Report on the eel stock and fishery in Belgium 2012/2013

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Reporting Period: This report was completed in August 2013, and contains data up to 2012 and some provisional data for 2013.

2 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 and 2012), 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).

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 2010–2013: 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 2012–2013: 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 2012–2013: 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 2012–2013: In Flanders 156 kg and 140 kg were stocked respectively in 2012 and 2013.

- 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 2012–2013:

Glass eel: the monitoring of the glass eel recruitment at Nieuwpoort (River IJzer) has been continued in 2012 and 2013, 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 2012–2013: 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 program to monitor eel and perch quality with respect to their levels of contaminants for reporting to the WFD has been initiated.

* General status:

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

For the Walloon region

Except for the glass eel restocking programme no updated information was made available by the Walloon region. We repeat here the information provided in last year's report.

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

Specific action in 2013: in Wallonia, for financial reasons, glass eel could not be stocked in 2013.

* 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.

3 Time-series data

3.1 Recruitment-series and associated effort

3.1.1 Glass eel

3.1.1.1 Commercial

There are no commercial glass eel fisheries.

3.1.1.2 Recreational

There are no recreational glass eel fisheries.

3.1.1.3 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 2012.

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.

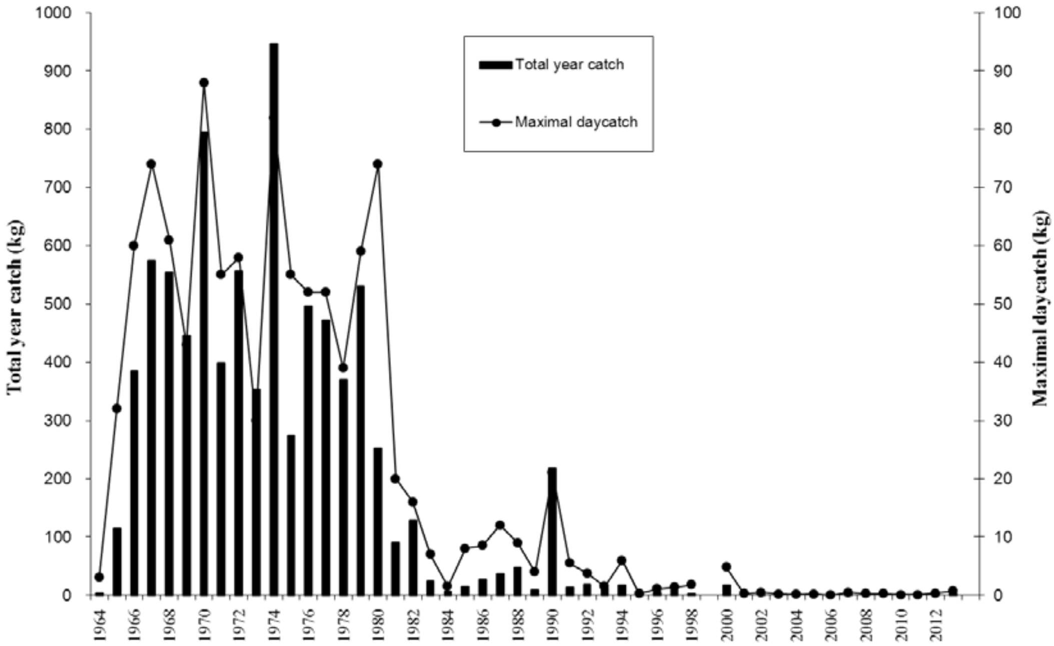
In 2010 fishing effort was normal with 265 dipnet hauls over 19 fishing nights. The fishing was carried out between and February 26th and May 26th. Total captured biomass of glass eel amounted 318 g (or 840 individuals). Maximum day catch was 100 g. Both total captured biomass, and maximal day catch 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.

See below in Chapter 7 for cpue data for the period 2002–2013.



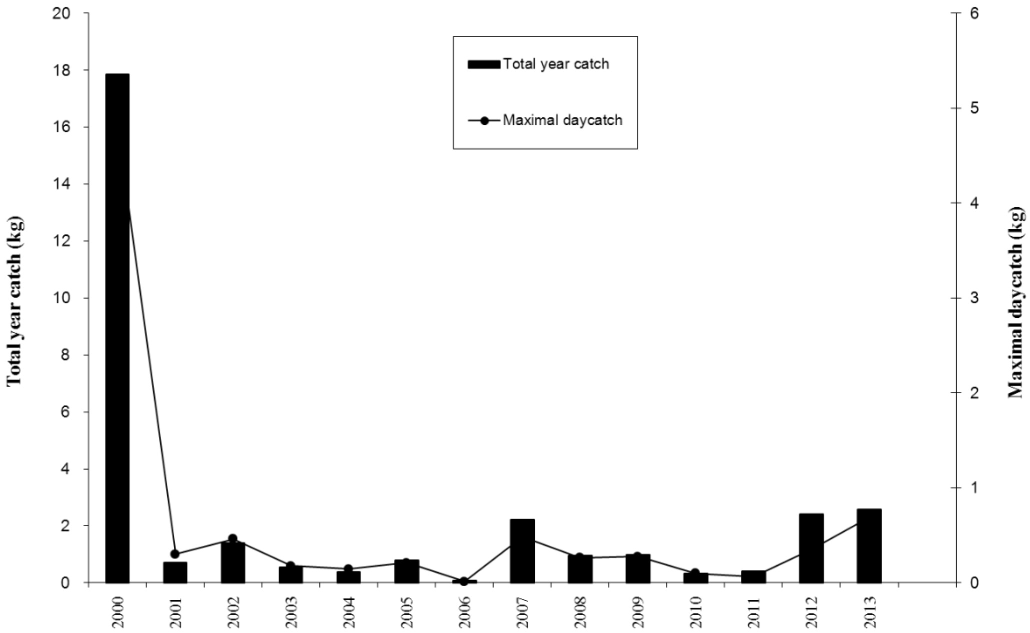


Figure 1 and Table 1. Annual variation in glass eel catches at river Yser using the dipnet catches in the ship lock at Nieuwpoort (total year catches and maximum day catch per season). Figure 1a represents the data for the period 1964–2013; Figure 1b shows the data for the period 2000–2013.

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	
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	

In Table 1 the presented data are the total year catches between 1964 and 2013. Data Provincial Fisheries Commission West-Vlaanderen.

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 temporarily. Data for 2012 and 2013 are not available.

3.1.2 Yellow eel recruitment

3.1.2.1 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.

3.1.2.2 Recreational

No data available.

3.1.2.3 Fishery independent

On the Meuse, the University of Liège is monitoring the amount of ascending young eels in a fishwaterbodpass. From 1992 to 2012 upstream migrating eels were collected in a trap (0.5 cm mesh size) installed at the top of a small pool-type fishpass 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 fishpass is checked continuously (three times a week) over the migration period from March to September each year, except in 1994. A total number of 36 776 eels was caught (biomass 2382 kg) with a size from 14 cm to 85 cm and an increasing median value of 28,5 cm (1992) to 35,5 cm (2010) 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 fishpass 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 (incomplete data, situation on 1/9/2013) 262 eels were caught (size range 19.6–76.5 cm, median 39.1 cm). 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 fishpasses located upstream in the Meuse and in the lower course of the river Ourthe (main tributary of River Meuse). Results will be published soon (Ovidio, pers. comm.). Note that some small changes have been made to the figure as presented in last years' reports.

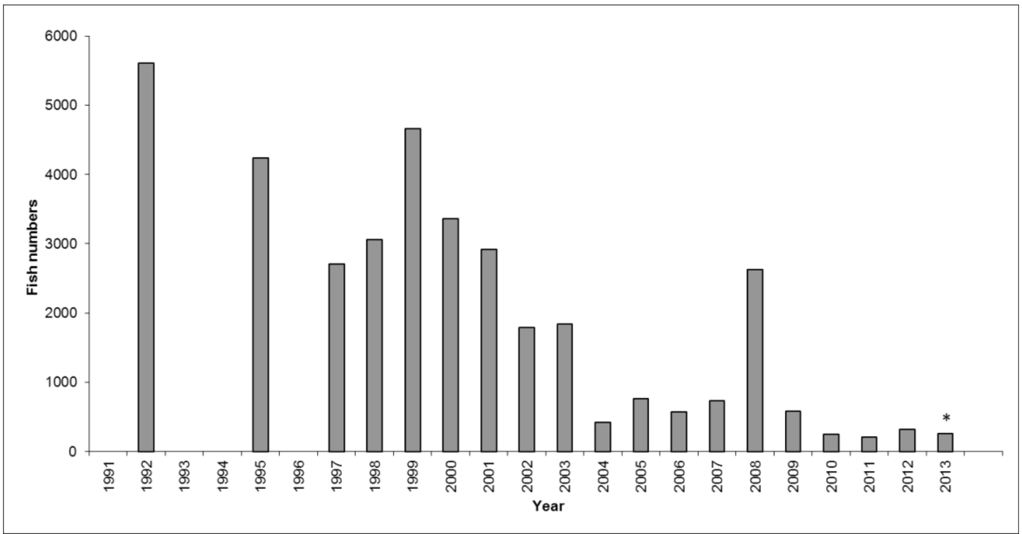


Figure 2. Variation in the number of ascending young yellow eels trapped at the fish trap of the Visé-Lixhe dam between 1992 and 2013. Data from University of Liège (J.C. Philippart) in Philippart and Rimbaud (2005), Philippart (2006) and Ovidio (pers. comm. 2013). * Data for 2013 are incomplete (situation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

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. 2013). * Data for 2013 are incomplete (situation 1/9/2013).

YEAR / DECADE	1990	2000	2010
0		3365	249
1		2915	208
2	5613	1790	317
3		1842	262*
4		423	
5	4240	758	
6		575	
7	2709	731	
8	3061	2625	
9	4664	584	

3.2 Yellow eel landings

3.2.1 Commercial

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

3.2.2 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.

3.3 Silver eel landings

3.3.1 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.

3.3.2 Recreational

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

3.4 Aquaculture production

There is no aquaculture production of eel in Belgium.

3.4.1 Seed supply

3.4.2 Production

3.5 Stocking

3.5.1 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 from the 2013via a French company (SAS Anguilla, Charron, 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 (2008–2012).

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

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

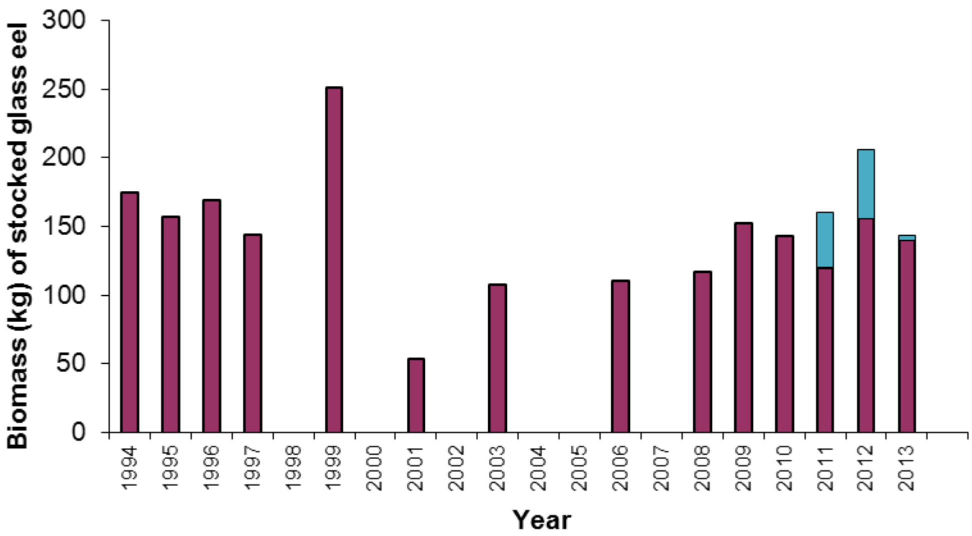


Figure 3 and Table 3. Restocking of glass eel in Belgium (Flanders and Wallonia) since 1994, in kg of glass eel. Flanders is represented in red and Wallonia in blue in the figure. * left Flanders/right Wallonia.

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

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 glasseel stocking is a valuable management measure to restore Walloon eel stocks.

More information on stocking details for Wallonia is presented in Table 4 (Cost of the glass eel) and Table 5 (origin).

3.5.2 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.

3.5.3 Reconstructed time–series on stocking

Stocking in Flanders

Table 5. Source and size of eel restocked in Flanders between 1994 and 2013.

	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			
20090					152			
2010					143			
2011					120			
2012					156			
2013					140			

Stocking in Wallonia

Table 5. Source and size of eel restocked in Wallonia between 1994 and 2013.

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								
20090								
2010								
2011					40			
2012					50			
2013					4			

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 or 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

See for the full time-series under Section 3.5.1.

4 Fishing capacity

4.1 Glass eel

Neither commercial nor recreational fishery for glass eels is allowed in Belgium.

4.2 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 were 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 and 62 574 in 2012. 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.

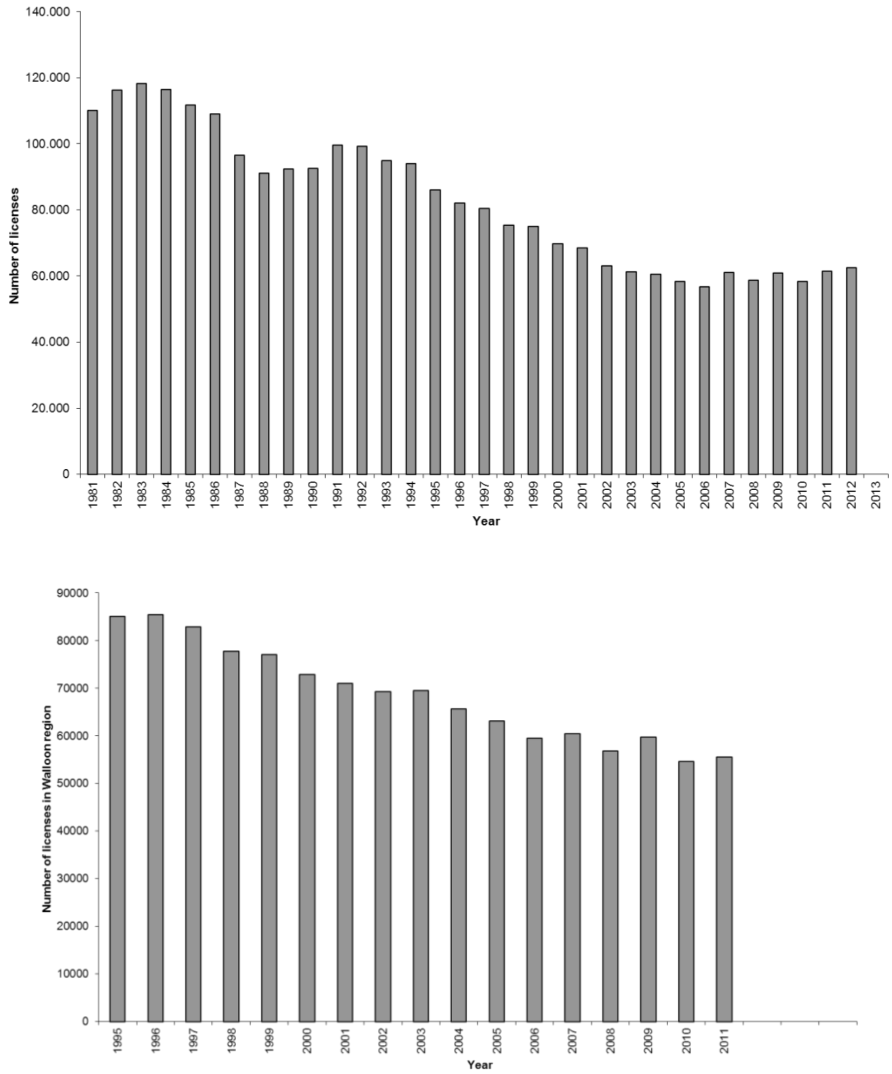


Figure 4. Time-series of the number of licensed anglers in Flanders (above) and Wallonia (below) since 1980 and 1995 respectively (Data Agency for Nature and Forests and Nature and Forestry Division (DNF) of the Walloon Environment and Natural Resources DG (DGRNE). 2012 data not updated for Walloon region.

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 was 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).

4.3 Silver eel

See Sections 3.3.1 and 3.3.2.

4.4 Marine fishery

See Section 4.2. Professional coastal and sea fisheries.

5 Fishing effort

5.1 Glass eel

There are no professional or recreational fisheries on glass eel.

5.2 Yellow eel

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

5.3 Silver eel

There are no professional or recreational fisheries on silver eel.

5.4 Marine fishery

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

6 Catches and landings

6.1 Glass eel

Neither commercial nor recreational fishery for glass eels is allowed in Belgium.

6.2 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 2010.

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).

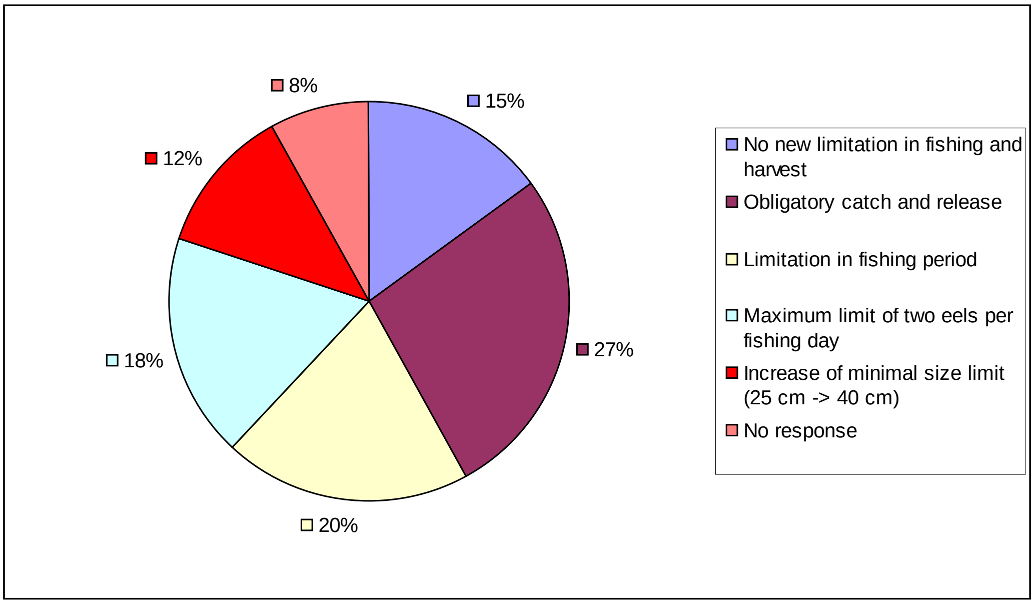


Figure 5. Results of a 2008 inquiry among 10 000 Flemish recreational anglers for their preference in management options for restoring the eel stock. 36% (N = 3627 anglers) responded (Vlietinck, 2010).

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 (2013), in Flanders the eel is in the process of being classified as "Critically Endangered" in the new Flemish Red List of Freshwater Fishes and Lampreys (Verreycken *et al.*, in press). 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.

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.

6.5 Recreational Fishery

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

No further data available.

7 Catch per unit of effort

7.1 Glass eel

Neither 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, 2002–2013). 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	0,4127	0,067	0,021	0,0014
2012	2,4077	0,35	0,105	0,0057
2013	2.5787	0.686	0.112	0.0063

7.2 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 are fishing 8.7 kg eel per year.

7.3 Silver eel

There are no professional or recreational fisheries on silver eel.

7.4 Marine fishery

Marine fisheries on eel are negligible and not documented.

8 Other anthropogenic 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 ongoing 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 subbasin 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.

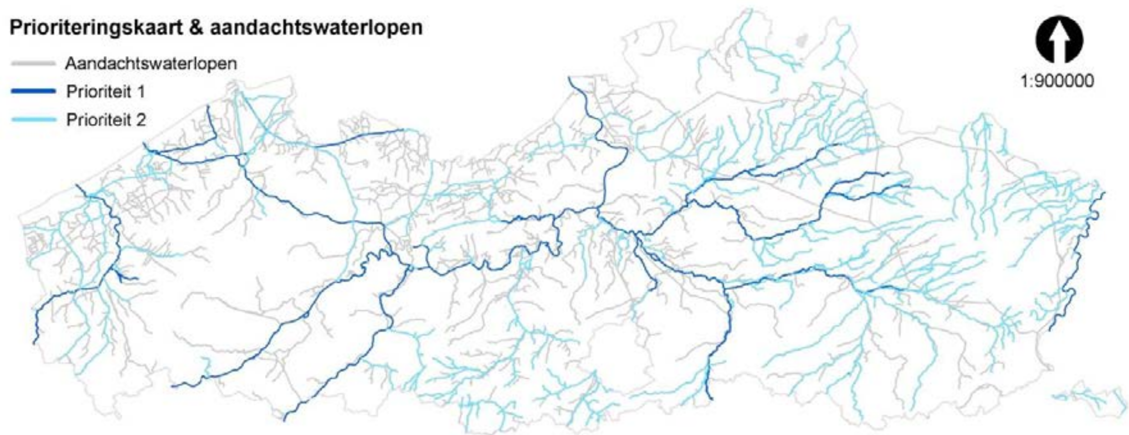


Figure 6. Fish migration prioritization network of Flemish water courses (blue) and water courses of special attention (grey) following the Benelux Decision "Free migration of fish" M(2009)1.

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 waterbodies.	Belgium	In progress	2027
Measures for sanitation of polluted sediments	Flanders	To be started	To be defined
	Wallonia	In progress	To be defined

Van Liefferinge *et al*. (2012) studied the role of a freshwater tidal area with controlled reduced tide as feeding habitat for eel. The study showed that with a controlled reduced tide to restore lateral connectivity of large tidal rivers with their adjacent floodplains, high quality habitats for the European eel are created. These measures could significantly contribute to the production of eels in better condition, which have better chances to reproduce successfully. Hence, wetland restoration is a way to enhance the recovery of the European eel stocks.

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*. (2013) 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*., 2013).

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).

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.milieuinfo.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*., in press), 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.

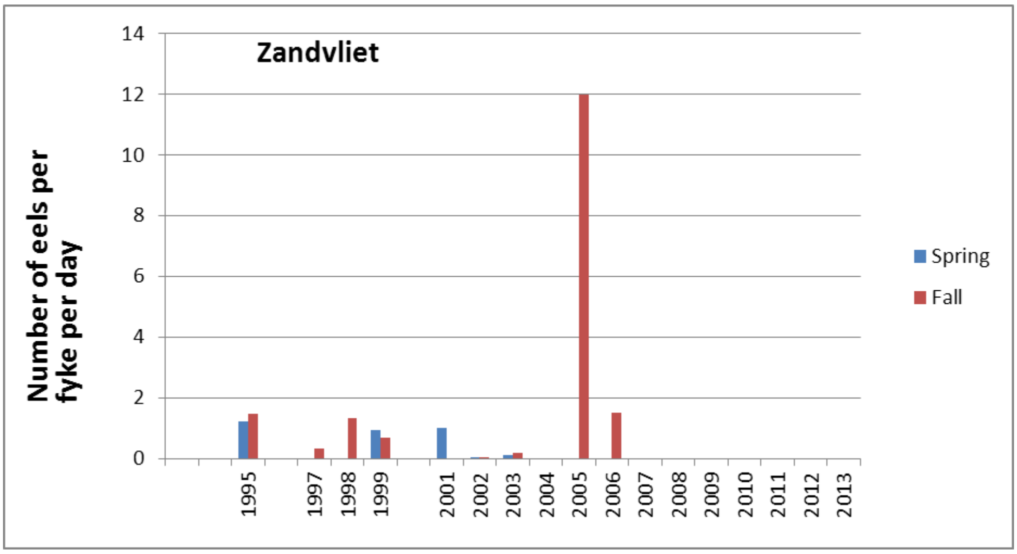
Finally, supporting research can be used to evaluate the effectiveness of measures in the management plan and to improve the model (e.g. research on the impact of eel quality and on the contribution of the Scheldt estuary in the production and migration of silver eels in Flanders) (Stevens *et al.*,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

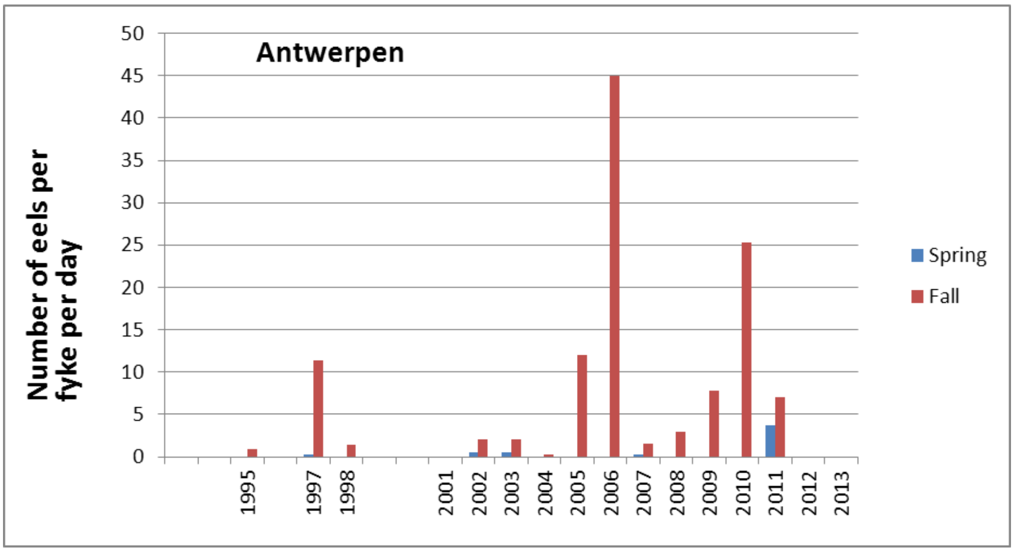
River Scheldt fish monitoring at the power station of Doel

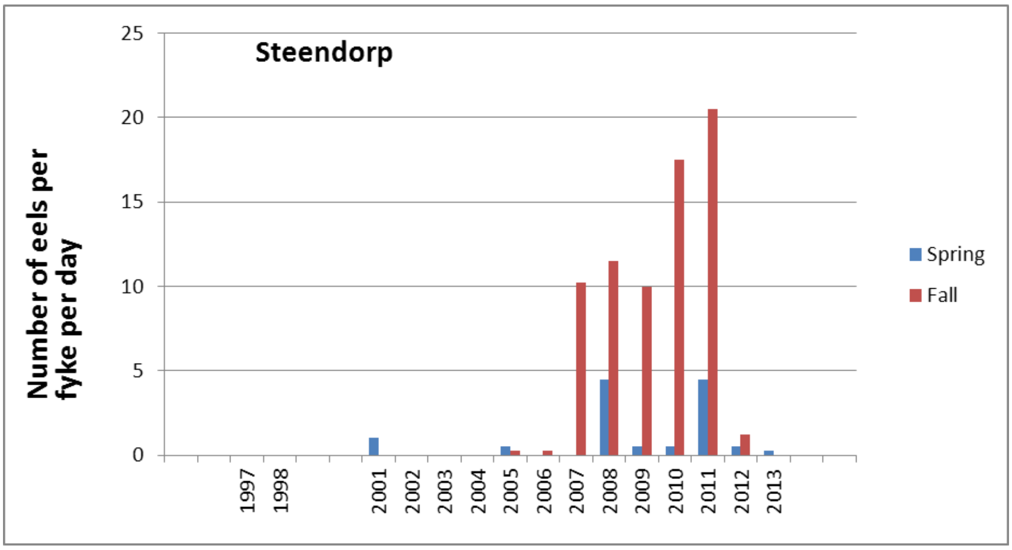
Between 1991 and 2012, INBO has been following the numbers of impinged fish at the nuclear power station of Doel on the Lower Scheldt. We refer to last year's report (Belpaire *et al.*, 2012) for a presentation of results and trends. Unfortunately, due to a shortness of means this monitoring series has 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. Catches in 2012 and 2013 were markedly lower than the years before (Data Jan Breine, INBO).







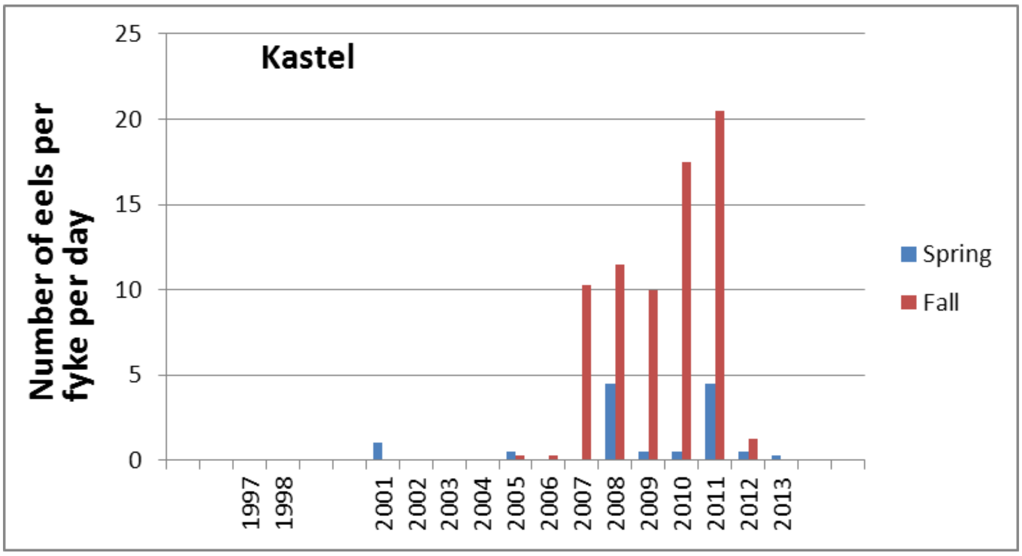


Figure 8. Time trend of fyke catches of eel along the River Scheldt estuary. Numbers are expressed as mean number of eels per fyke per day. Data are split up in spring catches and fall catches. Years without monitoring data are excluded from the X-axis. Data Jan Breine, INBO.

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 two to five 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)

In the Walloon region there is a lack of biological data on the resident eel stocks. No counting campaign specifically targeted on this species has been conducted, and no targeted characterization of potential habitats for the yellow eel is available. An FEP project has been initiated by the University of Namur to study the state of the resident stock of eel in the Lesse. This subbasin of the Belgian Meuse is a pilot basin of choice to study the status of stocks and the phenology of migration. In many electrofishing campaigns done on this subbasin during the past 20 years, various organizations (DEMNA, University of Namur, Department of Fisheries, ...) have identified a large number of sites with presence of eels, placing the Lesse just after the Meuse in terms of occurrence of eel on the stations sampled (SPW-DGARNE-DEMNA).

In that project, the research team will conduct the following actions:

- inventory and mapping to different degrees of accuracy of areas suitable for different life stages of eel in the basin of the Lesse, followed by an attempt to estimate the carrying capacity by comparing our results with literature and adaptation of the statistical model Eel Density Analysis (IAV, Onema Cemagref-Irstea);
- estimation of the resident stocks by capture-mark-recapture. Using different additional fishing methods, PITtag individual marks of silver eels and massive marking of the other stages with elastomers will be done;
- evaluation of the physiological and immune health of eels by focusing as possible on non-invasive techniques;
- downstream migration control at the confluence of the Lesse and the Meuse.

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 Section 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.

10 Catch composition by age and length

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.

11 Other biological sampling

11.1 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:

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

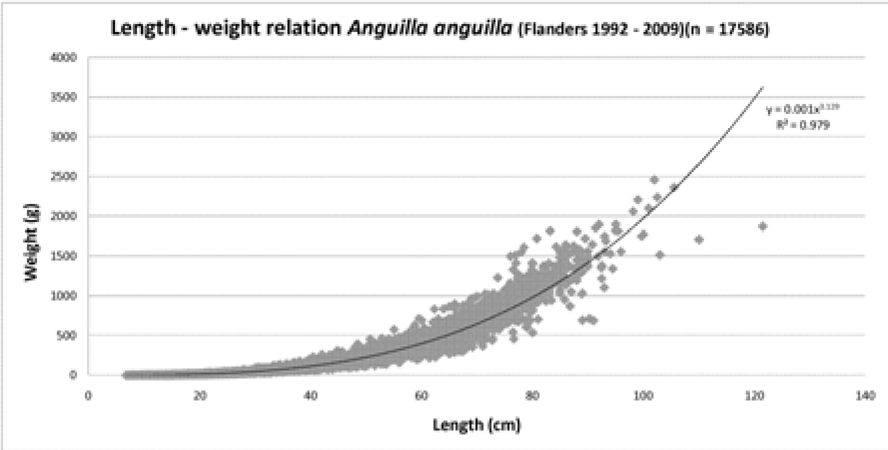


Figure 9. Length–weight relation of European eel (n = 17 586) sampled over Flanders in the period 1992–2009.

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).

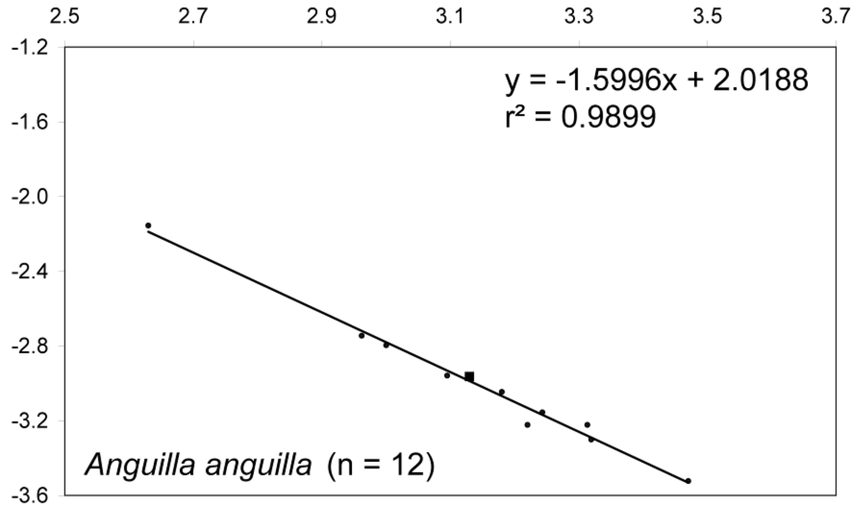


Figure 10. Estimated intercepts (log10a; Y-axis) versus estimated slope (b; X-axis) for the log10 transformed L/W regression and regression line for European eel from European datasets, as available in Fishbase (Froese and Pauly, 2010), compared to the Flemish populations (■; 1992 2009). Linear regression equation and r² are given (n = number of L/W relationships, including Flanders). (Verreycken *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.

11.2 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), last year's report (Belpaire *et al.*, 2012).

Walloon Region

No new information compared to earlier reports.

11.3 Contaminants

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

G.E. Maes, J.A.M. Raeymaekers, B. Hellemans , C. Geeraerts, K. Parmentier , L. De Temmerman, F.A.M. Volckaert, C. Belpaire. 2013. Gene transcription reflects poor health status of resident European eel chronically exposed to environmental pollutants. Aquatic Toxicology 126 (2013) 242–255.

Understanding the effects of chronic exposure to pollutants on the genome and transcriptome of diadromous fish populations is crucial for their resilience under combined anthropogenic and environmental selective pressures. The catadromous European eel (*Anguilla anguilla* L.) has suffered a dramatic decline in recruitment for three decades, necessitating a thorough assessment of the transcriptional effects of environmental pollutants on resident and migrating eels in natural systems. We investigated the relationship between muscular bioaccumulation levels of metals (Hg, Cd, Pb, Cu, Zn, Ni, Cr, As and Se), PCBs and organochlorine pesticides (DDTs), the health status (condition factor and lipid reserves) and the associated transcriptional response in liver and gill tissues for genes involved in metal detoxification (metallothionein, MT) and oxidative metabolism (cytochrome P4501A, CYP1A) of xenobiotic compounds. In total 84 resident eels originating from three Belgian river basins (Scheldt, Meuse and Yzer) were analysed along with five unpolluted aquaculture samples as control group. There was a large spatial variation in individual contaminant intensity and profile, while tissue pollution levels were strongly and negatively associated with condition indices, suggesting an important impact of pollution on the health of subadult resident eels. Gene transcription patterns revealed a complex response mechanism to a cocktail of pollutants, with a high variation at low pollution levels, but strongly down-regulated hepatic and gill gene transcription in highly polluted eels. Resident eels clearly experience a high pollution burden and seem to show a dysfunctional gene transcription regulation of detoxification genes at higher pollutant levels, correlated with low energy reserves and condition. To fully understand the evolutionary implications of pollutants on eel reproductive fitness, analyses of mature migrating eels and the characterization of their transcriptome-wide gene transcription response would be appropriate to unveil the complex responses associated with multiple interacting stressors and the long-term consequences at the entire species level. In the meanwhile, jointly monitoring environmental and tissue pollution levels at a European scale should be initiated, while preserving high quality habitats to increase the recovery chance of European eel in the future.

Jose M Pujolar, Ilaria AM Marino, Massimo Milan, Alessandro Coppe, Gregory E Maes, Fabrizio Capoccioni, Eleonora Ciccotti, Lieven Bervoets, Adrian Covaci, Claude Belpaire, Gordon Cramb, Tomaso Patarnello, Luca Bargelloni, Stefania Bortoluzzi and Lorenzo Zane. 2012. Surviving in a toxic world: transcriptomics and gene expression profiling in response to environmental pollution in the critically endangered European eel.

BMC Genomics 2012, 13:507 doi:10.1186/1471-2164-13-507, online at: http://www.biomedcentral.com/1471-2164/13/507

Genomic and transcriptomic approaches have the potential for unveiling the genome-wide response to environmental perturbations. The abundance of the catadromous European eel (*Anguilla anguilla*) stock has been declining since the 1980s probably due to a combination of anthropogenic and climatic factors. In this paper, we explore the transcriptomic dynamics between individuals from high (river Tiber, Italy) and low pollution (lake Bolsena, Italy) environments, which were measured for 36 PCBs, several organochlorine pesticides and brominated flame retardants and nine metals.

To this end, we first (i) updated the European eel transcriptome using deep sequencing data with a total of 640 040 reads assembled into 44 896 contigs (Eelbase release 2.0), and (ii) developed a transcriptomic platform for global gene expression profiling in the critically endangered European eel of about 15 000 annotated contigs, which was applied to detect differentially expressed genes between polluted sites. Several detoxification genes related to metabolism of pollutants were upregulated in the highly polluted site, including genes that take part in phase I of the xenobiotic metabolism (CYP3A), phase II (glutathione-S-transferase) and oxidative stress (glutathione peroxidase). In addition, key genes in the mitochondrial respiratory chain and oxidative phosphorylation were down-regulated at the Tiber site relative to the Bolsena site.

Together with the induced high expression of detoxification genes, the suggested lowered expression of genes supposedly involved in metabolism suggests that pollution may also be associated with decreased respiratory and energy production.

J.M. Pujolar, M. Milan, I.A.M. Marino, F. Capoccioni, E. Ciccotti, C. Belpaire, A. Covaci, G. Malarvannan, T. Patarnello, L. Bargelloni, L. Zane, G.E. Maes. 2013. Detecting genome-wide gene transcription profiles associated with high pollution burden in the critically endangered European eel. Aquatic Toxicology 132–133 (2013) 157–164.

The European eel illustrates an example of a critically endangered fish species strongly affected by human stressors throughout its life cycle, in which pollution is considered to be one of the factors responsible for the decline of the stock. The objective of our study was to better understand the transcriptional response of European eels chronically exposed to pollutants in their natural environment. A total of 42 pre-migrating (silver) female eels from lowly, highly and extremely polluted environments in Belgium and, for comparative purposes, a lowly polluted habitat in Italy were measured for polychlorinated biphenyls (PCBs), organochlorine pesticides (OCPs) and brominated flame retardants (BFRs). Multipollutant level of bioaccumulation was linked to their genome-wide gene transcription using an eel-specific array of 14 913 annotated cDNAs. Shared responses to pollutant exposure were observed when comparing the highly polluted site in Belgium with the relatively clean sites in Belgium and Italy. First, an altered pattern of transcription of genes was associated with detoxification, with a novel European eel CYP3A gene and gluthatione S-transferase transcriptionally up-regulated. Second, an altered pattern of transcription of genes associated with the oxidative phosphorylation pathway, with the following genes involved in the generation of ATP being transcriptionally down-regulated in individuals from the highly polluted site: NADH dehydrogenase, succinate dehydrogenase, ubiquinol-cytochrome c reductase, cytochrome c oxidase and ATP synthase. Although we did not measure metabolism directly, seeing that the transcription level of many genes encoding enzymes involved in the mitochondrial respiratory chain and oxidative phosphorylation were down-regulated in the highly polluted site suggests that pollutants may have a significant effect on energy metabolism in these fish.

Jonathan D. Byer, Mehran Alaee, R.Stephen Brown, Michel Lebeuf, Sean Backus, Michael Keir, Grazina Pacepavicius, John Casselman, Claude Belpaire, Kenneth Oliveira, Guy Verreault, Peter V. Hodson. 2013. Spatial trends of dioxin-like compounds in Atlantic anguillid eels. Chemosphere 91 (2013) 1439–1446.

Several temperate freshwater eel stocks have experienced unsustainable declines,yet to be explained. The decline of lake trout (*Salvelinus namaycush*) in Lake Ontario has been linked to aryl-hydrocarbon receptor agonists such as polychlorin ated dibenzo-p-dioxins/dibenzofurans (PCDD/Fs), dioxin-like poly- chlorinated biphenyls (dl-PCBs), and polychlorinated naphthalene s(PCNs), and the question remains whether eels are affected similarly by these compounds. Concentrations of PCDD/Fs, dl-PCBs, and PCNs were determined in eels collected at seven locations in eastern Canada including L. Ontario, one location in New York, USA, and one location in Flanders, Belgium. Concentrations varied greatly among origins, indicating dissimilar historic loadings to local areas. The risk to eel reproduction was evaluated with 2,3,7,8-TCDD toxic equivalents and increased by 10-fold from the least to most contaminated site. The risk to eel recruitment from dioxin-like compounds in American eel using available guidelines is low. The development of a more comprehensive model for eel recruitment risk assessment due to dioxin-like compounds, using eel-specific guidelines, is recommended. Toxic equivalents were 5-fold higher when based on mammalian toxic equivalency factors compared to fish values. About half of the eels captured in Lake Ontario exceeded the Canadian guideline for fish consumption (20pg TEQ g-1 ww), but there were no other exceedances in Canada. The current risk to eel consumers in Canada is low overall, except for highly urbanized and industrialized areas.

Molecular responses of peripheral blood mononuclear cells in European eel *Anguilla anguilla* following exposure to xenobiotics. Development of a low invasive multi-biomarker approach using sub-proteomic analysis.

PhD Thesis Kathleen Roland, 2013, Namur.

Since the beginning of the 1980s, stocks of European eel have been declining in most of their geographical distribution area. Many factors can be attributed to this decline such as pollution by xenobiotics released into the environment through agricultural, industrial and domestic activities. Because the New European Chemicals Legislation (REACh) is asking for alternatives to animal testing and reduction of animals sacrificed in ecotoxicology and in accordance with conservation biology considerations, we have developed an appropriate and reproducible methodology to obtain a post-nuclear fraction of isolated European eel peripheral blood mononuclear cells (PBMC) in order to evaluate the toxicity of xenobiotics using a subproteomic approach (Pierrard *et al*., 2012). In a first study (Roland *et al*., 2013a) we have studied the *in vitro* toxicity of perfluorooctane sulfonate (PFOS) in eel PBMC exposed during 48 hours to sublethal concentrations (10 µg and 1 mg PFOS/L). Exposure time and concentrations were chosen to avoid cell mortality. After *in vitro* contaminations, the post-nuclear fraction was isolated and a proteomic analysis using 2D-DIGE was performed to compare PBMC from the control group with cells exposed to the pollutant. On the 158 spots that were significantly affected by PFOS exposure, a total of 48 different proteins were identified using nano-LCESI-MS/MS and the Peptide and Protein Prophet of Scaffold software. These proteins can be categorized into diverse functional classes, related to cytoskeleton, protein folding, cell signalling, proteolytic pathway and carbohydrate and energy metabolism, which provide clues on the cellular pathways mainly affected by PFOS. Some of the identified proteins are rarely found in other ecotoxicological proteomic studies and could constitute potential biomarkers of exposure to PFOS in fish.

The advances made in the area of proteomic technologies offer a great potential in biomarker research as the identified proteins are the endpoints of cellular biological processes and represent an important part of the cellular phenotype. The interest of protein biomarkers in ecological risk assessment is recognized because such measures provide early warning indicators of ecologically relevant effects on biological systems. To develop specific and sensitive biomarkers, the use of a set of proteins is required and the identification of protein expression signatures or exposure "fingerprints" may reflect the exposure to specific classes of pollutants and help to predict their modes of action.

In order to determine the specificity of the proteomic pattern observed after *in vitro* PFOS contaminations, we have completed the set of data with *in vitro* exposures to two other xenobiotics, dichlorodiphenyl-trichloroethane (DDT) and cadmium, using exactly the same methodologies as for the PFOS experiment (Roland *et al*., 2013b, data not published). The aim of this new study was to identify protein expression signatures specific of different classes of pollutants. The identification of the proteins of interest by mass spectrometry allowed selecting four candidates for a minimal common signature between the three experiments. Results might be promising to detect the presence of these xenobiotics in field studies where mixtures of chemical compounds are present. Based on the proteomic results, ten protein biomarker candidates belonging to diverse functional classes have been selected to develop an Integrated Biomarker Proteomic index (IBP). For the first time, the use of star plot graphs has been applied to proteomic data in order to allow visual integration of a set of early warning responses measured with protein biomarkers. IBP values, as well as the areas of star plots, could be used to provide information about global adverse environmental effects as well as about the pollutants involved.

Lastly, the *in vivo* toxicological effects of PFOS on the whole animal have been investigated (Roland *et al*., 2013c). For that purpose, the protein expression profiles in PBMC of yellow eels exposed *in vivo* to environmental PFOS concentrations (28 days of exposure to 1 or 10 µg PFOS/L), as well as after *in situ* samplings of fish from Belgian rivers displaying different levels of PFOS contamination, have been studied. Based on the results of our previous *in vitro* proteomic study (Roland *et al*., 2013a), we also tried to evaluate the potential of *in vitro* studies in the prediction of the *in vivo* and *in situ* toxicity of xenobiotic compounds and in the discovery of new biomarkers of exposure for further field pollution monitoring programmes in an endangered species. The hopeful future applications should be the development of an ELISA test or a protein array that would be easily and rapidly performed in organisms sampled in the field. The comparison of the *in vitro*, *in vivo* and *in situ* results allowed the identification of two proteins in common, plastin-2 and alpha-enolase, the expression of which was both found to be significantly affected by PFOS. Interestingly, the expression of these two proteins was also modified in gills of European bullhead (*Cottus gobio*) exposed *in vivo* to either 0.1 or 1 mg PFOS/L, suggesting their potential use as biomarkers of PFOS exposure in fish species. Moreover, the recurrence of the main functional classes of proteins affected by PFOS lead us to think that *in vitro* exposure of cells to pollutants might be useful in the prediction of the *in vivo* toxicity of these compounds.

2013 Minnesota 61st ASMS Conference on Mass Spectrometry and Allied Topics.

Non-target and post-target analysis of emerging halogenated contaminants in American and European eels by Gas Chromatography-High Resolution Time-of-Flight MS.

Jonathan Byer; Grazina Pacepavicius; Peter V. Hodson; Claude Belpaire; David E Alonso; Joe Binkley; Mehran Alaee.

This work describes high resolution analysis of emerging environmental contaminants in two threatened species: American eel (*Anguilla rostrata*) and European eel (*Anguilla anguilla*).

Time-of-flight mass spectrometers (ToF MS) have gained popularity over scanning instruments for non-target and post-target analysis because full mass range spectra are acquired, and high acquisition rates can be achieved (up to 1000 Hz) with minimal mass bias. This provides a number of advantages including the possibility of deconvolving chromatographic interferences using modern software, further enhancing the ability to isolate and identify a greater number of compounds. In this study we used non-target analysis to determine the occurrence of lipophilic halogenated contaminants not identified previously by traditional target analysis of eel tissue (*Anguillid* sp.). This included the post-target analysis of compounds known to be in commerce that potentially persist and accumulate.

Homogenates of whole eels collected from Lake Ontario, Canada, the Hudson River, USA, and Canal Dessel-Schoten, Belgium were extracted on dried sodium sulfate columns with dichloromethane, and lipids were removed using gel permeation chromatography. The extracts were reduced in volume to 0.1 mL; individual and then pooled samples were analysed using an Agilent 7693 autosampler, and an Agilent 7890 GC coupled to a Leco Pegaus HRT time-of-flight mass spectrometer (ToF MS). The MS data were collected in EI+ mode with a mass range from 50 to 1400 m/z and a mass resolution >25 000, varying between 6 to 12 spectra/sec and an extraction frequency between 1.0 and 1.5 kHz. Data were processed using the Leco ChromaTOF HRT software.

The main purpose of this investigation was to identify additional environmental contaminants in eel samples beyond the classic targeted list of legacy persistent organic pollutants that were investigated and reported previously for these samples. The acquisition of mass spectral data in EI+ mode enabled library searching using NIST and other MS libraries. The unique deconvolution algorithm in the ChromaTOF HRT software increased the number of identified peaks substantially by isolating features that were not chromatographically resolved under very generic chromatographic conditions using a 30 m Restek Rxi-5Sil MS column, 0.25 mm i.d., 0.25 μm film thickness. High resolution, accurate mass data allowed for the calculation of chemical formulas for unknown compounds and to provide tentative identification. The identities of some previously unknown compounds in these eels were verified with authentic standards. Several brominated flame retardants were positively identified in the eel samples including pentabromobenzene and a number of tribromophenoxy compounds. A variety of bromo-chloro compounds, as well as some phosphate flame retardants, were also tentatively identified.

23rd Annual Meeting of the Society of Environmental Toxicology and Chemistry (SETAC Europe). 12–16 May 2013, Glasgow.

The influence of POP and metal contamination in Flemish waterbodies (Belgium) on ecological water quality and biota populations.

Evy Van Ael, Claude Belpaire, Jan Breine, Caroline Geeraerts, Gerlinde Van Thuyne, Ward De Cooman, Ronny Blust and Lieven Bervoets.

Worldwide industrial development, intensive agriculture and high population densities have led to the presence of numerous pollutants in the aquatic environment. These pollutants such as polychlorinated biphenyls (PCBs), organochlorine pesticides (OCPs) and metals, threaten the ecological quality of rivers, canals and lakes, and can cause adverse effects on local invertebrate and fish communities. However, it is hard to determine what pollution level will lead to detrimental effects on population level, because low level effects are not always translated into higher level effects and often they will manifest on a long term base. Indices, such as the Belgian Biotic Index (BBI) and Ecological Quality Ratio (EQR), try to describe the ecological quality of a waterbody by studying its macroinvertebrate or fish communities respectively. The indices are based on several parameters, including species composition ant their tolerance for disturbance. Since a well-balanced and adaptive community of organisms can only be maintained by a healthy ecosystem, the indices reflect the ability of the ecosystem to do so. In this study, pollution concentration levels of PCBs, pesticides and metals in sediment and European eel (*Anguilla anguilla*) of Flemish fresh waters, are linked with the Belgian Biotic Index (BBI) and Ecological Quality Ratio (EQR), as indicators of the ecological water quality. The main objectives of this study were 1) to investigate if ecological water quality, as indicated by BBI and EQR, was correlated with the pollution levels, 2) to determine which parameters (PCBs, metals, O2, water depth,…) influence the ecological status of Flemish waterbodies the most 3) to formulate concentration thresholds from which a community effect occurs.

14th EuCheMS International Conference on Chemistry and the Environment, ICCE 2013, Barcelona, June 25–28, 2013.

The influence of bioaccumulated POP and metal levels on ecological water quality and fish communities.

Evy Van Ael, Claude Belpaire, Jan Breine, Caroline Geeraerts, Gerlinde Van Thuyne, Ronny Blust and Lieven Bervoets.

Pollutants such as persistent organic pollutants (POPs) and metals, threaten the ecological quality of rivers, canals and lakes, and can cause adverse effects on local fish communities. Biotic indices, such as Flanders' Fish-based Index of Biotic Integrity (IBI), assess the ecological quality of a waterbody by evaluating different characteristics of the fish community. Well-balanced and adaptive fish assemblages can only be maintained by healthy ecosystems; hence fish community structure will reflect the ecosystem's health. The index is based on several metrics, including species distribution, trophic composition, reproductive success and their tolerance for disturbance. As the IBI reflects the overall quality of an aquatic ecosystem, it may also depict the potential impact of pollutants. From a governmental point of view, it would be very useful to know to what extent field levels of bioaccumulated pollutants show an effect on ecological quality of waterbodies. This enables defining threshold values of bioaccumulated levels to allow better protection of the aquatic environment (as demanded by the Water Framework Directive). Nevertheless, visualisation of the direct negative correlation between the concentration of a pollutant and the biotic index is not always achievable, because the index is impacted by many other anthropogenic stressors, including modifications in the structure of the riverbed, presence of barriers or eutrophication.

The current study investigates a possible relationship between the presence of pollutants (PCBs, OCPs and metals) and the IBI score (expressed as an Ecological Quality Ratio (EQR), ranging between 0 "bad" and 1 "high status") in waterbodies of Flanders (Belgium), based on concentrations in European eel (*Anguilla anguilla*). To this purpose, databases of long-term monitoring of pollution in eels and IBI have been combined and analysed (1156 fish and 185 locations). The main objectives of this study were to investigate if a decrease in ecological water quality, as indicated by IBI, was related with increasing pollution levels in the European eel, and if possible to formulate concentration thresholds above which a decrease in ecological water quality occurs. A generalized linear mixed model was used to determine which factors (PCBs, metals, O2, water conductivity,…) significantly influenced the ecological status of Flemish waterbodies.

For most pollutants, especially PCBs, arsenic, nickel, zinc and hexachlorobenzene (HCB) a clear decrease in IBI score was observed with increasing concentrations in European eel. This indicates that the presence of pollutants had a direct impact on the ecological quality. For these pollutants, a threshold concentration in eel tissue, above which a good ecological status (EQR≥0.6) was never reached, could be formulated. Only for mercury, the observed levels didn't cause a decrease in EQR.

11.4 Predators

Flemish Region

New 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 for 2012. See 2008 report and the Belgian Eel Management Plan.

12 Other sampling

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

13 Stock assessment

13.1 Method summary

13.2 Summary data

13.2.1 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		

13.2.2 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.**

13.2.3 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 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*
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.**

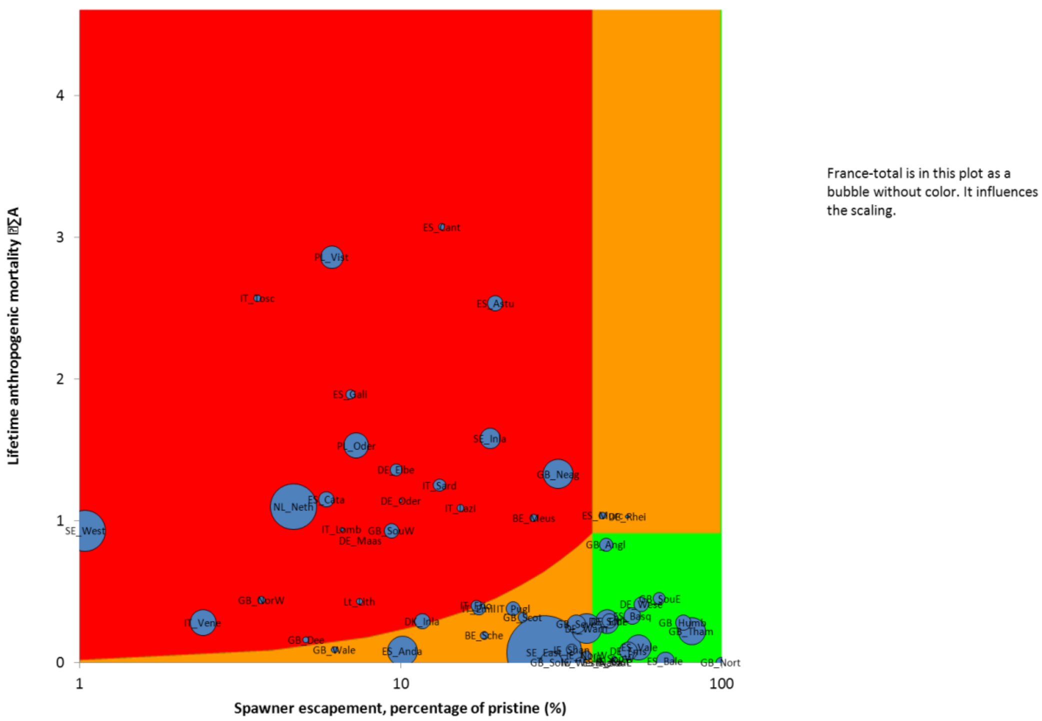
Express the loss in tonnes (t) for each impact per developmental stage or MI = not assessed, minor, MA = not assessed major, AB = impact absent. Where available, also report the total loss as silver eel equivalents, and explain the method used to calculate equivalents in Section 13.1.

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 and Scheldt together and then divided over both basins according to their contribution to overall biomass.**

13.2.4 Precautionary diagram



13.2.5 Management measures

No new information compared to last year's report.

13.3 Summary data on glass eel

See Chapters 3.1.1 and 3.5.1.

14 Sampling intensity and precision

No new data available.

15 Standardisation and harmonisation of methodology

No new 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

Recent (2011–2013) 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. The INBO long-term monitoring series (1991–2012) following the numbers of impinged fish at the nuclear power station of Doel on the Lower Scheldt has been stopped due to a shortness of means.

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 is in the process of being 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. 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.

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 has not been initiated until now.

Some research programmes 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 waterbodies within the WFD has been started 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.

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