.18	0.06	0.75
1991	2.3	0.44	0.32	3.06	**2005**	0.24	0.06	0	0.3
1992	2.94	0.81	0.11	3.86	**2006**	1.15	0.35	0.1	1.6
1993	2.97	0.76	0.23	3.96	**2007**	0.59	0.21	0.02	0.83
1994	6.12	0.61	0.67	7.4	**2008**	0.52	0.19	0.04	0.75
1995	6.83	0.72	0.9	8.44	**2009**	0.55	0.20	0.05	0.81
1996	3.58	0.58	0.44	4.6	**2010**	0.30	0.57	0.67	1.55
1997	2.02	0.29	0.22	2.53	**2011**	0.20	0.77	0.59	1.56
1998	2.35	0.53	0.1	2.98	**2012**	0.25	0.64	0.64	1.53
1999	3.38	0.56	0.18	4.12	**2013**	0.25	0.66	0.61	1.52
2000	3.02	0.55	0.25	3.83	**2014**	0.26	0.71	0.63	1.60

3.5.2 Catch of eel <12 cm and proportion retained for restocking

No data; catch of small eels is not allowed.

3.6 Trade in eel

Table 3.6.1. Value (Euro) of capture fisheries in DKK.

	FRESHWATER		MARINE WATER	
Year	**Yellow**	**Silver**	**Yellow**	**Silver**
2013	**34,133**	**100,267**	**961,867**	**2,740,000**
2014	**NR**	**NR**	**NR**	**NR**

4 Fishing capacity

4.1 Glass eel

No data; not allowed.

4.2 Yellow eel

No data.

4.3 Silver eel

No data.

4.4 Marine and freshwater fishery

From 1st July 2009, commercial eel fishing in marine and fresh waters are based on licences, and all gear must be registered with the Danish AgriFish Agency.

Commercial eel fishing effort and the reduction in fishing effort

Of the 783 commercial fishermen and entities with registered landings and poundnets in the reference period 2004–2006, a total of 525 applied for licences. A total of 406 commercial licenses were allocated in 2009. Since then 45 licenses have been cancelled, reducing the number of active commercial fishing licenses in 2012 to 361. (Danish AgriFish Agency).

Table 4.4 below illustrates the level of commercial fishing effort that catches eel each year specified into types of gear and the gradual reduction in fishing effort from the period 2004–2006. 2007. 2009. 2010 and 2011 (Danish AgriFish Agency).

Table 4.4. The level of commercial fishing effort by gear type from 2004–2006 to 2011 (Danish AgriFish Agency).

	Fyke nets		Small Pound nets		Large Pound nets		Hook lines	
Number of gear	Number	Reduction	Number	Reduction	Number	reduction	Number	Reduction
Avg. 2004-2006	43.500 *		1.588		1.572		6.366	
2007	41.114	5,5%	1.578	0,6%	1.582	-0,6%	5.875	7,7%
2009	38.336	11,9%	1.292	18,6%	1.466	6,7%	1.932	69,7%
Ultimo 2010	33.661	22,6%	1.082	31,9%	1.177	25,1%	1.200	81,1%
Ultimo 2011	32.761	25,6%	1.000	37,0%	1.139	27,5%	1.200	81,1%

***The total number of 40 077 fykenets registered by the fishermen who applied for commercial eel licences in 2009, and an estimate of 3423 fykenets used by the 258 fishermen who reported landings of eel in the reference period 2004–2006, but who did not apply for eel licences in 2009.**

5 Fishing effort

5.1 Glass eel

No data.

5.2 Yellow eel

No data.

5.3 Silver eel

No data.

5.4 Marine fishery

Year	Fykenet,#	Small pound-net, #	Large pound net, #	Hook line, #
2011	32,761	1000	1,139	1,200
2013	ND			

6 Catches and landings

6.1 Glass eel

Not allowed.

6.2 Freshwater landings

Best estimate of freshwater eel catches for 2012 are 21 tonnes. The official landings reported to the ministry (Table 6.2) were 13 tonnes. Estimated recreational (including landowners) landings make up additional 8 tonnes.

Table 6.2. Freshwater landings (ton) from 2004–2013.

Year	Silver	Yellow	Total
2004	4	12	15
2005	3	10	14
2006	7	8	14
2007	5	6	11
2008	5	4	9
2009	8	5	13
2010	10	3	13
2011	11	4	15
2012	9	4	13
2013	10	3	13

6.3 Marine landings

The commercial marine fishery reported 343 tonnes of eel in 2012.

Table 6.3.1. Marine landings (ton) from 2004–2012.

Year	Silver	Yellow	Total
2004	343	187	531
2005	372	149	520
2006	427	154	581
2007	404	115	519
2008	364	93	457
2009	367	87	454
2010	304	105	409
2011	271	84	355
2012	226	78	304
2013	243	100	343

6.4 Recreational fishery

The recreational catch of eel in marine waters was estimated at 50 tonnes. Recreational catch in freshwater was estimated at 8 tonnes.

Table 6.4. Interview survey of recreational fishermen.

Year	Marine (ton)	Freshwater (Ton)
2009	100	8
2011	80	8
2012	52	8
2013	50	8

7 Catch per unit of effort

No data.

8 Other anthropogenic impacts

Some mortality has been documented due to hydropower turbines especially from Tange Hydropower plant but not from Vestbirk Hydropower plant (see below). An estimate of mortality from all hydropower plants may be ~5 tonne. At flow-through trout farms located at the bank of rivers the mortality is estimated at ~5 tonne (see below).

Predation from cormorants and mammals in freshwater is unknown and difficult to estimate. An estimate is ~10 tonne. Cormorants do eat eel from rivers and lakes, but they mainly forage in coastal waters, where results from Ringkøbing Fjord show a predation of 40% of stocked eel during the first year. Mortality outside the fishery adds up to ca. 20 tonne.

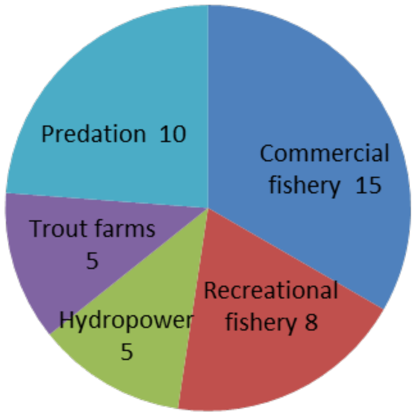


Figure 8.1. Best estimates of mortality (43 tonne) in freshwater. The number refers to tonne in each category.

8.1.1 Hydropower

In 2006 there were 43–61 hydroelectric power units in operation in Denmark. Since then several hydropower units have been closed down (e.g. Vilholt, Karlsgårdeværket, Harte).

Danish legislation stipulates that physical screens with a maximum bar distance of 10 mm must be installed in front of hydropower turbines. Bypasses guiding the eel around the power plant are established at some power plants, although at most power plants only fish ladders to guide salmonid are present. The knowledge of the efficiency of the different bypasses for the downstream migrating silver eel is limited and may differ from place to place. It is known that fish impinge on the turbine screens and die there.

Recent research at the biggest hydropower unit in Denmark, Tange Hydropower plant, suggests that up to 77% of the eels are lost bypassing the Hydropower plant. There is no exact knowledge of the proportion of eels that impinge on the screens or are lost for other reason e.g. predation and fisheries, but approximately 10% of the migrants overwinter upstream the power plant and resume migration in the next year. At Tange Hydropower plant there is a significant bypass problem for eels (Pedersen *et al.*, 2011).

At Vestbirk Hydro power station 25% of the water discharge is passed around the turbines in two bypass facilities. One bypass stream is the old river bed and the other is at the turbine screens guiding the fish around the turbines. The bypass facility seems appropriate and fish including eels do not impinge on the screens except at very low temperatures <5°C in combination with very high water discharge. These situations usually occur during winter outside the normal eel migration period.

Similar problems likely appear at other hydropower facilities in e.g. Holstebro Hydropower plant. This has not yet been investigated.

8.1.2 Aquaculture

Danish trout farms are often located on the banks of rivers depending on water intake from the rivers. To guide the river water into the trout farm a weir is built in the river. Less than 250 trout farms use "flow through" river water and approximately ten have systems for recirculation of water. To prevent fish from entering the trout farms a screen with a maximum 6 mm bar distance is obligatory at the point of the water inflow and a maximum 10 mm bar distance at the point of outflow. Small eel can easily enter trout farms, and are possibly predated by the trout. However for the past years there has been an ongoing process in collaboration with municipal environmental authorities to improve measures for the unhindered migration of several different fish species.

Research in relation to weirs of trout farms have been conducted in connection with three trout farms in River Kongeåen and River Mattrup Å.

Mattrup Å. At Brejnholt trout farm in River Mattrup Å the National Institute of Aquatic Resources studied the behaviour of silver eels while bypassing the weir at the trout farm. The river water is guided into the farm by a weir and screens prevent the eels to enter the farm. Fish passage is through an overflow spillway at the weir and the water discharge in the spillway may be significantly reduced depending on the hydrological conditions. The study was conducted during two years. The first year the water discharge was low and only 56% of the eels bypassed the weir. The second year the river discharge was normal and several more eels succeeded to pass the weir (82%) during the same year as they were released. It was concluded that the weir had a significant effect in delaying migrating silver eels. The delay varied with water discharge in the migration period. It is therefore recommended that a constant amount of water in the fish pass should be available e.g. 25% of the river discharge to neutralize the effect of the weir (and screens are placed appropriate to guide the fish) (Pedersen, 2012).

In **River Kongeå** two trout farms are situated on the bank of the river at Vejen and Jedsted. In the autumn 2011 forty fish were radio tagged and their downstream migration was monitored while passing the two trout farms. Both trout farms have 6 mm bar distance at the water intake. At Vejen fish farm several fish entered the fish farm despite the 6 mm bar screen which seems not correctly installed or damaged. At Jedsted no fish entered the fish farm and the screen was working well. If the screen at Vejen fish farm is fixed properly, eels would not be able to enter the fish farm. However it is quite difficult to see by eye if there is any such problem at other comparable fish farms unless the place where the screen is mounted is dried out.

9 Scientific surveys of the stock

9.1 Glass eel monitoring

Weirs in streams are being removed as a part of National river restoration projects e.g. to meet the requirements of the water frame directive. Monitoring young eel recruitment the traditionally way, using eel pass traps has become more difficult. New methods and locations are urgently needed in order to monitor the effect of the EU regulation in terms of recruitment of young eel from the ocean.

Since 2008 three small brooks situated on the North Sea coast of Jutland were selected for monitoring. At each brook two stations of 10–20 m length (close to the shoreline <1000 m) are electrofished at three different times from May to August and the population of eels at each station is calculated using the removal method. The brooks have a water depth <50 cm and width 1–4 m.

The aim is to have this type of monitoring replacing eel pass traps but data quality issues are not clear. E.g. is the number of times that we electrofish during the year sufficient and is the number of stations large enough to reproduce a clear signal from the data?

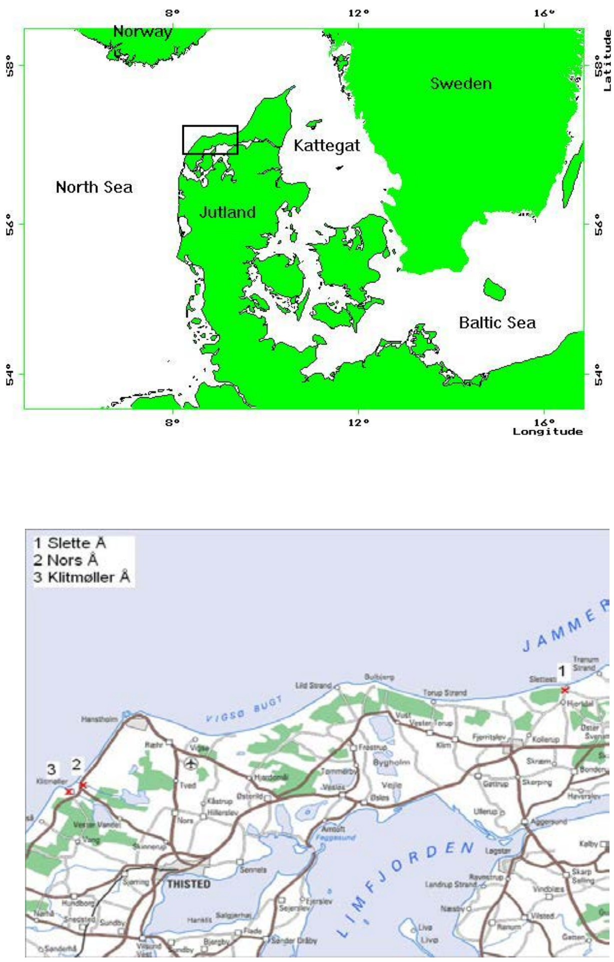
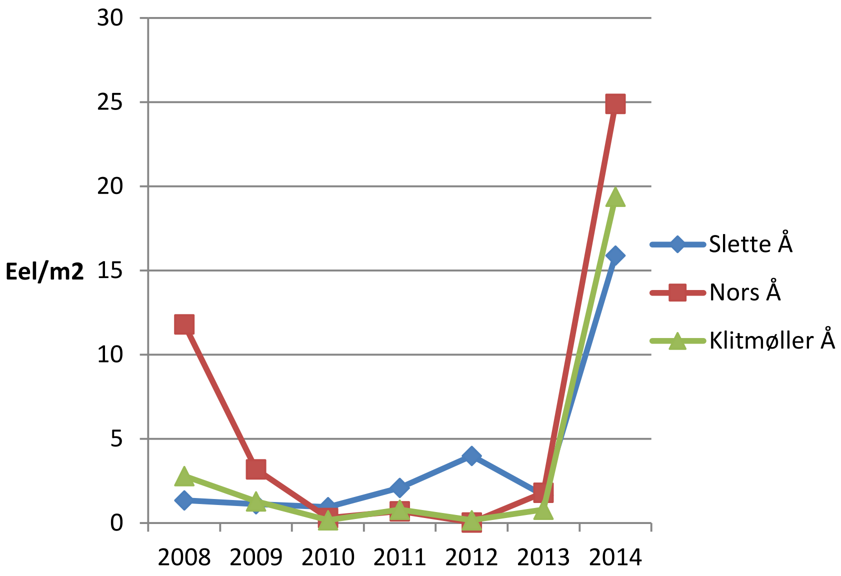


Figure 9.1. Map with New glass eel monitoring sites (1, 2 and 3) in the North Sea.

Table 9.1. Density of eel (eel/m²) as a mean of three different times of electrofishing starting medio-May to medio-August. The maximum density during the season is given.

	Slette Å (1)		Nors Å (2)		Klitmøller bæk (3)	
	Mean	Max.season	Mean	Max.season	Mean	Max.season
2008	1.4	1.4	11.8	11.8	2.8	2.8
2009	0.7	0.8	3.2	5.2	1.3	2.2
2010	0.7	0.9	0.3	0.3	0.2	0.2
2011	2.1	2.9	0.7	0.7	0.8	1.2
2012	0.5	0.7	0.1	1.7	0.2	0.2
2013	0.9	1.2	1.8	5.2	0.8	1.8
2014	15.9	29.5	24.9	33.2	19.4	30.9



Picture. The author monitoring glas eel recruitment at Slette Å. Photo by Jan Skriver.

9.2 Silver eel escapement from freshwater

In River Gudenå trapped silver eels are tagged annually with PIT tags and released during the autumn. Downstream movements are monitored by remote listening stations. These data are believed suitable for evaluating silver eel escapement from the river Guden Å, including anthropogenic mortality due to fishing and turbines. Monitoring silver eel escapement in other river basins is currently considered. River Ribe Å has been monitored in 2010 and will be again in 2014.

Production of silver eel in Lake Vester Vandet is monitored annually in an eeltrap.

9.3 Effect of stocking

Concerning stocking and the expected outcome in relation to the recovery programme of the eel DTU Aqua have initiated a programme to monitor the effect by stocking tagged (cw) eels in selected areas. Also short time experiments in ponds have been initiated to evaluate fitness of stocked eel compared to wild eels.

10 Catch composition by age and length

Table 10.1. Summary of the DCF monitoring implementation per EMU.

Data	River	Lakes	Estuaries	Lagoons	Coastal & Marine
No. of production / escapement surveys[1]	2	1			
No. of recruitment time-series surveys[2]	6	0			
No. fished aged	0	0			
No. of fished sexed	351	0			194
No. of fish examined for parasites		0			194
No. of fish examined for contaminants	0				
No. of non-fishery mortality studies[3]	1*)				
Socio-economic survey	0				

***) The study is from 2010.**

[1] Surveys to estimate B_{best} and/or $B_{current}$ [These should include WFD surveys where the data are being used to estimate production and/or escapement of eel].

[2] Fishery-independent surveys.

[3] Studies to determine ∑H for non-fisheries anthropogenic impacts, such as hydropower, barriers, predation, etc.

11 Other biological sampling

11.1 Growth, silvering and mortality

Table 11.1. Von Bertalanffy parameters, from three different rivers.

Location	L∞	T0	K	Reference
Bjørnsholm å	60,10	-1,6	0,07	Bisgaard & Pedersen, 1990
Køge Lellinge å	59,83	-0,57	0.12	Rasmussen & Therkildsen, 1979
Giber å	90.3	-1.44	0.05	Bisgaard & Pedersen, 1991

11.2 Parasites and pathogens

The swimbladder parasite *Anguillicola crassus* is widely distributed throughout both brackish and freshwaters in Denmark. Monitoring of Anguillicola parasites takes place on a yearly basis at three locations; however for 2013 only two locations were sampled. Monitoring has continued since 1987. The number of Anguillicola infected eels (prevalence) is relatively constant during 1987–2013 at all three locations.

Table 11.2. Anguillicola monitoring data for 2013.

Location	Salinity ppt	Coordinates	Year	Total	Infected	Prevalence	Intensity
				N	N	%	n
Isefjord	18	55.50N;11.50E	2013	99	32	32.3	9.4
Ringk. Fjord	5–10	55.55N;08.20E	2013	95	57	60	5.9

11.3 Contaminants

No new data available.

11.4 Predators

Cormorants

Cormorants are possibly the only important predator of eel due to the large number of nesting birds; predation is expected to be largest in the vicinity of the colonies, but birds migrating through Denmark may have significant impact during the fall.

The number of cormorants nesting in Denmark during the last 10–15 years can be regarded as stable, but with downward trend. In the year 2000 42 481 nests were counted in colonies throughout Denmark. **In 2014** the count was 30 558 nests.

In the Danish EMP it was suggested that in the period 2004–2006 approximately 80 tonne of yellow eel was eaten by cormorants. However recent work from Hirsholmene (57.29’N; 10.37’E) a cormorant colony in Kattegat analyzing 350 regurgitated pellets showed that eel otoliths occurred with a frequency of 0.3% (Poul Hald, 2007). The frequency of occurrence of eel otoliths found in cormorant pellets in 2005 was only 0.12% (Sonnesen, 2007) suggesting that wild eels are not important as food in Ringkøbing Fjord (55.55’N;08.20’E). However despite this low occurrence, the estimated number of eels eaten in Ringkøbing Fjord by cormorants in 2004 was 38 000, more individuals than was caught in the fishery, and recovery of cw-tags from 20 000 tagged stocked eels showed a 40% predation from cormorants during the first season (Jepsen *et al*., 2010). Thus cormorant predation can be a very significant factor in areas with a high cormorant density. The number of cormorants in Ringkøbing Fjord is not higher than most coastal areas in Denmark.

Recent analyses of data from ongoing studies of silver eel migration, using PIT tagging, showed that even relative large silver eels can be eaten by cormorants as PIT tags were recovered from nearby colonies and roosting sites. The recoveries may provide a basis for quantification of the predation in future studies.

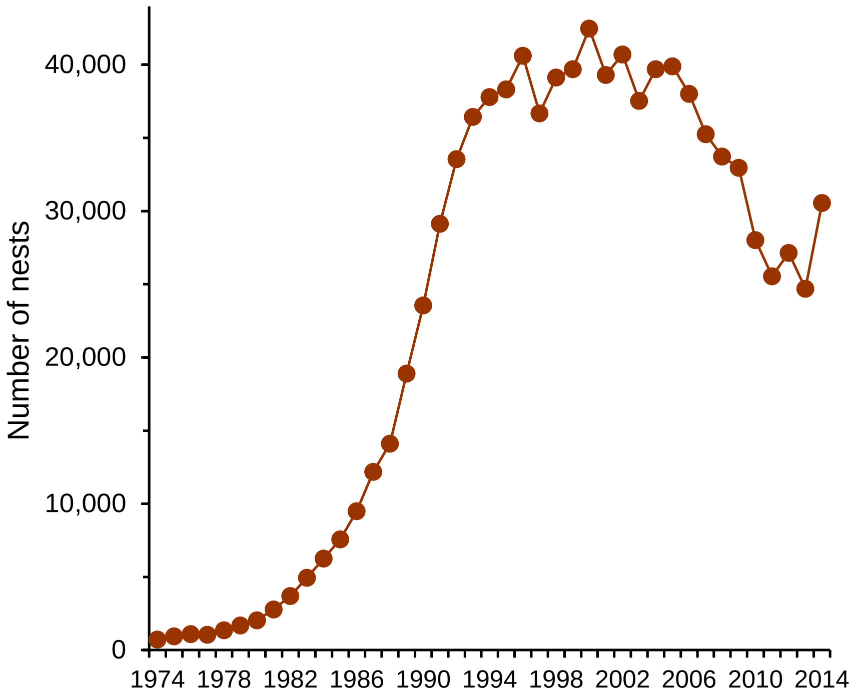


Figure 11.4. Number of cormorant nests in Denmark 1971–2014. Data from NERI. University of Århus.

12 Other sampling

No data.

13 Stock assessment

13.1 Method summary

The methods used to derive the stock indicators are as follows: B_o for rivers is based on production models and mark–recapture studies in three rivers. B_o for lakes is estimated assuming that the production in lakes was twice the catch level of the lakes. $B_{current}$ is estimated the same way but using recent surveys in rivers and lakes. B_{best} is derived by adding known anthropogenic and predation mortality to $B_{current}$.

See Anon, 2012 for further details.

13.2 Summary data

13.2.1 Stock indicators and targets

EMU: DK_Inla 2014

B_o = 1110 tonne

$B_{current}$ = 129.5 tonne

B_{best} = 162.5 tonne

Sigma F = 0.158; H = 0,069; A = 0.227

EMU: DK_marin

50% effort or catch reduction

Restocking is not encountered in estimates of mortality rates. B_{best} has earlier been presented including predation from cormorants (10 tons). The above figure B_{best} is without predation.

13.2.2 Habitat coverage

The present area of inland waters, where eel may be found, is approximately 15 000 ha. of running water and 45 000 ha. of lakes, in total 60 000 ha.

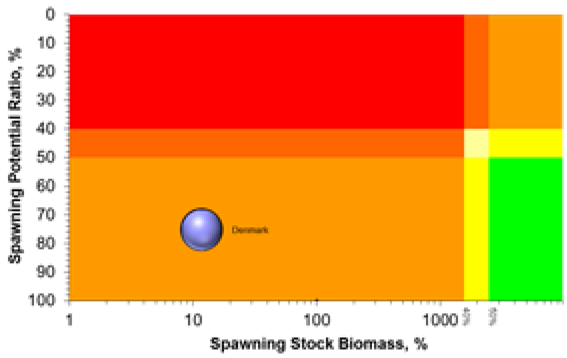
Table 13.2.2. Current escapement from inland waters. mortality factors and Target level.

Inland water	Area (ha)	Silver eel production kg/ha (range)	Total production Tonne (range)
Running water	15 000	7(2–12)	105(30–180)
Lakes	45 000	1.5 (1–2)	67.5(45–90)
Total	60 000		172.5 (75–270)
Mortality (fisheries. hydropower)			33
Current escapement			129.5
Target level–40% prestine.			444

13.2.3 Impacts

Impacts from fisheries hydropower adds up to estimated 33 tonnes. See Table 13.2.2 and Chapter 8 Other anthropogenic impacts.

13.2.4 Precautionary diagram



13.2.5 Management measures

All measures listed in Table 13.2.5 have been implemented in current management of the eel stock.

Table 13.2.5. Management measures planned to be implemented in 2009.

Legal size/ Season/ Selectivity/ Gear / Effort registration	Eel fisheries regulation in accordance with Danish Eel Management Plan EMU: DK_Inla	Eel regulation in accordance with the Danish Eel Management Plan EMU: DK_Marine
Legal size	45 cm minimum legal size for yellow eel	Minimum legal size for yellow eel will be step wise increased from 35,3 cm in 2007 to 38 cm to 40 cm in year 2013
Fishing season	Only fykenets, poundnets, eel traps, longlines and fishing rods are allowed for eel fishing. Eel traps must be made unable to catch eel by 31st December 2013. For licensed commercial fishing activities the number and type of gear must be at 2007 level or lower. Minimum 100 m distance between fyke or poundnets. Type, size and position coordinates of all pile fixed fykenets, poundnets and eel traps must be registered with the Directorate of Fisheries prior to use.	Only licensed commercial fishermen are allowed to use longlines, fykenets and poundnets designed to catch eel in the period from May 10th until July 31st
Selectivity	In lakes, only licensed commercial fishermen are allowed to use a limited number of fyke and poundnets designed to catch eel in the period between October 16th and July 31st. Eel traps allowed in operation only from sunset to sunrise, in the period August 1st until October 15th. All fishing activities with fixed nets in streams are restricted to the period August 1st until October 15th. All eel caught for recreational purposes in fixed gear, between October 16th and July 31st must immediately be returned to the wild. Depending on stock developments all eel fishing activities may be phased out by 31st December 2013.	Minimum 32 mm mesh size (14 x 14 cm) window in rear fykebag. Longlines will be banned from May 1st until September 30th for recreational fishermen. All fykenets and poundnets used for non-licensed fishing activities, targeting species other than eel must be fitted with mesh windows or square openings throughout the fyke, hindering the catch of eel

Legal size/ Season/ Selectivity/ Gear / Effort registration	Eel fisheries regulation in accordance with Danish Eel Management Plan EMU: DK_Inla	Eel regulation in accordance with the Danish Eel Management Plan EMU: DK_Marine
Gear	Minimum 32 mm mesh size (14 x 14 cm) window in rear fykebag. All fykenets and poundnets used in lakes, by non-licensed fishermen, outside the period allowed for eel fishing must be fitted with a mesh window, hindering the catch of eel. Gear must be presented for, registered with and approved by the Directorate of Fisheries.	The use of trawl, seinenets, eelpots, spear, torchlight and all other gear not explicitly described as legal, will be banned. Longlines will be banned from 1st May until 30th September for recreational fishermen. Only fykenets, poundnets, longlines[1] and fishing rods are allowed for eel fishing. Number of gear for all licensed commercial fishing activities must be equal to the level documented in 2007 or lower. Type, size and position coordinates of all pile fixed fykenets and poundnets must be registered with the Directorate of Fisheries prior to use. Recreational fishermen will be allowed to use only six fykenets or three nets during the fishing season. (The pile fixed fykenet will be banned)
Effort registration	All commercial catches and effort information must be reported frequently to the Directorate of Fisheries, according to specifications in licence. Historic catch data and effort must be reported to the Directorate of Fisheries in licence application.	All commercial catches and effort information must be frequently reported to the Directorate of Fisheries, according to specifications in licence conditions. Catch data and effort information (2004–2007) must be reported to the Directorate of Fisheries in licence application.
Stocking	Yes	No

14 Sampling intensity and precision

No data.

15 Standardisation and harmonisation of methodology

No data.

16 Overview, conclusions and recommendations

This report is an update of earlier reports on the eel stock and fishery in Denmark. Time-series data reported include commercial yellow and silver eel landings in marine and inland waters. Recruitment of yellow eel in three river basins using eel pass traps and electrofishing.

Stock indicators are produced by scientific surveys and include estimates of silver eel escapement in the River Gudenå and River Ribe Å and Lake Vester Vandet. These few surveys are up scaled to represent the total Danish inland waters which consist of 887 river basins.

Available data suggest that to meet the 40% target stocking of 3–4 tons of glass eel are needed in inland waters and 33 tons in marine waters.

Eel fisheries are managed according to the EU regulation, aiming at 40% (relative to the prestine) silver eel escapement in freshwater and 50% effort reduction in the marine waters.

All measures listed in the management plan have been implemented in current management of the eel stock.

17 Literature references

Anon. 2012. Danish Report to be submitted in line with Article 9 of Council Regulation (EC) No 1100/2007 of 18 September 2007 establishing measures for the recovery of the stock of European eel. pp17.

Bisgaard J. and& M. I. Pedersen. 1990: Populations- og produktionsforhold for ål (*Anguilla anguilla* (L)) i Bjørnholm å-systemet. D F & H rapport No. 378/1990.

Bisgaard J. and M. I. Pedersen. 1991: Mortality and growth of wild and introduced cultured eels (*Anguilla anguilla* (L)) in a Danish stream, with special reference to a new tagging technique, DANA, vol 9, pp. 57–69.

Hald P. 2007. Skarvernes Fødevalg ved Hirsholmene i årene 2001–2003. http://www.sns.dk/publikat/2001/hirsholmen_skarv_2001_2003.pdf.

Jepsen. N. R. Klenke. P. Sonnesen. T. Bregnballe. 2010. The use of coded wire tags to estimate cormorant predation on fish stocks in an estuary. Marine end freshwater Research. Volume 61. Issue 3. pp. 320–329.

Pedersen M. I. 2002. Monitoring of glass eel recruitment in Denmark. In: Dekker W. (*ed*) Monitoring of glass eel recruitment. Netherlands Institute of Fisheries Research IJmuiden. The Netherlands. report C007/02-WD.Volume 2A. pp. 97–106.

Pedersen M. I. N. Jepsen. K. Aarestrup. A. Koed. S. Pedersen and F. Økland. 2011. Loss of European silver eel passing a hydropower station. J. Appl. Ichthyol. 28. 189–193.

Pedersen. 2012. Ålens passage af Brejnholt dambrug og Vestbirk Vandkraftværk . Passage of eel at Brejnholt Aquacultura and Vestbirk hydropower station (DTU Aqua-repport. in prep).

Rasmussen G. and B. Therkildsen, 1979: Food, Growth and Production of *Anguilla anguilla* L. in a Small Danish Stream. Rapp. P.-v. Reun. Cons. int. Explor. Mer., 174, pp 32–40.

Sonnesen P. 2007. Skarvens prædation omkring Ringkøbing Fjord – en undersøgelse af sammenhænge mellem fødevalg og fiskebestandenes sammensætning. Pp 76 + bilag.

Report on the eel stock and fishery in Estonia 2013/2014

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Reporting Period: This report was completed in November 2014, and the data for 2014 are incomplete.

Contributors to the report: Herki Tuus, Department of Fisheries, the Ministry of the Environment of the Republic of Estonia.

2 Introduction

2.1 General overview

Eel fisheries in Estonia occur in Lake Võrtsjärv (10–100 t) and in coastal waters (1–30 t). Annual catch from small lakes and rivers mostly in L. Peipsi basin is 2–5 t. Eel catches by amateur fishermen constitute about 0,1–0,5 t from brackish waters and about 1–1,5 t from inland waterbodies. According to the fishery statistics during the last decades the total annual catch of eel from Estonian waters was nearly 50 tons, but diminished remarkably during last five years (in 2008 32 tons, 2009 21 tons in 2011 16 tons, in 2013 18 tons). During the first half of previous century eel was very abundant and one of the most important commercial fishes in western coastal waters of Estonia. At that time annual eel catches exceeded hundreds of tons.

Natural eel stocks have never been very dense in Estonian large lakes. The annual catch of eel in 1939 was only 3.8 tons from L. Võrtsjärv and 9.2 tons from L. Peipsi. The construction of the Ivangorod hydropower station in the early 1950s blocked almost totally the natural upstream migration of young eel from the Baltic Sea to the basins of lakes Peipsi and Võrtsjärv. As a result, eel almost disappeared from the fish fauna of Estonian large lakes. Today, thanks to the introduction of glass eels or farmed eels into L. Võrtsjärv, eel has become one of the most important commercial species in this lake. According to studies carried out in 2007 the downstream migration of silver eel through the hydropower station is possible.

Management of eel stock (restocking and fishery) is under the governmental control. The Fishery Department of Ministry of Environment takes care of stocking and local services and Ministry of Agriculture gives out fishing licences. Gear and size restrictions apply in eel fisheries. Since 2011 Lake Võrtsjärv Fisheries Development Agency (FDA) is responsible for stocking.

There are three main eel fishing areas in Estonia:

1) L. Võrtsjärv is a large but very shallow and turbid lake with a surface area of about 270 km^2 and mean and maximum depths of 2.8 m and 6.0 m, respectively. Its drainage basin (Figure EE 2) (3104 km^2, incl. 103 km^2 in Latvia) is situated in the Central Estonia. Eel *Anguilla anguilla* (L.), pikeperch *Sander lucioperca* (L.), northern pike *Esox lucius* L. and bream *Abramis brama* (L.) are the main commercial fishes in the lake. Professional fishing gears are fykenets and longlines are used by recreational fishermen. Every fisherman has own individual licences (number of fishing gear). The eel production of L. Võrtsjärv is entirely based on stocking with glass eels or farmed eels (2–

20 g). During the period 1956–2014 over 50 million eels were stocked. According to the official statistics in 1988, the maximum annual catch of eel exceeded 100 t. In the 1990s, the reported annual catch of eel was 22–49 t, in 2000s 10–37 tons. It was presumably much smaller than real catch (estimated catch was 80% higher). Professional fishermen get nearly half of their incomes from eel, despite the annual investments (>100 000 € annually). Since 2012 fishermen pay 1/3rd of the stocking material and 2/3rds come from different foundations. The tax for fishing licence was invested through the state Foundation of Environmental Investments into stocking material. Due to the changes in fishing law, the number of fishermen increased in the first decade of 2000s. During 1970–1998, the number of professional fishermen varied between 20–25, followed by an increase to 32 in 2003 and over 40 in 2004–2014. The total number of people involved in the fishery of L. Võrtsjärv is estimated to be two times higher.

2) In coastal waters, the Gulf of Riga, the Väinameri, the Gulf of Finland, the catches of eel increased in the beginning of the century (from 3–10 t in 1991–95 to 20–28 t in 1999–2003), but from 2004 decreased again down to 4 t in 2010 and only to 1 ton in 2014. Along the shore of the Baltics eels are caught with bottengarns (poundnets) and fykenets; longlines are also used. As there are hundreds of fishermen in that region, eel is not first-rate fishing object especially during the last five years. That is mostly because eel is regarded as side catch in the large fykenets and thus not significant.

3) Small lakes in Peipsi basin, where eel has migrated from L. Võrtsjärv and was additionally stocked consistently during the last twelve years: in Vooremaa district, L. Saadjärv (707 ha), L. Kuremaa (497 ha) and L. Kaiavere (250 ha) and L. Vagula (519 ha) in South Estonia. In small lakes mostly fykenets and longlines are used for eel fishing.

2.2 WDF and Eel Management Units

According to ordinance of government (RT I 2004, 48, 339) and WFD the territory of Estonia is divided into three basins and nine subbasins. Basins and subbasins are not connected directly with one river, as in European scale Estonian rivers are very small, except River Narva and its watershed area (1/3rd of territory of Estonia and shared with Russia and Latvia). Other more important rivers are River Pärnu, River Kasari and River Gauja, shared with Latvia (not incl. into EMP).

In connection with Eel Management Plan (EMP) Estonian waterbodies were divided into two eel management units on the basis of the formation of eel stock.

1) Narva River Basin District (east Estonian basin); population of eel based entirely on stocking;

2) West Estonian Basin District (coastal waters and west Estonian inland waterbodies); natural population of eel plus certain amount of eel emigrated from stocked waterbodies.

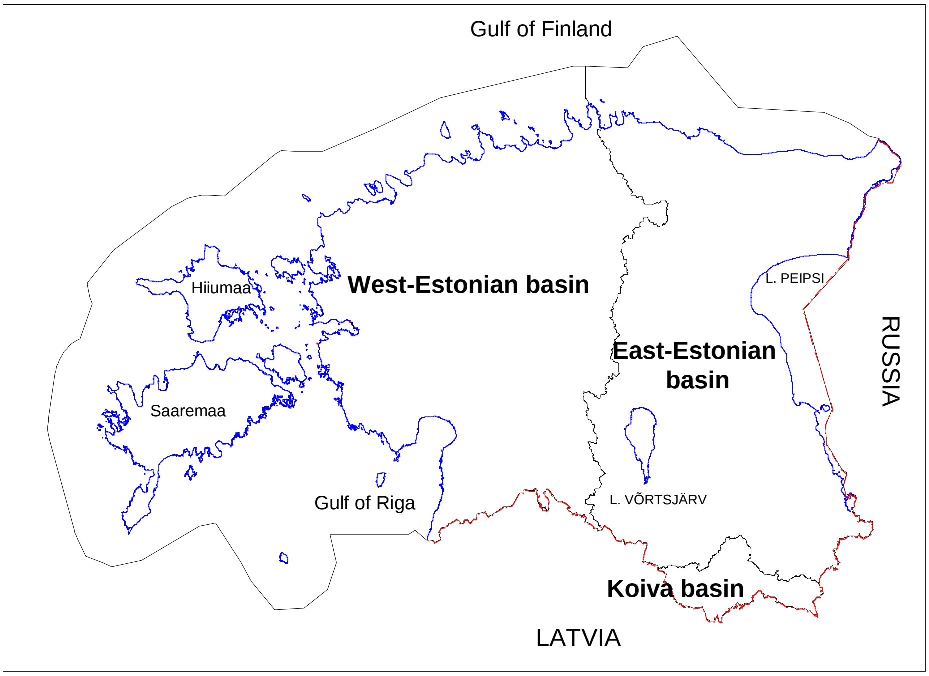

Figure 1. Map of basins.

3 Time-series data

3.1 Recruitment series and associated effort

3.1.1 Glass eel

3.1.1.1 Commercial

Glass eel does not occur in Estonian waters.

3.1.1.2 Recreational

Glass eel does not occur in Estonian waters.

3.1.1.3 Fishery independent

Glass eel does not occur in Estonian waters.

3.1.2 Yellow eel recruitment

Natural recruitment of eel in Estonian waters takes place in stage of young yellow eel. The length of eels migrating upstream to inland water bodies of Estonia was 27–32 cm and age 4–7 years (Herm and Dementjeva, 1949).

No data.

3.1.2.1 Commercial

No time-series are available.

3.1.2.2 Recreational

No time-series are available.

3.1.2.3 Fishery independent

No time-series are available.

3.2 Yellow eel landings

3.2.1 Commercial

No time-series are available as landings of yellow and silver eel are reported together.

3.2.2 Recreational

No time-series are available as landings of yellow and silver eel are reported together.

3.3 Silver eel landings

3.3.1 Commercial

No time-series are available as landings of yellow and silver eel are reported together.

3.3.2 Recreational

No time-series are available as landings of yellow and silver eel are reported together.

3.4 Aquaculture production

At present there are three eel farms in Estonia. The first started with farming of eel at 2000, from where in 2001–2010 the stocking material (young yellow eel 2–20 g) for Estonian lakes was brought.). Since 2011 a new eel farm started in Estonia (100 kg glass eels in 2011 and 300 kg in 2012) and in 2013 started third eel farm (130 kg glass eels).

Table 1. Aquaculture production of eel in Estonia.

2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
10	20	25	40	50	50	45	30	20	25	35	No data

In 2009 was imported 276 kg of glass eels. During the first week in eel farm the total loss was 12 kg and during next three months 2 kg (recalculated in weight of glass eels). Total mortality was 14 kg or 5%. In 2004–2008 the mortality varied between was 2–3% from glass eel to 5 g young yellow eel. In 2010 was imported 180 kg of glass eels, among them 60 kg for stocking into natural water bodies after farming (5 g). In 2011 there was imported 100 kg of glass eels for aquaculture and 206.5 kg for stocking directly into lakes. In 2011 Estonia brought from UK glass eels 306.5 kg of glass eels in total. In 2012 there was brought 271 kg for direct stocking and 387 kg for fish farms, in 2013 accordingly 270 kg for stocking and 330 kg for fish farms.

3.5 Stocking

3.5.1 Amount stocked

Estonia had a state stocking programme of fish, including eel, for years 2002–2010.

In Soviet times, government using the state money organized the stocking. Since the beginning of 1990s 75–100% was financed by fishermen. During the 1990s and beginning of 2000s stocking of eel has been financed fully by local fishermen (>100 000 € per annum). Finances for stocking were collected as licence tax of eel fishing gears (fykenets, longlines) of waterbodies where eel was stocked. Stocking quantities are listed in Tables 7 and 8. Estonia imported glass eel up to 1987 from France, afterwards from England. Young yellow eel (5–20 g) was imported from Germany in 1988 and 1995, from local fish farm in 2002–2010. Young eels were reared previously in a fish farm before stocking into lakes. During the period 2011–2014 the stocking of eel into L. Peipsi basin will supported by EFF up to 255 000 EUR (co-financing up to 1/3 of total annual financing). In 2011 680 000 glass eels were stocked (UK Glass Eels). Since 2012 fishermen pay 1/3rds of the stocking material and 2/3rds come from by Estonian Environmental Foundation. As the market price of glass eel in 2014 was extremely low, there was stocked 900 kg or 3 million of glass eels and 193 000 of ongrown cultured eels into Estonian lakes (Table 2).

In 1956 stocking of glass eels into L. Võrtsjärv was started. However, stocking has been irregular (Table 2**)**. The stocking rate with glass eels in L. Võrtsjärv has been relatively low: annual average in 1956–2000 was about 37 ind.ha^{-1}yr^{-1} with a maximum of 80 ind.ha^{-1}yr^{-1} in 1976–1984. The peak of stocking with glass eels occurred in the early 1980s. As a result, during the following eight–twelve years the catches of eel were the highest, constituting 2.5 kg ha^{-1} yr^{-1}. The maximum catch of this fish in L. Võrtsjärv was recorded in 1988 (104 t or 3.7 kg ha^{-1}). From the end of 1980s the declared annual catch was decreased. Since 2005 in Estonia there was stocked only into lakes named in Table 3.

Table 2. Stocking of glass eel and young yellow eel in the Estonia (in millions).

	1950		1960		1970		1980		1990		2000		2010	2010
Year	glass eel	young yellow eel	glass eel	young yellow eel	glass eel	young yellow eel	glass eel	young yellow eel	glass eel	young yellow eel	glass eel	young yellow eel	glass eel	young yellow eel
0			0,6		1		1,3				1,1			0,21
1							2,7		2			0,44	0,68	0,20
2			0,9		0,1		3		2,5			0,36	0,91	0,12
3							2,5					0,54	0,89	0,13
4			0,2		1,8		1,8		1,9			0,44	3,00	0,19
5			0,7				2,4			0,15		0,37		
6	0,2				2,6				1,4			0,38		
7					2,1		2,5		0,9			0,33		
8			1,4		2,7			0,18	0,5			0,19		
9									2,3			0,42		

Table 3. Stocking number of young yellow eel (10^3) into the lakes of Narva River Basin and stocking density in 2002–2014.

	Area									
Lake	(ha)	2002	2003	2004	2005	2006	2007	2008	2009	2010
Võrtsjärv	27000	285	408	483	330	330	290	175	370	178
Saadjärv	707	50	36	29,4	15	15	10	8,3	20,5	12,5
Kaiavere	250	20	25	22	10	10	10	4,5	12,1	7,5
Kuremaa	397	0	30	11,2	10	10	10	3	7,5	5,3
Vagula	519	6	20	19,6	10	10	8,1	2,6	8,4	5,7

						Stocking density	
Lake	2011	2012	2013	2014	Total	sp/ha	sp/ha/year
Võrtsjärv	154	87	111	164	3365	125	12
Saadjärv	11.6	6.5	7.8	11.8	234	331	33
Kaiavere	6.8	3.9	4.8	7.2	144	575	58
Kuremaa	5.5	3.2	3.6	5.3	105	263	26
Vagula	5.6	3.2	3.9	5.6	109	209	21

Since 2011 there was stocked glass eels and young yellow eel at the same year (Table 3 and 4).

Table 4. Stocking number of glass eel (10^3) into the lakes of Narva River Basin and stocking density in 2011–2014.

	Area						Stocking density	
Lake	(ha)	2011	2012	2013	2014	Total	sp/ha	sp/ha/year
Võrtsjärv	27000	576	769	761	2536	4642	172	43
Saadjärv	707	42	56	55	183	335	474	118
Kaiavere	250	25	34	34	112	205	820	205
Kuremaa	397	19	25	25	82	150	377	94
Vagula	519	20	27	26	87	160	308	77

Table 5. Stocking of glass eels in 1956–2000, yield 1964–2008 and recapture percentage in L. Võrtsjärv.

	Stocking rate		Yield		Recapture	
Stocking			average 8-12 years later		Reported	Estimated
period	sp/ha	sp/ha/year	kg/ha	kg/ha/year	%	%
1956–1960	29	5,7	0,8	0,2	4,9	6,1
1961–1970	156	15,6	11	2,2	12,9	16,1
1971–1980	392	39,2	19,1	1,9	7,0	11,1
1981–1990	585	58,5	14	1,4	4,5	7,4
1991–2000	489	48,9	8,5	0,9	4,2	6,0
Total	1611		53			
Mean		33		1,3	6	8,6

Percentage of re-capture was highest in 1970s (16.7) and lowest in 2000s (6.2) in Lake Võrtsjärv.

Table 6. Stocking of ongrown cultured eels in 2002–2006, yield 2009–2013 and recapture percentage in L. Võrtsjärv.

	STOCKING RATE		YIELD		RECAPTURE	
Stocking			average 7-11 years later		Reported	Estimated
period	sp/ha	sp/ha/year	kg/ha	kg/ha/year	%	%
2002–2006	94	13.4	3,73	0,53	8,8	13,6

In 2013 96% of the catch composition in L. Võrtsjärv were eels stocked in ongrown cultured stage.

3.5.2 Catch of eel <12 cm and proportion retained for restocking

There is no catch of eel <12 cm in Estonia.

4 Fishing capacity

Potential eel fishing gear are dominated by fykenets in coastal waters and in some lakes of the basin. According to fishery law fykenets in coastal waters are divided into four groups: large fykes in deeper open waters, the height of mouth of fykenet is over 3 m; fykenets 1–3 m; fykenets with the height of mouth up to 1 m and small fykes in line. Only small fykes in line are especially focused on eel. Table 7. Number of gear licences (professional) allocated for coastal waters in West Estonian Basin in 2008.

AREA (COUNTY)	IDA-	LÄÄNE-	HARJU-	HIIU-	LÄÄNE-	PÄRNU-	SAARE-		TYPE	CATCH
Type of gear	Virumaa	Virumaa	maa	maa	maa	maa	maa	Total	%	%
Large fyke nets	30	30	80	250	30	487	130	1037	11	37
Fyke nets (1-3 m)*	20	75	61	65	85	131	265	702	7	38,7**
Fyke nets up to 1 m*	12	29	101	1000	70	315	197	1724	18	
Small fyke nets in line	5	5	80	1026	1890	550	1300	4856	50	21
Longlines (100 hooks)	2	25	76	200	130	835	208	1476	15	4
Total	69	164	398	2541	2205	2318	2100	9795		

*** Height of the mouth of fykenet.**

**** Total catch of fykes up to 1 m and 1–3 m mouth height.**

In 2012 the number of gear will be the same as in Table 7, except the number of small fykenets in line (Table 8).

Table 8. Decrease in number of licences of small fykenets in line allocated for coastal waters in West Estonian Basin in 2008–2013.

YEAR	2008	2009	2010	2011	2012	1013
Small fykenets in line	4830	4106	4390	2964	2520	2414
Percentage from average 2004–2006	100	85	72,3	61,4	52,2	50

Table 9. The total catch of eel using different gear from West Estonian Basin in 2014.

Gear	Total catch (t)
Large fykenets	0.39
Fykenets (1–3 m)	0.38
Fykenets up to 1 m	0.05
Small fykenets in line	0.08
Gillnets	0.05
Longlines	0.00

Table 10. Number of fykenet and longline licences (professional) allocated for waterbodies in Narva River Basin in 2008 and 2012.

Type of gear		L. Peipsi	L. Võrtsjärv	Narva R. and res.	Small lakes and rivers	Total
Fykenet	2008	901	324	40	144	1409
	2012	906	324	40	168	1436
Longline	2008	10			26	36
(100 hooks)	2012	10			26	36

Fykenets are potential eel fishing gear in L. Võrtsjärv and small lakes but in L. Peipsi and Narva reservoir fykenets are not used specially for the catch of eel (Table 10).

The number of fykenets in L. Võrtsjärv in 1970s and 1980s was 200–250, in 1990s 300 and from 1998 up to 2004 350. In 2005 the total number of fykenets was reduced to 324 (1.2 fykenets per km^{-2}) (Table 10).

Only longlines and harpoons are used in recreational eel fisheries in Estonia.

Longlines are used only for sport fishing in L. Võrtsjärv. In 2003–2007 fishing effort was 500 fishing nights of 100 hooks per year and mean annual catch was 400 kg. However the annual catch decreased to 190 kg in 2013. In small Vooremaa lakes licensed fishermen have 36 fykenets (2.6 fykenets per km^{-2}) and 3 eel boxes on the outflow. 20 licensed longlines (professional fishery) are not continuously in use. In 2007 there was used totally 40 licences of longlines (100 hooks) in two Vooremaa lakes, L. Saadjärv and L. Kuremaa. Both are clear water lakes and therefore rather popular among underwater hunters. During 2007 there was gave out 150 licences of harpoon and the total catch was 110 kg. In 2013 harpoon catch was 213 kg.

The proportion of recreational catches from total eel catch in inland waters in 2005–2007 was 3.9%. In 2013 the longline eel catches (488 kg) made up 3.1% of total (15.4 t) inland catch numbers.

Eel has a legal (minimum) size: 55 cm in L. Võrtsjärv and L. Peipsi, 50 cm in other Estonian inland waterbodies and 35 cm in coastal waters.

4.1 Glass eel

There is no glass eel fishery in Estonia.

4.2 Yellow eel

4.3 Silver eel

4.4 Marine fishery

5 Fishing effort

5.1 Glass eel

There is no glass eel fishery in Estonia.

5.2 Yellow eel

5.3 Silver eel

5.4 Marine fishery

6 Catches and landings

6.1 Glass eel

There is no glass eel fishery in Estonia.

6.2 Yellow Eel

No distinction in catch statistics has been made between yellow and silver eels. Since 2008 in some of the eel lakes the proportion of silver eel in commercial fykenet catches was estimated.

Table 11. Mean length (TL cm), weight (TW g) and proportion (%) of silver eel in fykenet catches in "eel lakes" of Narva River Basin in Autumn 2008.

Lake	TL cm	TW g	Proportion (%) of silver eel	Number of measured eels
L. Võrtsjärv	58	412	41	199
L. Kuremaa	64	480	50	27
L. Saadjärv	70	608	94	69
L. Kaiavere	72	672	97	40

6.3 Silver eel

50–80% of total eel catch in Estonia based on stocking (Table 12). 80% from registered catch of eel from small lakes and rivers originated from the three lakes (Kaiavere, Kuremaa and Saaadjärv) situated in Vooremaa district.

Table 12. Catch of eel (tons) in different waterbodies of Estonia in 1993–2010 and proportion (%) of stocked eels.

YEAR	BALTIC SEA	L. VÕRTSJÄRV	L. PEIPSI	OTHERS	TOTAL	PROPORTION (%) OF STOCKED EELS
1993	10	49	0,2		59,2	83
1994	10	36,9			46,9	79
1995	6	38,8		0,6	45,4	87
1996	19,7	34,1	0,1	1,2	55,4	64
1997	18,3	40,3	0,5		58,8	69
1998	22,2	21,8	0,2		44,2	50
1999	28,3	36,3	0,2		64,8	56
2000	26,7	38,9	0,2	1,2	67	60
2001	27,1	37,6	0.3	2	65,2	58
2002	27,3	20,4	0,2	2	50,3	46
2003	18,8	26,4	0,2	3,2	48,6	61
2004	15,6	20,1	0,3	3,2	39,2	60
2005	9,4	18,2	0,1	3	30,7	69
2006	9,2	20,3	0,1	3,8	33,5	73
2007	6,3	21,7	0,1	3	31,1	80
2008	5,3	20,5	0,1	4,7	30,6	83
2009	4,4	13,6	0,1	4	22,1	80
2010	3,6	10,3	0,1	4,9	18,8	81
2011	2,2	11,3	0,1	2,6	16,2	86
2012	1,9	12,6		3,2	17,7	89
2013	1,7	12,7		3,0	17,4	90

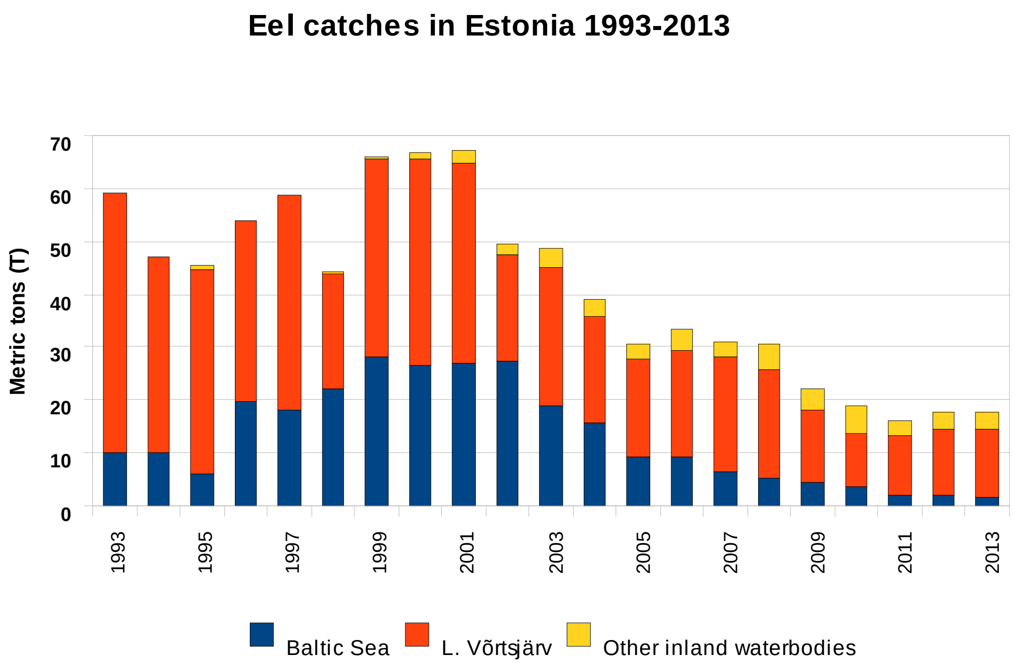

Figure 2. Catch of eel in Estonian waters in 1993–2013.

Table 13. Annual landings (in tons) from Lake Võrtsjärv.

YEAR	1933-1939	1960	1970	1980	1990	2000	2010
0	1,8	0	6,5	17,8	56,1	38,8	10,3
1	Mean	0	6,5	16,5	48,5	37,6	11,3
2		0	16,4	10,8	31	20,4	12,6
3		0	21,3	24,5	49	26,3	12,7
4		3	18,7	66,7	36,9	20,1	
5		0,3	36,9	71,9	38,8	17,6	
6		1,9	49,6	55,6	34,1	19,9	
7		2,7	50	61,2	40,3	20,5	
8		2,9	44,5	103,8	21,8	19,9	
9		5	45	47,6	35,2	12,9	

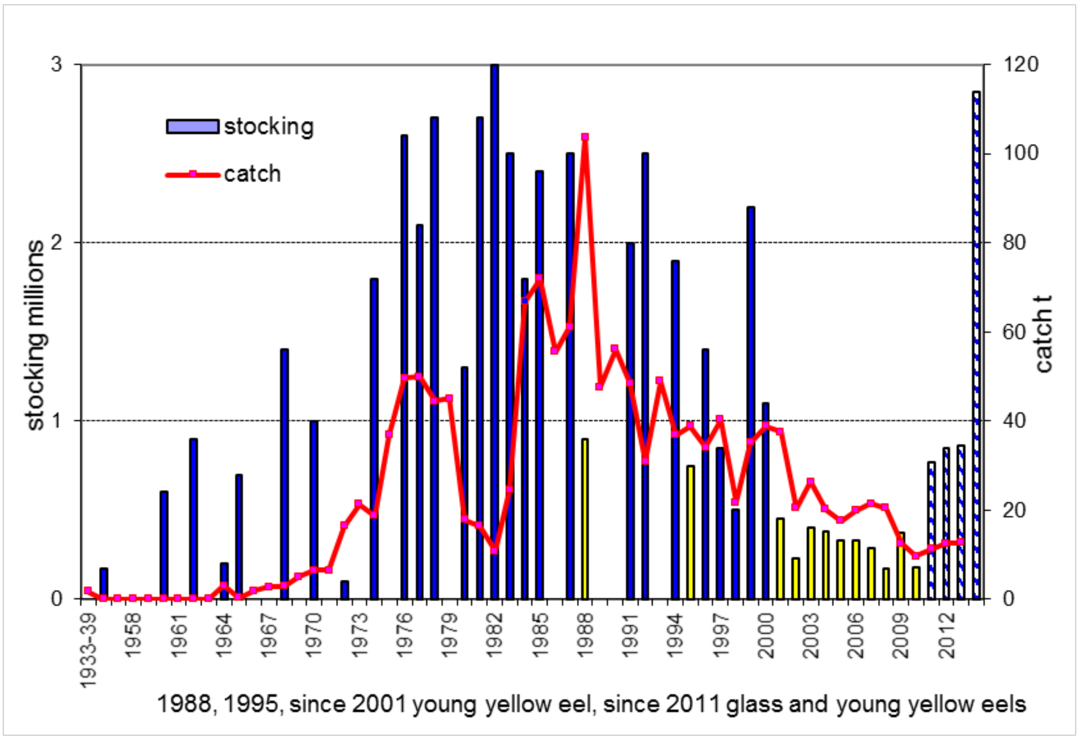

Figure 3. Restocking and catch of eel in L. Võrtsjärv 1933–2014.

6.4 Marine fishery

Eel catches by amateur fishermen, using mostly longlines, constitute totally 0.1–0.5 t from brackish waters and about 0.7–1 t from inland waterbodies. Statistics of non-commercial catches are incomplete.

Table 14. Non-commercial catches (kg) of eel in ICES subdivisions in Estonian coastal waters in 2005–2012.

YEAR	28-5	32	28-2	29-2	TOTAL
2005	230	58	134	57	479
2006	120	24	52	33	229
2007	84	31	69	18	202
2008	73	14	91	21	199
2009	21	4	81	0	106
2010	60	20	51	6	137
2011	25	5	21	13	64
2012	5	3	7	0	15
Total	618	159	506	148	1431
%	43	11	35	10	

7 Catch per unit of effort

7.1 Glass eel

There is no glass eel fishery in Estonia.

7.2 Yellow eel

Data on cpue have only been available for combined commercial and recreational landings of yellow and silver eels.

7.3 Silver eel

Data on cpue have only been available for combined commercial and recreational landings of yellow and silver eels. In logbook every professional fisherman makes records daily, according to specific fishing gear (fykenets, longlines). According to the longline data the natural density of eel population in Estonian lakes outside of Peipsi watershed area was 2–3 times lower. In 2000–2004 the mean annual catch of eel per fykenet in L. Võrtsjärv was 80 kg, in 2005–2008 60 kg and in 2009–2010 only 34 kg.

Table 15. Cpue (catch in grams per 100 hooks per night during June–August) of longlines in inland waterbodies of different river basins (data from 2001–2008).

		Number of			
River basin	cpue g	Longlines	Catch kg	Subbasin	Origin
Amme R.	1758	541,5	952	Peipsi	Stocked
Emajõgi R.	1071	135	145	Peipsi	Stocked
Võhandu R.	368	223	82	Peipsi	Stocked
Väike Emajõgi R.	1218	352	429	Võrtsjärve	Stocked
L. Võrtsjärv	1096	1330	1457	Võrtsjärve	Stocked
Õhne R.	836	44	36,8	Võrtsjärve	Stocked
L. Ermistu	800	4	3,2	Pärnu	Natural/stocked
Pärnu R.	421	67,5	29	Pärnu	Natural
Koiva (Gauja) R.	544	9	5	Mustajõe	Natural
Daugava R.	390	122	48	Mustajõe	Stocked
Salaca R.	0	6	0	Mustajõe	Natural

7.4 Marine fishery

Data on cpue have only been available for combined commercial and recreational landings of yellow and silver eels.

Table 16. Cpue (catch in grams per 100 hooks per night during June–August) of lonlines in coastal waters of Estonia (data from 2001–2008).

Area	cpue g	Number of longlines	Catch kg
Väinameri	635	262	167
Saaremaa	612	489	299
Riga Bay	629	397	250
Mean/Total	623	1148	715

8 IR.G. Scientific surveys of the stock

The fish stock assessment programme of Fishery Department of Ministry of Environment financed Environmental Investments Centre, includes some special projects of eel stock investigations (length and weight, age structure, recapture calculations, tagging, prognoses, limits) in L. Võrtsjärv and in some other inland waters of Estonia.

9 Catch composition by age and length

There is a sampling programme including measuring of length, weight and age determination of eel in L. Võrtsjärv and small lakes. Due to the legal size of eel 55 cm and minimum legal mesh size in the codend of fykenet (18 mm knot to knot) 30–60% of eels in commercial catch in L. Võrtsjärv is silver eel. In Vooremaa lakes this proportion reach up to 80%.

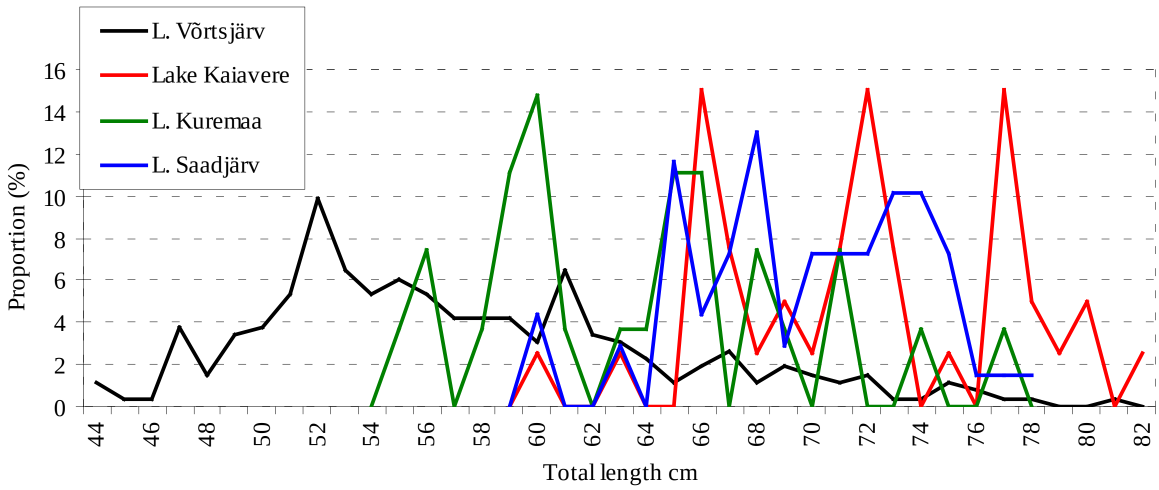

Figure 2. Length distribution of eel in fykenet catches in L. Võrtsjärv and in the lakes of Vooremaa.

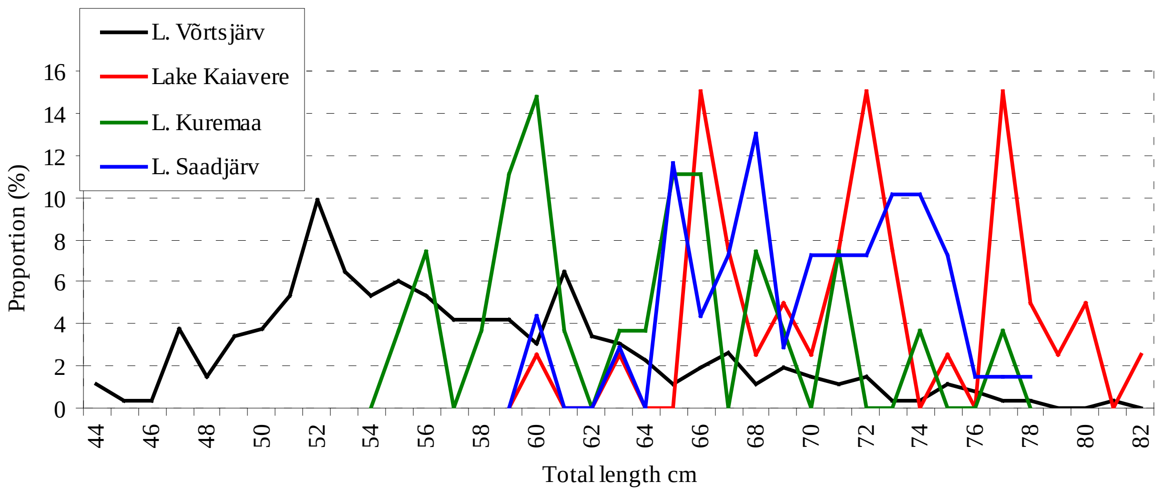

Figure 4. Length distribution of eel in fykenet catches in L. Võrtsjärv and in the lakes of Vooremaa district in Autumn 2008.

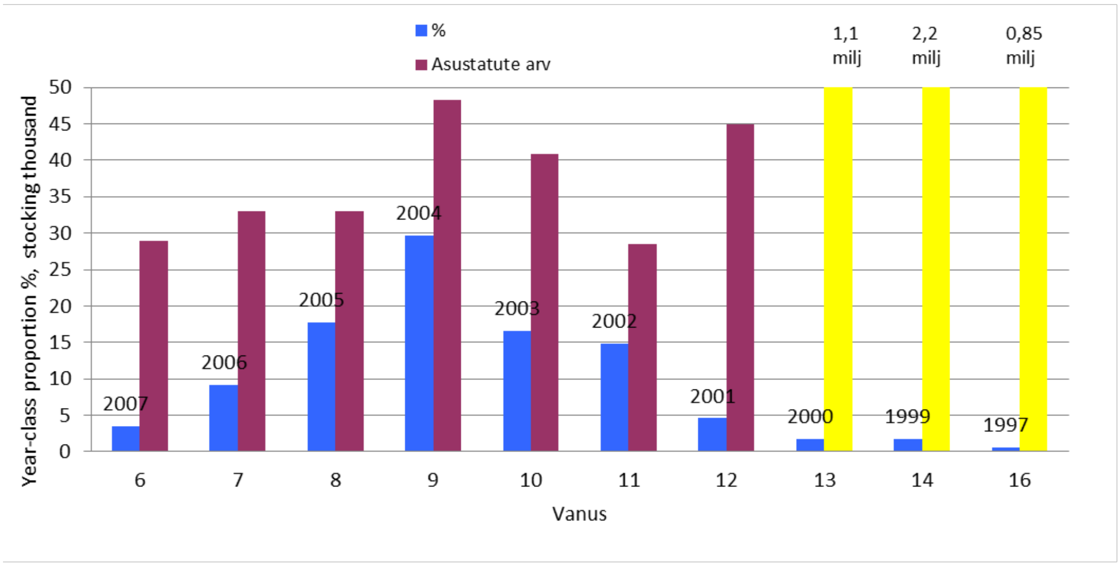

Figure 5. Age composition of eel in fykenet catches in L. Võrtsjärv in 2013 and restocking of farmed (red) and glass eels (yellow columns).

10 IR.I. Other biological sampling

Until the end of 1990s Estonian investigations, based on commercial catches, were focused on stocking and fishing return of eel in L. Võrtsjärv. Since 2001 the catches of yellow and silver eel are examined in many lakes and rivers all over Estonia. Main source of the information for the eel are the official catches and scientific longline, fykenet catches and electrofishing in rivers (multispecies survey in more than 300 stations every year, relative abundance).

10.1 Length & weight & growth (DCR)

There is a sampling programme including measuring of length, weight and age determination of eel in L. Võrtsjärv and in small lakes. The sampling programme from coastal waters has been conducted by Estonian Marine Institute since 1998.

10.2 Parasites & pathogens

There are no routine programmes monitoring parasites and pathogens of eel in Estonia, except special investigations in the end of 1990s, 2002, 2008–2009 and 2014. Two articles were published during this period (see literature).

10.3 Contaminants

There is no sampling related to contaminants and effects on eel in Estonia.

10.4 Predators

During 1999–2003 there was estimated food composition of cormorants in the coastal waters including the proportion of eel.

In 2002–2014 was investigated feeding of pike in winter and the proportion of eel in it.

11 Other sampling

Estonia had the state program for reproduction and re-stocking of fish (2002–2010) including European eel. In connection with this programme we have finished and ongoing scientific studies and monitoring projects concerning eel in Estonia financed by Ministry of Environment, ERDF and EFF:

1) Re-stocking results in small lakes;
2) Food resources of eel in waterbodies suitable for stocking ;
3) The distribution of eel and long-term re-stocking results in L. Peipsi and L. Võrtsjärv basin.
4) Downstream migration of silver eel;
5) Mark–recapture estimation of yellow and silver eel;
6) The Estonian Marine Institute annual data collection from coastal waters using small fykenets in line.

Registration of fishing efforts, investigation of catch composition, etc. is well organised in inland waters, but in coastal waters it should be monitored better.

Positive effect of restocking is clear and it is therefore recommended to continue the existing restocking according restocking programme. There is urgent need for monitoring of restocking results in more detail. In 2014 there was marked chemically the whole amount of farmed eels stocked into Estonian lakes and also glass eels stocked into small lakes. Silver eel migration investigations is necessary to continue and start with a pilot study for quantifying angling catch and effort in coastal waters.

12 Stock assessment

12.1 Local stock assessment

12.1.1 Habitat

12.1.2 Silver eel production

12.1.2.1 Historic production

Historically eel was one of the most important fish species in coastal waters of Estonia. Before the Second World War (1938) the total annual catch of eel in Estonia exceeded 500 tons (Kint, 1940). In 1950s total catch decreased to one hundred ton and continues to decline up to 20 t in the end of 1970s. In 1980s the eel catch increased again up to 30 tons. Shallow coastal waters close to western inlands and Väinameri were most productive areas at that time and there are biggest catches of eel at the present also.

According to A. Kangur (1998) the annual fishing return in L. Võrtsjärv has considerably changed. The specially high values (8,4–8,7%) were noticed in the end of 1970s and in 1980s (5–6,6%). Since the beginning of 1990s until the end of glass eel stocking fishing return decreased (4%). During long-term glass eel stocking period (1965–2001) the effectiveness of stocking (the number of glass eels required to produce 1 kg of eel catch) was 32 (Kangur, 2002). As in this period the legal size of eel was 60 cm and mean weight in fykenet catches was 0,5 kg, there was recaptured one silver eel per 16 stocked glass eels or mean recapture percentage was 6,3.

12.1.2.2 Current production

In spring 2007 was stocked first 81 Carlin-tagged eels over legal size (>55 cm) into L. Võrtsjärv. During the same year was recaptured twelve eels (14,8 %) and annual catch of eel was 21,5 tons. In 2007 mean weight of eel in the fykenet was 430 g and total catch in numbers was 50 thousand. According to the recapture percentage there was over 330 000 eels over mean length at first capture 50 cm in the lake. Similar results from years 2008–2009 (Table 12). On the basis of mark–recapture results approximately 85% of silver eel emigrating L. Võrtsjärv via Emajõgi R. to L. Peipsi and therefore via Narva R. to Gulf of Finnland. As there is not allowed to put fishing gear closer than 200 m from both side of outflow, entrance into river for migrating fish is free. There are 60 fykenets licences in Emajõgi R. (100 km), but 2/3 of riverbed should be let open. According to official statistics the total catch of eel in Emajõgi R. was 50–150 kg yr^{-1} in 1996–2007, in L. Peipsi 30–100 kg yr^{-1} (Table 12). For the calculation of abundance of fishable stock of eel in L. Võrtsjärv and small lakes the Lincoln-Petersen method was used (Ricker, 1975; Pollock jt., 1990).

$$N=(M+1)*(C+1)*(R+1)^{-1}$$

Table 17. The number of tagged and recaptured eels, annual catch in kilos and numbers, total number of eel over mean length at first capture (>50 cm) in fykenet catches in L. Võrtsjärv in 2007–2010.

Lake Võrtsjärv	Marked	Recapture	Recapture	Total catch	Mean	Total catch	Abundance in
Year	**in lake**	**sp.**	**%**	**kg**	**weight sp. g**	**sp.**	**lake (>50 cm)**
2007	112	12	10,7	21 500	430	50 000	466 667
2008	114	12	10,5	19 900	425	46 824	444 824
2009	165	10	6,1	12 580	500	25 160	415 140
2010	142	19	13,4	9 700	421	23 040	172 197
2011	127	20	15,7	11 300	448	25 223	160 167
2012	124	7	5,6	12 100	500	24 200	428 686
2013	109	7	6,4	12 700	562	22 598	351 881
			9,8				348 509
Lake Kuremaa							
2009	93	12	12,9	1 449	367	3 948	30 599
2010	94	14	14,9	1 993	445	4 479	30 071
2011	175	12	6,9	1 007	360	2 797	40 793
2012	231	10	4,3	824	404	2 040	47 115
2013	259	25	9,7	983	393	2 501	25 913
			9,7				34898
Lake Saadjärv							
2009	74	5	6,8	1 153	514	2 243	16 830
2010	86	5	5,8	1 319	601	2 195	24 522
2011	166	7	4,2	1 073	560	1 916	48 164
2012	226	8	2,7	1 367	524	2 609	97 350
2013	199	10	3,0	1 414	407	3 474	115 415
			4,5				60 456
Lake Kaiavere							
2010	39	3	7,7	658	655	1 005	13 060

Lake Võrtsjärv	Marked	Recapture	Recapture	Total catch	Mean	Total catch	Abundance in
2013	12	2	4,6	509	663	768	16 873
			6,1				14966

12.1.2.3 Current escapement

The construction of the hydropower station on the Narva River in the early 1950s blocked the natural path of eel to the waterbodies of L. Peipsi basin. As a result, eel almost disappeared from the fish fauna of Estonian large lakes.

To investigate the downstream migration of silver eel from L. Võrtsjärv and L. Peipsi and their possibility to go through the turbines there was tagged 146 eels. All specimens were tagged with Carlin-type of tags, among them seven specimens with radio telemetric tags. Release of label-tagged eels into Narva water reservoir took place in November 2006 and in June 2007. In spite of low intensity of catch with eel-type fishing gear in Narva River, there were recaptured four label-tagged eels downstream of the station in 2007–2009. One eel was recaptured in Finnish Gulf near the river mouth Purtse. During 2007–2009 three large eels with Carlin tag and one small eel (82 g) have been caught in Danish Straits. The smallest recaptured specimen was brought directly from fish farm and was released into L. Võrtsjärv in 2008. During a year of migration the lost in weight was 44 g (initial weight 126 g). As most of tagged eels were yellow eels, the recapture outside of the lake of release is still low, except Narva reservoir (Table 18, Figure 6).

In November 2007 there was observed also survival and behaviour of seven eels equipped with transmitters after coming through the turbines using manual registration of migration. As minimum four of radio-tagged eels came through the turbines alive and without any damage. Three of them were caught back in Narva R. after two month in winter and one next summer close to island Saaremaa.

During the last years the total catch and the part of natural population of eel in Estonian coastal waters is decreasing, but the proportion of stocked eels caught in Finnish Gulf mostly emigrating Narva RBD, is increasing.

Table 18. Release of tagged eels in Estonian inland water bodies, recapture and repeated recapture in the same lake or outside of the waterbody of release in 2007–2013.

Waterbody of release	Number of tagged eels	First recapture	Second recapture	Third recapture	Total recapture	Percentage of recapture	Recapture outside of waterbody of release
Narva Reservoir	139	8	0	0	8	5,8	7
Ivangorod HPS	7	4	0	0	4	57,1	1
Lake Võrtsjärv	702	88	7	0	95	13,5	5
Lake Saadjärv	339	39	3	0	42	12,3	1
Lake Kuremaa	413	77	8	1	86	20,8	1
Lake Kaiavere	53	6	0	0	6	11,3	0
Lake Vagula	38	3	0	0	3	7,9	0
River Emajõgi	25	1	0	0	1	4,0	1
River Amme	7	1	0	0	1	14,2	1
Total	1723	227	18	1	164	13,6	13

Figure 6. Waterbodies of release (blue - L. Võrtsjärv; red – L. Kuremaa; yellow – Narva reservoir) and recapture of eel outside of Narva RBD.

12.1.2.4 Production values e.g. kg/ha

No information available.

12.1.2.5 Impacts

No information available.

12.1.2.6 Stocking requirement eels <20 cm

In 1988, 1995, 2001–2010 there was stocked only farmed eels, mean weight 1–10 g. In 2011–2014 both glass and farmed eels (Table 2). According to the Estonian EMP, there is requirement to stock at least 0.6 million farmed or 2.5 million glass eels into Estonian lakes. This plan was first time completed in 2014.

12.1.2.7 Data quality issues

No information available.

13 Sampling intensity and precision

No information available.

14 Standardisation and harmonisation of methodology

On the bases cpue of longlines catches in lakes and coastal waters were estimated relative abundance in different areas (Tables 15 and 16).

14.1 Survey techniques

No surveys or samples are done.

14.2 Sampling commercial catches

Section 9.

14.3 Sampling

No surveys or samples are done.

14.4 Age analysis

Section 9.

14.5 Life stages

No surveys or samples are done.

14.6 Sex determinations

No surveys or samples are done.

15 Overview, conclusions and recommendations

The natural status of eel stock in Narva River Basin before the construction of hydropower station was not very abundant (annual catch 1,8 tons L. Võrtsjärv and 3–6 tons L. Peipsi), therefore the contribution into recruitment was tenth of times lower than at present. Due to permanent stocking and rather fetterless downstream migration, the 40% escapement objective of silver eel in Narva River Basin is achieved. On the basis of financing of local fishermen the present escapement capacity exceed the historically natural escapement several times and there is no need of reduction in fishing effort. The main proposal is to increase annual stocking amount of eel in the waterbodies of Narva River Basin and to enhance the stocking with additional financing. The hydroelectric power station lying on Russian side totally hindered the natural pass of eel into Narva River Basin. Therefore without stocking huge area (ca 4000 km^2) of suitable habitat for eel will be cut off for recruitment.

According to tagging and recapture results more than 2% of silver eel escaped from Narva River Basin were caught in Danish Straits.

As in most of fykenets used in coastal waters eel is as bycatch and it consists under the 1% of total, there is no need to diminish the number of licences of those gear, except small fykes in line what are focused on catch of eel. During 2009–2013 the number of licences of small fykes in line where diminished 50%. Catch of eel in West Estonia, mostly in coastal waters, should to be less than 6 tons per year, set in relation to the catches in 2004–2006 (12 tons). Actually, the requirement of 50% reduction in eel catch in maritime areas is followed up to now already as the yield of eel in coastal waters was 1.7 tons, in 2013. In spite of this there will be diminished licences of small fykes 55%.

16 Literature references

Dekker, W. 2003c. Did lack of spawners cause the collapse of the European eel, *Anguilla anguilla*? Fisheries Management and Ecology, 10: 365–376

Herm, A. and Dementjeva, T. 1949. Biologia I promisel ugrja v vodah sovetskoi bribaltiky. Rybnoe hosiaystvo, No 12, 17–22.

Järvalt, A. 1999 Võrtsjärve kalavarude uurimine ja prognoos. [The investigation and prognosis of fish stocks of L. Võrtsjärv] Viljandimaa Keskkonnateenistuse poolt tellitud uurimisprojekti aruanne. [Report] Tartu, 31 lk.

Järvalt, A. 2003 Võrtsjärve kalastiku seisund ja prognoos. [The status and prognosis of fish stocks of L. Võrtsjärv] Viljandimaa Keskkonnateenistuse poolt tellitud uurimisprojekti aruanne. [Report] Tartu, 41 lk.

Järvalt, A. 2004 Angerja asustamise tulemuslikkuse hindamine väikejärvedes. [The estimation of results of stocking of eel in small lakes] Keskkonnaministeeriumi poolt tellitud uurimisprojekti aruanne. [Report] Tartu, 58 lk.

Järvalt, A. 2004 Võrtsjärve kalastiku seisund ja prognoos. [The status and prognosis of fish stocks of L. Võrtsjärv] Viljandimaa Keskkonnateenistuse poolt tellitud uurimisprojekti aruanne. [Report] Tartu, 48 lk.

Järvalt A., Kangur A., Kangur K., Kangur P., Pihu E. Fishes and fisheries management. - In Haberman J., Pihu E., Raukas A. eds. Lake Võrtsjärv, Estonian Encyclopaedia Publishers, 2004, 281–295.

Järvalt, A., Laas, A., Nõges, P.and Pihu, E. 2005. The influence of water level fluctuations and associated hypoxia on the fishery of Lake Võrtsjärv, Estonia. Ecohydrology & Hydrobiology 4, (4): 487–497.

Järvalt, A.; Kask, M.; Krause,T., Palm, A.; Tambets, M.; Sendek, D. 2010. Potential Downstream Escapement of European Eel From Lake Peipsi Basin. 2010 (467, 6), 1–11. http://balwois.com/balwois/administration/full_paper/ffp-1789.pdf

Järvalt, A., Bernotas, P., Silm, M., Kask, M. 2014 Angerjavaru ja rännete hindamine, varu hindamise metoodika tõhustamine siseveekogudel [Estimation of stocks and migration of eel, the intensification of stock estimation methods in small lakes] Euroopa Kalandusfondi 2007–2013 meetme 3.1. projekti aruanne. [EFF project report] Tartu, 45 lk.

Kangur, A. 1998. European eel *Anguilla anguilla* (L.) fishery in Lake Võrtsjärv: current status and stock enhancement measures. Limnologica 28 (1): 95–101.

Kangur, A., Kangur, P. and Kangur K. 2002 The stock and yield of the European eel *Anguilla anguilla* (L.), in large lakes of Estonia. Proc. Estonian Acad. Sci. Biol. Ecol., 51/1: 45–61.

Kangur, A., Kangur, P. and Kangur K., Järvalt, A., Haldna, M. 2010. *Anguillicoloides crassus* infection of European eel, *Anguilla anguilla* (L.), in inland waters of Estonia: history of introduction, prevalence and intensity. Journal of Applied Ichthyology, 26 (2): 74–80.

Kint, P. 1940. Kalandus 1939. Eesti Kalandus, 4/5, 85–102.

Vasilyev, P. A. 1974. The main preconditions for organization of commercial fishing of the eel in Narva River. Izvestija GOSNIORH, 83: 144–152.

Report on the eel stock and fishery in Finland 2013/2014

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Reporting Period: This report was completed in October 2014, and contains data up to 2013 and some provisional data for 2014.

2 Introduction

In Finland eels are on their northeastern limits of natural geographical distribution. Natural eel populations have probably always been very sparse, and the overall importance of the species has been low. In fresh waters only in few areas in southern parts of the country eel has been a target in the recreational fisheries. According to old fishermen the catch and the importance of eel to local fisheries were still high in 1940–1960 in some parts of the Gulf of Finland, mainly in the estuary of the river Kymijoki and east of the city of Kotka. Also in Finnish Archipelago eel was a common species at that time. Almost all rivers running to the Baltic are closed by hydroelectric power plants. Natural eel immigration is possible only in few freshwater systems near the coast and in the coastal areas of the Baltic. Eel populations and eel fisheries in Finnish inland waters depend almost completely on introductions and re-stockings. First introductions were conducted in 1893 but until now the most numerous introductions were made in the sixties and 1970s. During the years 1979–1988 it was not allowed to import eels because eel was detected to be a possible carrier of some viral fish diseases. For this reason it was decided in 1989 to carry on re-stockings only with glass eels reared in a careful quarantine. Since then glass eel originating from River Severn in the UK have been imported through a Swedish quarantine and re-stocked in almost one hundred lakes in southern Finland and in the Baltic along the southern coast of Finland.

Finnish EMP covers the whole Finnish national territory as one eel river basin. It is bounded to the ICES Ecoregion Baltic Sea.

3 Time-series data

3.1 Recruitment-series and associated effort

3.1.1 Glass eel

No glass eel recruitment at all.

3.1.1.1 Commercial

3.1.1.2 Recreational

3.1.1.3 Fishery independent

3.1.2 Yellow eel recruitment

No data.

There is only occasional bycatch in lamprey pots in rivers running to the Baltic Sea, but only few individuals a year.

3.1.2.1 Commercial

3.1.2.2 Recreational

3.1.2.3 Fishery independent

3.2 Yellow eel landings

No data.

3.2.1 Commercial

3.2.2 Recreational

3.3 Silver eel landings

No data.

3.3.1 Commercial

3.3.2 Recreational

3.4 Aquaculture production

No aquaculture production.

3.4.1 Seed supply

3.4.2 Production

3.5 Stocking

3.5.1 Amount stocked

Table 1. Eel stockings in Finland in 1961–2013 (source, type, quantity (number of individuals)).

	Glass eels	Quarantined/on grown glass eels	Bootlace	Origin
1961			53 000	Denmark, Germany
1962			143 000	Denmark, Germany
1963				
1964			83 000	Denmark, Germany
1965			114 000	Denmark, Germany
1966	1 077 000		53 000	France, Denmark, Germany
1967	3 935 000			France
1968	2 803 000		4000	France, Denmark, Germany
1969			35 000	Denmark, Germany
1970			30 000	Denmark, Germany
1971–1974	no	introductions	allowed	
1975			38 000	Denmark, Germany
1976			19 000	Denmark, Germany
1977			30 000	Denmark, Germany

	Glass eels	Quarantined/on grown glass eels	Bootlace	Origin
1978	368 000		12 000	France, Denmark, Germany
1979			75 000	Denmark, Germany
1980-88	no	introductions	allowed	
1989		9700		Swedish quarantine
1990		58 840		Swedish quarantine
1991		108 515		Swedish quarantine
1992		102 450		Swedish quarantine
1993		105 000		Swedish quarantine
1994		103 500		Swedish quarantine
1995		216 600		Swedish quarantine
1996		74 580		Swedish quarantine
1997		82 200		Swedish quarantine
1998		77 550		Swedish quarantine
1999		62 500		Swedish quarantine
2000		61 015		Swedish quarantine
2001		45 500		Swedish quarantine
2002		55 000		Swedish quarantine
2003		0		Swedish quarantine
2004		63 500		Swedish quarantine
2005		64 000		Swedish quarantine
2006		55 000		Swedish quarantine
2007		107 000		Swedish quarantine
2008		206 000		Swedish quarantine
2009		117 500		Swedish quarantine
2010		153 000		Swedish quarantine
2011		306 000		Swedish quarantine
2012		177 000		Swedish quarantine
2013		197 000		Swedish quarantine
2014		147 000		Swedish quarantine

3.5.2 Catch of eel <12 cm and proportion retained for restocking

There are no eels less than 12 cm long in the catch. The smallest individuals ever caught in Finland have been about 20 cm long.

3.5.3 Reconstructed time-series on stocking

	Local Source				Foreign Source			
Year	Glass Eel	Quarantined Glass Eel	Wild Bootlace	On-grown cultured	Glass Eel	Quarantined Glass Eel	Wild Bootlace	On-grown cultured
1893							82	
1900							75	
1909							48 000	
1911					90 000		4 513	
1926							2 850	
1954							6 000	
1956							8 000	
1957							2 000	
1961							53 000	
1962							143 000	
1964							83 000	
1965							114 000	

	Local Source				Foreign Source			
Year	**Glass Eel**	**Quarantined Glass Eel**	**Wild Bootlace**	**On-grown cultured**	**Glass Eel**	**Quarantined Glass Eel**	**Wild Bootlace**	**On-grown cultured**
1966					1 077 000		53 000	
1967					3 935 000			
1968					2 803 000		4 000	
1969							35 000	
1970							30 000	
1975							38 000	
1976							19 000	
1977							30 000	
1978					368 000		12 000	
1979							75 000	
1989						9 700		
1990						58 840		
1991						108 515		

	Local Source				Foreign Source			
Year	Glass Eel	Quarantined Glass Eel	Wild Bootlace	On-grown cultured	Glass Eel	Quarantined Glass Eel	Wild Bootlace	On-grown cultured
1992						102 450		
1993						105 000		
1994						103 500		
1995						216 600		
1996						74 580		
1997						82 200		
1998						77 550		
1999						62 500		
2000						61 015		
2001						45 500		
2002						55 000		
2004						63 500		
2005						64 000		

	Local Source				Foreign Source			
Year	Glass Eel	Quarantined Glass Eel	Wild Bootlace	On-grown cultured	Glass Eel	Quarantined Glass Eel	Wild Bootlace	On-grown cultured
2006						55 000		
2007						107 000		
2008						206 000		
2009						117 500		
2010						153 000		
2011						306 000		
2012						177 000		
2013						197 000		
2014						147 000		

3.6 Trade in eel

No data.

4 Fishing capacity

There are no exact data available but for the professional fisheries eel is of no importance. Some semi-professional fishermen may have minor income from eels mainly as a bycatch. Therefore the recreational fisheries mainly catch the eel. The number of recreational fishermen in Finland is high but only a very small portion of those catch eels as a main target (with fykenets, longlines, angling, spears, etc.). For most of the people eel is a surprising bycatch.

4.1 Glass eel

4.2 Yellow eel

4.3 Silver eel

4.4 Marine fishery

5 Fishing effort

No data.

5.1 Glass eel

Not pertinent.

5.2 Yellow eel

5.3 Silver eel

5.4 Marine fishery

6 Catches and landings

The re-stockings in the late sixties and in 1970s gave a catch of 60–80 tonnes a year in the end of 1970s and the beginning of 1980s (Pursiainen and Toivonen, 1984). Introductions and re-stockings ceased in 1979, which caused a radical reduction in the annual eel catch (Table 2). After the year 1986 the catch was so low that the eel was not detected as a species in the official statistics, but included mainly into the group "other species". Pursiainen and Toivonen (1984) found out that 1000 stocked individuals/year in freshwaters in Southern Finland gave a catch of 90 kg/year about ten years later. Using the same figures the re-stockings after 1990 probably should give nowadays a catch between 5–10 tonnes/year.

Table 2. Eel (yellow and silver altogether) catches in Finland 1976–2013 (x1000 kg). The statistical data are collected by the FGFRI. Figures in the professional fisheries columns are based in marine fisheries on annual logbook data and in freshwater fisheries on questionnaires made every second year. In recreational fisheries figures are based on data collected by questionnaires every second year.

	Marine fisheries		Freshwater fisheries		
Year	Professional	Recreational	Professional	Recreational	Total catch
1976	4	15	2	7	28
1977	2	14	2	45	63
1978	1	14	2	60	77
1979	2	14	2	59	77
1980	2	14	3	60	79
1981	1	8	2	28	39
1982	1	8	1	28	38
1983	1	8	1	28	38
1984	1	4	1	22	28
1985	1	4	1	22	28
1986	1	4	2	49	56
1987	0,2	NC	0	NC	min 0,2
1988	0,4	NC	0	NC	min 0,4
1988–1995	ND	NC	0	NC	?
1996	ND	1	0	21	min 22
1997–2002	ND	NC	ND	NC	?
2003	0,4	NC	NC	NC	min 0,4
2004	1,1	ND	0	ND	min 1,1
2005	0,4	NC	NC	NC	min 0,4
2006	0,2	ND	0	ND	min 0,2
2007	0,5	NC	NC	NC	min 0,5
2008	1	13	0	4	17
2009	1,8	NC	NC	NC	min 1,8
2010	2,2	1	0	9	12,2
2011	2	NC	NC	NC	min 2,0
2012	2	2	0	3	7
2013	1	NC	NC	NC	min 1,0

6.1 Glass eel

Not pertinent.

6.2 Yellow eel

No data.

6.3 Silver eel

No data.

6.4 Marine fishery

See Table 2.

6.5 Recreational fishery

See Table 2.

Recreational Fisheries: Retained and Released Catches

	Retained				Released			
	Inland		Marine		Inland		Marine	
Year	Angling	Passive Gears	Angling	Passive gears	Angling	Passive gears	Angling	Passive gears

Provide the catch and release mortality (%) used in your country for angling in marine and inland waters.

Recreational Fisheries: Catch and Release Mortality

	Released			
	Inland		Marine	
	Angling	Passive gears	Angling	Passive gears
Year				

6.6 Bycatch, underreporting, illegal activities

Most of the eel catch is bycatch. This year (2014) it was the first time ever when illegal fishing activities were discovered. A group of fishermen was caught in action catching eel with longlines without a licence in the Vanajavesi watercourse near Hämeenlinna. Their catch was estimated to have been about 100–150 eels in this summer. They were also suspected of catching eels illegally in previous years (2012–2013) as smoked eels were sold in Facebook by them also at that time. The fishermen were not Finns and the activity seemed to be rather well organized. As the total catch of eels in freshwaters in Finland is low (according to a questionnaire 3 t in 2012) the role of this single group might have been remarkable. Their catch in that particular year might have been about 4–5% of the total catch. Otherwise illegal fishing is not significant because there is enough chance to catch eels legally if you wish.

7 Catch per unit of effort

No data.

7.1 Glass eel

7.2 Yellow eel

7.3 Silver eel

7.4 Marine fishery

8 Other anthropogenic impacts

No data.

9 IR.G. Scientific surveys of the stock

9.1 Recruitment surveys, glass eel (includes yellow eel in Scandinavia)

No data.

9.2 Stock surveys, yellow eel

No data.

9.3 Silver eel

DIDSON has been used in autumns in 2011 and 2012 and in spring in 2013 to monitor downstream migration of silver eels in Nokia in the upper reaches of the Kokemäenjoki watercourse above the uppermost dam. In autumn 2013 monitoring was done in Pämpinkoski downstream the same watercourse below the five electrical powerplants. Observations are presented in the table below.

Date	Observed ind.	mean length, cm	Range, cm
Nokia			
12.9–11.10.2011	221	90,5	63–123
27.9–8.11.2012	314	85,6	51–111
17.4–13.5.2013	98	89,1	61–115
Pämpinkoski			
11.9–23.10.2013	122	81,8	47–112

10 Data collected for the DCF

According to Finnish National Programme for data collection, no stock-related biological eel data (e.g. length–weight data or samples for ageing) are collected from the Finnish catches. There is no targeted professional or recreational eel fisheries in Finland, and catches are few and very scattered in time and space, so that sampling would consume too much time and resources. Data on eel catches in recreational fisheries are collected as part of the Finnish DCF every second year and reported to WGEEL. Eel catches in professional fisheries are negligible.

11 Life history and other biological information

During 1974–1994 over 2000 eels were collected in thirty lakes and in some lake outlets in southern Finland. Length, weight, eye diameter, colour of the sides and belly, sex and weight of the gonads (not always) were determined and after 1986 also swimbladders were examined for *Anguillicola*. Age and growth were also determined. The aim of the study was to evaluate the biological outcome of eel stockings made in 1960s and

1970s and to estimate the yield to fishery and the proportions of eels escaping the lakes. The results were published mainly in 1980s (Pursiainen and Toivonen, 1984; Pursiainen and Tulonen, 1986; Tulonen, 1988; Tulonen, 1990; Tulonen and Pursiainen, 1992). The concentrations of radionuclides ^{134}Cs and ^{137}Cs and PCB in eels were also investigated (Tulonen and Saxen, 1996; Tulonen and Vuorinen, 1996).

There were no routine biological sampling programmes or eel research projects during 1994–2005. Some occasional samples were taken in few lakes on the author's personal interest. Also in some small water systems silver eel escapement has been monitored since 1974 (one place), 1980 (two places) and 1989 (two places) with eel boxes in the outlets. Eels in the lakes have been re-stocked there in 1967, 1978 and 1989 respectively. One sample of "natural" elvers has been collected in 2002 in southwest Finland and on the coast of the Bothnian Bay. One third of the elvers were infected with *Anguillicola*. This was the first time *Anguillicola* ever found in Finland (Tulonen, 2002).

In 2006 a four year study on the biological and economical outcome of eel stockings made since 1989 and on the state of natural eel stocks was established in FGFRI. The main goal was to compile the facts and other biological data about eels in Finland to the Eel Management Plan. In the study some sampling was also done in ten lakes in southern Finland and in eight areas in the Baltic along the coasts of Gulf of Finland and Bothnian Bay and in the rivers running into them. Due to sparse populations the sample sizes are only in few cases big enough (>100 ind.) to make any scientific evaluations. Since 2010 there has been sampling only in the most interesting locations.

11.1 Growth, silvering and mortality

Data not yet processed.

11.2 Parasites and pathogens

Data not yet processed.

11.3 Contaminants

11.4 Predators

12 Other sampling

No data.

13 Stock assessment

No data. There is no routine assessment of local stocks. Neither there is any formal advice on fisheries management.

13.1 Method summary

No data.

13.2 Summary data

13.2.1 Stock indicators and Targets

No data.

EMUcode	Indicator	biomass (t)	Mortality (rate)				Target		
	B_0	B_{best}	B_{curr}	∑A	∑F	∑H	Source	Biomass (t)	∑A (rate)
XY_abcd							EMP		
							EU Reg		
							WGEEL		
XY_abcd							EMP		
							EU Reg		
							WGEEL		

13.2.2 Habitat coverage

Terms used in the EMP to define natural habitats for the eel were:

-outlet of the river basin is in Finland's national territory

-there has been natural immigration of elvers before the damming of the rivers

-there have been considerable stockings lately

-there has been regular eel fishery

On the grounds of the terms two categories with few subcategories were defined:

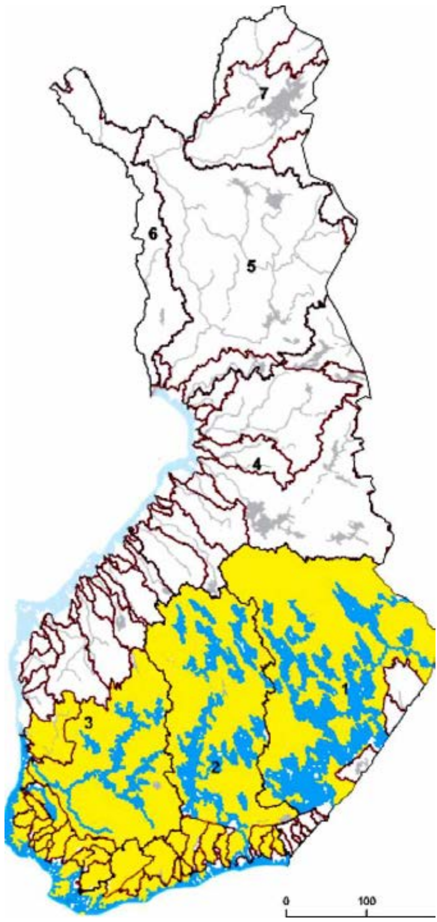
A) Area of free migration includes all coastal waters of the Baltic and the inner archipelago to the depth of ten meters and the few small undammed river basins running to the Baltic. The area was subdivided into two categories:

a) Reserve area (the Bothnian Bay area) where eels exist but for climatically and geographical reasons have always been very rare. Light blue area in the map. Total area is 1783 km².

EMU code Aa.

b) Main management area for the eel (the Gulf of Finland and the small undammed river basins running to it). Deep blue coastal area in the map Total area is 4677 km² for the coastal area and 382 km² for the small river basins. According to EMP stockings in this area compensates in the long run the loss of silver eels in freshwaters.

EMU code Ab



B) Area where immigration of elvers is totally prevented because of the dams and the hydroelectric turbines in the dams have a severe negative effect on the escapement of silver eels. This area includes three major freshwater river basins; Vuoksi (number 1 in the map), Kymijoki (number 2) and Kokemäenjoki (number 3), and also some small water basins running to the Baltic. Yellow area in the map, main lakes in the area are coloured in deep blue. Total area is 20 509 km². No management actions take place in this area.

EMU code B

EMU code	River		Lake		Estuary		Lagoon		Coastal	
	Area (ha)	A'd Y/N)	Area (ha)	A'd Y/N)	Area (ha)	A'd Y/N)	Area (ha)	A'd Y/N)	Area (ha)	A'd Y/N)
Aa									178 300	N
Ab									467 400	N
Ab			38 200	N						
B			2 050 900	N						

13.2.3 Impact

EMU code	Habitat	Fish com	Fish rec	Hydro & pumps	Barriers	Restocking	Predators	Indirect impacts
Aa	Coa	AB	AB	MI	MI	MI	MI	MI
Ab	Lak	AB	MI	AB	AB	MA	MI	MI
Ab	Coa	MI	MI	AB	AB	MA	MI	AB
B	Lak	AB	MI	MA	MA	MI	MI	MI
	All							

No data

EMU code	Stage	Fish com	Fish rec	Hydro & pumps	Barriers	Restocking	Predators	Indirect impacts
XY_abdc	Glass							
	Yellow							
	Silver							
	Silver EQ							

13.2.4 Precautionary diagram

No data.

13.2.5 Management measures

EMU code	Action Type	Action	Life Stage	Planned	Outcome
Aa	Com Fish	no			
	Rec Fish	no			
	Hydropower & Pumps	no			
	Restocking	no			
	Other	no			
Ab	Com Fish	catch statistics, log book		yes	yes
	Rec Fish	catch statistics, questionaires		yes	yes
	Hydropower & Pumps	no			
	Restocking	yes	quarantined glass eel	537 999/year	partly
	Other	no			
B	Com Fish	no			
	Rec Fish	no			
	Hydropower & Pumps	no			
	Restocking	no			
	Other	no			

13.3 Summary data on glass eel

No glass eel caught in Finland. All glass eels or on-grown eels are imported and used for stockings in Finland (100%).

14 Sampling intensity and precision

No data available yet. Only a small fraction of the data has been analysed.

15 Standardisation and harmonisation of methodology

15.1 Survey techniques

No data.

15.2 Sampling commercial catches

No data.

15.3 Sampling

Done by FGFRI since 1974 with long lines and fykenets in lakes and eel traps in the rivers. In 2006–2009 samples were collected in fresh waters with the help of local recreational fishermen and in the sea by few professional fishermen. Fish have been collected mainly alive from the fishermen but occasionally also as frozen. In few cases the fishermen have measured (weight and length) the fish and delivered the head and the guts together with the length–weight data to FGFRI where otolihs have been removed and swimbladder examined for Anguillicola.

For every fish the following information has been collected:

Catching date and killing date

Catching site

Fishing gear

Length

Weight

Sex

Colour (sides and belly)

Diameter of the eye

Weight of the gonad (only occasionally)

Anguillicola (no/yes, how many, size)

15.4 Age analysis

So far when age analysis has been done grinding and polishing method has been used, Swedish style as described in ICES WKAREA Report 2009 in Bordeaux. Lately also cutting slices with otolith saw and etching using EDTA and staining using neural red has been tried out.

15.5 Life stages

Silver eel: side silver or copper, glossy, belly white and glossy.

Yellow eel: sides brown, grey, green, not glossy, belly brown, green, grey, yellow, not glossy.

15.6 Sex determinations

From macroscopic examination of the gonads, confirmed by length and colour.

15.7 Data quality issues

16 Overview, conclusions and recommendations

In the EMP there are some recommendations for the research:

1) The natural distribution of eel in Finland and the state of this natural stock has to been examined and followed regularly;

2) Eel have to be taken as a species in the catch statistics both in recreational and professional fishery;

3) Research has to be carried out to find out the biological outcome of the stockings conducted according to the EMP. Natural and fishing mortality and especially recruitment of yellow eels to silver eels and the success of silver eel migration have to be studied;

4) *Anguillicola* infection level should be investigated in the natural and introduced eel populations.

Only the recommendation number 2 has been fulfilled and some aspects of recommendations 3 and 4.

17 Literature references

Pursiainen M. and Toivonen J. 1984. The enhancement of eel stocks in Finland; a review of introduction and stockings. EIFAC Technical Paper No. 42, Suppl., 1:59–67.

Pursiainen M. and Tulonen J. 1986. Eel escapement from small forest lakes. Vie Milieu 36 (4): 287–290.

Tulonen J. 1988. Ankeriaan ikä, sukupuolijakaumat ja kasvu eräissä eteläsuomalaisissa järvissä. (Age, sex ratio and growth of eels in some lakes in southern Finland). Rktl, Monistettuja julkaisuja 81: 1–106.

Tulonen J. 1990. Growth and sex ratio of eels (*Anguilla anguilla*) of known age in four small lakes in southern Finland. Abstract in: Int. Revue ges. Hydrobiol. 75: 792.

Tulonen J. and Pursiainen M. 1992. Ankeriasistutukset Evon kalastuskoeaseman ja kalanviljelylaitoksen vesissä. (Eel stockings in the waters of the Evo State Fisheries and Aquaculture Research Station) Suomen Kalatalous 60:246–261.

Tulonen J. and Saxen R. 1996. Radionuclides ^{134}Cs and ^{137}Cs in eel (*Anguilla anguilla* L.) in Finnish freshwaters after the accident at Chernobyl nuclear power station in 1986 Arch. Ryb. Pol. 4:267–275.

Tulonen J. and Vuorinen P. 1996. Concentrations of PCBs and other organ chlorine compounds in eels (*Anguilla anguilla*, L.) of the Vanajavesi watercourse in southern Finland, 1990–1993 The Science of the Total Environment 187 (1996): 11–18.

Tulonen J. 2002. *Anguillicola crassus* tavattu ensikerran Suomessa (*Anguillicola crassus* found in Finland). Suomen Kalastuslehti 4(2002):36–37.

Report on the eel stock and fishery in France 2013/2014

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Reporting Period: This report was completed in October 2014, and contains data up to 2013 and some provisional data for 2014.

2 Introduction

2.1 Presentation of eel fisheries in France

The French eel fisheries occur mainly in inland waters (rivers, estuaries, ponds and lagoons) but also in coastal waters (see Figure FR 1 and Table FR 1). The glass eel fisheries are more important in the Bay of Biscay region but they are also found in the Channel region. The yellow eel fisheries occur in the same areas and concern also the upper parts of the rivers of the Atlantic coast, the Rhine and tributaries. The Mediterranean lagoons produce the most part of yellow eels and bootlace eels are targeted for exportation towards Italy. Silver eel fisheries are limited to some rivers, mostly in the Loire basin and in the Mediterranean lagoons.

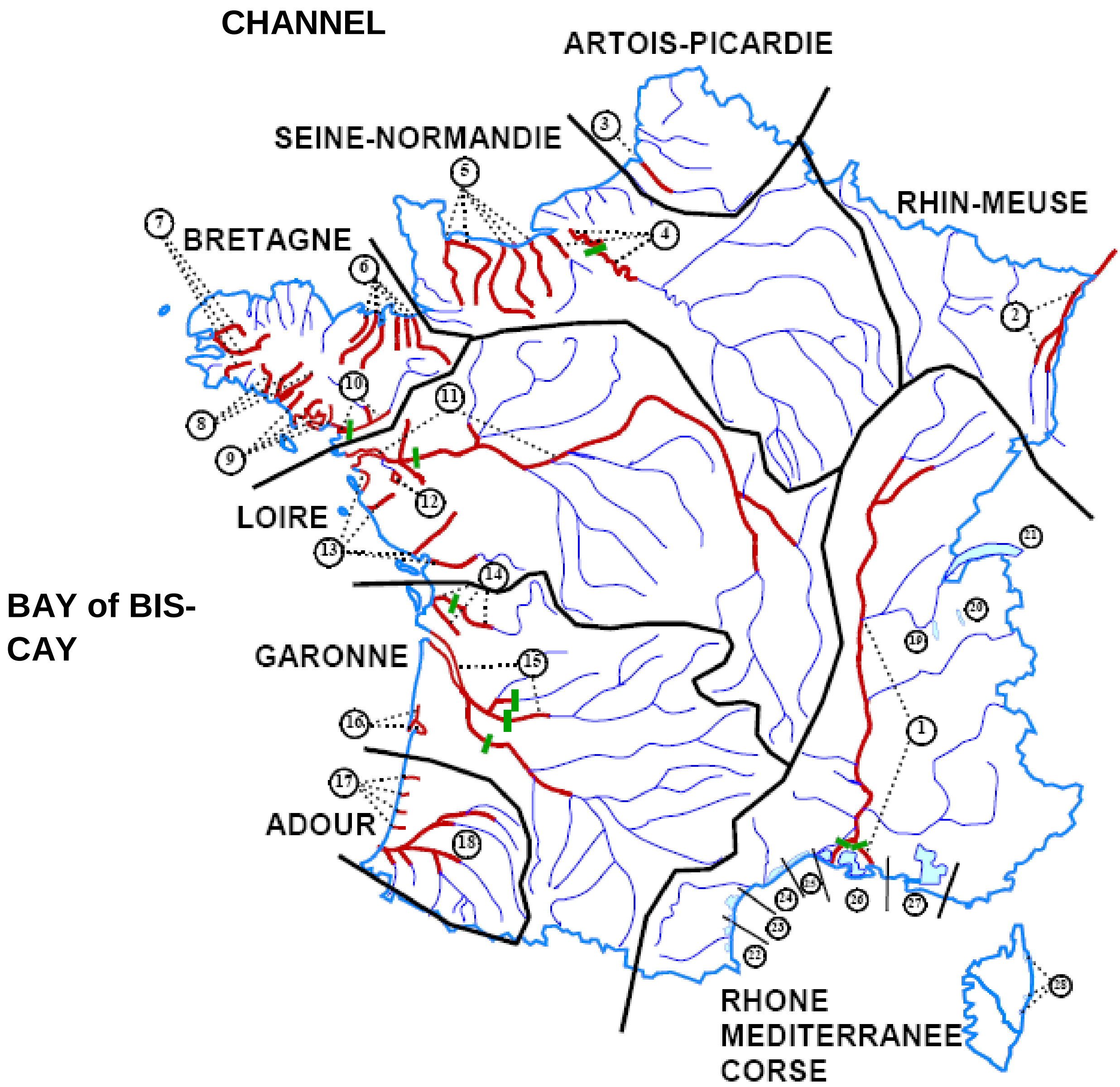


Figure FR 1. Inland waters in France (eel fisheries in red; tidal limits in green). The number correspond to the list of fishing zones in Table FR. The management unit names and limits are in black (redrawn from CASTELNAUD, 2000).

From 1999 to 2001, the total number of professional fishermen fishing eel, seeking one or several stages, was about 1800 with an estimated total catch of 200 tons of glass eels and 900 tons of yellow or silver eels (Castelnaud and Beaulaton, unpublished data).

Illegal fishermen are targeting glass eels in the tidal parts of rivers and other stages in whole France including sometimes for commercial purpose. Their number and the amount of their catches had never been clearly quantified.

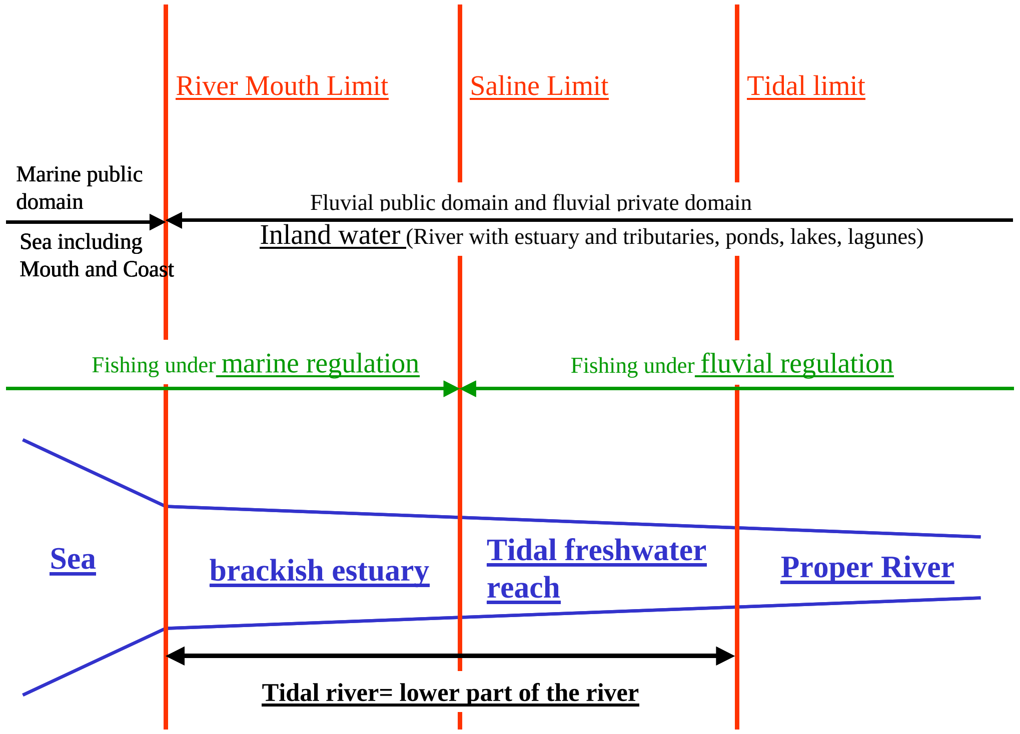
Table FR 1. Fishing zones in French inland waters related to the 8 management units (COGEPOMI) (modified from CASTELNAUD *et al.*, 2000, unpublished data).

(Number from Figure FR) Fishing zone – Surface for lagoons	COGEPOMI
(1) Delta du Rhône	Rhône-Méditerranée Corse
(1) Fleuve Rhône aval et amont, Saône, Doubs	Rhône-Méditerranée Corse
(2) Fleuve Rhin, Ill	Rhin Meuse
(3) Estuaire Somme	Artois-Picardie
(4) Estuaire Seine, Fleuve Seine aval	Seine Normandie
(4) Fleuve Seine amont, Risle	Seine Normandie
(5) Estuaires Touques, Dives, Orne, Aure, Vire	Seine Normandie
(6) Estuaires Couesnon, Rance, Fremur, Arguenon, Gouessan, Gouet	Bretagne
(7) Estuaires Elorn, Aulne, Odet	Bretagne
(8) Estuaires Laïta, Scorf, Blavet	Bretagne
(9) Rivières d'Etel, d'Auray, de Penerf, Golfe du Morbihan	Bretagne
(10) Estuaire Vilaine aval	Bretagne
(10) Estuaire Vilaine amont, Fleuve Vilaine aval, Oust, Chere, Don	Bretagne
(11) Estuaire Loire, Loire aval, Erdre, Sèvre Nantaise	Loire
(11) Fleuve Loire amont, Maine, Mayenne, Allier	Loire
(12) Lac de Grand-Lieu	Loire
(13) Baie de Bourgneuf, Estuaires Vie, Lay, Sèvre Niortaise	Loire
(14) Estuaire Charente, Fleuve Charente aval, Estuaire Seudre	Garonne
(14) Fleuve Charente amont	Garonne
(15) Estuaire Garonne, Garonne aval, Dordogne aval, Isle	Garonne
(15) Fleuve Garonne amont, Dordogne amont	Garonne
(16) Canal de Lège	Garonne
(16) Delta d'Arcachon	Garonne
(17) Courants de Mimizan, Contis, Huchet, Vieux-Boucau	Adour
(18) Estuaire Adour, Fleuve Adour, Nive, Bidouze, Gaves de Pau et d'Oloron, Luy	Adour
(19) Lac du Bourget	Rhône-Méditerranée Corse
(20) Lac d'Annecy	Rhône-Méditerranée Corse
(21) Lac Léman	Rhône-Méditerranée Corse
(22) Etang de Canet - 480 ha	Rhône-Méditerranée Corse
(22) Etang de Salses Leucate - 5800 ha	Rhône-Méditerranée Corse
(23) Etang de Lapalme - 600 ha	Rhône-Méditerranée Corse
(23) Etang de Bages-Sigean - 3700 ha	Rhône-Méditerranée Corse
(23) Etang de Campignol – 115 ha	Rhône-Méditerranée Corse
(23) Etang de l'Ayrolle – 1320 ha	Rhône-Méditerranée Corse
(23) Etang de Gruissan – 145 ha	Rhône-Méditerranée Corse
(24) Etang de Thau – 7500 ha	Rhône-Méditerranée Corse
(25) Etang d'Ingril – 685	Rhône-Méditerranée Corse
(25) Etang de Vic – 1255 ha	Rhône-Méditerranée Corse
(25) Etang de Pierre- Blanche – 371 ha	Rhône-Méditerranée Corse
(25) Etang du Prévost – 294 ha	Rhône-Méditerranée Corse
(25) Etang de l'Arnel – 580 ha	Rhône-Méditerranée Corse
(25) Etang du Grec – 270 ha	Rhône-Méditerranée Corse
(25) Etang Latte-Méjean – 747 ha	Rhône-Méditerranée Corse
(25) Etang de l'Or – 3200 ha	Rhône-Méditerranée Corse
(26) Etang du Ponant – 200 ha	Rhône-Méditerranée Corse
(26) Petite Camargue gardoise – 1200 ha	Rhône-Méditerranée Corse
(26) Etang du Vacares et des Impériaux – 12000 ha	Rhône-Méditerranée Corse
(27) Etang de Berre – 15500 ha	Rhône-Méditerranée Corse
(28) Etang de Palo – 210 ha	Rhône-Méditerranée Corse
(28) Etang d'Urbino – 790 ha	Rhône-Méditerranée Corse
(28) Etang de Diana – 570 ha	Rhône-Méditerranée Corse

2.2 Management and monitoring system

The administrative saline limit separates two different fishery regulations: marine and fluvial (freshwater) (Figure FR 2). The marine fisheries are located in coastal water, brackish estuaries and in the Mediterranean lagoons. The freshwater fisheries are located upstream from the saline limit and comprise rivers, lakes, ponds, ditches and canals. In large estuaries there is a special zone, called the “tidal freshwater reach”, located between the saline limit and the tidal limit, where some marine professional fishermen can fish along with river fishermen while these are not allowed to go downstream the saline limit.

In brackish and coastal waters within EMU, amateur fishermen do not need licences to fish with authorized fishing gears. A system of licences is set up for marine professional fishermen, for river professional and amateur fishermen in freshwaters. The glass eel fishery is limited with quotas of glass eel stamps and the silver eel fishery is limited by personal authorizations. Since EMP, professional and recreational fisher fishing with gears should have a special authorization to target eels. Anglers do not require any special authorization for eel fishing, just to have a general fishing licence. In the Mediterranean lagoons, where glass eel fishing is forbidden, there are also limitations in the number of marine professional fishermen and fishing capacities. Since the French EMP there is also a system of stamps one for yellow and one for silver eel fishing.



Fisher category	Marine professional = MP Marine recreational with or wihtout boat = MA	Marine professional = MP
		River professional = FP River amateur with gears with or without boat in public domain = FA Angler = AN River amateur (being also angler) with gears in private domain = AG
Fishing rights	MP: quota of license, eel specific stamps MA: no license, gears limited by rules	MP & FP: quota of licence, eel specific stamps FA: quota of licence, eel specific stamps AN: general rod licence AG: AN licence + eel specific authorisation

Figure FR 2. Inland waters and fisheries limits, fishermen categories and fishing rights by zones (Castelnaud and Beaulaton, 2005, unpublished data).

Outside EMU, eel fishing is forbidden.

In the rivers under fluvial regulation, the fishing rights are delivered to fishermen by the local Fluvial Fisheries Administrations. The regulation systems in brackish estuaries and Mediterranean lagoons are the result of a negotiation between fishermen organizations (respectively "Commission des poissons migrateurs et des estuaires" and "Prud'homies") and Marine Fisheries Administrations.

The marine professional fisheries in Atlantic coastal areas, estuaries and tidal part of rivers in France has been monitored by the "Direction des Pêches Maritimes et de l'Aquaculture" (DPMA) of the Ministry of Agriculture and fisheries trough the Centre National de Traitement Statistiques (CNTS, ex-CRTS) from 1993 to 2008 and is now by France-Agrimer. This system is evolving and is supposed to include marine professional fishermen from Mediterranean lagoons. In this system, glass eels are distinguished from subadult eel, but yellow and silver eels cannot be separated until recently.

The river professional and amateur fishermen in rivers above marine estuaries (and in lakes) have been monitored since 1999 by the ONEMA (Office National de l'Eau et des Milieux Aquatiques, ex-CSP) in the frame of the « Suivi National de la Pêche aux Engins et aux filets» (SNPE).

These two monitoring systems are based on mandatory reports of captures and effort (logbooks) using similar fishing forms collected monthly (or daily for glass eel) with the help of some local data collectors.

Beside these mandatory systems, for which reliability, accuracy and availability of data are variable, local scientific monitoring have been developed in the Gironde, the Adour and the Vilaine basin for instance. Data on annual captures were also provided for some sectors by the local fishery administrations: "Directions Départementales des Affaires Maritimes" (DDAM), "Directions Départementales du Territoire/du Territoire et de la Mer" (DDT/DDTM)". At some occasions, some punctual studies made by scientific institute, local fishery administration or fishermen themselves are available.

Table FR 2. Official administrative monitoring systems in France.

	Sea	Inland waters		
	Outside EMU	Saltwater	Brackish water (including Med. Lagoons)	Fresh water
Professional	Eel Fishing ban	No data available	Quota of licences Stage specific stamps Compulsory logbook (DPMA/France-Agrimer)	Quota of licences Stage specific stamps Compulsory logbook (ONEMA)
Recreational with gears		No licence, no logbooks		Licences and specific yellow eel authorisation Compulsory logbook (public domain: ONEMA / private domain: not monitored)
Anglers				Licences (not eel specific), no logbooks

To manage the migratory species and their fisheries all along the watershed (under marine and fluvial regulation), special organizations, called "Comités de Gestion des Poissons Migrateurs" (COGEPOMI), have been created in 1994. There are 8 COGEPOMI (management units, grouping basins), one for each important group of basin: Rhine-Meuse, Artois-Picardie, Seine-Normandie, Bretagne, Loire, Garonne, Adour and Rhone-Méditerranée-Corse (see Figure FR 1 and Table FR 1). They gather representatives of fishermen organizations, administrations and research centres. Each COGEPOMI propose a management plan and funding every five years and has to monitor them. The plan determines conservation and management actions, restocking operations, proposes fishing regulations for both recreational and professional fisheries.

Until 2009, these management plans did not aim at achieving a particular escapement rate for eel, and the results of management actions have not really been evaluated. While this system allows for a global approach, and tries to solve environmental problems such as migration barriers or turbine mortality, it does not give for the moment, a consistent management basis for eel at the national level by lack of central regulation and designing of practical management rules.

Since 2009, French eel management unit (EMU) as defined by the European eel regulation are more or less COGEPOMI. One should notice that Corse is a separate management unit and that EMU are extended to coastal waters (Figure FR 3 and Table FR 3). A national EMP has been build that gives national instructions that can for some measures be adapted by EMU through COGEPOMI or other local institutions.

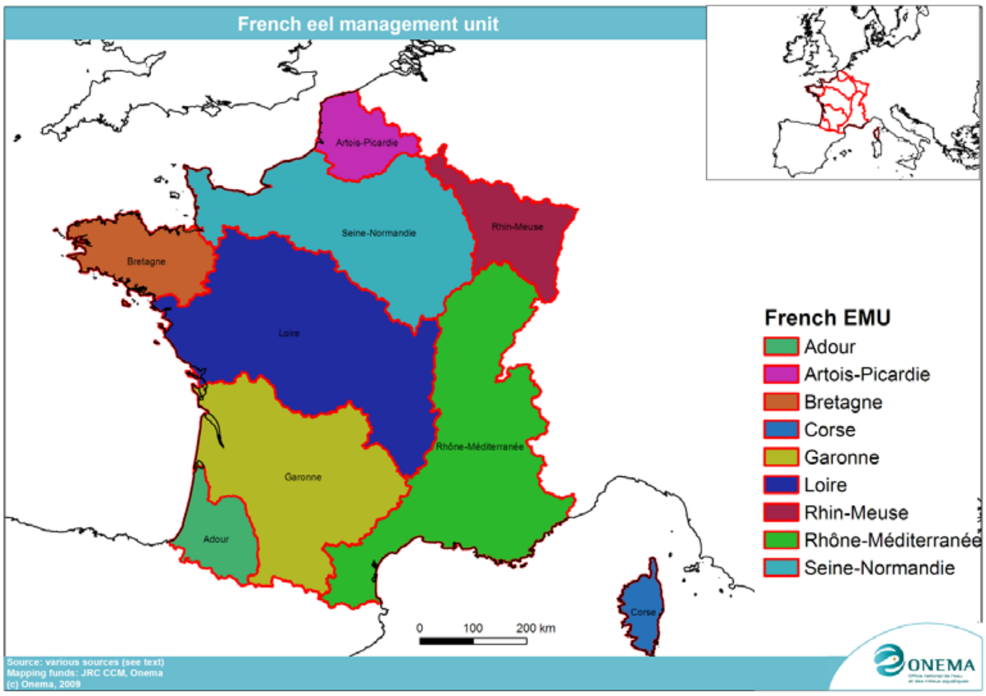


Figure FR 3. French eel management unit.

Table FR 3. French eel management unit and ICES ecoregion.

French EMU	French code	ICES Ecoregion
Rhin – Meuse	RMS	F – North Sea
Artois – Picardie	ARP	F – North Sea
Seine – Normandie	SEN	F – North Sea
Bretagne	BRE	E – Celtic Sea and G – South European Atlantic Shelf
Loire et côtiers vendéens	LCV	G – South European Atlantic Shelf
Garonne, Dordogne, Charente, Seudre, Leyre	GDC	G – South European Atlantic Shelf
Adour	ADR	G – South European Atlantic Shelf
Rhône – Méditerranée	RMD	H – Western Mediterranean Sea
Corse	COR	H – Western Mediterranean Sea

3 Time-series data

3.1 Recruitment

3.1.1 Glass eel recruitment

As foreseen by the working group, the regulation system set in place with the management plan has disrupted the existing series of capture. The Vilaine, Loire, Gironde and Adour series which were based on total catch of glass eel can no longer be considered as giving reliable information on the trend of recruitment.

The Vilaine still provided data up until 2011 as it was considered that the quota system had not changed much the exploitation of glass eel in the Vilaine and the assessment of the total recruitment remained feasible. This year (2011–2012 season) however, the fishery was closed for a while in the middle of the season, with no simple ways of rebuilding the recruitment during that period. For the other sites, since 2008, the geographic scale at which catch information is now made available at the national level is the management unit, with no simple ways of getting back to the estuary.

3.1.1.1 Commercial

Four total landings series commercial were provided for the Loire, Gironde, and Adour. These series are disrupted (see above).

3.1.1.2 Recreational

No "recreational" catch series is provided.

3.1.1.3 Fishery-independent

One fishery-independent recruitment survey is provided for the Gironde. The scientific survey (glass eel/1000 m^3) is conducted by Irstea (see 9.1.1 for details).

Table FR 4. Recruitment series in France. 2012 means 2011–2012 migration season (in yellow, 2014 update).

EMU	Bretagne	Loire		Garonne–Dordogne–Charente–Seudre–Leyre			Adour – Cours d'eau cotiers	
Year	Vilaine Arzal trapping all	Loire Estuary com. catch	Sèvres Niortaise Estuary com. CPUE	Gironde (catch) com. catch	Gironde pibalour (CPUE) com. CPUE	Gironde scient. Estim.	Adour Estuary (catch) com.[2] catch	Adour Estuary (CPUE) com. CPUE
1923				46.0				
1924		65						
1925		70						
1926		90		18.7				
1927		65		34.1				
1928		102		22.4				5
1929				22.5				5.5
1930		1		28.2				6.7
1931				26.9				18.7
1932				31.1				
1933				13.5				
1934		90		13.4				
1935		150		19.7				
1936		30						
1937		7						
1938		15						
1939		17						
1940		27						
1941		21						
1944		10						

[2] Com. =commercial

EMU	Bretagne	Loire		Garonne-Dordogne-Charente-Seudre-Leyre			Adour - Cours d'eau cotiers	
Year	Vilaine Arzal trapping all	Loire Estuary com. catch	Sèvres Niortaise Estuary com. cpue	Gironde (catch) com. catch	Gironde pibalour (cpue) com. cpue	Gironde scient. Estim.	Adour Estuary (catch) com.[2] catch	Adour Estuary (cpue) com. cpue
1945		66						
1946		43						
1947		178						
1948		197						
1949		193						
1950		86						
1951		166						
1952		121						
1953		91						
1954		86						
1955		181						
1956		187						
1957		168						
1958		230						
1959		174						
1960		411						
1961		334		32.2	10.47			
1962		185	30	218	30.64			
1963		116	72	363	33.15			
1964		142						
1965		134	17	353	62.74			
1966		253	13	27.6	10.02			5.1
1967		258	8	163	25.46			6.4
1968		712	15	284	38.23			10.1
1969		225	14	36.6	18.52			5
1970		453	15	204	24.98			7.5
1971	44	330	12	47.1	9.12			4.6
1972	38	311	11	69.0	13.73			4.4
1973	78	292	8.5	20.0	29.19			4.5
1974	107	557	9	54.6	21.44			7.4
1975	44	497	8.5	44.1	12.5			5
1976	106	770	17	121	34			11
1977	52	677	15	122	25.38			
1978	106	526	18	64.7	23.17			
1979	209	642	17.5	73.2	18.74			10
1980	95	526	12	125	35.05			5
1981	57	303	9	84.9	32.41			
1982	98	274	8.5	61.0	14.55			
1983	69	260	6	66.7	14.33			
1984	36	183		45.0	13.87			

EMU	Bretagne	Loire		Garonne–Dordogne–Charente–Seudre–Leyre			Adour – Cours d'eau cotiers	
Year	Vilaine Arzal trapping all	Loire Estuary com. catch	Sèvres Niortaise Estuary com. CPUE	Gironde (catch) com. catch	Gironde pibalour (CPUE) com. CPUE	Gironde scient. Estim.	Adour Estuary (catch) com. [2] catch	Adour Estuary (CPUE) com. CPUE
1985	41	154		27.0	7.39			2.4
1986	52.6	123		35.3	9.02		8	1.5
1987	41.2	145		44.6	9		9.5	3.3
1988	46.6	177		27.9	7.55		12	3.7
1989	36.7	87		45.9	8.9		9	4.1
1990	35.9	96		29.2	5.37		3.2	1.2
1991	15.35	36		38.4	6.78		1.5	0.7
1992	29.57	39		22.5	6.58	1.75	8	2.9
1993	31	91		42.4	8.92	2.83	5.5	2.4
1994	24	103		45.5	8.15	2.2	3	1.4
1995	29.7	133		43.5	8.49	2.92	7.5	2.6
1996	23.29	81		27.9	5.25	2.07	4.1	1.53
1997	22.85	71		49.3	9.24	3.14	4.6	1.6
1998	18.9	66		18.4	3.46		1.5	1.07
1999	16	87		43.1	7.41	3.49	4.3	1.82
2000	14.45	80		28.5	5.41	1	10	4.43
2001	8.46	33		8.2	1.85	0.36	2	0.49
2002	15.9	42		35.1	6.22	1.02	1.8	0.89
2003	9.37	53		9.6	2.52	0.28	0.6	0.31
2004	7.49	27		14.4	2.5	0.3	1.8	0.6
2005	7.36	17		17.3	2.7	0.53	3.2	1.13
2006	6.6	15		9.4	2.4	0.27	1.7	0.72
2007	7.7	21		7.5	2.1	0.14	1.4	0.66
2008	5.1	STOPPED	1.93	10	2.6	0.28	1.7	1.05
2009	2.2		STOPPED	3.5	1.4	0.44	STOPPED	STOPPED
2010	3.8			3.4	1.2	0.10		
2011	3.7			STOPPED	STOPPED	0.16		
2012	STOPPED					0.07		
2013						0.19		
2014						0.38		

GEREM (Glass-Eel Recruitment Estimation Model) model has been developed to estimate glass-eel recruitment at different nested spatial scales (Drouineau *et al*. submitted). More specifically the model estimates annual recruitments both at the river catchment level and at the eel management units' scale, which are two relevant spatial scales for management. The model has been applied to France on dataseries lasting from 1970 to 2012 and provides trends that are consistent with current expert knowledge, and absolute recruitment estimates that are consistent with expert knowledge on exploitation rates (Figure FR 4). Provided enough data become available in the future, it could be extended to the scale of the distribution area of any of the three temperate eel stocks, which would be consistent with the population scale.

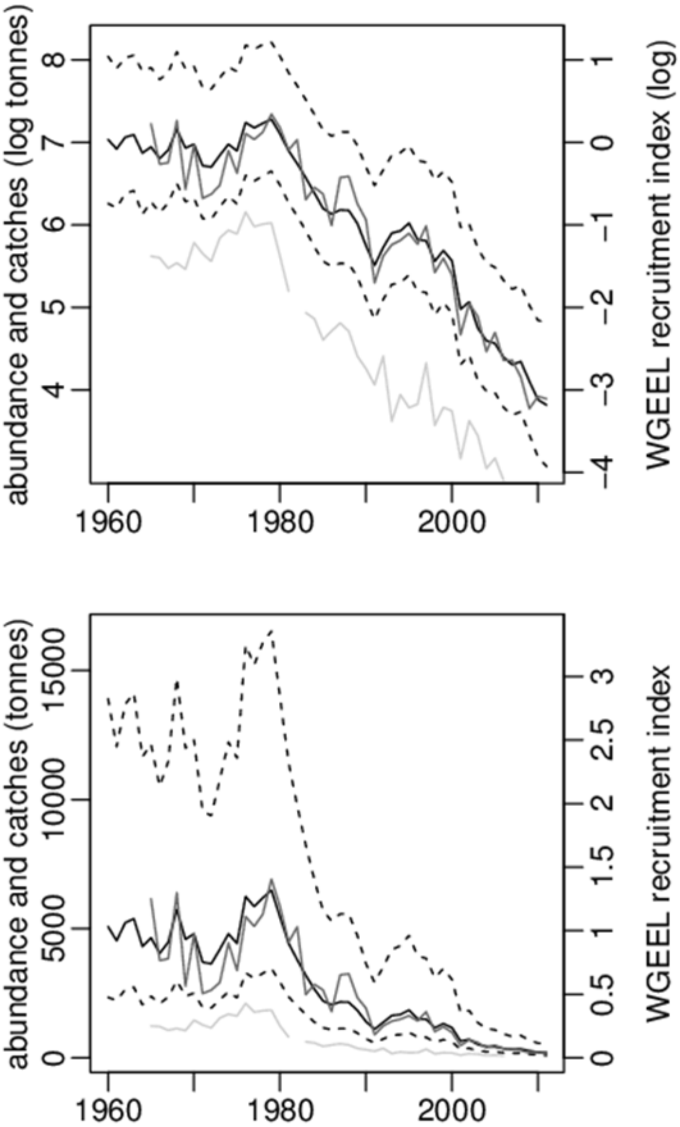


Figure FR 4. Estimated French glass-eel recruitment in tons by GEREM (Solid line indicates the median while dashed lines represent the corresponding 95% credibility interval. Grey lines represents French glass-eels catches estimates from Briand *et al.*, 2008b) (Drouineau *et al.*, submitted).

3.1.2 Yellow eel recruitment

3.1.2.1 Commercial

Not relevant.

3.1.2.2 Recreational

Not relevant.

3.1.2.3 Fishery-independent

3.1.2.3.1 Bresle river (Seine-Normandie EMU)

The Bresle River is the index river (see 9.1.2) from the Seine-Normandie EMU (close to the Artois-Picardie EMU). It is a 70 km long river with a mean flow of 7 m^3/s. A trap (daily counting from April to December) on an eel ladder (3 km from the sea, on the second dam) allows to follow the relative evolution of the upstream migration since 1994 (Figure FR 5 and Table FR 5). The proportion of eel that use the fish compared to other way of passage is under evaluation. Five marking–recapture campaigns have been made in 2009 and in 2010 using VIE. Eels are caught in the EU ladder, marked and released 1.3 km downstream. The provisional recapture rate is 21.9% (min=2.9%; max=40.3%). We can thus estimate that since 2005 between 14 000 and 37 000 eels (150–390 eels/ha of wetted area) are recruited in the Bresle river (2 km from the sea).

The increase observed in 2003 is probably caused by an improvement of the ladder accessibility and highlights the importance of the validation of such series. By the end of 2012 another improvement of the ladder has been made, but it is too early to assess its impact on the time-series.

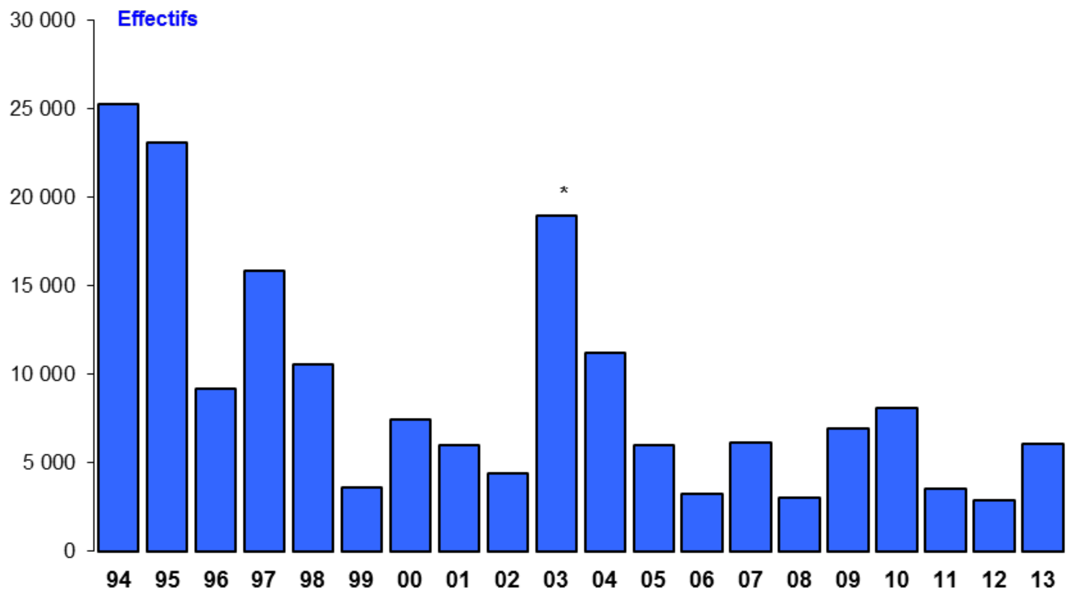


Figure FR 5. Annual evolution (1994-2013) of fish number in the eel ladder trap on the Bresle River (data: Onema DAST- Station Etude et Recherche EU). 2003: change in ladder device.

Table FR 5. Annual evolution (1994–2013) of fish number in the eel ladder trap on the Bresle River (data: Onema DAST- Station Etude et Recherche EU). 2003: change in ladder device.

YEAR	ASCENDING EELS	YEAR	ASCENDING EELS	YEAR	ASCENDING EELS
1990		2000	7403	2010	8097
1		1	5980	1	3536
2		2	4394	2	2890
3		3	18 932	3	6063
4	25 277	4	11 178	4	
5	23 068	5	5976	5	
6	9140	6	3206	6	
7	15 849	7	6132	7	
8	10 547	8	3010	8	
9	3558	9	6911	9	

The migratory period starts at the end of April and ends in mid-November with the maximum being between June and August (92%) (Figure FR 6).

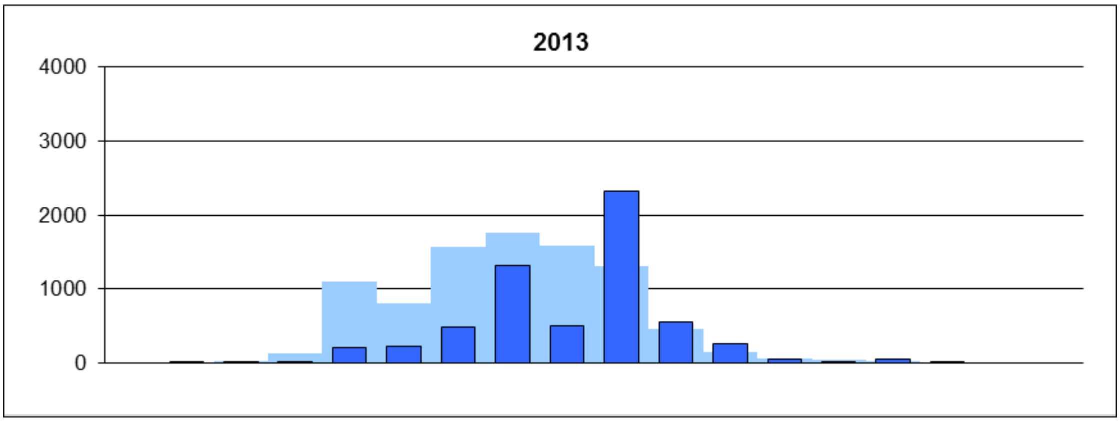


Figure FR 6. Bi-monthly migratory rythm of eels ascending the EU ladder (Bresle river ; data: Onema DAST- Station Etude et Recherche EU). Light blue: 1994–2012 average. Dark blue: 2013.

It is also possible to analyse the fish characteristics. For example, eel length ranges between 55 mm and 305 mm with 90% of fishes being between 75 mm and 115 mm among more than 28 000 eel measured (Figure FR 8). The mean eel length has slightly increased since 1994 (10 mm; Figure FR 7), with a decrease of the proportion of glass eels and small eels (<90 mm), the overall mean length is 97 mm.

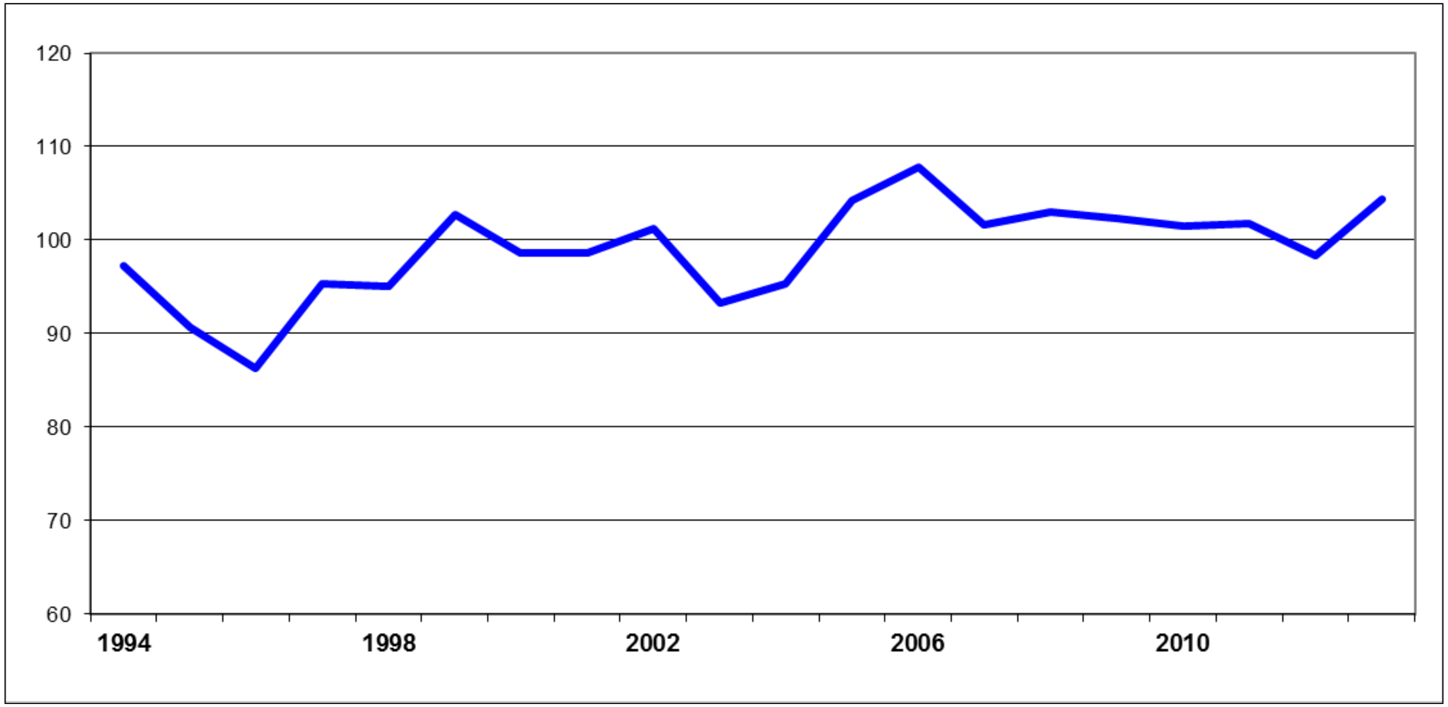


Figure FR 7. Annual evolution of mean length in the eel ladder trap on the Bresle River (data: Onema DAST- Station Etude et Recherche EU).

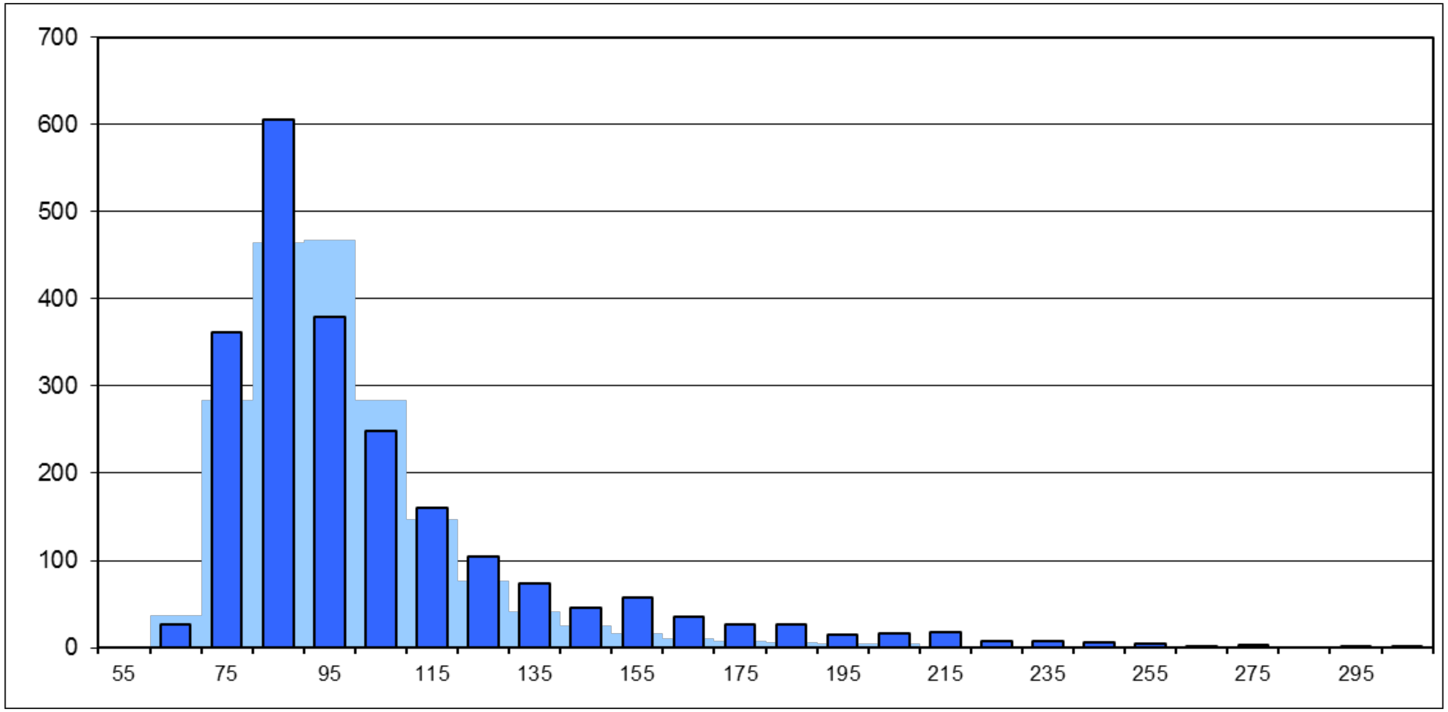


Figure FR 8. Length distribution of eels ascending the EU ladder (Bresle river ; data: Onema DAST- Station Etude et Recherche EU). Light blue: 1994–2012 average. Dark blue: 2013.

3.1.2.3.2 Frémur river (Britanny EMU)

The Frémur River is the main river (17 km) of a small basin (60 km²). An intensive eel monitoring program has taken place in 1995 (Charrier *et al.*, 2014). This monitoring is now part of the index river system (see 9.1.2).

The second dam (Pont es Omnès; 4.5 km from the sea) is equipped to monitor silver eel run. Except for extreme situation, the system catches any escaping silver eel. However the silver eel escapement is closely related with the water release for the dam which in use for water intake.

The series is given in Table FR 6. Between 1996–1997 and 2000–2001 the mean number of silver eel is about 850 (150 kg), since the silver eel number decrease to 152 (36 kg) in 2011–2012, the lowest number of the series. This last number is due both to the eel stock decline and to particularly low discharge that year that causes low possibility of escapement in the Bois-Joli dam. Preliminary results from the 2012–2013 season show an increase of the silver eel escapement to about 600 silver eels (185 kg). This escapement may include eels ready to migrate in 2011–2012 that delay their trip to 2012–2013.

During the whole period the sex-ratio increases from 33% of female (1996–2001 mean) to 48% of female (2007–2012 mean) (Table FR 6). Accordingly the mean weight of silver increases from 175 g to 267 g.

Table FR 6. Silver eel escapement on the Frémur river (Charrier *et al.*, 2014)

	Silver eel (#)	Silver eel (kg)	Sex-ratio (%F)
1996–1997	675	91.2	27%
1997–1998	828	165.1	34%
1998–1999	676	118.2	33%
1999–2000	1271	245.7	35%
2000–2001	815	141.4	38%
2001–2002	392	68.3	37%
2002–2003	372	97.2	58%
2003–2004	571	122.6	48%
2004–2005	333	72.3	46%
2005–2006	565	151.2	59%
2006–2007	602	142.9	53%
2007–2008	515	128.3	57%
2008–2009	473	118.7	49%
2009–2010	320	94.3	57%
2010–2011	228	54.7	39%
2011–2012	152	36.5	38%
2012–2013	625	194.4	54%
2013–2014 (*)	230	70.4	60%

(*) preliminary results.

3.2 Glass eel landings

3.2.1 The Garonne (Garonne EMU)

The Gironde series is collected by the Irstea (Girardin and Castelnaud, 2011) and was extended to the past before 1978 by Beaulaton (2008). The oldest catches (<1936) were extrapolated thanks to data that have been collected by Gandolfi in several papers, and that come from the railway statistics and San Sebastian market. In the 1980s, the catches from recreational fishermen were larger than those from commercial fishermen. The Gironde is one of the few estuaries where an estimation of recreational landings is available as a time series. It has been extrapolated from professional landings and number of river amateurs fishermen.

One should notice that landings were, until the beginning of the 1980s, dominated by the freshwater tidal reach catches ("Garonne Dordogne Isle rivers") but since then have been overtaken by brackish estuary catches ("Gironde estuary").

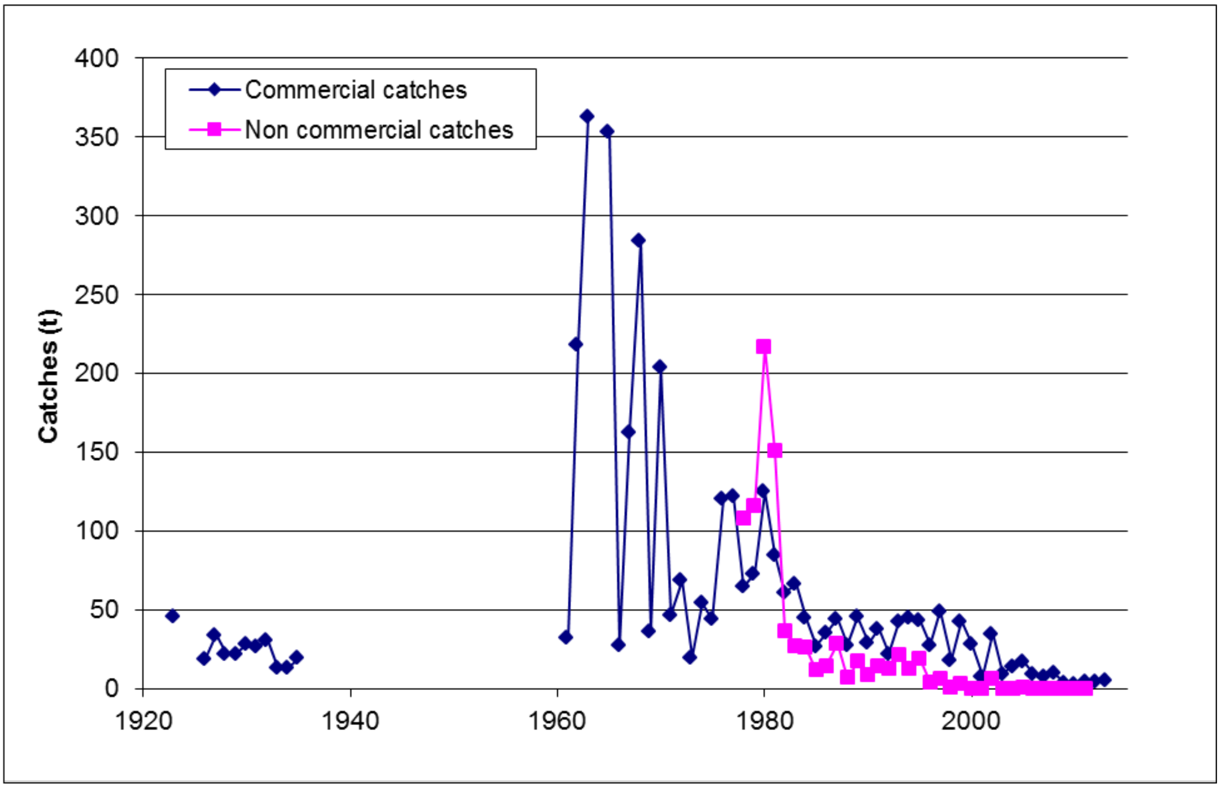


Figure FR 9. Glass eel landings in the Gironde (Garonne EMU).

3.2.2 General overview

Table FR 7 summarizes major French glass eel landings series from 1978 onwards. These series show clear decrease from more than 1000 t as overall before 1980 to less than 100 t as overall since 2004 and less than 50 t as overall since 2010.

Table FR 7. Glass eel professional catches in the large French basins and total production in France for professional and non-professional fishers. MP: marine professional fishers, PF: river professional fishers, Non-professional: amateur fishers including poachers for Gironde; numbers in black= estimations by extrapolation; 0 t = less than 1 t. * from official data; ** glass eel fishing is banned for non-commercial fishermen since 2010. Yellow underline = updated in 2014.

	COMMERCIAL FISHERMEN CATCH (TONS)								NON–COMM; FISHERMEN CATCH (TONS)			
Season	Adour		Gironde		Loire		Vilaine	Total France(1)	Adour	Gironde	Loire	Total France(2)
	MP	FP	MP	FP	MP	FP	MP					
1978			22	43	514	12	106	1393		108		647
1979			26	47	620	22	209	1850		116		697
1980			38	87	508	18	95	1491		217		1303
1981			36	49	288	15	57	890		151		904
1982			39	22	261	13	98	866		36		219
1983			48	19	241	19	69	791		27		161
1984			32	13	168	15	36	528		26		156
1985			21	6	145	9	41	444		12		71
1986	8		27	9	113	10	53	423		14		87
1987	10		26	19	131	14	41	461		29		172
1988	12		22	6	165	12	47	504		7		40
1989	9		32	14	78	9	37	410		17		110
1990	3	4	23	6	81	16	36	325		9		54
1991	2	4	30	9	31	5	15	179		14		87
1992	8	12	15	8	32	7	30	183		13		77
1993	6	7	33	9	80	11	31	329		22		130
1994	3	7	40	5	95		24	329	18	12	0	74
1995	8	4	36	8	127	6	30	413	10	19	0	113
1996	4	3	25	3	73	8	22	262	12	4		25
1997	5		36	13	67	4	23	287	6	6		39
1998	2	7	16	2	61		18	195	7	1		6
1999	4	2	35	8	80	7	15	242	2	3	1	6
2000	10		25	3	74	6	14	206		0	1	2
2001	2		8	0	33	3	8	101		0	0	1
2002	2		25	10	42	8	16	202		6		37
2003	1		9	1	53	4	9	151		0		
2004	2	2	13	1	20	2	8	89	0	0	0	
2005	3	6	13	4	17	4	7	89	0	0	0	0
2006	2	2	8	1	15	3	7	67	0	1	0	1
2007	1	2	7	1	21	3	8	77	0	0	0	0
2008	3	2	6	2	19	3	5	79	0			
2009		0	8	0		1	2	43	0			
2010		1	4	0		3	4	41*				
2011		1	3	0		2	4	31	-	-	-	0**
2012		1	5	0		2		34	-	-	-	0**
2013		2				2		34*	-	-	-	0**
2014		2		1		2		35*				0**

3.3 Yellow eel landings

3.3.1 ommercial

3.3.1.1 The Garonne (Garonne EMU)

The Gironde series has been collected by the Irstea (Girardin and Castelnaud, 2011) and concerns landings from professional fishermen in the lower part of the Garonne basin (comprising the brackish estuary and the tidal freshwater reach of the Garonne and Dordogne rivers). This series was extended in the past before 1978 by Beaulaton (2008). One should notice that 1946–1977 data are based on low number of fishermen that may explain high variability from these years (Figure FR 10). The fisheries also shifted from eel pot made of wood to plastic eel pots. Like for glass eel, the Gironde is one of the few estuaries where an estimation of recreational landings is available as a time series. It has been extrapolated from professional landings and number of river amateurs fishermen.

Yellow eel landings clearly decreased over the last twenty years from 158 t in average between 1978–1986 to less than 25 t between 2002 and 2009; after two years of fishery ban because of the contamination by PCB, the captures did not recover the last level, remaining around less than 10 t.

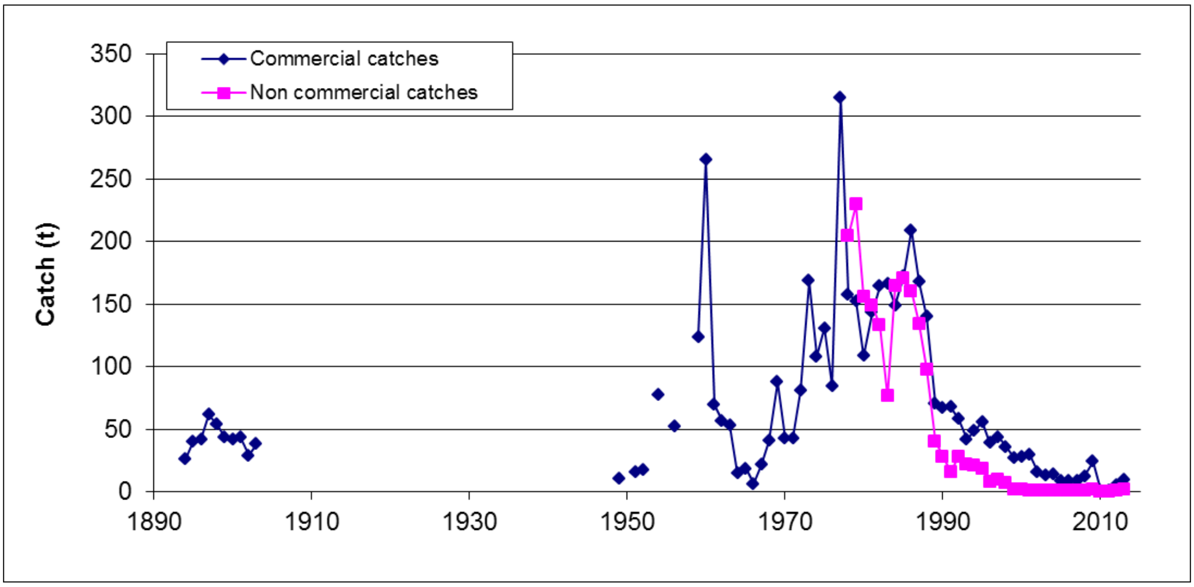


Figure FR 10. Marine and river professional and river non-professional yellow eel landings in the Gironde basin (brackish and freshwater estuary).

3.3.2 Recreational

No data available.

3.4 Silver eel landings

3.4.1 Commercial

3.4.1.1 Loire river (Loire EMU)

The Guideau fishery of the Loire is one of the French fishery targeting silver eels. Statistics on a sample of four fishers are available from 1987 and on the whole fishery from

2001 (Table FR 8). One should notice that since the entry into force of the French EMP (2008–2009 season) this fishery do not catch eel each week during Saturday 18:00 and Monday 06:00.

Table FR 8. Landings (in t) of silver eel "guideau" fishery in the Loire river. In Bracket: number of fishers considered.

Acou *et al.*, 2010 = Total landings from Acou *et al.* (2010) and Boisneau, pers. com. in Beaulaton *et al.*, 2009; 2012–2013 Acou *et al.*, 2014, provisional data.

Official statistics = Total landings as declared to SNPE from Onema.

Bodin *et al.*, 2011 = landings from a sample of four fishers from Bodin *et al.* (2011) and Boisneau and Boisneau (2014).

	Acou *et al.*/, 2010	Official statistics	Bodin *et al.*/, 2011
1987–1988			27.8 (4)
1988–1989			31.8 (4)
1989–1990			23.2 (4)
1990–1991			29.4 (4)
1991–1992			23.5 (4)
1992–1993			18.1 (4)
1993–1994			15.6 (4)
1994–1995			22.2 (4)
1995–1996			24.3 (4)
1996–1997			18.9 (4)
1997–1998			26.0 (4)
1998–1999			18.5 (4)
1999–2000			19.9 (4)
2000–2001			17.4 (4)
2001–2002	45.3 (12)		25.6 (4)
2002–2003	38.1 (10)		20.1 (4)
2003–2004	36.4 (10)		24.8 (4)
2004–2005	16.1 (8)	22.7 (7)	7.3 (3)
2005–2006	25.9 (9)	19.6 (7)	14.9 (4)
2006–2007	26.4 (7)	29.4 (8)	15.3 (4)
2007–2008	33.2 (9)	24.8 (6)	19.7 (4)
2008–2009	18.2 (7)	12.2 (7)	12.9 (4)
2009–2010		19.5 (7)	14.3 (4)
2010–2011		11.4 (10)	5.7 (4)
2011–2012			7.0 (4)
2012–2013	29.4 (8)		18.5 (4)
2013–2014			13.1 (4)

3.4.2 Recreational

No data available. No more relevant: the French EMP has banned silver eel recreational fishing.

3.5 Aquaculture production

3.5.1 Seed supply

No data available.

3.5.2 Production

No data available.

3.6 Stocking

3.6.1 Amount stocked

A public tender of 2 million Euros for restocking (and restocking monitoring) has been made each year since 2010. In 2014 this public tender was made twice.

Glass eels are all caught in the EMU in which they are restocked. Thus there is no restocking in EMU where there isn't a glass eel fishery. Glass eel have been quarantined in fish sellers' tanks for the duration of sanitary analyses (e.g. EVEX). All restocking sites are monitored to assess the efficiency of restocking.

In 2010, two projects representing 150 k€ (including monitoring) for 200 kg restocked have been selected. Finally no glass eel have been restocked because of the end of the glass eel season. However 209 kg (glass eel mean weight 0.233 g and thus 900 000 glass eels) have been restocked in the Loire River in July 2010. Those glass eel were collected from a CITES seizure.

In 2011, eleven projects have been selected for a total amount of 4024 kg. Finally only 747.5 kg were really restocked, partly because of late selection process and partly because of lack of supply.

In 2012, eleven projects have been selected for a total amount of 3475 kg. Finally 3086 kg were really restocked.

In 2013, eleven projects have been selected for a total amount of 3400 kg. Finally 2940 kg have really been restocked.

In 2014, eleven projects have been selected for a total amount of 6307 kg. Finally 5656 kg have really been restocked.

Apart from this national restocking program, some local restocking may have taken place but quantity, quality (glass eel or yellow eel, …), origins and objectives are unknown. For example: they have been a long history of stocking in Lake Grand Lieu (Adam, 1997) to enhance fishery with a maximum of more than 2 t of glass eels in the 1960s and more than 1.5 t of elvers in the 1990s. Dekker and Beaulaton (submitted) make a review of XIXth century's French data.

Table FR 9. Quantity (in kg) of glass eels restocked in France per EMU between 2010 and 2012. * = glass eels from a CITES seizure. (in yellow updated value).

EMU	2010	2011	2012	2013	2014
Artois-Picardie	0	45	37	34	35
Seine-Normandie	0	134	111	53	130
Britanny	0	200	333	306	650
Loire	209 *	323.5	1684	1667	3232
Garonne	0	45	870	563	1259

Adour	0	0	51	302	350
Total	209	747.5	3086	2925	5656

3.6.2 Catch of eel <12 cm and proportion retained for restocking

Table FR 10 described the quantity of glass eels fished in France and exported or used in France for restocking.

Table FR 10. Quantity exported or used in France for restocking purpose and originated from France. * = 209 kg seized in France from an unknown origin have been restocked in France in 2010.

Country	Quantity (kg)					
	2009	2010	2011	2012	2013	2014
Austria						
Belgium			120	160	181	397
Bulgaria						
Cyprus						
Czech Rep		671	620	520	181	500
Denmark		1050	600	2750	446	1516
Estonia						947
France		*	747.5	3086	2940	5656
Germany		2492	807	1761	1491	3979
Greece						
Finland						
Hungary						
Ireland		805				
Italy						
Latvia						
Lithuania					573	
Luxembourg						
Malta						
Morocco						
Netherlands		2890	370	2086		2362
Norway						
Poland		85	85	90	143	298
Romania						
Slovakia						
Slovenia						
Spain		250	169	351.5	460	830
Sweden		870				
UK		240	1487	400	307	
Hong Kong						
Unknown						
Total		9353	5005.5	11 204.5	6722	16 485

3.6.3 Reconstructed time-series on stocking

Table FR 11 presents a summary of known quantity of stocked eel. At present only those from the national restocking programme are fully known (Table FR 10). Some local restocking may have taken place but quantity, quality (glass eel or yellow eel, …), origins and objectives are unknown. Recent findings in historical grey literature show that restocking in France has begun at soon as the mid-XIXth and that quantity can be important (Dekker and Beaulaton, submitted), this is not reported here.

Table FR 11. Reconstructed time-series on stocking. Quantity in kg. * = from a CITES seizure, unknown origin.

	Local Source				Foreign Source			
Year	Glass Eel (kg)	Quarantined Glass Eel	Wild Bootlace	On-grown cultured	Glass Eel	Quarantined Glass Eel (kg)	Wild Bootlace	On-grown cultured
2010						209*		
2011	748.5							
2012	3086							
2013	2940							
2014	5656							

3.7 Silver eel "restocking"

Glass eels have never been exploited on the French Mediterranean coast. Restocking measures were therefore not applicable on the Mediterranean coastline. Instead, a new approach was experienced in 2011: a part of the exploited silver eels was released to the sea. In the Rhône Mediterranée Corse EMU, eel fishing activity is principally located in lagoons and both yellow and silver stages are targeted. Fishermen working in lagoons are small scale fishers (boat <7 m, using passive gears: mostly assemblage of fykenets called capecchades), relying mostly on eel species to sustain their livelihoods. This pilot study was closely followed by the scientists and the governmental authorities. A protocol was designed by a group of scientists (Amilhat *et al.*, 2012a) to ensure the respect of good practices. Eels were released at the mouth of the lagoons with direct access to the sea (no dams or fishing gears). They were released at dawn, their natural time to migrate, shortly after they have been captured (mostly the following night).In total 16 tons of silver eels were released in 2011, 17.3 in 2012 and 17.5 in 2013, from ten locations (Figure FR 11and Table FR 12) in the Languedoc Roussillon region (for details see Amilhat *et al*., 2012b, 2013, in prep.).

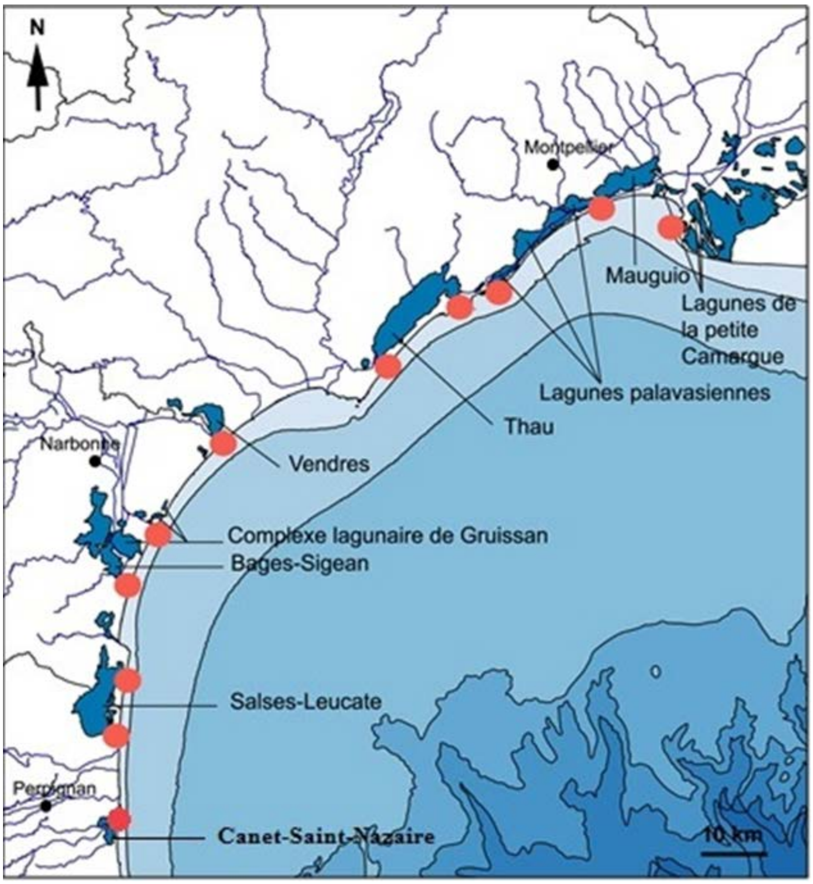


Figure FR 11. Locations (red dots) where silver eels were released (©S.Berné background map).

Table FR 12. Quantity of silver eels released in November and December 2011.

			Released quantity (kg)		
	Lagoon(s)	**Code**	**2011**	**2012**	**2013**
1	Canet-St-Nazaire	Canet	-	-	270
2	Salses-Leucate (Barcarès sector)	LeucateS	1452	2016	1620
3	Salses-Leucate (Leucate sector)	LeucateN	983.5	683	810
4	Bages-Sigean (South)	BagesS	1452	1386	1485
5	Bages-Sigean (North)	BagesN	1188	1260	1350
6	Gruissan lagoons (Ayrolle, Campignol, Gruissan)	Gruissan	1974.5	2006.5	1748
7	Vendres	Vendres	528	378	350
9	Thau (Marseillan sector)	Thau1_M	924	1512	1215
10	Thau (Bouzigues sector)	Thau2_B	924	756	675
11	Thau (Sète sector)	Thau3_S	3168	3756	3915
14	Palavas lagoons(Ingril, Vic, Pierre Blanche, Arnel, Pérols, Moures)	Palavas	942	1134	1350
13	Mauguio	Mauguio	1716	1638	1620
8	Little Camargue lagoons (Ponant, Médard, Marette)	PonantC	792	756	1080
	Total (kg)		**16 044**	**17 281.5**	**17 488**
	Estimated number of eels released		**97 913**	**111 409**	**111 695**
	Number of fishermen involved		**125**	**138**	**130**
	Time period		**24 Nov.–29 Dec.**	**8 Nov.–14 Dec.**	**7 Nov.–12 Dec.**

3.8 Trade in eel

The Table FR 13 gives the destination and price glass eel during the last season. The average price decrease by about 20% compare to 2012–2013 season. The market for yellow and silver is more largely a local market even though there is some export, particularly from Mediterranean fisheries.

Table FR 13. Destination and price of French glass eel during the 2013–2014 season.

	Consumption		Restocking		Total	
	weight (kg)	price (€/kg)	weight (kg)	price (€/kg)	weight (kg)	price (€/kg)
BE	73	250	397	248	470	248
CZ			500	86	500	86
DE	3739	261	3979	142	7718	200
DK	307	221	1516	109	1823	128
EE			947	67	947	67
FR	1312	215	5656	276	6968	265
NL	2889	242	2362	90	5252	174
PL	79	240	298	143	377	163
SP	8562	262	830	167	9392	254
Total	16 962	254	16 485	176	33 447	215
Unknown					1894	

4 Fishing capacity

reported by EMU

Since the enforcement of the management plan, the number of fishermen licensed for eel is reported at the national level. Data are given separately for the Mediterranean lagoons which have different regulations.

Before the entry into force of the French EMP, there was no special licence for yellow (and silver) eels fluvial fishermen.

4.1 Glass eel

The eel fishery is regulated by a licence and a local basin "stamp" is necessary to go fishing for glass eel in a given location. These "stamps" are granting access to the whole EMU but to a more local level.

The licences are delivered annually but the fishing season overlaps from one year to the next. Thus for the 2011–2012 season, the number of licences is between 573 and 500 for marine fishermen. Licenses will be however delivered for the fishing season from 2014–2015 onwards. The number of licences delivered for glass eel has been steadily diminishing from a total of 1224 in 2006 to 599 in 2014 (Table FR 14).

The Table FR 15 gives the details by EMU. Fishing for glass eel is not authorized in the Rhône Mediterranean, nor in the Corsica EMU. Before 2014 a fisher can have a licence in more than one UGA. This explains why the total of licences before that year do not correspond to the total given in Table FR 14.

Table FR 14. Glass eel fishers. (in yellow: updated data).

	2006	2007	2008	2009	2010	2011	2012	2013	2014
Marine commercial fisher	853	862	814	754	643	573	500	475	457
Marine commercial fisher by feet (Adour)	?	?	?	?	25	21	9	10	13
Fluvial Commercial fisher	371	343	328	205	180	158	147	145	129
Total	>1224	>1205	>1142	>959	848	752	656	630	599
Amateur	?	?	?	?	|←Fishing forbidden				

Table FR 15. Glass eel licences by EMU.

	Artois Picardie	Seine Normandie	Bretagne	Loire et Côtiers Vendéens	Garonne–Dordogne–Charente	Adour et Landes
2009	**19**	**22**	**142**	**366**	**296**	**173**
2010	**15**	**18**	**121**	**311**	**252**	**154**
2011	**12**	**16**	**104**	**281**	**226**	**132**
2012	**12**	**14**	**99**	**233**	**209**	**105**
2013	**13**	**12**	**91**	**223**	**199**	**104**
2014	**12**	**12**	**81**	**210**	**180**	**104**

4.2 Yellow eel

In addition to the diminution in the number of licences for yellow eel, several sectors have been closed for PCB contamination reasons (Seine, Rhône, Saône, Gironde estuary…).

Table FR 16. Yellow eel licences.

	2009	2010	2011	2012	2013	2014
Marine commercial fishermen	309	268	245	236	222	248
Mediterranean and Corsica (Yellow and Silver) commercial fishermen	.	295	265[3]	269	229	218
Fluvial commercial fishermen	169	171	170	169	175	146
Fluvial amateur with gears	.	.	.	5224		
Anglers[4]	.	.	1 414 017	1 321 924		

Table FR 17. Yellow eel licences by EMU in 2014. * = the three fishers from Bretagne also fish in Loire.

	Marine commercial fisher	Fluvial commercial fisher	Total
Rhin – Meuse	-	0	0
Artois – Picardie	1	0	1
Seine – Normandie	7	0	7
Bretagne	14	3	17
Loire …	59	53	112
Garonne …	147	56	203
Adour	20	24	44
Rhône – Méditerranée	202	13	215
Corse	16	-	16
Total	466	146*	612

4.3 Silver eel

Since the adoption of the French eel management plan, fishing for silver eels is no longer allowed in marine waters except in the Mediterranean lagoons where a specific licence is required (Table FR 31). In fluvial part, professional fishermen are allowed to fish silver eels from certain place of Loire EMU (mainly Loire River and Grand Lieu Lake) and of Rhône-Mediterranée EMU (lower part of Rhône River). However, due to PCB contamination, silver eel is only fished in Loire EMU.

3 Interregional number fixed.

4 Not eel specific licence. Eel fishing report is mandatory but no statistics are available yet.

Table FR 18. Silver eel licences.

	2009	2010	2011	2012	2013	2014
Marine fishermen	Not allowed					
Mediterranean and Corsica (Yellow and Silver)		295	265	269	229	219
Fluvial fishermen	44	41	37	34	34	34
Fluvial amateur with gears	Not allowed					
Anglers	Not allowed					

Table FR 19. Silver eel licences by EMU in 2014.

	Marine commercial fisher	Fluvial commercial fisher	Total
Bretagne	-	1	1
Loire …	-	20	20
Rhône – Méditerranée	203	13	216
Corse	16	-	16
Total	219	34	253

5 Fishing effort

reported by EMU

No data available.

6 Catches and landings

reported by EMU

6.1 Glass eel

The drop in landings from 2007/2008 is about 60%, consistent with the drop in daily fishing effort estimated as 56% (Table FR 20). Since 2009–2010 season a TAC and quota system has been set up. The TAC is split by EMU, sometimes by river or group of river and there are specific restocking quotas (also split according to the same geographical pattern. Since 2011–2012 season, the quota system really limit the catch and create long period without fishing within the fishing period.

Table FR 20. Trend in glass eel landings (kg), marine commercial fishermen, Source MEDDE-DPMA, WGEEL 2009, WGEEL 2010, WGEEL 2011, WGEEL 2012. Quota allowed is also given.

EMU	2007/2008	2009/2010	2010/2011[5]	2011/2012	2012/2013	2013/2014
Artois Picardie	1175	460	278	468[6]	384	499
Seine Normandie		860	400	369	694	975
Bretagne	5864	4095	3619	3322[8]	2000	4340
Loire et Côtiers Vendéens	42 816	24 761	17 415	18 415[8]	15 281	14 924
Garonne-Dordogne-Charente	17 031	6423	5352	6928	9692	7562
Adour et Landes	4519	537	1353	949	1126	2006
France	**71 405[7]**	**37 177[8]**	**28 417[9]**	**30 452[10]**	**29 179**	**30 306**
Quota		**53 540**	**38 860**	**32 190**	**29 580**	**36 975**

Table FR 21. Trend in glass eel landings (kg), Fluvial fishermen, Source ONEMA-MEDDE (DEB). Quota allowed is also given.

EMU	2007/2008	2008/2009	2009/2010	2010/2011	2011/2012	2012/2013	2013/2014
Loire et Côtiers Vendéens	3316	1270	3114	1669	2094	1727	1787
Garonne-Dordogne-Charente	1727	143	26	236	646	1120	1218
Adour et Landes	2224	217	542	936	1105	1592	2030
France	7267	1630	3683	2840	3845	4439	5035
Quota			8000	5806	4810	4420	5525

yy.6/2013–2013 fisheries have been banned due to a PCB level above consumption limit.

5 Source FranceAgrimer (DPMA), WGEEL 2011.

6 In cases where the total amount of catch is lower than the "official quota report", the official figure is used. The latter is then based on trade reports.

7 Extrapolated, see WGEEL 2009, 31 847 in the official database.

8 Probably quite inaccurate.

9 Note that this value is lower than official figure (32 291), see WGEEL 2011 for explanation.

10 Updated from national database in July 2011, this figure is slightly larger than official quota report 30 361.

6.2 Yellow eel

6.2.1 Marine fishery

The only information available for marine commercial fishery in France in 2011 is a sum (346 222 kg) of yellow and silver eel landing (source DPMA). The origin, the date and other type of information of these landing are not available.

6.2.1.1 Mediterranean lagoons

In the Mediterranean lagoons the eel catches have reached 2000 t/year during the 1980s. They have decreased progressively to 900 tons in 1998 with 200 t for the Camargue and Corsica and 700 t for the Languedoc-Roussillon (VERGNE *et al.*, 1999).

The mean average landing from 2003 to 2005 is estimated at 512 t for Languedoc-Roussillon lagoons (Cepralmar 2003, 2004, 2005). A recent analysis of fishermen logbooks estimated the total catch (yellow and silver eel) in Languedoc-Roussillon lagoons at 260 t in 2009 and 239 t in 2010.

In 2007, catches in PACA lagoons are estimated at 193 t (129 t of yellow eels and 64 t of silver eels) (Abdallah *et al.*, 2009). For 2010 and 2011, the declared landings (corrected for non-declaring fisher) are about 94 t (Anonymous, 2012).

For 2008, Demenache *et al*. (2009) have estimated that the production of yellow eels in continental French Mediterranean coast has dropped further to about 294 t (precision between 211/395 t).

For 2012, the declared landings (source: DPMA) for yellow and silver eels are 231 t for the Rhône EMU (Languedoc-Roussilon and PACA) and 6 t for Corse EMU.

All these data are summarized in Table FR 22.

Table FR 22. Yellow and silver eel landings in Mediterranean lagoons. See text for sources.

	1980s	1998	2003–2005	2007	2008	2009	2010	2011	2012
Languedoc-Roussilon		700	512			260	239		231
PACA		200		193			94	94	
Corsica									6
Total	2000	900			294				237

6.2.1.2 Others

No data available.

6.2.2 River fishery

The declared landings of professional fluvial fishermen is given in Table FR 23.

Table FR 23. Declared landings of yellow eels caught by professional fluvial fisher split by EMU. Source: SNPE Onema

	2007	2008	2009	2010	2011	2012	2013
Rhin	724				647		
Seine	862	230	120	214			
Loire	6447	11 755	12 678	10 329	10 685	16 362	14 086
Garonne	7572	15 185	15 073	910	2544	7218	9602
Adour	706	515	458	552	503	246	50
Rhône	576	1					
Total	16 887	27 686	28 329	12 005	14 378	23 827	23 738

The declared landings of recreational fluvial fishermen with gears in public domain is given in Table FR 24.

Table FR 24. Declared landings of yellow eels caught by recreational fluvial fisher with gears in public domain split by EMU. Source: SNPE Onema.

	2007	2008	2009	2010	2011	2012	2013
Rhin					202	127	
Bretagne					38	118	
Loire					2085	4021	
Garonne					265	350	
Adour					813	671	
Rhône					32	65	
Total					3437	5353	

6.3 Silver eel

No precise statistics are available for marine fishermen (see 6.2).

Silver eel fishing for fluvial fishermen in only allowed in Loire and Rhône EMU. Due to PCB contamination silver eel fishing only take place in Loire EMU. The status of Grand Lieu Lake being particular, we only give here the statistics for Loire EMU excluding this lake (Table FR 25).

Table FR 25. Declared silver eel landings for professional fluvial fisher in Loire EMU (Grand lieu Lake excluded). Source: Onema

	Loire
2004–2005	23 488
2005–2006	20 633
2006–2007	30 485
2007–2008	25 387
2008–2009	12 851
2009–2010	20 215
2010–2011	11 452

6.3.1 Marine fishery

No data available.

6.4 Recreational fishery

Recreational fishers are only allowed to fish for yellow eel according to French EMP. Catch from gear fishers in river public domain are given in 6.2.2. There is no up to date national estimate for anglers even if local estimate exists in some places.

6.5 Bycatch, underreporting, illegal activities

Table 6-x. Estimation of underreported catches in Country, per EMU and Stage.

		GLASS EEL				YELLOW EEL				SILVER EEL				COMBINED (Y + S)			
Year	EMU_code	Reported catches (kg)	Underrept. %	Underrept. (kg)	Total catches (kg)	Reported catches (kg)	Underrept. %	Underrept. (kg)	Total catches (kg)	Reported catches (kg)	Underrept. %	Underrept. (kg)	Total catches (kg)	Reported catches (kg)	Underrept. %	Underrept. (kg)	Total catches (kg)
2013	EMU_a																
	EMU_b																
	EMU_c																
	EMU_d																
	EMU_e																
	EMU_f																
	Total/mean (%)																

Table FR 26 summarizes all data we have on illegal fisheries and quantity seized. However since many enforcement service can seized eels these data should be considered as a minimum.

Table FR 26. Existence of illegal activities, its causes and the seizures quantity they have caused in 2014. Seizure data should be considered as a minimum.

	GLASS EEL			YELLOW EEL			SILVER EEL			COMBINED (Y +S)		
EMU	Y/N/?	Cause	Seizures (kg)	Y/N/?	Seizures (kg)	Cause	Y/N/?	Seizures (kg)	Cause	Y/N/?	Seizures (kg)	Cause
RMS	N			?			?					
ARP	?			?			?					
SEN	?			?			?					
BRE	Y		477	Y			Y					
LCV	Y			Y			Y					
GDC	Y			Y	34.5		Y	80.5				
ADR	Y			?			Y					
RMD	?			Y			Y	701				
COR	?			Y			Y					
Total			647		65			892				

AIM: Identify the illegal fishing activities and in case it is possible its causes and the seized kgs in case they were seizures.

NOTES:

- Y/N/?:

- Y: you know for sure they have been illegal activities;
- N: illegal activities are considered negligible / not significant;
- ?: You do not know whether they have been illegal activities or not.

- Cause: One of the followings:

- Fishing out of the season;
- Fishing without licence;
- Fishing using illegal gears;
- Retention of eel below or above any size limit;
- Illegal selling of catches.

7 Catch per unit of effort

reported by EMU

7.1 Glass eel

No new data at the national scale.

7.1.1 The Garonne (Garonne EMU)

The Gironde basin is the tidal part Figure FR 1 and Figure FR 2) of the Garonne basin, comprising the brackish estuary and the tidal freshwater reach of the Garonne River, Dordogne River and of its tributary, the Isle River. The results are providing by the Irstea statistical monitoring system and have been studied by Beaulaton (2008).

One of the notable features of the glass eel fishery in the Gironde is the major shift from scoopnet catches in favour of large pushnet catches (Figure FR 12 and Table FR 27). The fishery is presently very largely a large pushnet fishery in the estuary, whereas formerly it was a scoopnet fishery in freshwater estuary.

After a large decrease of the glass eel abundance (cpue) in the Gironde basin between 1981 and 1985, the cpue slightly decrease to reach is lowest level in the last recorded year between 2003 and 2012 (Figure FR 12 and Table FR 27). The legal catches remain at the same level the last three years while the cpue increase in 2013, due to a lower fishing effort (less professional fishermen) (Figure FR 12 and Table FR 26).

Table FR 27. Catches of glass eel for professional large pushnet (LPN), small pushnet (SPN) and scoopnet (SN) and non-professional scoopnet fishermen, cpue on the Gironde basin for 1961–2008 (Source: Irstea). "-": gears not used that year; "?" unevaluated.

Year	Total Catch (t)				Cpue (kg/day)
	Pro. LPN	Pro. SN	Pro. SPN	NonPro. SN	Pro. LPN
1960–1961	-	32.2	-	?	
1961–1962	-	217.8	-	?	
1962–1963	-	363	-	?	
1963–1964	-	?	-	?	
1964–1965	-	352.5	-	?	
1965–1966	-	27.6	-	?	
1966–1967	-	162.8	-	?	
1967–1968	-	284.2	-	?	
1968–1969	-	36.6	-	?	
1969–1970	-	203.8	-	?	
1970–1971	-	47.1	-	?	
1971–1972	-	69	-	?	
1972–1973	-	20	-	?	
1973–1974	1.9	52.7	-	?	7.8
1974–1975	6.6	37.5	-	?	6.7
1975–1976	25.2	95.7	-	?	13.2
1976–1977	39	82.6	-	?	11.7
1977–1978	26.7	83.3	-	107.8	12.8
1978–1979	28	89.7	-	116.2	14
1979–1980	45.8	167.3	-	217.1	25.4
1980–1981	45.5	78.3	-	150.6	14.9
1981–1982	49.6	36.6	-	36.5	10.9
1982–1983	49.5	25.8	-	26.9	12.7
1983–1984	30.5	26	-	26	17.6
1984–1985	16.3	11.7	-	11.8	8.1
1985–1986	26.3	13.6	-	14.4	8.8
1986–1987	31.9	25	-	28.6	13.5
1987–1988	25.4	6.7	-	6.7	9.3
1988–1989	37.5	15.6	-	17.3	7.1
1989–1990	28.6	8.6	-	9	5.6
1990–1991	36	9.6	-	14.5	8.5
1991–1992	17	8	-	12.8	4.5
1992–1993	29.6	11.6	-	21.7	8.9
1993–1994	34.6	6.5	-	12.4	9.2
1994–1995	47.5	9.6	-	18.9	7.9
1995–1996	21.4	1.5	2.2	4.2	4.7
1996–1997	33	3.6	7.9	6.4	6.3
1997–1998	14.1	0.4	1.7	1	3.8
1998–1999	40.6	0.8	7.5	2.7	8.9
1999–2000	21.2	0.1	3.4	0.3	6.6

Year	Total Catch (t)				CPUE (kg/day)
	Pro. LPN	**Pro. SN**	**Pro. SPN**	**NonPro. SN**	**Pro. LPN**
2000–2001	8.8	0	0.2	0.1	1.9
2001–2002	28.3	3.8	4.7	6.2	4.9
2002–2003	9.5	0.1	0.8	0.1	2.7
2003–2004	13.3	0.1	1	0.1	2.5
2004–2005	12.9	0.8	3.6	0.5	2.7
2005–2006	8.1	0	1.2	0	2.4
2006–2007	6.2	0.1	1.1	0.1	2.1
2007–2008	8.2	0.4	1.3	0.2	2.6
2008–2009	3.5	0	0	0	1.4
2009–2010	3.4	0	0	-	1.2
2010–2011	4.5	0.3	0.2	-	1.8
2011–2012	4.5	0.1	0.3	-	2.9
2012–2013	4.6	0.1	1.0	-	4.9

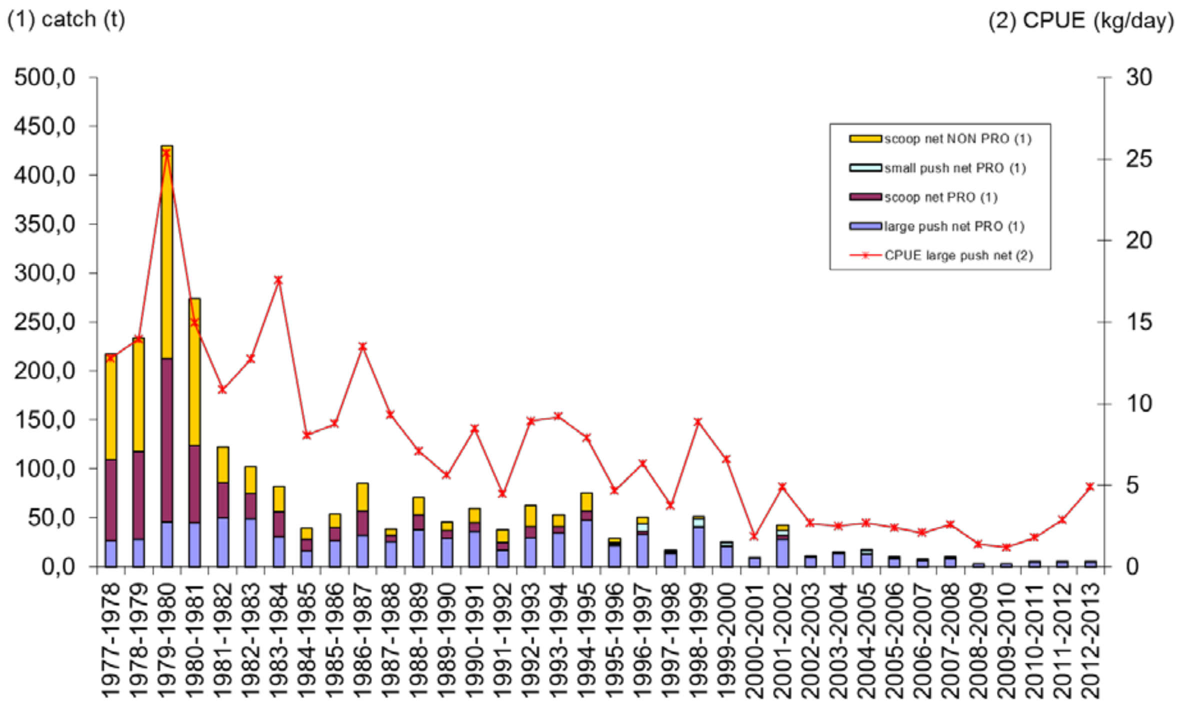


Figure FR 12. Cumulated capture of glass eel for non-professional and professional fishermen for 1978–2008, cpue of large pushnet professional fishermen on the Gironde basin for 1978–2011 (Source: Irstea).

7.3 Yellow eel

7.3.1 The Garonne (Garonne EMU)

Yellow eel cpue for the Gironde basin have been extended by Beaulaton (2008). The eelpot cpue increase in the 1970s, mainly because of change of eel pot (from wooden to plastic). Then the eelpot cpue for yellow eel has fallen since the middle of the 1980s, slightly increased until 1998 before decreasing again until 2007 (Table FR 28 and Figure

FR 13). The total catches have decreased while the number of fishermen has also decreased. But changes in the fishing power and in the tactics have increased the real effort and our effort unit does not reflect these changes. Consequently, this cpue is not fully representative of the real current tendency of the abundance which presents certainly a more marked decrease. After a ban of the fishery in 2010 and 2011 because of the contamination by PCB, the cpue reach a high level but in connection with a limited period of fishing and a few number of fishermen.

Table FR 28. Catches of yellow eel for professional and non-professional (from 1978 onwards only) yellow eel fishermen, cpue on the Gironde basin for 1894–2010 (Source: Irstea). * major fisheries have been banned due to PCB level.

YEAR	TOTAL CATCH (T)		CPUE (KG/EELPOT/MONTH)
	PRO.	NON PRO.	PRO.
1894	26.2		
1895	40.5		
1896	42.1		
1897	61.6		
1898	53.7		
1899	43.5		
1900	41.8		
1901	43.9		
1902	29.1		
1903	38.1		
1949	10.7		
1950			
1951	15.4		0.5
1952	17.6		0.5
1953			
1954	77.5		1
1955			
1956	51.9		0.7
1957			
1958			
1959	123.8		1.4
1960	265.3		2.5
1961	69.4		0.9
1962	56.8		0.8
1963	53.1		0.9
1964	14.5		0.6
1965	18.4		0.5
1966	6.3		0.7
1967	21.5		0.9
1968	40.8		0.8
1969	87.8		3.3
1970	42.4		1.4

Year	Total Catch (t)		CPUE (kg/eelpot/month)
	Pro.	Non Pro.	Pro.
1971	43.1		1.7
1972	80.6		1.9
1973	168.6		1.2
1974	108.2		2.7
1975	130.8		2.3
1976	84.8		1.8
1977	314.8		2.8
1978	157.9	204.1	2.6
1979	152.5	229.5	3.7
1980	108.4	155.7	2.5
1981	143.5	148.8	1.6
1982	164.3	133.1	3.3
1983	166	76.2	2.6
1984	148.8	164.1	2.8
1985	172.4	170.3	3.4
1986	208.8	160.5	3.3
1987	167.7	134.3	1.3
1988	140	97.7	1.9
1989	70.4	40.2	1
1990	67	28.3	1
1991	67.5	15.8	1.1
1992	58.5	27.7	1.1
1993	42.2	21.4	1.5
1994	48.7	21.1	1.5
1995	55.8	18.4	1.4
1996	38.8	7.7	1.3
1997	43.7	9.7	1.3
1998	36.1	7.3	1.3
1999	27.3	1.5	1.2
2000	27.9	1.4	1
2001	29.4	0.6	1.1
2002	15.8	1.1	0.9
2003	12.8	0.5	0.8
2004	14.4	1.3	1.3
2005	8.6	0.6	0.8
2006	8.4	0.6	0.9
2007	8.8	0.8	1
2008	12.4	1.3	2.3
2009	24.2	1.6	2.1
2010	1.3	0	-*
2011	0.6	0	-*
2012	5.2	0.5	1.2
2013	9.4	1.4	1.8

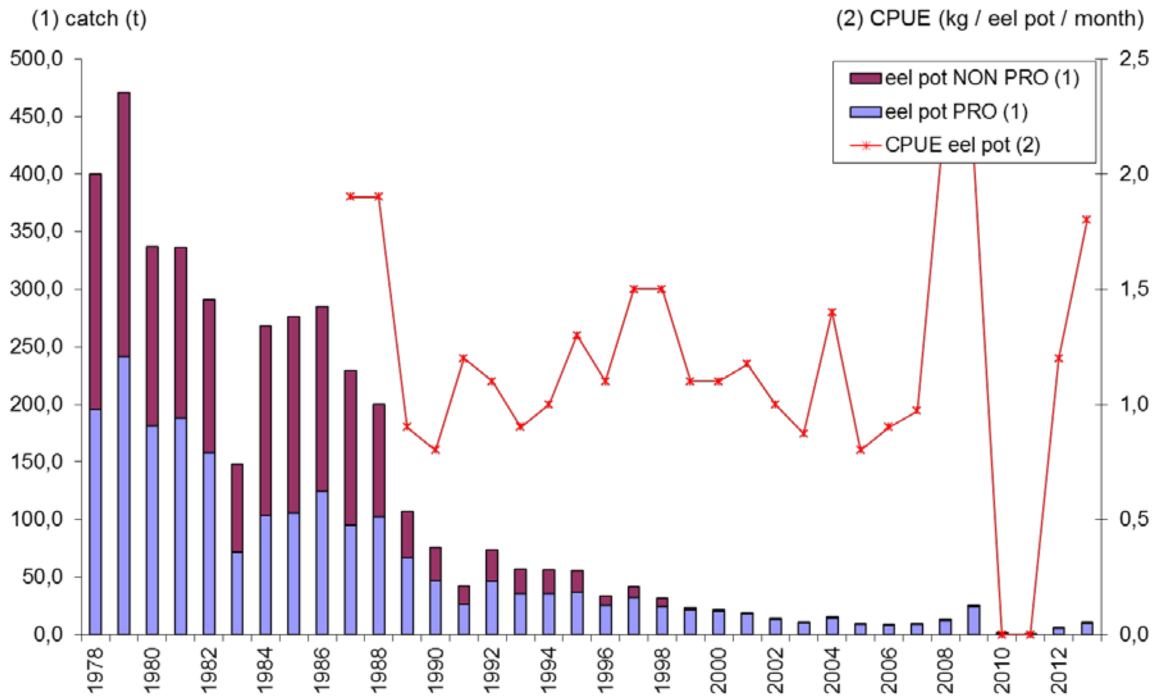


Figure FR 13. Cumulated catch of yellow eel for commercial and non-commercial fishermen, cpue on the Gironde basin for 1978–2011 (Source: Irstea).

7.4 Silver eel

Cpue have been extracted from data of a sample of four (three in between 2004 and 2007) fishers of the Guideau fishery (Boisneau and Boisneau, 2014; Figure FR 14). They show a significant decreasing trend over the 26 years.

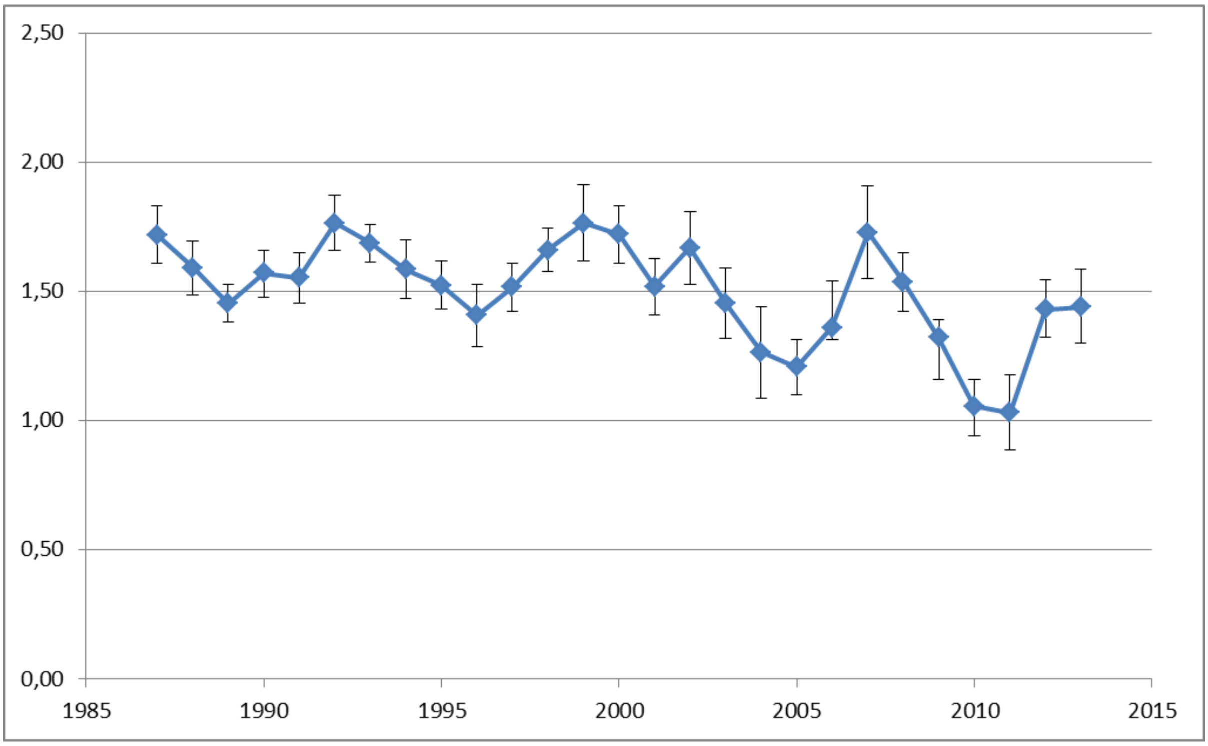


Figure FR 14. Cpue from four* Guideau fisheries (silver eel) in the Loire river (Boisneau and Boisneau, 2014). (*three fisheries between 2004 and 2007).

8 Other anthropogenic and environmental impacts

The Figure FR 15 highlighted contrasted evolution of the discharge in the estuary. Since 1960 the Gironde discharge has been highly decreasing, lightly in Loire while the discharge remained stable in Seine. Moreover the summer temperature in the Gironde estuary has increased of 2.5°C in 30 years. In France the concentration in nitrate has increased until the 1990s and has been stabilized since. Metallic and organic pollution is not well known and evolutions are site-specific (Le Treut ed., 2013).

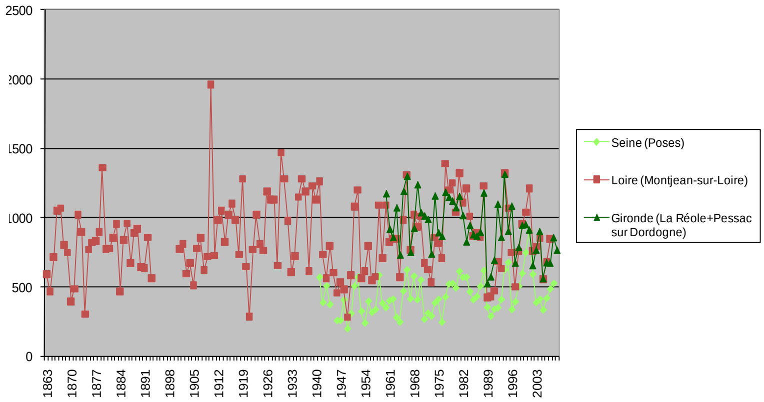


Figure FR 15. Evolution of discharge of Seine, Loire and Gironde Rivers at the river mouth (data sources Seine: GIP seine aval, MEEDAT, banque Hydro, Loire: GIP Loire Estuaire, Banque Hydro, CMB, Gironde: PAB).

9 Scientific surveys of the stock

9.1 Recruitment survey, glass eel

9.1.1 The Gironde (Garonne EMU)

The Gironde survey consists in a monthly sampling of 24 stations (surface + deep) distributed along four transects. This monitoring uses an estuarine research vessel (Figure FR 16) and aims at evaluating the abundance variations of the juveniles of fish and crustacean and the adults of small species.

Figure FR 16. "L'Esturial" boat used for scientific survey in the Gironde (Source: Irstea).

The results (annual average from September to August) for glass eels highlight a sharp decrease for season 1999–2000 and a steady low decrease afterwards. An increase is recorded for the last two seasons (2011–2012 and 2012–2013). In the main, this analysis confirms results coming from fishery data (Table FR 29 and Figure FR 17) even if some little differences remain to analyse.

Table FR 29. Time-series for the Gironde glass eel recruitment data by migratory season= year (n-1)- (n). This series has been reviewed – new figures (Girardin and Castelnaud, 2011).

Season (n–1,n)	1990	2000	2010
0		1.00	0.10
1		0.36	0.16
2	1.75	1.02	0.07
3	2.83	0.28	0.19
4	2.20	0.30	0.38
5	2.92	0.53	
6	2.07	0.27	

7	3.14	0.14
8		0.28
9	3.49	0.44

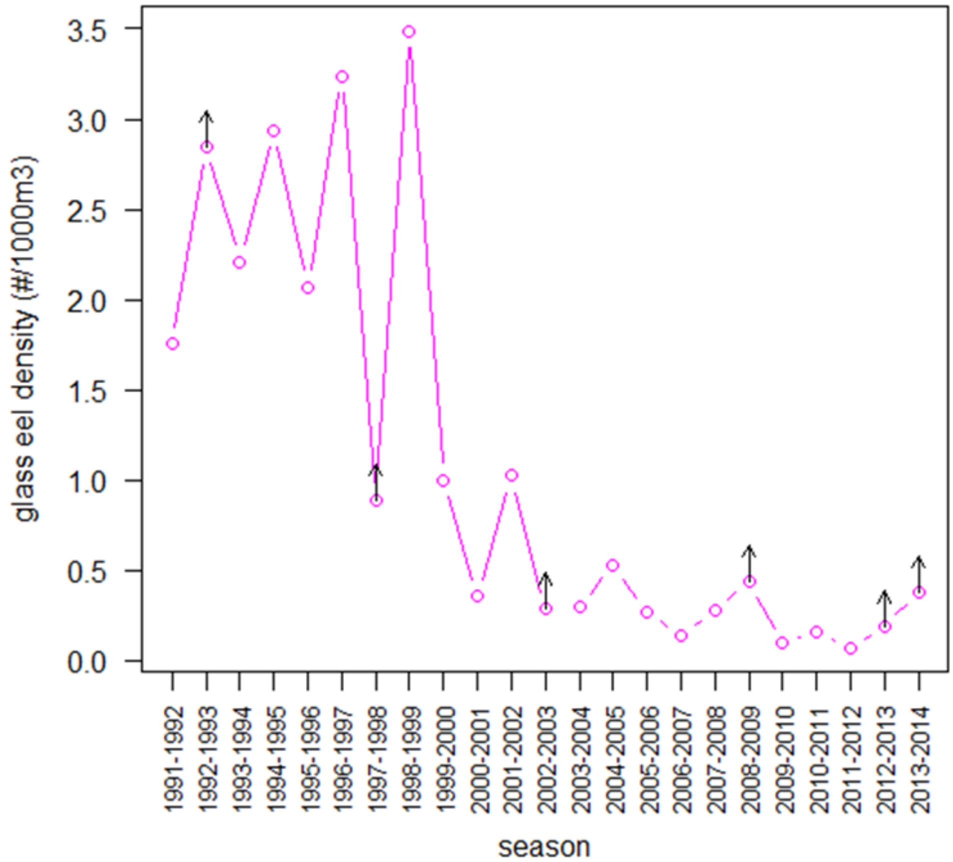


Figure FR 17. Results of the glass eel recruitment survey in the Gironde (↑ indicates a possible underestimates from missing sampling during the main part of the migration).

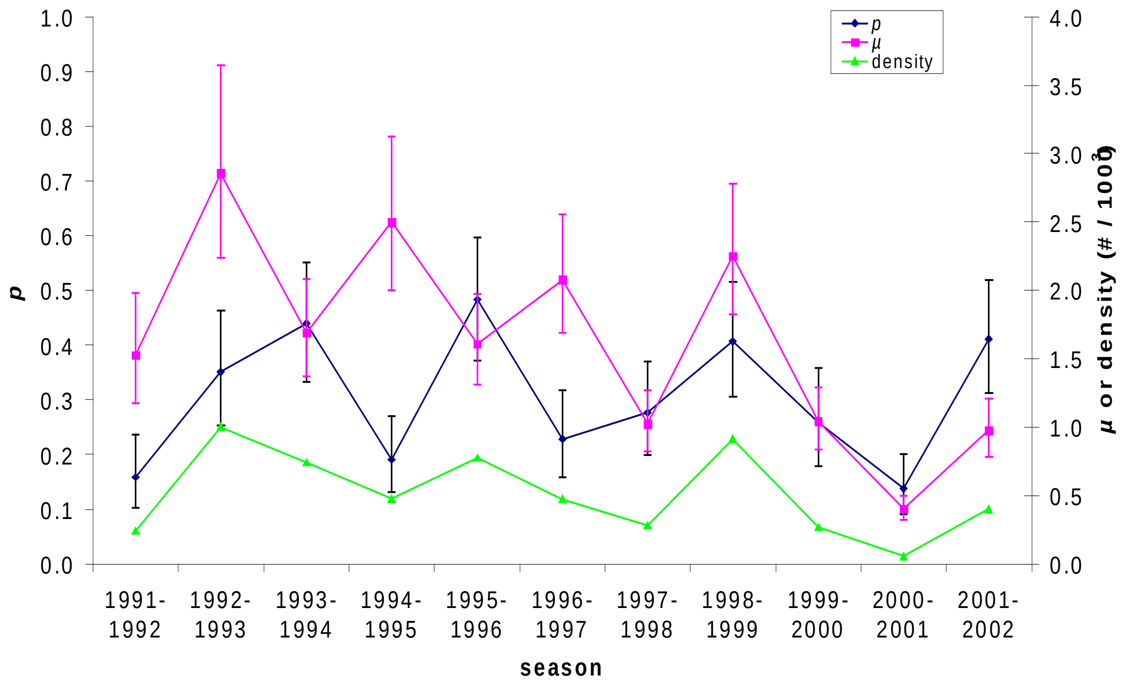


Figure FR 18. Results for glass eel of a delta-gamma analysis for season effect (p=probability of positive capture, μ=mean capture for only positive capture, density=p*μ) (extracted from Lambert, 2005).

These data were from seasons 1991–1992 to 2001–2002 were analysed by Lambert (2005) using a delta-gamma approach (Stefánsson, 1996). This method allows separate analyses of the presence probability (p) and positive capture (μ) and joint analyse through overall density. The delta and gamma approaches were performed thanks to generalized linear models (GLM; McCullagh and Nelder, 1989) with both spatial and temporal effects. Results on season effect (Figure FR 18) show some peculiar seasons like 2000–2001 for which glass eels were rarely caught (low p) and when caught, in low number (low μ), resulting in a very low density.

9.1.2 Index river system

In the framework of the French management plan, a network of index rivers (at least one for each EMU) are setting up in order to monitor ascending recruitment (glass eels or elvers) and migrating silver eels (Table FR 30).

Table FR 30. Selected river for a river index network.

EMU	Selected river	Upstream	Downstream	Stock in place
Adour	Courant de Soustons (fluvial basin with big lakes <1000 km²)	X	X	X
Gironde	Dronne (fluvial basin >1000 km²)		X	
Loire	Sèvre Niortaise (marshes)	X	X	X
Bretagne	Frémur (fluvial basin <1000 km²) and Vilaine (fluvial basin >1000 km²)	X	X	X
Seine-Normandie	Bresle (fluvial basin <1000 km²)	X	X	X
Artois-Picardie	Somme (fluvial basin >1000 km²)	X	X	X
Rhône-Méditerranée	Rhône (fluvial basin >1000 km²) and Vaccarès lagoon	X		X
Corse	Not yet selected			
Rhin-Meuse	Rhine (fluvial basin >1000 km²)	X		

The Frémur and the Bresle River is part of this system and results for recruitment survey are given above (3.1.2.3.1).

9.2 Stock surveys, yellow eel

9.2.1 WFD survey

Water Framework Directive (WFD) survey is operated by Onema for fish compartment in rivers. The survey consists of electrofishing in 1500 sites in France every two years.

An example of results has been presented in previous report (Briand *et al.*, 2008a). Poulet *et al.* (2011) used these data to study time trends in fish population (including eel) over a 20 years period (1990–2009) and 590 sites in France. They show that eel is one of the most declining fish both in terms of presence and abundance. Figure FR 19 shows the extraction per site from their results of the trend in eel population. Most sites show a decreasing trend.

Furthermore WFD survey is the raw data used by EDA model to assess the biomass (Jouanin *et al.*, 2012).

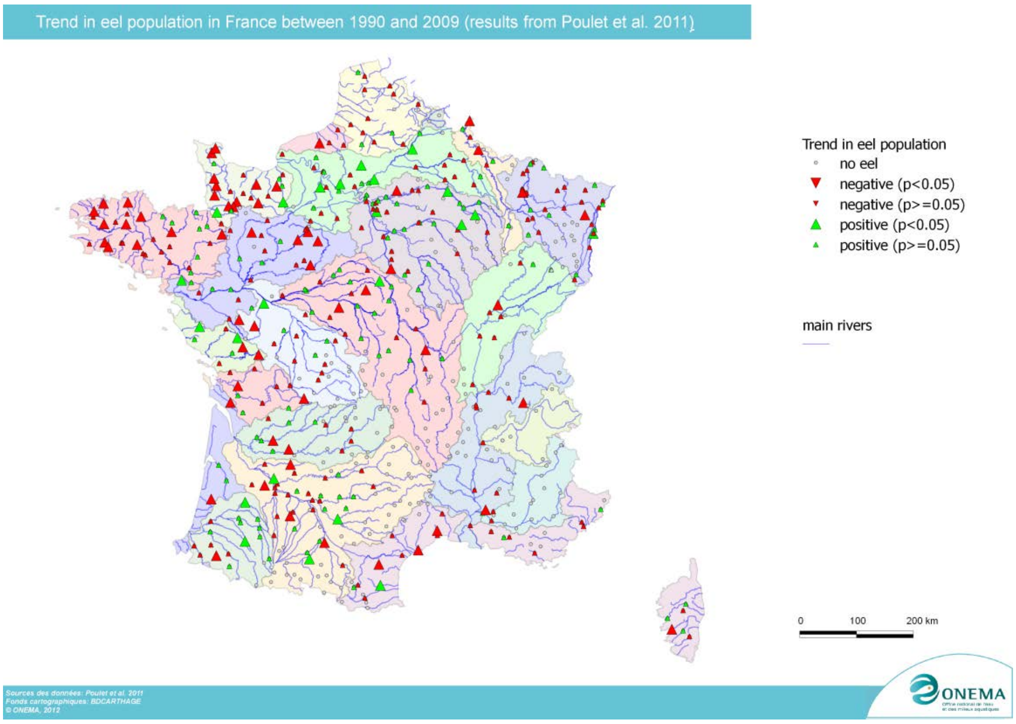


Figure FR 19. Trend in eel population in France between 1990 and 2009 according to Poulet *et al.* (2011) results.

9.2.2 Specific eel survey

To complete the WFD survey network, the French EMP established eel specific networks consisting of electrofishing network of sites close from the sea (<200 km) not cover by WFD network. There are about 300 sites that are fished in the following EMU: Artois-Picardie (62), Seine-Normandie (30), Brittany (49), Loire (27), Garonne (65), Adour (61). Some of them are localized on index river (Table FR 30).

Results need to be analysed.

9.3 Silver eel

9.3.1 Index river system

The index river system describe above (9.1.2) also provide data on silver run. Bresle River and Frémur River results are described above (3.1.2.3 and 3.1.2.3.2).

10 Data collected for the DCF

Provide summary information on the monitoring of eel by EMU in the current year.

Table 10-1. Summary of the DCF monitoring implementation per EMU.

Data	River	Lakes	Estuaries	Lagoons	Coastal & Marine
No. of production / escapement surveys[1]					
No. of recruitment time-series surveys[2]					
No. fished aged					
No. of fished sexed					
No. of fish examined for parasites					
No. of fish examined for contaminants					
No. of non-fishery mortality studies[3]					
Socio-economic survey					

[1] Surveys to estimate B_{best} and/or $B_{current}$ [These should include WFD surveys where the data are being used to estimate production and/or escapement of eel].

[2] Fishery-independent surveys.

[3] Studies to determine ∑H for non-fisheries anthropogenic impacts, such as hydropower, barriers, predation, etc.

DCF data from 2010 have been analysed in Beaulaton *et al.* (2011). Data from 2011 have been analysed by Mahé and Sévin (2012) and are summarised here.

In 2011, 140 eels have been sampled between July and October: 60 in the Loire River, 39 in the Garonne River and 41 in the Dordogne River. The overall length–weight relationship is $W_t = 5.10^{-7} L_t^{3.2047}$ (Figure FR 20).

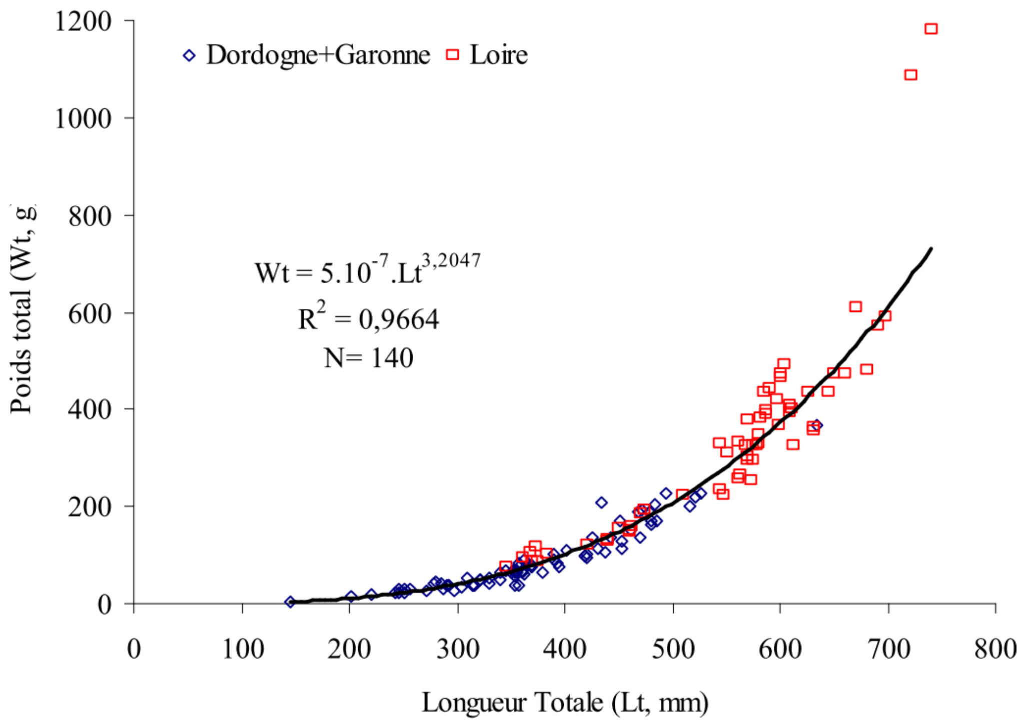


Figure FR 20. Length–weight relationship from 2011 DCF samples (from Mahé and Sévin, 2012).

From these 140 eels, 130 have been successfully aged Figure FR 21). The age range from 2 to 16 years in the Dordogne and Garonne (mean = 7 years) and from 5 to 15 years in the Loire (mean = 11 years).

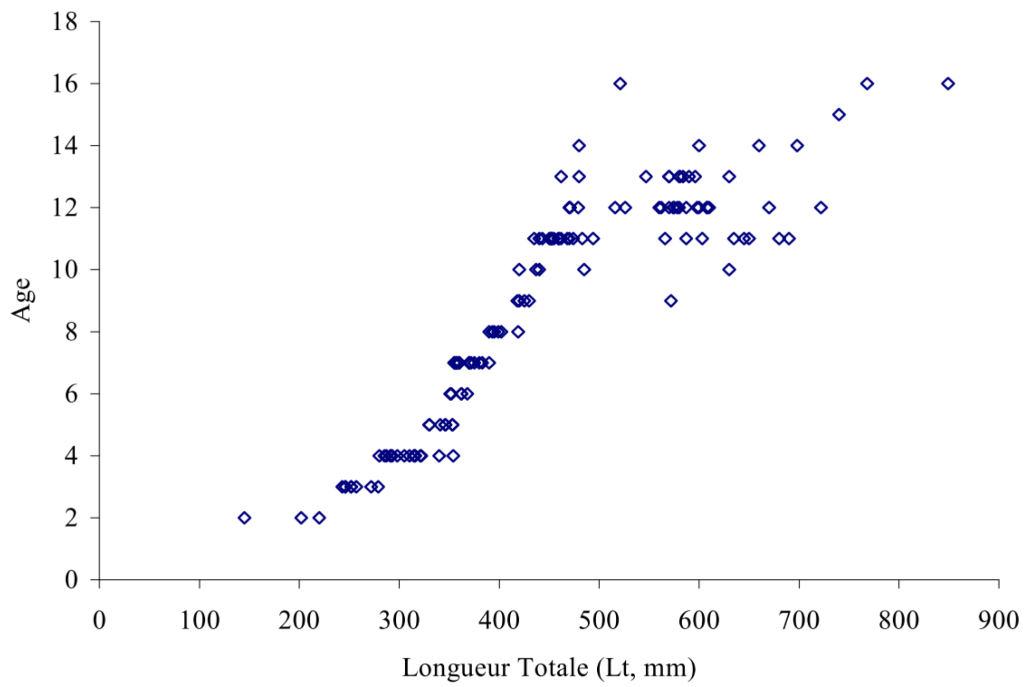


Figure FR 21. Length–age relationship from 2011 DCF samples (from Mahé and Sévin, 2012).

11 Life-history and other biological information

Report by country, EMU, catchment or sub-catchment, as appropriate

NEW: Report by sex, stage, as appropriate

11.1 Growth, silvering and mortality

Von Bertalanffy parameters: Linf, K, t0

L50 = the length at which 50% of the population has silvered (my interpretation of 50% maturity)

Length and age at silvering

Fecundity

Weight-at-age

Length–weight relationship

11.1.1 Garonne EMU

In the study of Lamaison (2005) age were estimated in 19% among the 865 otoliths, Based on a generalized estimating equation regression model (Horton and Lipsitz, 1999), this author found different mean linear growth rates according to sectors in the Garonnne catchment (Table FR 31).

Table FR 31. Mean linear growth rate in the Garonne basin for year 2004 (Lamaison, 2005).

Sector in the catchment		Linear growth rate (mm/year)
ESTUARY		67,53
GARONNE	Tidal freshwater zone (zone mixte)	53,49
	Tributaries of tidal freshwater zone	50,54
	Mainstream river	46,84
	Tributaries of mainstream river	44,70
	First obstacle of the mainstream river	43,65
DORDOGNE	Tidal freshwater zone (zone mixte)	50,33
	Tributaries of tidal freshwater zone	46,77
	Tributaries of mainstream river	41,86
	First obstacle of the mainstream river	41,86

The length–weight relationship leads to the equation:

$$W = \ln(-14.992)L^{3.2698}$$

And explain 97% of the variance.

The condition factor (Blackwell *et al.*, 2000) show differences betweet the estuary and the two main rivers Garonne and Dorgone (Table FR 32). On each river the worse condition factor are recorded for fish climbing the first obstacle (Lamaison, 2005).

Table FR 32. Condition factor in the Garonne basin for year 2004 (Lamaison, 2005).

Sector in the catchment		Kn (%)
ESTUARY		118
GARONNE	Tidal freshwater zone (zone mixte)	114
	Tributaries of tidal freshwater zone	110
	Mainstream river	113
	Tributaries of mainstream river	108
	First obstacle of the mainstream river	101
DORDOGNE	Tidal freshwater zone (zone mixte)	112
	Tributaries of tidal freshwater zone	94
	Tributaries of mainstream river	96
	First obstacle of the mainstream river	88

11.1.2 France

Using the BDMAP database of ONEMA's electrofishing (Poulet *et al.*, 2011), we can determined the relationship between length and weight on 91 153 eels caught throughout France from 1978 to 2012 (Figure FR 22). This relationship can be summarised by a quantile regression between the log of length and the log of weight. For the quantile 25%, 50% (median) and 75% the intercept are respectively -14.52011, -14.15382, -13.73644 and the coefficient is 3.19175, 3.14903 and 3.09744. Table FR 33 summarizes statistics by length class. Those statistics however hide geographical and temporal differences that need to be analysed.

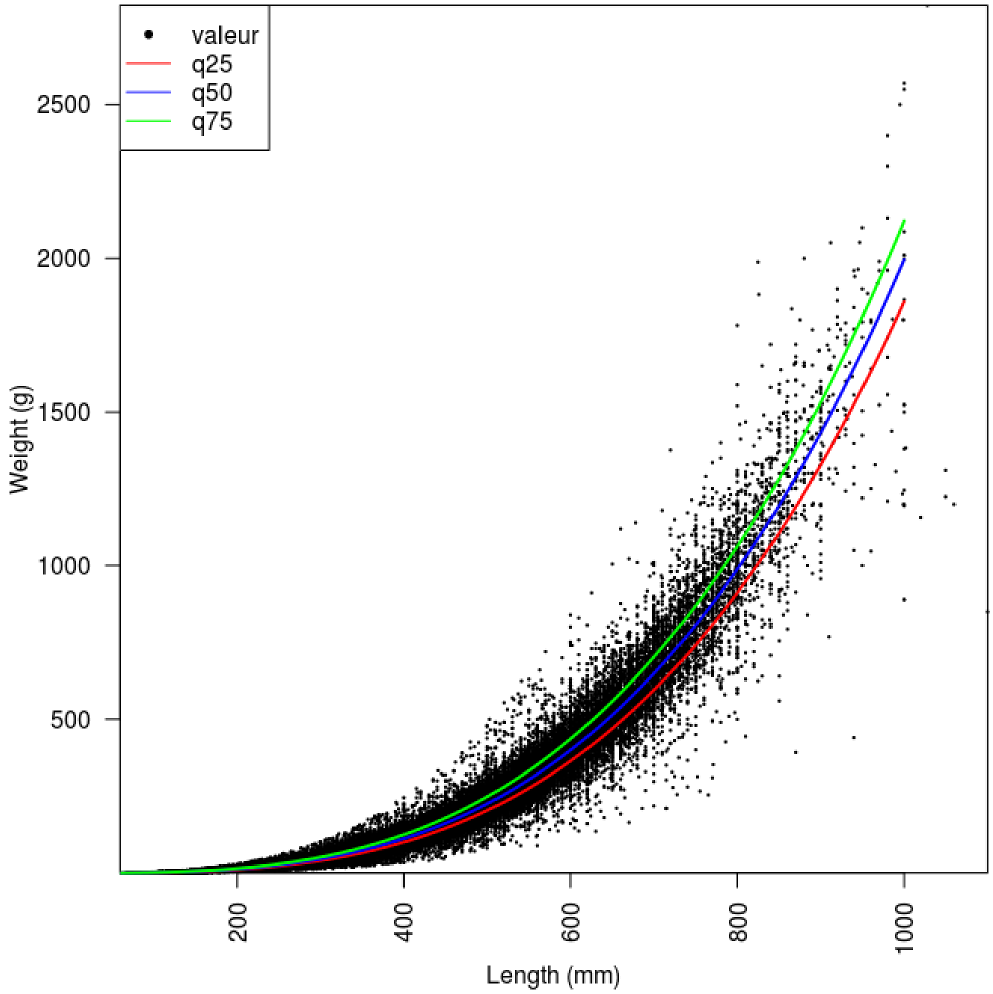


Figure FR 22. Length–weight relationship on French eel (n = 91 153) represented by quantile regression (25%, 50%, 75%).

Table FR 33. Weight by 20 mm length class. N = number of data used; q50, q05 and q95 = quantile statistic and Ws = predicted weight according to quantile 75% regression.

Length	N	q50	[q05–q95]	Ws
100	378	2	[1–3]	1.7
150	1318	5	[2–8]	6
200	2501	12	[8–18]	14.5
250	3904	25	[18–35]	29
300	4746	45	[32–60]	50.9
350	4961	74	[53–100]	82.1
400	3206	110	[81–142]	124.2
450	2681	159	[119–204]	178.9
500	2313	226	[171–290]	247.9
550	1750	302	[231–387.5]	333
600	1163	400	[300–514.5]	436
650	812	514.5	[378–664.2]	558.7
700	596	663.5	[506–830.5]	702.8
750	312	810	[606.6–1074]	870.3
800	221	987	[672–1240]	1062.9
850	103	1200	[900.8–1498.7]	1282.4
900	47	1400	[1018.1–1670]	1530.8
950	12	1839	[1121–2073.6]	1809.9
1000	22	1523.5	[905.2–2547.5]	2121.5

11.2 Parasites and pathogens

EEQD Data – only include new data not previously reported

11.3 Contaminants

EEQD Data – only include new data not previously reported

11.4 Predators

No data available.

12 Other sampling

12.1 Silver eel transfer in Mediterranean lagoons

Since 2011, operations of transport to the sea of silver eels have been done yearly in the autumns (3.7). A random sample of about 60 migrant silver eels (IO ≥6.5) was taken from each transport operation in order to characterize silver eels “population” in each lagoon. Figure FR 23 to Figure FR 26 present the results for length, Fulton’s condition factor, percentage of lipids in muscle and sex-ratio.

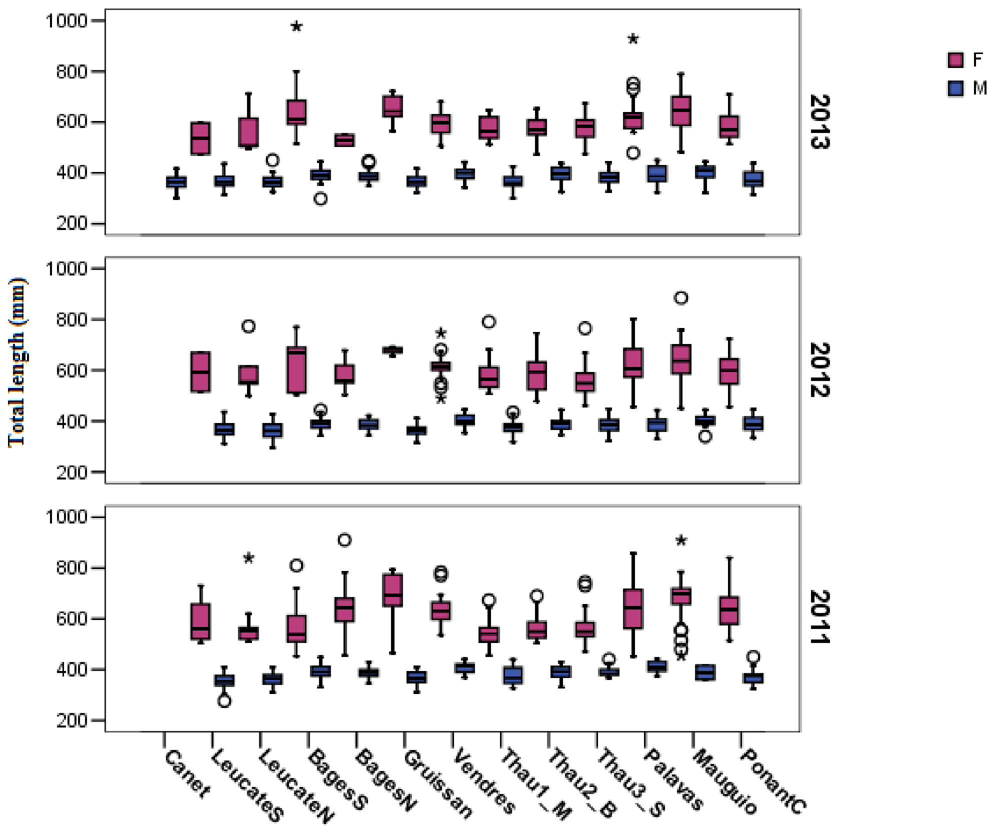


Figure FR 23. Total length (in mm) of silver eels sampled during the transport operations in 2011, 2012 and 2013 (see Figure FR 11 for locations). Males (M) and females (F) were distinguished according to their size, <45 cm for males and ≥45 cm for females.

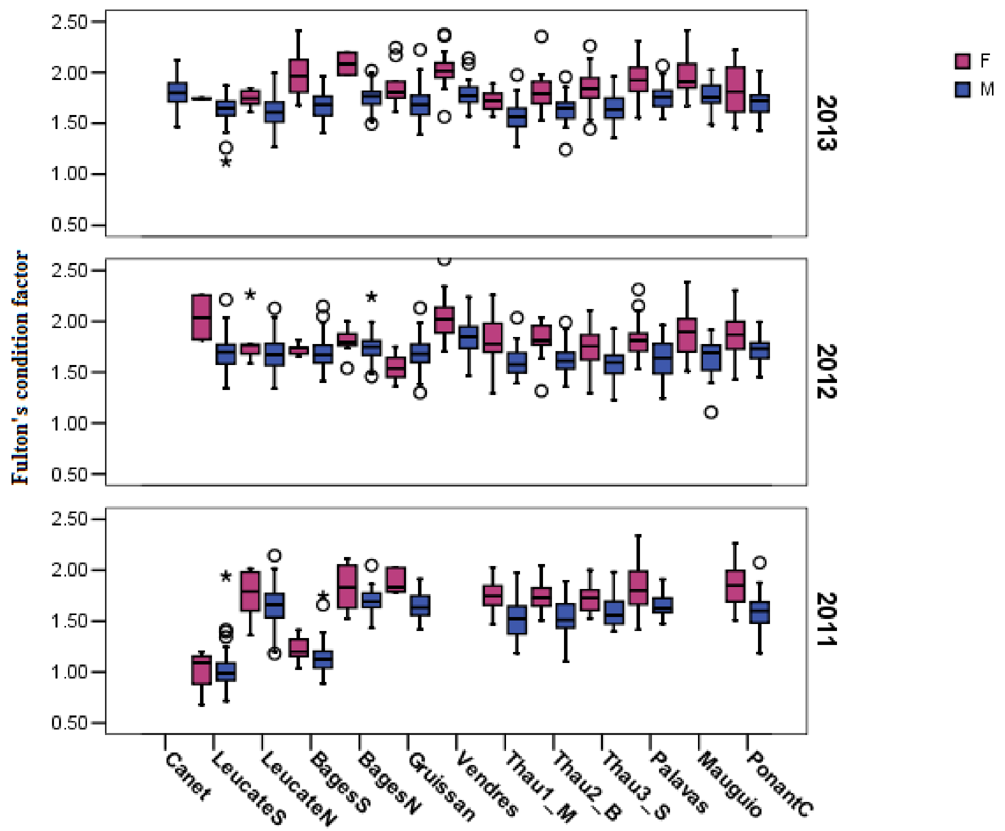


Figure FR 24. Fulton's condition index of silver eels sampled during the transport operations in 2011, 2012 and 2013 (see Figure FR 11 for locations). Males (M) and females (F) were distinguished according to their size, <45 cm for males and ≥45 cm for females.

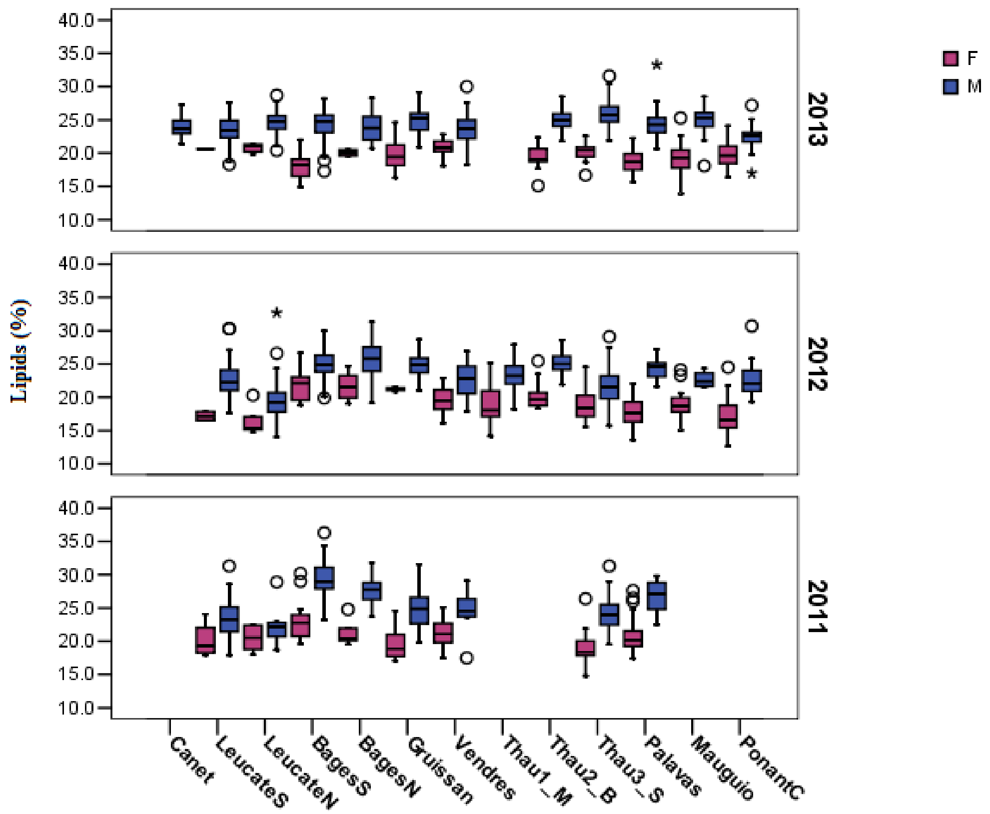


Figure FR 25. Lipids content (measured with a Distell© fatmeter) of silver eels sampled during the transport operations in 2011, 2012 and 2013 (see Figure FR 11 for locations). Males (M) and females (F) were distinguished according to their size, <45 cm for males and ≥45 cm for females.

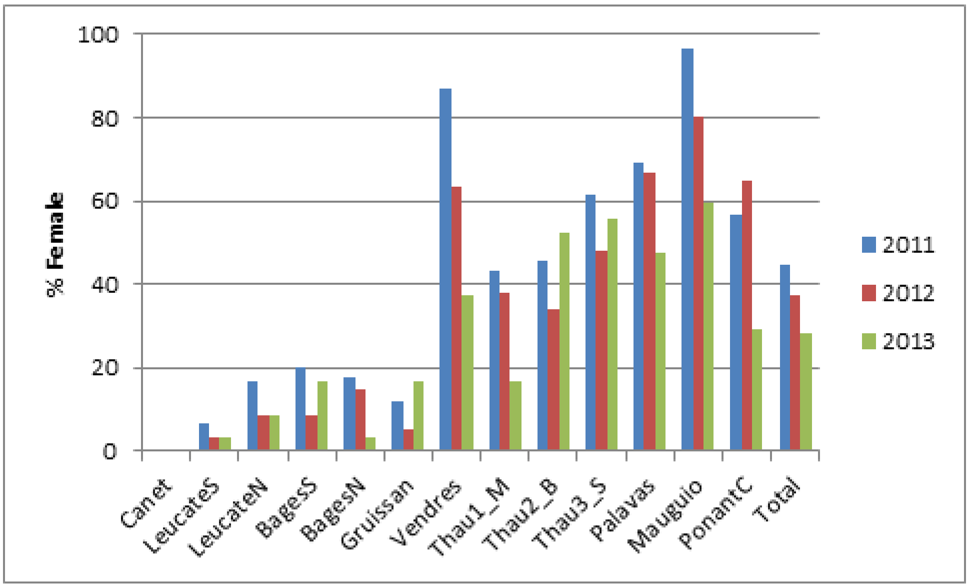


Figure FR 26. Percentage of females silver eels (≥45 cm) sampled during the transport events in 2011, 2012 and 2013 (see Figure FR 11 for locations).

13 Stock assessment

No new data.

14 Sampling intensity and precision

No new data.

15 Standardisation and harmonisation of methodology

No data available.

15.1 Survey techniques

15.2 Sampling commercial catches

15.3 Sampling

15.4 Age analysis

15.5 Life stages

15.6 Sex determinations

15.7 Data quality issues

16 Overview, conclusions and recommendations

17 Literature references

ABDALLAH, Y., CRIVELLI, A. J., LEBEL, I., MAUCLERT, V., HENISSART, C., and MAROBIN, D. 2009. État des lieux de la pêcherie professionnelle à l'Anguille (*Anguilla anguilla*) en Région Provence-Alpes-Côte d'Azur. Association Migrateurs Rhône Méditerranée, Pôle Relais Lagunes Méditerranéennes, Station biologique Tour du Valat, Comité Régional des Pêches et des Elevages Marins PACA, Parc Naturel Régional de Camargue. 51p.

ACOU A., BOURY P., BOISNEAU C., BODIN M. and FEUNTEUN E. 2010. Estimation du potentiel reproducteur en anguilles argentées de la Loire amont: saisons de migration 2001–05 à 2008–09 Muséum National d'Histoire Naturelle, CRESCO, 40p.

ACOU A., TRANCART T., FEUNTEUN E., BOISNEAU C., BODIN M. and BOISNEAU P. 2014. Inter-annual trend in recent years (2001–2012) of population size and reproductive potential of silver-phase European eels in the Loire River, France. 144th Annual Meeting of the American Fisheries Society, International Eel Symposium, Québec 17–21 August 2014.

ADAM G. 1997. L'anguille européenne (*Anguilla anguilla* L. 1758): dynamique de la sous-population du lac de Grand-Lieu en relation avec les facteurs environnementaux et anthropiques. Thèse de doctorat Université Paul Sabatier, Toulouse III, 353p.

AMILHAT E., FEUNTEUN E., SIMON G., FALIEX E., CRIVELLI A., LECOMTE R., CHASSANITE A., SASAL P. and FARRUGIO H. 2012a. Protocole de relâcher d'anguilles argentées en Méditerranée française. CEFREM, Université de Perpignan. 14p.

AMILHAT E., SIMON G., CHASSANITE A. and FALIEX E. 2012b. Suivi scientifique de l'étude pilote de relâchers d'anguilles argentées en Méditerranée – Nov–Déc 2011 - Résultats préliminaires. CEFREM, Université de Perpignan, 13p.

AMILHAT E., SIMON G., FALIEX E. 2013. Rapport technique du suivi scientifique des relâchers d'anguilles argentées menés en Méditerranée en 2012. CEFREM, Université de Perpignan, 49p.

AMILHAT E., SIMON G., FALIEX E. In prep. Rapport technique du suivi scientifique des relâchers d'anguilles argentées menés en Méditerranée en 2013. CEFREM, Université de Perpignan.

Anonymous. 2012. La pêche professionnelle à l'anguille européenne (*Anguilla anguilla*) en région Provence-Alpes-Côte d'Azur. 2012. CRPMEM PACA. 17p.

Anonymous. 2003. Prud'homies du Languedoc Rousillon. Suivi de la pêche aux petits métiers. Année 2003. Cépralmar, 57p.

Anonymous. 2004. Prud'homies du Languedoc Rousillon. Suivi de la pêche aux petits métiers. Année 2004. Cépralmar, 52p.

Anonymous. 2005. Prud'homies du Languedoc Rousillon. Suivi de la pêche aux petits métiers. Année 2005. Cépralmar, 46p.

BEAULATON L. 2008. Systèmes de suivi des pêches fluvio-estuariennes pour la gestion des espèces: construction des indicateurs halieutiques et évaluation des impacts en Gironde, Institut National Polytechnique de Toulouse, 348p.

BEAULATON L., BRIAND C., CASTELNAUD G., DE CASAMAJOR M.-N. and LAMBERT P. 2009. Report on the eel stock and fishery in France 2008/2009 in FAO EIFAC and ICES, 2009. Report of the 2009 session of the Joint EIFAC/ICES Working Group on Eels. EIFAC Occasional Paper. No. 45. ICES CM 2009/ACOM:15, 445–505.

BEAULATON L., BRIAND C., CASTELNAUD G., DE CASAMAJOR M.-N., LAMBERT P., HOLLEY J.-F. and BERGER V. 2011. Report on the eel stock and fishery in France 2010/'11 in ICES, 2011. Report of the Joint EIFAC/ICES Working Group on Eels. ICES CM 2011/ACOM:18., 357–414.

BODIN M., BONNET N., BOISNEAU P. and BOISNEAU C. 2011. Échantillonnage 2010–2011 des anguilles argentées du bassin de la Loire capturées au guideau à l'amont d'Ancenis, mesures biométriques, contamination par Anguillocoloides crassus et indice d'abondance. Association Agréée Interdépartementale des Pêcheurs Professionnels en eau douce du Bassin de la Loire et des cours d'eau Bretons (A.A.I.P.P.B.L.B), 31p.

BOISNEAU C. and BOISNEAU P. 2014. Long Term Evolution of Silver European Eel Indicator of Abundance in the Loire Watershed (France) (1987–2013), a Unique Data Set for Europe. 144th Annual Meeting of the American Fisheries Society, International Eel Symposium, Québec 17–21 August 2014.

BLACKWELL, B. G., M. L. BROWN and D. W. WILLIS. 2000. "Relative weight Wr status and current use in fisheries assessment and management." Reviews in Fisheries Science 8(1): 1–44.

BRIAND C., CASTELNAUD G., BEAULATON L., DE CASAMAJOR, M.N. and LAFFAILLE P. 2008a. Report on the eel stock and fishery in France 2007 in FAO EIFAC and ICES, 2008. Report of the 2008 session of the Joint EIFAC/ICES Working Group on Eels. EIFAC Occasional Paper. No. 43. ICES CM 2009/ACOM:15., 335–367.

BRIAND, C., BONHOMMEAU, S., BEAULATON, L., and CASTELNAUD, G. 2008b. An appraisal of historical glass eel fisheries and markets: landings, trade routes and future prospect for management. Wesport, Ireland.

CASTELNAUD, G. 2000. Localisation de la pêche, effectifs de pêcheurs et production des espèces amphihalines dans les fleuves français. Bulletin Français de la Pêche et de la Pisciculture, 357/358: 439–460.

CASTELNAUD G., LOSTE C. and CHAMPION L. 2000. La pêche commerciale dans les eaux intérieures françaises à l'aube du XXIème siècle: bilan et perspectives., Symposium CECPI on fisheries and society. Budapest. 1–24.

CHARRIER, F., MAZEL, V., BONNAIRE, F., KNAEBEL, B., and LEGAULT, A. 2014. Suivi des migrations d'anguilles et évaluation des stocks en place sur le Frémur en 2013. Contrat de Projet Etat-Région 2007-2013. Fish-Pass, Laille, France.

DEKKER, W., and BEAULATON, L. Submitted. Faire mieux que la nature - the history of eel restocking in Europe. Environment and History.

DEMANECHE S., MERRIEN C., BERTHON P., LESPAGNOL P. DAURES F., GUYADER O., REYNAL L., LE RU L., ROSE J., RUCHON F. 2009. Méthode d'élévation et évaluation des captures et de l'effort de pêche des flottilles de la façade Méditerranée continentale. Rapport R3 Programme P6 Aesypeche. SIH Usage action observation des marées au débarquement DCR, 217 p.

DROUINEAU, H., L. BEAULATON, P. LAMBERT and C. BRIAND. Submitted. "GEREM (Glass-Eel Recruitment Estimation Model): a model to estimate glass-eel recruitment at different spatial scales." ICES Journal of Marine Science.

GIRARDIN M. and CASTELNAUD G. 2011. Surveillance halieutique de l'estuaire de la Gironde: Suivi des captures 2010. Etude de la faune circulante 2010. Etude Cemagref Cestas n° 139. 243 p.

JOUANIN, C., BRIAND, C., BEAULATON, L., and LAMBERT, P. 2012. Eel Density Analysis (EDA 2.x). Un modèle statistique pour estimer l'échappement des anguilles argentées (*Anguilla anguilla*) dans un réseau hydrographique. Onema, Irstea. http://cemadoc.irstea.fr/cemoa/PUB00036398.

HORTON, N. J. and S. R. LIPSITZ. 1999. "Review of Software to Fit Generalized Estimating Equation Regression Models." The American Statistician 53(2): 160–169.

LAMAISON, G. 2005. Variabilité de la croissance de l'Anguille européenne (*Anguilla anguilla* L. 1758) au sein du bassin Gironde-Garonne-Dordogne. Diplôme d'Etudes Spécialisées, Université de Bordeaux 1.

LAMBERT P. 2005. Exploration multiscalaire des paradigmes de la dynamique de la population d'anguilles européennes à l'aide d'outils de simulation. Thèse de doctorat, Université Bordeaux 1, 219p.

LE TREUT, H. Les impacts du changement climatique en Aquitaine. Presse universitaire de Bordeaux.365 p.

MAHE, K. and SEVIN, K. 2012. Suivi Des Captures D'anguilles Pour La DCF : Analyse Des Otolithes. Année 2011. Rapport de Synthèse et Base de Données Des Lectures D'âge Mise à Jour. Convention Onema-Ifremer. Ifremer.

MCCULLAGH P. and NELDER J. A. 1989. Generalized linear models. Chapman and Hall, London, 511p.

POULET N., BEAULATON L. and DEMBSKI S. 2011. Time trends in fish populations in metropolitan France: insights from national monitoring data. Journal of Fish Biology, 79, 6, 1436–1452.

STEFÁNSSON G. 1996. Analysis of groundfish survey abundance data: combining the GLM and delta approaches. ICES Journal of Marine Science, 53, 3, 577–588.

VERGNE L., BRON L., DECORPS M. and ROMEYER D. 1999. Projet de réhabilitation de l'anguille dans le bassin Rhône - Méditerranée - Corse. Etude socio-économique . DIREN Rhône-Alpes/ISARA. 315 p. + annexes. p.

Report on the eel stock and fishery in Germany 2013

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2. Introduction

This report provides the most recent information about eel stocks, eel fishery and eel surveys in Germany. However, the report covers an "in between" period. The recent years were characterised by the implementation of the Eel Management Plans for nine German River Basin Districts. During that period, the legal frameworks had to be adapted in some States, structures for documentation of catch, efforts and re-stocking had to be established and, of course, many direct management measures had to be conducted. In June 2012, the first report about the implementation of the German Eel Management Plans and the recent development of the eel stocks, covering the period 2008–2010, was submitted to the European Commission (Fladung *et al.*, 2012a). There is, however, no permanent new calculation of escapement for each year. For practical reasons, the relevant authorities and institutions in the States mainly focus on the requirements of the reports to the EU Commission and not on providing detailed data on an annual basis. Therefore, there is no permanent new calculation of escapement, production and other population parameters for each year. These data have been provided for the period 2008–2010, in the progress / implementation report to the European Commission (Fladung *et al.*, 2012a). In addition, data have also been delivered in response to the "data call" for the WGEEL meeting in March 2013. In 2015, the next implementation report will be submitted to the European Commission. At present, the authorities in the Federal States ("Bundesländer") in Germany work on the preparation of this report. This also includes an upgrade of the German Eel Model to the version GEM III. However, not all data have been collected and analysed so far and no new calculation of stock indicators for the recent years has been conducted. For the purpose of practicability, in these cases the information from last year (i.e. from the progress report and the "data call") is repeated in the relevant chapters. The report also includes some data and analyses, which had been conducted in relation to the ICES workshop on Evaluation Progress in Eel Management Plans (WKEPEMP) in May 2013 (ICES 2013). Therefore, the available amount of "really new" data is rather low in the present Country Report, except for basic data on catches, aquaculture production and results of monitoring projects etc. This is mainly caused by limited resources and capacities of the regional fisheries authorities, which are confronted with an increasing effort for European and national regulations.

The relevant German river systems belong to the ICES Ecoregions North Sea (Rhine, Elbe, Weser, Ems, Eider) and Baltic Sea (Oder, Warnow/Peene, Schlei/Trave). The Danube, which drains into the Black Sea, is not considered to constitute natural eel habitats at a relevant level and hence, no stock indicators have been calculated for the Danube and no EMP has been established for this system.

Eel data collection under the DCF

Sampling of European Eel data in freshwaters is mandatory under the DCF. In Germany, sampling has started in spring 2009. The results of the biological sampling of eels in the freshwaters are regularly included as an Annex to the Country Report and this report contains the DCF data on eel for 2013. The recent years of sampling have been considered as a "pilot" phase. So far, sampling is focused on biological parameters of eel in commercial catches of the inland fishery. From each river basin district (according to WFD), about 200 eels (100 yellow and silver eels, respectively) have been sampled and investigated. Since 2011 the sampling scheme has slightly changed, but is still focused on biological parameters. Analyses include length, weight, age, sex. Some additional parameters are and will be also be analysed, such as *Anguillicola crassus* infestation and also concentration of some contaminants. However, these additional investigations are not mandatory under the DCF.

At present, no data on the fishery itself are sampled within the DCR. This was decided, because a lot of these data have to be obtained in the frame of the Eel Management Plans and the formal and administrative requirements of the EU Council Regulation 1100/2007. Yet, at present the future strategy of the DCF-sampling is under discussion and possibly may change (e. g. inclusion of detailed data about fishing effort in direct relation to catches).

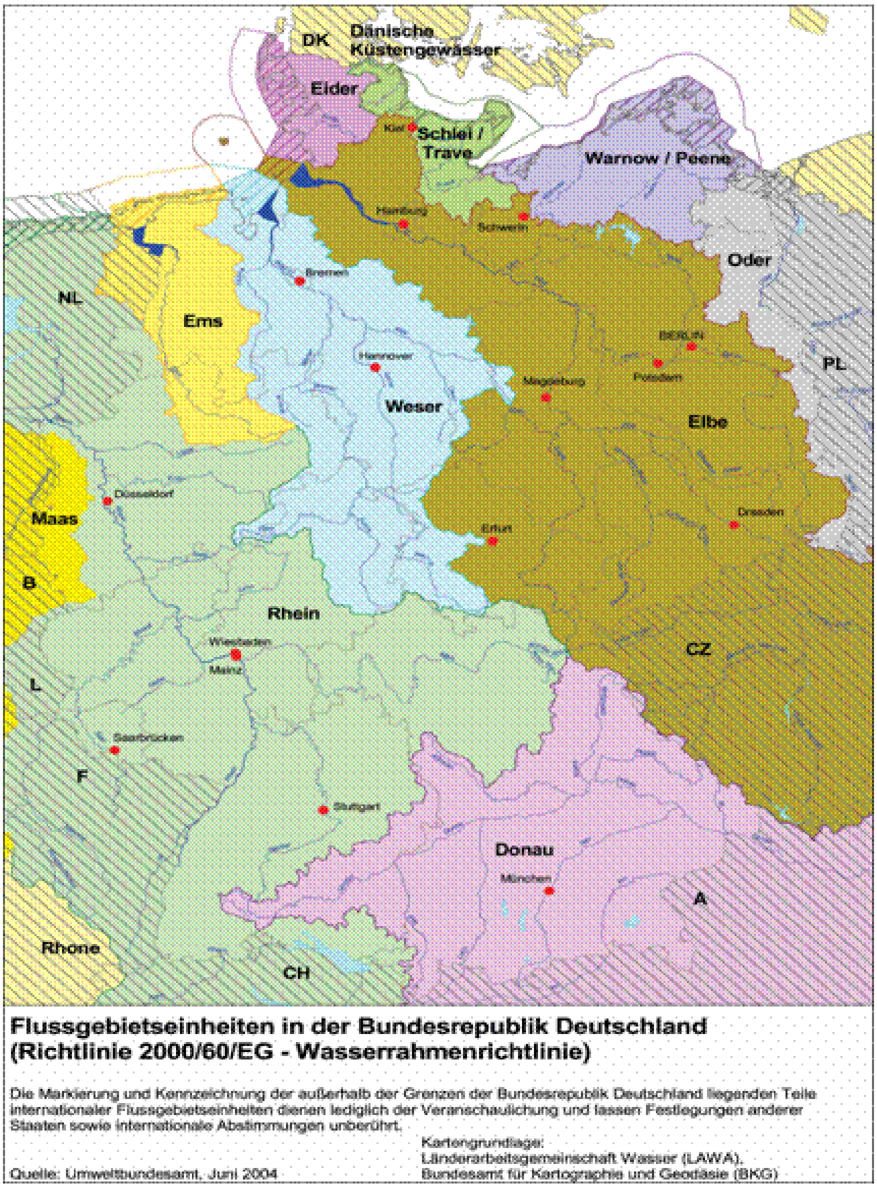


Figure 1. River Basin Districts (RBD) in the Federal Republic of Germany: Eider, Schlei/Trave, Elbe, Warnow/Peene, Oder, Weser, Ems, Rhine, Meuse and Danube.

3 Time-series data

3.1 Recruitment-series and associated effort

3.1.1 Glass eel

3.1.1.1 Commercial

There is no glass eel fishery in Germany.

3.1.1.2 Recreational

There is no recreational fishery for glass eel in Germany.

3.1.1.3 Fishery independent

There is no regular and long-term glass eel monitoring in Germany. A monitoring for immigrating elvers/young yellow eels is performed in Mecklenburg-Pomerania (see 3.1.2.3).

3.1.2 Yellow eel recruitment

3.1.2.1 Commercial

There is no time-series on yellow eel recruitment available based on commercial catches.

3.1.2.2 Recreational

There is no time-series on yellow eel recruitment available based on recreational catches.

3.1.2.3 Fishery independent

Immigration and upstream migration of young eels have been monitored on some locations in Mecklenburg-Pomerania. The monitoring stations were established in waters of the RBD's Warnow/Peene (both Baltic Sea) and Elbe (North Sea). Recruitment to the rivers of the Baltic Sea is considerably lower than in the rivers draining into the North Sea (Ubl and Dorow, 2010; Dorow and Ubl, 2011). The few data available indicate that the numbers of glass eels arriving are very low if compared to former data but there was no clear trend in the recent years (Lemcke, 2003; Schaarschmidt, 2005; Schaarschmidt *et al*., 2007; Ubl *et al*., 2007; Ubl and Dorow, 2010; Dorow and Ubl, 2011; Table 3-1).

In 2013, sampling at the location in Dömitz (North Sea) was not possible for about six weeks due to a flood event. Hence, these results represent only total catch numbers (no standardized values) and are not comparable to previous years. They only indicate that some recruitment occurred at the station.

Table 3-1. Comparison of standardised catches of upstream migrating eels (2002–2011) in several rivers in Mecklenburg-Pomerania (number of eels per fishing gear between May and October; Ubl and Dorow, 2010; Dorow and Ubl, 2011; data for 2011 to 2013 Dorow, pers. comm.). In 2013 only total catches are given for the station "Dömitz", because sampling was disturbed for six weeks due to a flood event.

River	Station	Distance to coast	Gear/Relation	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	20
Baltic Sea															
Warnow	Bützow	53 km	per eel ladder	230	73	56	76	40	35	Not sampled	Not sampled	Not sampled	Not sampled	Not sampled	
Hellbach	Mühle	7 km	per eel ladder	25	33	not sampled	not sampled	not sampled	Not sampled	Not sampled	Not sampled	Not sampled	Not sampled	Not sampled	
Wallenstein-graben	Wismar (Mühlenteich)	2 km	per eel ladder	not sampled	not sampled	173	153	123	296	509	238	614	113	39	39
Mühlengrube	Wismar (Ziegenmarkt)	0.1 km	per eel ladder	not sampled	not sampled	not sampled	not sampled	17	19	81	4	0	0	2	0
Uecker	Torgelow (Wehr)	52 km (Oder estuary) or 83 km (Peene estuary)	per eel ladder	70	33	---	---	53	32	25	37	37	52	62	39
Plastbach (or Farpener Bach)	Alt Farpen (Stausee/Speicher)	4.8	per eel ladder	not sampled	not sampled	not sampled	not sampled	---	101	67	25	29	84	37	16
North Sea															
Müritz-Elde-Wasserstraße	Dömitz (Fischpass)	224 km	per fyke net	5934	2365	3145	2861	3124	2440	1395	Not sampled	2659	3236	4686	(6
			per eel collector	not sampled	not sampled	not sampled	not sampled	9	---	Not sampled	Not sampled	Not sampled	Not sampled	Not sampled	
Dove Elbe	Dömitz (Wehr)	224 km	per eel ladder	not sampled	1981	676	721	1035	890	542	Not sampled	62	2024	1523	(3
			per eel collector	not sampled	not sampled	not sampled	not sampled	11	---	Not sampled	Not sampled	Not sampled	Not sampled	Not sampled	

3.2 Yellow eel landings

3.2.1 Commercial

There are no time-series on commercial catches of yellow eels available, which could serve as an index. Therefore, data on total landings of yellow eels are presented in Chapter 6.

3.2.2 Recreational

There are no time-series on recreational catches of yellow eel available.

3.3 Silver eel landings

3.3.1 Commercial

There are no time-series on commercial catches of silver eels available, which could serve as an index. Therefore, data on total landings of yellow eels are presented in Chapter 6.

3.3.2 Recreational

There are no time-series on recreational catches of silver eel available.

3.4 Aquaculture production

3.4.1 Seed supply

According to data of the German Federal Statistical Office (Statistisches Bundesamt) **5475 tons** of glass eel were brought to German eel aquaculture companies in 2013. However, information about the sources of the glass eels was not provided. In general, the legal situation regarding the availability of the data (sources) appears to be a bit unclear (data protection, etc.)

3.4.2 Production

Table 3-2. Production of eel in recirculation systems.

YEAR	PRODUCTION (T)
2003	372
2004	328
2005	329
2006	567
2007	740 (440 t for human consumption and 300 t stocking size eel)
2008	749 (447 t for human consumption and 302 t stocking size eel)
2009	667 (385 t for human consumption and 282 t stocking size eel)
2010	681 (398 t for human consumption and 283 t stocking size eel)
2011	660 (Data not available separately for consumption / stocking)
2012	706 (Data not available separately for consumption / stocking)
2013	757 (471 t for human consumption and 286 t for stocking)

3.5 Stocking

3.5.1 Amount stocked

Preliminary data on re-stocking in the period 2011–2013 are given in Table 3-3. A complete update will be available with the next progress report on the implementation of the EMPs. Yet, the most important States and RBS' have already delivered the data, so the changes will not be very large. The general level of re-stocking remained rather stable, but due to the higher availability of glass eels on the market, the use of glass eels for re-stocking increased in the recent years. The bootlace eels originate from local sources and should be considered as a "zero-balance" or "assisted migration".

Table 3-3. Eel re-stocking in German inland waters from 2011–2013 (numbers). Bootlace eel are wild caught eels with lengths of roughly 20–30 cm. A more detailed Excel-file with data for the RBDs will be provided on the SharePoint. Note that the data are not yet complete and have to be considered as minimum numbers.

Year	Glass eel	Ongrown eel	Bootlace eel
2011	2,243,425	6,431,356	333,921
2012	3,183,379	5,263,212	73,395
2013	3,615,066	6,297,537	33,124
Total 2011–2013	9,041,870	17,992,114	440,440

3.5.2 Catch of eel <12 cm and proportion retained for restocking

There is no glass eel fishery in Germany.

3.5.3 Reconstructed time-series on stocking

A document with detailed information about re-stocking with different types (age groups) of eel during the period 1990–2010 and some (possibly still incomplete) data for 2011–2013 will be provided to the WGEEL on the SharePoint. The table is too complex to be included in the report.

3.6 Trade in eel

Such data are not available.

4 Fishing capacity

4.1 Glass eel

There is no glass eel fishery in Germany.

4.2 Yellow eel

Fisheries in Germany usually are mixed fisheries, which catch different species and also both stages of eel, yellow and silver eel (even though some gears are more specialized for one of the stages). Therefore, fishing capacity is given combined for yellow and silver eels. The data were taken from the EMPs (for 2007, commercial fishery) and from the 2012 report to the European Commission about the implementation of the EMPs (anglers). A few new data have become available, but since they are not complete for the whole RBDs they are not given here. Yet, the data have probably not changed very strong since 2007 (2010). For anglers, new data are included, but it should be noted that these are only numbers of valid licences, which does not necessarily mean that these anglers fish for eel.

RBD Eider

- 69 full-time (68 coastal, 1 inland water), 146 part-time, 300 hobby fishermen (1200 fykenets allowed)
- about 20 000 anglers (in 2010)

RBD Elbe

- 413 full- and part-time fishermen/fishing enterprises, (11 102 fykenets, 31 stownets, 24 electrofishing gears, 38 stationary eel traps allowed in 2007)
- 323 181 anglers (in 2010)

RBD Ems

- four full-time and five part-time fishermen (using fykenets and stownets)
- 48 660 anglers (in 2010)

RBD Maas

- 6821 anglers (in 2010)

RBD Oder

- 89 full- and part-time fishermen/fishing enterprises (using 2116 fykenets, seven stownets, 23 electrofishing gears, five stationary eel traps)
- 30 080 anglers (in 2010)

RBD Rhein

- approximately 288 (full-) and part-time fishermen (fykenets and a few stownets)
- 178 845 anglers (in 2010)

RBD Schlei/Trave

- coastal fishery: 142 cutters (124 full-time, 18 part-time), 107 boats (full-time) and 379 boats (part-time fishermen) – in total 628 fishing vessels of different size; 808 hobby fishermen (allowed to use 3232 fykenets and 80 800 hooks on longlines)
- inland fishery: 16 fishing enterprises
- about 20 000 anglers (in 2010)

RBD Warnow/Peene

- coastal fishery: 345 full-time fishermen, 138 part-time fishermen, 261 hobby-fishermen (in total 846 fishing vessels <12 m and 34 vessels >12 m)
- inland fishery: 41 fishing enterprises with 125 vessels (using ca. 1800 fykenets or eel trap chains, ten seines, seven electrofishing gears, four stationary eel traps, longlines with 25 000 hooks)
- 134 655 anglers (in 2010)

RBD Weser

- 17 full-time fishermen, four cooperatives, 99 part-time fishermen (using stownets, fykenets, traps)
- 105 755 anglers (in 2010)

In 2010, the total number of valid fishing licences in the RBDs relevant for eel was 867 996. This is a reduction of 2% compared to 2008 (the first year of the implementation of the EMPs). Yet, it is not known, how many anglers actually fish for eel.

4.3 Silver eel

See 4.2.

4.4 Marine fishery

These data are included in the previous section (4.2).

5 Fishing effort

In the frame of the implementation of the EMPs, data on fishing effort became available due to documentation requirements in the Regulation 1100/2007 (the "Eel-Regulation"). The data are taken from the first report to the EU Commission on the implementation of the EMPs in Germany and refer to the period 2008–2010. New data will become available with the 2015 implementation report to the European Commission.

5.1 Glass eel

There is no glass eel fishery in Germany.

5.2 Yellow eel

Fisheries in Germany usually are mixed fisheries, which catch different species and also both stages of eel, yellow and silver eel (even though some gears are more specialized for one of the stages). Therefore, fishing effort cannot be presented separately for yellow and silver eel. Hence, Table 5-1 gives the data on total fishing effort on both stages. Except for large fykenets, a decreasing tendency in fishing effort is documented for the period 2008 to 2010.

Table 5-1. Fishing effort with the most relevant eel fishing gears of commercial and semi-commercial fisheries in German waters in 2010 and change (%) in relation to the 2008 data. Data are presented as *gear * days used*.

RBD	Small fykes	Large fykes	Longlines (eel line 100 at hooks)	Aalpuppen ("Hook buoy"?)	Stow nets	Stationary eel traps	Electro fishing
Eider	25,379	---	0	0	197	0	0
Elbe	403,531	309,032	301	10,965	4,130	872	69
Ems	3,410	16,892	0	0	5,209	0	0
Maas	0	0	0	0	0	30	0
Oder	373,285	60,838	83,478	12,300	1,599	0	30
Rhein	112,860	6,214	6	0	167	0	290
Schlei/Trave	623,181	---	3,027	0	0	0	8
Warnow/Peene	3,429,488	53,625	430,663	2,250	0	197	21
Weser	155,621	3,540	0	0	844	18	0
Total	5,126,755	450,141	517,475	25,215	12,146	1,117	418
Change from 2008 to 2010 (%)*	-12	+16	0	-73	-26	-44	-30

***Without the State of Brandenburg, because no data from this State were available for 2008.**

5.3 Silver eel

See 5.2.

5.4 Marine fishery

The data for the marine coastal fishery, which are conducted in the frame of the EMPs, are included in Table 6-2.

6 Catches and landings

At present, it is not possible to provide temporally structured information (e. g. on a monthly basis or so). Although the fishermen (will) have to deliver the information at least on a monthly basis to the authorities (at least in some States), it is not clear, if the authorities will have the capacities to analyse or summarise the data, at least in a regular scheme. However, the new documentation requirements have been established and most States document catches separately for yellow and silver eel, respectively.

6.1 Glass eel

There is no glass eel fishery in Germany.

6.2 Yellow eel

The separate documentation of yellow and silver eel catches has improved, but is not complete in all cases. Therefore, combined data for yellow and silver eels are given in some cases. In general, there are still data missing for some States.

Table 6-1. Combined catches of yellow and silver eels (t) by the German inland fishery in 2013. In the absence of 2013 data, previous year's values are given (indicated by *).

„Bundesland“ (State)		Commercial fishery		Recreational fishery
	Yellow eel	Silver eel	Undifferentiated)	
Baden-Württemberg	8.7	4.6		5.0
Bayern			8.0	16.0*
Berlin	5.0	3.8		7.1
Brandenburg	100.0	25.0		38.5
Bremen			2.8	1.5
Hamburg	No data	No data	No data	No data
Hessen			0.8*	No data
Mecklenburg-Vorpommern	20.0	42.5		60.0
Niedersachsen	10.7	12.3		26.9
Nordrhein-Westfalen			0.5	8.6
Rheinland-Pfalz	No data	No data	No data	No data
Saarland	0	0	0	<1
Sachsen	-	-	0.7	4.2
Sachsen-Anhalt			2.2	9.5
Schleswig-Holstein	10.4	6.8		60.0
Thüringen	0.1*	0*		3.1*
Total	**154.9**	**95.0**	**15.0**	**>241.4**

6.3 Silver eel

Silver eels are included in Section 6.2.

6.4 Marine fishery

Table 6-2. Eel landings from the coastal fishery in North and Baltic Sea by quantities and value.

	North Sea						Baltic Sea		
Year	Lower Saxony (incl. stocking size eel)		Schleswig-Holstein		Schleswig-Holstein Stocking size eel		Schleswig-Holstein		Mecklenburg-Pomerania
	t	€	t	€	t	€	t	€	t
1961	47.8	76,854							
1962	66.8	108,019							
1963	55.3	111,128							
1964	56.1	124,742							
1965	56.3	135,596							
1966	67.8	143,672							
1967	92.3	199,788							
1968	102.5	245,202							
1969	85.3	194,871	97.4	313,213			204.5	909.189	
1970	130.3	324,193	94.1	349,148			143.8	682.162	
1971	113.9	375,358	130.6	550,216			124.5	679.720	
1972	77.2	71,785	92.3	453,610			146.8	749.918	
1973	77.5	393,541	105.5	510,202			151.2	825.524	
1974	85.9	392,953	113.8	661,990			109.8	679.307	
1975	94.7	509,196	102.6	592,191			123.7	762.290	
1976	104.5	540,277	102.4	599,191			102.6	660.139	
1977	99.3	540,192	135.9	793,559			77.6	546.213	
1978	69.0	432,263	100.7	682,567			62.6	465.377	
1979	81.4	486,924	76.1	569,022			81.6	596.672	
1980	108.9	658,220	73.5	548,177			66.0	474.395	
1981	119.4	787,696	55.4	405,403			75.1	575.250	
1982	107.3	766,437	67.3	502,455			98.3	746.875	
1983	102.9	684,057	72.6	531,814			82.6	636.962	
1984	95.4	617,621	62.2	483,898			51.3	420.048	
1985	65.4	449,844	57.1	442,299			50.4	411.762	
1986	91.7	662,076	39.6	324,351			65.6	564.750	
1987	69.0	485,298	21.0	171,292			57.1	478.490	
1988	45.6	349,384	42.2	363,694			70.1	590.345	
1989	29.3	220,463	31.4	265,244			86.9	751.143	
1990	35.9	283,640	14.7	125,732			82.4	741.405	
1991	24.5	202,558	11.8	94,525			83.5	773.621	
1992	25.7	223,031	6.1	57,957			78.7	701.902	
1993	30.1	227,157	12.8	115,980	1.9	9,690	66.5	624.781	
1994	64.5	492,489	13.3	68,891	10.4	44,146	63.7	567.412	
1995	42.5	322,316	7.7	60,244	3.6	18,496	60.2	542.434	
1996	15.7	135,320	6.3	43,984	3.5	17,850	27.7	267.152	

	North Sea						Baltic Sea		
Year	Lower Saxony (incl. stocking size eel)		Schleswig-Holstein		Schleswig-Holstein Stocking size eel		Schleswig-Holstein		Mecklenburg-Pomerania
	t	€	t	€	t	€	t	€	t
1997	30.0	238,911	12.0	84,278	3.7	22,452	44.5	417.479	
1998	13.8	114,715	8.5	62,714	3.7	22,289	19.1	186.149	
1999	19.9	161,782	10.5	75,144	6.1	33,233	27.0	254.386	
2000	16.3	141,990	5.7	39,266	5.0	27,756	30.1	284.963	
2001	21.1	186,200	4.7	37,764	4.7	26,266	28.6	278.228	108
2002	35.3	292,198	4.4	38,850	4.0	21,547	28.0	218.217	98
2003	29.8	233,986	4.8	36,067	3.4	19,548	27.4	251.862	93
2004	31.7	246,038	5.4	39,745	4.1		17.3	136.337	94
2005	22.2	198,872	5.0	38,400			17.0	130,560	86
2006	19.1	165,340	4.1	29,247			21.1	141,178	91
2007	23.6	191,278	0.05	388			11.3	67,806	76
2008	14.3*		0.1				13.2		71
2009	13.2*		0.1				8.5		64
2010	13.5*		0				13.4	87,529	61
2011	14.8*		0				9.5	59,987	42
2012	9.2*		0.1	310			6.8	46,561	35
2013	20.0*		4.0*				11.5*		37.9

*** These catches do not reflect real "marine" fishery. Instead, they represent also catches from the lower reaches and estuaries of rivers draining into the North Sea and the Baltic Sea. They come from transitional waters according to the WFD, but in the fisheries legislation they are counted as "coastal fishery".**

6.5 Recreational fishery

Detailed data on recreational fishery are basically missing, except for some estimates of yields (see Chapter 6.2). Data on retained and released catches and on catch and release mortality are so far not available.

Table 6-3. Recreational Fisheries: Retained and Released Catches.

	Retained				Released			
	Inland		Marine		Inland		Marine	
Year	Angling	Passive Gears	Angling	Passive gears	Angling	Passive gears	Angling	Passive gears
2013	ND	ND	ND	ND	ND	ND	ND	ND

Table 6-4. Recreational Fisheries: Catch and Release Mortality.

	Released			
	Inland		Marine	
	Angling	Passive gears	Angling	Passive gears
Year				
2013	ND	ND	ND	ND

6.6 Bycatch, underreporting, illegal activities

Data on bycatch, underreporting or illegal activities are not available. With very few exceptions, inland and coastal fisheries in Germany usually are mixed fisheries, targeting a broader range of species. In that sense there is no bycatch.

The author is not aware of scientific studies on underreporting in relation to eel.

Illegal activities, such as "Fishing out of the season", "Fishing without licence", "Fishing using illegal gears", "Retention of eel below or above any size limit", "Illegal selling of catches" likely occur in Germany; but there is no database where relevant information is collected. Hence, detailed information about these aspects is not available.

In January, there was an article in the international press that eels from Germany ("Twelve cartons of live eel") had been seized in China. However, these were likely glass eels, which had been transported/traded via Germany, but which had been caught somewhere else (no glass eel fishery in Germany).

http://www.business-standard.com/article/pti-stories/thousands-of-eels-seized-in-beijing-airport-114011401034_1.html

Table 6-4. Estimation of underreported catches in Country, per EMU and Stage.

		Glass eel				Yellow eel				Silver Eel				Combined (Y + S)			
Year	EMU_code	Reported catches (kg)	Underrept. %	Underrept. (kg)	Total catches (kg)	Reported catches (kg)	Underrept. %	Underrept. (kg)	Total catches (kg)	Reported catches (kg)	Underrept. %	Underrept. (kg)	Total catches (kg)	Reported catches (kg)	Underrept. %	Underrept. (kg)	Total catches (kg)
2013	DE_Eide		ND	ND	ND		ND	ND	ND		ND	ND	ND		ND	ND	ND
	DE_Elbe		ND	ND	ND		ND	ND	ND		ND	ND	ND		ND	ND	ND
	DE_Ems		ND	ND	ND		ND	ND	ND		ND	ND	ND		ND	ND	ND
	DE_Maas		ND	ND	ND		ND	ND	ND		ND	ND	ND		ND	ND	ND
	DE_Oder		ND	ND	ND		ND	ND	ND		ND	ND	ND		ND	ND	ND
	DE_Rhei		ND	ND	ND		ND	ND	ND		ND	ND	ND		ND	ND	ND
	DE_Schl		ND	ND	ND		ND	ND	ND		ND	ND	ND		ND	ND	ND
	DE_Warn		ND	ND	ND		ND	ND	ND		ND	ND	ND		ND	ND	ND
	DE_Wese		ND	ND	ND		ND	ND	ND		ND	ND	ND		ND	ND	ND
	Total/mean (%)		ND	ND	ND		ND	ND	ND		ND	ND	ND		ND	ND	ND

Table 6-5. Existence of illegal activities, its causes and the seizures quantity they have caused.

		Glass eel			Yellow eel			Silver Eel			Combined (Y +S)		
Year	EMU	Y/N/?	Cause	Seizures (kg)	Y/N/?	Seizures (kg)	Cause	Y/N/?	Seizures (kg)	Cause	Y/N/?	Seizures (kg)	Cause
2013	DE_Eide	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	DE_Elbe	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	DE_Ems	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	DE_Maas	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	DE_Oder	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	DE_Rhei	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	DE_Schl	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	DE_Warn	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	DE_Wese	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

7 Catch per unit of effort

According to the EU Regulation 1100/2007, catches as well as effort have to be reported by the fishermen. In the frame of the implementation of the EMPs, the documentation of the catches has been improved and that of effort has been established. (See relevant sections in this report.). However, so far the catches are not directly related to the efforts, because this analysis would mean a substantial and additional effort for the responsible authorities. In the moment it is not clear, if, when or how such analyses will become available in the future.

7.1 Glass eel

There exists no glass eel fishery in Germany.

7.2 Yellow eel

There are no data on cpue available.

7.3 Silver eel

There are no data on cpue available.

7.4 Marine fishery

There are no data on cpue available.

8 Other anthropogenic and environmental impacts

Estimates for mortalities due to other anthropogenic impacts are given in Chapter 13.2.3 (stock indicators). These estimates for the RBDs are based on knowledge about numbers of turbines, etc. and the areas affected by them. This information has been included in the modelling of the eel stock and silver eel escapement.

There may be local information about development of trophic state or mean water temperatures. However, there is likely no uniform picture for whole Germany and a general effect of such factors on the population development of eel in German waters cannot be assessed in a simplified and generalized way.

9 Scientific surveys of the stock

9.1 Recruitment surveys, glass eel (includes yellow eel in Scandinavia)

See information/data on elver monitoring in Mecklenburg-Pomerania in Chapter 3.1.2.3.

Another glass eel and elver monitoring was established at the weir Bollingerfähr at the river Ems (Salva, 2013). The weir is located 6.4 km upstream of the weir Herbrum, where a glass eel monitoring had existed for many years. Due to heavy water works on the River Ems with the consequence of strong currents which did not exist before this station is no longer in operation. During the recent starting period of the monitoring the general suitability of the location and of the fish ladder as monitoring gear were assessed. In summary it was concluded that the location is suitable for a glass eel monitoring and that the eel ladder worked well. A few suggestions for technical improvements were made. Glass eel and elver (upstream) migrations were documented during the whole study period from April to November 2013, with a clear maximum in July (majority of registered individuals June to August). The size of the individuals varied between 5 and 24.5 cm. 92% of all eels were less than 10 cm long (and most of them less than 8 cm). In total 14 802 eels were caught during the monitoring period. The upstream migration usually occurred during the night, but in periods with high migration activity (July), fish were also observed to use the daytime for upstream migration. The monitoring will probably be continued in the coming years.

9.2 Stock surveys, yellow eel

Information on stock assessment (yellow eel monitoring) in coastal waters of the Baltic Sea is provided in Chapter 12 (methodological aspects).

9.3 Silver eel

No new information available.

10 Data collected for the DCF

Data obtained during the DCF-sampling are reported in a separate Annex to this report.

Table 10-1. Summary of the DCF monitoring implementation per EMU.

Data	River	Lakes	Estuaries	Lagoons	Coastal & Marine
No. of production / escapement surveys[1]	0	0	0	0	0
No. of recruitment time-series surveys[2]	See annex	See annex	0	0	0
No. fished aged	See annex	See annex	0	0	0
No. of fished sexed	See annex	See annex	0	0	0
No. of fish examined for parasites	See annex	See annex	0	0	0
No. of fish examined for contaminants	See annex	See annex	0	0	0
No. of non-fishery mortality studies[3]	See annex	See annex	0	0	0
Socio-economic survey	See annex	See annex	0	0	0

[1] Surveys to estimate B_{best} and/or $B_{current}$ [These should include WFD surveys where the data are being used to estimate production and/or escapement of eel].

[2] Fishery-independent surveys.

[3] Studies to determine ∑H for non-fisheries anthropogenic impacts, such as hydropower, barriers, predation, etc.

11 Life history and other biological information

11.1 Growth, silvering and mortality

Results of the sampling in the frame of the DCF are presented in a separate Annex.

In the frame of a master thesis, Kullmann (2014) studied growth of eels from the Kiel Canal, the Elbe-Lübeck-Canal and the Elbe estuary. The results are summarized in Table 11-1.

Table 11-1. Growth parameters of eels from three north German waters (Kullmann 2014).

Water body	N	L_∞ (cm)	K	T_0	Mean growth per year (cm)	Condition factor
Elbe estuary	121	93.34	0.12	-0.901	5.92	0.15214
Kiel Canal	115	88.31	0.11	-0.813	4.90	0.17249
Elbe-Lübeck-Canal	113	86.34	0.11	-0.720	4.81	0.15746

11.2 Parasites and pathogens

The infestation of eels with the swimbladder parasite *Anguillicola crassus* in north German inland and coastal waters was studied by Wysujack *et al*. (2014). Between 1996 and 2011, the swimbladders of 17 219 eels from eight freshwater and coastal water areas were analyzed. Prevalence, abundance of parasites, infection intensity and severity of the damage to the swimbladder were recorded by visual inspection. In the freshwaters the prevalence was in the range of 65–83%, whereas significantly lower values were found in the brackish waters. The differences were less clear for infection intensity but significantly lower values were found in the outermost location in the Baltic Sea. Mean damage to the swimbladders was highest in eels from the Rivers Weser and Elbe and lowest in the Baltic coastal waters. Prevalence and damage degree were stable in all waters except for two rivers, where a decreasing trend in infection intensity was found.

Leuner (2013) studied the infestation with *A. crassus* in eels in Lake Starnberger See. In 2013, the swimbladders of 90 eels were investigated in September and October and a prevalence of 87% was found (for comparison: 1998: 91%, 2006: 61%, 2012: 81%). Infection intensity was highest in 1998 (12 nematodes per swimbladder) and varied between five and nine parasites per swimbladder in the following years. In 2013, the value was six parasites per swimbladder. The proportion of swimbladders showing callosity was 18% in 1998 and increased to 100% in the following years. In 2012 (55%) and 2013 (56%) lower proportions of callosity were documented, possibly because younger eels had been studied.

Kullmann (2014) studied the infestation with *A. crassus* in eels from the river Elbe estuary, the Kiel Canal and the Elbe-Lübeck-Canal. Prevalence was highest in the Kiel Canal (64.91%), followed by eels from the river Elbe estuary (54.83%) and the Elbe-Lübeck-Canal (43.66%). Mean infection intensity (nematodes per swimbladder) was significantly higher in the Kiel Canal (5.94) than in river Elbe estuary (3.07) and the Elbe-Lübeck-Canal (1.04).

Information on infestation of eels with *A. crassus* is also given by Marohn *et al*. (2014a) for the Schwentine system. Prevalence of *A. crassus* infection was 79.9% and 21.4% of all analyzed eels had infection intensities above ten nematodes per host and were considered to be severely infected. Most specimens showed visible but moderate swimbladder damages (Hartmann class 2 and 3; 89.2%), whereas 4.3% were classified as severely damaged (Hartmann class 4; Hartmann, 1994). Only 6.5% were unaffected (Hartmann class 1). 73.3% of all nematode-free swimbladders showed signs of earlier infections.

11.3 Contaminants

Kammann *et al*. (2014) studied Polycyclic aromatic hydrocarbon (PAH) metabolites, glutathione-S-transferase (GST) and ethoxyresorufin-O-deethylase (EROD) in eels from German waters as possible indicators for eel habitat quality. PAHs are ubiquitous contaminants, which are rapidly metabolized in vertebrates. EROD and GST are two enzymes involved in PAH detoxification in fish. In their study, PAH metabolites as well as EROD and GST activity in a large, comprising dataset of more than 260 migratory and pre-migratory eels from five large German river basin districts were used to describe PAH exposure and its metabolism as possible indicators for the habitat quality for eels. Eel from the river Elbe appear to be moderately contaminated with PAH. Highest mean values of PAH metabolites were analyzed in fish from the river Rhine. However, the results suggest that contaminants such as PAH are metabolized in the fish and may have contributed to EROD activity in eels caught from the Elbe estuary to 600 km upstream. Since the eel's onset of cessation of feeding is closely linked to maturation and migration, we propose bile pigments as new indicators contributing to identify the proportion of migratory eel, which is crucial information for eel management plans. The authors showed that PAH metabolites normalized to bile pigments as well as EROD could be used to describe the habitat quality and might be suitable parameters in search for suitable stocking habitats.

In another study from Germany, Sühring *et al.* (2014) analyzed brominated flame retardants and dechloranes in European and American eels from the glass to the silver eel stage. They measured concentrations of polybrominated diphenylethers (PBDEs), alternate brominated flame retardants (alternate BFRs) and Dechloranes (Decs) in different life stages of European and American eels to compare the contamination patterns and their development throughout the eel's life cycle. In general, concentrations of flame retardants (FRs) were similar to or higher in American than in European eels, and a greater number of FRs were detected. PBDE congeners that are characteristic of the Penta-PBDE formulation were the most abundant FRs in all adult eels as well as American glass eels. In European glass eels the alternate BFR 2,3-dibromopropyl-2,4,6-tribromophenylether (DPTE) and Dechlorane Plus were the dominating FRs, with average concentrations of 1.1 ± 0.31 ng g^{-1} ww and up to 0.32 ng g^{-1} ww respectively. Of the PBDEs BDE-183 was the most abundant congener in European glass eels. Low concentrations (less than 10% of the total contamination) of Tetra and Penta-PBDEs in juvenile European eels indicated that bans of technical Penta-PBDE in the European Union are effective. Enrichment of PBDEs was observed over the life stages of both European and American eels. However, a greater relative contribution of PBDEs to the sum FR contamination in American eels indicated an ongoing exposure to these substances. High contributions of alternate BFRs in juvenile eels indicated an increased use of these substances in recent years. Concentrations seemed to be driven primarily by location, rather than life stage or age.

11.4 Predators

Estimates for predation by cormorants are included in Chapter 13.2.3.

12 Other sampling

Stocking

Simon and Dörner (2014) studied survival and growth of eels stocked as glass eels and ongrown farmed eels, respectively, in five German lakes in the first years after stocking. European eels stocked as wild-sourced glass eels showed a better overall performance of growth and survival compared with farm-sourced eels after stocking in five isolated lakes within a seven year study period. Eels stocked as farm eels lost their initial size advantage over eels stocked as glass eels within 3–5 years after stocking.

Population sizes estimated for consecutive stocking batches indicated that 8–17% of eels stocked as farm eels survived 3–6 years after stocking compared with 5–45% of eels stocked as glass eels. This study coupled with results of previous studies suggests that stocking of farm eels may have no advantage in growth and survival compared with stocking of glass eels if stocking occurs at an optimal time in spring. In addition, the use of relatively expensive farm eels may provide no general advantage over stocking of glass eels. However, if glass eels are only available for stocking purposes very early in the year, lower survival rates than obtained in the present study can be assumed and stocking with relatively more expensive farm eels could possibly be a better option.

Based on the results of the abovementioned project, the discussion about the type of eels used for restocking (glass eels vs. ongrown eels) has started again in Germany. The results of the study by Simon and Dörner (2014) were based on glass eel stocking in spring. However, the main catch period for glass eels is December to February. During this period, water temperatures typically are very low in Germany and lakes are often ice covered. Under such conditions glass eel stocking would likely result in high mortality rates of the stocked eels. Therefore, aspects of temporarily holding the eels in tanks before re-stocking were studied by Dorow and Paetsch (2014) in two small-scale experiments.

In the first experiment 50 000 glass eels (15 kg; source: France) were stocked into a plastic tank with an area of about 3 m^2 (water volume ca. 0.8 m^3) and kept in this tank for 42 days. Water temperature was kept rather constant at a mean value of 3.3°C. Mean oxygen concentration was 11.94 mg/l. At the end of the holding period, cumulative mortality amounted to 7.5% (3725 individuals). The authors observed an increase of the mortality throughout the study period.

In the second experiment 3800 glass eels were kept under brackish water conditions for 30 days (early March–early April). Water temperature in this study was 5–6°C. During the four weeks, a total mortality of 5.8% (221 individuals) was recorded. Based on their results, the authors concluded that the holding period should be limited to 4–5 weeks and that temperatures should not be too low. Then, a total mortality of about 5–6% could be expected.

Methodological aspects

A suitable monitoring approach is urgently needed to quantify the stock size of the European eel in coastal waters as coastal areas are considered to contribute significantly to the overall spawning stock. Ubl and Dorow (2014) developed a novel enclosure fishing method for yellow eels in non-tidal coastal waters. The fishing system consists of two main elements, an outer boundary net (100 m × 100 m, enclosing 1 ha) with fykenet chambers in each corner and six fykenet chains inside the enclosure. The system was tested in a variety of habitat types in the coastal waters of the southern Baltic Sea. In total, 200 samples were taken in 2008–2011, resulting in an overall harvest of 1184 eels. Eels were detected in all previously defined reference areas. Over 95% of the eels were classified as yellow eels. Based on the mesh size, full selectivity for yellow eels over 36 cm was assumed. The observed length distribution followed the expected trend as size classes between 36 and 55 cm accounted for most of the catch. Taking into account the gear selectivity, an overall mean density of 4.7 eels per hectare for yellow eels longer than 36 cm was estimated. Eel density varied considerably, with significantly higher yellow eel densities being observed in open coastal areas compared to the inner coastal waters. The enclosure approach appears suitable for assessing eel densities in non-tidal coastal waters.

Aspects of migration

There are still large gaps of knowledge about migration routes and behaviour of European silver eels during their long-distance oceanic migration. To achieve a better understanding of the migration behaviour, Wysujack *et al*. (2014) equipped 28 large female eels with pop-up satellite transmitters and released them at three different locations in the Atlantic Ocean and in the Sargasso Sea. The study covered tracking periods between seven and 92 days. The distance between release point and estimated pop-up position ranged from 40 to 1000 km, the mean minimum migration speeds from 1.5 to 17.0 km day^{-1}. The eels consistently conducted distinct diel vertical movements (DVM) with daily amplitudes of more than 300 m and maximum diving depths of more than 1000 m. Eels released in the Sargasso Sea used greater depths and a broader temperature range than individuals released in the Atlantic Ocean closer to the European continent. At least two eels were clearly preyed upon. The transmitters ascended in a considerable range of directions from the release points. Hence, the results of the study did not allow clear conclusions about the detailed location of the spawning site and on the routes of the eels to the spawning grounds.

Stock assessment and modelling

Marohn *et al*. (2014a) assessed female silver eel escapement from a northern German drainage system (Schwentine River) over a period of three consecutive years, and downstream migration patterns were compared to potential environmental triggers. Furthermore, the benefit of two fish bypasses (surface and deep) and a trash rack at the hydropower station for the survival of migrating eels was examined. The results indicate that silver eel escapement from the Schwentine drainage system is far below the estimated values underlying the respective Eel Management Plan, highlighting the necessity of direct migration assessments to validate indirect estimations that include multiple assumptions and uncertainties. Major downstream migration events took place during short time periods in autumn and appeared to be influenced by river discharge and water temperatures, suggesting that a precise prediction of escapement events is possible. A matter of concern is the high trash rack mortality at the hydropower station that illustrates the need of fish protecting devices that fulfil eel-specific requirements.

Oceanic life stages

Despite increasing efforts to establish species recovery measures, it is unclear if the decline in eel recruitment was caused by reduced numbers of reproductive stage silver eels reaching the spawning area, low early larval survival, or increased larval mortality during migration to recruitment areas. To determine if larval abundances in the spawning area significantly changed over the past three decades, a plankton trawl sampling survey for anguillid leptocephali was conducted in March and April 2011 in the spawning area of the European eel that was designed to directly compare to collections made in the same way in 1983 and 1985 (Hanel *et al*., 2014). The catch rates of most anguilliform leptocephali were lower in 2011, possibly because of the slightly smaller plankton trawl used, but the relative abundances of European eel and American eel, *Anguilla rostrata*, leptocephali were much lower in 2011 than in 1983 and 1985 when compared to catches of other common leptocephali. The leptocephali assemblage was the same in 2011 as in previous years, but small larvae of mesopelagic snipe eels, *Nemichthys scolopaceus*, which spawn sympatrically with anguillid eels, were less abundant.

Temperature fronts in the spawning area were also poorly defined compared to previous years. Although the causes for low anguillid larval abundances in 2011 are unclear, the fact that there are presently fewer European and American eel larvae in the spawning area than during previous time periods indicates that decreased larval abundance and lower eventual recruitment begin within the spawning area.

Genetic monitoring

During a study in the Schwentine system (northern Germany, draining into the Baltic Sea) seven of the 142 silver eels analyzed (4.9%) were identified as American eel *A. rostrata* (Marohn *et al*., 2014a).

In a further study, Marohn *et al*. (2014 b) investigated growth, condition and development of American eels that were introduced into a European river to estimate their competitive potential in a non-native habitat. Data of 11 *A. rostrata* were compared to 32 *A. anguilla*. Results demonstrate that *A. rostrata* develops normally in European waters and successfully competes with the native European eel. In addition, *A. rostrata* appears to be more susceptible to the Asian swimbladder nematode *A. crassus* than *A. anguilla* and could support the further propagation of this parasite. Detected differences in fat content and gonad mass between *Anguilla* species are assumed to reflect species-specific adaptations to spawning migration distances. This study indicates that *A. rostrata* is a potential competitor for the native fauna in European fresh waters and suggests strict import regulations to prevent additional pressure on *A. anguilla* and a potential further deterioration of its stock situation.

13 Stock assessment

13.1 Method summary

As already stated before, there is no continuous calculation of the stock indicators on an annual basis. At present an updated version of the population model is developed (GEM III), which will be used to calculate the indicators for the 2015 progress report for the European Commission. It will also include a possibility to calculate the so far missing mortality rates. Therefore, the data of the previous progress report (2012) are repeated here.

In seven of nine German RBDs, the stock indicators were calculated with the German Eel Model II (GEM II, Oeberst and Fladung, 2012), which is an improved version of the model used during the preparation of the original EMPs. The model incorporates the weight and sex of eel as well as the mean water temperature to estimate the natural mortality. Natural mortality was estimated based on Bevaqua *et al*. (2011). In addition, the three density levels of the eel stock are taken into account. The areas given in the EMPs and in the reports include all habitats, which would be potential eel habitats under undisturbed conditions; only some habitats e.g. in the trout region, far away from the coast may have been excluded, because these areas don't really form a typical eel habitat. Areas above impassable anthropogenic barriers are also included in the calculation of escapement. In agreement with the eel regulation, coastal waters have been included in some cases but not in others. When they were not included, fisheries should be decreased by 50% outside the areas covered by the EMP.

The estimates were done for the whole RBD without assuming any differences. It is clear that there will be differences between the different habitat types, but there were not sufficient data available to calculate everything separately. As a consequence, the values represent a mean value for the whole RBD. This is not really correct but under pragmatic aspects it was chosen as the best way to do it. Meanwhile the model predictions have been compared to real values by tagging experiments. In these experiments the model has been proven to give rather correct estimates of escapement, at least in the order of magnitude (Fladung *et al.*, 2012b; Prigge *et al.*, 2013).

Restocking applies in all German RBDs except for the River Eider. In the calculation of B_0 and B_{best}, re-stocking is not included (probably except for the RBD Schlei/Trave, where GEM / GEMII were not used). $B_{current}$ includes the effect of re-stocking in all RBD's, where re-stocking applies. The values of ∑A represent real mortalities and are not lowered by re-stocking.

For further detail see the documents and tables of previous WGEEL-meetings ("big nice table" and of WKEPEMP (ICES 2013).

13.1.1 Estimate of B_0

Table 13-1. Reference period for B_0.

EMU_CODE	B_0 (KG/HA)	REFERENCE TIME PERIOD	WHETHER OR NOT CHANGED FROM VALUE REPORTED LAST YEAR (Y/N)
DE_Eide	0.5	Pre-1980's	N (but was not asked for in last year's report)
DE_Elbe	7.2	Pre-1980's	N (but was not asked for in last year's report)
DE_Ems	16.1	Pre-1980's	N (but was not asked for in last year's report)
DE_Maas	4.7	Pre-1980's	N (but was not asked for in last year's report)
DE_Oder	1.5	Pre-1980's	N (but was not asked for in last year's report)
DE_Rhei	4.7	Pre-1980's	N (but was not asked for in last year's report)
DE_Schl	1.9	Pre-1980's	N (but was not asked for in last year's report)
DE_Warn	3.8	Pre-1980's	N (but was not asked for in last year's report)
DE_Wese	10.9	Pre-1980's	N (but was not asked for in last year's report)

13.2 Summary data

13.2.1 Stock indicators and targets

Table 13-2. Stock indicator and targets for individual RBDs.

EMUCODE	INDICATOR	BIOMASS (T)	MORTALITY (RATE)				TARGET		
	B0	Bbest	Bcurr	∑A	∑F	∑H	Source	Biomass (t)	∑A (rate)
DE_Eide	240	146	109	No data	No data	No data	EMP, Progress report, WKEPEMP	96	0.92
DE_Elbe	1450	118	186	1.36	No data	No data	EMP, Progress report, WKEPEMP	580	0.22
DE_Ems	711	235	390	0.08	No data	No data	EMP, Progress report, WKEPEMP	284	0.92
DE_Maas	4	1	0.5	0.86	No data	No data	EMP, Progress report, WKEPEMP	2	0.17
DE_Oder	118	9	19	1.14	No data	No data	EMP, Progress report, WKEPEMP	47	0.23
DE_Rhei	288	17	154	1.03	No data	No data	EMP, Progress report, WKEPEMP	115	0.92
DE_Schl	641	384	290	No data	No data	No data	EMP, Progress report, WKEPEMP	256	0.92
DE_Warn	1395	614	539	0.24	No data	No data	EMP, Progress report, WKEPEMP	558	0.87
DE_Wese	605	163	357	0.41	No data	No data	EMP, Progress report, WKEPEMP	242	0.92

13.2.2 Habitat coverage

Table 13-3. Habitat coverage of EMP's and calculations for individual RBDs.

EMU code	River		Lake		Transitional & lagoon		Coastal	
	Area (ha)	A'd Y/N)	Area (ha)	A'd Y/N)	Area (ha)	A'd Y/N)	Area (ha)	A'd Y/N)
DE_Eide	2,899	Y	4,978	Y	1,662	Y (but no lagoons present)	459,244	Y
DE_Elbe	18,097	Y	136,662	Y	46,260	Y (but no lagoons present)	Not included	N
DE_Ems	6,633	Y	1,194	Y	36,164	Y (but no lagoons present	Not included	N
DE_Maas	892	Y	0	Y	Not included	N	Not included	N
DE_Oder	2,654	Y	49,205	Y	28,507	Y (but no lagoons present	Not included	N
DE_Rhei	44,531	Y	14,400	Y	Not included	N	Not included	N
DE_Schl	2,483	Y	20,546	Y	0	Y (but no lagoons present	310,761	Y
DE_Warn	4,647	Y	30,175	Y	0	Y (but no lagoons present	310,080	Y
DE_Wese	15,096	Y	4,962	Y	34,650	Y (but no lagoons present	Not included	N

13.2.3 Impact

Table 13-4. Overview about assessment of several possible impacts in individual RBDs.

A = assessed, MI = not assessed, minor, MA = not assessed major, AB = impact absent.

EMU CODE	HABITAT	FISH COM	FISH REC	HYDRO & PUMPS	BARRIERS	RESTOCKING	PREDATORS	INDIRECT IMPACTS
DE_Eide	Overall	A	A	A	A	A	A	MI
DE_Elbe	Overall	A	A	A	A	A	A	MI
DE_Ems	Overall	A	A	A	A	A	A	MI
DE_Maas	Overall	A	A	A	A	A	A	MI
DE_Oder	Overall	A	A	A	A	A	A	MI
DE_Rhei	Overall	A	A	A	A	A	A	MI
DE_Schl	Overall	A	A	A	A	A	A	MI
DE_Warn	Overall	A	A	A	A	A	A	MI
DE_Wese	Overall	A	A	A	A	A	A	MI

Table 13-5.

EMU CODE	STAGE	FISH COM	FISH REC	HYDRO & PUMPS	BARRIERS	RESTOCKING	PREDATORS	INDIRECT IMPACTS
XY_abdc	Glass							
	Yellow							
	Silver							
	Silver EQ							

It was requested to quantify the effect of each single impact on single life stages in a table. (“*Express the loss in tonnes (t) for each impact per developmental stage or MI = not assessed, minor, MA = not assessed major, AB = impact absent. Where available, also report the total loss as silver eel equivalents, and explain the method used to calculate equivalents in Section 13.1.*).

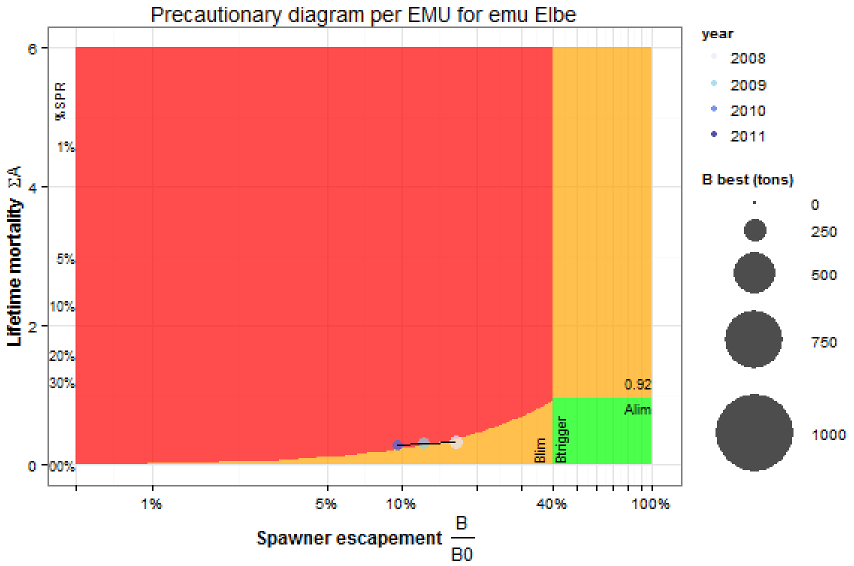
These data, however, are not available for Germany. Instead, in this section the overall losses due to the most important impacts as estimated in the first progress report on the implementation of the EMPs (Fladung *et al.*, 2012a) are provided in the following table. A more detailed analysis is not available so far. Note that all data refer to the year 2010. More recent data would have been available for fisheries, but this would have resulted in a mixture of data from different years, what would not be consistent.

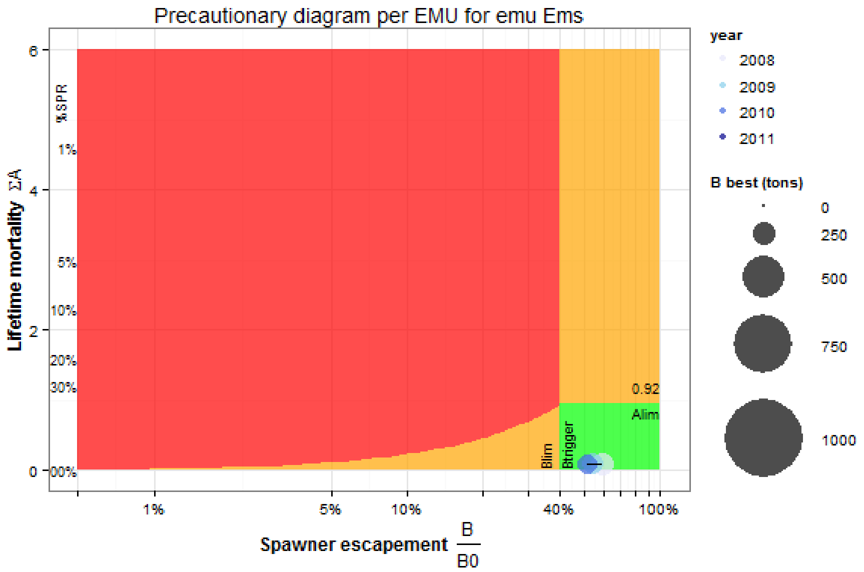
Table 13-6. Impacts on the eel stocks per RBD (2010). Data taken from the 2012 report to the European Commission on the implementation of the German EMPs (Fladung *et al.*, 2012a).

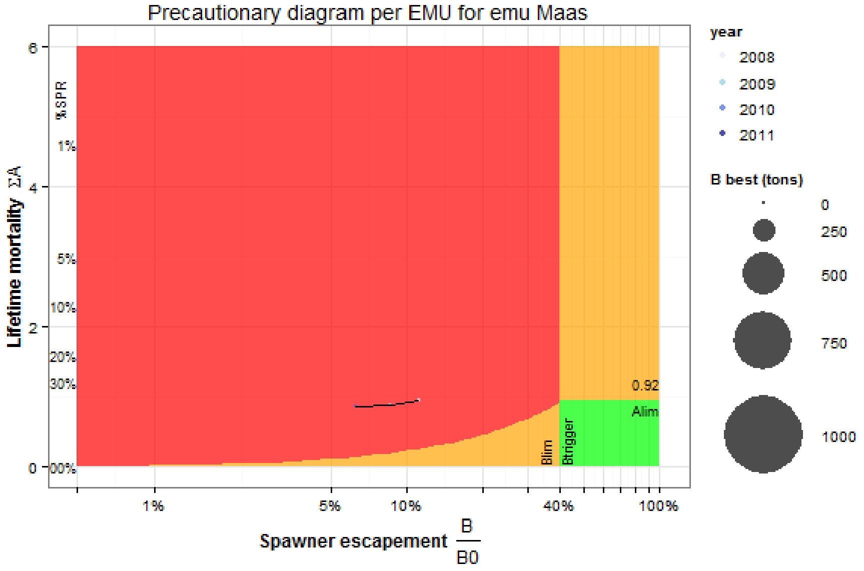
RBD	Impact (mortality in tons)		
	Commercial and recreational fishery (inland and coastal)	Mortality at technical constructions (turbines, pumping stations etc.)	Predation by cormorants
Eider	23	12	28
Elbe	296	43	75
Ems	20	5	2
Maas	<1	<1	<1
Oder	23	<1	19
Rhein	64	129	12
Schlei/Trave	59	23	79
Warnow/Peene	112	<1	6
Weser	50	70	9
Total	**647**	**283**	**231**

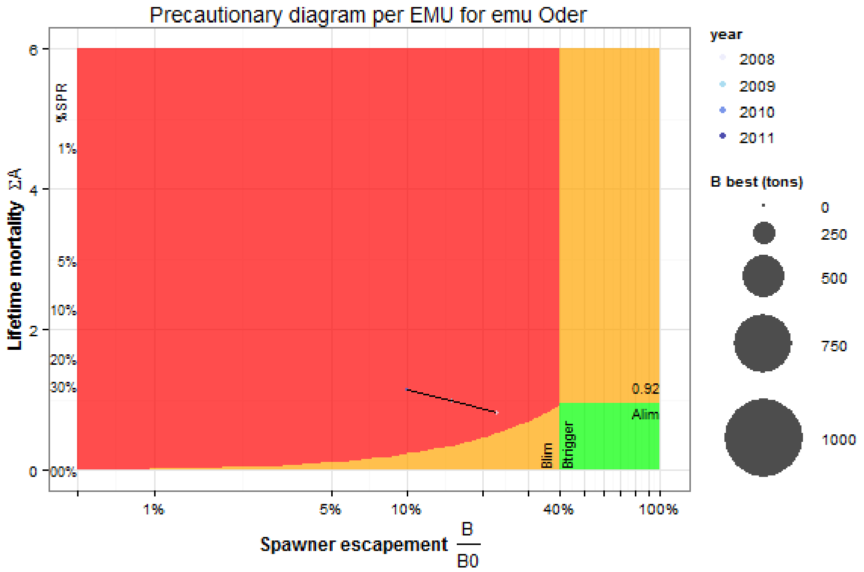
13.2.4 Precautionary diagram

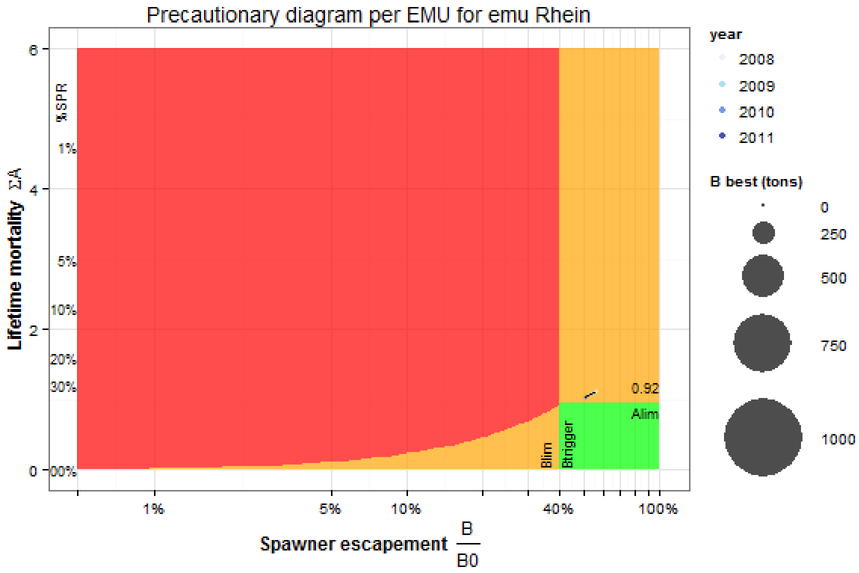
In this section the available precautionary diagrams for the single German RBDs are given. To provide a common working basis, the graphs are taken from the Report of the ICES Workshop WKEPEMP (ICES 2013). The graph for the RBD Warnow/Peene could not be calculated due to missing data for the coastal waters. The estimates for the RBDs Eider and Schlei/Trave did not provide data on mortality rates and hence, it was not possible to produce the graphs.

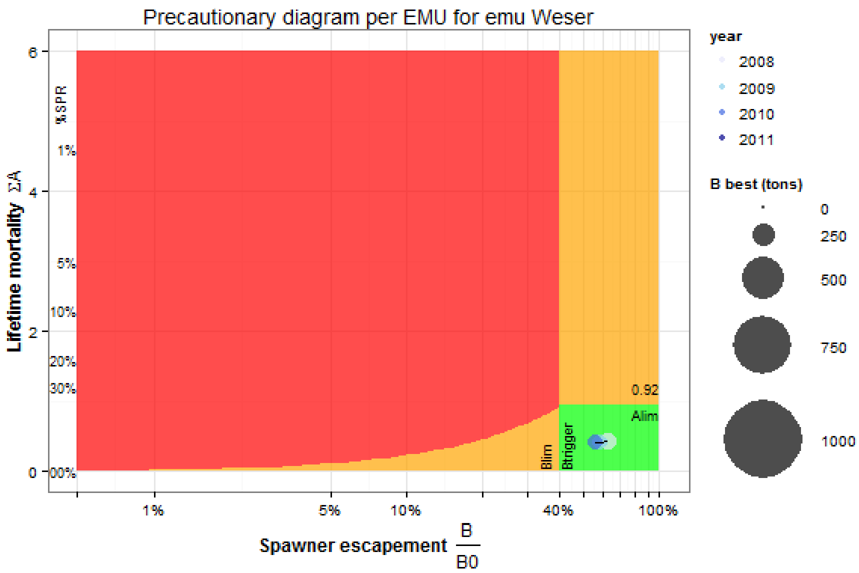

Precautionary diagram per EMU for emu Elbe
Lifetime mortality ΣA
%SPR
1%
5%
10%
20%
30%
00%
0.92
Alim
Blim
Btrigger
1%
5%
10%
40%
100%
Spawner escapement B/B0
year
2008
2009
2010
2011
B best (tons)
0
250
500
750
1000


Precautionary diagram per EMU for emu Ems
Lifetime mortality ΣA
%SPR
1%
5%
10%
20%
30%
00%
0.92
Alim
Blim
Btrigger
1%
5%
10%
40%
100%
Spawner escapement B/B0
year
2008
2009
2010
2011
B best (tons)
0
250
500
750
1000


Precautionary diagram per EMU for emu Maas
Lifetime mortality ΣA
%SPR
1%
5%
10%
20%
30%
100%
0
2
4
6
0.92
Alim
Blim
Btrigger
1%
5%
10%
40%
100%
Spawner escapement B/B0
year
2008
2009
2010
2011
B best (tons)
0
250
500
750
1000


Precautionary diagram per EMU for emu Oder
Lifetime mortality ΣA
%SPR
1%
5%
10%
20%
30%
100%
0
2
4
6
0.92
Alim
Blim
Btrigger
1%
5%
10%
40%
100%
Spawner escapement B/B0
year
2008
2009
2010
2011
B best (tons)
0
250
500
750
1000


Precautionary diagram per EMU for emu Rhein
Lifetime mortality ΣA
%SPR
1%
5%
10%
20%
30%
100%
0.92
Alim
Blim
Btrigger
0
2
4
6
1%
5%
10%
40%
100%
Spawner escapement B/B0
year
2008
2009
2010
2011
B best (tons)
0
250
500
750
1000


Precautionary diagram per EMU for emu Weser
Lifetime mortality ΣA
%SPR
1%
5%
10%
20%
30%
100%
0.92
Alim
Blim
Btrigger
0
2
4
6
1%
5%
10%
40%
100%
Spawner escapement B/B0
year
2008
2009
2010
2011
B best (tons)
0
250
500
750
1000

13.2.5 Management measures

Table 13-7. Implementation of management measures in the RBD Eider.

EMU CODE	ACTION TYPE	ACTION	LIFE STAGE	PLANNED	OUTCOME
DE_Eide	Com Fish	Increase minimum size limit	Yellow	EMP	Implemented
		Close stationary eel traps	Mixed	Other	Partially implemented
	Rec Fish	Increase minimum size limit	Yellow	EMP	Implemented
	Hydropower & Pumps	Trap & Transport	Silver	EMP	Implemented
	Restocking	no	---	---	---
	Other	Predator control	Mixed	EMP	Implemented
		Improve longitudinal connectivity	Mixed	EMP/Other	Partially implemented
		Scientific studies and monitoring and data collection	Mixed	EMP	Implemented
		Legal framework	Mixed	EMP	Implemented
		Improve means of fishery control	Mixed	Other	Implemented

Table 13-8. Implementation of management measures in the RBD Elbe.

EMU code	Action Type	Action	Life Stage	Planned	Outcome
DE_Elbe	Com Fish	Increase minimum size limit	Yellow	EMP	Partially implemented
		Close stationary eel traps	Silver	EMP	Partially implemented
		Reduction of fisheries intensity in coastal waters	Mixed	EMP	Partially implemented
		Introduction of regional fishing limitations	Mixed	Other	Implemented
	Rec Fish	Increase minimum size limit	Yellow	EMP	Partially implemented
		Introduction of bag size limit for eel anglers	(Yellow)/Mixed	Other	Implemented
		Closing fishery at night for anglers	(Yellow)/Mixed	Other	Implemented
	Hydropower & Pumps				
	Restocking	Stabilize/increase amount stocked	Glass	EMP	Implemented
	Other	Improve longitudinal connectivity	Mixed	EMP/Other	Partially implemented
		Scientific studies and monitoring and data collection	Mixed	EMP	Partially implemented
		Legal framework	Mixed	EMP	Partially implemented

Table 13-9. Implementation of management measures in the RBD Ems.

EMU code	Action Type	Action	Life Stage	Planned	Outcome
DE_Ems	Com Fish	Increase minimum size limit	Yellow	EMP	Partially implemented
		Reduction of fisheries intensity in coastal waters	Mixed	EMP	Not implemented
	Rec Fish	Increase minimum size limit	Yellow	EMP	Partially implemented
	Hydropower & Pumps				
	Restocking	Stabilize/increase amount stocked	Glass	EMP	Partially implemented
		Supply financial support for stocking	Glass	Other	Implemented
	Other	Improve longitudinal connectivity	Mixed	Other	Partially implemented
		Scientific studies and monitoring and data collection	Mixed	EMP	Partially implemented
		Legal framework	Mixed	EMP	Partially implemented

Table 13-10. Implementation of management measures in the RBD Maas.

EMU code	Action Type	Action	Life Stage	Planned	Outcome
DE_Maas	Com Fish	Increase minimum size limit	Yellow	EMP	Implemented
	Rec Fish	Increase minimum size limit	Yellow	EMP	Implemented
	Hydropower & Pumps				
	Restocking	Stabilize/increase amount stocked	Glass	EMP	Partially implemented
		Supply financial support for stocking	Glass	Other	Implemented
	Other	Improve longitudinal connectivity	Mixed	Other	Partially implemented
		Scientific studies and monitoring and data collection	Mixed	Other	Implemented
		Include eel in existing species protection programmes	Mixed	Other	Implemented
		Legal framework	Mixed	EMP	Implemented

Table 13-11. Implementation of management measures in the RBD Oder.

EMU code	Action Type	Action	Life Stage	Planned	Outcome
DE_Oder	Com Fish	Increase minimum size limit	Yellow	EMP	Implemented
		Close stationary eel traps	Silver	EMP	Partially implemented
	Rec Fish	Increase minimum size limit	Yellow	EMP	Implemented
		Introduction of bag size limit	Mixed	Other	Implemented
	Hydropower & Pumps				
	Restocking	Stabilize/increase amount stocked	Glass	EMP	Implemented
	Other	Improve longitudinal connectivity	Mixed	Other	Partially implemented
		Scientific studies, monitoring and data collection	Mixed	EMP	Partially implemented
		Legal framework	Mixed	EMP	Implemented

Table 13-12. Implementation of management measures in the RBD Rhine.

EMU code	Action Type	Action	Life Stage	Planned	Outcome
DE_Rhei	Com Fish	Increase minimum size limit	Yellow	EMP	Implemented
		Introduce closed season	Mixed	EMP	Implemented
		Establish prolonged closed season	Mixed	Other	Implemented
	Rec Fish	Increase minimum size limit	Yellow	EMP	Implemented
		Introduce closed season	Mixed	EMP	Implemented
		Establish a prolonged closed season	Mixed	Other	Implemented
	Hydropower & Pumps	Trap & Transport	Silver	EMP/Other	Implemented
	Restocking	Stabilize/increase amount stocked	Glass	EMP	Partially implemented
		Supply financial support for restockimng	Glass	Other	Partially implemented
	Other	Improve longitudinal connectivity	Mixed	Other	Implemented
		Predator control	Mixed	EMP	Partially implemented
		Scientific studies, monitoring and data collection	Mixed	Other	Implemented
		Legal framework	Mixed	EMP	Partially implemented
		Include eel in existing species protection programmes	Mixed	Other	Implemented

Table 13-13. Implementation of management measures in the RBD Schlei/Trave.

EMU code	Action Type	Action	Life Stage	Planned	Outcome
DE_Schl	Com Fish	Increase minimum size limit	Yellow	EMP	Implemented
		Reduction of fisheries intensity in coastal waters	Mixed	EMP	Implemented
		Close stationary eel traps	Mixed	Other	Partially implemented
	Rec Fish	Increase minimum size limit	Yellow	EMP	Implemented
		Introduction of a bag size limit	Mixed	Other	Implemented
	Hydropower & Pumps	Trap & Transport	Silver	EMP	Partially implemented
	Restocking	Stabilize/increase amount stocked	Glass	EMP	Partially implemented
	Other	Improve longitudinal connectivity	Mixed	EMP/Other	Partially implemented
		Predator control	Mixed	EMP	Implemented
		Scientific studies and monitoring and data collection	Mixed	EMP/Other	Partially implemented
		Legal framework	Mixed	EMP	Implemented
		Improve means of fishery control	Mixed	Other	Implemented

Table 13-14. Implementation of management measures in the RBD Warnow/Peene.

EMU code	Action Type	Action	Life Stage	Planned	Outcome
DE_Warn	Com Fish	Increase minimum size limit	Yellow	EMP	Implemented
		Reduction of fisheries intensity in coastal waters	Mixed	EMP	Implemented
		Close stationary eel traps	Mixed	Other	Partially implemented
		Introduce a closed season	Mixed	EMP	Implemented
	Rec Fish	Increase minimum size limit	Yellow	EMP	Implemented
		Introduce a closed season	Mixed	EMP	Implemented
	Hydropower & Pumps				
	Restocking	Stabilize/increase amount stocked	Glass	EMP	Partially implemented
	Other	Improve longitudinal connectivity	Mixed	Other	Partially implemented
		Predator control	Mixed	EMP	Partially implemented
		Scientific studies and monitoring and data collection	Mixed	EMP/other	Implemented
		Legal framework	Mixed	EMP	Implemented

Table 13-15. Implementation of management measures in the RBD Weser.

EMU code	Action Type	Action	Life Stage	Planned	Outcome
DE_Wese	Com Fish	Increase minimum size limit	Yellow	EMP	Partially implemented
		Reduction of fisheries intensity in coastal waters	Mixed	EMP	Not implemented
		Establish or prolong closed season for eel fishery	Mixed	Other	Partially implemented
	Rec Fish	Increase minimum size limit	Yellow	EMP	Partially implemented
		Establish or prolong closed season for eel fishery	Mixed	Other	Partially implemented
	Hydropower & Pumps	Introduce trap and transport programme and/or turbine management	Silver	Other	Partially implemented
	Restocking	Stabilize/increase amount stocked	Glass	EMP	Partially implemented
		Supply financial support for stocking	Glass	Other	Implemented
	Other	Improve longitudinal connectivity	Mixed	Other	Partially implemented
		Scientific studies and monitoring and data collection	Mixed	Otother	Implemented
		Legal framework	Mixed	EMP	Partially implemented

13.3 Summary data on glass eel

Quantities

caught in the commercial fishery: no glass eel fishery

exported to Asia: no export

used in stocking:
- 2011: 2 243 425 glass eels and 6 412 556 ongrown eels
- 2012: 3 183 379 glass eels and 5 036 512 ongrown eels
- 2013: 3 615 066 glass eels and 6 191 437 ongrown eels

(Minimum values since not all data have been reported yet)

used in aquaculture for consumption: (see comment below)*

consumed direct:	no fishery, potential import unknown
mortalities:	no data (but no fishery on glass eel)

A detailed table (in Excel-format) with data on re-stocking in the last years separately for the RBDs is provided on the SharePoint.

* According to data of the German Federal Statistical Office (Statistisches Bundesamt) **5.475 tons** of glass eel were brought to German eel aquaculture companies in 2013. However, information about the sources of the glass eels was not provided. In general, the legal situation regarding the availability of the data (sources) appears to be a bit unclear (data protection, etc.).

14 Sampling intensity and precision

A regular sampling is conducted in the frame of the Data Collection Framework (DCF). Information on the sampling design is provided in a special Annex to this report.

There are no data available from other studies, except for the information provided in the Chapters 11 and 12.

15 Standardisation and harmonisation of methodology

15.1 Survey techniques

So far, there is no standardized survey technique for eel monitoring. However, at least for the coastal waters, a monitoring system has been developed, which could allow a standardized monitoring in these waters in the future and which potentially could be used in other Baltic countries as well. For details see Chapter 13.1.of the 2012 Country Report (for 2011) and Ubl and Dorow (2014).

15.2 Sampling commercial catches

Commercial catches are sampled in the frame of the DCF. Details are given in a special annex to this report.

15.3 Sampling

Commercial catches are sampled in the frame of the DCF. Details are given in a special annex to this report.

15.4 Age analysis

Commercial catches are sampled in the frame of the DCF. Details are given in a special annex to this report.

15.5 Life stages

Commercial catches are sampled in the frame of the DCF. Details are given in a special annex to this report.

15.6 Sex determinations

Commercial catches are sampled in the frame of the DCF. Details are given in a special annex to this report.

15.7 Data quality issues

The quality of the available data is not easy to assess. There is no long history of eel stock assessment in Germany and hence the results are based on catch statistics, estimates and model calculations. The reliability of the catch statistics has not been evaluated so far. The model used to calculate the different population parameters of eel in German waters has been further developed (Oeberst and Fladung, 2012) and has also been tested in the frame of the POSE project. Meanwhile, the model assumptions (in the EMPs and in the 2012 report to the European Commission (Fladung *et al*., 2012)) have been compared to data obtained by tagging studies and proved to be acceptable (Fladung *et al*., 2012b; Prigge *et al*., 2013). Yet, the studies also indicated that the quality of the results strongly depends on the quality of the input data. Hence, the data basis for the modelling of the stock will have to be improved continuously in the future. In order to further improve the quality of the estimates, an updated version of the model (GEM III) is presently being developed. Furthermore, the reliability of the results will also be enhanced by increasingly using river specific growth data obtained in the frame of the DCF sampling.

16 Overview, conclusions and recommendations

In Germany, the relevant authorities and institutions have prepared eel management plans as required by the EU Regulation 1100/2007. The plans were submitted in December 2008 and have been approved by the European Commission in April 2010. For most of the measures planned in the EMPs the implementation has been started or already achieved. However, some targets could not be achieved completely and some of the measures are in some delay.

In 2012, the first report to the European Commission about the implementation of the EMPS and the recent development of the eel stocks was submitted. This report formed another milestone in the development of eel management in Germany. The structures of new documentation rules have been developed and established (statistics for effort, separate catch statistics for yellow and silver eels and so on).

In 2015, the next implementation report will be submitted to the European Commission. The authorities in the States ("Bundesländer") in Germany have established a dedicated (permanent) working group, which at present works on the preparation of this report. This also includes an upgrade of the German Eel Model to the version GEM III. However, not all data have been collated and analysed so far and no new calculation of stock indicators for the recent years has been conducted. Therefore, in this report the information from the previous report has been repeated in the relevant chapters. It can, however, be assumed that the general situation has not changed very strong, as can be concluded from data on catches, stocking etc.

In Germany, in the last years, several projects and studies have been conducted, which improved the availability of data on important population parameters (and will continue to do so in the future). The results of the biological sampling in the frame of the DCF will also help to improve the data basis for the population model used for the calculation of escapement.

The eel is still an important species for the German fisheries sector, especially for inland and coastal fishery, even though the importance of this sector itself is rather small. After a clear decrease during the last decades, due to considerable efforts spent on restocking, the eel catches now appear to be on a low but rather stable level.

17 Literature references

Bevacqua, D.; Melià, P.; De Leo, G.A.; Gatto, M. 2011. Intra-specific scaling of natural mortality in fish: the paradigmatic case of the European eel. Oecologia. 1–7. DOI 10.1007/s00442-010-1727-9.

Dorow, M. and Ubl, C. 2011. Überwachung des Aalbestandes in den Küstengewässern von Mecklenburg-Vorpommern – Ergebnisse einer zweijährigen Pilotstudie. Mitteilungen der Landesforschungsanstalt für Landwirtschaft und Fischerei Mecklenburg-Vorpommern 45: 21–30.

Dorow, M. and Paetsch, U. 2014. Die Zwischenhälterung von Glasaalen. Fischerei & Fischmarkt in Mecklenburg-Vorpommern 2: 46–49.

Fladung, E., Simon, J. and Brämick, U. 2012a. Umsetzungsbericht 2012 zu den Aalbewirtschaftungsplänen der deutschen Länder 2008. Auftraggeber: Niedersächsisches Ministerium für Ernährung, Landwirtschaft, Verbraucherschutz und Landesentwicklung. 53 pp. (http://www.portal-fischerei.de/fileadmin/redaktion/dokumente/fischerei/Bund/Bestands-management/AalbewirtschaftungBericht2012.pdf)

Fladung, E., Simon, J., Hannemann, N. and Kolew, J. 2012b): Untersuchung der .Blankaalabwanderung in der niedersächsischen Mittelelbe bei Gorleben. Institut für Binnenfischerei e.V. Potsdam-Sacrow, Projektbericht im Auftrag des Niedersächsischen Landesamtes für Verbraucherschutz und Lebensmittelsicherheit (LAVES), Potsdam, 21 S.

Hanel, R., Stepputtis, D., Bonhommeau, S., Castonguay, M., Schaber, M., Wysujack, K., Vobach, M. and Miller, M. J. 2014. Low larval abundance in the Sargasso Sea: new evidence about reduced recruitment of the Atlantic eels. Naturwissenschaften. DOI 10.1007/s00114-014-1243-6.

Hartmann, F. 1994. Untersuchungen zur Biologie, Epidemiologie und Schadwirkung von *Anguillicola crassus* Kuwahara, Niimi und Itagaki 1974 (Nematoda), einem blutsaugenden Parasiten in der Schwimmblase des europäischen Aals (*Anguilla anguilla* L.) Shaker Verlag Aachen. 139 pp.

ICES. 2013. Report of the Workshop on Evaluation Progress Eel Management Plans (WKEPEMP), 13–15 May 2013, Copenhagen, Denmark. ICES CM 2013/ACOM:32. 759 pp.

Kammann, U., Brinkmann, M., Freese, M., Pohlmann, J.-D., Stoffels, S., Hollert, H. and Hanel, R. 2014. PAH metabolites, GST and EROD in European eel (*Anguilla anguilla*) as possible indicators for eel habitat quality in German rivers. Environmental Science and Pollution Research 21(4): 2519–2530.

Kullmann, B. 2014. Bestandsstruktur und Wachstum des Europäischen Aals *Anguilla anguilla* (Linnaeus, 1758) im Nord-Ostsee-Kanal, Elbe-Lübeck-Kanal und Elbeästuar. Master Thesis. Hamburg University. 64 pp.

Lemcke, R. 2003. Etablierung eines langfristigen Glas- und Jungaalmonitorings in Mecklenburg-Vorpommern und erste Ergebnisse. Fischerei & Fischmarkt in Mecklenburg-Vorpommern 1/2003: 14–23.

Leuner, E. 2013. Untersuchungen zum Befall von Aalen mit dem Schwimmblasenwurm *Anguillicoloides crassus*. In: Jahresbericht 2013. Bayerische Landesanstalt für Landwirtschaft, Institut für Fischerei. Kap. 3.2.5: 41–43.

Marohn, L., Prigge, E. and Hanel, R. 2014a. Escapement success of silver eels from a German river system is low compared to management-based estimates. Freshwater Biology 59: 64–72.

Marohn, L., Prigge, E. and Hanel, R. 2014b. Introduced American eels *Anguilla rostrata* in European waters: life-history traits in a non-native environment. Journal of Fish Biology 84: 1740–1747.

Oeberst, R. and Fladung, E. 2012. German Eel Model (GEM II) for describing eel, *Anguilla anguilla* (L.), stock dynamics in the river Elbe system. Inf. Fischereiforsch. 59: 9–17.

Prigge, E., Marohn, L., Oeberst, R. and Hanel, R. 2013. Model Prediction versus Reality – Testing the predictions of a European eel (*Anguilla anguilla*) stock dynamics model against the *in situ* observation of silver eel escapement in compliance with the European Eel Regulation. ICES-Journal of Marine Science 70(2): 309–318.

Salva, J. 2013. Monitoring des Glas- und Steigaalaufkommens in der niedersächsischen Ems am Stauwehr Bollingerfähr April 2013–Oktober 2013. Bericht. Niedersächsisches Landesamt für Verbraucherschutz und Lebensmittelsicherheit, Dezernat Binnenfischerei. 32 pp.

Schaarschmidt, T. 2005. Erfassung des Aufkommens von Glas- und Jungaalen in ausgewählten Fließgewässern im Einzugsgebiet von Nord- und Ostsee in Mecklenburg-Vorpommern – Ergebnisbericht 2005. Landesforschungsanstalt für Landwirtschaft und Fischerei Mecklenburg-Vorpommern, Institut für Fischerei, Rostock: 8 pp.

Schaarschmidt, T., Lemcke, R., Krenkel, L. and Schulz, S. 2007. Erfassung des Aufkommens von Glas- und Jungaalen in ausgewählten Fließgewässern im Einzugsgebiet von Nord- und Ostsee in Mecklenburg-Vorpommern. Unpublished report. Landesforschungsanstalt für Landwirtschaft und Fischerei Mecklenburg Vorpommern, Institut für Fischerei: 33 p.

Simon, J. and Dörner, H. 2014. Survival and growth of European eels stocked as glass- and farm-sourced eels in five lakes in the first years after stocking. Ecology of Freshwater Fish 2014: 23: 40–48.

Sühring, R., Byer, J., Freese, M., Pohlmann, J.-D., Wolschke, H., Möller, A., Hodson, P. V., Alaee, M., Hanel, R. and Ebinghaus, R. 2014. Brominated flame retardants and Dechloranes in European and American eels from glass to silver life stages. Chemosphere 116: 104–111.

Ubl, C. and Dorow, M. 2010. Aktuelle Ergebnisse des Glas- und Jungaalmonitorings in Mecklenburg-Vorpommern. Fischerei & Fischmarkt in Mecklenburg-Vorpommern, 1/2010: 31–37.

Ubl, C. and Dorow, M. 2014. A novel enclosure approach to assessing yellow eel (*Anguilla anguilla*) density in non-tidal coastal waters. Fisheries Research. http://dx.doi.org/10.1016/j.fishres.2014.06.009 (will be: Fisheries Research 161 (2015): 57–63.)

Ubl, C., Schaarschmidt, T. and Lemcke, R. 2007. Glas- und Jungaalmonitoring in Mecklenburg-Vorpommern. Arbeiten des Deutschen Fischereiverbandes 85:117–137.

Wysujack, K., Dorow, M. and Ubl, C. 2014. The infection of the European eel with the parasitic nematode *Anguillicoloides crassus* in inland and coastal waters of northern Germany. J Coast Conserv 18(2): 121–130.

Wysujack, K., Westerberg, H. Aarestrup, K., Trautner, J., Kurwie, T., Nagel, F. and Hanel, R. 2014. The migration behaviour of European silver eels (*Anguilla anguilla*) released in open ocean conditions. Mar Freshw Res. http://dx.doi.org/10.1071/MF14023.

Annex

German National Data Collection of European eel (*Anguilla anguilla*) 2013

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Introduction

The European Eel population (all stages glass eel, yellow eel and silver eel) has decreased drastically during the last century. Indications state that the eel stock has continued to decline in 2012. The WGEEL recruitment index (five year average) is currently at its lowest historical level, less than 1% for the North Sea and 5% elsewhere in the distribution area with respect to 1960–1979 (ICES 2012). European Union Commission adopted a multiannual community program pursuant to Council Regulation (EC) No 199/2008 to establish a community framework for the collection, management and use of data in the fisheries sector and support for scientific advice regarding the common fisheries policy (2008/949/EC). Due to its catadromous life-cycle sampling of European Eel data also in freshwater have become mandatory in the DCF since 2009.

Technical report (2013)

European Eel (*Anguilla anguilla)* data collection in the EU–Data Collection

Framework (2008/199/EC) in German freshwater habitats

Sampling in Germany has started in spring. Due to little experience with DCF-sampling in fresh waters, sampling until the end of 2013 was considered an extension of the previously mentioned "pilot" phase (see Technical report 2009–2010). Data collection was coordinated and performed by the Institute of Fisheries Ecology of the Johann Heinrich von Thünen Institute, the Federal Research Institute for Rural Areas, Forestry and Fisheries, where special, temporal positions for two scientists have been established for the project until the end of 2016.

In this "pilot" phase, sampling focused on gathering biological parameters of eel in commercial catches of inland fisheries. During the ongoing sampling period from 2011 to 2013 the proposal for the German national program intended the gathering of 600 eels from the Baltic sea and 300 eels from the North Sea, including the respective discharging river basin districts (RBD; according to WFD, see Figure 1). However, recent sampling aimed at 600 eels from North Sea and 300 eels from the Baltic Sea, which has proven to be a more practical approach. If possible, 100 silver and 100 yellow eels per RBD were sampled, according to Council Decision (EC) No 949/2008. In some RBDs (e.g. Eider), the collection of eels was difficult due to low catches in 2013, thus sample sizes were not fully achieved. Exceptions were made for the RBD Meuse, where no commercial fishery exists in its German part and the RBD Danube, which is not considered a natural habitat of the European eel according to Council Regulation (EC) 1100/2007. Consequently, sampling was not required based on DCF standards. Due to low catches of commercial fishermen in the RBD Oder no samples were available in Germany. Thus, in 2013 samples were gathered in a bilateral agreement between Poland and Germany, with Poland being responsible for reporting DCF data for the Oder RBD to the EU, allowing Germany access to the respective data. However, samples gathered under this agreement are also mentioned in this report. A similar approach will be used for future sampling. In total, 901 eels were sampled in 2013 (see Table 1).

Yellow eels were mostly collected in spring/summer and silver eels in autumn 2013 (for detailed information see Table 1 and Figure 2). Analyses include length, weight, age, sex and maturity (detailed information in the list of biological variables). Although not mandatory under DCF regulations, additional parameters such as infestation with the invasive swimbladder nematode *Anguillicola crassus,* fat content of eel muscle tissue and contamination with several pollutants (e.g. BFRs, PCBs and PAHs) have been analyzed as well, partly in cooperation with other institutions (e.g. Helmholtz-Zentrum Geesthacht, Center for Materials and Coastal Research). Apart from, yet unpublished, ongoing research, the following results have been published in 2013:

1) M. Brinkmann, S. Stoffels, M. Freese, J.-D. Pohlmann, U. Kammann, R. Hanel, H. Hollert; *"Biomarker investigation on the contaminant exposure of European Eel (Anguilla anguilla) in German rivers"*; Conference Paper; SETAC Europe Annual Meeting 2013, Glasgow, Scotland; 01/2013.

2) Roxana Sühring, Jonathan Byer, Marko Freese, Jan-Dag Pohlmann, Hendrik Wolschke, Axel Möller, Renate Sturm, Peter Hodson, Mehran Alaee, Reinhold Hanel, Ralf Ebinghaus; *"From glass to silver eel – brominated flame retardants and dechloranes in European and American Eels";* Sixth International Symposium On Flame Retardants, San Francisco; 04/2013.

3) Ulrike Kammann, Markus Brinkmann, Marko Freese, Jan-Dag Pohlmann, Sandra Stoffels, Henner Hollert, Reinhold Hanel; *"PAH metabolites, GST and EROD in European eel (Anguilla anguilla) as possible indicators for eel habitat quality in German rivers"*, Environmental Science and Pollution Research 10/2013.

4) Roxana Sühring, Jonathan Byer, Marko Freese, Jan-Dag Pohlmann, Hendrik Wolschke, Axel Möller, Peter V. Hodson, Mehran Alaee, Reinhold Hanel, Ralf Ebinghaus; *"Brominated flame retardants and Dechloranes in European and American eels from glass to silver life stages"*; Chemosphere 12/2013.

Due to the limited number of commercial fishermen and better comparability, sampling was restricted to only few locations. To optimize comparability, eels were preferably collected downstream in the system (Figure 2), close to the estuaries. If necessary, exceptions from this general approach were made. At present, no data on the fishery itself were gathered in the frame of the DCF. Fishery catch data collection has to be performed as part of the Eel Management Plans under the administrative constraints of Council Regulation (EC) 1100/2007 by German regional authorities.

Eider, Schlei/Trave, Elbe, Warnow/Peene, Oder, Weser, Ems, Rhine, Meuse and Danube. According to the submitted Eel Management Plans of Germany in December 2008 (EU Council Regulation 1100/2007) we adopted the nine RBDs (Report on the eel stock and fishery in Germany 2008) for the EU-DCF (Figure 1).

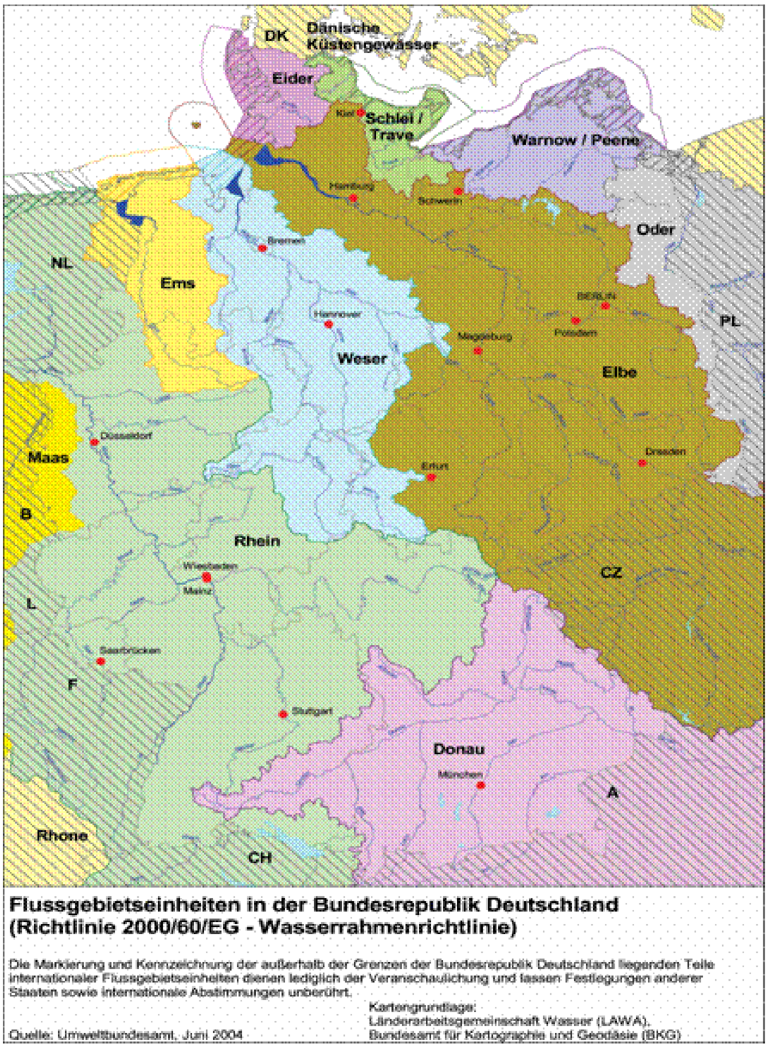

Figure 1. River Basin Districts (RBD) in the Federal Republic of Germany.

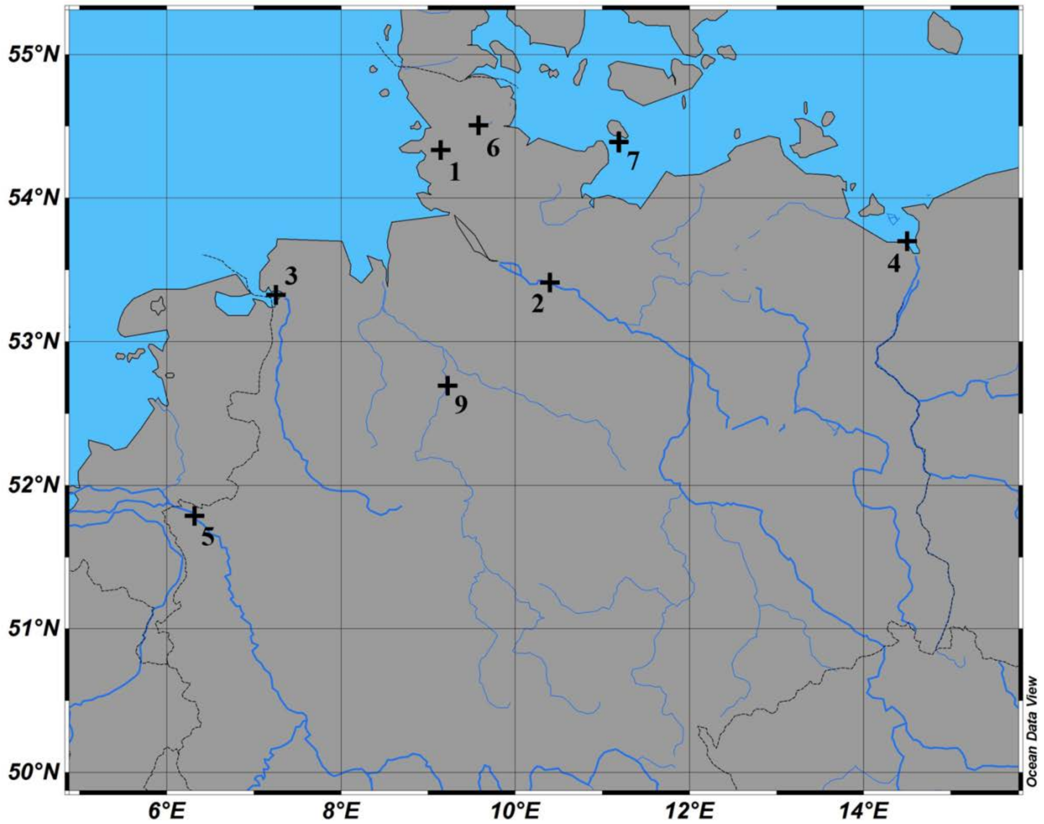

Figure 2. Overview of the spatial resolution for concurrent sampling of eels in German River Basin Districts (RBD).

Black crosses: Places of commercial eel catches, where samples were collected. For the Warnow/Peene RBD eel were collected from several small fisheries, which are not shown in this map.

Eider: 1

Elbe: 2

Ems: 3

Oder: 4

Rhine: 5

Schlei/Trave: 6–7

Warnow/Peene: 8 (not displayed)

Weser: 9

Table 1. Sampling scheme per RBD in the year 2013.

No.	RBD	Sampling Time	Sample Size (n)*			Gear
			Y	S	Total	
1	Eider	Mai 2013	24	5	29	fykenet
1	Eider	November 2013	1	24	25	fykenet
2	Elbe	Juli 2013	70	2	72	fykenet
2	Elbe	November 2013	6	18	24	trawl
3	Ems	Mai 2013	65	16	81	fykenet
3	Ems	Oktober 2013	5	34	39	fykenet
4	Oder	September 2013	87	98	185	fykenet
5	Rhine	September 2013	44	58	102	stownet
6	Schlei/Trave	June 2013	23	0	23	fykenet
6	Schlei/Trave	July 2013	27	0	27	fykenet
6	Schlei/Trave	November 2013	4	22	26	fykenet
7	Schlei/Trave	October 2013	2	39	41	fykenet
8	Warnow/Peene	August 2013	3	2	5	-
8	Warnow/Peene	Juli 2013	16	4	20	-
8	Warnow/Peene	September 2013	29	61	90	-
9	Weser	August 2013	84	1	85	fykenet
9	Weser	November 2013	3	24	27	stownet

***:S=Silver Eel; Y=Yellow Eel.**

List of biological variables within European eel (*A. anguilla*) DCF-sampling specifications

length [a], weight [b], sex [c], maturity [d], age [e]

[a]: total length was determined either immediately after catch (to the nearest 0.5 cm) or after thawing. In the second case the values were corrected by assuming a reduction of 2.5% according to Wickström *et al.*, 1986;

[b]: total weight was determined either immediately after catch or after thawing. In the second case the values were corrected by assuming a reduction of 2.8% according to Wickström *et al*., 1986;

[c]: sex determination via macroscopic assessment of gonadal development;

[d]: determination of silvering index according to Durif *et al*., 2005;

[e]: according to EU Council Regulation (1100/2007), 200 eels (100 yellow and 100 silver eels separately) were analyzed for each RBD. However, not for all RBDs 200 eels were available. To date, additional silver eel samples are still required for the rivers Trave and Oder. Age reading of otoliths was performed using a "cutting and burning" protocol (WKAREA 2009).

Financing

The average price for live European Eel from commercial fishermen of 14,98 € per kilogram caused final costs of 5.802,- € for 901 eels, excluding travel expenses. By considering a further decline in eel abundance and therefore eel landings, increasing eel prices for the subsequent DCF period have to be considered.

Proposal for the data collection of European Eel (*Anguilla anguilla)* in the EU-Data Collection Framework (2010/93/EU) for the period 2014–2016

The European Commission has adopted a multiannual Community program for the collection, management and use of data in the fisheries sector for the period 2011–2013 (2010/93/EC).

To further gather biological information on European eel, Germany proposes to continue data collection of its commercial catches. However, to better address the urgent questions for an eel fisheries management, sampling scheme and especially the collected parameters should be adapted as compared to the first sampling phase (2008/949/EU). Besides length, weight, age, sex and maturity of the sampled eels, parasite infestation and especially contamination with harmful substances are important parameters.

Several reviews on parasites and contaminants in eels have emphasized their negative influences on migration and reproduction. Therefore, estimation of an effective spawner biomass requires the quantification of the adverse effects of contaminants, parasites, diseases, and low fat levels on the capacity of eels to migrate and successfully spawn (EIFAC/ICES Working Group on Eels 2009).

In line with the report of the 2011 session of the Joint EIFAAC/ICES Working Group on Eels and the ICES Advice (2011) we strongly recommend that eel quality issues like *Anguillicola crassus* infestation as well as pollution with harmful contaminants like PCBs, DDT, dieldrin and heavy metals especially for silver eels should be taken into account for the new EU-Data Collection program (2010/93/EU).

Considering the limited availability of glass eel for restocking purposes, a comprehensive data collection of these parameters (contaminants, parasites, etc.) under the EU-Data Collection Regulation (2010/93/EU) would significantly contribute to the identification of suitable habitats for the production of high quality eel spawners.

Furthermore, no data on catch effort are collected within the DCF. Fishery data are collected as part of the Eel Management Plans under the administrative constraints of Council Regulation (EC) 1100/2007 by German regional authorities. We recommend the implementation of fishing effort data to the DCF, establishing a link between qualitative data (age, length, etc.) and quantitative data (e.g. catch per unit of effort), which would allow for a better estimation of the stock status.

Report on the eel stock and fishery in Greece 2013/2014

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Reporting Period. The present technical report presents the data collected during the year 2013.

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2 Introduction

2.1 General information

The population of European eel (*Anguilla anguilla* (L.) has been reduced and the current fishery is considered to be outside the limits of sustainability. Factors contributing to the decline include the fishing activity, and also other anthropogenic interferences (habitat loss, migration barriers, pollution) and physical factors (e.g. cormorants). Further assessment of the eels' biological status requires additional and continuous data (Dekker, 2005).

For this purpose, eel was included in the regulations for the data collection of the EU (Council Regulation 1543/2000 and Commission Regulations 1639/2001, 1581/2004). According to the new EU Regulation 199/08 (Article 3) the monitoring of the commercial and recreational eel fishery in inland waters must be included in the national programme of each Member State. The estimates must refer to the total landings, effort and biological efforts of the landings.

The fishery of European eel in Greece is limited to the capture of adults during their migration to the Atlantic for reproduction.

The majority of eels are caught in the lagoons, the majority of which are found in northern Greece (estuarine systems of Evros, Nestos and Lake Vistonis) and in western Greece (Messolonghi and Amvrakikos lagoons).

The regional authorities are responsible for the management of the lagoons, while some belong to the Ministries of Development and Economics and some belong to local municipalities. In any case, the economic exploitation of the lagoons is performed for a certain period of time by fishing cooperatives, which lease the lagoons (in most cases for ten years). The local fishing cooperatives have the exclusive right to exploit the fishes of the lagoons (Koutrakis *et al.*, 2007).

2.2 Description of the Eel Management Units

Greece is located close to the easternmost limit of the eel distribution and the country presents an extreme Mediterranean hydrologic profile, very different from the majority of the European countries. The total annual precipitation (about 700 mm) increases from southeast to northwest. 91 rivers have been recorded representing 4268 km, with deltas covering approximately 72 300 ha. The main characteristic of Greek rivers is their torrential flow that is caused by the uneven seasonal rainfall distribution, the mountainous terrain with large slopes, and the erosion of the ground. The total surface of Hellenic lakes is about 85 000 ha (30% are artificial). The total surface of the Hellenic lagoons is estimated to about 35 000 ha. The majority (75%) is located along the western coast.

EMU-01 (seven Prefectures, three Regions) is located in northwestern Greece. It comprises 70% of the total Hellenic lagoons surface and 45% of the lakes surface. Despite the considerable decrease of the EMU-01 landings (180 t in mid-1980, 50 t the recent years), the unit remains the most important eel producer. EMU-02 (five Prefectures, two Regions) is located on the western Peloponnesus. It comprises 5% of the total Hellenic lagoons surface and 3% of the lakes. The eel landings of this EMU increased since the mid-1980s, contrary to the general pattern and now represents about 40% of the Hellenic lagoon landings (about 40 t). EMU-03 (four Prefectures, one Region) is located in the northeastern part of the country. It comprises 24% of the total Hellenic lagoons surface and 9% of the lakes surface. The landings dropped from 70 t in early 1980s to less than 10 t. EMU-04 covers the rest of the country, mainly central eastern continental Greece and the islands of the Aegean Sea (35 Prefectures and eight Regions). The landings of the EMU-04 are almost zero (Figure 2.1).

According to ICES Convention area map the EMU 1 and EMU 2 are bounded from (I ecoregion) Adriatic-Ionian Seas and the EMU 3 and EMU 4 are bounded from (J ecoregion) Aegean-Levantine Seas.

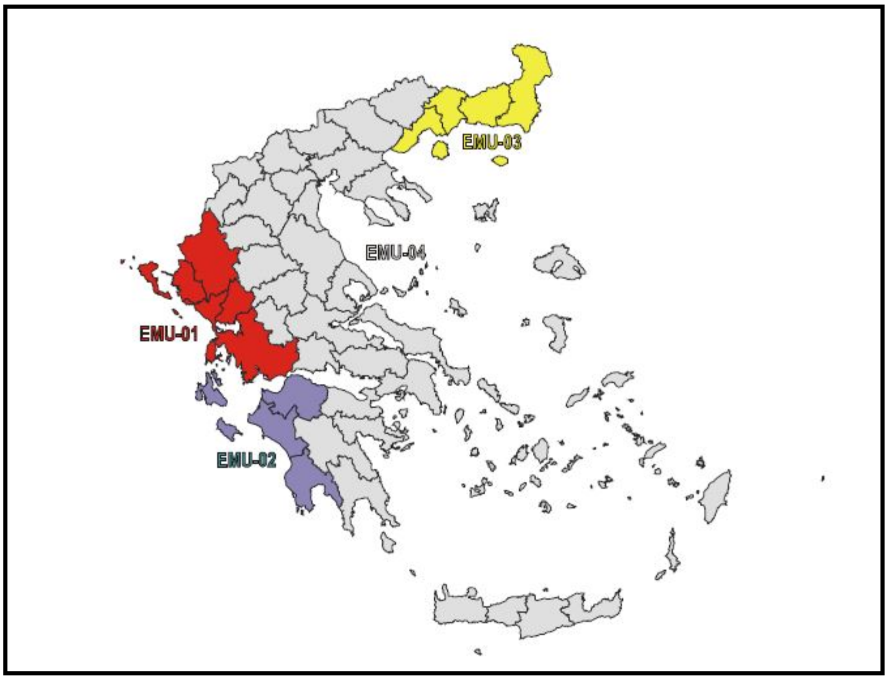


Figure 2.1. Geographical distribution of the Hellenic Eel Management Units (HEMU).

2.3 Fishing activity and relevant fishing reforms

According to the Ministerial Decision 643/39462/01-04-13 (in the framework of the EU Regulation 1100/07 implementation) the eel fisheries with the use of fykenets is prohibited in all lagoons of the country, including eel fishing carried from independent fishermen. Moreover with the same MD eel fisheries performed in lakes was also banned. However, the above Ministerial Decision permits the eel fishing the lagoons (with permanent installed traps), but it is mandatory to release the 30% of the annual eel landings and the lessees of the lagoons are obliged to promptly inform the fisheries service for the upcoming fishing eels, so that there is applicability of the proposed procedure.

Fishing in the lagoons is based on the use of fixed barrier traps, which catch fishes during their seasonal or ontogenic offshore migration every year from September to January. Barrier traps (V-shape traps) are passive, fixed gears and are part of the fence installed at the interface between the lagoon and the sea (for more details see Ardizzone *et al.*, 1988).

The fishermen's cooperatives usually have the adequate infrastructure to store live eels up to their sale (the largest quantity of these are exported to other European countries, such as Italy and Germany). The total fishery of the eels and the total fishery of the rest species must be declared every month to the regional authorities.

The traditional barrier fishtraps used to be wooden installations, consisting of wooden sticks hammered into the lakebed sustaining a net of reeds. Most of these installations were replaced after 1980 with cement installations (modern barrier fishtrap) as the Italian "vallicultura" capture systems (see Figure 4.4.).

Fishing in estuaries is practiced mainly by professional fishermen, who also use fykenets. With the above mentioned Ministerial Decision, eel fisheries are banned "for the period from November the 1st of each year until the end of January next year, by any means and every tool in the rivers and their deltas, within a radius of 3 nm from the estuaries". Moreover with the above MD the eel fishery from any professional vessel must be made by issuing a special fishing licence. The vessel owner must declare to the competent Fishery Department the number of captured eels, the quantities they caught and the catch area.

Small quantities of eels are also fished by independent fishermen using longlines. These quantities are not included in the total eel catches since they are used for personal use or being sold in local markets.

2.4 Status of eel imports and exports in Greece

Due to the limitations that exist in inter-EU trade of eels, a certificate called "single permit" is required. As defined by the No. 643/39462/2013 (Government Gazette 883/B'/2013) Ministerial Decision of the Minister of Rural Development and Food, the issuance of the "simple permit" is carried out by the competent Regional CITES Managing Authorities. Prior to the issue of the license, the applicant must submit the "eel release protocol".

There are two types of protocols about releasing eels, one for adult eels (silver eels) and one for juveniles (glass eels). The first protocol concerns silver eels caught at the permanent fish traps in the lagoons that are leased to Fishermen Cooperatives across the country, and also at the leased marine areas in the Amvrakikos Gulf. The only prerequisite for the issuance of this protocol is the release of at least 30% of the total annual eel landings caught by the Cooperatives. The process of eel release must take place in the presence of a three-member committee consisting of one representative from the Department of Regional Fisheries Unit, the Coast Guard and the Veterinary Office along with the presence of cooperative's representative. The release takes place only at specific area designated by the Fisheries Department. After the release takes place, the release protocol is drafted and afterwards is delivered to the local Regional CITES Management Authority for the "single permit" to get issued. All imported eel consignments from other EU Member States must also, be accompanied from the corresponding "simple licence" issued by the local authority CITES.

Regarding the second type of protocol, this concerns eel aquaculture farms that imports glass eels from other EU Member States. Specifically, each farm is required to release 10% of eels imported for fattening from other EU Member States. The release takes place under the supervision of the competent Department of Fisheries and the presence of the three-member committee mentioned above, which is responsible for drafting the release protocol. Afterwards the protocol is delivered to the appropriate Regional CITES Management Authority for the "single permit" to get issued. All imported eel consignments from other EU Member States must also, be accompanied from the corresponding "single permit" issued by the local authority CITES.

For inter-EU or inter-state trafficking of fry or silver eels produced by eel farms, which use glass eel caught in Greece, they must be accompanied by the appropriate "glasseel single permit". This licence is issued by the local fisheries department with the consent of the Division of Aquaculture and Inland Waters of the Ministry of Rural Development. "Glass-eel single permit" is granted only in the occasion of entrapped eel fry populations in irrigation and drainage systems, dams, pumping stations and generally in areas where the free movement of glass-eels is obstructed and as a result there are high rates of mortality. Glass-eels fishing must take place in correspondence with the regional management authorities and the presence of the three-member committee mentioned above. The only prerequisite for the issuance of the "Glass-eel single permit" is the release of at least 20% of the total biomass of glass-eels caught.

According to Circular No. 168029/1078/06-04-2012 of the CITES Central Management Authority of the Ministry of Environment, the import and export of eels from and to non-EU members is fully prohibited at least until the end of 2012.

3 Time-series data

ND.

3.1 Recruitment

ND.

3.1.1 Glass eel recruitment

3.1.1.1 Commercial

3.1.1.2 Recreational

3.1.1.3 Fishery-independent

3.1.2 Yellow eel recruitment

ND.

3.1.2.1 Commercial

3.1.2.2 Recreational

3.1.2.3 Fishery-independent

3.2 Yellow eel landings

ND.

3.2.1 Commercial

3.2.2 Recreational

3.2.3 Fishery-independent

3.3 Silver eel landings

3.3.1 Commercial

More than 80% of the landings are provided by lagoon fisheries. Figure 3.1 indicates the lagoon landings from the late 1970 until today. The figure shows a clear decreasing trend since late 1980. H EMU-1 (western Greece) provided the majority of the landings until mid-1990. The decreasing trends of the annual lagoon landings in EMU-01 (western Greece) and EMU-03 (eastern Macedonia and Thrace) are profound after 1990, while the annual lagoon's eel landings of the EMU-02 (western Peloponnese) showed a noticeable increase. The mean eel annual landings of the EMU-01 and EMU-03 lagoons decreased from 10 kg/ha during the period prior 1980 to 2.4 kg/ha in recent years. On the other hand, the EMU-02 eel annual landings increased from 10 kg/ha during the period before 1985 to 20–25 kg/ha during the period after 1990. The origin of this inverse pattern of the EMU-2 is not identified. However, since the rise of landings in the 1990s, landings have stabilized and shows signs of slight bending to all EMU (1 to 3). In any case the total landings decreased considerably despite the fact that the fishing effort was maintained stable at least since the installation of "modern fishing traps" in the 1980s.

In several areas of the EMU-01, individually operating fishermen, who do not belong to a particular fishing cooperative, target eels with total catches varying from 200 kg to 1000 kg per period (Koutsikopoulos *et al.*, 2001). The number of those fishermen remains unknown along with their spatial distribution and their gears. Individually operating fishermen also appear in lagoons, lakes and deltas of EMU-02 but no information exist on their activity. The same information exists for EMU-03 and finally some information for EMU-04 (rest of Greece) suggest that the intense eel fishing activities in some rivers stopped in the late 1970s, as a result of the severe degradation of the corresponding ecosystems.

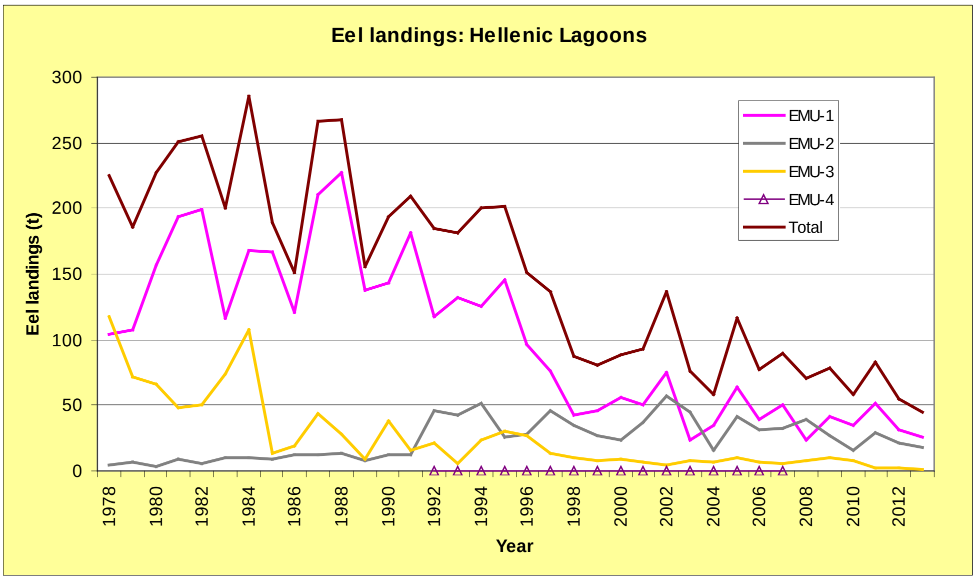


Figure 3.1. Eel landings in the Greek lagoons since the late 1970s until today in total and per Management Unit.

The so-called independent fishermen that fish inside the Greek lagoons are allowed only in 8.3% of them (mainly in Messolongi Lagoon) using nets and longlines, irrespective of the species caught. The lagoons with legal independent fishing activity are found in EMU-01 and EMU-04, and belong mainly to the most important deltas of Acheloos and Arachthos rivers (Figure 3.1). The independent eel fishery is carried out using eel traps, fykenets, lights, spears, longlines and other localized traditional fishing gears. The Hellenic Eel Management Plan proposed the prohibition of fykenet fishing in the lagoons and temporal closures prohibition in the rivers, especially in the delta and in the lakes. Measure that was implemented at the level of regions of the country after the 31-05-2011 relative circular of Management.

3.3.1.1 East Macedonia and Thrace (EMU-3)

As mentioned earlier, the fishing cooperatives that manage the lagoons in eastern Macedonia and Thrace are required to submit to the Fisheries Department of the Regional Authority of East Macedonia and Thrace, the annual landings, with the exception of the Fishermen Cooperative in Lake Vistonis, which, due to the specific regime govern the leasing of it, must submit the monthly landings. In Figure 3.1 the annual total eel landings (t) per lagoon in the Region of East Macedonia and Thrace for the years 1974–2013 are presented.

While gathering data on eel landings from previous years, the monthly landings from 1974–2013 for Lake Vistonida (Figure 3.1) were found. Figure 3.2 presents the mean monthly landings of eels in Lake Vistonida for the period from 1974 up to 1999. During this period intense eel harvesting was observed throughout the year. The maximum landings was166 t and December, January and March were the months with the highest landings. During this period eel fishing was also performed with fykenets.

In Figure 3.3 the average monthly landings of eels for the years 2000–2013 are presented and shows a significantly reduced eel harvesting with a maximum output of 1.4 t and December and January the months with the highest landings.

During the same period the eel fishery was performed only with the use of the permanent installed fishing devices in the lagoons. There was a significant reduction in eel fisheries during the last 13 years and especially during the period August–November, Figures 3.2 and 3.3, respectively. Regarding the rest of the lagoons in River Nestos Delta, in Komotini and in River Evros Delta, the data of total annual eel landings were found.

Figure 3.4 presents the total annual landings of eels in Nestos Delta lagoons for the period 1995–2009, while Figure 3.5 presents the mean annual eel landings per lagoon (Keramoti, Agiasma, Erateino and Vassova), for the same period as reported by the Fishermen Cooperative of Nestos Lagoons. Figure 3.6 and 3.7 present the annual landings of eels of the Evros Fishermen Cooperative. All Tables and Figures presenting the eel landings will be updated every year with new data.

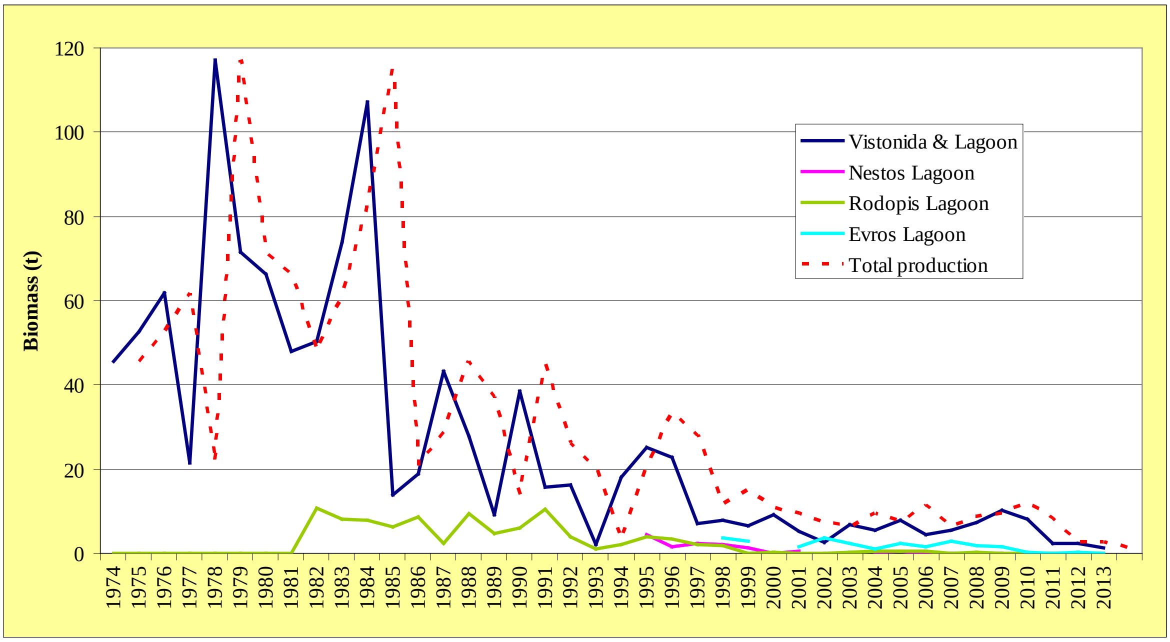


Figure 3.2. Time-series of eel landings (t) per lagoon and the total landings of them for East Macedonia and Thrace for the years 1974–2013.

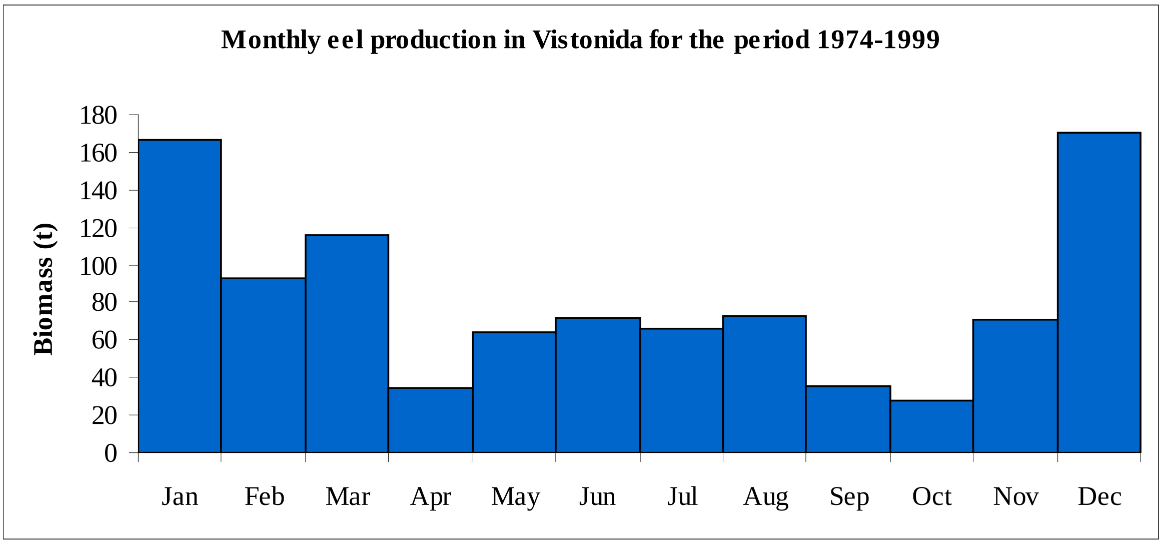


Figure 3.3. Mean monthly eel landings (t) in Lake Vistonida for the time period 1974–1999.

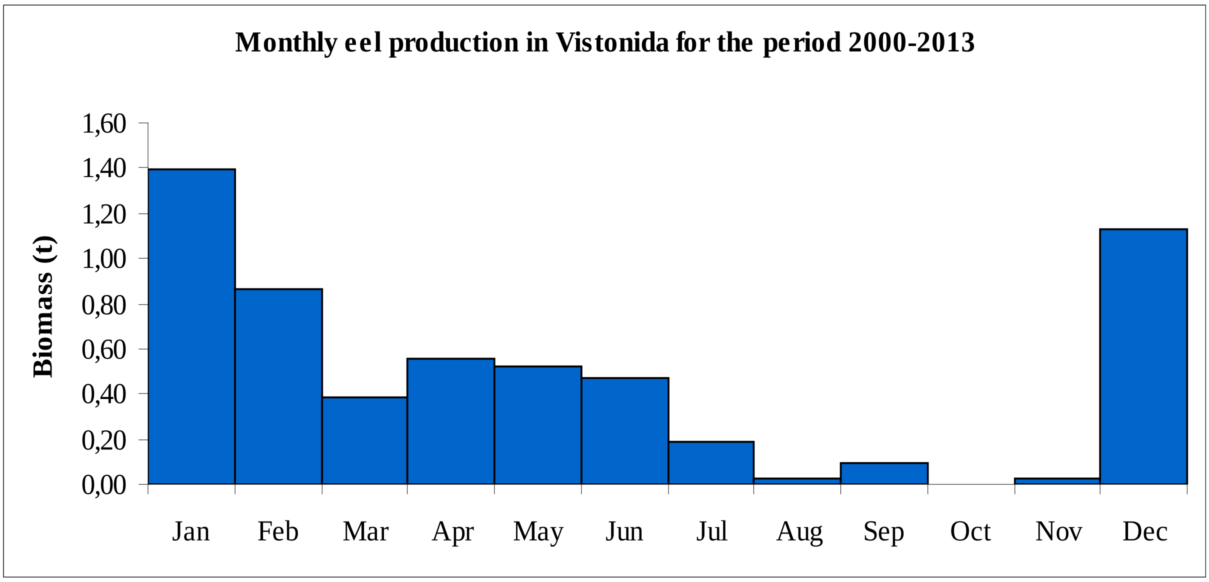


Figure 3.4. Mean monthly eel landings (t) in Lake Vistonida for the time period 2000–2013.

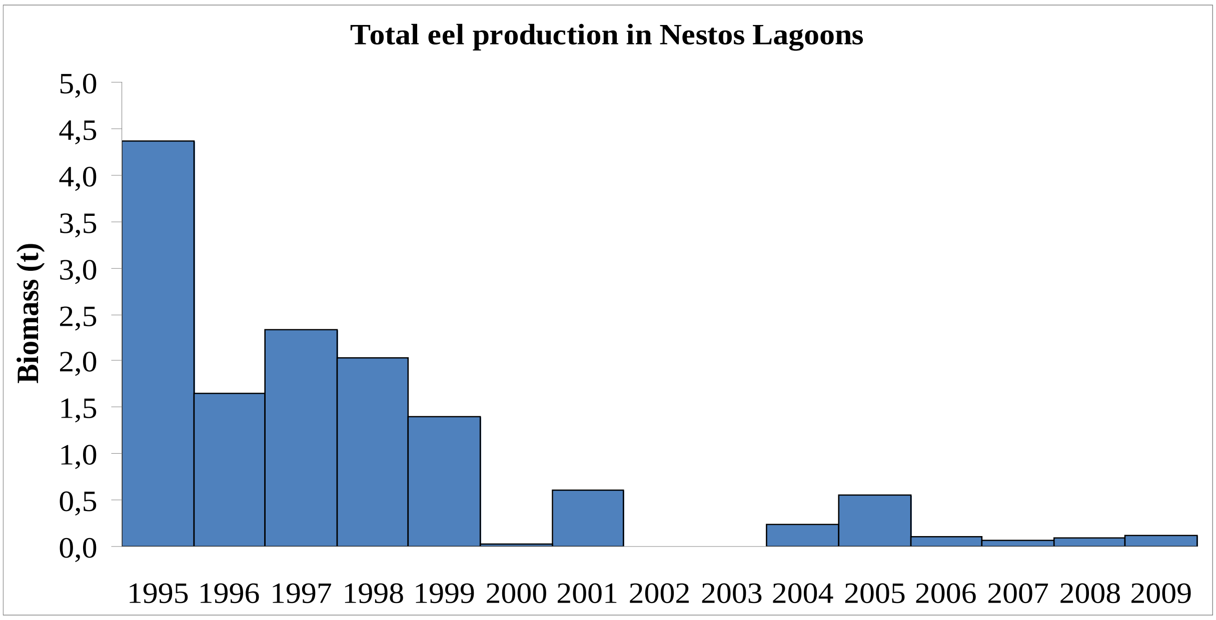
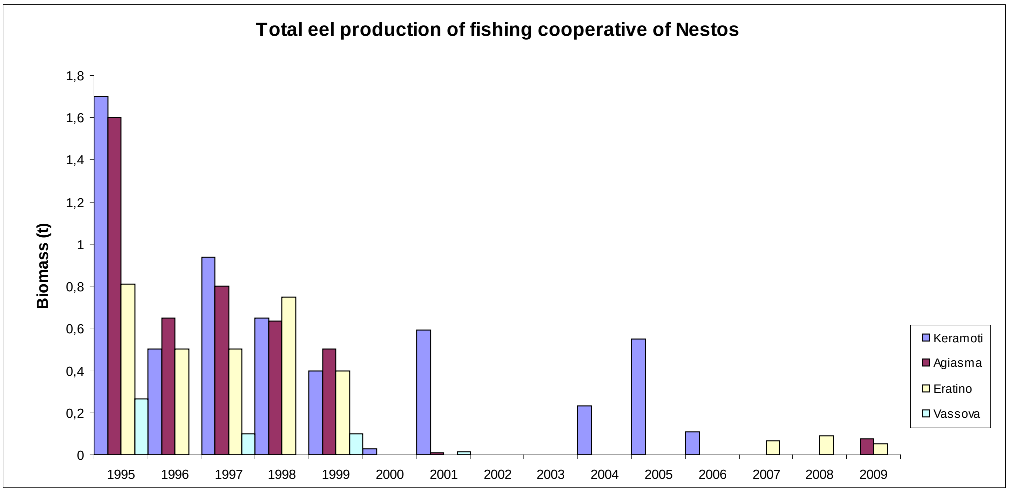


Figure 3.5. Total annual eel landings of Nestos Delta lagoons (Keramoti, Agiasma, Erateino, Vassova) for the time period 1995–2009, as stated by the local Fishing Cooperative.



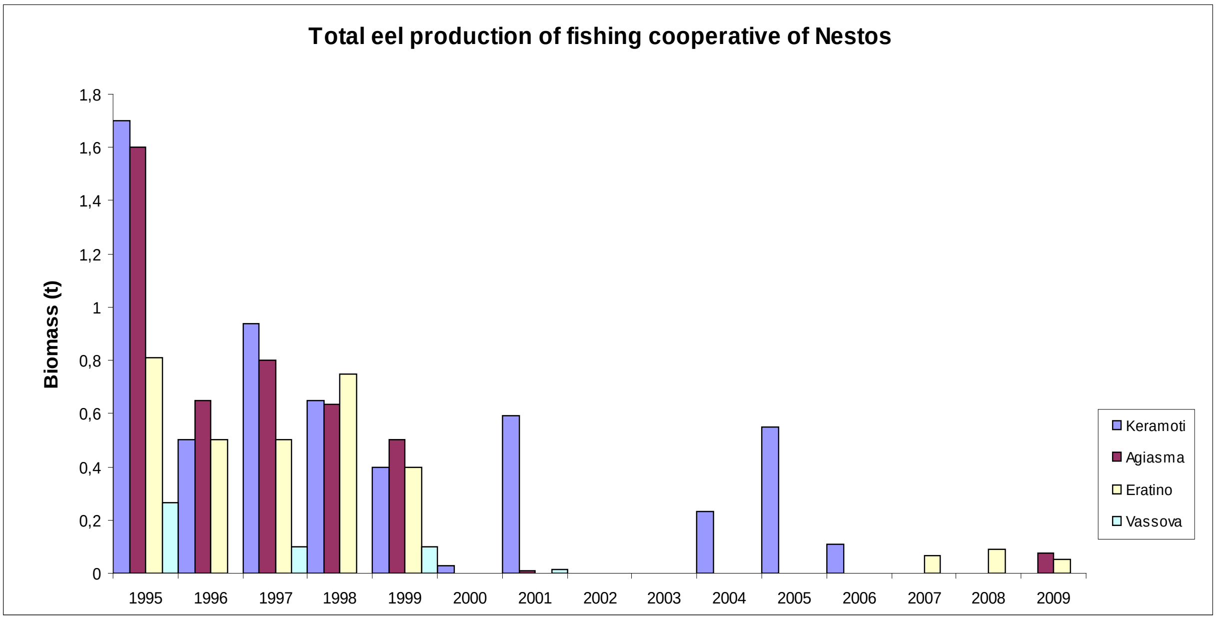


Figure 3.6. Average annual eel landings (t) per lagoon (Keramoti, Agiasma, Erateino, Vassova) for the time period 1995–2009, as stated by the local Fishing Cooperative.

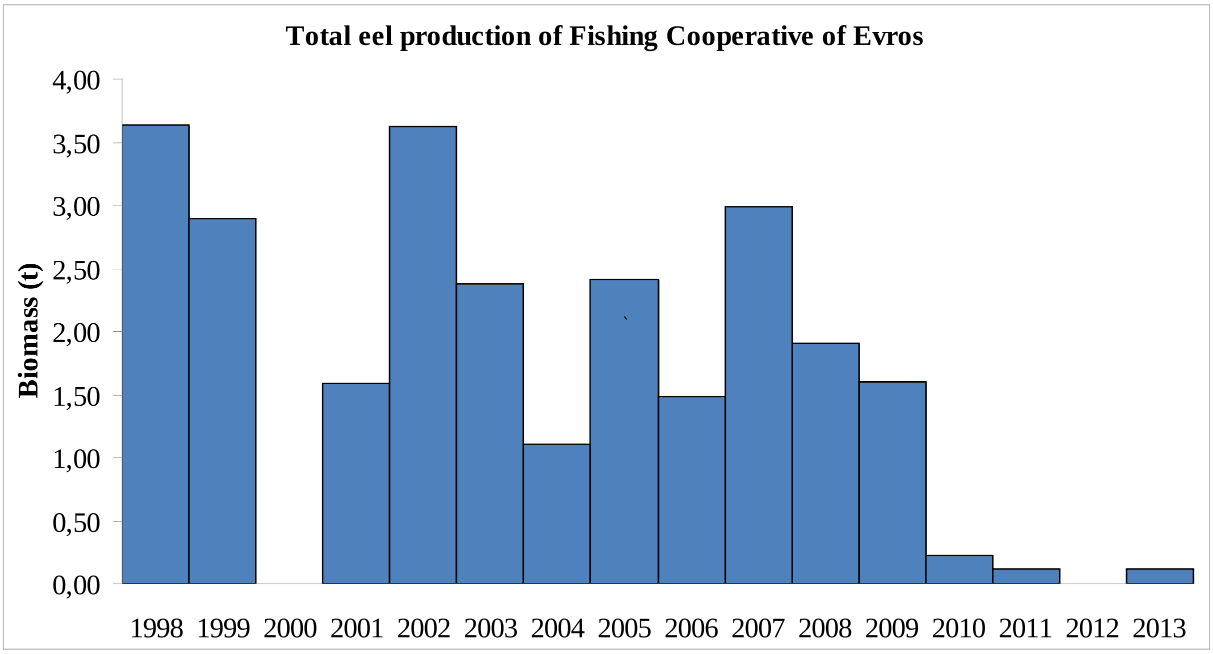


Figure 3.7. Annual eel landings (t) of the Fishing Cooperative of River Evros.

3.3.1.2 Western Greece (EMU-1)

3.3.1.2.1 Messolonghi - Aitoliko Lagoons

The eel landings time-series per fishing area of the Messolonghi-Aitoliko lagoon's complex (Figure 3.8). These time-series are characterized by a steep downward trend since the late 1980s to 2000, after this downward period they are stabilizing at low levels. During the main fishing season of 2013, in two different cases, extensive damage to the fish traps (16/10 and 25/11) due to severe weather phenomena, were recorded. Due to the destruction of the traps a significant part of the eel managed to escape to the sea, which affected negatively the number of eels caught.

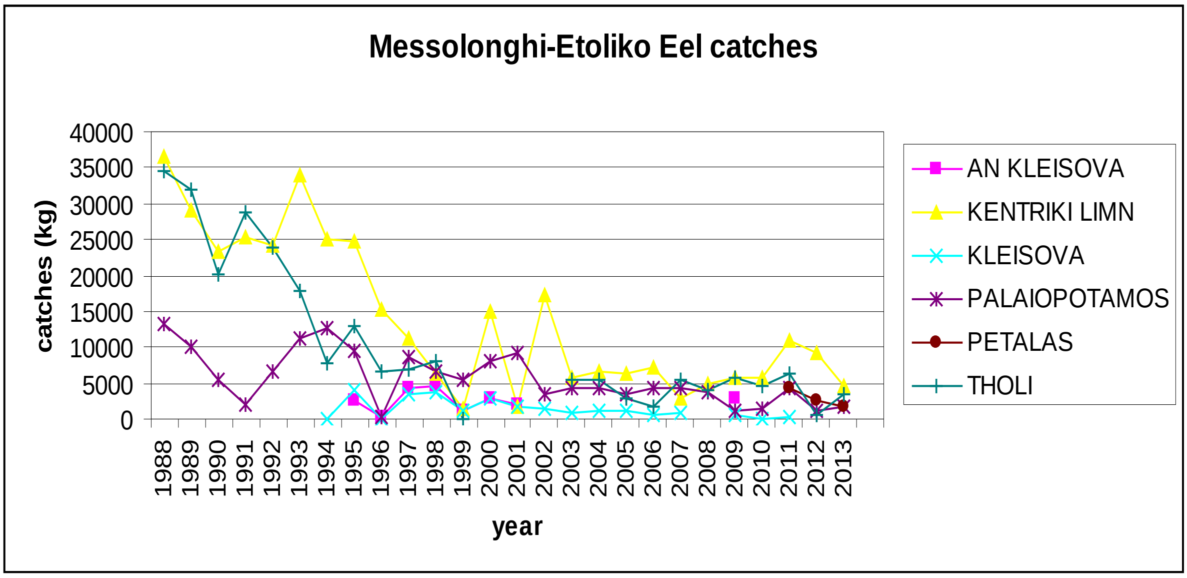


Figure 3.8. Evolution of eel landings per lagoon in Messolonghi-Aitoliko lagoons complex for the period 1988–2013.

3.3.1.2.2 Lagoons of Avrakikos, Preveza and Lefkada

Figures 3.9 and 3.10 show the annual eel landings (in kg) of Arta region and for the two bigger lagoons of the region, Logarou and Tsoukalio for the time period from 1970 to 2013.

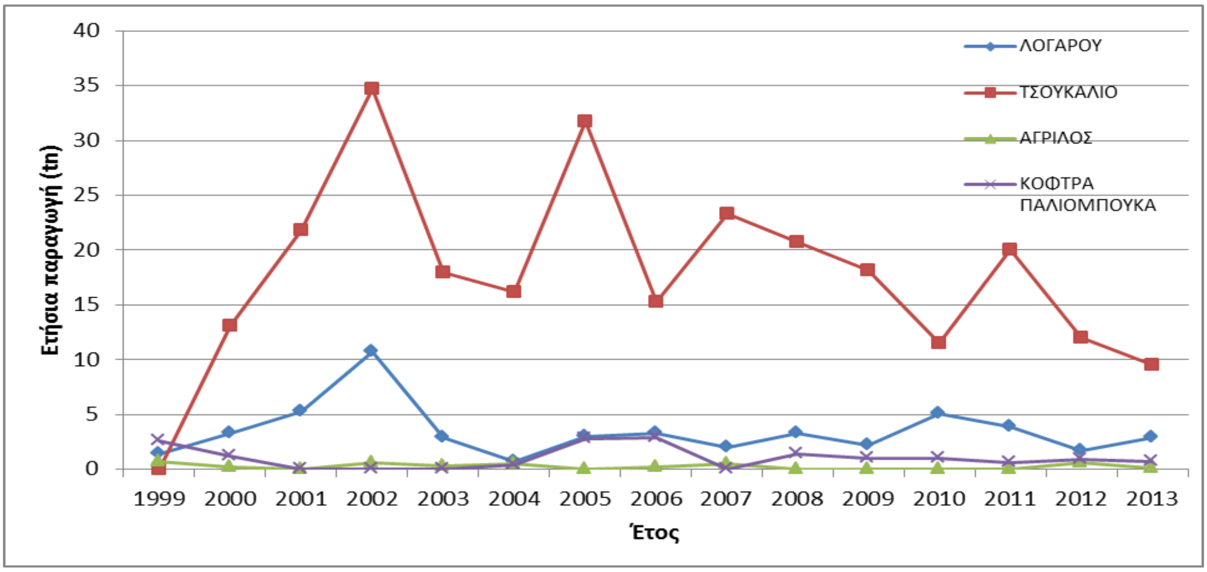


Figure 3.9. Annual eel landings (t) in the lagoons of Arta region for the time period 1999–2013.

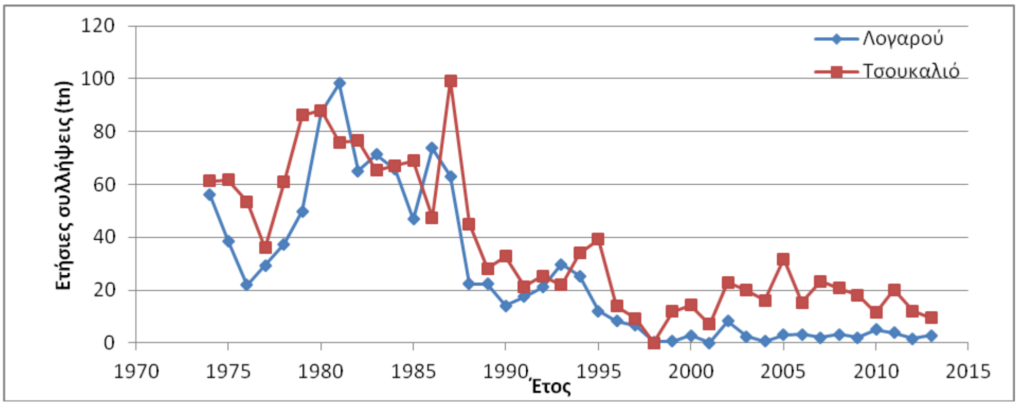


Figure 3.10. Annual eel landings in the two lagoons (Logarou, Tsoukalio) of Arta Region for the time period 1999–2013.

In Figure 3.9 and Figure 3.10 the annual eel catches in the region of Arta, are presented. As it can be observed the highest decrease in eel landings was recorded in the late 1990s. From 1990 and onward the annual landings remained in low levels, as the annual landings was less than 40 t/year).

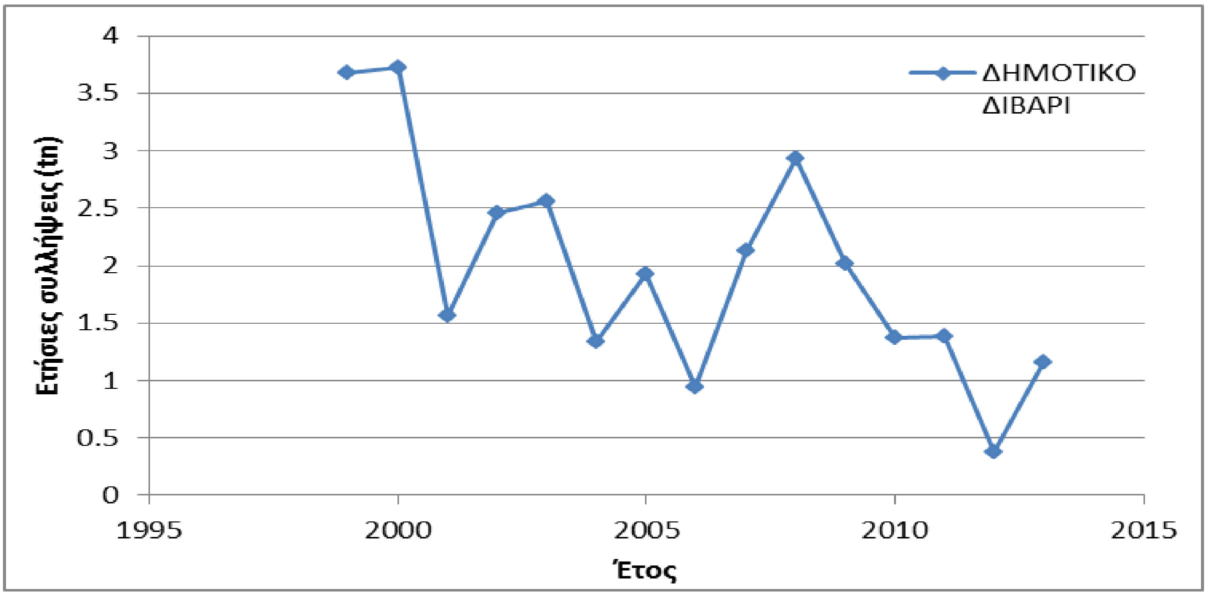


Figure 3.11. Annual eel landings in the Municipal fish-pen of Lefkada Island for the time period 1995–2015.

In Figure 3.11 the annual eel landings in the lagoon of Dimotiko-Divari in Lefkada, for the period 1995–2013 are presented. As it can be observed there is a downward trend during the last twenty years.

In Figure 3.12 the annual catches of the fishing pens in the Region of Preveza for the period 2002–2013 are presented. The annual eel landings for the aforementioned period remains in very low levels, less than 4 t/y.

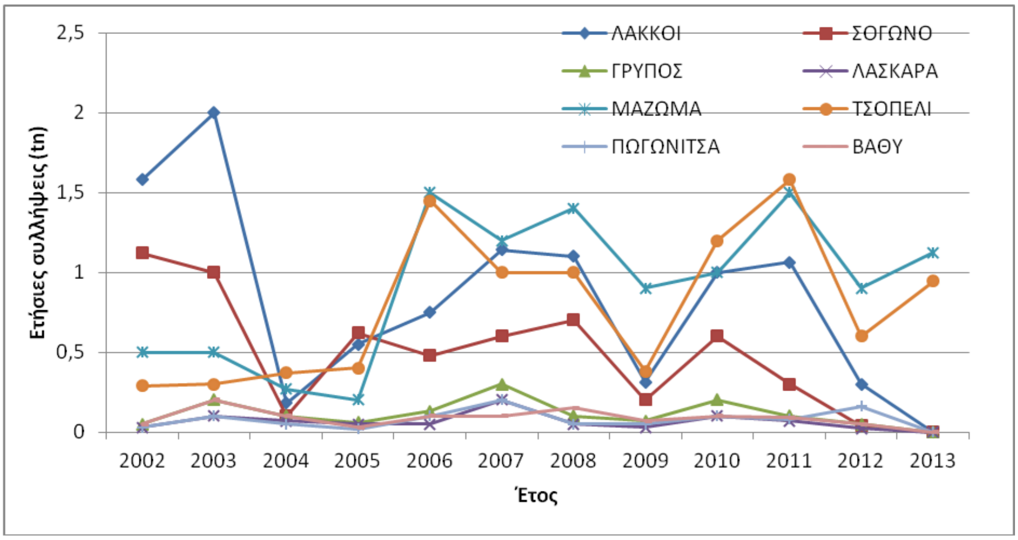


Figure 3.12. Annual eel landings (t) of the fish-pens in Preveza region for the time period 2002–2013.

Existing information concerning adult eels from the area of Loutsa-Papadia in the Regional Authority of Thesprotia, are given in Figure 3.13. According to unconfirmed information, during the period 1980–1986, there was a significant decrease in the eel stocks from the Regions of Recho, Vatatsa and Kalagka. Moreover, according to the data collected from the Fisheries Department of Thesprotia, the fishing pens in the region have collected very small quantities of eels during the period 2010–2013.

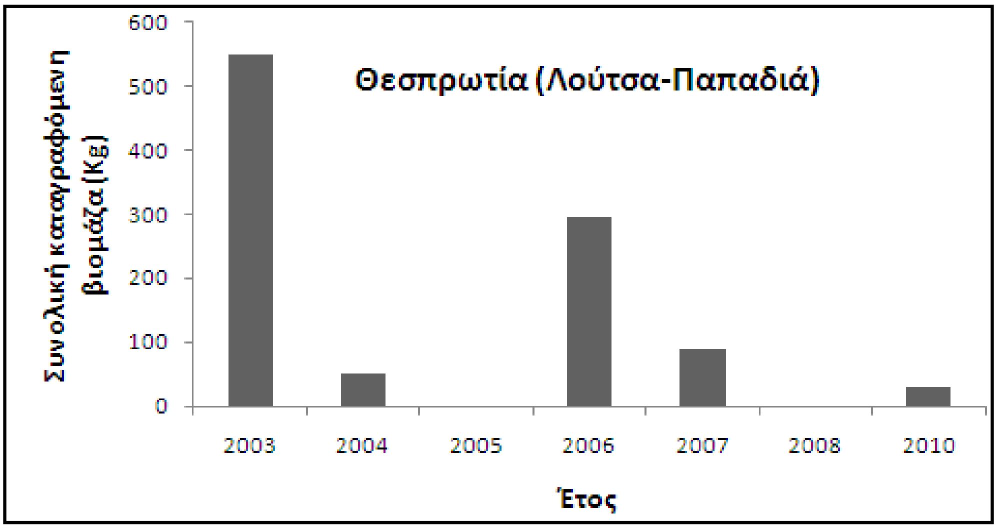


Figure 3.13. Annual eel landings (kg) in Thesprotia Perfecture for the time period 2003–2010.

As for Lake Pamvotis, in Ioannina, it is a unique case concerning its eel fishing management. According to Leonardos *et al.* (2008), eel is one of the four fish species mentioned in historical data Pamvotis. Eels migrated to the lake from the sea through Kalamas River and the ditches that were connected to the lake Pamvotis. However, Lake Lapsistas was drained and the construction of the Gitani dam, along with the degradation of water quality of Lake Pamvotis have contributed to the significant reduction and probably the extinction of eel from the basin of Lake Pamvotiss. Today the eel landings in Lake Pamvotis is supported by annual restockings.

3.3.1.3 Western Peloponese (EMU-2)

The main output of the EMU-2 comes from lagoons Prokopos and Papas from the Regional unit of Achaia and the lagoon Kotychi of the Regional unit of Ilia. The lagoons of Messinia shows very limited quantities. The following graph shows the evolution of eel landings in EMU-2 (Figure 3.14.). From these data it appears that from 2002 onwards there has been a diversification in the landings in the lagoons of Ilia to representing nearly the entire output of the Unit Management. The downward trend in the landings of Achaia from 2001 it now appears at the last five years and in lagoon Kotychi. The total landings of the diagram includes and the landings from Messinia for the period 1999–2008 but is annually less than 1 t. As mentioned in the case of Messolonghi (EMU-1) in recent years severe weather during at the main period of migration and the eels arrests cause damage to the shoreline and barriel fish traps facilities so we have significant leaks and reduce in the fish landings such as in 2010.

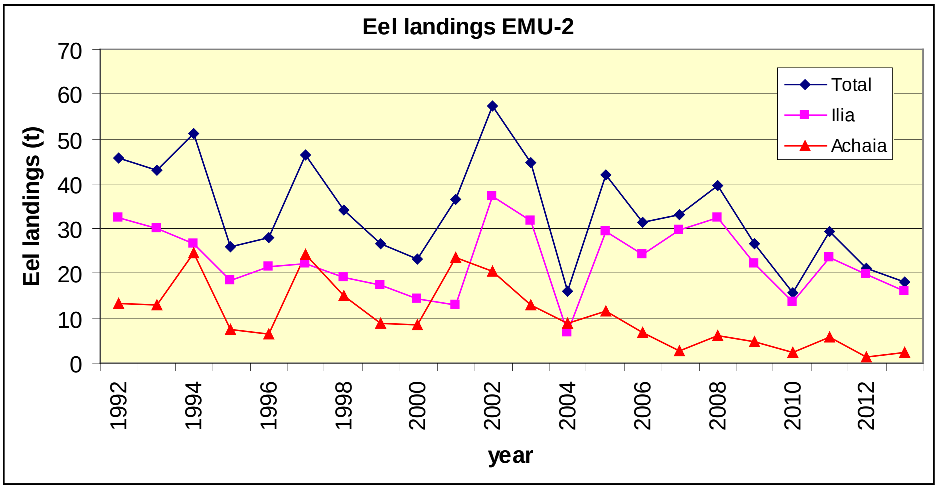


Figure 3.14. Adult eel catches (t) in Achaia and Ilia Perfectures for the time period 1992–2013.

3.3.1.4 Rest of Greece (EMU-4)

As it was mentioned in Chapter 2.2, EMU-04 covers the rest of the country, mainly the central eastern continental Greece and the islands of the Aegean Sea. Very few lagoons are located in this EMU, which are not exploited and the total landings, not only for eels, are almost zero. Moreover, the eel consumption in these areas is not very popular and for this reason there is not any record of recreational fishing in EMU-4.

3.3.2 Recreational

No quantitative data on recreational fishing for eels in Greece are available. Recreational fishing for eels was local activity mainly in West Greece. Recreational fishing was most common in lakes and coastal lagoons, but there is no information on the level of catch. The estimates presented for the Eel Management Plan indicated that the eel recreational catches ranged between 3% and 5% of total catch in the period 1980–2010.

Since 2012 when the Greek Eel Management Plan started to be implemented, as defined by Law 643/39462/2013 of the Minister of Rural Development and Food there is an absolute prohibition of recreational eel fisheries, throughout the year all over the country.

3.4 Aquaculture landings

3.4.1 Seed supply

The price per kilo varies each year and depending on the demand and the quantities may be disposed of. According to data gathered by the CITES office in Greece, the authorizations granted for eel imports in 2013 were seven for a total of 1.342 kg (Table 3.1).

Table 3.1. Total glass eels imports (kg) in Greece for the year 2013.

A/A	License number	Quantities (kg)	Species sampling	Export country	Country of origin
1	1050/86/10-01-2013	30	Alive (glasseel)	United Kingtom	France
2	2612/203/17-01-2013	230	Alive (glasseel)	United Kingtom	France
3	4247/347/28-01-2013	400	Alive (glasseel)	United Kingtom	France
4	5436/447/31-01-2013	132	Alive (glasseel)	United Kingtom	France
5	7770/625/11-02-2013	100	Alive (glasseel)	United Kingtom	France
6	21675/1686/18-4-2013	200	Alive (glasseel)	United Kingtom	France
7	28264/2264/23-5-2013	250	Alive (glasseel)	United Kingtom	France
Total quantity		1342			

3.4 Stocking

3.4.1 Amount stocked

In the past some scarce, empirical and small-scale attempts were undertaken with the aim of improving local fisheries. Glass eel stocking was performed in the lake Pamvotis (EMU-1) and the Kalama's delta (EMU-1), while young reared eels were introduced in the lake Pamvotis and at the estuaries of W. Greece rivers (Economidis, 1991 and Economidis *et al.*, 2000). There is no information concerning the number of eels or their characteristics, and no data exist about the results of these experiments. Then in 2010 and 2012 two more stockings have taken place in Messolonghi-Aitoliko lagoons (EMU 1) and in River Acherondas (EMU 1) according to the protocol suggested by the HEMP.

In 2013, eel stocking was performed in River Acherondas (EMU 1), with eels provided by a private company in Epirus. The agency responsible for the eel releases in 2013 was the Regional Fisheries Authorities of Epirus-western Macedonia. According to a decision (ΑΔΑ: ΒΛ10ΟΡ1Γ N02) in 2013, they have proceeded to the release of 10% of glass eels, imported by the aquaculture units in Epirus.

Table 3.2 and Figure 3.15 presents the annual releases of eels in Lake Pamvotis for the years 2005 to 2013. During the last years, it is custom to release, eels in Lake Pamvotis. The eels that were released derived from aquacultures units in Epirus. However, there is no information for the fate of these eels, since only small amounts were captured by fishermen. A very small number of fishermen have the appropriate fishing gears for catching eels. It is considered that the majority of eels are escaping through ditches during the winter or killed during anoxic events during the summer season. However, as the local fishery service estimates (without having any records or fisheries statements), annually 5–10 tones, averaged 7.5 tones, are captured.

Table 3.2. Annual eel releases in Lake Pamvotis per year and number individuals.

Year	Number of individuals	Origin
2005	60.000	Helpa, Psathotopi, Arta
2006	20.000	Helpa, Psathotopi, Arta
2007	18.640	Preveza
2008	11.000	Preveza
2009	18.320	Preveza
2010	113.500	Mornos, Preveza
2011		
2012	14.500	Preveza
2013	10000	Preveza

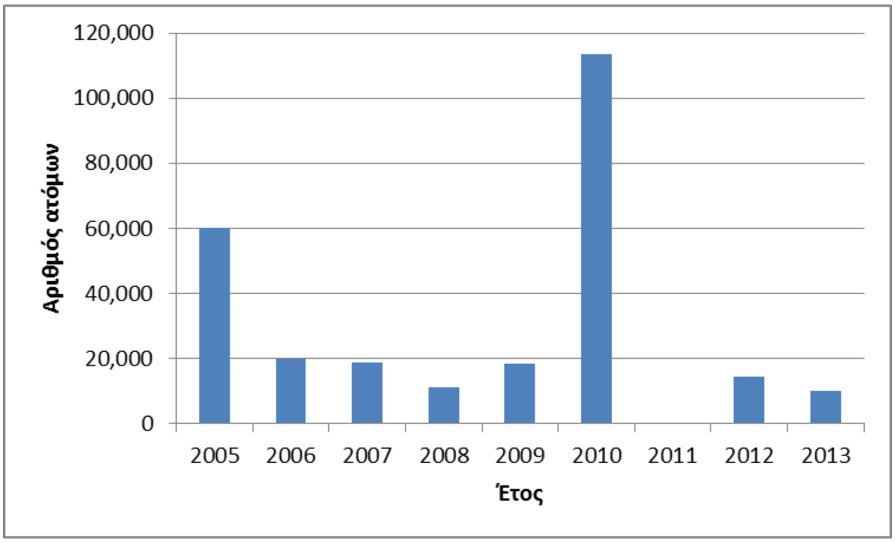


Figure 3.15. Annual eel releases (number of specimens) in Lake Pamvotis.

3.5.2 Catch of eel <12 cm and proportion retained for restocking

RD/142/1971clearly mentions that both fishing and the commercial exploitation of eels smaller than 30 cm, is entirely prohibited. Therefore there is no glass eel and young yellow eel fishing in Greece and it is not necessary to ensure price control, as provided by Article 7 (5) of Regulation No 1100/2007. Fishing activities targeting individuals smaller than 30 cm are allowed by special authorization only for restocking purposes (RD/142, Article 1/1971).

In Subchapter 3.5.1, in Table 3.2 and Figure 3.17 the annual releases of eels in Lake Pamvotis for the years 2005 to 2013 (EMU-1) are presented.

Then in 2010 and 2012 were done two further enhancements in Messolonghi lagoons-Aitoliko (EMU 1) and in the River Acheronda (EMU 1) according to the protocol suggested by the HEMP.

3.5.3 Reconstructed time-series on stocking

The only available data on restocking are from Lake Pamvotis in Ioannina, western Greece (Table 3.3). Unfortunately, there is no other data on eel restocking for the rest of Greece.

Table 3.3. Stocking of cultured and wild eel in country since 1984.

	Local Source					Foreign Source				
Year	Glass eel (n)	Quarantined Glass (n)	Wild Yellow (n)	On-grown cultured (n)	Total	Glass eel (n)	Quarantined Glass (n)	Wild Yellow (n)	On-grown cultured (n)	Total GEE (n)
2005				60,000	60,000					
2006				20,000	20,000					
2007				18,640	18,640					
2008				11,000	11,000					
2009				18,320	18,320					
2010				113,500	113,500					
2011										
2012				14,500	14,500					
2013				10,000	10,000					

AIM: track the quantity and sizes of eels being stocked in order to assess the biomass (and mortality rates) derived from stocked eel.

NOTES:

- Local Source: The source of the stocked eels is local;
- Foreign Source: Eels come from another country;
- Split the stocked eels into the stages in the column headings, do not add anymore;
- Please, translate the number of Wild Yellow and on-grown cultured into GEE (Glass Eel Equivalents). If you are not able to do that, you must provide average size of stocked eels; and in case you have it, mortality rates and growth and/or age in order to make the transformation to GEE.

3.6 Trade in eel

Eel aquaculture in Greece has been developed from the late 1980 (Figure 3.16.). Aquaculture landings data, which are provided by the Ministry of Rural Development and Food, have shown that until 1997 the mean landings reached 166 tons (123.9 SD), whereas afterwards there was a three-fold increase (mean landings 538 tons, 109.6 SD). The market size is larger than 130 g (up to 220 g), however it is variable, in accordance with market demands. Hellenic farmers are supplied glass eels or elvers mainly from the Great Britain and/or France. During the period from 2002 to 2007 an approximate number of 17×10^6 elver individuals has been imported to the Greek eel farming (source: MRDF).

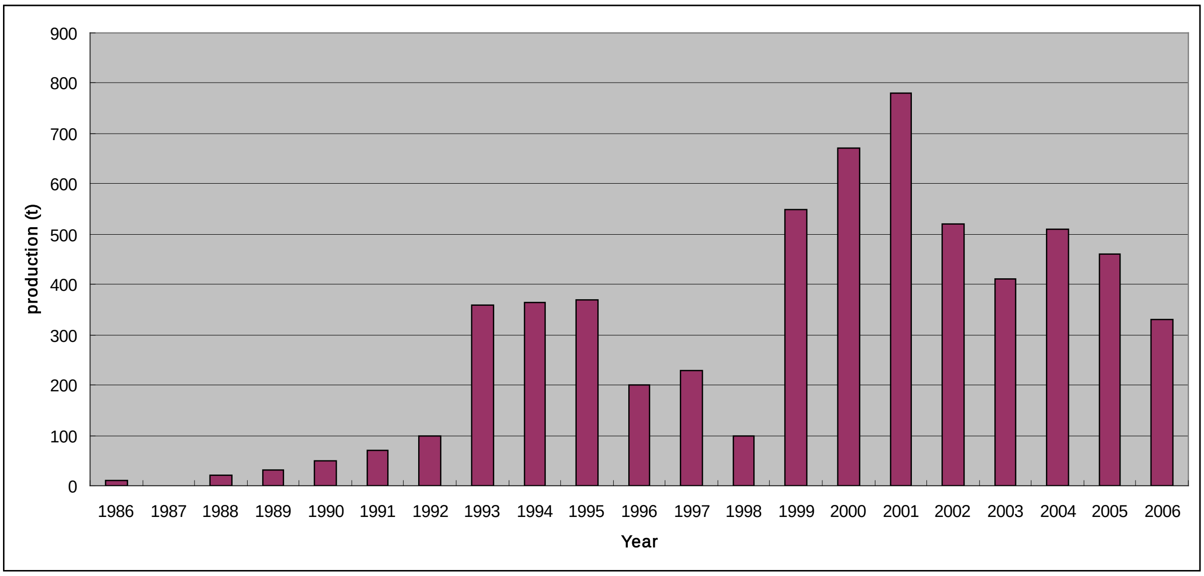


Figure 3.16. Landings of eels in aquaculture units in Greece for the time period 1986–2006.

Licences for exports of eel from Greece in 2013, according to data gathered from the CITES office in Greece was 14 and the total quantities for which licenses were authorized to export live eels were 399 400 kg. The total number of permits was for export eels in Italy (Table 3.4).

Table 3.4. Exported batches of European eels from Greece for the year 2013.

A/A	License number	Quantity (kg)	Species sampling	Export country	Country of origin
1	4251/350/28-01-2013	170.000	Alive	Italy	E.U.
2	18174/1346/8-4-2013	10.000	Alive	Italy	E.U.
3	72448/6122	150.000	Alive	Italy	E.U.
4	75666/6401	20.000	Alive	Italy	E.U.
5	75988/6414	30.000	Alive	Italy	E.U.
6	79717/6757	4.050	Alive	Italy	E.U.
7	79719/6758	4.500	Alive	Italy	E.U.
8	80707/6825	460	Alive	Italy	E.U.
9	73785/6241	420	Alive	Italy	E.U.
10	81097/6843	3.370	Alive	Italy	E.U.
11	81348/6860	1.900	Alive	Italy	E.U.
12	82138/6935	1.500	Alive	Italy	E.U.
13	159177/8747	2.500	Alive	Italy	E.U.
14	95108	700	Alive	Italy	E.U.
	Total quantity	399.400			

According to the data, which were collected from the local fisheries authorities, and visits to landings units, was found to be a significant activity of fattening of eels in Epirus. This can be attributed to the significant water potential of the region and the fact that he has developed considerable expertise. Figure 3.16 shows the annual landings of the culture units in the region of Arta.

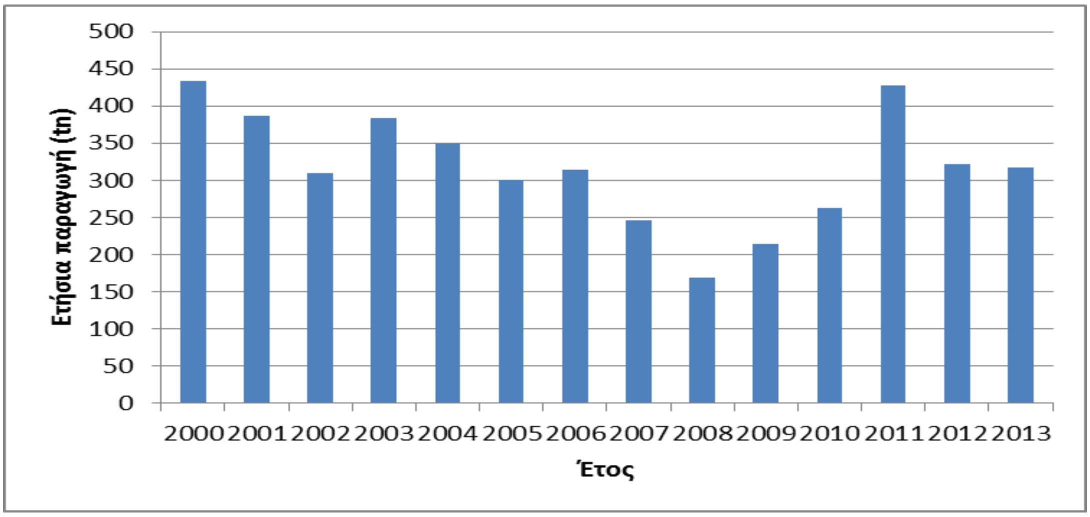


Figure 3.17. Annual eel landings (t) of eel-aquacultures in Arta region for the time period 2000–2013.

The total landings from the aquaculture units in region of Arta for the period of 2000 to 2013 ranged to 4432.3 t with a maximum annual landings of 433 t (2000) and with a minimum annual landings of 168,5 t (2008).

In Preveza Prefecture, according to the data of the local authority, operates an aquaculture unit which has started its activity in 2006 and continues until today. The capacity is 120 tons per year. The landings is rising in recent years, however, has not reached yet its capacity.

4 Fishing capacity

4.1 Glass eel

ND.

4.2 Yellow eel

ND.

4.3 Silver eel

The Hellenic lagoons are generally owned by the Hellenic State. However, most of the lagoons are managed by the local regional authorities. A few of them are owned and exploited by the Ministries of Development and Economics, and some others by local municipalities. In any case, economic exploitation usually happens by leasing of the lagoon or parts of it for a certain period of time (in most cases ten years). Organisations that are interested in renting lagoons are usually local professional fishermen's cooperatives, but sometimes private companies are also interested. Priority is given to local fishermen in order for them to have a more secure income and to create new job opportunities. Moreover, it was found that lagoons exploited by fishermen's cooperatives are in a better state than those leased to private companies and that fisheries' exploitation can also help ecosystem' conservation (Koutrakis, 2005).

Since management of these lagoons is almost the same every year, it is considered that the fishing capacity is the same for these years.

The lagoons of northern Greece and the Amvrakikos Gulf are all managed locally and are leased to local fishermen's cooperatives, which therefore, have the sole right to exploit the lagoon's fish. The lagoons in EMU 3 (northern Greece; Evros, Porto Lagos-Vistonis, Rodopi and Nestos complexes) support approximately 300 fishermen. Regarding the EMU 1, the Amvrakikos Gulf Lagoon complex supports approximately 450 fishermen (Table 4.1; Figure 4.1), whereas in the Messolonghi-Aitolikon Lagoon complex the situation is somewhat different. The peripheral lagoons are all leased as a whole to local fishermen's cooperatives, as is the case in the abovementioned lagoon complexes, but in the central part it is actually the entrapment installations that are leased and not the lagoons itself. As a result, the central lagoons are also open to exploitation by individual fishermen not belonging to any professional cooperation. Furthermore, the entrapment installations are usually leased directly for a period of one year only. For these reasons, management of the Messolonghi-Aitolikon Lagoon complex is mainly concentrated on maintaining the existing entrapment installations and external fences and management practices such as creation of winter channels and release of hatchery-born fingerlings are not systematically performed. On the whole, the Mesolongi-Aitolikon Lagoon complex supports approximately 60 fishermen belonging to professional cooperatives, as well as an additional 600 individual fishermen.

Table 4.1. Number of fishermen per Perfecture.

Perfecture	Area (ha)	Number of Fishermen
East Macedonia & Thrace	8286	218
Αττikis	188	1
West Greece	12 845	188
Ipirou	9408	367
Thessalias	36	1
Ionian Islands	6500	16
Central Macedonia	30	24
Peloponisou	595	4
Evias	120	1
Total	**38 027**	**821**

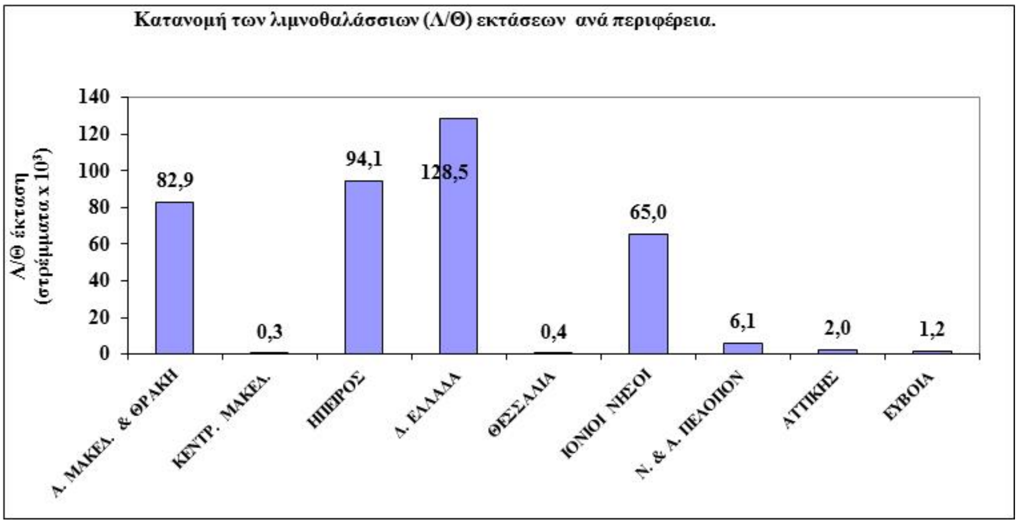


Figure 4.1. Total lagoons area (ha x10) per region (76 lagoons) (see also Table 4.1).

Figure 4.2. Permanent fish entrapment devices, which catch live fish as they move seawards (Vassova and Erateino Lagoons, Nestos Delta). The arrow shows the direction of fish movement (*Source: E.T. Koutrakis*).

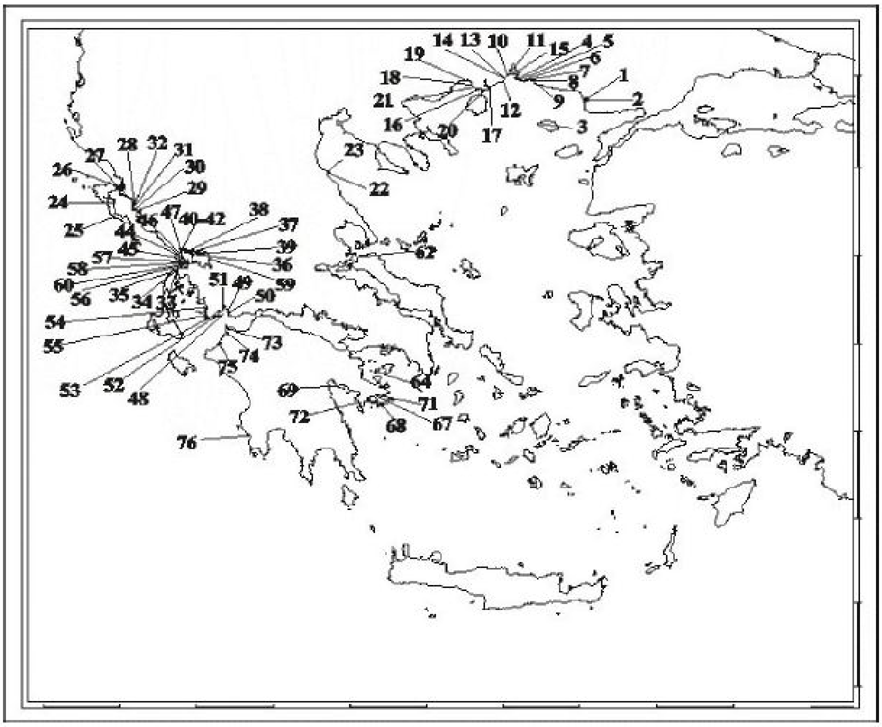


Figure 4.3. Geographical distribution of the Greek lagoons (76) were the main eel catches come from.

Eel fishing is usually performed with traditional barrier fish traps, consisted of permanent entrapment devices, like the Italian "valicultura" capture systems (Figure 4.2. see also Chapter 2.3) designed to catch the eels alive during their migration period to the sea for reproduction which takes place from September to January every year. The fishing cooperatives usually have adequate infrastructures to store the eels alive up to their sale (most of the eels are exported to other European countries, such as Italy and Germany). The total landings of eels must be reported to the local authorities every month, along with the fish catches of the other species that are caught. However the lagoons where eels are caught are currently considered as extensive aquaculture areas, thus their catches could be misleadingly considered as aquaculture products. Moreover as regards DCF, it is required exhaustive recording only of commercial marine fisheries, thus the eel fisheries that are inland fisheries in Greece are not recorded.

4.4 Marine fishery

ND.

5 Fishing effort

5.1 Glass eel

ND.

5.2 Yellow eel

ND.

5.3 Silver eel

The fishing methodology includes mostly fixed fishing installation in the lagoons; thus fishing effort is considered fixed during the years, changing only by the number of lagoons, where fishing is applied. Due to the specific fishing methodology, the fishing capacity is equal to fishing effort, since it is a passive fishing device and the fishing effort is not affected by any other factor such as fuel consumption.

5.4 Marine fishery

ND.

6 Catches and landings (2013)

6.1 Glass eel

ND.

There are very few eel aquaculture units in Greece, as eel consumption is very limited. The majority of the landings is exported to other European countries or is used for enrichments. The glass eels used by the farms are mostly imported from the United Kingdom and smaller quantities from France.

6.2 Yellow eel

ND.

6.3 Silver eel

As presented in the paragraph regarding the fishing effort, the vast majority of the catches come from the lagoons with the use of fixed barrier fish traps. It is important to point out the way in which eels are fished and marketed. Eel are fished continuously during their main migration period (November–January) in small daily quantities, and in large quantities when certain meteorological conditions (storms, heavy rain) occur. The eels are kept alive in special cages until sufficient quantities are gathered, and then are sold and usually exported alive to countries in Western Europe. Thus there are no available data of the daily landings, since the landings are recorded every ten to 20 days.

Landings from western Greece (EMU-1: Messolonghi-Aitoliko's, Amvrakiko's, Preveza's and Lefkada's Lagoons) recorded in 2013 were calculated to be in total 25.2 t.

Eel landings of Western Peloponnese (EMU-2: Ilia's and Achaia's Lagoons) recorded in 2013 were calculated to be in total 18.25 t.

Finally the total landings recorded in 2013 in the Region of East Macedonia and Thrace (EMU-3: Lake Vistonida and River's Evros delta) was 1.38 t.

The total eel landings of Greece for 2013 (EMU-1, EMU-2 and EMU-3) was 44.83 t.

6.3.1 East Macedonia & Thrace– EMU-3

For the year 2013, the quantities of eels declared to the Fisheries Authorities of the regional administration were almost zero, with the exception of the landings of Lake Vistonida and Evros Delta. Total eel landings in the prefecture of Eastern Macedonia and Thrace was 1.38 t (Table 3.1) The Lake Vistonida' cooperative of declared 1.27 t of eels in 2013, 2.45 t of eels in 2012, a quantity similar to the one declared in 2011 (Figure 6.1.) which amounts to 1.2% of the total landings of the cooperative while According to the monthly catches of eels of the Fishing Cooperative of Ebro's Delta (Regional Department of Evros) in 2013, 0.113 t of eels were caught. (Figure 6.2).

As regards to the other cooperatives, the cooperatives of the prefecture of Rhodopi (namely that of Fanari and that of Maronia for the year 2013 declared the catch of three specimens, weighting a total of 1.44 k. (Maronia lagoon).

Also the eel landings of the Cooperative of River Nestos Delta for the year 2013, according to the data declared, was zero.

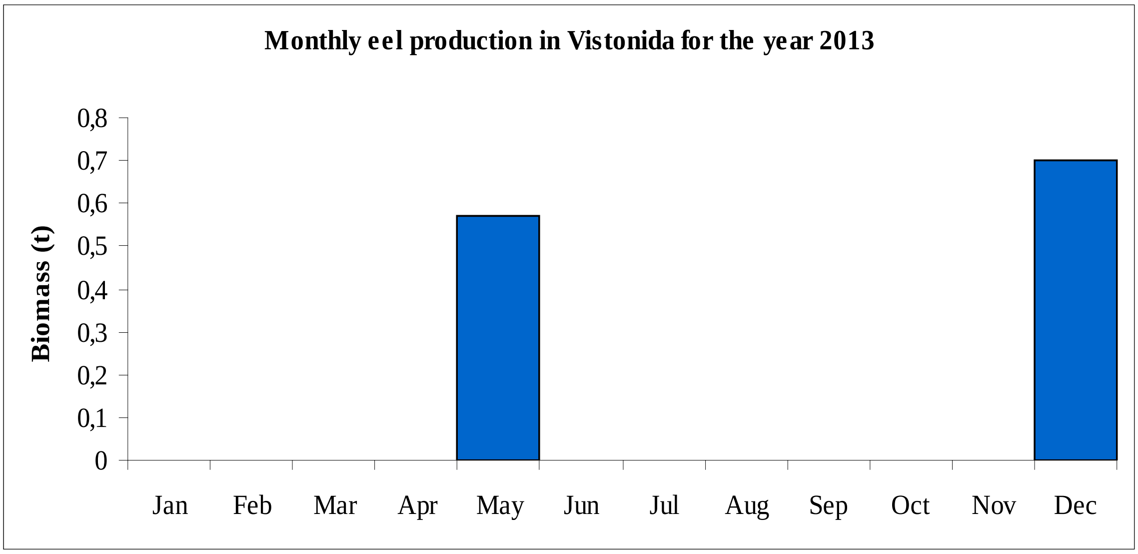


Figure 6.1. Monthly eel landings in Vistonida Lake for 2013.

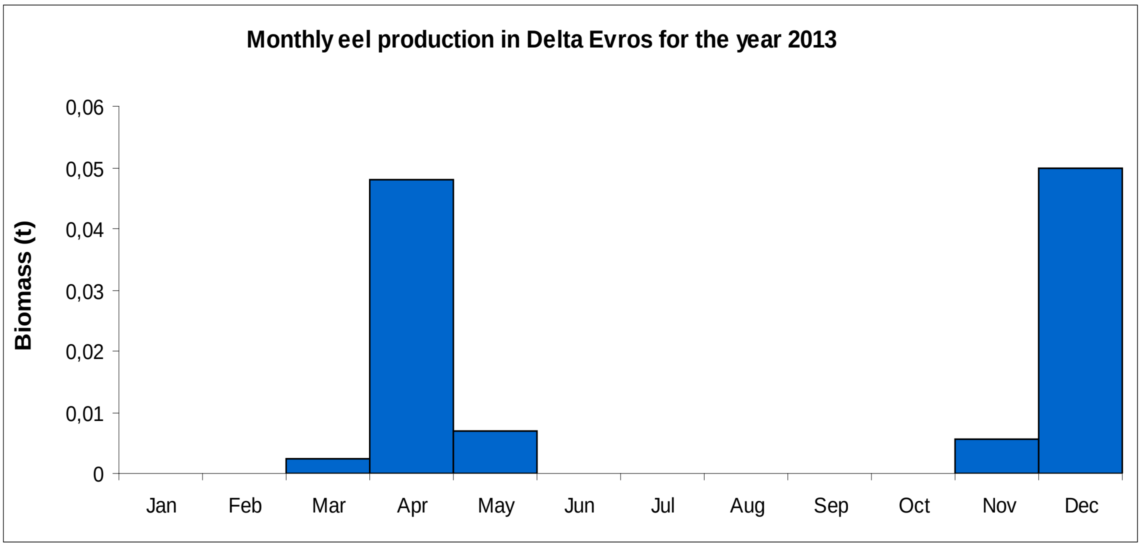


Figure 6.2. Monthly eel landings in the fishing market of Alexandroupolis (Regional Authority of Evros) for 2013.

6.3.2 Western Greece–EMU 1

6.3.2.1 Messolonghi–Aitoliko Lagoons

The recorded 2013 eel catches in the Messolonghi-Aitoliko lagoons were 11 341 kg catch. In this amount contained 3.143 kg released at sea in January–February 2013 and 658 kg released in December 2013 during the main fishing season. Both the timing and the quantities of the catches are site-specific.

Making reference to the calendar year then the amount of eel released represents 33% of the catches (Figure 6.3.). In addition to the actions referred by the management plan for eel conservation, must be also referred that lagoon Eastern Kleisova was not leased for the year 2013 and the removal of all installations of fish traps at the Dimikou Chanel (Trichonis - Lysimachia - Acheloos system).

The landings of 2013 can be partitioned to January (1392 kg), February (1751 kg) and December (8198 kg).

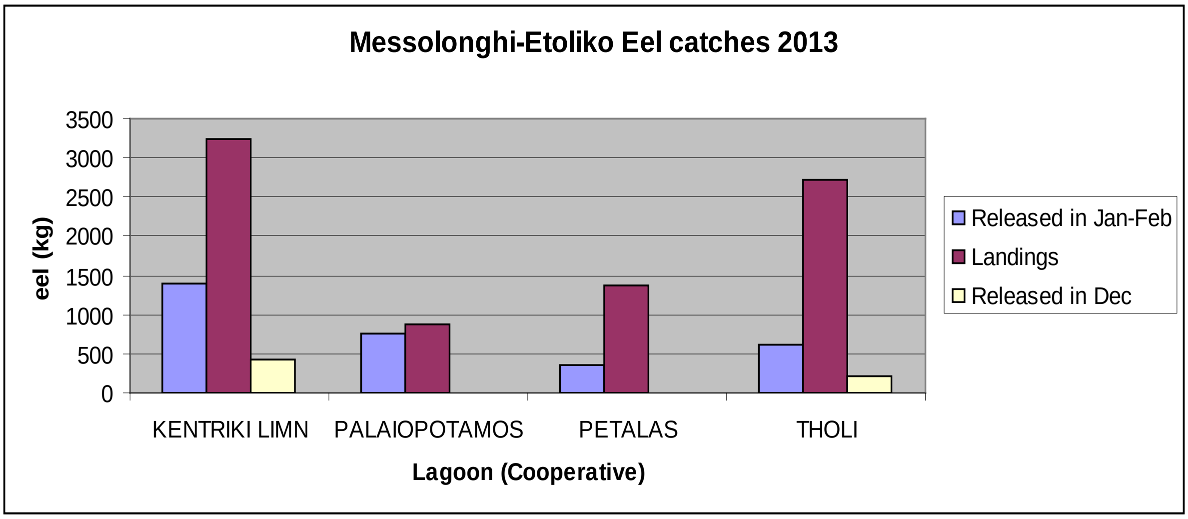


Figure 6.3. Total amount (kg) of eel landings and released adult specimen per lagoon in Messologi-Aitoliko lagoons complex for the year 2013.

6.3.2.2 Lagoons of Amvrakikos, Preveza and Lefkada

The total landings of the Preveza region for the year 2013 was 700 kg. The landings of the pens of Arta region in 2012 was 15 290 kg, while for the year 2013 amounted to 13 287 kg. The catches are only dated in the months November and December.

6.3.3 Western Peloponnese- EMU-2

6.3.3.1 Achaia and Ilia lagoons

Landings recordings in Kotychi (Ilia) for the year 2013 indicated total catches of 16 000 kg of eels. This amount contained 4800 kg released at sea on 12/12/2013. The total catches took place in December. The corresponding amounts of year 2012 were 19 907 kg and 5972 kg of catches and releases respectively. Landings recordings in Prokopos and Papas lagoons (Achaia) for the year 2013 indicated total catches of 2010 kg of eels, including the 240 kg released at sea. The total catches took place in December. The corresponding amounts of year 2012 were 1055 kg and 305 kg of catches and releases respectively.

6.4 Marine fishery

6.5 Recreational fishery

Recreational Fisheries: Retained and Released Catches

	Retained				Released			
	Inland		Marine		Inland		Marine	
Year	Angling	Passive Gears	Angling	Passive gears	Angling	Passive gears	Angling	Passive gears

Provide the catch and release mortality (%) used in your country for angling in marine and inland waters.

Recreational Fisheries: Catch and Release Mortality

	RELEASED			
	Inland		Marine	
	Angling	Passive gears	Angling	Passive gears
Year				

6.6 Bycatch, underreporting, illegal activities

Table 6-x. Estimation of underreported catches in Country, per EMU and Stage.

		Glass eel				Yellow eel				Silver Eel				Combined (Y + S)			
Year	**EMU_code**	**Reported catches (kg)**	**Underrept. %**	**Underrept. (kg)**	**Total catches (kg)**	**Reported catches (kg)**	**Underrept. %**	**Underrept. (kg)**	**Total catches (kg)**	**Reported catches (kg)**	**Underrept. %**	**Underrept. (kg)**	**Total catches (kg)**	**Reported catches (kg)**	**Underrept. %**	**Underrept. (kg)**	**Total catches (kg)**
2013	EMU_a																
	EMU_b																
	EMU_c																
	EMU_d																
	EMU_e																
	EMU_f																
	Total/mean (%)																

AIM: Determine the % of the underreporting and the total catches of the Country per stage.

NOTE: Please indicate in the text whether the percentage underreported catch is a direct measurement or a guess using the estimate to calculate the underreported kgs and Total catches.

Table 6-y. Existence of illegal activities, its causes and the seizures quantity they have caused.

		GLASS EEL			YELLOW EEL			SILVER EEL			COMBINED (Y +S)		
Year	EMU	Y/N/?	Cause	Seizures (kg)	Y/N/?	Seizures (kg)	Cause	Y/N/?	Seizures (kg)	Cause	Y/N/?	Seizures (kg)	Cause
2013	EMU_a												
	EMU_b												
	EMU_c												
	EMU_d												
	EMU_e												
	EMU_f												

AIM: Identify the illegal fishing activities and in case it is possible its causes and the seized kgs in case they were seizures.

NOTES:

- Y/N/?:

- Y: you know for sure they have been illegal activities;
- N: illegal activities are considered negligible / not significant;
- ?: You do not know whether they have been illegal activities or not.

- Cause: One of the followings:

- Fishing out of the season;
- Fishing without licence;
- Fishing using illegal gears;
- Retention of eel below or above any size limit;
- Illegal selling of catches.

7 Catch per unit of effort

7.1 Glass eel

NP.

7.2 Yellow eel

NP.

7.3 Silver eel

Due to the passive fishing gear used for eel fishing (permanent installed fishing traps), the cpue is believed to be constant every year.

7.4 Marine fishery

NP.

8 Other anthropogenic and environmental impacts

8.1 Dams

The movement of several fish species living in the Nestos river ecosystem, including eel, is limited by the presence of many barriers. One example is the irrigation dam of Toxotes, about 17 km from the river estuary, and also the two hydroelectric plants of the Public Electricity Company.

The irrigation dam of Toxotes was constructed during the period 1960–1966. It is a spillway dam made of concrete with a total length of 280 m, and spillway length of about 240 m. Its height is 4.0 m which allows overflooding of Q = 3000 m^3/s, with an overflooding height of H = 2.95 m (data from Paraskevopoulos and Georgiadis, 2001).

The hydroelectric dam of Platanovrisi came into operation in 1999. It is located at an altitude of 230.5 m above sea level, while the height difference created by the dam is 95 m (dam height). The artificial lake created covers a total area of 3.25 km^2. Energy productivity of the units can reach about 248 GWh.

The hydroelectric dam of Thisavros came into operation in 1997. It is located at an altitude of 390 m above sea level, while the height difference created by the dam is 175 m (dam height). The artificial lake created covers a total area of 18 km^2. Energy productivity of the units can reach about 426 GWh.

Based on the above, the probability of a fish overcoming the obstacles during the downstream migration is determined by its ability to overcome, bypass or cross an obstacle as well as from the impacts that this would have to its physiology (health) and its survival. The probability of successful surpassing is therefore the product of the two probabilities (probability of overcoming the obstacle x probability of survival). For downstream migration, a crucial factor is the mortality of the fish caused by their passage through obstacles (Lelievre and Steinbach, 2008). Unfortunately in Greece there are no data or studies on the subject of the mortality (natural or anthropogenic) of eels.

There are also no data or studies regarding the abundance evaluation of the species on specific ecosystems. The GMPE realizes this absence, and thus bases the whole quantification approach on indices deriving from fishing landings. The only available reports are reports of presence-absence and their validity (especially for absence) is limited.

Consequently the assessment of the barriers will inevitably be based on the physical and technical characteristics in relation to the ecology of the species.

According to Larinier *et al.* (2006) successful escapement rates of eels display heterogeneity depending on the barriers, as not every eel can pass through the turbines of a dam. Also the rate of escapement depends on the presence of facilitation equipment, and on the hydrological conditions prevailing at the time of the migration.

So according to international experience, accessibility through a barrier, and also its impact to eel population depends on:

- The height of the barrier (higher barriers decrease the possibility of successful upstream or downstream migration, and/or increase mortality during transit.
- The distance from the sea (eel abundance decreases further from the coastal zone).
- Altitude (we have higher abundances in lowland areas with an altitude lower than 200 m since there we have lower flows, wider riverbeds, higher temperatures and milder flow fluctuations)
- Last but not least, a crucial factor for the evaluation of barriers is their relative position. The probability of successful surpassing of a series of consecutive barriers is the product of the successful surpassing of each one of them. Both in downstream and upstream migration, the last and the first barriers (towards the sea) are the most important, at least with regards to taking measures for the improvement of fish accessibility through barriers.

The criteria for barrier assessment and evaluation should follow the main objective of the regulation 1100/2007. The regulation aims to increase the numbers of genetically mature eels (silver eels) that migrate to the sea to reproduce and complete their life cycle. The successful downstream migration is therefore a priority. Since the 1970s, many acts in Europe and America have intended to enhance eel populations in inland waters through technical interventions and enrichments. Their main aim was the enrichment of local stock to support fisheries, while their successful migration to the sea during adulthood only concerned researchers to a lesser extent. But nowadays, given the alarming state of eel stocks, migration for reproduction is the main objective. Thus, any evaluation of barriers and ecosystems must be done under this consideration.

The peculiarities of Greek ecosystems lead to the construction of projects "insurmountable" for eels, and renders technical approaches for improving the accessibility through barriers difficult, highly expensive and of doubtful results. Interventions in lowland ecosystems near the estuaries will be significantly more effective, as suggested in the Greek Management Plan for the Eel.

9 Scientific surveys of the stock

No surveys have taken place in Greece regarding fish stock (length and age distribution, abundance, etc.).

10 Data collected for the DCF

Provide summary information on the monitoring of eel by EMU in the current year.

In total 499 specimens of *A. anguilla* were collected form the three EMUs. The specimens were sexed and examined for parasites, while otoliths were removed and kept for the age determination. More specific 225 samples have been collected in EMU 1, 76 from EMU 2 and 198 samples from EMU 3.

Table 10-1. Summary of the DCF monitoring implementation per EMU.

Data	River	Lakes	Estuaries	Lagoons	Coastal & Marine
No. of landings/ escapement surveys[1]					
No. of recruitment time-series surveys[2]					
No. fished aged		198	225	76	
No. of fished sexed		60	225	77	
No. of fish examined for parasites		103	201	77	
No. of fish examined for contaminants					
No. of non-fishery mortality studies[3]					
Socio-economic survey					

[1] Surveys to estimate B_{best} and/or $B_{current}$ [These should include WFD surveys where the data are being used to estimate landings and/or escapement of eel].

[2] Fishery-independent surveys.

[3] Studies to determine ∑H for non-fisheries anthropogenic impacts, such as hydropower, barriers, predation, etc.

10.1 Length–frequency distribution

Eels caught in Northern Greece have higher average length than eels caught in other parts of Greece. Moreover, eels caught in Lake Vistonida are longer than those of all the other areas (Table 10.1). The dominated size classes of the specimens was 85–90 cm, while the maximum length of the samples was 100.4 cm, the average length was 84.78 cm, maximum weight 2760 gr and average weight 1609 gr. In the Evros Delta lagoons, length classes of 55–65 cm dominated the length–frequency distribution, while the maximum length of the sample's specimen was 78.5 cm, the average length was 57.48 cm.

10.1.1 Eastern Macedonia and Thrace

As was mentioned earlier, eels that are caught are kept alive in special cages until sufficient quantities are gathered and sold, so the landings are recorded every 10 to 20 days. Thus, only total biomass of the catches is recorded, while the biometric characteristics of the fishes are not recorded. Therefore very scarce data regarding the morphometric characteristics of the fish catches are available.

The length–frequency distribution of the catches derived from Lake Vistonida was calculated using the total available sample (305 specimen). For a big portion of this sample (202 specimen) just Total Length and Total Weight were recorded *in situ*, after they were anesthetized with a eugenol solution. This particular portion of the sample, that was afterward released to the sea, was the portion of the annual eel landings of Lake Vistonida that as defined by the No. 643/39462/2013 (ΦΕΚ 883/Β'/2013) Ministerial Decision of The Minister of Rural Development and Food had to be released so the rest to be legitimately sold. The length–frequency distribution of the catches derived from Lake Vistonida are presented in Figure 10.1. The length–frequency distribution of specimens collected from the Evros Delta lagoons in December 2013 are presented in Figure 10.2. The length–frequency distribution of the catches derived from Evros Delta lagoons are presented in Subchapters 11.2.1.1.2 and 11.2.1.1.1 for Yellow eels (45 specimens) and Silver-eels (six specimens) respectively.

The total number of sample in Vistonida lake was 305 specimens of which 202 specimens were released after being on the spot recording of the total length (TL, mm) and total weight (TW, mm),(with minimum length 724 mm, with maximum length 1004 mm and average of the length 847 mm) (Figure 10.1).

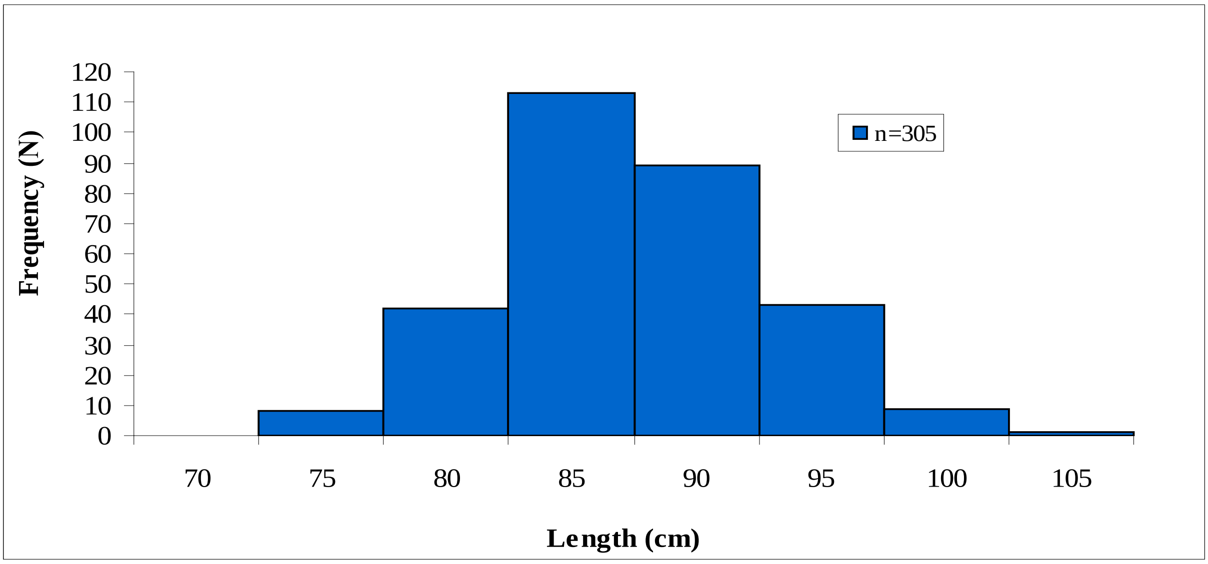


Figure 10.1. Length–frequency distribution of eels from the area of Lake Vistonida for the year 2013.

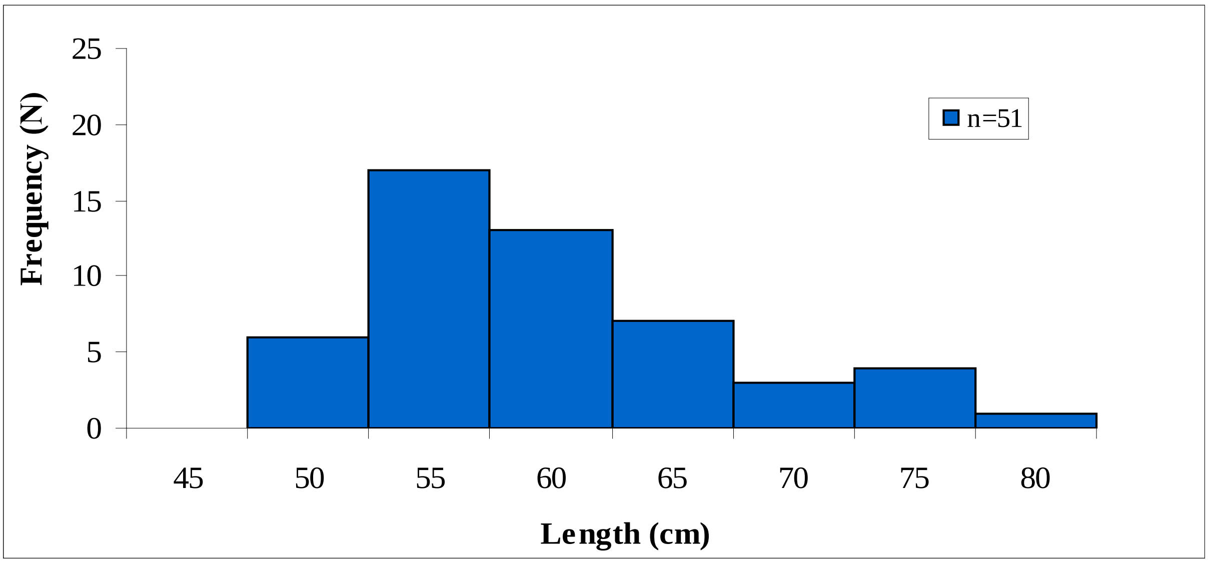


Figure 10.2. Length–frequency distribution of eels from the area of the Nestos Delta lagoons for the year 2013.

10.1.2 Western Greece

10.1.2.1 Messolonghi-Aitoliko Lagoons

The length–frequency distributions of eel landings of the Messolonghi-Aitoliko lagoons complex are presented aggregated in the following graph (Figure 10.3.). The most dominant length class was 55–65 cm and the length–frequency distribution of eels (*Anguilla anguilla*) per lagoon in Messolonghi-Aitoliko lagoons complex for the year 2013 in Figure 10.4.

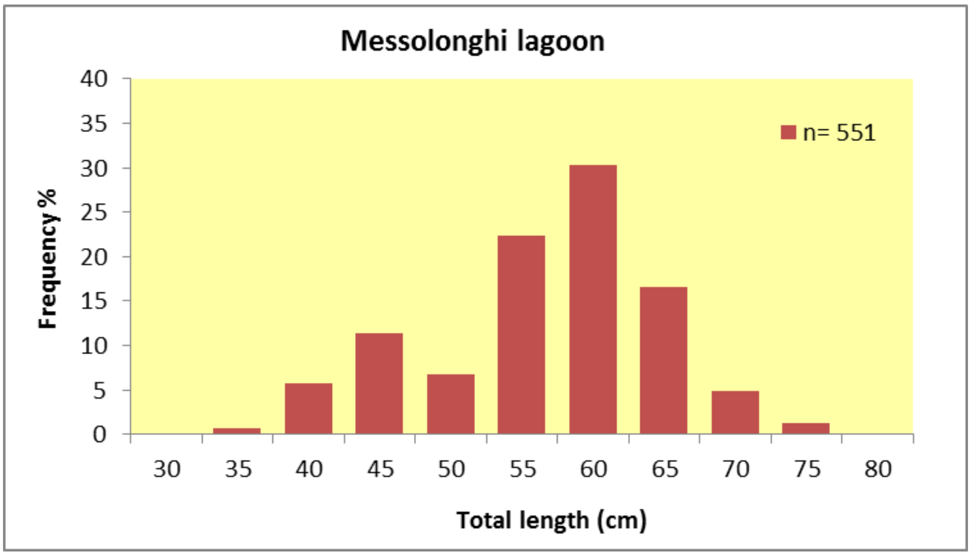


Figure 10.3. Length–frequency distribution of eels (*A. anguilla*) in Messolonghi-Aitoliko lagoons complex for the year 2013.

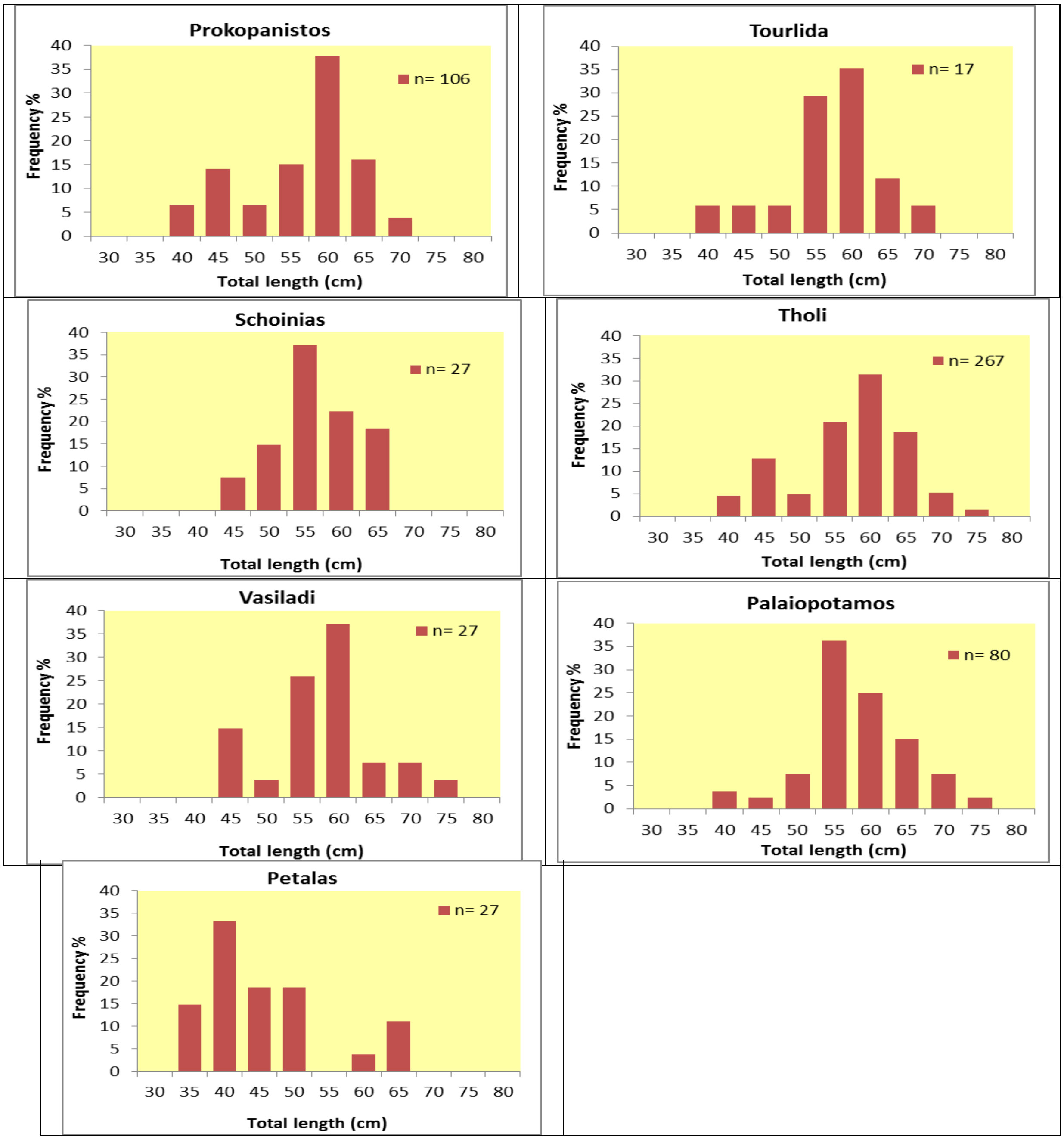


Figure 10.4. Length–frequency distribution of eels (*Anguilla anguilla*) per lagoon in Messolonghi-Aitoliko lagoons complex for the year 2013.

Comparisons of length–frequency distributions between individual lagoons of the Messolonghi-Aitoliko Lagoon's complex, did not show significant differences with the exception of Petalas Lagoon but is a peculiar ecosystem with a big portion of fresh waters and is known in the community of local fishermen that its eels are smaller than the others lagoons of the complex. It is quite interesting that the length class 46–49 cm is infrequently, a fact that has been, also, observed in the length-distributions of 2012 and in other regions of Western Greece.

10.1.2.2 Lagoons of Amvrakikos, Preveza and Lefkada

Since the length composition of eels in different parts of Epirus (Figures 10.5–10.7) shows that there is a significant difference sizes of eels in relation to lagoons of Epirus. It seems that show through mid-lengths and weights were considerably higher than those of the other two regions (Table 10.1).

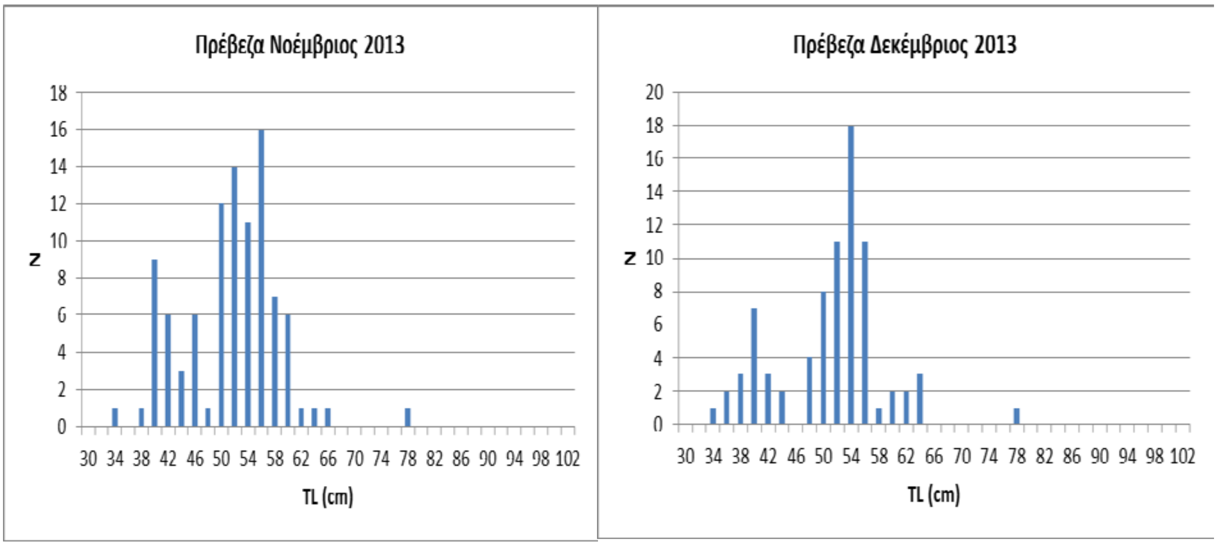


Figure 10.5. Length–frequency distribution of two eel samples collected in Preveza region during November (left figure) and December (right figure) 2013.

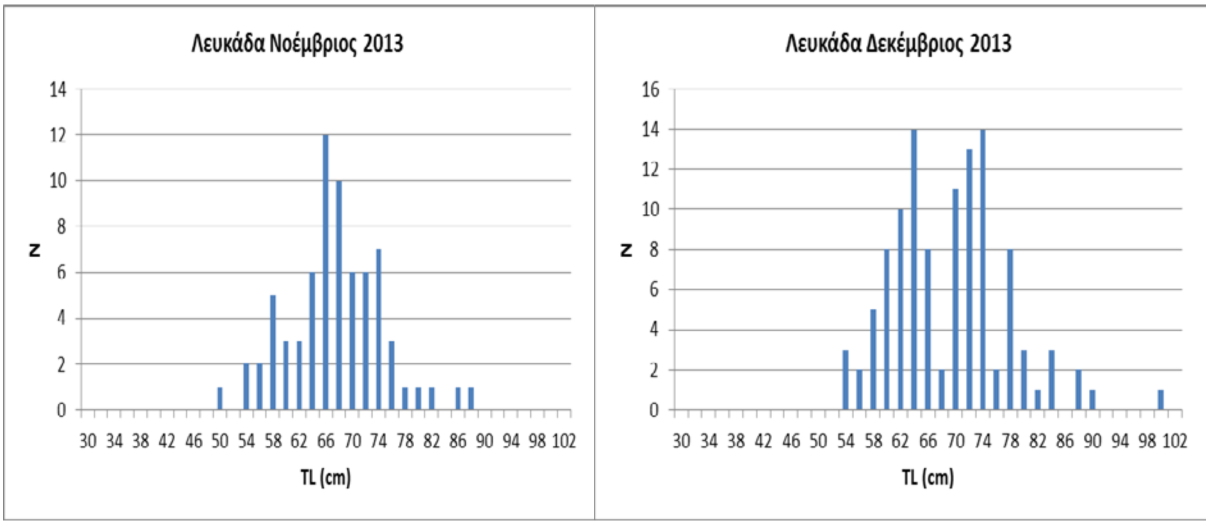


Figure 10.6. Length–frequency distribution of two eel samples collected in Lefkada island during November (left figure) and December (right figure) 2013.

Length–frequency distribution of eels collected from the region of Arta (Tsoukalio) in December 2013 are presented in Figure 10.7. and in Table 10.1. the number of specimen studied (N), average, maximum and minimum values and STDev of total lengths (TL) and total weights (TW) of eels studied per region.

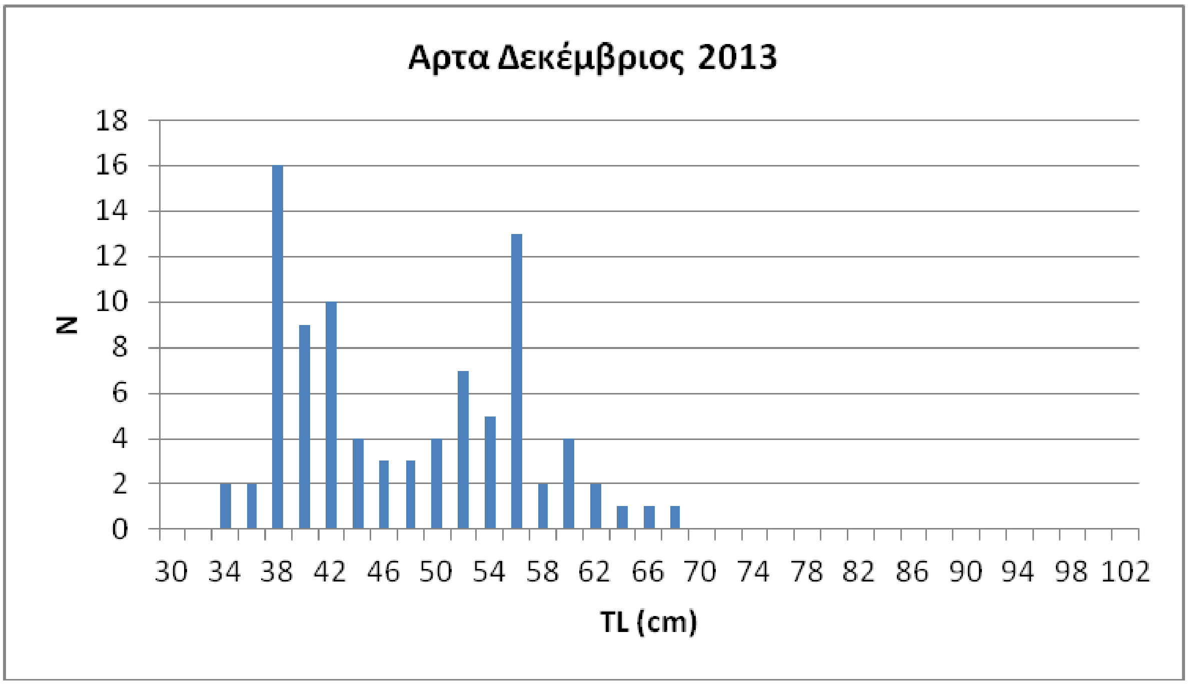


Figure 10.7. Length–frequency distribution of eel-sample collected in Arta region (Tsoukalio) during December 2013.

Table 10.1. Number of eel specimen studied (N), average, maximum and minimum values and STDev of total length (TL) and total weight (TW) per each region.

Prefecture	N	Mean TL(cm)	Max TL(cm)	Min TL(cm)	StdDev TL(cm)	Mean TW (g)	Max TW (g)	Min TW (g)	StdDev TW (g)
Arta	89	46.84	67.20	34.00	8.67	221.56	563.10	66.50	134.26
Lefkada	182	67.94	99.00	50.00	7.93	588.97	1766.00	178.00	211.28
Preveza	176	50.86	78.00	33.00	7.44	295.13	908.00	76.50	116.46

Length–frequency distributions also reveal that in every region and every season there are at least three (3) length classes. The age analysis of the eels using the otoliths method that will be later applied on the samples will give more information about the size and age composition of the samples.

10.1.2.3 West Peloponnese (EMU-2)

The length–frequency distribution of the eel landings from the Prokopos and Papas lagoons is presented in the graph of Figure 10.8. The most dominant length classes are 50–60 cm.

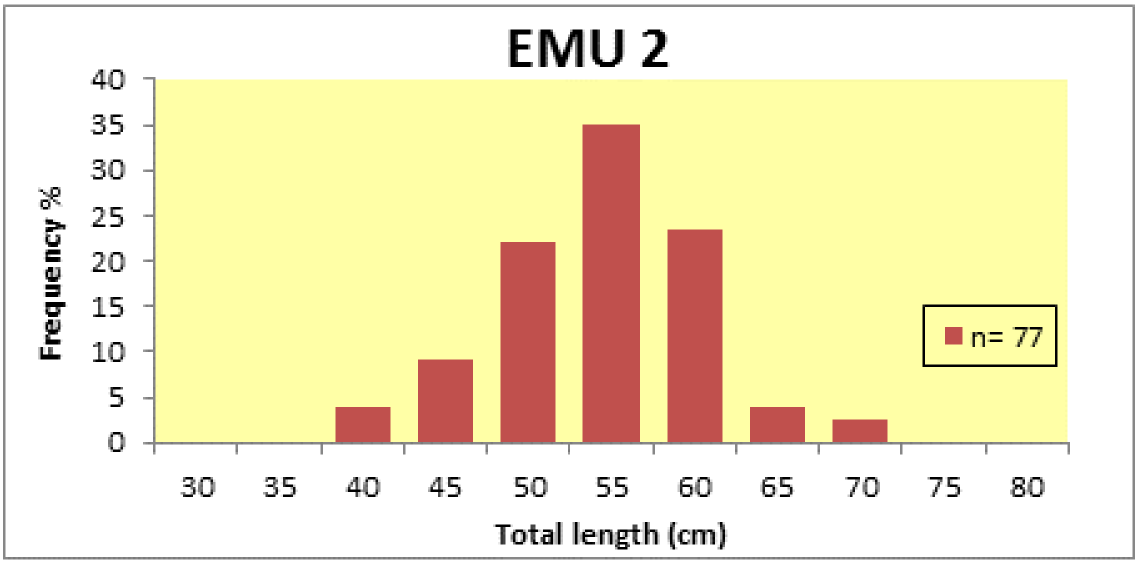


Figure 10.8. Length–frequency distribution of eels in Prokopos and Papa lagoons for the year 2013.

10.2 Age composition

10.2.1 East Macedonia and Thrace

The age–frequency distribution of catches of Lake Vistonida is presented in Figure 10.9. Seven age groups were observed and the age 5 was found to be the most abundant followed by the age 6. Age groups with the smaller number of specimen were age 2 and 7. The mean age of the samples is estimated to be 4.68 years with a standard deviation SD = 1.06.

The *prima facie* paradoxical results of Lake Vistonida is that specimen are longer than expected comparatively to their age estimated by their otoliths. Anadromous lengths, that were also calculated, were bigger in proportion to other references. There are other references that presents similar length–age proportions (Golani *et al*., 1988).

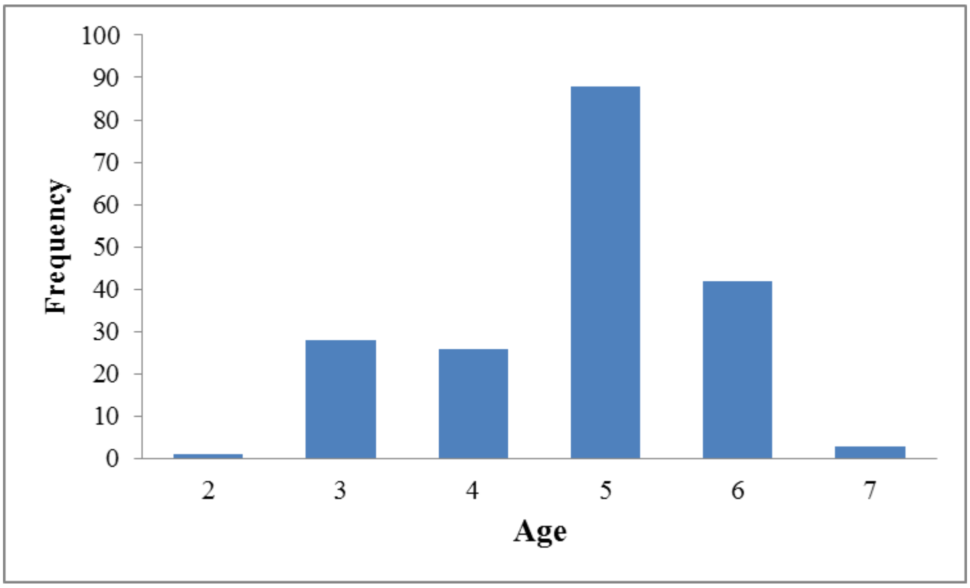


Figure 10.9. Age–frequency distribution of eels in Lake Vistonida for the year 2013.

10.2.2 West Greece

10.2.2.1 Messolonghi-Aitoliko lagoons

The age–frequency distribution of the silver eels caught in the lagoons of Messolonghi-Aitoliko is presented in Figure 10.10. The majority of specimen were silver eels (n=168), while 53 specimen were yellow eels. The average age of the sample was 5.86 (sDev=1.76). Particulary silver eels average age was 5.79 (sDev=2.08) while yellow eels average was 6.05 (sDev=2.06). Paradoxical results are due to the sample, the uncertainty of the age calculation method and to the heterogeneity of the complexes' lagoons (especially if u take, also, into account the freshwater ecosystem of the region that interact with the brackish water of the lagoons). The average age of the eels are following the limits set by HEMP (five to ten years) taking into account geographical and environmental factors of the country and data of the international literature.

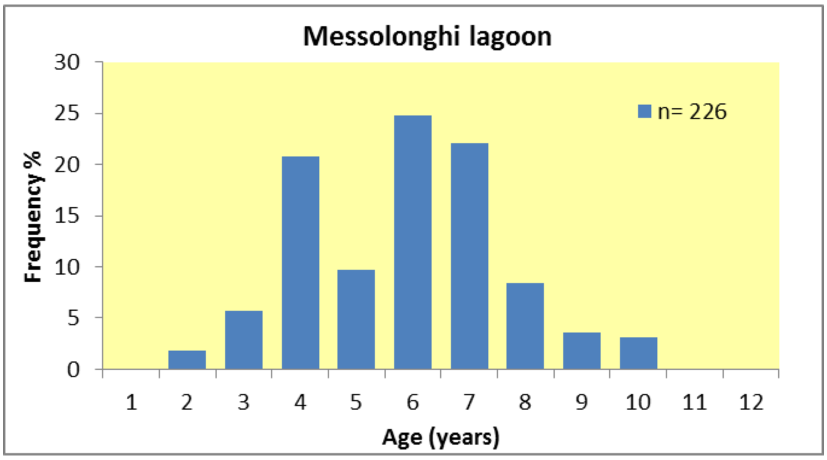


Figure 10.10. Age–frequency distribution of eels (*Anguilla anguilla*) in Messolongi-Aitoliko lagoons complex for the year 2013.

10.2.3 Western Peloponnese

The eel age–frequency distribution of lagoons Prokopu and Papa is presented in Figure 10.11. The mean age of the catch is estimated at 3.8 years (SD = 1.33). The mean age is less than that estimated in the neighbouring lagoon of Messolonghi (5.86 years).

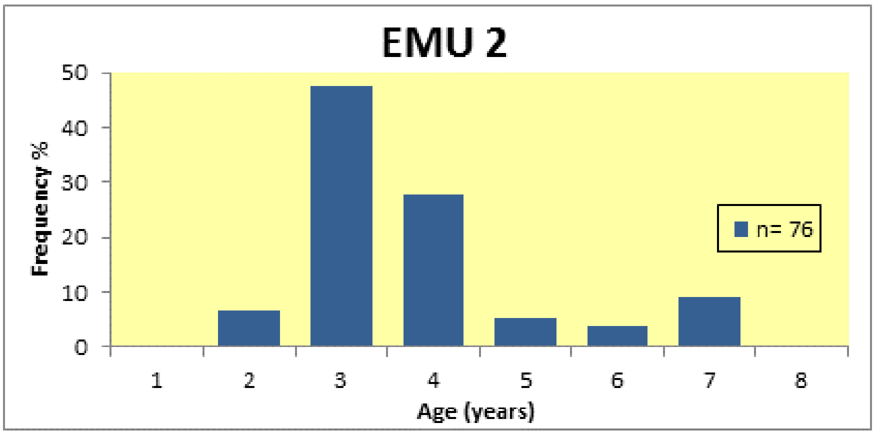


Figure 10.11. Age–frequency distribution of eels in Prokopou and Papa lagoons for the year 2013.

11 Life history and other biological information

11.1 Growth, silvering and mortality

11.2 Other biological sampling

11.2.1 Length, weight and growth

11.2.1.1 East Macedonia and Thrace

11.2.1.1.1 Yellow eels

For the length–weight correlation of the Ebro's sample (yellow eels 45 persons) t-test analysis (t=0.332 p> 0.5) indicated that the b coefficient of the length–weight correlation is not statistically different than the value 3 and therefore Evro's eels exhibit isometric growth (Figure 11.1.).

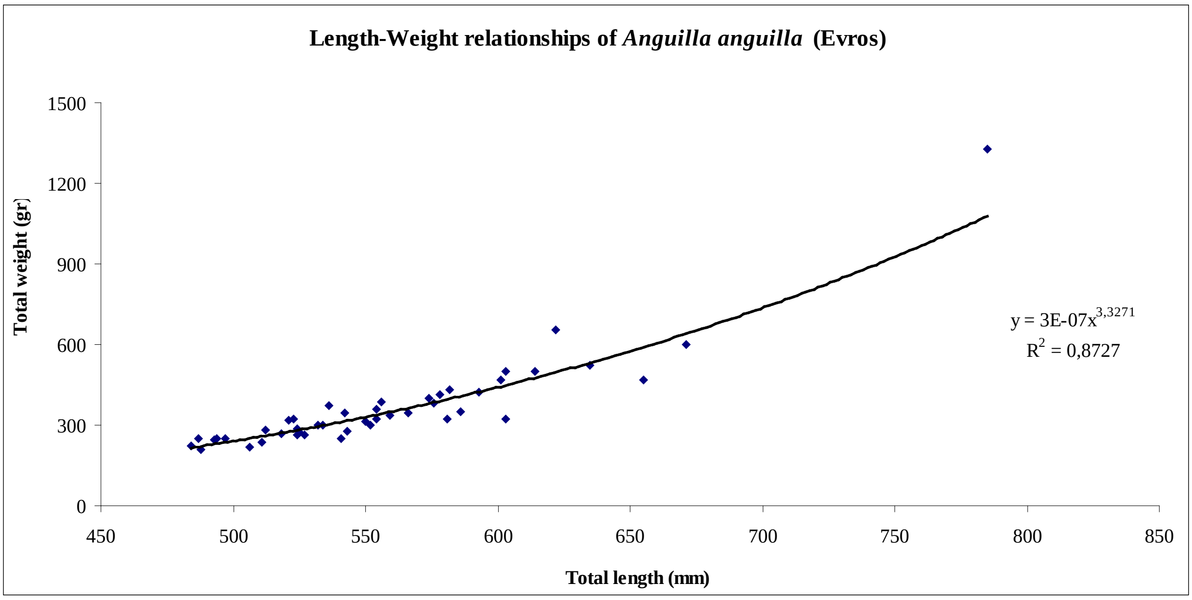


Figure 11.1. Length–weight relationship of *A. anguilla* samples collected in Evros region during 2013.

11.2.1.1.2 Silver eels

Regarding the length–weight correlation of Vistonida's sample (305 silver-eel specimen) t-test analysis (t=0.020 and p>0.5) indicated that b coefficient of the length–weight correlation is not statistically different than the value 3 and therefore Vistonida's population exhibit isometric growth (Figure 11.2.)

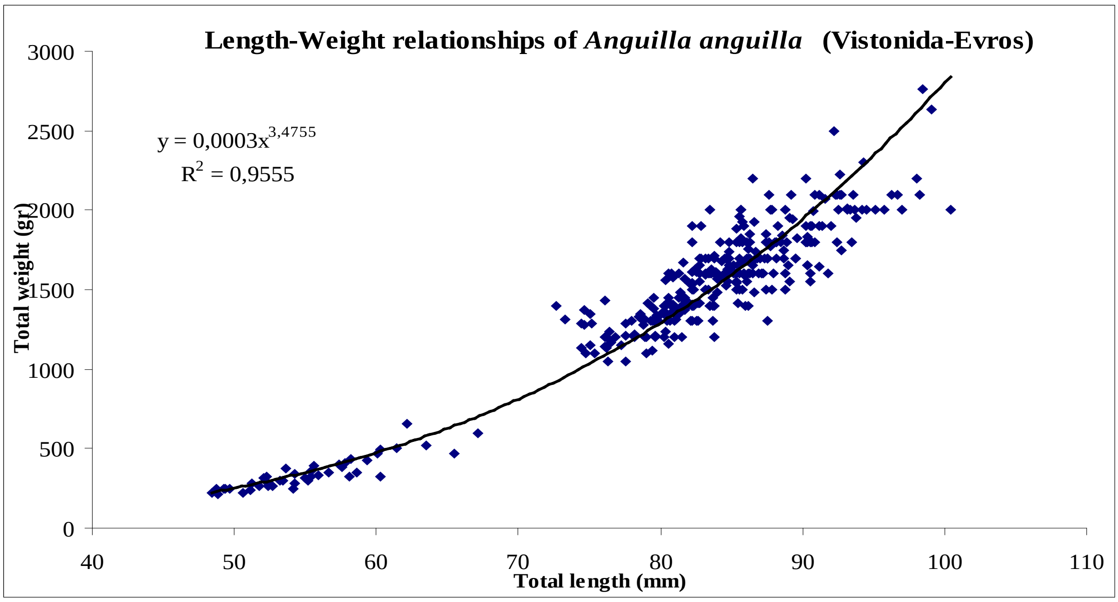


Figure 11.2. Length–weight relationship of *A.anguilla* samples collected both in the Evros region and Vistonida Lake in 2013.

11.1.2 Western Greece

11.1.2.1 Messolonghi-Aitoliko lagoons

The length–weight correlation of the total sample of Messolonghi-Aitoliko eels presented in the following graph (Figure 11.3). The exponent of the length–weight correlation indicates isometric growth. The correlation covers a wide range of sizes (30–75 cm). Concerning the large specimens (>55 cm), they distinguished a relatively large dispersion of the weights of individuals for a given length. This observation may be the result of strong environmental heterogeneity that characterizes the complex of Messolonghi-Aitoliko lagoons.

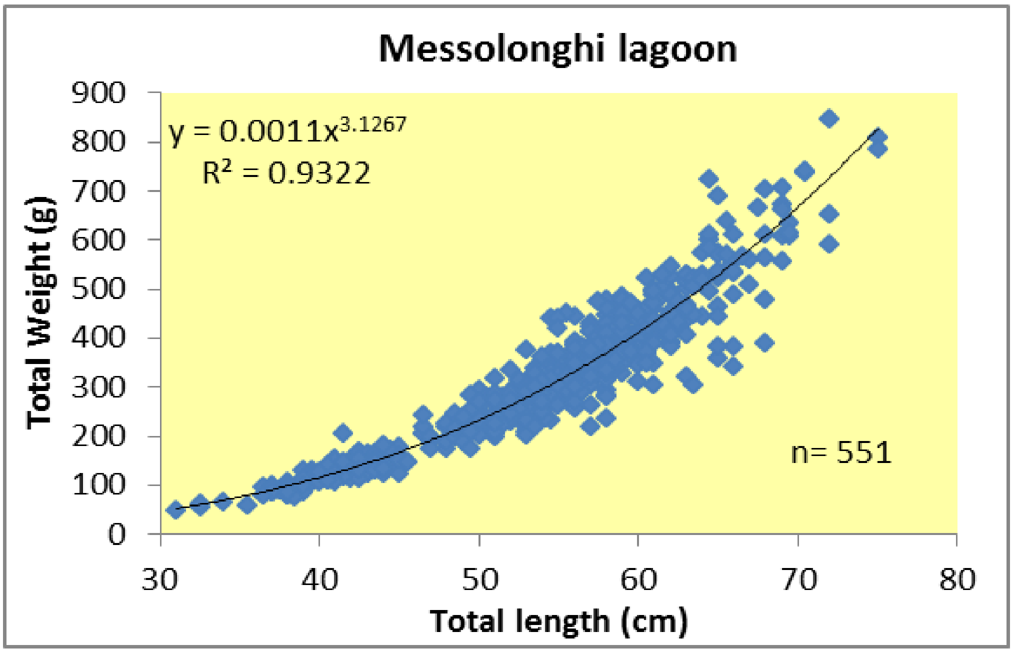


Figure 11.3. Length–weight relationship of *A. anguilla* samples collected in the Messolonghi-Aitoliko region.

11.1.2.2.Preveza and Lefkada

The analysis of the weight growth of eels in the three regions of Epirus indicated that populations of Lefkada and Preveza exhibits negative allometric growth, while the population of Arta isometric.

The length–weight correlation for the eel sample of Preveza is presented in Figure 11.4 and of Lefkada in Figure 11.5.

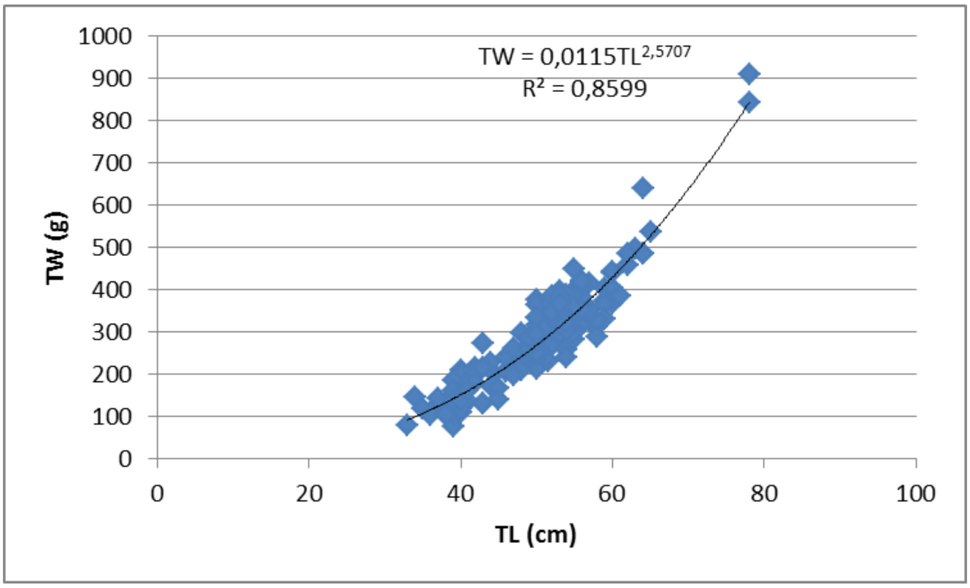


Figure 11.4. Length–weight relationship of *A. anguilla* samples collected in Preveza region.

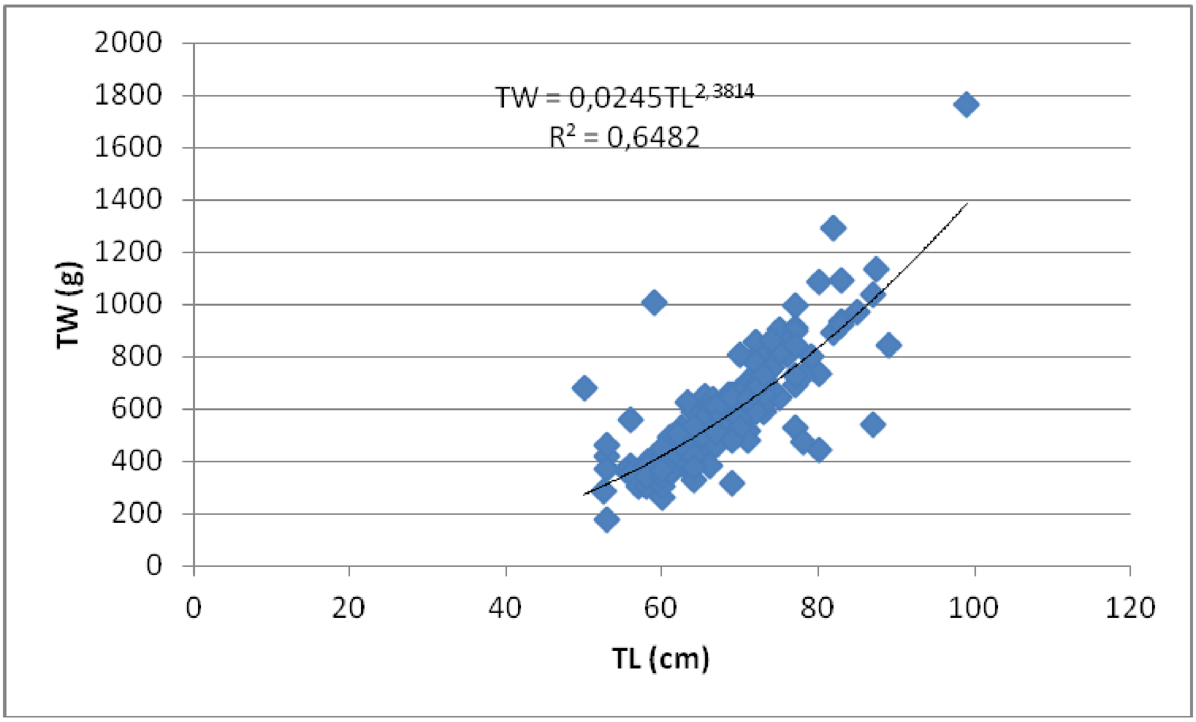


Figure 11.5. Length–weight relationship of *A. anguilla* samples collected in Lefkada region.

In Figure 11.6 the length–weight relationship of *A. anguilla* samples collected in Arta region is presented.

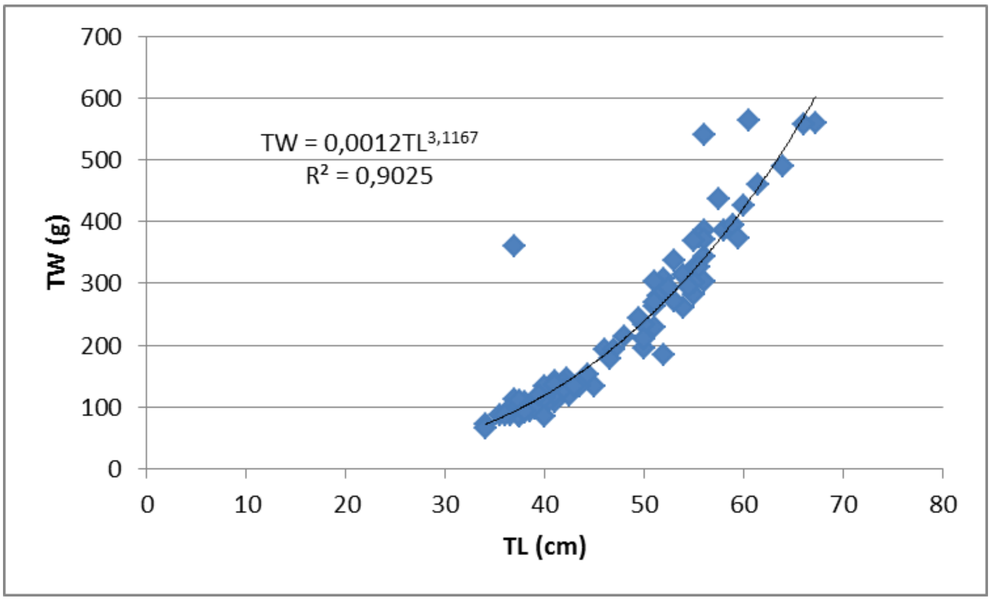


Figure 11.6. Length–weight relationship of *A. anguilla* samples collected in Arta region.

11.1.3 Western Peloponnesus

The length–weight relationship of eels and Papas Lagoons is presented below (Figure 11.7.). Analysis of the data indicated that eels in Prokopu and Papas Lagoons exhibit isometric growth.

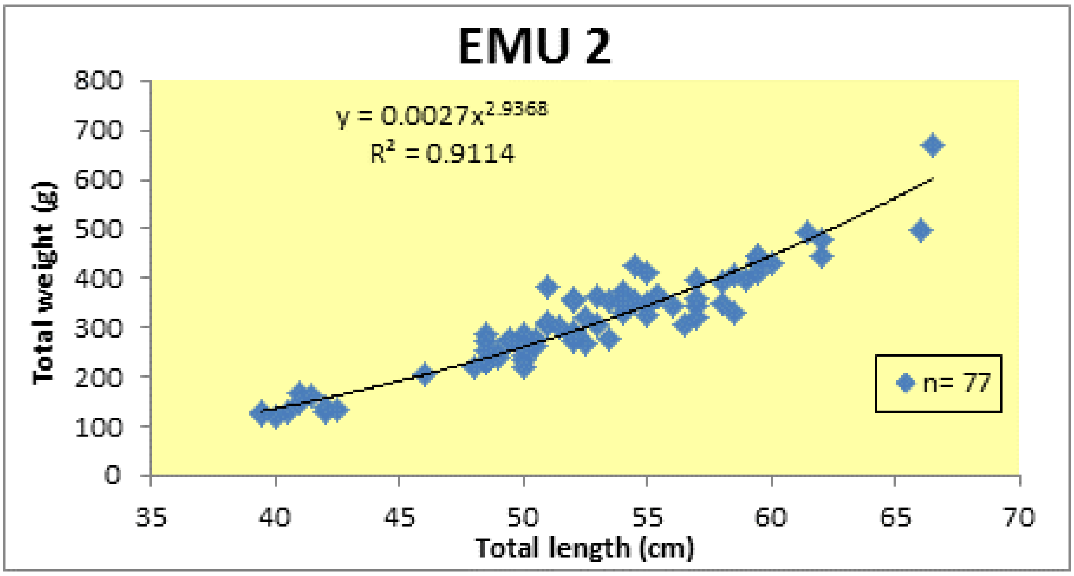


Figure 11.7. Length–weight relationship of *A. anguilla* samples collected in Prokopu and Papa for the year 2013.

11.3 Parasites and other diseases

11.3.1 East Macedonia and Thrace

The eel samples collected from Lake Vistonida were examined in the laboratory for parasites, where a large number of parasites were counted. Of all the specimen gathered (305 total specimen of which 202 were released) 103 specimens were tested in the laboratory from which 31 specimens had no parasites while 72 specimens (30%) had parasites, the average of which was 7.75 per specimen parasites. The sum of the parasites of 72 specimens was 558 parasites of which ten specimens had one parasite, 35 specimens had five parasites, eleven specimens had ten parasites, five specimens had 15 parasites, five specimens had 20 parasites, two specimens had 25 parasites, two specimens had 35 parasites and two specimens had 40 parasites.

The eel sample of Evros Delta were also examined in the laboratory, four individuals with parasites one of which had five parasites while the rest of one were found.

Three samples from Maroneia had no parasites.

11.3.2 Messolonghi-EtolikoAitoliko lagoons

A total of 201 *A. anguilla* specimen from the lagoon complex of Messolonghi-Aitoliko were collected and examined in the laboratory, parasites were detected in 13 of them (6.5%). Affected specimens were found in samples from the lagoons Vasiladi, Shinias, Tholi and Prokopanistos.

11.3.3 Western Peloponnese lagoons (Prokopos-Papas)

A total of 77 specimen *Anguilla anguilla* from lagoons Prokopos and Papas were collected and tested in the laboratory, 18 specimen (23.4%) were carrying the the parasite *Anguillicoloides crassus*. All 18 affected specimen were caught in the lagoon of Prokopos.

11.4 Contaminants

11.5 Predators

There is insufficient information about the presence of predators or about the impacts that their presence could induce to the populations of eels. The only large predator is the Great Cormorant (*Phalacrocorax carbo*), a fish-eating bird that consumes about 400–500 g of fish per day (Bonetti *et al.*, 1998).

In Greece the Great Cormorant breeds in at least four different regions (Axios and Evros Deltas, in Lake Kerkini and in Lake Prespa), and its population amounts to approximately 4300 pairs. Their population increases during the winter period (ranging from 12 000 to 22 000 individuals) due to individuals traveling to Greece for wintering from northern countries. The majority of the travelling birds are distributed in major wetlands (Evros, Porto Lagos, Amvrakikos, Messolonghi).

The great increase of cormorant population caused the concern of many professional and amateur fishermen throughout Europe, who believe that the decrease in populations of certain fish species, especially in fresh waters, is partly caused by cormorant predation. Many European countries researched this issue, and verified that cormorant populations indeed have a negative impact on fish landings, especially in lakes and rivers where fishing is practiced intensively. According to studies in Scotland, it is regarded that eel predation by cormorants can amount to 10 t per year.

11.6 Fecundity

11.6.1 East Macedonia and Thrace

The fecundity control was performed in 44 specimen (maximum length (TL) was 994 mm, the minimum length was 687 mm and the average length was 873 ± 69 mm). The fecundity of the samples ranged from 3 287 500 to 10 832,000 eggs (6 413 250 ± 1 719 874 oocytes). The Relative Fecundity assayed 3 906 153 oocytes per kilogram body weight (MacNamara *et al.*, 2013).

12 Other sampling

In 2009, an eel trap was installed in the area of River Nestos Delta, in a distance of 20 km from the mouth of the river, for a period of 12 months. During that period only one yellow eel (25 cm total length) was captured.

13 Stock assessment

13.1 Method summary

Alternatively, refer to published materials. Estimate of B_0.

Table 13-1. Reference period for B_0.

EMU_CODE	B_0 (KG/HA)	REFERENCE TIME PERIOD	WHETHER OR NOT CHANGED FROM VALUE REPORTED LAST YEAR (Y/N)

13.2 Summary data

13.2.1 Stock indicators and targets

EMUcode	Indicator	Biomass (t)	Mortality (rate)				Target		
	B0	Bbest	Bcurr	∑A	∑F	∑H	Source	Biomass (t)	∑A (rate)
XY_abcd							EMP		
							EU Reg		
							WGEEL		
XY_abcd							EMP		
							EU Reg		
							WGEEL		

13.2.2 Habitat coverage

During 2013, there was an effort to assess the majority of the habitats that eels could be found, such as lakes, estuaries and lagoon. Regarding rivers, there is a prohibition in eel fishing in rivers by any type of fishing gear (e.g. fykenets). As for the coastal zones, there isn't any fishing activity in those concerning eels since the total landings comes from lagoons and estuaries. Also, in EMU-3 there is the only lake, Lake Visonis, where there is eel exploitation.

EMU code	River		Lake		Estuary		Lagoon		Coastal	
	Area (ha)	A'd Y/N)	Area (ha)	A'd Y/N)	Area (ha)	A'd Y/N)	Area (ha)	A'd Y/N)	Area (ha)	A'd Y/N)
EMU 1		N		N		N	32,500	Y		N
EMU 2		N		N		N	1.750	Y		N
EMU 3		N	4.500	y	16300	y	8,600	Y		N
EMU 4		N		N		N		N		N

13.2.3 Impact

A = assessed, MI = not assessed, minor, MA = not assessed major, AB = impact absent

EMU CODE	HABITAT	FISH COM	FISH REC	HYDRO & PUMPS	BARRIERS	RESTOCKING	PREDATORS	INDIRECT IMPACTS
XY_abdc	Riv	A/MI/ MA/AB						
	Lak							
	Est							
	Lag							
	Coa							
	All							

EMU CODE	STAGE	FISH COM	FISH REC	HYDRO & PUMPS	BARRIERS	RESTOCKING	PREDATORS	INDIRECT IMPACTS
XY_abdc	Glass							
	Yellow							
	Silver							
	Silver EQ							

13.2.4 Precautionary diagram

13.2.5 Management measures

When the Greek EMP was submitted to the EU, there were certain measures proposed for the protection of the Greek eel population. These measures included the prohibition of glass and yellow eel fishing, commercial and recreational and restocking. After the approval of the EMP the construction of fish passages in areas where various types of obstacles exist was also proposed for the protection of the population. However, not all of these measures have been fully implemented, as it presented in the following table.

EMU CODE	ACTION TYPE	ACTION	LIFE STAGE	PLANNED	OUTCOME
EMU 1, 2, 3	Com Fish	Fishing prohibition	Glass and yellow eel	in the original EMP	Fully Implemented
EMU 1, 2, 3	Rec Fish	Fishing prohibition	yellow & silver eel	in the original EMP	Partial Implemented
EMU 1, 3	Hydropower & Pumps	Fish passage	Yellow & Silver eel	after EMP approval	Not implemented
EMU 1	Restocking	Restocking in lakes	yellow eel	in the original EMP	Partial Implemented
EMU 1, 2, 3	Other	Data collection	Silver eel	after EMP approval	Fully implemented

13.3 Summary data on glass eel

quantities	caught in the commercial fishery
	exported to Asia
	used in stocking
	used in aquaculture for consumption
	consumed direct
	mortalities

14 Sampling intensity and precision

15 Standardisation and harmonisation of methodology

15.1 Survey techniques

15.2 Sampling commercial catches

15.3 Sampling

15.4 Age analysis

The estimation of eels' age was conducted according to the European Protocol of Age Assessment of ICES, using otoliths of eels and not scales. Specifically, the method used was that of grinding and polishing of the otoliths. Left otolith was used according to the same protocol and always the hollow part, because the annual rings required less sharpening to become visible from this part and as a result there were less chances of breaking the otolith. The sharpening was conducted using dry friction sandpaper P1000. Afterwards otoliths were cleaned with 90% alcohol. Finally, the otolith was placed on a microscope slide along with a small amount of 86% glycerol. This procedure resulted in the emergence of the otoliths annual rings and the counting of the rings and measuring of their radius assuming a stable centre for all the annual rings of each otolith using a stereoscope in order to estimate back-calculated lengths. The calculation of back-calculated lengths was carried out using the following equation:

$$Ti = (TL - 30) * Ri / Rtotal$$

T_i = Length-at-age i

TL = Eels' length when caught (30 cm are subtracted considering to be the length of eels entering freshwater after their transformation into Yellow-eels)

R_i = Distance between the center of the Otolith and the Ring i

R_{total} = Total length of the Otolith

In parallel to the implementation of the method above, the method of breaking–burning and reading age on a cross section of the otolith. The project team has planned to organize a meeting to compare the results of the two methods.

15.5 Life stages

15.6 Sex determinations

15.7 Data quality issues

15.8 Fecundity

Within the framework of Fisheries Data Collection Program, determination of eels' sample fertility was carried out. The gonads were examined macroscopically following Tesch (2003) to determine the sex. Pectoral fin length and eye diameter were measured (to the nearest 0.01 mm) to classify eels into silvering stages according to Durif *et al*. (2009a). The weight of the gonads has, also, been measured to the nearest 0,01 gr. These measurements were taken to confirm the maturation stage of each specimen of the sample, based on the GSI and Eye index.

Gonadosomatic index (GSI) was calculated as:

(gonad weight / body weight) x 100

and eye index (Pankhurst, 1982), based on the relationship between body length and the mean size of both eyes, was calculated as:

[{ (right horizontal eye diameter + right vertical eye diameter) / 4 } x (left horizontal eye diameter + left vertical eye diameter) / 4 } x (π / body length)] x 100

To ensure eels were sufficiently mature, and to facilitate comparison with other studies (i.e. MacNamara and McCarthy, 2012), only eels with an eye index >6.5 (Pankhurst, 1982) and GSI >1.2% (Durif *et al*., 2005) were considered for fecundity analysis. Gonads were treated according to the protocols described by Barbin and McCleave (1997) and MacNamara and McCarthy (2012).

Finaly, age determination was carried out based on the Otolith method.

16 Overview, conclusions and recommendations

Within the framework of the National Fisheries Data Collection Programme a pilot study concerning the European Eel (*Anguilla anguilla*) was carried out in 2012. The pilot program completed in 2012 contributed to the standardization of methodology used by all partners, according to the literature and standards set by the European Working Group on Eels (Working Group for Eels - WGEEL). For the purposes of this study, the populations of eels were monitored a) in the lagoon complex of Mesolonghi- Aitoliko, the lagoons of Ambracicos Gulf, Preveza's regions and Lefkada's island of western Greece (EMU-1) b) in the lagoons Prokopou and Papa of Western Peloponnese (EMU-2) and c) in Lake Vistonidas, in River's Evros Delta and River's Nestos Delta's lagoons of East Macedonia and Thrace (EMU-3). Historical data for the rest of Greece (EMU-4) show that eel fishing stopped in the late 1970s as a result of severe degradation of the ecosystems sustaining eel populations. There are not newer data for EMU-4 eel populations.

In 2013, data on eel landings and collection of biological material (otoliths for age determination) were realized in the framework of DCF.

In the context of monitoring and data collection about fishing and state of eel stocks, three action categories were carried out: 1) recording of landings 2) collection of biological material and data, and 3) *in situ* measurements of length and weight of caught eels. All of these actions contribute to the understanding of the state and the sustainable management of eel stocks in Greece. Moreover historical data on eel fishing in Greece were collected.

The analysis of data gathered from the three main eel management units (EMU-1, EMU-2 and EMU-3), presents a long and steady decline in eel stocks, revealed by the eel catches declared by fishing cooperatives managing the lagoons.

Remarks–suggestions

2013s main fishing period (November–December) could be characterized as "un-typical" due to the relatively high temperatures and to the scarcity of the meteorological events occurring usually during the "eel-nights". As a result the eel-landings was relatively low.

Moreover, it is believed that fishing cooperatives, prior to the implementation of the Regulation 1100/2007, tended to declare smaller quantities of eels. This concealment of the true eel landings was performed in order to minimize the amount of eels released back to the sea, allowing them to have additional benefits. This was more pronounced at the beginning of the period because in most of the eel-productive areas, this was the first implementation of the measures proposed by the. In the course of the year, and after the implementation of the Regulation 1100/2007 and given that the biggest segment of the eel landings is intended to be exported, thus a "single permit" by CITES is required, the tendency of concealment of the true eel landings declined. However, in each case, a reconsideration of the implementation of the country's commitment about the releasing of eels, would only have positive effects on the quality of the data acquired for the implementation of ICES measures in Greece.

17 Literature references

Ardizzone G.D., Cataudella S., and Rossi R. 1988. Management of coastal lagoon fisheries and aquaculture in Italy. FAO Fish. Tech. Pap. 293.

Barbin, G.P., McCleave, J.D. 1997. Fecundity of the American eel Anguilla rostrata at 45°N in Maine, U.S.A. Journal of Fish Biology, 51: 840–847.

Bonhommeau S., Chassot E. and Rivot E. 2008. Fluctuations in European eel (*Anguilla anguilla*) recruitment resulting from environmental changes in the Sargasso Sea. *Fisheries Oceanography*, 17(1): 33–44.

Bonetti Andrea, Carss D., Goutner V., Kazatzidis S., Kardakari N., Naziridis Th., Papakonstantinou C., Pergantis F., Hatzilakou D. Review of the effects of Great Cormorant Phalacrocorax carbo on fisheries in Hellenic and European level: Conclusions of workshop, Pylos, 13–14 December 1998.

Castonguay M., Hodson P. V., Moriarty C., Drinkwater K. F., Jessop B. M. 1994. Is there a role of ocean environment in American and European eel decline? *Fisheries Oceanography*, 3: 197–203.

Daverat F., Limburg K. E., Thibault I., Shiao J. C., Dodson J. J., Caron F. O., Tzeng W. N., Iizuka, Y., Wickstrom H. 2006. Phenotypic plasticity of habitat use by three temperate eel species, *Anguilla anguilla*, *A. japonica* and *A.rostrata*. Marine Ecology-Progress Series, 308: 231–241.

Dekker W. Ed. 2005. Report of the Workshop on National Data Collection for the European Eel, Sånga Säby (Stockholm, Sweden), 6–8 September 2005, 283 pp.

Désaunay Y., Guerault D. 1997. Seasonal and long-term changes in biometrics of eel larvae. A possible relationship between recruitment variation and North Atlantic systems productivity. Journal of Fish Biology, 51: 317–339.

Durif, C., Guibert, A., Elie, P. 2009a. Morphological discrimination of the silvering stages of the European eel. p. 103–111. In: Casselman, J. M., Cairns, D. K. (Eds) Eels at the Edge: Science, Status, and Conservation Concerns. American Fisheries Society Symposium. Bethesda, MD, USA.

Economidis, P.S. 1991. Checklist of freshwater fishes of Greece. Recent status of threats and protection. Greek Society for the Protection of Nature, Athens, 1–47.

Economidis, P.S., Dimitriou, E., Pagoni, R., Michaloudi, E. and Natsis, L. 2000. Introduced and translocated fish species in the inland waters of Greece. *Fisheries Management and Ecology*, 7: 239–250.

Golani D., Shefler D. and Gelman A. 1988. Aspects of growth and feeding habits of the adult European eel (*Anguilla anguilla*) in Lake Kinneret (Lake Tiberias), Israel. *Aquaculture*, 74(3–4): 349–354.

ICES. 2007. Report of the Working Group on Eels (WGEEL), 3–7 September 2007, Bordeaux, France. ICES CM 2007/ACE:23. 46 pp.

Katselis G., Koutsikopoulos C., Dimitriou E. and Rogdakis Y., 2003. Spatial patterns and temporal trends in the fishery landings of the Messolonghi-Aitoliko lagoon system (western Greek coast). *Scientia Marina*, 67(4): 501–511.

Kettle A.J. and Haines K. 2006. How does the European eel (*Anguilla anguilla*) retain its population structure during its larval migration across the North Atlantic Ocean? *Canadian Journal of Fisheries and Aquatic Sciences*. 63: 90–106.

Koutsikopoulos C., Cladas Y., Zompola S., Passas N., Tzanatos E., Vavoulis D., Spinos E., Ramfos A., Georgiadis M. 2001. A database and a recording system for the eel exploitation in Greece. Ministry of Agriculture, O.P. Pesca – measure 12, 75pp. (in Greek).

Koutsikopoulos C., Y. Cladas, G.Katselis, S.Zompola, E. Dimitriou, D.Mitropoulos and A.Chatzispyrou. 2009. Hellenic Eel Management Plan. General Directorate of Fisheries of the Ministry of Rural Development and Food (MRDF, Des. No. 147800), 55pp.

Koutrakis E.T., A. Conides, A.C. Parpoura, E.H. van Ham, G. Katselis and C. Koutsikopoulos, 2007. Lagoon Fisheries' Resources in Hellas. Chapter 6, pp. 223–234. In. Papaconstantinou C., Zenetos A., Vassilopoulou V. & G. Tserpes (eds), State of Hellenic Fisheries. Hellenic Centre for Marine Research, Athens, Greece.

Larinier, M., Courret, D. and Gomes, P. 2006. Guide Technique pour la Conception des Passes « Naturelles » [Technical Guide to the Concept on Nature-Like Fishways]. Rapport GHAAP-PERA.06.05-V1, 5.

Lelievre, M. and Steinbach, P. 2008. Etat migratoire de la Sioule. Expertise détaillée de l'axe Sioule et de l'impact des ouvrages sur la circulation des poissons migrateurs. Janvier 2008.

Lecomte-Finiger R.1994. The early life of the European eel. *Nature*, 370: 424.

MacNamara, R., McCarthy, T.K. 2012. Size-related variation in fecundity of European eel (*Anguilla anguilla*). ICES Journal of Marine Science, 69: 1333–1337.

MacNamara R., Koutrakis E.T., Sapounidis A., Lachouvaris D., Arapoglou F., Panora D. and McCarthy T.K. 2013. Reproductive potential of silver European eels (*Anguilla anguilla*) migrating from Vistonis Lake (Northern Aegean Sea, Greece). Mediterranean Marine Science. (In press).

Pankhurst, N.W. 1982. Relation of visual changes to the onset of sexual maturation in the European eel *Anguilla anguilla* (L.). Journal of Fish Biology, 21: 127–140.

Schmidt J. 1912. Danish researches in the Atlantic and Mediterranean on the life-history of the freshwater-eel (*Anguilla vulgaris*, Furt.). With notes on other species. Internat. Revue Hydrobiology and Hydrography, 5: 317–342.

Schmidt J. 1925. The breeding places of the eel. *Smithsonian Institute Annual Report 1924*: 279–316.

Tesch, F.W. 2003. The Eel. Fifth edition. Blackwell, Oxford, UK, 408 pp.

Tremblay, V., Cossette, C., Dutil, J.-D., Verreault G., and Dumont P. 2011. Assessment of upstream and downstream passability for eel at dams. Can. Tech. Rep. Fish. Aquat. Sci. 2912: pp. x + 73.

Tsukamoto K., Nakai I., Tesch W. V. 1998. Do all freshwater eels migrate? *Nature* 396(6712): 635–636.

van Ginneken V., Dufour S., Sbaihi M., Balm P., Noorlander K., de Bakker M., Doornbos J., Palstra A., Antonissen E.; Mayer I., van den Thillart G. 2007. Does a 5500-km swim trial stimulate early sexual maturation in the European eel (*Anguilla anguilla* L.)? Comparative Biochemistry and Physiology a-Molecular & Integrative Physiology, 147(4): 1095–1103.

Volponi S. 1997. Cormorants wintering in the Po Delta: estimated and possible impact on aquaculture landings. Suppl. Ric. Biol. 323–332.

Zompola, S., Cladas, Y., Vavoulis, D., Kentrou, A., Pagoni, S., Koutsikopoulos, C. 2001. European eel (*Anguilla anguilla* L.) fisheries landings in Greece. Proceedings of the 10th Hellenic Congress of Ichthyologists, 237–240 (in Greek with abstract in English).

Report on the eel stock and fishery in Ireland 2013/2014

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Reporting Period: This report was completed in October 2014, and contains data up to the end of 2013 and recruitment data for 2014.

The data presented in this report have been drawn from various sources including the Irish Standing Scientific Committee on Eel Report to IFI/DCENR (2014), the annual IFI Eel Monitoring Programme Annual Reports (O'Leary *et al*., 2009–2014), annual reports to the ESB and the SSCE by NUIG on Silver Eel Research and trap and transport monitoring (McCarthy *et al*., 2009–2014), Marine Institute annual stock assessments for the Burrishoole (2009–2013) and the 2012 Irish Report to the EU on the Progress of Implementation of the Eel Management Plans.

2 Introduction

This report continues the sequence of reporting annual national eel data to the ICES/EIFAAC Eel Working Group. In line with the requirements of the EU Eel Recovery Plan (Action Plan; COM 2003, 573: Regulation; COM (2005) 472) and the EU Data Collection Regulation for fisheries (Council Regulation 1543/2000 and Commission Regulations 1639/2001, 1581/2004) the National Eel Reports were restructured under the standard headings of the DCR. The EU requires under the Regulation (COM (2005) 472) that Eel Management Plans be established and implemented.

2.1 The Irish National Programme

The Irish National Programme is conducted in close co-operation between the following organisations.

Department of Communications Energy and Natural Resources (DCENR)

DCENR is the main governmental department with responsibility for inland fisheries policy, management, control and enforcement.

Department of Environment, Heritage and Local Government (DEHLG)

DEHLG is the main governmental department with responsibility for core functional areas of environment, water and natural heritage, built heritage and planning, housing, local government and meteorological services and implementation of the Habitats and Water Framework Directives.

The Marine Institute (MI) - DAFM

The MI is a semi-state marine research organisation with national responsibility for the provision of scientific advice on eel and the collection of scientific data on the fisheries sector and the implementation of the module on evaluation of inputs, fishing capacities and fishing effort and the module of evaluation of catches and landings as defined in the Application Regulation of EU Council Regulation 1543/2000.

Inland Fisheries Ireland - DCENR

Inland Fisheries Ireland (IFI) was formed in 2010 following the amalgamation of the Central Fisheries Board and the seven former Regional Fisheries Boards into a single agency. Inland Fisheries Ireland is responsible for the protection, management and conservation of the inland fisheries resource across the country, including implementation and monitoring of the Irish eel Management Plans. Ireland has over 70 000 kilometres of rivers and streams and 144 000 hectares of lakes all of which fall under the jurisdiction of IFI. The agency is also responsible for sea angling in Ireland.

National Parks & Wildlife - DAHG

The National Parks and Wildlife Service (NPWS) section of the Department manages the Irish State's nature conservation responsibilities under national and European law. A particular responsibility of the NPWS is the designation and protection of Special Areas of Conservation (SACs), Special Protection Areas (SPAs) and Natural Heritage Areas (NHAs). NPWS is responsible for CITES.

Electricity Supply Board (ESB)

ESB has a statutory role in preserving and developing the Shannon fishery, since the establishment of a hydroelectric scheme on the river when the government handed over all fishing rights to the company in 1935. The ESB is responsible for implementing the silver eel trap and transport schemes on the Shannon, Erne and Lee.

The Loughs Agency

The Loughs Agency aims to provide sustainable social, economic and environmental benefits through the effective conservation, protection, management, promotion and development of the fisheries and marine resources of the Foyle and Carlingford Areas.

Standing Scientific Committee on Eel

The Standing Scientific Committee on Eel (SSCE) was established under Section 7.5 (a) of the 2010 Inland Fisheries Act. The purpose of the committee is to provide independent scientific advice to guide IFI in making the management and policy decisions required to ensure the conservation and sustainable exploitation of the Ireland's eel stocks. The SSCE is comprised of representatives from the relevant State Agencies, and its ToR is to define and oversee a programme of monitoring, stock assessment and post-evaluation of management measures and to provide advice on eel.

2.2 Eel Management Plans-Ireland

Eel management plans were submitted to the EU in early January 2009 and these were accepted by the EU in early July 2009 and implemented by Ireland in 2009. The plans were continued through 2009–2011 and again for 2012–2014. The only modification in 2012 being how the target for the silver eel trap and transport programme on the Erne was determined.

The following is the Executive Summary from the National Report (Irish EMPs) to the EU updated where relevant with new information.

2.2.1 Introduction

Ireland established a National Working Group on eel management in 2006, in advance of the agreement of the Regulation (EC) No. 1100/2007, in order to begin the preparatory work required and Irish scientists participated in Working Groups and EU projects (i.e. EU SLIME) in developing methodologies and data collection and modelling for eel stock assessment.

2.2.2 Organisation of the Eel Management Units

The Eel Management Plans were established and implemented for River Basin Districts as defined in Directive 2000/60/EC and in accordance with Article 2 of the Eel Regulation. Ireland submitted a National Report encompassing five River Basin EMPs and one transboundary EMP. These are the Eastern EMP, South Eastern RBD EMP, South Western RBD EMP, Shannon IRBD EMP, Western RBD EMP and the transboundary North Western RBD EMP (Figure 2.1). Figure 2.1 also shows the transboundary agreement for the Eastern RBD and Neagh Bann RBDs.

All Irish EMUs are in the ICES Celtic Seas Ecoregion (E).

Inland and estuarine eel fisheries in Ireland were managed by seven Regional Fisheries Boards, divided into Fisheries Districts, and the Loughs Agency. Fisheries District boundaries largely conformed to the arrangement of river catchments. Fisheries management is now undertaken by Inland Fisheries Ireland using the WFD boundaries.

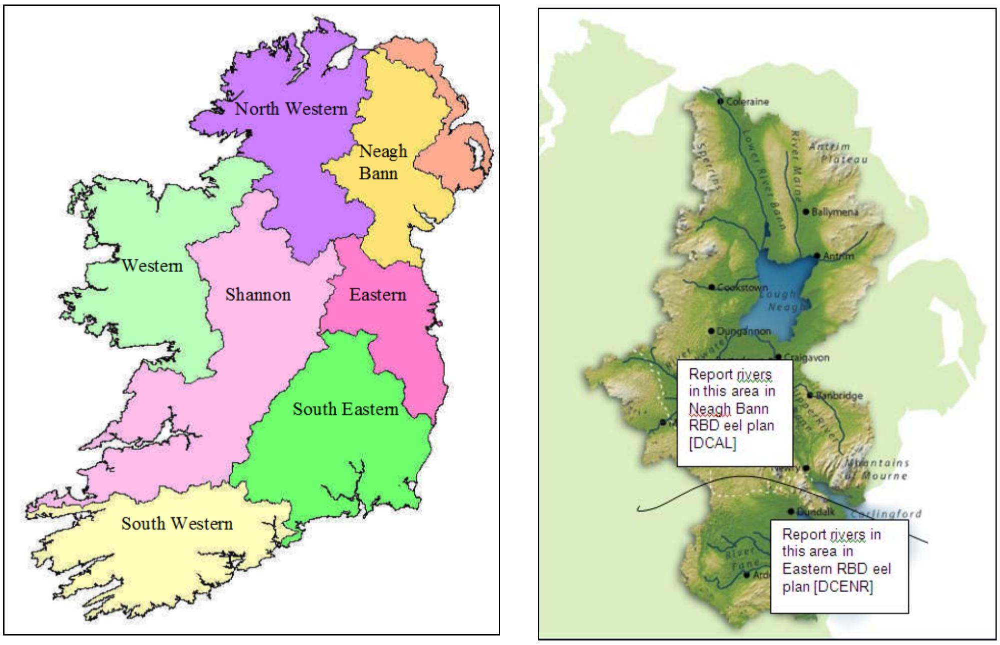

Figure 2.1. Map (left) showing the River basin Districts and the map (right) showing the transboundary agreement between the Neagh/Bann RBD and the Eastern RBD.

2.2.3 Description of the Eel Management Units

Current management of migratory species in Ireland, salmon and sea trout, has been at the catchment level and it is therefore logical to expand this to encompass the management of eel. A G1S based data model was established for the quantification of the fresh water salmon habitat asset and for the determination of the quantity of habitat available to migratory salmonids. 261 discrete migratory salmonid 'Fishery Systems' were identified. Four Northern Ireland catchments have now been included in this quantification in support of the NWIRBD transboundary management plan. It is likely that eel are present in the majority or all of these systems. Commercial fishing probably only takes place in 4.6% of the catchments, although this accounts for some 71% of the total wetted area.

The estimated total wetted area of the 265 lake, river and stream habitat accessible to migratory fish (including 1st order streams) in Ireland (including the Northern Ireland part of the Erne and the Loughs Agency Rivers in the Foyle and Carlingford areas) is 153 881 ha. The 265 "migratory" systems were estimated to contain 132 275 ha of lake habitat and 21 606 ha of fluvial habitat, of which 2826 ha is estimated to be 1st order stream. The ShIRBD, WRBD and NWIRBD are dominated by lacustrine habitat.

The catchments have been characterised on the basis of their underlying geology, specifically in terms of the proportion of the surface area comprising calcareous and non-calcareous types. This catchment characterisation led to a continuous summary variable for catchment freshwaters, i.e. the proportion of wetted area comprising non-calcareous geology. Lacustrine habitat dominates Ireland's freshwaters, comprising more than 85% of the wetted area. Similarly, calcareous habitat heavily dominates overall.

Water quality in Ireland is generally good and compares favourably with other Member States. The main challenge for water quality is to deal with eutrophication arising from excess inputs of nutrients from all sources. The extent of eutrophication has been increasing persistently since the 1970s and is probably the most serious environmental pollution problem in Ireland. Poor water quality impacts on the potential of rivers to produce salmon. It is unknown whether similar poor water quality levels have an effect on eel. Nationally (RoI), the current water quality in 82.7% of the habitat available for salmon production is unpolluted, a further 12.8% is considered slightly polluted and the remaining 4.5% is considered to be moderately or seriously polluted. In general, persistent organic pollutants were relatively low in the Irish eels sampled to date.

Anguillicoloides crassus continues to spread and more than 70% of the wetted area is now infested (Beccera-Jurado *et al.*, 2014; SSCE, 2014).

Six catchments in Ireland have major hydropower installations in the lower catchments. 46% of the available wetted habitat is upstream of major barriers, although there is a greater proportion (53%) of the potential silver eel production when the differences in relative productivity are taken into account. An average mortality of 28.5% per turbine installation (ICES 2003) was used in assessing the impact of hydropower for the purpose of setting up the EMPs. This mortality figure has since been updated for both the Erne and the Shannon and was reported in the 2012 Report to the EU (Anon, 2012; SSCE, 2014). It is intended that immediate measures will be put in place to mitigate against turbine mortality, including silver eel trap and transport on the Erne, Shannon and Lee. These are outlined in the management actions section. It is also recommended that all new hydropower turbines and potential barriers to upstream migration should be evaluated in Environmental Impact Assessments for potential impacts on eel.

Natural mortality of eels is a major, but relatively unknown, factor in the population dynamics of eels and mortality caused by predation is one of the factors contributing to natural mortality. There are few data on the level of predation on eel in Ireland or on the impact on the eel stock. The most recent census of cormorants in Ireland (Seabird 2000 breeding survey) reports that the Irish coastal population has remained stable since the previous census (1985–1988). Other legislation must be complied with when considering possible actions against predators.

2.2.4 The eel fishery

Glass eel and elver fishing in Ireland is prohibited by law (1959 Fisheries Act). The commercial eel fishery involved harvesting both yellow and silver eel in fresh water and in estuarine or tidal waters. Yellow eel were fished using a variety of techniques, the most common of which are baited longline, fykenets and baited pots. When silver eel were migrating downstream are caught in fykenets and stocking-shaped nets called "coghill nets" which are attached to fixed structures in the river flow, often at "eel weirs". The declared commercial eel catch in the Irish Republic, 2001–2007, ranged from 86 t to 120 t involving about 150–200 part-time fishermen, but inadequate reporting and illegal fishing makes this difficult to quantify accurately and it maybe a substantial under estimate. A total maximum of 278 licences were issued in 2006 and a maximum of 182 of these were actively fished in 2005. The value of the reported catch was therefore in the order of €0.5 million to €0.75 million.

In May 2008, a byelaw was introduced (Conservation of Eel Fishing (Annual Close Season) Bye-law No. C.S. 297, 2008) restricting the fishing season for both yellow and silver eel. Analysis of the impact of implementing a yellow eel fishing season from 1st June to 31st August and a silver eel season from the 1st of October to 31st December showed the impact of the reduced fishing season would have been different in each region with the level of reduction ranging from 7 to 42% in yellow eel catch and 0–40% in silver eel catch.

Recreational eel fishing is only carried out by a minority of rod anglers and there is no legal, or voluntary, declaration of catch which is probably relatively small. There is no legislation protecting eels from angling. All other fishing engines, including, fykenet and baited pots, are authorized under the commercial legislation.

There is no eel culture in Ireland at the present time and none is envisaged in the near future.

NOTE: the commercial eel fishery was closed in Ireland in 2009 and possession of eel caught in the State was deemed illegal. Eel captured in the recreational fishery should be released.

2.2.5 Escapement-local stock modelling

The Irish Management Plans will include a time period for detailed data collection and a parallel programme of stock assessment, including silver eel escapement estimates, and model development. In the interim, the three options proposed in the Eel Regulation were used to make preliminary estimates of pristine production and current escapement. The approach outlined in Article 2 of the Eel Regulation (EC No. 1100/2007) was followed to calculate pristine and current escapement and a simple model was proposed to project the impact of management actions on escapement from fresh waters.

No estimates of truly pristine escapement exist for Irish eel fresh water catchments. Recruitment of juvenile eel to Irish catchments (2003–2007) has declined to between 4% (Shannon) and 23% (Erne) of historical values (1979–1984) and has been particularly poor in 2008. Historical production of silver eels was calculated (for fresh waters only) using catch series for four catchments (where the fishery efficiency was estimated) for periods prior to 1980. These data were calibrated using eel growth rates for 17 catchments and a regression model was developed relating production to catchment geology, a proxy for productivity. This gave historic production rates of 0.9 kg/ha

(Burrishoole; unproductive) to 5.5 kg/ha (Moy; productive) and total historic silver eel potential production (without anthropogenic mortality) of 586 t per annum.

Current (2008) silver eel production from freshwaters was estimated using a similar approach with rates of 1.3 kg/ha (Burrishoole; unproductive) to 2.7 kg/ha (Ennell; productive) and total current silver eel escapement of 143 t. Current (2008) Irish escapement expressed as a percent of historic production (EU target = 40%) range from 10% in the ShIRBD to 68% in the SWRBD. The national percent escapement is 24.3%.

Current (2009–2011 average) silver eel production from fresh waters was estimated using a similar approach with rates of 1.0 kg/ha (Burrishoole) to 1.64 kg/ha (Shannon) and total current silver eel escapement of 216 t. Current (2009–2011 average) Irish escapement expressed as a percent of historic production (EU target = 40%) range from 34.2% in the ShIRBD to 46% in the EEMU and SWRBD. The national percent escapement is 36.9%.

Due to the last 18+years of low and declining recruitment, regardless of which management actions are taken, achieving the 40% EU target in the long term will require a recovery of recruitment arising from concerted international action and cannot be achieved in Ireland alone. It was difficult to assess a timeframe for recovering the predicted downward trend in escapement in the absence of knowing what the European recruitment levels will be in the future and in the absence of a clear timeframe from the EU. To facilitate setting a timescale to recovery it was decided to adopt the approach used by Astrom and Dekker (2007) in predicting the recovery time for recruitment under different reduced levels of mortality. Two assumptions were made: the first that Europe responds in a similar fashion to reducing mortality and the second, that as recruitment recovers towards historical, the Spawning–Stock Biomass is recovering towards the target. Therefore, recruitment recovery is used as an alternative target towards the escapement target. It is also possible that the EU biomass escapement target may be reached in a shorter timescale than full historical recruitment.

2.2.6 Stocking

Purchase of glass eel for stocking from outside the State has not taken place in the last 20 years (at least) and does not currently take place. Assisted migration of upstream migrating pigmented elvers takes place in the Shannon (Ardnacrusha) and Erne (Cathaleen's Fall) and of pigmented young eel (bootlace) on the Shannon (Parteen Regulating Weir). Prior to 2009, small amounts of glass eel and elver were taken in the Shannon estuary and in neighbouring catchments and these were stocked into the Shannon above Ardnacrusha and Parteen HPSs. Given the widespread presence of *Anguillicoloides* and the move towards risk averse management strategies at low recruitment levels, this practice was **discontinued**.

2.2.7 Monitoring and post-evaluation

The National plan describes a comprehensive programme of monitoring and evaluation of management actions and their implementation, and also a programme of eel stock assessment to establish a stock baseline, estimate silver eel escapement and monitor the impact of the management actions on the local stocks.

Ireland is committed to compliance with the Data Collection Framework. Given the cessation of the fishery there was no obligation to undertake sampling under the DCF in 2009–2011.

Ireland has submitted the 2012 Report to the EU with an annexed science report on the status of the eel stock in Ireland.

2.2.8 Management actions

There are four main management actions aimed at reducing eel mortality and increasing silver eel escapement in Irish waters. These are a cessation of the commercial eel fishery and closure of the market, mitigation of the impact of hydropower, including a comprehensive silver eel trap and transport plan, ensure upstream migration of juvenile eel at barriers and improve water quality including fish health and biosecurity issues.

2.2.9 Summary

In 2008, Irish silver eel escapement from freshwaters expressed as a percent of historic production (EU target = 40%) ranged from 10% in the ShIRBD to 68% in the SWRBD. The national percent escapement is 24%.

In 2009–2011, Irish silver eel escapement from freshwaters expressed as a percent of historic production (EU target = 40%) ranged from 34.2% in the ShIRBD to 46% in the EEMU and SWRBD. The national percent escapement is 36.9%.

In general, we have demonstrated an increase in biomass of silver eel escaping and the reduction in mortality caused by fishing and hydropower. While further reduction in mortality is unlikely, it possible that additional biomass will feed through in the coming years from the closure of the yellow eel fishery.

However, it is unclear how the collapse in recent recruitment will impact on silver eel biomass and whether density dependent effects (change from small males to higher proportions of larger females) will buffer the collapse in recruitment by temporarily increasing biomass of silver eels, even with falling numbers.

The projected indications, given past recruitment patterns, yellow eel surveys and the closure of the yellow eel fishery, are that production of silver eels will remain at current levels, or may even increase until circa 2018, after which it is anticipated that a marked reduction will take place. Recruitment in the Erne, in particular, was relatively high between 1994 and 2001 and it is anticipated that this will have a positive effect on silver eel production in the coming 5–6 years. Some RBDs (e.g. SERBD & SWRBD) may already be showing the impact of declining recruitment.

It is therefore unlikely that the EU target and recovery of recruitment to historic levels will be achieved within the projected 90 years outlined in the Irish EMP. While management measures (i.e. cessation of fishing, trap and transport around hydropower stations) implemented in Ireland have led to considerable improvements in silver eel escapement, equivalent EU-wide actions have not, to the best of our knowledge, taken place. Further improvement in silver eel production is contingent on increased recruitment of juveniles to Irish waters. Conclusion of the EU 2012 reporting and evaluation process will provide the opportunity to evaluate whether the initial implementation of the Regulation is likely to lead to an improvement in recruitment.

3 Time-series data

Figure 3.1 gives the locations of the recruitment time-series in Ireland. Recruitment monitoring of 0+ age glass eel (elvers) takes place on the Shannon at Ardnacrusha and the Erne at Cathaleen's Fall (Ballyshannon) and of >0+ age recruits at Parteen Regulating weir on the Shannon. Additional monitoring takes place at a number of stations, mostly in the Shannon Region and on the Lee (south coast); Ballysadare, Corrib (west coast) and the Liffey (east coast).

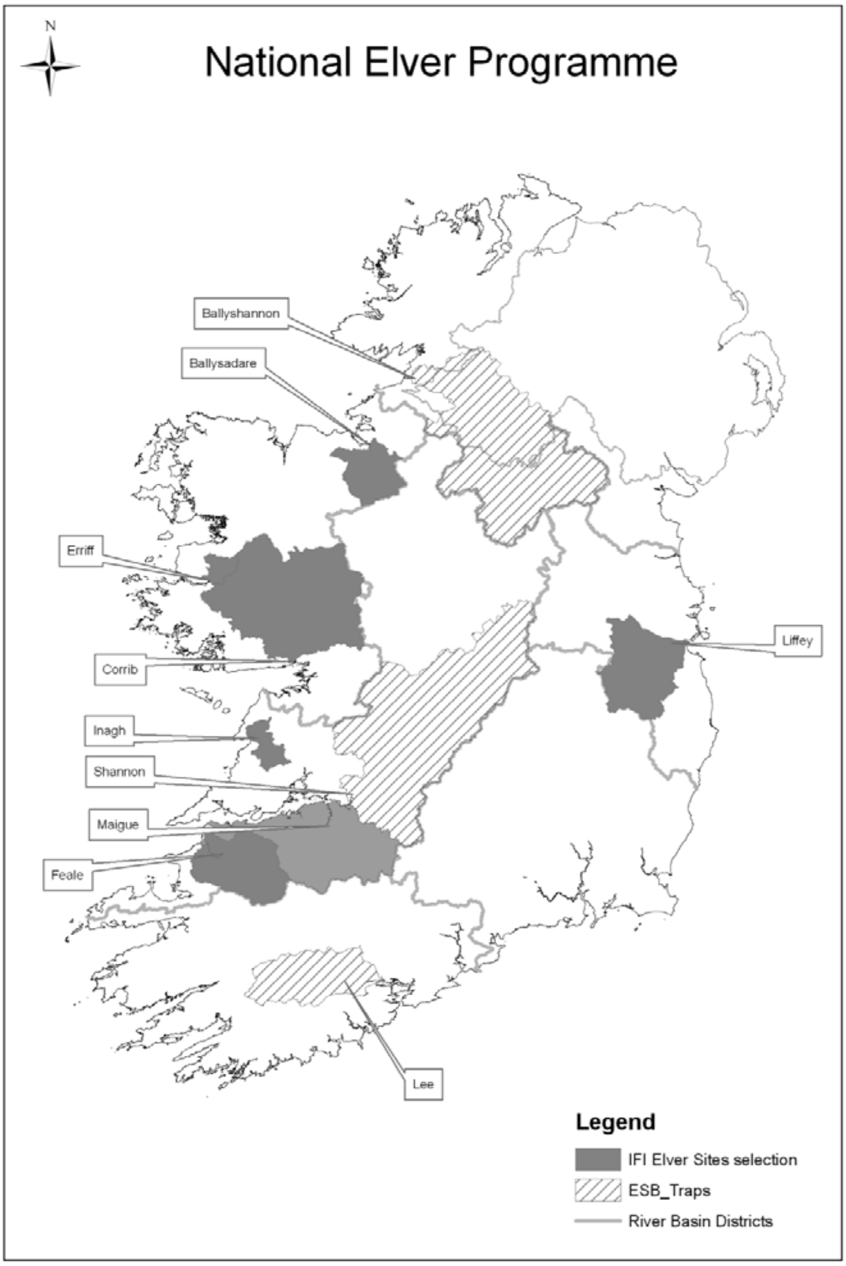

Figure 3.1. Location of recruitment monitoring stations in Ireland.

3.1 Recruitment

3.1.1 Glass eel recruitment

3.1.1.1 Commercial

There is no authorised commercial catch of juvenile eel in Ireland as glass eel and elver fishing in Ireland is prohibited by law (1959 Fisheries Act, Sec. 173).

3.1.1.2 Recreational

There is no recreational catch of juvenile eel in Ireland as glass eel and elver fishing in Ireland is prohibited by law (1959 Fisheries Act, Sec. 173).

3.1.1.3 Fishery independent

There is no authorised commercial catch of juvenile eel in Ireland, but some fishing has been authorised in the past under Section 18 of the Fisheries Act for enhancement of the fisheries. Catches are made at impassable barriers and this is reported in the relevant Regional Eel Management Plans.

Monitoring of elver migrating at Ardnacrusha (Shannon) and Cathaleen's Fall (Erne) is undertaken by the ESB (Figure 3.2). Indications are that recruitment remains low. Catches in 2004 for both Erne and Shannon were the second lowest recorded. Numbers in 2005 were more unpredictable, with good catches of elvers recorded in the Erne (45% of the 1979–1984 mean) and a poor catch in Ardnacrusha (1.4% of the 1979–1984 mean). 64% of the Erne catch was made in April 2014, with 25% on the first night on the 22nd April.

There was an increase in elver catch in both the Erne and the Shannon in 2012 and 2013 and in the Erne in 2014. The 2014 Shannon catch was similar to 2013.

Long-term monitoring of elver migrating also takes place at on the Feale, Inagh and Maigue Rivers and fishing was also previously undertaken in the Shannon Estuary for glass eels (Tables 3.1–3.2).

All catches reported in Tables 3.1–3.2 were transported upstream within the catchment and restocked. Additional elver monitoring is shown in Table 3.3.

Due to the unseasonal high rainfall during the summer of 2012, the Inagh and the Maigue sites in the Shannon River Basin District were unable to be monitored. The Feale site started catching elvers on the 9th April 2012 and fished up to the 2nd June when flood conditions resulted in the trap being unable to fish (Table 3.2). Despite not fishing for most of June and July the catch of elvers has increased compared with 2011.

There are two monitoring traps on the Liffey; a second trap was installed on the weir in 2012 due to the low levels of catches in 2010 and in 2011. However in 2012 both traps caught more elvers than in the previous two years. The two traps were monitored in 2013 and 2014 but catches remained low.

Pipe traps were used for monitoring elvers in the Corrib for the last four years. Catches in the pipe traps were variable and seemed to be influenced by changes in water flow. A ramp trap was introduced along with the pipe traps in 2013 and the ramp was continued in 2014.

The data for Ballysadare are 0.842 kg in 2012, just below the 0.924 kg in 2013. The fish pass was closed in early June 2014 compared to 2013 when it was July due to low water levels. 84% of the catch came the 24th April 2014; similar April run as observed in the Erne.

Recruitment for the 2013 and 2014 seasons indicated that there was a general increase in the recruitment levels to Ireland in 2013. The picture was less clear in 2014 with three sites showing decreases, three sites showing increases and one site with little change.

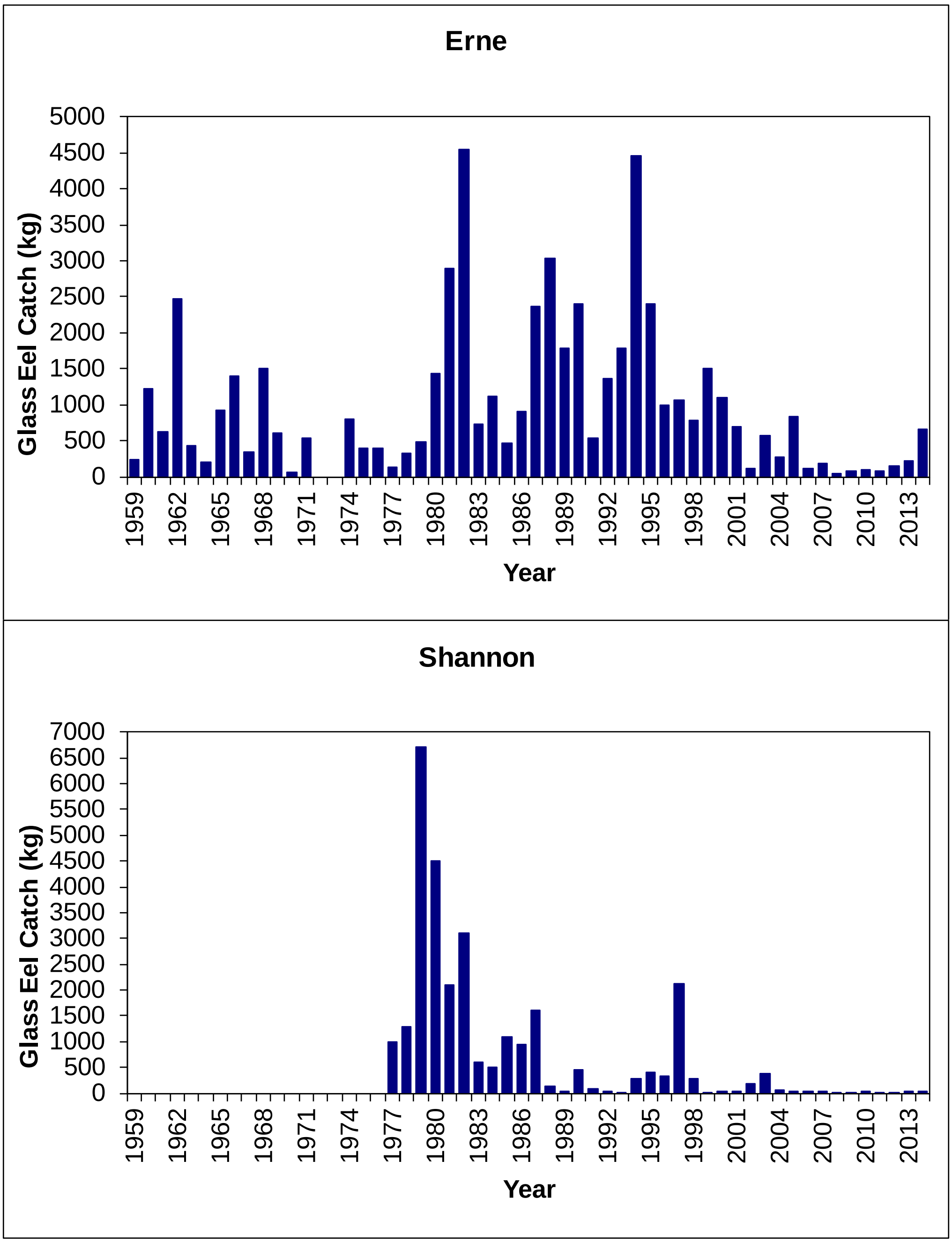

Figure 3.2. Annual elver catches (t) in the traps at Ardnacrusha (Shannon) and Cathaleen's Fall (Erne); data from ESB. Full trapping of elvers took place on the Erne from 1980 onwards.

Table 3.1. Annual elver catches (kg) in the traps at Ardnacrusha (Shannon) and Cathaleen's Fall (Erne).

Year	Erne (kg)	Shannon (kg)	Year	Erne (kg)	Shannon (kg)
1952			1984	1121	500
1953			1985	463	1093
1954			1986	898	948
1955			1987	2367	1610
1956			1988	3033	145
1957			1989	1781	27
1958			1990	2409	467
1959	244		1991	546	90
1960	1229		1992	1371	32
1961	625		1993	1785	24
1962	2469		1994	4463	287
1963	426		1995	2400	398
1964	208		1996	1000	332
1965	932		1997	1065	2120
1966	1394		1998	782	275
1967	345		1999	1500	18
1968	1512		2000	1100	39
1969	600		2001	699	27
1970	60		2002	113	178
1971	540		2003	576	378
1972			2004	269	58
1973			2005	838	41
1974	794		2006	118	42
1975	392		2007	189	45
1976	394		2008	38.7	7
1977	138	1000	2009	88.3	8
1978	320	1300	2010	96.6	50
1979	488	6700	2011	74.34	7
1980	1434	4500	2012	145.71	23
1981	2892	2100	2013	214.7	47
1982	4550	3100	2014	659.37	45
1983	728	600			

Table 3.2. Glass eel catches (kg), 1985 to 2014 (blanks = not fished).

Year	Erne Estuary	Moy Estuary	R Feale	R Maigue	Inagh R	Sh. Estuary Glass Eels	R. Liffey MI	R. Liffey IFI
1985			503					
1986								
1987								
1988								
1989								
1990								
1991								
1992								
1993								
1994			70	14				
1995			0	194				
1996			0	34	140			
1997			407	467	188	616		
1998	46		81	8	11	484		
1999	441		135	0	0	416		
2000	188		174	0	120	43		
2001		13	58	2	18	1		
2002		21	116	5		37		
2003		36	36	72	111	147		
2004		0	0	0	24	1		
2005		14	0	1	0	41		
2006		0	1	0	4	3		
2007		0	0	0	39	12		
2008		0	0	0	82.5	2		
2009		1	42					
2010		7	20	3	1.3	3		
2011		0	5	5	8			
2012		0	55		*		0.5	0.2
2013			68	14	43		1.1	2.7
2014			5	29**	40		0.3	0.3

*** trap flooded ** partial trapping effort to avoid mortality due to large run.**

Table 3.3. Recruitment data for the years 2010–2014.

Location	Year	Total Wt. Elvers (kg)	Est. No. Elvers	Av Wt. Elver (g)	Total Wt. Yellow Eels (kg)	Est. Nos Yellow Eels	Av. Wt. Yellow Eel (g)
Ballysadare	2013	0.924	2,640	0.35	4.612	1,005	4.59
	2014	0.842	2,148	0.35	0.873	203	4.51
Corrib pipe trap	2010	29.696	95,254	0.33	7.401	728	9.83
	2011	4.189	11,970	0.35	24.493	3,244	7.55
	2012	2.383	5,168	0.34	7.487	1,143	8.55
C Ramp and pipe	2013	14.260	42,064	0.34	12.520	2,149	5.41
Corrib Ramp trap	2013*	10.168	29,994	0.34	0	0	-
	2014	3.283					
Feale	2010	20.361	42,161	0.48			
	2011	1.099	3,139	0.35	6.298	834	7.55
	2012	35.975	102,785	0.35	10.860	1,601	5.47
	2013	44.661	71,854	0.62	23.313	6,133	4.31
	2014	3.224	6,466	0.48	1.343	301	4.88
Inagh	2010	1.417	2,931	0.5			
	2011	8.168	23,338	0.35	7.134	945	7.55
	2012	*	*	*	*	*	*
	2013	31.069	88,641	0.35	12.581	4,089	3.07
	2014	34.894	90,153	0.39	4.690	1,152	4.25
Liffey	2012	0.213	608	0.35	-	-	-
	2013	2.742	7,849	0.35	-	-	-
	2014	0.285	746				
Liffey MI	2012	0.454	1,298	0.35	-	-	-
	2013	1.144	3,359	0.36			
	2014	0.311	1,402			4	
Maigue	2010	2.772	5,650	0.42	-	-	-
	2011	5.061	13,678	0.37	0.054	7	7.55
	2012	*	*	*	*	*	*
	2013	14.032	39,665	0.35	0.019	3	6.4
	2014	29.020	78,042	0.37	-	-	-

3.1.2 Yellow eel recruitment

3.1.2.1 Commercial

There is no authorised commercial catch of juvenile eel in Ireland as glass eel and elver fishing in Ireland is prohibited by law (1959 Fisheries Act, Sec. 173). Fishing for juvenile eel is also prohibited under the conservation bye-laws.

3.1.2.2 Recreational

There is no authorised recreational catch of juvenile eel in Ireland as glass eel and elver fishing in Ireland is prohibited by law (1959 Fisheries Act, Sec. 173).

3.1.2.3 Fishery independent

Monitoring of juvenile yellow eel migrating at Parteen Dam (Shannon) and Inniscarra on the R. Lee takes place using fixed brush traps.

The data for Parteen are presented in Figure 3.3 and Table 3.4. In 2009 and 2010, due to maintenance work by ESB at the Parteen regulating weir the discharge patterns were less favourable than in 2008. This may partly account for the poor catches recorded in 2009 and 2010. However, catches in the Parteen trap continued to decline in 2011, 2012 and 2013. The catch in 2014 was 365 kg.

A new trap was installed in 2012 on the Shannon at Parteen, on the opposite bank. The catch was 6.6 kg and 6.8 kg in 2013 and 7.8 kg in 2014.

In 2010, less than one kg was recorded in the Inniscarra trap on the River Lee and in 2011, 48 kg were recorded. The catch has declined since 2011 with only 0.6 kg recorded in 2014.

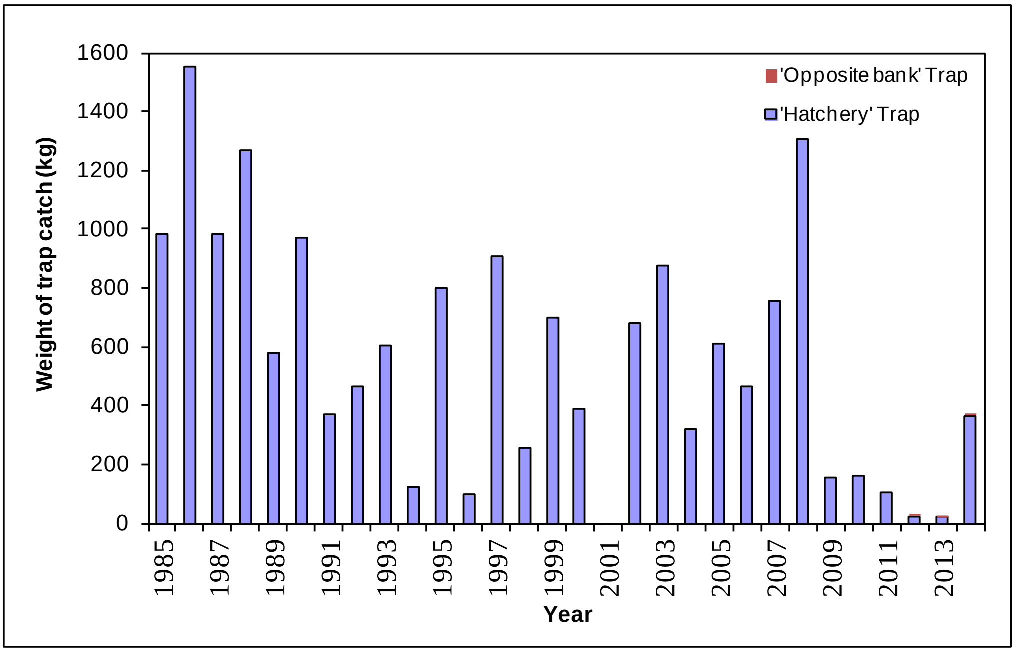

Figure 3.3. Juvenile yellow eel catches (kg) at Parteen Weir, 1985 to 2014. From 2012, a second trap was installed on the opposite bank and this is included in the figure.

Table 3.4. Juvenile yellow eel catches (kg), 1985 to 2014.

	Shannon	Shannon	Lee
Year	Parteen hatchery	Parteen New trap	Inniscarra
1985	984		
1986	1555		
1987	984		
1988	1265		
1989	581		
1990	970		
1991	372		
1992	464		
1993	602		
1994	125		
1995	799		
1996	95		
1997	906		
1998	255		
1999	701		
2000	389		
2001	3		
2002	677		
2003	873		
2004	320		
2005	612		
2006	467		
2007	757		
2008	1303		
2009	153		
2010	159.5		1
2011	104.5		48
2012	23.9	6.6	23.8
2013	20.3	6.8	5
2014	365.3	7.8	0.6

3.2 Yellow eel landings

There are no true index series for yellow eel landings. Most of the data were aggregated by RBD.

3.2.1 Commercial

There are no new landings data since 2008 as the commercial fisheries were closed in 2009.

3.2.2 Recreational

There are no data available for yellow eel caught by recreational fishermen (only rod angling).

3.3 Silver eel landings

Commercial Silver Eel Fisheries were closed in 2009.

3.3.1 Commercial

3.3.1.1 Shannon

The annual downriver migrations of silver eels have traditionally been exploited in the River Shannon and the three commercial eel weirs, owned by ESB since 1937, have continued this practice with varying success (Figure 3.4; Table 3.5). In many respects the overall pattern of change, with steadily declining silver eel catches at Killaloe/Clonlara, but relatively steady catches at Athlone, mirrors the results obtained by monitoring the Lough Derg fykenet cpue yellow eel catches versus those in upper catchment lakes.

The silver eel run was fished at a limited number of stations in 2009/2010 as a conservation fishery for trap and transport around the barriers at Parteen and Ardnacrusha. The silver eel catch in 2009/2010 in Killaloe was 12.020 t, upstream of Killaloe it was 12.999 t, giving a total silver eel catch for the river of 25.019 t, of which 23.73 t were released downstream of the turbine. 1.17 t was lost in a flood back into the river and the remainder were taken as samples.

The silver eel run was fished at a limited number of stations in 2010/2011 as a conservation fishery for trap and transport around the barriers at Parteen and Ardnacrusha. The silver eel catch in 2010/2011 in Killaloe was 12.722 t, upstream of Killaloe it was 15.536 t, giving a total silver eel catch for the river of 28.258 t, of which 27.768 t was released downstream of the turbine. The remainder was taken as samples and 490 kg were returned to the river for tracking studies.

The silver eel run was again fished at a limited number of stations in 2011/2012 as a conservation fishery for trap and transport around the barriers at Parteen and Ardnacrusha. The silver eel catch in 2011/2012 in Killaloe was 10.402 t, upstream of Killaloe it was 15.550 t, giving a total silver eel catch for the river of 26.952 t, of which 25.680 t were released downstream of the turbine. The remaining 272 kg were returned to the river for tracking studies.

The silver eel run was fished at a limited number of stations in 2012/2013 as a conservation fishery for trap and transport around the barriers at Parteen and Ardnacrusha. The silver eel catch at Killaloe was 12.48 t which was over half the total catch (24.23 t) on the Shannon in 2012. The fishing season at Killaloe extended from 19/10/2012 to 09/02/2013 and a total of 97 nights were fished at that location. Fishing at the other sites ended in late November (Finea and Rooskey) and late December (Athlone).

The silver eel run was fished at a limited number of stations in 2013/2014 as a conservation fishery for trap and transport around the barriers at Parteen and Ardnacrusha. The silver eel catch at Killaloe was 12.808 t which was over half the total catch (22.561 t) on the Shannon in 2013. The fishing season at Killaloe extended from 23/10/2013 to 26/02/2014. Fishing at the other sites ended in early December.

Note: while the effort in Killaloe has probably remained similar in recent years, the catch & cpue may now be influenced by changes in management and effort further upstream in the Shannon.

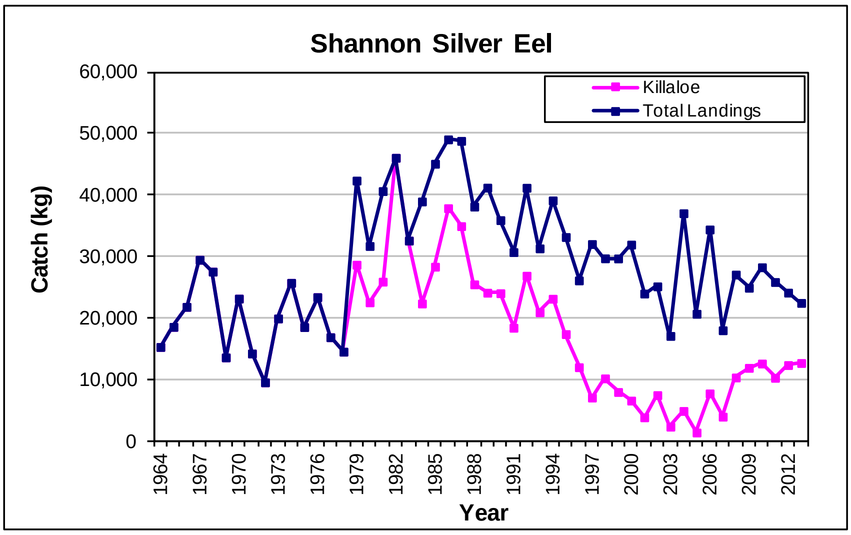

Figure 3.4. Silver eel catches from the Killaloe eel weir and the total Shannon system, for 1964 to 2013. Note that the totals in 2009–2013 are for a conservation fishery with reduced effort: Killaloe effort remains comparable.

3.3.1.2 Corrib

The Galway Fishery comprised a weir with 14 coghill nets. These were fished throughout the dark moon phases and could be lifted during periods of very high water. The fishery was purchased by the state in 1978 and has been fished consistently since then. Fishing effort may have increased in later years. The downward trend in silver eel catch (Figure 3.5; Table 3.5) therefore probably reflects the decreasing stock in the greater Corrib catchment and falling silver eel escapement. The catch in 2007 was 9.3 t, in 2008 it was 5.2 t and in 2009 it was 12.65 t. The data in 1976 and 1977 for the Galway Fishery are estimates.

The Galway Fishery was not fished in since 2010 due to structural safety issues with the weir.

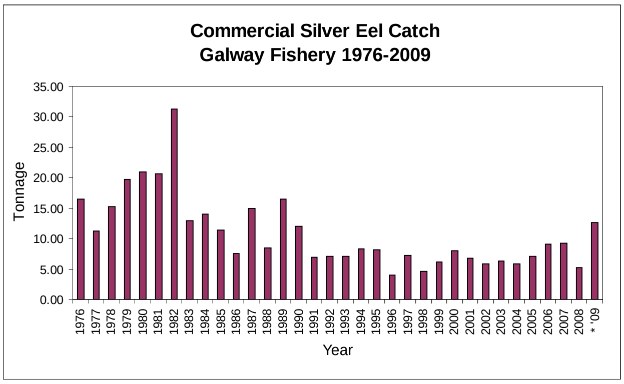

Figure 3.5. Annual silver eel catch (t) in the commercial Galway Fishery, Corrib System, for 1976 to 2009. *Note the fishery was operated as a research catch & release fishery in 2009 and was closed in 2010.

Table 3.5. Annual silver eel catch (t) in the commercial Galway Fishery, Corrib System and for the Killaloe Fishery and total Shannon catch. Note: 2009–2013 was a non-commercial fishery. nf = not fished.

Season	Year	Galway Fishery	Shannon Killaloe	Shannon Total
1964/65	1964		15.4	15.4
1965/66	1965		18.7	18.7
1966/67	1966		21.9	21.9
1967/68	1967		29.6	29.6
1968/69	1968		27.6	27.6
1969/70	1969		13.7	13.7
1970/71	1970		23.3	23.3
1971/72	1971		14.4	14.4
1972/73	1972		9.7	9.7
1973/74	1973		20.0	20.0
1974/75	1974		25.8	25.8
1975/76	1975		18.6	18.6
1976/77	1976	16.5	23.5	23.5
1977/78	1977	11.3	17.0	17.0
1978/79	1978	15.3	14.6	14.6
1979/80	1979	19.7	28.8	42.4
1980/81	1980	20.9	22.7	31.8
1981/82	1981	20.6	26.0	40.7
1982/83	1982	31.3	46.1	46.1
1983/84	1983	13.0	32.7	32.7
1884/85	1984	14.0	22.5	39.0
1985/86	1985	11.4	28.4	45.1
1986/87	1986	7.5	37.9	49.1
1987/88	1987	15.0	35.0	48.9
1988/89	1988	8.5	25.6	38.2
1989/90	1989	16.5	24.2	41.3
1990/91	1990	12.1	24.1	36.0
1991/92	1991	7.0	18.5	30.8
1992/93	1992	7.2	27.0	41.2
1993/94	1993	7.1	21.0	31.4
1994/95	1994	8.3	23.2	39.2
1995/96	1995	8.2	17.5	33.3
1996/97	1996	4.1	12.1	26.2
1997/98	1997	7.3	7.2	32.1
1998/99	1998	4.6	10.3	29.8
1999/00	1999	6.1	8.1	29.8
2000/01	2000	8.0	6.7	32.0
2001/02	2001	6.8	4.0	24.1
2002/03	2002	5.8	7.6	25.2
2003/04	2003	6.3	2.5	17.2
2004/05	2004	5.8	5.0	37.1

Season	Year	Galway Fishery	Shannon Killaloe	Shannon Total
2005/06	2005	7.2	1.5	20.8
2006/07	2006	9.2	7.9	34.5
2007/08	2007	9.3	4.1	18.1
2008/09	2008	5.2	10.5	27.2
2009/10	2009	12.7	12.0	25.0
2010/11	2010	nf	12.7	28.3
2011/12	2011	nf	10.4	26.0
2012/13	2012	nf	12.5	24.2
2013/14	2013	nf	12.8	22.6

3.3.2 Recreational

There is no recreational silver eel fishing in Ireland. All silver eel fishing was authorised and recorded under the commercial effort. Silver eel fishing is currently closed.

3.3.3 Fishery independent

3.3.3.1 Burrishoole

The only total silver eel production and escapement data available in Ireland are for the Burrishoole catchment in the Western RBD, a relatively small catchment (0.3% of the national wetted area), in the west of Ireland. The Burrishoole consists of rivers and lakes with relatively acid, oligotrophic, waters. The catchment has never been commercially fished for yellow eels, not been stocked and there are no hydropower turbines.

The eels have been intensively studied since the mid-1950s; total silver eel escapement from freshwater was counted since 1970 (Poole *et al.*, 1990; Poole, data unpublished); and an intensive baseline survey was undertaken in 1987–1988 (Poole, 1994). The detailed nature of the Burrishoole data make it suitable for model calibration and validation (e.g. Dekker *et al.*, 2006; Walker *et al.*, 2011).

3.3.3.2 Catch

Silver eel trapping was continued in 2013. The total run amounted to 3623 eels. The main run (68%) occurred in October following a period of low water during late September and most of October (Figure 3.6).

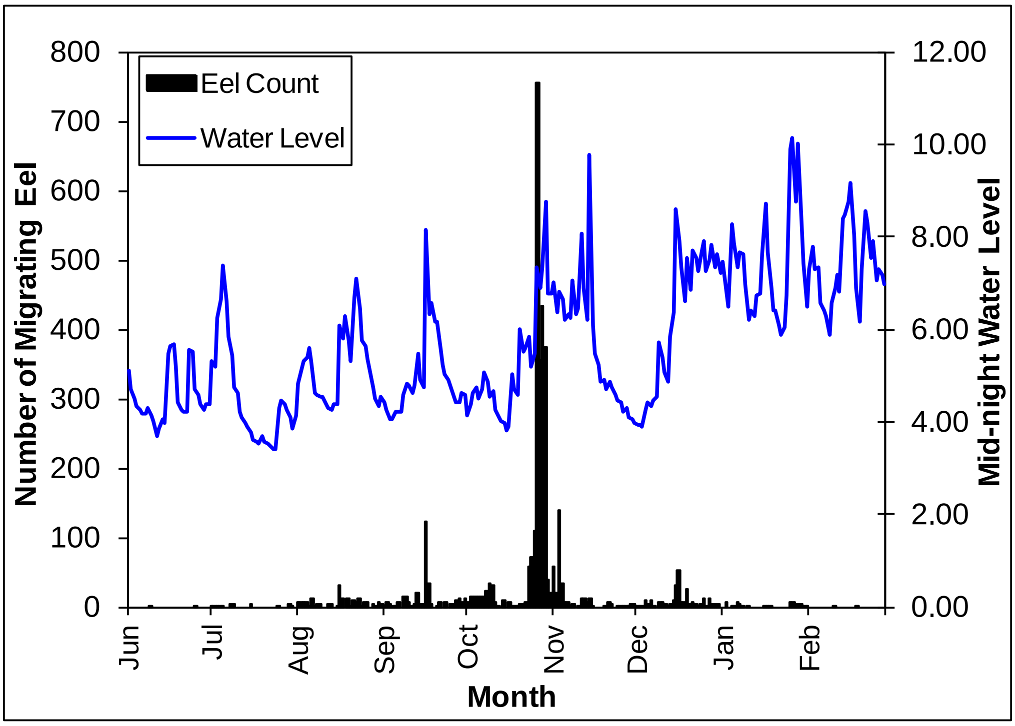

Figure 3.6. Daily counts of downstream migrating silver eel and midnight water levels (m); 2013 migration season.

Counts of silver eel between the years 1971 (when records began) and 1982 averaged 4400, fell to 2200 between 1983 and 1989 and increased again to above 3000 in the 1990s (Figure 3.7). The average weight of the eels in the samples has been steadily increasing from 95 g in the early 1970s to 216 g in both the 1990s and the 2000s (Figure 3.7).

In 2012, the majority of the eel run was sampled (n=3317; 99.5%). The run increased from 1969 eels in 2011 to 3335 eels in 2012 and the average weight decreased from 180 g to 163.5 g. The sex ratio changed from 24% to 45% over the past five years. Male eels have remained the same length over the past 15 years (36 cm) whereas the females have changed on average from 53 cm (1997–2005) to 50 cm (2008–2012) and they were 49.2 cm in 2012.

In 2013, the migration was 3623 eels and 1332 (37%) were sampled. The mean weight was 157.3 g and the proportion of male eels was similar to that in 2012 at 45.7%.

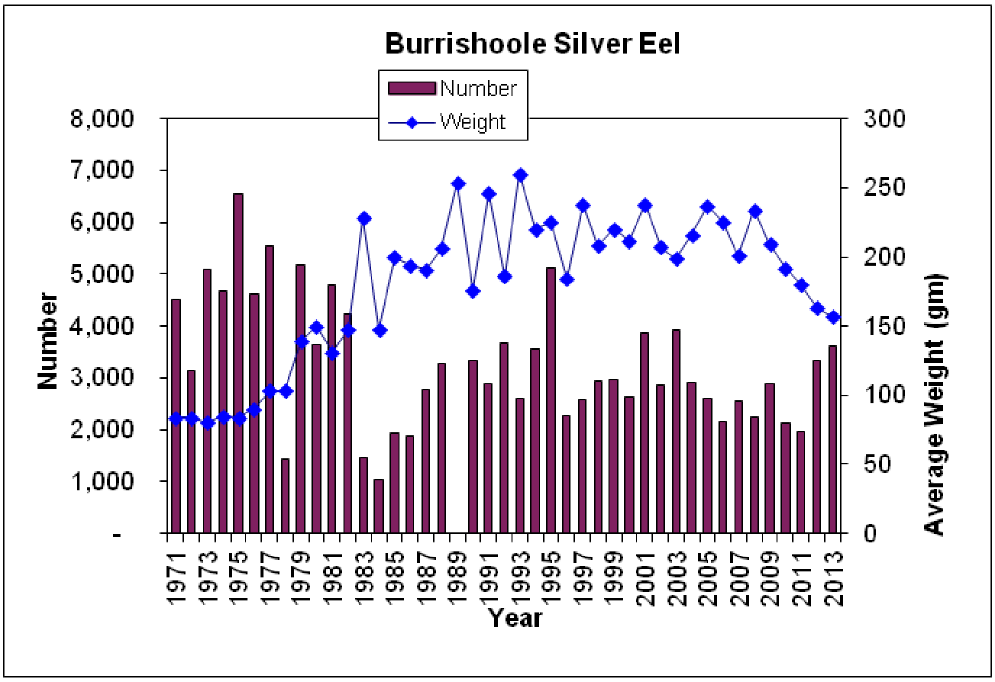

Figure 3.7. Annual number and mean weight of silver eels trapped in the downstream traps.

3.4 Aquaculture production

Not applicable; no culture in Ireland

3.4.1 Seed supply

Not relevant.

3.4.2 Production

Not applicable; no culture in Ireland.

3.5 Stocking

No stocking of imported eel takes place in Ireland. The only stocking that takes place is an assisted upstream migration around the barriers on the Shannon, Erne and Lee. All recruits reported in Tables 3.1–3.3 were moved upstream in assisted migration.

3.5.1 Catch of eel <12 cm and proportion retained for restocking

No stocking of imported eel takes place in Ireland. There is no catch of eel <12 cm in Ireland and therefore no retention for stocking.

3.5.2 Reconstructed time-series

Not relevant to Ireland as most stocking is upstream assisted migration within the same catchment.

3.6 Trade in eel

There was no trade of eel in Ireland and no official import or export of any life stage of eel.

Illegal trade 2013

Four regions have reported some level of illegal fishing in 2013 which led to gear and equipment seizures (ERBD, ShIRBD, WRDB, NWRBD). Some old lost nets were also located in the WRBD. The most significant activity appeared to be in the Shannon IRBD with 1100 m of fykenet (approximately 70 nets) and 800 m of longline seized. It is likely, however, that eel sales have occurred in the Shannon IRBD given the level of seizures.

No seizures of eel dealers transport trucks have been reported and no illegal activity was reported in relation to the silver eel trap and transport programmes.

No export data are currently available to the SSCE which is making it difficult to determine the level of illegal catch. There were no instances of seizures of illegal or undocumented eel shipments.

4 Fishing capacity

Prior to 2009

Bye-law No. C.S. 297

In May 2008, the Minister for Communications, Energy and Natural Resources introduced a byelaw (Conservation of Eel Fishing (Annual Close Season) Bye-law No. C.S. 297, 2008). This Bye-law prohibited the taking or fishing for yellow eel under 30cm in length. The Bye-law also provided for a close season for yellow eel, from 1 September to 31 May of the following year. The Bye-law also provided for a close season for silver eel from 1 January to 30 September in any year.

Bye-Law No. 838, 2008

In May 2008, the Minister for Communications, Energy and Natural Resources introduced a byelaw (Conservation of Eel Fishing (Restriction on Issue of Licences) Bye-Law No. 838, 2008). This Bye-law capped the number of eel fishing licences which may be issued in each Fishery District in 2008 or any year thereafter.

The Management of Eel Fishing Bye-Law No.752, 1998 capped the number of long-line licenses that a Regional Fisheries Board may issue for longline fishing for eels in any district. In addition, the Fisheries (Amendment) Act 1999 delegated authority to the Regional Fisheries Boards to issue authorisations for the use any fishing engine for the capture of eels including any longline, as it sees fit.

Each Regional Fisheries Board had a policy on the number of fykenets permitted for each licence and in some cases the locations where they are permitted to fish. It was difficult to convert the number of licensed nets into an actual fishing effort, as many licensed fisherman either didn't fish at all or only fished for a limited period of the year. In some areas for example, such as in the south east, fykenets were used during the weaker tides and baited pots were used when the tides were too strong for fykenets.

4.1 2009–2015 Bye-laws.

CONSERVATION OF EEL FISHING BYE-LAW NO. C.S. 303, 2009

In May 2009, the Minister for Communications, Energy and Natural Resources introduced a byelaw (Conservation of Eel Fishing Bye-law No. C.S. 303, 2009). This Bye-law prohibits fishing for eel, or possessing or selling eel caught in a river in the State.

CONSERVATION OF EEL FISHING (PROHIBITION ON ISSUE OF LICENCES) BYE-LAW NO. 858, 2009

In May 2009, the Minister for Communications, Energy and Natural Resources introduced a byelaw (Conservation of Eel Fishing (Prohibition on Issue of Licences) Bye-Law No. 858, 2009). This Bye-law prohibits the issue of any licences for fishing for eels of the species Anguilla anguilla by any fishing method in any fishery district.

These two bye-laws revoked the previous bye-laws enacted in 2008 and close all fisheries for 2009–2012.

It should be noted that since EU Commission ratification of the Ireland/UK NWIRBD transboundary plan in March 2010, the fishery in the NI portion of the Erne was closed from April 2010 to date.

Following a public consultation in June 2012, Minister O'Dowd signed a new byelaw (C.S. 312/2012) on the 7th December prohibiting the fishing for eel in Ireland and the possession of eel caught in Ireland.

Bye-law No C.S. 312, 2012 prohibits fishing for eel, or possessing or selling eel caught in a Fishery District in the State until June 2015

4.2 Glass eel

There was no authorised commercial fishing of juvenile eel in Ireland as glass eel and elver fishing in Ireland is prohibited by law (1959 Fisheries Act, Sec. 173).

4.3 Yellow eel

There was no authorised commercial fishing of yellow eel in Ireland for 2009–2013. No licences were issued from 2009 to 2014.

4.4 Silver eel

There was no authorised commercial fishing of silver eel in Ireland for 2009–2013. No licences were issued from 2009 to 2014.

4.5 Marine fishery

There was no authorised commercial fishing of any eel in marine waters in Ireland for 2009–2013. No licences were issued from 2009 to 2014.

5 Fishing effort

In May 2008, the Minister for Communications, Energy and Natural Resources introduced a byelaw (Conservation of Eel Fishing (Annual Close Season) Bye-law No. C.S. 297, 2008) restricting the fishing season for both yellow and silver eel as follows:

a) to take or to attempt to take, or to fish for or to attempt to fish for, or to aid or assist in the taking or fishing for or the attempting to take or fish for, or to be in possession of brown eel during the period:
   - i) from 16 May 2008 to 31 May 2008, and
   - ii) in any year from 1 September to 31 May in the next following year.

b) to take or to attempt to take, or to fish for or to attempt to fish for, or to aid or assist in the taking or fishing for or the attempting to take or fish for, or to be in possession of silver eel during the period
   - i) from 16 May 2008 to 30 September 2008, and
   - ii) in any year from 1 January to 30 September.

Fishing effort was not monitored in the Irish eel fishery. There was no logbook or compulsory recording system for fishermen and there is no eel dealer register or regular monitoring of eel dealers. There is also no registration of fishing boats in the eel fishery. Efforts were made to improve on the data collection by circulating an agreed catch reporting form which may lead to data discontinuity.

In May 2009, the Minister for Communications, Energy and Natural Resources introduced byelaws prohibiting fishing for eel, or possessing or selling eel caught in a river in Ireland and prohibiting the issue of any licences for fishing for eels of the species *Anguilla anguilla* by any fishing method in any fishery district.

In December 2012, the Minister for Communications, Energy and Natural Resources signed a new byelaw (C.S. 312/2012) on the 7th December prohibiting the fishing for eel in Ireland and the possession of eel caught in Ireland. *Bye-law No C.S. 312, 2012 prohibits fishing for eel, or possessing or selling eel caught in a Fishery District in the State until June 2015*

5.1 Glass eel

There is no authorised commercial effort for juvenile eel in Ireland as glass eel and elver fishing in Ireland is prohibited by law (1959 Fisheries Act, Sec. 173).

No licences were issued from 2009 to 2013.

5.2 Yellow eel

No licences were issued from 2009 to 2013.

5.3 Silver eel

No licences were issued from 2009 to 2013.

5.4 Marine fishery

There was no authorised marine fishery in Ireland. Fishing took place in transitional estuaries and lagoons and this effort was licensed and managed along with the inland fisheries.

6 Catches and landings

Until 2008 there was no compulsory declaration of eel catch in Ireland and in many regions, declarations of catches are not complete and under-reporting is probably widespread. Reported catches were available on an annual basis at the Fisheries Regional Level with most RFBs reporting on a District basis. The introduction of a new catch reporting form led to considerable improvement in the system after 2005.

For the Eel Management Plans, catches (RoI) of yellow and silver eel have been collated from the District returns and are presented in the 2010 Country Report for Ireland. Also included were the catches for the N. Ireland part of the NWIRBD on the Erne supplied by DCAL and AFBINI.

It would appear from the declared catch data that the conservation byelaws implemented in 2008 had little impact on the catch. This may be due to a number of factors, including greater effort in a shorter season, better data reporting and recording since 2005 and changes in reporting practices by fishermen.

With the introduction of the Conservation of Eel Fishing bye-laws in 2009, all regions confirmed a closure of the eel fishery for the 2009 to 2012 seasons with no licences issued. In the transboundary areas 'The Foyle Area and Carlingford Area (Conservation of Eels) Regulations 2009' was created which prohibits the taking or killing of eels within the FCILC area. Some illegal fishing was reported and there were concerns about the traceability of eels in dealer trucks passing through some areas. Overall, illegal activity was thought to be relatively low (Ireland 2012).

6.1 Glass eel

There is no authorised commercial catch of juvenile eel in Ireland as glass eel and elver fishing in Ireland is prohibited by law (1959 Fisheries Act, Sec. 173).

6.2 Yellow eel

No official catch 2009–2013.

6.3 Silver eel

No official catch 2009–2013.

6.4 Marine fishery

No official catch 2009–2013.

6.5 Recreational fishery

The legislation (CONSERVATION OF EEL FISHING BYE-LAW NO. C.S. 303, 2009) prohibits the possession of eel caught in Ireland and this extends to cover recreational angling. There was no legal recreational catch and rod angling for eel, even as bycatch during angling for other species, was on a catch and release basis (Table 6.1).

Table 6.1. Recreational Fisheries: Retained and Released Catches.

	Retained				Released			
	Inland		Marine		Inland		Marine	
Year	Angling	Passive Gears	Angling	Passive gears	Angling	Passive gears	Angling	Passive gears
2012	0	0	0	0	Catch & Release	Not fished	Catch & Release	Not fished
2013	0	0	0	0	Catch & Release	Not fished	Catch & Release	Not fished
2014	0	0	0	0	Catch & Release	Not fished	Catch & Release	Not fished

Passive gears were not fished from 2012–2014 so there is zero % mortality of released eels (Table 6.2). The number of eels caught by anglers is unknown and the % of angler caught eels released that die is also unknown. This has not been taken into account in the 2009–2011 stock indicators.

Table 6.2. The catch and release mortality (%) used in your country for angling in marine and inland waters.

	Released			
	Inland		Marine	
Year	Angling	Passive gears	Angling	Passive gears
2012	?	0	?	0
2013	?	0	?	0
2014	?	0	?	0

6.5 Bycatch, underreporting, illegal activities

Four regions have reported some level of illegal fishing which led to gear and equipment seizures (ERBD, ShIRBD, WRDB, NWRBD) (SSCE, 2014). Some old lost nets were also located in the WRBD. The most significant activity appeared to be in the Shannon IRBD with 1100m of fykenet (approximately 70 nets) and 800 m of longline seized. It is likely, however, that eel sales have occurred from the Shannon IRBD given the level of seizures of gear but no seizures of catch have been made.

No seizures of eel dealers transport trucks have been reported and no illegal activity was reported in relation to the silver eel trap and transport programmes.

No export data is currently available to the SSCE which is making it difficult to determine the level of illegal catch. There were no instances of seizures of illegal or undocumented eel shipments.

Table 6.3. Estimation of underreported catches in Country, per EMU and Stage.

		Glass eel				Yellow eel				Silver Eel				Combined (Y + S)			
Year	EMU_code	Reported catches (kg)	Underrept. %	Underrept. (kg)	Total catches (kg)	Reported catches (kg)	Underrept. %	Underrept. (kg)	Total catches (kg)	Reported catches (kg)	Underrept. %	Underrept. (kg)	Total catches (kg)	Reported catches (kg)	Underrept. %	Underrept. (kg)	Total catches (kg)
2013	EEMU	0	0	0	0	0				0				0			
	SERBD	0	0	0	0	0				0				0			
	SWRBD	0	0	0	0	0				0				0			
	ShIRBD	0	0	0	0	0				0				0			
	WRBD	0	0	0	0	0				0				0			
	NWIRBD	0	0	0	0	0				0				0			
	Total/mean (%)	0	0	0	0	0				0				0			

Table 6.4. Existence of illegal activities, its causes and the seizures quantity they have caused

		Glass eel			Yellow eel			Silver Eel			Combined (Y +S)		
Year	EMU	Y/N/?	Cause	Seizures (kg)	Y/N/?	Seizures (kg)	Cause	Y/N/?	Seizures (kg)	Cause	Y/N/?	Seizures (kg)	Cause
2013	EEMU	N		0	Y	0	Low	N	0		Y	0	Low
	SERBD	N		0	N	0		N	0		N	0	
	SWRBD	N		0	N	0		N	0		N	0	
	ShIRBD	N		0	Y	0	Gear	N	0		Y	0	Gear
	WRBD	N		0	?	0	Gear	N	0		?	0	Gear
	NWIRBD	N		0	Y	0	Gear	N	0		Y	0	Gear

AIM: Identify the illegal fishing activities and in case it is possible its causes and the seized kgs in case they were seizures.

NOTES:

- Y/N/?:

- Y: you know for sure they have been illegal activities;
- N: illegal activities are considered negligible / not significant;
- ?: You do not know whether they have been illegal activities or not.

- Cause: One of the followings:

- Fishing out of the season;
- Fishing without licence;
- Fishing using illegal gears;
- Retention of eel below or above any size limit;
- Illegal selling of catches.

7 Catch per unit of effort

There was no authorised commercial catch of juvenile eel in Ireland as glass eel and elver fishing in Ireland is prohibited by law (1959 Fisheries Act, Sec. 173).

7.1 Glass eel

No new data; refer to 2009 Country Report.

7.2 Yellow eel

No new data; refer to 2009 Country Report.

7.3 Silver eel

No new data; refer to 2009 Country Report.

7.4 Marine fishery

No new data; refer to 2009 Country Report.

8 Other anthropogenic and environmental impacts

The turbine mortality rates are determined using acoustic tagged and tracked silver eel and these data are reported in the 2012 report (SSCE 2012). Additional data for the Erne were reported to the SSCE in 2012 (McCarthy *et al*., 2013).

For the Shannon, summarising the annual data gives mortality ranges of 16.6% to 25% and an overall average mortality of 21.15 ± 8% for 104 tagged eel arriving at Ardnacrusha HPS (SSCE 2012). In the Eel Management Plan, a figure of 30% was used to account for the amount of eel potentially using the bypass route down the old river channel and around Ardnacrusha HPS. For 2009–2011, the actual amount of eels estimated to bypass were used in determining the escapement (59%, 4.4% and 12.5% respectively) and 1.6% was estimated for 2012. A general figure estimated to use the bypass in recent years is 17.8% (SSCE, 2012).

In 2013 (SSCE 2014), in the silver eel migration season there was high spillage at the Parteen Regulating Weir. It has been estimated by NUIG that 24.27% of the eels migrating downstream of Killaloe are likely to have travelled via the old river route. The hydropower dam passage mortality for the remaining (75.73%) silver eels that are assumed to have entered the Ardnacrusha headrace canal was estimated using the 21.15% rate determined by NUIG using acoustic telemetry in 2008–2011. During the 2013 season one turbine was removed for refurbishment and an equivalent amount of water was discharged via the Ardnacrusha spillway. However, it was not possible to estimate the extent to which this may have reduced turbine passage mortality because of loss of telemetry receivers downstream of the dam during extreme winter flood events.

For the Erne, Summarising the data from 2009 to 2011 gives mortality ranges for Cliff HPS of between 6.9% and 8.5% and an average of 7.8% ± 5% and mortality for Cathaleens Fall of 22% (9 tags) in 2009. In 2010 and 2011, one turbine was removed for renovation and therefore the mortalities were lower at 6.1% and 7.7%. It is likely that these will at least double when both turbines are operational and this should be assessed in the next three years.

Currently there is no solid information about the proportions of eel that migrate via spillways compared to via the turbine passages. There may be selective migration towards the spillways, especially at Cliff, and this may be indicative of safe passage and help to explain the low HPS mortality levels observed on the Erne.

The 2012 silver eel migration season was characterized by an almost complete absence of spillage at Cliff dam. In contrast, at Cathaleen's Fall dam high spillage occurred throughout much of the migration season. Planned telemetry experiments, which were intended to provide estimates of eel mortality during periods in which the hydropower stations were on full load, had to be postponed to 2013. Because of the limited spillage, a precautionary estimate of mortality (25%) at the Cliff HPS dam was used in the calculation of silver escapement in the 2012 season. Telemetry results from previous research were used for estimation of the hydropower passage mortality rate (8%) at the Cathaleen's Fall HPS dam.

In 2013 (SSCE 2014), during the experimental period (20 December 2013–20 February 2014), Cliff HPS had no turbines operating with spillage at volumes equivalent to generation at the downstream Cathaleen's Fall HPS. 100% hydropower passage success occurred during this period. Outside of the experimental period, spillage occurred at Cliff HPS with turbines in operation, following the generation protocols from previous seasons (2009–2011). Therefore, the combined mortality (7.9%, 8/101) from these years was used in escapement calculations. When turbines were operating without spillage, the mortality estimate from the 2012 season (26.7%, 8/30) was used in calculations.

The hydrometric situation at the Cathaleen's Fall HPS was relatively complex during the experimental period in 2013. Initial analysis of discharge patterns at Cathaleen's Fall identified two basic generation protocols during period when telemetry studies were undertaken:

1) Two turbines operational with no spillage.
2) Two turbines operational with spillage.

The mortality rate at Cathaleen's Fall HPS during generation protocol 1 was calculated to be 27.3% (3/11). During generation protocol 2, the mortality rate was calculated to be 15.4% (22/26). For the remainder of the silver eel season, outside of the experimental period, a third generation protocol was also in operation. This was one turbine plus spillage. During the previous three migration seasons this was the generation protocol in operation. Therefore, the average mortality (7.7%, N=91) from this period (2010–2012) was used in the calculation of hydropower passage mortality on dates in which this generation protocol was being implemented.

These estimates of mortality (three generation protocols) were incorporated into the escapement calculations for the 2013 season on the Erne.

9 Scientific surveys of the stock

9.1 Recruitment

This was described in Chapter 3.1 and in the Irish Standing Scientific Committee Report for 2013 (SSCE, 2014).

9.2 Yellow eel assessment

Yellow eel stock monitoring is integral to gaining an understanding of the current status of local stocks and for informing models of escapement, particularly within transitional waters where silver eel escapement is extremely difficult to measure directly.

Such monitoring also provides a means of evaluating post-management changes and forecasting the effects of these changes on silver eel escapement. The monitoring strategy aims to determine, at a local scale, an estimate of relative stock density, the stock's length, age and sex profiles, and the proportion of each length class that migrate as silvers each year. A second objective of the yellow eel study was to carry out an indirect estimation of silver eel escapement.

2013 fykenet survey

In 2013 intensive sampling of yellow eels took place at five lake locations (Lough Derg (Meelick Bay), Burrishoole (two lakes), Lough Key, Lough Muckno and Upper Lough Erne, along with several site locations on the River Barrow. Additional sampling in conjunction with the Water Framework Directive was on L. Gill. The standard procedure in the field was to set chains of five fykenets joined end to end, set overnight and lifted the following morning, as described by Moriarty (1975). The sampling process in 2013 consisted of setting approximately 6–8 chains of five fykenets during two or three monthly sessions of two or three nights per session.

Of the lakes sampled, Lough Muckno had the highest cpue (28.7) with relatively high cpues in L. Derg (13.6) and L. Key (10.7) and relatively low cpues were recorded in the western lakes, Bunaveela and Feeagh.

Eels were present in all 30 lakes and both estuaries surveyed under the Water Framework Directive.

Transitional waters (Barrow, Burrishoole (Furnace, Furnace lwr)) were also surveyed in 2013 and the cpues were 4.11, 2.4 and 2.7 eels per net per night respectively.

Ageing of eels is progressing well with all otoliths from 2009–2011 prepared and read. Over 80% of otoliths extracted have now been processed.

Transboundary

The Upper Erne Survey was carried out in October 2013. A total weight of 3 kgs and eight eels were caught in a nine fykenets. The WFD in cooperation with AFBI surveyed Upper and Lower MacNean in 2013. These data will be reported in the 2015 report.

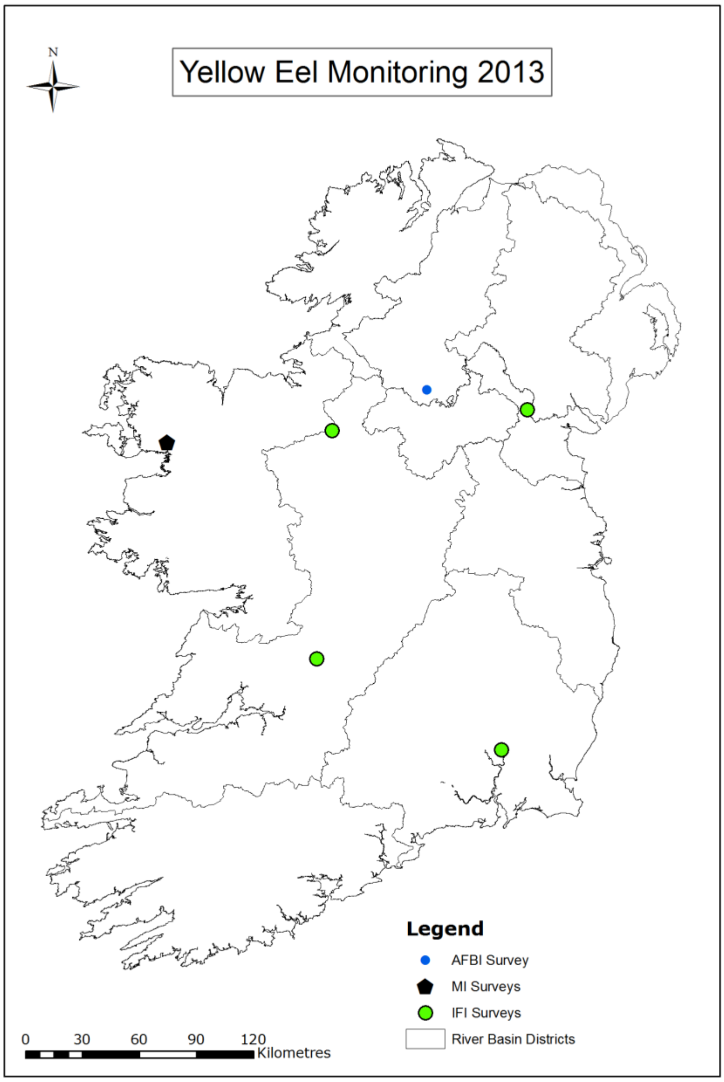

Figure 9.1. Locations of yellow eel survey work 2013.

9.3 Silver eel assessment

The Council Regulation (EC) No 1100/2007 sets a target for silver eel escapement to be achieved in the long term. Ireland is therefore required to provide an estimate of contemporary silver eel escapement. The Regulation also requires post-evaluation of management actions by their impact directly on silver eel escapement. Quantitative estimates of silver eel escapement are required both to establish current escapement and to monitor changes in escapement relative to this benchmark. Quantifying migrating silver eel each year is a difficult and expensive process but it is the only way of ultimately calibrating the outputs of the assessments.

Silver eels are being assessed by annual fishing of index stations on the Shannon, Erne, Burrishoole and Fane catchments (Figure 9.2). Trials will also be carried out at other locations identified in the EMP using coghill nets, mark–recapture and technology options such as electronic counters or DIDSON technology.

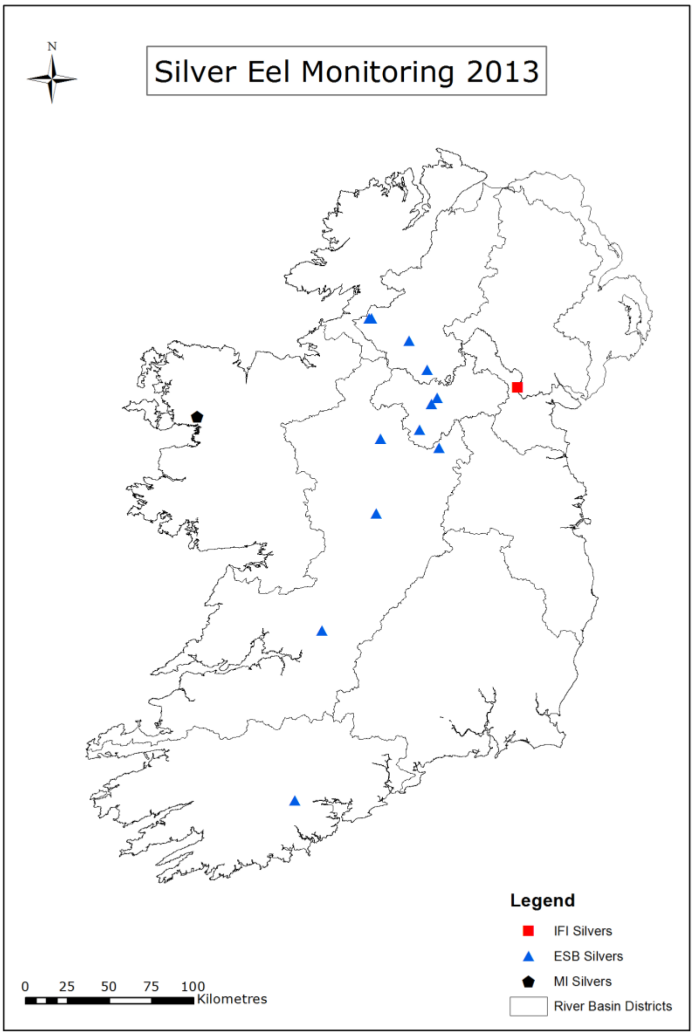

Figure 9.2. Location of silver eel monitoring in 2013.

Shannon

Eels have been fished on the Shannon in both historic and more recent times. Commercial fishing was initially established by the ESB in 1937. The ESB control the fishing rights as a result of the Shannon Fisheries Acts of 1935 and 1938. In 2009, commercial silver eel fishing ceased on the Shannon. The pre-EMP pilot trap and transport system of fishing at Killaloe has been continued as part of the EMP and the catch, along with that of the four contracted fishermen was transported downstream of Ardnacrusha HEP. The Killaloe catch in 2013 was 12.808 t. Fishing was also undertaken by ESB contracted crews upstream of Killaloe and their catches (9.753 t) were also transported downstream.

Following adoption of new analytical protocols for estimation of Shannon silver eel production by MacNamara and McCarthy (2013), as in 2012, the 2013 production/escapement results were presented by NUIG as part of the new time-series. The production and escapement estimates obtained following the new protocols were 79.970 t and 70.775 t (with 21.15% turbine mortality and 24.27% bypass in the old river channel). (Figure 9.3).

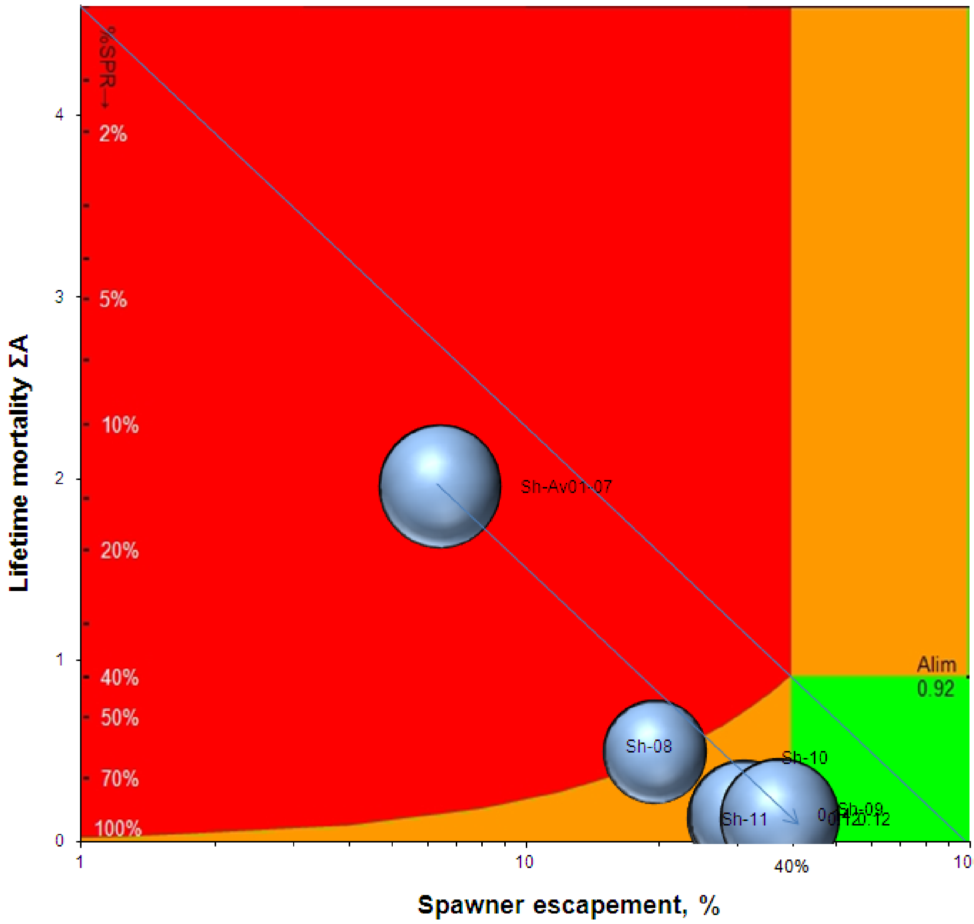

Figure 9.3. Status of the stock and the anthropogenic impacts, for the Shannon as presented in the Eel Management Plans for the average 2001–2007, in 2008 and for the years, 2009–2013. For each, the size of the bubble is proportional to B_{best}, the best achievable spawner escapement given the recent recruitment, while the centre of the bubble gives the stock status relative to the targets/limits. The horizontal axis represents the status of the stock in relation to pristine conditions, while the vertical axis represents the impact made by anthropogenic mortality.

Burrishoole

Silver eel trapping was continued in by the Marine Institute Burrishoole in 2013. The main run occurred in October (68%). The total run amounted to a count of 3633 eels or a production/escapement of 572 kg. The run had a mean weight of 0.157 kg and was composed of 45.7% male eels.

The data for the Burrishoole Catchment are presented on the modified ICES precautionary diagram as developed by the WGEEL (2011) using the EU management target (40% SSB) as the reference point and a calculated mortality reference point based on the EU management target (Alim 0.92) (Figure 9.4).

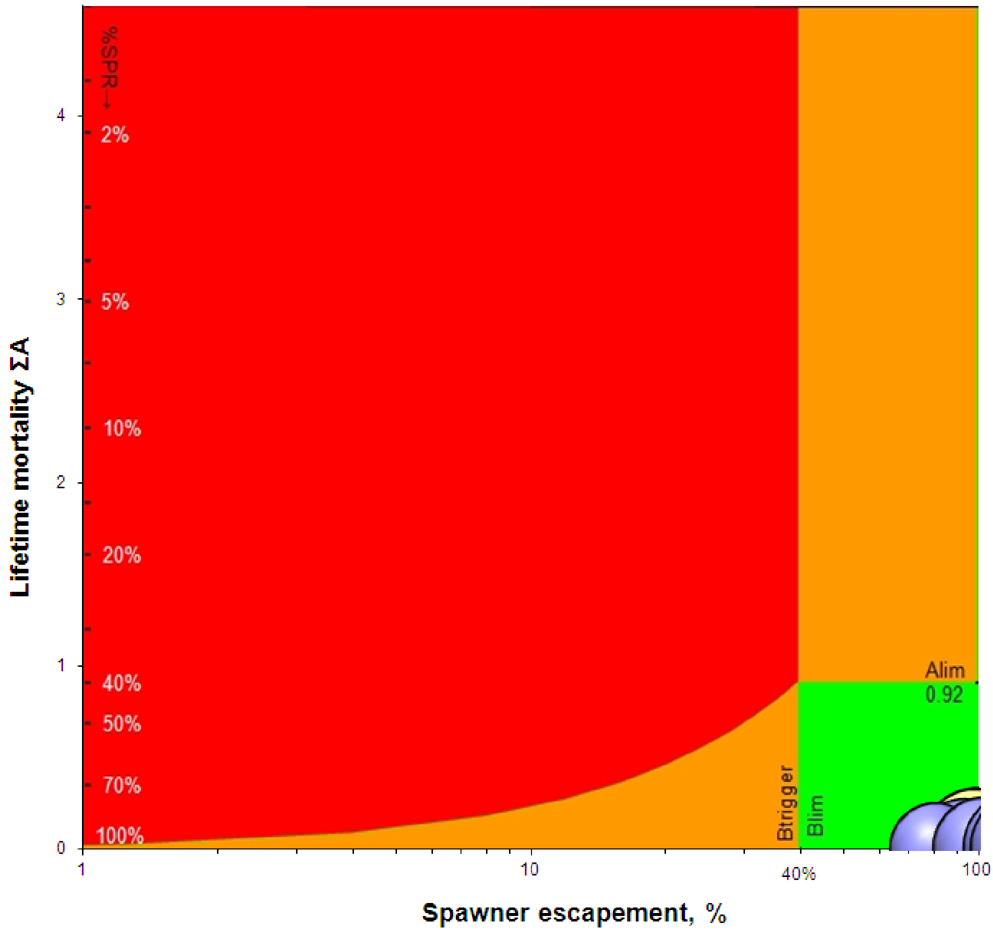

Figure 9.4. Status of the stock and the anthropogenic impacts, for the Burrishoole as presented in the Eel Management Plans for the average 2001–2007 and for the years, 2009–2013. For each, the size of the bubble is proportional to B_{best}, the best achievable spawner escapement given the recent recruitment, while the centre of the bubble gives the stock status relative to the targets/limits. The horizontal axis represents the status of the stock in relation to pristine conditions, while the vertical axis represents the impact made by anthropogenic mortality.

Erne

The analysis of downstream migrating silver eel population dynamics was complicated in 2009 by: Lack of reliable historical fishery data for the River Erne system; delayed fishery closure in part of the system; difficulties in establishing an effective monitoring site in the lower part of the system and development of research protocols. Following establishment in 2010 of an experimental fishing weir, which was scientifically monitored by NUIG, at Roscor Bridge significant progress became possible culminating in a useful protocol now published (McCarthy *et al.*, 2013). Estimates of both silver eel production and escapement rates were possible in the 2010 and 2011 seasons and these have been reported previously (SSCE 2012). In both the 2010 and 2011 season's estimation of eel mortalities associated with downstream passage at the two hydropower dams (Cliff HPS and Cathaleen's Fall HPS) was undertaken by means of acoustic telemetry. In 2012 it was possible to adapt protocols developed in 2009–2011 and to refine the methodology used for calculation of silver eel production in the River Erne system. The 2012 season was characterised by unusual weather and discharge patterns. These were reflected in the eel migration patterns and in the catches obtained in the conservation fishing undertaken during the ESB trap and transport programme. In addition to an experimental fishery established by NUIG at Roscor Bridge, seven sites were fished by ESB contract crews on the Erne system during 2012/2013. All sites contributed catches to the ESB silver eel trap and transport system.

In the 2013 season the River Erne conservation fishery and the trap & transport programme were monitored by NUIG. This was undertaken in conjunction with studies on silver eel production and escapement. The scientific protocols used in the 2013 season were those described in previous reports and publications (e.g. McCarthy *et al.*, 2014).

In 2013, the trap and transport total (39.319t) represented 53.6% of silver eel production and exceeded the target (50%) by 2.654 t. The silver eel production was estimated as 73.33 t and escapement was estimated to be 64.285 t (87.7% of production). The combined Cliff HPS and Cathaleen's Fall hydropower mortalities were estimated provisionally as 8.809 t (12% of production). A relatively high proportion of male silver eels, also noted in 2011–2013 in upper catchment sites as well as at Roscor Bridge, was observed in 2013.

The data for the Erne Catchment are presented on the modified ICES precautionary diagram as developed by the WGEEL (2011) using the EU management target (40% SSB) as the reference point and a calculated mortality reference point based on the EU management target (Alim 0.92) (Figure 9.5).

Fane

The Fane is a relatively small catchment with the silver eel fishery located in the upper reaches of the system approximately 28 km from the coast. The Fane has a riverine wetted area of 21 ha (84 ha 2012 wetted area) and a lacustrine wetted area of 553 ha. A research silver eel fishery was carried out on the Clarebane River on the outflow of Lough Muckno in the Fane catchment in 2011 and 2012. The site was at the location of a previous commercial fishery until 2008. For the 2013 season, the fishing commenced in October following low water levels in August and September.

A total catch of 1.151 t was caught for the 2013 season compared with 0.448 t in 2012. The estimated pristine production of silver eels from the Fane catchment is 2.679 t with an estimated current production (2009–2011) of 1.264 t.

In 2013, a new tag release site was used at the mouth of the Clarebane River and additional deflector nets were used to improve fishing efficiency. A recapture rate of 20% was achieved in 2013 and if this is used to determine the efficiency of the fishing site, then a production of 5.755 t is estimated.

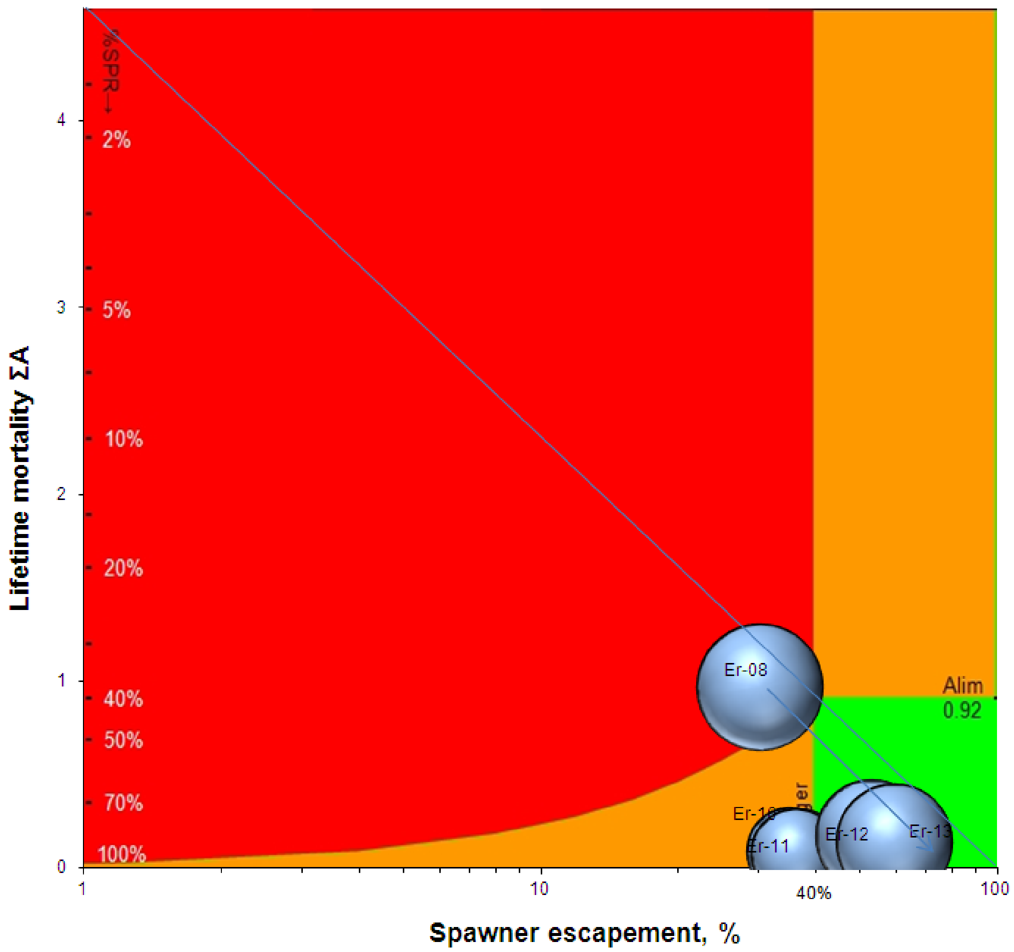

Figure 9.5. Status of the stock and the anthropogenic impacts, for the Erne as presented in the Eel Management Plans for the average 2001–2007 (Er-08) and for the years, 2009–2013. For each, the size of the bubble is proportional to B_{best}, the best achievable spawner escapement given the recent recruitment, while the centre of the bubble gives the stock status relative to the targets/limits. The horizontal axis represents the status of the stock in relation to pristine conditions, while the vertical axis represents the impact made by anthropogenic mortality.

10 Data collected for the DCF

Currently no data are collected under the DCF. With the closure of fisheries in 2009, Ireland was not eligible for funding for data collection under the DF. Ireland awaits clarity on the inclusion of eel in the new DCF-MAP and intends to apply for funding as soon as eel is included by the Commission. Ireland supports the recommendations of the ICES Workshop WKESDCF 2012.

11 Life history and other biological information

11.1 Length and weight and growth (DCF)

No sampling took place under the DCF. The following summarises the sampling under the national monitoring programme.

11.1.1 Length and weight

Length and weight are measured for all the yellow eel surveys and for some of the silver eel locations. Tables 11.1–11.2 give the summarised data for the national fykenet surveys and the eel captured under the WFD monitoring programme 2012 (Tables 11.3–11.6).

11.1.2 Growth

Samples of yellow and silver eels were taken from 2009 to 2012 during the yellow eel and silver eel surveys undertaken by IFI. Otoliths were prepared by burning and cracking (Christensen, 1964; Moriarty, 1973), mounted against a glass slide in silicone rubber (Hu and Todd, 1981) and measured under *100 magnification with an eye-piece graticule (Poole *et al*., 1992; Poole, 1994).

11.1.2.1 Preliminary results

Early results suggest that transitional water sites (with higher productivity in comparison to inland waters) present the highest mean (and fastest) growth rates (Table 11.7). On average, the eels aged from 2009–2011 present a growth rate of 2.29 cm/year. Yellow eels average at 2.42 cm/year, while silvers demonstrated lower growth in later years which led to an average growth rate of 2.09 cm/year. The yellow eels analysed have an average age of 15 years with a minimum of nine and maximum of 21 years. The silver eels analysed have an average age of 19 years old with a minimum of 15 and a maximum of 30 years old. The growth rates and descriptive statistics for growth for all eels currently aged are presented in Table 11.7.

When considering yellow eels, the average growth rate was 2.42 cm/year (n=1042). The fastest growth rate recorded was for the eels captured from the Waterford Barrow Estuary (3.78 cm/year, n=65). The Barrow Estuary also had the lowest mean age of nine years (±2 years). In contrast, the slowest yellow eel growth rate was noted at Lough Ballynahinch (1.44 cm/year, n=81), where the highest mean age for yellow eels to date was also recorded (mean 21+ years, ± 6 years). This site also presented some of the oldest yellow eels so far (45+ years) (Figure 11.1 and Table 11.7).

Silver eel growth rates were more uniform. Lower growth rates in later years, led to an overall lower average among silvers as opposed to yellows. The average growth rate was 2.09 cm/year (n=832). The highest growth rates were recorded for eels captured at sites on the Erne catchment (Lower Lough Erne (Portora): 3.23 cm/year, n=20; Oughter: 2.90 cm/year, n=21 and Ballyshannon/Ferny Gap: 1.97 cm/year, n=140 eels). The lowest mean age was also found among Erne silver eels (Oughter: 15 years, ±3 years). The lowest growth rate was recorded among the Fane (Muckno) silvers sampled in the autumn of 2011, which presented an average growth rate of 1.48 cm/year (n=140). The highest mean age for silvers of 30 years (± 5 years) was noted at Lough Mask (Cong) (Figure 11.2 and Table 11.7).

11.2 Growth, silvering and mortality

These data are not included here but are available if required.

Von Bertalanffy parameters: Linf, K, t0

Historic data are available (Moriarty, various) and these are also available for some current catchments, such as Burrishoole, Erne and Galway.

L50 = the length at which 50% of the population has silvered (my interpretation of 50% maturity)

These are available for some catchments, such as Burrishoole, Erne, Shannon, Fane and Galway.

Length and age at silvering

These are available for some catchments, such as Burrishoole, Erne, Shannon, Fane and Galway.

Fecundity

These are available for the Shannon. See Chapter 12 of this report.

Weight-at-age

These are available for some catchments, such as Burrishoole, Erne, Shannon, Fane and Galway.

Lengthweight relationship

These are available for silver eel for some catchments, such as Burrishoole, Erne, Shannon, Fane and Galway and for yellow eel from the catchments covered in the National Survey.

11.3 Parasites and pathogens

A. crassus was introduced into Europe in the early 1980s and it has since spread widely and has successfully colonized most European countries. It was first recorded in Ireland (Waterford Harbour) in 1997. Later records came from the Erne catchment in 1998 and it is now present in approximately 74% of the wetted area of Ireland. The most likely infective route to Ireland was the commercial eel trade although localised spread can be through natural eel movements and paratenic hosts.

Under the IFI and WFD monitoring programme samples of eels from various locations are examined for the presence of the parasite. This information has been supplied to the European Eel Quality Database.

11.3.1 Burrishoole

The Burrishoole catchment remained free of the parasite until recently. In the fykenet survey in 2012, samples of yellow eels captured in L. Furnace (saline) and at the Back of the House (tidal lough below L. Furnace) were found to be infected with *A. crassus.* Samples of yellow eels from L. Feeagh were negative and a comprehensive sample of silver eels from the traps was also negative indicating that in 2012 the infection seemed to be confined to the tidal lough. This was somewhat surprising as a number of environmental factors have been shown to influence *A. crassus* infections. High salinity has been shown as having a negative impact in the egg hatching and larvae survival of the parasite although the effects of water salinity remain unclear as various surveys have shown no differences in infection levels in waters with different salinity values.

Examination of previous samples would indicate that the parasite was likely to have been introduced into L. Furnace in 2010 or early 2011 (Table 11.8).

The infection intensity in L. Furnace eels continued to rise in 2013. To date it has not been recorded in the freshwater catchment.

11.4 Contaminants

No new data.

11.5 Predators

No new data.

Table 11.1. Catch details of the yellow eel survey in the national EMP Survey, 2013.

Site	Dates	No. Eels	Nets*Nights	CPUE	Total Weight (kg)	Mean Length (cm)	Min. Length (cm)	Max. Length (cm)	Mean Weight (kg)	Min. Weight (kg)	Max. Weight (kg)
Meelick Bay, Lough Derg	05/06/2013	40	30	1.33	6.494	44.2	29.1	59.5	0.162	0.040	0.399
	06/06/2013	72	30	2.40	9.971	41.5	25.9	63.8	0.138	0.042	0.497
	07/06/2013	86	30	2.87	12.476	42.7	27.0	62.5	0.145	0.034	0.436
	27/08/2013	48	30	1.60	5.971	41.1	30.7	61.2	0.124	0.048	0.300
	28/08/2013	56	30	1.87	7.295	41.5	30.1	59.2	0.130	0.043	0.376
	29/08/2013	107	30	3.57	13.182	41.3	25.3	61.5	0.123	0.024	0.379
	2013	**409**	**180**	**13.63**	**55.389**	**41.9**	**25.3**	**63.8**	**0.135**	**0.024**	**0.497**
Lough Key	18/06/2013	78	35	2.23	22.001	54.1	37.5	77.4	0.282	0.089	0.689
	19/06/2013	105	35	3.00	32.724	55.1	37.0	73.2	0.312	0.071	0.673
	20/06/2013	39	35	1.11	10.398	53.2	41.5	75.6	0.267	0.115	0.820
	20/08/2013	52	35	1.49	14.761	53.7	39.7	80.2	0.284	0.089	0.907
	21/08/2013	47	35	1.34	13.902	55.1	43.6	72.8	0.296	0.124	0.591
	22/08/2013	54	35	1.54	14.348	52.9	36.9	78.6	0.266	0.075	0.758
	18/06/2013	78	35	2.23	22.001	54.1	37.5	77.4	0.282	0.089	0.689
	2013	**375**	**210**	**10.71**	**108.134**	**54.2**	**36.9**	**80.2**	**0.288**	**0.071**	**0.907**
Lough Muckno	11/06/2013	388 (209)*	35	11.09	51.018	50.4	32.4	73.6	0.244	0.053	0.902
	12/06/2013	238	35	6.83	50.511	48.3	31.0	82.8	0.212	0.047	1.078
	13/06/2013	157**	35	4.49	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Site	Dates	No. Eels	Nets*Nights	CPUE	Total Weight (kg)	Mean Length (cm)	Min. Length (cm)	Max. Length (cm)	Mean Weight (kg)	Min. Weight (kg)	Max. Weight (kg)
	13/08/2013	86	35	2.46	21.274	50.1	33.5	71.0	0.247	0.058	0.728
	14/08/2013	68	35	1.94	14.147	46.4	32.3	79.0	0.208	0.053	1.133
	15/08/2013	67	35	1.97	13.375	47.3	26.7	70.4	0.200	0.042	0.710
	2013	**1007 (667)**	**210**	**28.7**	**150.325**	**48.9**	**26.7**	**82.8**	**0.225**	**0.042**	**1.133**
River Barrow	14/05/2013	12	35	0.34	0.651	30.8	21.1	35.4	0.054	0.015	0.076
	15/05/2013	5	35	0.14	0.283	31.9	28.2	35.4	0.057	0.044	0.084
	16/07/2013	120	30	4.00	13.225	37.1	23.4	67.0	0.110	0.019	0.620
	2013	**137**	**100**	**4.11**	**14.159**	**36.3**	**21.1**	**67.0**	**0.103**	**0.015**	**0.620**
Bunaveela L.	04/07/2013	15	30	0.50	3.0	45.8	37.8	57.5			
Lough Feeagh	10/07/2013	96	60	1.60	13.64	40.3	31.3	93.2	0.142	0.050	2.270
L. Furnace tidal	17/7/2013	145	60	2.40	21.82	43.1	29.1	73.0	0.151	0.040	0.695
Lwr Furnace tidal	25/7/2012	54	20	2.70	10.46	45.3	29.8	77.8	0.194	0.040	0.940

Table 11.2. Biological data from the yellow eel surveys, 2013.

Location	Total Eels	No. Females	No. Males	% Female	% Male	% Prevalence *A. crassus*	Mean Intensity *A. crassus*	Preferential Diet from Stomach Contents
Lough Key	102	102	0	100	0	55	2.64	*Asellus* sp.
Lough Muckno	100	94	6	94	6	56	3.41	Fish Remains

Table 11.3. WFD Lake Summary Data 2012.

RBD	Catchment	Lake	No Eels	No. Nights	No. Nets	CPUE	Mean length (cm)	Min. length (cm)	Max. length (cm)	Mean weight (Kg)	Min. weight (Kg)	Max. weight (Kg)	Total weight (kg)
ERBD	Ovoca	Dan, Lough	8	1	9	0.889	52.2	40.3	60.2	0.213	0.101	0.376	1.7
ERBD	Ovoca	Tay, Lough	0	1	9	0.000	n/a	n/a	n/a	n/a	n/a	n/a	n/a
NBIRBD	Fane	Muckno, Lough	6	1	9	0.667	50.5	40.5	69.8	0.312	0.120	0.928	1.872
NWIRBD	Coastal	Dunglow Lough	5	1	9	0.556	43.1	33.0	60.0	0.165	0.059	0.398	0.825
NWIRBD	Coastal	Kindrum Lough	16	1	9	1.778	40.0	30.5	54.3	0.126	0.050	0.258	2.023
NWIRBD	Coastal	Sessaigh, Lough	8	1	6	1.333	42.5	32.4	53.5	0.130	0.052	0.263	1.04
NWIRBD	Erne	White, Lough (Ballybay)	9	1	9	1.000	52.5	41.0	59.2	0.264	0.093	0.392	2.377
NWIRBD	Gweedore	Anure, Lough	23	1	9	2.556	45.3	30.9	70.3	0.201	0.049	0.767	4.627
NWIRBD	Owenamarve	Nasnahida, Lough	5	1	6	0.833	41.6	28.5	51.6	0.139	0.039	0.244	0.697
SHIRBD	Fergus	Cullaun, Lough	7	1	9	0.778	48.9	35.5	58.1	0.220	0.083	0.363	1.539
SHIRBD	Fergus	Dromore Lough	16	1	9	1.778	50.1	42.0	58.1	0.217	0.102	0.323	3.468
SHIRBD	Fergus	Muckanagh Lough	1	1	9	0.111	58.7	58.7	58.7	0.339	0.339	0.339	0.339
SHIRBD	Owencashla	Caum, Lough	3	1	6	0.500	38.9	32.6	43.0	0.099	0.064	0.117	0.296
SHIRBD	Shannon	Alewnaghta, Lough	4	1	9	0.444	46.5	33.6	54.8	0.190	0.062	0.297	0.758
SHIRBD	Shannon	Derg, Lough	75	1	36	2.083	47.4	32.3	100.3	0.233	0.052	2.720	17.467
SHIRBD	Shannon	Gur, Lough	5	1	9	0.556	63.9	57.0	79.4	0.548	0.317	1.059	2.742
SHIRBD	Shannon	Inchicronan Lough	10	1	9	1.111	56.7	47.0	73.0	0.333	0.177	0.733	3.334
WRBD	Ballysadare	Arrow, Lough	22	1	9	2.444	50.2	34.5	65.8	0.239	0.047	0.506	5.261
WRBD	Bundorragha	Lough, Doo	5	1	6	0.833	44.0	37.5	49.5	0.148	0.089	0.218	0.739
WRBD	Corrib	Carra, Lough	10	1	9	1.111	57.4	45.2	73.4	0.374	0.111	0.741	3.74
WRBD	Corrib	Mask, Lough	14	1	27	0.519	56.7	44.1	63.6	0.342	0.147	0.507	4.781
WRBD	Fergus	Bunny, Lough	1	1	9	0.111	44.8	44.8	44.8	0.158	0.158	0.158	0.158
WRBD	Moy	Cullin, Lough	67	1	18	3.722	39.7	30.4	58.4	0.123	0.046	0.329	7.998

Table 11.4. Summary data from WFD Rivers Survey 2012.

RBD	Catchment	River	Site	No. Sets	No. Runs	Area (m2)	Density (no./m^2)	No. Eels captured
ERBD	Boyne	Athboy River	Br. nr Clonleasan Ho_A	2	3	212	0.0000	0
ERBD	Boyne	Athboy River	Br. nr Clonleasan Ho_B	2	3	249	0.0040	1
ERBD	Liffey	Liffey, River	500 m d/s Ballyward Br._A	2	1	4228	0.0000	0
ERBD	Dargle	Dargle River	Bahana_A	2	3	311	0.0000	0
ERBD	Avoca	Glenealo River	Br. d/s Upper Lake_B	2	3	276	0.0254	7
ERBD	Nanny	Nanny (Meath), River	Br. at Julianstown_A	3	3	456	0.0526	24
ERBD	Dargle	Glencree River	Br. u/s Dargle R confl_A	3	3	401	0.0025	1
ERBD	Avoca	Glenealo River	Br. d/s Upper Lake_A	3	2	242	0.0000	0
NBIRBD	Castletown	Big River (Louth)	Ballygoly Br._A	2	3	209	0.0192	4
NBIRBD	Dee	White River (Louth)	Coneyburrow Br._B	3	3	358	0.0028	1
NWIRBD	Clady	Clady River (Donegal)	Bryan's Br._A	3	3	380	0.0079	3
NWIRBD	Eany water	Eany Water	Just d/s Eany Beg/More confl_A	2	1	7849	0.0004	3
SERBD	Nore	Dinin River	Dinin Br._A	3	3	667	0.0030	2
SERBD	Burren	Lerr River	Prumplestown Br._A	2	3	225	0.0000	0
SERBD	Burren	Greese, River	Br. NE of Belan House_A	3	3	307	0.0033	1
SERBD	Burren	Greese, River	Br. NE of Belan House_B	3	3	258	0.0039	1
SERBD	Barrow	Burren River	Ullard Br._A	2	3	159	0.0126	2
SERBD	Barrow	Burren River	Ullard Br._B	2	3	216	0.0000	0
SERBD	Barrow	Tully Stream	Soomeragh Br._A	1	3	163	0.0000	0
SERBD	Barrow	Tully Stream	Soomeragh Br._B	1	3	102	0.0099	1
SERBD	Barrow	Barrow, River	Pass Br._B	2	1	10951	0.0006	7
SERBD	Barrow	Barrow, River	Upper Tinnahinch Lock_A	2	1	20645	0.0007	15
SERBD	Barrow	Barrow, River	Ballykeenan Lock_A	2	1	11143	0.0013	14
SERBD	Barrow	Barrow, River	Graiguenamanagh Br._A	2	1	15549	0.0007	11
SERBD	Barrow	Barrow, River	Bagenalstown (Slipway to lock)_A	1	1	16377	0.0007	12

RBD	Catchment	River	Site	No. Sets	No. Runs	Area (m2)	Density (no./m²)	No. Eels captured
SERBD	Barrow	Barrow, River	Dunleckny (Swimming pool)_A	2	1	25531	0.0004	9
SERBD	Barrow	Barrow, River	Leighlinbridge Lord Bagenal Hotel_A	1	1	16380	0.0002	3
SHIRBD	Shannon Lwr	Tullamore River	Br. SW of Ballycowen Br._A	2	3	786	0.0000	0
SHIRBD	Shannon Lwr	Little Brosna River	Riverstown Br._A	2	3	1646	0.0000	0
SHIRBD	Shannon Lwr	Kilcrow River	Ballyshrule Br._A	2	3	1720	0.0012	2
SHIRBD	Creegh	Creegh River	Drumellihy Br._A	1	3	1071	0.0019	2
SHIRBD	Shannon Lwr	Ballyfinboy River	Ballinderry Br._A	2	3	254	0.0000	0
SHIRBD	Shannon Lwr	Nenagh River	Ballysoilshaun Br._A	2	3	980	0.0000	0
SHIRBD	Feale	Owveg River (Kerry)	Owveg Br._B	2	3	344	0.0000	0
SHIRBD	Shannon Est sth	Owvane River (Limerick)	Br. u/s (SE of) Loghill_A	3	3	609	0.3171	193
SHIRBD	Tyshe	Tyshe River	West br. Ardfert at Friary_A	1	3	92	0.1740	16
SHIRBD	Tyshe	Tyshe River	West br. Ardfert at Friary_B	1	3	170	0.2235	38
SHIRBD	Shannon Lwr	Bilboa River	Br. u/s Blackboy Br. - Bilboa Br._A	4	3	553	0.0000	0
SHIRBD	Caher	Caher River	Br. 2 km d/s Formoyle_A	2	3	223	0.0045	1
SHIRBD	Shannon Lwr	Dead River	Pope's Br._A	2	3	161	0.0000	0
SHIRBD	Shannon Lwr	Dead River	Pope's Br._B	2	3	250	0.0080	2
SHIRBD	Shannon Est Sth	Maigue, River	Castleroberts Br._A	2	1	13148	0.0008	10
SWRBD	Blackwater	Awbeg River (Buttevant)	Kilcummer Br._A	3	1	3910	0.0026	10
SWRBD	Blackwater	Bride (Waterford), River	Footbr. N of Ballynella_A	3	1	3126	0.0003	1
SWRBD	Blackwater	Bride (Waterford), River	Footbr. N of Ballynella_B	3	1	2806	0.0000	0
SWRBD	Argideen	Argideen River	Ballinoroher Ford_B	3	3	430	0.1651	71
SWRBD	Adrigole	Adrigole River	0.5km d/s of Glashduff Adrigole confluence_A	2	3	430	0.0419	18
WRBD	Glenamoy	Glenamoy River	Glenamoy Village_A	3	2	419	0.0597	25
WRBD	Moy	Deel River (Crossmolina)	Bridge at Castle Gore_A	3	3	4085	0.0022	9
WRBD	Bunowen	Bunowen River (Louisburgh)	Tully Br._A	3	3	334	0.0120	4
WRBD	Corrib	Black River (Shrule)	Br. at Kilshanvy_A	2	3	262	0.0115	3

RBD	Catchment	River	Site	No. Sets	No. Runs	Area (m2)	Density (no./m²)	No. Eels captured
WRBD	Corrib	Black River (Shrule)	Br. at Kilshanvy_B	2	3	206	0.0145	3
WRBD	Corrib	Owenbrin River	Br. u/s L. Mask_A	3	3	339	0.0088	3
WRBD	Easky	Gowlan River	Track west of Lough Black_A	2	3	205	0.0292	6
WRBD	Easky	Gowlan River	Track west of Lough Black_B	2	3	257	0.0194	5
WRBD	Dunneill	Dunneill River	Donaghintraine Br._A	3	3	389	0.1647	64
WRBD	Dunneill	Dunneill River	Dromore West_A	2	3	468	0.0278	13
WRBD	Moy	Moy, River	U/s Ardnaree Br._A	1	1	17861	0.0001	1

Table 11.5. Summary length and weight data from WFD Rivers Surveys.

RBD	Catchments	River Name	River Site	No. Eel	Average Length (cm)	Min. Length (cm)	Max. Length (cm)	Average Weight (kg)	Min. Weight (kg)	Max. Weight (kg)	Total Weight (kg)
ERBD	Boyne	Athboy River	Br. nr Clonleasan Ho_B	1	22	22	22	0.014	0.014	0.014	0.014
ERBD	Avoca	Glenealo River	Br. d/s Upper Lake_B	7	24.4	19.7	32.1	0.025	0.011	0.062	0.178
ERBD	Nanny	Nanny (Meath), River	Br. at Julianstown_A	24	23.4	9.2	48	0.031	0.002	0.215	0.721
ERBD	Dargle	Glencree River	Br. u/s Dargle R confl_A	1	38.8	38.8	38.8	0.092	0.092	0.092	0.092
NBIRBD	Castletown	Big River (Louth)	Ballygoly Br._A	4	26.9	11.2	33.6	0.043	0.002	0.065	0.172
NBIRBD	Dee	White River (Louth)	Coneyburrow Br._B	1	17.2	17.2	17.2	0.009	0.009	0.009	0.009
NWIRBD	Clady	Clady River (Donegal)	Bryan's Br._A	3	37.3	31.7	45	0.105	0.061	0.167	0.314
NWIRBD	Eany water	Eany Water	Just d/s Eany Beg/More confl_A	3	24.7	17.2	30.7	0.023	0.007	0.037	0.07
SERBD	Nore	Dinin River	Dinin Br._A	2	32.5	32.5	32.5	0.061	0.06	0.062	0.122
SERBD	Burren	Greese, River	Br. NE of Belan House_A	1	65.7	65.7	65.7	0.575	0.575	0.575	0.575
SERBD	Burren	Greese, River	Br. NE of Belan House_B	1	63.1	63.1	63.1	0.512	0.512	0.512	0.512
SERBD	Barrow	Burren River	Ullard Br._A	2	50.5	50.3	50.6	0.253	0.251	0.256	0.506
SERBD	Barrow	Tully Stream	Soomeragh Br._B	1	29.8	29.8	29.8	0.04	0.04	0.04	0.04
SERBD	Barrow	Barrow, River	Pass Br._B	7	45	26.7	56.5	0.186	0.013	0.366	1.303
SERBD	Barrow	Barrow, River	Upper Tinnahinch Lock_A	15	34.4	15.3	52.5	0.092	0.008	0.265	1.374
SERBD	Barrow	Barrow, River	Ballykeenan Lock_A	14	26.8	10	47.3	0.065	0.004	0.185	0.71
SERBD	Barrow	Barrow, River	Graiguenamanagh Br._A	11	24.7	8.5	59.8	0.138	0.044	0.487	0.826
SERBD	Barrow	Barrow, River	Bagenalstown (Slipway to lock)_A	12	37.6	24.5	46.6	0.098	0.022	0.208	1.171
SERBD	Barrow	Barrow, River	Dunleckny (Swimming pool)_A	9	39.4	31.5	55.2	0.098	0.053	0.235	0.784

RBD	Catchments	River Name	River Site	No. Eel	Average Length (cm)	Min. Length (cm)	Max. Length (cm)	Average Weight (kg)	Min. Weight (kg)	Max. Weight (kg)	Total Weight (kg)
SERBD	Barrow	Barrow, River	Leighlinbridge Bagenal Hotel_A	3	28.7	22.3	33.7	0.038	0.014	0.063	0.115
SHIRBD	Shannon Lwr	Kilcrow River	Ballyshrule Br._A	2	52.4	47.8	57	0.187	0.187	0.187	0.187
SHIRBD	Creegh	Creegh River	Drumellihy Br._A	2	29	28	30	0.056	0.054	0.057	0.111
SHIRBD	Shannon Est sth	Owvane River (Limerick)	Br. u/s (SE of) Loghill_A	193	16	6.9	35.6	0.012	0.001	0.086	2.272
SHIRBD	Tyshe	Tyshe River	West br. Ardfert at Friary_A	16	18.1	8.7	34.5	0.014	0.001	0.08	0.218
SHIRBD	Tyshe	Tyshe River	West br. Ardfert at Friary_B	38	10.6	6.6	22.1	0.002	0.001	0.021	0.086
SHIRBD	Caher	Caher River	Br. 2 km d/s Formoyle_A	1	18.6	18.6	18.6	0.012	0.012	0.012	0.012
SHIRBD	Shannon Lwr	Dead River	Pope's Br._B	2	34.9	33.8	36	0.073	0.063	0.083	0.146
SHIRBD	Shannon Est Sth	Maigue, River	Castleroberts Br._A	10	26.5	12.2	33.9	0.038	0.003	0.072	0.383
SWRBD	Blackwater	Awbeg River (Buttevant)	Kilcummer Br._A	10	21.7	10.5	51	0.044	0.002	0.291	0.441
SWRBD	Blackwater	Bride (Waterford), River	Footbr. N of Ballynella_A	1	23.2	23.2	23.2	0.024	0.024	0.024	0.024
SWRBD	Argideen	Argideen River	Ballinoroher Ford_B	71	17.6	8	37.8	0.014	0.001	0.086	0.992
SWRBD	Adrigole	Adrigole River	Adrigole confluence_A	18	23	12	30.8	0.02	0.002	0.04	0.356
WRBD	Glenamoy	Glenamoy River	Glenamoy Village_A	25	15.1	7.2	30	0.009	0.001	0.045	0.229
WRBD	Moy	Deel River (Crossmolina)	Bridge at Castle Gore_A	9	33.1	22.4	53.5	0.076	0.02	0.271	0.604
WRBD	Bunowen	Bunowen River (Louisburgh)	Tully Br._A	2	10	8.1	11.9	0.002	0.001	0.003	0.004
WRBD	Corrib	Owenbrin River	Br. u/s L. Mask_A	1	33.9	33.9	33.9	0.059	0.059	0.059	0.059

RBD	Catchments	River Name	River Site	No. Eel	Average Length (cm)	Min. Length (cm)	Max. Length (cm)	Average Weight (kg)	Min. Weight (kg)	Max. Weight (kg)	Total Weight (kg)
WRBD	Easky	Gowlan River	Track west of Lough Black_A	5	29.2	21.6	34.4	0.045	0.018	0.073	0.227
WRBD	Easky	Gowlan River	Track west of Lough Black_B	4	31.6	27.3	37.5	0.053	0.034	0.084	0.211
WRBD	Dunneill	Dunneill River	Donaghintraine Br._A	64	21.3	9.1	34.1	0.018	0.001	0.065	1.138
WRBD	Dunneill	Dunneill River	Dromore West_A	13	32	20.5	52.1	0.061	0.012	0.182	0.791
WRBD	Moy	Moy, River	U/s Ardnaree Br._A	1	34.3	34.3	34.3	0.078	0.078	0.078	0.078

Table 11.6. Summary data from WFD Transitional Waters 2012.

RBD	Catchment	Estuary	No. Nights	No. Nets	No. Eels	CPUE	Average Length (cm)	Min. Length (cm)	Max. Length (cm)
ERBD	Boyne	Boyne Estuary	1	27	32	1.185	35.9	27.0	59.5
NWIRBD	Gweebarra	Gweebarra Estuary	1	30	17	0.567	36.8	29.0	51.0

Table 11.7. Growth rates for sacrificed eels, 2009–2011 (n = 1874 eels).

Location	Year	Lifestage	No. Of Eels	Growth Rate (cm/yr)	Mean Age (Years)	Standard Deviation
Waterford Estuary	2009	Yellow	65	3.78	8.74	2.15
Lough Cullen	2009	Yellow	81	3.11	11.26	2.61
Lough Conn	2009	Yellow	95	2.50	13.54	4.19
Lough Corrib Lower	2009	Yellow	1	3.06	13.00	-
Lough Corrib Upper	2010	Yellow	83	2.07	17.33	5.49
Lough Ree *	2010	Yellow	82	2.28	12.62	3.02
Lough Erne Upper	2010	Yellow	76	2.76	13.27	2.83
Lough Derg °	2009 & 2010	Yellow	139	1.90	16.16	4.61
Barrow Canal	2010	Yellow	39	1.70	15.95	4.58
Grand Canal	2011	Yellow	32	1.97	16.03	5.65
Lough Inchiquin	2011	Yellow	89	2.11	17.73	5.93
Lough Ramor	2011	Yellow	80	2.25	14.94	3.93
Lough Ballynahinch	2011	Yellow	81	1.44	21.04	6.28
Lough Oughter	2011	Yellow	99	2.98	12.37	3.79
Corrib (Galway Weir)	2009	Silver	91	1.90	16.48	6.19
Corrib (Moycullen) ∞	2010 & 2011	Silver	127	1.87	18.67	5.70
Mask (Cong)	2010	Silver	92	1.79	30.60	5.33
Killaloe ♦	2009 & 2010	Silver	114	1.89	17.87	5.52
Athlone	2010	Silver	87	1.79	24.12	7.52
Erne (Ballyshannon/Ferny Gap)×	2009 & 2010	Silver	140	1.97	17.59	5.68
Erne LLE (Portora)	2010	Silver	20	3.23	15.70	2.90
Erne (Oughter Seized Eels)	2010	Silver	21	2.90	14.62	3.11

Location	Year	Lifestage	No. Of Eels	Growth Rate (cm/yr)	Mean Age (Years)	Standard Deviation
Fane (Muckno)	2011	Silver	140	1.48	18.29	4.42
Burrishoole Freshwater	2012	Silver	105	1.55	26.7	9.01

*** Upper and Lower Lough Ree were sampled in two separate surveys in summer 2010 and are pooled above.**

° Lower and Upper Lough Derg were surveyed in summers of 2009 and 2010 respectively, and are pooled above.

∞ Corrib silvers sampled at Moycullen (Lower Lough Corrib) using fykenets in the autumn of 2010 and 2011 are pooled above.

♦ Killaloe silver eels fished at the weir in autumn 2009 and 2010 are pooled above.

✖ Erne silver eels sampled at Ballyshannon (Ferny Gap) in autumn 2009 and 2010 are pooled above

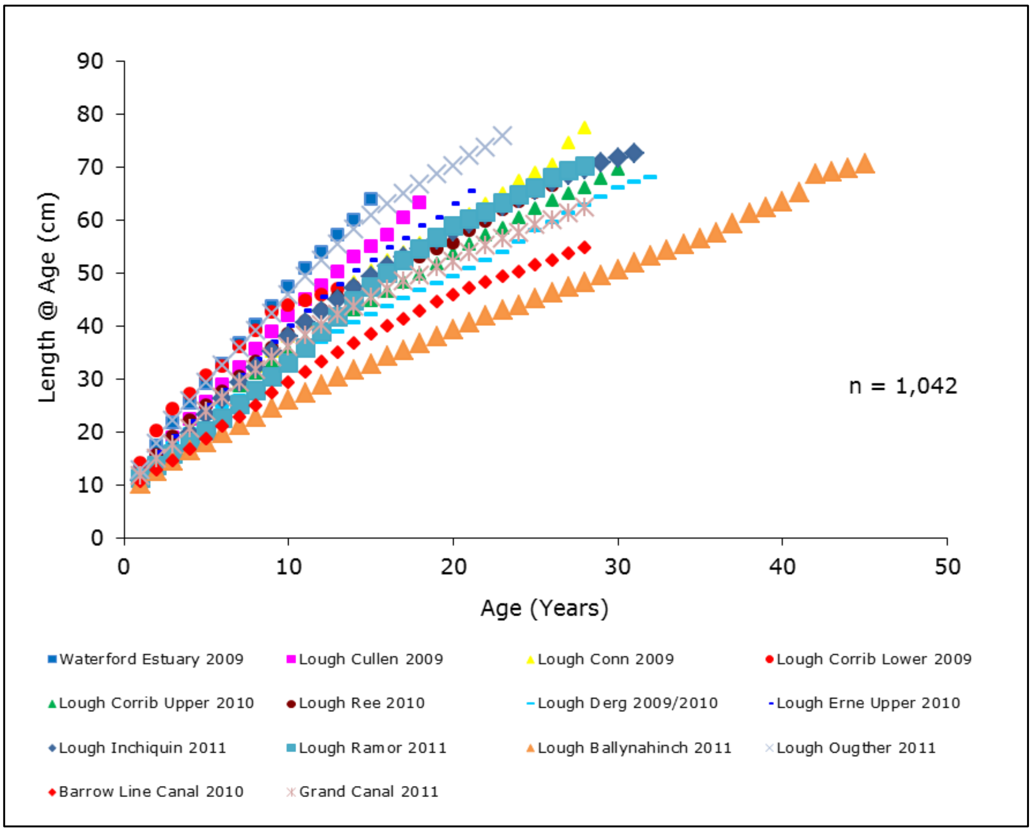

Figure 11.1. Observed growth rates (length-at-age) for yellow eels surveyed from 2009–2011.

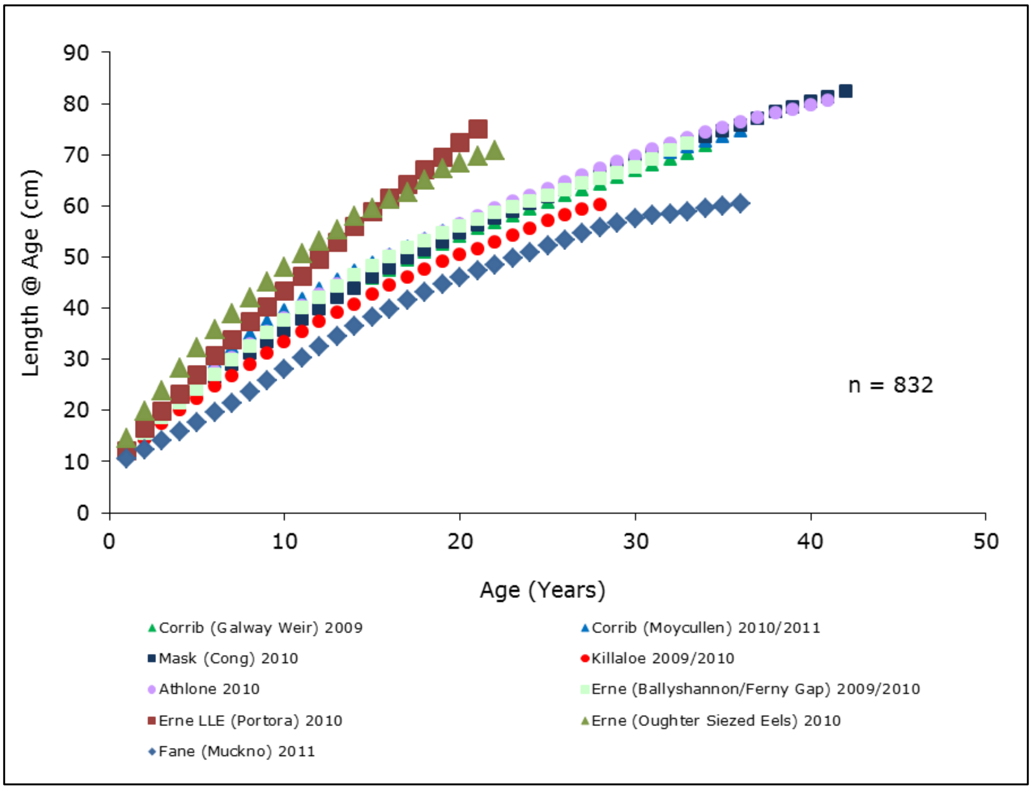

Figure 11.2. Observed growth rates (length-at-age) for silver eels surveyed from 2009–2011.

Table 11.8. Location and sample details for eels in Burrishoole examined for the presence of *Anguillicoloides crassus.*

YEAR	LOCATION	NO. OF EELS CHECKED	STAGE	NO. INFECTED	PREVALENCE	INTENSITY
Fresh water						
2009	Traps	50	Silver	0	0	0
2010	Yellow R.	5	Yellow	0	0	0
2010	Black Lakes	3	Yellow	0	0	0
2010	Glenamong R.	3	Yellow	0	0	0
2010	Feeagh	2	Yellow	0	0	0
2010	Traps	17	Silver	0	0	0
2011	Traps	50	Silver	0	0	0
2011	Feeagh	30	Yellow	0	0	0
2012	Feeagh	4	Yellow	0	0	0
2012	Traps	168	Silver	0	0	0
2013	Traps	106	Silver	0	0	0
Saline Water						
2008	Furnace	60	Yellow	0	0	0
2009	Fu Nixons	47	Silver	0	0	0
2010	Furnace	10	Yellow	0	0	0
2010	Fu Nixons	50	Silver	0	0	0
2011	Furnace	4	Yellow	2	50	1.0
2012	BOH	6	Yellow	6	100	2.0
2012	Furnace	10	Yellow	7	70	4.43
2013	Furnace	6	Yellow	6	100	13.5

12 Other sampling

Results of a study of *Anguilla anguilla* fecundity, based on samples of female silver eels from the River Shannon system in 2007–2009, have been reported by MacNamara and McCarthy (2012). The laboratory analysis followed protocols used in a similar study of fecundity of American eel *Anguilla rostrata* previously published by Barbin and McCleeve (1997). Fecundity estimates for the eels examined ranged from 626 000 to 8 006 667 for individuals for individual eels of 465 mm (211 g) to 1003 mm (2472 g). The estimates of fecundity were higher than those previously reported for *A. anguilla*. The latter were based on research involving hormonally treated eels, rather than wild caught specimens. Fecundity varied positively with eel length, eel body weight and gonad weight. Size-related fecundity did not differ significantly between upper Shannon (Lough Ennell outlet) and lower Shannon (Killaloe). A $\log_{10}$ transformed fecundity–length regression equation (fecundity = –2.992 + 3.293 * length) can be used for estimation of the potential contribution that particular silver eel runs may make in terms of egg production to the spawning stock (e.g. MacNamara and McCarthy, 2013).

13 Stock assessment

13.1 Method summary

The Irish assessment is built around the use of index catchments, where the silver eel escapement and mortality is assessed directly using mark–recapture (Shannon, Erne, Fane), DIDSON (Shannon), acoustic tracking for mortality (Shannon, Erne) or by total trap (Burrishoole). A comprehensive wetted area database of habitat is used along with the index catchments and eel growth data from 18 catchments to extrapolate to other catchments where there are no eel data.

The index catchments (Shannon, Erne, Fane and Burrishoole) contribute to 45% of the total freshwater wetted area.

The transitional and coastal waters have not been assessed for silver eel production. Transitional waters are being surveyed using fykenets under the National Eel Monitoring Programme and for the WFD, but these yellow eel data have not yet been incorporated in an assessment.

13.2 Local stock assessment

A national database is in the process of being compiled and this contains local stock assessment data. The main assessments included in the database are, single pass electrofishing surveys, multispecies three fishing depletion electrofishing surveys, boat electrofishing multispecies surveys, fykenet and electrofishing surveys under the Waterframework Directive and eel specific fykenet surveys.

A national programme of stock assessment and monitoring is outlined in the Eel Management Plan and in the Irish report to the EU. Index catchment have been intensively studied (Shannon, Erne, Corrib, Burrishoole) and these have been used to calibrate a wider assessment of data-poor catchments. The stock surveys were all reported in the Irish Science Report to the EU 2012.

13.3 EMU stock assessment

The following sections are drawn from the National Eel Management Report which accompanied the EMPs submitted to the EU in 2008/2009. It was updated in the Ireland Report to the EU (2012).

13.3.1 Habitat

13.3.1.1 Introduction

A G1S based data model was established for the quantification of the freshwater salmon habitat asset and for the determination of the quantity of habitat available to migratory salmonids. 261 discrete migratory salmonid 'Fishery Systems' were identified nationally (McGinnity *et al.*, 2003; 2012). An additional four Northern Ireland catchments have been included in the quantification in support of the NWIRBD transboundary management plan. It is likely that eels are present in the majority or all of these systems although commercial fishing probably only takes place in 4.6% of them accounting for 71% of the total wetted area. It is also possible that this number of 265 catchments may change in the future as more information becomes available.

The river and lake network held in the EPA and CFB GIS and used for Water Framework Directive and other applications is derived from original 1:50 000 scale Ordnance

Survey of Ireland mapping. The original OSI data has been subject to a thorough examination, removal of errors and addition of extra descriptor values so that the GIS version now contains:

- All component lines are 'with flow' in direction;
- Spurious breaks in the linework have been removed;
- Each "reach" or section between an upstream confluence and downstream confluence comprises a single line;
- Lines have been inserted through lakes to connect inflowing tributaries with the lake outflow point to enable linear network analysis in the GIS;
- Each reach is provided with a unique code identification number;
- Additional variables (including reach length, reach gradient, Strahler stream order number (Strahler, 1952). Shreve link magnitude number (Shreve, 1967), EPA river code have been added.

The number of lakes in the 1:50 000 scale GIS dataset comprises >12 000 units. Many are small and many are not connected to the river network by mapped channels. Each contains a unique identification number and measurement of surface area.

The national river network and lakes have been assigned to River and Lake Waterbodies for implementation of the Water Framework Directive. Rivers with a catchment area >= 10 km^2 are included. In most instances the derived river waterbodies comprise a series of original 'reach' segments merged into longer waterbodies using Stahler stream order values to group connected reaches. Some 4500 waterbodies are identified.

The logic for the derivation of Lake Waterbodies from the national lake dataset requires that >= 1 of the following three criteria are applicable:

- Lake surface area > 50 ha;
- Lake is used for water abstraction;
- Lake occurs within a Protected Area designation.

Some 805 lake waterbodies are identified on this basis.

13.3.1.2 Wetted area

The wetted area model (2007) has its origin in a CFB methodology (Quantification of the Freshwater Salmon Habitat Asset in Ireland, 2003). It predicts the likely river width along rivers based on a statistical model built from information derived in a GIS (McGinnity *et al*., 2012).

The core GIS datasets used in the development of the model include the river and lake network at 1:50 000 scale (EPA WFD GIS); estimates of the catchment area u/s of each reach; the total length of river channel u/s of each reach, the gradient of each reach and the stream order value (Strahler, 1952). These factors were related to field survey measurement of the river width at some 277 sites to allow derivation of a statistical formula that predicts the width at any reach where these GIS variables are known.

> * a 'reach' is defined in the GIS as the river line between an upstream confluence and a downstream confluence - typically of the order of ½–1 km in length.

An exercise to derive an improved model for river width prediction was undertaken in 2006/2007 (McGinnity *et al*., 2012). A new series of field measurements of width were obtained with a more complete distribution across the national river network (in the 2003 study the surveyed rivers were concentrated in the northwest and excluded the larger rivers from the sample). Arising from exploratory statistical analysis it was determined that the most appropriate model to estimate river width would be based on two predictive variables - the catchment area u/s of each reach and the stream link magnitude (Shreve, 1967) which is a less conservative form of hierarchical numbering of streams in a network than the Strahler stream order. Comparisons in Irish and Scottish rivers between modelled and measured widths were highly correlated and suggest that the model may be transferable to neighbouring areas.

The estimated total freshwater wetted area of the 265 lake, river and stream habitat accessible to migratory fish (including 1st order streams) in Ireland (including the Northern Ireland part of the Erne and the Loughs Agency Rivers in the Foyle and Carlingford areas) is 153 881 ha (Table 13.1). The 265 “migratory” systems were estimated to contain 132 275 ha of lake habitat, 21 606 ha of fluvial habitat, of which 2826 ha is estimated to be 1st order stream (calculated at a nominal width of 0.8 m). The ShRBD, WRBD and NWIRBD are clearly dominated by lacustrine habitat.

It is intended to refine this database in the future, adding in additional information such as obstacles to migration and natural barriers and ground truthing the potentially productive area with the presence/absence of eels.

Habitat quality data using the Amiro (Amiro, 1993) and Rosgen (Rosgen, 1994) gradient classification systems are available. For example, in the Kerry Fisheries District 48% of the potential salmon producing habitat has a gradient of <0.5% (Amiro Class 1).

The area of transitional and coastal waters is summarised in Table 13.2 for each RBD. The area is taken for the mean high tide level. Transitional and coastal waters were not considered in the productivity modelling for silver eel due to lack of eel data on these areas and a lack of a suitable methodology for estimating eel quantities.

Table 13.1. Total freshwater wetted areas (ha) for lake, first order fluvial and greater than first order fluvial habitat for each River Basin District, including Northern Ireland* (Erne, Drowes, Foyle, Roe and Faughan). *Data supplied by Inland Fisheries Ireland, Compass Informatics, the Loughs Agency and EHS Water Management Unit, Northern Ireland.

	Lake	>1st order fluvial	1st order fluvial	Total Wetted Area
EEMU	4861	1920	262	7043
SERBD	178	3626	412	4216
ShRBD	40 241	4487	590	45 317
SWRBD	7534	2714	419	10 666
WRBD	46 602	2869	473	49 944
NWIRBD	32 859	3165	670	36 694
Total	132 275	18 780	2826	153 881

Table 13.2. Total wetted areas (km²) for transitional and coastal waters for each River Basin District, including Northern Ireland (NWIRBD), but excluding the RoI part of the NBIRBD in the EEMU.

	Transitional Waters	Coastal Waters	Total Tidal Area
EEMU*	23	359	383
SERBD	90	1024	1114
ShRBD	250	1220	1470
SWRBD	166	3576	3743
WRBD	133	4574	4707
NWIRBD	131	2230	2361
Total (km²)	795	12 984	13 780

***excludes the RoI part of NBIRBD.**

13.3.2 Silver eel production

Ireland used a system of extrapolating from index data-rich catchments to data-poor catchments for calculating estimates of pristine and current biomass as described in the Irish Eel Management Plan (Chapter 5) and the WGEEL report (ICES, 2008).

> Note: tidal and transitional waters were not included in the production and escapement analysis

As set out in the EU template for the National Report 2012, the following definitions are adhered to:

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.
ΣF	The fishing mortality rate, summed over the age-groups in the stock, and the reduction effected.
ΣH	The anthropogenic mortality rate outside the fishery, summed over the age-groups in the stock, and the reduction effected.
R	The amount of glass eel used for restocking within the country.
ΣA	The sum of anthropogenic mortalities, i.e. ΣA = ΣF + ΣH.

13.3.2.1 Introduction

The estimation of pristine and current (2008 based on the average of 2001–2007) silver eel biomass being produced and escaping was fully described in the National Eel Plan (2008, Ch.5) and in ICES (2008, page 47). The calculation of pristine productivity for exploited catchments requires estimates of silver eel escapement along with historic silver and yellow eel catches, raised to account for unreported and also illegal catches. Historical catch records for silver eel fisheries were available for the five catchments of the Corrib, Moy, Garavogue, Burrishoole and Erne. The efficiencies of the fisheries had been previously estimated for the Shannon, Corrib and Erne silver eel fisheries. Where fishery efficiency was not measured an approximately average value of 33% was used to calculate escapement. In addition to the catch at the recording station and escapement past the recording station the yellow eel and silver eel catches made upstream were included to estimate pristine productivity. In the absence of historic data for these latter parameters (yellow and silver eel catches upstream of the recording station) it was assumed that the yields were equal to those currently observed (2001–2007). A similar process was used to calculate the 2008 production, based on the average of 2001-2007, and escapement using data from four catchments, the Shannon, Corrib, Burrishoole and Lough Ennell (estimate based on depletion fishing surveys by NUIG).

For those catchments with hydropower at the lower end of the catchment (Shannon, Erne, Liffey and Lee), an estimate of the impact was derived by imposing a 28.5% mortality per turbine passage (ICES, 2003). Therefore, the probability of surviving passage through 'n' number of hydropower installations is $(0.715)^n$. In this report, we have recalculated these estimates using the newly available hydropower mortality data.

Silver eel production was then determined for the other catchments by using a habitat-based approach. The method involved determining the relationship between productivity and the geological characteristics of the catchment.

Growth rate of eel were available for 17 catchments (Moriarty, 1988; Poole, pers com., WFD). The wetted area within each catchment was quantified using a geographical information system and classified according to the proportion of the catchment area comprising non-calcareous geology. For 17 catchments growth rate was found to be closely negatively related to the proportion of the catchments comprising non-calcareous geology. This allowed the estimation of silver eel production to be made on the basis of geology (natural productivity) and growth rate.

> Note: tidal and transitional waters were not included in the production and escapement analysis.

13.4 Summary data

13.4.1 Stock indicators and targets

Stock indicator and mortality data unchanged from Ireland (2012) report and May WKEPEMP Report (ICES 2013) (Table 13.3).

Table 13.3. Stock indicators and mortality data for irish EMUs from 2009–2011. These are averages for the three year assessment period.

CODE	YEAR	BIOMASS (T)			MORTALITY			TARGET	TARGET
		B_0	B_{best}	$B_{current}$	∑A	∑F	∑H	Biomass	∑A
IE_East	2008	20.5	14.2	7	0.71	0.68	0.03	8.2	0.79
	2009	20.5	9.6	9.4	0.01	0	0.01	8.2	0.92
	2010	20.5	9.6	9.4	0.01	0	0.01	8.2	0.92
	2011	20.5	9.6	9.4	0.01	0	0.01	8.2	0.92
IE_NorW	2008	135.8	103.5	48.8	0.75	0.58	0.18	54.3	0.83
	2009	135.8	54.3	51.5	No data	No data	No data	54.3	0.87
	2010	135.8	54.3	51.5	0.05	0	0.05	54.3	0.87
	2011	135.8	54.3	51.5	0.05	0	0.05	54.3	0.87
IE_Shan	2008	201.2	94.2	19.9	1.55	1.29	0.26	80.5	0.23
	2009	201.2	75.4	68.7	0.09	0	0.09	80.5	0.79
	2010	201.2	75.4	68.7	0.09	0	0.09	80.5	0.79
	2011	201.2	75.4	68.7	0.09	0	0.09	80.5	0.79
IE_SouE	2008	14.8	10.1	8.7	0.15	0.15	0	5.9	0.92
	2009	14.8	6.8	6.8	0	0	0	5.9	0.92
	2010	14.8	6.8	6.8	0	0	0	5.9	0.92
	2011	14.8	6.8	6.8	0	0	0	5.9	0.92
IE_SouW	2008	24.5	17.4	16.6	0.05	0.01	0.04	9.8	0.92
	2009	24.5	11.6	11.3	0.03	0	0.03	9.8	0.92
	2010	24.5	11.6	11.3	0.03	0	0.03	9.8	0.92
	2011	24.5	11.6	11.3	0.03	0	0.03	9.8	0.92
IE_West	2008	189.2	96.9	41.6	0.85	0.85	0	75.7	0.51
	2009	189.2	68.7	68.7	0	0	0	75.7	0.84
	2010	189.2	68.7	68.7	0	0	0	75.7	0.84
	2011	189.2	68.7	68.7	0	0	0	75.7	0.84

13.4.2 Habitat coverage

Table 13.4. Areas of habitat (ha for freshwater, km² for saline) and assessment status (2009–2011).

EMU code	River		Lake		Estuary & lagoon		Lagoon		Coastal	
	Area (ha)	A'd Y/N)	Area (ha)	A'd Y/N)	Area (km2)	A'd Y/N)	Area (ha)	A'd Y/N)	Area (km2)	A'd Y/N)
EEMU	2,182	Y[1]	4,861	Y[2]	23	N	*[3]	N	359	N
SERBD	4,038	Y[1]	178	Y[2]	90	N	*[3]	N	1,024	N
ShRBD	5,077	Y[1]	40,241	Y[2]	250	N	*[3]	N	1220	N
SWRBD	3,133	Y[1]	7,534	Y[2]	166	N	*[3]	N	3,576	N
WRBD	3,342	Y[1]	46,602	Y[2]	133	N	*[3]	N	4,574	N
NWIRBD	3,835	Y[1]	32,859	Y[2]	131	N	*[3]	N	2,230	N
Total	21,607	Y[1]	132,275	Y[2]	795	N	*[3]	N	12,984	N

Y[1] rivers not assessed separately. All freshwater assessed as a whole.

Y[2] rivers not assessed separately. All freshwater assessed as a whole.

***[3], area of lagoons included with estuaries.**

13.4.3 Impact

It should be noted that for the Irish EMU's, the assessment of silver eel stock indicators and mortalities is undertaken at the freshwater basin scale and rivers and lakes are not assessed separately of each other. This table (Table 13.5) is referenced to the period 2009–2011.

A = assessed, MI = not assessed, minor, MA = not assessed major, AB = impact absent

Table 13.5. Assessment of the different impacts x habitat.

EMU code	Habitat	Fish com	Fish rec	Hydro & pumps	Barriers	Restocking	Predators	Indirect impacts
IE_East	Riv	AB	AB	MI	MI	AB	MI	MI
	Lak	AB	AB	MI	MI	AB	MI	MI
	Tot Fresh	AB	AB	A	MI	AB	MI	MI
	Est	AB	AB	AB	AB	AB	MI	MI
	Lag	AB	AB	AB	AB	AB	MI	MI
	Coa	AB	AB	AB	AB	AB	MI	MI
	All	AB	AB	AB	AB	AB	MI	MI
IE_NorW	Riv	AB	AB	MA	MI	AB	MI	MI
	Lak	AB	AB	MA	MI	AB	MI	MI
	Tot Fresh	AB	AB	A	MI	AB	MI	MI
	Est	AB	AB	AB	AB	AB	MI	MI
	Lag	AB	AB	AB	AB	AB	MI	MI
	Coa	AB	AB	AB	AB	AB	MI	MI
	All	AB	AB	AB	AB	AB	MI	MI

EMU code	Habitat	Fish com	Fish rec	Hydro & pumps	Barriers	Restocking	Predators	Indirect impacts
IE_Shan	Riv	AB	AB	MA	MI	AB	MI	MI
	Lak	AB	AB	MA	MI	AB	MI	MI
	Tot Fresh	AB	AB	A	MI	AB	MI	MI
	Est	AB	AB	AB	AB	AB	MI	MI
	Lag	AB	AB	AB	AB	AB	MI	MI
	Coa	AB	AB	AB	AB	AB	MI	MI
	All	AB	AB	AB	AB	AB	MI	MI
IE_SouE	Riv	AB	AB	AB	MI	AB	MI	MI
	Lak	AB	AB	AB	MI	AB	MI	MI
	Tot Fresh	AB	AB	AB	MI	AB	MI	MI
	Est	AB	AB	AB	AB	AB	MI	MI
	Lag	AB	AB	AB	AB	AB	MI	MI
	Coa	AB	AB	AB	AB	AB	MI	MI
	All	AB	AB	AB	AB	AB	MI	MI
IE_SouW	Riv	AB	AB	MI	MI	AB	MI	MI
	Lak	AB	AB	MI	MI	AB	MI	MI
	Tot Fresh	AB	AB	A	MI	AB	MI	MI
	Est	AB	AB	AB	AB	AB	MI	MI
	Lag	AB	AB	AB	AB	AB	MI	MI
	Coa	AB	AB	AB	AB	AB	MI	MI
	All	AB	AB	AB	AB	AB	MI	MI
IE_West	Riv	AB	AB	MI	MI	AB	MI	MI
	Lak	AB	AB	MI	MI	AB	MI	MI
	Tot Fresh	AB	AB	A	MI	AB	MI	MI
	Est	AB	AB	AB	AB	AB	MI	MI
	Lag	AB	AB	AB	AB	AB	MI	MI
	Coa	AB	AB	AB	AB	AB	MI	MI
	All	AB	AB	AB	AB	AB	MI	MI

Table 13.6. Losses in tonnes by the different impacts for 2009–2011 following implementation of fishery closure and silver eel trap and transport around hydropower stations.

A = assessed, MI = not assessed, minor, MA = not assessed major, AB = impact absent

EMU code	Stage	Fish com	Fish rec	Hydro & pumps	Barriers	Restocking	Predators	Indirect impacts
IE_East	Glass	0	0	0	MI	0	MI	MI
	Yellow	0	0	MI	MI	0	MI	MI
	Silver	0	0	0.2	MI	0	MI	MI
	Silver EQ	0	0	na	MI	0	MI	MI
IE_NorW	Glass	0	0	0	MI	0	MI	MI
	Yellow	0	0	MI	MI	0	MI	MI
	Silver	0	0	2.8	MI	0	MI	MI
	Silver EQ	0	0	na	MI	0	MI	MI
IE_Shan	Glass	0	0	0	MI	0	MI	MI
	Yellow	0	0	MI	MI	0	MI	MI
	Silver	0	0	6.7	MI	0	MI	MI
	Silver EQ	0	0	na	MI	0	MI	MI
IE_SouE	Glass	0	0	0	MI	0	MI	MI
	Yellow	0	0	MI	MI	0	MI	MI
	Silver	0	0	0	MI	0	MI	MI
	Silver EQ	0	0	na	MI	0	MI	MI
IE_SouW	Glass	0	0	0	MI	0	MI	MI
	Yellow	0	0	MI	MI	0	MI	MI
	Silver	0	0	0.3	MI	0	MI	MI
	Silver EQ	0	0	na	MI	0	MI	MI
IE_West	Glass	0	0	0	MI	0	MI	MI
	Yellow	0	0	MI	MI	0	MI	MI
	Silver	0	0	0	MI	0	MI	MI
	Silver EQ	0	0	na	MI	0	MI	MI

13.4.4 Precautionary diagram

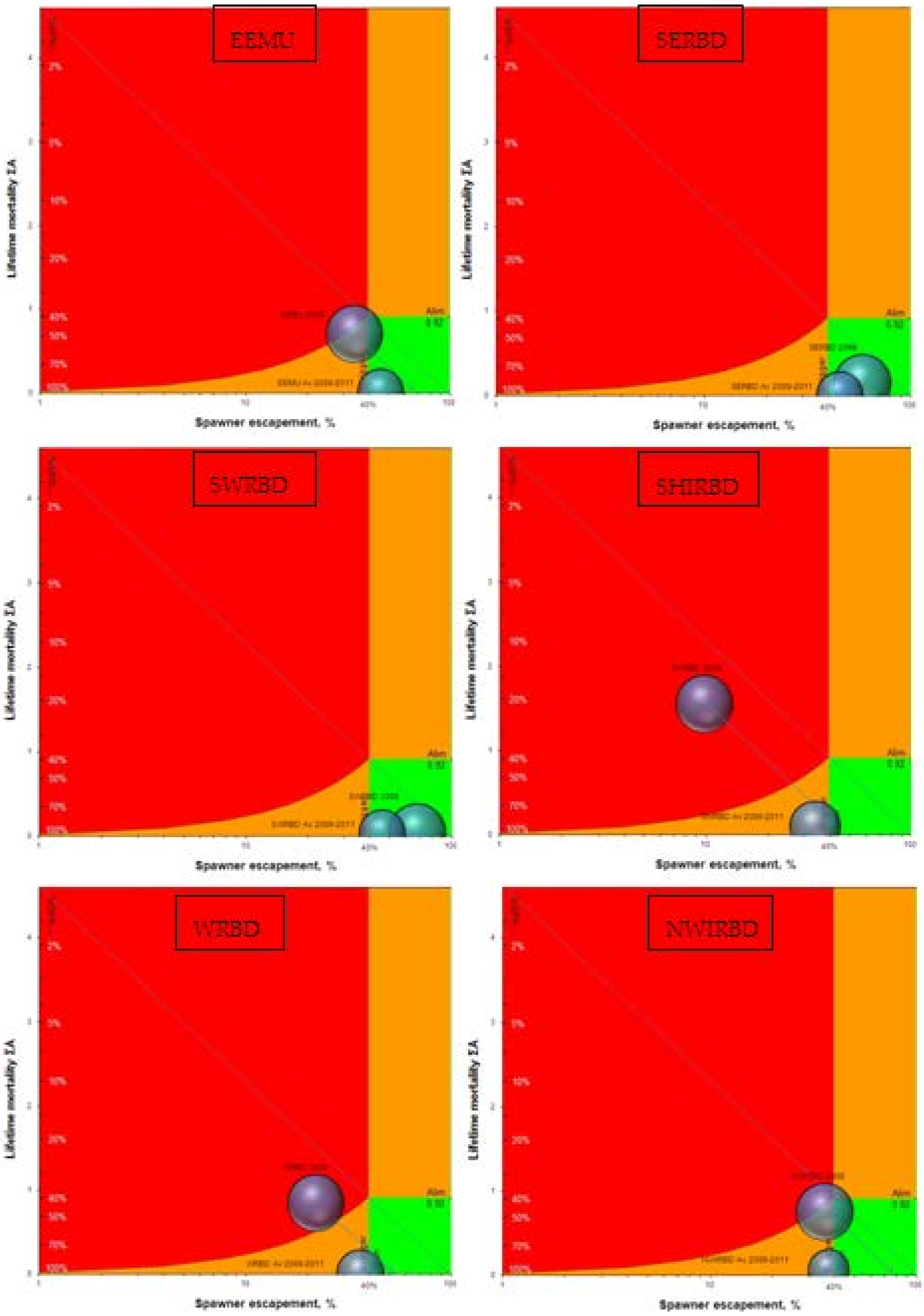

Figure 13.1. Status of the stock and the anthropogenic impacts, for each EMU in 2008 (average 2001–2007) and for the 2009–2011 period. For each, the size of the bubble is proportional to B_{best}, the best achievable escapement given recent recruitment, while the centre of the bubble gives the stock status relative to the targets/limits. The horizontal axis represents the stock status related to pristine conditions while the vertical axis represents anthropogenic mortality.

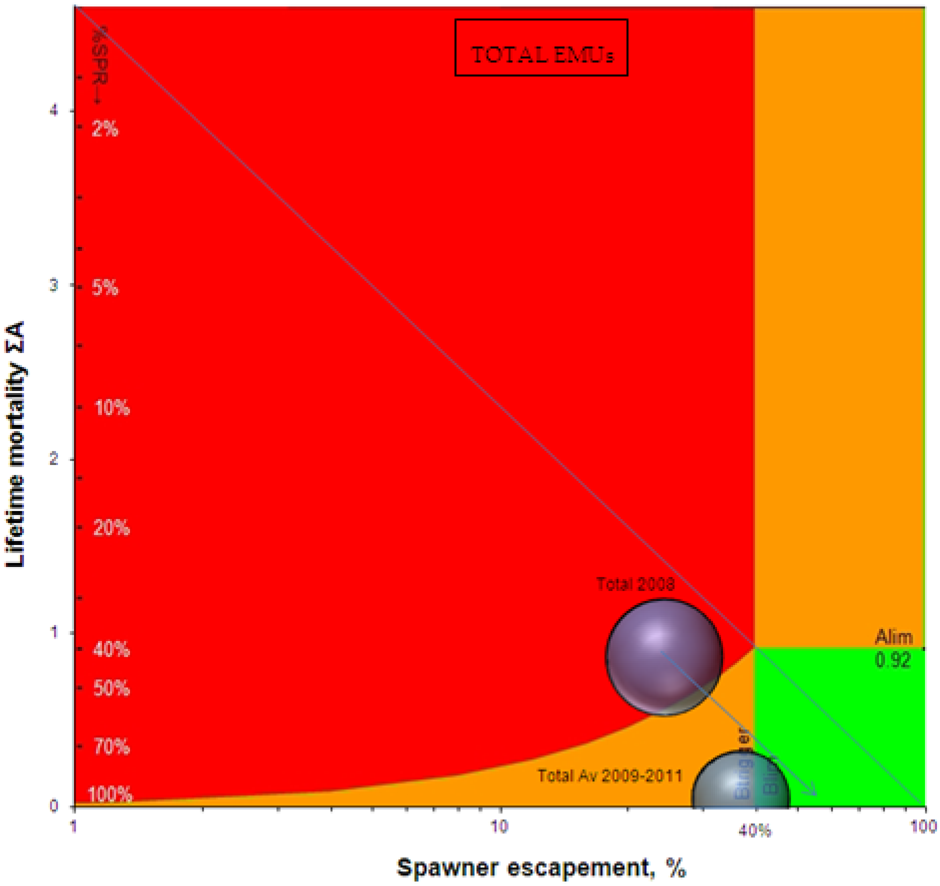

Figure 13.2. Status of the stock and the anthropogenic impacts, for total EMUs in 2008 (average 2001–2007) and for the 2009–2011 period. For each, the size of the bubble is proportional to B_{best}, the best achievable escapement given recent recruitment, while the centre of the bubble gives the stock status relative to the targets/limits. The horizontal axis represents the stock status related to pristine conditions while the vertical axis represents anthropogenic mortality.

13.4.5 Management measures

This management table was provided to WGEEL in March 2013 and also to the WKEPEMP (Table 13.7).

13.5 Summary data on glass eel

No glass eel were landed, imported or exported to or from Ireland in 2012, 2013 or 2014.

Table 13.7. Table of management measures in the Irish Eel Management Plan.

Country	IE						
Summe von outcome		emu_name_short					
action type	Subaction	IE_East	IE_NorW	IE_Shan	IE_SouE	IE_SouW	IE_West
Hydropower and obstacles	trap & transport		2	1		2	
	Engineered solutions (turbine design and modification)	2	2	2		2	
	Ensure upstream migration at barriers - assisted migration & stocking	1	1	1	1	1	1
	Ensure upstream migration at barriers - excisting barriers	2	2	2	2	2	2
	Ensure upstream migration at barriers - new potential barriers	1	1	1	1	1	1
	Improve water quality - ensure compliance with Water Framework Directive	1	1	1	1	1	1
	New turbine installations	1	1	1	1	1	1
	Other solutions (e.g. migromat)	3	2	1		3	
	Quantify turbine mortality and morbidity	3	2	1		3	
Recreational fishery	Close fishery	1	1	1	1	1	1
Commercial fishery	Close eel market	2	2	2	2	2	2
	Close fishery	1	1	1	1	1	1
	Investigating possible diversification for former commercial fishermen	2	2	2	2	2	3
Other	Fish health and biosecurity issues - ensure compliance withFish Health Directive	1	1	1	1	1	1

14 Sampling intensity and precision

14.1 Fykenet surveys – extracted from SGAESAW 2009

Fykenets are a common gear for capturing anguillid eels in both commercial and research fisheries. Researchers may use fykenet catches for estimating biological parameters of local populations, for tracking abundance trends, or for mark–recapture population estimates. Size selectivity of fykenets and the relation between fykenet catch per unit of effort (cpue) and its standard deviation were examined using data from western Ireland.

In 1987 and 1988, 2614 eels were captured in fykenets, marked and released in the Burrishoole (Poole and Reynolds, 1996a). The proportion of these eels which were recaptured in fykenets increased from nil at length 30–35 cm to over 0.2 at length 60–65 cm (Figure 14.1). This size bias must be accounted for if slopes of length–frequency distributions are used to determine biological parameters.

Based on data from >20 000 net-nights (Matthews *et al.*, 2001; Poole, 1994), the standard deviation of cpue increased linearly with cpue (Figure 14.2). Increasing the number of fykenets in a chain of nets from five to ten did not decrease standard deviation of cpue (Figure 14.3). This suggests that increasing chain length does not assist in achieving accurate estimates. Instead, more locations or more fishing nights may be more helpful in producing accurate estimates. A power analysis indicates that the sample size required to achieve a given precision in cpue is strongly influenced by population density. Overall, cpue is an insensitive tool with wide variation in numbers and weight per net. A relatively high effort is required to attain tight precision in cpue.

For the Irish surveys, the number of hauls required to achieve even modest precision in cpue (e.g. CV = 10%) is high, especially where eel density is low (Figure 14.4). Achieving a CV of 10% where the average cpue is high requires approximately 50 hauls. Assuming chains of five fykenets are used this equates to 250 net-nights.

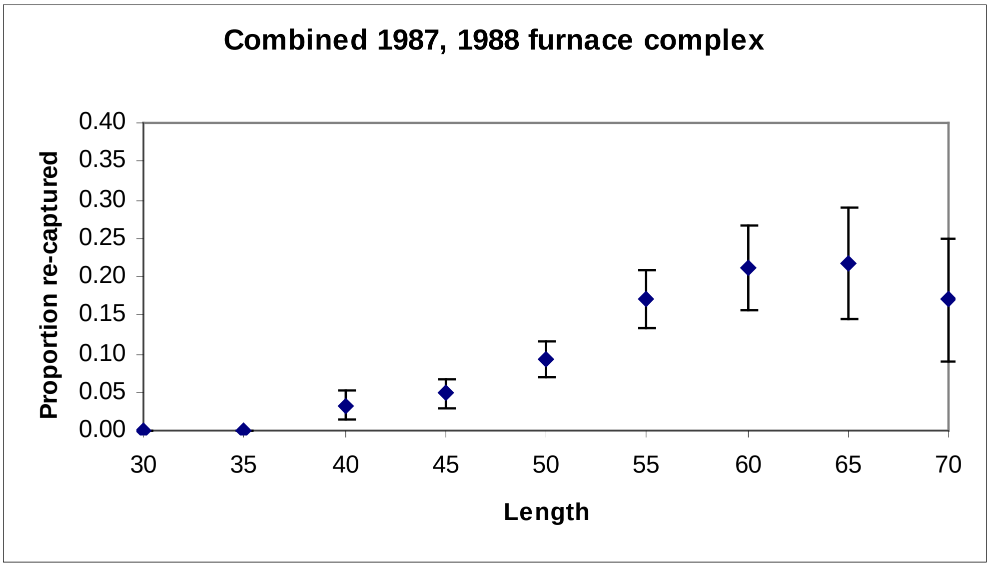

Figure 14.1. Proportion of European eels recaptured in fykenets in relation to length.

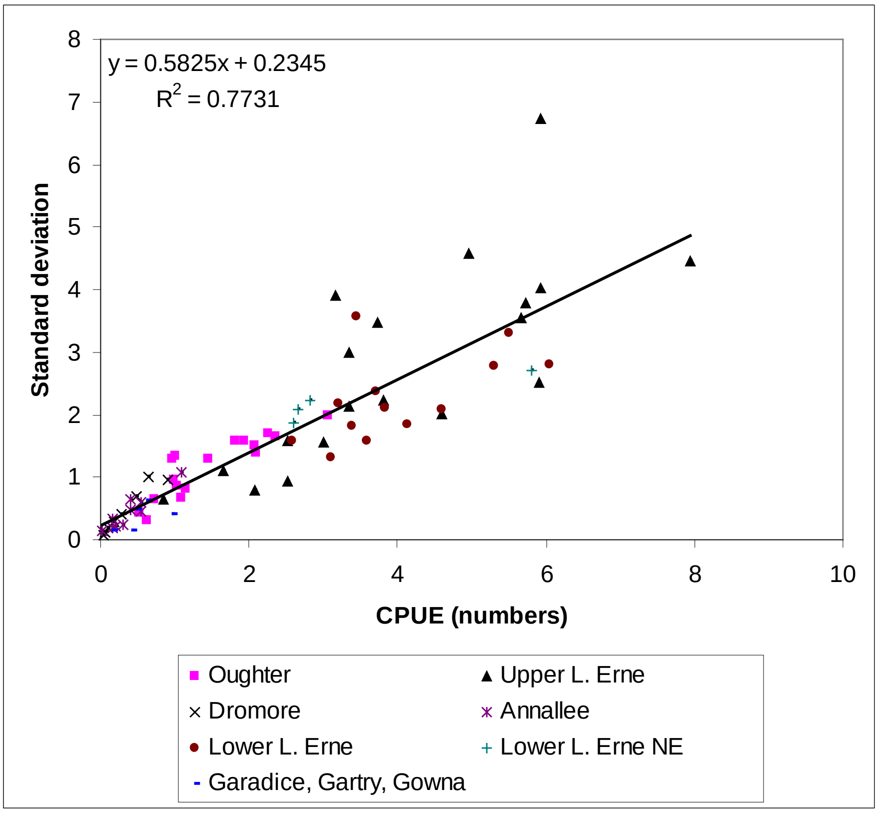

Figure 14.2. Relation between the standard deviation of five fyke chain cpue and cpue.

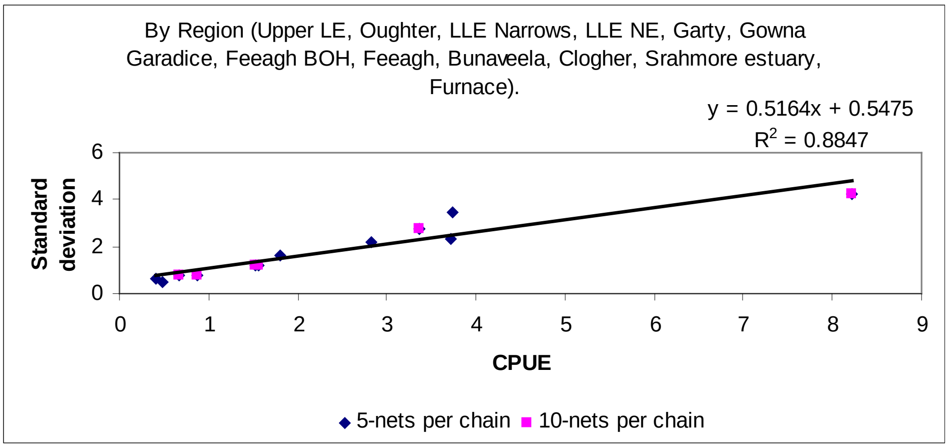

Figure 14.3. Relation between standard deviation and cpue for fykenets with five and ten nets per chain.

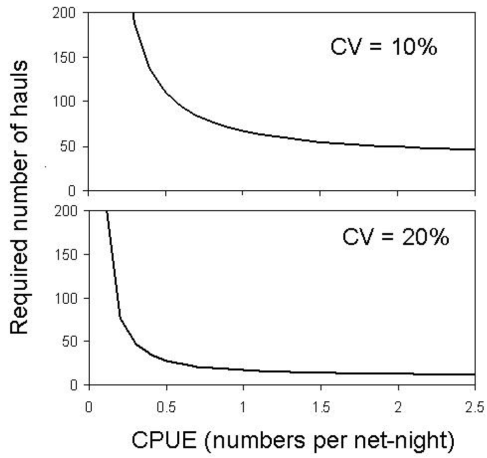

Figure 14.4. Power analysis of the number of hauls required to achieve precision levels in cpue consistent with indicated coefficients of variation. The required sample size is highly sensitive to the population density (assuming cpue is directly related to density).

14.2 Length sampling of silver eel

Data for length, weight, age, etc. have not been analysed in detail as a time-series or to look at change over time. Annual variation has been observed in silver eel lengths and this raises an issue relating to timing of sampling and differential timing of migration of large and small eel.

The lunar silver eel length data collected in 1995, and in other years (i.e. 2012), indicates a change in length distribution of the migrating silver eels throughout the season (Figure 14.5). This means that careful planning of silver eel sampling is required.

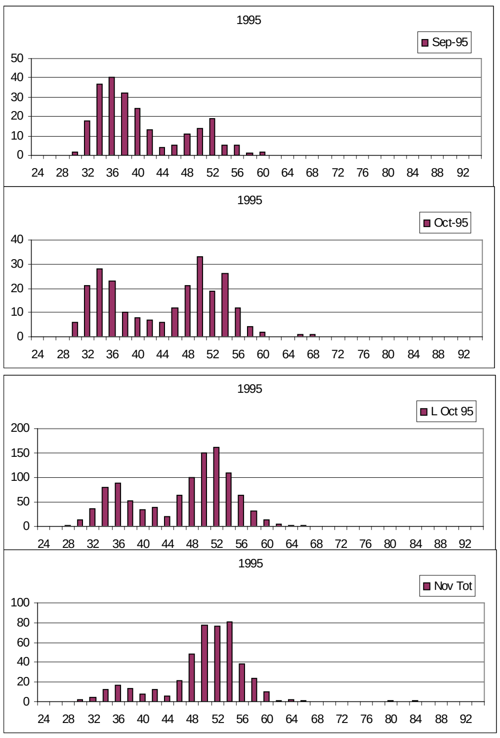

Figure 14.5. Monthly length distributions, taken for each lunar phase, for Burrishoole silver eels

15 Standardisation and harmonisation of methodology

15.1 Survey techniques

Fykenets – Standard summer fykenets (Matthews *et al*., 2001; McCarthy *et al*., 1994; Moriarty, 1975; Poole, 1990; 1994; Poole and Reynolds, 1996a) have been widely used in eel surveys around Ireland since the early 1970s. The nets used have been generally similar in all the surveys, normally fished in chains of five or ten nets. A "typical" summer fykenet consists of two traps (each 3.3 m in length), facing each other, joined by a leader net (8 m in length), mesh size 16–18 mm. Each trap consists of two chambers and a codend with knot to knot mesh sizes of 16, 12, and 10 mm respectively. The diameter of the trap entrance was 58 cm and the outer ring of each trap was 'D' shaped.

Catch per unit of effort (cpue) data are normally reported in number of eels, or weight, per net (pair of traps) per night fished.

Fykenets are the standard tool for the 2009–2011 and 2012–2014 monitoring programmes.

Longlines – Longlines have not been extensively used as a survey tool in Ireland. On the Shannon (McCarthy and Cullen, 2000) longlines were standardised and the bait was restricted to earthworm allowing some comparisons to be made between fishing areas and years.

River surveys – In deeper rivers and estuaries, fykenets have been the standard survey tool. In smaller rivers electrofishing is generally employed, in spite of being fraught with difficulties when applied to eel, with a variety of back-pack portable and bankside generator gear being used. Single pass and three fishing depletion methods are used, but often eel assessments are carried out as a "by-product" of other surveys, in particular salmonid surveys.

15.2 Sampling commercial catches

There was no National programme for sampling commercial catches in Ireland during 2009–2011.

Erne – The survey of the Erne catchment 1998–2001 was carried out using a semi-commercial research team of crews (Matthews *et al*., 2001). An observer was placed with each crew at least once a week to ensure standardisation. Eels were stored in keep nets or boxes similar to those used by commercial fishermen. Eels were graded and sold to eel dealers at the lake shore. The entire catch was sampled prior to grading and the fishermen were paid full price for undersized eel, before their release.

Shannon – Before 2009, commercial crews were authorised by the ESB sell to eel dealers at lakeside locations on designated dates. ESB staff and NUIG researchers attended at sales points, to monitor catches and to obtain samples for length, weight, age and parasitology analyses. Dealers were required to provide advance notice of their collection schedules. Comparisons were made annually between sales statistics and cumulative catches, reported in log-books, by the fishing crews. Dealers were required to disinfect truck tanks, monitored by ESB staff, before collections begin and to ensure that no water/potential pathogens were introduced to the river system.

15.3 Sampling

Catch sampling is normally carried out on anaesthetised eel, although some samples may be taken from either freshly sacrificed or frozen samples. Lengths measured to $\pm$0.1 cm and weights to $\pm$5 g. Otoliths are stored dry in paper envelopes.

15.4 Age analysis

Age analysis of eel in Ireland has generally followed the methodology of burning & cracking (Christensen, 1964; Cullen and McCarthy, 2003; Hu and Todd, 1981; Moriarty, 1983; Poole and Reynolds, 1996b; Vollestad *et al*., 1988). Otoliths are extracted as described by Moriarty (1973), stored dry and prepared by burning in either gas or spirit flame. There is no formal validation or quality control in Ireland. Some cross validation and double reading has been carried out between projects and between agencies and this has ensured some degree of continuity between samples and surveys, (i.e. Moriarty, 1983; Poole *et al*., 1992; Matthews *et al*., 2001; Matthews *et al.,* 2003; Maes, unpublished). Comparisons have also been made between age derived growth (back-calculations) and tag/mark–recapture determined growth, thereby validating the use of burning & cracking otoliths for age and growth determinations in slow growing Irish eel (Poole and Reynolds, 1996a; Moriarty, 1983).

Ireland is using the recommendations and manual of the ICES Workshop on Eel Age WKAREA 2009 and 2011. An initial training workshop was held in Inland Fisheries Ireland in February, 2010, using the WKAREA information as a guideline and a follow-up workshop was held in the Marine Institute in February 2012. Further intercalibration is envisaged in 2014.

15.5 Life stages

Glass Eel/Elver life stages are determined the pigmentation classification using that published by Elie *et al*. (1982).

Yellow eel and silver eel are categorised by a combination of capture method and season, colouration and eye size. Silver eels are generally captured during their downstream migration, or can be recognised in the yellow eel catch by the enlarged eyes and onset of coloration change.

15.6 Sex determinations

Yellow eel <25 cm are problematical to sex and >25 cm up to 45 cm are sexed by dissection.

Silver eel are sexed by length and some studies have carried out dissections on eels between ~38 cm and 48 cm in order to determine the length overlap between the sexes. Histological verification has not been used to any extent in Ireland.

15.7 Data quality issues

An eel age intercalibration workshop is planned for December 2014.

Interpretation of subjective variables, such as fish colour, presence of lateral line dots in silver eels, can be interpreted differently between observers.

Very low levels of fishing effort, such as some fykenet effort in transitional waters under WFD sampling, need to be interpreted with caution.

16 Overview, conclusions and recommendations

Recruitment time-series are largely effort independent and up to date (2014) for all sites. Recruitment generally increased in Ireland in 2012, 2013 and 2014 although some sites in 2014 showed little or no improvement.

Catch statistics are up to date to 2008 and with the closure of the fisheries in 2009–2014, these data cease to exist.

Ireland submitted an EMP and this was accepted in July 2009.

Ireland has implemented its management actions in 2009–2012 and undertaken the National Monitoring programme also in 2009–2012.

Ireland intends determining current escapement on a three year rolling average (2009–2011 and 2012–2014) in line with the reporting schedule laid out in the EU Regulation. Where available, historic production estimates, wetted areas, etc. were also be improved and updated for 2012. Ireland submitted a Report to the EU in 2012 with 3B & A estimates for all freshwaters. Estimates were not provided for transitional and coastal waters.

17 Literature references

Anon. 2012. Report on the implementation of eel management plans for Ireland, including the transboundary NWIRBD 2009 – 2011. Dept. of Communications & Natural Resources, Dublin.

Amiro, P.G. 1993. Habitat measurement and population estimation of juvenile Atlantic salmon. In; R.J. Gibson and R.E. Cutting (ed). Production of juvenile Atlantic salmon in natural waters. Can. Spec. Publ. Fish. Aquat. Sci., 118; 81–97.

Åström, M. and Dekker, W. 2007. When will the eel recover? A full life-cycle model. – ICES Journal of Marine Science, 64; 1–8.

Barbin, G. P., and J. D. McCleave. 1997. Fecundity of the American eel *Anguilla rostrata* at 45°N in Maine, U.S.A. *Journal of Fish Biology* 51:840–847.

Beccera-Jurado, G., Cruikshanks, R., O'Leary, C., Kelly, F., Poole, R. and Gargan, P. 2014. Distribution, prevalence and intensity of *Anguillicola crassus* (Nematoda) infection in *Anguilla anguilla* in the Republic of Ireland. *Journal of Fish Biology* **84;** 1046–1062.

Christensen J. M. 1964. Burning of otoliths, a technique for age determination of soles and other fish. J. Cons. perm. int. Explor. Mer, 29, 73–81.

Cullen P. and McCarthy T.K. 2003. A comparison of two age determination techniques commonly used for eels *Anguilla anguilla* (L.). Ir. Nat. J. 27 (8), 301–305.

Dekker W., Pawson M., Walker A., Rosell R., Evans D., Briand C., Castelnaud G., Lambert P., Beaulaton L., Åström M., Wickström H., Poole R., McCarthy T.K., Blaszkowski M., de Leo G. and Bevacqua D. 2006. Report of FP6-project FP6-022488, Restoration of the European eel population; pilot studies for a scientific framework in support of sustainable management: SLIME. 19 pp. + CD.

Elie P., Lecomte-Finiger R., Cantrelle I. and Charlon N. 1982. Définition des limites des différents stades pigmentaires durant la phase civelle d'*Anguilla anguilla* L. Vie et milieu 32 (3), 149–157.

Hu L.C. and Todd P.R. 1981. An improved technique for preparing eel otoliths for aging. N. Z. J. Mar. and Freshw. Res., 15, 445–446.

ICES. 2002. The report of the 2003 Session of the Joint EIFAC/ICES Working Group on Eels. Nantes, ICES CM 2002/ACFM; 06.

ICES. 2008. The report of the 2008 Session of the Joint EIFAC/ICES Working Group on Eels. Leuven, Sept. 2008; ICES CM 2008/ACOM; 15.

ICES. 2013. Report of the Workshop on Evaluation Progress Eel Management Plans; ICES CM 2013/ACOM:32; 757pp.

Matthews M., Evans D., Rosell R., Moriarty C. and Marsh, I. 2001. Erne Eel Enhancement Programme. EU Programme for Peace & Reconciliation Project No. EU 15. Northern Regional Fisheries Board, Donegal; 348pp.

Matthews M., Evans D.W., McClintock C.A. and Moriarty C. 2003. Age, growth and catch-related data of yellow eel *Anguilla anguilla* (L.) from the lakes of the Erne catchment, Ireland. American Fisheries Society Symposium 33, 207–215.

McCarthy T.K. and Cullen P. 2000. Eel Fishing in the River Shannon: Eel population changes, fishery management options and fishery conservation issues. A synthesis report on the River Shannon Eel Management Programme 1992–2000. Report to the ESB, NUIG; 21pp.

McCarthy T.K., O'Farrell M., McGovern P. and Duke A. 1994. Elver Management Programme; Feasibility Study Report, Forbairt, Dublin, 90pp.

McCarthy, T.K., Nowak, D., Grennan, J., Bateman, A., Conneely, B. and MacNamara, R. 2013. Spawner escapement of European eel (*Anguilla anguilla*) from the River Erne, Ireland. Ecology of Freshwater Fish, doi: 10.1111/eff.12091. 12pp.

McCarthy, T.K., Nowak, D., Grennan, J., Bateman, A., Conneely, B. and MacNamara, R. 2014. Spawner escapement of European eel (*Anguilla anguilla*) from the River Erne, Ireland. Ecology of Freshwater Fish **23** (1), 21–32.

McGinnity P., Gargan P., Roche W., Mills P., and McGarrigle M. 2003. Quantification of the freshwater salmon habitat asset in Ireland using data interpreted in a GIS platform. Irish Freshwater Fisheries Ecology and Management Series: No. 3, Central Fisheries Board, Dublin, Ireland, 132pp.

McGinnity, P., de Eyto, E., Gilbey, J., Gargan, P., Roche, W., Stafford, T., McGarrigle, M., O'Maoileidigh, N. and Mills, P. 2012. A predictive model for estimating river habitat area using GIS-derived catchment and river variables. Fisheries Management and Ecology, 19 (1); 69–77.

MacNamara, R., and McCarthy, T.K. 2012. Size-related variation in fecundity of European eel (*Anguilla anguilla*). ICES Journal of Marine Science,doi :10.1093/icesjms/fss123. 5pp.

MacNamara, R., and McCarthy, T.K. 2013. Silver eel (*Anguilla anguilla*) population dynamics and production in the River Shannon, Ireland. Ecology of Freshwater Fish, 2013.

Moriarty C. 1973. A technique for examining eel otoliths. J. Fish Biol. 5, 183–184.

Moriarty, C. 1975. The small fyke net as a sampling instrument in eel research. EIFAC/T23 (Suppl. 1), 507–518.

Moriarty, C. 1983. Age determination and growth rate of eels, *Anguilla anguilla* (L). J. Fish Biol. 23, 257–264.

Moriarty, C. 1988. The Eel in Ireland. Royal Dublin Society. Went Memorial Lecture. Occasional papers in Irish Science and Technology 4, 9 pp.

Poole W.R. 1990. Summer fyke nets as a method of eel capture in a salmonid fishery. Aquaculture and Fisheries Management 21, 259–262.

Poole, W.R., Reynolds, J.D.R. and Moriarty, C. 1990. Observations on the silver eel migrations of the Burrishoole river system, Ireland. 1959–1988. Int. Revue Ges Hydrobiol. 75 (6); 807–815.

Poole W.R., Reynolds J.D. and Moriarty C. 1992. Age and growth of eel (*Anguilla anguilla* L.) in oligotrophic streams. Irish Fisheries Investigations, Series A (Freshwater). 36, 74–79.

Poole W.R. 1994. A population study of the European Eel (*Anguilla anguilla* (L.)) in the Burrishoole System, Ireland, with special reference to growth and movement. PhD Thesis, Dublin University, 416pp.

Poole W.R. and Reynolds J.D. 1996a. Age and growth of yellow eel, *Anguilla anguilla* (L), determined by two different methods. Ecology of Freshwater Fish 5 (2), 86–95.

Poole W.R. and Reynolds J.D. 1996b. Growth rate and age at migration of *Anguilla anguilla*. J. Fish Biology, 48, 633–642.

Rosgen, D.L. 1994. A classification of natural rivers. Catena, 22; 169–199.

Shreve, R.L. 1967. Infinite topologically random channel networks. Journal of Geology, 75: 179–186.

SSCE. 2012. Report on the status of the eel stock in Ireland, 2009–2011. Dept. of Communications & Natural Resources, Dublin. 197pp.

SSCE. 2014. Activity report of the Standing Scientific Committee for Eel, 2013. *Inland Fisheries Ireland*; 136pp.

Strahler, A. N. 1952. Hyposmetric (area-altitude) analysis of erosional topography. Bulletin of the Geological Association of America, 63; 1117–1142.

Vøllestad L. A., Lecomte-Finiger R. and Steinmetz B. 1988. Age determination of *Anguilla anguilla* (L.) and related species. EIFAC Occas. Pap., 21, 1–28.

Walker, A.M., Andonegi, E., Apostolaki, P., Aprahamian, M., Beaulaton, L., Bevacqua, P., Briand, C., Cannas, A., De Eyto, E., Dekker, W., De Leo, G., Diaz, E., Doering-Arjes, P., Fladung, E., Jouanin, C.11, Lambert, P., Poole, R., Oeberst, R. and Schiavina, M. 2011. Report of Studies and Pilot Projects for carrying out the Common Fisheries Policy; LOT 2: Pilot projects to estimate potential and actual escapement of silver eel; POSE. DGMARE Contract: SI2.539598.

Report on the eel stock and fishery in Italy 2013/2014

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Reporting Period: This report was completed in October 2014, and contains data up to 2013.

2 Introduction

Description of national approach to eel management, fisheries, reporting etc.

NEW: The new format for the ICES advice relates the stock advice to the relevant ICES ecoregion. So, your report should include an explanation of which EMUs are bounded to which ecoregions. You can provide this information in text or in a table. The relevant ICES ecoregions are: Norwegian Sea; Celtic Sea; North Sea; South European Atlantic Shelf; Western Mediterranean Sea; Adriatic-Ionian Seas; Aegean-Levantine Seas; Baltic Sea.

In the present report, data on eel stock and fisheries are reported for Italy relative to the year 2013, based on the data and assessments prepared in the Italian report to DG Mare required to assess progress achieved through the implementation of the National EMP, as foreseen by Article 9 of Regulation 1100/2007 (PNG Italia, 2014) and based on the National Report relative to the Data Collection Framework, modules "Eel recreational and commercial fishery" and "eel biological samplings", also relative to the year 2013.

The period 2010–2013 has been important in Italy with regards to eel management. Following the submission of the Italian Eel Management Plan (IT-EMP), with the latest amendment submitted to the European Community September 30, 2010, the Plan was finally adopted in July 2011 (PNG Italia, 2010). With it, Italy has set the instrument to participate in the process recovery of the eel stock, as required by Regulation 1100/2007. Notwithstanding the initial delay, Italy has recovered the lag in the application of the Eel Management Plan because since 2009 at different levels in Italy the process of implementation of the IT-EMP was already in place. The work concerning the IT-EMP has been coordinated within a National Working Group that has involved Administrations, Technicians and Scientists. During 2012 and 2013, the work of the Nat Working Group has been finalized to the gathering of data for the evaluation of the parameters required to assess progress achieved through the implementation of the National EMP, as foreseen by Article 9 of Regulation 1100/2007, for the first report in 2012 (PNG Italia, 2012) and for the following Reports in 2013 and 2014 (PNG Italia, 2013; PNG Italia, 2014). Italy, as extensively explained in the IT-EMP and as discussed during the consultation meetings organized by the EC - DG Mare, has followed the approach of using for the assessment process a database progressively implemented. Compared to 2008, when the work for the compilation of the IT-EMP was initiated, a series of tools and activities have been put in place between 2009 and 2013 that have resulted in a database much more detailed and reliable, and therefore for the evaluation of the reference points required for the assessment foreseen by art. 9, this updated dataset has been used.

Eel (*Anguilla anguilla* L.) exploitation in Italy has a long standing tradition, and is still important, despite a loss of interest towards this species. Fisheries still concerns all continental stages, i.e. glass eel, yellow and migratory silver eel. The most distinctive exploitation pattern for eel in Italy has been in the past coastal lagoon fishery, that yielded most of yellow and silver eel extensive culture and fishery production (Ciccotti, 1997; Ciccotti *et al*., 2000; Ciccotti, 2005). Quite important was also eel intensive aquaculture, that played a major role within the national and European context up to some years ago and that has strongly reduced today (Ciccotti *et al*., 2000; Ciccotti and Fontenelle, 2001).

Eel is still present in lagoons and inland waters in all the regions, but its density, population characteristics and growth vary widely depending on the type of environment (lagoons, rivers, lakes), hence production patterns are also very diverse.

Lagoons cover around 1420 km^2, 610 of which are exploited at the present moment. Of the exploited area, about 300 km^2 are located in the upper Adriatic and 120 in the Po delta, the rest being scattered in Puglia, Campania, Lazio, Toscana, Sicilia and Sardegna (Ardizzone *et al*., 1988). In the upper Adriatic lagoons the typical form of management was the *vallicoltura* that slightly differed from other lagoon management and fisheries because relying on fry stocking and active hydraulic management.

Inland eel fisheries are still found in main rivers and lakes, even if a relic activity. Professional eel fisheries in rivers have never been important, confined to the low course of a small number of rivers even in the past, and further reduced now. Most of the eel catches were from the great Alpine lakes in the northern regions, but the eel also was an important target species for professional fisheries in some volcanic lakes of Central Italy. In lakes, fisheries were enhanced by eel restocking, because accessibility to lakes was reduced also in pristine times owing to the structure of river-lakes systems, and secondarily to presence of dams, most of which were implemented after the II World War. Recreational eel fisheries were common in some specific regions in relation to local traditions, and are still present, where allowed, with a patchy pattern.

Administrative responsibility for eel fisheries is still fragmented in teo, despite the coordination required by the application of the Regulation 1100: sea fisheries and sea fishing up to river mouths are under the responsibility of central government (Ministry of Agricultural, Food and Forestry Policy - Directorate-General for Sea Fishing and Aquaculture), whilst Regions are responsible for freshwater fisheries, including eel fishing, because Presidential Decrees No 11 of 15 January 1972 and No 616 of 24 July 1977 gave them this responsibility. Therefore the only eel fisheries under a central Administration are glass eel fisheries practiced in estuaries, as no marine adult eel fishery exists in Italy. With regards to inland fisheries, that include lagoon as well as lake and river fisheries, each Region has its own regulation. Since 2009, some specific regulations for eel are being issued, in relation to the application of the Eel Management Plans. Usually, as a rule individual professional fishing licences are issued, which are valid for six years, by each Region, and are enlisted in registers kept by the Provinces. The permitted gears vary from region to region, also in relation to local traditions, and are specified by each Administration, together with authorised times and places. For the nets, mesh sizes and minimum and maximum dimensions of gears are listed.

The management framework described above has influenced the setting up of the Eel National Management Plan (IT-EMP) foreseen by Regulation 1100/2007. The IT-EMP has taken into account the complexity of the situation in the country, and is therefore a combined plan: it provides a national framework covering coastal waters and those administrative regions which preferred to delegate eel management to central government (eleven regions in all, see Table IT.1.). For these eleven Regions, a total closure of all eel fishing has been applied, both commercial and recreational, and the transposition of this indication into Regional regulations is nearly completed. The remaining nine regions have drawn up their own Regional Eel Management Plans, which were prepared on a coordinated basis and using a standard calculation method for defining targets, whilst the intervention measures and implementation aspects were defined according to regional regulations and local choices. Italy has in fact decided to avail itself of the opportunity provided in Article 2 of the regulation, which stipulates that *'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'* and, for the reasons highlighted above, therefore has proposed the regional administrations as Eel Management Units, point accepted by the Commission.

Figure 2.1. The 20 Italian Regions. Nine produced an Eel Regional Management Plan (green) and still allow commercial and recreational fisheries. Eleven Regions have closed commercial and recreational eel fisheries (white), in some only recreational fisheries are still temporarily allowed that are going to be closed (light blue).

Figure 2.1 shows the geographical distribution of the regions (EMU) that have provided their regional Plans. In all these, areas of particular importance for eel fishing are included, either in terms of the presence of wetland areas (Grado and Marano Lagoons, the Venice Lagoon, the Po Delta and Valli di Comacchio, Lesina and Varano Lagoons, Orbetello Lagoon, Pontini Lakes and Sardinia's coastal wetlands) or in terms of the historical importance of eel fishing in the region's inland waters (Lombardia, Umbria, Lazio). For what concerns the bounding the assignment of Italy and its EMU to ICES Ecoregions, it must be considered that Italy is located in the Mediterranean, lying across two Ecoregions, the Western Mediterranean Sea and the Adriatic Ionian Sea.

Therefore, some Management Units fall within the WMS ecoregion and some look out on the AIS. In Table 2.1, attribution of each EMU to its Ices ecoregion is reported.

In each Region/Management Unit, different habitat typologies (such as coastal lagoons, with or without fish barriers, lakes and rivers) have been considered. In fact in the different Italian EMUs, a great ecological heterogeneity exists, that reflects also in a diversified productivity of the different aquatic environments within each Region/Management Unit. The habitat categories that were identified are as follows: coastal lagoons, lakes, rivers. In the case of coastal lagoons, for those regions that follow different management strategies an explicit distinction has been introduced, within the lagoons specifically managed (fish stockings, presence of fish barrier) from the lagoons where only artisanal fisheries are present. In Table 2.1, the wetted areas for the different habitat typologies in each administrative Region in Italy are reported. A distinction is made between Regions without a MP, where eel fishing has closed definitively, and Regions with a Management Plan, that have been identified as EMU.

Table 2.1 Wetted area for the different habitat typologies in each administrative region in Italy. A distinction is made between regions without a MP, where eel fishing has closed definitively, and regions with a Management Plan, that have been identified as EMU. First column gives reference of the attribution of EMUs to ICES Ecoregions (I: Adriatic-Ionian seas; H: Western Mediterranean Sea).

Attribution of EMU to ICES Ecoregion	Region or EMU	Code of Region or EMU	Regional Eel Management Plan	Lagoons (ha)	Managed lagoons (ha)	Private lagoons (ha) *	Rivers (ha)	Lakes (ha)	Total wetted area (ha)
I	Valle D'Aosta	VDA	N	-	-	-	-	-	0
I	Piemonte	PIE	N	-	-	-	-	780	780
I	Lombardia	EMU_LOM	Y	-	-	-	1.676	4.487	6.163
I	Trentino Alto Adige	TAA	N	-	-	-	-	370	370
I	Friuli Venezia Giulia	EMU_FVG	Y	12.700	-	1.660	1.356	-	15.715
I	Veneto	EMU_VEN	Y	63.120	-	18.597	9.252	1.665	92.633
H	Liguria	LIG	N	-	-	-	344	-	344
I	Emilia Romagna	EMU_EMR	Y	3.100	12.263	6.000	5.663	-	27.026
H	Toscana	EMU_TOS	Y	-	2.700	-	1.025	39	3.764
I	Marche	MAR	N	-	-	-	228	-	228
H	Umbria	EMU_UMB	Y	-	-	-	-	12.800	12.800
H	Lazio	EMU_LAZ	Y	913	630	-	714	1.145	3.402
I	Abruzzo	ABR	N	-	-	-	236	-	236
H	Campania	CAM	N	-	487	-	570	-	1.057
I	Molise	MOL	N	-	-	-	73	-	73
I	Calabria	CAL	N	-	-	-	192	-	192
I	Basilicata	BAS	N	-	-	-	218	-	218

Attribution of EMU to ICES Ecoregion	Region or EMU	Code of Region or EMU	Regional Eel Management Plan	Lagoons (ha)	Managed lagoons (ha)	Private lagoons (ha) *	Rivers (ha)	Lakes (ha)	Total wetted area (ha)
I	Puglia	EMU_PUG	Y	11.533	-	-	414	-	11.947
H	Sardegna	EMU_SAR	Y	3.336	4.625	-	600	-	8.561
I	Sicilia	SIC	N		278	-	238	-	516
	* Private lagoons are not included in Regional Management Plans								
	Total Italy			94.702	20.983	26.257	22.799	21.286	186.025

Habitat	Code
River	RIV
Lake	LAK
Lagoon	LGN
Managed lagoon	MLG

A distinctive feature of the IT-EMP, which reflects on management at the national level, concerns the reforming of the regulation for glass eel fishing. Up to 2008, professional glass were regulated by the Ministero delle Politiche Agricole Alimentari e Forestali by a national legislation (DM March 22, 1991; D.M August 7 1996) that did not contain specific indications for the eel, *Anguilla anguilla*, because generally targeting juvenile fish of all euryhaline species caught for aquaculture purposes. Glass eel fisheries did occur in many river mouths, and in many channel mouths as well. Most of the glass eel yield was from the Central and Southern Tyrrenhian area (Western Mediterranean Sea). The main sites of glass eel catches were the estuaries of rivers such as the Arno and Ombrone in Toscana, the Tiber and the Garigliano in Lazio, and the Volturno and Sele in the Campania region. Those sites were frequented not only by local fishermen but occasionally also by fry fishermen from other regions, who reached those sites with trucks equipped with oxygenated tanks to collect mullet, sea bass, sea bream and eel fry. Local fishermen were usually single or co-operative fishermen that are were equipped with boats and structures to store the product alive. Fishing instruments vary depending on the characteristics of the site.

The Italian National Management Plan has contemplated the implementation of a new legislation specific for glass eel fishery, on the basis of the fact that this fishing takes place in sites (estuarine areas and low river courses) legally partitioned between State and Regions. The new legislation prepared by the Ministero delle Politiche Agricole Alimentari e Forestali (MIPAF) (DM 12/01/2011, 26/01/2011 OJ, 20 - "Regulation of fishing and marketing of juvenile eels, glass eel and elvers of the species *Anguilla anguilla*") regulates fishing of glass eels (eels <12 cm) in marine and brackish waters of the Italian territory. This new legislation lays down rules regarding monitoring of the fishing and end-use of the product and gives priority to use for restocking purposes (thus aiming to reach the target of 60% of catches by 2013, as provided in Article 7 of the regulation), specifying that this quota relates to restocking into waters which flow into the sea, so that the measure will contribute to recovery of the eel stock. One of the ways envisaged for meeting the obligations under the Council regulation is to create a system which will include a national register of fishermen authorised to fish glass eel, allocation of quotas and the obligation to submit catch returns. This new legislation has come in force in 2011, and, together with reinforced controls by the Corpo Forestale dello Stato, should ensure that information on recruitment in Italy is available from year to year, that most glass eel is conveyed to restocking and that illegal fishing is definitively broken off. Glass eel fishing in inland waters, i.e. in rivers above the limit of salt and brackish waters, are under Regional regulations. Therefore, the EMUs (Regions) that have their own Regional Eel management Plans have taken steps to regulate glass eel fishing in inland waters in a manner consistent with the National law. Glass eel fisheries are at the moment allowed in inland waters of two EMUs on the Tyrrhenian coast: Toscana (TOS) and Lazio (LAZ, D.G.R. n. 76 of 2/3/2012). Tuscany has, through a Regional Document for the implementation of the Eel Management Plan, set up the instrument for the implementation of the measures provided for Eel Regional Plan, financed by regional laws that regulate the fishing industry (LR 66/2005 and L.R. 7/2005). Among these actions, the provinces of Grosseto and Pisa have created two facilities for stocking glass eels fished within the region, while the EMU Lazio has taken steps to enact a specific discipline for glass eel fishery, which provides inter alia that the juvenile eel caught in inland waters of the Lazio region is exclusively for farming or restocking inland waters of the region. Glass eel fisheries are explicitly prohibited fishing in inland waters of the Veneto region (VEN, DGR n. 91 18/05/2012), Emilia Romagna (EMR) and Friuli Venezia Giulia (FVG), while the remaining EMUs are not interested by this fishery for natural reasons (no access to the sea, scarce glass eel ascent) or have not yet enacted specific rules. In the 11 Regions which have not submitted any Eel Man Plan, glass eel fishing is prohibited as well as any other activity involving eels, such as commercial and recreational fishing for eels. For the moment, only 5 regions (Piemonte, Valle d'Aosta, Liguria, Marche and Sicily) have implemented such forbiddance with explicit rules, the other 6 regions are still providing.

Italy has established, since 2009, its Data Collection Framework for Eel, as foreseen by the Regulation 199/2008, and therefore eel has been included in the DCF Italian National Programme. The Eel Fisheries Data Collection (under Reg. 199/2008, DCF) is at present definitively in place, and concerns all eel fisheries in inland and coastal waters, commercial as well recreational. Most data presented in this Report for the year 2013 are derived from the Eel Fisheries DCF, presented for the national level or environmental typology (such as inland or coastal waters), and disaggregated by Region (EMU) as well.

The management framework for DCF is the same that has been set up for the eel management under Regulation 1100/2007. In the eleven Regions that preferred to delegate eel management to central government (Directorate-General for Sea Fishing and Aquaculture of the Ministry of Agricultural, Food and Forestry Policy) where commercial eel fishing has been stopped completely since the year 2009, no data collection is carried out. In the remaining nine regions -EMUs, where eel fisheries are still ongoing, eel fishery data are collected with a standard methodology, as foreseen by the Italian National Plan for the Data Collection Framework.

3 Time-series data

The Data Collection Framework for Eel, as foreseen by the Regulation 199/2008, has replaced the previous statistical system, (ISTAT) in place up to 2004 for the marine compartment and to 2008 for inland fisheries. In this report, time-series for eel catches are presented only when available, joining data derived by the old official statistical system (ISTAT) and the new data from the Eel Fisheries Data Collection (under Reg. 199/2008). The data from the ISTAT system present some gaps such as uncertain estimates, possible overlaps with aquaculture production, no distinction between stages, no information on the fishing effort. Nevertheless, these time series represent at the moment the only official source for eel for the period before 2009.

3.1 Recruitment

The recruitment dataseries supplied in the past to the Working Group was relative to a fishery-based monitoring on the river Tiber estuary, specifically carried out within a series of research projects for the resource assessment. The fishery ceased its activity in 2001, but some monitoring of recruitment continued within research. When the mentioned projects stopped, this monitoring ceased as well. As this fishery has stopped to exist, no monitoring on the Tiber is at present in place on a similar basis. No information on a continuative basis can be derived, and no centralised monitoring programme of recruitment is in place anywhere in Italy at the present moment.

On the other hand, since 2011 in some Regions recruitment monitoring have been progressively activated (see Figure 3.1) on a local basis (EMU Toscana, EMU Emilia Romagna, EMU Puglia), each following a specific methodology but based on a common approach. Most of these monitoring are active within specific programmes for Eel Regional Plans implementation under EFF (European Fisheries Funds) projects.

Figure 3.1. Monitoring sites for recruitment; green: river mouths; blue: coastal lagoons.

Also for the EMU Lazio, a regional monitoring has begun that takes into account some sites in the region (rivers and coastal lagoons), the river Tiber and the river Marta among others (Figure 3.2). Even if the methodology will not be exactly the same, because of the closure of the fishery, it will be important to have again in place these monitoring sites in central Italy, for comparison with the past time-series.

Ambiente acquatico	Siti di monitoraggio
Fiume Marta	
Fiume Tevere	
Lago di Fogliano	

Figure 3.2. Monitoring sites for recruitment in the EMU Lazio.

Monitoring is carried in each site out on a daily basis for a week each month for the whole duration of the ascent season (five months, October–March) (Figure 3.3). At the moment, no time-series can be derived because the monitoring with such a methodology have begun only recently, but it is foreseen to process data in order to compare present results with historical dataseries.

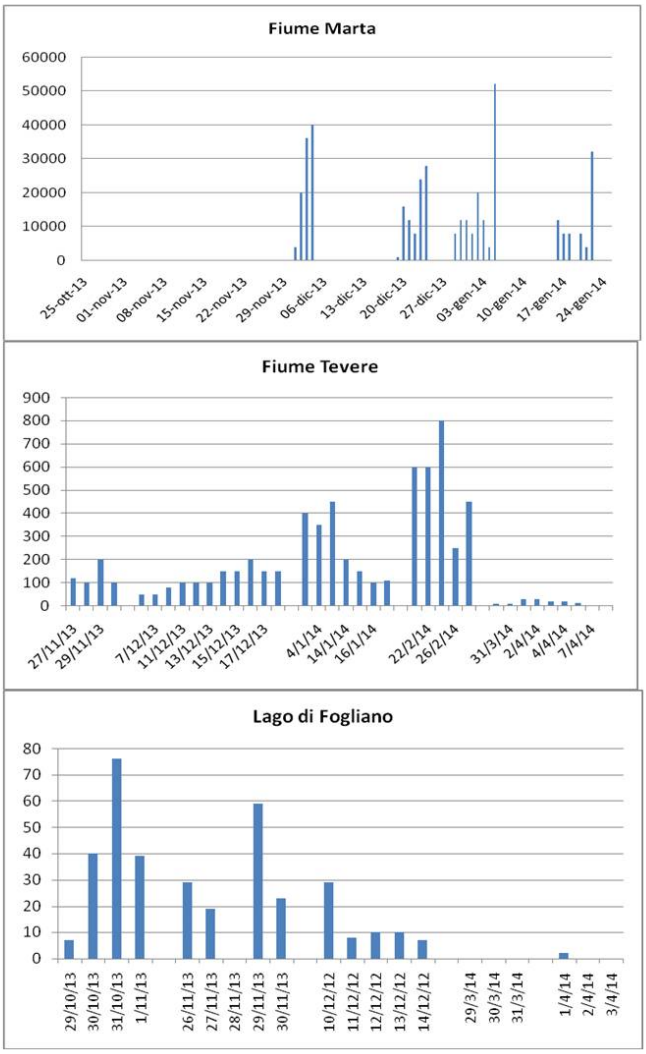

Figure 3.3. Monitoring for recruitment in EMU Lazio: preliminary results for the season 2013–2014.

3.1.1 Glass eel recruitment

NA.

3.1.1.1 Commercial

NA.

3.1.1.2 Recreational

NA.

3.1.1.3 Fishery independent

NA.

3.1.2 Yellow eel recruitment

NA.

3.1.2.1 Commercial

NA.

3.1.2.2 Recreational

NA.

3.1.1.3 Fishery independent

NA.

3.2 Yellow eel landings

3.2.1 Commercial

Detailed data on catches and landings (by life stage, by type of fishing gear, by EMU, commercial and recreational etc.) are available only from 2009, when the DCF has been definitively put in place. Time-series with this degree of detail (stage yellow and silver) are not available for the period antecedent to 2009, apart from some figures for 2007, year in which a pilot project for eel fisheries assessment took place. At present, therefore, time-series for eel landings are available only from the old statistical system (ISTAT), that are national catches (also available at the Region disaggregated level) separated for inland and coastal waters. These time-series for Italy landings are cumulated, i.e. yellow and silver eels. Inland waters catches are referred to lakes and reservoirs, riverine fisheries being too negligible also in pristine periods, while statistics for coastal waters are relative to coastal lagoons fisheries, marine fisheries not being present in Italy. These data are the landing data forwarded to FAO Fishery Statistic Department, and therefore coincide with the FAO FishStat data.

The ISTAT system has discontinued the collection of data from the brackish and marine waters compartment since 2004 that have been resumed only in 2009 within the DCF. Therefore a discontinuity in this dataseries shall probably remain. The ISTAT system is still going on for inland water fisheries, but up to now no cross-check with the DCF has been done, so the two sources might present discrepancies.

Eel total landings from lagoon fisheries in Italy from 1969 to 2013 are reported in Figure 3.4, data refer to coastal lagoons only, no marine fisheries existing, and are derived from the ISTAT system up to 2004 and to the DCF from 2009, while the 2007 figure is from Unimar (2007).

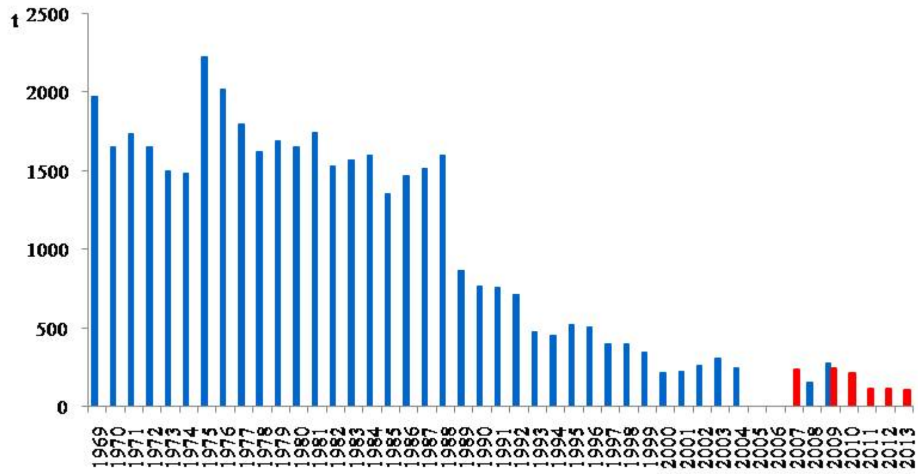

Figure 3.4. Eel landings (yellow and silver cumulated) in Italy, period 1969–2011, from coastal lagoon fisheries (Istituto Nazionale di Statistica 1969-2004, blue; Unimar, 2007, and DCF, 2009–2013, red).

Inland waters eel landings from 1969 to 2013 are reported in Figure 3.5; statistics refer only to lakes and artificial basins for the ISTAT dataseries (green), and include rivers for the 2007–2013 DCF data (red).

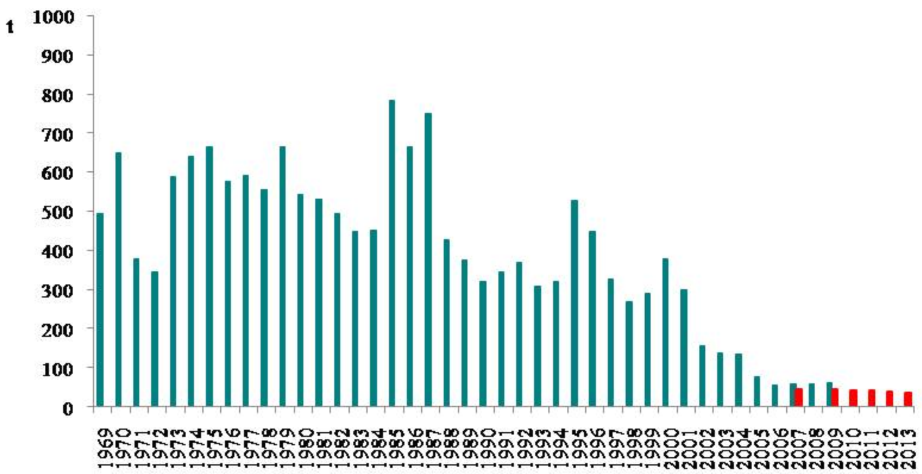

Figure 3.5. Eel landings (yellow and silver cumulated) in Italy, period 1969–2011. Data sources: 1969–2006 ISTAT - Istituto Nazionale di Statistica, referred only to lakes and artificial basins; 2007: Unimar and DCF, 2009–2013: riverine fisheries included.

In Table 3.1, the DCF dataseries from 2009 is presented, with data disaggregated by stage, with the 2007 reference value from the Unimar (2007) pilot study.

Table 3.1. DCF new catch dataseries (2009–2012): commercial landings (t) disaggregated by stage, and 2007 value from the Unimar (2007) pilot study.

YEAR	INLAND WATERS: LAKES & RIVERS			COASTAL WATERS: LAGOONS			*NATIONAL*
	Yellow	Silver	Total	Yellow	Silver	Total	
2007	25.08	19.70	44.78	151.82	81.79	232.32	277.10
2008	na	na	na	na	na	na	na
2009	23.58	19.99	43.57	149.27	88.33	237.61	281.18
2010	22.14	18.40	40.54	73.13	135.73	208.85	249.39
2011	23.26	17.14	40.40	48.74	60.54	109.28	149.68
2012	21.29	15.52	36.81	65.56	40.07	105.62	142.43
2013	21.12	13.00	34.14	51.03	51.32	102.35	136.49

The conspicuous reduction in landings in 2012 and 2013, that concerns mostly silver eel catch, is a consequence of the fact that the reduction in fishing effort foreseen by the IT-EMPs has been in force for 1,5 years, since middle half 2010.

3.2.2 Recreational

No time-series are available for yellow eel recreational fisheries, recreational fisheries are being recorded only since 2009 within the DCF.

3.3 Silver eel landings

3.3.1 Commercial

See above.

3.3.2 Recreational

No time-series are available for yellow eel recreational fisheries, recreational fisheries are being recorded only since 2009 within the DCF.

3.4 Aquaculture production

In Italy, total aquaculture production accounted for 587 t in 2009, with intensive production accounting for 278 t and extensive for 309 t. Data concerning 2011 production included only the exportation.

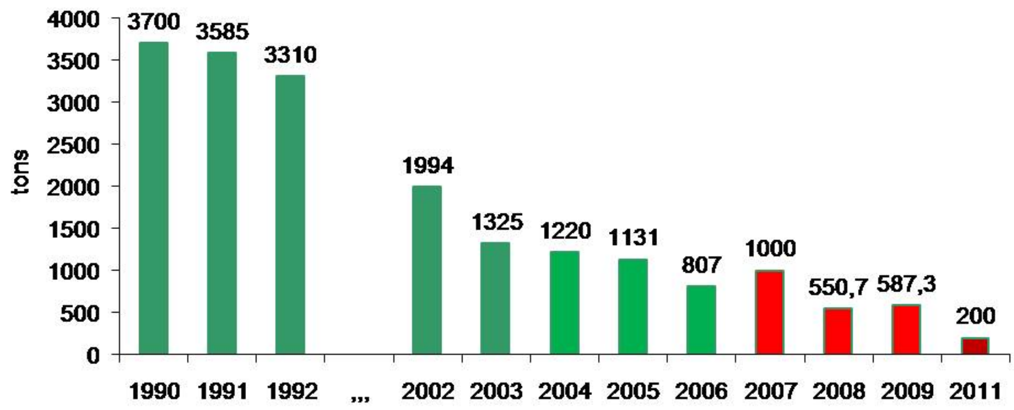

Figure 3.6. Aquaculture production in Italy from 2002 to 2011 (Source: 2002–2007 Idroconsult, green; 2008–2011: Unimar and API, red).

3.4.1 Seed supply

3.4.2 Production

3.5 Stocking

3.5.1 Amount stocked

See below, Section 3.5.2.

3.5.2 Catch of eel <12 cm and proportion retained for restocking

The glass eel regulation foresees that glass eel fisheries can continue on a local scale, provided that 60% is used for restocking in national inland waters open to the sea, and provided that fishers compile specific and detailed logbooks of catches and sales. This system together with reinforced controls by the Corpo Forestale dello Stato, should ensure that information on recruitment in Italy is available from year to year, that most glass eel is conveyed to restocking and that illegal fishing is definitively broken off. Up to 2010, the new regulation was not in force; its definite approval being achieved in 2011, therefore no licences were issued in 2010 and there were no catches, nor information on quantities used for restocking. From 2011, the new regulation being in force, fishing has started again and catches are declared to the Ministry on a weekly basis. In Table 3.2 glass eel catches in kg for the season 2013/2014 are reported, as inferred by the fishers declarations, separated for coastal waters (estuaries) under the Central Administration, and inland waters (rivers up of the tidal limit), under Regional Administrations.

Table 3.2. Glass eel catches (eel <12 cm) kg, season 2013/2014.

	EMU Veneto	EMU Toscana	EMU Lazio	TOTAL
Inland waters	0.00	135.54	139.00	274.54
Coastal waters	7.00	142.00	19.69	168.69
TOTAL	7	277.54	158.69	443.23

With regard to destination of glass eel catches, and to the proportion retained for restocking, on the basis of the forms returned to Administrations it has been possible to document the destination of glass eel only in a generic way. Glass eel destination from national fisheries seems documented, while import data apparently escape registration. In some EMUs, there are still quantities whose origin and destination are only generically declared.

In some EMUs (EMUS Toscana, EMU Puglia) restocking have been performed with quarantined or ongrown elevers, kept after capture in specific facilities.

The unavailability or scarcity of glass eels on the domestic market has resulted in the fact that some Regions used eels of size greater than 12 cm (20–30 g, and in some cases (EMU Veneto) also of larger size (400 g) to make restocking in public waters, as foreseen by the Regional Management Plans. The source of this restocking seed is aquaculture or imported (France). This highlights the need to pay attention to health and quality when dealing with restocking of eel of size exceeding 12 cm.

A summary of the amounts of glass eels, quarantined elvers and bootlace and yellow eels (size >12 cm) restocked in 2013 are reported in Table 3.3.

Table 3.3. Quantities (kg) of wild glass eels (<12 cm), glass eels ongrown to elvers and small eels (size 12 cm) stocked in Italy by EMU; year 2013.

	Wild glass eels (<12 cm)	Ongrown elvers	Bootlace and yellow eels (>12 cm)
EMU_LOM	0	0	1.931
EMU_FVG	0	0	0
EMU_VEN	0	0	7.221
EMU_ER	0	0	200
EMU_TOS	0	46,9	0
EMU_UMB	np	np	np
EMU_LAZ	67,0	0	0
EMU_PUG	0	78,9	0
EMU_SAR	0	0	0
Totale	*67,0*	*125,8*	*9.352*

At present, it is not possible to document where exactly restocking were performed, as provinces and regions have not provided documentation that allows to document exact destination.

Overall, the two first years of implementation of the new regulatory framework for glass eel fisheries (2011 and 2012) must be considered as a pilot period, accounting for the setting up of the declaration system. At present (2013 and 2014), filling of the forms is still lacking, and the details of the documents of purchase and sale are also deficient. This does not allow complete traceability of movements on the Italian territory. To overcome this problem, a full traceability system is currently being studied, developed in collaboration with the Corpo Forestale dello Stato - Unit CITES. This system should ensure the full traceability of all glass eel movements, either from national waters or imported, also aiming to definitively eradicate illegal fishing of glass eels.

3.5.3. Reconstructed time-series on stocking

In Table 3.4, a reconstruction of time-series of stockings is tentatively presented, on the basis of data gathered for the Report prepared for the DG Mare on the basis of Art. 9 of the Regulation 1100/2007 (PNG Italia 2013).

Table 3.4. Reconstructed time-series of stockings since 2009.

	Local Source				Foreign Source			
Year	Glass Eel	Quarantined Glass Eel	Wild Bootlace	On-grown cultured	Glass Eel	Quarantined Glass Eel	Wild Bootlace	On-grown cultured
2009 *	100		9.502 °					
2010 *	44,5		8.940 °					
2011 *	248,49		6.857 °		130 ?			
2012	145,25		1.930 °		200 ?			
2013	67	125,8	9.352					

*** in the years 2009, 2010 and 2011 glass eel fisheries were closed, apart a few particular cases of experimental fishing or Province authorizations for stocking purpose. Glass eel fisheries under the new rule began again in 2011/2012.**

° bootlace and yellow eels used for stocking are in part wild eels from France (Camargue), and part from on-grown cultured (Italy, Netherlands), but the exact quantities of each source are not available.

AIM: track the quantity and sizes of eels being stocked in order to assess the biomass (and mortality rates) derived from stocked eel.

NOTES:

- Local Source: The source of the stocked eels is local;
- Foreign Source: Eels come from another country;
- Split the stocked eels into the stages in the column headings, do not add anymore;
- Please, translate the number of Wild Yellow and on-grown cultured into GEE (Glass Eel Equivalents). If you are not able to do that, you must provide average size of stocked eels; and in case you have it, mortality rates and growth and/or age in order to make the transformation to GEE.

3.6 Trade in eel

4 Fishing capacity

reported by EMU

Total fishing capacity for eel in Italy is difficult to assess, it should coincide with the whole amount of fishers licensed for fishing in inland waters (river and lakes) and coastal lagoons, both commercial and recreational, and for authorized glass eel fishers in coastal and inland waters. Glass eel fishing is allowed by authorization on a yearly basis, both in coastal and inland waters, in the nine EMUs. For 2011 the new regulation was entered in force only in December, and hence only a few authorizations were issued (four firms).

For the eel commercial fishing capacity relative to the nine MUs where eel fisheries are present, fishing being prohibited in the remaining eleven regions where non EMP is in place, the best estimates are from census returns (the first carried out in 2007 and then a revision in 2011) of the total number of fishermen involved in eel fishing.

Commercial eel fisheries occur in 9 Regions: Lombardia, Veneto, Friuli Venezia Giulia, Emilia Romagna, Toscana, Umbria, Lazio, Puglia e Sardegna. Within these regions, four main habitat typologies have been identified, where eel fishing takes place that are rivers, lakes, lagoons and managed lagoons. The latter differs from lagoons, where only artisanal fisheries occur, for the fact that more detailed management strategies are carried out, such as stocking or water management.

Overall, 1476 operators are involved in eel fishing, in the nine Regions all typologies included (see Table 4.1). These fishermen are licensed fishers as well as employees in the managed lagoons, and they do not target only eel, but other freshwater or euryhaline fish as well. In most cases, eel importance in catches is quite low. An assessment of eel importance among catches has been performed in 2010, on all the fishermen operating in rivers lakes and lagoons, and it revealed that for about 77% of the fishermen, eel represents at most 15% of total catch. For 23% of the fishermen, eel is less than 1% of total catch.

Table 4.1. Total number of commercial fishermen, by EMU and by habitat typology, from the census DCF 2011 and confirmation in DCF 2013.

EMUs	River	Lake	Lagoon	Managed lagoon	total/ EMU	%
EMU_LOM	0	30	0	0	**30**	*2*
EMU_FVG	70	0	106	0	**176**	*12*
EMU_VEN	173	0	170	0	**343**	*23*
EMU_EMR	5	0	141	0	**146**	*10*
EMU_TOS	0	0	0	28	**28**	*2*
EMU_UMB	0	28	0	0	**28**	*2*
EMU_LAZ	5	25	11	0	**41**	*3*
EMU_PUG	0	0	79	0	**79**	*5*
EMU_SAR	42	0	121	442	**605**	*41*
total/HT	**295**	**83**	**628**	**470**	**1476**	*100*
%	*20*	*6*	*43*	*32*	*100*	*100*

For recreational fisheries, potential fishing capacity coincides with all licensed fishers on the whole national territory, all Regions included. The effective number of recreational fishermen involved in eel fishing is obviously much lower. The estimate of the total amount of eel recreational fishermen was obtained within the DCF programme, on the basis of the information provided by two different Recreational fishermen organizations (FIPSAS and ARCI Pesca), that account for most of inland waters recreational fisheries. The effective number of eel recreational fishers estimated for 2013 amounts to 2950 (see Table 5.1).

Table 4.2. Total number of recreational fishermen in the 20 Regions (DCF, 2013).

Region	EMU code	Total Licenses
Valle d'Aosta	-	NA
Piemonte	-	34.000
Lombardia	EMU_LOM	104.591
Trentino Alto Adige	-	11.350
Friuli Venezia Giulia	EMU_FVG	17.583
Veneto	EMU_VEN	89.000
Liguria	-	4.700
Emilia Romagna	EMU_EMR	42.881
Toscana	EMU_TOS	34.200
Umbria	-	15.035
Marche	EMU_UMB	8.000
Lazio	EMU_LAZ	44.309
Abruzzo	-	11.621
Molise	-	3.227
Campania	-	16.351
Calabria	-	18.500
Basilicata	-	2.262
Puglia	EMU_PUG	462
Sardegna	EMU_SAR	12.128
Sicilia	-	3.157
Total		473.357

For both commercial and recreational fisheries, targets are both the yellow and the silver eel stage that are exploited by the same fishers on a seasonal basis.

4.1 Glass eel

Glass eel fishing is allowed by authorization on a yearly basis, in coastal or in inland waters, in most EMUs. For 2013, with regards to the authorizations issued by the Central Administration, three firms were authorized, one in the EMU Veneto and two in the EMU Toscana. At the regional level, two firms were authorized by the EMU Toscana and two single fishermen were authorized by the EMU Lazio.

4.2 Yellow eel

See above.

4.3 Silver eel

See above.

4.4 Marine fishery

No marine fishery exists for eel in Italy.

5 Fishing effort

reported by EMU

The methodology to describe the commercial fishing effort is based on direct and detailed interviews to a sample of fishermen, extracted on a statistical basis for each habitat typology in each MU. Almost total eel catch is from fykenets fisheries, used in all habitat typologies in all MUs, with the exception of fish barriers used in managed coastal lagoons. Longlines are sporadically used only in one or two lakes.

The interviews consist of questionnaires where each fisherman reports catch data (yellow and silver eel separated), type of gear, number of gears used daily and number of fishing days per year. A detailed cpue in each habitat typology of all nine MUs has been derived from a reliable subset of interviewed fishermen: an average parameter of fishing effort (number of gears * number of fishing days) was multiplied by the total fishermen operant in each habitat typology. Results are reported in Table 5.1. Yellow and silver eel catches were assessed with the same method.

Table 5.1. Effort parameters used for eel commercial fishing in Italy in 2013, disaggregated by EMU and habitat typology (DCF, 2013). NA: not applicable.

Region (EMU)	Habitat typology	Gear type	Eel stage	Number of gears used per day	Number of fishing days per year	Number of fishermen	Effort
EMR	LGN	FYK	Y	21	42	141	189.561
EMR	LGN	FYK	S	21	42	141	189.561
EMR	MLG	BAR	S	NA	NA	NA	
EMR	RIV	FYK	Y	31	35	5	10.938
EMR	RIV	FYK	S	31	35	5	10.938
FVG	LGN	FYK	Y	51	105	106	725.603
FVG	LGN	FYK	S	51	105	106	725.603
FVG	RIV	FYK	Y	70	60	70	138.180
FVG	RIV	FYK	S	70	60	70	138.180
LAZ	LAK	FYK	Y	12	63	25	19.247
LAZ	LAK	FYK	S	12	63	25	19.247
LAZ	LGN	FYK	Y	9	75	11	14.850
LAZ	LGN	FYK	S	9	75	11	14.850
LAZ	RIV	FYK	Y	267	57	5	151.106
LAZ	RIV	FYK	S	267	57	5	151.106
LOM	LAK	FYK	Y	8	48	30	23.741
LOM	LAK	FYK	S	8	48	30	23.741
PUG	LGN	FYK	Y	50	36	79	220.757
PUG	LGN	FYK	S	50	36	79	220.757
SAR	LGN	FYK	Y	5	32	121	34.320
SAR	LGN	FYK	S	5	32	121	34.320
SAR	MLG	BAR	S	NA	121	NA	NA
SAR	MLG	FYK	Y	6	50	442	280.051

Region (EMU)	Habitat typology	Gear type	Eel stage	Number of gears used per day	Number of fishing days per year	Number of fishermen	Effort
SAR	MLG	FYK	S	6	50	442	280.051
SAR	RIV	FYK	Y	8	77	42	51.744
SAR	RIV	FYK	S	8	77	42	51.744
TOS	LAK	FYK	Y	0	0	0	0
TOS	LAK	FYK	S	0	0	0	0
TOS	MLG	BAR	S	NA	90	NA	NA
TOS	MLG	FYK	Y	10	78	27	42.292
TOS	MLG	FYK	S	10	78	27	42.292
TOS	RIV	FYK	Y	0	0	0	0
TOS	RIV	FYK	S	0	0	0	0
UMB	LAK	FYK	Y	24	72	28	97.853
UMB	LAK	FYK	S	24	72	28	97.853
VEN	LGN	FYK	Y	52	105	170	1.539.147
VEN	LGN	FYK	S	52	105	170	1.539.147
VEN	RIV	FYK	Y	47	87	173	636.844
VEN	RIV	FYK	S	47	87	173	636.844

The same methodology (interviews to a sample of fishermen) has been used to assess data for recreational fishermen (Table 5.2).

Table 5.2. Effort parameters used for eel recreational fishing in Italy in 2013, disaggregated by EMU and habitat typology and type of gears (DCF, 2013).

Region	Pool sample (Recreational fishing association members)	Eel fishermen interviewed	Sample representa-tiveness (%)	Habitat typology	Eel fishermen interviewed per gears type					Effort
					Fishing rod	Umbrella	Shore lift net	Big Shore lift net	Total	Number of fishing days * year
VDA	NA	NA	NA	RIV	NA	NA	NA	NA	NA	NA
PIE	11,453	243	33.68	RIV	243	0	0	0	243	8
EMU_LOM	23,291	222	22.27	LAK	322	0	0	63	385	71
		385	22.27	RIV	222	0	0	0	222	28
		388	22.27	RIV/LAK	388	0	0	0	388	23
TAA	2,181	NA	19.22		NA	NA	NA	NA	NA	NA
EMU_FVG	6,477	16	36.84	RIV/LAK	16	0	0	0	16	15
EMU_VEN	31,817	280	35.75	RIV	280	0	0	0	280	30
		276	35.75	RIV/LGN	276	0	0	0	276	18
LIG	4,333	470	92.18	RIV	254	216	0	0	470	12
EMU_EMR	26,670	1049	62.2	RIV	817	24	208	0	1,049	17
EMU_T	20,354	297	59.51	RIV	156	133	8	0	297	10

Region	Pool sample (Recreational fishing association members)	Eel fishermen interviewed	Sample representa-tiveness (%)	Habitat typology	Eel fishermen interviewed per gears type					Effort
					Fishing rod	Umbrella	Shore lift net	Big Shore lift net	Total	Number of fishing days * year
OS										
EMU_UMB	4,363	158	29.02	RIV/LAK	158	0	0	0	158	9
MAR	4,538	NA	56.73		NA	NA	NA	NA	NA	NA
EMU_LAZ	7,800	41	17.6	RIV	41	0	0	0	41	10
		16	17.6	RIV/LAK	16	0	0	0	16	15
ABR	3,477	NA	29.92	RIV	NA	NA	NA	NA	NA	NA
CAM	6,576	NA	40.22		NA	NA	NA	NA	NA	NA
MOL	693	NA	21.48		NA	NA	NA	NA	NA	NA
CAL	4,470	113	24.16	RIV	113	0	0	0	113	27

5.1 Glass eel

Glass eel fishing is allowed by specific authorization on a yearly basis, both in coastal and inland waters, in most EMUs, to firms dealing with juvenile fish harvest and commercialization. Authorized firms are obliged to return catch data inclusive of details on the fishing site and fishing effort, but for this first period of implementation, returned forms were unsatisfactory with regards to these information.

5.2 Yellow eel

See above.

5.3 Silver eel

See above.

5.4 Marine fishery

No marine fishery exists for eel in Italy.

6 Catches and landings

reported by EMU

Annual catch by life stage for commercial fisheries in the year 2013, as evaluated under the DCF programme, is reported in Table 6.1, by EMU, and by stratum (EMU_Habitat typology) in Table 6.2. For glass eel catches, data for 2011 are reported in Section 3.5.2.

Table 6.1. Yellow and silver eel commercial catches, and total for the two stages cumulated, for 2013, disaggregated by EMU (DCF, 2013).

EMUs	Yellow eels (kg)	Silver eels (kg)	Total (kg)	Total (tons)
LOM	942	1,127	2,069	2.07
FVG	2,721	1,304	4,025	4.03
VEN	12,248	10,883	23,131	23.13
EMR	7,704	4,287	11,991	11.99
TOS	8,159	16,739	24,898	24.9
UMB	4,782	0	4,782	4.78
LAZ	7,500	3,749	11,249	11.25
PUG	4,998	3,720	8,718	8.72
SAR	23,111	22,515	45,626	45.63
Total	72,165	64,324	136,489	136.49

Table 6.2. Yellow and silver eel commercial catches, and total for the two stages cumulated, for 2013, disaggregated by stratum (EMU and habitat typology) (DCF, 2013).

EMUs	Habitat typology	Yellow eels (kg)	Silver eels (kg)	Total (kg)	Total (tons)
LOM	LAK	942	1,127	2,069	2.07
VEN	LGN	2,157	1,280	3,437	3.44
VEN	RIV	564	24	588	0.59
FVG	LGN	5,280	4,177	9,457	9.46
FVG	RIV	6,968	6,706	13,674	13.67
EMR	LGN	7,573	460	8,033	8.03
EMR	MLG	0	3,827	3,827	3.83
EMR	RIV	131	0	131	0.13
TOS	LAK	0	0	0	0
TOS	MLG	8,159	16,739	24,898	24.9
TOS	RIV	0	0	0	0
UMB	LAK	4,782	0	4,782	4.78
LAZ	LAK	2,479	1,961	4,440	4.44
LAZ	LGN	688	1,788	2,476	2.48
LAZ	RIV	4,333	0	4,333	4.33
PUG	LGN	4,998	3,720	8,718	8.72
SAR	LGN	11,440	4,348	15,787	15.79
SAR	MLG	10,731	14,984	25,715	25.72
SAR	RIV	940	3,184	4,124	4.12
Total		72,165	64,325	136,489	136.49

6.1 Glass eel

See above.

6.2 Yellow eel

See above.

6.3 Silver eel

See above.

6.4 Marine fishery

No marine fishery exists for eel in Italy.

6.5 Recreational fishery

Total catch by life stage for recreational fisheries by Region is reported in Table 6.3, relative to 2013, evaluated under the DCF Programme.

Further data at the level of detail requested for this report are not available.

Table 6.3. Yellow and silver eel catches, and total for the two stages cumulated, from recreational fisheries in 2013, disaggregated by Region (DCF, 2013).

Region	Code	Yellow eel (kg)	Silver eel (kg)	Total (kg)	Total (tons)
Valle d'Aosta	VDA	NA			
Piemonte	PIE	1,804	0	1,804	1.80
Lombardia	EMU_LOM	29,657	849	30,506	30.51
Trentino Alto adige	TAA	0	0	0	0.00
Friuli Venezia Giulia	EMU_FVG	217	120	337	0.34
Veneto	EMU_VEN	17,707	2760	20,467	20.47
Liguria	LIG	3,528	0	3,528	3.53
Emilia Romagna	EMU_EMR	7,702	7,629	15,331	15.33
Toscana	EMU_TOS	1,348	647	1,995	2.00
Umbria	EMU_UMB	1,361	0	1,361	1.36
Marche	MAR	0	0	0	0.00
Lazio	EMU_LAZ	1,619	1,260	2,879	2.88
Abruzzo	ABR	0	0	0	0.00
Campania	CAM	0	840	840	0.84
Molise	MOL	0	0	0	0.00
Calabria	CAL	2,338	0	2,338	2.34
Basilicata	BAS	845	0	845	0.85
Puglia	EMU_PUG	0	0	0	0.00
Sardegna	EMU_SAR	0	0	0	0.00
Sicilia	SIC	407	0	407	0.41
Total		**68,533**	**14,105**	**82,638**	**82.64**

Recreational Fisheries: Retained and Released Catches

	RETAINED				RELEASED			
	Inland		Marine		Inland		Marine	
Year	Angling	Passive Gears	Angling	Passive gears	Angling	Passive gears	Angling	Passive gears

Provide the catch and release mortality (%) used in your country for angling in marine and inland waters.

Recreational Fisheries: Catch and Release Mortality

	RELEASED			
	Inland		Marine	
	Angling	Passive gears	Angling	Passive gears
Year				

6.6 Bycatch, underreporting, illegal activities

Data not available.

Table 6.x. Estimation of underreported catches in Country, per EMU and Stage.

		Glass eel				Yellow eel				Silver Eel				Combined (Y + S)			
Year	EMU_code	Reported catches (kg)	Underrept. %	Underrept. (kg)	Total catches (kg)	Reported catches (kg)	Underrept. %	Underrept. (kg)	Total catches (kg)	Reported catches (kg)	Underrept. %	Underrept. (kg)	Total catches (kg)	Reported catches (kg)	Underrept. %	Underrept. (kg)	Total catches (kg)
2013	EMU_a																
	EMU_b																
	EMU_c																
	EMU_d																
	EMU_e																
	EMU_f																
	Total/mean (%)																

AIM: Determine the % of the underreporting and the total catches of the Country per stage.

NOTE: Please indicate in the text whether the percentage underreported catch is a direct measurement or a guess using the estimate to calculate the underreported kgs and total catches.

Table 6.y. Existence of illegal activities, its causes and the seizures quantity they have caused.

		Glass eel			Yellow eel			Silver Eel			Combined (Y +S)		
Year	EMU	Y/N/?	Cause	Seizures (kg)	Y/N/?	Seizures (kg)	Cause	Y/N/?	Seizures (kg)	Cause	Y/N/?	Seizures (kg)	Cause
2013	EMU_a												
	EMU_b												
	EMU_c												
	EMU_d												
	EMU_e												
	EMU_f												

AIM: Identify the illegal fishing activities and in case it is possible its causes and the seized kgs in case they were seizures.

NOTES:

- Y/N/?:

- Y: you know for sure they have been illegal activities;
- N: illegal activities are considered negligible / not significant;
- ?: You do not know whether they have been illegal activities or not.

- Cause: One of the followings:

- Fishing out of the season;
- Fishing without licence;
- Fishing using illegal gears;
- Retention of eel below or above any size limit;
- Illegal selling of catches.

7 Catch per unit of effort

Catch per unit of effort has been assessed under the DCF Programme for year 2013, for both commercial and recreational fisheries. Cpue has been calculated as mean catch of the year per fisherman. The detailed cpue has been derived for a small and reliable subset of fishers, and then referred to the whole set of fishermen. In Table 7.1, annual mean cpue for 2013 are reported by stratum (EMU_Habitat typology), for commercial landings. In Table 7.2, annual mean cpue for 2013 are reported by stratum (EMU_Habitat typology), for recreational landings.

Table 7.1. Yellow and silver eel cpue (kg/fisherman) for commercial fisheries for 2013, disaggregated by stratum (EMU and habitat typology) (DCF, 2013).

EMU	Habitat typology	Type of gear	CPUE Yellow eel	CPUE Silver eel
			Kg/fisherman	**Kg/fisherman**
LOM	LAK	FYK	31.4	35.89
FVG	LGN	FYK	20.35	62.9
FVG	RIV	FYK	8.06	2.98
VEN	LGN	FYK	31.06	134.49
VEN	RIV	FYK	40.28	166.5
EMR	LGN	FYK	53.71	8.56
EMR	MLG	BAR	NA	NA
EMR	RIV	FYK	26.2	0
TOS	LAK	FYK	NA	NA
TOS	MLG	BAR	302.19	55.39
TOS	RIV	FYK	NA	NA
UMB	LAK	FYK	170.79	0
LAZ	LAK	FYK	99.16	19.78
LAZ	LGN	FYK	62.55	28.59
LAZ	RIV	FYK	866.6	0
PUG	LGN	FYK	63.27	58.8
SAR	LGN	FYK	94.55	45.99
SAR	MLG	BAR	24.28	617.18
SAR	RIV	FYK	22.38	142.26

Table 7.2. Yellow and silver eel cpue (kg/fisherman) for recreational fisheries in 2013, disaggregated by stratum (EMU and habitat typology) (DCF, 2013).

EMU	Habitat typology	CPUE Yellow eel	CPUE Silver eel
		Kg/fisherman	Kg/fisherman
PIE	RIV	2.5	0
EMU_LOM	RIV	2.50	0.00
EMU_LOM	LAK	11.40	0.49
EMU_FVG	RIV/LAK	5.00	0.00
EMU_VEN	LGN	20.00	0.00
EMU_VEN	RIV	2.89	0.00
LIG	RIV	6.92	0.00
EMU_EMR	RIV	4.57	0.25
EMU_TOS	RIV	2.70	0.03
EMU_UMB	LAK	2.50	0.00
EMU_LAZ	RIV	5.00	0.00
EMU_LAZ	RIV/LAK	5.00	0.00
BAS	RIV	5.00	0.00
CAL	RIV	5.00	0.00
SIC	RIV	2.50	0.00

7.1 Glass eel

See above.

7.2 Yellow eel

See above.

7.3 Silver eel

See above.

7.4 Marine fishery

No marine fishery exists for eel in Italy.

8 Other anthropogenic and environmental impacts

Anthropogenic and environmental impacts are considered in Italian stock assessment only for EMU where stocking practices have been carried out in rivers over dams. The model used allows to consider this anthropogenic mortalities such as the silver eels survival during the downstream migration, by considering the number of dams with hydroelectric turbines and their correspondent probability of survival of each plant (ς=0,682, ICES 2011).

9 Scientific surveys of the stock

Not available.

10 Data collected for the DCF

Biological surveys under the DCF National Program are carried out for every MU (Region), in a site, lagoon or catchment, representative of the MU in terms of habitat extent and/or amount of eel landings. Sampling is usually carried out by taking a random batch of eels from a fisherman cumulated catch of the day or of the week. Sample processing foresees different procedures depending on data to be obtained from the samples. Usually length and weight are directly measured on anaesthetized eel, and digital pictures for subsequent specific morphometric measurements are obtained. Samples are released if no other observations are due, or else sacrificed or frozen for further analyses.

For 2013, length and weight measurements were foreseen and age estimation too.

Table 10.1. Summary of the DCF monitoring implementation per EMU.

Data	River	Lakes	Estuaries	Lagoons	Coastal & Marine
No. of production / escapement surveys[1]					
No. of recruitment time-series surveys[2]					
No. fished aged	84	76		423	
No. of fished sexed	84	76		423	
No. of fish examined for parasites					
No. of fish examined for contaminants					
No. of non-fishery mortality studies[3]					
Socio-economic survey					

[1] Surveys to estimate B_{best} and/or $B_{current}$ [These should include WFD surveys where the data are being used to estimate production and/or escapement of eel].

[2] Fishery-independent surveys.

[3] Studies to determine ∑H for non-fisheries anthropogenic impacts, such as hydropower, barriers, predation, etc.

11 Life history and other biological information

11.1 Growth, silvering and mortality

Von Bertalanffy parameters

EMU		K_MALE	L_INF_MALE	K_FEMALE	L_INF_FEMALE
EMR	LGN	0,28	777	0,25	1107
LAZ	LAK	0,44	400	0,07	988
LAZ	LGN	0,74	378	0,15	724
LAZ	RIV	0,49	394	0,28	692
LOM	LAK	0,44	400	0,07	988
LOM	RIV	0,44	400	0,07	988
PUG	LGN	0,87	413	0,30	712
SAR	LGN	0,96	393	0,28	707
TOS	MLG	0,46	450	0,38	524
UMB	LAK	0,44	385	0,24	576

Length and age at silvering

EMU			LT	AGE
LAZ	RIV	Male	386	7
		Female	588	8
LOM	LAK	Male	na	na
		Female	772	17
UMB	LAK	Male	354	5
		Female	471	7
LAZ	LAK	Male	401	8
		Female	673	12
VEN	LGN/MLG	Male	na	na
		Female	630	10
PUG	LGN/MLG	Male	418	5
		Female	660	6
LAZ	LGN/MLG	Male	66,0	7
		Female	573,0	10
SAR	LGN/MLG	Male	394	4
		Female	623	7
TOS	LGN/MLG	Male	404	5
		Female	490	7
EMR	LGN/MLG	Male	na	na
		Female	817	5

11.2 Parasites and pathogens

No relevant data because new data were not available and no routine monitoring have been implemented.

11.3 Contaminants

Some lake fisheries have been closed in 2011, and remained closed in 2012. These concerned also eel (such as the Lago di Garda, Lombardia), in relation to fish contamination by dioxin or other contaminants. Contaminant data are not available, because carried out by local Health Agencies.

11.4 Predators

Ichthyophagous birds have a strong impact in the area of the lagoon of Venice and in all the North Adriatic area, mainly in relation to fish predation in the valli, and represent one of the main causes of product loss.

Predation by ichthyophagous birds represents the main factor limiting fish productions in Italian coastal lagoons or in the North Adriatic extensive aquaculture situations (valli). The specific impact on eel cannot be quantified; it depends on a number of factors that vary among lagoons. On the other hand, the presence of other water birds represents a main attraction in these same sites, in relation to the different usages of lagoons (tourism, conservation and hunting).

Another predator of eel that is found in some rivers and estuaries is *Silurus glanis*. Its presence is ascertained in the Tiber River (Lazio) and in the river Po lower course (Emilia Romagna), but its impact on eel local stocks cannot be quantified at the present moment.

12 Other sampling

NA.

13 Stock assessment

13.1 Method summary

Italy presented a mixed Eel Management Plan that includes a National EMP and nine Regional EMPs. The former deals only with coastal waters, and hence only with glass eel fisheries. The stock assessment for eel was however carried out for all the 20 Italian Regions, i.e. including the nine MUs with a Regional Eel Management plan and the other eleven Regions where no recovery plans for the eel were foreseen.

Within each region, a habitat-based approach was used for assessments, considering separately lake, river and estuarine waters and lagoon surfaces. Local stock assessment was performed at EMUs (i.e. regions) for wetted areas and also taking into account specific habitat typologies (lakes, lagoons, rivers), by means of a demographic model tuned on available data on recruitment, fishing effort and age/size structure or on bibliographic data. The model (DemCam), developed by Bevacqua *et al.* from University of Parma and Politecnico di Milano and evaluated in the ICES working group SGIPEE, was used, specifically revised for this purpose.

DemCam was developed specifically for the assessment of the eel stock and catches in spatially implicit environments such as lagoons, lower water systems or uniform traits of rivers. A general formulation makes it suitable to describe the demography of different eel stocks, provided that a sufficient number of data are available for parameter calibration. The model covers the whole continental phase of the European eel's life cycle, from the recruitment at the glass eel stage up to the escapement of migrating silver eels. It defines the eel stock and the harvest structured by age, length, sex and maturation stage (yellow or silver) on an annual basis. The model allows also considering the system in pristine conditions by using the extension of pristine habitat in the absence of human pressure (fishing mortality and presence of dams) and the abundance of recruitment to the maximum carrying capacity.

As far as the data of body growth curves are concerned, the model proposed by Melià *et al*. (2006a) was used: for each Region (MU) and habitat type parameters calibrated with the data obtained from DCF biological samplings in the respective reference site of the habitat typology have been used, or from other available data, extending these parameters in those cases where no other data were available.

The probability of reaching sexual maturity, and natural mortality were estimated with the model proposed by Bevacqua *et al*. (2006; 2011).

Fishing mortality rate (F) was calculated as the result of the effort applied, the selectivity of the nets used (depending on the length and the mesh size of the gears), and the catchability, (Bevacqua *et al*., 2009), specifically calibrated for each combination of EMU and habitat typology.

In the case of managed lagoons, where fishing barriers are present, all silver eel caught by these traps were deducted from the total silver eel biomass estimated by the DEMCAM model in these habitat typology.

The model allows to consider other anthropogenic mortalities such as the silver eels survival during the downstream migration, by considering the number of dams with hydroelectric turbines and their correspondent probability of survival of each plant (ς=0,682, ICES 2011).

On the basis of the escapement pristine data, B_o, (assessed with different levels of productivity for each habitat typology, from 3,2 to 34,5 kg/ha taken from scientific literature) and the pristine available wetted areas (in hectares), the model estimates the pristine level of recruitment R_0. Considering the current recruitment $R_{current}$as a fraction of the pristine one (ICES, 2013), the model calibrate a negative exponential function for recruitment time series (1950–2009) (ICES, 2013) imposing $R_{1980} = R_0$ and $R_{2009} = R_{current}$, with an increment in the subsequent years (2010–2013) following the analysis reported by ICES (2013).With this series and considering the current actual available wetted areas, the model simulates the system in the absence of human pressure, to obtain an estimate of the potential silver eel biomass (Bbest), and in actual conditions, assessing the annual escapement of silver eels ($B_{current}$)

With regards to recruitment, an estimation of the fraction of actual recruitment by considering in Italy four macro areas differing in recruitment level. With this procedure it was estimated that recruitment is currently 10% for the pristine inland waters (not directly connected to the sea), 15% for the Northern Adriatic Sea, 20% for the Southern Adriatic Sea and 30% for the Tyrrhenian area and the islands.

The limits to the application of this model are largely due to the lack of specific data for each site. The generalization process for a particular species so may lead to overestimates or underestimates the biomass of spawners. In particular the value of recruitment, both pristine and actual, has a strong influence on model predictions and the lack of specific data for the estimation of this parameter makes assessments less reliable.

13.1.1 Estimate of B_0

Table 13.1. Reference period for B_0.

EMU_code	B_0 (kg/ha)	Reference time period	Whether or not changed from value reported last year (Y/N)
VDA_RIV	3.2		N
PIE_RIV	3.2		N N
PIE_LAK	4.2		N
TRN_RIV	3.2		N N
TRN_LAK	4.2		N
EMR_VAL	20.0		N N
EMR_LGN	20.0		N
EMR_MLG	20.0		N N
EMR_RIV	3.2		N
FVG_LGN	20.0		N N
FVG_RIV	3.2		N
FVG_VAL	20.0		N N
LAZ_LAK	4.2		N N
LAZ_LGN	20.0		N
LAZ_MLG	20.0		N N
LAZ_RIV	11.6		N
LOM_LAK	4.2		N N
LOM_RIV	3.2		N
LIG_RIV	3.2		N N
PUG_LGN	34.5		N
PUG_RIV	3.2		N N
SAR_LGN	24.2		N
SAR_MLG	24.2		N N
SAR_RIV	13.7		N
TOS_LAK	4.2		N N
TOS_MLG	24.5		N
TOS_RIV	3.2		N N
MAR_RIV	3.2		N
UMB_LAK	0		N N
UMB_RIV	3.2		N
ABR_RIV	3.2		N N
VEN_LAK	4.2		
VEN_LGN	20.0		
VEN_RIV	11.7		

VEN_VAL	20.0
CAM_LGN	20.0
CAM_RIV	3.2
MOL_RIV	3.2
CAL_RIV	3.2
BAS_RIV	3.2
SIC_LGN	20.0
SIC_RIV	3.2

Cannas A. (1988) Studio sulle lagune salmastre della Sardegna. Studio per la pianificazione delle risorse idriche in Sardegna. Assessorato alla programmazione della R.A.S.

Cannas A., Trisolini R., Rossi R. (1992) La pesca nello stagno di Tortolì (Sardegna).OEBALIA, suppl. XVII:27–128.

Cottiglia M. (1984) Gli "stagni" salsi sardi situazione attuale e possibilità future. Quad.Lab. tecnol. Pesca, Ancona, 61,2:400–459.

De Leo, G., and M. Gatto. (1995) A size and age-structured model of the European eel (*Anguilla anguilla* L.). Canadian Journal of Fisheries and Aquatic Sciences 52:1351–1367.

Fanciulli G., Curto R. (1985) Ecologia dello stagno di San Teodoro. 1. Rendimenti di pesca: 1980–1985. Nova Thalassia, 7(3), pp. 412.

Grimaldi, 2001. La laguna di Varano: una risorsa da Valorizzare. Ed. Grenzi. pp. 312.ISBN 88-8431-049-0.

Innamorati, M. & Melillo, C. (2004) Studio della Laguna di Orbetello: ecologia ed aspetti economici. Laboratorio di Ecologia, Dipartimento di Biologia Vegetale, Università di Firenze.

Lumare e Villani, 1989. Pesca ed indirizzi di gestione produttiva nel lago di Lesina (costa SUD-EST Adriatica). Oebalia XV(2):683–691.

Moriarty, C. e Dekker, W. (Eds) 1997 Management of the European eel. Fisheries Bulletin, Vol. 15, The Marine Institute, Dublin, Ireland pp 110.

Rossi R., Cataudella S. 1998. La produzione ittica nelle Valli di Comacchio. Laguna suppl. 5/98: 67–76.

13.2 Summary data

13.2.1 Stock indicators and targets

Table 13.2. Stock indicators, mortality rates and EMP targets for each IT-EMU.

	Indicators			Mortality			Target	
EMU	B0 (ton)	Bbest (ton)	Bcurr (ton)	∑A	∑H	∑F	EU (ton)	WGEEL (ton)
ABR	1.928	0.424	0.349	0.028	0.028	0.000	0.77	1.38
BAS	2.318	0.660	0.497	0.040	0.040	0.000	0.93	1.53
CAL	1.580	0.450	0.360	0.032	0.032	0.000	0.63	1.32
CAM	14.339	5.295	4.280	0.040	0.040	0.000	5.74	8.52
EMR	458.236	130.226	84.287	0.049	-0.134	0.184	183.29	337.15
FVG	293.033	73.306	55.557	0.151	-0.139	0.291	117.21	218.21
LAZ	71.054	30.973	5.137	1.117	1.065	0.051	28.42	51.46
LIG	1.684	0.680	0.588	0.021	0.021	0.000	0.67	1.31
LOM	65.561	7.889	4.257	0.154	0.154	0.001	26.22	58.97
MAR	3.516	0.774	0.360	0.111	0.111	0.000	1.41	3.07
MOL	0.903	0.257	0.185	0.047	0.047	0.000	0.36	0.61
PIE	15.632	2.212	0.237	0.086	0.086	0.000	6.25	14.87
PUG	399.772	106.722	79.422	0.061	0.048	0.013	159.91	247.52
SAR	210.386	82.199	21.240	1.228	0.195	1.033	84.15	156.68
SIC	7.871	3.098	2.305	0.056	0.056	0.000	3.15	4.37
TOS	75.404	27.034	2.652	1.448	0.085	1.363	30.16	65.38
TRN	7.195	1.010	0.239	-0.044	-0.044	0.000	2.88	6.43
UMB	3.569	0.557	0.000	2.000	1.730	0.270	1.43	3.57
VDA	1.082	0.166	0.000	2.000	2.000	0.000	0.43	1.08
VEN	1773.133	440.073	360.037	0.031	-0.012	0.043	709.25	1257.16

13.2.2 Habitat coverage

All habitats have been assessed (Table 2.1 for wetted areas).

13.2.3 Impact

NA.

NA

13.2.4 Precautionary diagram

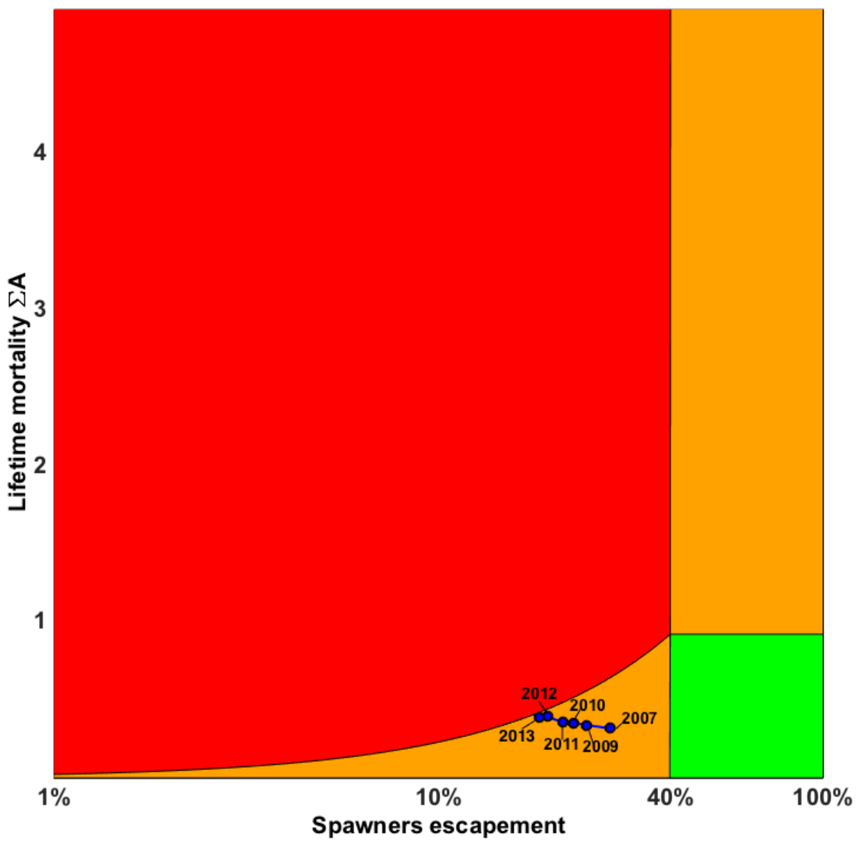

Figure 13.1. Precautionary Diagram for Italian country. It display the evolution since 2007 showing the effect of the implementation of the EMP.

13.2.5 Management measures

Table 13.2. Management measures and implementation status for each IT-EMU.

Action Type	Com Fish	Rec Fish	Com Fish	Com Fish	Rec Fish	Restocking	Hydro&Pumps	Other	Other	Hydro&Pumps	Other	Other	Other
EMU	Professional fishery closure	Recretional fishery closure	Glass eel fishery	Reduction of professional fishery effort	Reduction of recreational fishery effort	Restocking	Transport programs	Habitat restoration	Predators control	Sistemi dissuasivi sulle turbine	Habitat improvement	Monitoring programs	Other
VDA	Y	Y	n.r.	-	-	-	-	-	-	-	-	-	-
PIE	Y	Y	n.r.	-	-	-	-	-	-	-	-	-	-
LOM	-	-	n.r.	Y	Y	Y	N	Y	N	N	N	Y	N
TAA	?	?	n.r.	-	-	-	-	-	-	-	-	-	-
FVG	-	-	NA/NA	N	Y	Y	N	N	N	N	N	N	N
VEN	-	.	NA/A	Y	Y	N	Y	Y	N	N	N	N	N
LIG	Y	?	n.r.	-	-	-	-	-	-	-	-	-	-
EMR	-	-	NA/NA	Y	Y	Y	N	Y	N	N	N	Y	N
TOS	-	-	A/A	Y	Y	Y	Y	Y	N	N	N	Y	N
MAR	-	-	n.r.	-	-	-	-	-	-	-	-	-	-
UMB	-	-	n.r.	Y	Y	N	N	N	N	N	N	ns	N
LAZ	-	-	A/A	Y	Y	Y	N	N	N	N	N	N	N
ABR	?	?	n.r.	-	-	-	-	-	-	-	-	-	-
MOL	?	?	n.r.	-	-	-	-	-	-	-	-	-	-
CAM	?	?	?	-	-	-	-	-	-	-	-	-	-
BAS	?	?	n.r.	-	-	-	-	-	-	-	-	-	-
PUG	-	-	NA/NA	Y	Y	Y	N	N	N	N	N	Y	N
CAL	?	?	n.r.	-	-	-	-	-	-	-	-	-	-
SIC	Y	?	n.r.	-	-	-	-	-	-	-	-	-	-
SAR	-	-	NA/NA	Y	Y	N	N	N	N	N	N	Y	N

Legend: Y: Implemented; N: Not yet implemented; n.r.: Not relevant; -: Not applicable; NA: Not allowed (inland waters/coastal waters); A: Allowed (inland waters/coastal waters.

13.3 Summary data on glass eel

quantities	caught in the commercial fishery
	exported to Asia
	used in stocking
	used in aquaculture for consumption
	consumed direct
	mortalities

14 Sampling intensity and precision

No relevant data available.

15 Standardisation and harmonisation of methodology

15.1 Survey techniques

NA.

15.2 Sampling commercial catches

Surveys are currently carried out on a regular basis only under the DCF National Programme 2009–2010, and are foreseen for the 2011–2013 Programme. Samplings are foreseen for every Eel Management Unit (EMU). In Article 2(1) of Regulation (EC) No 1100/2007 for the recovery of the eel stock the river basin units should be generally considered as EMU. Contrary Italy has decided to avail itself of the opportunity provided in the above-mentioned Article 2 of the regulation, which stipulates that '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' and, for the reasons highlighted above, therefore proposes the regional administrations as Eel Management Units. This point has been accepted by the Commission and shall therefore remain in the amended version of the Italian Eel Management Plan.

Triennial biological surveys under the DCF National Program are carried out for every EMU (Region), in a site, lagoon or catchment, representative of the EMU in terms of habitat extent and/or amount of eel landings. Eel fishery is still allowed in only nine regions, which presented a management plan.

About 100 individuals for each eel life stage (yellow and silver eel) are sampled in order to assess stage composition (reconfirm yellow or silver stage), length and age frequency distributions and sex ratio. Sampling is usually carried out by taking a random batch of eels from a fisherman cumulated catch of the day or of the week. Sample processing foresees different procedures depending on data to be obtained from the samples. Usually length and weight are directly measured on anaesthetized eel, and digital pictures for subsequent specific morphometric measurements are obtained. Samples are released if no other observations are due, or else sacrificed or frozen for further analyses.

15.3 Sampling

NA.

15.4 Age analysis

Eel otoliths, once removed from fish heads, were both immerged in distilled water and then cleaned from attached tissues with the absorbent side of a laboratory bench paper. Then otoliths were stored dry in labelled Eppendorf micro tubes and left in a heater (70°C) overnight. Then Eppendorf were closed and stored until otolith examination.

Procedure for aging eel otoliths by grinding and polishing used in the Tor Vergata University Rome for *A. anguilla* species

This procedure provides a safe and reliable method for processing eel otoliths and assessing the age of the eel by counting the annuli illuminated via polarized or transmitted light as a result of the grinding and polishing. This method has been developed at the Cemagref laboratories (Bordeaux – France) but has been modified in several steps in our laboratories.

Each left otolith was placed on the bottom of a numbered mould cavity, external side face up (concave side). Then some drops of an epoxy resin preparation were added each cavity until the mould is filled up. The bubbles under the otoliths were gently removed by moving the sample with a needle. The mould was left drying overnight until the resin is hard, than the resin blocks with the embedded otoliths were removed from the moulds.

Each embedded otolith is mounted with the convex side up, on a histological slide with a drop of Eukitt (transparent glue) by quickly pressing the corresponding resin block on it. Glass slides are labelled with appropriate code for the otolith.

The grinding procedure was carried on using a Struers grinding machine (LABPOL-5) beginning with 1200 grits silicon-carbide sanding papers, increasing to 4000 grits until the centre and edge are visible. Slide is checked every so often to ensure that the grinding is in sufficient direction and force and that the origin has not been removed. When satisfied with the level of grinding the otolith is then polished using a jewellery cloth with an abrasive paste (suspension of 1 μ alumina) to remove any score lines.

The sample is now ready for the hatching with an acid preparation and then for the staining process. A drop of 5% EDTA was applied on each otolith for three minute and then rinsed with distilled water. Subsequently a drop of 5% toluidine blue is applied on the grinded otolith surface. The stained otoliths were left dry overnight and then rinsed with water.

Now the otoliths are ready for the observation with the binocular microscope and PC with image acquisition. Each result is recorded within an EXCEL file database.

100% of otoliths were re-read by another operator and "second opinion" was recorded. Moreover after three week the first operator makes a second and definitive reading.

Fish age was determined by reading annual otolith rings (annuli) from the first growth check (age 1+) outside the so called "zero band". This band is commonly assumed as the beginning of continental growth in eel (Moriarty, 1983; Poole *et al*., 2004; ICES, 2009).

15.5 Life stages

Maturation stage was determined combining gonad development, Pankhurst's (1982) ocular index (OI) which reflects changes in eye diameter during metamorphosis to the silver stage (Acou *et al*., 2009) and Durif's silvering index (Durif *et al*., 2005).

15.6 Sex determinations

Sex was assessed macroscopically whenever possible, or by histological examination of gonads (Colombo and Grandi, 1996)

15.7 Data quality issues

NA.

16 Overview, conclusions and recommendations

In the present report, data on eel stock and fisheries are reported for Italy for 2013. As pointed out in the Introduction, notwithstanding the initial delay, Italy has recovered the lag in the application of the Eel Management Plan, approved in 2011, because since 2009 at different levels in Italy the process of implementation of the IT-EMP was already in place. The work concerning the IT-EMP has been up to now coordinated within a National Working Group, that has involved Administrations, Technicians and Scientists. During 2012 and 2013, the work of the Nat Working Group has been finalized to the gathering of data for the evaluation of the parameters relative to escapement (Bo, Bcurr, Bbest) required to assess progress achieved through the implementation of the National EMP, as foreseen by Article 9 of Regulation 1100/2007. This has been done for the first report in 2012 (PNG Italia, 2012) and for the following Reports in 2013 and 2014 (PNG Italia, 2013; PNG Italia, 2014). Italy, as extensively explained in the IT-EMP and in all Reports and communications, has followed the approach of using for the assessment process a database progressively implemented. Compared to 2008, when the work for the compilation of the IT-EMP was initiated, a series of tools and activities have been put in place between 2009 and 2013 that have resulted in a database much more detailed and reliable, and therefore for the evaluation of the reference points required for the assessment foreseen by Art. 9, this updated dataset has been used.

In this report, as in the Report (PNG Italia, 2013), revised estimates of B_o and estimates of B_{curr} and B best have been presented, calculated using revised estimates of wetted areas and using productivity values in kg/ha diversified by habitat type, based on new evidence from the literature. This approach seems more appropriate, and the only one that allows to take into account the diversity of situations in the various EMU in Italy, balancing the roles of different Management Units in the process of recovery of the eel stock, depending on the type of habitat prevailing in each.

In this report, estimates of some parameters are provided for those regions (11) that do not have presented a Regional Management Plan, choosing the option of a total closure of the eel fisheries in their waters. For these regions, which do not participate for the moment in the process of recovery of the eel stock, no data of eel biomass in pristine conditions or in current conditions had been provided in the IT-EMP (PNG Italia 2009). However, it became necessary to quantify the role that the complete closure of the fishery in these regions can have in terms of biomass of escaping silver eels.

The National Management Plan and the Regional Management Plans are operating in all EMU, Many EMUs (Veneto, Lazio, Toscana, Puglia) and have activated many management projects and initiatives, based on Regional Fundings and specific projects under the CFP, that are resulting in a management framework well established at the regional level.

A better coordination should be foreseen with regards to glass eel fisheries and glass eel use for restocking, also in consideration that this is a major point of interest. The fragmentation between Central Administration (for coastal waters) and Regions (for inland waters) results in a system lacking coherence for all the aspects involved, i.e. catch registration, sales declaration etc. In some Regions, on the other hand, such as Tuscany, a complete coordination has been set up at the local level, and the system is well established that foresees specific licenses, transfer of catches in specific facilities were glass eels are ongrown to elvers and then used for restocking in the EMU, on the basis of a specific yearly regional restocking llan.

At the national level, the DFC for eel is definitively in place, and this has proven to be a valuable tool for eel management and fisheries evaluation, that also provides a coordinated framework for other actions for eel monitoring and assessment.

Overall, despite the delay in the approval of the National Management Plan in Italy and the consequent delays in the implementation of regional plans, the general structure and the implementation framework are now in place. A coordination table which involves the central and regional administrations has been set up, with the support of scientists and technicians, which is unprecedented in Italy for the fisheries and management of inland waters.

17 Literature references

Acou A., Boury P., Laffaille P., Crivelli A.J., Feunteun E. 2005. Towards a standardized characterization of the potentially migrating silver European eel (*Anguilla anguilla* L.). Arch. Hydrobiol., 164, 237–255.

Andrello, M., Bevacqua, D., Maes G.E., and De Leo, G.A. 2011. An integrated genetic-demographic model to unravel the origin of genetic structure in European eel (*Anguilla anguilla* L.). *Evolutionary application*, 4-4:517–533.

Ardizzone, G.D.; Cataudella, S.; Rossi, R 1988. Management of coastal lagoon fisheries and aquaculture in Italy. FAO Fisheries Technical paper n. 293, 111 p.

Bevacqua, D., G. De Leo, M. Gatto, and P. Melià. 2009. Size selectivity of fyke nets for European eel Anguilla anguilla. *Journal of Fish Biology*, 74:2178–2186.

Bevacqua, D., Melià, P., Crivelli, A.J., De Leo, G.A. and Gatto, M. 2006. Timing and rate of sexual maturation of European eel in brackish and freshwater environments. *Journal of Fish Biology*, 69 supp C:200–208.

Bevacqua, D., Melià, P., De Leo, G.A. and Gatto M. 2011. Intra-specific scaling of natural mortality in fish: the paradigmatic case of the European eel. *Oecologia* 165**,** 333–339.

Bevacqua, D., P. Melià, A. Crivelli, M. Gatto, and G. De Leo. 2007. Multi-objective assessment of conservation measures for the European eel (*Anguilla anguilla*): an application to the Camargue lagoons. *ICES Journal of Marine Science: Journal du Conseil,* 64:1483–1490.

Cannas A. 1988. Studio sulle lagune salmastre della Sardegna. Studio per la pianificazione delle risorse idriche in Sardegna. Assessorato alla programmazione della R.A.S.

Cannas A., Trisolini R., Rossi R. 1992. La pesca nello stagno di Tortolì (Sardegna).*OEBALIA*, suppl. XVII:27–128.

Colombo G. and Grandi G. 1996. Histological study of the development and sex differentiation of the gonad in the European eel. J. Fish Biol., 48, 493–512.

Cottiglia M. 1984. Gli "stagni" salsi sardi situazione attuale e possibilità future. Quad.Lab. tecnol. Pesca, Ancona, 61,2:400–459.

Council Regulation (EC) No 199/2008 of 25 February 2008 concerning the establishment of a Community framework for the collection, management and use of data in the fisheries sector and support for scientific advice regarding the Common Fisheries Policy.

De Leo, G., and M. Gatto. 1995. A size and age-structured model of the European eel (*Anguilla anguilla* L.). *Canadian Journal of Fisheries and Aquatic Sciences* 52:1351–1367.

Durif C., Dufour S. and Elie P. 2005. The silvering process of *Anguilla anguilla*: a new classification from the yellow resident to the silver migration stage. J. Fish Biol., 66, 1025−1043.

European Commission. 2007. Council Regulation (EC) No 1100/2007 of 18 September 2007 establishing measures for the recovery of the stock of European eel. Official Journal of the European Union 22.9.2007 L 248: 17–23.

Fanciulli G., Curto R. 1985. Ecologia dello stagno di San Teodoro. 1. Rendimenti di pesca: 1980–1985. *Nova Thalassia*, 7(3), pp. 412.

Grimaldi. 2001. La laguna di Varano: una risorsa da Valorizzare. Ed. Grenzi. pp. 312.ISBN 88-8431-049-0.

ICES. 2009. Report of the 2009 session of the Joint EIFAC/ICES Working Group on Eels. *ICES CM 2009/ACOM:15*, 117 pp.

ICES. 2011. Report of the 2011 session of the Joint EIFAC/ICES Working Group on Eels. *ICES CM 2011/ACOM:18*, 223 pp.

ICES. 2012. Report of the Workshop on Eel and Salmon DCF Data (WKESDCF), 3–6 July 2012, ICES HQ, Copenhagen, Denmark. I*CES CM / ACOM:62. 67 pp.*

Innamorati, M. and Melillo, C. 2004. Studio della Laguna di Orbetello: ecologia ed aspetti economici. Laboratorio di Ecologia, Dipartimento di Biologia Vegetale, Università di Firenze.

Lumare e Villani. 1989. Pesca ed indirizzi di gestione produttiva nel lago di Lesina (costa SUD-EST Adriatica). *Oebalia* XV(2):683–691.

Melià, P., Bevacqua, D., Crivelli, A.J., De Leo, G.A., Panfili, J. and Gatto, M. 2006a. Age and growth of *Anguilla anguilla* in the Camargue lagoons. *Journal of Fish Biology* 68:876–890.

Melià, P., Bevacqua, D., Crivelli, A.J., Panfili, J., De Leo, G.A. and Gatto, M. 2006b. Sex differentiation of the European eel in brackish and freshwater environments: a comparative analysis. *Journal of Fish Biology* 69:1228–1235.

Moriarty, C. e Dekker, W. 1997. Management of the European eel. Fisheries Bulletin, Vol. 15, The Marine Institute, Dublin, Ireland pp 110.

Pankhurst N.W. 1982. Relation of visual changes to the onset of sexual maturation in the European eel *Anguilla anguilla* (L.). J. Fish Biol., 21, 127−140.

Piano Nazionale di Gestione (PNG) per l’anguilla in Italia - Regolamento (CE) 1100/2007 –Rapporto Annuale Italia Art. 9 – Anno 2012, 17 pp.

Piano Nazionale di Gestione (PNG) per l’anguilla in Italia - Regolamento (CE) 1100/2007 –Rapporto Annuale Italia Art. 9 – Anno 2013, 36 pp.

PNG Italia. 2011. Piano Nazionale di Gestione (PNG) per l’anguilla in Italia Reg. (CE) 1100/07. February 2011.

Rossi R., Cataudella S. 1998. La produzione ittica nelle Valli di Comacchio. *Laguna* suppl. 5/98: 67–76.

Scientific, Technical and Economic Committee for Fisheries (STECF). 2004. Revision of DCF part 4 (STECF-14-07). 2014. Publications Office of the European Union, Luxembourg, EUR XXXX EN, JRC XXXX, XXX pp.

Unimar. 2007. Indagine finalizzata alla costituzione di una base conoscitiva per l’elaborazione di un piano di gestione Nazionale per la risorsa anguilla. 131 pp.

Report on the eel stock and fishery in Latvia 2013/'14

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Reporting Period: This report was completed in October 2014, and contains data up to 2013 and some provisional data for 2014.

2 Introduction

According to Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for the Community action in the field of water policy and Article 2(1) of the Council Regulation (EC) No. 1100/2007 of 18 September 2007 establishing measures for the recovery of the stock of European eel, it has been proposed in Latvia to define only one eel management unit or a single 'eel river basin', which includes part of four river basin districts established for in Latvia while separating the natural eel distribution waters with the adjacent coastal and transitional waters.

Rivers and lakes accessible for eel upstream migration and rivers and lakes without downstream migration obstacles as HPS. Private lakes and lakes, were regular fish winterkills occurs were not included in EMU.

All together 27 rivers with eel habitat area 8718 ha, 15 lakes-15 507 ha and coastal and transitional waters-89 776 ha proposed as LV_Latv EMU waterbodies.

Latvia's EMU belongs to Baltic sea Ecoregion according to ICES classification or 15. Ecoregion- Baltic province according to WFD.

3 Time-series data

Time-series of landings (yellow and silver eel mixed) in inland and coastal waters and data of restocking by lakes or rivers of country are available from 1949. Electrofishing surveys in rivers (since 1992) accessible for eel and lakes and rivers restocked by eel:

- historical restocking from 1920s all;
- restocking in frame of EMP since 2011 are available.

3.1 Recruitment

NC.

3.1.1 Glass eel recruitment

NP.

3.1.1.1 Commercial

NP.

3.1.1.2 Recreational

NP.

3.1.1.3 Fishery independent

NP.

3.1.2 Yellow eel recruitment

NC.

3.1.2.1 Commercial

NC.

3.1.2.2 Recreational

NC.

3.1.2.3 Fishery independent

Electrofishing data?

3.2 Yellow eel landings

NC.

3.2.1 Commercial

NC.

3.2.2 Recreational

NC.

3.3 Silver eel landings

Mixed silver and yellow eel landings since 1949 from three lakes situated in EMU.

3.3.1 Commercial

NC.

3.3.2 Recreational

NC.

3.4 Aquaculture production

3.4.1 Seed supply

NP.

3.4.2 Production

NP.

3.5 Stocking

3.5.1 Amount stocked

From 2011 all glass eel restocked only in EMU lakes and rivers. All previous restocking carried out in lakes up from dams, inaccessible for eel. Some municipalities restock ongrown eel in lakes not included in LV_Latv.

3.5.2 Catch of eel <12 cm and proportion retained for restocking

NP.

3.5.3 Reconstructed time-series on stocking

Restocking in EMU waterbodies x1000.

Table 3.x. Stocking of cultured and wild eel in country since 1984.

	Local Source					Foreign Source				
Year	Glass eel (n)	Quarantined Glass (n)	Wild Yellow (n)	On-grown cultured (n)	Total	Glass eel (nx1000)	Quarantined Glass (n)	Wild Yellow (n)	On-grown cultured (nx1000)	Total GEE (n)
1984										
1985						1481				
1986										
1987						260				
1988						2978			72,5	
1989										
1990										
1991										
1992										
1993										
1994										
1995						572				
1996										
1997										
1998										
1999						294				
2000										
2001										
2002						270,8				
2003										
2004										
2005						120				
2006						3			3	
2007						15			3 (8)	
2008									4,25 (18)	
2009										
2010									8,7 (14)	
2011							386		3,64 (3- 5)	
2012							1030		4	
2013									6,285 (5- 10)	
2014							1386,2			

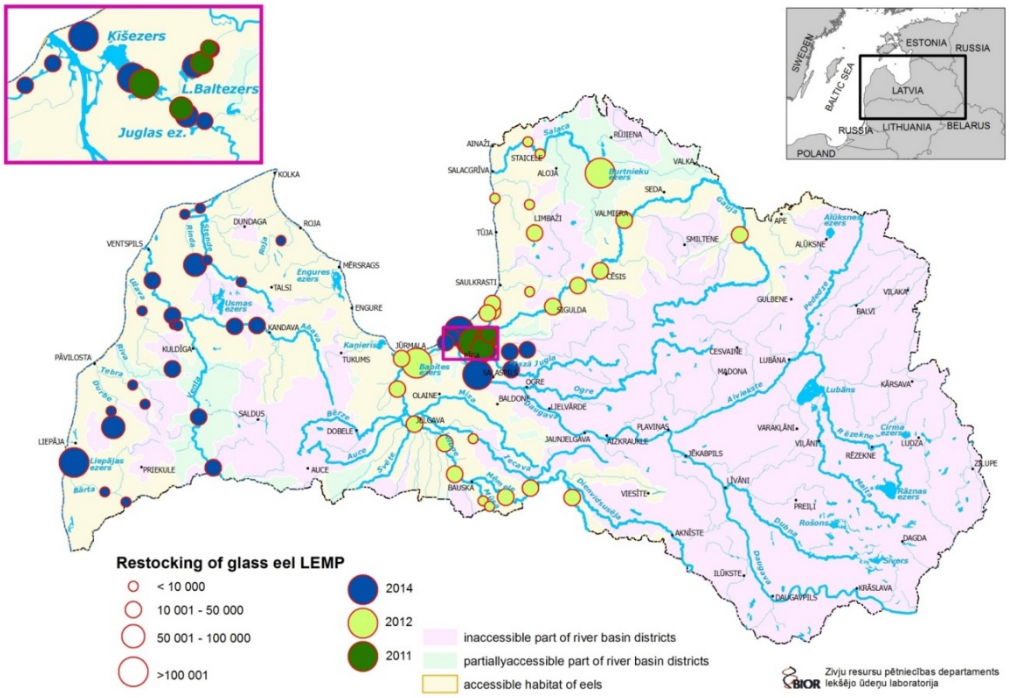
All restocking- foreign source.

EEL- restocked in frame of EMU;

EEL- restocked by fishing rights owners, inland lakes outside EMU;

EEL- restocked by municipalities.

()- in brackets weight in g.



NOTES:

- Local Source: The source of the stocked eels is local;
- Foreign Source: Eels come from another country;
- Split the stocked eels into the stages in the column headings, do not add anymore;
- Please, translate the number of Wild Yellow and on-grown cultured into GEE (Glass Eel Equivalents). If you are not able to do that, you must provide average size of stocked eels; and in case you have it, mortality rates and growth and/or age in order to make the transformation to GEE.

3.6 Trade in eel

Catches are too low for trade outside from Latvia. Market price for fresh eel was 16–20 Euros/kg in 2014. These prices were first sale prices about eel >1 kg. Price of foreign aquaculture eel (probably Netherlands origin) was 10–12 EUR in market.

4 Fishing capacity

Table 4.1. Data regarding number of gear allowed and number of companies operating in eel fishery in EMU LV_latv lakes available from 2007.

Year	Number of gear in operation	Number of companies
2007	64	16
2008	68	16
2009	68	15
2010	68	13
2011	68	12
2012	68	14
2013	68	13

Number of licences issued are same as number of companies operating in fisheries. Largest part of these companies belongs to smallest enterprises form where owner is also fisherman in one person.

4.1 Glass eel

NP.

4.2 Yellow eel

Mixed, but more probably silver eels.

4.3 Silver eel

Mixed, but more probably silver eel. Same as in Table 4.1.

4.4 Marine fishery

NP, eel caught only as bycatch in coastal gears, less than 0,5 t/year. In 2013 44 fishermen's reported eel bycatch all together 0,28 t.

5 Fishing effort

Number of gear are limited annually every year by Cabinet Instruction. Table 4.1 number of gear allowed in LV_Latv approved for calendar year by instruction.

Landings are reported in monthly logbooks by the date, number and type of gear, catch/landing in kg. Logbooks are obligation. Zero catches are registered too. Fishing effort would be calculated as gear days.

Two types of trapnets are allowed in LV_Latv waterbodies:

- trapnets with side arm less than 30 m;
- trapnets with side arm more than 30 m.

Number of gear by waterbody is limited; total limit for EMU is 70 trapnets.

5.1 Glass eel

NP.

5.2 Yellow eel

NP.

5.3 Silver eel

Bycatch of other species are allowed in eel fisheries. Low catches of eel is not reason to decrease the number of gear or length of fishing season.

Table 5.3. Fishing effort and landings (kg) of eel LV_EMU (three lakes).

YEAR	EFFORT (TRAP DAYS)	LANDING OF EEL
2004	10 760	651
2005	13 820	619
2006	14 257	412
2007	14 625	412
2008	13 254	420
2009	11 052	400
2010	11 023	322
2011	9759	231
2012	10 845	287
2013	13 480	381

5.4 Marine fishery

Number of gear are limited. Effort calculation possible, but no reason to do that due to very low catch.

6 Catches and landings

Eel landings in Latvia (t)

	YEAR							
	2006	2007	2008	2009	2010	2011	2012	2013
Coastal	2	1,1	1	0,8	1,0	0,7	0,5	0,3
Lakes[1]	6	8,5	12,0	4,2	8.2	5.4	5,9	4,4
Kopā	8,0	9,6	13,0	5,0	9,0	6,1	6,4	4,7

[1]- eel landings in rivers and reservoirs are <50 kg, added to landings in lakes.

Mixed landings. In coastal waters more probably silver eel.

Table 6. Eel landings (kg) in LV_Latv (EMU waters).

	Freshwater	Freshwater	Saltwater
	Lakes	**Rivers**	**Coastal**
1949	2004		
1950	3083		10 000
1951	2655		10 000
1952	2729		10 000
1953	2137		20 000
1954	2644		20 000
1955	6149		40 000
1956	4448		20 000
1957	4510		20 000
1958	4999		20 000
1959	4410		24 000
1960	6245		37 000
1961	6603		43 000
1962	4257		41 000
1963	7952		56 000
1964	5927		37 000
1965	5252		35 000
1966	5380		33 000
1967	3727		39 000
1968	4182		28 000
1969	4813		36 000
1970	3072		21 000
1971	3175		17 000
1972	1700		15 000
1973	1185		19 000
1974	800		12 000
1975	1000		10 000
1976	794		12 000
1977	389		10 000
1978	505		6000
1979	381		6000
1980	838		1000
1981	759		2000
1982	1010		2000
1983	621		1000
1984	590		1000
1985	660		2000
1986	850		1000
1987	622		2000
1988	1180		1000
1989	650		1000
1990	374	86	1000

	Freshwater	Freshwater	Saltwater
	Lakes	Rivers	Coastal
1991	380	111	1000
1992	71		1000
1993	318	79	1000
1994	900	111	1000
1995	815	89	1000
1996	1406	42	2000
1997	894	92	1000
1998	253	23	2000
1999	460	78	2000
2000	599	43	2000
2001	765	76	2000
2002	807	52	2000
2003	811	206	2000
2004	599	34	2000
2005	619	37	2600
2006	472	74	2100
2007	430	24	1100
2008	420	4	1000
2009	400	9	900
2010	322	4	1000
2011	231	4	660
2012	287		498
2013	381		280

6.1 Glass eel

NP.

6.2 Yellow eel

NP.

6.3 Silver eel

More probable silver eel for last decade (Table 6).

6.4 Marine fishery

No reason reduce due to losses for other sectors of fishery.

6.5 Recreational Fishery

NC, planned from 2017.

Recreational Fisheries: Retained and Released Catches

	RETAINED				RELEASED			
	Inland		Marine		Inland		Marine	
Year	Angling	Passive Gears	Angling	Passive gears	Angling	Passive gears	Angling	Passive gears

Provide the catch and release mortality (%) used in your country for angling in marine and inland waters.

Recreational Fisheries: Catch and Release Mortality

	RELEASED			
	Inland		Marine	
	Angling	Passive gears	Angling	Passive gears
Year				

6.6 Bycatch, underreporting, illegal activities

All eel caught in coastal waters are bycatch, proportion of eel is less than 1% from total catch in herring poundnets, traps, bottom longlines and eelpout fyknets (all fixed gear). Dataseries from 1992 available.

Table 6.x. Estimation of underreported catches in Country, per EMU and Stage.

		Glass eel				Yellow eel				Silver Eel				Combined (Y + S)			
Year	EMU_code	Reported catches (kg)	Underrept. %	Underrept. (kg)	Total catches (kg)	Reported catches (kg)	Underrept. %	Underrept. (kg)	Total catches (kg)	Reported catches (kg)	Underrept. %	Underrept. (kg)	Total catches (kg)	Reported catches (kg)	Underrept. %	Underrept. (kg)	Total catches (kg)
2013	EMU_a																
	EMU_b																
	EMU_c																
	EMU_d																
	EMU_e																
	EMU_f																
	Total/mean (%)																

AIM: Determine the % of the underreporting and the total catches of the Country per stage.

NOTE: Please indicate in the text whether the percentage underreported catch is a direct measurement or a guess using the estimate to calculate the underreported kgs and Total catches.

Table 6.y. Existence of illegal activities, its causes and the seizures quantity they have caused.

		GLASS EEL			YELLOW EEL			SILVER EEL			COMBINED (Y +S)		
Year	EMU	Y/N/?	Cause	Seizures (kg)	Y/N/?	Seizures (kg)	Cause	Y/N/?	Seizures (kg)	Cause	Y/N/?	Seizures (kg)	Cause
2013	LV_Latv										Y		Fishing using illegal gears, Illegal selling of catches
	EMU_b												
	EMU_c												
	EMU_d												
	EMU_e												
	EMU_f												

AIM: Identify the illegal fishing activities and in case it is possible its causes and the seized kgs in case they were seizures.

NOTES:

- Y/N/?:

- Y: you know for sure they have been illegal activities;
- N: illegal activities are considered negligible / not significant;
- ?: You do not know whether they have been illegal activities or not.

- Cause: One of the followings:

- Fishing out of the season;
- Fishing without licence;
- Fishing using illegal gears;
- Retention of eel below or above any size limit;
- Illegal selling of catches.

7 Catch per unit of effort

BIOR using system of fishermen's and observers' reporting all the catch and bycatch including sea mammals, bird invasive species, strayers, etc. in coastal gear by type and date of fishing for all season. Data not used for eel assessment due to very low catches. Important for herring stock assessment and DCF.

7.1 Glass eel

NP.

7.2 Yellow eel

NC.

7.3 Silver eel

NC.

7.4 Marine fishery

Few years' data for one trap in the Gulf of Riga reported as number of eel by date of fishing. All caught eels sampled for DCF.

8 Other anthropogenic and environmental impacts

Some research results (but not about eel) are reported in book:

Climate change in Latvia and adaptation to it /eds. Maris Klavins and Agrita Briede. - Riga: University of Latvia press, 2012. -188 pp.

Increase of water temperature and eutrofication would be factors improving eel living conditions in Latvia.

9 Scientific surveys of the stock

No surveys.

10 Data collected for the DCF

From Latvia's DCF report:

The precision levels have been calculated for length and weight-at-age, sex ratio and sexual maturity of all collected fish species Latvia has planned the sampling at CV 0.025.

During 2013 for the estimation of precision, the methods included into the COST toolbox (for species that had data in COST format) as well as analytical and boot-strap methods adopted for the calculation of precision were used.

The main reasons why the precision levels of national data are deviating from target can be summarized as follows:

1) Differences in growth of males and females and also in sex distribution by ages;
2) For sex–ratio@ age variable there were not enough age readings by species. If target should be met it is necessary to increase age reading samples or the target should be changed;
3) Lower number of sampled fish in youngest and eldest age groups;

4) There were too many length classes and métier groups and low number of fishes in each group;

5) Evidently that the required precision levels are too high and to reach them the number of samples had to be substantially increased and accordingly the expenses of the sampling.

Table 10.1. Summary of the DCF monitoring implementation per EMU.

Data	River	Lakes	Estuaries	Lagoons	Coastal & Marine
No. of production / escapement surveys[1]					
No. of recruitment time-series surveys[2]					
No. fished aged[1]					
No. of fished sexed					
No. of fish examined for parasites					
No. of fish examined for contaminants					
No. of non-fishery mortality studies[3]					
Socio-economic survey					

[1] Surveys to estimate B_{best} and/or $B_{current}$ [These should include WFD surveys where the data are being used to estimate production and/or escapement of eel].

[2] Fishery-independent surveys.

[3] Studies to determine ∑H for non-fisheries anthropogenic impacts, such as hydropower, barriers, predation, etc.

11 Life history and other biological information

Research and popular publications on eel in Latvia:

Andrušaitis, G. 1960. Zivju savairošana un aklimatizācija Latvijā. –In: LPSR Iekšējo ūdeņu zivsaimniecība, IV, Rīga [The fish re-stocing and acclimatization in Latvia]

Cimermanis, S. 1998. In.: Zveja un zvejnieki Latvijā 19.gs.Latvijas Zinātņu Akadēmijas Vēstis, Rīga. [Fisheries and fishemrn's in Latvia]

Eglītis, P. 1937. Zušu audzēšana Latvijas ezeros. Zvejniecības Mēnešraksts, II, Nr.2, Rīga. [Eel re-stocking in the lakes of Latvia]

Kairov E.A., Rimsh E.Y. Biocommervial characteristic of the Gulf of Riga eel. (in Russian)- In: Rybokhozaistvenniye issledovanya (BaltNIIRKH), Riga, Zvaigzne, 1979, p83–90.

Ludvigs, P. 1940. Zvejniecība un zivkopība. In.: Latvijas zeme, zemnieki un viņu darbs, XIX - Lauksaimniecības pārvalde, Rīga [Latvia, Latvia's farmers and their labour]

Mansfelds, V. 1936. Latvijas zivis. In.: Latvijas zeme, daba un tauta, II., Rīga, 1936

[The fishes of Latvia]

Mansfelds, V. 1937. Zušu sarkansērga Liepājas ezerā. Zvejniecības Mēnešraksts, II, Nr.7, Rīga, 1937

Miezis, V. 1925–1939. In.: Latvijas jūras zvejniecība 1924–1938. – Rīga, Lauksaimniecības pārvalde, 1925–1939.

[Sea fisheries in Latvia]

Miezis, V. 1938. Zušu zveja. Zvejniecības Mēnešraksts, II, Nr.7, Rīga, 1938

[Eel fisheries]

Sapunovs, A. 1893. Reka Zapadnaja Dvina (in Russian). Tipografija G. A. Malkina, Vitebsk, 1893.

[The river Daugava]

Volkova L.V., Tarkach G.M. Growth of eel in lakes of Latvia. (in Russian) In: Rybokhozaistvenniye issledovanya (BaltNIIRKH), Riga, Zvaigzne, 1971, p.83–89.

11.1 Growth, silvering and mortality

NC, ND.

11.2 Parasites and pathogens

Sampled eel examined for Anguillicola presence.

11.3 Contaminants

NR.

11.4 Predators

NC.

One research project carried out in 2011. Available in Latvian. Reason for project- assessment of losses for inland fish resources due to cormorants.

12 Other sampling

13 Stock assessment

13.1 Method summary

NC.

13.1.1 Estimate of B_0

NC.

Table 13.1. Reference period for B_0.

EMU_CODE	B_0 (KG/HA)	REFERENCE TIME PERIOD	WHETHER OR NOT CHANGED FROM VALUE REPORTED LAST YEAR (Y/N)

13.2 Summary data

NC.

13.2.1 Stock indicators and targets

NC.

EMUcode	Indicator	biomass (t)	Mortality (rate)				Target		
	B0	Bbest	Bcurr	∑A	∑F	∑H	Source	Biomass (t)	∑A (rate)
XY_abcd							EMP		
							EU Reg		
							WGEEL		
XY_abcd							EMP		
							EU Reg		
							WGEEL		

13.2.2 Habitat coverage

EMU code	River		Lake		Estuary		Lagoon		Coastal	
	Area (ha)	A'd Y/N)	Area (ha)	A'd Y/N)	Area (ha)	A'd Y/N)	Area (ha)	A'd Y/N)	Area (ha)	A'd Y/N)
LV_Latv										

13.2.3 Impact

A = assessed, MI = not assessed, minor, MA = not assessed major, AB = impact absent

EMU code	Habitat	Fish com	Fish rec	Hydro & pumps	Barriers	Restocking	Predators	Indirect impacts
LV_Latv	Riv	AB	MI	AB	A	A	MI	
LV_Latv	Lak	MI	MI	AB	A	A	MI	
	Est							
	Lag							
LV_Latv	Coa	MI	MI	AB	AB	AB	MI	
	All							

EMU CODE	STAGE	FISH COM	FISH REC	HYDRO & PUMPS	BARRIERS	RESTOCKING	PREDATORS	INDIRECT IMPACTS
XY_abdc	Glass							
	Yellow							
	Silver							
	Silver EQ							

13.2.4 Precautionary diagram

NC.

13.2.5 Management measures

EMU CODE	ACTION TYPE	ACTION	LIFE STAGE	PLANNED	OUTCOME
LV_Latv	Com Fish				
	Rec Fish				
	Hydropower & Pumps				
	Restocking	Realised as planned			
	Other				

13.3 Summary data on glass eel

Data on number restocked glass eel in Chapter 3.5.

quantities	caught in the commercial fishery
	exported to Asia
	used in stocking
	used in aquaculture for consumption
	consumed direct
	mortalities

14 Sampling intensity and precision

Sampling of eel from commercial fishery carried by sampling of all caught eels from one trap in the Gulf of Riga, last 2 years number of sampled eel <100. Data are not analysed, otholits stored in collection.

Young yellow eel caught in rivers and lakes sampled in same way; length, weight, sex, eye diameter, pectoral fin length. Otoliths stored in collection.

15 Standardisation and harmonisation of methodology

15.1 Sampling commercial catches

Fishermen as observer. All landed eels sampled.

15.2 Sampling

All landed eels from one trap, all season. Fresh eel analysed.

15.3 Age analysis

Ages were not analysed.

15.4 Life stages

Criteria for life stages: *as in* EELREP Project (1 November 2001–31 January 2005) *Summary & Recommendations*. Estimation of the reproduction capacity of European eel.

15.5 Sex determinations

From macroscopic examination of the gonads.

15.6 Data quality issues

16 Overview, conclusions and recommendations

17 Literature references

Report on the eel stock and fishery in Lithuania 2013/2014

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Reporting Period: This report was completed in October 2014, and contains data up to 2013 and some provisional data for 2014.

2 Introduction

2.1 ICES ecoregion

Baltic Sea.

2.2 Eel habitats

Eel habitats in Lithuania include lakes, reservoirs, the Curonian Lagoon and the Baltic Sea coastal zone. According to Barak and Mason (1992), natural populations of eel in rivers are concentrated in estuaries or lower reaches. Eel are found more than 1000 km upstream. However, normally the migration rate of their populations is less than 20 km a year (Dekker, 2004). It is evident that this migration, when occurring during the stage of the yellow eel, depends on the population density. Eel migration route from the Curonian Lagoon to upstream of the Nemunas can reach more than 100 km, but the population density in the upstream is relatively small. According to the survey results, yellow eels occasionally caught in lower reaches of Nemunas by amateur fishermen. According Commercial fishing statistics eel catches in the Nemunas delta fluctuated between between 0.1 t and 0.3 t per year during the period 1950 to 1969. Eels fishing with typical fishing gears is complicated in the lower reachers of rive Nemunas, because streams and bottom structure. At present commercial eel fishing is banned in the river Nemunas .Yellow eels are extremely rare in small Lithuanian rivers; according to Virbickas (pers. comm.) in Lithuania and Birzaks in Latvia (pers. comm.), decades-long studies of electrofishing have shown just a few eels caught in rivers. Those few eel in rivers have been found in the streams in short distance from the lakes stocked with eel (Lithuania) or by river dams near the sea (Latvia). Thus, in the present state of stocks, small rivers in Lithuania are not considered typical eel habitats, but they are ways of silver eel migration. Most of the bigger lakes are located in the eastern part of Lithuania, 300 km from the sea. Only artificially stocked eels were found there.

2.3 River basins in Lithuania and EMU according to national EMP

Lithuania has 2782 lakes with areas exceeding 0.5 ha (88 548 ha) and 1159 reservoirs with areas over 0.5 ha (28 306 ha), also 4418 rivers longer than 3 km, their total length measuring 37 636 km and their surface area totalling 33 200 ha. Lakes and reservoirs over 50 ha number 285 (68 754 ha) and 70 (21 291 ha) respectively. Lithuanian territory covers 41 300 ha (26%) of the Curonian Lagoon (total area 158 400 ha). The Baltic Sea coastal zone is the area between the coastline and the 20 m depth isobath. This zone makes up an area of 41 500 ha. According to Directive 2000/60/EC, there are four RBDs in the territory of Lithuania (Figure 2.2.1):

6) Nemunas RBD (73.9% of the LT territory);
7) Daugava RBD (2.8% of the LT territory);
8) Lielupe RBD (13.7% of the LT territory);
9) Venta RBD (9.6% of the LT territory).

All four RBDs are transboundary basins. The largest one is the Nemunas RBD where 41.9% of the river basin area is in the territory of Lithuania, 39.6% in Belarus, 9.7% in Poland, 8.7% in Russia (the Kaliningrad region) and 0.1% in Latvia.

The Daugava, Lielupe and Venta RBDs are situated in the territories of Lithuania and Latvia. The Daugava RBD is also located in the territories of Russia and Belarus. Only 2.8% of the territory of this RBD is in Lithuania, where eel habitats (lakes) are not numerous. In addition, the habitats are not viable for the recovery of eel stocks as there are as many as three large HPs on the Daugava River in the territory of Latvia. With regard to this, Lithuania does not find it reasonable to recover stocks in this part of the Daugava RBD as long as the HPs should cause mortality for migrating the silver eel. Lithuania will apply common EMP measures by way of fishery restrictions in this part of the Daugava RBD, just as it does in the remaining territory of the country.

The Lielupe and Venta RBDs are situated in the territories of Lithuania and Latvia only. In Lithuania, these two basins cover 23.3% of the country's area, but habitats appropriate for eel (lakes and reservoirs) make up only 4.2% and 4.4%, respectively. It should be noted that over the past ten years the annual eel catch in inland waterbodies has only been 5.1 tonnes on average and has depended on stocking. The Lielupe and Venta RBDs practically have no eel as no stocking in the waterbodies of the Lielupe basin has occurred since 1983, while stocking in the Venta basin has amounted to 0.1% of the total quantity of stocked eel in the same period. In addition, the Venta basin has a number of hydropower plants built in series on rivers that have their source in the basin's largest lakes. Under these circumstances Lithuania does not see need to prepare the individual plans for the RBDs where eel are practically non-existent at present. However, common EMP measures will be applied to the territories of these RBDs by imposing fishery restrictions. With a view to recovering the eel population in these RBDs, Lithuania will apply measures similar to those in the whole territory of the country. However, it would implement those actions only upon coordinating them with Latvia to ensure migration of silver eel.

Lithuania has designated one Management Unit for the EMP based on Council Regulation (EC) 1100/2007 where Article 2(1) stipulates such a possibility and is developing one EMP for the whole territory of the country. The EMP Management Unit has been designated according to Lithuania's division into RBDs under Directive 2000/60/EC. The EMP also includes the Baltic Sea coastal zone. Assumptions for the designation of one EMU:

- The commercial catch and stocks of eel are not high in the territory of Lithuania and have averaged around 15 t annually over the past ten years;
- The Nemunas RBD comprises 74% of the territory of Lithuania and 81% of eel habitats;
- About 99% of eels stocked since 1983 are found in the Nemunas RBD;
- About 99% of the eel catch and stocks are attributed to the Nemunas RBD;
- The Nemunas RBD includes 96% of lakes of reservoirs from which eel can escape unaffected by turbines or through passes installed on HP dams;

- Although the Daugava RBD comprises a fairly large part of lakes and reservoirs (11.6%), escapement of eel to the sea is restricted by three large HPs in Latvia;
- Conditions in the other RBDs are similar (except for the different impacts of HPs), thus no specific measures for implementation of the plan in the other basins are needed.

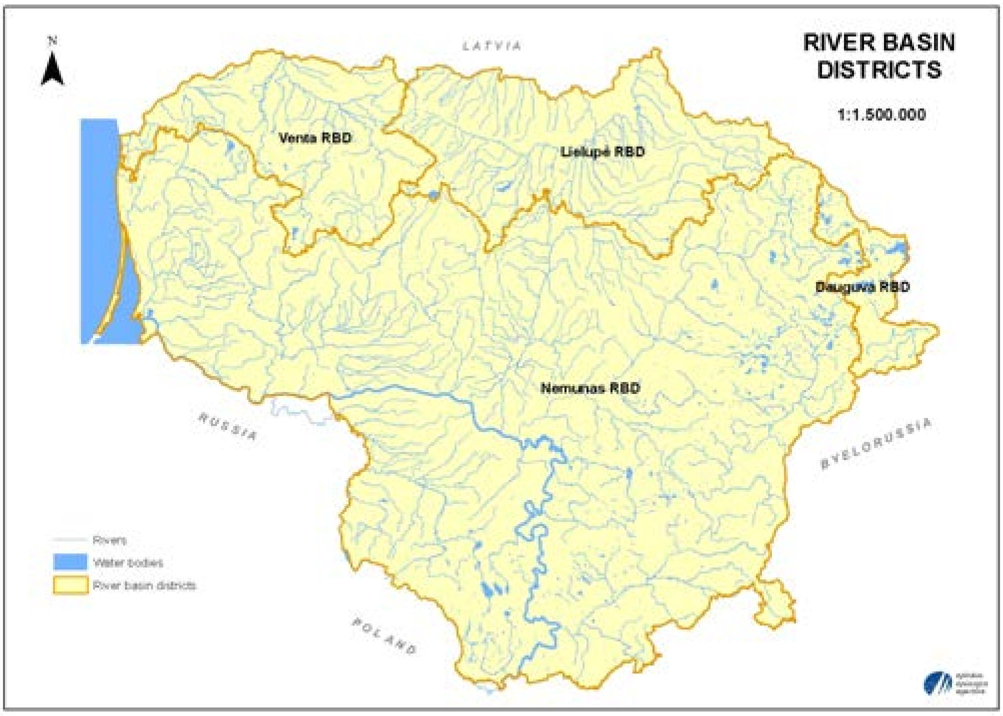


Figure 2.2.1. Lithuanian River Basin Districts.

2.4 Eel fishery

According to importance, fishery features, catches and the origin of eels, fisheries in Lithuania should be divided into fishery in inland waters and the Curonian Lagoon, and very small-scale fishery in the Baltic Sea. Commercial fishery statistics have been available since 1926. That year saw a 55.1 tonne catch of eel. Similar catches were recorded until 1938. Active fishing began again from the early 1950s (at least statistics became available), and the average catches of eel were 141 tonnes during 1953–1978. The largest catches amounting to 260 tonnes were recorded in 1963. Catches went into decline from the mid-1970s, and over the last ten years they have made up 13 tonnes on average. During 1926–1990, the major part of catches (more than 90%) came from the Curonian Lagoon.

During the period from 1947 to 1980, eels on average accounted for 48% of the total value of fish products in the Curonian Lagoon. The value of catches from these waterbodies in 2001–2010 amounted to about 200 000 EU. Eel consisted of 9% of the value of catches at the price of 20 EU/kg (the average price of other fish was 1.5 EU/kg). Therefore, despite relatively low catches, income from the eel fishery in the structure of fishermen's income was significant.

2.5 Fishery management and authorities responsible for EMP implementation

Pursuant to the Law on Fisheries of the Republic of Lithuania (27 June 2000, No VIII-1756), the regulatory authorities in the fisheries sector are:

The Ministry of Agriculture which participates in the making and implementation of the Lithuanian fisheries policy, conducts management of the fisheries sector, implements the Common Fisheries Policy of the European Union, organizes and implements conservation and control of fish stocks in maritime waters; establishes the procedure for commercial fishery and issues permits for fishing in maritime waters; owns, manages and uses a data system of fisheries in maritime waters (exploitation of fish stocks, users, economic and biological data, etc.).

The Ministry of Environment which participates in the making and implementation of the fish stock conservation and control policy, conducts public management of the fisheries sector in inland waterbodies; establishes the regulation for commercial and recreational fisheries in inland water bodies and issues permits (except for private fish waterbodies); owns, manages and uses a data system of fisheries in inland waterbodies (use of fish stocks, users, economic and biological data, etc.).

The Ministry of Agriculture and the Ministry of Environment which, within their respective competence, organise the recovery of fish stocks and fisheries research in fisheries waterbodies.

The Ministry of Environment is responsible for the exploitation of fish stocks in inland waterbodies, including the Curonian Lagoon. The Ministry of Agriculture is responsible for the implementation of the Common Fisheries Policy of the European Union. Since the Council Regulation contains the obligation to prepare and implement the EMP, therefore both ministries assume the responsibility for preparing and implementing the plan. In addition, conservation measures for protected fish species, including the eel, and their habitats and migratory routes are established and their implementation is controlled by the Ministry of Environment, while the work of improving the conditions for farming, spawning and migration of protected fish species is organised by the Ministry of Agriculture or a body authorised by it. The procedure for fisheries in public fisheries waterbodies and also of eel stocking, carried out according to the programmes approved by the Ministry of Agriculture and agreed with the Ministry of Environment, is also established by both ministries.

3 Time-series data

Only time-series of landings (yellow and silver eel mixed) in inland and coastal waters and data of restocking by waterbody available.

3.1 Recruitment

3.1.1 Glass eel

Glass eel do not occur in Lithuanian waters. The likelihood that eel used to come to the Lithuanian coast in the glass eel stage at the beginning of the 20th century cannot be ruled out. However, the last two reports on glass eel found in coastal streams come from the mid-1940s.

3.1.1.1 Commercial

Glass eel do not occur in Lithuanian waters.

3.1.1.2 Recreational

Glass eel do not occur in Lithuanian waters.

3.1.1.3 Fishery independent

Glass eel do not occur in Lithuanian waters.

3.1.2 Yellow eel recruitment

No available data.

3.1.2.1 Commercial

No available data.

3.1.2.2 Recreational

No available data.

3.1.2.3 Fishery independent

A study of eel otoliths' microchemistry intending to restore the migratory past and origin of eels have established that all eel examined in inland waterbodies are stocked, while in the Curonian Lagoon and the Baltic Sea coastal zone 80% and 98% of eel respectively come from natural migration and 20% and 2% are stocked. These studies indicate that eel arrive in Lithuania's fresh waterbodies in the stage of the yellow eel at the age ranging between one and ten years (average 5.2 (±2.1)) (Schiao *et al*., 2006; Lin *et al*., 2007). Additional the same type investigations are planned for 2014–2015 period.

3.2 Yellow eel landings

3.2.1 Commercial

Total landings of yellow and silver eels combined. Landings were separated using 2012–2013 DCF data.

Table 3.2.1.1. Yellow Eel landings (in tons) in the Lithuania waterbodies.

Years	***0	***1	***2	***3	***4	***5	***6	***7	***8	***9
1940–1949	n/d	n/d	n/d	n/d	n/d	n/d	n/d	2.5	4.5	6.7
1950–1959	9,0	10,2	12,5	25,6	47,3	52,9	42,5	54,6	48,3	50,2
1960–1969	53,5	45,1	50,1	84,4	73,1	40,2	76,8	48,9	52,7	42,6
1970–1979	36,6	38,7	39,5	37,1	26,6	35,5	27,4	20,8	21,0	16,5
1980–1989	13,5	7,9	7,7	6,5	6,6	7,9	8,8	5,3	6,4	5,4
1990–1999	4,7	3,9	3,1	2,7	3,2	2,5	2,5	2,8	4,5	5,2
2000–2009	3,2	3,5	3,8	3,6	4,4	5,8	4,5	3,9	3,5	2,3
2010–2019	4,3	2,6	1,7	3,3						

3.2.2 Recreational

No available data.

No statistics of the recreational fishery on eels are available. Studies of the impact of recreational fishery on eels have been performed in 2012. Data on eel landings to the inland waters from the recreational fishery was collected using the questionnaires strategy. Data on total catch volume was estimated using the questionnaires on the number of anglers participating at inland angling trips in different parts of Lithuania. Data on the total number of fishermen were taken from the Ministry of Environment. There are no records for eel catches in the marine waters of Lithuania. The total eel catch in the inland waters and Curonian Lagoon estimated was 1.4 tonnes 1200 individuals in 2012 and 3.0 tonnes in 2013.

3.3 Silver eel landings

3.3.1 Commercial

No available data. Total landings of yellow and silver eels combined. Landings were separated using 2012–2013 DCF data.

Table 3.3.1.1. Silver Eel landings (in tons) in the Lithuania waterbodies.

Years	***0	***1	***2	***3	***4	***5	***6	***7	***8	***9
1940–1949	n/d	n/d	n/d	n/d	n/d	n/d	n/d	5.1	9.4	13.9
1950–1959	19,9	22,1	26,8	53,9	99,2	110,4	88,8	113,6	100,3	104,8
1960–1969	111,4	94,0	104,9	175,5	152,2	84,4	161,3	103,9	112,0	91,0
1970–1979	80,9	85,4	86,4	82,5	59,6	78,4	61,0	47,5	49,1	40,2
1980–1989	31,6	19,1	20,6	16,9	19,9	20,7	23,2	14,8	16,8	15,4
1990–1999	13,8	11,9	8,5	7,5	9,2	7,0	6,1	7,9	12,7	12,8
2000–2009	7,9	8,3	8,8	8,7	11,9	15,9	11,4	11,0	10,0	6,3
2010–2019	14,5	8,5	6,1	12,5						

3.3.2 Recreational

No available data.

3.4 Aquaculture production

3.4.1 Seed supply

No available data.

3.4.2 Production

In Lithuania, eel have been reared by one company since 1998, which in recent years has produced about 10 tonnes of eel annually (Table 3.4.2.1). The aquaculture company, Auksinis ungurys Ltd, is about to complete building a new aquaculture facility and expects to produce 100 tonnes of eel per year. After it is completed the company will need 280 kg of glass eels annually. According companies provided information, they exported eels for stocking to Belarus in 2004–2008 (Table 3.4.2.2).

Table 3.4.2.1. Marketable and Values yellow and silwer eel production in aquaculture during 1998–2013.

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Production, t	2	2	1	5	17	20	9	8	12	13
Values, million*EUR	0.1	0.1	0.05	0.25	0.85	1.0	0.45	0.4	0.6	0.65
	2008	2009	2010	2011	2012	2013				
Production, t	10.6	12.0	8,3	12,6	3,5	3.0				
Values, million*EUR	0.53	0.6	0.415	0.63	0.175	0.15				

Table 3.4.2.2. Auksinis ungurys Ltd information on exports to Belarus.

Year	Quantity, units	Size
2004	375 000	1–4 g
2005	1 050 000	glass eels
2006	150 000	1–5 g
2007	350 000	1 g
2008	260 000	1–5 g
Total	2 185 000	

3.5 Stocking

3.5.1 Amount stocked

Stocking of lakes with glass eel in the territory of Lithuania was carried out in 1928-1939 in the Vilnius area (a part of the area and the stocked lakes now belong to Belarus). Back then, about 3.2 million glass eel were stocked. In the post-war period, stocking of Lithuanian inland waterbodies with glass eel originating from France or Great Britain began in 1956 (or 1952, according to other data). During 1956–2007, a total of 148 lakes and reservoirs covering an area of 95 618 ha was stocked. About 50 million glass and juvenile eels were stocked in total, or 1.25 million per year on average (Figure 3.5.1.1). Some 89% of them were stocked in the Nemunas RBD, mostly in the basins of the rivers Žeimena and Šventoji. Stocking during the most intensive period of 1960–1986 amounted to 33.2 million eel. The area of waterbodies where stocking was carried out comprised 40 204 ha, and the average stocking density made up almost 826 individuals/ha throughout the whole period. Later on, the quantities declined and stocking was sporadic, but small quantities were stocked on an annual basis. The last more sizeable stocking took place in 2004 with 70 100 juvenile eel stocked. From 1983 (a period when at least some eel could have remained in the country's waterbodies) about ten million eel were stocked, their major part (96.5%) being in the Nemunas basin (99% of the Nemunas RBD). Lakes of the Žeimena (60%) and the Šventoji (19%) sub-basins saw the most intensive stocking. Stocking in the Curonian Lagoon (143 000) in that period was low (Figure 3.5.1.2). Stocking activities started again in 2010 (Table 3.5.1.3.). 28 895 individuals were released in 2010, 152 000 individuals in 2011, 490 660 individuals in 2012, more than 1 300 000 individuals in 2013, more than 399 400 individuals in 2014 in inland waters. About 10% of released individuals were marked by colorant Alizarin Main stocking activity was performed by Fishery service under the Ministry of Agriculture of the Republic of Lithuania. Stocking by fisheries companies and individual fishermen was less important.

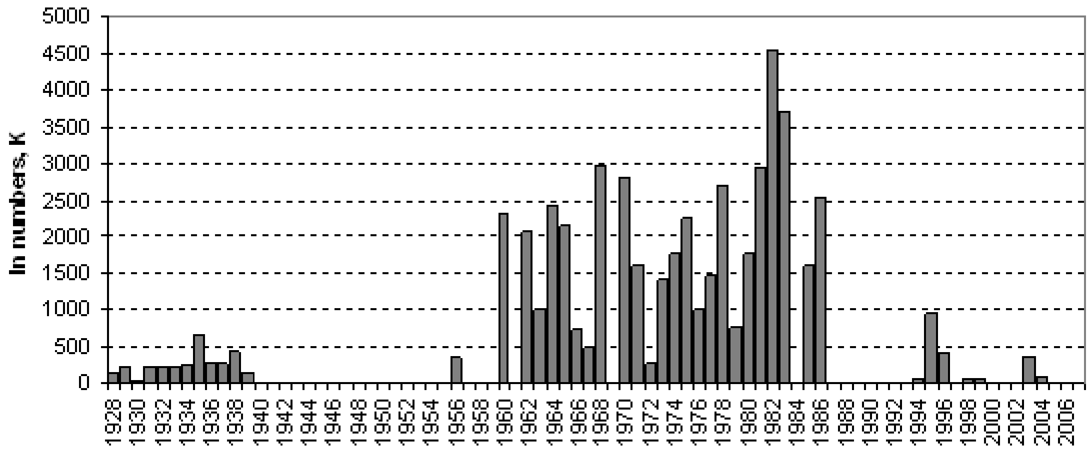


Figure 3.5.1.1. Stocking of inland waterbodies with glass eels in the period 1928 to 2006 (thousand units).

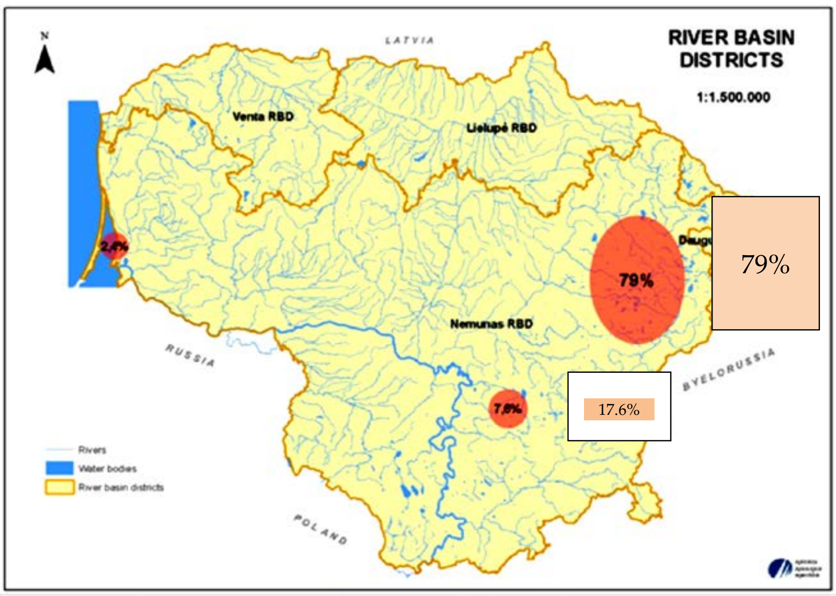


Figure 3.5.1.2. Major eel stocking regions since 1983.

Table 3.5.1.3. Stocking of inland waterbodies with eels in Lithuania in the period 2007–2013

	Year	Number	Type of eel stocking material [g/indiv.]	Total weight of eel stocking material, kg
Fisheries companies and individual fishermen	2007	4500	2,1	9,25
	2008	5000	1,5–2,6	10,58
	2009	11 200	1,2–10,0	43,24
	2010	28 895	6,9–16	187,62
	2011	18 000	15	270
	2012	150 000	10	1500
	2013	100 000	5	500
	2014	?		
Fishery Service	2011	134 000	2,5	335
	2012	444 000	2,5	1108
	2013	1 300 000	0.3–1.0	462
	2014	399 400	1.0	399.4

3.5.2 Catch of eel <12 cm and proportion retained for restocking

There is no fishery of eel <12 cm.

3.5.3 Reconstructed time-series on stocking

Table 3.5.2.4. LT. Stocking of eels in Lithuania (in millions) stocked.

Local Source						Foreign Source		
Year	Glass Eel	Quarantined Glass Eel	Wild Bootlace	On-grown cultured	Glass Eel	Quarantined Glass Eel	Wild Bootlace	Ongrown cultured
1950					-			
1951					-			
1952					-			
1953					-			
1954					-			
1955					-			
1956					0.344			
1957					-			
1958					-			
1959					-			
1960					2.300			
1961					-			
1962					2.100			
1963					1.000			
1964					2.400			
1965					2.200			
1966					0.750			
1967					0.500			
1968					3.000			
1969					-			
1970					2.800			

Local Source						Foreign Source		
Year	**Glass Eel**	**Quarantined Glass Eel**	**Wild Bootlace**	**On-grown cultured**	**Glass Eel**	**Quarantined Glass Eel**	**Wild Bootlace**	**Ongrown cultured**
1971					1.600			
1972					0.237			
1973					1.400			
1974					1.750			
1975					2.240			
1976					1.000			
1977					1.450			
1978					2.700			
1979					0.750			
1980					1.750			
1981					2.950			
1982					4.550			
1983					3.700			
1984					-			
1985					1.600			
1986					2.550			
1987					-			
1988					-			
1989					-			
1990					-			
1991					-			
1992					-			
1993								0.013
1994					0.065			

Local Source					Foreign Source			
Year	Glass Eel	Quarantined Glass Eel	Wild Bootlace	On-grown cultured	Glass Eel	Quarantined Glass Eel	Wild Bootlace	Ongrown cultured
1995					0.529			
1996					0.394			
1997								0.004
1998					0.064			
1999								0.050
2000								0.004
2001								0.009
2002								
2003					0.353			
2004								0.071
2005								0.002
2006								
2007								0.005
2008								0.005
2009								0.011
2010								0.029
2011								0.152(2.5 g)
2012								0.491(2.5g)
0.15(10g)								
2013					1.197			0.103(1 g)
0.1(5 g)								
2014								0.3994(1 g)

4 Fishing capacity

4.1 Glass eel

There is no glass eel fishery.

4.2 Yellow eel

Fishery in Inlands waters. In 2013 eel fishing quota was distributed for 34 fishing companies and individual fishermen, which have small enterprises with one or three employees. Fishing sites are established and fishing permits are issued by the Ministry of Environment, while the Ministry of Agriculture allocates fishing quotas for fisheries companies and individual fishermen. In 2005–2008, the number of fishing sites in rivers was reduced from 77 to 44 but in 2012 it increased to 51 (Figure 5.2.1). Fishing with one trap is allowed in each fishing site. On average, one company was fishing in 4.3 sites in 2004 and in 1.8 sites in 2007, while 1.5 in 2013.

Fishery in the Curonian Lagoon. Fykenets are distributed by 48 local fishing companies, which mostly are small enterprises only with two or three employees (Figure 5.2.2). Not all companies are targeting eels. Most companies own one–three small vessels or boats (up to 10 m long). There are only a few vessels with the length exceeding 10 m. A total of 148 boats and vessels are registered for fishing in the Curonian Lagoon. Pursuant to the rules of implementation of the activity 'Modification for reassignment of inland fishing vessels' of priority axis 2 'Aquaculture, inland fishing, processing and marketing of fishery and aquaculture products' under the Operational Program for the Lithuanian Fisheries Sector for the period 2007–2013, approved by Order No 3D-549 of the Minister for Agriculture of 9 October 2008, 3 million EUR was allocated to modification for reassignment of inland fishing vessels to other activities. Up to now, 20 fishing companies that were fishing in the Curonian Lagoon changed commercial fishing activity to other. In 2009 fishing fleet was reduced by 73 vessels.

4.3 Silver eel

See above.

4.4 Marine fishery

During the Soviet occupation, commercial fishery in the coastal zone was banned until 1991. Since 1991, about 100 mainly small companies with two to three employees and one or two small vessels (up to 10 m) have fished in the coastal zone. Mostly employees are engaged in fishing only part-time. Recently, the number of fisheries companies has dropped and stood at 54 in 2014.

5 Fishing effort

Fisheries companies provide information according to their logbooks (each fishing trip, including gears used and catch must be obligatory recorded) about fishing effort and catches on a monthly basis to the authority issuing permits:

- to a Regional environmental protection department under the Ministry of Environment of the Republic of Lithuania if a company is engaged in inland fisheries (including the Curonian Lagoon);
- to the Fisheries Service of the Ministry of Agriculture of the Republic of Lithuania if an company is engaged in maritime fisheries.

5.1 Glass eel

There is no glass eel fishery.

5.2 Yellow eel

There is no statistical information about catch divided by life stage.

In Lithuania's inland waters (rivers) in 2013 eel fishing quota was established for 51 rivers (51 eel traps) (Figure 5.2.1). At present (2010–2014) eel fishing season is spring time (about 45 days). Before 2010 eel fishing season was continued from spring to autumn.

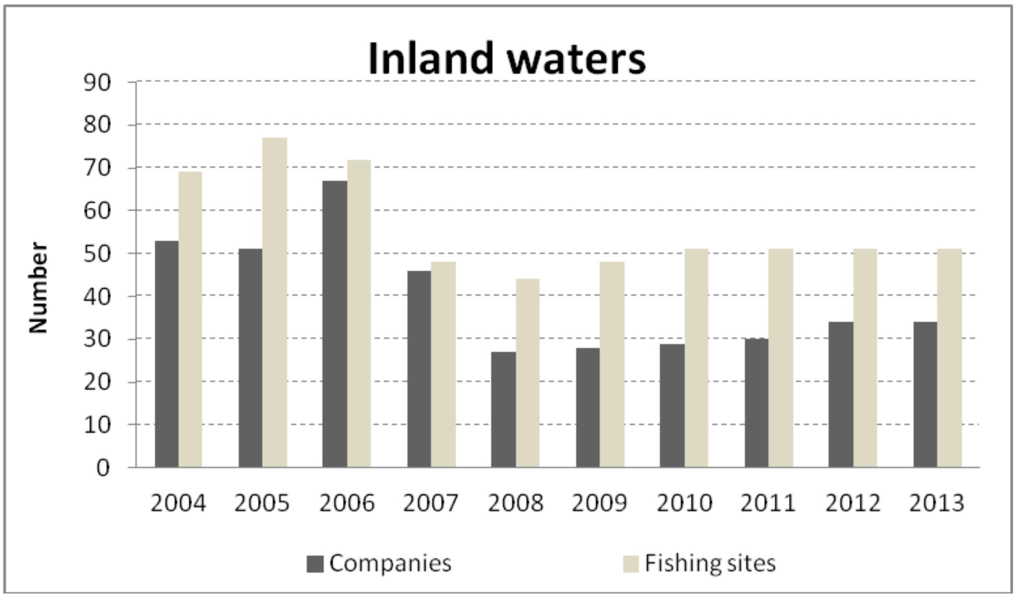


Figure 5.2.1. Number of companies engaged in the eel fishery with river traps and trap quotas in 2004–2013.

In Curonian lagoon eel fishing season continues from spring to autumn (about 180 days). In Curonian lagoon established quota for fishermen in 1991–1997 was 600 units of fykenets, in 2004 350 units, from 2010 fykenets quota reduced to 223 units (Figure 5.2.2).

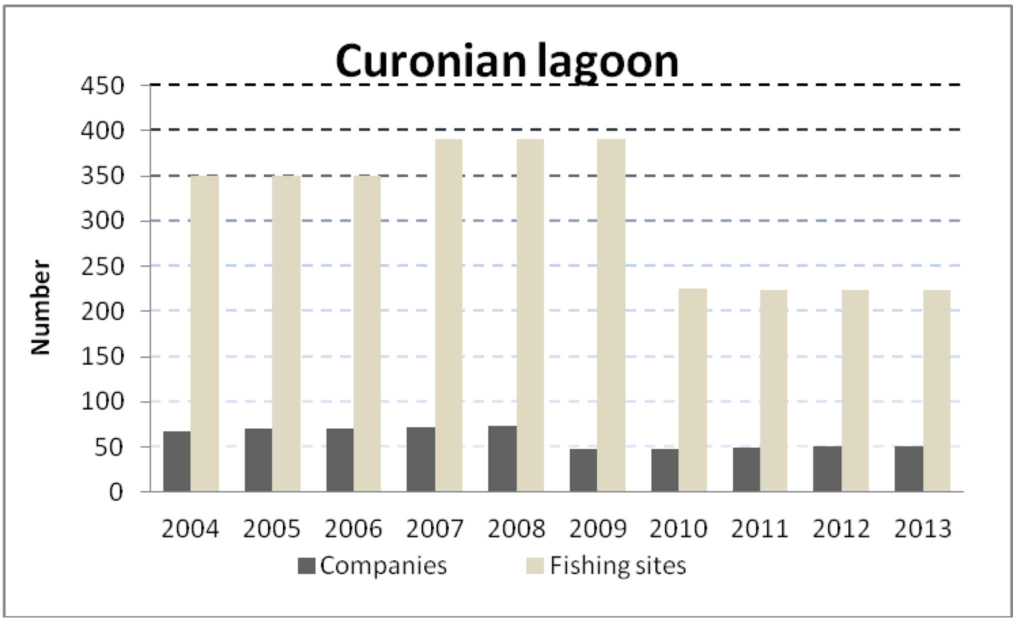


Figure 5.2.2. Number of fishing sites and companies engaged in the eel fishery with fykenets in 2004–2013.

5.3 Silver eel

There is no statistical information about catch divided by life stage.

5.4 Marine fishery

No data.

6 Catches and landings

6.1 Glass eel

There is no glass eel fishery in Lithuania.

6.2 Yellow and silver eel

Lithuania's inland waters (without Curonian Lagoon). According statistical data on eel catches during the period of 2008–2013, 82% of eel is caught in rivers using traps, 18% in lakes using small fyknets and traps, while a small amount is caught using longlines (Table 6.2.1). Eel traps in the river outlets at lakes consist from two wings with a cage or trap placed between them. Dynamics of eel catches in inland waters provided in Figure 6.2.2.

Table 6.2.1. Eel catches (in tons and %) in the Inland Lithuania waterbodies.

Years	Lakes		Rivers		Total
	tonnes	%	tonnes	%	tonnes
2008	1.207	18,9	5.167	81,1	6.374
2009	1.249	33,7	2.456	66,3	3.705
2010	0.758	5,8	13.081	94,5	13.839
2011	2.223	28,1	5.685	71,9	7.908
2012	1.423	22,9	4.801	77,1	6.224
2013	2.273	18.1	10.282	81.9	12.555

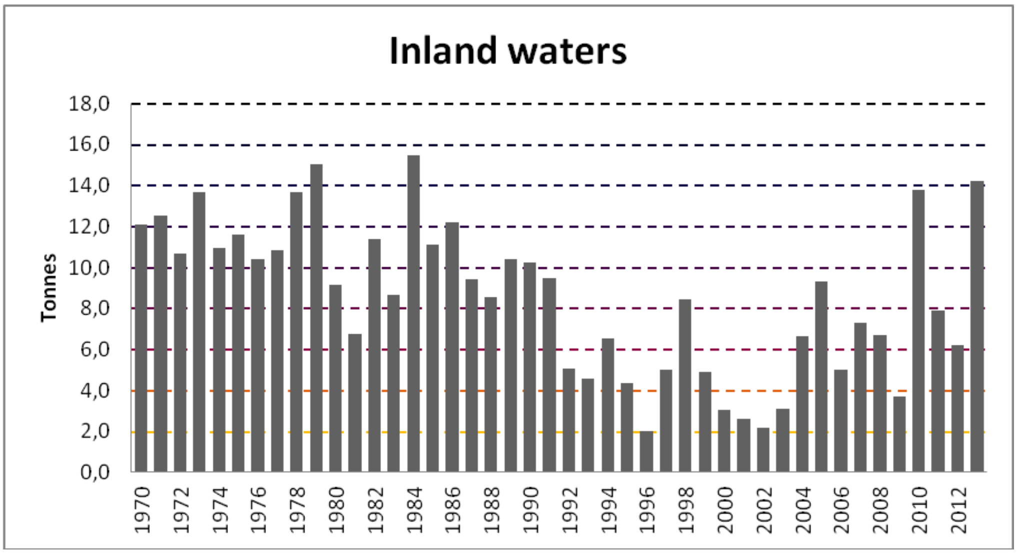


Figure 6.2.2. Eel landings of Lithuanian fishermen in the Inland waters during the period of 1970–2013.

Curonian lagoon. According statistical data on eel catches during the period of 1947–2013, since 1963 eel catches continuously were decreasing (Figure 6.2.3.). Comparing the relative catches with Kaliningrad oblast. Lithuanian catches increasing (Figure 6.2.4.). At present 99% of eel is caught in Curonian Lagoon is caught using fykenets, while a very small amount is caught using longlines. Fykenets in lagoon are stationary, big-size fykenet with a 100–120 m long fence and three cages fastened at both ends.

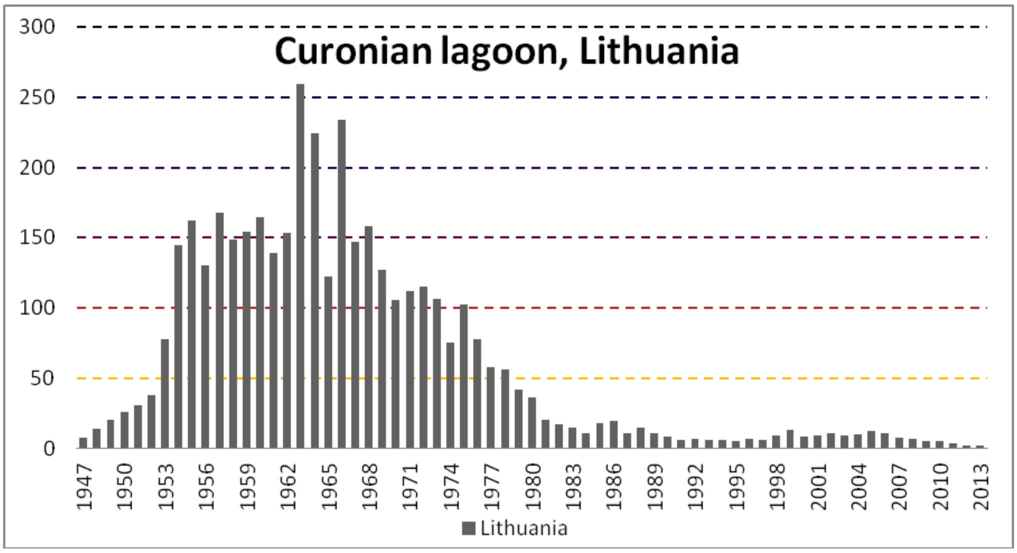


Figure 6.2.3. Eel landings Lithuanian fishermen in the Curonian lagoon during the period of 1947–2013.

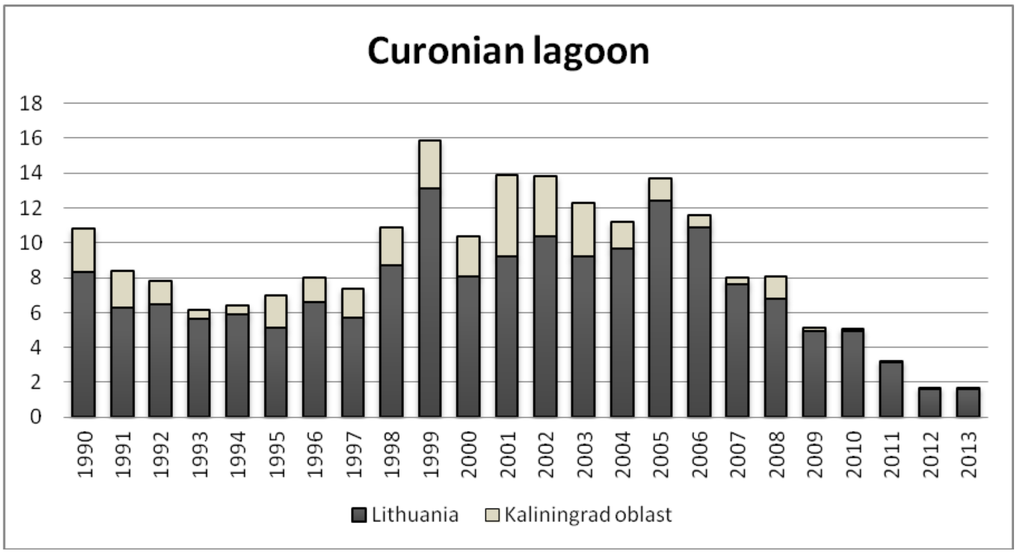


Figure 6.2.4. Eel landings (in tonnes) in the Kaliningrad oblast (Russia) and Lithuanian fishermen in the Curonian lagoon during the period of 1947–2013.

Fisheries companies provide information according to their logbooks (each fishing trip, including gears used and catch must be obligatory recorded) about fishing effort and catches on a monthly basis to the authority issuing permits:

- to a Regional environmental protection department under the Ministry of Environment of the Republic of Lithuania if a company is engaged in inland fisheries (including the Curonian Lagoon);
- to the Fisheries Service of the Ministry of Agriculture of the Republic of Lithuania if an company is engaged in maritime fisheries.

6.3 Silver eel

Statistical data do not provide information on the eel stage. Yellow eel fishery is mixed with silver eel (Table 6.3.1).

Table 6.3.1. Total landings of eel in Inland waters and Curonian lagoon (1995–2013).

	Lakes and rivers (small fykenets and trapnets)	Curonian Lagoon (fykenets)	Baltic Sea (longlines)
	Inland	Inland	Coastal
	Yellow/silver	Yellow/silver	Yellow
1995	4.3	5.1	0.1
1996	2.0	6.6	0.1
1997	5.0	5.7	0.0
1998	8.4	8.7	0.1
1999	4.7	13.2	0.3
2000	2.9	8.1	0.2
2001	2.3	9.2	0.3
2002	2.4	10.4	0.2
2003	2.1	9.7	0.6
2004	6.3	9.7	0.3
2005	9.9	12.4	0.1
2006	4.9	10.9	0.1
2007	7.3	7.6	0.0
2008	6.7	6.8	0.0
2009	3.7	4.9	0.0
2010	13.8	5.0	0.0
2011	7.9	3.4	0.0
2012	6.2	1.7	0.0
2013	12.6	1.6	0.0

6.4 Marine fishery

The eel fishery in the Baltic Sea coastal zone has never been significant. Pre-war commercial fishery statistics mentioned eels in 1931 (0.6 tonnes), with catches in 1937 and 1938 making up 0.5 tonnes and 0.2 tonnes respectively. In subsequent years, there must have been no eel catches at all, as commercial fishery statistics were sufficiently accurate and well managed in Lithuania at that time. Eel are fished with longlines in the stage of the yellow eel. Eel recorded in commercial fishery in the period 1995 to 2011 inclusive made up only about 0.14 tonnes on average. Companies are not specialised on eel fishery in recent years because specialised eel fishery is prohibited in coastal waters. By reason of eel fishing ban in coastal zone in 2011 according to commercial fishery statistics, eel catches are negligible. Low catch rates are probably a result of low stocks and low fishing efforts. Almost all eels studied in the coastal zone were of natural origin.

6.5 Recreational fishery

Recreational Fisheries: Retained and Released Catches

	Retained				Released				
	Inland		Marine		Inland			Marine	
Year	Angling	Passive Gears	Angling	Passive gears	Angling	Passive gears		Angling	Passive gears
2008	3,3	NA	NA	NA	NA	NA	NA	NA	NA
2009	2,2	NA	NA	NA	NA	NA	NA	NA	NA
2010	4,3	NA	NA	NA	NA	NA	NA	NA	NA
2011	3.0	NA	NA	NA	NA	NA	NA	NA	NA
2012	1.4	NA	NA	NA	NA	NA	NA	NA	NA
2013	3.0	NA	NA	NA	NA	NA	NA	NA	NA

Provide the catch and release mortality (%) used in your country for angling in marine and inland waters.

Recreational Fisheries: Catch and Release Mortality

	Released				
	Inland			Marine	
	Angling	Passive gears		Angling	Passive gears
Year	NA	NA	NA	NA	NA
2008	NA	NA	NA	NA	NA
2009	NA	NA	NA	NA	NA
2010	NA	NA	NA	NA	NA
2011	NA	NA	NA	NA	NA
2012	NA	NA	NA	NA	NA
2013	NA	NA	NA	NA	NA

6.6 Bycatch, underreporting, illegal activities

Bycatch is allowed in marine waters coastal fishery but it is negligible, because it is mainly gillnet fishery.

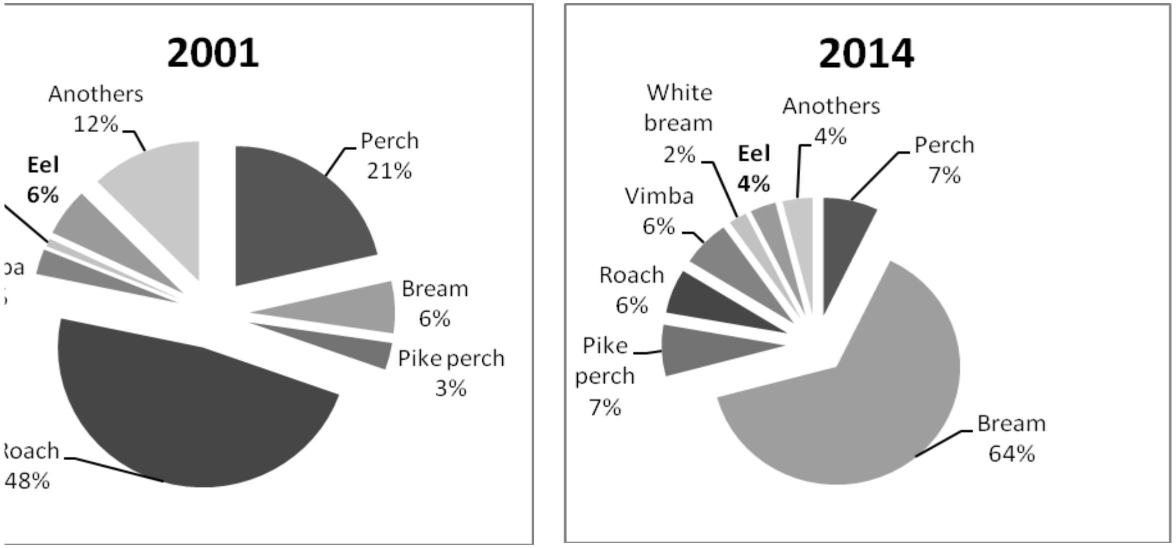


Figure 6.6.1. The fykenets composition of fish catches (by weight) in Curonian lagoon in 2001 and 2014.

Table 6.6.2. Estimation of underreported catches in Country, per EMU and Stage.

		Glass eel				Yellow eel				Silver Eel				Combined (Y + S)			
Year	EMU_code	Reported catches (kg)	Underrept. %	Underrept. (kg)	Total catches (kg)	Reported catches (kg)	Underrept. %	Underrept. (kg)	Total catches (kg)	Reported catches (kg)	Underrept. %	Underrept. (kg)	Total catches (kg)	Reported catches (kg)	Underrept. %	Underrept. (kg)	Total catches (kg)
2013	Curonian Lagoon	0				n/d				n/d				1.6	n/d		
	Inland waters	0				n/d				n/d				12.6	n/d		
	Total/mean (%)													14.2	n/d		

Table 6.6.3. Existence of illegal activities, its causes and the seizures quantity they have caused.

		Glass eel			Yellow eel			Silver Eel			Combined (Y +S)		
Year	EMU	Y/N/?	Cause	Seizures (kg)	Y/N/?	Seizures (kg)	Cause	Y/N/?	Seizures (kg)	Cause	Y/N/?	Seizures (kg)	Cause
2013	Curonian Lagoon	N		N	Y	n/d			n/d		Y	n/d	• Illegal selling of catches.
	Inland waters				Y	n/d			n/d		Y	n/d	• Fishing out of the season; • Fishing without licence; • Fishing using illegal gears; • Retention of eel below or above any size limit; • Illegal selling of catches.

7 Catch per unit of effort

7.1 Glass eel

There is no fishery for glass eel.

7.2 Yellow eel

Statistical data do not provide information on the eel stage.

Lithuania's inland waters. Information on Catch per fishing site (eel trap) according commercial data and DCF data provided in Table 7.2.1.

Table.7.2.1. Catch per fishing site in Inland waters during the period of 2009–2012.

Years	Catches in the rivers, tonnes	Number of FISHING SITES	Catch per fishing site, kg	Catch per fishing site ACCORDING DCF datA, kg
2009	2.5	48	51,2	NA
2010	13.1	51	256,5	NA
2011	5.7	51	111,5	NA
2012	4.8	51	94,1	79,7
2013	12.6	51	201.6	242.5

Curonian lagoon. Information on Catch per fykenets according commercial data and DCF data provided in s date (Table 7.2.2).

Table.7.2.2. Catch per fykenet in Curonian lagoon during the period of 2009–2013.

Years	Catches, tonnes	Number of fykenets	Catch per fykenet, kg	Catch per fykenet by DCF date, kg
2009	4,9	223	22	NA
2010	5,0	223	22,4	NA
2011	3,4	223	15,2	NA
2012	1,7	223	7,6	19,6
2013	1.6	223	7.2	24.7

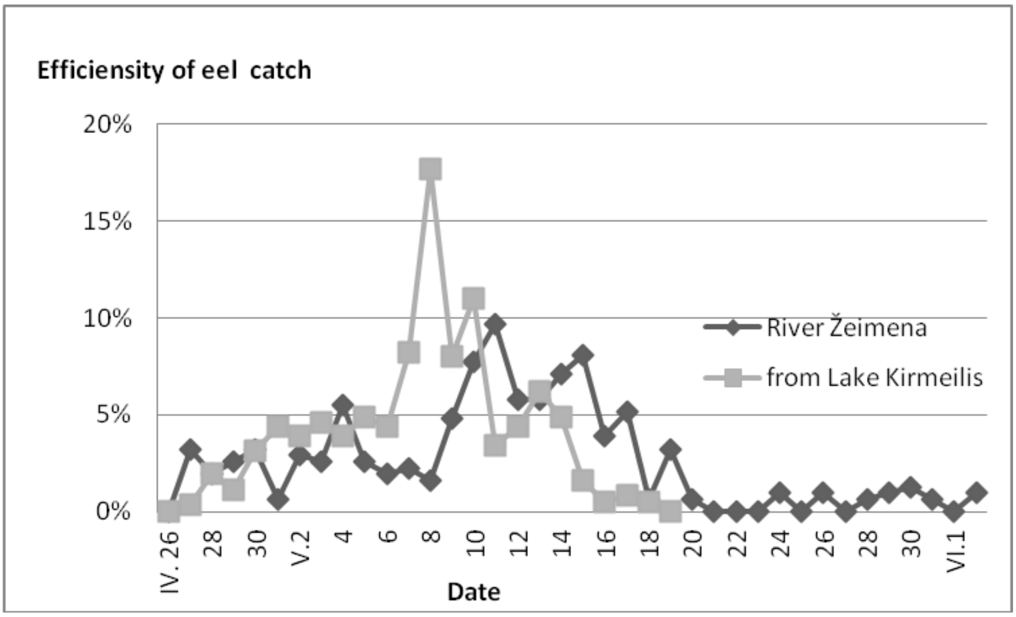


Figure 7.2.3. Eel migrations (efficiency of eel catch (%)) in two sites per fishing season (April–May) in Inland waters in 2013.

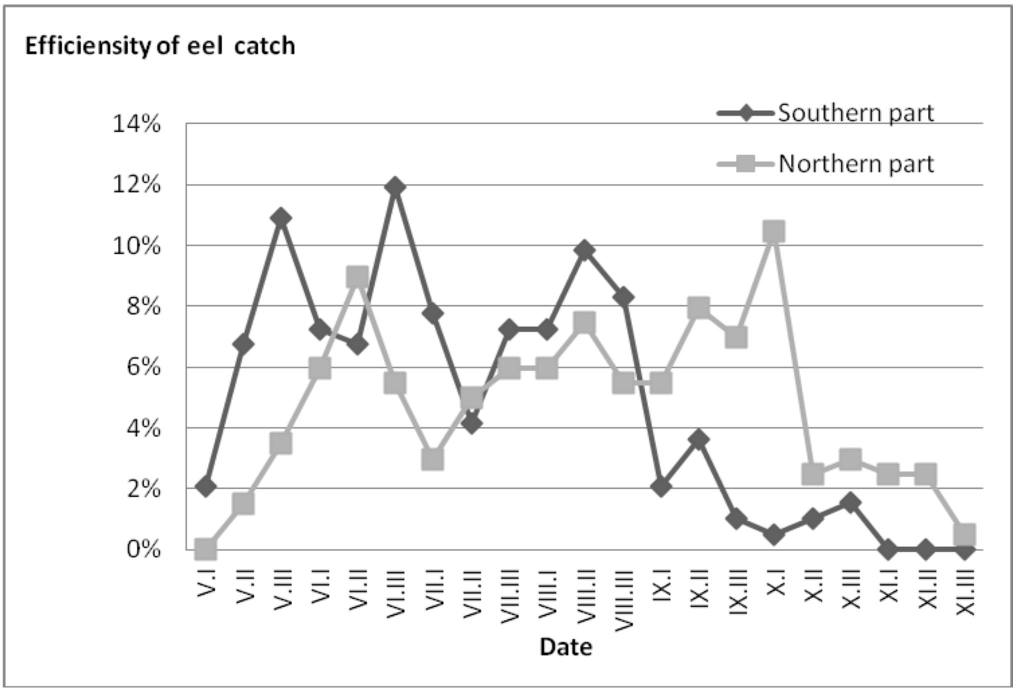


Figure 7.2.4. Eel migrations (efficiency of eel catch (%)) per fishing season (May–November) in Curonian lagoon in 2013.

7.3 Silver eel

See above.

7.4 Marine fishery

No available data.

8 Other anthropogenic impacts

According to a rough GIS analysis, 32% of eel stocked to inland lakes during the last 20 years are in the basins blocked by hydropower stations. Detailed analyses as well as surveys of mortality in turbines are started in 2013.

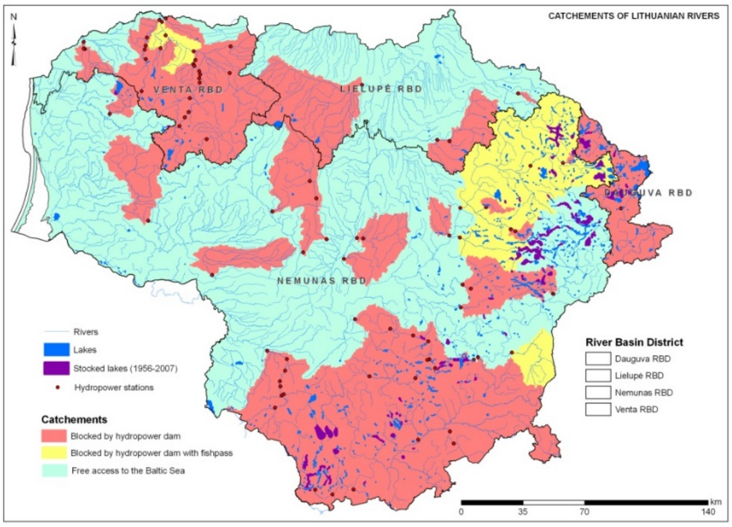


Figure. 8.1. Catchments of Lithuanian rivers and hydropower stations.

9 Scientific surveys of the stock

Preliminary data provided using Nature Research Centre study "Assessment of impact of hydropower turbines on European eels using tagged eels and overview of hydropower plants turbines in Lithuania (2014)". **Intermediate report.** Contract No. F11-223. December 30, 2013. Contractor Fisheries service under the Ministry of Agriculture of the Republic of Lithuania.

Research surveys on the stock and e.g. HP impact planned under national EMP are started in 2013. **Preliminary results** showed that 69 percent of tagged eel individuals passed the biggest Lithuanian Kaunas hydropower station. Final results are expected at the end of 2014.

10 Data collected for the DCF

Data were obtained during eel fishing season. In Curonian lagoon eel was regularly sampled in harbours from May to October. In Inland waters eel was sampled from three rivers sites in April–May. 200 fish are analyzed for age and 1500 for length and weight values 2013. Sampling started in 2011.

Table 10.1. Summary of the DCF monitoring implementation in Lithuania in 2013.

Data	River	Lakes	Estuaries	Lagoons	Coastal & Marine
No. of production/ escapement surveys	1023			503	
No. of recruitment time-series surveys					
No. fished aged	100			100	
No. of fished sexed	100			100	
No. of fish examined for parasites					
No. of fish examined for contaminants					
No. of non-fishery mortality studies					
Socio-economic survey					

11 Life history and other biological information

11.1 Growth, silvering and mortality (DCF)

Length, weight, and growth are collected as part of DCF.

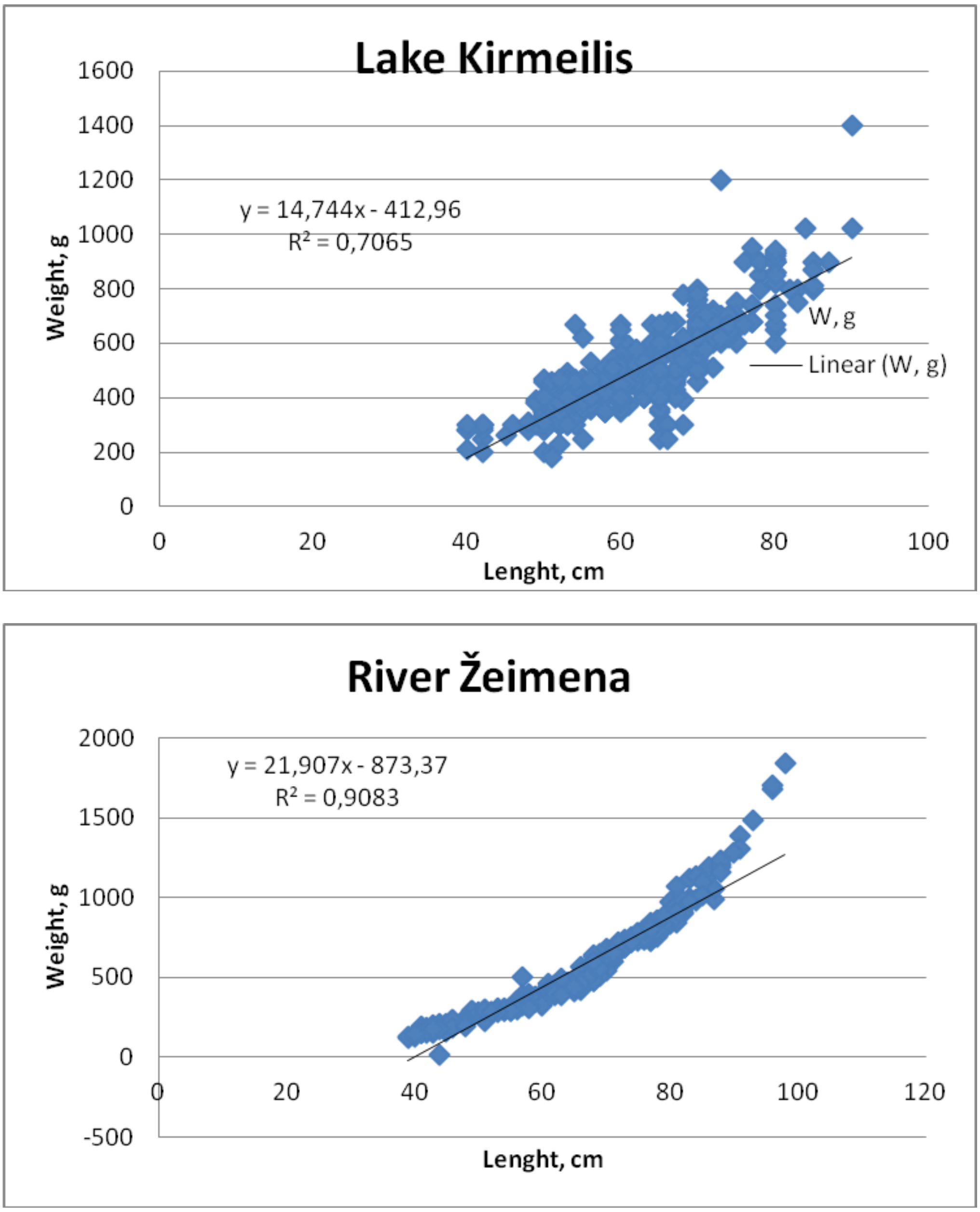
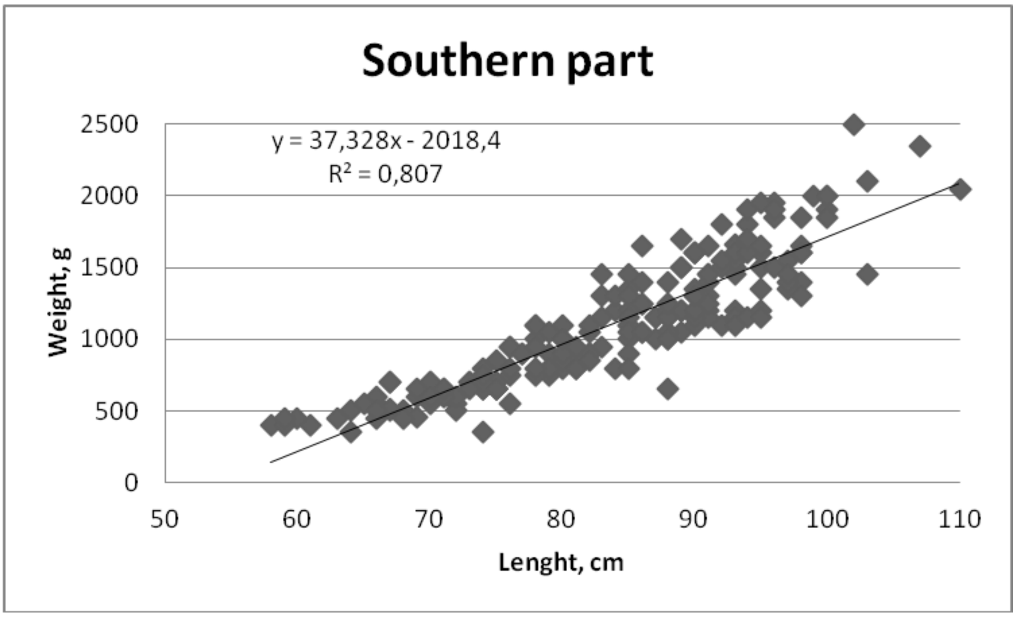


Figure 11.1.1. Length–weight relationship of eel samples from Inland waters (n=921) in 2013.



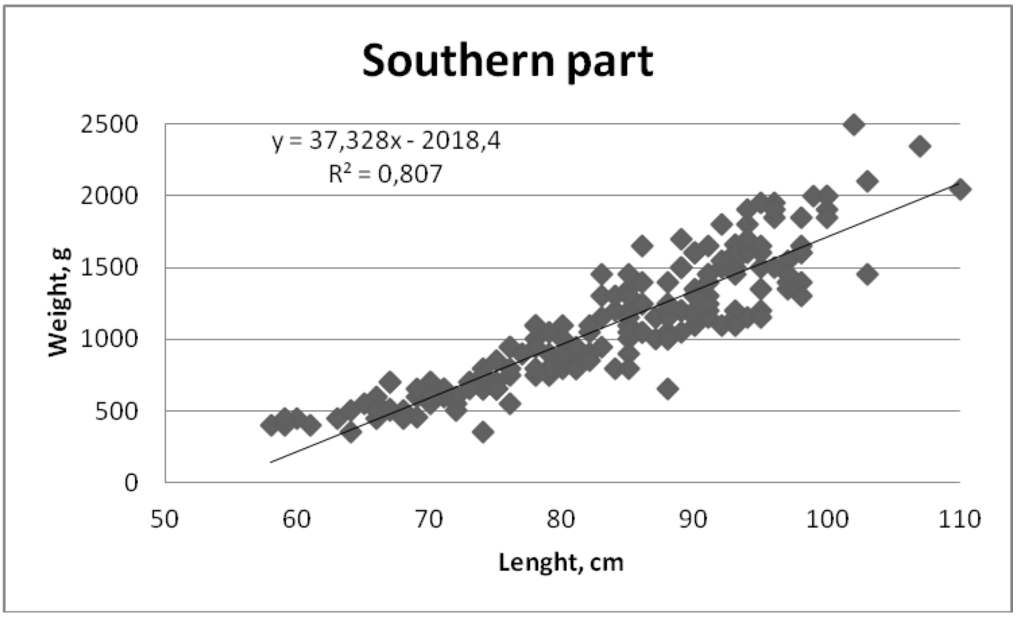


Figure 11.1.2. Length–weight relationship of eel samples from Curonian lagoon (n=405) in 2013.

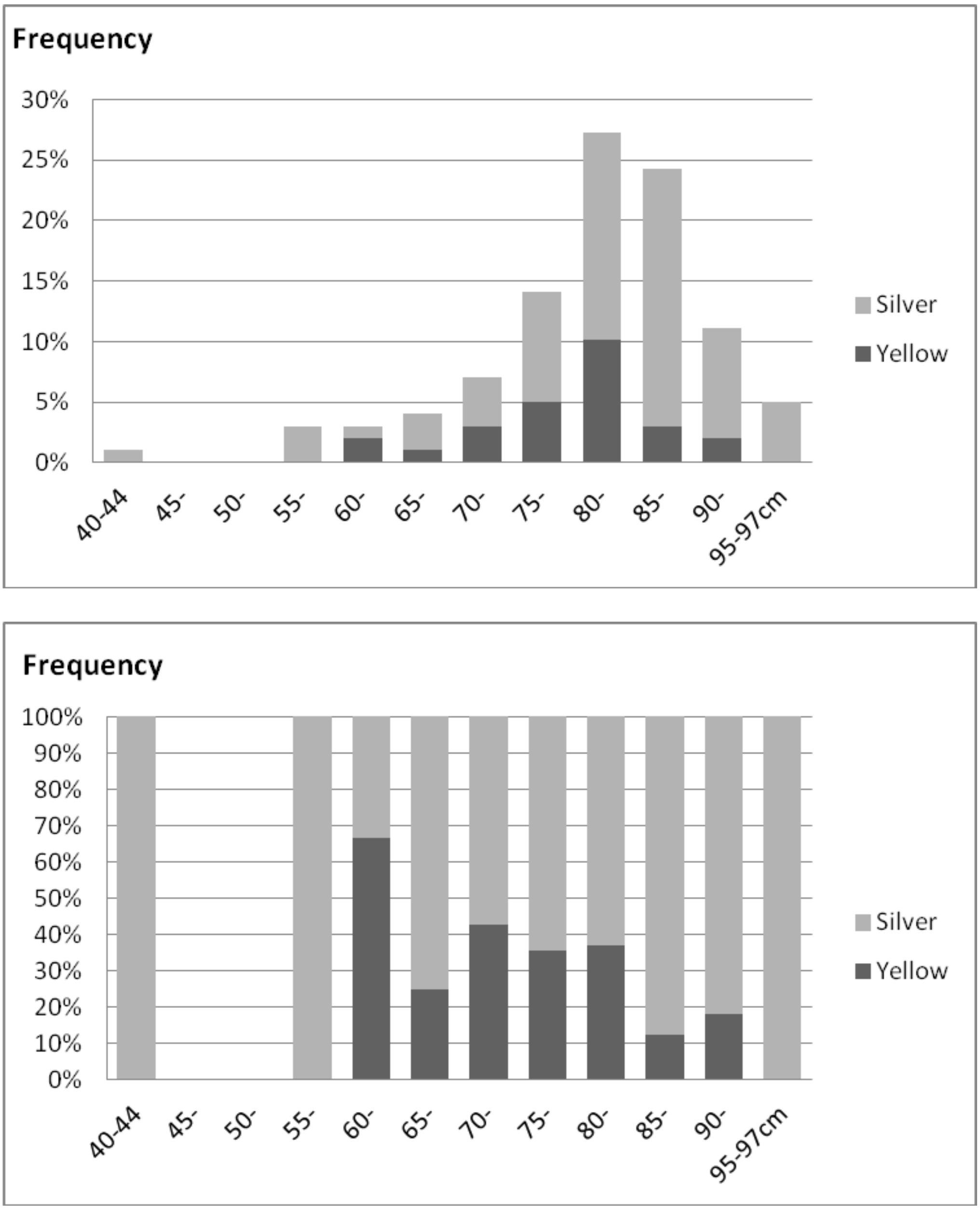
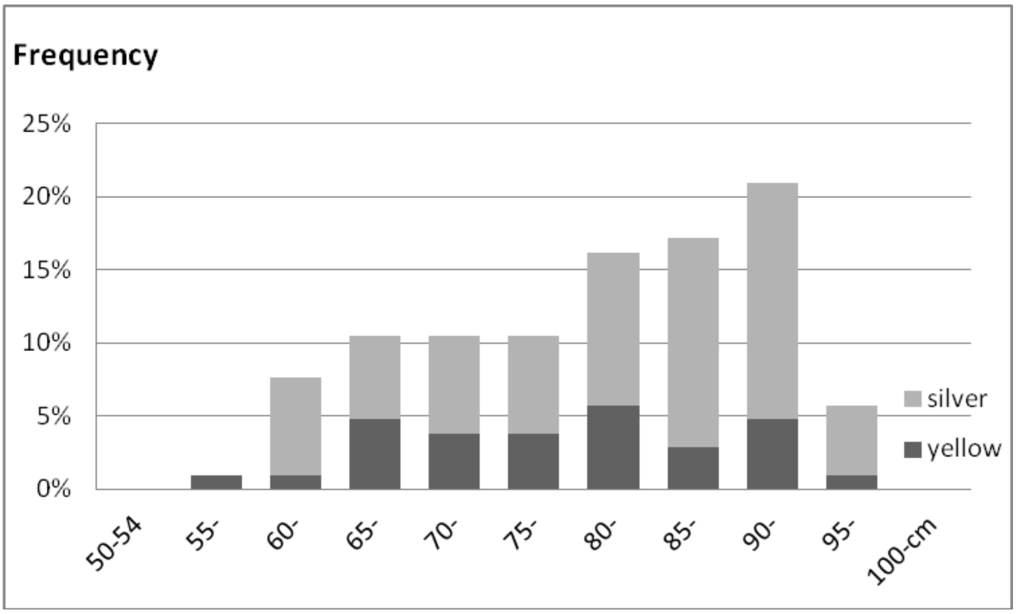


Figure 11.1.3. Length at silvering eel from Inland waters (n=100) in 2013.



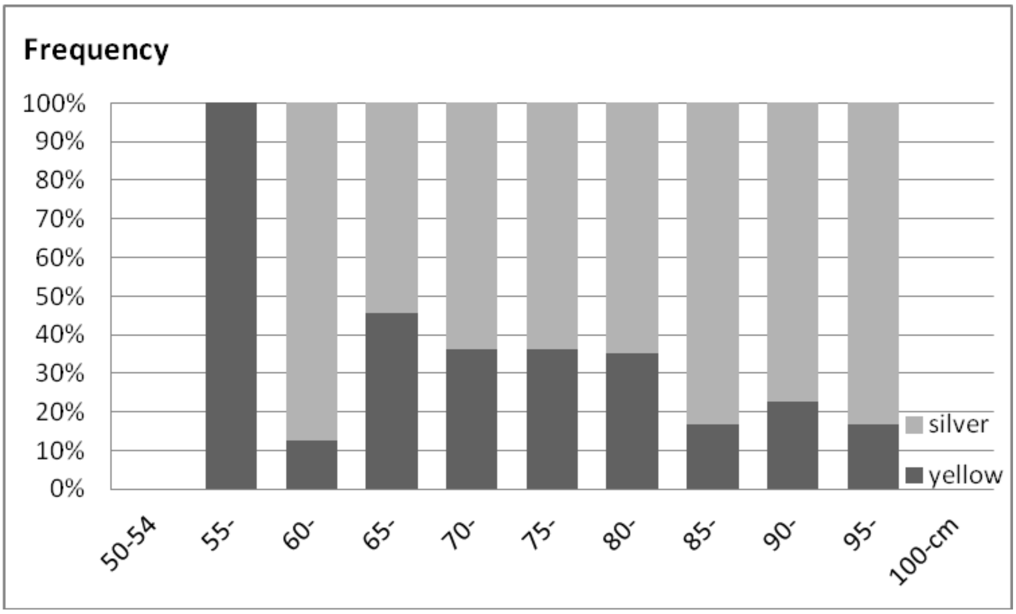


Figure 11.1.4. Length at silvering eel from Curonian lagoon (n=100) in 2013.

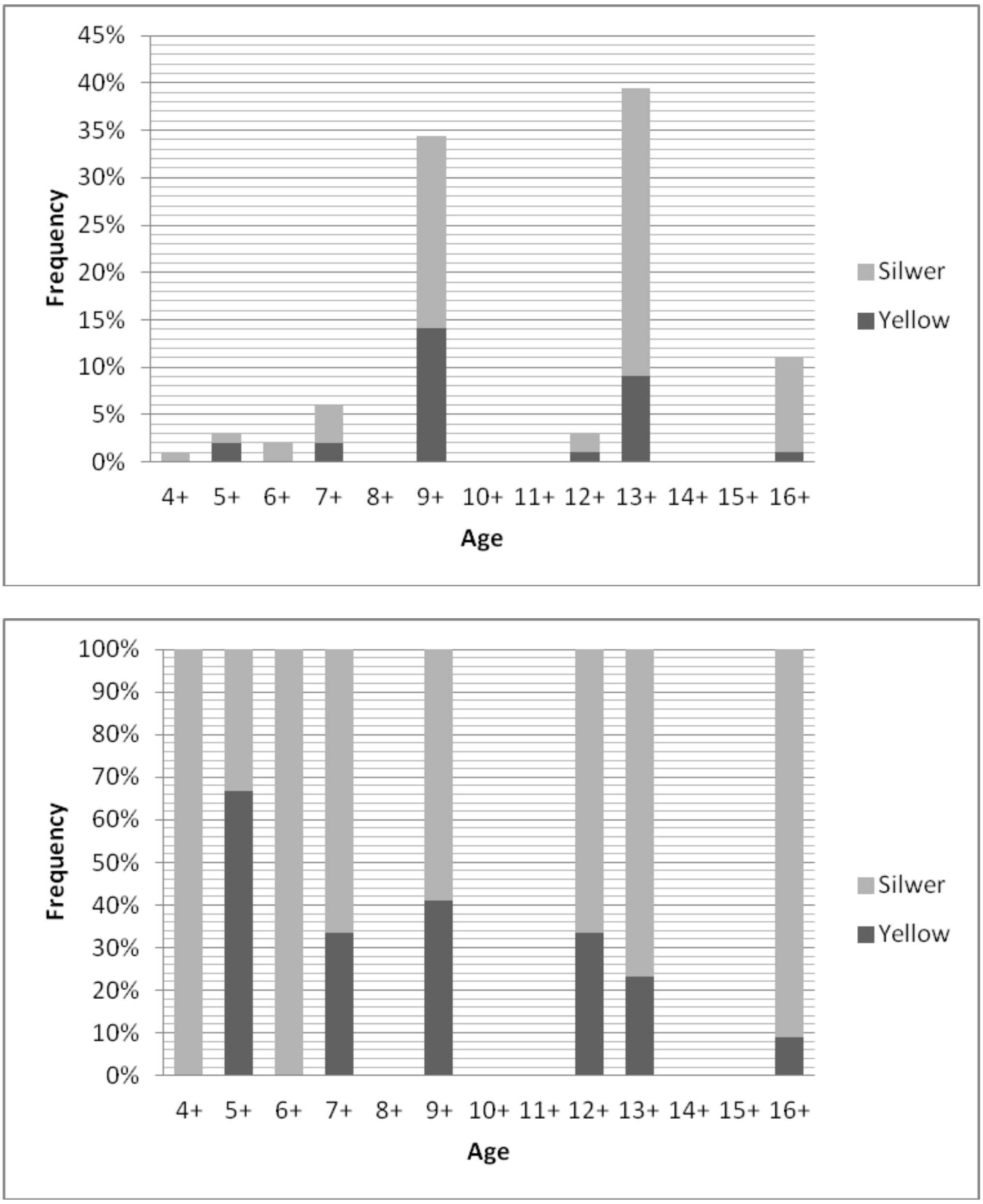
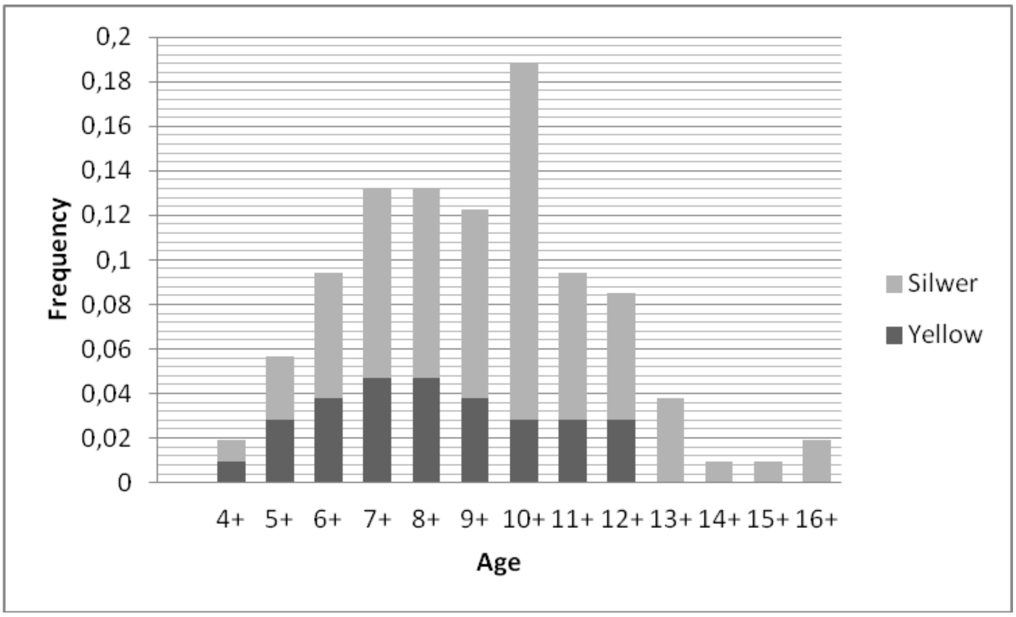


Figure 11.1.5. Age at silvering eel from Inland waters (n=100) in 2013.



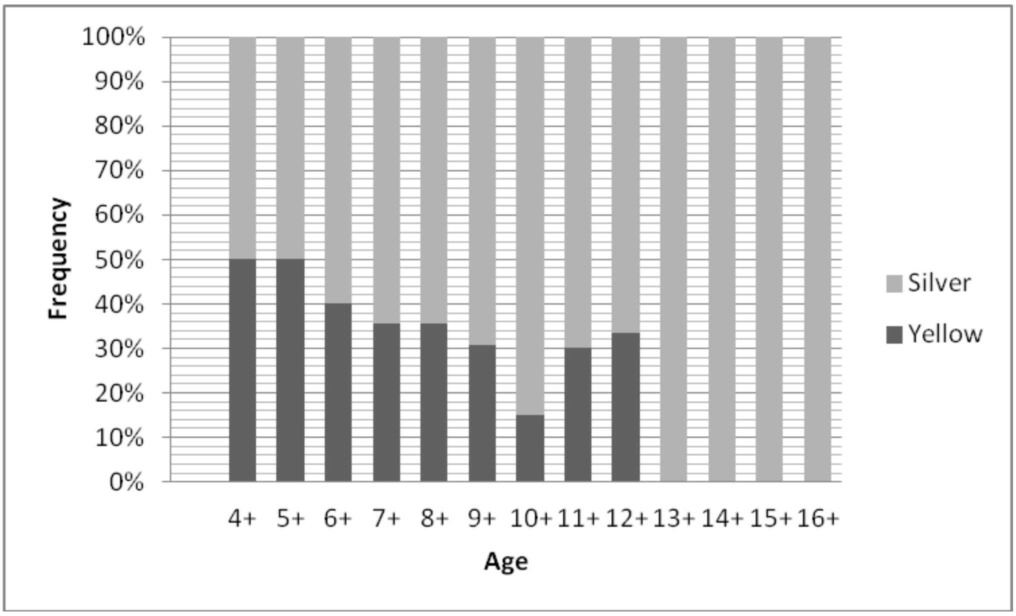


Figure 11.1.6. Age at silvering eel from Curonian lagoon (n=100) in 2013.

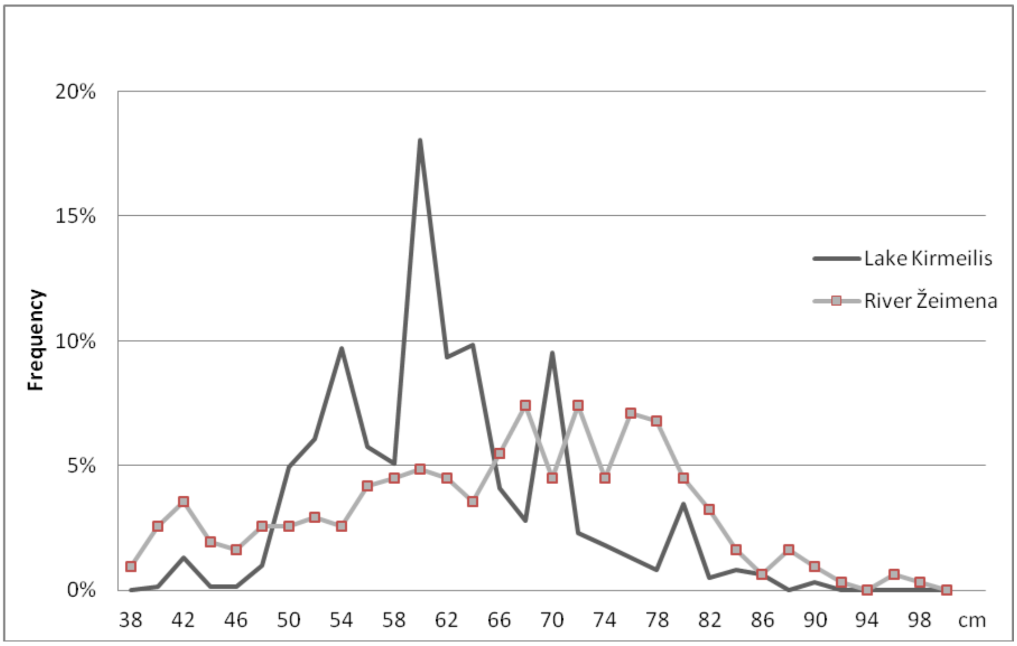


Figure 11.1.7. Length frequencies of commercial catch in Inland waters in Lithuania (2013 DCF data n=921).

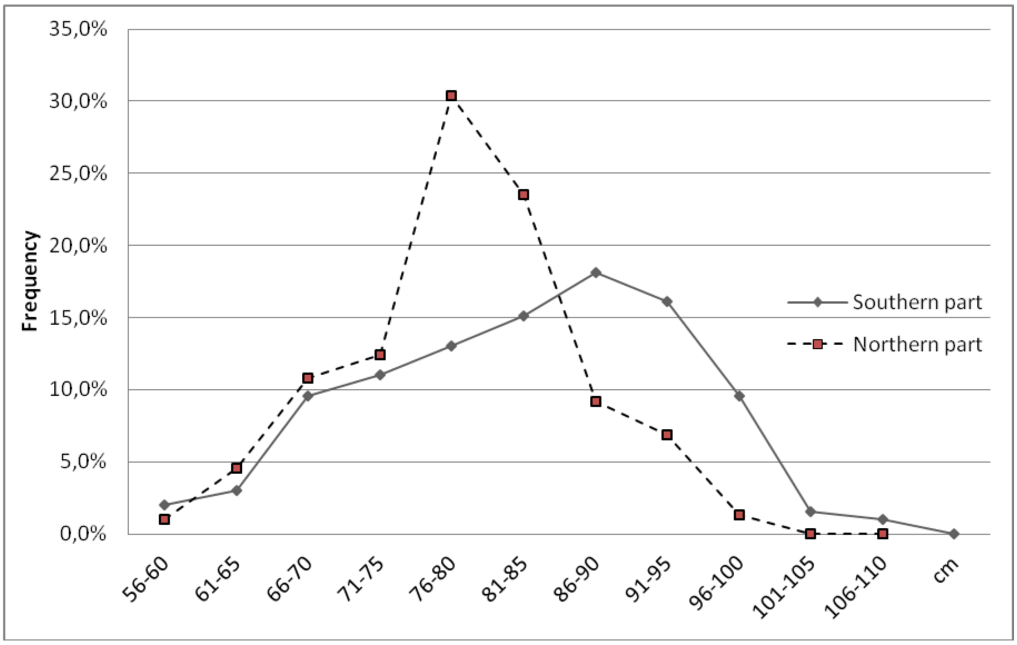


Figure 11.1.8. Length frequencies of commercial catch in Curonian lagoon in Lithuania (2013 DCF data n=405).

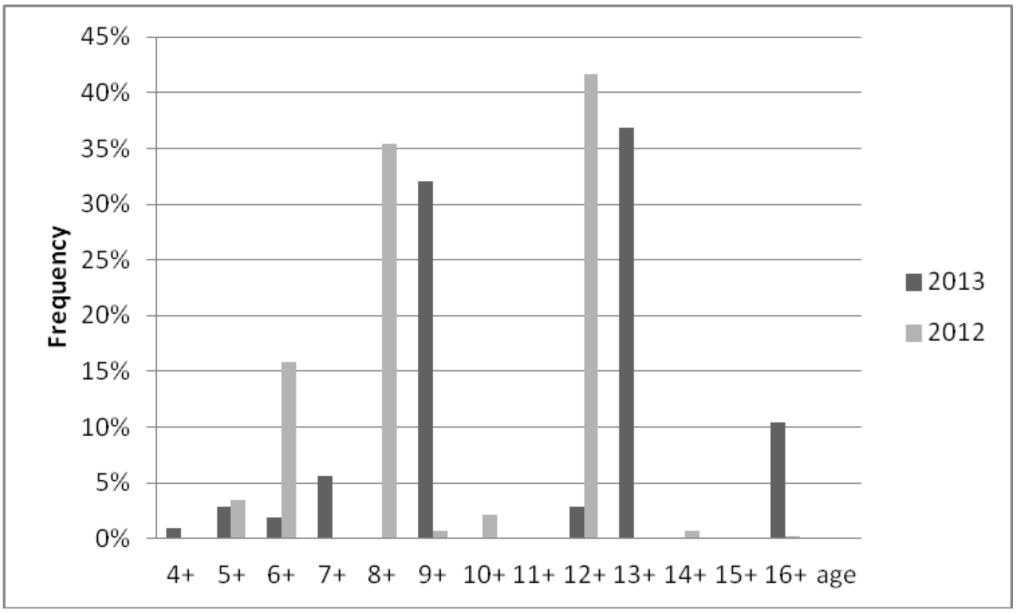


Figure 11.1.9. Age frequencies of commercial catch in Inland waters in Lithuania (2012–2013 DCF data n=200).

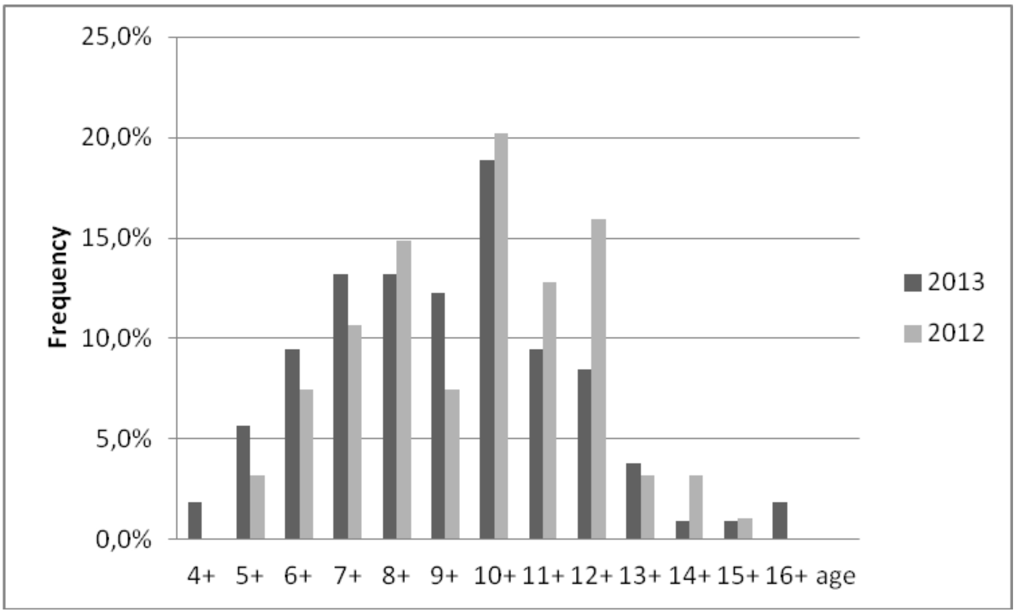


Figure 11.1.10. Age frequencies of commercial catch in Curonian lagoon in Lithuania (2012–2013 DCF data n=200).

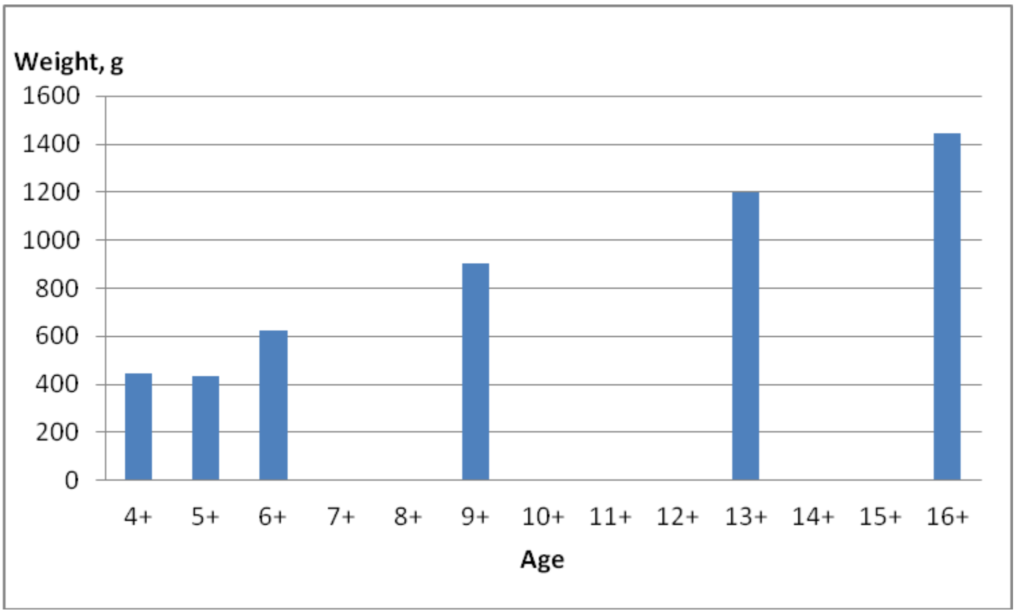


Figure 11.1.11. Weight-at-age eel from Inland waters (n=100) in 2013.

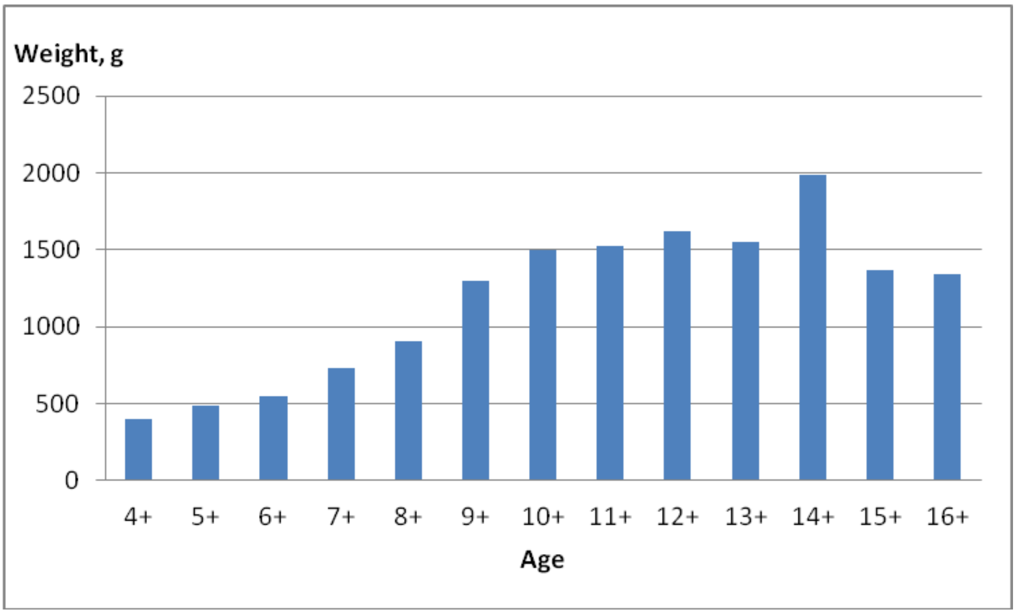


Figure 11.1.12. Weight-at-age eel from Curonian lagoon (n=100) in 2013.

11.2 Parasites and pathogens

Preliminary data provided using Nature Research Center study "Evaluation of effectiveness of eel restocking measures, with special emphasis on eel survival, infection with parasites, growth rates and sex ratio (2014)". **Intermediate report.** Contract No F11-222; July 02, 2013. Contractor Fisheries service under the Ministry of Agriculture of the Republic of Lithuania.

Study place – Lake of Balsys. N=44.

After parasitological analysis a total of seven different taxons of parasites were found (unidentified species of ectoparasites belonging to two genera and five species of endoparasites) (Table 11.2.1). The most common species was a swim bladder parasite *Anguilicola crasssus* (Nematoda) native to South-East Asia. *A. crasssus* infected 24 of 44 analysed eels (parasite prevalence was 54.6 %). Mean infection intensity was 7.9 parasites per infected eel (maximum 27 parasites in one eel).

Unidentified species of ectoparasites belonging to two genera, *Trichodina* sp. (Ciliophora) and *Dactylogyrus* sp. (Monogenea) were found on the eel gill leaflets. Infection with *Trichodina* sp. prevalence and intensity were very low, only one individual of parasite was found (prevalence was 2.3%, intensity 1). On gills of eight eel was found *Dactylogyrus* sp. Parasite prevalence was 18.2%, mean infection intensity six parasites (maximum 27). Among intestine endoparasites, *Bothriocephalus claviceps* (Cestoda) was the most frequent. It was found in eight eel intestines, prevalence was 18.2%, mean infection intensity: 7.5 parasites per infected eel. 15.9% of analysed eels were infected by *Camallanus lacustris* (Nematoda). Infection intensity was 7.7. *Acanthocephalus lucii* (Acanthocephala) was found in three eels, prevalence was 6.8%, mean infection intensity: 3. Encysted metacercarias of *Paracoenogonimus ovatus* (Digenea) were found in stomach and intestine walls of two eels. Parasite prevalence was 4.5%, mean infection intensity: 624 cysts. It was no parasite found in eel liver.

Table 11.2.1. Eel infection by parasites in Balsys Lake in 2013.

Infection indicator	Gill		Liver	Swim bladder	Intestine				Stomach
	Trichodina sp.	*Dactylogyrus* sp.		*Anguilicolla crassus*	*Camallanus lacustris*	*Bothriocephalus claviceps*	*Paracoenogonimus ovatus*	*Acanthocephalus lucii*	*Paracoenogonimus ovatus* (metacerk.)
Number of infected eel	1	7	0	24	7	8	2	3	2
Prevalence, %	2,3	18,2	0	54,6	15,9	18,2	4,5	6,8	4,5
Mean infection intensity	1	6	0	7,9	7,7	7,5	55	3	568

Figure 14. ***Camallanus lacustris*** **(left) and** ***Anguillicola crassus*** **(right). Phot by J. Dainys).**

11.3 Contaminants

No available data.

11.4 Predators

No available data.

12 Other sampling

Sampling for cormorant diet analysis is done on regular basis as part of PhD project on Cormorant effect on fish stocks in the Curonian Lagoon since 2005. About 1000 samples were analysed and no eel are found in the diet.

According study on recreational fishery about 700 kg of eels could be caught by recreational fishermen in 2012 (interviewed 1500 respondents).

13 Stock assessment

13.1 Local stock assessment

There are no stock assessment surveys in Lithuania. However, first stock assessment was conducted in 2008 using Simplified model of the eel population dynamics (Dekker *et al*., 2008). Using the model natural escapement levels of silver eel under pristine conditions were calculated as well as current escapement.

13.2 International stock assessment

13.2.1 Habitat

Wetted Area:

Lacustrine: 117 000 ha (lakes and reservoirs);

Riverine: 33 200 ha (38 000 km);

Transitional and lagoons: 41 300 ha (Curonian Lagoon);

Coastal: 41 500 ha (Baltic Sea).

Lithuania has 2782 lakes with areas exceeding 0.5 ha (88 548 ha) and 1159 reservoirs with areas over 0.5 ha (28 306 ha), also 4418 rivers longer than 3 km, their total length measuring 37 636 km and their surface area totalling 33 200 ha (Table 13.1.1.1). Lakes and reservoirs over 50 ha number 285 (68 754 ha) and 70 (21 291 ha) respectively. Lithuania has 41 300 ha (26%) of the Curonian Lagoon (total area 158 400 ha). The Baltic Sea coastal zone is the area between the coastline and the 20 m depth isobath. This zone makes up an area of 41 500 ha. According to Directive 2000/60/EC, there are four RBDs in the territory of Lithuania (Figures 13.2.1.1 and 13.2.1.2).

Table 13.2.1.1. Eel habitats in Lithuania.

Habitat	Number	Length, area
Rivers	4418	37 636 km
Lakes	2782 (>0.5 ha)	88 548 ha
Reservoirs	1159 (>0.5 ha)	28 306 ha
Curonian Lagoon	1	41 300 ha
Baltic Sea coastal zone	1	41 500 ha

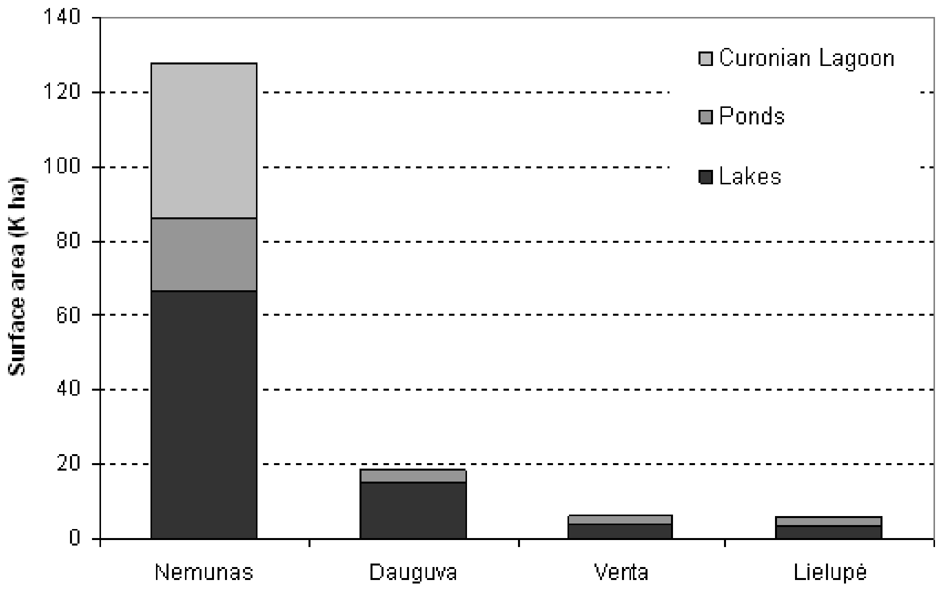


Figure 13.2.1.2. Areas of RBD waterbodies in Lithuania (thousand ha).

13.3 Silver eel production

Based on historical data on eel catches and information about the structure of catches, the average production of silver eel was calculated simplified model of the eel population dynamics (Dekker *et al.*, 2008).

According to the calculations presented in Tables 13.2.2.1 and 13.2.2.1.1, in the Lithuanian EMP the 40% target level of escapement of the spawning–stock biomass from Lithuanian waterbodies (SSB is calculated under pristine conditions) makes up 35 tonnes of silver eel per year. Meanwhile, according to theoretical calculations, the current escapement from the Curonian Lagoon, where the major part of the eel population is natural, and from stocked lakes should be around five tonnes. Thus, to achieve the objective set by the Council Regulation, Lithuania would have to stock at least such a quantity of glass eel that would allow additional production of at least 30 tonnes of silver eel in Lithuanian waterbodies, provided that the natural eel population and its recruitment with new individuals in the Curonian Lagoon do not decline in future.

Table 13.3.1. Eel production in the absence of anthropogenic impacts.

Eel habitat	Period	Stocking	Catch, t	Catchnat. indiv., t	SSBnat, t
Curonian Lagoon (total area)	1954–1978	0	250	250	333

13.4 Historic production

Calculations of the historical production are done using simplified model of the eel population dynamics (Table 13.3.1.). It was assumed that the effectiveness of the silver eel fishery in the past was similar to that of other Baltic countries (the level established by experiments with tagged eel in Scandinavia, i.e. 25%). In addition, the calculations were based on the assumption that an insignificant overfishing of yellow eel had occurred, with the rate of yellow eel exceeding that of silver eel in catches. The calculation was only done for the Curonian Lagoon, as catches in other inland waterbodies had been extremely poor in the past, while current catches mostly include stocked eel. In the Baltic Sea coastal zone, eel catches have always been insignificant, usually amounting to a few hundred kilograms per year or no eel fishery has occurred at all. Plans are made to support the eel fishery of very low intensity (<100 kg/year) and to prohibit any specialised fishery in the Baltic Sea. Thus, it can be assumed that there were no and there will be no anthropogenic impacts on eel in Lithuania’s coastal zone of the Baltic Sea. For that reason, the spawning eel stock biomass under pristine conditions and the target level of escapement in these waterbodies were not included in the calculations.

Table 13.4.1. Calculation of EMP target SSB (SSB_{prist} is SSB under pristine conditions and $SSB_{curr.}$ is the current level of escapement).

Escapement	Spawning Stock Biomass, t
SSBprist, t (Curonian Lagoon, total area)	333
SSBprist, t (Curonian Lagoon, LT section (26%))	87
SSB, 40% under pristine conditions)	35
SSBcurr. (lakes and Curonian Lagoon (LT section))	5

13.5 Current production

Table 13.5.1. LT current and escapement production.

YEAR	BIOMASS(T)	TARGET			
	B_0	B_{best}	$B_{current}$	Biomass	∑A
2008	87	28,0	11,1	34,8	0,40
2009	87	18,8	7,6	34,8	0,40
2010	87	47,0	23,3	34,8	0,50
2011	87	28,4	12,6	34,8	0,44
2012	87	18,5	8,3	34,8	0,45
2013	87	32,4	13,7	34.8	0,42

13.6 Current escapement

See above and Table 13.5.1.

13.7 Production values e.g. kg/ha

Table. 13.7.1. EEL catch in kg/ha in Curonian lagoon.

YEAR	CURONIAN LAGOON, LT SECTION AREA (HA)	CATCHES, TONNES	PRODUCTION, KG/ HA
1954–1978	41 300	250	6.053
2008	41 300	6,8	0,165
2009	41 300	4,9	0,119
2010	41 300	5,0	0,121
2011	41 300	3,4	0,082
2012	41 300	1,7	0,041
2013	41 300	1.6	0.039

13.8 Impacts

There are no calculations.

13.9 Stocking requirement eels <20 cm

The quantity of glass eel needed for stocking was calculated by taking into account the optimal stocking density for the area's latitude where Lithuania is located (100 glass eel ha^{-1}) and the area of waterbodies appropriate for stocking. The Lithuanian EMP contains a specific stocking strategy: in stocking, priority will be given to habitats that are unaffected or partially affected by HP turbines (HPs have fish passes), have low levels of pollution and are remote from cormorant colonies. Stocking of priority lakes unaffected by HP turbines (excluding rivers and the Curonian Lagoon) requires one tonne of glass eel per year approximately (≈€ 0.5 million per year). If the country has sufficient financial resources and the possibility to acquire glass eel (if recruitment of glass eel does not decline, their fishery is not banned and all Member States have sufficient glass eel resources for implementing their national EMPs), Lithuania plans to stock up to 30 000 ha of waterbodies in implementing the EMP(Table 13.8.1). This would allow expecting a larger escapement level of silver eel than that set out in the

Council Regulation (40% of natural production). The maximum total surface area of priority lakes was calculated, as not all lakes will be stocked due to various risk factors, and stocking in some lakes and reservoirs will be below 100 units ha^{-1} where a waterbody has lower productivity. In addition, some waterbodies still contain eels and these basins will not be stocked or stocking will be low-scale.

Stocking activities started again in 2010. 28 895 individuals vere released in 2010, 152 000 individuals were released in 2011, 490 660 individuals in 2012 in inland waters. About 10% of released individuals were marked by colorant Alizarin.

Table 13.9.1 LT. Quantity of glass eel needed for stocking and expected annual costs (if the price is about 500 €/kg).

Waterbodies by order of priority	Surface area, ha	Quantity of glass eels, kg (units, million)	SSB production, t*
Lakes and reservoirs unaffected by HPs	23 995	800 (2.4)	44
Lakes and reservoirs partially affected by HPs	15 159	500 (1.5)	28
Curonian Lagoon	41 300	1400 (4.2)	78

Note: *SSB production without prohibiting the fishery (catches of 5% of yellow eel and 25% of silver eel per year).

13.10 Summary data on glass eel

No glass eel caught in Lithuania. All glass eel or ongrown are imported and used for stocking in Lithuania.

13.11 Data quality issues

No available data.

14 Sampling intensity and precision

Sampling started in 2011. Samples of 200 individuals are collected for further ageing in 2012 and 2013.

15 Standardisation and harmonisation of methodology

Sampling under DCF started in 2011; sampling activities are implemented by Fisheries Service under the Ministry of Agriculture.

15.1 Survey techniques

Studies of the intensity and dynamics of eel migrations are realized using traditional fishing gears.

15.2 Sampling commercial catches

Eels were collected from fykenets fishery in the Curonian Lagoon and from river traps from three fishing sites in Inland waters.

15.3 Sampling

Sampling carried out by local fisherman.

Eel sampling 200 specimens per year:

length (mm), weight (g), length of pectoral fin (mm), eye diam. (mm) (vertical and horizontal), sex by macroscopic examination, otholiths.

15.4 Age analysis

Otoliths were soaked ten minutes in xylene ((CH3)2C6H4), after that observation of rings was made with binokuliar changing intensity of light.

15.5 Life stages

No available data.

15.6 Sex determinations

Sex was not determined, however, according to earlier studies in Lithuania and eel size it is presumed that most sampled eels were females.

15.7 Date quality issues

No available data

16 Overview, conclusions and recommendations

Eel studies in Lithuania in the past were undertaken only in occasional cases aiming to collect samples for different research purposes (e.g. otolith microchemistry, recreational fishery study). Implementation of the national EMP until the end of 2010 was limited to legal regulations which are aimed to reduce fishery impact on the stock. Lithuania submitted national DCF program and started collect data in 2011. In 2011 Lithuania started programme for implementation of the EMP using financial mechanism of the European Fisheries Fund. The programme is aimed to restock lakes and to fulfil gaps in the research on the eel stock.

17 Literature references

Dekker, W. 2004. Slipping through our hands-Population dynamics of the European eel. Doctoral dissertation, University of Amsterdam: 186 p.

Dekker W., Ch. Deerenberg ir H. Jansen. 2008. Duurzaam beheer van de aal in Nederland. Onderbouwing van een beheerplan. Wageningen IMARES IJmuiden.

Ložys L. 2013. Evaluation of effectiveness of eel restocking measures, with special emphasis on eel survival, infection with parasites, growth rates and sex ratio (2014). Intermediate report. Contract No F11-222; July 02, 2013. Contractor Fisheries service under the Ministry of Agriculture of the Republic of Lithuania.

Lin Y.J., Ložys L., Shiao J.C., Iizuka Y. ir Tzeng W.N. 2007. Growth differences between naturally recruited and stocked European eel *Anguilla anguilla* from different habitats in Lithuania. Journal of Fish Biology 71: 1773–1787.

Ložys L. 2014. Evaluation of effectiveness of eel restocking measures, with special emphasis on eel survival, infection with parasites, growth rates and sex ratio. **Intermediate report**. Contract No F11-222; July 02, 2013. Contractor Fisheries service under the Ministry of Agriculture of the Republic of Lithuania.

Shiao J.C., Ložys L., Iizuka Y. ir Tzeng W.N. 2006. Migratory patterns and contribution of stocking to population of European eel in Lithuanian waters as indicated by otolith Sr:Ca ratios. Journal of Fish Biology 69: 749–769.

Stakenas S. 2014. "Assessment of impact of hydropower turbines on European eels using tagged eels and overwiew of hydropower plants turbines in Lithuania (2014)." **Intermediate report**. Contract No. F11-223. December 30, 2013. Contractor Fisheries service under the Ministry of Agriculture of the Republic of Lithuania.

Report on the eel stock and fishery in Montenegro 2013/2014

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Reporting Period: This report was completed in November 2014, and contains data up to 2014.

2 Introduction

As Montenegro is in Adriatic-Ionian subregion eel as a species that occurs in MNE fresh and brackish waters. The fishery on eel exists and as a matter a fact it represents important income for local fisherman since eel is traditional delicacy in MNE and there is constant and strong demand for eel on markets and in restaurants which all caused high price for eel (10–15 EUR/kg).

Although the eel fishery is important there are no management plans for this species in MNE. Nevertheless, there is no regulation that obliged fisherman for reporting of their catch so we do not know the total amount of eel landed in MNE for one year. Monitoring of glass eel recruitment is absent as well as the monitoring of silver eel escapement. We have no data on proportion of yellow and silver eel landed in MNE each year.

From eel fishery point of view most important area is Skadar Lake which is National Park. The management of NP is in power of issuing of fishing licences for eel fishing as well as in charge for controlling of whole fishing on Skadar Lake. Second by importance is Bojana River with Šasko Lake while in third place are middle and lower part of Morača river and Zeta river in her course through Bjelopavlići valley.

By MNE legislation it is allowed to catch eel with longlines and with fykenets. There is no minimal size proscribed by MNE law or bylaw as well as no fishing ban season for any stage (gals, yellow or silver eel).

3 Time-series data

3.1 Recruitment

No Data (ND).

3.1.1 Glass eel recruitment

3.1.1.1 Commercial

No data (ND).

3.1.1.2 Recreational

No data (ND).

3.1.1.3 Fishery independent

No data (ND).

3.1.2 Yellow eel recruitment

No data (ND).

3.1.2.1 Commercial

No data (ND).

3.1.2.2 Recreational

No data (ND).

3.1.2.3 Fishery independent

No data (ND).

3.2 Yellow eel landings

3.2.1 Commercial

Not collected (NC).

3.2.2 Recreational

Not collected (NC).

3.3 Silver eel landings

3.3.1 Commercial

Not collected (NC).

3.3.2 Recreational

Not collected (NC).

3.4 Aquaculture production

3.4.1 Seed supply

No eel aquaculture in MNE.

3.4.2 Production

No eel aquaculture in MNE.

3.5 Stocking

3.5.1 Amount stocked

No eel stocking program in MNE.

3.5.2 Catch of eel <12 cm and proportion retained for restocking

No eel restocking program in MNE.

3.5.3 Reconstructed time-series on stocking

No eel restocking program in MNE.

Table 3-x. Stocking of cultured and wild eel in country since 1984.

	Local Source					Foreign Source				
Year	Glass eel (n)	Quarantined Glass (n)	Wild Yellow (n)	On-grown cultured (n)	Total	Glass eel (n)	Quarantined Glass (n)	Wild Yellow (n)	On-grown cultured (n)	Total GEE (n)
1953										
1954										
1955										
1956										
1957										
1958										

AIM: track the quantity and sizes of eels being stocked in order to assess the biomass (and mortality rates) derived from stocked eel.

NOTES:

Local Source: The source of the stocked eels is local;

Foreign Source: Eels come from another country;

Split the stocked eels into the stages in the column headings, do not add anymore;

Please, translate the number of Wild Yellow and on-grown cultured into GEE (Glass Eel Equivalents). If you are not able to do that, you must provide average size of stocked eels; and in case you have it, mortality rates and growth and/or age in order to make the transformation to GEE.

3.6 Trade in eel

No trade with eel, there is no eel export from MNE till now.

4 Fishing capacity

In MNE, on Skadar Lake where it occurs is 70% of eel fishery NP "Skadar Lake" is issuing licences for the professional eel fishing (longlines and fykenets). According to their data number of eel fisherman goes from 54–112 anglers. But on one fishing licence "normally" fish few fishermen since the yearly licences for eel are expensive considering MNE economic situation (400 EUR for eel licence) so we estimate that on Skadar Lake there are not less than 100 eel fisherman that mainly fish yellow eel. Of course, during eel downstream migration they caught silver eels also but we do not know their proportion in total catch. This probably happens during late autumn high water level (autumn floods) and continuing during winter. Unfortunately no researches in MNE were done on eels as a target species.

In terms of boats they use traditional small wooden boats called "čun" that are up to 6 m in length and 1,5 m in width (more common those that are 4,5 m long and 1 m wide). It is impossible to estimate their numbers but we can count that at least 100 of them are in use for eel fishery.

4.1 Glass eel

There is no fishing on glass eel.

4.2 Yellow eel

All previous is mainly related on yellow eel, so there are not less than 100 fishermen only on Skadar lake with no less than 100 small wooden boats.

4.3 Silver eel

Since the fisherman doesn't make any distinction between yellow and silver eel and regarding that in period of downstream migration (mainly late autumn) there is strongest market demand for eel (during the period price for eel rich the highest level; up to 15 EUR/kg) therefore in this period fishing pressure is the highest on yearly level. So, as for yellow eels the same is for the silver ones: there are not less than 100 fishermen only on Skadar lake with no less than 100 small wooden boats.

4.4 Marine fishery

There is no marine fishery of eel within MNE.

5 Fishing effort

5.1 Glass eel

There is no fishery on glass eel in MNE.

5.2 Yellow eel

There are no data of yellow eel catch and therefore we can't calculate fishing effort.

5.3 Silver eel

There are no data of yellow eel catch and therefore we can't calculate fishing effort.

5.4 Marine fishery

In Marine fishery eel are not targeted as a species and some catch could occur near Bojana delta but those are mainly bycatch that are rare. So there is no marine fishery of eel within MNE.

6 Catches and landings

Since there are no data on total catch we tried to make some estimation. If we take that on Skadar Lake there are about 100 fishermen and that fishing season for eel is during whole year (365 days) if we know the average daily catch we can make an estimation of total lending. There are about 150 days that are favourable for eel fishing and according to questioner averagely daily catch of fisherman on Skadar Lake is about 2 kg/day (sometimes more, sometimes nothing but averagely 2 kg/day). If we multiply those figure we come to total yearly eel catch in Skadar Leke (MNE part) of 30 tonnes. This reflects only on legal fisherman.

In reality we have a strong and very high poaching on Skadar Lake and sometimes fish mass landed by poacher is higher than those landed bay legal fisherman (thanks to high eel price) . Poachers use all spectra of forbidden tools but for eel they preferred electro-fishing gears that shows best results (smallest effort). In addition eel fishing on rivers Bojana, Šasko lake, Morača and Zeta are not regulated well so it is unclear what is allowed and what is not so it is unclear who is regular angler and who is poacher.

In the end we can estimate that poaching on Sakdar Lake, plus every kind of eel fishing in Bojana, Zeta and Morača river together with Šasko lake is at least on the same level as legal fishing on Skadar lake. This all bring us to estimated amount of 60 tonnes of total eel landed in MNE.

6.1 Glass eel

No glass eel fishing in MNE.

6.2 Yellow eel

We estimated that total amount of eel landed in MNE every year is about 60 tonnes but it is unclear and we do not have the information that will help us to determine proportion of yellow eel.

6.3 Silver eel

We estimated that total amount of eel landed in MNE every year is about 60 tonnes but it is unclear and we do not have the information that will help us to determine proportion of silver eel.

6.4 Marine fishery

There is no eel fishery in marine ecosystem in MNE.

6.5 Recreational fishery

Although the recreational fishermen are numerous in MNE they are mainly oriented or on trout species or on cyprinid species so eel is not in their focus. Eel appear in their catch but only as occasional bycatch and those who undertake eel fishing (in terms of bait and fishing equipment) are extremely rare and if they do so they are going on eel fishing only during high water levels during autumn and spring floods (on heavy rains during night with thunderstorm). They of course do not release the eels they caught.

It is highly unlikely that any fisherman in MNE if it catches eel release it back in water.

Recreational Fisheries: Retained and Released Catches

	Retained				Released			
	Inland		Marine		Inland		Marine	
Year	Angling	Passive Gears	Angling	Passive gears	Angling	Passive gears	Angling	Passive gears
2013	NC	NP	NC	NC	NC	NP	NC	NC

Provide the catch and release mortality (%) used in your country for angling in marine and inland waters.

Recreational Fisheries: Catch and Release Mortality

	Released			
	Inland		Marine	
	Angling	Passive gears	Angling	Passive gears
Year				

6.6 Bycatch, underreporting, illegal activities

Table 6-x. Estimation of underreported catches in Country, per EMU and Stage.

		Glass eel				Yellow eel				Silver Eel				Combined (Y + S)			
Year	EMU_code	Reported catches (kg)	Underrept. %	Underrept. (kg)	Total catches (kg)	Reported catches (kg)	Underrept. %	Underrept. (kg)	Total catches (kg)	Reported catches (kg)	Underrept. %	Underrept. (kg)	Total catches (kg)	Reported catches (kg)	Underrept. %	Underrept. (kg)	Total catches (kg)
2014		0	0	0	0	0	100	NC	NC	0	100	NC	NC	0	100	NC	NC
	Total/mean (%)																

AIM: Determine the % of the underreporting and the total catches of the Country per stage.

NOTE: Please indicate in the text whether the percentage underreported catch is a direct measurement or a guess using the estimate to calculate the underreported kgs and total catches.

Table 6-y. Existence of illegal activities, its causes and the seizures quantity they have caused

		Glass eel			Yellow eel			Silver Eel			Combined (Y +S)		
Year	EMU	Y/N/?	Cause	Seizures (kg)	Y/N/?	Seizures (kg)	Cause	Y/N/?	Seizures (kg)	Cause	Y/N/?	Seizures (kg)	Cause
2014		N	-	0	Y	ND	Fishing without licence, Fishing using illegal gears, Illegal selling of catches	Y	ND	Fishing without licence, Fishing using illegal gears, Illegal selling of catches	Y	ND	Fishing without licence, Fishing using illegal gears, Illegal selling of catches

AIM: Identify the illegal fishing activities and in case it is possible its causes and the seized kgs in case they were seizures.

NOTES:

- Y/N/?:

- Y: you know for sure they have been illegal activities;
- N: illegal activities are considered negligible / not significant;
- ?: You do not know whether they have been illegal activities or not.

- Cause: One of the followings:

- Fishing out of the season;
- Fishing without licence;
- Fishing using illegal gears;
- Retention of eel below or above any size limit;
- Illegal selling of catches.

7 Catch per unit of effort

7.1 Glass eel

Since there is no glass eel fishing, there are no cpue calculated.

7.2 Yellow eel

Since there are no reported data on yellow eel catch it is impossible to calculated cpue.

7.3 Silver eel

Since there are no reported data on silver eel catch it is impossible to calculated cpue.

7.4 Marine fishery

Since there are no reported data on eel fishery in marine ecosystem and because there are no eel fishery in marine habitats it is impossible to calculated cpue.

8 Other anthropogenic and environmental impacts

The only anthropogenic activity that could have negative impact on eel population is existence of fish weir trap in Buna river downstream of city of Schodra (Skadar-Albania). This cannot have negative impact on upstream migration of glass eel but could have significant negative effect on downstream migration of silver eel. The size and construction of this fish trap is presented on Picture 1.

Picture 1. Fish weir trap on Bojana river downstream of city of Schodra.

There are no other environmental problems caused by human activities in MNE, no hydropower, no obstacles, no swamp draining, etc. But as we speaking on human activities high level of poaching could be estimated as negative anthropogenic effect too.

9 Scientific surveys of the stock

So far in MNE there was no organized scientific research on any part of eel stock. The only one research was individual research conducted in 1997 and 1998 for purpose of writing of PhD of our colleague from Serbia, Aleksandar Hegediš. He has done research on glass eel that enters in Bojana river, left prong of delta. He estimates that only in left prong, which brings twice less water than right one which is positioned more southern then left one and therefore is the first in which glass eel enters, based on two year monitoring every year enters **2 338 500–3 118 000** individuals of glass eel with average total length of about 55 mm. This is only information that we have it related to eel stock in MNE.

Therefore, in MNE there is strong need for starting and lunching of monitoring project related to eels, at least monitoring of glass eel immigration in Bojana river if not starting researching on eel population structure and migratory patterns.

10 Data collected for the DCF

Since there are no data on eel in MNE we do not collect any data for the DFC.

Provide summary information on the monitoring of eel by EMU in the current year.

Table 10-1. Summary of the DCF monitoring implementation per EMU.

	Data	River	Lakes	Estuaries	Lagoons	Coastal & Marine
	No. of production/ escapement surveys[1]					
	No. of recruitment time-series surveys[2]					
	No. fished aged					
	No. of fished sexed					
	No. of fish examined for parasites					
	No. of fish examined for contaminants					
	No. of non-fishery mortality studies[3]					
	Socio-economic survey					

[1] Surveys to estimate B_{best} and/or $B_{current}$ [These should include WFD surveys where the data are being used to estimate production and/or escapement of eel].

[2] Fishery-independent surveys.

[3] Studies to determine ∑H for non-fisheries anthropogenic impacts, such as hydropower, barriers, predation, etc.

11 Life history and other biological information

There are no data on eel life history from MNE not at all.

11.1 Growth, silvering and mortality

Von Bertalanffy parameters: Linf, K, t0

L50 = the length at which 50% of the population has silvered (my interpretation of 50% maturity)

Length and age at silvering

Fecundity

Weight-at-age

Length–weight relationship

11.2 Parasites and pathogens

No data.

11.3 Contaminants

No data.

11.4 Predators

No data.

12 Other sampling

In other sampling we had eel as a bycatch but it was never treated as something important for reporting and therefore no data were collected; data that could be useful for this report.

13 Stock assessment

13.1 Method summary

We haven't done any stock assessment on eel population within MNE.

13.1.1 Estimate of B_0

Table 13-1. Reference period for B_0.

EMU_CODE	B_0 (KG/HA)	REFERENCE TIME PERIOD	WHETHER OR NOT CHANGED FROM VALUE REPORTED LAST YEAR (Y/N)

13.2 Summary data

No data.

13.2.1 Stock indicators and targets

EMUcode	Indicator	biomass (t)	Mortality (rate)				Target		
	B0	Bbest	Bcurr	∑A	∑F	∑H	Source	Biomass (t)	∑A (rate)
XY_abcd							EMP		
							EU Reg		
							WGEEL		
XY_abcd							EMP		
							EU Reg		
							WGEEL		

13.2.2 Habitat coverage

EMU code	River		Lake		Estuary		Lagoon		Coastal	
	Area (ha)	A'd Y/N)	Area (ha)	A'd Y/N)	Area (ha)	A'd Y/N)	Area (ha)	A'd Y/N)	Area (ha)	A'd Y/N)
Skadar Lake			~350 km^3 in MNE							

13.2.3 Impact

Since there is no eel management plan in MNE we cannot fulfill this table

A = assessed, MI = not assessed, minor, MA = not assessed major, AB = impact absent

EMU code	Habitat	Fish com	Fish rec	Hydro & pumps	Barriers	Restocking	Predators	Indirect impacts
XY_abdc	Riv	A/MI/ MA/AB						
	Lak							
	Est							
	Lag							
	Coa							
	All							

EMU CODE	STAGE	FISH COM	FISH REC	HYDRO & PUMPS	BARRIERS	RESTOCKING	PREDATORS	INDIRECT IMPACTS
XY_abdc	Glass							
	Yellow							
	Silver							
	Silver EQ							

13.2.4 Precautionary diagram

13.2.5 Management measures

Since there is no eel management plan in MNE we cannot fulfill this table and we have no EMU oriented management plans.

EMU CODE	ACTION TYPE	ACTION	LIFE STAGE	PLANNED	OUTCOME
XY_abcd	Com Fish				
	Rec Fish				
	Hydropower & Pumps				
	Restocking				
	Other				

13.2.5 Summary data on glass eel

No data except the one from mentioned PhD thesis, glass eel are not matter of fishery in any terms (restocking, fish farming, exporting, etc.)

quantities	caught in the commercial fishery
	exported to Asia
	used in stocking
	used in aquaculture for consumption
	consumed direct
	mortalities

14 Sampling intensity and precision

15 Standardisation and harmonisation of methodology

15.1 Survey techniques

15.2 Sampling commercial catches

15.3 Sampling

15.4 Age analysis

15.5 Life stages

15.6 Sex determinations

15.7 Data quality issues

16 Overview, conclusions and recommendations

Unfortunately there is no material for any conclusions for MNE when this issue is about. We as a country are on zero position; we miss all data we need for making any decent report or management plan.

We do not recommend to produce management plans first and then to go in researching and monitoring because this will make a lot of problems due to data missing. Without data we could not make any management measures and what we can do is only to divide eel living area in MNE in EMUs as separate managements units but what we should do within them is impossible to determine.

Our main recommendations are that for beginning, we have to start with monitoring of glass eel entrance in freshwaters of MNE and to start working on determination of eel abundance in order to have any clue about eel population. In the same time we can do a lot on population structure (age, length, weight, sex) and try to find out proportion of silver eel in total catch, or to define migratory patterns that occur in MNE waters.

17 Literature references

Report on the eel stock and fishery in Netherlands 2013/2014

1 Authors

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Contributors to the report: Ingeborg de Boois (IMARES: survey data coastal areas), Mennobart van Eerden (Rijkswaterstaat – Waterdienst; cormorant breedings pairs IJsselmeer area), Ben Griffioen (IMARES; glass eel index, silver eel index); Arjan Heinen (Combinatie van Beroepsvissers; stocking data; silver eel fisheries data), Twan Leijzer (IMARES; parasite infections); Jaap van der Meer (NIOZ; yellow eel data NIOZ fyke), Michiel Kotterman (IMARES; data on contaminants), William Swinkels (DUPAN, glass eel data and eel aquaculture production).

2 Introduction

2.1 General overview fisheries

Eel fisheries in the Netherlands occur in coastal waters, estuaries, larger and smaller lakes, rivers, polders, etc. Management of eel stock and fisheries has been an integral part of the long tradition in manipulating water courses (polder construction, river straightening, ditches and canals, etc.). Governmental control of the fishery is restricted to on the one hand a set of general rules (gear restrictions, size restrictions, for course fish: closed seasons), and on the other hand site-specific licensing. Within the licensed fishing area, and obeying the general rules, fishermen are currently free to execute the fishery in whatever way they want. Since 1/1/2010 there is a general registration of landings, whereas a general registration of fishing efforts has not yet been implemented. In recent years, licensees in state-owned waters are obliged to participate in so-called Fish Stock Management Committees ['Visstand Beheer Commissies' VBC], in which commercial fisheries, sports fisheries and water managers are represented. The VBC is responsible for the development of a regional Fish Stock Management Plan. The Management Plans are currently not subject to general objectives or quality criteria. The future of VBC and their role in fish stock management is under debate.

Until April 2011 the total fishery involved approximately 200 companies, with an estimated total catch of nearly 442 tonnes in 2010. However, on 1 April 2011 a large part of the fishery was closed due to high PCB-levels in the eel (Figure 1). This closure has affected about 50 fishing companies catching 170 tonnes of eel in 2010, roughly a third of the annual landings of inland waters in the Netherlands.

Figure NL.1. Overview of the areas closed for eel and Chinese mitten crab fishery as of 1 April 2011 (Source Ministry of Economic Affairs).

2.2 Spatial subdivision of the territory

The fishing areas can be categorised into five groups:

1) The Wadden Sea; 53ºN 5ºE; 2591 km². This is an estuarine-like area, shielded from the North Sea by a series of islands. The inflow of sea water at the western side mainly consists of the outflow of the river Rhine, which explains the estuarine character of the Wadden Sea. The fishery in the Wadden Sea is permitted to licence holders and assigns specific fishing sites to individual licencees. Fishing gears include fykenets and poundnets; the traditional use of eelpots is in rapid decline. The fishery in the Wadden Sea is obliged to apply standard EU fishing logbooks. Landings statistics are therefore available from 1995 onwards; <50 tons per year. There are 21 companies having a commercial licence for fishing eel, and the total number of fykenets is estimated at 400.

2) Lake IJsselmeer; 52º40'N 5º25'E; now 1820 km². Lake IJsselmeer is a shallow, eutrophic freshwater lake, which was reclaimed from the Wadden Sea in 1932 by a dike (Afsluitdijk), substituting the estuarine area known before as the Zuiderzee. The surface of the lake was reduced stepwise by land reclamation, from an original 3470 km² in 1932, to just 1820 km² since 1967. In preparation for further land reclamation, a dam was built in 1976, dividing the lake into two compartments of 1200 and 620 km², respectively, but no further reclamation has actually taken place. In managing the fisheries, the two lake compartments have been treated as a single management unit. The discharge of the river IJssel into the larger compartment (at 52º35'N 5º50'E, average 7 km³ per annum, coming from the River Rhine) is sluiced through the Afsluitdijk into the Wadden Sea at low tide, by passive fall. Fishing gears include standard and summer fykenets, eel boxes and longlines; trawling was banned in 1970. Licensed fishermen are not spatially restricted within the lake, but the number of gears is controlled by a gear-tagging system. The registered landings at the auctions are assumed to cover some the actual total. There are, however, differences in estimated landings reported by PO IJsselmeer, PVIS and catch registration system of the Ministry of Economic Affairs. There are 70 fishing licences, owned by about 30 companies. The

total number of gears allowed in 2012 was: fixed fykes 1579, train fykes 6386, eel boxes 7415 and unknown numbers of longlines. This number hasn't changed since.

3) Main rivers; 180 km² of water surface. The Rivers Rhine and Meuse flow from Germany and Belgium respectively, and in the Netherlands constitute a network of dividing and joining river branches. Traditional eel fisheries in the rivers have declined tremendously during the 20th century, but following water rehabilitation measures in the last decades, is now slowly increasing. The traditional fishery used stownets for silver eel, but fykenet fisheries for yellow and silver eel now dominates. Individual fishermen are licensed for specific river stretches, where they execute the sole fishing right. No registration of effort is required. There were 28 fishing companies, using an estimated number of 318 fixed fykes, 2,433 train fykes, 551 eel boxes, and unknown quantities of other gears (electric dipnet, longlines, etc). Since 1 April 2011 the eel fishery on the main rivers has been closed due to high levels of pollutants in eel.

4) Zeeland; 965 km². In the Southwest, the Rivers Rhine, Meuse and Scheldt (Belgium) discharge into the North Sea in a complicated network of river branches, lagoon-like waters and estuaries. Following a major storm catastrophe in 1953, most of these waters have been (partially) closed off from the North Sea, sometimes turning them into fresh waterbodies. Fishing is licensed to individual fishermen, mostly spatially restricted. Fishing gears are dominated by fykenets. Management is partially based on marine, partly on fresh water legislation. There are 27 companies, using an estimated number of 174 fixed fykes, 233 train fykes, and unknown numbers of eel pots. This area has also been affected by the ban on eel and Chinese mitten crab fishery due to high pollution levels.

5) Remaining waters; inland 1340 km². This comprises 636 km² of lakes (average surface: 12.5 km²); 386 km² of canals (> 6 m wide, 27 590 km total length); 289 km² of ditches (<6 m wide, 144 605 km total length); and 28 km² of smaller rivers (all estimates based on areas less than 1 m above sea level, 55% of the total surface; see Tien and Dekker, 2004 for details). Traditional fisheries are based on fykenetting and hook and line. Individual licences permit fisheries in spatially restricted areas, usually comprising a few lakes or canal sections, and the joining ditches. Only the spatial limitation is registered. Eight small companies operating scattered along the North Sea coast have been added to this category. There are about 100 companies, using unknown quantities of gears of all types.

The Water Framework Directive subdivides the Netherlands into four separate River Basin District (RBD), all of which extend beyond our borders. These are:

c) the River Ems (Eems), 53º20'N 7º10'E (=river mouth), shared with Germany. This RBD includes the north-eastern Province Groningen, and the eastern part of Province Drenthe. Drainage area: 18 000 km², of which 2400 km² in the Netherlands.

d) the River Rhine (Rijn), 52º00'N 4º10'E, shared with Germany, Luxemburg, France, Switzerland, Austria, Liechtenstein. Drainage area: 185 000 km², of which 25 000 km² in the Netherlands, which is the major part of the country.

e) the River Meuse (Maas), 51º55'N 4º00'E, shared with Belgium, Luxemburg, France and Germany. Drainage area: 35 000 km^2 , of which 8000 km^2 in the Netherlands.

f) the River Scheldt (Schelde), 51º30'N 3º25'E, shared with Belgium and France. Most of the south-western Province Zeeland used to belong to this RBD, but water reclamation has changed the situation dramatically. Drainage area: 22 000 km^2, of which 1860 km^2 in the Netherlands.

Within the Netherlands, all rivers tend to intertwine and confluent. Rivers Rhine and Meuse have a complete anastomosis at several places, whereas a large part of the outflow of the River Meuse is now redirected through former outlets of the River Scheldt. Additionally, the coastal areas in front of the different RBDs constitute a confluent zone. Consequently, sharp boundaries between the RBDs cannot be made; neither on a practical nor on a juridical basis. This report will subdivide the national data on a pragmatic basis.

In the following, we will subdivide the national data on eel stock and fisheries by drainage area on a preliminary assumption that water surfaces and fishing companies are approximately equally distributed over the total surface, and thus, totals can be split up over RBDs proportionally to surface areas.

3 Time-series data

3.1 Recruitment

3.1.1 Glass eel recruitment

3.1.1.1 Commercial

Glass eel fisheries is forbidden, NO AVAILABLE DATA.

3.1.1.2 Recreational

Glass eel fisheries is forbidden, NO AVAILABLE DATA.

3.1.1.3 Fishery independent

Recruitment of glass eel in Dutch waters is monitored at Den Oever and eleven other sites along the coast (Figure NL. 2; see Dekker, 2002 for a full description). In Den Oever (Figure NL.3), 2013 recruitment roughly “doubled” and was at the highest level since the mid-1990s. The data at the other sites (Figure NL.2) confirm the overall trend, though individual series may deviate. Note that in contrast to previous years the glass eel data are presented simply as the average number of glass eels per haul in the months April and May, between 18:00–8:00 and only years with >five hauls are included.

Figure NL.2. Locations of glass eel monitoring in the Netherlands.

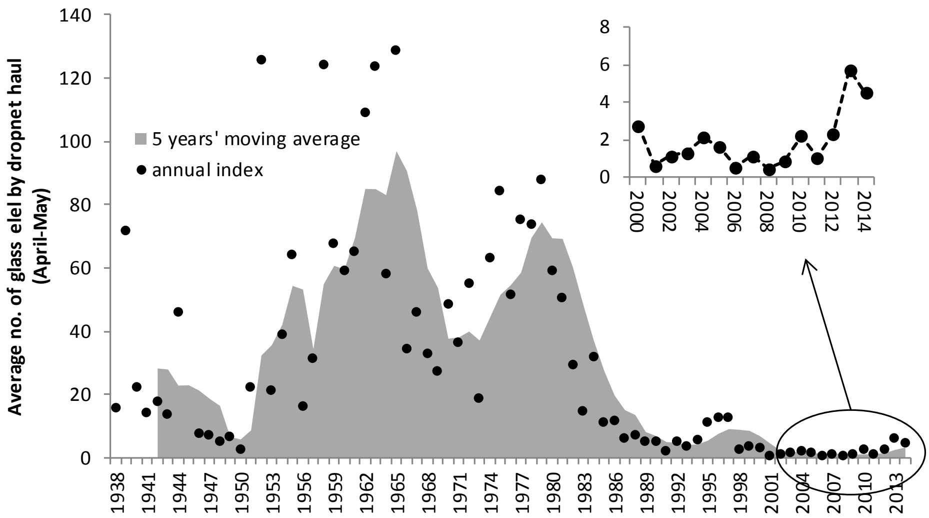

Figure NL.3. Trend indices (mean number per haul in April and May) of glass eel recruitment at Den Oever.

Table NL.A. Average number of glass eel caught per lift net haul at the sluices in Den Oever in de period April–May.

Decade Year	1930	1940	1950	1960	1970	1980	1990	2000	2010
0		22.4	2.7	58.9	48.1	59.0	4.9	2.8	2.2
1		14.3	21.9	65.2	36.1	50.4	1.8	0.6	1.1
2		17.5	125.6	108.9	55.0	29.4	5.2	1.2	2.4
3		13.7	21.1	123.7	18.8	14.7	3.5	1.3	5.8
4		46.1	38.8	58.1	63.0	31.6	5.4	2.1	4.5
5		NA	64.1	128.3	84.3	11.2	11.1	1.6	
6		7.5	16.1	34.0	51.4	11.4	12.5	0.6	
7		7.2	31.3	45.8	75.0	6.2	12.6	1.2	
8	15.3	4.8	124.0	32.9	73.6	7.0	2.5	0.5	
9	71.5	6.6	67.6	27.1	87.7	4.8	3.7	0.9	

Table NL.B. Average number of glass eel caught by dropnet haul between 18:00 and 8:00 hrs in the period April–May at twelve sites in the Netherlands. If five or less hauls were carried out, this was recorded as NA. 1 = very early season (warm spring), sampling stopped early (early May), low number of empty samples. 2 = sampling took place in part of the season.

	Otheense Kreek	Bath	Krammersluis	Bergsche Diep	Stellendam	Katwijk	IJmuiden	Den Oever (Schiplock)	Harlingen	Lauwersmeer	Nieuwstaten-zijl	Termunten-zijl
RBD	Scheldt		Meuse			Rhine					Ems	
1979										100.4		
1980												
1981										75.9		
1982										21.6		
1983										15.8		
1984										9.6		
1985							0.6			25.2		
1986							3.3			1.3		
1987							7.7					
1988					13.8					1.0		
1989					4.4					14.3		
1990	0.3		0.3		10.9					6.0		
1991	0.0		0.2	1.3	3.1	5.1				6.6		0.5
1992	0.0	6.6	0.4		16.9	9.1			16.7	12.1		0.6
1993	0.0	22.7	0.4		10.1	13.5				33.2		1.2
1994	0.0	14.2	0.5		4.0				16.0	31.0		2.8
1995	0.5		0.4		3.3	29.7	2.0	34.7	6.6	16.9		3.7
1996	1.3	22	0.7		0.5	25.3		11.0	34.2	49.4	27.5	7.7
1997			0.6		2.8	12.9		11.4	11.2	27.8	30.0	15.6
1998	0.7		0.6		1.0	38.8	2.0	6.5	18.3	14.4	21.8	1.4
1999	1.4		0.5		1.2	140.1		7.2		31.7	12	10.2
2000	0.9	10.2	1.0	3.8	7.1	11.6		5.0		7.2	38.8	8.7
2001	0.4		0.1		1.0			1.7		2.4	39.7	1.1
2002		1.9	0.2		4.2	13.2	0.1	1.4	3.2	5.5	36.4	1.6

RBD	Otheense Kreek	Bath	Krammersluis	Bergsche Diep	Stellendam	Katwijk	IJmuiden	Den Oever (schiplock)	Harlingen	Lauwersmeer	Nieuwstaten-zijl	Termunten-zijl
	Scheldt		**Meuse**			**Rhine**					**Ems**	
2003		7.5	0.1		0.3	12.7		4.8		1.7	23.6	0.8
2004	0.0	16.4[2]	0.1		0.3	4.5			14.3[2]	2.3	28.1	1.9
2005	0.0	15.3	0.6		0.2	5.6				1.4	21.1	1.8
2006	0.0	12.4	0.2		0.0	1.4		0.3	0.6	1.7	8.3	1.3
2007[1]	0.0	43.9	0.1	0.4	0.1	27.9	0.1		1.7	1.0	21.7	4.0
2008	0.0	13.2	0.0	2.5	0.0	4.5	0.1	0.8	1.1	2.8	15.6	1.3
2009	0.0	9.1	0.0	1.3	0.5	3.5	0.1		0.7	0.6	13.6	1.2
2010		28.4	0.0	1.7	0.2		0.0	1.2	1.0	1.1	13.0	1.2
2011		39.2	0.1	1.3	0.3		0.0		3.1	1.4	11.6	1.4
2012		25.8	0.2	0.8	0.1	1.6	0.2		1.1	2.9	27.6	1.3
2013		73.8	0.0	16.7	0.2	1.6	0.0		5.2	9.1	60.5	1.9
2014		96.3	0.0	6.3	0.6	0.4	0.0		5.8	18.0	72.0	2.1

3.1.2 Yellow eel recruitment

3.1.2.1 Commercial

NO AVAILABLE DATA.

3.1.2.2 Recreational

One of the few long time-series for eel is the fyke monitoring at NIOZ (Den Burg, Texel; van der Meer *et al.*, 2011). This dataset shows a familiar pattern of a steep decline in abundance since the 1980s. In the past almost all catches were yellow eel, based on their length. More recently, the catches also comprise silver eel.

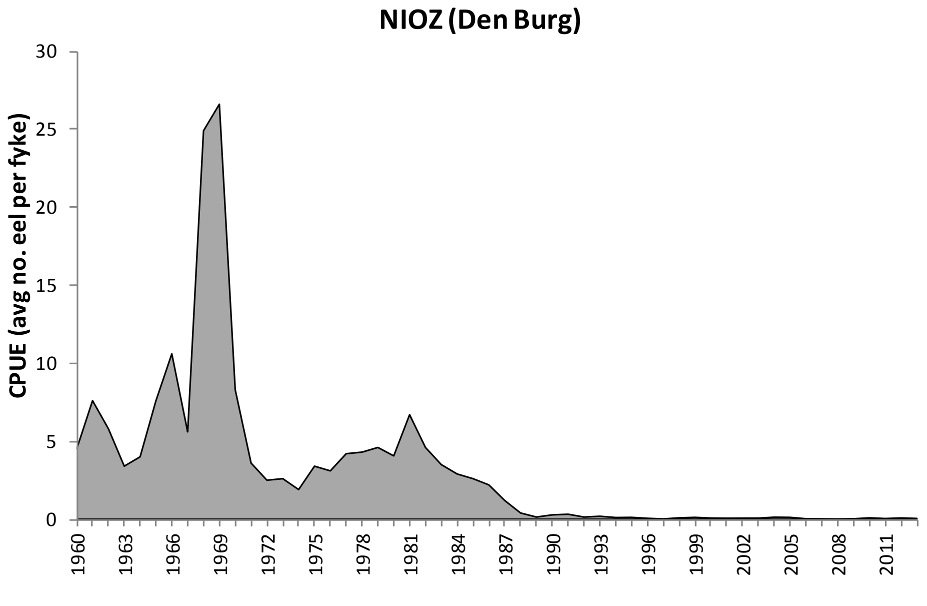

Figure NL.4. Time-series of the mean catch per fyke (numbers) of yellow eel at NIOZ (data NIOZ and van der Meer *et al.*, 2011.).

3.2 Yellow eel landings

3.2.1 Commercial

No reliable long-term time-series of yellow eel landing exist; total landings of yellow and silver eel combined, have been reported.

Statistics from the auctions around Lake IJsselmeer were kept by the government (EZ, previously LNV) until 1994; since then and until 2012 statistics were kept by the Fish Board (PVis; Table NL.E; Figure NL.5, main graph). These statistics are broken down by species, month, harbour and main fishing gear. The quality of this information has deteriorated considerably over the past decades, due to misclassification of gears, and the trading of eel from other areas at IJsselmeer auctions. In the data from auctions around Lake IJsselmeer yellow and silver eel were reported separately, but information in recent decades (from early 1990s onwards) is unreliable: yellow eel from eel boxes and silver eel from all gears have been combined (see Section NL.0 for further details).

In addition, the fishers organisation (PO IJsselmeer) has kept records of the catches of their associated fishers (>90% of the fishers active in the IJsselmeer area) from 2001 onwards (Figure NL.5, insert graph).

An obligatory catch registration system was introduced in the Netherlands in January 2010 by the Ministry of Economic Affairs (EZ). Weekly catches of eel are reported, but yellow eel and silver eel catches are combined in this programme and no information on effort and gears is reported. Information from this registration system is reported in Section NL.0.

Table NL.C. Landings in tons by year, from the auctions around Lake IJsselmeer, Rhine RBD. Only landings recorded at the auctions are included; other landings are assumed to represent a minor and constant fraction. Figures in italics (since 1995) are suspect, due to misclassification of catches and trade from areas outside Lake IJsselmeer at the IJsselmeer auctions. Source Ministry of Economic Affairs (EZ; 1900–1994), Products chap Vis (PVIS; 1995–2012); PO IJsselmeer (in brackets; 2001–current).

DECADE YEAR	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990	2000	2010
0	324	620	1157	838	3205	4152	2999	1112	641	472	*368*	*21*(79)
1	387	988	989	941	4563	3661	2460	853	701	573	*381* (405)	*62*(124)
2	514	720	900	1048	3464	3979	1443	857	820	548	*353* (343)	*59*(121)
3	564	679	742	2125	1021	3107	1618	823	914	293	*279* (293)	NC(90)
4	586	921	846	2688	1845	2085	2068	841	681	330	*245* (280)	
5	415	1285	965	1907	2668	1651	2309	1000	666	*354*	*234* (238)	
6	406	973	879	2405	3492	1817	2339	1172	729	*301*	*230* (224)	
7	526	1280	763	3595	4502	2510	2484	783	512	*285*	*130* (188)	
8	453	1111	877	2588	4750	2677	2222	719	437	*323*	*122* (141)	
9	516	1026	1033	2108	3873	3412	2241	510	525	*332*	*58* (105)	

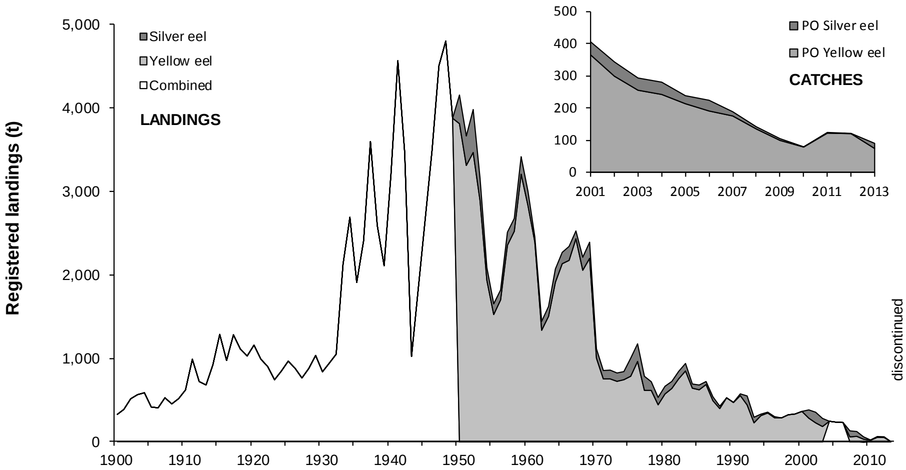

Figure NL.5. Main graph: Time-series of landings of yellow eel and silver eel from Lake IJsselmeer/Markermeer at auctions. Source data main graph EZ and Productschap Vis. Insert graph: catches of yellow eel and silver eel recorded by PO IJsselmeer.

3.2.2 Recreational

NO AVAILABLE DATA.

3.3 Silver eel landings

3.3.1 Commercial

No reliable long-term time-series of yellow eel landing exist. Data on total landings of yellow and silver eel combined, have been reported for Lake IJsselmeer/Markermeer. Data from auctions around Lake IJsselmeer did report yellow and silver eel separately, but information in recent years (early 1990s onwards) is unreliable: yellow eel from eel boxes and silver eel from all gears have been combined and labelled 'silver eel' (see Section NL. 6.2. for details). In addition, catches registered by the PO IJsselmeer from 2001 onwards do distinguish silver eel from other eel catches. However, some silver eel may still be reported amongst the catches of 'other eel'. Still, landings and catches of silver eel are included "as is" in the figure of yellow eel landings and catches (Figure NL.5). An obligatory catch registration system has been introduced in the Netherlands in January 2010 by the Ministry of Economic Affairs (EZ). However, weekly catches of eel are reported, but they consist of combined data for yellow eel and silver eel and no information on effort or gears is reported.

In 2012, a fisheries time-series of silver eel catch data from three closely related sites in **Friesland** were made available. Two series covered the years 1933–1968 (Figure NL.6), the other series covered the years 1974–1978 and 1990–2012 (Figure NL.7; Figure NL.8).

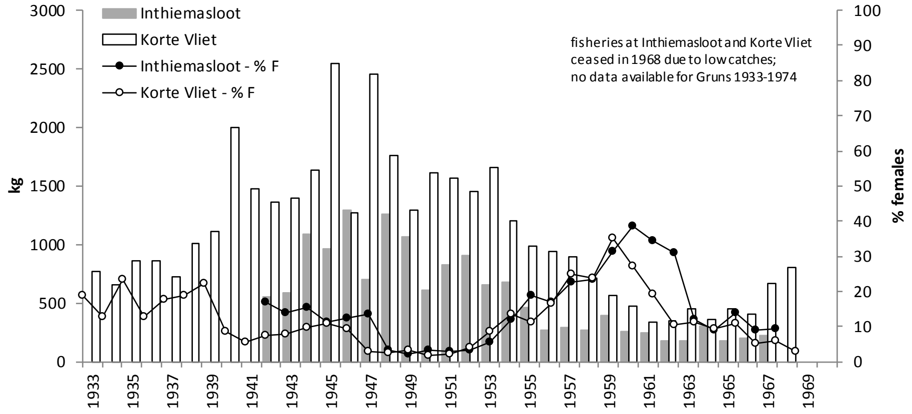

Figure NL.6. Silver eel catches in kg at two sites in Friesland between 1933 and 1968. The catch composition is represented by the percentage of females in the catch.

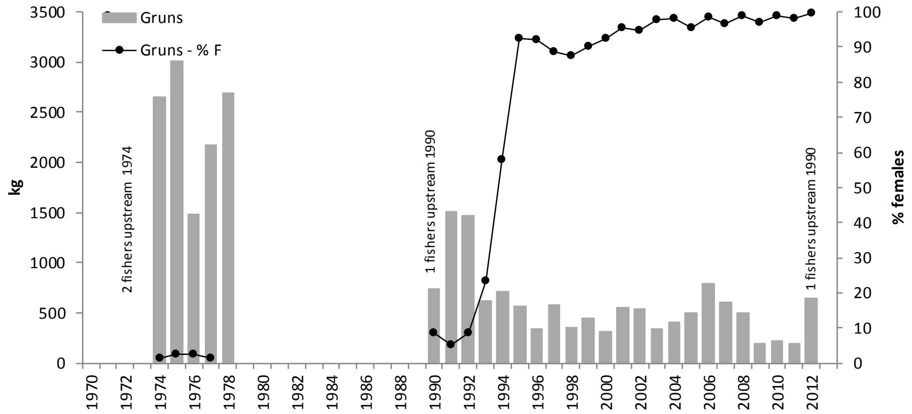

Figure NL.7. Silver eel catches in kg at a site in Friesland between 1974 and 1978 and between 1990 and 2012. The catch composition is represented by the percentage of the catch that consists of females.

Silver eel catches at two sites (Inthiemasloot and Korte Vliet) in Friesland declined already in the late 1950 and fishing for silver eel at those two locations ceased in 1968 due to reduced catches. This decline coincided with a temporary change in the sex ratio of the catch from predominantly males to a higher fraction (>25%) of females. After less than ten years, however, the catch composition was again dominated by male silver eel. The third site (Gruns), with silver eel catch data from 1974–1978 and from 1990 onwards, shows declined catches in the early 1990s compared to the 1974–1978 data. In addition to the decline in the total volume of the annual catch, the sex ratio reversed from a male dominated catch to a female dominated catch. This reversal in sex ratio means that the decline in numbers of silver eel caught is more pronounced than the decline in catch weight, as the average female silver eel (ca. 700 gr) weighs significantly more than the average male (ca. 100 gr). This is illustrated in Figure NL.8.

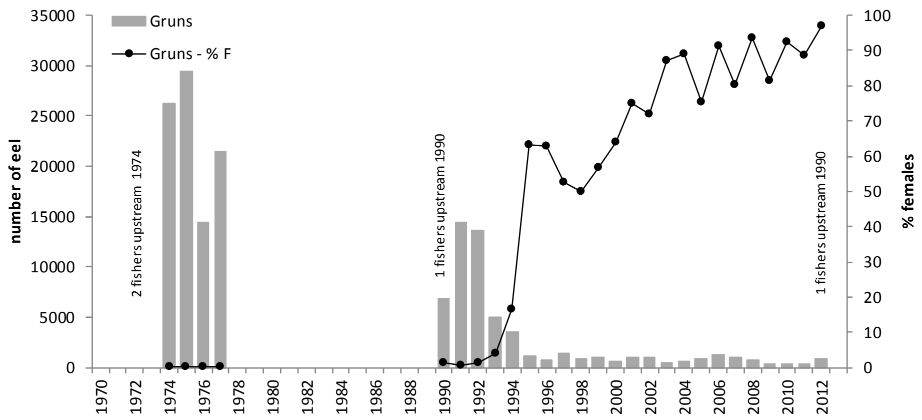

Figure NL.8. Silver eel catches in numbers at a site in Friesland between 1974 and 1978 and between 1990 and 2012. The catch composition is represented by the percentage of females in the catch.

3.3.2 Recreational

NO AVAILABLE DATA.

3.4 Aquaculture production

3.4.1 Seed supply

Table NL.D. Origin of glass eel used for aquaculture in the Netherlands since 2010 (Source DUPAN).

Season	France	Spain	England	Total (kg)
2010/2011	4725	1890	135	6750
2011/2012	5325	1350	100	6775
2012/2013	5500	650	550	6700
2013/2014	3400	250	1250	4900

3.4.2 Production

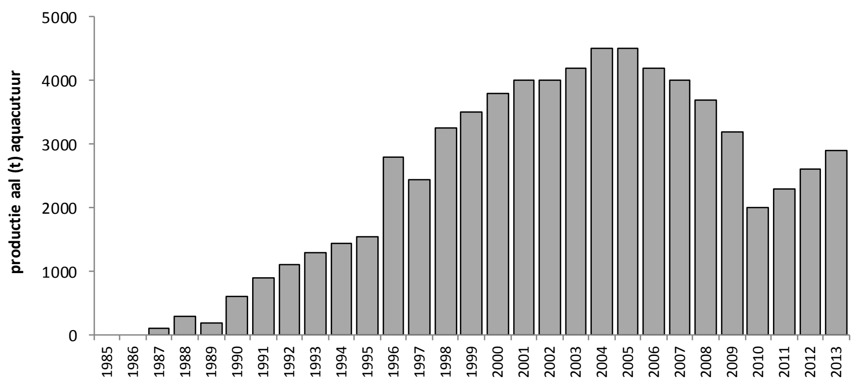

Figure NL.9. Trend in aquaculture production of yellow eel for consumption in the Netherlands (Source DUPAN).

3.5 Stocking

3.5.1 Amount stocked

Table NL.E. Overview of glass eel and young yellow eel stocked in the Netherlands in 2013 (Source DUPAN and CvB). For yellow eel, the location where they have been raised is set between brackets in the column 'Origin'.

Date	Stocking Location	Origin	Quaran-tined	kg	#	#/kg
GLASSEEL						
01/04/2014	Wieringermeer	UK Severn	N	26	84,500	3250
01/04/2014	Zeeland (semi-closed areas)	UK Severn	N	60	195,000	3250
02/04/2014	Veersemeer	South France	N	175	560,000	3200
02/04/2014	Grevelingenmeer	South France	N	900	2,940,000	3267
03/04/2014	Noord-Holland	UK Severn	N	377	1,225,000	3249
07/04/2014	Friese Boezem	South France	N	592	1,900,000	3209
09/04/2014	Noord-West Overijssel	UK Severn	N	80	260,000	3250
09/04/2014	Zuid-Holland (semi-closed areas)	UK Severn	N	91	295,750	3250
09/04/2014	Groningen	UK Severn	N	40	130,000	3250
April-May	Den Oever	Local	N	119	357,000	3000
			Total	2,460	7,947,250	
YOUNG YELLOW EEL						
21/05/2014	Tjeukemeer/ Sneekermeer	South France (Nijmegen)	Y	1,855	530,000	286
21/05/2014	Kampen	South France (Nijmegen)	Y	159	45,500	286
21/05/2014	Elburg	South France (Nijmegen)	Y	18	5,000	286
21/05/2014	Harderwijk	South France (Nijmegen)	Y	298	85,000	286
05/09/2014	Markermeer Lelystad	UK Severn (Denmark)	Y	600	208,000	347
05/09/2014	Markermeer Hoorn	UK Severn (Denmark)	Y	612	212,000	346
			Total	3,541	1,085,500	

3.5.2 Catch of eel <12 cm and proportion retained for restocking

Catch and retention of eels <28 cm is illegal. There is no organised trap and transport of undersized eels.

3.5.3 Reconstructed time-series on stocking

No (historical) data available with regards to origin and whether or not stocked eels were quarantined, overall all stocked of glass eel (see Figure NL.6) is sourced outside the Netherlands.

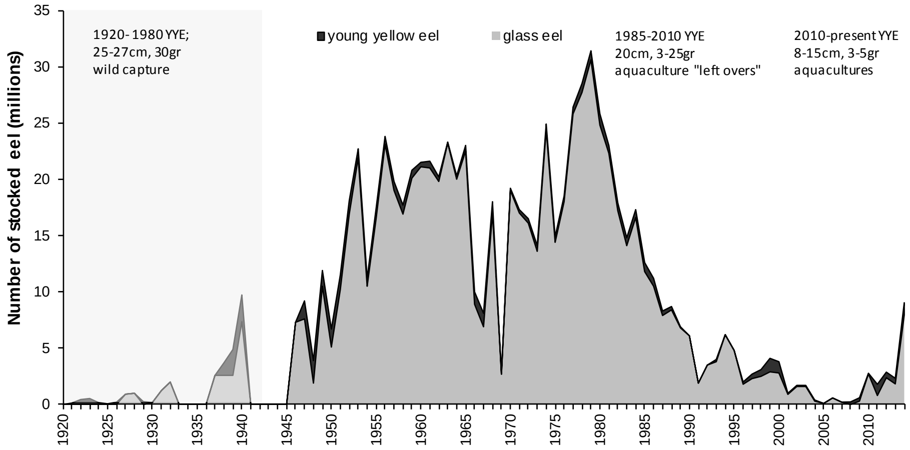

Figure NL.10. Overview of stocking of glass eel and young yellow eel in the Netherlands. Note that the average weight of stocked young yellow eel decreased from ~30g to ~3 g between 1920 and 2010.

3.6 Trade in eel

Source	Destination	Stage	Kg	Market value (€/kg)
South France	Netherlands	glass eel	2,329	?
UK Severn	Netherlands	galss eel	1,212	?
		TOTAL	3,541	

4 Fishing capacity

For marine waters and Lake IJsselmeer, a register of ships is kept, but for the other waters, no central registration of the ships being used is available. Registration of the number of gears owned or employed was lacking until recently.

For Lake IJsselmeer/Markermeer (Figure NL.11), an estimate of the number of gears actually used is available for the years 1970–1988 (Dekker, 1991). In the mid-1980s, the number of fykenets was capped, and reduced by 40% in 1989. In 1992, the number of eel boxes was counted, and capped. Subsequently, the caps have been lowered further in several steps, the latest being a buy-out in 2006. Since the number of companies has reduced at the same time, the nominal fishing effort per company has not reduced at the same rate, and underutilisation of the nominal effort probably still exists. The effort in the longline fishery is not restricted, other than by the number of licences.

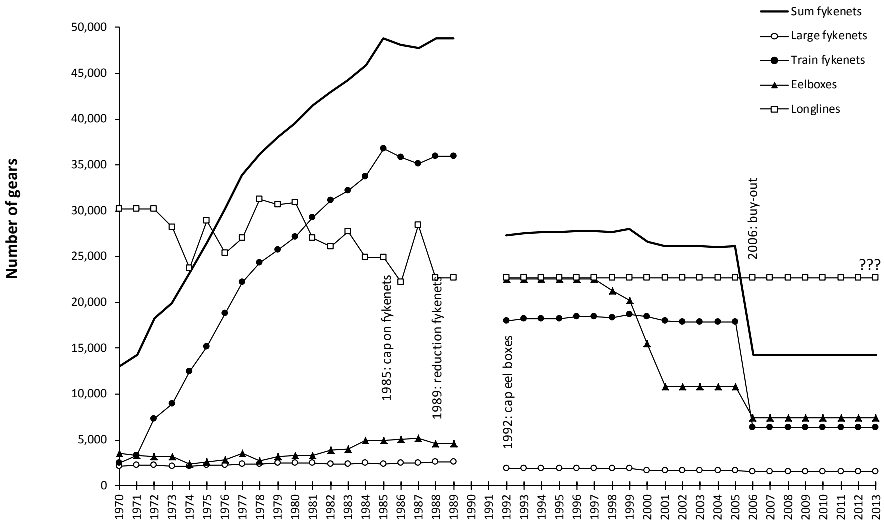

Figure NL.11. Trends in the nominal number of fishing gear employed in the eel fishery on Lake IJsselmeer/Markermeer. Information before 1989 is based on a voluntary inquiry in 1989 (Dekker, 1991); after 1992, the licensed number of gear is shown. Note that longline fishery is only restricted by the number of licences, the number of longlines per licence is not regulated. The number of longlines since 1992 is unknown.

5 Fishing effort

5.1 Glass eel

No fishing on glass eel.

5.2 Yellow eel

No distinction between fishing effort on yellow eel and silver eel. Data are combined.

For most of the country, fishing effort was unknown until 2012. In areas where fishing capacity was known (IJsselmeer/Markermeer, no record had been kept of the actual usage of fishing gears. For Lake IJsselmeer, a maximum number of gears by company is enforced (authenticated tags are attached to individual gears; see Chapter 0), but the actual usage is often much lower, amongst others since restrictions apply on the combinations of types of fishing gears (e.g. fykenets and gillnets should not be operated concurrently, since perch and pikeperch are the target species of the gillnetting, whereas landing perch and pikeperch from fykenets is prohibited).

A national catch registration system was introduced by Ministry of Economic Affairs on 1/1/2010. Since 2012, eel fishers are obliged for the first time to weekly record their effort in addition to their catches; all eel fishers have to record the type of gear and number of gear used. Overviews of the number and type of gear deployed weekly throughout 2013 is presented in Figure NL.12 for Lake IJsselmeer/Markermeer (combined) and in Figure NL.13 for the other locations in The Netherlands (combined). In general, effort was fairly constant throughout the season, with at most a slight increase during the season. Only eelboxes were deployed mainly in the first half of the season.

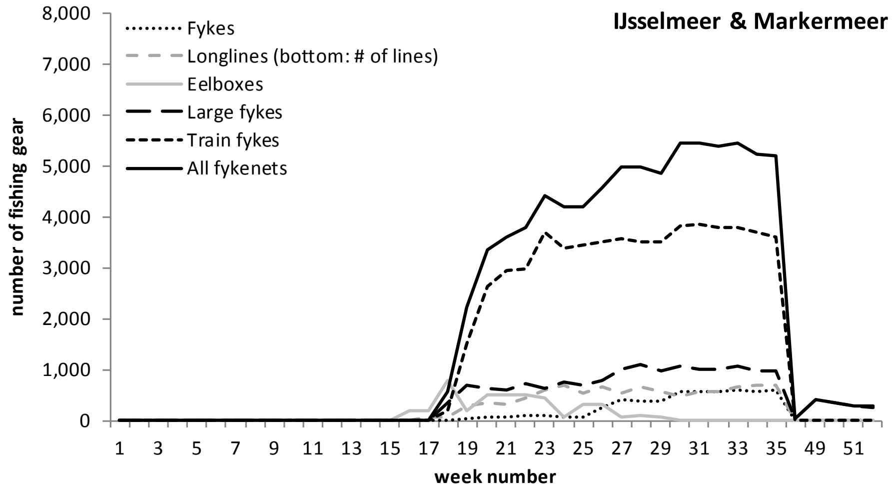

Figure NL.12. The number of fishing gear employed weekly in the eel fishery on Lake IJsselmeer and Markermeer (Source EZ).

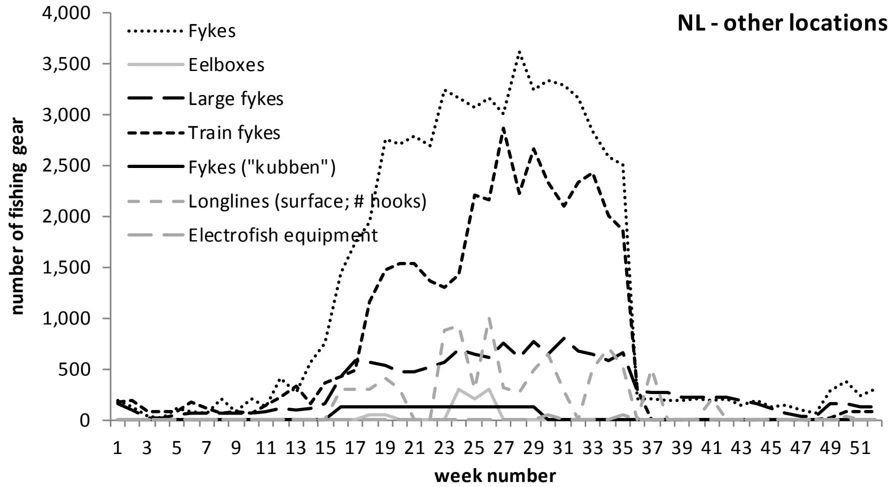

Figure NL.13. Number of fishing gear employed weekly in the Dutch eel fishery in 2013 on other locations throughout the Netherlands (source EZ).

The comparison of the maximum number of each eel fishing gear type deployed in IJsselmeer/Markermeer in 2012 and 2013 with the maximum number of markers allowed (Table NL.F) demonstrates that for most gears there was an 'overcapacity' of fishing gears; the number of actually used fishing gears was considerably lower that the number of legally allowed gears.

Table NL.F. Maximum number of eel fishing gear deployed weekly by the eel fishery in 2012 and 2013, on Lake IJsselmeer and Markermeer and on other locations. The number of fishing gear ("markers") allowed on Lake IJsselmeer/Markermeer is also given (6th column). [1] Longlines employed in IJsselmeer/Markermeer are bottom lines, longlines employed elsewhere are surface lines; [2]The gear type listed as "Fykes" has been included in the gear type Large fykes.

	IJsselmeer/Markermeer					Other locations	
Gear type	2012		2013		Available	2012	2013
	no.	%	no.	%		no.	no.
Longlines[1]	755	--	695	--	no limit	1330	1040
Eelboxes	1300	18	800	11	7400	125	300
Large fykes[2]	1795	19	1706	18	9400	4953	4523
Train fykes	4311	68	3842	60	6380	2955	2861
Electrofish equipment	--		--			6	57

5.3 Silver eel

No distinction between fishing effort on yellow eel and silver eel. Data are combined and reported under yellow eel (Paragraph 0).

5.4 Marine fishery

Only the number of vessels reporting eel catches are known. These are reported in paragraph 0, Figure NL.14.

6 Catches and landings

6.1 Glass eel

Glass eel fishing is forbidden; no data available.

6.2 Yellow eel

6.2.1 Catches and/or landings from Lake IJsselmeer/Markermeer

The fishers organisation (PO IJsselmeer) has kept records of the catches of their associated fishers (>90% of the fishers active in the IJsselmeer area) from 2001 onwards (see Section NL0). Yellow eel catches and silver eel catches are reported separately (Table NL.G). In addition, in January 2010, an obligatory catch registration system was introduced in the Netherlands by the Ministry of Economic Affairs (EZ). In this program weekly catches of eel are reported, but yellow eel and silver eel catches are combined (Table NL.H). No information on effort and gears is reported.

Catches from the IJsselmeer have declined following the partial ban on eel fishery (September–November annually) as a result of the Council regulation for European Eel (2008) and the ensuing Dutch Eel management plan.

Table NL.G. Left table: Catches of yellow eel in tonnes by year for the IJsselmeer area. Right table: Catches of silver eel in tonnes by year for the IJsselmeer area. (Source: PO IJsselmeer).

Yellow eel			Silver eel		
Decade Year	2000	2010	Decade Year	2000	2010
0		78	0		1
1	364	122	1	41	2
2	299	120	2	44	1
3	255	74	3	38	16
4	242		4	38	
5	213		5	25	
6	191		6	33	
7	175		7	13	
8	135		8	7	
9	99		9	5	

6.2.2 Catches and/or landings from other areas

In January 2010, an obligatory catch registration system was introduced in the Netherlands by the Ministry of Economic Affairs (EZ). In this program weekly catches of eel are reported, but yellow eel and silver eel catches are combined (Table NL.H). No information on effort and gears is reported.

The reduction in catches following the closure of a most river systems due to high contamination levels in eel is apparent (Table NL.H).

Table NL.H. Comparison of combined yellow eel and silver eel catches in 2013 from different sources for IJsselmeer area and other areas in The Netherlands.

Source	IJsselmeer		other areas
	PO	EZ	EZ
2010	79	128	324
2011	124	179	188
2012	121	168	182
2013	90	144	171

6.3 Silver eel

The fishers organisation (PO IJsselmeer) has kept records of the catches of their associated fishers (>90% of the fishers active in the IJsselmeer area) from 2001 onwards (see Section NL0). Yellow eel catches and silver eel catches are reported separately (Table NL.G).

Catches from the IJsselmeer area have declined following the partial ban on eel fishery (September–November annually) as a result of the Council regulation for European Eel (2008) and the ensuing Dutch Eel management plan. Catches in 2013 were high compared to the previous years.

6.4 Marine fishery

Catches and landings in marine waters are registered in EU logbooks, but these do not allow for a break down by RBD. Annual registrations are available since 1995; data prior to 1984 are presented in the 2009 Country Report. Until 2001, vessels with a total length (LOA) ≥15 m were obliged to report all their eel catches; this obligation did not apply to smaller vessels. From 2001 onwards, vessels with a total length ≥10 m are obliged to report their eel catches, but only if their landings per day exceeded 50 kg. Thus, in 2001 the number of ships potentially reporting eel catches rose, but the actual reporting per ship potentially declined. This change the regulation was partly driven by changing practices, and vice versa.

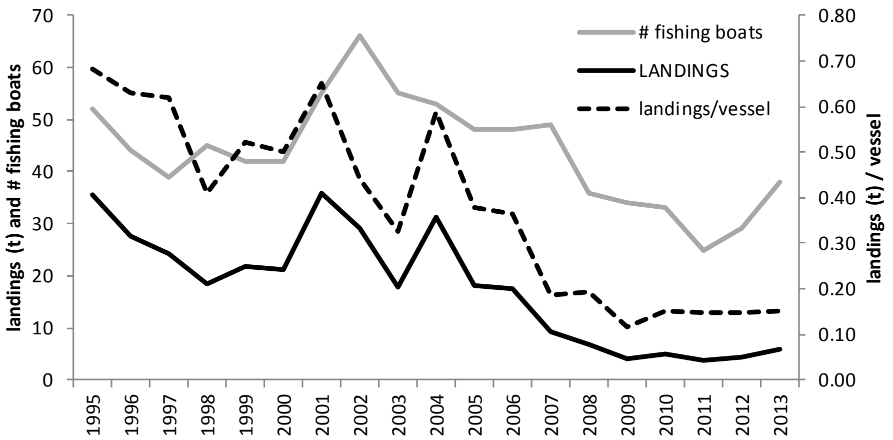

Figure NL.14. Registered landings of eel (no distinction available between yellow eel and silver eel) from marine waters in Dutch harbours since 1995.

The number of vessels reporting eel catches, total landings and the landings per vessel have declined from 2001 until 2009. Since 2009, landings and landings by vessel have remained more or less constant, whereas the number of vessels reporting catches varied, with lower numbers in 2011 and 2012.

6.5 Recreational fishery

In 2009 an extensive Recreation Fisheries Program was started in the Netherland. In December 2009, 50 000 households were approached during the screening survey to determine the number of recreational fishermen in the Netherlands (result 1.69 million recreational fishermen). In 2010, 2000 recreational fishermen were selected for a 12-month logbook programme (March 2010–February 2011). In the Netherlands about 1 500 000 eels are caught by recreational fishermen, while about 500 000 eels are retained. Due to the lack of reliable length–frequency data of the eel caught, raising the number of eels caught to a biomass estimate of eel caught remains difficult (van der Hammen and de Graaf, 2012). The programme was repeated in 2012/2013 and the data have been analysed, but not yet been reported.

Table NL.I. Recreational Fisheries: Retained and Released Catches of eel (in numbers) in the Netherlands in inland and marine areas. [1]Only combined numbers from both angling and passive gears were available.

	RETAINED				RELEASED			
	Inland		Marine		Inland		Marine	
Year	Angling	Passive Gears	Angling	Passive gears	Angling	Passive gears	Angling	Passive gears
2010	34 0536[1]	ibid.	174 215[1]	ibid.	872 570[1]	ibid.	108 462[1]	ibid.

Table NL.J. Recreational Fisheries: Catch and Release Mortality for eel in the Netherlands.

	RELEASED			
	Inland		Marine	
Year	Angling	Passive gears	Angling	Passive gears
2012	0%	0%	0%	0%

6.6 Bycatch, underreporting, illegal activities

6.6.1 Bycatch

No available data.

6.6.2 Underreporting and illegal catches

The task of adherence to rules and regulations pertaining to eel fishery in carried out by Netherlands Food and Consumer Product Safety Authority. Following indication of illegal eel fishing in 2012, they intensified their monitoring in 2013. The overall result (number of fishers involved and total illegal catch) of the illegal fishing activities are reported in the annual report of the NVWA over 2013: http://www.nvwa.nl/onderwerpen/meest-bezocht-a-z/dossier/ jaarverslag-2013/pal-ingstroperij (Table NL.L).

Table NL.K. Estimation of underreported catches in 2013 by stage.

	Glass eel				Yellow eel				Silver Eel				Combined (Y + S)			
EMU	Reported catches (kg)	Underrept. %	Underrept. (kg)	Total catches (kg)	Reported catches (kg)	Underrept. %	Underrept. (kg)	Total catches (kg)	Reported catches (kg)	Underrept. %	Underrept. (kg)	Total catches (kg)	Reported catches (kg)	Underrept. %	Underrept. (kg)	Total catches (kg)
NL																
Total/mean (%)															NC	

Table NL.L. Existence of illegal activities, its causes and the seizures quantity they have caused. For indications used in the column 'Cause' see Table NL.M.

	Glass eel			Yellow eel			Silver Eel			Combined (Y +S)		
EMU	Y/N/?	Cause	Seizures (kg)	Y/N/?	Seizures (kg)	Cause	Y/N/?	Seizures (kg)	Cause	Y/N/?	Seizures (kg)	Cause
NL	NP			ND			ND			Y	4.402	1.

Table NL.M. Overview of suspected causes of illegal fishing activities in the Netherlands.

Cause		IJsselmeer	other areas
1.	Fishing out of the season	Y	Y
2.	Fishing without licence	Y	Y
3.	Fishing using illegal gears	Y	Y
4.	Retention of eel below size limit	?	?
5.	Illegal selling of catches	?	?

7 Catch per unit of effort

No data available.

8 Other anthropogenic and environmental impacts

8.1 Assisted migration of silver eel

Since 2011 several (pilot) projects have started at migration barriers (pumping stations) to assist the migration of silver eel. In 2011 0,54 t of silver eel was caught and released again past barriers at four sites ('assisted migration'). In 2012 this amount increased almost tenfold to 4,80 t (15 sites), and in 2013 to 9,32 t (25 sites; Figure NL.15).

However, the mortality rates of silver eel passing the selected barriers has been assessed at moderate to low (Bierman *et al.*, 2012; Winter *et al.*, 2013). Thus, the net amount of eels saved by the assisted migration is much lower than the amount caught and released. In 2013 the barriers for silver eel were prioritised (Winter *et al.*, 2013) to improve the selection and efficiency of assisted migration initiatives. Applying location-specific mortality rates, the net amount of 'saved' eels was 0,14 t in 2011, 0,72 t in 2012 and 0,86 t in 2013, a five-fold (2012) to six-fold increase (2013) compared to 2011 (Figure NL.15).

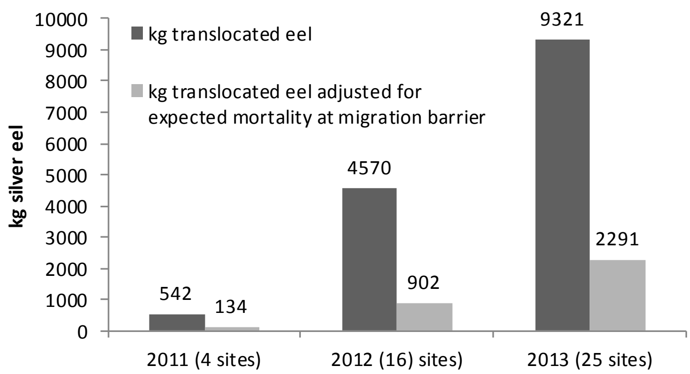

Figure NL.15. Overview of the "gross" and "net" amount of silver eel assisted over migration barriers in the Netherlands.

9 Scientific surveys of the stock

9.1 NL.G.1 Recruitment surveys, glass eel

See Paragraph 0.

9.2 NL.G.2 Stock surveys, yellow eel

9.2.1 Lake IJsselmeer/Markermeer (active gear)

Figure NL.14 presents the trends in cpue for the annual (yellow) eel surveys in Lake IJsselmeer (25 sites) and Lake Markermeer (15 sites), using the electrified trawl.

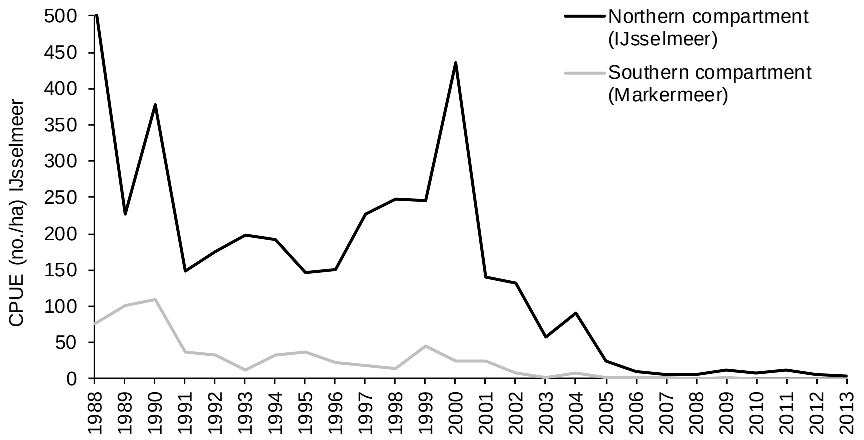

Figure NL.16. Cpue trends in Lake IJsselmeer stock surveys, in number per hectare swept area, using the electrified trawl. Note: The northern and southern compartments have been separated by a dyke since 1976.

9.2.2 Main rivers (active gear)

Data collected for the main rivers, but not (yet) available.

9.2.3 Main rivers (passive gear)

No new data.

9.2.4 Coastal waters (active gear)

The number of eel caught in a coastal survey (Demersal young Fish Survey) is presented in Figure NL.15. Until the mid-1980s, considerable catches of eel were observed. Since that time, a gradual decrease is observed. A more elaborate statistical analysis of the abundance and length composition of the eel stock in coastal waters is presented in Dekker (2009).

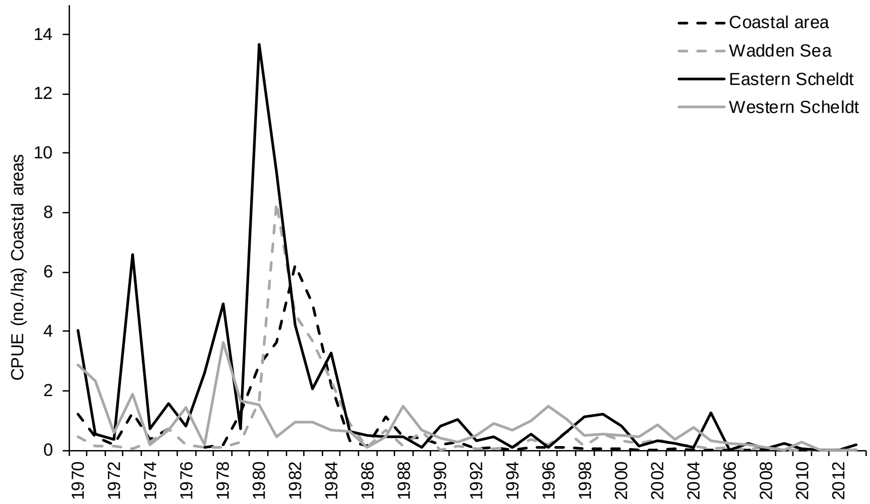

Figure NL.17. Trends in coastal survey cpue. Most of the Wadden Sea belongs to RBD Rhine; Eastern Scheldt is mixed RBD Scheldt and Meuse; Western Scheldt belongs to RBD Scheldt (with an extra inflow from Meuse), the coastal area belongs to RBD Rhine.

9.3 NL.G.3 Silver eel

The Silver Eel Index has been implemented in the Netherlands since 2012. In cooperation with commercial fishermen the abundance of migrating silver eel is monitored on seven locations (main entry and exit points for migratory fish) during the months September–November. The programme and the results will be presented and discussed when sufficient data have become available, after at least five years.

10 Data collected for the DCF

Table NL.N. Summary of the DCF monitoring implementation for The Netherlands.

DATA	RIVER	LAKES	ESTUARIES	LAGOONS	COASTAL & MARINE
Production / escapement surveys[1]	Y (WFD)	Y (WFD)	NP	NP	NP
No. of recruitment time-series surveys[2]	10	1	NP	NP	NP
No. fished aged	100		0	0	0
No. of fished sexed	531		0	0	0
No. of fish examined for parasites	531		0	0	0
No. of fish examined for contaminants	ca. 475		0	0	0
No. of non-fishery mortality studies[3]	1	0	0	0	0
Socio-economic survey	0	0	0	0	0

[1] Surveys to estimate B_{best} and/or $B_{current}$, including WFD surveys of which the data are being used to estimate production and/or escapement of eel.

[2] Fishery-independent surveys.

[3] Studies to determine ∑H for non-fisheries anthropogenic impacts (hydropower, barriers, predation, etc.)

11 Life history and other biological information

11.1 Growth, silvering and mortality

See Bierman *et al*., 2012.

11.2 Parasites and pathogens

The swimbladder nematode *Anguillicoloides crassus* was introduced in wild stocks of European eel in The Netherlands in the early 1980s, from Southeast Asia. The market sampling for Lake IJsselmeer collects information on eels showing *Anguillicoloides crassus* infection based on inspection of the swim bladder by the naked eye. We scored an infection as 'present' when either we observed one or more *Anguillicoloides crassus* or a thickened swimbladder. As part of the extended market sampling programme in 2009, data on *Anguillicoloides* infection rates have since also been collected in two other areas (Friesland and Rivers), and since 2011 the market sampling was conducted in most of the country.

Following the initial break-out in the late 1980s, infection rates in Lake IJsselmeer have been stable around 50%. Over the past years, infection rates appear slightly lower both in the southern compartment of Lake IJsselmeer (i.e. Markermeer) and on average in the rest of the Netherlands (Table NL.O).

Table NL.O. Infection rates of eels with *A. crassus* in the Netherlands. [1]Median infection rates of all sampled locations.

	IJSSELMEER		MARKERMEER		FRYSLAN			OTHER LOCATIONS		
	N eels	% infected	N eels	% infected	N locations	N eels	% infected	N locations	N eels	% infected[1]
2010	390	49	225	48	11	534	46	10	1660	48
2011	293	43	104	34	5	107	37	17	1087	33
2012	320	53	253	38	5	133	33	17	1235	34
2013	159	55	93	43	2	17	47	9	531	38

11.3 Contaminants

In 2013, 19 locations have been sampled to assess contaminant levels (dioxins and dioxin-like PCBs) in eel. Samples consisted of about 25 individuals, 30–40 cm or >45 cm length, and were pooled prior to analysis. (Table NL.P).

Table NL.P. Monitoring data of PCBs and dioxin-like PCBs in eel in The Netherlands. Grey-shaded results are above limits.

Area, location	size class (cm)	no. eels	Mean length (cm)	Mean weight (g)	Sum TEQ (ub,pg/g)	PCB 153 (ng/g)	Sum dioxin-like PCBs (UB, ng/g)
Amsterdam-Rijnkanaal	30-40	25	36	84	10.5	138	330
Amsterdam-Rijnkanaal	>45	8	50	239	14.9	256	
Haringvliet, seaside	30-40	5	38	73	1.7	26	42
Haringvliet, seaside	40-45	11	44	112	2.6	25	38
Haringvliet, seaside	>45	23	56	259	5.5	47	77
Hollands Diep	30-40	25	36	89	6.3	179	390
Hollands Diep	>45	15	61	493	21.4	471	970
IJssel, Deventer	30-40	17	36	69	4.0	90	200
IJsselmeer, Lelystad	30-40	25	36	85	3.1	31	64
IJsselmeer, Lelystad	>45	14	51	251	7.6	75	150
IJsselmeer, Urk	30-40	25	35	74	4.0	44	92
IJsselmeer, Urk	>45	12	53	326	6.6	76	170
IJsselmeer, Medemblik	30-40	25	35	80	1.5	13	25
IJsselmeer, Medemblik	>45	12	54	334	3.9	26	52
Kan Gent-Terneuzen	30-40	2	39	104	7.8	154	370
Kan Gent-Terneuzen	>45	5	53	277	9.7	189	460
Kan Wessem-Nederweert	>45	17	61	415	11.2	228	510
Ketelbrug, north side	30-40	17	36	84	7.1	118	250
Ketelbrug, south side	30-40	21	34	70	5.9	151	300
Ketelbrug, south side	>45	13	53	313	12.0	216	460
Ketelbrug, north side	>45	15	55	341	14.0	173	380
Ketelmeer, north	30-40	11	36	87	7.1	128	270
Ketelmeer, north	>45	14	56	388	23.2	246	550
Lek, Culemborg	30-40	21	35	74	4.7	124	280
Maas, Eijsden	30-40	8	35	79	6.8	216	500
Maas, Eijsden	>45	5	50	253	13.0	355	830
Rijn, Lobith	30-40	4	36	77	5.3	110	250
Rijn, Lobith	>45	9	53	302	8.3	153	350
Volkerak shiplock	30-40	25	36	83	3.7	83	180
Volkerak shiplock	40-45	10	43	155	7.3	117	260
Volkerak shiplock	>45	15	50	238	10.6	151	350
Volkerak south-west	30-40	25	37	88	4.5	53	110
Volkerak south-west	>45	18	54	399	8.2	98	210
Vossemeer	30-40	25	34	75	7.4	111	240
Vossemeer	>45	5	55	345	12.5	151	340
Waal, Tiel	30-40	9	37	87	6.9	125	300
Waal, Tiel	>45	22	60	443	14.7	215	530

Contaminant concentrations are higher in larger eel than in smaller eel from the same locations. In 2013, several samples have contaminant levels above the revised regulatory limits of 2012 (10 pg/g Sum TEQ and 350 ng/g PCB-153, 10% uncertainty included). All locations that did have eels with a concentration of Sum TEQ or Sum dioxins and dioxin-like PCBs above the regulatory levels were fed by the rivers Rhine (IJssel), Meuse or Scheldt. Following the closure of these areas to eel fishery, samples are no longer available from these Rhine- or Meuse-fed locations.

Since 1978/1979 several locations have been monitored annually for PCB-153. Concentrations in 2013 were about similar to those in previous year.

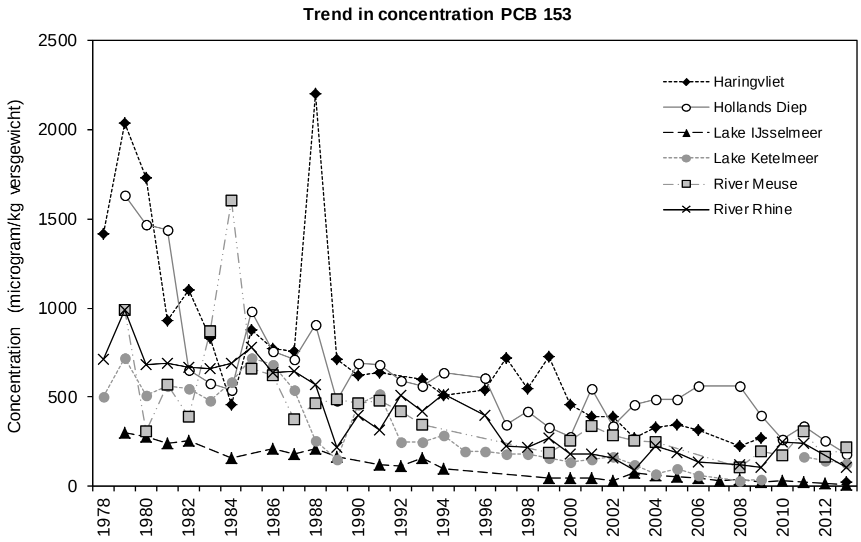

Figure NL.18. Trend in PBC-153 in 30–40 cm eel (data: IMARES and RIKILT).

11.4 Predators

Predation of eel by cormorants (*Phalacrocorax carbo*) is much disputed amongst eel fishermen and bird protectors. The number of cormorant breeding pairs increased rapidly until the early 1990s, then stabilised and even decreased in recent years (Figure NL.19). For Lake IJsselmeer, food consumption has been well quantified (van Rijn and van Eerden, 2001; van Rijn, 2004); eel constitutes a minor fraction of the diet of cormorants. In other waters, neither the abundance, nor the food consumption is accurately known.

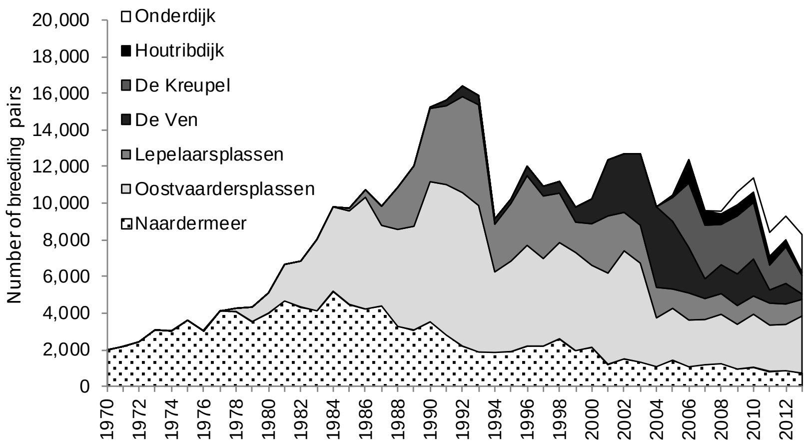

Figure NL.19. Trends in the number of breeding pairs of cormorants (*Phalacrocorax carbo*) in and around Lake IJsselmeer/Markermeer (Source: Waterdienst RWS).

12 Other sampling

Nothing to report.

13 Stock assessment

13.1 Method summary

Bierman SM, Tien N, van de Wolfshaar KE, , Winter HV, de Graaf M (2012) Evaluation of the Dutch Eel Management Plan 2009-2011. IMARES C067/12, pp. 132.

13.1.1 Estimate of B_0

Table NL.Q. Reference period for B_0.

EMU_CODE	B_0 (KG/HA)	REFERENCE TIME PERIOD	WHETHER OR NOT CHANGED FROM VALUE REPORTED LAST YEAR (Y/N)
NL_Neth	10.400	2011	N

13.2 Summary data

The summary data in the tables below are from “2011” as presented in Bierman *et al.* (2012).

13.2.1 Stock indicators and targets

Table NL.R. Stock indicators and Target derived from: Bierman *et al.*, 2012.

EMUCODE	INDICATOR	BIOMASS (T)		MORTALITY (RATE)			TARGET		
	B_0	B_{best}	B_{curr}	∑A	∑F	∑H	Source	Biomass (t)	∑A (rate)
NL_Neth	10.400	1.443	482	1.1	1.16	0.04	EMP		
							EU Reg	4160	
							WGEEL		0.106

13.2.2 Habitat coverage

Table NL.S. Habitat coverage derived from Bierman *et al.*, 2012.

EMU code	River		Lake		Estuary		Lagoon		Coastal	
	Area (ha)	A'd (Y/N)	Area (ha)	A'd (Y/N)	Area (ha)	A'd (Y/N)	Area (ha)	A'd (Y/N)	Area (ha)	A'd (Y/N)
NL_Neth	88 391	Y	232 758	Y	NP	NP	NP	NP	358 802	N

13.2.3 Impact

Table NL.T. Overview of the assessed impacts per habitat type or for 'All' habitats where the assessment is applied across all relevant habitats. Barriers include habitat loss; indirect impacts are anthropogenic impacts on the ecosystem, but only indirectly on eel (e.g. eutrophication). A = assessed, MI = not assessed, minor, MA = not assessed major, AB = impact absent.

EMU code	Habitat	Fish com	Fish rec	Hydro & pumps	Barriers	Restocking	Predators	Indirect impacts
NL_Neth	Riv	A	A	A	A	MI/MA	MI/MA	MI/MA
	Lak	A	A	A	A	MI/MA	MI/MA	MI/MA
	Est	NP	NP	NP	NP	NP	NP	NP
	Lag	NP	NP	NP	NP	NP	NP	NP
	Coa	MI	A	AB	AB	AB	AB	MI
	All							

Table NL.U. Loss of eel (kg) for each impact per developmental stage. MI = not assessed, minor; MA = not assessed major; AB = impact absent. [1]All eel caught recreationally were assumed to be yellow eel. [2]Including 6 t mortality of GER/BE silver eel.

EMU code	Stage	Fish com	Fish rec	Hydro & pumps	Barriers	Restocking	Predators	Indirect impacts
NL_Neth	Glass	AB	AB	MI/MA	MI/MA	MI	MI/MA	MI/MA
NL_Neth	Yellow	290	100	MI/MA	MI/MA	AB	MI/MA	MI/MA
NL_Neth	Silver	77	AB[1]	76[2]	MI/MA	AB	MI/MA	MI/MA
NL_Neth	Silver EQ							

13.2.4 Precautionary diagram

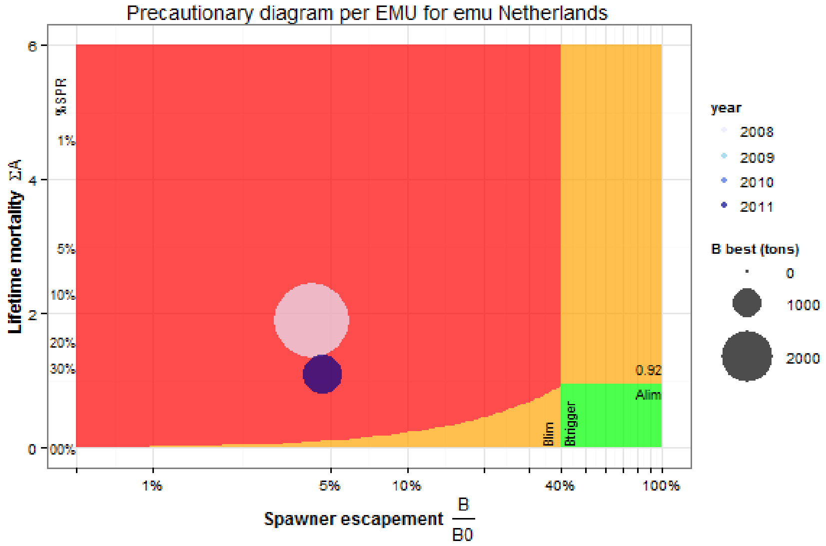

Figure NL.20. Modified precautionary diagram for the Netherlands EMU (after WGEEL 2012), see Section 1.3.2 of ICES 2013) for more information.

13.2.5 Management measures

Table NL.V. Proposed and implemented management measures. Com fish: commercial fisheries; Rec fish: recreational fisheries; 'Hydropower & Pumps' includes obstacles; 'Other' refers to indirect measures (e.g. implementing data collection and conducting studies).

EMU CODE	Action Type	Action	Life Stage	Planned	Outcome
NL_Neth	Com Fish	Closing fishing season	M	EMP	Fulfilled
NL_Neth	Com Fish	Introducing fishery-free zones	M	EMP	Fulfilled
NL_Neth	Com Fish	Closure of fishery in contaminated areas	M	After EMP	Fulfilled
NL_Neth	Com Fish	Sniggling Ban	M	EMP	Fulfilled
NL_Neth	Rec Fish	Eel releasing by anglers	M	EMP	Fulfilled
NL_Neth	Rec Fish	Ban on recreational fishery using professional gears	M	EMP	Fulfilled
NL_Neth	Rec Fish	Closing fishing season	M	EMP	Fulfilled
NL_Neth	Rec Fish	Sniggling ban	M	EMP	Fulfilled
NL_Neth	Hydropower & Pumps	Barriers reduction from 2015	M	EMP	Partially
NL_Neth	Hydropower & Pumps	Hydroelectric stations barriers reduction	M	EMP	Partially
NL_Neth	Restocking	Stocking with glass eels	M	EMP	Fulfilled

13.3 Summary data on glass eel

Table NL.W. Overview of use of glass eel. [1]Not all translocated glass eel is stocked for recovery purposes.

USE OF GLASS EEL	2009	2010	2011	2012	2013	2014
Caught in commercial fishery	0	0	0	0	0	0
Used in stocking[1]	100	904	244	766	630	2.460
Used in aquaculture for consumption	?	?	6.750	6.775	6.700	4.900
Consumed directly	0	0	0	0	0	0
Mortalities	?	?	?	?	?	?

14 Sampling intensity and precision

No new information.

15 Standardisation and harmonisation of methodology

15.1 Survey techniques

GLASS EEL MONITORING				
Gear	Location	Frequency	Time	Period
liftnet (1x1 m; mesh 1x1 mm)	Den Oever	daily	five hauls every two hours between 22:00–5:00	~March–May
liftnet (1x1 m; mesh 1x1 mm)	ten other locations along the coast	weekly	two hauls at night time	~March–May

SILVER EEL MONITORING				
Gear	Location	Frequency	Time	Period
Fykes (six sites)	Den Oever, Kornwerderzand, Noordzeekanaal, Nieuwe waterweg, Haringvliet, upper reaches river Meuse	continuous	weekly	September–November
Eel shocker	upper reaches river Rhine	continuous	once a week	September–November

Passive monitoring program: Main rivers and Lake IJsselmeer			
Gear	Location	Frequency	Period
fykes (4) (stretched mesh 18–20 mm)	Veerse Meer, Haringvliet (North Sea)	continuous	~May–September
Fykes (10) or summer fykes (20–40) (stretched mesh 18–20 mm)	seven locations in main rivers, estuaries and lakes	continuous	September–November
Fykes (10) or summer fykes (20–40) (stretched mesh 18-20 mm)	six locations in main rivers, estuaries and lakes	continuous	March–May

Due to closure of the eel fishery in polluted areas, this programme, which started in the 1990s, has been interrupted. Almost two thirds of the sampling locations were located in the polluted areas and sampling ceased on 1 April 2011. An alternative programme is currently being developed and will hopefully start in 2013.

Active monitoring program: Main rivers			
Gear	Location	Frequency	Period
bottom trawl (channel; 3 m beam; 15 mm stretched mesh)	~50 locations in main rivers	10 min trawl, ~1000m transect	~May–September
Electrofishing (shore area)	~50 locations in main rivers	20 min, 600 m transect	~May–September

15.2 Sampling commercial catches

Area	Sampling frequency	No. of fishers sampled	Gear
Grevelingen	once	1	large fyke
Friesland	once	2	large fyke
Hollands Noorderkwartier	twice	2	large fyke
IJssel Plus	twice	1	large fyke
Lauwersmeer	once	1	large fyke
Noorderzijlvest	once	1	large fyke
Veluwe Randmeren	twice	1	large fyke
Rijnland	twice	1	large fyke
Volkerak-Zoommeer	twice	1	large fyke
Lake IJsselmeer	once	1	train fyke
Lake IJsselmeer	once/twice	2	large fyke
Lake IJsselmeer	twice	1	eel boxes
Lake IJsselmeer	once	1	longlines
Lake Markermeer	once/twice	2	large fyke
Lake Markermeer	twice	1	longlines

Parameter	Sample details
No. eels for length-frequency	max. 150 eels per sample
No. eels for biology (sex, life stage, parasites)	<50 cm: four eels per 10 cm size class ≥50 cm: two eels per 10 cm size class
Period	June–August (Fryslan: February–April)

15.3 Sampling

Nothing to report.

15.4 Age analysis

Since 2010, age readings have been obtained annually of ~150 otoliths, which were collected from eel in different areas of the Netherlands. The number of annuli were counted to determine the age of individuals (“crack and burn” method). Furthermore, distances between consecutive annuli were measured using image analysis software to determine individual growth curves.

15.5 Life stages

Life stages (yellow, silvering, silver) are visually determined based on colouration of body and fins and eye diameter. Criteria for life stages are at present not formally described.

15.6 Sex determinations

Sex is determined by macroscopic examination of the gonads.

15.7 Data quality issues

Nothing to report.

16 Overview, conclusions and recommendations

During the development of the current models for the evaluation of the eel management plan in the Netherlands, the main weaknesses of the current methodology surfaced quickly. Here we list the main recommendations to improve the quality of the assessment before the next evaluation in 2015.

Dynamic Population Model

Key biological parameters: improve the quality of the following key biological parameters

Sex-ratio of cohorts: estimates could be improved by using eels smaller than 30 cm. These eels could be obtained during the WFD fish sampling.

Growth rate: estimates could be improved by including eels smaller than 30 cm. These eels could be obtained during WFD fish sampling. Population models could be improved by including variation in growth curves between individuals and locations.

Maturation-at-age: estimates of the silvering ogive for a given area could be improved by using data collected year round. Furthermore, it is recommended to record the stage of the eel (yellow/silver) during research surveys (e.g. IJsselmeer electro-trawl survey). Quantitative data on maturity stage should be collected such as eye diameter, rather than a purely visual (informal) assessment. **Anthropogenic mortalities**: quantify sources of anthropogenic mortalities that are excluded from the current assessments; 1) catch-&-release mortality of recreational fisheries, 2) yellow eel mortality pumping stations and hydropower plants.

Static Spatial Model

WFD survey data: improve the accessibility of WFD fish survey data of regionally managed waters by establishing a central database for The Netherlands, and ensure that the data are properly checked to ensure the quality of data.

Catch efficiency: conduct experiments to determine efficiencies of electrofishing for eel in different WFD water types in both nationally and regionally managed waters.

Spatial distribution: conduct experiments to determine the spatial distribution of eel in wide rivers and lakes in both nationally and regionally managed waters.

Ditches: conduct electrofishing surveys for eel in ditches to supplement the existing WFD eel survey data in regionally managed waters.

Habitat: correct eel densities for habitat in nationally and regionally managed waters.

Electro-beam trawl: develop an electro-beam trawl to provide reliable estimates of eel (>30 cm) densities in large lakes and wide rivers.

Silver Eel Migration Model

Migration routes: finalise the GIS model (Appendix A in Bierman *et al.*, 2012) to improve the estimate of silver eel mortality during migration. When this proves difficult or too expensive, an alternative is to further refine the simpler model based on hierarchies of waterbodies (Chapter 6 in Bierman *et al.*, 2012) by creating such a model for various spatially separate parts. For example, such a simple model could be constructed for various water boards. The proportions of silver eels choosing different routes could be set equal to water discharge levels. It is not clear which of the two methods (GIS model, or further refinement of the 'simple' model) would lead to the best results or would be most cost-effective to get up and running. The GIS method would certainly need a lot more investment, but would be generic and work for the whole of The Netherlands and could be adapted for other species too. For the 'simple' model based on hierarchies of water bodies, information will have to be collected from water boards which will also take a lot of time and the results will apply only to that particular water board.

Silver eels migrating downstream from Belgium and Germany: The mortality caused by hydropower stations on silver eels migrating downstream on the river Meuse from Belgium and the river Rhine from Germany ('foreign' silver eels) have not been taken into account in the estimation of LAM in this report. It is unclear at the time of the writing of this report whether these mortalities have been included in the LAM of silver eels that were produced in German and/or Belgian waters. It is recommended that come to an agreement on how these mortalities should be accounted for.

Furthermore, as many other European countries (France, UK, Ireland) are using similar spatial models to estimate yellow eel standing stock and silver eel production, close international co-operation and collaboration will enhance the quality and uniformity of these models in the years to come.

17 Literature references

Bierman, SM, Tien, N., van de Wolfshaar, K.E., Winter, H.V. and M. De Graaf. 2012. Evaluation of the Dutch Eel Management Plan 2009–2011. Imares rapport C067/12.

Dekker, W. 1991. Assessment of the historical downfall of the IJsselmeer fisheries using anonymous inquiries for effort data. — In: I.G. Cowx (ed.): Catch Effort Sampling Strategies, their Application in Freshwater Management, pp. 233–240. Fishing News Books, Oxford. 420 pp.

Dekker W. Ed. 2002. Monitoring of glass eel recruitment. Report C007/02-WD, Netherlands Institute of Fisheries Research, IJmuiden, 256 pp.

Dekker W. 2008. Coming to Grips with the Eel Stock Slip-Sliding Away. pp 335–355 in M.G. Schlechter, N.J. Leonard, and W.W. Taylor, editors. International Governance of Fisheries Eco-systems: Learning from the Past, Finding Solutions for the Future. American Fisheries Society, Symposium 58, Bethesda, Maryland.

Dekker W. 2009 Bottom trawl surveys in the southern North Sea. Working document presented to the Study Group on Anguillid Eels in Saline Waters, Goteborg Sweden, 3–5 September 2009, 11 pp.

Tien N. and Dekker W. 2004 Trends in eel habitat abundance in the Netherlands during the 20th century. ICES C.M. 2004/S:12 (mimeo).

van der Hammen T, de Graaf M. 2012. Recreational fishery in the Netherlands: catch estimates of cod (*Gadus morhua*) and eel (*Anguilla anguilla*) in 2010. IMARES C014/12, pp. 61.

van der Meer J, van der Veer HW, Witte J IJ. 2011.The disappearance of the European eel from the western Wadden Sea Journal of Sea Research 66; 434–439.

Van Rijn S. and M.R. van Eerden. 2001. Aalscholvers in het IJsselmeergebied: concurrent of graadmeter? [Cormorants in the IJsselmeer area: competitor or indicator?] RIZA rapport 2001.058.

Van Rijn S. 2004. Monitoring Aalscholvers in het IJsselmeergebied [Monitoring cormorants in the IJsselmeer area]. Voortgangsverslag 2004. RIZA werkdocument 2004.187x.

Winter, H.V. A.B. Griffioen, K.E. van de Wolfshaar. 2013. Knelpunten inventarisatie voor de uittrek van schieraal t.b.v. 'Paling Over De Dijk' Rapport C134/13, pp. 20.

Report on the eel stock and fishery in Norway 2013/2014

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2 Introduction

The data given in this report is relevant to the North Sea (F) ecoregion.

2.1 Distribution

Eel occurs in coastal areas and numerous watersheds along the entire coastline, with a reduced abundance towards the north. The occurrence and abundance of eel is generally not well known. The length of the continental coastline is 25 148 km (including fjords and bays). Including islands, the total shoreline adds up to 83 281 km. Occurrence of eel is registered in 1788 lakes in 361 precipitation areas, but many areas and habitats have not been surveyed, so this is a minimum estimate (Thorstad *et al.*, 2010).

2.2 Fishing

Eel fishing is banned in Norway since January 1st 2010, except for a quota of 50 tons for which fishers have to apply. However, no fishers have applied since 2011 because they were unable to export their catch in (due to CITES export regulations) and there is no local market for eels.

Traditionally, eel fishing mainly took place along the coast in southern (Skagerrak coast) and southwestern Norway, in estuarine, brackish and saltwater areas around coastal islands, but also to some extent in fresh water. Some eel fishing also took place in Middle Norway. Fykenets were set on soft and muddy bottom, with preference of areas with seagrass beds (eel grass *Zostera marina*). No distinction was made between yellow and silver eels and they were both caught with eelpots and fykenets. Glass eel fishing has always been prohibited in Norway. Catch in the sea was officially recorded by the Fisheries Directorate, but there was no record of effort by the authorities (only the number of licences). There was a minimum legal size of 37 cm for silver eels and 40 cm for yellow eels.

Recreational fishing (prohibited since 2009) was quite important relative to commercial fishing (represented approximately 100 tons: average between 2000 and 2008). Recreational fishers along the southern coast of Norway caught eel and sold them through fishmongers. There was no limitation on fishing gear, and it was allowed to sell the catch up to 6250 Euros/year.

Some fishers were asked by the Institute of Marine Research to report their catch in logbooks since 1971. They recorded fishing gear, the number of days the traps were set out, and the number of small and large eels (limit was approximately 200 g because fishers obtained different prices for those eels). This stopped in 2010.

2.3 Management plan

The European eel is included in the Norwegian Red List since May 2006, categorized as critically endangered. A re-assessment is currently underway.

In 2007, a working group was appointed to write a report on the status of eel in Norway and to draft a subsequent management plan. The report was completed in 2008 [11]. Several research needs were identified among which the necessity to investigate the distribution of eels in saltwater. The report concluded in two alternative management strategies: 1) that all eel fishing should be banned in Norway for a period of 15 years, or 2) that eel fishing catches be halved compared to the level of 2004–2007. Finally, it was decided that all recreational fishing for eel in freshwater and marine waters in Norway must be stopped from 1 July 2009 (not allowed to catch, land, or keep eel on board). The total quota for commercial fisheries in 2009 was 50 t, with cessation of fishing when this quota was reached. All commercial fisheries were stopped from 1 January 2010. However, since 2010 and onwards, fishers could apply to a 'scientific fishery' with an annual quota of 50 t, aiming at monitoring eel and collecting scientific catch data. This scientific fishery was supposed to be financed by the fishers being allowed to keep and sell the catch. However, since eels cannot be imported into the EU [12], and there is no local market, all fishing has ceased.

2.4 Eel monitoring

The following monitoring plan (details are available upon request) was submitted (by IMR in March 2011) to the authorities (Nature Directorate) to monitor eel in saltwater:

1) Monitoring eel abundance trend using existing time-series (Skagerrak IMR beach seine survey, cpue of scientific fishery;
2) Monitoring biological characteristics (age, length, weight, sex, maturity);
3) Monitoring eel quality (parasites, contaminants);
4) Filling in knowledge gaps (salt vs. freshwater residency, geographic distribution in the sea).

There has been no follow-up on these issues in 2013, because of a lack of budget.

The Norwegian Environment Agency is funding annual monitoring of yellow eel recruitment and silver eel escapement in the River Imsa in Southwestern Norway.A plan for extended monitoring of eels in freshwater was developed in 2011 (together with a review of known information on eel in Norway, Thorstad *et al.*, 2011). There has been no follow up on this due to no available funding.

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[11] Anonymous (2008) Forvaltning av ål I Norge: rapport med forslag til revidert forvaltning av ål I saltvann fra arbeidsgruppe nedsatt av Fiskeridirektøren. Bergen, 15.10.2008.

[12] In 2007, CITES listed the species in Appendix II (this came into force in March 2009) and requires exporting states to have an export permit which can only be issued if the export will not be detrimental to the survival of the species. Norway has not obtained such an export permit.

3 Time-series data

3.1 Recruitment

3.1.1 Glass eel recruitment

3.1.1.1 Commercial

NP.

3.1.1.2 Recreational

NP.

3.1.1.3 Fishery independent

Table 3.1. Recruitment of elvers at the NINA research station on the River Imsa (see Section 0 for details).

YEAR	TOTAL ELVERS
1975	51 250
1976	57 750
1977	34 000
1978	15 000
1979	3000
1980	41 500
1981	18 500
1982	54 250
1983	19 250
1984	7607
1985	4971
1986	6723
1987	4348
1988	18 385
1989	8805
1990	33 138
1991	6588
1992	11 078
1993	8774
1994	2085
1995	2208
1996	1177
1997	5765
1998	1842
1999	4338
2000	1717
2001	2003
2002	1576
2003	3774
2004	418

YEAR	TOTAL ELVERS
2005	494
2006	468
2007	15
2008	1428
2009	6947
2010	1312
2011	5
2012	485
2013	3611
2014	8138

3.1.2 Yellow eel recruitment

3.1.2.1 Commercial

NP.

3.1.2.2 Recreational

NP.

3.1.2.3 Fishery independent

NR.

3.2 Yellow eel landings

3.2.1 Commercial

NP.

3.2.2 Recreational

NP.

3.3 Silver eel landings

3.3.1 Commercial

NP.

3.3.2 Recreational

NP.

3.4 Aquaculture production

3.4.1 Seed supply

NP.

3.4.2 Production

NP.

3.5 Stocking

3.5.1 Amount stocked

NP.

3.5.2 Catch of eel <12 cm and proportion retained for restocking

NP.

3.5.3 Reconstructed time-series on stocking

NP.

3.6 Trade in eel

NP.

4 Fishing capacity

4.1 Glass eel

NP.

4.2 Yellow eel

NP.

4.3 Silver eel

NP.

4.4 Marine fishery

NP.

5 Fishing effort:

5.1 Glass eel

NP.

5.2 Yellow eel

NP.

5.3 Silver eel

NP.

5.4 Marine fishery

NP.

6 Catches and landings

6.1 Glass eel

NP.

6.2 Yellow eel

NP.

6.3 Silver eel

NP.

6.4 Marine fishery

NP.

6.5 Recreational Fishery

NP.

6.6 Bycatch, underreporting, illegal activities

NP.

7 Catch per unit of effort

7.1 Glass eel

NP.

7.2 Yellow eel

NP.

7.3 Silver eel

NP.

7.4 Marine fishery

NP.

8 Other anthropogenic and environmental impacts

Norway has abundant rivers and lakes, and 6% of the total area of 323 802 km² is covered by fresh water. There are 144 river systems with a catchment area ≥200 km². Approximately one third of the water covered areas are influenced by hydropower development. There are between 600 and 700 hydropower stations with an installed effect larger than 1 MW in operation. Effects by hydropower development on eel and eel distribution have not been studied or quantified.

Acidification has caused the loss or reduction of many Atlantic salmon (*Salmo salar* L.) populations in southern Norway, and some rivers are still severely affected by chronic or episodic acid water. The areas affected by acidification have likely been among the most important areas for eel in Norway. Based on surveys in 13 rivers that are now limed, it seems that occurrence and density of eel was reduced due to acidification (Thorstad *et al*., 2010; Larsen *et al*., 2014). Densities of eel increased more than four-fold after liming when compared with pre-liming levels.

9 Scientific surveys of the stock

9.1 NO.G.1 Recruitment surveys, glass eel *(includes yellow eel in Scandinavia)*

The only available time-series of elvers is from a trap at the mouth of the River Imsa in southwestern Norway (58°50′ N, 5°58′ E) (Figures 1 and 2). Staff at the Norwegian Institute for Nature Research (NINA) Research Station at Ims have been trapping and recording upstream migration of elvers annually since 1975. There is a wolf trap across the river at this site, collecting all downstream migrating fish as well. A few elvers may be able to migrate upstream at this site without being trapped, but probably not in large numbers. Larger elvers (>3 mm diameter) are counted, whereas smaller ones are measured in litres, with the assumption that there are 2000 elvers per litre. This assumption should have been checked. There should also have been a control check of the historical data, but still, the quality of the dataseries seems good. It should be noted that in Imsa, recruits migrating upstream are not true glass eel, but have already achieved a brown colour, and are here therefore termed elvers (true transparent glass eels do occur in Norway and were collected in 2014 for a population genetics study).

Table 9.1. Elver data from Imsa. The trap was destroyed during a flood in 2007, and the number of elvers not counted this year. This is repeated data from 3.1.1.3. Numbers have been revised (there had been some variation in the way the number of glass eels were calculated) and updated since the previous country reports.

YEAR	TOTAL ELVERS
1975	51 250
1976	57 750
1977	34 000
1978	15 000
1979	3000
1980	41 500
1981	18 500
1982	54 250
1983	19 250
1984	7607
1985	4971
1986	6723
1987	4348
1988	18 385
1989	8805
1990	33 138
1991	6588
1992	11 078
1993	8774
1994	2085
1995	2208
1996	1177
1997	5765
1998	1842
1999	4338
2000	1717
2001	2003
2002	1576
2003	3774
2004	418
2005	494
2006	468
2007	15
2008	1428
2009	6947
2010	1312
2011	5
2012	485
2013	3611
2014	8138

9.2 NO.G.2 Stock surveys, yellow eel

The Skagerrak beach-seine surveys data from Norway constitute the longest non-fishery-dependent set of data. It is also the only potential time-series on the subpopulation of marine eels. This unique monitoring program was initiated at the Norwegian Skagerrak coast (Figure 1) as a result of a controversy between the founder of the Flødevigen Marine Research Station Gunder Mathiesen Dannevig (1841–1911) and the great pioneer in marine research Johan Hjort (1869–1948). Every year, a series of beach-seine hauls are carried out in some selected fjords of the Norwegian-Skagerrak coast.

The first hauls of the Skagerrak monitoring program were conducted in 1904, and during the following years, new sampling stations were added, and a standard routine for the hauls was developed. Approximately 130 stations are sampled in 20 different areas. All hauls are taken at the same season (autumn) and always during daytime. Based on the initial results from these hauls, the monitoring programme was established and reached its present form in 1919. These data have been analyzed up to 2010 and compared to oceanic factors (Durif *et al.*, 2011).

The SSC (standardized Skagerrak catch) index has been calculated using sampling areas where eels represented at least 4% of the grand total. See Durif *et al.*, 2011 for complete details. These calculations (SSC) have not been updated for the most recent figures.

Data from the Skagerrak beach seine survey. It includes yellow (approximately 70%) and silver eels (30%).

Table 9.2. Data from the Skagerrak beach-seine survey.

YEAR	NO OF EELS	NO OF HAULS	NO OF SAMPLED AREAS	EELS PER HAUL
1925	4	68	12	0.06
1926	3	69	12	0.04
1927	8	66	12	0.12
1928	0	69	12	0.00
1929	12	69	12	0.17
1930	11	68	12	0.16
1931	14	72	12	0.19
1932	10	69	12	0.14
1933	2	66	12	0.03
1934	8	67	12	0.12
1935	4	68	13	0.06
1936	15	121	17	0.12
1937	38	121	17	0.31
1938	36	122	17	0.30
1939	30	118	17	0.25
1940				
1941				
1942			NO DATA	
1943				
1944				
1945	41	120	17	0.34
1946	28	120	17	0.23

Year	No of eels	No of hauls	No of sampled areas	Eels per haul
1947	33	121	17	0.27
1948	25	119	17	0.21
1949	21	118	17	0.18
1950	20	117	17	0.17
1951	29	119	17	0.24
1952	14	101	17	0.14
1953	21	132	18	0.16
1954	30	128	18	0.23
1955	31	126	18	0.25
1956	23	133	18	0.17
1957	12	130	18	0.09
1958	44	131	18	0.34
1959	15	132	18	0.11
1960	12	133	18	0.09
1961	29	134	18	0.22
1962	12	138	20	0.09
1963	18	135	20	0.13
1964	28	135	20	0.21
1965	8	112	20	0.07
1966	26	112	20	0.23
1967	14	109	20	0.13
1968	13	108	20	0.12
1969	11	109	20	0.10
1970	34	110	20	0.31
1971	19	111	20	0.17
1972	11	110	20	0.10
1973	15	107	20	0.14
1974	27	108	20	0.25
1975	28	112	20	0.25
1976	20	109	20	0.18
1977	26	106	20	0.25
1978	15	108	20	0.14
1979	16	106	20	0.15
1980	31	106	20	0.29
1981	45	104	20	0.43
1982	20	109	20	0.18
1983	19	108	20	0.18
1984	24	107	20	0.22
1985	28	110	20	0.25
1986	27	110	20	0.25
1987	17	111	20	0.15
1988	50	119	20	0.42
1989	31	122	20	0.25
1990	20	121	20	0.17
1991	18	118	20	0.15

Year	No of eels	No of hauls	No of sampled areas	Eels per haul
1992	25	118	20	0.21
1993	15	119	20	0.13
1994	32	119	20	0.27
1995	16	120	20	0.13
1996	39	121	20	0.32
1997	19	120	20	0.16
1998	22	119	20	0.18
1999	23	119	20	0.19
2000	7	126	20	0.06
2001	15	129	20	0.12
2002	6	130	20	0.05
2003	5	130	20	0.04
2004	1	131	20	0.01
2005	2	129	20	0.02
2006	9	130	20	0.07
2007	0	130	20	0.00
2008	3	130	20	0.02
2009	9	85	!!Series was truncated that year	0.11
2010	4	135	20	0.03
2011	9	134	20	0.07
2012	5	136	20	0.04
2013	21	136	20	0.15

9.3 NO.G.3 Silver eel

Downstream trap on the river Imsa.

The only available time-series of downstream migrating silver eel is from a wolf trap at the mouth of the River Imsa in southwestern Norway (58°50′ N, 5°58′ E). Staff at the Norwegian Institute for Nature Research (NINA) Research Station at Ims have been trapping and counting downstream migrating silver eel annually since 1975. All descending fish are captured in this wolf trap, except at days of extreme flood. The quality of the dataseries is good.

Table 9.3. Number of silver eels counted at the trap on the River Imsa (Sandnes).

YEAR	ESTIMATED TOTAL SILVER EELS
1975	5491
1976	4175
1977	5882
1978	4985
1979	2934
1980	3382
1981	2354
1982	3818
1983	3712
1984	3377
1985	4427
1986	3733
1987	1895
1988	4274
1989	2107
1990	2196
1991	1347
1992	1859
1993	681
1994	1704
1995	1515
1996	1420
1997	2833
1998	1723
1999	2596
2000	1749
2001	4580
2002	1850
2003	2824
2004	2076
2005	1894
2006	2827
2007	3067
2008	1952
2009	3246
2010	2133
2011	2776
2012	2518
2013	1939
2014	274

Skagerrak beach-seine survey

Silver eels are sampled along with yellow eels, but stages are not differentiated in the data. Lengths have been measured since 1993.

Eels have also been caught during the seasonal IMR cruises in the North Sea. Approximately 3000 eels have been caught since 1980. Data are not yet collated.

10 Data collected for the DCF

NC.

11 Life history and other biological information

11.1 Growth, silvering and mortality

Von Bertalanffy parameters: Linf, K, t0

Data exists but there is no funding to analyze those data so these parameters have not been determined.

L50 = the length at which 50% of the population has silvered (my interpretation of 50% maturity)

Data exist but there is no funding to analyze those data so this parameter has not been calculated.

Length and age at silvering

In 2013, a subsample of 262 downstream migrating silver eel in the River Imsa was length measured and weighed. Mean body length was 687 mm (range 492–964, SD 87) and mean body mass was 604 g (range 201–2223 g, SD 254.

Fecundity

NC.

Weight-at-age

Data exist but the data have not been analysed.

Length-weight relationship

Data exist but the data have not been analysed.

11.2 Parasites and pathogens

ND.

11.3 Contaminants

ND.

11.4 Predators

ND.

12 Other sampling

Glass eels were collected in spring 2014 for a population genetics study.

13 Stock assessment

13.1 Method summary

There is no stock assessment.

13.2 Summary data

NC.

13.3 Summary data on glass eel

The only "glass eel" data is the number of ascending elvers caught in a trap (research) in the river Imsa. The trap was destroyed during a flood in 2007, and the number of elvers not counted this year. These are repeated data from Section 0).

YEAR	TOTAL ELVERS
1975	51 250
1976	57 750
1977	34 000
1978	15 000
1979	3000
1980	41 500
1981	18 500
1982	54 250
1983	19 250
1984	7607
1985	4971
1986	6723
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1991	6588
1992	11 078
1993	8774
1994	2085
1995	2208
1996	1177
1997	5765
1998	1842
1999	4338
2000	1717
2001	2003
2002	1576
2003	3774
2004	418
2005	494
2006	468
2007	15

YEAR	TOTAL ELVERS
2008	1428
2009	6947
2010	1312
2011	5
2012	485
2013	3611
2014	8138

14 Sampling intensity and precision

NR.

15 Standardisation and harmonisation of methodology

15.1 Survey techniques

- Annual standardized beach seine survey along the southern coast of Norway;
- Counting ascending elvers, and downstream migrating silver eels in a trap at the river Imsa.

15.2 Sampling commercial catches

We collect eels from wrasse fishermen (eelpots and fykenets) along the coast of Norway (only in the marine habitat). A lot of these samples are waiting to be processed.

15.3 Sampling

Eels are frozen alive.

15.4 Age analysis

Age is read from the otoliths (polishing and staining).

15.5 Life stages

We measure: body length, body weight, eye diameters, and pectoral fin length. Life stage is determined according to Durif *et al.*, 2005 and using equations from Durif *et al.*, 2009.

15.6 Sex determinations

Sex is determined macroscopically.

15.7 Data quality issues

We record the number of *A. crassus* in the swimbladder.

16 Overview, conclusions and recommendations

Only two time-series of eel are available from Norway, which are beach-seine surveys in the Skagerak (since 1904), and counting of upstream and downstream migrating eel in the River Imsa (since 1975). Both time series shows a decline (Durif *et al.*, 2008), with a collapse in the fresh water recruitment (number of ascending elvers) in the River Imsa from 1981. The silver eel escapement from the River Imsa showed a significant decline seven years after, which corresponds with the mean age of silver eels in this river. A collapse in eel numbers was also observed in the Skagerrak time-series at the end of the 1990s.

Recreational fishing was prohibited in Norway since 2009, and commercial fishing since 2010.

There are limited data on occurrence, abundance and biological characteristics of eel in Norway, and the knowledge level should generally be increased.

17 Literature references

Bergersen, R. and Klemetsen, A. 1988. Freshwater eel *Anguilla anguilla* L. from North Norway with emphasis on occurrence, food, age and downstream migration. *Nordic Journal of Freshwater Research* **64**, 54–66.

Davidsen, J. G., Finstad, B., Økland, F., Thorstad, E. B., Mo, T. A. and Rikardsen, A. H. 2011. Early marine migration of European silver eel (*Anguilla anguilla*) in Northern Norway. *Journal of Fish Biology* 78: 1390–1404.

Durif C, Dufour S, Elie P. 2005. The silvering process of *Anguilla anguilla*: a new classification from the yellow resident to the silver migrating stage. Journal of Fish Biology 66: 1025–1043.

Durif, C. M. F., Knutsen, J. A., Johannessen, T. and Vøllestad, L. A. 2008. Analysis of European eel (*Anguilla anguilla*) time series from Norway. In Fisken og Havet, p. 22: Institute of Marine Research.

Durif C, Guibert A, Elie P. 2009. Morphological discrimination of the silvering stages of the European eel. In: Casselman JM, Cairns DK, editors. Eels at the edge: science, status, and conservation concerns. Bethesda, Maryland: American Fisheries Society Symposium 58. pp. 103–111.

Durif, C. M. F., Gjøsæter, J. and Vøllestad, L. A. 2011. Influence of oceanic factors on *Anguilla anguilla* (L.) over the twentieth century in coastal habitats of the Skagerrak, southern Norway. *Proceedings of the Royal Society B: Biological Sciences* **278**, 464–473.

Larsen, B.M., Hesthagen, T., Thorstad, E.B. and Diserud, O.H. 2014. Increased abundance of European eel (*Anguilla anguilla*) in acidified Norwegian rivers after liming. Ecology of Freshwater Fish, in press.

Thorstad, E.B., Larsen, B.M., Finstad, B., Hesthagen, T., Hvidsten, N.A., Johnsen, B.O., Næsje, T.F. and Sandlund, O.T. 2011. Kunnskapsoppsummering om ål og forslag til overvåkingssystem i norske vassdrag. NINA Rapport 661: 1–69. (In Norwegian).

Vøllestad, L. A. 1985. Age determination and growth of yellow eels, *Anguilla Anguilla* (L.), from brackish water in Norway. *Journal of Fish Biology* **26**, 521–525.

Vøllestad, L. A. 1986. Growth and production of female yellow eels (*Anguilla anguilla* L.) from brackish water in Norway. *Vie et Milieu - Life and Environment* **36**, 267–271.

Vøllestad, L. A. 1992. Geographic variation in age and length at metamorphosis of maturing European eel: environmental effects and phenotypic plasticity. *Journal of Animal Ecology* **61**, 41–48.

Report on the eel stock and fishery in Poland 2013/2014

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2 Introduction

The data given in this report is relevant to the Baltic Sea (L) ecoregion.

Eel fisheries in Poland are conducted in lakes, rivers, coastal open waters, and two brackish water basins; the Szczecin and Vistula lagoons. Part of the Szczecin Lagoon is in Germany, while part of the Vistula Lagoon is in Russia. Inland and coastal fisheries target silver and yellow eel, but no data on the shares of these forms in the catches are available. The total area of inland lakes and reservoirs exceeding 50 ha is 2293 km^{2}. Dams in the Vistula and Oder rivers and in many of their tributaries prevent migrations of eel and other fish species.

Eel fisheries have a long tradition in Poland. Prior to World War II they were conducted mainly in inland waters because the short length of coastline within Polish borders did not provide access to sea fisheries. Following the war, the length of the Polish coastline increased considerably to over 500 km. With this broader access to the Baltic Sea, Polish coastal eel fisheries developed and landings were as much as 388 tons annually. Inland eel fisheries also expanded to a substantially larger number of lakes, and landings were as much as 1500 tons annually. In the 1974–1994 period inland catches comprised up to 75% of the total annual Polish eel catch. Since the end of this period, catches have declined considerably, and the two types of eel fisheries together currently land about 200 tons annually.

Until the late 1950s Polish eel fisheries were based almost exclusively on natural recruitment. Later, extensive stocking programmes that released mainly glass eel were conducted in many lakes and in both lagoons. Changes in fishery management and the high price of glass eel put a near stop to these programmes by the late 1990s. This, in turn, resulted in very serious decreases in eel catches, mainly in inland fisheries.

2.1 River basins in Poland according to the Water Framework Directive, eel management units according to the Polish Eel Management Plan

The following river basins were designated based on the Water Framework Directive:

Oder – including the basins of Pomeranian rivers to the west of the Słupia mouth and those flowing into the Szczecin Lagoon;

Vistula – including the basins of Pomeranian rivers to the east of the Słupia mouth and those flowing into the Vistula Lagoon;

Other – river basins located within the territory of the Republic of Poland that are part of the international basins of the Dniester, Danube, Jarft, Elbe, Neman, Pregoła, Świeża, and Ücker rivers.

For the needs of the Eel Management Plan, in consideration of the availability of data essential to estimating the population size and the potential escapement of silver eel and in consultation with countries that share transboundary river basins, the territory of Poland was divided into two Eel Management Units (Figure 1).

Oder EMU

Vistula EMU

These EMUs include the following river basins, running waters, and maritime waters:

Oder EMU:

the transboundary Oder River basin within Poland;

the Szczecin Lagoon with nearby Polish waters;

the coastal zone (to 12 miles) of ICES Subdivision 24 (Pomeranian Bay);

the coastal zone (to 12 miles) of ICES Subdivision 25;

the transboundary Elbe and Űcker river basins within Polish borders.

Vistula EMU:

the Vistula River basin;

the transboundary Vistula River basin within Poland;

the inner Gulf of Gdańsk;

the coastal zone (to 12 miles) of ICES Subdivision 26;

the transboundary Jarft, Nemen, Pregoła, and Świeża river basins within Polish borders.

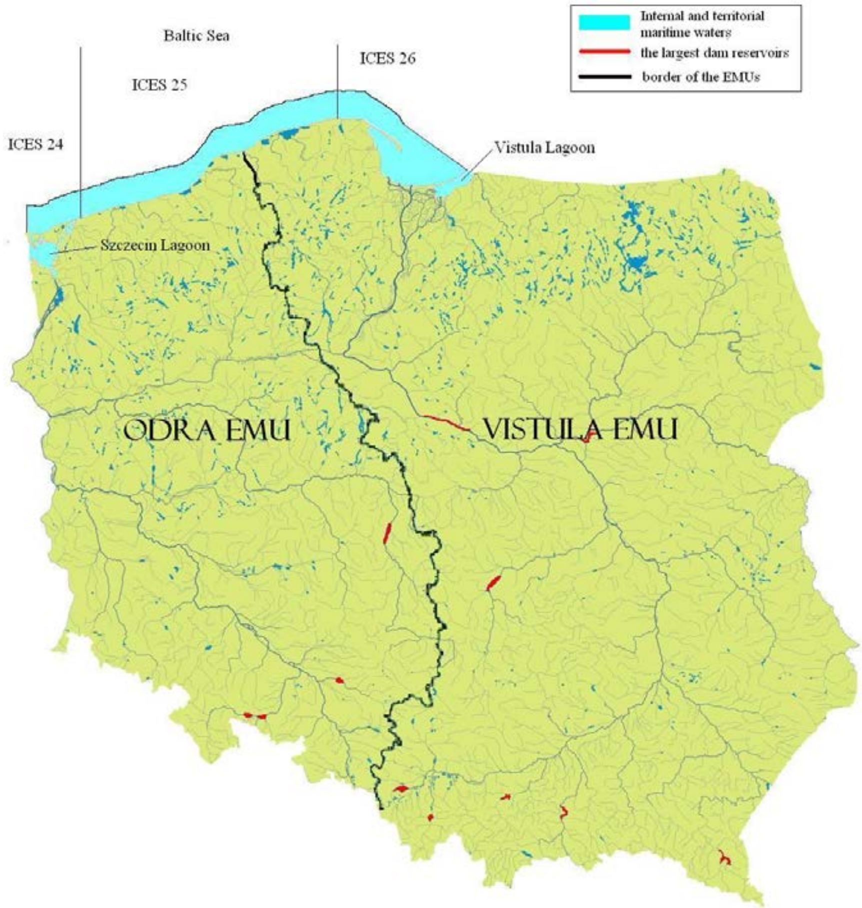


Figure 1. EMU in Poland according to the Polish EMP.

2.2 Fishery management

Areas of inland surface waters referred to as fisheries districts were established by the directors of the individual Regional Boards for Water Management, with the exception of waters located within the borders of national parks and nature reserves where fishing is banned. The basis for obtaining a permit to conduct fisheries in a fisheries district depends on winning a tender and signing a long-term exploitation agreement with the director of the corresponding Regional Board for Water Management.

Fisheries conducted within fisheries district are based on fishery plans. These documents set forth precise descriptions of proposed fisheries operations, with details regarding stocking programmes. Fishery plans must receive positive evaluations from an authorized institution. In total, there are 2370 fisheries districts in Poland. These support approximately 800 enterprises (natural persons and legal persons).

Recreational fisheries in inland waters are permitted if fishers hold fishing permits or underwater hunting licences. Local government officials issue these documents after the applicant has demonstrated knowledge of protection and catch regulations to a commission comprising volunteers from recreational fisheries organizations. Additionally, recreational fishers must have a fishing permit.

Marine fisheries are conducted using fishing vessels that have catch licences and special catch permits for a given calendar year. Special catch permits are issued by:

the minister in charge of fisheries – for the Polish Exclusive Economic Zone, in territorial maritime waters, in the Puck Bay and the Gulf of Gdańsk and outside Polish maritime regions;

the regional inspector in charge of marine fisheries – for catches in the Vistula Lagoon, the Szczecin Lagoon, the Kamieńskie Lagoon, and Lake Dąbie.

Sport and recreational catches can be made in Polish marine areas after sport catch permits are obtained. These are issued by regional marine fisheries inspectors or District Inspectorates for Marine Fisheries inspectors with permission to issue them. Permits are valid throughout the Polish EEZ.

2.3 Polish Eel Management Plan

The first version of Polish EMP was submitted to the EU in December 2008, and was updated by the document submitted in June 2009. The EU officially accepted the Polish EMP in January 2010. Regulations for protecting eel, such as designated minimum length and closed seasons, were introduced into Polish law in 2010, and stocking started in August 2011.

The major elements and measures of the Polish EMP are as follows:

stocking – 6 million glass eels annually in the Oder River basin and 7 million in the Vistula River basin, or 1.2 and 1.4 million elvers <20 cm, respectively;

make migration routes passable – removing barriers, building passes, closing hydroelectric facilities periodically during eel escapement, technical modifications;

designate closed seasons – to achieve the principles of the plan and reduce fishing mortality by 25% there must be a month-long closed fishing season from June 15 to July 15 throughout Poland;

unify minimum length – the optimum protected size for European eel in Polish waters should be 50.0 cm *L.t.* regardless of weight;

improve fishing gear selectivity – the selectivity of the most commonly used trap gear can be increased by installing selective sieves or by increasing the mesh size in the chamber to 20 mm (bar length);

limit daily rod catches to two eel – Polish regulations do not limit daily rod catches; doing so will counteract the increased mortality caused by recreational catches above that foreseen in the population model applied;

limit great cormorant pressure (predation);

limit IUU;

include protected areas in the eel protection process (national parks).

3 Time-series data

3.1 Recruitment-series and associated effort

3.1.1 Glass eel

Glass eel do not occur in Polish waters.

3.1.1.1 Commercial

Glass eel do not occur in Polish waters.

3.1.1.2 Recreational

Glass eel do not occur in Polish waters.

3.1.1.3 Fishery-independent

Glass eel does not occur in Polish waters.

3.1.2 Yellow eel recruitment

3.1.2.1 Commercial

No commercial dataseries on recruitment exist; minimum landing size is 50 cm.

3.1.2.2 Recreational

No recreational dataseries on recruitment exist.

3.1.2.3 Fishery-independent

No fishery-independent dataseries on recruitment exist; first estimation will be available from 2012.

3.2.1 Yellow eel landings

3.2.1.1 Commercial

No dataseries exist; total landings of yellow and silver eels combined (see Section 6.2).

3.2.1.2 Recreational

3.3.1 Silver eel landings

3.3.1.1 Commercial

No dataseries exist; total landings of yellow and silver eels combined.(see Section 6.2).

3.3.1.2 Recreational

3.4 Aquaculture production

3.4.1 Seed supply

3.4.2 Production

Since last years there has been only one eel rearing facility in Poland, facility of Polish Anglers Association. It still produces about 1.5 tonnes of fingerlings annually for internal restocking market in Poland. From 2012 some new eel production units have started, but data about production quantity are unknown.

3.5 Stocking

3.5.1 Amount stocked

Eel stocking was initiated in regions within current Polish borders as early as at the beginning of the 20th century, and it produced good results (Sakowicz, 1930). This was done mainly in rivers in the Vistula River basin and in the Vistula Lagoon. The stocking material of the day originated from the coasts of Great Britain (glass eel), although the Vistula Lagoon was also stocked with eel inhabiting the River Elbe (20–30 cm total length; Roehler, 1941). In the 1950s, great demand developed in Western Europe for live eel, and this fuelled efforts to stock all appropriate waters with this species. The restocking programme collapsed after the socioeconomic changes of 1989 transformed the former state fisheries enterprises into private enterprises. The Stocking Fund, which had been a department of the central government budget office, was also discontinued at this time. Private fisheries enterprises leased waters in which stocking had once been performed, and the import of eel recommenced in the mid-1990s. Because of economic concerns and the increasing price of glass eel, these were mostly elvers. Stocking did not recommence in either lagoon until 2005 as part of the stocking plan for Polish Marine Areas. Data on stocking quantities are listed in Table 1.

Table 1. Data on stocking quantities.

Decade	1950		1960		1970		1980		1990		2000		2010	
Year	glass eel	young yellow eel	glass eel	young yellow eel	glass eel	young yellow eel	glass eel	young yellow eel	glass eel	young yellow eel	glass eel	young yellow eel	glass eel	young yellow eel
0			64.4		23.5		52.9		8.6	1.0	3.1	0.8		1.4
1			65.1		17.4		60.5		1.7	0.1	0.7	0.6		2.7
2	17.6		61.6		21.5		64	0.1	13.8	0.1	0.0	0.6		1.7
3	25.5		41.7		61.9	0.2	25.1	2.3	10.6		0.5	0.5		3.5
4	26.6		39.2		71		49.2	0.3	12.2	0.1	2.3	0.5		
5	30.8		39.8		70		36.3	0.5	23.7			0.7		
6	21.0		69.0		68		54.4	0.2	2.8	0.5		1.1		
7	24.7		74.2		77	0.1	56.8		5.1	1.1		0.9		
8	35.0		16.6		73		15.9	0.1	2.5	0.6		1.0		
9	52.5		2.0		74.3		5.9	0.7	4.0	0.5		1.4		

3.5.2 Catch of eel <12 cm and proportion retained for stocking

There was no catch of eel <12 cm.

3.5.3 Reconstructed time-series on stocking

All eel are foreign source, glass eels – France, England , yellow eels – on grown cultured – Denmark, Germany, Netherlands

3.5 Trade in eel

Data on trade are available from Eurostat. Data are not aggregated on EMU level, only country of export and destination is available. Below a tables with quantities and value. Note that life stage of live batch is divided by length classes (<12 cm, 12–20 cm and >20 cm).

Table 2. Import of live eels in 2013 (EuroStat).

Country of origin	product	quantity (kg)	value (EUR)
Germany	<12	900	24 251
Germany	12–20	300	8356
Germany	>20	7500	109 473
Denmark	<12	1000	34 275
Denmark	12–20	16 300	766 243
Netherlands	12–20	13 000	197 843
Netherlands	>20	7100	104 855
France	<12	2500	82 458
Germany	frozen	62 700	948 726
Denmark	frozen	10 000	158 870
Netherlands	frozen	7300	104 549
Sweden	frozen	200	3046
China*	frozen	24 000	273 798
Total		152 800	2 816 743

*** reported as *Anguilla* spp.**

Table 3. Export of frozen eels in 2013 (EuroStat).

Country of destination	product	quantity (kg)	value (EUR)
Germany	frozen	5800	100 632
Denmark	frozen	3000	54 312
Lithuania	frozen	100	2463
Netherlands	frozen	1300	21 110
Total		10 200	178 517

4 Fishing capacity

There is a lack of precise data regarding the number and type of fishing gear deployed and the types of fishing boats active in Polish inland waters, and there is no system in place to collect this type of statistical data. There are 800 enterprises authorized to catch eel on the basis on long-term agreements for their exploitation with directors of the responsible Regional Boards for Water Management.

4.1 Glass eel

No catches.

4.2 Yellow eel

Estimated data from questionnaires:

ODRA EMU: 250 fishing boats

VISTULA EMU: 470 fishing boats

4.3 Silver eel

See above.

4.4 Marine fishery

Fisheries in coastal and transitional waters are limited with regard to the number of vessels operating and the maximum number of gears deployed. Eel are fished almost exclusively by vessels of up to 12 m in the 12-mile zone. Special permits specify which types and the number of gear used.

As of 31 December 2013, the fishing capacity was as follows (boats up to 12 meters).

Table 4. Fleet, number of vessels, 2013.

	Eel vessels <12 m*		Total active vessels <12 m in 2013
ICES Area	eel directed**	total	
24–25	33	84	333
26	80	117	294

*** vessels which reported eel catches (regardless amount).**

**** vessels which reported even a single day of directed eel catches.**

5 Fishing effort

There is a lack of precise data regarding the number and type of fishing gear deployed and the types of fishing boats active in Polish inland waters, and there is no system in place to collect this type of statistical data. All data come from questionnaires and are estimated values.

5.1 Glass eel

No catches.

5.2 Yellow and silver eel

ODER EMU

The fishing effort in inland waters is estimated at 1000 sets of trap gear, 50 sets of towed gear, and 120 fixed gears in flowing waters. The most important are fixed gears in flowing waters (Table 5).

Table 5. Fishing effort in inland waters of the Oder EMU in 2013.

	Share of gear in eel catches [%]	Estimated exploitation intensity [one gear/ 100 ha lake]
Trap	45,3	1.14
Towed	2,3	0.06
Fixed gear on flowing waters	35,6	0.14
Electric	3,2	No data
Longlines	13,4	No data

VISTULA EMU

The fishing effort in inland waters was estimated at approximately 4200 sets of trap gear, 120 sets of hauled gear, and 500 sets of fixed gear set in running waters. The most important type of gear is fykenets, and other trapnets (Table 6).

Table 6. Fishing effort in inland waters of the Vistula EMU in 2013.

	Share of gear in eel catches [%]	Estimated intensity of deployment [one gear/100 ha lake]
Trap	46,2	2.66
Hauled	4,2	0.07
Fixed gear on flowing waters	37,6	0.32
Electric	2,0	No data
Longlines	9,9	No data

5.3 Marine fishery (DCR data)

In coastal waters, eel is most frequently bycatch in catches of other species. The majority of catch is fished in fykenets. Some minor landings are also noted in longline fishery in Gulf of Gdańsk and Puck Bay.

As of 31 December 2013, the fishing effort was as follows:

Table 7. Fishing effort in marine Polish waters in 2013.

		Eel as a bycatch			Eel directed fisheries*			Total: days	Total: kg	Total: no of gears
Gear	ICES Subdivision	days	Kg	no of gears	days	kg	no of gears			
FPO	27.3.d.24	2 889	25 523	66 912	52	2 075	939	2 941	27 598	67 851
	27.3.d.25				1	2	2	1	2	2
	27.3.d.26	1 156	7 606	12 660	427	3 918	19 144	1 583	11 524	31 804
FPO total		4 045	33 129	79 572	480	5 995	20 085	4 525	39 124	99 657
GNS	27.3.d.24	27	168	1 257				27	168	1 257
	27.3.d.25	1	2	30				1	2	30
	27.3.d.26	42	187	1 347	19	137	5 007	61	324	6 354
GNS total		70	357	2 634	19	137	5 007	89	494	7 641
LLS	27.3.d.24	49	801	226 400	61	2 463	288 700	110	3 263	515 100
	27.3.d.25	16	178	71 000	48	2 993	140 000	64	3 171	211 000
	27.3.d.26	131	1 150	303 700	195	1 429	338 350	326	2 579	642 050
LLS total		196	2 129	601 100	304	6 885	767 050	500	9 013	1 368 150
Total		4 311	35 615	683 306	803	13 017	792 142	5 114	48 631	1 475 448

*** these days where eel constituted 50 or more percent of total catches.**

6 Catches and landings

6.1 Glass eel

There is no glass eel fishery in Poland.

6.2 Yellow and silver eel

No distinction has been made between yellow and silver eel in statistics. The data on inland catches were obtained by surveying selected fisheries facilities, then extrapolating the results for the entire river basin. These data are thus approximated. The data from the lagoons were drawn from official catch statistics (logbooks). These might also be incomplete because of poor statistics, the quality of which declined notably following 1990.

6.3.1 Total landings (time-series)

Table 8. Total landings of eel in entire basins and marine waters (1954–2013).

Decade Year	1950	1960	1970	1980	1990	2000	2010
0		733	847	1221	697	305	178
1		640	722	1018	580	296	119
2		663	696	1033	584	236	119
3		762	636	822	495	204	137
4	609	884	796	831	531	148	
5	732	682	793	1010	507	284	
6	656	804	803	982	499	257	
7	616	906	903	872	384	244	
8	635	943	946	923	397	227	
9	566	935	912	752	406	156	

6.4 Recreational fishery

Table 9. Recreational Fisheries: Retained and Released Catches.

	Retained (tons)				Released			
	Inland		Marine		Inland		Marine	
Year	Angling	Passive Gears	Angling	Passive gears	Angling	Passive gears	Angling	Passive gears
2013	26,7	NA	<1 ton	NA	NA	NA	NA	NA

Table 10. Recreational Fisheries: Catch and Release Mortality.

	RELEASED			
	Inland		Marine	
	Angling	Passive gears	Angling	Passive gears
Year				
2013	NA	NA	NA	NA

6.5 Bycatch, underreporting, illegal activities

Eel is mostly a bycatch in marine waters (See Table 5), eel directed fishery represent about 20% of total landings (Table 7).

Volume of illegal catches is available from IFI estimations based on questioning private enterprises and lake owners.

Table 11. Illegal fishing activities – seizures and cause.

		COMBINED (Y +S)		
Year	EMU	Y/N/?	Seizures (kg)	Cause
2012	Oder	Y	13 800	Fishing without licence
2012	Vistula	Y	16 700	Fishing without licence
2013	Oder	Y	10 800	Fishing without licence
2013	Vistula	Y	16 700	Fishing without licence

7 Catch per unit of effort

7.1 Glass eel

There is no glass eel fishery in Poland.

7.2 Yellow eel

No data.

7.3 Silver eel

No data.

7.4 Marine fishery

The catch per unit of effort was only estimated in coastal waters. The negative trend is significant, and cpue is at the lowest reported level since 1995. See the 2008 Poland country report for details (WGEEL, 2008).

8 Other anthropogenic impacts

Not applicable.

9 Scientific surveys of the stock

Routine electrofishing surveys are conducted every year in Pomeranian rivers to estimate abundance of salmon and see trout. Every ten years each of lake and rivers owners must investigate structure and abundance of fish fauna on their own. Some data are available, but quality and usefulness of these datasets are considered to be low.

10 Data collected for the DCF

Landings are regularly sampled in marine harbours, and the main gears sampled are fykenets within FWS métier, because eel is only a bycatch in coastal freshwater fishery. Approximately 200–400 fish have been analysed since 2005.

Table 12. Summary of the DCF and EMP monitoring implementation for Poland. Note that DCF is applicable only for métier and biological variables sampling.

Data	River	Lakes	Estuaries	Lagoons	Coastal & Marine
No. of production / escapement surveys[1]					
No. of recruitment time-series surveys[2]	4				
No. fished aged	20	100		399	
No. of fished sexed	20	100		399	
No. of fish examined for parasites	20	100		399	
No. of fish examined for contaminants		30*		30*	
No. of non-fishery mortality studies[3]	2				
Socio-economic survey					

***number of samples (one sample consists of 1–5 eels).**

11 Life history and other biological information

11.1 Growth, silvering and mortality

Data regarding biological variables such as length, weight, and growth are collected regularly as part of DCF. NMFRI is responsible for collecting these data.

Table 13. Von Bertalanffy parameters.

RBD	Stage	L_∞	K	T_0
Oder	II–IV	102	0,135	0,641
Oder	IV	95,2	0,147	-1,393
Vistula	II–V	111,7	0,116	-0,459
Vistula	IV, V	98,1	0,189	-1,189

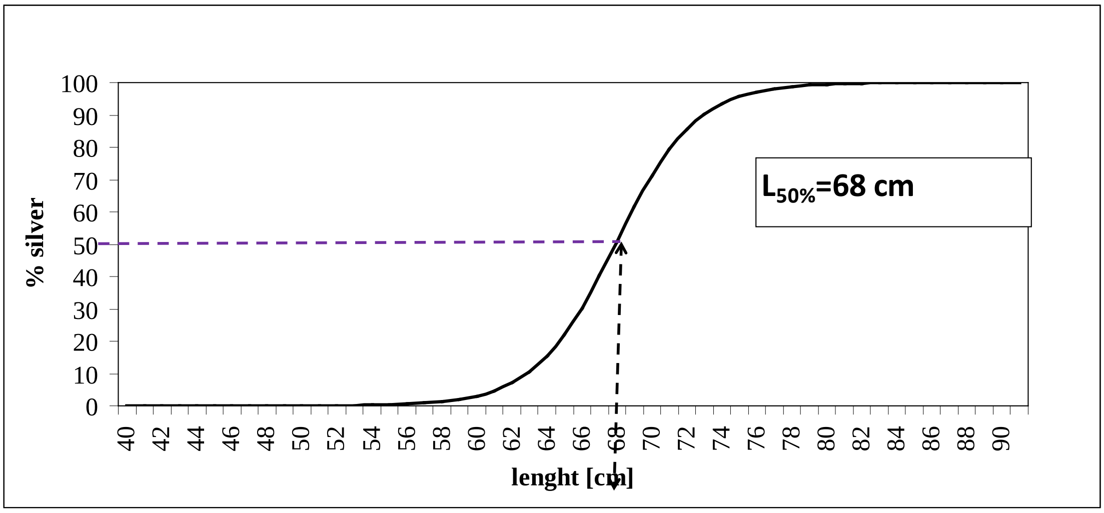


Figure 2. Length at which 50% of the population has silvered. Data from Vistula Lagoon 2013.

Table 14. Mean weight-at-age of eels in Oder and Vistula RBD.

	MEAN WEIGHT (G)	
AGE	ODER RBD	VISTULA RBD
3		75.0
4	257.0	291.5
5	464.5	531.2
6	683.2	684.5
7	651.3	797.0
8	988.4	1087.8
9	1294.8	1157.7
10	906.6	1312.7
11	897.9	908.8
12	1131.2	730.0
13	1172.6	
14	626.1	
15	517.0	
16	1304.0	
17	1625.0	
18	1558.0	
20	540.0	975.0
22		1405.0
25	1000.0	
27	1112.0	

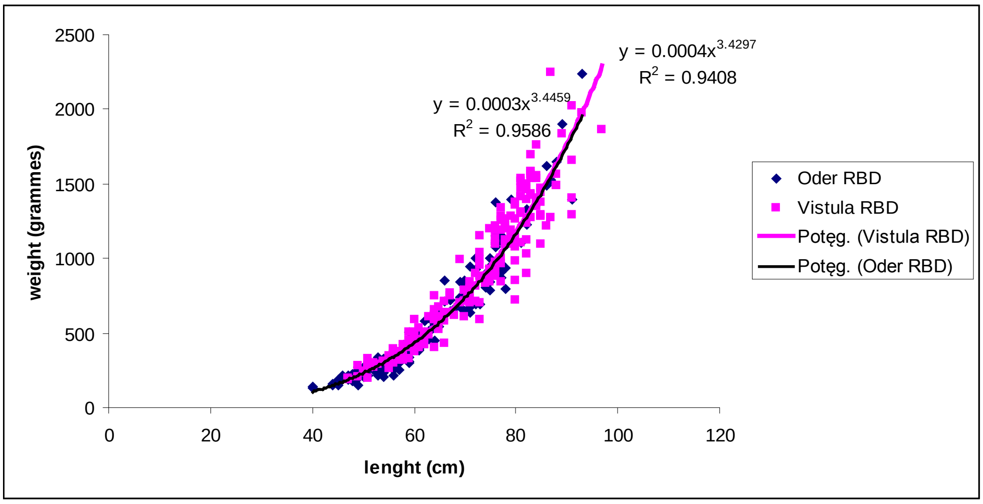


Figure 3. Length @ weight of eel from commercial catches conducted in 2013 in Oder and Vistula RBD.

11.2 Parasites and pathogens

11.3 Contaminants

The chemical compounds in muscle tissues of eel, *Anguilla anguilla*, caught in 2013 in: the Vistula Lagoon and the Szczecin Lagoon were assayed. Forty samples were collected for the chemical tests (twenty three in the Szczecin Lagoon and seventeen in the Vistula Lagoon). Each sample represented one individual. An average length of fish collected was 68,25 ± 11.53 cm (46–88 cm), and mean weight was 35.1 ± 442,3 g (185–1610 g). Eels collected in the Vistula Lagoon were characterized by higher weight and length than eels collected in the Szczecin Lagoon, however the difference between those two groups was not statistically significant (P≤0,05).

Fat and protein contents

The samples tested varied in fat content from 6.34 % (an eel weighting 192 g from the Szczecin Lagoon) to 29.09% (an eel weighting 1160 g from the Szczecin Lagoon). Generally, it can be concluded that higher fat contents are found in individuals of higher body mass and in a more advanced stage of sexual maturity.

The protein content was more stable in the samples assayed as it fluctuated from 15.38% (an eel weighting 1160 g from the Szczecin Lagoon) to 19.19% (an eel weighting 250 g from the Vistula Lagoon). It is notable that samples comprising individuals of a lower weight have higher protein contents.

The higher mean fat content was found in samples from the Vistula Lagoon but the difference between fat content in fish collected in the Vistula Lagoon and ones collected in the Szczecin Lagoon was not statistically significant (P≤0,05).

Heavy metals

Levels of toxic metals measured in tested samples were compared with permissible limits laid down in the Commission Directive 2006/1881/EC). In case of eel permissible limits are higher than for other fish species and they are as follows: 100 µg/ kg for cadmium, 300 µg/ kg for lead and 1000 µg/kg for mercury.

The permissible limits of toxic metals in eel was exceeded in one of the tested samples, in the individual weighing 615 g caught in the Vistula Lagoon. Concentration of mercury in that individual was 1199 μg/kg. In the remaining samples limits for cadmium and mercury were not exceeded even when compared to the limits for species other than eels (50 μg/ kg for cadmium and 500 μg/kg for mercury). The average content of mercury in the tissue of eels collected in the Szczecin Lagoon and in the Vistula Lagoon did not differ significantly. (Szczecin Lagoon – 164.5 ± 85.22 μg/kg, Vistula Lagoon – 140.29 ± 276.85 μg/kg).

The contents of cadmium and lead in all of the samples assayed were very low in comparison to the allowable limits. Cadmium contents fluctuated from 1.0 μg/kg to 8.0 μg/kg, which means that the maximum cadmium content was only 8.0% of the allowable limit. The lead contents fluctuated from 10.0 μg/kg to 81.0 μg/kg; thus, the maximum lead content was 27.0% of the allowable limit.

The content of zinc and copper were compared with the recommended daily allowances of these macro-elements (Commission Directive 2008/100/EC), which are 10 000 μg for zinc and 1000 μg for copper. The mean contents of zinc and copper indicated that 200 g of eel tissue meet 42.6% of the daily requirement of an adult person for zinc and approximately 7.2% of that of copper.

Organochlorine pesticides and total indicators of polychlorinated biphenyls

Results obtained were evaluated according to permissible limits defined under the Council Directive 86/363 EEC (organochlorine pesticides) and the Council Directive 1259/2011 (ndl-PCB):

α-HCH: 20 μg/kg

γ-HCH: 200 μ/kg

HCB: 100 μg/kg

ΣDDT: 1000 μg/kg

Σndl-PCB: 300 μg/kg for eel and 75 μg/kg for other fish species

Levels of pesticides and ndl-PCBs (congeners: 28, 52, 101, 153, 138, 153) varied in quite wide range even in the samples originated from the same location. The highest levels of organochlorine pesticides were measured in a sample from the Szczecin Lagoon. In this sample maximum levels of α-HCH, γ-HCH, HCB and ΣDDT were 0.255 μg/kg, 0.682 μg/kg, 3.8 μg/kg and 108.7 μg/kg, respectively. It means that the highest pesticide levels constituted 1.3%, 0.35%, 3.8% and 10.9% of permissible limits established for particular compounds. The lowest level of ΣDDT was measured in eels caught in the Vistula Lagoon (8.02 μg/kg).

The permissible contents of Σ PCB6 (300 μg/kg) in eel tissues was not exceeded in any of samples tested. However, the allowable limit designated for other fish species (75 μg/kg) was exceeded in four samples (two samples from the Vistula Lagoon, and two samples form the Szczecin Lagoon). The lowest ndl-PCB content was noted in sample of eel from the Vistula Lagoon (6.34 μg/kg).

Organochlorine pesticides and total indicators of polychlorinated biphenyls

Contamination level of eels collected in the Vistula Lagoon in the years 2010, 2011, 2012 and 2013 has been compared. The highest level of contamination was found in 2012. Higher levels noted in 2012 cannot be explained by the biological characteristic of the samples collected in that year (e.g. weight or length of individuals). Perhaps they should be ascribed to external factors (e.g. greater runoff of pollutants into catchment area in a given period).

11.4 Predators

The abundance of the great cormorant population in spring in breeding colonies is determined by counting nesting pairs (nests). Populations are linked permanently to these nesting sites until their young leave the nests. The cormorant nests are counted in early spring (April) before they are hidden by the leaves of the trees.

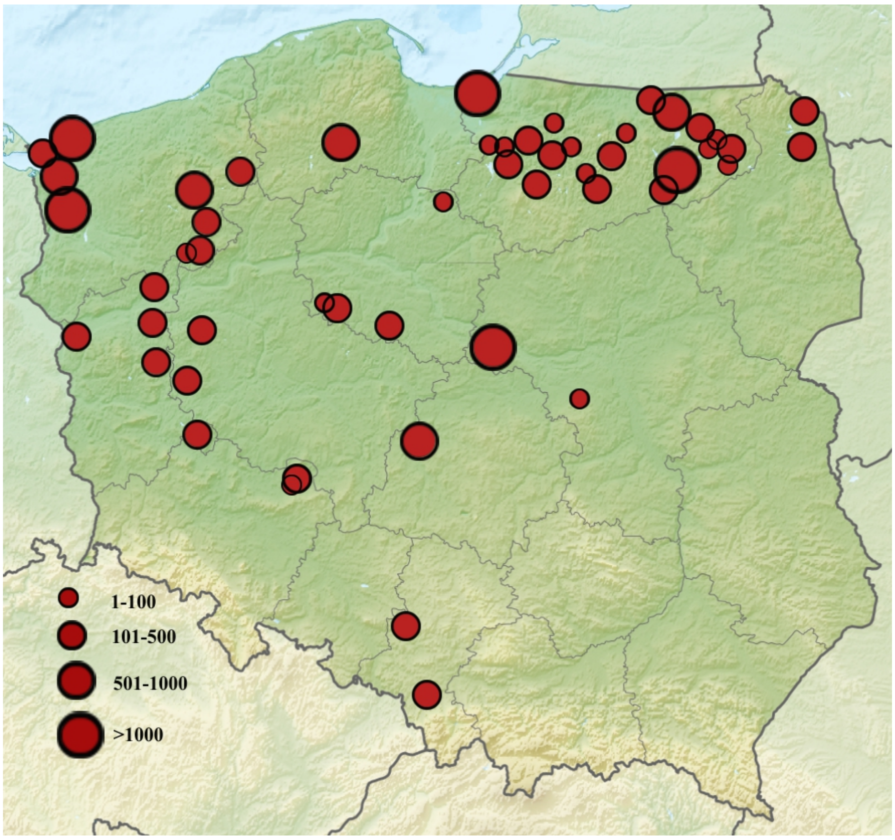


Figure 4. Breeding colonies abundance in Poland in 2013 (IFI report on predators, 2013).

Determining the breeding success of the colony by noting the mean number of reared individuals per nest permits determining the abundance of the great cormorant population in the colony in fall. Studying the breeding success of the colony is done just before the young birds leave the nests when they are clearly visible and very mobile in the nests and immediate vicinity. The water conditions in Poland mean that breeding success is often varied and is usually about two individuals/nest. Knowing the abundance of the colony is a fundamental element of establishing the share of eel in the overall diet of the colony. Cormorants will fish in waters within a radius of 30 km (and sometimes even of 50 km) from their nests.

Resting colonies are formed by young great cormorants that arrive but are not yet nesting. After the arrival of the year's young, these colonies are often supplemented by birds from nesting colonies. The great cormorants in resting colonies are loosely linked to these sites, and they tend to move around, which means that the abundance of birds at these sites is variable. Determining the mean numbers in such colonies requires frequent counts that are performed before the year's young leave the colony. All of the colonies are counted over the shortest span of time, which is done to eliminate error stemming from bird mobility.

The studies are conducted by verifying information obtained during previous field studies and based on current, supplementary data regarding the location and numbers of great cormorants throughout Poland. This permits updating this knowledge and helps in properly planning and conducting nationwide counts of colony nests and birds.

Based on the results obtained by analysing the materials collected, and knowledge regarding the abundance of great cormorants in the colonies studied, the periods during which the birds are in the area penetrated by the colony, and the daily feed ration (determined and verified based on studies of regurgitated pellets and fish), the total weight, abundance, and length distribution of the eel that are a component of the prey consumed by great cormorants is determined for different colonies. The results refer to the current eel state, which is linked to stocking and catches of this species.

Based on knowledge of the size of the entire great cormorant population inhabiting lakes in Poland and of the magnitude of cormorant pressure on eel in different basins, the total weight, size structure, and age structure are estimated for all eel that fall prey to great cormorants in the waters of the Oder and Vistula river basins. The primary eel habitats in Poland are lakes. In recent years, fishers landed approximately 100 tonnes of eel from 270 000 ha of lakes that are exploited by the fisheries, while great cormorants consumed approximately 35 tonnes. The mean weight of eel in the great cormorant diet is 197 g. The estimated mean weight of eel in fisheries catches was approximately 500 g. Thus, the great cormorants caught approximately 178 000 individuals, while fishers caught approximately 200 000 eel. In comparison to those of the 1980s, fisheries catches of eel decreased approximately ten-fold because of drastic reductions in stocking. This is also why the share of eel in the great cormorant diet also decreased from approximately 15% previously to less than 1% currently. Since the early 1990s, the lake populations of great cormorants have increased by 270%, and the current great cormorant diet exceeds fisheries catches by almost three-fold, which is a serious threat to all of lake fisheries. The current size of the great cormorant population poses a serious threat to the restoration of the eel population in Polish waters even with the proposed increase in eel stocking, which is already being implemented. Reducing the great cormorant population by one third of its current size is viewed as necessary, and even if this is done, the magnitude of the great cormorant diet will still exceed that of all other piscivorous animals combined. Despite European incentives, Poland has yet to develop the recommended Strategy for the Management of Cormorant Populations. Article 9 of the Birds Directive (Council Directive 79/409/EEC of 2 April 1979 on the conservation of wild birds) allows exceptions to be made if they prevent serious damage being done to other interests, such as fisheries. Unfortunately, in the face of strong pressure from some groups, attempts to use this possibility to reduce the great cormorant population in Poland have been negligible.

Table 15. Results of cormorants predation study in 2013 (IFI 2013).

River basin	Number of pellets collected (indiv.)	Number of eel in pellets (indiv.)	Calculated number of eels in colony	Mean body weight of eel (g)	Weight of eel in overall great cormorant diet (kg)	Total weight of great cormorant prey in the colony studied (kg)	Share of eel weight in great cormorant diet (%)
Oder	422	1	317	195	162	53 539	0.3
	478	1	701	205,9	144	112 565	0.12
	145	1	159	44,0	7	9261	0.07
Vistula	992	5	3173	209,9	671	299 650	0.22
	314	1	10 487	136,0	1426	16 206 040	0.008
	304	0	0	0	0	93 531	0

12 Other sampling

No new information is available.

13 Stock assessment

13.1 Method summary

The stock dynamics of eel in both river basin districts was estimated using a version of CAGEAN model (Deriso *et al.*, 1985). The model was fitted to data covering period 1960–2011. It were a lot of gaps in the age-structured data, and for some data only approximate or assumed values were available, so the model was fitted using simplifying assumptions. The available data included:

- Fishery and recreational catches covering whole period.
- Restocking numbers covering whole period.
- Age structure and weight-at-age for several years, but in most years these data were not available. The best covered by age and weight data period was since 2006.
- Predation on eels by cormorants.

In the CAGEAN model fishing mortality (F) was separated into year effect (fishing mortality at reference age in a year) and age effect (selection). Up to 2005 data for estimating year effect in F were too scarce, the F has been presented as time-dependent polynomial of 7th degree, and coefficients of such polynomial were estimated within the model. Since 2006 F has been calculated for each year due to age data availability. Predation mortality from cormorants was included, but it appeared to be low (usually at 0.01–0.02). Recruitment to the model was assumed as proportional to recruitment indices estimated using GLM by WGEEL (ICES, 2011) and coefficient of proportionality (Ralfa) was estimated in the model. Selection was estimated at ages 3–6, at others it was assumed at 1. Other parameter was Zini, total mortality used to estimate initial stock numbers (in 1960) from average recruitment at the beginning of simulation period.

The model was fitted by minimizing the sum of squared residuals between observed and modelled catch and observed and modelled catch-at-age in those years in which age distribution was available. The residuals were determined from logged values. Details of the model were presented in 2008 Polish eel management plan. The inverse of variance weighting was applied to weight terms of total sum of squared residuals. The estimated fishing mortality and Ralfa were inversely correlated and it was relatively little information in the data to select most representative estimate of Ralfa. Thus, the model was run for series of Ralfa values, and as a representative for eel dynamics it was selected such Ralfa, at which minimized sum of squared residuals showed low changes, while the total mortality was relatively close to mortality estimates from catch curve. Otherwise, the minimizing procedure tended to select high Ralfa and produced unrealistically low fishing mortality.

The model fit in 2013 differs from the model in 2008 for a few reasons:

- Recruitment indices were now taken from GLM estimates presented in WGEEL Report in 2013.
- Weight-at-age were updated and appeared to be much higher than previously used at younger ages.
- Data from 2008–2013 were included in the analysis.
- As a result the biomass estimates now are similar to previous estimates at the beginning of series (1960s) and comparable at the end of series (after 2000), however in middle of the assessed period present biomass estimates are markedly higher from previously estimated.

13.1.1 Estimate of B_0

EMU_CODE	B_0 (T)	Reference time period	Whether or not changed from value reported last year (Y/N)
PL_ODER	1611	1960–1979	N
PL_VISTULA	1343	1960–1979	N

13.2 Summary data

13.2.1 Stock Indicators and target

EMUcode	Indicator	biomass (t)	Mortality (rate)				Target	
	B_0	B_{best}	B_{curr}	∑A	∑F	∑H	Source	Biomass (t)
PL_ODER	1611	241	58	1.55	1.04	0.51	EMP	645
							EU Reg	
							WGEEL	
PL_VISTULA	1343	234	33	2.31	1.51	0.8	EMP	537
							EU Reg	
							WGEEL	

B_0 is based on average recruitment from reference period taken as 1960–1979;

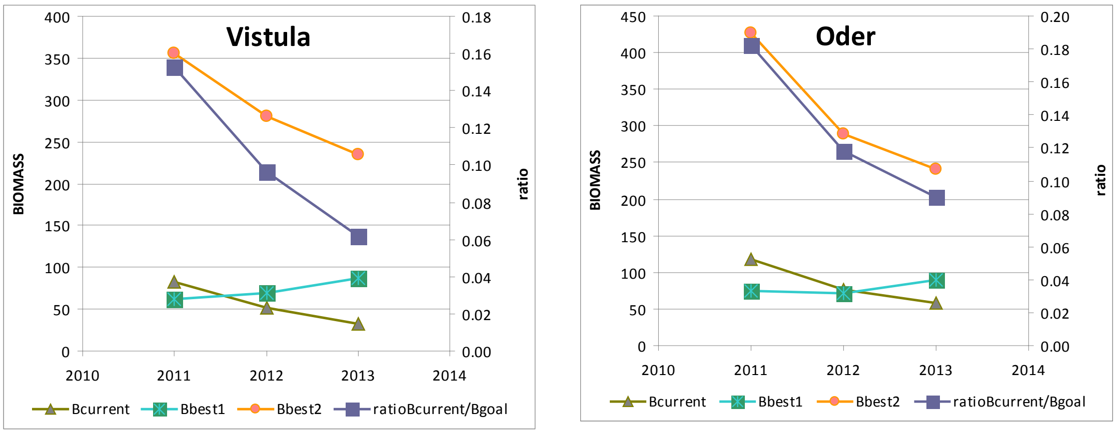
B_{best1} is based on current recruitment (2013);

B_{best2} is based on recruitment from those year classes, which form current escapement of silver eel to spawn;

sumF, $B_{current}$, B_{best} are provided in 2013.

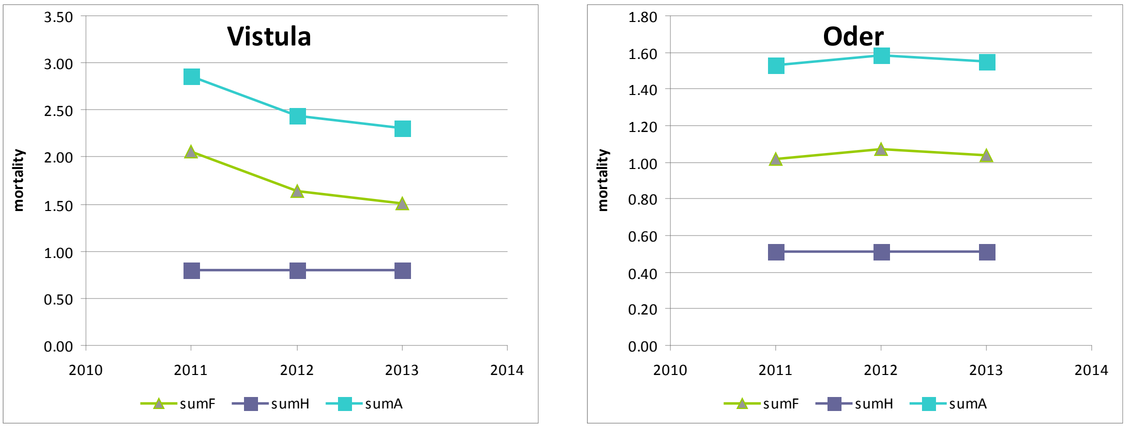
Two versions of B_{best} were provided, as it was not fully clear from the guidelines how B_{best} is defined. In addition, it is not clear how to calculate B_{best} from $B_{current}$, sumF and sumH, because to calculate B_{best}, the sumF referring to generations forming current escapement should rather be used instead of sumF from current years.

Changes in silver eel biomass and mortality factors over the last three years are presented in figures below.



A B

Figure 5. Stock dynamics in Vistula RBD (A) and Oder RBD (B) presented as a $B_{current}$, B_{best} and ratio in 2011–2013.



A B

Figure 6. Changes in mortality factors in Vistula RBD (A) and Oder RBD (B) in 2011–2013.

13.2.2 Habitat coverage

Natural eel habitats in Poland are found in nearly all waters (Table 7), the only differences are in their importance for the occurrence of eel. Rivers are of the least importance to the occurrence of eel because they are routes for feeding and spawning migrations (silver eel escapement). The most important eel habitats have been and are transitional waters (Vistula and Szczecin lagoons) and lakes which comprise the lakelands situated in northern Poland.

Table 16. Surface areas of water categories in the EMUs (ha).

Types of waters	Oder EMU	Vistula EMU	TOTAL POLAND
Rivers, width >3 m	-	-	134 700*
Lakes, surface area >1 ha	163 000	118 400	281 400
Dam reservoirs	16 000	32 000	48 000
Transitional waters	45 700	32 800	78 500
Maritime waters**	646 450	344 100	990 550

*** length in km.**

**** maritime waters include the inner Gulf of Gdańsk, which nominally belongs to inner maritime waters.**

13.2.3 Impacts

Mortality in eel is caused by a number of factors, the most important of which include hydroelectric power facilities, fishery, cormorant predation, water pollution, parasite infection, and illegal catches.

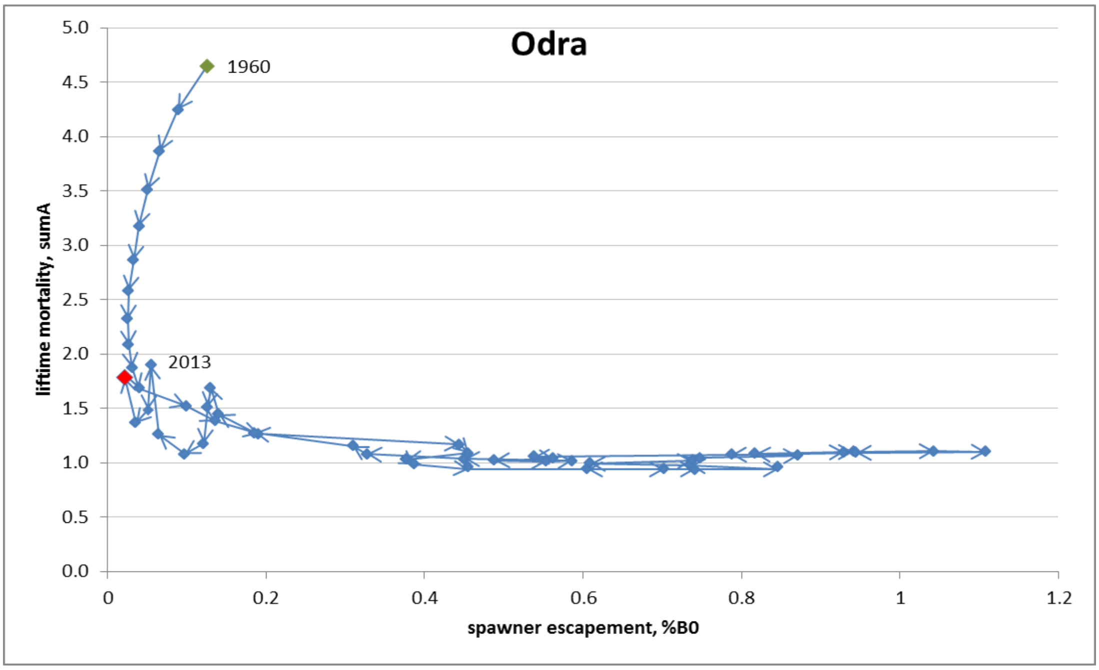
Detailed study on impacts is currently ongoing (see chapter Other sampling), so the first results will be ready in 2013.

Table 17. Causes of mortality in eel other than fishing.

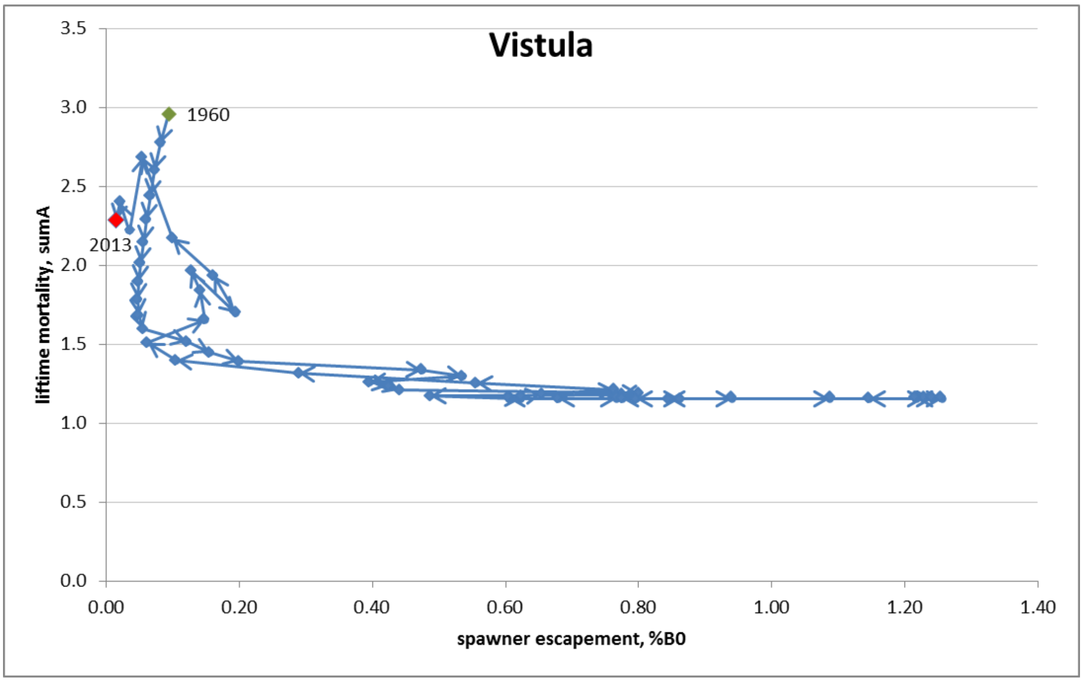
EMU code	Habitat	Fish com	Fish rec	Hydro & pumps	Barriers	Restocking	Predators	Indirect impacts
PL_ODER	All	A	A	A	NA	AB	A	MI
PL_VISTULA	All	A	A	A	NA	AB	A	MI

No.	Cause of mortality	Habitat type	Impact
6.1	Hydroelectric power facilities	Rivers	Vistula EMU – 44% (EMP) Oder EMU – 30% (EMP) New data – 0 to 22%
6.2	Predation	All	Potentially substantial (research required)
6.3	Pollution	All	Quality data (low impact)
6.4	Diseases and parasites	All	Quality data
6.5	Illegal catches	All	Quantity data

13.2.4 Precautionary diagram



A



B

Figure 7. Precautionary diagrams in one of the form, i.e. lifetime mortality (sumF+sumH) plotted against spawner escapement (in terms of percent of B_0). The estimates for the beginning and end of the considered period are marked in green and red. High spawner escapement biomass at end of 1970s up to beginning of 1990s is effect of the intensive restocking in 1960s till middle of 1990s. Lifetime mortality (sumF+sumH) plotted against spawner escapement (fraction of B_0) for 1960–2013 (a= Odra river basin district, b= Vistula river basin district).

13.2.5 Management measures

EMU code	Action Type	Action	Life Stage	Planned	Outcome
PL_ODER PL_VISTULA	Com Fish	Closed period 15 June–15 July	Y/S	2009	2010 Fully
PL_ODER PL_VISTULA	Rec Fish	Closed period 15 June–15 July	Y/S	2009	2010 Fully
PL_ODER PL_VISTULA	Hydropower & Pumps	Limiting mortality	S	2019	NA
PL_ODER PL_VISTULA	Restocking	Restocking		2009	2009 suplemented in 2011, 2010 and 2011 suplemented in 2013 Partially
PL_ODER PL_VISTULA	Com Fish	Minimum landing size 50 cm	Y/S	2009	2010 Fully
PL_ODER PL_VISTULA	Rec Fish	Minimum landing size 50 cm	Y/S	2009	2010 Fully
PL_ODER PL_VISTULA	Com Fish	Gear Selevtivity >20 mm	Y/S	2013	2013 Partially (not in all areas)
PL_ODER PL_VISTULA	Rec Fish	Decreasing daily catch	Y/S	2009	2010 Fully
PL_ODER PL_VISTULA	Other	Reducing cormorants	Y/S	In case of negative impact	NA (small impact now)

14 Sampling intensity and precision

Since 2006, Poland has participated in the programme for collecting fisheries data, which includes sampling eel landings. Until 2008, the framework for data collection was set forth in Council Regulation (EC) No. 1639/2001. Thus far, samples have been collected in the Szczecin and Vistula lagoons and survey forms have been completed and entered into the SFI database.

The detailed ichthyological analysis of eel from landings follows standard procedure for population sampling, and includes recording parameters such as length, weight, sex, stomach fullness, and parasitic infection (nematode *Anguillicola crassus)*. Otoliths are also collected for later age and growth-rate determinations. Because commercial fisheries to not differentiate between yellow and silver eel, the metamorphosis stage is determined using the silvering index.

From 2009, there has been a shift in the framework for collecting dataset forth in Council Regulation (EC) No. 199/2008 concerning the establishment of a Community framework for the collection, management, and use of data in the fisheries sector and support for scientific advice regarding the Common Fisheries Policy.

Specifically, this is a move away from single-species sampling performed in the 2005–2008 period toward multispecies sampling based on métiers or fleet segments. In the case of eel, sampling in 2010 will be introduced in inland waters as part of commercial and recreational catches. Although the framework for data collection in maritime fisheries is quite precisely described (Guidelines for the new DCR (SGRN-08-01), for inland fisheries there is just one short notation regarding the required number of fish analysed to determine age. The SFI planned a monitoring system that functions on similar principles to those of the marine system (Table 10). The catches sampled will be those made with gear groups that include up to 90% of the entire fishing effort. It is planned to analyse 200 fish from each river basin.

Table 17. Basic scheme for collecting marine fisheries data from eel catches in 2009–2010.

Choice of region(Baltic region; fishing grounds)	ICES SD 22-24 Oder EMU	ICES SD 25-32 Vistula EMU
Choice of métier (fleet segment) for eel	Pot and trap gear (FPO)	
Degree of sampling segment (landings + discards)	Minimum of one cruise per month	
Total number of sample	Depending on the variation coefficient CV, assumed CV=12.5% for eel	
Age analysis	100 yellow eel 100 silver eel	100 yellow eel 100 silver eel
Other biological parameters*	as above	as above

*** sex, silvering index – gonad maturity, degree of parasitic infection with *Anguillicola crassus*.**

The level of precision regarding age required by DCF regulations was not achieved. The numerous length and age classes would require performing age analysis on a thousand fish annually to achieve a CV coefficient of about 12.5%.

15 Standardization and harmonization of methodology

15.1 Survey techniques

See chapter “other sampling.”

15.2 Sampling commercial catches

Data regarding commercial fisheries are collected in fishing ports in which eel catches are reported. Measurements and analysis are performed at the SFI laboratory. Prior to analysis the fish are anaesthetized then sacrificed.

15.3 Age analysis

Age analysis is conducted at the SFI laboratory. Age is calculated based on the number of growth interval rings visible as dark rings and clearly differing from the light protein matrix on the surface of otoliths (Moriarty, 1983; Campana, 1992; Campana and Jones, 1992; Lecomte-Finiger, 1992; Tzeng *et al.*, 1994). Two otolith preparation methods are used; the more common break and burn, and the less common section and stain. Thin sections are cut using a high-speed Acutom-50 micro-tome with a diamond blade.

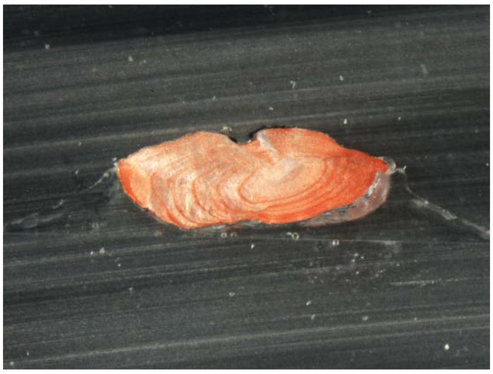


Photo 1. Sectioned eel otolith prepared in NMFR laboratory.

15.4 Life stages

Eel life stage is determined using the method described in Durif *et al*. (2005).

15.5 Sex determinations

Eel sex is determined macroscopically according to established schema of ovary and core build.

Report on the eel stock and fishery in Portugal 2013/2014

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Reporting Period: This report was completed in October 2014, and contains data up to 2013 and some provisional data for 2014.

Contributors to the report: Capitania do Porto de Caminha; Comandancia Naval de Tuy; DGRM (General Directorate of Natural Resources, Maritime Safety and Services)

2 Introduction

This report is an update of last year´s report but most of the information related to the EMP, despite having been presented in previous reports, was repeated because there is no new information for some chapters. It contains data for 2013 and some provisional data for 2014.

The data presented in this report are relevant to the South European Atlantic Shelf Ecoregion.

2.1 Eel fishery

The European eel occurs in different types of water bodies that include coastal lagoons, estuaries and rivers but the presence of impassable dams reduced the distribution area, which is now restricted to areas below obstacles in most river basins, especially in the largest. Commercial exploitation of eel includes glass eel fishing, exclusively in River Minho, and yellow eel fishing, all over the country, except in River Minho, where it was prohibited following the Transboundary EMP.

The species has been traditionally exploited in Portugal, where it has a high gastronomic value, especially fried when small, and stewed when large. This preference restricts fishery as demanding for eels for human consumption, falls preferably for individuals of about 25 cm, which is the most appreciated size for frying. There is no fishing for silver eels in Portugal, and given the lack of tradition to eat glass eels, glass eel fishery was non-existent until the early 1980s, except for the River Minho.

Eel fishery is managed by DGRM (General Directorate of Natural Resources, Maritime Safety and Services) with responsibility in coastal waters, and ICNF (Institute of Conservation of Nature and Forests)) with responsibility in inland waters. Both institutions are under the Ministry of Agriculture and Sea, former Ministry of Agriculture, Sea, Environment and Planning (MAMAOT). The exception is River Minho because as an international river having a common stretch bordering both countries, there is a Commission (Standing Transboundary Commission of the River Minho) with representatives from both countries, setting specific rules that are applied to the fishery conducted in the international section of that river basin. Licences to fish in inland waters are issued by ICNF, whereas licences to fish in transitional and coastal waters are issued by DGRM.

Following a period of high fishing pressure and intensive poaching on glass eels, glass eel fishing became prohibited after the fishing season 2000/2001 (*Decreto Regulamentar* nº 7/2000 of 30/05/2000) in all river basins, except in the River Minho where it is still permitted (Decreto Lei nº 316, artº 55 of 26/11/81). Despite the enormous efforts of the authorities which results in the seizure of a large number of nets, poaching remains a problem all over the country, especially in the North and Central parts of Portugal. Some investment has however been done to increase supervision by the Authorities. An example is the establishment of a protocol between the Administration of the River Basin District from the Tagus (ARHTejo) and the SEPNA (Service of Nature and Environment Protection) from GNR (National Republican Guard) who can now use a boat and a car from AHR to monitor the river to guarantee compliance with the law.

Although landings do not separate yellow eels from silver eels, the fishing gears used are mainly directed to catch yellow eels, which is the dominant type in landings.

Yellow eel fishery is ruled by eleven specific byelaws applied to eleven fishing areas in coastal waters (estuaries and coastal lagoons) and nine other byelaws that are applied to specific fishing areas called ZPPs (Zonas de Pesca Profissional / Professional Fishing Zones) (See Figure 2.1), which are the only areas where professional eel fishery is allowed in inland waters. These laws set the rules for types and characteristics of fishing gears and in most cases, limit the maximum number of gears per fishing licence. Fishing effort is not recorded. In inland waters, professional fishery is ruled by Law 2097/59 (6 June, 1959) in the stretches represented in green, whereas in the sections represented in yellow it is ruled by the byelaws (Figure 2.1a). Fisheries managed by DGRM have obligatory landing reports because eels are sold at fish auctions, while in inland waters, there are no auctions. Since 2012, professional fishermen have however become obliged to report annual catches in order to be able to renew their fishing licences. Minimum legal size is 22 cm in both areas of jurisdiction.

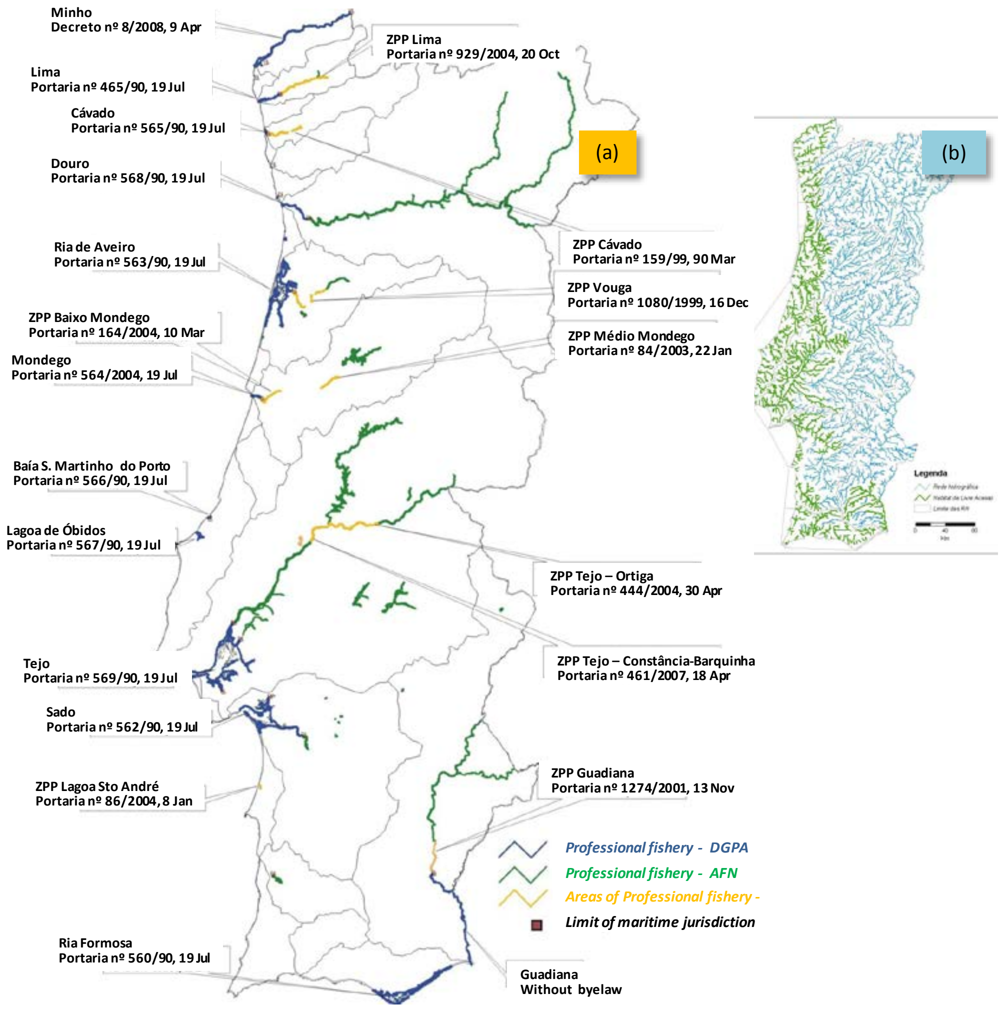


Figure 2.1. Map showing areas where professional fisheries can be conducted both in estuaries and coastal lagoons (jurisdiction of DGRM) and in inland waters (jurisdiction of ICNF) (a). The limit of maritime jurisdiction and the byelaws that rule the fisheries at each area are presented in the map (a). (Source: ICNF). The habitat that is accessible for the eel is also represented in green (b).

Eel fishery is permitted from January 1st until September 30th. A closed season of three months (October, November and December) has been set to increase escapement of silver eels. This prohibition was first set in 2010 for waters within the jurisdiction of DGRM, *i.e.* estuaries and coastal lagoons (Portaria nº 928/2010, from 20 September) and in 2012 for waters under the jurisdiction of ICNF, *i.e.* inland waters (Portaria nº 180/2012, from 6 June). In River Minho the yellow/silver eel fishery is forbidden since season 2011–2012.

2.2 Portuguese Eel Management Plan

The Portuguese Eel Management Plan was approved by the European Commission on the 5th April 2011, following the delivery of the last revised version on the 19th November 2010.

In response to Regulation EC 1100/2007, Portugal has submitted an Eel Management Plan in December 2008. This plan was resubmitted in May 2009 and accepted by the EC in July 2009. The Portuguese Eel Management Plan was established to be implemented for the entire territory, which was designated as one eel river basin, *i.e.* the eel management unit, in accordance with Article 2, number 1. Madeira and Azores islands were excluded from the plan because anthropogenic impacts such as fishery and physical obstacles were considered of little or no importance, and similar to pristine conditions.

As mentioned above, the eel management unit for the purpose of the EMP is the entire territory. The designation of the entire territory as one eel river basin, originated from the generalised lack of information at the national level as well as from the fact that the entire territory can be considered as a potential habitat for the species. Data from the fishery are underestimated for coastal waters, and non-existent for inland waters, where catches are not reported. In addition, silver eels are not separated from yellow eels in landings and there are no scientific data on yellow and silver eel production neither in the present nor in pristine conditions.

Despite the existence of five river basins extending beyond Portugal (Minho, Lima, Douro, Tagus, and Guadiana) (Figure 2.2a), and included in three different River Basin Districts (Figure 2.2b), it was agreed between both countries that the only Transboundary Eel Management Plan that should be considered was for River Minho, as it is the only international river where the river mouth is shared by both countries and there is a strong interest on the glass eel fishing. As coordination between the two countries was delayed, it was not possible to consider it in December 2008, when submitting the Portuguese Eel Management Plan.

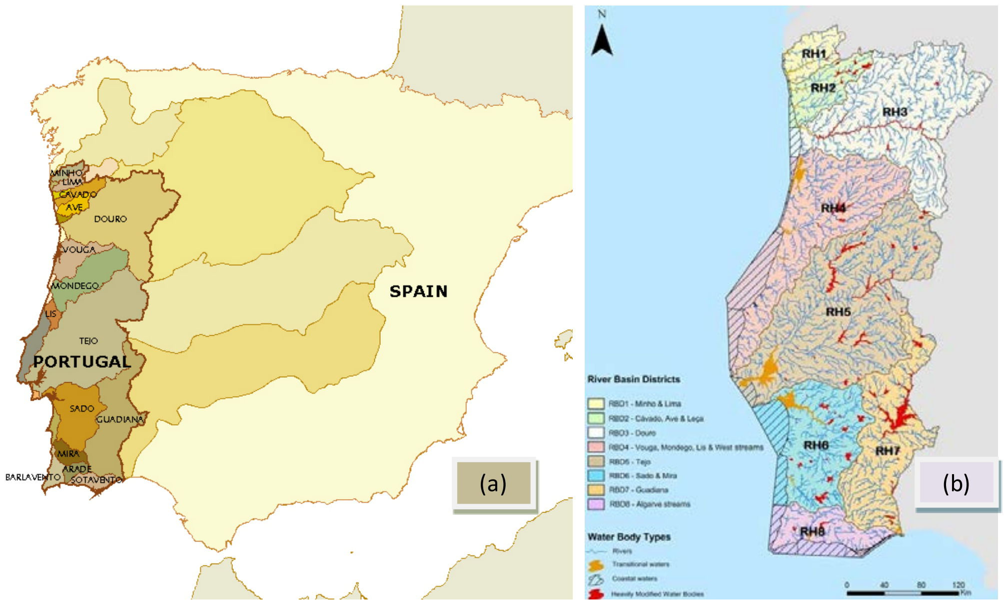


Figure 2.2. Map showing Portuguese River basins including the catchment area extending to Spain (a), and limits of the eight Portuguese River Basin Districts defined according to the Directive 2000/60/EC (b). RBD is labelled as RH in the map.

A project financed by INTERREG IV, (NATURA-Minho: Levantamento do habitat fluvial, os habitats de interesse comunitário, avaliação dos recursos migradores e ordenamento do seu aproveitamento no baixo Minho" which started by the end of 2009 and finished by the end of 2010 (with both countries as partners) was the support to prepare the Transboundary EMP for the River Minho, as one of the outputs of this project was the EMP for the River Minho.

Because the EMP for the River Minho was not delivered in time, Portugal had to reduce the fisheries effort until the implementation of the EMP in that river. Hence, several measures were taken to comply with the provisions of Article 4, number 4 *i.e.* to reduce fishing effort by at least 50% relative to the average effort deployed from 2004 to 2006. Those measures included reducing the number of fishing licences to fish glass eels, shrinking the authorized fishing zone for glass eels, shortening the fishing period, and banning fishery for eels.

A first version of the Transboundary EMP was sent to the European Commission in June 2011 followed by a revised version in November of the same year. The Transboundary EMP was approved by the European Commission on the 21st May 2012.

The first report on the implementation of the Portuguese EMP, which included a list of the measures that have been implemented, was sent to the European Commission in June 2012. Assessment of the effectiveness of those measures could not be estimated because of lack of data on stock assessment.

As for the report on the implementation of the Transboundary EMP for the River Minho it was not delivered to the European Commission because of its very recent approval (21st May 2012).

3 Time-series data

3.1 Recruitment

3.1.1 Glass eel recruitment

In the River Minho, the monitoring of glass eel recruitment has been carried out since the mid-1970s based on professional fishermen catch values that have been annually reported to the authorities. Official fishery statistics have been kept by the responsible local authorities – *Capitania do Porto de Caminha* (Portugal) and *Comandancia Naval de Tuy* (Spain). Total annual statistics have been recorded since 1974. There is no recruitment monitoring of glass eels at the national level.

3.1.1.1 Commercial

The glass eel fishery is prohibited in all rivers of Portugal (*Decreto Regulamentar* nº 7/2000 of May 30) with the exception of the River Minho (Decreto-Lei 316 artº 55 of 26/11/81). It was after the fishing season 2000/2001 that the fishery became prohibited in all other Portuguese rivers, except for aquaculture and restocking programmes. However, there has been no national need to harvest them.

Glass eel fishery in the River Minho has been permitted between November and April for many years, but after the fishing season 2005/2006, mostly due to the eel population decline and the high fishing pressure, an agreement between the Portuguese and Spanish authorities, has been gradually reducing the fishing period. The fishing season is currently defined, to include four New Moons (the most profitable period). In the last fishing season (2013/14) fishing occurred between the 26th October and the 6th February).

The fact that a fisherman has a licence to fish glass eels in a certain year does not necessarily mean that he will actually fish. The seasonal occurrence of other, relatively abundant species, like sea lamprey, influences the effort put in the glass eel fishery in an unpredictable manner. However, following the implementation of the Transboundary EMP for the Minho, fishermen, who have not reported catches on glass eels, are not given a licence to fish the following year.

Fishermen are obliged to report their catches to the local authorities. The official fishery statistics are kept by the responsible local Authority – *Capitania do Porto de Caminha.*

Total annual statistics have been recorded since 1974 (Table 3.1). Between 1974 and 2005, 13.4 tons of glass eels were caught. However, it is estimated that values are 80% underestimated. A maximum of 50 tons was declared in 1980/1981 followed by a second peak of 30.3 tons in 1984. In the period from 1985 to 1988 the official yield dropped to 9.5 tons with a peak of 15.2 tons in 1995. In 2000/2001 low catches were obtained, probably due to bad weather conditions that prevented fishing for three months. After the 2001/2002 fishing season and until 2007, the values decreased to 2.0 tons. For the 2008/2009 season there was a slight increase in the amount declared, which can be a consequence of a higher number of issued licences (see Table 3.1), rather than a real increase in recruitment. The same false increase in the yield from 2010 is probably related to changes in the new way to report catches as fishermen are obliged to fill in logbooks and report catches every three months. The amount declared will be compared to the quantity sold at the fish auction. In case there is any false declaration there will be consequences, and their licences will not be renewed. A change in reporting catches has been introduced in the fishing season 2011/2012. Fishermen have to report their catches on a monthly basis filling in a logbook where they should register the amount caught in each fishing session.

Table 3.1. Glass eel recruitment in the River Minho (Portuguese and Spanish parts), 1974 to 2013 (Source: Capitania do Porto de Caminha and Comandancia Naval de Tuy).

YEAR	PORTUGAL	SPAIN	TOTAL (TONS)
1974	0.05	1.6	1.65
1975	5	5.6	10.6
1976	7.5	12.5	20
1977	15	21.6	36.6
1978	7	17.3	24.3
1979	13	15.4	28.4
1980	3	13	16
1981	32	18	50
1982	6.7	9.7	16.4
1983	16	14	30
1984	14.8	15.3	30.1
1985	7	6	13
1986	9.5	5.5	15
1987	2.6	5.6	8.2
1988	3	5	8
1989	4.5	4	8.5
1990	2.5	3.6	6.1
1991	4.5	2.4	6.9
1992	3.6	9.8	13.4
1993	2.9	2.1	5
1994	5.3	4.7	10
1995	8.7	6.5	15.2
1996	4.4	4.3	8.7
1997	4.5	2.9	7.4
1998	3.6	3.8	7.4
1999	3	3.8	6.8
2000	1.2	6.5	7.7
2001	1.1		1.1
2002	1.443	7.8	9.243
2003	0.814	1.6	2.414
2004	1.17	1.3	2.47
2005	2.7	0.32	3.02
2006	0.905	1.14	2.045
2007	0.75	1.03	1.78
2008	1.35	1.33	2.68
2009	0.576	n.a.	
2010	1.085	1.325	2.410
2011	0.807	1.022	1.829
2012	1.081	0.814	1.895
2013	1.176	n.a.	

3.1.1.2 Recreational

Not applicable, as there is no recreational fishery of glass eels in the River Minho.

3.1.1.3 Fishery-independent

No available data. There is no fishery-independent dataseries on glass eel recruitment.

3.1.2 Yellow eel recruitment

3.1.2.1 Commercial

There is no commercial dataseries on yellow eel recruitment.

3.1.2.2 Recreational

Not applicable. Catches are not reported.

3.1.2.3 Fishery independent

No available data.

3.2 Yellow eel landings

3.2.1 Commercial

No available data. There is no commercial data on yellow eel recruitment.

3.2.2 Recreational

Not applicable as there are no landings from recreational fishery and fishermen are not obliged to report their catches or sell the fish. In River Minho it is forbidden to catch eels by recreational fishing since 2010.

3.3 Silver eel landings

There is no separation between yellow and silver eels and fishing gears are not directed to catch silver eels, despite their occurrence in fykenets. Besides, with the implementation of the EMP, the fisheries were closed during the most important period of spawning migration, *i.e*. from the 1st October to 31st December.

3.3.1 Commercial

No data.

3.3.2 Recreational

Not pertinent.

3.4 Aquaculture production

Aquaculture production of European eel is not significant in Portugal because there are no units of eel aquaculture in Portugal. In brackish water systems, production of eels is a byproduct in aquaculture systems directed towards extensive and semi-intensive seabass (*Dicentrarchus labrax*) and seabream (*Sparus aurata*) farming. In fresh water, there is no production of eels in aquaculture systems since 2000, despite the existence of four inactive production units. The difficulties in obtaining glass eels (after the prohibition to fish), the high price they reached, and water availability, might have been responsible for that interruption in production.

3.4.1 Seed supply

Not pertinent as the semi-intensive and extensive ponds are naturally colonised by eels.

3.4.2 Production

The production of eel is presented in Table 3.2.

Table 3.2. Aquaculture production of eels (tons) between 1997 and 2013 (Source: DGRM).

YEAR	PRODUCTION (TONS)	
1997		16.2
1998		13.2
1999		3
2000		6
2001		6.5
2002		4.2
2003		4.7
2004		1.5
2005		1.4
2006		1.1
2007		0.5
2008		0.4
2009		1.1
2010		0.5
2011		0.6
2012	n/a	
2013	n/a	

3.5 Stocking

There is no stocking of eels in Portugal.

3.5.1 Amount stocked

Not pertinent. There is no stocking in Portugal.

3.5.2 Catch of eel <12 cm and proportion retained for restocking

Except for River Minho, it is forbidden to fish for glass eels in Portugal. River Minho is the only national exception where glass eel fishery is still permitted. Because River Minho extends to Spain, a stocking programme to stock 60% of the glass eels fished, in accordance with Article 7 of the Eel Regulation (EC Regulation 1100/2007) has been discussed by both countries. Because actual recruitment is considered above the carrying capacity of available habitat in the international section of the River Minho (River Minho EMP), glass eels caught in this area will be available to be used on stocking actions elsewhere, either in Portugal or Spain.

Xunta da Galiza caught 700 kg of pigmented eels (± 12 cm) in the fish trap of the first dam (Frieiras Dam). They were released in the River Minho.

3.5.3 Reconstructed time-series on stocking

Not pertinent. There is/was no stocking.

3.6 Trade in eel

The destination of all glass eels captured in the River Minho is Spain. It is not clear if they remain in Spain or are exported to other countries. Glass eel price paid to fishermen varied between 200 €/kg and 350 €/kg considering the entire fishing season. The price of glass eels declined after the implementation of CITES.

4 Fishing capacity:

4.1 Glass eel

Glass eel fishery is only permitted in River Minho where fishery is regulated by Decree 8/2008, of 9/04/ 2008. Fishery is operated with a stownet. This net has the following maximum dimensions: 10 m of floatline kept at the surface by 10–20 buoys, 8 m height, 15 m leadline, width of net end 2.5 m and wet mesh size >2 mm. Opening area is around 50 m^2. The net is anchored when the tide is rising, the end fastened to a boat, and glass eels are frequently scooped out with the help of a small dipnet. Glass eels can also be fished from the river bank with a dipnet of 1.5 m maximum diameter and mesh size of 2–5 mm.

The fishery, which depends completely on the rising tidal current, is always performed at night around new moon. Depending on the weather conditions, peaks may occur in winter or spring. Catches in summer months are usually very low (Domingos, 1992; Antunes, 1994a), although heavy rain during summer months can promote a more intense migration and higher catches (Domingos, 2002).

In 1983 there were 450 licensed fishermen in Spain and 750 in Portugal, corresponding to 300–400 nets in total. In 1988 approximately 600 boats in Portugal had permission to fish glass eels with one net each and in 1995, around 450 Portuguese boat inscriptions were recorded. In 1999, 251 Spanish fishermen were registered for the glass eel fishery. The number of fishing licences issued by *Capitania do Porto de Caminha* is presented in Table 4.1.

To reduce fishing pressure it was decided by the Standing Transboundary Commission of the River Minho that starting on the fishing season 2010/2011 the maximum number of fishing licences for each country would be 200, and also that the fishing zone for glass eels would decrease 25 km in the river length. In the fishing season 2011/12 a new change was introduced in the licensing process, as licences started to be issued to the owners of the boats and not to fishermen, implying that the drop to 126 licences is a consequence of these changes rather than a real reduction in fishing pressure. As observed in Table 4.1., the fishing period has been progressively reduced since the fishing season 2006/2007.

Table 4.1. Number of fishing licences (stownets) issued by *Capitania do Porto de Caminha* to fish glass eels in the River Minho, 1987 to 2012 (Source: Capitania do Porto de Caminha).

Fishing season*	Nr. fishing licences
1987/88	721
1988/89	633
1989/90	565
1990/91	475
1991/92	435
1992/93	349
1993/94	327
1994/95	432
1995/96	426
1996/97	378
1997/98	387
1998/99	385
1999/00	320
2000/01	295
2001/02	224
2002/03	197
2003/04	236
2004/05	224
2005/06	209
2006/07 **(1)**	185
2007/08 **(2)**	200
2008/09 **(3)**	216
2009/10 **(4)**	200
2010/11 **(5)**	126
2011/12 **(6)**	142
2012–2013 **(7)**	128
2013–2014 **(8)**	115

*** Licences for glass eel fishery are issued by fishing season (1 November to 30 April before 2006/07). In the seven last fishing seasons (1) 1 November to last New Moon of March; (2) 1 November to 12 February; (3) 20 November to 01 March, (4) 9 November to 22 February; (5) 1 November to 1 February; (6) 18th November to 1 March; (7) 7 November to 17 February; 26th October to 6th February.**

The Portuguese glass eel catches are sold to Spain for human consumption, aquaculture and possibly stocking elsewhere. In general, the highest prices are attained before Christmas. In the past glass eels used to be sold (in average-350 €/Kg, although they can be sold at 500 €/Kg). Despite forbidden all over the country, illegal glass eel fishery occurs in all estuarine areas due to the high economic value. The nets used are different from the type used in the River Minho, because there is no need to collect the eels with a dipnet, helping poachers to hide from the authorities. The net is fixed to the bottom by anchors that are attached to the wings, and fishing is conducted without the need to have fishermen close to the boat. These nets are conical and tied with a cable in the end of the cone. With the rising tide, the wings open and the net starts to fish the glass eels which get trapped inside the bag. There is no need to take the nets out of the water. The only thing to do is to pick up the end of the net, open it into the boat and release all the catches. Because these nets are left fishing in the water, they are extremely used in illegal fishery. The authorities from DGAM (Maritime Police) and SEPNA (a special unit from GNR, National Republican Guard) make a tremendous effort to control the situation, but the seized nets are rapidly substituted by new ones.

4.2 Yellow eel

Fishing capacity in inland waters is not known, and under the present legislation it is not possible to estimate the number of fishermen and eel fishing gears they owe/use. Professional and recreational fishermen must obtain a licence issued by ICNF to fish in these waters but only professional fishermen have become obliged to report their catches since last year. Licences for recreational fishery can be national or regional (North, Centre, South) and fishermen can fish where they choose to according to the type of fishing licence. Professional fishery is ruled by nine byelaws, which define the river stretches where fishermen are allowed to fish, and lay down the rules to fish (gears and mesh sizes, size limit of species, hour restrictions and species restriction).

The number of specific eel fishing licences issued by DGRM for local fishery in estuarine and coastal waters, grouped by gear type and RBD, is listed in Table 4.4. These licences are linked to fishing boats, together with other licences that are used for other species. The same fishing boat can be licensed to fish with more than one type of fishing gear. In some areas within the DGRM jurisdiction, there is a policy on maximum number of fishing gears permitted by licence. That does not imply fishermen use them all, but the number they use is unknown. The type, number and characteristics of eel fishing gears vary according to fishing area. There are eleven specific byelaws that set the rules for eleven fishing areas. However, for certain areas and/or fishing gears there is no restriction on the number permitted for each licence. These different rules and the lack of record on the actual number of fishing gears fishermen use, contribute as extra difficulties to estimate fishing capacity.

The use of fykenets in the River Minho was banned by Decree 8/2008 (April 9th) and its application started on the fishing season 2008/2009. However, longlines are still permitted in the international part of the river (80 Km) and eels are caught as bycatch (maximum 10% allowed) of other fisheries.

4.3 Silver eel

Not pertinent. There is not a fishery for silver eels.

4.4 Marine fishery

Not pertinent. In coastal waters, eels are caught in estuaries and coastal lagoons, but there is not a fishery for eels in marine habitats.

5 Fishing effort

Fishing effort is not recorded in the Portuguese eel fishery.

There is a variety of fishing gears that are used to catch yellow eels, namely fykenets, sniggle, fishing rods and longlines. Despite being selective fishing gears mostly directed to catch demersal fish species, longlines can occasionally be used to catch eels.

In coastal areas, these are licensed and linked to boats, but their use by fishermen (number of fishing sessions and number of fishing gears used) is unknown. There is no registration of number of fishing gears really used per licence, although maximum number per fishing licence in each fishing area is set by law. The boats used in local fisheries within the jurisdiction of DGRM (estuaries and coastal waters) are small (less than 9 m long) and they are not obliged to keep log-books. Landings are obligatory but the only information that is kept is the name of the boat and total catches per species, without any record about type and/or number of gears used.

With the jurisdiction of inland waters ICNF introduced, in 2012, the obligation to report catches obtained by professional fishermen, who can only fish in the ZPPs (Professional fishing zones) established in inland waters. Data are not yet available.

5.1 Glass eel

No data.

5.2 Yellow eel

No data.

5.3 Silver eel

Not pertinent. No fishery directed towards catching silver eels.

5.4 Marine fishery

Not pertinent. There is no marine fishery for eels.

6 Catches and landings

6.1 Glass eel

Fishermen have always been obliged to report their total annual catches to local authorities. Official fishery statistics have been kept by the responsible local Authority – *Capitania do Porto de Caminha*. Total annual statistics have been recorded since 1974, and as observed in Figure 6.1 there were three periods in landings. Following a decline after 1986, there was a period of medium landings and a final decline was registered after 1999. Since 2000, total landings have remained in low levels, corresponding to less than 1.5 tons per year, with the exception of 2005, when catches were slightly higher.

In fishing season 2010/2011 a new regulation entered into force obliging fishermen to fill in a logbook and report their catches every three months and the regulation for fishing season 2011/2012 obliged fishermen to report their catches on a monthly basis.

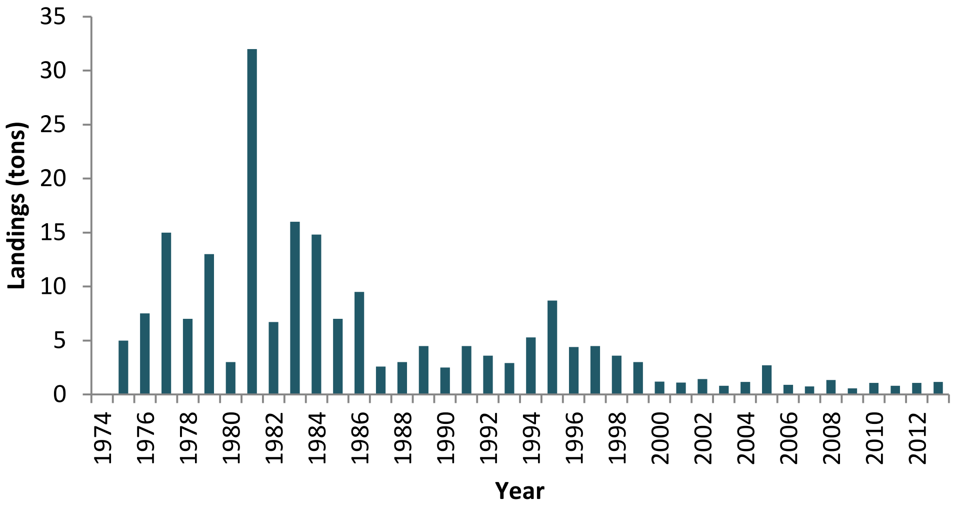


Figure 6.1. Annual landings of glass eel fishery in the Portuguese part of the River Minho, 1974 to 2014 (Source: Capitania do Porto de Caminha).

6.2 Yellow eel

There are no landings available from inland waters but professional fishermen were for the first time, obliged to declare their catches in 2012. However, at present the only information on eel landings is provided by coastal fishery.

There is not a separation between silver eels or yellow eels, although silver eels are seldom caught by fishermen. Hence, landings from coastal fisheries (estuaries and coastal lagoons), presented in Figure 6.2, are mostly from yellow eels.

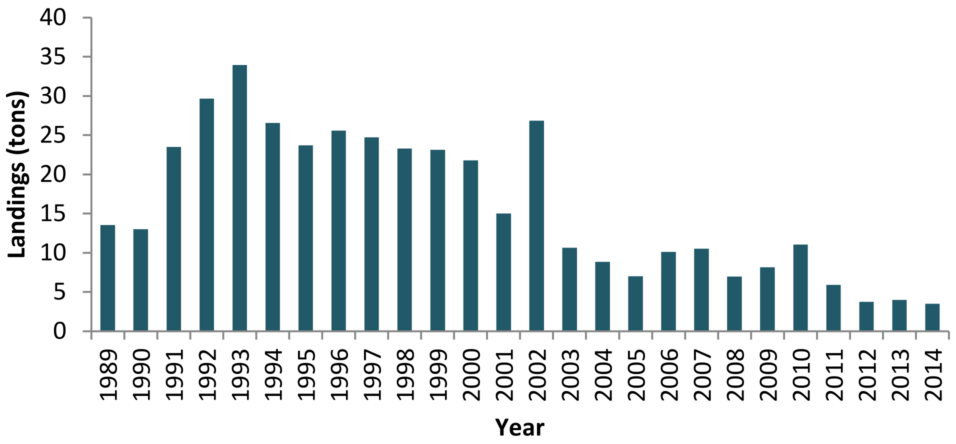


Figure 6.2. Total annual landings of yellow eel fishery in coastal waters (estuaries and coastal lagoons), 1989 to 2014 (Source: DGRM). (Data for 2014 include only ten months).

As shown in Figure 6.2, there was a decline in catches after 2000 which, despite a peak in 2002, has continued until today. However, it should be noted that a ban of three months (October, November and December), implemented in 2010 (Portaria nº 928/2010, from 20 September), might account for the decline observed in 2011. The changes in fishery regulations, derived from the implementation of the EMP, add as extra difficulties to evaluate the trend on the stock, based on landings.

The importance of eel landings varies across the country, as can be seen in Table 6.1. The highest landings were however, registered in RBD5 where 236.9 tons were landed between 1989 and 2013. RBD5 includes the Tagus estuary, undoubtedly the most important fishing area. The lowest landings occurred in RBD6, RBD7 and RBD8.

Table 6.1. Annual landings of yellow eel fishery in coastal waters (estuaries and coastal lagoons), by River Basin District and total, 1989 to 2014 (Source: DGRM and Capitania do Porto de Caminha).

YEAR	LANDINGS (KG)								
	RBD1	**RBD2**	**RBD3**	**RBD4**	**RBD5**	**RBD6**	**RBD7**	**RBD8**	**TOTAL**
1989	3885	768	821	173	6311	306	84	1184	13 532
1990	2598	1081	721	1442	5720	300	128	1011	13 000
1991	3754	612	940	1410	12 371	3024	43	1331	23 486
1992	3675	878	1434	918	18 814	2163	256	1527	29 665
1993	5676	1173	1692	1232	20 767	830	604	1969	33 943
1994	1435	1765	1117	1029	18 215	801	401	1790	26 553
1995	1957	1499	863	3953	13 007	501	409	1520	23 706
1996	1472	2228	662	3177	16 210	378	301	1139	25 566
1997	1476	2099	662	2776	15 349	1007	342	997	24 707
1998	1981	767	1201	2752	15 429	81	421	646	23 277
1999	810	897	2137	2223	15 734	70	728	545	23 143
2000	898	641	1431	2667	15 598	18	221	299	21 772
2001	404	112	775	1517	12 095	1	57	43	15 003
2002	784	163	1226	3039	21 501	3	28	121	26 863
2003	1095	889	717	3174	4646	54	8	47	10 630
2004	1036	986	428	3254	3028	16		100	8848
2005	1281	1235	397	1612	2418	1	4	74	7022
2006	1970	1218	361	3382	2976	221	2	1	10 131
2007	2591	825	150	3953	2859	127	2	5	10 512
2008	1200	1150	345	1913	2333	0	6	7	6954
2009	1269	1175	333	1968	3363	2	0	59	8169
2010	2430	934	496	2706	4422	3	16	24	11 031
2011	1432	310	61	1606	2457	0	0	0	5889
2012	1141	117	236	1350	899	0	0	1	3742
2013	1299	197	292	1790	407	0	0	0	3983
2014(*)	429	134	154	2255	502	0	0	16	3489

(*) Data for 2014, include the first ten months of the year.

As shown in Figure 6.3, there is an increase in landings in 2014 when compared to the previous year. It should however be noted that despite the ban of three months (October to December) there are still landings occurring during those months. Summer months are the poorest for the fishery as reflected in landings.

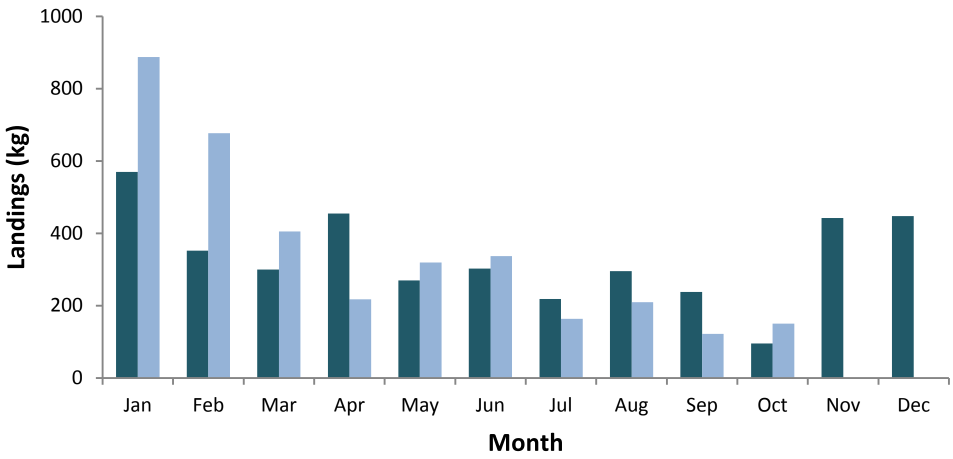


Figure 6.3. Monthly variation in landings for the period 2013 (dark blue) and 2014 (dark blue). (Source: DGRM). (Data for 2014 include only ten months).

6.3 Silver eel

No data, because there is no distinction between yellow and silver eels.

6.4 Marine fishery

Marine fisheries are not directed to catch eels.

6.5 Recreational fishery

Not reported. The only recreational fishing for eel that catches eel is the rod and line, but there is no obligation to report catches.

6.6 Bycatch, underreporting, illegal activities

There is no information/data on bycatch of eel in fisheries targeting other species because landings are done for each boat and the fishing gears they use are several. There is not a distinction between them and the fish they catch. Illegal fishing for glass eels (without a licence and using illegal gears) remains a problem all over the country. The authorities (Maritime Police and SEPNA) make a huge effort to control the situation, but the confiscated nets are rapidly substituted by new ones.

The results obtained by SEPNA (a special unit from GNR, National Republican Guard) from monitoring illegal glass eel catches were not obtained for this year. However, the results of those actions for three fishing seasons are presented in Table 6.1.

Table 6.1. Number of men and equipment used in monitoring glass eel poaching (2009–2012) during three fishing seasons. The amount of glass eel seizures is also presented (Source: SEPNA-GNR). (n.a.=not available).

	FISHING SEASON 2009/10				*FISHING SEASON 2010/11*				*FISHING SEASON 2011/12*			
District	**Men**	**Cars**	**Boats**	**Kg**	**Men**	**Cars**	**Boats**	**Kg**	**Men**	**Cars**	**Boats**	**Kg**
AVEIRO	26	10	0	0	86	31	0	22	n/a	n/a	n/a	
BEJA	239	103	4	8.6	201	63	28	2.15	105	n/a	n/a	21
BRAGA	32	5	0	7	33	13	5	4	50	n/a	n/a	0
COIMBRA	149	54	0	0	209	79	0	1	42	n/a	n/a	0
FARO	8	3	0	0	23	8	0		30	n/a	n/a	0
LEIRIA	293	95	0	3.165	155	58	0	13.4	31	n/a	n/a	6.3
LISBOA	88	33	5	0.75	88	33	5	0.75	n/a	n/a	n/a	
PORTO	135	46	0	1.8	94	31	0	0	n/a	n/a	n/a	
SANTARÉM	106	40	0	3.12	106	31	7	14.12	47	n/a	n/a	0
SETÚBAL	22	10	0	3	19	8	0	2	34	n/a	n/a	0
V. CASTELO	46	17	0	0	57	23	0	0	n/a	n/a	n/a	
VILA REAL	56	19	0	0	53	23	0	0	n/a	n/a	n/a	
Total	1200	435	9	27.435	1124	401	45	59.42	339	n/a	n/a	27.3

SEPNA has among other competences, the obligation to monitor the illegal activities of fishing and can act on land. However, another special unit from GNR, the UCC acting close to the coast, obtained the results presented in Table 6.2 for the fishing season 2010/2011.

As observed in Table 6.2, there was an enormous effort to control illegal fishing for glass eels, especially during the years following the delivery of the EMP.

Table 6.2. Number of nets and weight of glass eels confiscated between 1st October (2010) and 31st July (2011) (Source: UCC- GNR).

	KG	NETS
Lisboa	2.53	28
Figueira da Foz	98.71	94
Matosinhos	163.7	10
Total	264.94	132

Maritime Authorities have also been conducting some actions to control illegal fishing for glass eels and the results of their actions for the period from 2007 to 2012 are presented in Table 6.3.

Table 6.3. Number of nets and weight of glass eels seizures between 1st October (2010) and 31st July (2011) (Source: DGAM- General Directorate for Maritime Authority).

		FISHING SEASONS				
Capitania	RIVER BASIN	2007/2008	2008/2009	2009/2010	2010/2011	2011/2012
AVEIRO	Aveiro Ria	11	6	4	1	
DOURO	River Douro	16	18	6	27	6
FIGUEIRA FOZ	River Mondego	4	4	9	91	42
LISBOA	Rivers Tejo & Sorraia	6	8	10	2	
VIANA DO CASTELO	River Minho	5	2			
	Rivers Cávado & Lima	12	4	5	9	23
NAZARÉ/PENICHE	Ribeiras do Oeste	20	30	34	90	40
PV7VC	River Ave	7	6	12	7	
SETÚBAL	River Sado	4	6	6	7	11
SINES	River Mira			1		
V. R. S. ANTÓNIO	River Guadiana	1	2	1	3	1
Total actions		*86*	*86*	*88*	*237*	*123*
Gears seizured		729	521	492	706	302
Glass eels (kg)		67.25	54.5	21.15	55.98	166.55
Men involved		172	471	387	841	494

7 Catch per unit of effort

7.1 Glass eel

No data.

Cpues could not be estimated because fishermen reported total catches for the entire fishing season and they were not obliged to keep a record on fishing intensity. With the implementation of the logbooks for glass eel fishery in River Minho, this information might become available for the future on a regular basis.

However, based on data obtained by IPMA/CIMAR from logbooks distributed to five fishermen who volunteered to cooperate, during the fishing season 2011/2012 the average cpue/gear/night was 627 g (5–6 days/New Moon).

7.2 Yellow eel

No data. Cpue cannot be estimated because the number of eel fishing gears used per fishing licence is not recorded.

In Óbidos Lagoon, one of the most important areas for eel fishery in Portugal, IPMA is trying to establish a dataseries for the fykenet fishery with the cooperation of some fishermen. Activity data such as: date, fishing duration, number of gears, number and total weight of eels captured, composition (yellow/silver) are recorded in a logbook. This work was initiated in 2009 included in a pilot project and is expected to be a routine since last year.

Table 7.1. Cpue of the commercial fishery from the Óbidos Lagoon.

YEAR	CPUE	
(Nr fishermen)	eels/fykenet/day	Weight (g)/fykenet/day
2009 (n=4)	0.17	13.5
2012 (n=7)	0.06	6.73
2013(*) (n=11)	0.13	7.98

(*) Data until end of May.

The decrease observed from 2009 to 2012 might not be related to a real decline in the abundance of eels but with disturbances in hydrodynamics at the interior of the Lagoon, with high currents and significant variations in the height of the water column, that negatively affects gear efficiencies. These changes were caused by human interventions in the connection between the Lagoon and the sea that were performed in 2012 to improve the conditions offered to tourists in that area. In 2013 cpue increased, more in number (smaller eels) than in weight, but still under 2009 figures.

7.3 Silver eel

Not pertinent. There is no fishery for silver eels.

7.4 Marine fishery

Not pertinent. There is not an eel fishery in marine waters.

8 Other anthropogenic and environmental impacts

Anthropogenic impacts identified in the eel management plan were mainly related to fisheries. Although turbine activity is usually a major mortality factor especially for silver eels, in Portugal there is no passage for eels in the dams, which implies there is no mortality associated with turbines.

9 Scientific surveys of the stock

9.1 Recruitment surveys for glass eel

Experimental glass eel fishery in the Minho River was initiated in 1981, supported by grants and projects, and conducted for several purposes, with no fixed sampling sites in general (Weber, 1986; Antunes and Weber, 1990, 1993; Antunes, 1994a,b). Occasional studies in Lis River, Mondego River, Guadiana River and Lima River were conducted for short periods (Jorge and Sobral, 1989; Jorge *et al.*, 1990; Domingos, 1992; Bessa, 1992; Bessa and Castro, 1994, 1995; Domingos, 2003). Generally the information available from scientific studies includes fishing time, yield, bycatch, biometric parameters, pigmentation, relation with moon's phase and time of the year.

IPMA conducted experimental fishing of glass eels in the River Lis (March–June 2013) to evaluate the possibility of replicating the fishing that existed before the 2001 ban. The main purpose is to compare current cpue data with historical data collected in the 1990s of last century. Experimental fishing from October 2013 to June 2014 was performed in order to entirely cover a recruitment season.

9.2 Stock surveys for yellow eel

No data. There are no current surveys of yellow eels.

9.3 Stock surveys for silver eel

No data. There are no current surveys of silver eels.

10 Data collected for the DCF

In Lis River, between March 2013 and June 2013, experimental fisheries were performed, by IPMA, in order to evaluate the possibility of replicating glass eel fishing activity that existed before ban. During a complete recruitment season (October 2013–June 2014) experimental fishing, four days/month, was performed. Cpues will be compared with historical ones collected in the 1990s of last century. Individual length, weight and pigmentation stages were determined, to be related with environmental parameters and lunar phase.

Since 2009, in Ria de Aveiro and especially in Lagoa de Óbidos, two of the most important areas of eel fishery in Portugal, IPMA, with the cooperation of fishermen, is collecting data.

In Lagoa de Óbidos, since 2012 this has been done in a regular basis in order to establish a dataseries for the fykenet fishery.

In logbooks fishermen register information of their daily activity such as: date, fishing duration, number of gears, number and total weight of eels captured, composition (yellow/silver).

Biological data are collected by local samplings, twice a month, recording individual developmental stage (yellow/silver), length and weight. Sex determination, *Anguillicoloides* prevalence and removal of otoliths for future age determination are performed in the laboratory.

11 Life history and other biological information

11.1 Growth, silvering and mortality

Growth parameters have been published for some brackish water systems (Costa, 1989; Gordo and Jorge, 1991; Domingos, 2003; Lopes 2013) and riverine habitats (Costa 1989; Domingos, 2003).

Data on fecundity has not been collected, so far.

The length–weight relation for eel catches in Ria de Aveiro and Lagoa de Óbidos is given in Figures 11.1 and 11.2 respectively. Significant differences are depicted in the two relations, with eels from Ria de Aveiro being almost 10% heavier for a given size.

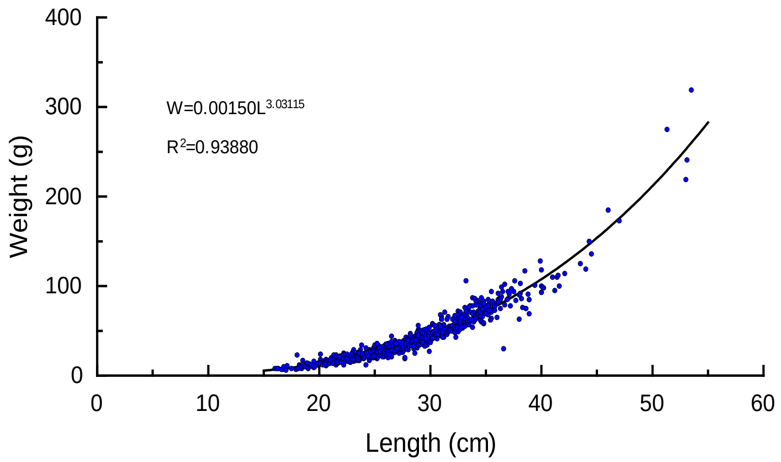


Figure 11.1. Length–weight relation of eels sampled from the Aveiro Lagoon (n=830) between 2009 and 2012 (Source: DCF Report).

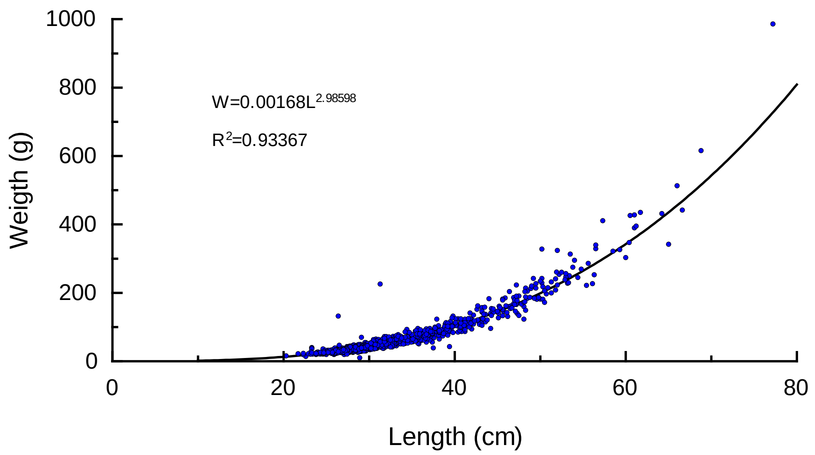


Figure 11.2. Length–weight relation of European eels sampled from Óbidos Lagoon (n=1222) between 2009 and 2012 (Source: DCF Report).

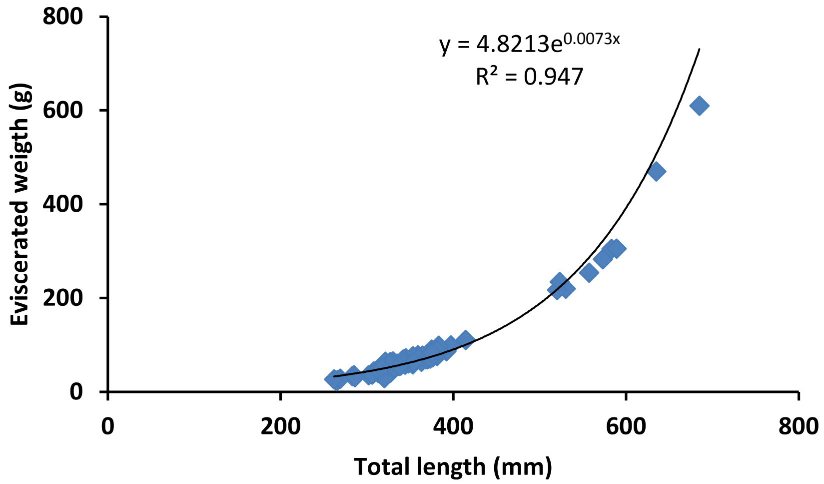


Figure 11.3. Length–weight relation of European eels sampled from Santo André Lagoon (n=114) in 2012 (Source: Lopes, 2013).

11.2 Parasites and pathogens

There is not a national programme to monitor parasites or pathogens. *Anguillicoloides crassus* is however probably spread throughout the country. No new data were available for 2013. However, there is some information from previous years.

In a study conducted in 2008 in five brackish water systems (Aveiro Lagoon, Óbidos lagoon, Tagus estuary, Santo André Lagoon and Mira estuary) it was concluded that *A. crassus* was spread in all the surveyed systems except in Óbidos lagoon, which was probably related to the higher salinity observed in this lagoon, similarly to what happens in one sampling site (Barreiro) (Neto *et al*., 2010) located in the lower part of the Tagus estuary. Prevalence values ranged from 0 to 100% and intensity values ranging from 0.4 to 5.8 (unpublished data). More recently, within the DCF programme, the parasite was found in the swimbladder of seven among the 404 eels examined for the Óbidos Lagoon. The low prevalence found (1.73%) reinforces the idea that the infection rate is very low in areas with higher salinity, as it is the case in this lagoon. The presence of the parasite had already been reported for the River Minho (Antunes, 1999) and River Mondego (Domingos, 2003), which suggests the parasite is probably widespread in Portugal. In River Minho, recent data revealed the presence of the parasite in the entire international section of the river and prevalence ranged between 23% and 100% (Braga, 2011). The map shows the locations where this parasite has been reported so far.

River Minho

Aveiro Lagoon

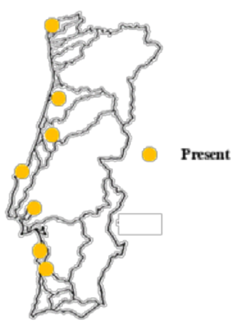
River Mondego

Óbidos Lagoon

River Tagus

Santo André Lagoon

River Mira



11.3 Contaminants

No new data were available for 2013. However, there is some information from previous years.

Samples of eels caught from five brackish water systems (Aveiro Lagoon, Óbidos Lagoon, Tagus estuary, Santo André Lagoon and Mira estuary), were analysed for some trace metals (Hg, PB, Zn, Cu, Cd) revealing low contamination loads when compared to their European congeners (Passos, 2008; Neto, 2008; Neto *et al.*, 2011a). The most contaminated eels were obtained from the Tagus estuary. However, in this estuary no clear relationships could be established between contaminant concentrations in eel tissues (liver and muscle) and in sediment, probably because of the general heterogeneity in environmental conditions (Neto *et al.*, 2011b). In the River Minho, significant increases in the levels of metals (Zn, Pb and Cr) were found when comparing glass eels with muscle of yellow eels between 15 and 30 cm. However the whole sample of yellow eels (muscle and liver) revealed low contamination levels (Braga, 2011).

A comparative study about the effects of pollution on glass and yellow eels from the estuaries of Minho, Lima and Douro rivers was developed by Gravato *et al.* (2010). Fulton condition index and several biomarkers indicated that eels from polluted estuaries showed a poorer health status than those from a reference estuary, and adverse effects became more pronounced after spending several years in polluted estuaries.

Predators11.4

No new data on predators were available for 2013. However, some information is available for previous years.

Apart from the fish species Lusitanian toadfish (*Halobatrachus didactylus*) that can predate on eels (Costa *et al.*, 2008) and the European eel, which can display cannibalistic behaviour (Domingos *et al.*, 2006), the main predators of eels in Portuguese aquatic systems include the great cormorant, *Phalacrocorax carbo*, and the European otter, *Lutra lutra*. The eel is present in the diet of otters and cormorants throughout the year, but they become more important in spring and summer when the water level is lower (Trigo, 1994; Cerqueira, 2005; Dias, 2007). The impact of predation on the eel population is unknown but eels represented 25.4% of the diet of otters from Ria Formosa (Cerqueira, 2005), a shallow coastal lagoon, located in the south of the country, and 7% of the diet of cormorants from Minho estuary (Dias, 2007). The real impact of this predation on the eel stock in Portuguese waters is unknown, despite the increase in the population of the great cormorant and the European otter in recent years.

12 Other sampling

Sampling has been conducted within the framework of the Project "Habitat Recovery for diadromous fish in the Mondego River" funded by PROMAR. Biological aspects to be studied included sex, age, *Anguillicoloides crassus* infection, and silvering. Ecological aspects include size distribution, abundance, influence of obstacles and escapement.

13 Stock assessment

No data. There is no stock assessment in Portugal.

13.1 Method summary

The estimation of silver eel production presented in the revised version of the Portuguese EMP and in this section are simply exploratory and require validation, which is intended to be improved as data on the population are obtained. So far, it was not yet possible to collect such data.

In the absence of data on historic production of silver eels in Portugal it was necessary to make some extrapolations and use information from other countries to estimate this parameter.

The methodology used to estimate historic and current silver eel production is presented in the revised version of the Portuguese EMP (April 2010). Lack of data concerning silver eel estimates, requires the use of alternative approaches to meet the demands of Council Regulation 1100/2007 (ICES, 2008). Hence, yellow eel proxies were used to determine silver eel production.

The density of yellow eels was based on data from France (Rhône-Mediterranée http://www.onema.fr/IMG/paf/PAF-rhonemediter) because data from our neighbouring country were not available. The production was then calculated considering the wetted area up to the first obstacle to migration. A distinction between brackish water and fresh water systems was included in those estimates, which resulted in mean values for brackish water systems and riverine habitats in each river basin. A mean value for riverine and brackish water systems was then obtained for each river basin.

Assuming that 5% of yellow eels become silver (Plan de Gestion Anguille de la France – Volet National) and that the mean weight for silver eels in Portugal is 71 g (Mondego and Tagus rivers, unpublished data) the current production of silver eels in Portugal is 640 tons at the national level, with differences among river basins as shown in Table 13.1. **Current production** varies between 3.3 kg/ha and 6.1 kg/ha across the RBDs and the mean value, at the national level, is **4.7 kg/ha**.

Table 13.1. Current production ($B_{current}$) of silver eels from Portuguese River Basin Districts (RBD). Data reported in the revised version of the Portuguese EMP or estimated from there.

RBD	Total production (ton)	Relative production kg/ha
RH1	38	3.3
RH2	9	3.6
RH3	11	3.5
RH4	95	5.3
RH5	254	4.4
RH6	138	5.9
RH7	30	3.4
RH8	64	6.1
TOTAL	639	4.7

The **pristine production** estimated varied between 47.2 kg/ha and 15.7 kg/ha, assuming that the actual escapement varies between 10% and 30% of historical levels based on information obtained from the *Plan de Gestion Anguille de la France- Volet National*.

In the Transboundary EMP for the River Minho the **current** silver eel production was estimated considering the wetted area up to the first dam (wetted area=1678,88 ha) resulting in a value of **5,52 Kg/ha**.

13.2 Summary data

13.2.1 Stock indicators and Targets

No data.

Lack of data regarding production of yellow and/or silver eels both in pristine and actual conditions, hampered to completely fulfil the objectives set by Regulation EC 1100/2007. In view of this, despite the identification of the main threats/problems, the impacts on the population could not be quantified due to lack of data on production and, therefore, the measures set in the plan are not associated with target levels of escapement.

13.2.2 Habitat coverage

Table 13.2. Estimated total wetted areas (ha) for each river basin district (RBD) accessible for the eel. Riverine habitat is separated from coastal and transitional waters.

EMU Code	River		Coastal lagoons & Transitional Waters	
	Area (ha)	A'd Y/N)	Area (ha)	A'd Y/N)
RH1	7769	N	3898.5	N
RH2	1742	N	744.0	N
RH3	2308	N	830.8	N
RH4	4165	N	13 811.5	N
RH5	20 486	N	36 911.0	N
RH6	1489	N	21 919.4	N
RH7	5297	N	3579.4	N
RH8	501	N	10 035.5	N
TOTAL	43 757	N	91 730.2	N

13.2.3 Impact

An overview of the impacts is presented in Table 13.3. As can be noted the impacts were not assessed. As such, the table was filled in based on Best Judgment Assessment. The whole country is considered as one management unit, except for the River Minho, where a Transboundary EMP is being implemented. As such it is not possible to estimate the loss in kg per developmental stage.

Table 13.3. Overview of the assessed impacts per habitat type. A = assessed, MI = not assessed, minor, MA = not assessed major, AB = impact; na = not applicable.

EMU code	Habitat	Fish com	Fish rec	Hydro & pumps	Barriers	Restocking	Predators	Indirect impacts
	Riv	MI	MI/MA?	MA	MA	na	MI	AB
	Lak	na	na	na	na	na	na	na

National EMP (Whole country)	Est	MA	MI/MA?	AB	AB	AB	MA	AB
	Lag	MA	MI/MA?	AB	AB	AB	MA	AB
	Coa	MI	MI/MA?	AB	AB	AB	MI	AB
	All	MA	MI/MA?	MA	MI	AB	MA	AB

13.2.4 Precautionary diagram

No data. There is no information to construct the Precautionary Diagram.

13.2.5 Management measures

The main objective of the Portuguese Eel Management Plan, which considered the entire country as one management unit, was to establish a series of measures, to be applied at the national level, which could contribute to reduce mortality and increase silver eel escapement as requested by Regulation 1100/2007. These measures can be classified into four categories:

- Fisheries restrictions/Closed season;
- Mitigation of obstacles to upstream migration;
- Reinforcing police control on glass eel poaching;
- Data collection (Habitat/stock assessment).

An overview of the measures foreseen and their state of implementation can be seen in Table 13.4. In general most measures related to the fisheries have been implemented and the ones that have not been implemented yet require changes in the legislation. The most difficult measures to be implemented are related to establish the longitudinal connectivity in rivers and data collection because they both require funding, hard to obtain at the present economic situation of the country. In the first case, an extra difficulty is added because the obstacles are innumerous and their impact has not been assessed. As for the need to collect data on the stock (recruitment/production and escapement) it remains as one of the main difficulties in accomplishing the objectives set by the Eel Regulation.

Table 13.4. List of the management measures foreseen (state of implementation) within the scope of the Portuguese EMP and the Transboundary EMP for the River Minho.

☺ - Fully implemented; 😐 - Partially implemented; ☹ - Not implemented.

EMU code	Action Type	Action	Life Stage	Planned	Outcome
National EMP (Whole country)	Com Fish	Prohibit the eel fishery outside the professional fishing areas in freshwater jurisdiction	Y/S	After 2011	☺
		Set maximum number of fishing gears per license, in freshwater	Y/S	After 2011	☹
		Introduce fishing quotas for professional fishery in freshwater	Y/S	After 2011	☹
		Introduce obligation to report catches in freshwater to obtain licence the following year	Y/S	After 2011	☺
		Introduce a specific annual license for eel fishing in freshwater jurisdiction	Y/S	After 2011	☹
		Introduce closed fishing season (1st October to 31st December) in freshwater jurisdictions	Y/S	After 2011	☺
		Introduce closed fishing season (1st October to 31st December) in marine water jurisdiction		until 2012	☺
		Reduce the number of licences for marine water jurisdiction	Y/S	2009–	☺
	Rec Fish	Prohibit recreational eel fishery in marine (M) and freshwater (F) jurisdictions	Y/S	After 2011	☹
	Hydropower & Pumps	Mitigate the impact of existing obstacles (upstream migration)	G/Y	After 2011 Prioritized 2011–2016 2011–2021 >2021	😐
	Restocking	0	na	na	na

EMU code	Action Type	Action	Life Stage	Planned	Outcome
	Other	Collect data and conduct studies on the stock (Recruitment/Production/Escapement)	All	Until 2012	☹
		Monitoring and control of glass eel poaching	G	2009–	😐

EMU code	Action Type	Action	Life Stage	Planned	Outcome
Transboundary EMP for River Minho	Com Fish	Prohibit the eel fishery	Y/S	EMP	☺
		Reduce fishing effort	G	EMP	☺
		Introduce obligation to fill in logbooks	G	After approval	☺
	Rec Fish	Prohibit eel fishery in marine jurisdiction	Y/S	EMP	☺
	Hydropower & Pumps	0	na	na	na
	Restocking	0	na	na	na
	Other	0	na	na	na

13.3 Summary data on glass eel

The quantity of glass eels caught in the commercial fishery from the River Minho is presented in Table 13.5.

Table 13.5. Quantity (kg) of glass eels caught in the River Minho between 2010 and 2013.

YEAR	QUANTITY (KG)
2010	1085
2011	0.807
2012	1081
2013	1176

The destination of these glass eel is probably Spain because glass eel are not eaten in Portugal or used for any other purpose, and fishermen usually sell them to the neighbouring country. It is assumed that all glass eel catches have been sold to Spain, which means they can be used for stocking elsewhere, but this requires confirmation. Their final use is however, unknown.

14 Sampling intensity and precision

There is no consistent sampling design employed in Portugal.

15 Standardisation and harmonisation of methodology

There are no protocols applied in Portugal to sample eels. Until 2009, when the DCF programme started, there was no sampling of commercial catches. The methodologies used in scientific studies, have varied according to author, sampling site and objectives of the work.

15.1 Survey techniques

Electric fishing has been the method used in eel surveys in fresh water habitats, which has been conducted either from the river banks, in large and deep river stretches, or across the river stretch when water level is low (Costa, 1989; Domingos, 2003). In estuaries and coastal lagoons, fykenets or beam trawls have been the sampling methods most used (Costa, 1989; Domingos, 2003; Gordo and Jorge, 1991). A stownet has been used in most of the glass eel surveys.

15.2 Sampling commercial catches

Eel sampling is part of the routine sampling of DCF.

Glass eel monitoring is being conducted through the project "Pilot study for glass eel (*Anguilla anguilla*) 2011–2013", which was also proposed within the DCF Framework. The objective is to establish monitoring sites for recruitment, related to the commercial fisheries in the River Minho and to a fishery-independent dataseries from the 1990s in the River Lis.

15.3 Sampling

Sampling of eel follows the legal requirements to deal with animals, implying that to sacrifice them it is necessary to kill them by an overdose of anaesthetic.

15.4 Age analysis

In studies of eel age which have been conducted in Portugal, *Sagitta* otoliths have been removed, cleaned with water, stored dry, and cleared in 70% alcohol (Vollestad, 1985) for 24 hours before being examined under a stereoscope microscope. The otoliths were read by more than one person (Gordo and Jorge, 1991), or by the same person who read them twice (Costa, 1989; Domingos, 2003; Lopes, 2013). In the lack of agreement between both readings, a third reading was performed and if inconsistent, otoliths were excluded from analyses.

IPMA is following the recommendations of the ICES Workshop on Eel Age WKAREA 2009.

15.5 Life stages

Pigmentation stages of glass eels analysed in some studies were determined according to Elie *et al*. (1982) by Casimiro (1988) and Antunes (1994b). In a study conducted in the River Mondego, silver eels were identified by Domingos (2003) based on the eye index, colour of back and belly, colour of pectoral fins and state of lateral line according to Pankhurst (1982).

In the River Minho some differences were obtained when comparing the classification of silver eels based on the criteria established by Pankhurst (1982) or Durif *et al*. (2005) (River Minho EMP).

15.6 Sex determinations

In Portugal, the determination of sex in scientific studies has been performed by dissection and macroscopic analysis of gonads or under a dissecting microscope, for smaller individuals (Costa, 1989; Domingos, 2003; Neto, 2008; Passos, 2008; Braga, 2011; Lopes, 2013). In a recent study, Quintella *et al*. (2010) have sexed silver eels by length, to avoid sacrificing animals, considering eels larger than 45 cm as females.

IPMA is determining sex by macroscopic analysis under the Data Collection Framework.

15.7 Data quality issues

No information.

16 Overview, conclusions and recommendations

Portugal submitted a national progress report with regard to the implementation of the Portuguese EMP in June 2012. This report included a list of measures that have been implemented. Most of the measures were focused on the fisheries. However, there were no data to make an assessment of the stock.

The implementation of a programme to collect data on the eel stock in Portuguese waters, that was considered a priority during the development of the Portuguese EMP, was set in the plan as one of the measures to cope with the need to measure the effectiveness and outcomes of management actions, in line with Article 9 of the Eel Regulation 1100/2007. This program has not commenced so far. It would be extremely convenient, necessary and desirable that European Regulations and Directives were followed by financial instruments in support of achieving the objectives.

Finally it is strongly recommended that a national Working group on eels involving all stakeholders is implemented.

17 Literature references

Antunes C. 1990. Abundance and distribution of eels (*Anguilla anguilla*) in the Rio Minho. *Int. Revue ges. Hydrobiol.*, **75**:795.

Antunes C. 1994a. The seasonal occurrence of glass eels (*Anguilla anguilla*) in the Rio Minho between 1991 and 1993 (North of Portugal). *Int. Revue ges. Hydrobiol.*, **79**:287–294.

Antunes C. 1994b. Estudo da migração e metamorphose de Anguilla anguilla L. por análise dos incrementos dos sagittae, em leptocéfalos e enguias de vidro. [Study of the migration and metamorphosis of *Anguilla anguilla* L. by the analysis of sagittae increments in leptocephali and glass eels. Tese de Doutoramento, Instituto de Ciências Biomédicas Abel Salazar, Universidade do Porto, 294 pp.

Antunes C. 1999. *Anguillicola* infestation of eel population from the Rio Minho (North of Portugal). ICES-EIFAC, 20–24 September, Silkeborg, Denmark.

Antunes C. and Weber M. 1990. Influência da pesca do meixão, *Anguilla anguilla* L. no stock de enguias, no rio Minho internacional. [Glass eel fishing influence on the eel stock of international Minho River]. Comissão de Coordenação da Região Norte, 69 pp.

Antunes C. and Weber M. 1993. The glass eel fishery and by-catch in the Rio Minho after one decade (1981–1992 and 1991–1992). *Archiwum Rybactawa Polskiego*, **4**: 131–139.

Antunes C., Araújo M.J., Braga C., Roleira A., Carvalho R., Mota M. 2011. Valorização dos recursos naturais do rio Minho. Final Report from the Project Natura Miño-Minho. CIIMAR, University of Porto.

Bessa R. 1992. Apanha de meixão com "sarrico" na safra de 1989/90 no rio Lis. *Relatório Técnico Científico INIP*, 57, 13pp.

Bessa R. and Castro M. 1994. Evolução das capturas de meixão ao longo do ano no rio Lis e sua relação com as condições ambientais. Relatório Técnico e Científico, IPIMAR, **2**:1–18.

Braga A.C.R. 2011. Susceptibilidade da enguia europeia, *Anguilla anguilla* e do parasita *Anguillicoloides crassus*, às concentrações de metais pesados no rio Minho internacional. Master Thesis, ICBAS, University of Porto, Portugal.

Casimiro A.M.C. 1988. Anéis anuais de crescimento em otólitos de enguias de vidro e alevins de *Anguilla anguilla* (L.) – Época de formação das diferentes zonas de crescimento. Licenciateship in Biology, Faculdade de Ciências da Universidade de Lisboa.

Cerqueira, L. 2005. Distribuição e ecologia alimentar da Lontra (*Lutra lutra*) em dois sistemas costeiros em Portugal.). [Distribution and feeding ecology of the otter (*Lutra lutra*) from two Portuguese coastal systems]. Master Thesis, University of Minho, Portugal.

Costa J.L. 1989. Estudo da biologia e ecologia da enguia europeia *Anguilla anguilla* (Linnaeus, 1758) no estuário do Tejo e tributários. Final degree in Biology, Faculdade de Ciências da Universidade de Lisboa.

Costa, J.L., I. Domingos, A.J. Almeida, E. Feunteun, and M.J. Costa. 2008. Interaction between *Halobatrachus didactylus* and *Anguilla anguilla*: What happens when these two species occur in sympatry? *Cybium*, **32**:111–117.

Dias, E. 2007. Estudo da dieta do Corvo-marinho-de-faces-brancas (*Phalacrocorax carbo* Linnaeus, 1758) no Estuário do Rio Minho (NO-Portugal). [A study on the diet of the cormorant (*Phalacrocorax carbo* Linnaeus, 1758) in the Minho estuary]. Master Thesis, University of Porto, Portugal.

Domingos I.M. 1992. Fluctuation of glass eel migration in the Mondego estuary (Portugal) in 1988 and 1989. *Irish Fisheries Investigations Series A (Freshwater)*, **36**:1–4.

Domingos I. 2002. Glass eel migration and fisheries in the Mondego estuary – future perspectives. *In*: M.A. Pardal; J.C. Marques e M.A. Graça (eds.), *Aquatic Ecology of the Mondego River*

Basin. Global Importance of local Experience. Imprensa da Universidade de Coimbra, Coimbra, p. 493–503.

Domingos I. 2003. A enguia-europeia, *Anguilla anguilla* (L., 1758), na bacia hidrográfica do Rio Mondego. [The European eel (*Anguilla anguilla* (L.1758) in the Mondego River catchment]. PhD dissertation, Universidade de Lisboa.

Domingos, I., J.L. Costa, and M.J. Costa. 2006. Factors determining length distribution and abundance of the European eel, *Anguilla anguilla*, in the River Mondego (Portugal). *Freshwater Biology*, **51**:2265–2281.

Durif C., S. Dufour and P. Elie. 2005. The silvering process of *Anguilla anguilla*: a new classification from the yellow resident to the silver migrating stage. *J. Fish Biol.*, **66**: 1025–1043.

Elie P., Lecomte-Finiger R., Cantrelle I. and Charlon N. 1982. Définition des limites des differents stades pigmentaires durant la phase civelle d'*Anguilla anguilla* L. *Vie et milieu*, **32**: 149–157.

Gordo L.S. and Jorge I.M. 1991. Age and growth of the European eel, *Anguilla anguilla* (Linnaeus, 1758) in the Aveiro Lagoon, Portugal. *Scientia Marina*, **55**:389–395.

Gravato C., Guimarães L., Santos J., Faria M. and Alves A. 2010. Comparative study about the effects of pollution on glass and yellow eels (*Anguilla anguilla*) from the estuaries of Minho, Lima and Douro Rivers. *Ecotoxicology and Environmental Safety*, **73**:524–533.

ICES. 2008. International Council for the Exploration of the Sea. Report of the ICES/EIFAC Working Group on Eels. ICES C.M. 2008/ACOM:15.

Jorge I. and Sobral M. 1989. Contribuição para o conhecimento da pescaria do meixão (*Anguilla anguilla* L.) – dados preliminares sobre a influência das principais artes de pesca e importância das capturas acessórias no estuário do Mondego. *Relatório Tècnico Científico INIP*, 82 pp.

Jorge I., Sobral M. and Bela J. 1990. On the efficiency and bycatch of the main glass eel (*Anguilla anguilla* L.) fishing gears used in Portugal. *Int. Revue ges. Hydrobiol.*, **75**:841.

Lopes V.C.P. 2013. A enguia na lagoa de Santo André - Contributo para a gestão da sua pesca.. [The eel in the Santo André Lagoon – a contribution to the management of its fishery]. Master Thesis, Faculty of Sciences, University of Lisbon.

Neto A.F. 2008. Susceptibilidade da enguia-europeia (*Anguilla anguilla*) à degradação ambiental no estuário do Tejo: contaminação biológica pelo parasita *Anguillicola crassus* e contaminação química por metais pesados. [Susceptibility of the European eel (*Anguilla anguilla*) to environmental degradation in the Tagus estuary: biological contamination by *Anguillicola crassus* and chemical contamination by heavy metals]. Master Thesis, Faculty of Sciences, University of Lisbon.

Neto A.F., Costa J.L., Costa M.J. and Domingos I. 2010. Epidemiology and pathology of *Anguillicoloides crassus* in the European eel, *Anguilla anguilla*, from the Tagus estuary (Portugal). *Journal of Aquatic Diseases*, **88**:225–233.

Neto, A.F., Passos, D., Costa, J.L., Costa, M.J., Caçador, I., Pereira, M.E., Duarte, A.C., Pacheco, M. and Domingos, I. 2011a. Metal concentrations in the European eel, *Anguilla anguilla* (L., 1758), in estuaries and coastal lagoons from Portugal. *Vie et milieu - life and environment*, **61**: 167–177.

Neto, A.F., Passos, D., Costa, J.L., Costa, M.J., Caçador, I., Pereira, M.E., Duarte, A.C., Pacheco, M. and Domingos, I. 2011b. Accumulation of metals in *Anguilla anguilla* from the Tagus estuary and relationship to environmental contamination. *Journal of Applied Ichthyology*, **27**:1265–1271.

Pankhurst N.M. 1982. Relation of visual changes to the onset of sexual maturation in the European eel *Anguilla anguilla* L. *J.Fish Biol.*, **21**:127–140.

Passos D.M. 2008. Concentração de metais pesados na enguia europeia, *Anguilla anguilla* (Linnaeus, 1758), em estuários e lagoas costeiras de Portugal [Heavy metal concentration in the

European eel, *Anguilla anguilla* (Linnaeus, 1758), in Portuguese estuaries and coastal lagoons]. Biology Degree Thesis, University de Aveiro.

Trigo, M.I. 1994. Predação por lontra (*Lutra lutra* Linnaeus, 1758) em pisciculturas do estuário do Mira. [Predation by the otter (*Lutra lutra* Linnaeus, 1758) in fish cultures from the Mira estuary]. Biology Degree Thesis, University of Lisbon.

Quintella B.R., Mateus C., Costa J.L., Domingos, I. and Almeida P.R. 2010. Critical swimming speed of yellow and silver European eels (*Anguilla anguilla*, L.). *J. Appl. Ichth.*, **26**:432–435.

Vollestad L.A. 1985. Age determination and growth of yellow eels, *Anguilla anguilla* L. from a brackish water, Norway. *J. Fish Biol.*, **26**:521–525.

Weber M. 1986. Fishing method and seasonal occurrence of glass eels (*Anguilla anguilla* L.) in the Rio Minho, west coast of the Iberian Peninsula. *Vie et Milieu*, **36**:243–250.

Report on the eel stock and fishery in Spain 2013/2014

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2 Introduction

2.1 Spanish EMUs

Spanish River Basin Districts (RBDs), charged of the design of the hydrological plan and the management of continental waters, were defined after the approval of the Royal Decree 125/2007 by which the territorial limits of the RBDs were fixed (Figure 1).

All the territory of the RBDs of Guadalquivir, Galicia Costa, Basque Country Inner basins, Catalonia Inner basins, Canary Islands basins, Balearic Islands basins and Atlantic and Mediterranean basins of Andalucía belongs to a single autonomous region (Figure 2) and are managed by the autonomous region they belong to. On the contrary, Segura, Júcar, Miño-Sil, Cantábrico, Duero, Tajo, Guadiana, Ebro and Guadalquivir RBDs extend over different autonomous regions and are managed by the Spanish Ministry of the Environment and Rural and Marine Affairs (MARM) through eight hydrographical confederations. Additionally, the Miño, Duero, Tajo and Guadiana RBDs are shared with Portugal, whereas the Ebro RBD is shared with France.

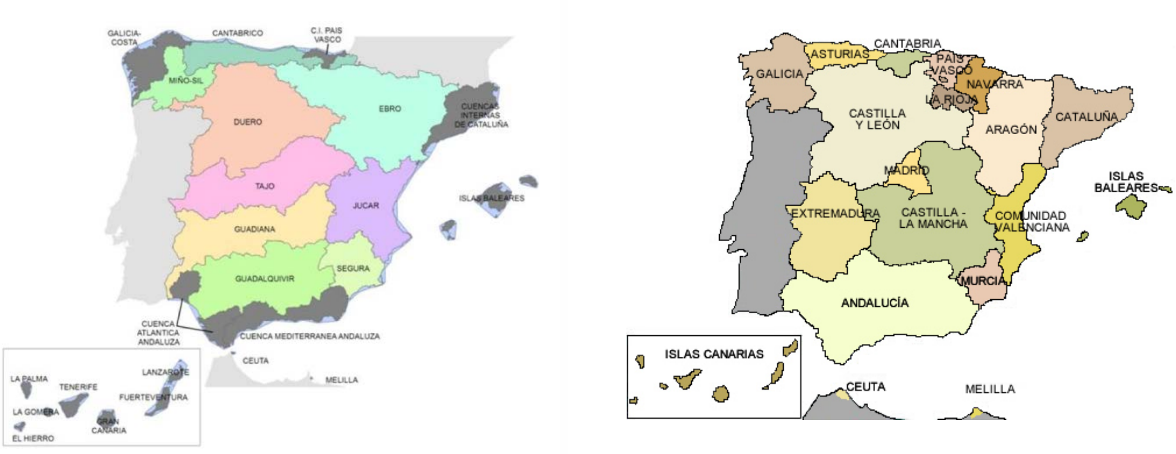


Figure 1. RDBs and Autonomous regions of Spain.

The main characteristics of the River basins included in this report are:

Autonomy	RBD	River Basin	Latitude	Longitude	Drainage area (km^2)	River length (km)
Basque	B. Inner	Bidasoa	43º19'	1º58'W	700	69
	B. Inner	Oria	43º16'	2º06'W	882	77
	B. Inner	Urola	43º17'	2º14'W	342	65
	B. Inner	Deba	43º19'	2º26'W	530	60
	B. Inner	Artibai	43º21'	2º29'W	104	26
	B. Inner	Lea	43º22'	2º35'W	99	26
	B. Inner	Oka	43º21'	2º40'W	183	27
	B. Inner	Butrón	43º23'	2º56'W	172	44
	B. Inner	N. Ibaizabal	43º19'	3º00'W	1798	72
	B. Inner	Barbadun	43º17'	3º07'W	128	27
Asturias	Cantábrico	Nalón	48º17'	5º23'W	4866	142
Galicia	G. Coast	Ferrol	43º27'	8º08'W	27	17
	G. Coast	Eo	43º4'	7º05'W	819	78
	G. Coast	Vigo	42º09'	8º36'W	176	33
	G. Coast	Pontevedra	42º15'	8º41'W	145	23
	G. Coast	Arousa	42º26'	8º46'W	230	33
	Miño	Miño	41º5'	8º52'W	9775	308
Murcia	Segura	Mar menor lagoon	37º 41	00º 50' W	170	
Valencia	Jucar	Albufera lagoon	39º22'	0º18' E	738	
	Segura	El Hondo lagoon	38º11	0º46'W	23.9	

Autonomy	RBD	River Basin	Latitude	Longitude	Drainage area (km²)	River length (km)
	Segura	Santa Pola lagoon	38º11	0º37'W	25.0	
Catalonia	Ebro	Ebro	40ª41′	0º44′E	85362	910
	C. Inner	Muga	42º14,2′	3º7,6E	758	
		Fluvià	42º12,2′	3º6,7E	974	
		Ter	42º1,4′	3º11,7′E	2955	

2.2 Review of the main regional characteristics of the eel fishery in Spain

The autonomous regions are in charge of the management of the fishery in inner waters (including coastal waters). This causes great differences among the autonomous regions:

The amplitude of the historical dataseries is variable among the autonomous regions, depending on the date in which the regulation of each autonomous region was issued.

In some of the autonomous regions, the same regulation is applied to all the River basins while in others, each basin or even a particular zone within the same basin has its own regulation. Additionally, even in the same autonomous region, the fishery is regulated for some River basins but not in others.

In some of the autonomous regions, fishermen are professional and have to sell their catches to the fishmarket, while in others, they are non-professional. In this sense, the accuracy of the information related to catches and landings differs greatly among those autonomous regions.

Each autonomous region has its own way of managing the stock: different fishing techniques are allowed.

In many cases, the organizations that are involved in the management of the eel could differ within the same autonomous region, depending on the eel development stages.

In the 2008 year report, a table detailing eel fishery in Spain was included which contained the legislation in force at that time. The management plans include some fishery restrictions. In the Atlantic, the most important glass eel fishery River basins are the Miño (Miño-Sil RBD), the Asturian River basins (Cantabrico RBD), the Basque River basins (Basque inner RBD) and the Guadalquivir. In the Mediterranean, the most important glass eel fishing points are the Delta of the Ebro River (Ebro RBD) in Catalonia and the Albufera (Júcar RBD) in the C. Valenciana. In addition, there is an important yellow and silver eel fishery in Galicia, C. Valenciana and Catalonia.

Spanish government does not compile eel catches data recorded in the different autonomous regions, and there are not any official statistics about landings in Spain. Different autonomous regions have contributed to the present report providing their data.

As explained above, the available information from each autonomous region is variable:

BASQUE COUNTRY: There is not a professional yellow or silver eel fishery in the Basque Country and recreational fishery catches were historically insignificant and the fishery was forbidden in 2009. On the contrary, glass eel fishery is very traditional in the Basque Country and affects to zones associated to River mouths, including beaches, estuaries and River banks. Glass eel fishery is located in most of the River basins of Bizkaia (Artibai, Lea, Oka, Butrón and Nervión- Ibaizabal) and Gipuzkoa (Bidasoa, Oiarzun, Urumea, Oria, Urola, and Deba). Basque fishermen cannot sell the catches and therefore they should be classified as recreational. Although the fishery was very traditional, there was not any management plan for glass eels until 2001, when the Basque Government with the advice of AZTI, launched a fisheries monitoring plan. In 2003, a new regulation for glass eel fisheries was issued. It stated that there must be only one license per person and fishing basin and that it is mandatory to fill in the Daily Catches report with catches and effort data.

There are a lot of little River basins in the Basque Country. The River mouths of those basins are included in the Basque Inner River basins district (Basque Inner RBD), but the upper parts of some of these Rivers are included in CantábricoRBDs (Figure 1).

CANTABRIA: There is not a professional yellow or silver eel fishery, and the catches of recreational fishery are insignificant. On the contrary, both, professional and recreational glass eel fishery exists in Cantabria, mainly located in the Nansa, Pas and Campiazo River basins. Recreational fishermen must have the maritime fishing recreational license and can´t sell the catches. Professional fishermen sell their catches in the market or in other licensed establishments. Fishermen fish in land and they are only allowed to use one sieve (≤1.2 m^2) by fishermen. Since 2005, fishermen report their catches.

ASTURIAS: There is only one professional eel fishermen in Asturias, and the recreational fishery was forbidden in 2007.

Glass eel fishery, is very traditional in zones associated to River mouths, including beaches, estuaries and River banks. The Fisheries General Direction of Asturias has provided the data concerning the number of issued licenses and the glass eel sales data in Asturias using fish auctions. There are 18 fishermen guilds in Asturias; in the San Juan de la Arena fisherman guild data are available since 1952 and for the other 17, data are available since 1983. In the 2006 report (ICES, 2006), all the catches from Ribadesella fishermen guild were attributed to the Sella River which is the closest one. However, fishermen from other eastern Rivers of Asturias sell their catches in Ribadesella also, and therefore it is not correct to attribute all the sales of Ribadesella to the Catches of the Sella. In fact, until now, the origin of the sold glass eel must be identified only in the fishermen guilds corresponding to the Nalón River (San Juan de la Arena and Cudillero). In addition, the catches of the Nalón are sold only in the San Juan de la Arena and Cudillero fish markets. So, it is perfectly possible to identify the glass eel from the Nalón. For that reason, from the 2007 report on, the fishery data are split into the Nalón and the "Other Rivers" from Asturias. In October 2010, a new regulation was implemented in the Nalón River (*Resolución de 7 de octubre de 2010, de la consejería de Medio Rural y Pesca, por la que se regula la campaña 2010/2011 de pesca de la angula y se aprueba el Plan de explotación de la Ría del Nalón*; BOPA No 241, 18-10-2010). This regulation limits the number of boat and land licences in the Nalón River to 45 and 55 respectively. The gear type is also limited to a sieve no bigger than 200x60 cm. Boat dimensions and power together with fishing effort has also been regulated in this area. The rest of fishermen guilds are asked to record the glass eel catches and the fishing effort data of the free zone. In Asturias there are many little River basins and all of them are included in the Cantábrico RBD (Figure 1).

GALICIA: Only one management unit has been defined in the Galicia-Costa RBD, in which recreational fishing activity has been completely forbidden. Yellow and silver eel fishery is made from boat and the number of gear types is limited per boat. The boats need a specific licence for the fishing gear that will be used in each fishing trip. They might have more than one fishing gear licence, but only one of them can be used in each fishing operation. According to the resolution that allows eel fishing in the Arousa, Ferrol and Vigo Rivers ("Resolución do 23 de decembro de 2010, da Dirección Xeral de Ordenación e Xestión dos Recursos Mariños, pola que se autoriza o plan de pesca de anguía para as confrarías de pescadores das rías de Arousa, Ferrol e Vigo" publicado no DOG nº 251 de 31 de diciembre de 2010), the maximum number of sieves is 80, and the fishing period is limited from the 1st of February to the 29th of October. Nowadays, there are 66 boats allowed to fish using the 'butrón' sieve, but only 37 of them are active nowadays. Regarding the 'anguila' sieve, there are 41 boat licences but this gear has been practically abandoned, and there is only one boat currently working with it.

As mentioned in the introduction, Miño-Sil RBD is one of the most important eel fishing areas in Spain. The Miño River is the most important fishing point. There is both, professional and non-professional glass eel and yellow and silver eel fishery in this RBD. The lower part of the Miño River limits the border of Spain and Portugal and for that reason the permanent International Commission of the Miño is responsible for the management of this part of the River. In the present report, the information collected by the Galician autonomous region regarding the Galicia-Costa RBD is included together with the data from the Miño RBD. The catches are established using auctions data from the different fishermen guilds, which are assigned to a determined River basin. In the Galician fishermen guilds, yellow and silver eel catches are not split up. The estuaries are considered basins themselves because of their size, and are managed as basin units. In this way, the estuaries listed below contain catches data from the following fishermen guilds:

- Arousa Estuary: Cambados, Carril, and Rianxo fishermen guilds.
- Eo River: Asturians fishermen guilds.
- Ferrol Estuary: Barallobre, Mugardos and Ferrol fishermen guilds.
- Pontevendra Estuary: Pontevedra fishermen guilds.
- Vigo Estuary: Arcade and Redondela fishermen guilds.

Data from the Ulla River are collected by Ximonde Centre for fishing preserve. This information belongs to the Galician Coast RBD and it is obtained from the web of the Galician Government (www.pescagalicia.com) and UTPB (Unidade Técnica Pesca Baixura).

The other River basins mentioned in this report belong to the Miño Basin (Figure 2). Data from this River are collected from the Miño River Command. Two thirds of the River basin drainage area is located inside the autonomous region of Galicia. The rest of the area is located among Asturias and Castilla-León autonomous regions of Spain, whilst a little part of the lower basin belongs to Portugal. Eel fishing is regulated according to the autonomous region where fishing is carried out. There is an international stretch of Miño between Spain and Portugal. There, the eel fishing is professional and land fishing is allowed only if sieves are used. The conic tackle was allowed only for two years after the publication of the regulation of the international stretch of Miño and until the sand barrier of the Miño estuary is dredged that will facilitate the entry of the migratory species.

ANDALUCIA: A new regulation is in force in Andalucía since November 2010, in which several measures have been established in order to implement a recovery plan for the European Eel (*DECRETO 396/2010, de 2 de noviembre, por el que se establecen medidas para la recuperación de la anguila europea (Anguilla anguilla)*). A complete closure of the eel fishery has been issued. Only some aquaculture factories will get a permission to fish and then grow a certain amount of eel per year. At least 60% of these catches should be directed to restocking activities, whereas the rest of the eels could go to the market.

MURCIA: Eel fishery is professional and the minimum landing size for eel is set at 38 cm. The number of boats varies between 30 and 40 per year. Eel are fished using a "paranza" (a fixed box made with net or/and canes) or bottom-set longlines. This fishery takes place in the Mar Menor and catches are sold through the "Lo Pagán" guild.

C. VALENCIANA: Glass eel fishery is a professional fishery, while the yellow and silver fishery are both, professional and recreational.

There are two types of professional yellow/silver fisheries depending on the province. In Valencia, there are four fishing associations: in the Albufera, El Palmar, Silla, Catarroja associations exercise their rights to exploit the yellow and silver eel around the Albufera which is a 2.100 ha costal lagoon between Turia and Júcar Rivers; on the other hand, Molinell association operates in Pego-Oliva fen which constitutes an agrarian landscape with a traditional economic activity. The fishermen community of El Palmar is the fishing organization with the major tradition and number of members, and the only one that is allowed to fish in fixed places in the lagoon. Eel fishery in the Albufera has its own regulation and two types of fishing are considered: the fixed place fishing (named "redolins") and the traveling fishing.

Regarding glass eel fishery, there are six professional associations of glass eel fishermen distributed between the provinces of Valencia and Castellón, with 168 fishing licences and 89 fishing points ("postas"). In the Albufera, Perelló-Perellonet fishing association has the exploitation rights. Fishermen of the Albufera fish in different "Golas", the channels that connect the Albufera with the sea. In the province of Alicante, professional fishery occurs in eleven fishing preserves located between the El Hondo wetlands (Elche) and the salt flats of Santa Pola. In the fishing preserve of Alicante, a maximum number of fishing tackles (named "mornells") is allowed. The fishermen guilds and associations give their catches data to the territorial service of each province responsible for the continental fishing. In the case of glass eel, they also report the fishing days.

CATALONIA: There are two RBDs in Catalonia: the Catalonia Inner River basins, which include small and medium Rivers, and the Ebro RBD, which is the second largest River basin in Spain. The delta of the Ebro River is the most important eel fishing point in Catalonia regarding the number of active fishermen with licence and eel catches. The glass eel fishery is professional in the Ter, Muga and Fluviá Rivers (province of Gerona) and the delta of the Ebro River (province of Tarragona). Adult eel recreational fishing is only allowed with rods, except from the lagoons of the Delta, where there is a professional yellow and silver eel fishery.

BALEARIC ISLANDS: There is not any glass eel fishery in the Balearic Islands. Professional eel fishery (>40 cm) was allowed only in Mallorca and Menorca, but there has not been any licence in Menorca during the last two seasons. Fishermen fish using a conic pot called "gánguil". In the Albuferas of Mallorca recreational fishery is allowed, but catches are very low. Nowadays, there are 1000 licences for River fishing and it is estimated that only from 10 to 20% of them are devoted to eel fishery.

2.3 Spanish EMPs

The Ministry of Environment, and Rural and Maritime Environment (MARM), responsible for fisheries and environmental issues, submitted the Spanish Eel Management Plan in December 2008. In May 2009 were submitted the clarifications and additional information required by the commission. Spanish EMP was revised in October 2009 by ICES, and the commission asked MARM to modify the Spanish EMP according to that evaluation. The revised version of the Spanish EMP was sent to the commission on June 2010, and was approved in October 2010. Spain and Portugal made the Miño international River plan that was approved in May 2012 (all the plans are available at http://www.magrama.gob.es/es/pesca/temas/planes-de-gestion-y-recuperacion-de-especies-pesqueras/planes-gestion-anguila-europea/).

The Marine Secretary from MARM has coordinated the plan. *Anguilla anguilla* is a native species in Spain, whose population has undergone a significant decline in recent years as in the rest of Europe. The construction of large dams since the 1960s has led to its disappearance from most of the inland River basins of the Iberian Peninsula, leaving the current populations confined to the coastal areas (Figure 2). Some individuals can be found in the interior due to restocking.

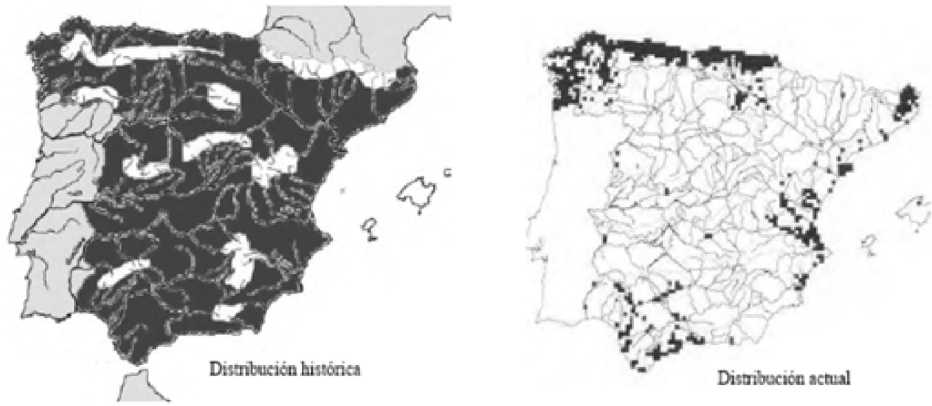


Figure 2. Historic and present distribution of eel in Spain according to Doadrio *et al.* (2001).

Given Spain's national and regional structures, the Spanish management plan is based on a **National Eel Management Plan (EMP) and 12 specific EMPs** (eleven EMPs for the Autonomous Communities with eel populations that can complete their life cycle in these basins, and one EMP specific for the Ebro River Basin also with eel populations):

1) EMP of Galicia;
2) EMP of Asturias;
3) EMP of Cantabria;
4) EMP of Basque Country;
5) EMP of ES_Nava;
6) EMP of Catalonia;
7) EMP of the Ebro RBD (only Catalonia);
8) EMP of C. Valenciana;
9) EMP of Castilla La Mancha, only for the eels in the upper part of the Jucar and in coordination with C. Valenciana;

10) EMP of Murcia;

11) EMP of Balearic Islands;

12) EMP of Andalucía.

The National EMP defines the structure and methodology, the monitoring and evaluation measures and the objectives at national level. It also contains a summary of the twelve specific EMPs. Each participating Autonomous Community, with exclusive competences on eel fisheries, has been defined as an **Eel Management Unit** (EMU) that shall undertake an Eel Management Plan, in accordance with Article 2(1) of Council Regulation (EC) 1100/2007. According to the Spanish EMP**,** the selection of the EMUs and of the areas that currently have natural occurrence of eel is based on the scientific data available. There are large differences between the monitoring and evaluation, available data and the capacity for action between the inner regions with no current eel populations and the coastal regions that still have them. Those autonomous regions where the eel disappeared many years ago and that have no data or criteria for action cannot put forward effective measures in the short term according to the Spanish EMP. However, a commitment at national level was adopted within the Sectorial Environmental Conference on 7th June 2010.between the Ministry of Environment, Rural and Marine Affairs (MARM) and the Regional Ministers of Environment of the Autonomous Communities, allowing for effective measures to take place in the medium term to deliver the 40% silver eel escapement target in the Spanish territory.

This should be achieved by a two phase rolling plan:

- In the first phase (2010–2015) the coastal autonomous communities that had data available and management measures prior to the drafting of the plan will implement their proposed measures. These measures are based on the best available estimates of the pristine and current situation of the European eel in Spain. They aim to achieve 40% escapement in their area of competence, within the overall aim of reaching the 40% national escapement target. In the inland River basins, a series of commitments and specific measures will be adopted at national level such as the elimination of barriers, habitat improvement, monitoring, study and assessment of the eel population and more accurate definition of pristine habitat in order to develop specific measures. In addition to that, working groups comprising representatives of all the public administrations involved in the eel management and scientific experts will be created. Estimates of the pristine and current situations of the European eel in Spain will be updated on that basis. At the end of this first phase, the new data will allow to reassess the stock situation and to launch the second phase from 2016 on, with specific regional measures to strengthen and improve the plan's objectives across the potential surface defined.

- The second phase (2016–2050) kicks off in 2016 and will coincide with the timescale for reviewing the River Basin Management Plans as set out in the Water Framework Directive to take account of further measures needed to meet the Directive objectives. Therefore, it makes sense to review the EMPs in parallel.

This two-step approach will be carried out without prejudice of the periodic evaluation of the proposed measures in the EMPs, both at regional and national level.

The measures provided for in the National EMP and in the specific EMPs aim to ensure the protection and sustainable exploitation of European eel and to restore the escapement levels of eel at national level, by the year 2050. In those autonomous communities where fishing for eel <12 cm is authorized, the reserve percentages of glass eels for restocking provided for in Article 7 of the Regulation are also met. In general, there is a clear difference between the measures proposed by the regions of the north of the Peninsula, with their waters flowing to the Atlantic, and those of the Mediterranean. The first ones propose the reduction of fishing effort by up to 50% compared to reference periods as the main measure to comply with the objectives of the regulation. The last ones mainly focus on restocking measures and maintaining the fishing management measures already set in their legislation. In certain cases, these last ones also propose measures to reduce fishing effort or to ban certain fisheries. As a general rule, stricter control and catch monitoring measures to control illegal fishing or poaching are proposed.

Finally, Spain presented a post evaluation report in July 2012 as required by the commission which includes the revision of the eel habitat area and the silver eel biomass estimations for some of the autonomous regions.

The following EMU codes will be used for each of the EMUs:

EMU	EMU CODE	ECOREGION
Basque Country	ES_Basq	South European Atlantic shelf
Navarra	ES_Nava	South European Atlantic shelf
Cantabria	ES_Cant	South European Atlantic shelf
Asturias	ES_Astu	South European Atlantic shelf
Galicia	ES-Gali	South European Atlantic shelf
Andalucia	ES_Anda	South European Atlantic shelf (Guadalquivir, Tinto, Odiel, Piedras, Guadalete, Barbate) Wester Mediterranean Sea(Almanzora, Andarax, Adra, Guadalfeo, Guaro, Guadalorce, Guadiaro, Guardarranque y
Murcia	ES-Murc	Wester Mediterranean Sea
Castillas la Mancha	ES_Cast	Wester Mediterranean Sea
Valencia	ES_Vale	Wester Mediterranean Sea
Catalunya	ES_Cata	Wester Mediterranean Sea
Balearic Island	ES_Bale	Western Mediterranean Sea
Inner Bassins	ES_inner	Western Mediterranean Sea

3 Time-series data

3.1 Recruitment-series and associated effort

3.1.1 Glass eel

3.1.1.1 Commercial

All the data in this section are obtained from auctions or fishermen guilds (Table 1). Highest landings of glass eel in Spain were obtained in late 1970s prior to the decline in early 1980s (Figure 3). There are four historical dataseries for glass eel catches in Spain which are updated yearly:

- San Juan de la Arena fishmarket in Asturias: It includes almost all the catches from the Nalón River. Since 1995, the administration of Asturias also compiles data from the rest of the fish markets in Asturias. Until the 1970s only land fishing existed, then fishermen started to fish in boats, and the catches increased notably.

- The Albufera in C. Valenciana. In the 1949–2000 period data were collected from fishermen guilds corresponding to three fishing points (Golas of Pujol, Perelló and Perellonet). From 2001 on, the administration of C. Valenciana also compiles data from other fishing points in the Albufera, and the rest of C. Valenciana. To maintain the coherence of the dataseries, the Pujol, Perelló and Perrellonet data will be taken into account for the historical dataseries of the Albufera.
- The Delta del Ebro lagoons in Catalonia. Data are obtained from the fish-markets in the area. Since 1998, the administration from Catalonia compiles data for the fish markets corresponding to the Ebro River mouth, obtaining total catches in the Ebro. Additionally, since 1998 it compiles information from the rest of Catalonian Rivers also.
- The Miño. As this RBD is shared with Portugal in includes data from both, Spain and Portugal. The Miño River command compiles the Spanish catch data.

Table 1. Glass eel professional catches in Spain (kg), 1949 to 2014. Updated and modified data are shown in bold.

	San Juan de la Arena	ES_Astu *	Puchol, Perellonet, Perelló **	Albufera	Delta del Ebro lagoons	Ebro RBD ***	Catalunya Inner Basins	Miño Spain	Miño Portugal	Miño RBD
1949			9319							
1950			3828							
1951			2093							
1952										
1953	14529		2535							
1954	8318		5910							
1955	13576		906							
1956	16649		884							
1957	14351		2833							
1958	12911		402							
1959	13071		6637							
1960	17975		9453							
1961	13060		16731							
1962	17177		11088							
1963	11507		7997							
1964	16139		11000							
1965	20364		4000							
1966	11974		6000		4651					
1967	12977		5000		4937					
1968	20556		4000		8858					
1969	15628		4000		2524					
1970	18753		5000		2947					
1971	17032		1000		2022					
1972	11219		1000		1261					
1973	11056		1000		1129					
1974	24481		2000		1354					
1975	32611		1000		2466			1600	50	1650
1976	55514		6000		5626			5600	5000	10 600
1977	37661		5000		-			12 500	7500	20 000
1978	59918				3400			21 600	15 000	36 600
1979	37468				4177			17 300	7000	24 300
1980	42110				3514			15 400	13 000	28 400
1981	34645				3800			13 000	3000	16 000
1982	26295		1309		2636			18 000	32 000	50 000
1983	21837		640		2327			9700	6700	16 400
1984	22541		2387		1815			14 000	16 000	30 000
1985	12839		2980		1690			15 300	14 800	30 100
1986	13544		402		301			6000	7000	13 000
1987	23536		2845		2027			6539	9500	16 039
1988	15211		4255		-			5600	2600	8200
1989	13574		2513		-			7359	3000	10 359

	San Juan de la Arena	ES_Astu *	Puchol, Perellonet, Perelló **	Albufera	Delta del Ebro lagoons	Ebro RBD ***	Catalunya Inner Basins	Miño Spain	Miño Portugal	Miño RBD
1990	9216		1321		1108			3962	4500	8462
1991	7117		1079		897			5743	2500	8243
1992	10259		830		323			2835	4500	7335
1993	9673		355		799			4893	3600	8493
1994	9900		303		350			2068	2900	4968
1995	12500		199		190			4701	5300	10 001
1996	5900	7751	271		409			6523	8700	15 223
1997	3656	7329	366		847	3033		4283	4400	8683
1998	3273	6514	1348		939	3379		2878	4500	7378
1999	3815	7113	615		465	1983	346	3812	3600	7412
2000	1330	3058	323		112	3373	401	3812	3000	6812
2001	1285	2732	569		1383	7425	368	1519	1200	2719
2002	1569	3105	557	574	922	3315	77	1427	1100	2527
2003	1231	2770	390	411	1558	4571	357	1755	1400	3155
2004	506	1351	269	320	564	1504	285	1562	800	2362
2005	914	2875	**230**	237	298	1805	134	1331	1292	2623
2006	836	2175	**203**	208	557	1209	147	320		
2007	615	2265	**283**	292	611	611	148	1140		
2008	871	2379	**119**	125	445	1170	79	1333		
2009	272	749	**77**	78	411	1511	0	**1178**		
2010	1089	2612	**125**	125	501	1536	131	**2000**	320	
2011	1231	2055	**151**	179	419	1426	101	**1311**		
2012	612	1812	**123**	151	1158	1967	**193**	**1037**		
2013	1327	3511	**112**	**140**	1117	2477	**107**	**813**		
2014	**2086**	**5820**	**109**	**123**	**1470**	**3648**	**121**	**985**		

*** Includes San Juan de la Arena fishmarket.**

**** This corresponds to the time-series formerly known as "Albufera"; it includes catches from Pujol, Perellonet, Perelló, Rey, San Lorenzo and Vaca.**

***** Includes lagoons and River mouth catches.**

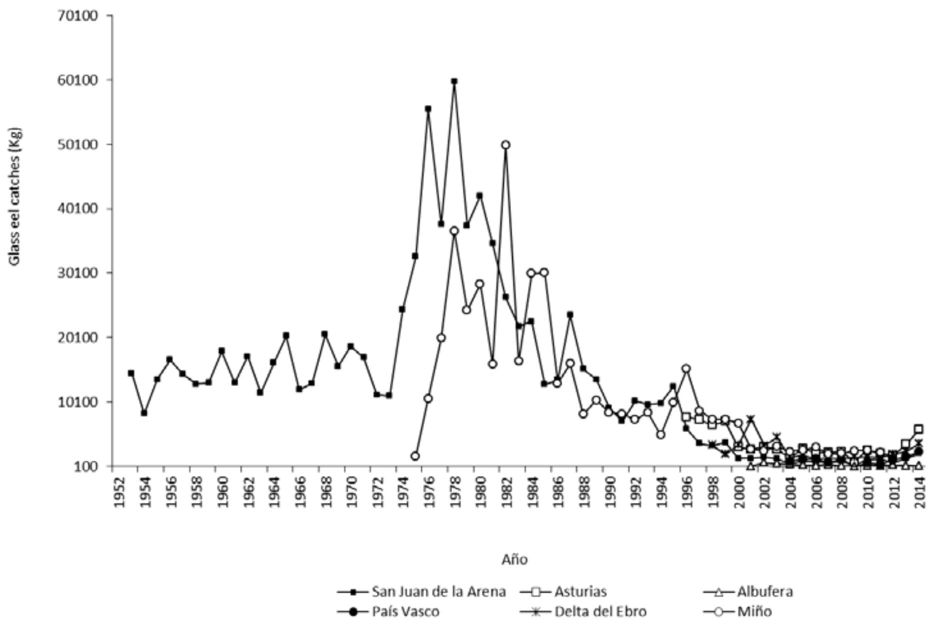


Figure 3. Glass eel catches (kg) time-series in Spain during the 1952–2014 period.

3.1.1.2 Recreational

In the Basque Country glass eel fishing is recreational. It is obligatory to fill in the Daily Catches report with data regarding catches and effort (Table 2). In Cantabria the recreational fishermen report their data to the local administration; but 2013 and 2014 data are not available.

Table 2. Glass eel recreational in Spain (kg), 2004 to 2014. Updated and modified data are shown in bold.

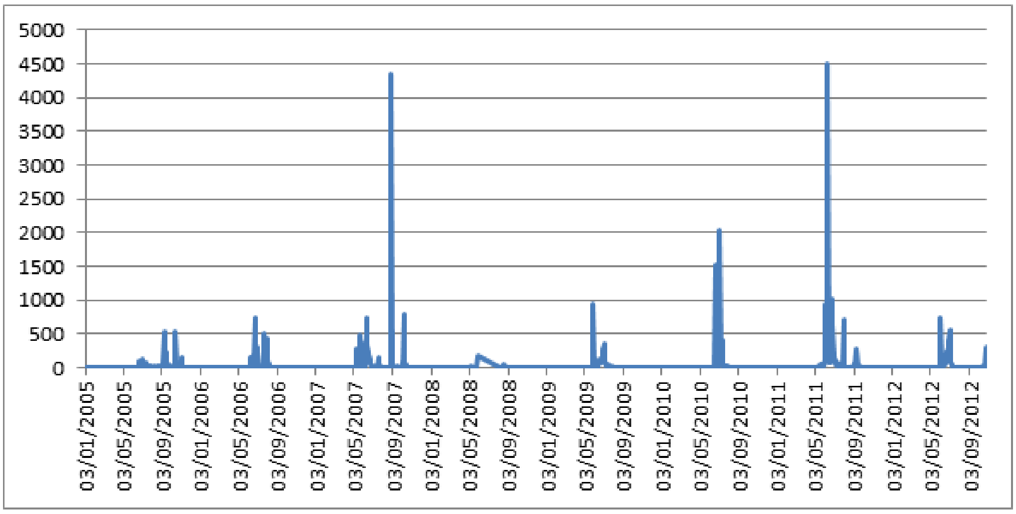
	ES_BASQ	ES_CANT
2004	858	
2005	1181	
2006	1282	398
2007	687	341
2008	1205	94
2009	212	
2010	614	65
2011	376	13
2012	1082	21.7
2013	1534	
2014	**2405**	

3.1.1.3 Fishery independent

No historical data are available: however some experimental fishing is being carried out in the Guadalquivir (Sobrino *et al*., 2005; Arribas *et al*., 2012), Nalón and Oria Rivers.

3.1.2 Yellow eel recruitment

Upstream migration data have been collected since 2005 in a trap located in the tidal limit of the Oria River. Excluding 2008, when the trap did not work properly, 2009 data were the lowest value of the historical series, which could be related to the very low recruitment in that year. However, apparently, recruitment has been increasing from then on, reaching to one of the highest value in the time-series in 2011 (Figure 4). In 2012 the recruitment dropped again coinciding with a very dry summer. The trap did not work during 2013, and data are not available for 2014.



YEAR	2005	2006	2007	2008	2009	2010	2011	2012
Nº eels	2656	3868	8957	233	1823	3244	11466	3577

Figure 4. Number of eels collected in the Orbeldi trap (River Oria, Basque Country).

3.1.2.1 Commercial

Eel catches are only split up into yellow and silver in the Albufera and in the Mar Menor (Murcía).

3.1.2.2 Recreational

No data available.

3.1.2.3 Fishery independent

All the autonomous regions carry out multispecific electrofishing samplings. However, data are not compiled at a national level.

3.2 Yellow eel landings

3.2.1 Commercial

Eel catches are only split up into yellow and silver in the Albufera and in Murcia (Table 3). Additionally, aggregated information exits for other RBDs (Table 4). The data sources are described in the introduction.

Table 3. Yellow eel catches (kg), 1951 to 2014. Updated and modified data are shown in bold.

	Albufera	Mar Menor
1951	30 000	
1952	38 000	
1953	30 200	
1954	40 400	
1955	30 400	
1956	30 260	
1957	40 000	
1958	40 000	
1959	40 000	
1960	30 000	
1961	30 040	
1962	20 200	
1963	22 400	
1964	18 000	
1965	12 300	
1966	15 000	
1967	59 500	
1968	16 000	
1969	11 200	
1970	12 600	
1971	11 612	
1972	18 300	
1973	12 428	
1974	11 210	
1975	6570	
1976	5300	
1977	4668	
1978		
1979		
1980		
1981	6848	
1982	9126	
1983	7697	
1984	3577	
1985	3464	
1986	2871	
1987	3611	
1988	2098	
1989		

	ALBUFERA	MAR MENOR
1990	1843	
1991		
1992	2330	
1993	2349	
1994	2155	
1995	2897	
1996	3105	
1997	2123	
1998	2563	
1999	2503	
2000	2047	
2001	1995	
2002	2126	
2003	2598	
2004	2138	
2005	1472	
2006	1479	
2007	1911	
2008	2245	
2009	4640	
2010	2029	
2011	1543	
2012	1634	
2013	1678	
2014	**364**	**13 509**

Table 4. Yellow + silver eel catches (kg) per EMU, 1951 to 2014. Updated and modified data are shown in bold.

YEAR	ES_ASTU	ES_VALE*	ES_ GALI	EBRO	MIÑO (SPAIN)	MAR MENOR	ES_BALE
1961						58497	
1962						24241	
1963						41453	
1964							
1965						54144	
1966						112518	
1967						84326	
1968						110001	
1969						79856	
197						76546	
1971						63358	
1972						75614	
1973						67170	
1974						68581	
1975						60812	
1976						69169	
1977						63447	54
1978						60734	63
1979						90323	65
198						83997	58
1981						74089	45
1982							39
1983							43
1984							
1985					227		
1986					1334		
1987					1282		514
1988					1228		289
1989					1368		394
199							4853
1991					137	45150	3631
1992					1275	44014	3666
1993					813	56718	361
1994					1126	43003	2457
1995					146	61027	2417
1996					1266	49663	4738
1997			17639		1543	32285	578
1998		121	3789		796	30150	1993
1999		174	4297	16522	78	18512	221
2000		5	15794	17921	83	16002	69
2001		868	5544	35317	93	35489	3756
2002		817	39700	2695	64	30402	442

Year	ES_Astu	ES_Vale*	Es_ Gali	Ebro	Miño (Spain)	Mar menor	ES_Bale
2003		191	31336	18626	614	32671	3838
2004		141	35373	169	598	22225	225
2005		1922	3175	1380	265	32682	2159
2006	653	137	63114	1737	277	25631	267
2007	225	1165	2829	22640	149	22789	638
2008	159	2953	32766		447	20314	2138
2009	142	3779	4552			25631	1993
2010	1168	494	28497	**12016**		**22789**	933
2011	248	471	31984	**1900**		**18662**	339
2012		4232	**36140**	**17600**		**19473**	96
2013		**3220**	**46030**	**6630**		**24490**	7
2014	90	**2778**	**30610**	**6473**		**33537**	

*** Albufera is not included.**

Some EMUs with high catches (Ebro, Murcia, and Galicia) do not have historical data, thus adding the available catches subestimates the total historic catches in Spain. In this way, total historic catches have been estimated taking into account the percentage of the total catches they account for now, and the historic trends from Albufera yellow and silver catches (Table 5).

Table 5. Total landings (tons) in Spain. NOTE: Historical data have been estimated in those EMUs with no historical landings.

Year	Glass	Yellow	Silver	Total
1950	4	499	990	1.493
1951	2	495	981	1.479
1952	4	562	1.115	1.680
1953	3	441	875	1.318
1954	6	537	1.065	1.609
1955	1	566	1.122	1.689
1956	1	584	1.157	1.742
1957	3	440	872	1.315
1958	0	633	1.254	1.887
1959	7	550	1.091	1.647
1960	9	539	1.069	1.617
1961	17	524	1.040	1.581
1962	11	499	989	1.499
1963	8	525	1.040	1.573
1964	11	503	998	1.512
1965	4	420	832	1.256
1966	6	435	862	1.302
1967	5	437	867	1.309
1968	4	361	715	1.080
1969	4	311	616	931
1970	5	236	467	708

Year	Glass	Yellow	Silver	Total
1971	1	242	480	723
1972	1	241	478	720
1973	1	182	360	543
1974	2	137	271	409
1975	4	95	187	286
1976	17	75	148	240
1977	30	61	120	211
1978	43	92	182	316
1979	35	80	159	274
1980	31	77	152	260
1981	26	105	208	340
1982	37	88	174	299
1983	20	78	154	251
1984	30	60	120	210
1985	34	80	158	271
1986	12	67	132	211
1987	16	82	162	259
1988	15	54	107	176
1989	17	70	140	227
1990	9	21	42	72
1991	13	57	113	182
1992	7	29	58	94
1993	10	29	58	98
1994	4	23	45	73
1995	10	25	49	83
1996	29	33	66	128
1997	24	27	54	104
1998	20	31	62	113
1999	27	16	32	75
2000	22	19	37	77
2001	24	44	87	154
2002	17	35	70	123
2003	20	32	64	116
2004	11	29	57	96
2005	14	29	58	102
2006	10	39	77	125
2007	11	28	55	93
2008	11	28	55	94
2009	7	30	59	96
2010	14	26	52	92
2011	11	21	41	72
2012	12	29	57	97
2013	14	45	89	148
2014	13	26	51	89

3.2.2 Recreational

No data available.

3.2.3 Fishery independent

No data available.

3.3 Silver eel landings

3.3.1 Commercial

The data from the Albufera and the Mar Menor are detailed in Table 6. The source of the data is the same as described above for glass eel catches in Albufera (Table 1).

Table 6. Silver eel catches (kg), 1951 to 2011. Updated and modified data is shown in bold.

	Albufera	Mar Menor
1951	60000	
1952	64200	
1953	50000	
1954	57300	
1955	72500	
1956	75860	
1957	40000	
1958	75000	
1959	60000	
1960	68000	
1961	65300	
1962	70500	
1963	73000	
1964	73500	
1965	64000	
1966	64000	
1967	20000	
1968	49600	
1969	45300	
1970	30250	
1971	32400	
1972	25500	
1973	20600	
1974	13612	
1975	10620	
1976	8260	
1977	6352	
1978		
1979		
1980		
1981	12269	
1982	6845	
1983	6397	

	ALBUFERA	MAR MENOR
1984	7395	
1985	11013	
1986	9243	
1987	11228	
1988	7698	
1989		
1990	2000	
1991		
1992	3000	
1993	3000	
1994	2000	
1995	1600	
1996	2960	
1997	2784	
1998	3100	
1999	2400	
2000	1537	
2001	1284	
2002	1432	
2003	4042	
2004	5591	
2005	4045	
2006	3632	
2007	4276	
2008	4910	
2009	6942	
2010	3688	
2011	2497	
2012	3822	
2013	3598	
2014	2293	20 028

3.3.2 Recreational

Yellow and silver eel recreational fishery is only allowed in Valencia and the Balearic islands, but historical data do not exists in these regions.

3.3.3 Fishery independent

No data available.

3.4 Aquaculture production

In 2006 there were 19 eel farms in Spain:

- four of them were located in continental waters:
    - Two in Valencia: one of them ("C. Valenciana de Acuicultura") produces yearly around 300 ton of eel and is the main eel producer in Spain. The other one ("Puchades") can produce 150 ton of eel per year;
    - One in Andalucia, in the Guadalquivir River;

   - One in the Basque Country with capacity to produce 60 ton; but closed in 2011.
- 15 in brackish waters from Andalucia.

There was a fishfarm in the Ebro Delta (Cataluña) that produced around 60 tons of eel per year but it closed.

Additionally, in the Basque Country, in Aginaga (Oria River basin), there are six companies dedicated to the commercialization of glass eels.

3.4.1 Seed supply

The fishfarms from C. Valenciana buy glass eel mainly from the Ebro Delta, Guadalquivir, Galicia, Asturias fishermen and to a lesser extent from UK and Morocco.

The companies from the Basque Country have hatcheries in Asturias, C. Valenciana, Catalonia and the Atlantic coast of France to maintain the glass eel they buy off local fishermen until they are transported to the hatcheries in Aginaga.

There are no quantitative data available.

3.4.2 Production

The production in Spain is stabilized at around 400 tons, which is mainly locally commercialized (Table 7).

Table 7. Aquaculture production (tons) in Spain per autonomous region until 2013 (source: Spanish Ministry of Agriculture, Food and Environment, http://www.magrama.gob.es/es/pesca/temas/acuicultura/produccion-de-acuicultura/).

	ES_BASQ	ES_CATA	ES_VALE	ES_ANDA	TOTAL
1998	0	0.70	200.1	146.7	347.5
1999	0	0.30	200.09	182.9	383.29
2000	0	3.70	275.48	131.5	410.68
2001	0	0.00	238.07	100.9	338.97
2002	0	0.00	260.38	34.54	294.92
2003	0	0.00	260.25	31.37	291.62
2004	0	0.00	316.69	60.01	376.7
2005	0	0.00	300.5	20.43	320.93
2006	0	0.00	185.65	89.17	274.82
2007	80	0.00	261.44	27.7	369.14
2008	65.00	0.00	369.73	25.07	459.8
2009	80.00	0.00	399.15	13.38	492.53
2010	31.45	0.00	348	12.23	391.68
2011	19.19	0.00	442.23	7.18	468.6
2012	0	0	371.86	0.86	372.72
2013	0	0	393.29	0	393.29

3.5 Stocking

In Spain different restocking experiences have been carried out (Table 8):

- In Navarra stocking is carried out in the Ebro River but only as a measure of artificial maintenance of the presence of eel in the Rivers.

- Since 1988, C. Valenciana fishermen from the Albufera and from the Bullent and Molinell Rivers must give a percentage of their glass eels catches for restocking. These glass eel are raised in the public Centre for the Production and Experimentation of Warm Water Fishes until they reach a weight of 8–10 g. Fattened eels are released up in the River waters and wetlands of C. Valenciana and other autonomous regions. The EMP of C. Valenciana contains a detailed stocking plan.

- In Asturias, the Head Office of Fishery purchased 6 kg and 8 kg of glass eel that were released in Sella and Nalón Rivers in 2010 and 2011 respectively. The price per kg of glass eel was 531.8 € in 2010 and 577.8 € in 2011. No stocking was performed during 2012–2014.

- In Catalonia Inner River Basins and the Ebro RBD, different stocking experiences have been carried out since 1996. During the 1998–2007 period, fishermen gave 5% of their seasonal glass eel catches approximately for restocking in the Fluvia, Muga, Ter and Ebro Rivers; restocked eel had an average weight of between 0.15 and 0.33 g. During the 2005–2006 and 2006–2007 seasons, a pilot study was carried out by the government of Cataluña and the IRTA (Insitut de Reserca i Tecnlogia Agroalimentâires). Eel fishermen provided 38 276 eels with an average weight between 0.65–0.70 g. The initial biomass was 25.7 kg, and after fattening, the biomass was 1617 kg. So biomass increased in 1591.8 kg, and glass eel; yellow eel survival rate in the farm was 71.4%. This work has continued during the 2008–2009 and 2009–2010 seasons, and a total of 1300 of these individuals have been used in 2011 for restocking in the Ter River. All these individuals have been tagged for future monitoring experiences. The results of this pilot study will be used in the following years aiming to increase the success rate of the restocking operations. No stocking was performed during 2012–2014.

- In Cantabria a 40% of the total glass eel landings of the 2010–2011 fishing season was used for restocking. Some of the catches were kept alive in tanks by the Council and stocked weekly along the fishing period in different River basins depending on the source of landings. The rest of glass eels were cultured and stocked in different stages of their life cycle, aiming to assess the efficiency of each of the methods. No data are available for the 2012–2014.

- In the Basque Country, a new pilot study started in the Oria River in 2011. In a first phase, 2400 young eels trapped in the Orbeldi trap (in Usurbil, Gipuzkoa) were translocated up to the Ursuaran River (in Idiazabal, Gipuzkoa). Both Rivers belong to the same River basin (Oria River basin). During 2012, and within the same project, 2.8 kg of glass eels from the fishery were stocked directly in the Oria River and another amount was kept for fattening in an eel farm; 1.7 kg of ongrown glass eel was stocked after. In 2013 6250 glass eels from the fishery in the Urola River were stocked directly upstream. During the summer 2011, 2012, 2013 and 2014 different electric fishing operations have been carried out aiming to monitor the restocked individuals.

Table 8. Amount of eels stocked during 2008–2014 period. Updated and modified data are shown in bold.

	Region	Origin	Number	Weight (kg)	Mean weight (g)	Mean size (mm)
2008	ES_Astu	On-grown cultured		14.82		200
	ES_Nava	On-grown cultured		101	8	
2009	ES_Astu	On-grown cultured		50		200
		On-grown cultured		50		150
	ES_Nava	On-grown cultured		102	10	
	ES_Cata	Wild eel-fishery		380	359	400–600
	ES_Vale	On-grown cultured	19 843	318	16	
2010	ES_Nava	On-grown cultured		90	7	
	ES_Vale	On-grown cultured	4577	141	30.8	
2011	ES_Astu	On-grown cultured		15		150
		On-grown cultured		9.5		150
	ES_Cant	Wild glass eel-fishery		4.9		
	ES_Nava	On-grown cultured		88	7	
	ES_Cata	Wild eel-fishery		273	210	200–500
		Wild eel-fishery		630	210	200–500
		Wild bootlace-fishery		30	4.7	120–150
		Wild bootlace-fishery		14	4.7	150–190
	ES_Vale	On-grown cultured	16 394	180	11.006	
	ES_Anda	On-grown cultured		12		120
		On-grown cultured		5.7		<120
		Forfeitured		131		1000
2012	ES_Cant	Wild glass eel-fishery		12.35		
	ES_Basq	Wild glass eel-fishery	9333.33	2.8	0.3	70.3
		On-grown cultured	4722.22	1.7	0.36	6.7
	ES_Cata	Forfeitured		41		60–90
		Forfeitured		16		60–90
		Forfeitured		24		60–90
		Forfeitured		24		60–90
		Forfeitured		33		60–90
		Forfeitured		114		60–90
		Forfeitured		114		60–90
		Forfeitured		114		60–90
		Forfeitured		33		60–90
		Forfeitured		16		60–90
		Wild bootlace-fishery		72	2.9	60–140
		Wild glass eel-fishery		80	632	340–740

	Region	Origin	Number	Weight (kg)	Mean weight (g)	Mean size (mm)
	ES_Vale	On-grown cultured	147 099	101	2.62	100–200
	Andalucía-Guadalquivir river	Quarantined Glass eel	28 540	53.3	1.91	112
	Andalucía-Palmones river-1st set	Quarantined Glass eel	2757	5.9	2.14	109
	Andalucía-Palmones river-2nd set	Quarantined Glass eel	1691	7.04	4.14	137
2013	Valencia	On-grown cultured	96 883	77.25	5.22	80–200
	ES_Basq	Wild glass eel-fishery	6250	2	0.32	69
2014	Valencia	On-grown cultured	16 706	42.01	7.04	80–200

Catch of eel <12 cm and proportion retained for restocking.

Only the number of glass eels for restocking inside Spain is known, the destination of the rest of the catch is unknown (Table 9).

Table 9. Destiny of the catched glass eels per EMU. NC: Not compilled.

			National	EU Countries						
Year	Region	Glass eel (kg)	Stocking (kg)	% Stocking	Human consumption (kg)	Aquaculture	Stocking (kg)	% Stocking	Human consumption (kg)	Aquaculture
2009–2010	Miño (Spain)	2000								
	ES_Astu	2612	14.9	0.6	NC	NC	NC	NC	NC	NC
	ES_Cant	228	0.0	0.0	NC	NC	NC	NC	NC	NC
	ES_Basq *	614	0.0	0.0	614	0	0	0	0	0
	ES_Cata	1667	380.0	22.8	NC	NC	NC	NC	NC	NC
	ES_Vale	167	41.6	24.9	NC	NC	NC	NC	NC	NC
	TOTAL	7287	436.5	6.0	NC	NC	NC	NC	NC	NC
2010–2011	Miño (Spain)	1325								
	ES_Astu	2067	19.8	1.0	NC	NC	NC	NC	NC	NC
	ES_Cant	58	4.9	8.5	52.6	NC	NC	NC	NC	NC
	ES_Basq *	376	0.0	0.0	376	0	0	0	0	0
	ES_Cata	1527	947.0	62.0	NC	NC	NC	NC	NC	NC
	ES_Vale	256	55.0	21.5	NC	NC	NC	NC	NC	NC
	TOTAL	5608	1026.7	18.3	NC	NC	NC	NC	NC	NC
2011–2012	Miño (Spain)	1022								
	ES_Astu	1813	18.0	1.0	NC	NC	NC	NC	NC	NC
	ES_Cant	63	12.3	19.4	51.1	NC	NC	NC	NC	NC
	ES_Basq	1082	5.0	0.5	1077	0	0	0	0	0
	ES_Cata	2160	529.0	24.5	NC	NC	NC	NC	NC	NC

			National	EU Countries						
Year	Region	Glass eel (kg)	Stocking (kg)	% Stocking	Human consumption (kg)	Aquaculture	Stocking (kg)	% Stocking	Human consumption (kg)	Aquaculture
	ES_Vale	274	52.9	19.3	NC	NC	NC	NC	NC	NC
	TOTAL	6414	617.2	9.6	NC	NC	NC	NC	NC	NC
2012–2013	Miño (Spain)	na								
	ES_Astu	3511	0.0	0.0	NC	NC	NC	NC	NC	NC
	ES_Cant	NR	NR	NR	NR	NC	NC	NC	NC	NC
	ES_Basq	1534	2.1	0.1	1532	0	0	0	0	0
	ES_Cata	2584	0.0	0.0	NC	NC	NC	NC	NC	NC
	ES_Vale	223	50.2	22.5	NC	NC	NC	NC	NC	NC
	TOTAL	7852	52.3	0.7	NC	NC	NC	NC	NC	NC
2013–2014	Miño (Spain)									
	ES_Astu	**5820**	**0,0**	**0,0**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**
	ES_Cant	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**
	ES_Basq	**2405**	**0,0**	**0,0**	**2405**	**0**	**0**	**0**	**0**	**0**
	ES_Cata	**3769**	**0,0**	**0,0**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**
	ES_Vale	**185**	**46,9**	**25%**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**
	TOTAL									

*** Recreational fishery.**

3.5.1 Reconstructed time-series on stocking

The time-series of stocked eels has been reconstructed converting all the stocked eels into glass eel equivalents (the equivalent number of naturally immigrating glass eels related to the year that the naturally immigrated eels of the same size as the restocked eels did immigrate) (Table 10). All the eels are from a local source.

Table 10. Stocking of cultured and wild eel in Spain since 1984. Updated and modified data are shown in bold.

	LOCAL SOURCE			
	Wild	On grown Cultured		Total (n)*
Year	Glass eels (n)	Elvers (n)*	Yellow-silver (n)*	
1984		19730		19730
1985		1444		1444
1986		0		0
1987		54136		54136
1988		66670		66670
1989		31866		31866
1990		68510		68510
1991		69160		69160
1992		201447		201447
1993		145944		145944
1994		259299		259299
1995		133165		133165
1996	66290	172478		238768
1997	74934	103920		178854
1998	95527	53197		148724
1999	161006	111755		272761
2000	0	104265		104265
2001	12750	187718		200468
2002	0	99999	2857	102856
2003	0	198406		198406
2004	35769	143938	373	180080
2005	0	2117		2117
2006	0	25028	8212	33239
2007	0	103432		103432
2008	0	36142		36142
2009	0	75108		75108
2010	0	127839		127839
2011	17748	252105		269853
2012	248057	116553		364610
2013	**6250**	**20098**		**26348**

**** Number of glass eel equivalents.**

3.6 Trade in eel

Information from the customs department form the Spanish Tax Agency has been compiled. Living eel trade information is available until 2014, although data from 2013 and 2014 might be incomplete (Tables 11 and 12). No information is available in 2013 and 2014 in the case of fresh, smoked and frozen eels (Tables 12, 13 and 14).

Table 11. Living eel export and import quantities (kg) per destination country in Spain. Source: Departamento de Aduanas de la Agencia Tributaria de España ([http://aduanas.camaras.org/).

	2010		2011		2012		2013		2014	
Paises	Exp.	Imp.	Exp.	Imp.	Exp.	Imp.	Exp.	Imp.	Exp.	Imp.
DE	1552	22			280	18				
DK	353	17					584		273	
FR	118	9664	300	10415		14544	771	4111		3295
GB					113		63		70	500
GR					545			11700	1000	14550
HU									20	
IE						3				
IT	13968		45250		1098	206	376		188	
NL	43074	24473	85775	31421	3733	8841	2406	16828	2124	4831
PT	66213	844	42377	3962	21660	784	20636	80	31622	56
RO							1090		622	
UE	125277	35019	173702	45798	27429	24396	25926	32719	35918	23232

Table 12. Fresh eel export and import quantity and value (thousand €) per destination country in Spain. Source: Departamento de Aduanas de la Agencia Tributaria de España http://aduanas.camaras.org/).

		Exports		Imports	
		Kgs	Thousand €	Kgs	Thousand €
2010	DK			26100	119.7
	FR	500	1.7	85200	923.2
	GB	800	22.3	29500	102.3
	IE			36000	159.7
	IT		94.7		
	NL			10000	67.2
	PT			1400	152.2
2011	DE			22500	111.8
	DK			75800	1.053.70
	GB			62300	134.6
	GR	200	76.1		
	IE	0		37000	233.4
	IT	0			8.8
	NL	600	243		79
	PT	102600	412.8		46.4

Table 13. Smoked eel export and import quantity and value Thousand € per destination country in Spain. Source: Departamento de Aduanas de la Agencia Tributaria de España http://aduanas.camaras.org/).

		Exports		Imports	
		Kgs	Thousand €	Kgs	Thousand €
2010	China		0.3		
	PT	100	0.6		
2011	Morocco	800	7.6		
	PT		0.4		
	NL			1400	22.8

Table 14. Frozen eel export and import quantity and value Thousand € per destination country in Spain. Source: Departamento de Aduanas de la Agencia Tributaria de España http://aduanas.camaras.org/).

		Exports		Imports	
		Kgs	Thousand €	Kgs	Thousand €
2010	Gibraltar		0.3		
	Hong Kong		4.6		
	Morocco		2.3		
	Mexico		23.7	1400	22.8
	PT		32.4	900	9.9
	DE			500	6.1
	Cuba			400	12.9
	FR			1700	108.3
	Madagascar			1700	69.2
	Mauritania			200	0.1
	NL			3100	54.2
	Taiwan			200	1.9
2011	Afganistan		0.3		
	USA		0.5		
	Gibraltar		0.3		
	Mexico	200	36.8		
	PT	16000	50.4		
	DE			6300	93.7
	Cuba			800	26.7
	FR			1400	16.5
	NL			5000	65.7

4 Fishing capacity

4.1 Glass eel

The available information is shown in Table 14.

Table 14. Number of glass eel fishing licences or boats per EMU. Updated and modified data are shown in bold.

		Recreational		Commercial					
		ES_Basq	ES_Cant	ES_Astu	ES_Vale	Ebro	ES_Cata	ES_Cant	Miño
2005–2006	Boat	54		50					
	Land	363		271	89		15		
2006–2007	Boat	50		47					
	Land	367		234	89		15		
2007–2008	Boat	42		45					
	Land	284		205	89	283	15		
2008–2009	Boat	366		45					
	Land	44		219	89				
2009–2010	Boat	46							
	Land	348			89				163
2010–2011	Boat	47		43					
	Land	349	35	183	89		10		160
2011–2012	Boat	45		37				5	
	Land	363	64	169	89				169
2012–2013	Boat	45		37		45		37	
	Land	354		160	89	354		160	154
2013–2014	Boat	43		33					
	Land	354		158	89	305	19		

4.2 Yellow eel

The available information is shown in Table 15.

Table 15. Number of yellow and silver eel fishing licences per EMU. Updated and modified data are shown in bold.

Year	ES_Gali*	ES_Astu"	ES–Murc^	ES_Vale¨	ES_Bale"
2005–2006		2	45	4	76
2006–2007		2	39	4	36
2007–2008		2	42	4	52
2008–2009		1	47	4	41
2009–2010		1	38	4	
2010–2011	62	1	40	4	
2011–2012		1	46	4	
2012–2013			40		
2013–2014		1	43	4	

Number of * tackles, "licenses, ^boats and ¨posts

4.3 Silver eel

See Section 4.2 above.

4.4 Marine fishery

This is not a target fishery.

5 Fishing effort

Not all the EMUs record effort data, and the ones recording data, have its own data collection system (see introduction).

Glass ee5.1

The available information is shown in Table 16.

Table 16. Number of hours (Basque Country and Catalonia) or days (Asturias and C. Valenciana) dedicated to glass eels fishing since 2005–2006 fishing season. Updated and modified data are shown in bold.

		RECREATIONAL	COMMERCIAL		
		ES_Basq*	ES_Astu ^	Albufera ^	ES_Cata *
2005–2006	Boat	3229			
	Land	8132			
2006–2007	Boat	2667	952		
	Land	7551	321	110	
2007–2008	Boat	3231	861		
	Land	7502	376	220	
2008–2009	Boat	909	588		
	Land	2973	393	200	
2009–2010	Boat	1894			
	Land	5337		105	
2010–2011	Boat	1271	963		
	Land	4227	2547	134	
2011–2012	Boat	3016,1	931		
	Land	5938,1	3501	123	770 700
2012–2013	Boat	2162	927		
	Land	8062	3936	155	
2013–2014	Boat	**2162**	**805**		
	Land	**8062**	**3695**	**87**	

***Hours.**

^Days.

5.2 Yellow eel

Data for yellow and silver eel fishing in Marjal Pego-Oliva (C. Valenciana, Jucar RBD) are given in Table 17. This season data from the Ría del Eo (Asturias) and Mar menor are available.

Table 17. Number yellow and silver eel fishing days in Marjal Pego-Oliva (ES_Vale), Ría del Eo (Es_Astu) and Mar Menor (ES_Murcia) during the 1998–2014 period. Updated and modified data are shown in bold.

Season	Fishing days	Ría del Eo	Mar Menor
1997–1998	53		
1998–1999	55		
1999–2000	23		
2000–2001	26		
2001–2002	42		
2002–2003	73		
2003–2004	33		
2004–2005	39		
2005–2006	44		
2006–2007	46		
2007–2008	82		
2008–2009	57		
2009–2010	34		
2010–2011	47		
2011–2012	50		
2012–2013	26		
2013–2014	**566**	**20**	**124**

5.3 Silver eel

See Section 5.2 above.

5.4 Marine fishery

There are not data available; however, this is not a target fishery, and the eel catches are accidental.

6 Catches and landings

Each EMU has its own data collection system (see introduction).

6.1 Glass eel

The available information is shown in Table 18.

Table 18. Glass eel catches (kg) in Spain since 2005–2006 season. Updated and modified data are shown in bold.

		ES_CANT	P VASCO	ES_ASTU	ES_VALE TOTAL	ES_CATA
2005–2006	Boat		555	993		
	Land		666	1182		1356
2006–2007	Boat		321	706		
	Land		452	1559	341	148
2007–2008	Boat		475	1054		
	Land		683	1325	157	79
2008–2009	Boat		54	213		
	Land		142	536	117	87
2009-–2010	Boat		252			
	Land		362	2612	167	1667
2010–2011	Boat		128			
	Land		248	2054	276	1528
2011–2012	Boat			628		
	Land	42	324	744	193	2241
2012–2013	Boat		497	1203		
	Land		1037	1639	223	2584
2013–2014	Boat		**1037**			
	Land		**497**		**185**	**3769**

6.2 Yellow eel

Only catches from the Albufera and Mar Menor (only 2013–2014 season) are split into yellow and silver (see Table 4).

6.3 Silver eel

Only catches from the Albufera and Mar Menor (only 2013–2014 season) are split into yellow and silver (see Table 5).

6.4 Marine fishery

This is not a target fishery.

6.5 Recreational fishery

There is a recreational glass eel fishery in the Basque Country and Cantabria (see Table 2) and a yellow and silver recreational fishery in Valencia, Catalunya and Balearic Island; but the catches are not recorded.

6.6 Bycatch, underreporting, illegal activities

Two papers have been published in Spain regarding the bycatch produced by glass eel fishery. Sobrino *et al*. (2005) stated that glass eel fishery negatively affected nursery function of the estuary: fishing is performed with 1 mm mesh size nets, and produces an average of 10–20 kg of juvenile bycatch, that could reach 90 kg when glass eel entrance is advanced to October or delayed to April/May.

Gisbert and Lopez (2008) revealed that glass eel fishery had a negative impact on bycatch ichthyofauna mainly composed of mugilid fry and small-size estuarine species of the Ebro delta. Data showed that between 10 and 69% of incidental species died as a consequence of glass eel capture and sorting procedures.

There are no estimations for underreporting.

There has been a glass eel seizure in 2014. The SEPRONA (the environmental division of the Spanish police) has been in charge. The glass eels coming from Andalucia were sent to Lisboa by trucks, and then they were sent to China from Lisbon airport. Although the exact number of glass eels is unknown ("hundreds") the value of the seizure has been estimated in 500 000 euros. (http://www.guardiacivil.es/es/prensa/noticias/4975.html).

7 Catch per unit of effort

7.1 Glass eel

The available information is shown in Tables 19 and 20.

Table 19. Glass eel cpues in Spain since the 2005–2006 fishing season. Updated and modified data are shown in bold.

		ES_Cant Professional *	ES_Cant Recreational *	ES_Basq^	Asturias Nalón *	ES_Astu *	Valencia Albufera *	Ebro*	Cataluña Inner Bassims*
2005–2006	Boat			0.429	0.750				
	Land			0.588	0.720		1.63		
2006–2007	Boat			0344	0.740				
	Land			0.409	0.730		3.11		
2007–2008	Boat			0.147	1 180				
	Land			0.090	0.880		0.59		
2008–2009	Boat			0.052	0.360				
	Land			0.034	0.460		0.56		
2009–2010	Boat			0.115	0.360				
	Land			0.062	0.460		1.19		
2010–2011	Boat			0.085	0.840				
	Land			0.055	0.600		1.39		
2011–2012	Boat		0.210	0.193	0.670	0.670			
	Land	0.400		0.068	0.230	0.210	1.17		
2012–2013	Boat			0.204	1.270	1.270			
	Land			0.112	0.650	0.450	1.02		
2013–2014	Boat			0.204	2.050	2.050			
	Land			0.112	1.290	0.730	1.6	0.182	0.049

*** kg/fykenet/day.**

^ kg/hour.

Table 20. Temporal trends in glass eel cpue (kg per fishing day) in the Albufera from C. Valenciana (includes Pujol, Perello and Perellonet fishing points). Updated and modified data are shown in bold.

YEAR	CPUE
1982	18.44
1984	14.83
1985	17.32
1987	17.89
1988	21.17
1989	12.76
1990	7.69
1993	4.23
1994	3.26
1995	2.31
1996	3.57
1997	3.42
1999	4.16
2000	1.9
2001	**3.18**
2002	**7.43**
2003	**2.75**
2004	**1.75**
2005	**1.66**
2006	**1.63**
2007	**3.11**
2008	**0.59**
2009	**0.56**
2010	**1.19**
2011	**1.39**
2012	**1.17**
2013	**1.02**
2014	**1.38**

7.2 Yellow eel

The available information is shown in Table 21.

Table 21. Catches of yellow and silver eel per day of fishing in Marjal Pego-Oliva (ES_Vale), Ría del Eo (Es_Astu) and Mar Menor (ES_Murcia) during the 1998–2014 period. Updated and modified data are shown in bold.

	Marjal Pego-Oliva (Valencia)				Ría del Eo (Asturias)			Mar Menor (Murcia)		
	Catches (Kg)	Fishing Days	kg/fishing day	kg/fishing day/fishing place	Catches (Kg)	Fishing Days	kg/fishing day	Catches (Kg)	Fishing Days	kg/fishing day
1998	1201	53	22.7	7.6						
1999	1074	55	19.5	6.5						
2000	500	23	21.7	7.2						
2001	868	26	33.4	11.1						
2002	817	42	19.5	6.5						
2003	1910	73	26.2	8.7						
2004	1041	33	31.5	10.5						
2005	1922	39	49.3	16.4						
2006	1370	44	31.1	10.4	653					
2007	1165	46	25.3	8.4	225					
2008	1413	82	17.2	5.7	159					
2009	1079	57	18.9	6.3	142					
2010	1375	34	40.4	13.5	1168					
2011	1369	47	29.1	9.7	248					
2012	995	50	19.9	6.6	635	60	10.58			
2013	619	26	23.8	7.9	450					
2014	**566**	**33**	**17.2**	**5.7**	**90**	**20**	**4.50**	**33537**	**124**	**270.4**

7.3 Silver eel

See Section 7.2 above.

7.4 Marine fishery

This is not a target fishery.

8 Other anthropogenic impacts

Major impacts are described in the Spanish EMP but quantitative data are not available in general terms.

There is a theoretical study in the Basque Country based on mortality rates per turbine type from bibliography and silver eel population estimates (Díaz *et al.*, 2012; https://www6.euskadi.net/u81-0003/es/contenidos/informe_estudio/2013_recuper-ando_anguila/es_docu/adjuntos/4.OBJETIVOC.pdf). The cumulative mortality among eels passing throw the turbines is between 51.9 and 81.0% in the Oria River. In another study in the Basque Country (EKOLUR S.L.L 2012) the impact of a hydropower station in the Silver eel from the Urola was determined. Preliminary results showed that less than 10% of silver eel passed through the bypass channel.

There are two studies assessing the effectiveness of fish passages: Aparicio *et al*. (2012) used a combination of video recording, electrofishing and trapping to assess the effec-tiveness of the fishway in facilitating the passage of fish at the most downstream barrier of the Ebro River (NE Iberian Peninsula). Ordeix *et al*. (2011) aimed to test the functionality of fish passages to enhance these structures for optimizing their management. They analyzed river connectivity and fish pass facilities in Catalan rivers according to international best practices.

There is no information regarding how the environment in your EMU has changed in the last 50 years that might have influenced eel production.

9 Scientific surveys of the stock

There is not any national eel specific survey programme in Spain; all the autonomous regions have multispecific electrofishing surveys. Additionally, some of the autonomous regions have eel-specific monitoring programmes. In the Basque Country, for example, glass and yellow eel recruitment and potential silver eel escapement are monitored in a yearly basis in the Oria River. There is an experimental fishing of glass eel in the Guadalquivir and Nalon Rivers. Some punctual studies have been done by Spanish researches; however collaborative studies to exchange knowledge and methodologies are lacking. Some autonomous regions had promoted punctual studies too, but these data are not gathered at a national level. However, the autonomous regions envisaged making silvering eel specific surveys in their management plans.

9.1 Recruitment surveys, glass eel

Glass eel recruitment in the Oria River is sampled in a yearly basis (Diaz *et al*., 2012 https://www6.euskadi.net/u81-0003/es/contenidos/informe_estudio/2013_recuperando_anguila/es_docu/adjuntos/2.OBJETIVOA.pdf).

During 2011–2012 and 2012–2013 fishing seasons, Asturias performed monthly experimental fishing in order to analyze the recruitment. It is planned to continue in the following years. Also, in the southernmost European estuary, the Guadalquivir glass eel recruitment was studied during nine successive migration seasons (June 1997–December 2006) using a fishery-independent experimental survey at three sampling sites in the estuary (Arribas *et al*., 2012).

9.2 Stock surveys, yellow eel

All the autonomous regions make periodic multispecific electrofishing surveys for the WFD, but until now, none of them has been directed exclusively to eel. There is not any agreed protocol for sampling, and there is not any compilation of this information at the national level. Some of the autonomous regions envisaged making eel-specific surveys in their management plans.

Yellow eel recruitment in the Oria River is sampled in a yearly basis in a fishpass in the tidal limit (see 3.1.2.).

9.3 Silver eel

The Basque management plan, determines the spawning potential according to Durif *et al*. (2003; 2005) in the different basins every five years. Results are available in the post-evaluation report. Additionally, in another study (EKOLUR S.L.L 2012) silver eel migration period and related environmental variables were studied in the Urola River (Basque Country). The silver eel migrated between October and January, with a peak in November, and mainly during night and when there is high flow and turbidity. Valencia also started making silvering eel-specific surveys in 2012.

Total density of eels and the size and number of male silver eels were quantified between 1990–2011 at 15 sites spread along four Rio Esva tributaries (Asturias, northwestern Spain) (Iglesias and Lobón, 2012).

Some of the autonomous regions envisaged making silvering eel specific surveys in their management plans.

10 Catch composition by age and length

No data available.

Until 2009, the eel was not included in Spanish DCF and since that year only glass eel catches from the Basque Country (recreational) were reported. Some of the autonomous regions have measured age and length punctually, but not in the DCF framework.

11 Life history and other biological information

Biological parameters are not sampled routinely in the autonomous regions, although the autonomous regions envisaged sampling them in their management plans.

11.1 Growth, silvering and mortality

The available information is shown in Tables 22 to 25.

Table 22. Von Bertalanffy equation parameters.

EMU CODE		YEAR	LINF	K	T0	M	REF.
ES_Murc	Mar Menor	2007–2009	120	0.05	-1.39	0.119	Martinez Baños, 2010
ES_Bale	Es Grau	2001	149.8	0.069	-1.65		Cardona *et al.*, 2002

Tabla 4. Parámetros biológicos de crecimiento y mortalidad estimados para la anguila para el mar Menor en el presente estudio. Año 2009. (Donde: Linf, k, t0: parámetros de la ecuación de von Bertalanffy; y M: mortalidad natural).

Especie	L∞	k	t0	M
Anguila	120	0,05	-1.39	0.119

Table 23. Length-at-age in Cadiz Bay and Guadalquivir wetlands (Es_Anda) and in the Mar Menor (Es-Murc).

	SL (MM)		
Age	Cadiz Bay*	Guadalquivir wetlands**	Mar Menor***
0			
1	26.3	13.5	
2	35.1	28.7	
3	41.8	38.5	40.7
4	48.6	44.3	46
5	63.3	50.4	50
6	69	54.1	53
7	85.3		55
8			60
9	96		64
10			68

*** Arias y Drake, 1985.**

**** Fernández-Delgado *et al.*, 1989.**

***** Martinez Baños, 2010.**

Table 24. Length–weight relationships in some Spanish EMUs.

EMU CODE	YEAR	LENGTH WEIGHT	R
ES_Basq	2002–2005	W = 0.0093L^2.533	0.899
ES_Vale	1998–2002	W = 0.0024L^2.915	0.924
ES_Vale	2009–2014	W = 0.0102L^2.539	0.921
ES_Cata			
ES_Bale	2001	W = 0.001L^3.14	0.974

Table 25. Length–weight relationships in some Spanish EMUs.

EMU CODE	YEAR	% SILVER EELS	% FEMALE	SL SILVER FEMALE (MM)	SL SILVER MALE (MM)
ES_Basq	2012		31.0	628.9	376.3
ES_Basq	2013		40.9	630.2	371.0
ES_Basq	2014		33.3	537.6	367.4
ES_Vale	2012	21.9	80.6	675.0	340.0
ES_Vale	2013	17.1	40.3	618.2	399.3
ES_Vale	2014	40.0	55.6	635.0	346.3

11.2 Parasites and pathogens

There is new information regarding the presence of some parasites in the Mar Menor (Mayo *et al.*, 2014) (Table 26).

Table 26. Presence of parasites in the eels from the Mar Menor during 2010 (N:189, average size 52.8) (Source, Mayo *et al.*, 2014).

	Prevalence (%)	Infection intensity	Abundance (n)
Trematode: *Deroprisitis inflata*	67	101	68
Trematode: *Bucephalus anguillae*	60	39	23
Nematode: *Contracaecum sp*	46	8	4
Cestodes: *Proteocephalidae larvae*	2	0.01	1

11.3 Contaminants

There are no new data or data are not available (see Spanish CR 2011).

11.4 Predators

In Catalunya fishing competitions have been made to remove fish species like bullhead, perch, pikeperch and black bass. Potential predators like American mink (*Neovison vison*) are controlled by trap in Catalunya. The cormorant (*Phalacrocorax carbo*) and heron (*Ardea cinerea*) populations are monitored and controlled, although predation on eel is practically non-existent.

A recent study in Andalucía showed that the impact of cormorants on eel population is not significant.

12 Other sampling

No data available.

13 Stock assessment

There is no stock assessment in Spain at a national level. Each autonomous region has assessed the stock for the management plan in a different way. The management plan of each autonomous region has its own objectives, methodology and structure.

In Spain, each autonomous government is in charge of the control, regulation and management of eel fishery and population. Thus population assessment is made at the autonomous region level, and the methodology data requirement and monitoring methods depend on the autonomy. Almost all the autonomies compile eel fishery data; but each autonomous region has its own methodology of compiling data. AZTI-Tecnalia made the first data compilation for eel in Spain for the WGEEL report (2006). After, another compilation of data was made for the EMP and for the post-evaluation of the EMP (2012). But all these three, were data compilations since there is not any study or sampling programme at the national level to compile eel information in a coordinate way (fishery data, biological information, etc.).

Similarly, there are some research projects going on in Spain, but there is not any that includes researchers from different regions. Finally, most of the autonomies made electric fishing surveys in the WFD framework; but only a few make eel specific electrofishing surveys.

In this way, the objectives of the different EMUs depend on the region (available in : http://wwwmagramagobes/es/pesca/temas/planes-de-gestion-y-recuperacion-de-especies-pesqueras/planes-gestion-anguila-europea/); therefore, some of the regions have focused mainly in restocking (mainly in the Mediterranean) and others in fishery or environmental measures.

13.1 Method summary

Regarding the assessment of the current eel population in the post evaluation report, there is a great variability among EMUs. There have been three different situations:

1) **Total lack of data in the EMU:** those EMUs have applied reference area production values from bibliography or from similar nearly habitats.

2) **EMUs with electrofishing surveys:** those EMUs have their own production values from certain areas, and they have extrapolated these values to areas of similar habitats where no information was available.

3) **EMUs with fishery data and surveys**: They have calculated productivity based on these data.

As pristine production is concern, some EMUs have used reference values, and others have applied a conversion factor to current production. The only quantified anthropogenic mortality is the fishery one; and to calculate B_{best}, catches (in silver eel equivalents) had been added to $B_{current}$; thus B_{best} is underestimated (Table 27). To calculate the equivalents, a six year generation time was considered; thus, the catches of glass and yellow eel, from six and three years ago and current silver eel catches were used. Also, an 80% mortality in glass eel settlement and an annual mortality of 0.138 was considered. (Dekker, 2000).

The Spanish EMP includes a series of calculations to define the pristine habitat and escapement. As the exact definition of the pristine habitat was unknown and due to the lack of complete sets of data or harmonized methods to estimate escapement levels, a series of general criteria were assumed, based on the data available in each region and on scientific literature consulted. This initial data will be reviewed and improved before the end of the first implementation phase of the EMPs (2015) in order to begin the second phase with more accurate estimates. In fact, these calculations had already been improved and reported in the 2012 post-evaluation report.

The criterion generally adopted for the definition of the **pristine habitat** was to consider the natural habitat of eel as the watercourses to a height of 800 m in basins with little slopes and 600 m in those of greater slopes, provided that there were no natural obstacles in levels below these heights. For the internal basins (without EMP in the first phase, see Section 2.3), data on surface water layer have been used, with a series of technical criteria provided by the Hydrographic Confederations. The autonomous communities with EMP in the first phase have defined a more detailed estimate of their habitat, which may mean that the inland habitat area is underestimated in comparison to the coastal one. The **current habitat** was quantified as the previous one, but only taking into account the habitat before the first artificial impassable obstacle.

Table 27. Approaches used by the Spanish autonomies to determine the 3Bs.

EMU	Bo	$B_{current}$	B_{best}
ES_Basq	Area production rate	EDA Extrapolation of area production rate	$B_{current}$ + F
ES_Nava	Area production rate	Extrapolation of area production rate	
ES_Cant	Apply a conversion factor to $B_{current}$	Extrapolation of area production rate	
ES_Astu	Apply a conversion factor to $B_{current}$	Extrapolation of area production rate	
ES-Gali	Surveys	Surveys	
ES_Anda	Area production rate	Extrapolation of area production rate	
ES-Murc	Apply a conversion factor to $B_{current}$	Based on fishery data and surveys	
ES_Cast	Area production rate	No current production	
ES_Vale	Area production rate	Area production rate from Bibliography	
ES_Cata	Area production rate	Extrapolation of area production rate	
ES_Bale	Apply a conversion factor to $B_{current}$	Based on fishery data and surveys	
ES_inner	Area production rate	No current production, inaccessible habitat	

In the initial version of the EMP (2010), an average pristine productivity of 20 kg/ha was assumed in the internal basins (without EMP in the first phase, see Section 2.3) in the inland water areas and 50 kg/ha in transitional waters (ICES 2001). The autonomous communities with EMP in the first phase took a different approach, based on the information available that best matches their specific environmental and ecological conditions (Table 27). A more detailed explanation might be find is the EMP of each EMU. Some of the regions have improved their estimations in the 2012 post-evaluation report: they have obtained new current productivity values and they have calculated historic values applying a conversion factor (Table 28).

Table 28. Silver eel productivity according to the Spanish EMP post-evaluation report (2012).

	Bo (kg/ha)			Current productivity (kg/ha)			Whether or not changed from value reported last year (Y/N)
	Fluvial	Transitional	Lagoons	Fluvial	Transitional	Lagoons	
Es_Basq	20	82.7		5.0–14	44.7		N
ES_Nava	20			10			N
ES_Cant	20			0.8–7.4			N
ES_Astu	8.6–20	14.3		2.4–8.7	4.3		N
ES-Gali	30		30	3.0		3.0	N
ES_Anda	20	50		0.5–2.9	10		N
Es_Murc	20		1.62			0.8	N
ES_Cast	20			0			N
ES_Vale	20	80	77.8	33.75	78.75	56.25	N
ES_Cata	20		77.8	0.8–65.1		51.9	N
ES_Bale			77.8			51.9	N

13.2 Summary

13.2.1 Stock indicators and targets

The available information is shown in Table 29.

Table 29. Summary of stock indicators, mortality rates and targets according to the Spanish EMP post-evaluation report.

EMUCODE	BIOMASS			MORTALITY (RATE)			TARGET		
	B0	Bbest	Bcurr	∑A	∑F	∑H	Source	Biomass (t)	∑A (rate)
ES_Basq	245.04	178.638	129.164	ND	0.33	ND	EMP	98.016	
							EU Reg	98.016	
							WGEEL		0.92
ES_Nava	5.448	2.305	2.305	ND		ND	EMP	2.179	
							EU Reg	2.179	
							WGEEL		0.92
ES_Cant	9.68	28.063	1.294	ND	3.08	ND	EMP	3.872	
							EU Reg	3.872	
							WGEEL		0.03
ES_Astu	64.042	159.13	12.584	ND	2.54	ND	EMP	25.617	
							EU Reg	25.617	
							WGEEL		0.05
ES-Gali	130.257	60.392	9.122	ND	1.89	ND	EMP	52.103	
							EU Reg	52.103	
							WGEEL		0.02
ES_Anda	5562.53	610.396	562.732	ND	0.08	ND	EMP	2225.01	
							EU Reg	2225.01	
							WGEEL		0.02
ES-Murc	26.271	31.525	11.17	ND	1.04	ND	EMP	10.508	
							EU Reg	10.508	
							WGEEL		0.92
ES_Cast	23.488	0	0	ND	0	ND	EMP	9.395	
							EU Reg	9.395	
							WGEEL		0.00
ES_Vale	698.026	427.984	385.175	ND	0.11	ND	EMP	279.21	
							EU Reg	279.21	
							WGEEL		0.13
ES_Cata	858.759	159.542	50.42	ND	1.15	ND	EMP	343.504	
							EU Reg	343.504	
							WGEEL		0.92
ES_Bale	330.883	222.662	220.561	ND	0.01	ND	EMP	132.353	

EMUCODE	BIOMASS			MORTALITY (RATE)			TARGET		
							EU Reg	132.353	
							WGEEL	0	0.15
ES_inner	2420.21	0	0	ND	0	ND	EMP	968.082	
							EU Reg	968.082	
							WGEEL		0.00
Total	10374.6	1880.64	1384.53				EMP	4149.85	
							EU Reg	4149.85	
							WGEEL		0.03

13.2.2 Habitat coverage

In Spain the lakes are very small and located at high altitudes; thus they have not been assessed. Coastal waters have not been assessed (Table 30).

Table 30. Pristine and current wetted area of the EMUs according to the Spanish EMP post evaluation report. A´d indicates whether or not eel are assessed in that habitat type. NP: Not pertinent, this type of habitat is not present in this EMU.

	Pristine wetted area							Current wetted area						
	Fluvial		Transitional/ estuaries		Lagoons		Total	Fluvial		Transitional/ estuaries		Lagoons		Total
	Area (ha)	A´d	Area (ha)	A´d	Area (ha)	A´d	Area (ha)	Area (ha)	A´d	Area (ha)	A´d	Area (ha)	A´d	Area (ha)
Es_Basq	1434	Y	2616	Y		NP	4050	1375	Y	2616	Y		NP	3991
ES_Nava	272	Y		NP		NP	272	231	Y		NP		NP	231
ES_Cant	1936	Y		N		NP	1936	615	Y		N		NP	615
ES_Astu	2437	Y	1337	Y		NP	3774	1268	Y	1337	Y		NP	2605
ES-Gali	2906	Y	1436	Y		NP	4342	1656	Y	1436	Y		NP	3092
ES_Anda	25377	Y	101100	Y		NP	126477	13550	Y	53539	Y		NP	67089
Es_Murc	219	Y		NP	13519	Y	13737	219	Y		NP	13500	Y	13719
ES_Cast	1174	Y		NP		NP	1174	0	Y	0	NP	0	NP	0
ES_Vale	12499	Y	1457	Y	4261	Y	18217	12499	Y	1457	Y	4261	Y	18217
ES_Cata	39398	Y	910	Y		Y*	40308	984	Y	676	Y		Y*	1660
ES_Bale		NP		NP	4253	Y	4253		NP		NP	4253	Y	4253
ES_inner	66868	Y	21657	NP		NP	88525	0	Y	0	NP		NP	0
TOTAL	**154 520**	**Y**	**129 077**		**23 469**		**307 065**	**32 396**	**Y**	**59 624**		**23 450**		**115 470**

*** Included in transitional.**

13.2.3 Impacts

The available information is shown in Tables 29 and 31 and was calculated for the post-evaluation report using data until 2011.

Fishery: Only fishery impact has been considered totally. B_{best} has been calculated adding fishery catches to $B_{current}$, and fishing mortality has been calculated as Ln ($B_{current}$/B_{best}), and the loss in tones due to the fishery has been translated into Silver Eel Equivalents (Table 32).

Hydro and Pumping: only the Basque EMU reports gives a theoretical cumulative mortality among eels passing throw the turbines between 51.9 and 81.0% in the Oria River.

Barriers: Habitat loss due to impassable dams has been assessed, and corresponds to the difference between the current and pristine habitat. Other effects of barriers have not been assessed.

Predators: The most important predators are described but their impact in eel population has not been assessed.

Indirect impacts: Some of them are described but their impact in eel population has not been assessed.

Table 31. Overview of the assessed impacts per EMU according to the Spanish EMP post evaluation report. A = assessed, MI = not assessed, minor, MA = not assessed major, AB = impact absent.

	Fishery Com	Fishery Rec	Hydro & Pumps	Barriers	Resctocking	Predators	Indirect impacts
ES_Anda	A	AB	MI	A*			
ES_Astu	A	AB	MI	A*			
ES_Bale	A	MI	AB	A*			
Es_Basq	AB	A	A*	A*	MI	MI	MI
ES-Cant	A	A	MI	A*			
ES_Cast	AB	AB	MI	A*			
ES_Cata	A	MI	MI	A*			
ES-Gali	A	AB	MI	A*			
ES_inner	AB	AB	MI	A*			
Es-Murc	A	AB	MI	A*			
ES_Nava	AB	AB	MI	A*			
ES_Vale	A	MI	MI	A*			

*** Partially.**

Table 32. Loss in tonnes due to the fishery according to the Spanish EMP post-evaluation report translated into Silver Eel Equivalents (KG). The loss produced by the rest of the impacts is unknown. MI = not assessed, minor, MA = not assessed major, AB = impact absent.

EMU code	Stage	Fish com	Fish rec	Hydro & pumps	Barriers	Restocking	Predators	Indirect impacts
ES_Basq	Glass	0	769	MA	MA	MI	MI	
	Yellow	0	0	MA	MA	MI	MI	
	Silver	0	0	MA	MA	MI	MI	
	Silver EQ		51723					
ES_Nava	Glass	0	0					
	Yellow	0	0					
	Silver	0	0					
	Silver EQ	0	0					
ES_Cant	Glass	373	25					
	Yellow	0	0					
	Silver	0	0					
	Silver EQ	26769						
ES_Astu	Glass	2875	2875					
	Yellow	159	0					
	Silver	0	0					
	Silver EQ	146546	0					
ES-Gali	Glass	0	0					
	Yellow	48071	0					
	Silver	31984	0					
	Silver EQ	51270,3	0					
ES_Anda	Glass	600	0					
	Yellow	0	0					
	Silver	0	0					
	Silver EQ	47664	0					
ES-Murc	Glass	0	0					
	Yellow	11489	0					
	Silver	10710	0					
	Silver EQ	20355	0					
ES_Cast	Glass	0	0					
	Yellow	0	0					
	Silver	0	0					
	Silver EQ	0	0					
ES_Vale	Glass	183	0					
	Yellow	15824	NC					

EMU code	Stage	Fish com	Fish rec	Hydro & pumps	Barriers	Restocking	Predators	Indirect impacts
	Silver	3822	NC					
	Silver EQ	42809	NC					
ES_Cata	Glass	1356	0					
	Yellow	19753	0					
	Silver	882	0					
	Silver EQ	109122	0					
ES_Bale	Glass	0	0					
	Yellow	1068,8	0					
	Silver	306,8	0					
	Silver EQ	2101	0					
ES_inner	Glass	0	0					
	Yellow	0	0					
	Silver	0	0					
	Silver EQ	0	0					
TOTAL	Glass	5387	3669					
	Yellow	96 364,8	0					
	Silver	47 704,8	0					
	Silver EQ	446 636	51 723					

13.2.4 Precautionary diagram

There is a high variability regarding eel population among the different EMUs (Figure 5), ranging from the 0% to the 66.7% of the target (see Table 29). $B_{current}$ escapement is 13% of the pristine one. Regarding anthropogenic mortality, only the fishery one has been considered in the analysis, so B_{best} is underestimated.

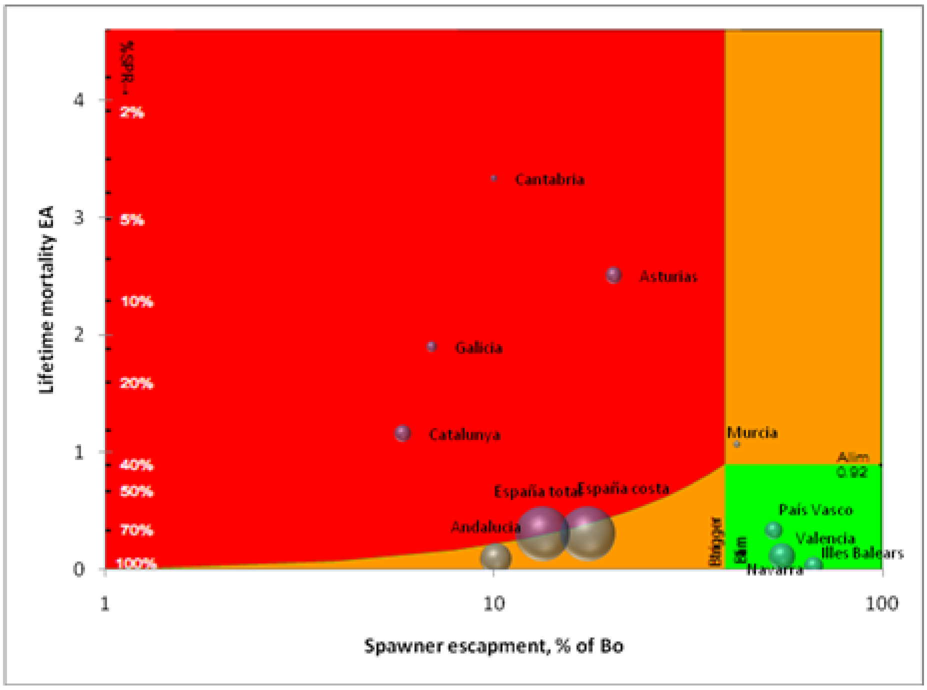


Figure 5. Modified Precautionary Diagram (ICES 2012).

13.2.5 Management measures

The available information is shown in Table 33.

Table 33. Overview of management measures per EMU in Spain according to the Spanish EMP post evaluation report.

EMU code	Action_type	Subaction	LS	Planned	Outcome
ES_anda	Commercial fishery	Introduce total closed fishery	M	EMP	Fullfilled
	Commercial fishery	Introduce total closed fishery	G	EMP	Fullfilled
	Commercial fishery	Poaching control	U	Undefined	Partially fullfilled
	Habitat improvement	Introduce eel passes	U	EMP	Partially fullfilled
	Habitat improvement	Overall improvement	U	EMP	Partially fullfilled
	Habitat improvement	Predator control	U	EMP	Partially fullfilled
	Hydropower and obstacles	Trap & transport	U	EMP	No information
	Hydropower and obstacles	Scientific studies	U	EMP	Partially fullfilled
	Stocking	Stock pregrown eel	U	EMP	Fullfilled
ES_Astu	Commercial fishery	Reduce fishing effort	G	EMP	Partially fullfilled
	Commercial fishery	Reserve of the caught for stocking	G	EMP	Fullfilled
	Habitat improvement	Demolish obstacles	U	EMP	Partially fullfilled
	Habitat improvement	Improve longitudinal conectivity	G	EMP	Partially fullfilled
	Habitat improvement	Improve water quality	G	Undefined	Fullfilled
	Habitat improvement	Introduce eel passes	U	EMP	Partially fullfilled
	Habitat improvement	Predator control	U	EMP	Partially fullfilled
	Hydropower and obstacles	Introduce sonic barrier	U	EMP	Partially fullfilled
	Recreational fishery	Introduce closed fishery	M	EMP	Fullfilled
ES_Bale	Commercial fishery	Introduce fishing quota	M	EMP	Fullfilled
	Commercial fishery	Introduce minimun size	M	EMP	Fullfilled
	Habitat improvement	Elimination programs of aloctone predators	U	EMP	Fullfilled

EMU code	Action_type	Subaction	LS	Planned	Outcome
ES_Basq	Habitat improvement	General improvement	U	EMP	Partially fullfilled
	Hydropower and obstacles	Demolish obstacles	U	Undefined	Partially fullfilled
	Habitat improvement	Improve water quality	U	EMP	Partially fullfilled
	Predactors reduction	Scientific studies.	U	Undefined	Not started or failed to be implemented
	Stocking	Scientific studies.	U	EMP	Fullfilled
	Hydropower and obstacles	Scientific studies. Study in the Oria to determine the teoretical impact in the Oria depending on the turbine type	U	EMP	Fullfilled
	Hydropower and obstacles	Scientific studies. Corridor establishment study	M	EMP	Partially fullfilled
	Recreational fishery	Introduce closed fishery	M	EMP	Fullfilled
	Recreational fishery	Introduce fishing quota	G	EMP	Fullfilled
	Recreational fishery	Reduce fishing effort	G	EMP	Fullfilled
	Commercial fishery	Reduce fishing effort	G	EMP	Fullfilled
	Commercial fishery	Reserve of the caught for stocking	G	EMP	Fullfilled
	Habitat improvement	Improve longitudinal conectivity	U	EMP	Not started or failed to be implemented
	Habitat improvement	Program of habitat improvement	U	EMP	Not started or failed to be implemented
	Predactors reduction	Scientific studies	U	Other	Fullfilled
	Recreational fishery	Introduce closed fishery	M	EMP	Fullfilled
	Recreational fishery	Introduce fishing quota	G	EMP	Fullfilled
	Recreational fishery	Reduce fishing basins	G	EMP	Fullfilled
	Habitat improvement	Discharge control	U	EMP	Fullfilled
ES_Cant	Hydropower and obstacles	Scientific studies	U	EMP	Partially fullfilled
	Hydropower and obstacles	Stablish collaboration measures with hydropower stations	U	EMP	Not applicable

EMU code	Action_type	Subaction	LS	Planned	Outcome
	Stocking	Stock pregrown eel	U	EMP	Not applicable
	Commercial fishery	Introduce closed fishery	M	EMP	Fullfilled
	Commercial fishery	Reduce fishing effort	G	EMP	Fullfilled
	Commercial fishery	Reserve of the caught for stocking	U	EMP	Fullfilled
	Habitat improvement	Overall improvement	U	EMP	Fullfilled
	Habitat improvement	Predator control	U	EMP	Fullfilled
ES_Cata	Predactors reduction	Scientific studies	U	undefined	Fullfilled
	Recreational fishery	Catch and release	M	EMP	Fullfilled
	Commercial fishery	Introduce closed fishery	G	EMP	Fullfilled
	Commercial fishery	Introduce minimun size	M	EMP	Fullfilled
	Commercial fishery	Introduce Regulation of the fishery	M	EMP	Fullfilled
	Commercial fishery	Reduce fishing effort	M	EMP	Fullfilled
	Habitat improvement	Recovery plan of endemic species	U	Other	Fullfilled
	Habitat improvement	Improve water quality	U	EMP	Partially fullfilled
	Hydropower and obstacles	Inventory of obstacles	U	EMP	Fullfilled
	Hydropower and obstacles	Temporal disconnection	U	EMP	Partially fullfilled
ES_Gali	Recreational fishery	Introduce closed fishery	M	EMP	Fullfilled
	Recreational fishery	Introduce total closed fishery	G	EMP	Fullfilled
	Commercial fishery	Reduce fishing effort	M	EMP	Fullfilled
	Commercial fishery	Reserve of the caught for stocking	G	EMP	No information
	Habitat improvement	Improve longitudinal conectivity	U	EMP	Partially fullfilled
ES_Inne	Habitat improvement	Overall improvement	U	EMP	No information
	Habitat improvement	Predator control	U	EMP	Partially fullfilled

EMU code	Action_type	Subaction	LS	Planned	Outcome
ES_Murc	Recreational fishery	Catch and release	M	EMP	Fullfilled
	Commercial fishery	Introduce minimun size	M	EMP	Fullfilled
	Commercial fishery	Reduce fishing effort	M	EMP	Fullfilled
	Commercial fishery	Introduce closed fishery	M	EMP	Fullfilled
ES_Nava	Habitat improvement	Improve longitudinal conectivity	U	undefined	Partially fullfilled
	Recreational fishery	Introduce closed fishery	M	EMP	Fullfilled
	Stocking	Stock pregrown eel	S	EMP	Fullfilled
	Commercial fishery	Poaching control	G	EMP	Partially fullfilled
	Habitat improvement	Overall improvement	U	EMP	Partially fullfilled
	Habitat improvement	Stablish protected areas	M	EMP	Fullfilled
	Hydropower and obstacles	Put grids in turbines, mantain offshoot chanals	U	EMP	Partially fullfilled
	Hydropower and obstacles	Scientific studies	U	EMP	Partially fullfilled
	Predactors reduction	Scientific studies	U	EMP	Partially fullfilled
	Recreational fishery	Introduce closed fishery	M	EMP	Fullfilled
	Stocking	Adjust percentage of catches for stocking	G	EMP	Partially fullfilled
	Stocking	Reserve of the caught	M	EMP	Partially fullfilled
ES_Vale	Stocking	Stocking fee increase	M	EMP	Fullfilled

13.3 Summary data on glass eel

Table 34. Overview of glass eel data in Spain. Updated and modified data are shown in bold.NC: Not compiled. NR: Not recorded.

			National				EU Countries			
Year	Region	Glass eel (kg)	Stocking (kg)	% Stocking	Human consumption (kg)	Aquaculture	Stocking (kg)	% Stocking	Human consumption (kg)	Aquaculture
2009–2010	Miño (Spain)	2000								
	ES_Astu	2612	14.9	0.6	NC	NC	NC	NC	NC	NC
	ES_Cant	228	0.0	0.0	NC	NC	NC	NC	NC	NC
	ES_Basq *	614	0.0	0.0	614	0	0	0	0	0
	ES_Cata	1667	380.0	22.8	NC	NC	NC	NC	NC	NC
	ES_Vale	167	41.6	24.9	NC	NC	NC	NC	NC	NC
	TOTAL	7287	436.5	6.0	NC	NC	NC	NC	NC	NC
2010–2011	Miño (Spain)	1325								
	ES_Astu	2067	19.8	1.0	NC	NC	NC	NC	NC	NC
	ES_Cant	58	4.9	8.5	52.6	NC	NC	NC	NC	NC
	ES_Basq *	376	0.0	0.0	376	0	0	0	0	0
	ES_Cata	1527	947.0	62.0	NC	NC	NC	NC	NC	NC
	ES_Vale	256	55.0	21.5	NC	NC	NC	NC	NC	NC
	TOTAL	5608	1026.	18.3	NC	NC	NC	NC	NC	NC
2011–2012	Miño (Spain)	1022								
	ES_Astu	1813	18.0	1.0	NC	NC	NC	NC	NC	NC
	ES_Cant	63	12.3	19.4	51.1	NC	NC	NC	NC	NC
	ES_Basq	1082	5.0	0.5	1077	0	0	0	0	0
	ES_Cata	2160	529.0	24.5	NC	NC	NC	NC	NC	NC
	ES_Vale	274	52.9	19.3	NC	NC	NC	NC	NC	NC
	TOTAL	6414	617.2	9.6	NC	NC	NC	NC	NC	NC
2012–2013	Miño (Spain)	na								
	ES_Astu	3511	0.0	0.0	NC	NC	NC	NC	NC	NC
	ES_Cant	NR	NR	NR	NR	NC	NC	NC	NC	NC
	ES_Basq	1534	2.1	0.1	1532	0	0	0	0	0
	ES_Cata	2584	0.0	0.0	NC	NC	NC	NC	NC	NC
	ES_Vale	223	50.2	22.5	NC	NC	NC	NC	NC	NC
	TOTAL	7852	52.3	0.7	NC	NC	NC	NC	NC	NC
2013–2014	Miño (Spain)									
	ES_Astu	**5820**	**0,0**	**0,0**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**
	ES_Cant	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**
	ES_Basq	**2405**	**0,0**	**0,0**	**2405**	**0**	**0**	**0**	**0**	**0**
	ES_Cata	**3769**	**0,0**	**0,0**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**
	ES_Vale	**185**	**46,9**	**25%**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**
	TOTAL									

14 Sampling intensity and precision

As mentioned in previous section the DCF was not applied for eel until 2009; only glass eel catches in the recreational glass eel fishery from the Basque Country are reported since then. Also there is not any sampling programme at the national level, thus is not possible to analyse sampling intensity and precision.

15 Standardisation and harmonisation of methodology

Since there is not a national survey or sampling programme, standardization and harmonization have not been analyzed until now.

15.1 Survey techniques

15.2 Sampling commercial catches

15.3 Sampling

15.4 Age analysis

15.5 Life stages

15.6 Sex determinations

16 Overview, conclusions and recommendations

As mentioned above, in Spain, each autonomous government is in charge of the control, regulation and management of eel fishery and population. The only information that is compiled routinely corresponds to fishery. In addition to that, each autonomous region has its own methodology to compile fishery data. In this way, the assessment of the general eel status in Spain is a very complicated task. Apart from the present report and the management plan, there is not any global study or sampling programme to compile information (fishery data, biological information, etc.) in Spain in order to give a national overview of eel situation. Similarly, they are some research projects going on in Spain, but there is not any that includes researchers from different regions.

All the above-mentioned, makes a very complicated task to compile the data required in the report, and also, the one necessary to be able to make a proper assessment of the eel population.

In this way, it is essential to compile eel data as required by the DCF. Additionally, the different autonomous regions should coordinate their data collection and management and research plans. Thus, it is recommended to **create a Spanish eel group,** including autonomic administrations, RBDs, and researchers. Also, in those RBDs that extend over different autonomous regions, the different local administrations should make an effort to coordinate their work in the basin, concerning both management and research.

17 Literature references

Arias, A. M.; Drake, P. 1985. Estructura de la población y régimen alimentario de *Anguilla anguilla* L., 1758 (Osteichthyes, Anguillidae), en los esteros de San Fernando (Cádiz). Investigación Pesquera, 49 (4): 475–491.

Arribas C., Fernández-Delgado C., Oliva-Paterna F.J., Drake, P. 2012. Oceanic and local environmental conditions as forcing mechanisms of the glass eel recruitment to the southernmost European estuary. Estuarine, Coastal and Shelf Science.

Aparicio, E., Pintor, C., Durán, C., Carmona-Catot, G. 2012. Fish passage assessment at the most downstream barrier of the Ebro River (NE Iberian Peninsula). Limnetica 31(1): 37–46.

Cardona, L., Sales, M., Gisbert, E. 2002. Estructura demografica de l'estoc d'anguila (*Anguilla anguilla* (Linnaeus, 1758)) explotat a s'Albufera d'es Grau (Menorca). Bolleti de la Societat d'Historia Natural de les Balears, 45: 59–68.

Díaz, E., Korta, M., Andonegi, E., Aranburu, A., Santurtún, M., Franco, J., Azpiroz, I., Gaspar, S., Felipe, A. 2012. RECANG: Recuperando la anguila: desarrollo de herramientas científico-técnicas para la implementación de planes de gestión en las cuencas europeas. AZTI Tecnalia.-EKOLUR. Informe para: La Fundación Biodiversidad, URA y la Diputación de Gipuzkoa.

Doadrio, I. Ed. 2001. Atlas y libro rojo de los peces continentales de España Museo Nacional de Ciencias Naturales-MMA, Madrid, 364 pp.

Durif C. La migration d'avalaison de l'anguille européenne *Anguilla anguilla*: Caractérisation des fractions dévalantes, phénomène de migration et franchissement d'obstacles Doctorat de l'université en Ecologie Aquatique Thesis, Université Paul Sabatier, Toulouse III, Toulouse.

Durif, C., Dufour, S., Elie, P. 2005. The silvering process of *Anguilla anguilla*: a new classification from the yellow resident to the silver migrating stage Journal of Fish Biology 66 (4), 1025–1043.

EKOLUR SLL. 2012. Estudio de la migración descendente de anguila plateada y afección de una central hidroeléctrica (C.H. Altuna Txiki) en el río Urola. Informe técnico elaborado para la Agencia Vasca del Agua-Ur Agentzia.

Fernández-Delgado, C., Hernando, J. A., Herrera, M., Bellido, M. 1989. Age and growth of yellow eels, *Anguilla anguilla*, in the estuary of the Guadalquivir River (southwest Spain). J. Fish Biol., 34 (4): 561–570.

ICES. 2001. WGEEL. International Council for the Exploration of the Sea. Report of ICES/EIFAC Working Group on Eels. ICES C.M. 2001/ACFM:03.

ICES. 2011 Report of the 2006 Session of the Joint EIFAC/ICES Working Group on Eels CM 2006/ACFM, 16: 352p.

Martinez Baños. 2010. Informe sobre el estado de explotación de la anguila (*Anguilla anguilla*; Linnaeus,) en el Mar Menor", C&C-MEDIO AMBIENTE.

Mayo E., Peñalver J., A. García-Ayala., Serrano E., Muñoz P., Ruiz de Ibañez R. 2014. Richness and diversity of helminth species in eel from a hypersaline cosatal lagoon, Mar Menor, southeast Spain Lagoon, Mar Menor, southeast Spain. Journal of Helmintology 31: 1–7.

Ordeix M., Pou Q, Sellarés N, Bardina M., Casamitjana Anna, Solá C, Munné A. 2011. Fish pass assessment in the rivers of Catalonia (NE Iberian Peninsula). A case study of weirs associated with hydropower plants and gauging stations Limnetica, 30(2): 405–426.

Sobrino, I., Baldó, F., García-González, D., Cuesta, J.A., Silva-García, A., Fernández-Delgado, C., Arias, A.M., Rodríguez, A. and Drake, P. 2005. The effect of estuarine fisheries on juvenile fish observed within the Guadalquivir Estuary (SW Spain) Fisheries Research, 76: 229–242.

Report on the eel stock and fishery in United Kingdom 2013/2014

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2 Introduction

2.1 UK overview

Eel are widespread throughout estuaries, rivers and lakes of the UK, with the possible exception of the upper reaches of some rivers, particularly in Scotland, due to difficulties of access.

There are eleven Eel Management Plans (EMPs) for England and Wales, including one shared with Scotland, one for the remainder of Scotland, and three in Northern Ireland including one shared with the Republic of Ireland (Figure 1). Most of the UK EMPs have been set at the River Basin District (RBD) level, as defined under the Water Framework Directive. The RBDs in Northern Ireland deviate slightly from those defined for the WFD, owing to their transboundary nature. The North Western International EMP is a transboundary plan with the Republic of Ireland.

Figure 1: Map of River Basin Districts for the UK and Northern Ireland

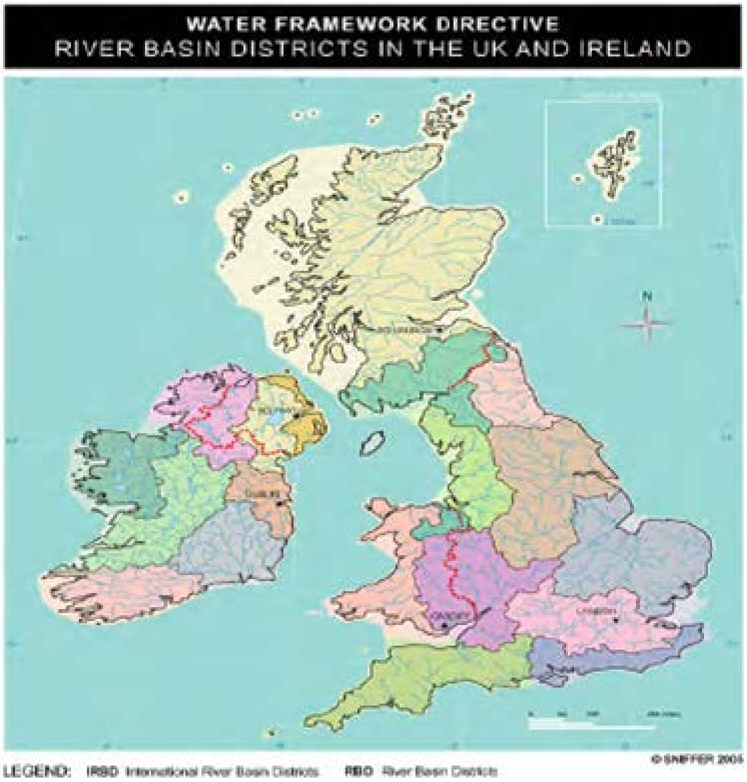

Table 1. The ICES ecoregions into which the UK EMUs drain.

EMUcode	ICES ecoregion
GB_Sco	Celtic Sea & North Sea
GB_Neag	Celtic Sea
GB_NorE	Celtic Sea
GB_Nort	North Sea
GB_Humb	North Sea
GB_Angl	North Sea
GB_Tham	North Sea
GB_SouE	North Sea
GB_SouW	Celtic Sea
GB_Seve	Celtic Sea
GB_Wale	Celtic Sea
GB_Dee	Celtic Sea
GB_NorW	Celtic Sea
GB_Solw	Celtic Sea & North Sea

2.2 England and Wales

Responsibility for the management of eel fisheries rests with the Environment Agency in England and with Natural Resources Wales in Wales. All fishing for eel requires authorisation, which is subject to standard national conditions that control seasons, methods, apply geographic restrictions and other measures to protect bycatch species. The Environment Agency, under formal agreement, issues authorisations on behalf of Natural Resources Wales for those fisheries operating in Wales.

Standard conditions allow the use of four instrument types for eel fishing: permanently fixed traps (e.g. weir or rack traps and 'putts'); moveable or temporary nets or traps without leaders or wings and with a maximum diameter of less than 75 cm; moveable or temporary nets or traps with leaders or wings with a maximum diameter of less than 100 cm (usually fykenets); and elver (glass eel) dipnets. Recreational angling is permitted using rod-and-line but all rod-caught eels must be returned alive to the waters from where they were caught. Appendix 1 in the 2007 UK report provides a summary description of netting and trapping methods used to catch eels in England and Wales.

Conditions also stipulate that all eel (apart from glass eel) less than 300 mm in length must be returned to the water, that no part of any net, wing or leader shall be made of a mesh greater than 36 mm stretched mesh, and that monofilament material is prohibited (except for an elver dipnet or fishing with rod-and-line). It is also a requirement that nets set in tidal waters should not dry out, unless they are checked just before they do so, and that nets should not cover more than half the width of the watercourse, or should not be set closer than 30 m apart (apart from in still waters and tidal waters). All fykenets must be fitted with an otter guard (a 100 mm square mesh hard plastic frame, fitted in the mouth of the first trap, to prevent otters becoming trapped in the nets). No fishing is allowed within 10 m upstream or downstream of any obstruction. Elver dipnets must be used singly, by hand and without the use nets, chains, or boats. Small wingless traps and winged traps (fykes) can be used across the whole of England and Wales unless local byelaw restrictions apply.

Since 2010, the yellow and silver eel fisheries have been limited to those individuals who were already licensed, and these individuals are limited to the number of nets that they can apply for based on previous effort. Applications from newcomers are considered, but only for scientific studies, stock monitoring or for personal consumption. Thus, commercial fishing is effectively capped to existing fisherman who can use up to a maximum number of nets.

The glass eel fishery is restricted to two zones: in parts of South Wales and Southwest England, and in parts of Northwest England.

Every authorised instrument must carry an identity tag issued by the Environment Agency and it is a legal requirement that all eel and elver fishermen submit a catch return. The Environment Agency, under formal agreement, collates catch return information on behalf of Natural Resources Wales. Eel fishers are required to give details of the number of days they have fished, the location and type of water fished, the total weight of eel caught and retained or a statement that no eel have been caught. Annual eel and elver net authorisation sales and catches are summarised by instrument type and region (soon to be River Basin Districts (RBDs)) and reported in the "Salmonid and Freshwater Fisheries Statistics for England and Wales" series (www.environment-agency.gov.uk/research/library/publications/33945.aspx).

2.3 Scotland

There have been no regulated eel fisheries in Scotland for the past several decades, and new legislation has been introduced in 2009 to require that anyone wishing to fish for eel in Scotland must seek a licence from the Secretary of State.

2.4 Northern Ireland

Lough Neagh in Northern Ireland is the largest freshwater lake in the UK. Prior to 1983, estimates of annual recruitment of glass eel to the Lough consistently exceeded 6 million and averaged in excess of 11 million (based on a mean weight of 3000 glass eel per kg). Productivity is such that the Lough sustains a large population of yellow eel and produces many silver eels that migrate via the out-flowing Lower River Bann.

The system sustains the largest remaining commercial wild eel fishery in Europe, producing 16% of total EU landings and supplying 3.6% of the entire EU market (wild caught + aquaculture) in 2007. Fishing rights to all eel life stages are owned by the Lough Neagh Fishermen's Co-operative Society (LNFCS). The fishery is managed to enable the capture of approximately 250–350 t of yellow eel and 75–100 t of silver eels annually, with an escapement of silver eels at least equivalent to the catch of silvers. Whilst it is illegal to fish for glass eels in N. Ireland, provision is made whereby LNFCS staff are allowed to catch glass eels using dragnets below a river-spanning sluice gate, which creates a barrier to upstream juvenile eel migration, for onward placement into L. Neagh. Elvers are also trapped at the same location and placed into the Lough.

The yellow eel fishery (May–September, five days a week) supports 80–90 boats each with a crew of two men using draftnets and baited longlines. Eels are collected and marketed centrally by the Co-operative. Silver eels are caught in weirs in the Lower River Bann. Profit from the less labour-intensive silver eel fishery sustains the management of the whole co-operative venture, providing working capital for policing, marketing and stocking activity and an out-of-season bonus payment for yellow eel fishermen at Christmas.

Natural recruitment has been supplemented since 1984 by the purchase of glass eel from outside the RBD. Approximately 96.7 million (32.2 t) additional glass eel have been stocked by the LNFCS. Reviews on the fishery, its history and operation can be found in Kennedy (1999) and Rosell *et al.* (2005).

The cross-border Erne system is comparable in size to L. Neagh and produced a fishery yield in the region of 33 t of eels per year. Within N. Ireland, Upper and Lower Lough Erne sustained a small-scale yellow eel fishery, which was closed in 2010 under the terms of the NWIRDB Eel Management Plan (EMP). There has been no commercial silver eel fishery on the Erne since 2001, but a trap and truck conservation silver eel fishery was instigated in 2009. Elvers are trapped at the mouth of the River Erne using ladders placed at the base of the hydroelectric facility that spans the Erne, and trucked upstream into the Erne lake system. A comprehensive study into the structure, composition and biology of the eel fisheries on the Erne was conducted by Matthews *et al.* (2001).

Overall policy responsibility for the supervision and protection of eel fisheries in Northern Ireland, and for the establishment and development of those fisheries rests with the Department of Culture, Arts and Leisure (DCAL). The Agri-Food and Biosciences Institute for N Ireland (AFBI) are employed by DCAL to provide the scientific basis for eel management in Northern Ireland.

3 Time-series data

3.1 Recruitment

3.1.1 Glass eel recruitment

3.1.1.1 Commercial

England & Wales

The glass eel fisheries of England and Wales are prosecuted by hand-held dipnets, in estuaries draining into the Bristol Channel, in particular from the Rivers Severn, Wye and Parrett, with smaller fisheries elsewhere, such as that in Morecambe Bay, Cumbria.

Those authorised to fish for glass eel in England and Wales are obliged to report their annual catch by weight, effort in terms of days and gears fished, location and water type (coastal, river, still water). Catches reported to the Environment Agency have historically been aggregated and reported to the WG as the catch for England and Wales. In addition to these catch returns, annual trade statistics from Her Majesty's Revenue & Customs (HMRC) provided an alternative indication of catches, for the period 1979–2006. Trade reports did not discriminate by eel size or stage, and therefore a procedure was developed to estimate glass eel trade into and out of the UK, and hence nett export trade; see the 2010/11 UK Country report for further details. Comparison between the catch reported to the EA and the nett exports HMRC data for 1979–2006 suggested a significant but variable level of under-reporting to the Agency, by between five and 15 times.

In 2009, legislation was introduced to improve the traceability of eel caught, such that there are now three sources of data:

1) Catch returns to the Agency;
2) The quantity of glass eel bought by the dealers from the fishermen (consignment notes);
3) The quantity of glass eel exported from the UK or stocked within the UK.

Updating the provisional data reported to WGEEL in the UK Country Report 2012/2013 (2013: Table 2), the final catch reported to the Environment Agency for 2013 was 5.91 t of glass eel. The quantity of glass eel bought by the dealers was 8.66 t, and 7.79 t was exported or used internally (within UK), representing a loss (mortality or weight loss) between capture and sale by dealer of 10.0% by weight.

For 2014, the provisional data (as of 24th September) are catch reported to the Environment Agency of 10.97 t, the quantity bought by the dealers was 12.66 t, and 12.39 t was exported or used internally (within UK), representing a loss (mortality and shrinkage) of 2.10% by weight.

Table 2 also presents data for catch per unit of effort (cpue) based on catch (kg) and effort (days fished) returns to the Environment Agency (see Table 33 for regional data). Though underreporting of catch and effort are recognised, the consistency in the data collection over the time period (2005–2014) allows an evaluation of the trend in stock <u>over this time period</u>. Over the last five years, there has been an increase in glass eel recruitment from the low of 2008 and 2009, and the increase in reported catch of 186% compared to 2013, is thought to reflect a true increase in the availability of glass eel to the fishery. However, the catch of UK glass eel remains at the very low levels observed (reported) since the late 1990s (Table 2).

Table 2. Time-series of 'UK' glass eel commercial fishery catch, s reported to Environment Agency and predecessor Agencies, and as estimated from HMRC nett export trade reports to 2006 and then consignment notes at first sale reported to the Environment from 2009 onwards. 'n/a' = no data available. * Note that the 2014 reported catch is provisional, as of 24 September 2014.

Year	Catch reports to Agency (t)	HMRC nett trade (to 2006) or Consignment Notes (t)	Dealers purchase (t) 2009 onwards	CPUE (kg/day) Agency returns 2005 onwards
1972	16.7	n/a		
1973	28.2	n/a		
1974	57.5	n/a		
1975	10.5	n/a		
1976	13.1	n/a		
1977	38.6	n/a		
1978	61.2	n/a		
1979	67	40.1		
1980	40.1	32.8		
1981	36.9	n/a		
1982	48	30.4		
1983	16.9	6.2		
1984	25	29		
1985	20	18.6		
1986	19	15.5		
1987	21.3	17.7		
1988	21.4	23.1		
1989	20.6	13.5		
1990	20.9	16		
1991	1.1	7.8		
1992	5	17.7		
1993	5.73	20.9		

Year	Catch reports to Agency (t)	HMRC nett trade (to 2006) or Consignment Notes (t)	Dealers purchase (t) 2009 onwards	CPUE (kg/day) Agency returns 2005 onwards
1994	9.5	22.3		
1995	11.9	n/a		
1996	18.8	23.9		
1997	8.7	16.2		
1998	11.2	20.1		
1999	n/a	18		
2000	n/a	7.6		
2001	0.809	5.4		
2002	0.521	5.1		
2003	1.715	10		
2004	0.97	14.4		
2005	1.701	8.8		0.26
2006	1.274	8.2		0.12
2007	2.07	n/a		0.29
2008	0.816	n/a		0.13
2009	0.29	0.45	0.45	0.06
2010	1.24	1.72	1.89	0.37
2011	2.24	3.28	3.64	0.31
2012	2.77	3.61	3.82	0.29
2013	5.91	7.79	8.66	0.65
2014*	10.97	12.39	12.66	0.61

Regional indices for England and Wales

Catches are now reported per "nearest water body" and, as such, new time-series are being developed reporting catches to basin or more likely River Basin District (Table 3).

Table 3. Commercial catches (kg) of glass eel from England and Wales RBDs reported to the EA, 2005 to 2014. Note that the 2013 catches are updated from the provisional data reported in the 2013 report, the *2014 catches are provisional (as of 24th September 2014), and that no glass eel fisheries operate in the other RBDs, i.e. Northumbria, Humber, Anglian, Thames and Solway-Tweed.

YEAR	NORTH WEST	DEE	WEST WALES	SEVERN	SOUTH WEST	SOUTH EAST
2005	166.2	39.0	87	784.8	626.5	0
2006	116.1	5.5	37	631.3	482.7	1.5
2007	200.0	6.3	26	1172.5	669.0	0
2008	91.6	2.0	3.8	370.7	348.6	0
2009	19.6	0.5	0	76.8	194.5	0
2010	30.3	4.8	1.1	531.7	756.5	0
2011	75.8	12.9	2.5	897.5	1249.8	0
2012	35.8	16.9	0.0	1151.5	1568.7	0
2013	81.0	14.8	23.3	2693.0	3095.0	0
2014*	138.0	0.0	8.0	5541.0	5281.0	0

Scotland and Northern Ireland

There are no commercial glass eel fisheries in Northern Ireland or Scotland.

3.1.1.2 Recreational

There are no recreational fisheries for glass eel in the UK.

3.1.1.3 Fishery independent

Fisheries-independent data are available for two sites: Leighton Moss (GB_NorW) and Brownshill (GB_Angl), Figure 2 and Table 4.

Trend in the number of glass eel counted at Leighton Moss (Lat/lng: 54.16814,-2.80107) between 1997 and 2013 (Figure A).

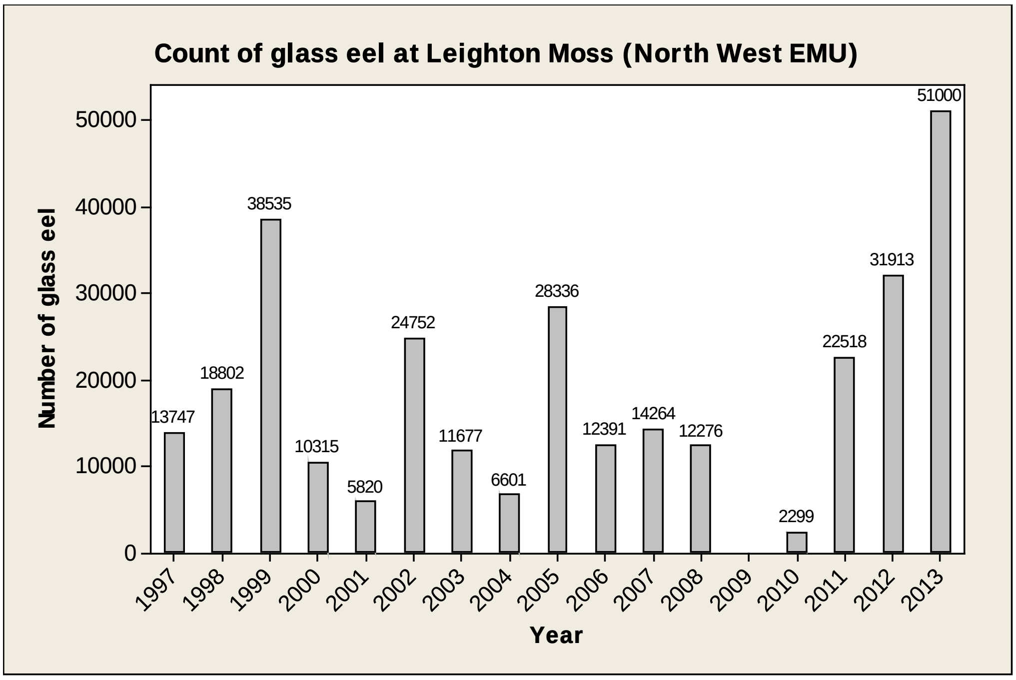

Figure 2. Trend in the number of glass eel counted at Leighton Moss between 1997 and 2013, there was no count in 2009.

The number of glass eel counted at Brownshill on the River Great Ouse (Anglian EMU) (lat/lng: 52.335444, 0.008360) between 2011 and 2014 (Table 4). In 2012 the trap was not operational for a long period due to summer flooding; the catching chamber was completely flooded out.

Table 4. The number of glass eel counted at Brownshill on the River Great Ouse (Anglian EMU) between 2011 and 2014 (as of October 1st 2014). *2012 represents a partial count.

Year	Glass / Pigmented <80 mm
2011	5175
2012*	24
2013	36 908
2014	631

For two sites in the Thames EMU (GB_THAM) the trend in the number the number of glass eel are shown in Figure 3.

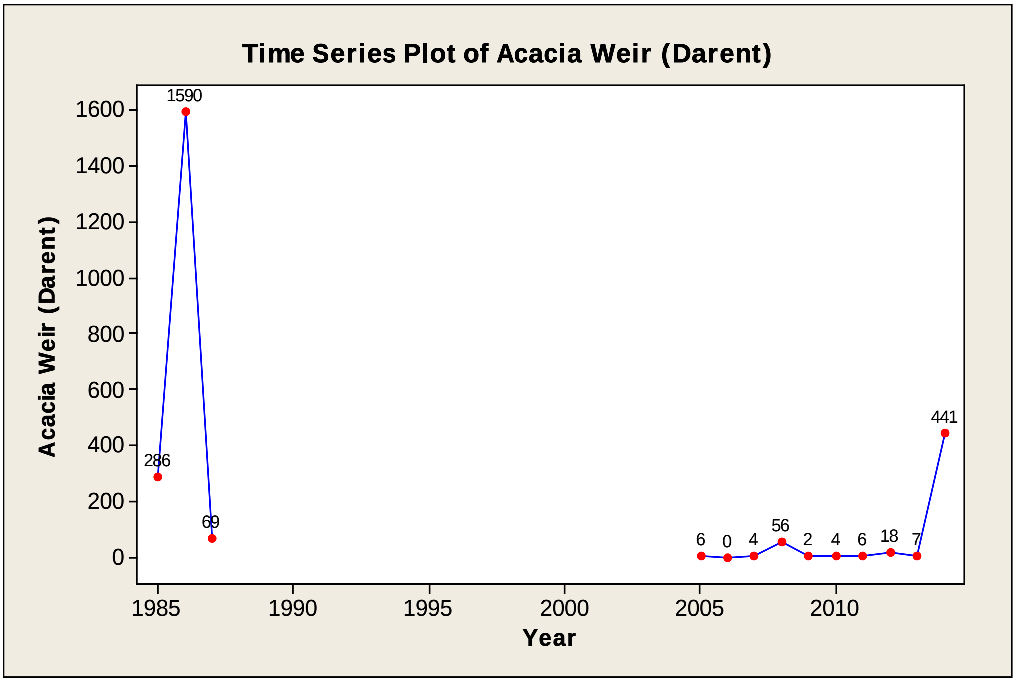

Figure 3 Time-series of glass eel counts on the River Darent (GB_Thames).

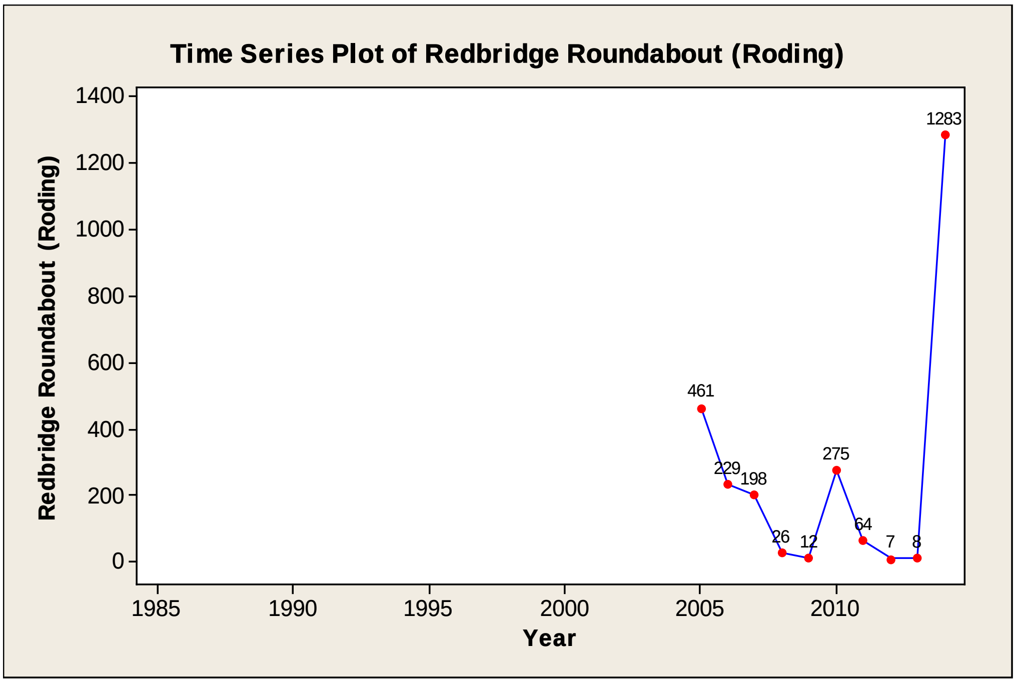

Figure 4. Time-series of glass eel counts on the Roding (GB_Thames).

Scotland

A time-series for glass eels ascending the Shieldaig River in Wester Ross, using pinhole traps fishing from March to July inclusive was instituted in 2014. Table 5.

Table 5. Number of ascending elvers at the mouth of the Shieldaig River.

YEAR	UNPIGMENTED EELS <80 MM	
	Number	Mean length (mm)
2014	176	70

Northern Ireland

The LNFCS catch glass eels using dragnets with an area of 0.94 m^2, fished below a river-spanning sluice gate, which creates a barrier to upstream juvenile eel migration on the River Bann. A record of total catch per night is recorded, but not catch per individual net. These, and elvers trapped at the same location, are transported upstream to be stocked into the Lough. These catches provide a time-series of 'natural' recruitment into the Lough (Table 6). Recruitment had shown an overall downward trend to only 16 kg (approximately 48 000 glass eel) in 2011, which was the lowest catch on record. The catch has increased over the following three years and recorded as to 189.3 kg, 384 kg and 477 kg respectively by 2014. It should be noted that elvers were captured in September whilst migrating silver eels were also found in the Bann.

Table 6. Glass eel recruitment to the River Bann, Northern Ireland, 1960 to 2014.

YEAR	NATURAL ELVER RUN (KG)	YEAR	NATURAL ELVER RUN (KG)	YEAR	NATURAL ELVER RUN (KG)
1960	7408.55	1978	5034.4	1996	2667.93
1961	4938.69	1979	2088.8	1997	2532.6
1962	6740.46	1980	2485.93	1998	1283.33
1963	9076.7	1981	3022.6	1999	1344.93
1964	3136.92	1982	3853.73	2000	562.8
1965	3801	1983	242	2001	315
1966	6183	1984	1533.93	2002	1091.53
1967	1898.77	1985	556.73	2003	1155.93
1968	2524.9	1986	1848.47	2004	334.6
1969	4008.3	1987	1682.8	2005	930
1970	3991.63	1988	2647.4	2006	456
1971	4157.07	1989	1567.53	2007	444
1972	2905.27	1990	2293.2	2008	24
1973	2524.2	1991	676.67	2009	158
1974	5859.47	1992	977.67	2010	68
1975	4637.27	1993	1524.6	2011	16
1976	2919.93	1994	1249.27	2012	189.3
1977	6442.8	1995	1402.8	2013	384
				2014	677

The elver run to the River Erne is monitored by capture at a box at the foot of the dam of Cathaleens Fall hydropower station (at tidal head) and transported to upper and lower Lough Erne. This RBD is transboundary between Northern Ireland and the Republic of Ireland. The glass eel fishery operates in the Republic of Ireland, but upstream transport of that catch is distributed to both countries. The elver run to the Erne was

73.0 kg in 2011, 132.1 kg in 2012, 219.7 kg in 2013 and 659.4 in 2014. The full time-series index of glass eel recruitment to this basin is reported in the Republic of Ireland Country Report.

3.1.2 Yellow eel recruitment

3.1.2.1 Commercial

There are no commercial fisheries for larger 'yellow' eel recruits, and therefore no time-series data.

3.1.2.2 Recreational

There are no recreational fisheries for larger 'yellow' eel recruits, and therefore no time-series data.

3.1.2.3 Fishery independent

The number of yellow eels counted at Brownshill on the River Great Ouse (Anglian EMU) (lat/lng: 52.335444, 0.008360) between 2011 and 2014 (Table 7). In 2012 the trap was not operational for a long period due to summer flooding; the catching chamber was completely flooded out.

Table 7. The number of yellow eels counted at Brownshill on the River Great Ouse (Anglian EMU) between 2011 and 2014 (as of October 1st 2014). *2012 represents a partial count.

Year	Elver 81-120 mm	Yellow Eel >121 mm
2011	21 331	23 690
2012*	560	54
2013	139 531	734
2014	23 635	216

The numbers of yellow eel migrating upstream past Greylake on the River Parrett (GB_SouW), 11.7 km upstream from tidal influence are recorded annually (Figure 5).

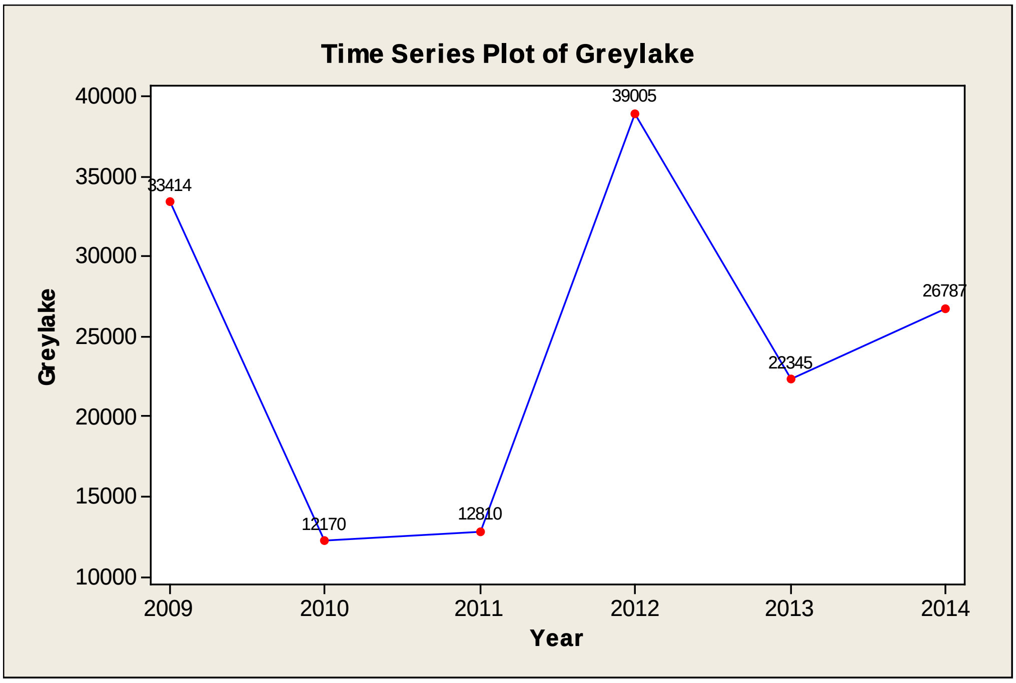

Figure 5. Time-series of yellow eel counts on the River Parrett at Greylake (GB_SouW).

Scotland

A short time-series is available of yellow eel recruitment from the mainstem River Dee into a single small catchment in northeast Scotland, the Girnock Burn. An upstream trap approximately 50 km from the sea catches upstream migrating yellow eels (length range 96–254 mm) and these are manually counted. There is uncertainty about how representative these counts are of the total upstream migration, because although there is a substantial barrier to migration at the site, eels can find alternative routes upstream. The annual counts of upstream migrants, and mean length, are presented in Table 8.

Table 8. Yellow eel recruitment to the Girnock Burn, a tributary of the River Dee, northeast Scotland, from 2008 to 2012.

Year	Count	Mean length (mm)
2008	572	156
2009	370	155
2010	89	156
2011	48	158
2012	273	158
2013	181	154
2014	276	159

Northern Ireland

There are no fishery-independent yellow eel recruitment data.

3.2 Yellow eel landings

3.2.1 Commercial

The yellow and silver eel catches reported to the Environment Agency have historically been reported to the WG as a single catch for England and Wales. Since 2005, catches have been recorded according to the "nearest water body" and reported separately for yellow and silver eels (Tables 9 a and b).

Table 9a. Commercial catch (t) of yellow eel for Northumbria, Humber Anglian, Thames, Southeast and Southwest RBDs between 2005–2013.

YEAR	NORTHUMBRIA	HUMBER	ANGLIAN	THAMES	SE	SW
2005	0.005	1.295	13.065	7.175	0.406	3.787
2006	0.001	1.160	6.282	5.688	3.069	6.788
2007	0.000	2.138	3.739	6.963	1.807	2.019
2008	0.000	1.429	9.903	5.548	0.602	6.626
2009	0.045	0.411	6.616	4.745	7.029	2.546
2010	0.060	3.033	10.708	5.655	1.432	2.722
2011	0.000	4.857	16.478	6.082	1.879	3.792
2012	0.000	3.267	15.335	1.815	2.116	5.966
2013	0.000	3.865	9.351	3.991	0.286	8.688

Table 9b. Commercial catch (t) of yellow eel for Severn, West Wales Dee Northwest and Solway RBDs, together with the total for England and Wales, between 2005–2013.

YEAR	SEVERN	WEST WALES	DEE	NORTHWEST	SOLWAY TWEED	TOTAL
2005	0.565	0.240	0.034	1.619	0.000	28.191
2006	0.170	0.475	0.028	1.250	0.000	24.911
2007	0.068	0.273	0.023	0.211	0.000	17.240
2008	0.027	0.118	0.642	0.474	0.000	25.369
2009	0.000	0.022	0.070	0.114	0.000	21.598
2010	0.150	0.345	0.053	0.150	0.000	24.309
2011	0.350	0.252	1.082	1.477	0.000	36.248
2012	0.000	0.647	0.478	2.972	0.000	32.596
2013	0.000	0.100	0.152	0.669	0.000	27.102

Scotland

There are no commercial fisheries for yellow eel in Scotland.

Northern Ireland

The supplementary stocking of glass eel and the operation of a market driven quota system for yellow eel fishing in Lough Neagh means that the yellow eel catch data are not suitable as an index time-series of yellow eel production. However, the catch data are useful for scientific understanding of eel production processes.

3.2.2 Recreational

There is no recreational time-series and no recreational fisheries targeting eel in the UK. Recreational taking of eels is prohibited without a licence in Scotland, and no licences have been issued. A Bye law to the Northern Ireland Fisheries Act 2010 prohibits the recreational taking of eels.

3.3 Silver eel landings

3.3.1 Commercial

The silver eel catches reported to the Environment Agency have historically been reported to the WG as a single catch for England and Wales. Since 2005, catches have been recorded according to the "nearest water body" (Tables 10 a and b).

Table 10a. Commercial catch (t) of silver eel for Northumbria, Humber Anglian, Thames, Southeast and Southwest RBDs between 2005–2013.

YEAR	NORTHUMBRIA	HUMBER	ANGLIAN	THAMES	SE	SW
2005	0.00	0.24	6.66	1.07	3.59	1.89
2006	0.00	0.32	2.42	0.97	4.10	1.90
2007	0.00	2.19	0.20	0.48	2.62	0.23
2008	0.09	0.86	1.97	0.40	1.65	0.55
2009	0.01	0.11	0.59	0.12	3.20	0.30
2010	0.00	0.20	0.74	0.07	0.82	0.17
2011	0.00	0.26	2.01	0.51	0.69	0.07
2012	0.00	1.63	2.98	0.20	0.65	0.53
2013	0.00	0.26	2.49	0.31	1.99	0.95

Table 10b. Commercial catch (t) of silver eel for Severn, West Wales Dee Northwest and Solway RBDs, together with the total for England and Wales, between 2005–2013.

YEAR	SEVERN	WEST WALES	DEE	NORTHWEST	SOLWAY TWEED	TOTAL
2005	0.40	0.01	0.01	0.20	0.00	14.07
2006	0.15	0.03	0.01	1.10	0.00	11.00
2007	0.12	0.14	0.01	0.09	0.00	6.08
2008	0.12	0.01	0.02	0.26	0.00	5.94
2009	1.22	0.04	0.01	0.08	0.00	5.69
2010	0.10	0.01	0.02	0.07	0.00	2.20
2011	0.38	0.01	0.12	0.27	0.00	4.32
2012	0.00	0.00	0.00	0.46	0.00	6.45
2013	0.00	0.00	0.03	0.11	0.00	6.13

Scotland

There are no commercial fisheries for silver eel in Scotland.

Northern Ireland

The supplementary stocking of glass eel in Lough Neagh means that the silver eel catch data are not suitable as an index time-series of unassisted silver eel production, for present purposes. However, the catch data are useful for scientific understanding of eel production processes.

On the Erne system in the North Western International RBD, the trap and truck conservation fishery caught approximately 19 t in 2010, 25.3 t in 2011, 29.6 t in 2012 and 39.3 t in 2013.

3.3.2 Recreational

There is no recreational time-series and no recreational fisheries targeting silver eels. Recreational taking of eels is prohibited without a licence in Scotland, and no licences have been issued. A Bye law to the Northern Ireland Fisheries Act 2010 prohibits the recreational taking of eels.

3.4 Aquaculture production

3.4.1 Seed supply

There is no eel aquaculture in the UK.

3.4.2 Production

There is no eel aquaculture in the UK.

3.5 Stocking

3.5.1 Amount stocked

There is limited stocking undertaken in England and Wales all of which is using glass eel (Table 11) obtained from either Severn or Southwest EMU.

Table 11. Quantity of glass eel (kg) stocked between 2009–2014 in EMUs of England and Wales (data source: Section 30 consents).

Year	Humber	Anglian	Thames	SE	SouthWest	Severn	WW	NW	Total
2009	18.5	4.6							**23.1**
2010	38.0	15.2				0.4			**53.6**
2011		11.3	0.0			38.8			**50.1**
2012	10.0	1.5	3.2		5	21.5			**41.2**
2013	3.0	9.8	2.00		12.9	37.0	1.0		**65.7**
2014	3.8		14.0	7.5	8.7	21.5		0.03	**55.6**

Scotland

There has been no recorded stocking of eel in Scotland.

Northern Ireland

Recruitment of glass eel and elver to Lough Neagh has been supplemented by stocking of purchased glass eel since 1984 (Table 12), and these eel have been sourced from the UK glass eel fishery. However, in 2010 the 996 kg of glass eel purchased from UK Glass Eel Ltd originated from fisheries in San Sebastian, Spain and the west coast of France:

no glass eels from UK waters were purchased. In 2011 and 2012, glass eel from UK and French sources were stocked into Lough Neagh though all were purchased from UK Glass Eels Ltd. In 2013 and 2014 1866 kg and 2680 kg respectively of entirely UK sourced glass eels were stocked into L. Neagh.

Glass eel are not routinely quarantined before stocking into Lough Neagh, but arrive from UK Glass Eels Ltd with a Veterinary Health certificate. However, following the recent purchases from outside the UK, 1 kg of each new delivery is held in tanks and survival rates monitored for several weeks.

For the first time ever the River Lagan in the NERBD was stocked with 20 kg of glass eel purchased by the LNFCS from UK Glass Eels Ltd.

2014 was also the first time that glass eel going into Lough Neagh (and the River Lagan) were marked using Strontium Chloride.

Table 12. Weight (kg) of glass eel stocked into Lough Neagh, 1984 to 2014.

Year	glass eel (kg)	Year	glass eel (kg)
1984	1334.67	1999	1200
1985	3638.51	2000	150.33
1986	5935.16	2001	0
1987	4584.07	2002	1007
1988	2107	2003	1368.03
1989	0	2004	427.09
1990	0	2005	718.67
1991	0	2006	330
1992	785.87	2007	1000
1993	0	2008	428
1994	771.87	2009	215
1995	686	2010	996
1996	33.19	2011	1035
1997	70.47	2012	1300
1998	17.27	2013	1866
		2014	2680

2.5.2 Catch of eel <12 cm and proportion retained for restocking

There are no long-term time-series of data on restocking. The catch is that reported in Section 3.1.1.1 (Table 2), but there are historic issues of under-reporting the catch which mean that it is not appropriate to derive a proportion stocked from this historical catch data. New measures to accurately record catch and proportion retained for stocking have been implemented as part of the EMPs.

In 2014, 12.66 t of UK caught glass eel were bought by dealers, 62.9% were subsequently used in stocking, 28.2% for aquaculture and 6.7% for direct consumption (the fate of 500 kg sent to Spain is "unknown" but it is assumed the fish were used for consumption, rather than restocking / aquaculture) (Table 13).

Table 13. Percentage of glass eel caught in the UK and used for stocking, aquaculture or direct consumption. [Note these percentages may not add up to 100% because of mortality and weight loss after capture].

	2009	2010	2011	2012	2013	2014
Stocking	100	53.8	43.9	84.7	72.6	62.9
Aquaculture	0	36.5	45.3	10.5	27.4	28.2
Direct Consumption	0	0	0	0	0	6.7

The destinations and tonnages of glass eel caught in the UK are shown in Table 14.

Table 14. The destination and tonnages of glass eel caught in the UK.

	2009	2010	2011	2012	2013	2014
Belgium					4	
Czech Republic			30	76	470	594
Denmark		200	515	400		400
Estonia			307	90	480	420
France						863
Germany		97	882	384	470	1199
Greece			411		1005	650
Latvia			100	343	15	483
Lithuania					180	330
Netherlands		1288	593	100	1620	2232
Poland				120	95	15
Slovakia		85	80			
Spain						500
Sweden	205			1200	1300	1400
U.K.	240	54	366	921	2151	3300

3.5.3 Reconstructed time-series on stocking

England and Wales

There is limited stocking undertaken in England and Wales all of which is using wild glass eel (Table 15) obtained from either Severn or Southwest EMU.

Table 15. The quantity of glass eel stocked (kg) between 2009–2014.

Year	Humber	Anglian	Thames	SE	South West	Severn	WW	NW	Total
2009	18.5	4.6							**23.1**
2010	38.0	15.2				0.4			**53.6**
2011		11.3	0.0			38.8			**50.1**
2012	10.0	1.5	3.2		5	21.5			**41.2**
2013	3.0	9.8	2.00		12.9	37.0	1.0		**65.7**
2014	3.8		14.0	7.5	8.7	21.5		0.03	**55.6**

Scotland

There is no stocking taking place in Scotland.

Northern Ireland

Table 16. Reconstructed time-series of eel stocking (kg) in Northern Ireland.

	Local Source				Foreign Source			
Year	Glass Eel	Quarantined Glass Eel	Wild Bootlace	On-grown cultured	Glass Eel	Quarantined Glass Eel	Wild Bootlace	On-grown cultured
1984	1334.67				0			
1985	3638.51				0			
1986	5935.16				0			
1987	4584.07				0			
1988	2107				0			
1989	0				0			
1990	0				0			
1991	0				0			
1992	785.87				0			
1993	0				0			
1994	771.87				0			
1995	686				0			
1996	33.19				0			
1997	70.47				0			
1998	17.27				0			
1999	1200				0			
2000	150.33				0			
2001	0				0			
2002	1007				0			
2003	1368.03				0			
2004	427.09				0			
2005	718.67				0			
2006	330				0			
2007	1000				0			

	Local Source				Foreign Source			
Year	Glass Eel	Quarantined Glass Eel	Wild Bootlace	On-grown cultured	Glass Eel	Quarantined Glass Eel	Wild Bootlace	On-grown cultured
2008	428				0			
2009	215				0			
2010	0				996			
2011	321				714			
2012	900				400			
2013	1866				0			
2014	2700				0			

3.6 Trade in eel

In the UK glass eel are obtained from five EMUs (Southwest, Severn, West Wales, Dee and Northwest) these are treated as one group for the purpose of exports / destinations (Table 17).

Table 17. The quantities (kg) and destinations of glass eel caught in the UK between 2009–2014.

	2009	2010	2011	2012	2013	2014
Belgium					4	
Czech Republic			30	76	470	594
Denmark		200	515	400		400
Estonia			307	90	480	420
France						863
Germany		97	882	384	470	1199
Greece			411		1005	650
Latvia			100	343	15	483
Lithuania					180	330
Netherlands		1288	593	100	1620	2232
Poland				120	95	15
Slovakia		85	80			
Spain						500
Sweden	205			1200	1300	1400
UK	240	54	366	921	2151	3300

Scotland

There are no commercial glass eel fisheries in Scotland.

Northern Ireland

There are no commercial glass eel fisheries in N. Ireland.

Yellow eel

There are no commercial yellow eel fisheries in the northeast or northwestern International RBDs.

The Neagh/Bann RBD contains a yellow eel fishery, bulk of the catch destined for the Netherlands, and small amount to UK (London) (Table 18).

Market Value: to maintain our scientific independence and impartiality we are prohibited from enquiring about commercial values of catches.

Table 18. Catches of yellow eel in the Lough Neagh fishery, Northern Ireland, from 1965 to 2013 (catches rounded to nearest 1000 kg, 2005 onwards). Note that a daily quota system operates per boat in this fishery.

Year	Yellow eel catch (kg)	Year	Yellow eel catch (kg)
1965	236759.1	1989	643395.5
1966	284772.7	1990	613231.8
1967	327281.8	1991	578868.2
1968	382327.3	1992	533240.9
1969	368677.3	1993	535150
1970	516504.5	1994	597418.2
1971	610909.1	1995	659050
1972	509090.9	1996	594045.5
1973	562481.8	1997	554750
1974	587904.5	1998	531968.2
1975	576354.5	1999	556213.6
1976	481886.4	2000	486595.5
1977	455350	2001	451309.1
1978	544695.5	2002	432313.6
1979	702609.1	2003	413763.6
1980	668945.5	2004	363522.7
1981	681545.5	2005	317800
1982	705759.1	2006	242000
1983	662709.1	2007	351000
1984	807672.7	2008	290000
1985	616668.2	2009	345000
1986	522359.1	2010	337000
1987	503777.3	2011	342000
1988	503236.4	2012	302000
		2013	321000

Silver eel

There are no commercial silver eel fisheries in the northeast or northwestern International RBDs.

Neagh/Bann RBD contains a silver eel fisheries, bulk of the catch destined for the Netherlands, and small amount to UK (London) (Table 19).

Table 19. Catches of silver eel in the River Bann flowing from Lough Neagh, Northern Ireland, from 1965 to 2013 (catches rounded to nearest 1000 kg, 2005 onwards).

Year	silver eel catch (kg)	Year	silver eel catch (kg)
1965	329563.6	1989	152436.4
1966	332800	1990	123600
1967	242727.3	1991	121381.8
1968	204618.2	1992	148036.4
1969	238327.3	1993	90327.27
1970	237345.5	1994	95200
1971	233309.1	1995	138581.8
1972	124945.5	1996	112290.9
1973	162400	1997	109418.2
1974	178872.7	1998	104545.5
1975	187527.3	1999	113054.5
1976	144872.7	2000	101963.6
1977	236690.9	2001	84000
1978	280727.3	2002	95963.64
1979	341163.6	2003	114327.3
1980	245272.7	2004	99636.36
1981	228690.9	2005	117000
1982	209890.9	2006	104000
1983	203636.4	2007	76000
1984	165890.9	2008	78000
1985	135054.5	2009	88000
1986	129854.5	2010	97000
1987	121345.5	2011	73000
1988	150981.8	2012	74000
		2013	72000

4 Fishing capacity

4.1 Glass eel

England & Wales

As glass eel fishing in England and Wales is by hand-held dipnets, the potential fishing capacity is recorded as the number of licences/authorisations sold by the EA each year (Table 20). The glass eel fishery is restricted to two zones: in parts of South Wales and southwest England, and in parts of northwest England.

Table 20. Numbers of dip-net fishing licences sold or authorised by the Environment Agency or predecessors for commercial fishing for glass eel in England and Wales, 1980 to 2014.

Year	Agency dipnet Licences	Year	Agency dipnet Licences/Authorisations
1980	1367	1998	2480
1981	1303	1999	2207
1982	1288	2000	2100
1983	1537	2001	838
1984	1192	2002	899
1985	1026	2003	922
1986	917	2004	957
1987	1162	2005	812
1988	918	2006	719
1989	1087	2007	705
1990	1169	2008	656
1991	960	2009	484
1992	969	2010	369
1993	1000	2011	446
1994	1058	2012	489
1995	1530	2013	482
1996	1682	2014	485
1997	2450		

Scotland

There are no fisheries for glass eel in Scotland.

Northern Ireland

The capture of glass eel and elvers is prohibited in Northern Ireland, except under licence from the Department of Culture, Arts and Leisure (DCAL) to help with upstream migration past in-river obstacles on the River Bann.

4.2 Yellow eel

England & Wales

Since 2010, authorisations for yellow and silver eel fisheries have been limited to those individuals who were already licensed, and these individuals are limited to the number of nets that they can apply for based on previous effort. Applications from newcomers are considered, but only for scientific studies, stock monitoring or for personal consumption. Thus, commercial fishing is effectively capped to existing fisherman who can use up to a maximum number of nets.

No distinction is made between fishing for yellow or silver eels in the authorisations and most gears, with the exception of fixed traps on weirs, can be used to catch either stage. Therefore, fishing capacity in England and Wales is reported as licences/authorisations sold for commercial fishing for yellow and silver eels combined (Table 21).

Table 21. Numbers of yellow/silver eel fishing licences/authorisations sold by the Environment Agency, 1983 to 2014. Note that licences/authorisations are for gears and not per person but the number of licensees are available for 2009 onwards. *The 2014 data are provisional (as of October 1st 2014).

Year	Agency Licence sales	Number of Licensees	Year	Agency Licence/authorisation sales	Number of Licensees
1983	1523		1999	1670	
1984	2085		2000	n/a	
1985	2624		2001	1991	
1986	1994		2002	1992	
1987	2168		2003	1831	
1988	2443		2004	1600	
1989	2041		2005	2369	
1990	1589		2006	2679	
1991	1704		2007	2818	
1992	1724		2008	2799	202
1993	1859		2009	3120	215
1994	2647		2010	2970	167
1995	2648		2011	2777	130
1996	2752		2012	2939	124
1997	2602		2013	2599	95
1998	1825		2014*	2534	85

Scotland

In Scotland, historic commercial fisheries for yellow eels were largely based in low-lying productive lochs, the eels being sold mainly to local smokehouses. There is no tradition of eel consumption in Scotland. During the 1960s–1970s, eel catches in Scotland were estimated at around 10–40 t per annum. In 1989, 17 eel fisheries were operating, with catches ranging from 0.25 to 10.76 t (total: 23 t) (I. McLaren, Marine Scotland (Science), unpublished data). Correspondence with proprietors of eel fisheries in 2003 indicated a catch of less than 2–3 t per annum, chiefly yellow eels. The last known fishery closed in 2005. Since January 2009, a licence has been required to conduct any form of eel fishing. No applications for licences have been received to date (September 2014).

Northern Ireland

In Northern Ireland, longlines and draftnets are authorised fishing instruments for yellow eels (the 2007 UK Report: Appendix 1 provides a description of netting and trapping methods).The use of fykenets as a fishing engine for catching eels was banned in 2010 under the terms of all EMPs in Northern Ireland.

There are no eel fisheries in the northeast or northwestern International RBDs.

Neagh/Bann RBD

Lough Neagh/River Bann comprises a 400 km^2 lake-based system, which produces all of the commercial eel harvest in Northern Ireland.

Eel fishing on Lough Neagh is controlled by the LNFCS who licence the fishery to 180 fishermen, though in 2013 this number has ranged from 160 to 186 fishermen operating at different times during the fishing season. Around 1990, there were 200 boats (400 fishermen) fishing the Lough, but this number has steadily declined to the present day number of 80 to 90 boats as a result of an ageing fisher population, availability of alternative employment and falling market prices for eel. Boat size on L. Neagh is restricted to 8.6 m long and 2.7 m wide. Information on licence applications, number of boats, fishing activity, recruitment to the fishery and the catch of yellow and silver eels from L. Neagh is collected and maintained by the LNFCS with several aspects of these data spanning over 50 years. This information is made available to DCAL and AFBI for scientific analysis and the provision of management advice.

Thirty percent of the Lough Neagh yellow eel catch is derived from draftnets, the other 70% from longline fishing using a maximum of 1200 standard sized hooks baited with earthworms, fish fry or the larvae of the flour beetle (meal worm). The fishery is run on a market-driven quota-based system (usually 50 kg per boat per day) and a log is kept of each individual boat's daily (Monday–Friday) catch, though this normally just records "quota achieved". New technologies such as hydraulic draftnet haulers have been introduced over the last 20 years, thereby reducing the labour needed in the fishery or enabling fishermen to fish for longer if required. Recently fishermen have begun commenting on difficulties in "making quota" both in terms of time and effort.

4.3 Silver eel

England & Wales

See Section 4.2 for silver eel fishing capacity in England and Wales.

Scotland

Correspondence with proprietors of eel fisheries in 2003 indicated a catch of silver eel less than 100 kg, mostly from traps in mill races. Although there are few comprehensive records, data for one silver eel fishery show a 90% decline in catches between the early 1990s and 2002, although a yellow eel fishery was established in the upstream loch during the same period. The last known commercial silver eel fishery in Scotland ceased operation in late 2006. Since January 2009, a licence has been required to conduct any form of eel fishing. No licence applications for commercial fishing have been received to date (September 2014).

Northern Ireland

Northeast RBD

There are no silver eel fisheries in this RBD.

Northwestern International RBD

There are no silver eel fisheries in this RBD. The fisheries using large coghill nets at fixed weirs on Lower Lough Erne have been suspended since 2005, and closed since 2010 as part of the implementation of the EMP for this RBD.

Neagh/Bann RBD

Silver eel from Lough Neagh were caught in the River Bann using coghill nets fished on three weirs at two locations, but from 2012 the LNFCS reduced this to two weirs as an additional conservation measure. The number of coghill nets fished depends on weather and river flow conditions, and normally ranges from 2–4 nets per fishing night. The record of nightly catch is estimated at the time (though rarely accurate). True daily catch is only obtained if the catch is processed and sold the following day. Otherwise, catches are retained in tanks and sold as and when market conditions are more favourable. Therefore, a 'single' catch sale record may be a total for several nights fishing.

4.4 Marine fishery

England & Wales

In England and Wales, the Environment Agency authorisations extend to targeted eel fishing in the coastal waters of RBDs. There are some authorised fisheries operating off the Anglian and south coast of England, but these are not distinguished from inland fisheries in terms of fishing capacity (see Section 4.2). Eel are occasionally landed as a bycatch by marine registered vessels, but these vessels are not reported here as a fishing capacity.

Scotland

There are no marine fisheries for eel in Scotland.

Northern Ireland

There are no marine fisheries for eel in Northern Ireland.

5 Fishing effort

5.1 Glass eel

England and Wales

Since 2005, glass eel fishermen have been required to annually report the number of days fished as part of their catch return, and these data are being used to develop time-series of fishing effort (Table 22). Over the time period there has been no glass eel fishing in the following EMUs; Northumbria, Thames and Solway Tweed.

Table 22. Commercial glass eel fishing effort reported to the Environment Agency as days (nights) fished by EMU, for 2005 to 2014. * Note that the 2014 data are provisional (September 24th 2014).

Year	Humber	Anglian	South East	Southwest	Severn	West Wales	Dee	Northwest
2005		92		1876	4508	20		172
2006	36	60	15	6065	4574	35	29	193
2007		3		2440	4560	26	33	204
2008				2064	4060	18	10	194
2009			16	1344	3020	16	14	142
2010				1178	2271	22	14	82
2011				3141	3903	14	23	95
2012				4026	5390	9	32	108
2013				4301	4660	17	12	101
2014*				9371	8306	7	0	153

Scotland

There are no glass eel fisheries in Scotland.

Northern Ireland

There are no glass eel fisheries in Northern Ireland.

5.2 Yellow eel

Since 2005, yellow and silver eel fishers are now required to annually report the number of days fished as part of their catch return, and these data allow the development of a time-series of fishing effort, which is the number of codends multiplied by the number of nights fished and summed for the entire fishing season. Note that there is no separation of effort into that targeting yellow vs. silver eel.

Table 23. Total effort (number of codends*number of nights fished) deployed fishing for yellow and silver eel in England and Wales between 2009 and 2013, by RBD.

Year	Northumbria	Humber	Anglian	Thames	South East	South West	Severn	West Wales	Dee	North West	Solway Tweed	England & wales
2005	84	13078	56565	21998	4451	17379	2207	590	152	4989	0	121493
2006	29	10306	32721	28689	12140	25755	190	2770	134	5383	0	118117
2007	0	5826	24673	35745	20720	14475	1057	534	116	0	0	103146
2008	186	17898	54163	24811	13296	28999	185	186	5102	5909	0	150735
2009	168	16157	41561	13610	30277	11494	5330	2458	210	548	0	121813
2010	66	6991	52358	13940	7898	17728	366	331	144	533	0	100355
2011	0	19346	99418	18305	6783	17483	1980	557	5184	14604	0	183660
2012	0	17380	83572	10267	19315	27885	0	5703	4423	27574	0	196119
2013	0	24545	75430	21796	13381	48437	10	302	884	9305	0	194090

Scotland

There are no yellow eel fisheries in Scotland.

Northern Ireland

Fishing effort in Lough Neagh is only represented as capacity, which is reported in Section 4.2.

5.3 Silver eel

England & Wales

See Section 5.2.

Scotland

There are no silver eel fisheries in Scotland.

Northern Ireland

Silver eel fishing effort at the outflow of Lough Neagh is only represented as capacity, which is reported in Section 4.3.

5.4 Marine fishery

Not applicable; see Section 4.4.

6 Catches and landings

6.1 Glass eel

England & Wales

Across England and Wales, the glass eel catch is only reported by weight, so number or length–frequency data are not available. The annual catch reported to the Environment Agency is presented in Table 2.

Updating the provisional data reported to WGEEL in the UK Country Report 2012/2013 (2013: Table 2), the final catch reported to the Environment Agency for 2013 was 5.91 t of glass eel (Table 24). The quantity of glass eel bought by the dealers was 8.66 t, and 7.79 t was exported or used internally (within UK), representing a loss (mortality or weight loss) between capture and sale by dealer of 10.0% by weight.

For 2014, the provisional data (as of 24th September) are catch reported to the Environment Agency of 10.97 t, the quantity bought by the dealers was 12.66 t, and 12.39 t was exported or used internally (within UK), representing a loss (mortality and shrinkage) of 2.10% by weight.

The catch of glass eel by RBD is shown in Table 24 and that reported by dealers for 2013–2014 is shown in Table 25.

Table 24. Commercial catch (kg) of glass eel reported to the Environment Agency, for 2005 to 2014. * Note that the 2014 data are provisional (September 24th 2014) as the deadline for catch returns was mid-August.

Year	Humber	Anglian	Southeast	Southwest	Severn	West Wales	Dee	Northwest
2005	0.0	0.0	0.0	626.5	784.8	87.0	39.0	166.2
2006	0.0	0.0	1.5	482.7	631.3	37.0	5.5	116.1
2007	0.0	0.0	0.0	669.0	1172.5	26.0	6.3	200.0
2008	0.0	0.0	0.0	348.6	370.7	3.8	2.0	91.6
2009	0.0	0.0	0.0	194.5	76.8	0.0	0.5	19.6
2010	0.0	0.0	0.0	756.5	531.7	1.1	4.8	30.3
2011	0.0	0.0	0.0	1249.8	897.5	2.5	12.9	75.8
2012	0.0	0.0	0.0	1568.7	1151.5	0.0	16.9	35.8
2013	0.0	0.0	0.0	3095.0	2693.0	23.3	14.8	81.5
2014*	0.0	0.0	0.0	5281.0	5541.0	8.0	0.0	138.0

Table 25. The catch of glass eel (kg) by RBD (dealer returns).

Year	Northwest	Severn	Southwest	Total
2013	47	4559	4053	8659
2014		5594	12652	7058

Scotland

There are no commercial glass eel fisheries in Scotland.

Northern Ireland

There are no commercial glass eel fisheries in Northern Ireland.

6.2 Yellow eel

England & Wales

Across England and Wales, yellow eel catch is only reported by weight, so number or length–frequency data are not available.

Prior to 2005, catches were only reported as ‘yellow and/or silver eel’ and therefore it was not possible to separate catches by stage. Since 2005, licensees have been required to report separate catch returns for yellow and silver eels, and these data are available from 2007 (Table 26).

The reported yellow eel catch for 2012 was 27.1 t, a decrease of 17% compared to 2012, and 97% of the average annual catch 2008–2012 (28.03 t). The catch by RBD is shown in Table 28.

Table 26. Time-series of yellow and silver eel catches (t) for England and Wales reported to the Environment Agency or predecessor agencies, and derived from HMRC trade data. n/a = data not available.

	HMRC NETT EXPORT (T)	AGENCY RETURNS (T)		
Year	Yellow + Silver	Yellow + Silver	Yellow	Silver
1979	162			
1980	196			
1981	229			
1982	273			
1983	270			
1984	283			
1985	283			
1986	274			
1987	381	60.41		
1988	456	280.58		
1989	376	80.63		
1990	277	48.74		
1991	358	38.26		
1992	234	35.63		
1993	232	46.62		
1994	384	86.79		
1995	514	103.76		
1996	540	100.51		
1997	526	68.04		
1998	306	58.31		
1999	294	n/a		
2000	113	n/a		
2001	207	48.62		
2002	122	24.06		
2003	46	25.44		
2004	171	9.58		
2005	110	42.26	28.19	14.07
2006	62	35.91	24.91	11.00
2007	n/a	23.32	17.24	6.08
2008	n/a	31.31	25.37	5.94
2009	n/a	27.29	21.60	5.69
2010	n/a	26.50	24.31	2.20
2011	n/a	40.56	36.25	4.32
2012	n/a	39.05	32.60	6.45
2013	n/a	33.23	27.10	6.13

Scotland

There are no commercial yellow eel fisheries in Scotland.

Northern Ireland

There are no eel fisheries in the northeast or northwestern International RBDs.

Neagh/Bann RBD

Yellow eel catches in L. Neagh in 2013 amounted to 321 t, continuing the general downward trend since the late 1990s (Table 27), associated with reducing effort in the yellow eel fishery as a function of falling boat numbers (Section 4.2). This is a significant cause of the long-term decline in catches and a response to alternative work/low prices available for yellow eels, rather than declining stocks. Catches per boat per day in the longline and draftnet fisheries continue to meet daily quotas imposed by the Co-operative, implying that sufficient stocks are maintained for the reduced number of boats fishing in the Lough, but fishermen have commented that it takes longer to catch their quota (Section 4.2).

Table 27. Catches of yellow eel in the Lough Neagh fishery, Northern Ireland, from 1965 to 2013 (catches rounded to nearest 1000 kg, 2005 onwards). Note that a daily quota system operates per boat in this fishery.

Year	Yellow eel catch (kg)	Year	Yellow eel catch (kg)
1965	236759.1	1989	643395.5
1966	284772.7	1990	613231.8
1967	327281.8	1991	578868.2
1968	382327.3	1992	533240.9
1969	368677.3	1993	535150
1970	516504.5	1994	597418.2
1971	610909.1	1995	659050
1972	509090.9	1996	594045.5
1973	562481.8	1997	554750
1974	587904.5	1998	531968.2
1975	576354.5	1999	556213.6
1976	481886.4	2000	486595.5
1977	455350	2001	451309.1
1978	544695.5	2002	432313.6
1979	702609.1	2003	413763.6
1980	668945.5	2004	363522.7
1981	681545.5	2005	317800
1982	705759.1	2006	242000
1983	662709.1	2007	351000
1984	807672.7	2008	290000
1985	616668.2	2009	345000
1986	522359.1	2010	337000
1987	503777.3	2011	342000
1988	503236.4	2012	302000
		2013	321000

6.3 Silver eel

England & Wales

Across England and Wales, the silver eel catch is only reported by weight, so number or length–frequency data are not available.

Since 2005, licensees have been required to report separate catch returns for yellow and silver eels, and these data are available from 2007 (Table 28).

The reported silver eel catch for 2013 was 6.13 t, a decrease of 5% compared to 2012, but 125% of the average annual catch 2008–2012 (4.92 t). The catch by RBD is shown in Table 29.

Table 28. Declared catch (t) of yellow eel for England and Wales by RBD.

Year	Northumbria	Humber	Anglian	Thames	Southeast	Southwest	Severn	West Wales	Dee	Northwest	Solway Tweed	England & Wales
2005	0.005	1.295	13.065	7.175	0.406	3.787	0.565	0.240	0.034	1.619	0.000	28.191
2006	0.001	1.160	6.282	5.688	3.069	6.788	0.170	0.475	0.028	1.250	0.000	24.911
2007	0.000	2.138	3.739	6.963	1.807	2.019	0.068	0.273	0.023	0.211	0.000	17.240
2008	0.000	1.429	9.903	5.548	0.602	6.626	0.027	0.118	0.642	0.474	0.000	25.369
2009	0.045	0.411	6.616	4.745	7.029	2.546	0.000	0.022	0.070	0.114	0.000	21.598
2010	0.060	3.033	10.708	5.655	1.432	2.722	0.150	0.345	0.053	0.150	0.000	24.309
2011	0.000	4.857	16.478	6.082	1.879	3.792	0.350	0.252	1.082	1.477	0.000	36.248
2012	0.000	3.267	15.335	1.815	2.116	5.966	0.000	0.647	0.478	2.972	0.000	32.596
2013	0.000	3.865	9.351	3.991	0.286	8.688	0.000	0.100	0.152	0.669	0.000	27.102

Table 29. Declared catch (t) of silver eel for England and Wales by RBD.

Year	Northumbria	Humber	Anglian	Thames	Southeast	Southwest	Severn	West Wales	Dee	Northwest	Solway Tweed	England & Wales
2005	0.000	0.243	6.659	1.067	3.594	1.886	0.396	0.010	0.010	0.202	0.000	14.065
2006	0.000	0.323	2.417	0.971	4.104	1.896	0.146	0.031	0.006	1.103	0.000	10.996
2007	0.000	2.188	0.198	0.484	2.621	0.228	0.124	0.140	0.009	0.085	0.000	6.077
2008	0.090	0.865	1.974	0.404	1.650	0.552	0.117	0.010	0.015	0.263	0.000	5.941
2009	0.010	0.110	0.592	0.119	3.198	0.303	1.224	0.043	0.014	0.080	0.000	5.691
2010	0.000	0.199	0.739	0.067	0.823	0.172	0.100	0.009	0.015	0.072	0.000	2.195
2011	0.000	0.257	2.006	0.513	0.694	0.068	0.380	0.009	0.119	0.270	0.000	4.315
2012	0.000	1.627	2.980	0.200	0.650	0.533	0.000	0.000	0.000	0.462	0.000	6.452
2013	0.000	0.259	2.486	0.308	1.991	0.950	0.000	0.000	0.031	0.105	0.000	6.130

Scotland

There are no commercial silver eel fisheries in Scotland.

Northern Ireland

There are no commercial silver eel fisheries in the northeast or northwestern International RBDs.

Neagh/Bann RBD

Silver eel catches in L. Neagh in 2013 totalled 72 t, and is their lowest silver eel catch on record (Table 30).

Table 30. Catches of silver eel in the River Bann flowing from Lough Neagh, Northern Ireland, from 1965 to 2013 (catches rounded to nearest 1000 kg, 2005 onwards).

Year	silver eel catch (kg)	Year	silver eel catch (kg)
1965	329563.6	1989	152436.4
1966	332800	1990	123600
1967	242727.3	1991	121381.8
1968	204618.2	1992	148036.4
1969	238327.3	1993	90327.27
1970	237345.5	1994	95200
1971	233309.1	1995	138581.8
1972	124945.5	1996	112290.9
1973	162400	1997	109418.2
1974	178872.7	1998	104545.5
1975	187527.3	1999	113054.5
1976	144872.7	2000	101963.6
1977	236690.9	2001	84000
1978	280727.3	2002	95963.64
1979	341163.6	2003	114327.3
1980	245272.7	2004	99636.36
1981	228690.9	2005	117000
1982	209890.9	2006	104000
1983	203636.4	2007	76000
1984	165890.9	2008	78000
1985	135054.5	2009	88000
1986	129854.5	2010	97000
1987	121345.5	2011	73000
1988	150981.8	2012	74000
		2013	72000

6.4 Marine fishery

There are no marine fisheries targeting eel outside the EMUs in the UK.

6.5 Recreational fishery

In England and Wales any eel caught on rod and line (the only recreational fishing that catches eel) must be returned to the same water with as little damage as possible. There is no requirement for anglers to report catches and effort for rod caught eel. The mortality from catch and release has therefore been treated as part of natural mortality as any further management action to reduce catch and release mortality is not considered feasible.

Similar approaches are in place in Scotland and Northern Ireland.

6.6 Bycatch, underreporting, illegal activities

Table 31. Estimation of underreported catches in Country, per EMU and Stage.

		Glass eel				Yellow eel				Silver Eel				Combined (Y + S)			
Year	EMU_code	Reported catches (kg)	Underrept. %	Underrept. (kg)	Total catches (kg)	Reported catches (kg)	Underrept. %	Underrept. (kg)	Total catches (kg)	Reported catches (kg)	Underrept. %	Underrept. (kg)	Total catches (kg)	Reported catches (kg)	Underrept. %	Underrept. (kg)	Total catches (kg)
2013	GBNW*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GBNoE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	EMU_d																
	EMU_e																
	GBNea	344	0	0	344	321t	0	0	321t	72t	0	0	72t	393t	0	0	0
	GB_Sco	0	ND	ND	0	0	ND	ND	0	0	ND	ND	0	0	ND	ND	0
	Total/mean (%)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

AIM: Determine the % of the underreporting and the total catches of the Country per stage.

NOTE: Please indicate in the text whether the percentage underreported catch is a direct measurement or a guess using the estimate to calculate the underreported kilos and total catches.

Table 32. Existence of illegal activities, its causes and the seizures quantity they have caused.

		Glass eel			Yellow eel			Silver Eel			Combined (Y +S)		
Year	EMU	Y/N/?	Seizures (kg)	Cause	Y/N/?	Seizures (kg)	Cause	Y/N/?	Seizures (kg)	Cause	Y/N/?	Seizures (kg)	Cause
2013	GBNW*	N	0	-	N	0	-	N	0	-	N	0	-
	GBNoE	N	0	-	N	0	-	N	0	-	N	0	-
	GBNea	N	0	-	N	0	-	N	0	-	N	0	-
	EMU_d												
	EMU_e												
	GB_Sco	N	0	-	N	0	-	N	0	-	N	0	-

AIM: Identify the illegal fishing activities and in case it is possible its causes and the seized kgs in case they were seizures.

NOTES:

- Y/N/?:

- Y: you know for sure they have been illegal activities;
- N: illegal activities are considered negligible / not significant;
- ?: You do not know whether they have been illegal activities or not.

- Cause: One of the followings:

- Fishing out of the season;
- Fishing without licence;
- Fishing using illegal gears;
- Retention of eel below or above any size limit;
- Illegal selling of catches.

7 Catch per unit of effort

7.1 Glass eel

England & Wales

The overall (provisional) cpue for glass eel was 0.62 kg/day, which was 5% lower than in 2013 (0.65 kg/day) and 182% higher than the five year mean (2009–2013) of (0.34 kg/day). For the two main fishery areas, the SW and Severn RBD fishery the cpue for 2014 showed a decrease of 22% and an increase of 15% respectively. The data for 2014 are provisional because not all data were available at the time of writing. However, provisional cpue for 2014 suggests little change on 2013.

Over the time period since 2004 there has been no glass eel fishing in the following EMUs: Northumbria, Humber Anglian and Solway Tweed.

Table 33. Cpue (kg/day) for glass eel fisheries by RBD of England and Wales based on catch and effort returns to the Environment Agency. The 2014* data are provisional as of September 24th 2014.

Year	Southeast	Southwest	Severn	West Wales	Dee	Northwest	Overall
2005	0.0	0.334	0.174	4.350	0.0	0.966	0.256
2006	0.100	0.080	0.138	1.057	0.190	0.602	0.116
2007	0.0	0.274	0.257	1.000	0.191	0.980	0.285
2008	0.0	0.169	0.091	0.211	0.200	0.472	0.129
2009	0.0	0.145	0.025	0.000	0.036	0.138	0.064
2010	0.0	0.642	0.234	0.051	0.343	0.370	0.371
2011	0.0	0.398	0.230	0.179	0.561	0.798	0.312
2012	0.0	0.390	0.214	0.000	0.528	0.331	0.290
2013	0.0	0.720	0.578	1.368	1.234	0.807	0.650
2014*	0.0	0.564	0.667	1.143	0.000	0.902	0.615

Scotland

There are no glass eel fisheries in Scotland.

Northern Ireland

There is no commercial fishing for glass eel in Northern Ireland. No standardised cpue data are available for glass eel fishing on the River Bann, which is for local assisted migration purposes only.

7.2 Yellow eel

England & Wales

As it is not possible to differentiate between fishing effort targeting yellow vs silver eel in England and Wales, it is not possible to derive cpue separately for either stage. Therefore, the cpue for the combined yellow-silver eel fishery is reported in Table 28, both per RBD and for the fishery as a whole.

The cpue for the national yellow and silver eel fishery for 2013 was 0.171 which is similar to 2012 of 0.199 kg per trap per day, and comparable to the values from 2007 onwards, but only 52% of the cpue from 2005 and 2006 (0.326 kg per trap per day). This reduction suggests that the stock is currently lower when compared with the estimates in 2005 and 2006, but has remained steady over the last seven years (Table 29).

Scotland

There are no yellow eel fisheries in Scotland.

Northern Ireland

A market driven quota-based catch management system, combined with varying boat numbers on L. Neagh (on an almost daily basis) means it is impossible to calculate an accurate cpue for the yellow eel fishery. However a comparison of catch against average boat numbers produces a mean catch of 2830.1 kg $boat^{-1}$ in 2006–2008 and 3788.9 kg $boat^{-1}$ in 2009–2011, (increase of 33.9%). Analysis of the Lough Neagh data reveals no relationship between cpue and time-lagged input stock density. This is most likely because (i) two different gears are operated (nets and baited longlines) with very different catch vs effort limitations and with catch reported as a combined daily catch for both gear types, and (ii) there is a variable market related daily cap on the amount of eel that fishermen are allowed to catch.

However, for the first time since the 1960s two fykenet surveys were carried out on L. Neagh during the summer of 2013. Using 30 fykenets nightly over five nights, the cpue for eel caught ranged from 1.5–2.3 eel and were deemed essentially useless given the known catch of eels from L. Neagh. The surveys were repeated in 2014.

7.3 Silver eel

England & Wales

Effort data for the silver eel fishery are reported in combination with the yellow eel fishery (see Section 7.2 and Table 34).

Scotland

There are no silver eel fisheries in Scotland.

Northern Ireland

There are no commercial silver eel fisheries in the east or northwestern International RBDs.

Given that a night's catch from the silver eel fishery in the River Bann may not be marketed the next day, but is combined with several nights' capture (with this reported at the time of sale as the "catch"), it is difficult to calculate a cpue for the silver eel fishery that would provide a meaningful indicator of stock abundance. However, attempts were made to analyse catch by number of nights in 2013 (as had been attempted for 2012) but as outlined previously proved to be very difficult as the processing (and thus access for analysis) was dictated by market demands.

7.4 Marine fishery

There are no marine fisheries targeting eel outside the EMUs in the UK.

Table 34. Cpue (kg/trap-day) of combined yellow and silver eel fisheries by RBD [based on catch and effort returns to the Environment Agency].

Year	Northumbria	Humber	Anglian	Thames	Southeast	Southwest	Severn	West Wales	Dee	Northwest	Solway Tweed	England & Wales
2005	0.063	0.118	0.349	0.375	0.899	0.326	0.435	0.423	0.289	0.365	0.000	0.348
2006	0.034	0.144	0.266	0.232	0.591	0.337	1.663	0.182	0.256	0.437	0.000	0.304
2007	0.000	0.743	0.160	0.208	0.214	0.155	0.181	0.773	0.276	0.000	0.000	0.226
2008	0.484	0.128	0.219	0.240	0.169	0.248	0.778	0.688	0.129	0.125	0.000	0.208
2009	0.327	0.032	0.173	0.357	0.338	0.248	0.230	0.026	0.398	0.354	0.000	0.224
2010	0.909	0.462	0.219	0.410	0.286	0.163	0.683	1.069	0.472	0.416	0.000	0.264
2011	0.000	0.264	0.186	0.360	0.379	0.221	0.369	0.468	0.232	0.120	0.000	0.221
2012	0.000	0.282	0.219	0.196	0.143	0.233	0.000	0.113	0.108	0.125	0.000	0.199
2013	0.000	0.168	0.157	0.197	0.170	0.199	0.000	0.331	0.207	0.083	0.000	0.171

8 Other anthropogenic and environmental impacts

The level of impact has been reported in Section 13.2.3, at present there have been no estimates of the impact of the management measures on mortality.

9 Scientific surveys of the stock

9.1 Recruitment surveys for glass eel

Although there are several scientific surveys to qualify recruitment time-series, there are no scientific surveys to quantify total capture of glass eel recruitment in the UK.

9.2 Yellow eel stock surveys

England and Wales

Avon re-survey

A fykenet survey was under taken on the River (at Sabines), the stretch had been fished previously in 1996, 2000, 2006 and again in 2012–2014. The results from the survey are shown in Table 35. The survey was undertaken over a four week period in summer (July/August), similar to the timing in previous years. There is evidence of a decline in catch over the ten year period from 1996–2006, with an increase in 2012–2014.

The 2014 survey showed a rise in the population, apparently above that of 1996 level. However much of that (2014) weight was made up of silver females (unlike previous years). As these eels are migratory, one has to treat the results with caution as these eels were probably passing through. Numbers of browns were slightly down but the presence of elvers was evident throughout and in very large numbers, although that cannot be qualified statistically. The traps were possibly more efficient as the survey was carried four weeks earlier than previous surveys (July 15th–August 15th).

Table 35. Total catch of yellow and silver eel per ten codends between 1996 and 2014 (Roger Castle pers. comm.).

Year	Catch (kg)
1996	50
2000	28
2006	12
2012	30
2013	37
2014	62

Scotland

Since 2008, the Scottish Environment Protection Agency (SEPA) has undertaken routine electrofishing surveys for all fish species, including eels. In 2008, 48 sites were fished, eels were present at 39 sites (80%), and three of the nine sites where they were not found may have been affected by natural barriers to migration. This suggests that the SFCC data significantly overestimates the number of sites at which eels are absent. Minimum density of eels estimated from three pass electrofishings at the 39 sites where they were found ranged from 0.3–23.7 eels per 100 m^2, giving a mean minimum density across the RBD of 6.7 eels per 100 m^2 (or 5.4 eels per 100 m^2 including those sites from which eels were absent).

A further eleven electrofishing sites above the Girnock and Baddoch traps are fished annually by Marine Scotland Science.

The other site monitored by Marine Scotland - Science is the Allt Coire nan Con Burn, which is situated in the Strontian region of western Scotland and drains into the River Polloch, an inflow to Loch Shiel. The catchment covers 790 ha and its altitude falls from 756 m to 10 m at the sampling point, where the river is 5–6 m wide and features riffle interspersed with glides which can be deep. Riparian vegetation at the sampling sites is predominantly mature deciduous woodland. Annual electrofishing surveys show no clear evidence of declines in yellow eel densities since 1992 (Adams *et al*., 2012).

Data from eel captures on trash screens of a pumping station (1982–2003) on Loch Lomond found no evidence of a decline in yellow eels (Adams *et al*., 2012)

Northern Ireland

The North–South Shared Aquatic Resource (NSSHARE) Project covers three River Basin Districts; Northwestern International River Basin District, Neagh/Bann River Basin District and Northeast River Basin District. One of the main outcomes of the project is to develop ecological classification tools for assessing water quality under the Water Framework Directive using three biological quality elements; aquatic flora, benthic invertebrate fauna and fish fauna. The fish fauna biological quality element must include species composition, abundance and age structure. Eels are recorded as part of the species composition element (see Table 6 from 2008 UK Country Report).

The NSSHARE Fish in Lakes team was set up to develop an ecological classification tool using fish fauna, suitable for monitoring and classification of lakes under the requirements of the Water Framework Directive. This involved developing a standard methodology for sampling fish populations in lakes, and 83 lakes have been surveyed to date. The ecological classification tool is currently under development.

Northeast RBD

Eel are known to be present throughout this RBD but there are limited scientific data. Three lakes in this region have been selected as potential fish monitoring sites in the trial implementation phase of the Water Framework Directive. These lakes were sampled with a standardised (CEN) gill netting method supplemented with fykenets specifically for eel. Yellow eel populations are present in every lake examined thus far, though there were significant differences between two of these sites in length and age distribution.

There is clearly a difference between the eel population of the Clea Lake (Strangford Catchment) and Castlewellan Lake (South Down coastal). The Castlewellan eels are larger and older, probably reflecting the different characteristics of the two lakes. Castlewellan is further from the sea, and at higher altitude, whereas Clea is close to the sea and lowland, and perhaps biologically more productive. Furthermore, it is probable that the Castlewellan eel population is affected by natural impacts on access for recruits and emigrating silver eels. Clea Lake is a better index site for the catchment area and reflects continuing recruitment to at least 1992.

The age–length profiles of eels from a silver eel weir on the Quoile River from 1983 and 1984 confirm the view that the Castlewellan lake eels may well be partially land-locked, with restricted emigration potential resulting in long residence in freshwater.

Data are available for a sample of Quoile River yellow eel from 1969. This is important data in that it relates to a period before the opening of the upper of two barrages. This upper barrage may have restricted access upstream and retained eels within a brackish impoundment between the two barrages, especially to the small eel (less than 50 cm). However, the Quoile River system is now more accessible to eel than at any time since 1950, as the fish pass gates in the Lower Barrage between the estuary and the sea were renovated for eel and other fish passage in 2005.

Eel are present and widespread through the Quoile and Lagan river systems, though stock densities are not known. During electrofishing by Hodgson (2001) for trout, small numbers of eels were noted in the Annacloy and the Glasswater tributaries of the Quoile. They were absent from the majority of sites, but eel habitat may not have been adequately covered in a survey focussed on trout.

A recent survey undertaken in a small group of mixohaline lakes at Strangford netted 240 yellow eels. Length–frequency analysis indicated a much more normal distribution of eel lengths in comparison to other parts of the RBD previously surveyed such as the Quoile: with the length ranges were similar but mean length was much larger in Strangford (52.1 cm). Such differences illustrate that eel in this part of the system have unimpeded access to good eel habitat. This was further confirmed following analysis of the total eel biomass for the lakes surveyed, which was calculated at 71.6 kg, giving a standing stock of 17.9 kg ha^{-1}.

A PhD research project carried out an intensive sampling programme in regions of the Northeast RBD using fykenets. Results have been incorporated into the reviewed EMP for this RBD in 2012.

Only one additional site is required to complete eel monitoring for the RBD, i.e. a new site representing a lake on the Lagan system. This is planned for September 2012. Additional surveying of four small lakes within this RBD was undertaken in August 2011, mainly to assess the potential impacts of barriers to migration along riverine stretches. Whilst not abundant, eels of all expected size and age classes were recorded in each of the lakes sampled, illustrating migration throughout the catchments.

The first reporting round collating eel data from WFD and SMP monitoring was completed for the first review of this EMP in 2012.

Northwestern International RBD

A recent intensive fykenet survey into the yellow eel population of Lower Lough Erne was completed summer 2014 with samples and results awaiting analysis. The results of this survey will be compared with those of the Erne Eel Enhancement Programme (Matthews *et al.*, 2001) and viewed against the closure of the yellow eel fishery in this RBD in July 2010.

Neagh/Bann RBD

Eel are sampled regularly as part of a long-term research programme which investigates all life stages throughout the year. Yellow eel catches are sampled weekly over 20 weeks (from May to September). A sample of 20 eels is chosen to reflect all size ranges caught, and analysed for age and length. In addition, the entire, ungraded landing of two fishing crew on one day each month is sampled, usually comprising 400–600 eels captured by longline and a similar number by draftnet, to enable comparison between methods. Every eel is measured for length and the total catch recorded.

Preliminary analysis indicates that a larger proportion of small eels (<40 cm) are captured by draftnets (34%, compared to 21.4% on longlines), whereas more of the larger eels (>60 cm) are taken on longlines. Furthermore, there was significant variation in the numbers of small eels captured by long lining dependent upon bait type (earthworms caught more) and hook size (larger hook caught fewer small eels).

For the first time in 50 years, permission to carry out a fykenet survey on Lough Neagh was granted by the LNFCS in the summer of 2013. At the time of writing part one of this survey has been undertaken with the repeat to take place late September. Results from this work discussed in Section 7.2.

In 2014 a new Queens University PhD funded directly by the LNFCS began examining all aspects of the biology of the Male eel based on L. Neagh.

http://www.afbini.gov.uk/index/news/news-releases/news-releases-archive-2014.htm?newsid=26679.

9.3 Silver eel

England and Wales

Silver eel movement and behaviour in estuarine environments

Piper, A.

In collaboration with Cefas, an array of 14 acoustic receivers has been deployed in the Stour estuary, Suffolk. This will allow tagged silver eel movements to be monitored to the estuary mouth (19 km downstream from the Stour tidal limit). These data will enhance knowledge of eel movements through the estuary and indicate the influence of tide cycles. Secondly, it is hoped that these data, combined with freshwater movement data, will allow investigation into the influence of recent freshwater history such as delay at structures or passage through HP turbines on the estuarine movements of eel.

Scotland

Downstream migrating silver eels have been trapped at three sites in Scotland: the Girnock Burn and Baddoch Burn (two adjacent tributaries of the river Dee, emptying ultimately into the North Sea), and the Shieldaig (an entire small catchment on the western seaboard). The biomass of migrating silver eels for each available year have been converted to area production rates (kg/ha) and are reported in Table 36.

Table 36. Silver eel escapement from three catchments in Scotland (kg.ha^{-1}).

Year	Girnock	Baddoch	Shieldaig	Year	Girnock	Baddoch	Shieldaig
1966	0.53	-	-	1991	-	-	-
1967	0.44	-	-	1992	-	-	-
1968	1.42	-	-	1993	-	-	-
1969	1.02	-	-	1994	-	-	-
1970	0.86	-	-	1995	-	-	-
1971	1.25	-	-	1996	-	-	-
1972	0.84	-	-	1997	-	-	-
1973	1.59	-	-	1998	-	-	-
1974	1.07	-	-	1999	-	-	0.57
1975	2.23	-	-	2000	-	-	-
1976	1.91	-	-	2001	-	-	-
1977	1.42	-	-	2002	-	-	0.69
1978	1.25	-	-	2003	1.05	-	0.51
1979	1.07	-	-	2004	-	-	-
1980	0.61	-	-	2005	0.86	-	-
1981	1.02	-	-	2006	-	0.32	1.59
1982	-	-	-	2007	0.51	0.35	0.63
1983	-	-	-	2008	0.42	0.57	0.55
1984	-	-	-	2009	0.44	0.53	1
1985	-	-	-	2010	-	0.1	0.53
1986	-	-	-	2011	0.30	0.47	0.38
1987	-	-	-	2012	0.78	0.45	0.43
1988	-	-	-	2013	0.44	0.34	0.61
1989	-	-	-	2014	0.22*	0.66*	1.86*
1990							

Northern Ireland

Northeast RBD

No current surveys of silver eels.

Northwestern International RBD

Surveys on the migrating silver eel stock on the Erne system began in 2009, as an integral component of a conservation fishery designed to trap and transport silver eels around hydropower plants within this RBD. The results of this survey work are presented in the National Report of Ireland.

Neagh/Bann RBD

Samples of ten eel chosen to reflect all size ranges in the catch are removed every week over a 12 week period and analysed for age and length. At weekly intervals the previous night's haul is measured for length. The number analysed can vary widely but on average covers at least 400 fish within a nights catch of >1 t. In addition the weekly silver eel samples are also analysed for weight, sex, prevalence and intensity of *Anguillicola crassus*, stomach contents, and gastrointestinal endohelminths. Sex ratio of the silver eel population is also examined by counting the numbers of individuals contained in the graded (depending upon size) 15 kg boxes. The fishery records the number of boxes of small (male) and large (female) eels sold, and from this the sex ratio and number of silver eels can be estimated.

10 Data collected for the DCF

Provide summary information on the monitoring of eel by EMU in the current year.

England & Wales

Recruitment surveys were undertaken at a number of sites, the details of which are reported in Sections 3.1.1.3 and 3.1.2.3.

In 2014 monitoring of yellow eel was undertaken on ten rivers at a total of 94 sites, Table Z, (these sites are in addition to the ones used for WFD assessment) and is used to assess the biomass of silver eel escaping from each eel management unit (equivalent to a River Basin District), as required by the EU Eel Regulation (1100/2007), using SMEPII. These data (B_{best}) have yet to be processed, but previous year's data are summarised in Section 13.2.1. At each site the following data are collected; number and size (mm) of each eel, together with the site's dimensions (length and average width).

Table 37. Eel specific monitoring carried out during 2014.

EMU	River	Number of sites
GB_Angl	Suffolk Stour	10
GB_Humb	Ure/Ouse	10
GB_NorW	Gowy	9
GB_NorW	Bela	8
GB_NorW	Ribble	10
GB_Nort	Coquet	10
GB_Seve	Severn	12
GB_Seve	Usk	6
GB_Wale	Wnion (Mawdach)	10
GB_SouW	Fowey	9

Scotland

No data on eels are collected under the DCF in Scotland, because Scotland is not in receipt of any DCF money for work with eels.

Table 38. Summary of the DCF monitoring implementation for Scotland RBD (GB_Sco).

DATA	RIVER	LAKES	ESTUARIES	LAGOONS	COASTAL & MARINE
No. of production / escapement surveys[1]	0	0	0	0	0
No. of recruitment time-series surveys[2]	0	0	0	0	0
No. fished aged	0	0	0	0	0
No. of fished sexed	0	0	0	0	0
No. of fish examined for parasites	0	0	0	0	0
No. of fish examined for contaminants	0	0	0	0	0
No. of non-fishery mortality studies[3]	0	0	0	0	0
Socio-economic survey	0	0	0	0	0

[1] **Surveys to estimate B_{best} and/or $B_{current}$ [These should include WFD surveys where the data are being used to estimate production and/or escapement of eel].**

[2] **Fishery-independent surveys.**

[3] **Studies to determine $\sum H$ for non-fisheries anthropogenic impacts, such as hydropower, barriers, predation, etc.**

Northern Ireland

Northeastern RBD

Table 39. Summary of the DCF monitoring implementation per EMU.

DATA	RIVER	LAKES	ESTUARIES	LAGOONS	COASTAL & MARINE
No. of production / escapement surveys[1]		5			
No. of recruitment time-series surveys[2]		2			
No. fished aged		130			
No. of fished sexed		130			
No. of fish examined for parasites		130			
No. of fish examined for contaminants		0			
No. of non-fishery mortality studies[3]		0			
Socio-economic survey		0			

Northwestern IRBD

Table 40. Summary of the DCF monitoring implementation per EMU.

Data	River	Lakes	Estuaries	Lagoons	Coastal & Marine
No. of production / escapement surveys[1]	0				
No. of recruitment time-series surveys[2]	1				
No. fished aged	0				
No. of fished sexed	0				
No. of fish examined for parasites	0				
No. of fish examined for contaminants	0				
No. of non-fishery mortality studies[3]	0				
Socio-economic survey	0				

Neagh Bann RBD

Table 41. Summary of the DCF monitoring implementation per EMU.

Data	River	Lakes	Estuaries	Lagoons	Coastal & Marine
No. of production / escapement surveys[1]		1			
No. of recruitment time-series surveys[2]		1			
No. fished aged		390			
No. of fished sexed		390			
No. of fish examined for parasites		390			
No. of fish examined for contaminants		0			
No. of non-fishery mortality studies[3]		0			
Socio-economic survey		0			

In addition to the glass eel sampling at the River Bann, other sampling is undertaken at several coastal sites: the Foyle Estuary, the River Lagan (Belfast), River Quoile (Strangford Lough) and Carlingford Lough Estuary.

In Lough Neagh, the glass eel/elvers are monitored for the presence of *Anguillicoloides crassus*, and the weekly samples of yellow eels are also examined for weight, sex, age, stomach contents, the prevalence and intensity of *A. crassus*, and gastrointestinal endo-helminths. The undersized yellow eels (<40 cm long) captured via longline are returned to the Lough at the point of capture with hooks in place. Every month 100 undersized eels are sampled at the fishery, their hook location recorded and in conjunction with analysis of the catch composition, attempts are made to quantify possible losses to the fishery through hook mortality.

The weekly silver eel samples are also analysed for weight, sex, age, stomach contents, the prevalence and intensity of *A. crassus*, and gastrointestinal endohelminths. Sex ratio of the silver eel population is also estimated by counting the numbers of individuals contained in the graded 15 kg boxes which the fishery then sell. Eels are graded as small (males) and large (females), based on a length–sex key derived from previous sampling. Sex ratios in the silver eels in 2004 to 2005 were numerically close to 1:1, but changed in 2006 and 2007 to 63% and 62% females (Table 42. However, in 2008, 2009 and 2010, this trend has reverted to close to 1:1 (48, 52 and 47% females). Taking account of differing sizes and weights of males and females, 74% of the recorded silver eel biomass is now female.

Table 42. Biological characteristics of silver eels emigrating from Lough Neagh. Note – mean ages of males and females for 2005 and 2006 have been revised in light of additional data.*age data to be QA verified.

	Males				Females			
year	%	mean L (cm)	mean Wt (g)	Age	%	mean L (cm)	mean Wt (g)	Age
1927	0				100		567	
1943	27				73			
1946	40				60			
1956	61				39			
1957	62				38			
1965	10		180		90		330	
2004	51	40.6	122	11	49	58.6	386	18
2005	52	41.4	126	11.4	48	58.1	393	18.2
2006	37	40.1	117	11.3	63	59.5	368	18.7
2007	38	40.2	121	11	62	62.3	370	n/a
2008	52	40.3	122	n/a	48	59.5	367	n/a
2009	54	40.9	128	n/a	46	61.7	378	n/a
2010	54	40.1	117	12.3	46	56.7	365	17.8
2011	57	40.2	118	14.7*	43	61.4	375	20.1*
2012	54	38.4	117	13.9*	46	61.2	396	19.6*
2013	51	41.1	125	12.8	49	61.4	472	18.6

11 Life history and other biological information

11.1 Growth, silvering and mortality

Von Bertalanffy parameters: Linf, K, t0

L50 = the length at which 50% of the population has silvered (my interpretation of 50% maturity)

Length and age at silvering

Fecundity

Weight-at-age

Length–weight relationship

Scotland

Individual growth rates of PIT tagged eels are measured by Marine Scotland Science in two tributaries of the River Dee. To date, growth rates for eels with more than a season between capture and recapture have ranged from 0.8 to 35.2 $mm.yr^{-1}$, with mean ± s.e growth of 8.85 ± 0.62 $mm.yr^{-1}$ (n = 78). On the Baddoch, the range of growth rates was 0.0–14.5 $mm.yr^{-1}$, with mean ± s.e growth rates of 6.36 ± 0.84 $mm.yr^{-1}$ (n = 26). These may be the lowest growth rates ever reported for the European eel.

Since 2008, yellow eel recruitment into the Girnock Burn has been assessed by Marine Scotland, using an eel pass. Eels are measured, weighed, and most are individually marked, either using PIT tags or VIE elastomer. Mean size of these ascending yellow eels is ca 157 mm (see Section 3.1.2), ranging from 96–254 mm.

Eel otoliths (ca 100 pairs) have been collected (by SEPA) and read (by Marine Scotland Science) from a number of sites around Scotland, but these data are not available. Historical data are available for age (estimated from otoliths) and length composition at a variety of sites in Scotland from a survey conducted in the early 1970s (Williamson, 1975).

Some Fisheries Trusts collect data on the length of eels captured during routine electrofishing surveys targeted at salmonids (1136 eels were measured between 1996 and 2008). Lochaber Fisheries Trust conducted an eel specific survey in 2010, and data are available at http://www.lochaberfish.org.uk/cust_images/Lochaber_eel_report_2010[1].pdf

11.2 Parasites and pathogens

England & Wales

1) Detection of *Herpesvirus anguillae* during two mortality investigations of wild European eel in England: implications for fishery management

Herpesvirus anguillae (HVA) was detected during disease investigations of European eel, *Anguilla anguilla* L. at two stillwater fisheries in central England. These represent the first records of HVA from UK eels. Both mortalities were eel specific and took place during August 2009 and July 2010 at water temperatures between 17 and 19.4°C. Pathological changes consistent with HVA infection included haemorrhaging in the fins, skin lesions and necrosis within the gills and liver. Transmission electron microscopy revealed active virion replication within the gill tissue. An initial assessment of risk is presented, indicating that HVA represents a high disease risk to UK eel stocks. However, further studies are required to establish the distribution of HVA before a reliable assessment of impact may be obtained. Until then, the detection of HVA holds important implications for eel conservation and management, in particular eel stocking activity.

Armitage, J., Hewlett, N. R., Twigg, M., Lewin, N. C., Reading, A. J., Williams, C. F., Aprahamian, M., Way. K., Feist, S. W. and Peeler, E. J. 2014. Detection of *Herpesvirus anguillae* during two mortality investigations of wild European eel in England: implications for fishery management. Fisheries Management and Ecology, 2014, 21, 1–12.

2) European eel health and disease investigations

Eel health and diseases in England and Wales are monitored through mortality investigations, targeted surveillance and screening of eels prior to re-stocking.

Since 2013, two eel-specific mortalities have been reported from still water fisheries in England. Field investigations and detailed post-mortem examinations confirmed the primary cause for these losses to be Anguillid herpesvirus 1 (AngHV-1). These events, combined with previous outbreaks reported in 2009 and 2010 (Armitage *et al*., 2013), bring the total number of mortalities associated with this virus in England to four.

All four outbreaks of AngHV-1 have involved large eels, measuring between 70 and 120 cm in length. These fish had estimated ages of between 17 and 29 years and many eel examined showed morphological characteristics of silvering. Affected eels were lethargic and unresponsive with signs of external haemorrhaging, skin lesions and severe gill necrosis. Histopathological examinations revealed marked necrosis, haemorrhage and inflammatory changes within the gills, kidney, skin, liver and spleen.

Post mortality sampling suggested that up to 70% of the eel populations were lost from these waters. It is proposed that the onset of silvering, with associated physiological changes and migration pressure, were triggers for these disease events, which so far have all occurred in still waters with barriers to escapement. Further sampling is underway to assess the prevalence, persistence and impact of the virus within these waters.

Since 2011, efforts have been made to establish the distribution of AngHV-1 in wild eels in England and Wales. This collaborative study between the Environment Agency and Cefas, has involved taking blood samples from live eels captured and returned during routine monitoring activities. To date, 685 eels, from 36 rivers in eleven RBDs have been tested for antibodies to AngHV-1. An additional 429 glass eels have been tested, from 14 sites in five RBDs. This work has confirmed that AngHV-1 has a relatively widespread distribution, but exists at a low prevalence (~5%) in most of the rivers sampled. This work will help inform existing disease risk assessments for this virus. Efforts are also underway to assess the presence and distribution of other eel viruses in England.

Since 2013, yellow eel from two rivers and glass eels from three rivers have been screened for parasites and disease prior to movement/stocking. *Anguillicola crassus* was found in all of the yellow eel samples at a prevalence of between 50 and 93%. Within these populations mean intensity of infection ranged from six to seven parasites respectively. Of the glass eels examined, only one of the samples revealed infections of *A. crassus,* at a prevalence of 37% and intensity of 1–7 nematodes (mean 2.4). These data are consistent with historic surveys of this nematode, now widely distributed throughout England and Wales. It is thought that a small number of catchments and some isolated rivers in North Wales and Northern England remain either sparsely infected or tentatively free of the parasite. No other parasites or diseases of concern were recorded during these examinations.

3) Collaborative studies

A number of collaborative projects are underway to progress understanding of European eel health interactions. This includes development of a standardised protocol to harmonise assessments of eel spawner quality and maximise retrieval of data from UK monitoring activities (Lewin *et al*., 2014).

A study in collaboration with Southampton and Cardiff Universities was also conducted to assess the influence of parasites on the behaviour and passage of silver eels in freshwater. This involved observations of 150 silver eels in response to a range of flow regimes within flume facilities. It has been shown that infections of *A. crassus* alters the behaviour of silver eels, causing avoidance of high flow velocities, in turn delaying downstream migration (Newbold *et al.*, in press). This could have important implications for eel passage, escapement and eel spawner quality.

References

Lewin, N.C. Reading, A.J. Hockley, F.A. Cable, J. Turnbull, J.T. Davies, G.D. Feist, S.W. Evans, D. Belpaire, C. Walker, A.M. Way, K. Kemp, P.S. Aprahamian, M.W. Haenen, O.L.M. Hoole, D. Dufour, S. Hickley, P. and Williams, C.F. 2014. Silver Service: A Standard Protocol for Eel Health Examinations. Poster presentation, European Association of Fish Pathologists (EAFP), UK Meeting, Keele, 15–16 September 2014.

Newbold, L.R., Hockley, F.A., Williams, C.F., Cable, J., Auchterlonie, N., and Kemp, P.S. In press. Non-native parasites alter European eel (*Anguilla anguilla*) swimming behaviour on encountering accelerating flow. Journal of Fish Biology.

Scotland

No new data.

N Ireland

No new data; *Anguillicola crassus* is now considered to be ubiquitous throughout Northern Ireland.

11.3 Contaminants

Scotland

No new data.

N Ireland

No new data.

11.4 Predators

No new information is available on eel predation this year. The historic information, albeit limited, on predation levels in UK eels has been reviewed in recent UK reports.

12 Other sampling

England & Wales

Assessing the influence of low-head hydropower (Archimedes screw), Larinier and elver passes on up and downstream fish passage

Piper, A.

The EC Renewables Directive 2009 (2009/28/EC) is driving an increase in low-head hydropower schemes across Europe; however the impacts of such installations on the movement and behaviour of fish are poorly understood.

A field investigation on the River Stour, Suffolk, commenced autumn 2012, focuses on a low-head hydropower installation at Flatford Mill. The site comprises several structures including an Archimedes screw turbine, Larinier fish pass, two elver passes and multiple water level control weirs. PIT telemetry, acoustic telemetry and DIDSON sonar camera are being employed to monitor fish movement, behaviour and route choice. Fish were captured, PIT tagged and released up and downstream of the study site during the period April to October 2013 (n= 228 upstream; n=223 downstream). In March 2014 a further 261 individuals were tagged and further capture and tagging sessions are planned April–August 2014. Up and downstream fish movements through the site will be continuously monitored over the period January 2013 to September 2014. Concurrent with this, water level and flow via each of the structures will be recorded using depth loggers and fixed side-looking ADCP telemetry. These data will be supplemented with hydrodynamic mapping upstream and downstream of the structures over a range of flow conditions using a raft mounted downward facing ADCP.

In addition, actively migrating silver eel were captured by fykenetting in autumn 2013, tagged with acoustic transponders and released 5 km upstream of the site (n=67). A network of acoustic receivers deployed throughout the downstream freshwater reach and into the estuary (see below) will track eel movements past a series of cross-channel structures, including those at Flatford Mill. The use of DIDSON at Flatford Mill will record fine-scale eel behaviour in the vicinity of the Archimedes screw and Larinier fish pass. This work follows a previous study of eel escapement and route choice through the same reach in 2009 and 2010, prior to installation of the hydropower scheme and fish passes (Piper *et al.*, 2012); hence the current study will enable quantitative assessment of the impacts of the hydropower installation on eel. Analysis of movement and passage data from autumn/ winter 2013 is still underway, but early indications show the negative influence of power generation regimes on the delay and energy expenditure of seaward migrating eel.

This work will demonstrate the efficacy of low head hydropower and associated passage facilities at providing safe passage routes for multiple species and life stages of migrating fish under a range of flow scenarios. Findings will provide valuable information for river managers that increasingly need to balance the growing demand to develop low-head hydropower with maintaining and improving free passage for all fish species.

Assessing the efficiency of acoustic behavioural guidance for deterring silver eel from water intakes

Piper, A.

European eel are particularly susceptible to damage and mortality at hydropower and water abstraction intakes. Mitigating for the negative impacts of such structures is a key focus of EU legislation (1100/2007/EC) aimed to restore declining eels stocks.

Field investigations on the River Stour, Dorset, aim to establish the efficacy of infrasound at deterring silver eel from water abstraction and hydropower intakes. The study site comprises an intake channel originally built to divert river flow to two turbines (now redundant). During November 2013, sub-metre fish positioning telemetry (HTI) was used to monitor the movements and fine-scale behaviour of tagged silver eel (n = 60) on the approach to the intake during 6 nights (batches of ten fish per night) with the infrasound source (12 Hz) alternately in 'on' and 'off' modes. The fine control of water levels afforded at the site enables hydrodynamic parameters to be kept constant throughout the study period.

The study generates eel swim paths (± 0.5 m positioning accuracy) on the approach to the intake and infrasound deterrent. This will enable quantification of deterrent/passage success, movement metrics (e.g. swim speed, tortuosity, etc.), and fine-scale behavioural changes in response to the infrasound source. Detailed flow mapping, using an ADCP, and infrasound mapping, using a pair of hydrophones, will enable interrogation of eel tracks in relation to stimuli within the site.

This work is conducted in response to the recent urgent drive to develop novel behavioural devices as an alternative to traditional mechanical screens for the mitigation of negative impacts of water resource infrastructure on eel populations. Early stage analysis from the winter 2013 study has indicated some downstream migrating silver eel react to 12 Hz infrasound within a near field detection distance to the infrasound device. The labour intensive nature of processing fine scale acoustic telemetry data means it will not be possible to quantify the true efficacy of this device for several months. On completion of the work, findings will be immediately disseminated nationally to the Environment Agency.

Piper, A. T., Wright, R. M., Walker, A. M. and Kemp, P. S. 2013. Escapement, route choice, barrier passage and entrainment of seaward migrating European eel, *Anguilla anguilla*, within a highly regulated lowland river. *Ecological Engineering*, 57, 88–96.

Assessing the impact of hydropower and riverine structures on silver eel migration, River Stour Suffolk

Piper, A.

The efficacy of low head hydropower and associated passage facilities at providing safe passage routes for migrating fish is poorly understood and requires investigation in terms of current impact, with the objective to identify optimal passage criteria. To achieve this, it is necessary to address knowledge gaps in fish responses to abiotic stimuli, and passage efficiency at a range of typical structures and conditions.

Building on previous (pre-and-post turbine installation) eel movement data. Seaward migrating adult eels will be captured and tagged (PIT and Acoustic) upstream of a complex of river structures including Archimedes Hydropower turbine, Larinier fish-pass, elver passes and sluice gates on the river Stour, Suffolk. Subsequent fish movements will be monitored at fixed logging stations and via manual tracking. An ARIS sonar camera and conventional underwater filming techniques will also be employed to assess fine-scale behaviour.

This work will demonstrate the impact and efficacy of low head hydropower and associated facilities at providing safe downstream passage routes for adult eel under a range of scenarios and help inform best practice guidance for future installations and management.

Additionally, fixed receiver monitoring stations will be situated to record fish movements past a number of other structures and abstraction intakes through the freshwater catchment and estuary. These data will provide additional insight into freshwater escapement rate, and elucidate on barrier impacts and movement patterns of eel; all of which are deemed knowledge gaps requiring attention under current eel management plans.

Datasets will also enable more robust analysis of the survival and energetic consequences for individuals that have and have not passed through the hydropower facilities.

Silver eel trap-and-transport feasibility study

Piper, A.

Large drinking water reservoirs have been identified by the Environment Agency as waterbodies likely to hold significant stocks of European eel. In many cases, disconnectivity from river and estuary systems prevents mature adult eels from contributing to the wider eel population by completing their oceanic spawning migration. Trap-and-transport has been proposed as a more feasible and cost effective method of facilitating adult spawning migration than provision of permanent connectivity between reservoirs and rivers using fishways.

The feasibility of trap-and-transport for enhancing adult eel spawning stock is poorly understood, with particular knowledge gaps in the viability of adult eels translocated from disconnected still waters to contribute to the breeding population i.e. will such individuals migrate.

Before a long-term trap-and-transport programme is undertaken, there is a need to establish the viability and efficacy of this technique.

A telemetry study to track the movement of tagged adult eel captured from a disconnected reservoir and translocated to the Suffolk Stour river/estuary system will provide an evidence base for management decisions regarding future implementation of trap-and-transport.

The use of acoustic telemetry will enable tracking of a sub-sample of tagged, translocated eel through the lower river Stour and Stour estuary. Concurrent tracking of silver eel captured directly from the river Stour will allow comparison between the two groups.

Understanding eel and trout movement in relation to obstructions in an East Anglian chalk stream

Piper, A.

Little is known about eel and trout populations and movement in small East Anglian chalk streams. Such information is required to fulfil obligations under the Water Framework Directive, Eel Management Plans and The Eels (E&W) Regulations 2009 and will, in a wider context, contribute to guidance for the enhancement of eel and trout passage at structures.

A PIT tagging study will focus on the impact of structures such as flow gauging weirs and tidal flaps on the movements of eels and trout in the River Stiffkey, Norfolk. Intensive electro-fishing will be conducted to capture fish, a representative sample of both species will be PIT tagged and released. PIT telemetry arrays will enable monitoring of fish movement, both up and downstream, over four flow-gauging weirs and past modified (pet flap) and unmodified tidal flaps. At each of the PIT detection stations, additional monitoring of water level, flow and temperature will be conducted. These data will allow quantification of the impact of low-head structures, and associated environmental parameters, on fish movement within and between freshwater and estuarine environments.

Efficiency of vertical oriented bristle passes for upstream moving European eel (Anguilla anguilla) at an experimental Crump weir

Kerr, J., Karageorgopoulos, P and Kemp, P.

When head difference was at its greatest (230 mm) (High Velocity regime) and velocity was high (max: 2.43 m s-1) the upstream passage of large eel was severally hindered (passage success: 17.2%), and for the eel that did pass, delay was long. The addition of bristle passes, under these conditions, increased passage success to 76.5% and reduced delay. As such, the addition of bristle passes considerably improved the passage of European eel when hydraulic conditions restricted movement.

The new configuration of bristle pass tested in this study represents a cost-effective, easy to install, non-mechanical, low-maintenance and hydraulically unobtrusive (Environment Agency, 2010) alternative to conventional fish passes at low-head structures.

We recommend that new methods for reducing habitat fragmentation continue to be researched, but suggest that in the absence of a better alternative the configuration of bristle pass tested in this study represents a good short-term solution to improve habitat connectivity for European eel at low-head barriers.

Efficiency of "Eel Tiles" for upstream migrating glass eel (Anguilla anguilla) ascending as experimental Crump weir

Vowles, A. Don, A. Karageorgopoulos, P and Kemp, P.

"Eel tiles" may provide a cost effective solution for mitigating barriers to juvenile eel migration. However, as eels were observed bursting upstream in a single attempt resting locations may be required on longer/larger barriers. Passage efficiency increased from 0% to an average of 66.9% per trial when the weir was modified with eel tiles. Higher passage efficiencies were attained for smaller (58.7%) rather than larger (41.3% study configuration.

Northern Ireland

In 2014 a new Queens University PhD funded directly by the LNFCS began examining all aspects of the biology of the Male eel based on L. Neagh.

http://www.afbini.gov.uk/index/news/news-releases/news-releases-archive-2014.htm?newsid=26679.

13 Stock assessment

13.1 Method summary

England and Wales

Silver eel production

Silver eel production is based on yellow eel electric fishing surveys and production estimated using the SMEP II model. The numbers of potential silver eel emigrants arising from the yellow eel population in the survey year, is estimated from the abundance and length distribution of those eels considered to be long enough to have a probability >0 of becoming silver eels in that year. The biomass of silver eels is estimated from the numbers-at-length using a length–weight relationship derived from data for over 16 000 eels sampled throughout England and Wales (unpublished).

Fishery impact

To estimate fishing mortality rate, the yellow and glass eel catches were first converted to silver eel equivalents. The biomass of yellow eel caught was considered to be the equivalent of the potential silver eel escapement as the instantaneous mortality rate of 0.139 yr-1 (Dekker, 2000) approximated to the instantaneous growth rate of 0.2 yr-1 (Aprahamian, 1986).

For the glass eel catch, 1 kg of glass eel was considered equivalent to 59.4 kg of silver eel, based on the instantaneous mortality of 0.00915 $day^{-1}$for the first 50 days post-settlement and there after a mortality of 0.139 yr^{-1}, a 50:50 sex ratio with males maturing at 12 (@90 g) and females at 18 years (@570 g) (Aprahamian, 1988).

Non-fishery anthropogenic impact

Tidal flaps/gates, pumping stations, surface water abstraction points and hydropower facilities were assessed for their impact on eel. Over the last three years, there has not been any substantial change in the infrastructure or methods of operating at the sites associated with these factors which would reduce eel mortality, and no reduction was specified in the EMPs.

Tidal flaps/gates

A total of 1048 tidal sluices exist within England and Wales. A study was undertaken to produce a nationally consistent, prioritised list of tidal outfall structures in England and Wales where upstream and/or downstream fish passage is adversely affected (HIFI, unpublished). The decision of which sluices to assess was initially made on the basis of channel width, with the narrowest watercourses (those <5 m wide) rejected because these are unlikely to provide large quantities of habitat for eel (even if channel length is long). This reduced the number of structures from 1048 to 449. These 449 were prioritised based on (1) fish stock status; (2) passage efficiency; (3) channel length; (4) channel width and (5) habitat quality.

An initial assessment of the impact on eel production was estimated for the top 106 of the prioritised tidal structures. Assuming that all the area upstream of the tidal gates/ flaps is lost production the total loss in terms of silver eel biomass was derived from total wetted area upstream * B_{best} production (kg/ha) in that RBD. In the absence of site-specific information on impacts, a conservative approach was taken to assume total loss of eel production upstream of the top 10% of tidal structures, and no loss of production from the remainder. This assessment will likely be revised as and when further information becomes available.

Pumping stations

In England and Wales, there are 321 pumping stations identified as having the greatest potential to impact on eel, based on: 1) distance from head of tide (shorter distance = greater impact) and 2) the predicted presence of eel.

To estimate the impact it has been assumed that all the area upstream of the pumping station is lost to eel production. The total annual loss in terms of silver eel biomass is derived from wetted area upstream * B_{best} production (kg/ha) for the relevant RBD.

Surface water abstraction sites

Surface water is abstracted at 29 863 sites in England and Wales. Those sites with the greatest potential to impact on eel were identified using the following criteria: distance from head of tide, size of the abstraction, predicted presence of eel, the sensitivity of the waterbody to abstraction; and were quality assured by consultation. 772 sites were identified as posing the greatest threat to eel.

A study of eel entrainment and mortality has been carried out at twelve surface water abstraction sites. The average number of eel entrained at these twelve sites was 627 eel per year, with the average age of those eel being two years (~150 mm). The equivalent in terms of silver eel biomass is estimated to be 0.03 kg per entrained eel. This equates to 18.81 kg per year entrained per abstraction.

Hydropower facilities

In England and Wales, there are 212 hydropower facilities in operation (Figure 2.9) affecting 11 158 ha of eel producing habitat. The impact of each hydropower facility is estimated according to the B_{best} production (kg/ha) for the relevant RBD, the area of habitat upstream, the presence or absence of screens (preventing eel entrainment) and the type of turbine. For those sites with screens, the proportion of eel entering the turbine(s) was assumed to be zero if the spacing between the bars/mesh was <15 mm, 50% if the spacing was between 16–29 mm and 100% if >30 mm: 27.6% of hydropower schemes (excluding Archimedes screws) are adequately screened to prevent the entrainment of eel (i.e. spacing was <15 mm). The estimates of turbine mortality were taken from the WGEEL 2011 report and were; Archimedes screw 0%, Francis Turbine 32%, Kaplan turbine 38%. All hydropower facilities have some form of bypass channel that provides an alternative route for fish around the turbine. On this basis, it has been assumed that approximately 50% of the silver eels produced upstream of a turbine will become entrained therein.

On those river systems where there is more than one hydro facility, the loss of production from the upstream turbine(s) has been accounted for in estimating the potential impact of turbines further downstream, i.e. the cumulative impact of all turbines has been calculated.

Estimation of B_o

B_o was based on survey data carried out between 1977 and 1990 as follows: Anglian RBD (rivers Stour (1983) and Chelmer (1986)), Southwest RBD (rivers Frome (1990), Fowey (1977–1983), Teign (1979), Axe (1979), Otter (1978), Plym (1982)), Severn RDB (River Severn (1983) and Dee RBD (Dee 1984). For the rivers Stour and Chelmer no length data were recorded and the mean eel length for a site was based on data from other rivers as follows:

Mean length (mm) = 281.0 (±15.54)+ 0.9879 (±0.245) * Distance from tidal limit (km) $P<0.001$; $r^2 = 0.23$

The length distribution was estimated using a random number generator based on the mean length (calculated above) a standard deviation (SD) of 102 (the mean SD of all sites where length had been recorded) and assuming a binomial distribution.

For those rivers (Frome, Fowey Teign, Axe, Otter, Plym) where only the mean length and SD were available the length distribution was estimated using a random number generator, assuming a binomial distribution. SMEPII was then used to estimate the biomass of silver eel escaping. These estimates were then corrected for the impact of barriers to give a B_o for the river.

For the SW RBD where historic data were available for more than one river, the mean escapement (kg/ha) for the RBD was estimated based on the assumption that 14% of the production is derived from chalk streams (River Frome) and 86% from rain fed rivers (rivers Fowey Teign, Axe, Otter, Plym) as follows:

SW RBD (kg/ha) =((Frome*0.138876)+((Fowey +Teign + Axe + Otter + Plym)/5)*(1-0.138876))

If the current production was greater than the historic production then the current production has been taken as B_0.

Where no historic data were available, the following assumptions have been made:

- The east coast RBDs (Northumbria, Humber, Thames and Southeast) follow a similar trajectory to that of the Anglian.
- The West Wales and Northwest RBDs were extrapolated from the SW (excluding chalk rivers), Severn and Dee estimates, weighted according to wetted areas.
- The Solway-Tweed estimate was based on combination of the estimates for the Northwest and Northumbria RBDS, weighted according to wetted areas.

13.1.1 Estimate of B_0

England and Wales

Table 43. Reference period for B_0.

EMU_CODE	B_0 (KG/HA)	REFERENCE TIME PERIOD	WHETHER OR NOT CHANGED FROM VALUE REPORTED LAST YEAR (Y/N)
GB_Nort	5.98	1983–1986	N
GB_Humb	2.73	1983–1986	N
GB_Angl	2.26	1983–1986	N
GB_Tham	11.91	1983–1986	N
GB_SouE	8.56	1983–1986	N
GB_SouW	19.30	1977–1990	N
GB_Seve	6.84	1983	N
GB_Wale	13.98	1977–1990	N
GB_Dee	29.89	1984	N
GB_NorW	13.98	1977–1990	N
GB_Solw	13.37	1977–1990	N

Scotland

Stock assessment methods have been developed for the Scotland RBD, based on quantification of upstream and downstream counts of eel at traps on three rivers. The estimates of B_0, $B_{current}$ and B_{best} rely heavily on the extrapolation of data from small study areas to the RBD as a whole, with the inherent possibility of bias. To derive an estimate of current production and anthropogenic mortality for the RBD from the available data has required a number of assumptions; these have tended to be precautionary in nature (i.e. likely to underestimate current production and overestimate current anthropogenic mortality (see Scotland RBD EMP 2010 for details). Some of these precautionary assumptions could be tested, and the production/mortality estimates adjusted accordingly, if resources become available.

Scotland RBD EMP is available at: http://archive.defra.gov.uk/foodfarm/fisheries/documents/fisheries/emp/scot-ap1.pdf

From 2013, and following the methods used in England and Wales, Scotland has adopted the inclusion of a silver eel production estimate for transitional waters based on the simplistic assumption that this is equivalent to silver eel production in the lowland rivers and lochs of Scotland (<240 m). Pristine production for transitional waters is assumed to be equivalent to pristine production in Scottish freshwaters during the reference period. For this reason, the inclusion of transitional waters has no effect on modelled silver eel output as a percentage of pristine output. However, because anthropogenic mortality is assumed to be zero in transitional waters, as there are no fisheries, the inclusion of transitional waters leads to a substantial reduction in the estimate of the value of $\sum A$ for GB_Sco.

Northern Ireland

The estimate of pristine escapement from the Northeast RBD was calculated with reference to the ecology and hydrology of similar systems (option c Article 5 of the Regulation) as described in Section 2.4.1 of the EMP. Current escapement is unknown and not monitored as there are no fisheries in this RBD, and escapement assessments were not an original feature of the terms of this EMP, but all rivers and upland lakes which are suitable for eel have been assessed as having no barriers to migration. As such under adequate recruitment levels and an adherence to the criteria laid down in the Northeast RBD EMP, this RBD should reach or better the 40% target naturally.

An annual mark–recapture programme of silver eel emigrating from Lough Neagh was initiated in October 2003, to estimate silver eel escapement ($B_{current}$) past the weir fishery, which is subject to a trap-free gap in the river channel, a three-month fishing season (some silver eel movement occurs outside this season), and inefficient fishing when river flows are very high. Recaptures occur both during the year of release and at least one or even two years afterwards. To date, 5823 silver eels have been tagged and maximum estimates of escapement, based on the proportion of recaptured Floy™ tagged eels, range from 38% to 85% during 2003 to 2013 (Table 45). No tagging was undertaken in 2007 due to the sporadic nature of the silver eel run. The Neagh/Bann estimate of B_{best} is derived from a known history of natural recruitment plus enhancement stocking, time lagged for known growth rates of silver eel; the current fishery management arrangements significantly contribute to outputs of this system.

The assessment methods for the Northwestern International RBD are detailed in the original EMP (Section 8; Action 2a). Stock assessment was carried out on the Erne as part of the Erne Eel Enhancement Programme which ended in 2001 (Matthews *et al.*, 2001).

Table 44. Estimate of B_0 for Northern Ireland RBDs. (Note GBNW* Transboundary NW IRBD with Ireland will be in Ireland report also).

EMUCODE	B0 (KG/HA)	REFERENCE TIME PERIOD
GBNW*	136	<1980s
GB NoE	4	
GB Nea	500	

Table 45. Results of mark–recapture estimation of silver eel escapement from the Lough Neagh silver eel fishery 2003–2013.

		Recaptures						
Year	No. tagged	Toome	Kilrea	Carry over to catch (T+1, T+2y)	Total	Rate (%)	Total annual silver catch (t)	Max. possible escapement estimate (t)
2003	189	33	7	7	47	24.9	114	343
2004	838	302	15	4	321	38.3	99	159.4
2005	792	118	0	7	125	15.8	117	623
2006	700	197	1	2	199	28.4	104	262
2007	0	no tagging due to sporadic nature of silver eel run.					76	
2008	950	193	18		211	22.2	76	266.2
2009	486	187	0	1	188	38.8	85	134.1
2010	491	167	14	0	181	36.9	97	165.9
2011	474	82	64	3	149	31.4	73	159.5
2012	452	65	19	2	86	19.0	74	315.9
2013	451	74	19	3	96	21.2	72	267.6
							10 yr mean	269.7
							1stEMPmean	153.2
							TARGET	200.0

13.2 Summary data

13.2.1 Stock indicators and Targets

England and Wales

The stock indicators for RBDs in England and Wales for 2011 are shown in Table 43. These are being updated and revised stock indicators will be available in June 2015.

Table 46. Stock indicators for 2011, the source of the material is the ICES data call of March 2013. Biomass targets = 0.4*B_o and ∑A is = *0*.92 if '$B_{current}/B_0$' >40%, or 0.92 * $B_{current}/(40\%*B_0)$ if '$B_{current}/B_0$' <40%.

EMUCODE	INDICATOR	BIOMASS (T)	MORTALITY (RATE)				TARGET		
	B0	Bbest	Bcurr	∑A	∑F	∑H	Source	Biomass (t)	∑A (rate)
GB_Nort	70.7	70.6	70.3	0	0	0	WGEEL	28.28	0.92
GB_Humb	157.9	157.9	119.6	0.28	0.02	0.26	WGEEL	63.16	0.92
GB_Angl	122.9	122.9	53.7	0.83	0.15	0.68	WGEEL	49.16	0.92
GB_Tham	509.9	509.7	411.1	0.22	0.01	0.20	WGEEL	203.96	0.92
GB_SouE	97.9	97.9	62.6	0.45	0.06	0.38	WGEEL	39.16	0.92
GB_SouW	595.5	141.1	55.7	0.93	0.77	0.16	WGEEL	238.2	0.22
GB_Seve	513.5	236.1	180.6	0.27	0.23	0.04	WGEEL	205.4	0.81
GB_Wale	371.4	25.4	23.1	0.09	0.01	0.08	WGEEL	148.56	0.14
GB_Dee	422.3	25.1	21.4	0.16	0.04	0.11	WGEEL	168.92	0.12
GB_NorW	654.0	37.3	24.1	0.44	0.15	0.28	WGEEL	261.6	0.08
GB_Solw	1169.8	344.7	344.5	0	0	0	WGEEL	467.92	0.68

Scotland

Table 47. Stock indicators for the Scotland RBD for 2013.

EMUCODE	BIOMASS (T)			MORTALITY (RATE)				TARGET	
	B_0	B_{best}	B_{curr}	∑A	∑F	∑H	Source	Biomass (t)	∑A (rate)
GB_Sco	267.7	158.4	128.3	0.210	0	0.210	WGEEL	107.1	0.92

Northern Ireland

Table 48. Stock indicators for Northern Ireland RBDs. (Note GBNW* Transboundary NWIRBD with Ireland will be in Ireland report also).

EMUCODE	BIOMASS (T)			MORTALITY (RATE)				TARGET	
	B_0	B_{best}	B_{curr}	∑A	∑F	∑H	Source	Biomass (t)	∑A (rate)
GBNW*	136	54.3	51.5	0.05	0.0	0.05	WGEEL	54.3	0.87
GB NoE	4			0.0	0.0	0.0	WGEEL	1.6	0.0
GB Nea	500	582	154.6	1.33	1.33	0.00	WGEEL	200.0	0.71

13.2.2 Habitat coverage

England and Wales

Table 49. The areas of habitat used in the assessment to determine B_0, $B_{current}$ and B_{best} for EMU in England and Wales. N/A indicates not applicable.

EMU code	River		Lake		Estuary		Lagoon		Coastal	
	Area (ha)	A'd Y/N)	Area (ha)	A'd Y/N)	Area (ha)	A'd Y/N)	Area (ha)	A'd Y/N)	Area (ha)	A'd Y/N)
GB_Nort	5760	Y	3599	Y	2457	Y	0	N/A	70461	N
GB_Humb	15305	Y	9743	Y	32805	Y	0	N/A	32885	N
GB_Angl	12048	Y	9539	Y	32786	Y	0	N/A	225599	N
GB_Tham	34	Y	9162	Y	33615	Y	0	N/A	4268	N
GB_SouE	3954	Y	2061	Y	5428	Y	0	N/A	171207	N
GB_SouW	9798	Y	2621	Y	23431	Y	0	N/A	349787	N
GB_Seve	14372	Y	6157	Y	54542	Y	0	N/A	0	N/A
GB_Wale	8824	Y	4271	Y	13475	Y	0	N/A	433095	N
GB_Dee	1579	Y	1623	Y	10928	Y	0	N/A	0	N/A
GB_NorW	9076	Y	9780	Y	27927	Y	0	N/A	151109	N
GB_Solw	10933	Y	6760	Y	69803	Y	0	N/A	191300	N

Scotland

The wetted area of rivers and lakes in the Scotland RBD were calculated from UK Ordnance Survey MasterMaps, scales 1:10 000 and 1:1250. Below a certain channel width (defined as normal winter flow width) the digital network represents channels as a single dimensional line, which thus provides no data on the width of river channels. On 1:10 000 scale maps this occurs nominally on channels below 5 m in width; at the 1:1250 scale, it is for channels below 1 m. To provide a reasonable measure of the true extent of water area represented by all non-determined widths of channels, these were attributed 1 m width. In some cases this will overestimate and in others underestimate the true width and hence wetted areas.

Area of the WFD defined transitional waters, combining estuarine and lagoon waters, was also calculated in GIS, with a value of 60 502 ha.

Table 50. The areas of habitat used in the assessment to determine B_0, $B_{current}$ and B_{best} in the Scotland RBD.

EMU code	River		Lake		Estuary		Lagoon		Coastal	
	Area (ha)	A'd Y/N)	Area (ha)	A'd Y/N)	Area (ha)	A'd Y/N)	Area (ha)	A'd Y/N)	Area (ha)	A'd Y/N)
GB_Scot	138 557	Y	48 104	Y	60 502	Y	0	Y	4 589 412	N

Northern Ireland

Table 51. The areas of habitat used in the assessment to determine B_0, $B_{current}$ and B_{best} in the EMUs of Northern Ireland.

EMU code	River		Lake		Estuary		Lagoon		Coastal	
	Area (ha)	A'd Y/N)	Area (ha)	A'd Y/N)	Area (ha)	A'd Y/N)	Area (ha)	A'd Y/N)	Area (ha)	A'd Y/N)
GB_Neag	0	N	40000	Y	0	N	0	N/A	0	N
GB_NorE	0	N	5000	Y	0	N	0	N/A	0	N

13.2.3 Impact

England and Wales

The following impacts have been assessed for all RBDs in England and Wales; commercial fisheries, tidal gates, pumping stations, surface water abstractions and hydropower installations. The main impact that has not been assessed is the impact of manmade barriers (Table 52), but work is ongoing to quantify the impact. The impact of the recreational fishery, predators and contaminants and parasites is treated as part of natural mortality.

Table 52. England and Wales: An overview of the assessed impacts per habitat type or for 'All' habitats where the assessment is applied across all relevant habitats. Barriers includes habitat loss. Indirect impacts are anthropogenic impacts on the ecosystem but only indirectly on eel (e.g. eutrophication). A = assessed, MI = not assessed, minor, MA = not assessed major, AB = impact absent.

EMU code	Habitat	Fish com	Fish rec	Hydro & pumps	Barriers (tidal)	Restocking	Predators	Indirect impacts
GB_Nort	Riv	A	MA	A	A	M1	MI	MI
	Lak	A	MA	A	A	MI	MI	MI
	Est	A	MA	A	A	MI	MI	MI
	Lag	AB	AB	AB	AB	AB	AB	AB
	Coa	AB	AB	AB	AB	AB	AB	AB
	All	A	MA	A	A	MI	MI	MI
GB_Humb	Riv	A	MA	A	A	MI	MI	MI
	Lak	A	MA	A	A	MI	MI	MI
	Est	A	MA	A	A	MI	MI	MI
	Lag	AB	AB	AB	AB	AB	AB	AB
	Coa	AB	AB	AB	AB	AB	AB	AB
	All	A	MA	A	A	MI	MI	MI
GB_Angl	Riv	A	MA	A	A	MI	MI	MI
	Lak	A	MA	A	A	MI	MI	MI
	Est	A	MA	A	A	MI	MI	MI
	Lag	AB	AB	AB	AB	AB	AB	AB

EMU code	Habitat	Fish com	Fish rec	Hydro & pumps	Barriers (tidal)	Restocking	Predators	Indirect impacts
	Coa	AB	AB	AB	AB	AB	AB	AB
	All	A	MA	A	A	MI	MI	MI
GB_Tham	Riv	A	MA	A	A	MI	MI	MI
	Lak	A	MA	A	A	MI	MI	MI
	Est	A	MA	A	A	MI	MI	MI
	Lag	AB	AB	AB	AB	AB	AB	AB
	Coa	AB	AB	AB	AB	AB	AB	AB
	All	A	MA	A	A	MI	MI	MI
GB_SouE	Riv	A	MA	A	A	MI	MI	MI
	Lak	A	MA	A	A	MI	MI	MI
	Est	A	MA	A	A	MI	MI	MI
	Lag	AB	AB	AB	AB	AB	AB	AB
	Coa	AB	AB	AB	AB	AB	AB	AB
	All	A	MA	A	A	MI	MI	MI
GB_SouW	Riv	A	MA	A	A	MI	MI	MI
	Lak	A	MA	A	A	MI	MI	MI
	Est	A	MA	A	A	MI	MI	MI
	Lag	AB	AB	AB	AB	AB	AB	AB
	Coa	AB	AB	AB	AB	AB	AB	AB
	All	A	MA	A	A	MI	MI	MI
GB_Seve	Riv	A	MA	A	A	MI	MI	MI
	Lak	A	MA	A	A	MI	MI	MI
	Est	A	MA	A	A	MI	MI	MI
	Lag	AB	AB	AB	AB	AB	AB	AB
	Coa	AB	AB	AB	AB	AB	AB	AB
	All	A	MA	A	A	MI	MI	MI
GB_Wale	Riv	A	MA	A	A	MI	MI	MI
	Lak	A	MA	A	A	MI	MI	MI
	Est	A	MA	A	A	MI	MI	MI
	Lag	AB	AB	AB	AB	AB	AB	AB
	Coa	AB	AB	AB	AB	AB	AB	AB
	All	A	MA	A	A	MI	MI	MI
GB_Dee	Riv	A	MA	A	A	MI	MI	MI
	Lak	A	MA	A	A	MI	MI	MI
	Est	A	MA	A	A	MI	MI	MI
	Lag	AB	AB	AB	AB	AB	AB	AB
	Coa	AB	AB	AB	AB	AB	AB	AB
	All	A	MA	A	A	MI	MI	MI
GB_NorW	Riv	A	MA	A	A	MI	MI	MI
	Lak	A	MA	A	A	MI	MI	MI

EMU code	Habitat	Fish com	Fish rec	Hydro & pumps	Barriers (tidal)	Restocking	Predators	Indirect impacts
	Est	A	MA	A	A	MI	MI	MI
	Lag	AB	AB	AB	AB	AB	AB	AB
	Coa	AB	AB	AB	AB	AB	AB	AB
	All	A	MA	A	A	MI	MI	MI
GB_Solw	Riv	A	MA	A	A	MI	MI	MI
	Lak	A	MA	A	A	MI	MI	MI
	Est	A	MA	A	A	MI	MI	MI
	Lag	AB	AB	AB	AB	AB	AB	AB
	Coa	AB	AB	AB	AB	AB	AB	AB
	All	A	MA	A	A	MI	MI	MI

The estimated loss in tonnes from fishing, hydropower, surface water abstractions and pumping stations (recorded under Hydro & Pumps) and from tidal barriers is presented in Table 53. Note that only the impact of tidal barriers has been estimated, the impact of other obstructions has not been quantified.

Table 53. England and Wales: The loss in tonnes (t) for each impact per developmental stage (mean 2009–2011) or MI = not assessed, minor, MA = not assessed major, AB = impact absent. Recreational fishing loss has been included as part of natural mortality.

EMU code	Stage	Fish com	Fish rec	Hydro & pumps	Barriers (tidal)	Restocking	Predators	Indirect impacts
GB_Nort	Glass	0.000	0	MI	0.000	MI	MI	MI/MA
	Yellow	0.035	0	MI	0.000	MI	MI	MI/MA
	Silver	0.003	0	0.287	0.000	MI	MI	MI/MA
	Silver EQ	0.038	0	0.287	0.000	MI	MI	MI/MA
GB_Humb	Glass	0.000	0	MI	0.000	MI	MI	MI/MA
	Yellow	2.767	0	MI	0.000	MI	MI	MI/MA
	Silver	0.189	0	11.676	23.735	MI	MI	MI/MA
	Silver EQ	2.956	0	11.676	23.735	MI	MI	MI/MA
GB_Angl	Glass	0.000	0	MI	0.000	MI	MI	MI/MA
	Yellow	11.267	0	MI	0.000	MI	MI	MI/MA
	Silver	1.112	0	14.764	42.015	MI	MI	MI/MA
	Silver EQ	12.379	0	14.764	42.015	MI	MI	MI/MA
GB_Tham	Glass	0.000	0	MI	0.000	MI	MI	MI/MA
	Yellow	5.494	0	MI	0.000	MI	MI	MI/MA
	Silver	0.233	0	1.180	91.744	MI	MI	MI/MA
	Silver EQ	5.727	0	1.180	91.744	MI	MI	MI/MA
GB_SouE	Glass	0.000	0	MI	0.000	MI	MI	MI/MA

EMU code	Stage	Fish com	Fish rec	Hydro & pumps	Barriers (tidal)	Restocking	Predators	Indirect impacts
	Yellow	3.447	0	MI	0.000	MI	MI	MI/MA
	Silver	1.572	0	7.914	22.444	MI	MI	MI/MA
	Silver EQ	5.019	0	7.914	22.444	MI	MI	MI/MA
GB_SouW	Glass	1.131	0	MI	0.000	MI	MI	MI/MA
	Yellow	3.020	0	MI	0.000	MI	MI	MI/MA
	Silver	0.181	0	8.630	6.320	MI	MI	MI/MA
	Silver EQ	70.269	0	8.630	6.320	MI	MI	MI/MA
GB_Seve	Glass	0.777	0	MI	0.000	MI	MI	MI/MA
	Yellow	0.167	0	MI	0.000	MI	MI	MI/MA
	Silver	0.568	0	0.690	7.902	MI	MI	MI/MA
	Silver EQ	46.811	0	0.690	7.902	MI	MI	MI/MA
GB_Wale	Glass	0.002	0	MI	0.000	MI	MI	MI/MA
	Yellow	0.206	0	MI	0.000	MI	MI	MI/MA
	Silver	0.020	0	1.588	0.309	MI	MI	MI/MA
	Silver EQ	0.345	0	1.588	0.309	MI	MI	MI/MA
GB_Dee	Glass	0.010	0	MI	0.000	MI	MI	MI/MA
	Yellow	0.402	0	MI	0.000	MI	MI	MI/MA
	Silver	0.049	0	0.216	2.421	MI	MI	MI/MA
	Silver EQ	1.044	0	0.261	2.421	MI	MI	MI/MA
GB_NorW	Glass	0.065	0	MI	0.000	MI	MI	MI/MA
	Yellow	0.580	0	MI	0.000	MI	MI	MI/MA
	Silver	0.140	0	2.848	5.755	MI	MI	MI/MA
	Silver EQ	4.575	0	2.848	5.755	MI	MI	MI/MA
GB_Solw	Glass	0.000	0	MI	0.000	MI	MI	MI/MA
	Yellow	0.000	0	MI	0.000	MI	MI	MI/MA
	Silver	0.000	0	0.211	0.000	MI	MI	MI/MA
	Silver EQ	0.000	0	0.211	0.000	MI	MI	MI/MA

Scotland

Table 54. Scotland RBD: an overview of the assessed impacts per habitat type or for 'All' habitats where the assessment is applied across all relevant habitats. Barriers includes habitat loss. Indirect impacts are anthropogenic impacts on the ecosystem but only indirectly on eel (e.g. eutrophication). A = assessed, MI = not assessed, minor, MA = not assessed major, AB = impact absent.

EMU CODE	HABITAT	FISH COM	FISH REC	HYDRO & PUMPS	BARRIERS (TIDAL)	RESTOCKING	PREDATORS	INDIRECT IMPACTS
GB_Sco	Riv	AB	AB	A	A	AB	A	MI
	Lak	AB	AB	A	A	AB	A	MI
	Est	AB	AB	A	A	AB	na	na
	Lag	AB	AB	A	A	AB	na	na
	Coa	AB	AB	A	A	AB	na	na
	All	AB	AB	A	A	AB	MI	MI

Table 55. Scotland RBD: the loss in tonnes (t) for each impact per developmental stage (2011) or MI = not assessed, minor, MA = not assessed major, AB = impact absent.

EMU CODE	STAGE	FISH COM	FISH REC	HYDRO & PUMPS	BARRIERS (TIDAL)	RESTOCKING	PREDATORS	INDIRECT IMPACTS
GB_Sco	Glass	0.000	0	MA	MA	AB	MI	MI/MA
	Yellow	0.000	0	MA	MA	AB	MI	MI/MA
	Silver	0.000	0	2.363	15.726	AB	MI	MI/MA
	Silver EQ	0.000	0	2.363	15.726	AB	MI	MI/MA

Northern Ireland

Table 56. Northern Ireland: an overview of the assessed impacts per habitat type or for 'All' habitats where the assessment is applied across all relevant habitats. Barriers includes habitat loss. Indirect impacts are anthropogenic impacts on the ecosystem but only indirectly on eel (e.g. eutrophication). A = assessed, MI = not assessed, minor, MA = not assessed major, AB = impact absent.

EMU CODE	HABITAT	FISH COM	FISH REC	HYDRO & PUMPS	BARRIERS (TIDAL)	RESTOCKING	PREDATORS	INDIRECT IMPACTS
GB_Neag	Riv	AB	AB	A	A	AB	MI	MI
	Lak	AB	AB	AB	A	A	MI	MI
	Est	MI	MI	AB	AB	na	na	na
	Lag	na	na	na	na	na	na	na
	Coa	MI	AB	AB	AB	AB	na	na
GB_NorE	Riv	AB	AB	A	A	na	MI	MI
	Lak	AB	AB	AB	A	na	MI	MI
	Est	MI	MI	AB	AB	na	na	na
	Lag	na	na	na	na	na	na	na
	Coa	MI	AB	AB	AB	AB	na	na

Table 57. Northern Ireland (only GB Neag is included due to the presence of commercial fishery): the loss in tonnes (t) for each impact per developmental stage (2011) or MI = not assessed, minor, MA = not assessed major, AB = impact absent.

EMU CODE	STAGE	FISH COM	FISH REC	HYDRO & PUMPS	BARRIERS (TIDAL)	RESTOCKING	PREDATORS	INDIRECT IMPACTS
GB_Neag	Glass	0.000	0	AB	MA	na	MI	MI/MA
	Yellow	337	0	AB	AB	MI	MI	MI/MA
	Silver	97	0	AB	AB	MI	MI	MI/MA
	Silver EQ	434	0	AB	AB	MI	MI	MI/MA

13.2.4 Precautionary diagram

(Include graph(s))

Not available at this time.

13.2.5 Management Measures

England and Wales

The list of management measures is presently being updated and a list of management measures undertaken between 2009 and 2013 will be available by June 2015. Between 2009 and 20133, 222 foreseen measures, plus an additional 46 measures not foreseen were implemented, whereas 57 measures were foreseen but not implemented. In summary (Table 58), actions in this period have delivered:

- Introduction of 100% catch and release for eel by angling;
- Close season for net and trap fishing for eel;
- Limits on the geographical extent of the eel fishery;
- Creation of no fishing areas;
- Restrictions on eel fishing methods and gear
- A programme of eel specific monitoring for all eel life stages;
- 334 new eel passes restoring access to over 2000 km of river;
- 1726 Hectares of additional river habitat available for eel;
- Legislation providing new powers to require passes and screening to protect eel;
- Raised awareness and widespread engagement with key stakeholder groups.

In January 2010, the Eels (England and Wales) Regulations, 2009 Statutory Instrument came into force. This legislation was specifically developed to facilitate the implementation of Council Regulation (EC) No 1100/2007 in England and Wales. The legislation makes provisions to monitor exploitation, imposed a temporary close season on fishing for eels, enabled some control on the fishery and makes provision to protect the passage of eels. Much time and effort has been (and will continue to be) dedicated to the implementation of these Regulations.

Table 58. Summary of management measures taken in England and Wales between 2009 and 2013.

EMU code	Action Type	Action	Life Stage	Planned	Outcome
GB_Nort	Com Fish	Controlled through legislation	All	Implemented fully	Increase catch
	Rec Fish	Catch & Release	All	Implemented fully	Not measured
	Hydropower & Pumps	High priority sites screened	All	2015-20121	Not measured
	Restocking	0	GE	Implemented fully	Not measured
	Eel pass	8	All	Implemented fully	Not measured
GB_Humb	Com Fish	Controlled through legislation	All	Implemented fully	Increase catch
	Rec Fish	Catch & Release	All	Implemented fully	Not measured
	Hydropower & Pumps	High priority sites screened	All	2015-20121	Not measured
	Restocking (kg)	57	GE	Implemented fully	Not measured
	Eel pass	44	All	Implemented fully	Not measured

EMU code	Action Type	Action	Life Stage	Planned	Outcome
GB_Angl	Com Fish	Controlled through legislation	All	Implemented fully	Increase catch
	Rec Fish	Catch & Release	All	Implemented fully	Not measured
	Hydropower & Pumps	High priority sites screened	All	2015-20121	Not measured
	Restocking (kg)	31	GE	Implemented fully	Not measured
	Eel pass	65	All	Implemented fully	Not measured
GB_Tham	Com Fish	Controlled through legislation	All	Implemented fully	Decrease catch
	Rec Fish	Catch & Release	All	Implemented fully	Not measured
	Hydropower & Pumps	High priority sites screened	All	2015-20121	Not measured
	Restocking (kg)	<0.1	GE	Implemented fully	Not measured
	Eel pass	39	All	Implemented fully	Not measured
GB_SouE	Com Fish	Controlled through legislation	All	Implemented fully	Increase catch
	Rec Fish	Catch & Release	All	Implemented fully	Not measured
	Hydropower & Pumps	High priority sites screened	All	2015-20121	Not measured
	Restocking (kg)	0	GE	Implemented fully	Not measured
	Eel pass	37	All	Implemented fully	Not measured
GB_SouW	Com Fish	Controlled through legislation	All	Implemented fully	Increase catch
	Rec Fish	Catch & Release	All	Implemented fully	Not measured
	Hydropower & Pumps	High priority sites screened	All	2015-20121	Not measured
	Restocking (kg)	0	GE	Implemented fully	Not measured
	Eel pass	7	All	Implemented fully	Not measured

EMU CODE	ACTION TYPE	ACTION	LIFE STAGE	PLANNED	OUTCOME
GB_Seve	Com Fish	Controlled through legislation	All	Implemented fully	Decrease catch
	Rec Fish	Catch & Release	All	Implemented fully	Not measured
	Hydropower & Pumps	High priority sites screened	All	2015-20121	Not measured
	Restocking	9	GE	Implemented fully	Not measured
	Eel pass	75	All	Implemented fully	Not measured
GB_Wale	Com Fish	Controlled through legislation	All	Implemented fully	Decrease catch
	Rec Fish	Catch & Release	All	Implemented fully	Not measured
	Hydropower & Pumps	High priority sites screened	All	2015-20121	Not measured
	Restocking (kg)	0	GE	Implemented fully	Not measured
	Eel pass	27			
GB_Dee	Com Fish	Controlled through legislation	All	Implemented fully	Increase catch
	Rec Fish	Catch & Release	All	Implemented fully	Not measured
	Hydropower & Pumps	High priority sites screened	All	2015-20121	Not measured
	Restocking (kg)	0	GE	Implemented fully	Not measured
	Eel pass	6	All	Implemented fully	Not measured
GB_NorW	Com Fish	Controlled through legislation	All	Implemented fully	Decrease catch
	Rec Fish	Catch & Release	All	Implemented fully	Not measured
	Hydropower & Pumps	High priority sites screened	All	2015-20121	Not measured
	Restocking (kg)	0	GE	Implemented fully	Not measured
	Eel pass	25	All	Implemented fully	Not measured
GB_Solw	Com Fish	Controlled through	All	Implemented fully	No change

EMU code	Action Type	Action	Life Stage	Planned	Outcome
		legislation			
	Rec Fish	Catch & Release	All	Implemented fully	Not measured
	Hydropower & Pumps	High priority sites screened	All	2015-20121	Not measured
	Restocking (kg)	0	GE	Implemented fully	Not measured
	Eel pass	3	All	Implemented fully	Not measured

Scotland

Table 59. Summary of management measures in Scotland 2009–present.

EMU code	Action Type	Action	Life Stage	Planned	Outcome
GB_Scot	Com Fish	Controlled through legislation	All	Implemented fully	Zero legal fishing
	Rec Fish	Controlled through legislation	All	Implemented fully	Not measured
	Hydropower & Pumps	Regulations for new licences	All	Implemented fully	Not measured

Northern Ireland

Table 60. Summary of management measures in Northern Ireland, 2009 to present.

EMU code	Action Type	Action	Life Stage	Planned	Outcome
GB_Neag	Com Fish	Controlled through legislation	All	Implemented fully	No change
	Rec Fish	Controlled through legislation Catch & Release	All	Implemented fully	Not measured
	Hydropower & Pumps	Regulations for new licences	All	Implemented fully	Not measured
	Restocking (kg)	5414	GE	Implemented fully	Target unachieved
GB_NorE	Com Fish	Absent Controlled through legislation	All	Implemented fully	No change
	Rec Fish	Controlled through legislation Catch & Release	All	Implemented fully	Not measured
	Hydropower & Pumps	Regulations for new licences	All	Implemented fully	Not measured
	Restocking (kg)	20	GE	Implemented fully	Target unachieved

13.3 Summary data on glass eel

Quantities caught in the commercial fishery

exported to Asia

used in stocking

used in aquaculture for consumption

consumed direct

mortalities

England and Wales

Table 61. Quantities of glass eel caught in the UK between 2009 and 2014, as reported to Environment Agency and predecessor Agencies, and as estimated from HMRC nett export trade reports. 'n/a' = no data available. * Note that the 2014 reported catch is provisional, as of 24th September 2014.

Year	Catch reports to Agency (t)	Consignment Notes (t)	Dealers purchase (t) 2009 onwards	Loss (Mortality and weight loss) Percent
2009	0.29	0.45	0.45	0.0
2010	1.24	1.72	1.89	9.0
2011	2.24	3.28	3.64	9.9
2012	2.77	3.61	3.82	5.5
2013	5.91	7.79	8.66	10.0
2014*	10.97	12.39	12.66	2.1

For 2014, the provisional data (as of 24th September) are catch reported to the Environment Agency of 10.97 t, the quantity bought by the dealers was 12.66 t, and 12.39 t was exported or used internally (within UK), representing a loss (mortality and shrinkage) of 2.10% by weight.

In 2014, of the 12.66 t of UK caught glass eel that bought by dealers, 62.9% were subsequently used in stocking, 28.2% for aquaculture and 6.7% for direct consumption (the fate of 500 kg sent to Spain is "unknown" it is assumed the fish were used for consumption, rather than restocking/aquaculture) (Table 62).

Table 62. Percentage of glass eel caught in the UK and used for stocking, aquaculture or direct consumption. [Note these percentages may not add up to 100% because of mortality and weight loss after capture].

	2009	2010	2011	2012	2013	2014
Stocking	100	53.8	43.9	84.7	72.6	62.9
Aquaculture	0	36.5	45.3	10.5	27.4	28.2
Direct Consumption	0	0	0	0	0	6.7

The quantities (kg) and destinations of glass eel caught in the U.K. are shown in Table 63.

Table 63. The quantities (kg) and destinations of glass eel caught in the UK between 2009 and 2014.

	2009	2010	2011	2012	2013	2014
Belgium					4	
Czech Republic			30	76	470	594
Denmark		200	515	400		400
Estonia			307	90	480	420
France						863
Germany		97	882	384	470	1199
Greece			411		1005	650
Latvia			100	343	15	483
Lithuania					180	330
Netherlands		1288	593	100	1620	2232
Poland				120	95	15
Slovakia		85	80			
Spain						500
Sweden	205			1200	1300	1400
U.K.	240	54	366	921	2151	3300

Scotland

No data on glass eel because there are no commercial glass eel fisheries.

Northern Ireland

No data on glass eel because there are no commercial glass eel fisheries.

14 Sampling intensity and precision

No new information available. Refer to previous UK Country Reports.

15 Standardisation and harmonisation of methodology

15.1 Survey techniques

England & Wales

Knights *et al.* (2001) provided recommendations for design of monitoring programmes to detect spatial and temporal changes in population status, including those on electrofishing method. The Environment Agency has two standard work instructions in relation to eel, for eel-specific electrofishing surveys in rivers and for fykenetting.

Baldwin and Aprahamian (2012) undertook an evaluation of electric fishing for assessment of resident eel in rivers. Electric fishing is the sampling method of choice in smaller rivers and can be very efficient in optimal conditions. There are, however, widely held assumptions about the efficiency of electric fishing for eel which suggest that it is difficult, if not impossible, to get accurate population estimates from electric fishing surveys. Relationships between efficiency of eel capture by electric fishing and survey method were examined. Data from over 2000 routine electric fishing surveys carried out by the UK Environment Agency were used. Catch efficiencies (CE) were compared for surveys targeted at salmonid, coarse fish (multispecies) or eel (mean CE 0.575, 0.569, 0.605 respectively), and different size ranges of eel. Eel catch efficiency was compared with that for other species. The assumption that surveys targeted at multiple species or salmonids invariably under-represent eel is not supported by this study. The results from eel specific surveys examined in this study did not demonstrate any significant advantage over multispecies or salmonid surveys in terms of catch efficiency.

Scotland

No information.

Northern Ireland

No information.

15.2 Sampling commercial catches

Scotland

No commercial catches are reported.

Northern Ireland

Methods described above. No Quality Assurance is undertaken within the sampling of the commercial catches.

15.3 Sampling

England & Wales

Details can be found in http://publications.environment-agency.gov.uk/PDF/GEHO0411BTQF-E-E.pdf

Scotland

No information.

Northern Ireland

No information.

15.4 Age analysis

England & Wales

Ages reported in Knights *et al.* (2001) were quality assured by the Environment Agency's National Fisheries Laboratory at Brampton. A similar QA method was employed by Bark *et al.* (2007). Age analyses currently being conducted on otoliths using the cutting and burning method (as per ICES Eel Ageing Workshops held in Bordeaux in 2009 and 2011), or sectioning and staining where the otoliths are used for micro-chemistry analyses.

Scotland

Age analyses currently being conducted on otoliths deploy the cracking and burning method (as per ICES Eel Ageing Workshops held in Bordeaux in 2009 and 2011).

Northern Ireland

Age analysis is performed on yellow and silver eels sampled from the Lough Neagh fisheries using the grinding and polishing technique. The results have been quality assured against burning and cracking of sister otoliths performed at the Marine Institute laboratories in Newport. Results to date indicate mean yellow eel age of 14 years, male silvers eleven years and female silvers 18 years. These findings and the methodologies by which they were calculated were corroborated during the ICES Eel Ageing Workshop held in Bordeaux in 2009.

15.5 Life stages

Scotland

No information available.

Northern Ireland

All life stages on Lough Neagh are studied. Glass eels and yellow eels are periodically examined from those systems listed previously and as part of NS Share work.

For Northern Ireland in general, no analysis of glass eel developmental stage is undertaken. The difference between yellow eel and silver eel is determined by gross morphology, aided by length and time of year and was originally under the guidance of senior fisheries scientists and in the company of experienced fishermen.

15.6 Sex determinations

Scotland

No information available.

Northern Ireland

The correct gender assignment was originally under the guidance of senior fisheries scientists and is based on *in situ* macroscopic examination.

15.7 Data quality issues

Scotland

No information available.

16 Overview, conclusions and recommendations

17 Literature references

Adams, C.E., Godfrey, J.D., Dodd, J.A. and Maitland, P.S. 2013. Is proximity to the North Atlantic Drift and the Continental Shelf Current sustaining freshwater European eel populations in western Scotland? Freshwater Biology, 58, 1–9.

Armitage, J., Hewlett, N. R., Twigg, M., Williams, C. F., Aprahamian, M., Way, K., Feist, S. W. and Peeler, E. J. 2013. Detection of *Herpesvirus anguillae* during two mortality investigations of wild European eels in England: implications for fishery management. *Fishery Management and Ecology*.

Baldwin, L. and Aprahamian, M. 2012. An evaluation of electric fishing for assessment of resident eel in rivers. *Fisheries Research* 123–124:4–8.

Bark, A., Williams, B. and Knights, B. 2007. The current status and temporal trends in stocks of the European eel in England and Wales. ICES Journal of Marine Science, 64. 1368–1378.

Clark PF, Stefanoudis PV, Crimmen OA, Pearce D and Morritt D. 2013. Commercial exploitation of eels (*Anguilla anguilla*) and Chinese mitten crabs (*Eriocheir sinensis*): fyke net trials. The final report for the Marine Management Organisation and the Environment Agency. For the attention of Philip Lynn, Marine Management Organisation and Heidi Stone and Darryl Clifton-Dey, Environment Agency. pp 52.

Dekker, W. 2000. A Procrustean assessment of the European eel stock. *ICES Journal of Marine Science*, 57: 938–947.

Kennedy Rev. O.P. 1999. The Commercial eel fishery on Lough Neagh. In: L. Watson, C. Moriarty & P. Gargan (eds) *Development of the Irish Eel fishery*. Fisheries Bulletin, Marine Institute, Dublin, Ireland 17**,** pp. 27–32.

Knights, B. 2001. Economic evaluation of eel and elver fisheries in England and Wales. R&D Technical Report W2-039, Environment Agency, Bristol, UK, 44 pp.

Matthews, M., Evans, D., Rosell, R., Moriarty, C. and Marsh, I. 2001. The Erne Eel Enhancement Programme. EU Programme for Peace and Reconcilliation Project Number EU15, Bord Iascaigh Regiunach An Tuaisceart, Ballyshannon, Co. Donegal, Ireland. 348 pp.

Lucia Privitera, Kim Aarestrup, Andy Moore. Online 2013. Impact of a short-term exposure to tributyl phosphate on morphology, physiology and migratory behaviour of European eels during the transition from freshwater to the marine environment. Ecology of Freshwater Fish, Article first published online: 20 MAR 2013 | DOI: 10.1111/eff.12043.

Rosell, R.S., Evans, D., and Allen, M. 2005. The Eel fishery in Lough Neagh, Northern Ireland- An example of sustainable management? Fisheries Management and Ecology, **12**, 377–385.

A. M. Walker, M. J. Godard and P. Davison. 2013. The home range and behaviour of yellow-stage European eel *Anguilla anguilla* in an estuarine environment. Aquatic Conservation: Marine and Freshwater Ecosystems (2013) DOI: 10.1002/aqc.2380.

Williamson, G.R. 1976. *Eels in the Scottish Highlands*, Highlands and Islands Development Board, Commissioned Report 1976/15.