Report on the eel stock and fishery in Belgium 2010/'11

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Reporting Period: This report was completed in August 2011, and contains data up to 2010 and some provisional data for 2011.

BE.2 Introduction

This report is written in preparation of the EIFAC/ICES Working Group on Eel meeting in Lisbon (5–9 September 2011). 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 and 2010) and in the Belgian Eel Management Plan (EMP). 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) will be responsible for the implementation and evaluation of the proposed EMP measures on their respective territory.

In the next months and 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 bottlenecks for upstream eel migration (priority and timing for solving migration barriers)

  Specific action in 2010–2011: In Flanders, 38 fish migration bottlenecks of high priority were identified, and some were recently remediated (two fish passes build in the Upper Scheldt, one on the Dyle at Rotselaar (under construction), one on the Kleine Nete at Grobbendonk). In addition, a number of bottlenecks of moderate priority were remediated. In 2010, a study was conducted at the sea sluices of the River IJzer to optimize management of the sluices in order to allow glass eel migration. By a controlled and limited opening of the sluices, glass eel migration could be substantially increased. Through the experience gained it will be possible to set up appropriate management in different salt-freshwater transition sites along the Belgian coast.

- for downward migration: update inventory of draining pumps and fixing priorities for sanitation

  Specific action in 2010–2011: The inventory has been finished. Fixing priorities for sanitation is planned. At the end of 2011, a study of the pumping station at Boekhoute will be performed. The mortar was indeed adjusted to be more fish-friendly. The effect on mortality of eels will be monitored. The study will include estimations of the actual present eel stock and the effective escape of silver eel. This research may contribute to the refinement of the Flemish estimates of current eel densities and production.

- controlling poaching,

  Specific action in 2010–2011: actions have been focused 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 2010–2011: In Flanders 143 kg and 120 kg were stocked respectively in 2010 and 2011.

- achieving WFD goals for water quality

  Specific action in 2010–2011: Flanders continues to work to the development of water treatment infrastructure to achieve the good ecological status and ecological potential for the WFD. In the course of this year, Flanders will fully comply with the Urban Waste Water Directive.

- eel stock monitoring

  Specific action in 2010–2011:

  Glass eel: the monitoring of the glass eel recruitment at Nieuwpoort (River IJzer) has been continued in 2010 and 2011, and will be continued in upcoming years.

  Yellow eel: no specific monitoring for yellow eel has been conceived

  Silver eel: no specific monitoring for silver eel has been conceived

- eel quality monitoring

  Specific action in 2010–2011: Flanders has contributed to the scientific work about the status and effects of hazardous substances on the eel. A significant contribution has been given to the Eeliad programme and to several other international cooperations. Flanders continues to coordinate the European eel Quality Database. Several scientific papers have been issued in 2010 and 2011 (Belpaire *et al*., 2011a, b; Geeraerts and Belpaire, 2010; Geeraerts *et al*., 2011; Roosens *et al*., 2010; Ide *et al*., 2011).

For the Walloon region

- avoiding mortality at hydropower stations
- sanitation of migration barriers on main waterways (especially in the Meuse catchment)

  Specific action in 2010–2011: an operational fish pass was build in the Lower Ourthe river considered as a bottleneck for upstream fish migration.

- Glass eel restocking programme.

  Specific action in 2011: in Wallonia 40 kg of glass eel was stocked in 2011.

- controlling poaching,

  Specific action in 2010–2011: actions have been focused specifically on the river Meuse and in the canals during the night. A great amount of 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).

BE.3 Time-series data

BE.3.1 Recruitment-series and associated effort

BE.3.1.1 Glass eel

BE.3.1.1.1 Commercial

There is no commercial glass eel fisheries.

BE.3.1.1.2 Recreational

There is no recreational glass eel fisheries.

BE.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 is 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 2011.

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).

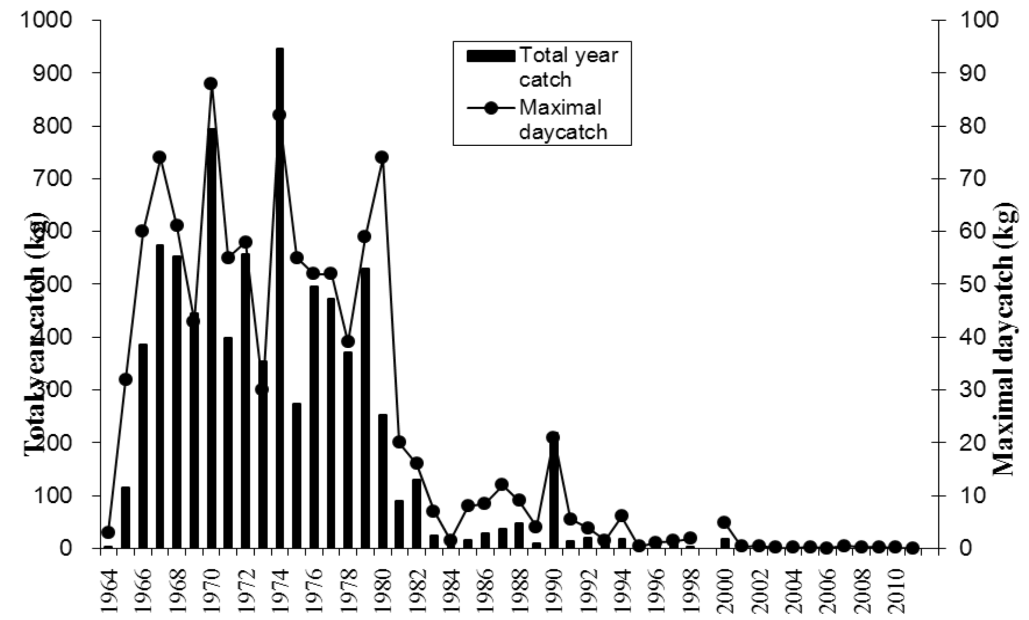


Figure 1A

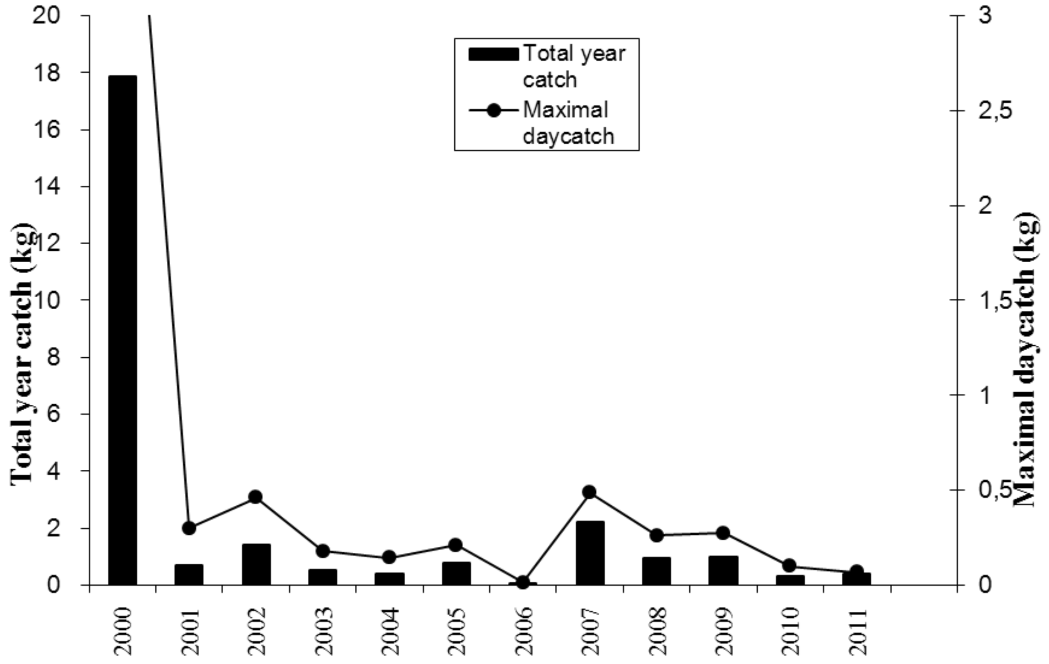


Figure 1B.

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 1964–2011; Figure 1B shows the data for the period 2000–2011. In Table 1 the presented data are the total year catches between 1964 and 2011. 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	
3		354	25	11.8	0.539	
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	

Other glass eel recruitment studies

Since 2004, the glass eel recruitment in the Schelde estuary is monitored by a volunteer (Figure 2). The sampling station is situated in the freshwater tidal zone of the estuary, at the effluent of a sewage treatment plant (N51°02′41″–E4°02′58″). The glass eels hide under stones in the effluent canal, where they are caught with a small handnet. Data that were collected in this way are available since 2004. The number of sampling days differed between years. In 2004, the sampling started only the 8th of

May, the other years on the first of April. In 2010, no monitoring was possible between 12 and 28 May. This series shows a minimum value for 2011.

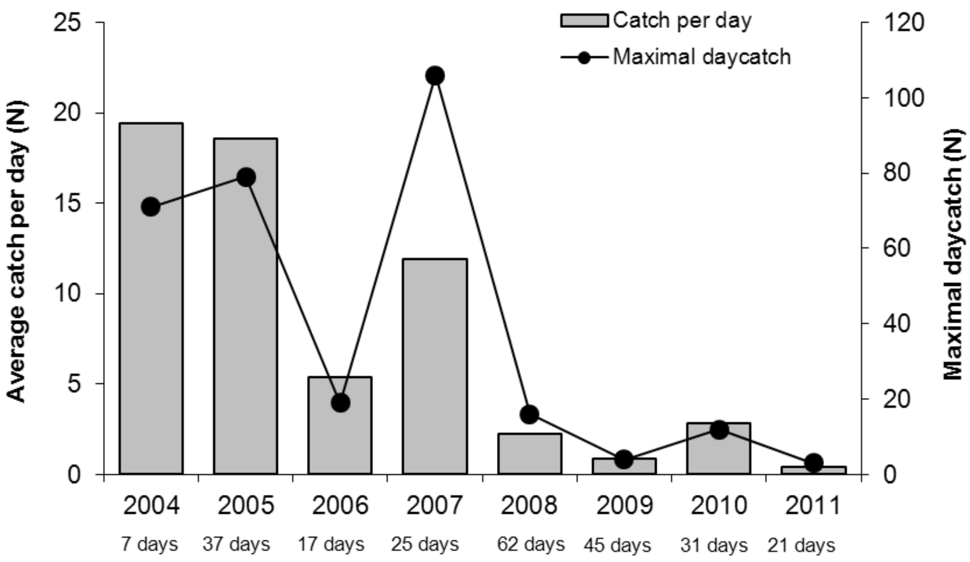


Figure 2. Annual variation in glass eel catches at the sampling station in the Schelde estuary. Data are given as the average number of glass eels caught per day and as the maximal day catch between 1 April and 31 June. The number of sampling days is given below the x-axis.

BE.3.1.2 Yellow eel recruitment

BE.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.

BE.3.1.2.2 Recreational

No data available.

BE.3.1.2.3 Fishery-independent

On the Meuse, the University of Liège is monitoring the amount of ascending young eels in a fish-pass. From 1992 to 2010 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 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 3). 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 with the lowest level (n = 249) ever recorded since the start of the controls (1992, n = 5613). The figure for 2011 will probably be lower. This result continues the decreasing trend in the recruitment of young eels in this part of the Meuse which was particularly marked from 2004 onwards. This warrants a study to see whether eels fail to reach the Meuse in the Liege region by ascending the Albert channel through the Lanaye locks. This kind of study will start in 2012–2014 as a European Fisheries Fund project conducted by the University of Liege.

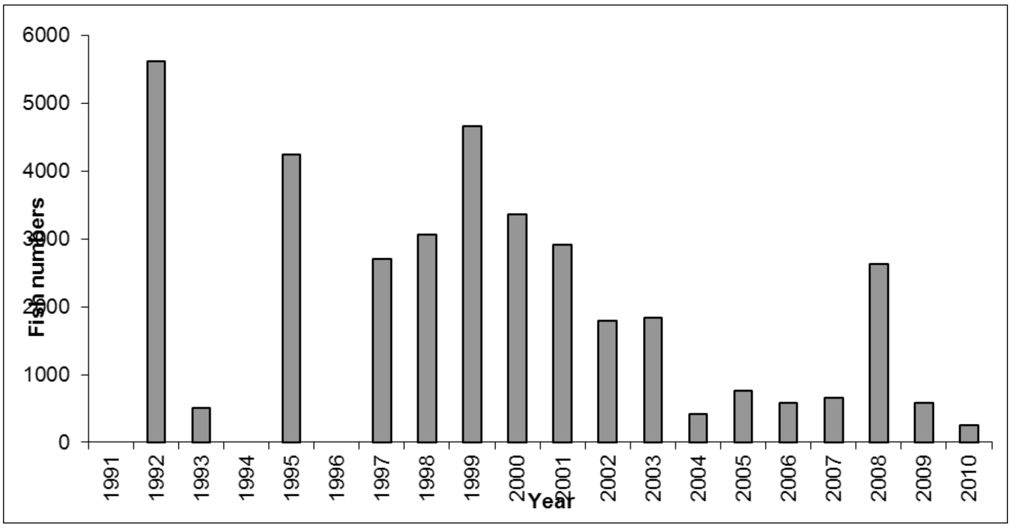


Figure 3. Variation in the number of ascending young yellow eels trapped at the fish trap of the Visé–Lixhe dam between 1992 and 2010. Data from University of Liège (J.C. Philippart) in Philippart and Rimbaud (2005), Philippart (2006) and Philippart and Ovidio (pers. comm., 2011).

BE.3.2 Yellow eel landings

BE.3.2.1 Commercial

See Section 3.1.2.1.

BE.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 estimate for 2010 and 2011 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.

BE.3.3 Silver eel landings

BE.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.

BE.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.

BE.3.4 Aquaculture production

There is no aquaculture production of eel in Belgium.

BE.3.5 Stocking

BE.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 4). Glass eel restocking is proposed as a management measure in the EMP for Flanders.

In recent 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 4 and Table 2). In 2008 117 kg of glass eel from UK origin (rivers Parrett, Taw and Severn) was stocked in Flemish water bodies. 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 was 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 was delivered.

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

Decade				
Year	1980	1990	2000	2010
0	0	0	0	143
1	0	0	54	120
2	0	0	0	
3	0	0	108	
4	0	175	0	
5	0	157.5	0	
6	0	169	110	
7	0	144	0	
8	0	0	117	
9	0	251.5	152	

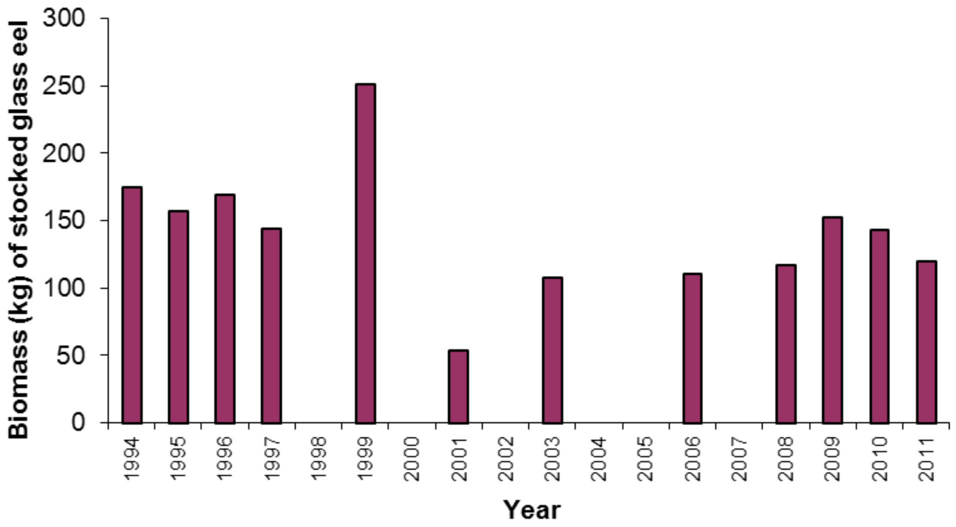


Figure 4 and Table 2. Restocking of glass eel in Belgium (Flanders) since 1994, in kg of glass eel.

Stocking in Wallonia

Stocking of yellow eels in Wallonia

For the Walloon region, no new data were made available for 2008, 2009, 2010 and 2011. Stocking is assumed to be nihil.

Table 3. Restocking of yellow eel in Belgium (Walloon region) over the period 1999 to 2011, in kg of yellow eel. For 2000 and 2001 data were provided as partly biomass and partly numbers. In this case total restocked biomass was calculated using an expected mean weight of 10 g for eels <15 cm, of 20 g for eels 15–25 cm and 100 g for eels >30 cm. (Data Service de la Pêche, Walloon Region).

DECADE				
Year	1980	1990	2000	2010
0			535	0
1			355	0
2			105	
3			101	
4			311	
5			324	
6			0	
7			0	
8			0	
9		1268	0	

Stocking of glass eels in Wallonia

To compensate for the lack of natural recruitment of young eels in Wallonian waters, the Regional Fishery Service performed in April 2011 a first semi-experimental stocking of glass eels purchased in UK. About 120 000 (40 kg) glass eels were released into rivers offering relatively good habitat conditions in the Scheldt basin (R. Dyle) and mostly in the Meuse basin (R. Ourthe, Amblève, Mehaigne, Lesse and Semois). A monitoring programme will be developed to study major biological parameters of the stocked populations: short-term survival in optimal stocking conditions at the Regional Fish Culture of Erezée, dynamic of upstream dispersion in relation to habitat characteristics and physical obstacles, density of sedentary populations, fish growth, survival and health.

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

Catching eels < 12 cm is not allowed in Belgium. Minimal size for recreational fisheries is 25 cm in Flanders. Catching of eel in Wallonia is prohibited.

BE.4 Fishing capacity

BE.4.1 Glass eel

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

BE.4.2 Yellow eel

Professional coastal and sea fisheries

Following a global European downward tendency, the Belgian fleet consisted at the start of 2009 of a total of 100 motorized vessels, with a power of 60 620 kW and a gross registered tonnage of 19 007 GT (De Belgische Zeevisserij Aanvoer en Besomming 2008). The national fishing fleet represents 0.1% of the European fleet, 1.1% of the European tonnage and 0.9% of the total engine power (2005 data). The fleet consists mostly of beam trawlers, the remainder being otter trawlers. There are data available on fishing effort. But as mentioned before, eel catches through professional and coastal fisheries are negligible.

Estuarine fisheries on the Scheldt

Fishing capacity has decreased from 1999 onwards and this fishery has been closed in 2009. The estuarine Scheldt fisheries around 2000 was performed by two boat trawlers (one beam trawler and one otter trawler) and by ca. 30 semi professional fishermen fishing with fykes (estimated at 150 fykes). The trawl fishery was focused on eel, but since 2006 boat fishing has been prohibited, and only fyke fishing was permitted until 2009. The number of licensed fishermen fishing with fykes decreased from 17 in 1999 to nine licenses in 2006–2008. See Figure 5 for a time-series between 1992 and 2009. A license allows a fisherman to use a maximum of five fykenets, which means that at most 45 legal fykenets are used in the estuary. Since 2009 no more licences are issued, which is as a measure of the Eel Management Plan of Flanders to reduce catches. A new Decree (Besluit van de Vlaamse Regering van 5 maart 2010) was issued to regulate the prohibition of fyke fishing in the lower Seascheldt.

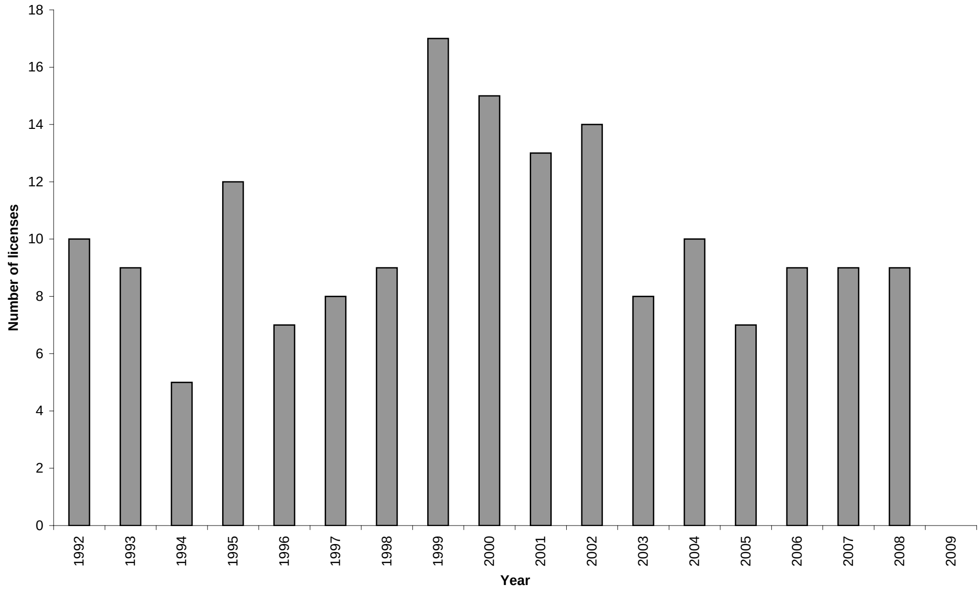
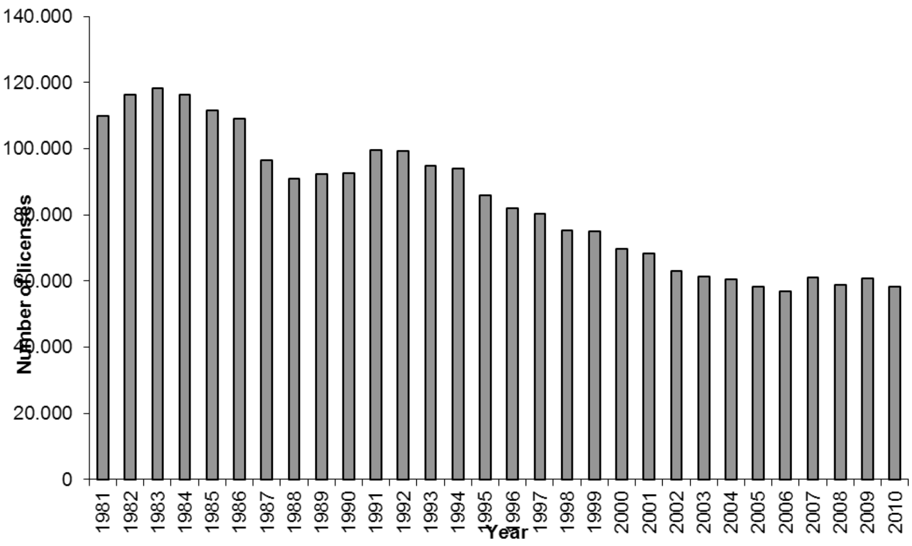


Figure 5. Time-series of the number of licensed semi professional fishermen on the Scheldt from 1992 to 2009 (Data Agency for Nature and Forests).

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, and 58 338 in 2010. 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% fish for eel.



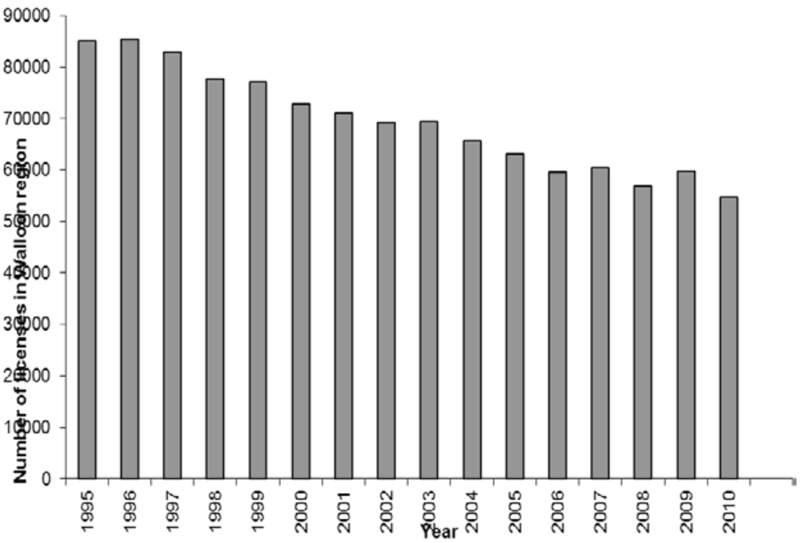


Figure 6. Time-series of the number of licensed anglers in Flanders (above) and Wallonia (below) since 1980 and 1995 respectively (Data Agency for Nature and Forests and Nature and Forestry Division (DNF) of the Walloon Environment and Natural Resources DG (DGRNE)).

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 and 54 636 in 2010 (Figure 6).

Recreational fisheries in the Brussels capital

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

BE.4.3 Silver eel

See Sections 3.3.1 and 3.3.2.

BE.4.4 Marine fishery

See Section 4.2. Professional coastal and sea fisheries.

BE.5 Fishing effort

BE.5.1 Glass eel

There is no professional or recreational fisheries on glass eel.

BE.5.2 Yellow eel

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

BE.5.3 Silver eel

There is no professional or recreational fisheries on silver eel.

BE.5.4 Marine fishery

Marine fisheries on eel is negligible and not documented.

BE.6 Catches and landings

BE.6.1 Glass eel

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

BE.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 and 2011 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).

It is worth mentioning that based on this 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 7).

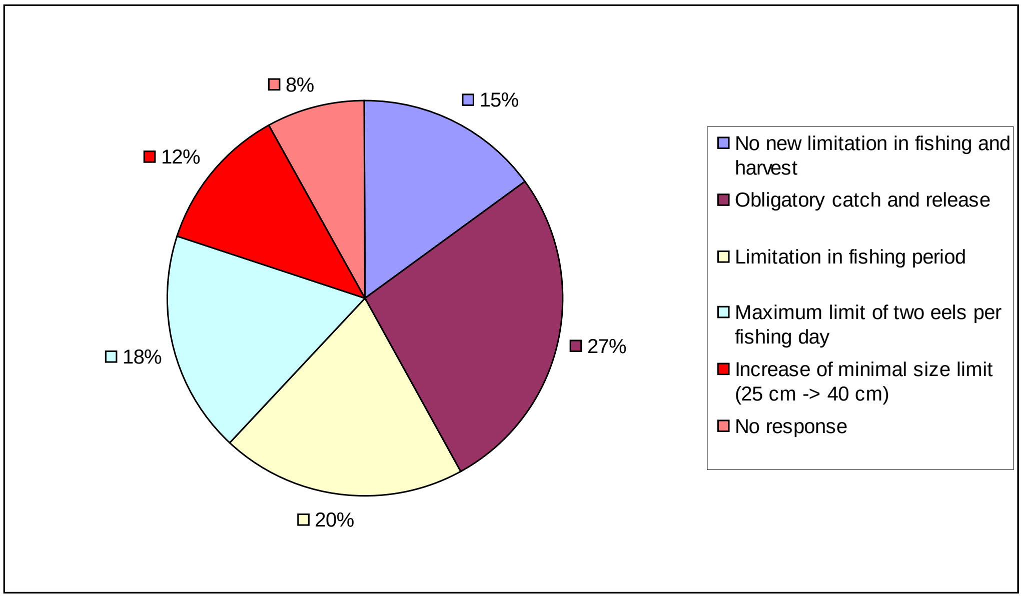


Figure 7. Results of a 2008 inquiry among 10 000 Flemish recreational anglers for their preference in management options for restoring the eel stock. 36 % (N = 3627 anglers) responded (Vlietinck, 2010).

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.

BE.6.3 Silver eel

There is no professional or recreational fisheries on silver eel.

BE.6.4 Marine fishery

Marine fisheries on eel is negligible and not documented.

BE.7 Catch per unit of effort

BE.7.1 Glass eel

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

BE.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 on average eel fishermen are fishing 8.7 kg eel per year.

BE.7.3 Silver eel

There is no professional or recreational fisheries on silver eel.

BE.7.4 Marine fishery

Marine fisheries on eel is negligible and not documented.

BE.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 wastewaters of the capital, has lead 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 (M (2009) 1) 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 8).

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 fish. Therefore, we also accounted for the distribution of the rheophilic species for which Flanders has developed a restoration programme (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.

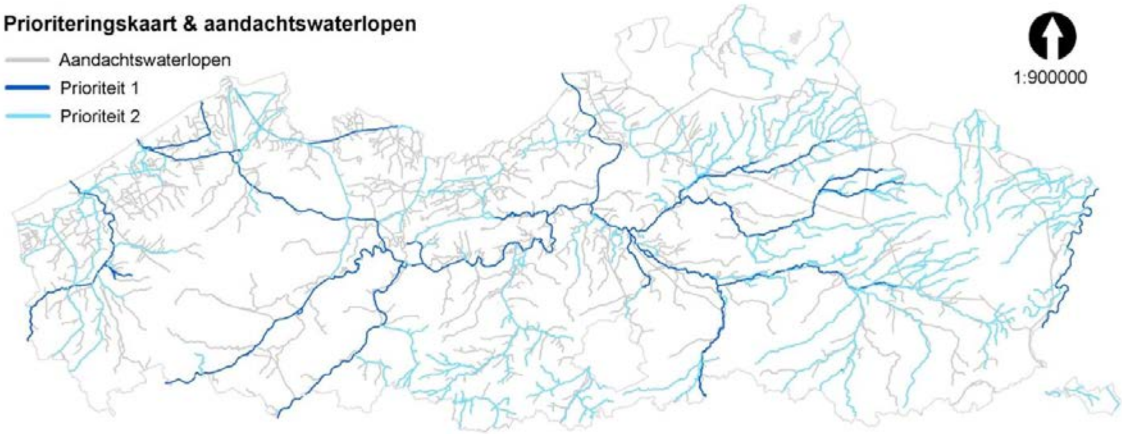


Figure 8. Fish migration prioritization network of Flemish water courses (blue) and water courses of special attention (grey) following the Benelux Decision "Free migration of fish" M(2009)1.

Restoring glass eel migration possibilities at the sluices of Nieuwpoort (mouth of river Yser)

A study was conducted aiming to analyse glass eel migration and to evaluate possible mitigation alternatives at a tidal barrier system of the IJzer river mouth in Flanders. Glass eel were sampled during tidal rise with stownets and lift nets to study their distribution over the study area, while a fykenet was used to evaluate the impact of limited barrier opening on glass eel migration. Glass eel migrating at the barriers appeared to have arrived during a previous tidal cycle, while a density peak was observed in the tidal flow during the last hour before high tide. Limited barrier opening during tidal rise appeared to be a cost-efficient and effective mitigation option to improve upstream glass eel migration, without significant penetration of seawater (Mouton *et al.*, 2009).

Impact of pumping station, type Archimedes screw, on silver eel mortality

The INBO investigated the impact of a pumping station with Archimedes screws on the silver eel migration (Baeyens *et al.*, 2011). Archimedes screws are believed to be less harmful compared to other types of pumping devices (centrifugal pumps, screw pumps, submersible pumps). The 'Isabellagemaal' pumping station is located on the Leopold Canal and has a total capacity of 14 m^3s^{-1} to drain a large polder area in Flanders. Passage through a large (3,6 m^3s^{-1}) and smaller (1,6 m^3s^{-1}) Archimedes screw was monitored. In total 173 eels were caught between October and November 2009. With 131 individuals, passage through the larger pump was highest. Mortality rates for the large and smaller pump were respectively 16 and 19%. These data show that also Archimedes screws may have a substantial impact on the quantity of silver eels succeeding in leaving polder waters for their reproductive journey to the ocean.

Figure 9. Deadly injured silver eels after passage through the Archimedes screw (Baeyens *et al.*, 2011).

New threats for the eel population of the Meuse RBD

From 1989 to 2007 all the mobile weirs on the Meuse in The Netherlands (seven weirs) and in Belgium downstream of Liège (two weirs) have been equipped with modern fish passes allowing an efficient upstream migration of all fish species including reintroduced Atlantic salmon and juvenile eels as illustrated by the study carried on in Visé–Lixhe. This 25-year huge effort to improve fish upstream migration in the Meuse from The Netherlands to Belgium might be jeopardized by the building of two new large hydropower plants in The Netherlands: one in Roermond (project) and one in Borgharen–Maastricht (permits already given to the company but recently suspended thanks to an 'action en justice' by anglers associations). These sites are located in a strategic international migration route: the Meuse at the Belgian–Dutch border. The hydropower plant in Borgharen should have been built in the place occupied by a river-like fish-pass (in operation since December 2007) to be replaced by a vertical slot pool fish-pass with unknown performance for small eels. The major impact of this planned hydro-power plant would likely be on the downstream migrating silver eels (descending from Belgium) because of the absence of any efficient downstream fish-pass. The permit given for this hydropower plant by the Dutch authorities clearly imposed strict conditions and measures for migratory fish protection. But the problem was what would happen (complete or partial stopping, installation of new protection systems, other solutions) if the hydropower plan was constructed and the fish protection facilities were not working adequately.

BE.9 Scientific surveys of the stock

BE.9.1 Glass eel

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

BE.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/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 en 2006–2009. 334 locations were assessed in those three periods (30 on canals and 304 on rivers). In this time spam there is an increase in the proportion of locations where eel are present (Figure 10). This is a similar trend as for the figures with presence/absence of fish in general. Presumably this is the result of the ongoing efforts to increase the water quality in Flemish rivers, resulting in an increase in the number of rivers with a water quality sufficient to allow fish life. However, the proportion of rivers where eel is present is still only 33%. In contrast ca. 90% of locations on canals eels have eels.

If the presence of eel seems to increase, a different trend is apparent for eel abundancies. Figure 11 shows that eel abundances (in terms of catch per unit of effort) are decreasing considerably during this time spam.

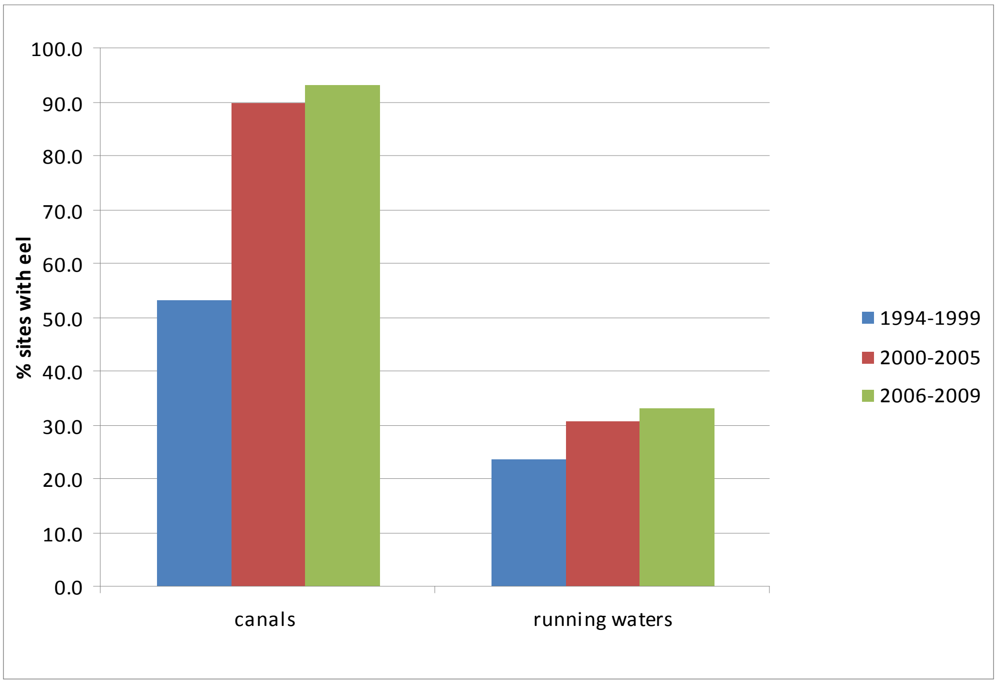


Figure 10. Presence of eels from 334 locations in canals and running water between 1994 and 2009 (the same locations were fished in the three periods) (Source G. Van Thuyne, INBO).

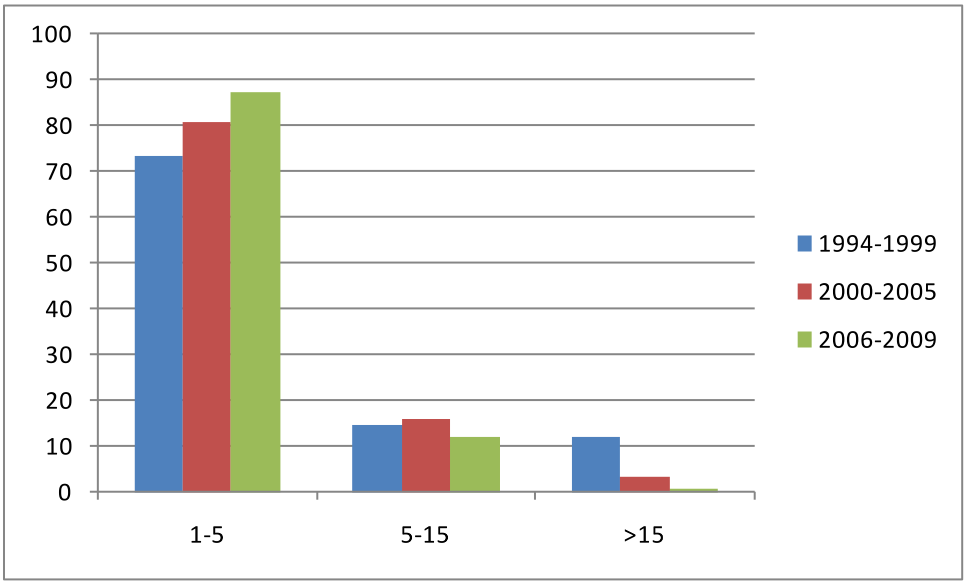
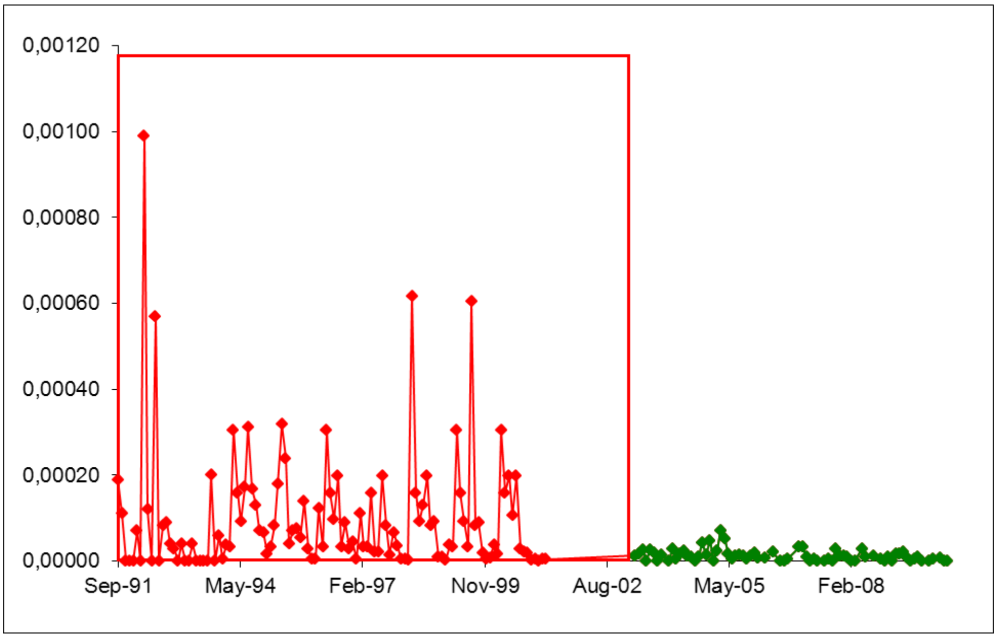


Figure 11. Frequency distribution of the abundance of eels (number of eels/100m EF and number of eels/fyke/24 u) on sites where eels are present in canals and running waters between 1994 and 2009 (the same locations were fished in the three periods). (Source G. Van Thuyne, INBO).

River Scheldt fish monitoring at the power station of Doel

The Catholic University of Leuven and INBO are following the numbers of impinged fish at the nuclear power station of Doel on the Lower Scheldt. The numbers of impinged eels are given in Figure 12.

There is a clear decrease in numbers of eels between period 1991–2001 (red) and period 2002–2011 (green); this is not necessarily reflecting the real state of the stock on the River Scheldt, but might be the result of a change in sampling procedure between both periods. Since 2003, sampling has been standardized to a three hour time span around low tide, which was not the case for the sampling during the earlier period.



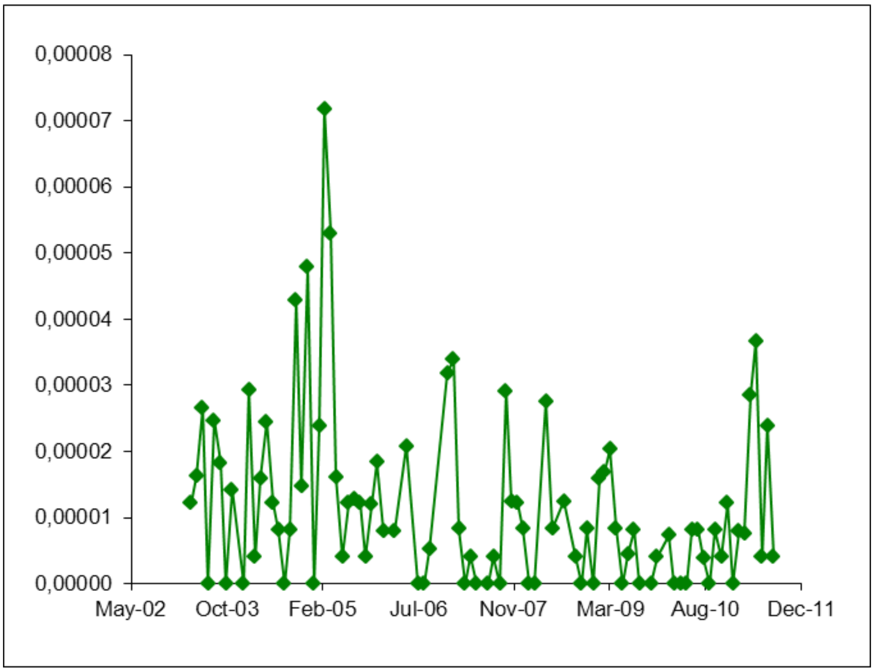
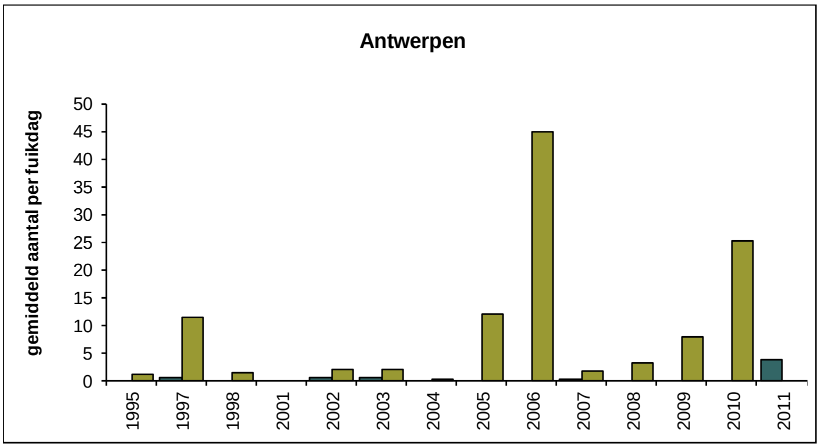


Figure 12. Time-trend in the quantities of eels impinged at the Doel power station on the River Scheldt nearby Antwerp (1991–2010). Quantities are expressed as number of individuals per m³ water. Data period 1991–2001 (red) from Maes *et al.* (2005); period 2002–2009 (green) from Wambacq (2010). Data KU Leuven and INBO. Later data from INBO.

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, one or two double fykenets were positioned at low tide and emptied daily; they were placed for two successive days. Data from each survey per site was standardized as number of fish per fyke per day. Figure 13 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 (1.38 eels/fykeday). This could be due to the applied methodology. However, a decline is apparent as no eel was caught in Zandvliet since 2007. On the other hand, since 2005, more eel was caught upstream in the oligohaline zone (Antwerpen (9.43), Steendorp (4.73)) and freshwater zone (Kastel, 6.83). Generally eel catchability is higher in autumn than in spring. (Data Jan Breine, INBO).


Antwerpen
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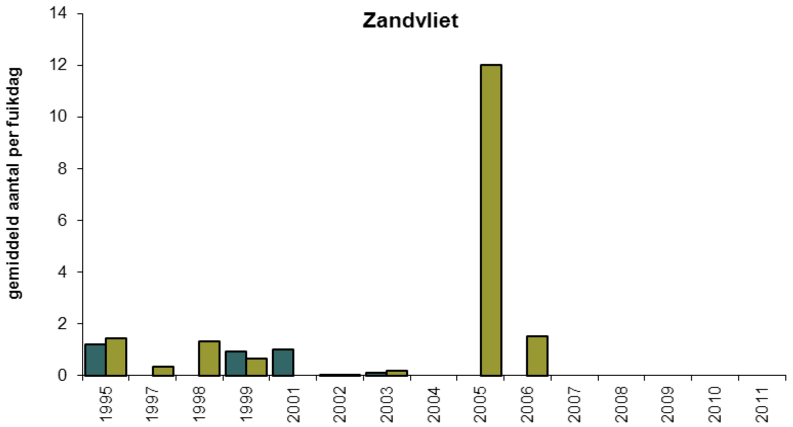
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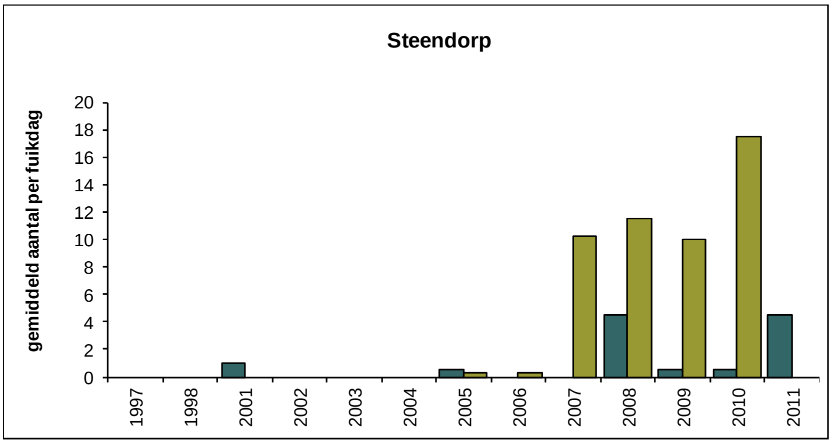
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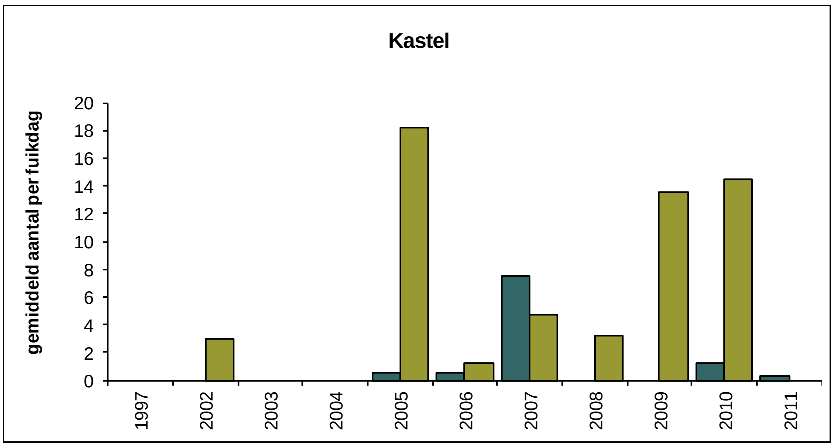


Figure 13. Time-trend of fyke catches of eel along the River Scheldt estuary. Numbers are expressed as mean number of eels per fyke per day. Data are split up in spring catches (light green) and fall catches (dark green). Data Jan Breine, INBO.

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. In March–June 2009, radio-tagged eels (505–802 mm; 220–1226 g) occupied longitudinal home ranges ranging from 2 m (0,002 ha) to 341 m (0,3 ha) and displayed cumulated net movements ranging from 9 to 940 m with an average value of 305 m. Eels were a little less mobile in habitat with natural flow (more stable) than in habitat with reduced flow (less stable) due to water abstraction for hydropower generation. Telemetry data on microhabitat use reveal a strong preference of eels for blocks, undercuts banks and tree roots. Improving the quantity and quality of these types of microhabitats in the river stretch should help increase the carrying capacity and hence the eel population density. This management hypothesis remains to be tested in the field (study by Seredynski, 2009 reported in Philippart *et al*., 2010).

BE.9.3 Silver eel

No new data on silver eel escapement are available.

BE.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.

BE.11 Other biological sampling

BE.11.1 Length and weight and growth (DCF)

Flemish Region

Length and weight data of individual eels collected through the freshwater fish monitoring network are available via the website http://vis.milieuinfo.be/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 14).

Following equation was found:

W = 0.0011 L3.130
$r^2 = 0.98$

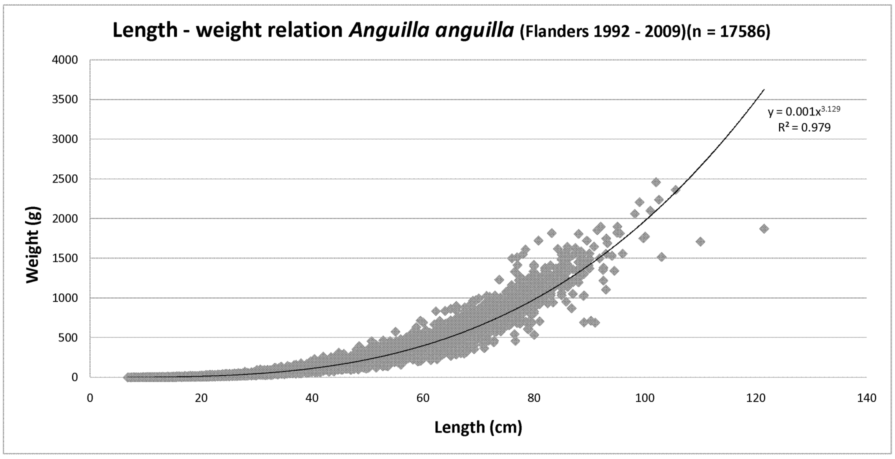


Figure 14. Length–weight relation of European eel (n = 17 586) sampled over Flanders in the period 1992–2009.

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 15).

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).

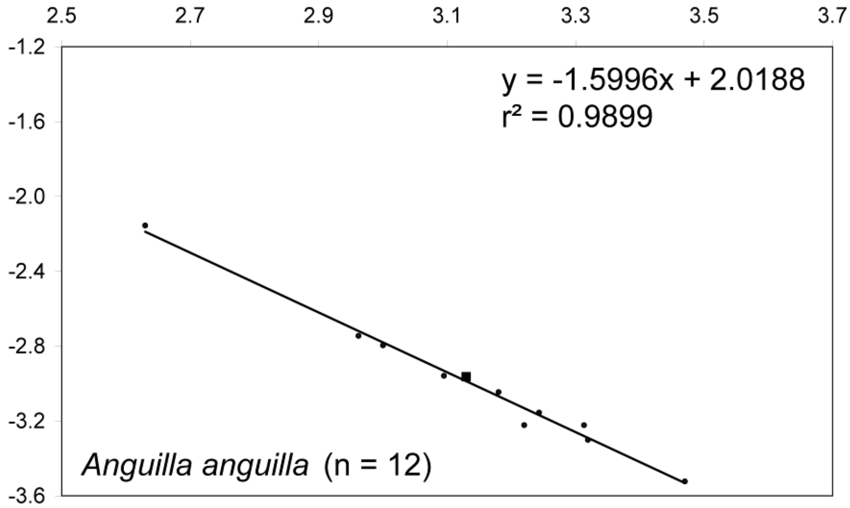


Figure 15. Estimated intercepts ($\log_{10}a$; Y-axis) vs. estimated slope (*b*; X-axis) for the $\log_{10}$ transformed L/W regression and regression line for European eel from European datasets, as available in FishBase (Froese and Pauly, 2010), compared to the Flemish populations (■; 1992–2009). Linear regression equation and r^2 are given (n = number of L/W relationships, including Flanders). (Verreycken *et al*., 2011).

A study on head shape dimorphism

Both glass eels and yellow eels were sampled from different locations. Glass eels were sampled in 1994 and originated from the Yser river mouth. Yellow eels were sampled during the period 2001 till 2007, relying on specimens obtained in other sampling campaigns (INBO eel pollutant monitoring network) as well as samplings at Lippensbroek and Lake Weerde in the frame of a UGent Special Science Foundation funded research project (collaboration UGent, INBO and UA). Studies focused on head shape variation, where Ide *et al*. (2011) provided statistical support for bimodality in yellow eel head shape (broad vs. narrowheaded phenotypes) in all locations. Surprisingly, this bimodality in head shape was also supported at the glass stage (Ide *et al*., in prep.), which suggests an early onset of phenotypic divergence. However, current data does not allow rejecting or supporting the hypothesis that this dimorphism is environmentally induced.

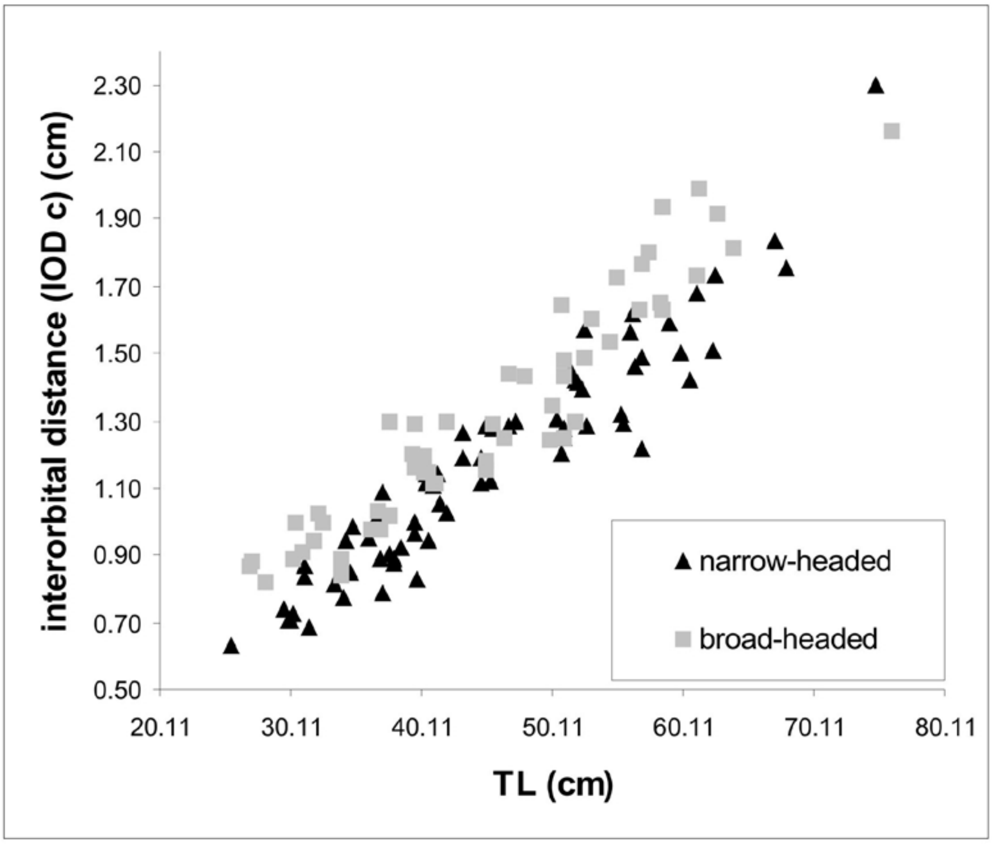


Figure 16. Graph representing size-independence of broadheadedness vs. narrowheadedness (interorbital distance at the level caudal border of the eye plotted against total length). From Ide *et al.*, 2011 Journal of Zoology.

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.

BE.11.1 Parasites and pathogens

Flemish Region

No new information compared to earlier reports.

Walloon Region

No new information compared to earlier reports.

BE.11.2 Contaminants

A comprehensive review on literature on the impacts of contaminants on metabolic functions and on behaviour of the eel (see last year's country report). This report has now been published (Geeraerts and Belpaire, 2010). It includes a figure with the variation in PCB 180 in eel over eleven European countries (Figure 17).

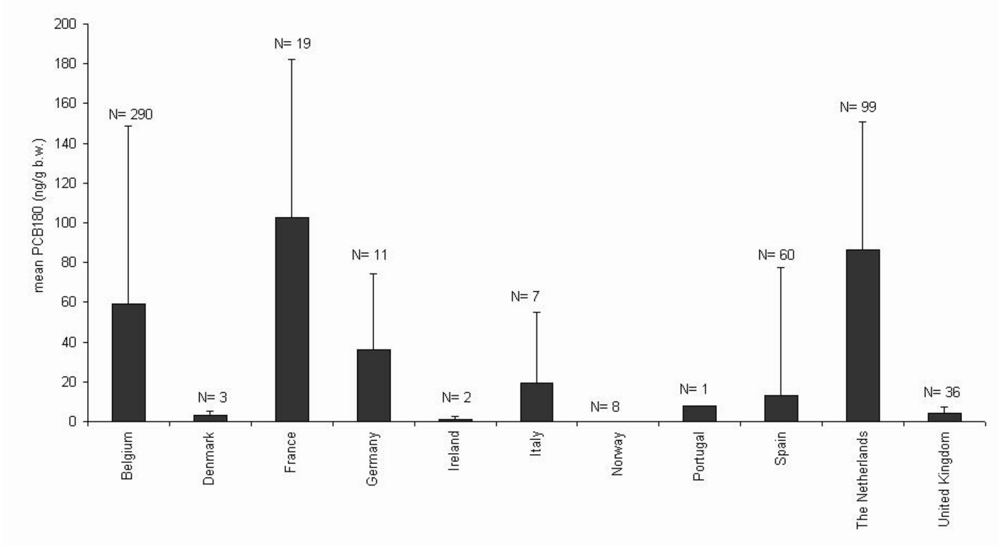


Figure 17. Mean concentration of PCB 180 (ng/g b.w.) in 11 countries in European eel muscle as reported recently (Belgium: INBO Eel Pollution Database (http://visapp.milieuinfo.be/pages/welcome.do); Denmark: Erichsen *et al.*, 2000; France: Durrieu *et al.*, 2005; Tapie *et al.*, 2006; Germany: Gaumert *et al.*, 2001; 2002; Bladt and Jansen, 2002; Krinitz *et al.*, 2002; Gaumert *et al.*, 2003; Bergemann and Gaumert, 2005; Ireland: Santillo *et al.*, 2005; Italy: Orban *et al.*, 2004; Mancini *et al.*, 2005; Storelli *et al.*, 2007; Norway: Knutzen *et al.*, 1998; 1999; 2001; Portugal: Bordajandi *et al.*, 2003; Santillo *et al.*, 2005; Spain: Sanchez *et al.*, 1997; Bordajandi *et al.*, 2003; Usero *et al.*, 2003; Santillo *et al.*, 2005; Alcaide and Esteve, 2007; The Netherlands: Pieters *et al.*, 2005; Hoogenboom *et al.*, 2007; Hoek-van Nieuwenhuizen and Kotterman, 2007; United Kingdom: Foster, 2005. The number of sites is indicated (N). (From Geeraerts and Belpaire, 2010; for full references see this paper).

Roosens *et al.* (2010) assessed the degree of pollution with the brominated flame retardants PBDEs and HBCDs in pooled eel samples from 50 locations in Flemish waters collected in the period 2000–2006. Concentrations of ∑PBDE ranged between 10 and 5811 ng/g lipid weight (lw). ∑HBCDs ranged between 16 and 4397 ng/g lw, with a median value of 73 ng/g lw. Comparison with previous studies shows that PBDE and HBCD levels in Flemish eels have decreased rapidly between 2000 and 2008 at some particular sites, but also that alarming concentrations can still be found at industrialized hot spots. Human intakes of eel by fishermen were above reference doses described in literature to induce adverse effects. These data have been submitted for inclusion in the EEQD during the Hamburg meeting in 2010.

Belpaire *et al.* (2011a) analysed 30 polychlorinated biphenyl (PCB) congeners in pooled muscle tissue samples of eel collected from 48 sites in Flanders between 2000 and 2007. There was a large variation between individual sites (range 11–7752 ng/g wet weight (ww) for the sum of the ICES 7 PCBs), eels from the River Meuse basin (mean 1545 ng/g ww) being considerably more polluted than those from the River Scheldt (615) and IJzer (61) basins. Overall, PCB 153, PCB 138 and PCB 180 were the most prominent congeners, however PCB patterns varied between the monitored locations. Analysis of the weight percentage of congeners demonstrates obvious differences in PCB composition between sites, indicating differential sources of pollution. It was shown that atmospheric fallout does not seem to be the main source of the PCB spread, but instead both local and upstream sources linked to industrial activities seem to be the main cause for PCB presence in Flanders. These results emphasize the potential significance of PCBs in the decline of the eel and support (inter)national eel management (e.g. by taking PCB levels into account when designing glass eel restocking programmes).

On average, five congeners contribute up to 52.7% of the total PCB load (30 congeners). In all samples, these dominant congeners were PCB 153 (17.5%), PCB 138 (11.5%), PCB 180 (8.6%), PCB 187 (7.7%) and PCB 149 (7.4%). In Europe, PCBs 153 and 138 are the most dominant PCB congeners in eels, but the relative abundance of individual congeners in the samples vary depending on the origin and country considered. In the River Garigliano (south Italy) of a total of 20 PCBs, the four most dominant in eels were PCB 138 (22.9%), PCB 153 (18.9%), PCB 118 (12.4%) and PCB 180 (10.0%) (Ferrante *et al.*, 2010), while in Italian eels from the Lesina lagoon (east coast) PCB 153 (19.8%), PCB 138 (18.9%), PCB 118 (15.3%), PCB 101 (14.7%) and PCB 180 (12.3%) were the most dominant (Storelli *et al.*, 2006). In Germany, Fromme *et al.* (1999) reported PCB 138 (21.7%), PCB 153 (19.3%), PCB 118 (19.2%), PCB 180 (8.7%) and PCB 101 (6.2%) as most prominent in eels from Berlin. Apparently, Flemish eels are characterized by a larger proportion of PCB 153 and PCB 180 compared to the other European countries (Figure 18). Within Flanders, PCB composition also varies between sites. Considering the levels of the Sum 7 PCBs, eels are not compliant with the Belgian legal limits for consumption (75 ng/g ww) in 71% of the sites. Regular consumption of eels from the most polluted sites leads to exceeding the WHO Acceptable Daily Intake values by a factor 375. Clearly, recommendations to fishermen to avoid consumption of their own catch are not effective: an inquiry among 10 000 recreational fishermen in 2008 indicated that annually 33.6 tons of eels are fished in Flemish waters and taken home for personal consumption (Vlietinck, 2010). The authors therefore recommend more stringent public health measures to prevent fishermen and their families from consuming their catch. Consumption of wild eels should by all means be prevented, as it presents risks for human health, especially for local anglers consuming their catch. The data of this report has been submitted for inclusion in the EEQD during the Hamburg meeting in 2010 (Belpaire *et al.*, 2011a).

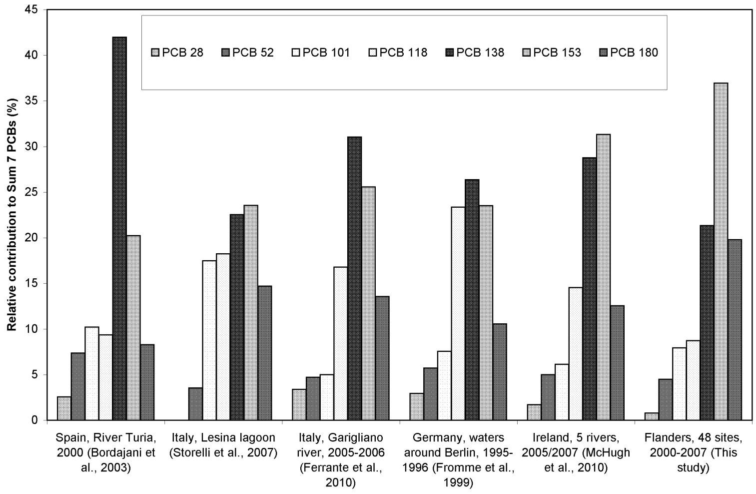


Figure 18. Weight % of the ICES 7 PCB congeners based on Sum 7 PCBs in eels from several European studies. In the case of the Lesina lagoon, PCB ratios were calculated on Sum 6 PCBs, as PCB 28 measurements were not available in this study (Storelli *et al.*, 2007) (From Belpaire *et al.*, 2011a).

In order to gain insight in the current status of pollution by dioxins and related compounds, in Flanders, a baseline spatial analysis was conducted in (yellow) eel from 38 locations (Geeraerts *et al.*, 2011). Spatial variation in the level of dioxin pollution might indicate areas of concern for these substances. Results also give an indication of the current dioxin concentrations in Belgian wild eel in relation to the international food safety standards and the health of the Belgian eel population. Dioxin concentrations in eel vary considerably between sampling sites, indicating that they are good indicators of local pollution levels. Measured levels of dioxin-like PCBs (DL-PCBs) are much higher than those of the dioxins (PCDDs) and furans (PCDFs). The majority of Flemish eel from this study had levels considered to be detrimental for their reproduction. Field levels of dioxins and DL-PCBs are therefore suggested as a further contributing causal factor in the decline of the European eel. In almost half of the sampling sites show especially DL-PCB levels exceeding the European consumption level (with a factor 3 on average; Figure 19). Human consumption of eel, especially in these highly contaminated sites, seems unjustified.

The European maximum limit for the sum of dioxins and dioxin-like PCBs (ΣWHO-PCDD/F+DL-PCBs TEQ) in muscle meat of eel and products thereof is expressed in toxicity equivalents. It is set on 12 pg TEQ g^{-1} fresh weight. In this study the levels of this sum varied between 1.14 and 142 pg TEQ g^{-1}. In 42% of the sampling sites the limit is exceeded (Figure 19). Palstra *et al.* (2006) reported disrupting effects in the embryonic development of eel, occurring at levels below 4 pg TEQ kg^{-1} gonad. In a Japanese study it was determined that about 20% of the dioxins in adult female crucian carp were transferred to the eggs (Kajiwara *et al.*, 2007). Applying this conversion rate to eel, by calculating the mass of eggs which could be produced by using all available lipids through a conversion factor of 1.7 g eggs g^{-1} fat (as used in van Ginneken and van den Thillart, 2000), ΣPCDD/Fs+DL PCBs levels in eggs would range between 1.4 and 593 pg WHO_{1998} TEQ g^{-1} (mean 42.0 pg WHO_{1998} TEQ g^{-1}), which, compared to the Palstra *et al*. (2006) benchmark of 4 pg WHO_{1998} TEQ g^{-1} , suggests that in 79% of the sites, levels are high enough to induce disrupting effects in eel eggs. As arguably, the semelparous eel will use a larger proportion of her body lipids to form eggs, compared to an iteroparous species such as the crucian carp, these data may be an underestimation.

The contribution of the DL-PCBs to the total-TEQ value is significant and consistent, regardless of the sampling site (mean 91%, range 72.5–97.7%; Figure 19). In the Congovaart (COM), the contribution of DL-PCBs to the total-TEQ is as high as 97% while the lowest contribution is found in the Handzamevaart (HV) with 72.5%. Due to its high toxicity, DL-PCB congener 126 is the most prominent DL-PCB. A maximum concentration is reached in Mid-Flanders at the Congovaart (409 152 pg g^{-1} fresh weight). The broad range in ΣDL-PCBs and ΣPCDD/Fs concentrations monitored in the current study is likely due to the large variety in environmental pressure at sampling locations, from large rivers or canals in highly industrialized areas to small rural creeks. The Handzamevaart stands out with high levels of ΣPCDD/Fs (110.5 pg g^{-1} fresh weight) which is surprising, as it is situated in an agrarian area known for its strong pesticide pollution. A possible source is unclear. The Congovaart and the Canal Bocholt-Herentals are well-known for their high PCB load and they belong to the most PCB polluted waters in Belgium. They run through an important industrial area including energy production and power transformation industries, which are possible historical sources of PCB contamination. Similar reasons lay at the basis of high levels in the Albertcanal (AK), Canal Dessel-Schoten (KDS) and Old Meuse (OM). Dioxin profiles seem to differ from catchment to catchment and probably will depend of local pollution sources. Many questions arise of what the causes of these specific contamination profiles are. Apparently, local specific sources with typical profiles are responsible for this variation in pollution profiles in the eel. Further research is required to identify these local sources.

The highest human exposure risk is through the consumption of fish, containing more contaminants than most other food products (Leonards *et al*., 2005). Hence fish consumption can lead to an increase in (human) body burden. Health effects are expected through the long-term exposure of the most sensitive part of the population, i.e. recreational fishermen consuming self caught eel from contaminated locations. So, the Total Daily Intake standard (4 pg WHO TEQ per kg body weight per day (WHO, 2000) aims at lowering the intake of dioxins and related compounds in order to prevent tissue levels from reaching critical concentrations (Hoogenboom *et al*., 2001). Thus, in such cases, an advice to limit consumption of fish from such areas may be the most appropriate risk management option to decrease the intake of dioxins and related compounds (Geeraerts *et al*., 2011).

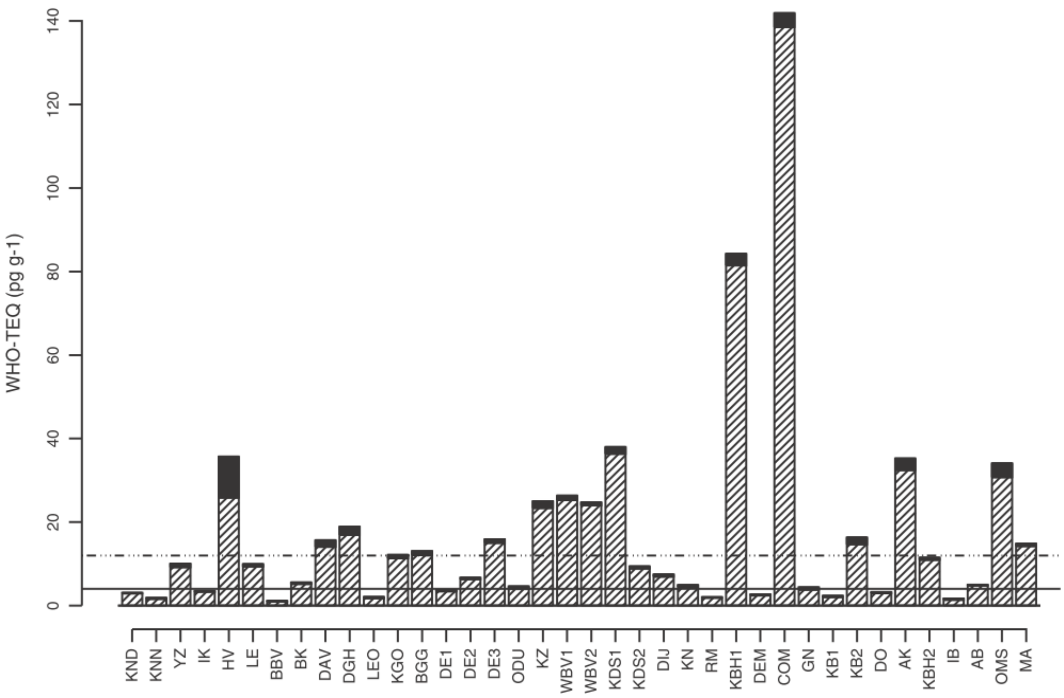


Figure 19. Concentrations of DL-PCBs-TEQ (white striped) and PCDD/Fs-TEQ (black) in eel muscle tissue from pool samples in Flanders. For comparison, the permitted maximum levels of the EC Regulation (EC, 2006) are drawn parallel with the X-axis: (—) maximum level PCDD/Fs =4 pg WHO_{1998} TEQ g^{-1} fresh weight, (–····–) maximum level PCDD/Fs and DL-PCBs =12 pg WHO_{1998} TEQ g^{-1} fresh weight (Geeraerts *et al.*, 2011).

Recent work (Reyns *et al.*, 2010) investigates the possible presence of dye residues in yellow eel muscle. About hundred eels, captured in Flanders (Belgium) between 2000 and 2009 were analysed for 14 dyes, i.e. triarylmethanes, xanthenes, phenothiazines and phenoxazines. Preliminary results indicate that contamination of eels was present for malachite green, crystal violet and their respective leuco-metabolites. The presence of dyes was ascertained in approximately 35% of the sites. Concentrations ranged typically between 0.25 and 9.51 ng/g ww. None of the dyes are registered for use as veterinary drugs. Nevertheless, some of them are widely illegally used in fish-farming industry against protozoan, fungal and bacterial infections. These dyes could be of concern due to possible toxicological properties, but their effect on the eel is still unclear. These preliminary findings warrant further investigation on the presence of these chemicals in our environment, their potential effects on aquatic organisms and the dietary exposure by humans.

A paper (Belpaire *et al.*, 2011b) has been published in the journal *Environmental Monitoring and Assessment* aiming to describe the objectives, the set up and future development of the database in order to give it greater publicity and to call on scientists or managers to submit data on eel health status. The database represents now the first comprehensive pan-European compilation of eel health data, including data from over 10 000 eels from approximately 1200 sites over 14 countries. Preliminary work has indicated a number of shortcomings and future developments will be needed. Guaranteeing further development of the database, harmonization of methods, quality assurance, and setting up harmonized eel monitoring strategies over Europe will be a great challenge and will need pan-European cooperative work. This paper includes some overview tables and figures about eel quality monitoring over Europe. Specifically, there is a table with an overview of information and eel health descriptors included in the European Eel Quality Database, and a table with the number of records of eel quality data over quality elements reported by European countries and compiled by WGEel (2007–2010) in the European Eel Quality Database. A figure with the densities of records of PCBs and the swimbladder nematode *Anguillicoloides crassus* in eel in European countries is presented. Another figure represents levels of PCBs and prevalences of *A. crassus* in eel from several European countries. We refer to the full paper for details.

A FNRS–FRFC study has been started in the Walloon Region to study the effects of hazardous substances on the nervous system of the eel ("Integrated study of the impacts of pollutants on the nervous system of the European eel, *Anguilla anguilla*" by Jean-François Rees, Jean-Pierre Thomé, Cathy Debier, Marc Ylieff, Patrick Kestemont, Frédéric Silvestre). The effects of pollutants on the nervous system were described for numerous species. An important induction of cyt-P450 was revealed in the brain of numerous vertebrates, among which of the fish and particularly in the olfactive bulbs. The increasing activity of this enzyme can generate excessive quantities of reactive oxygen species (ROS) causing oxydative damages in the neuronal cells. Numerous pesticides are inhibitors of the acetylcholine esterase (AChE) which can disrupt the functioning of cholinergic synapses of the central and parasymphatic nervous systems. To the eel, the AChE activity is strongly reduced in the eyes of animals contaminated by a pesticide like carbamate. To other species, it is demonstrated that the tyrosine hydroxylase, the enzyme that limits the synthesis of the dopamine (DA), is inhibited by certain PCBs, what reduces the contents of DA in synaptosomes, PCBs also affects the vesicular monoamine transporter (VMAT) it favours the production of ROS and the appearance of an oxydative stress in dopaminergic nerve endings. Dopaminergic system is particularly involved in the functioning of the olfactive system. So, antagonists of the DA inhibit the olfactory memory of mammals. The nervous ways using serotonin are also affected: the activity of the tryptophane hydroxylase (TPH) and the serotonin content that this enzyme synthetizes, are reduced by an exposure to PCBs. By the effects on neurones, pollutants exercise effects on the behaviour of animals such as hyperactivity, or a disturbance of the schooling behaviour to the fish *Oryzias latipes*. Recent studies show that Cd can interfere with the olfactive system of the mouse and penetrate into the brain by this way and can modify the neurogenesis to the streak fish or still the proteome of the brain of *Paralichthys olivaceus*. This study postulates that pollutants found to the European eel exercise effects on the nervous system of fish and affect in particular their olfaction. The objective thus is to study in vitro and in vivo the effects of sublethal concentrations of pollutants on the nervous system of the European eel by integrating several additional approaches (proteomic, transcriptomic, biochemical and behavioural) to bind the cellular and behavioural effects. The results will allow verifying the possibility that the neurological effects of pollutants can play a significant role in the regression of the European eel populations.

BE.113 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 2010. See 2008 report and the Belgian Eel Management Plan.

BE.12 Other sampling

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

BE.13 Stock assessment

BE.13.1 Local stock assessment

Until now, no special eel stock assessment in the framework of the Belgian Eel Management Plan has been set up. There is no formal advice based on results of scientific surveys on fisheries management.

BE.13.2 International stock assessment

BE.13.2.1 Habitat

Wetted area: lacustrine

riverine

transitional and lagoon

coastal

See EMP.

BE.13.2.2 Silver eel production

BE.13.2.2.1 Historic production

EMU Scheldt (only Belgian part): 167 tons silver eel

EMU Meuse (only Belgian part): 53 tons silver eel

Source : Belgian EMP

BE.13.2.2.2 Current production

EMU Scheldt (only Belgian part): 45 tons silver eel

EMU Meuse (only Belgian part): 41 tons silver eel

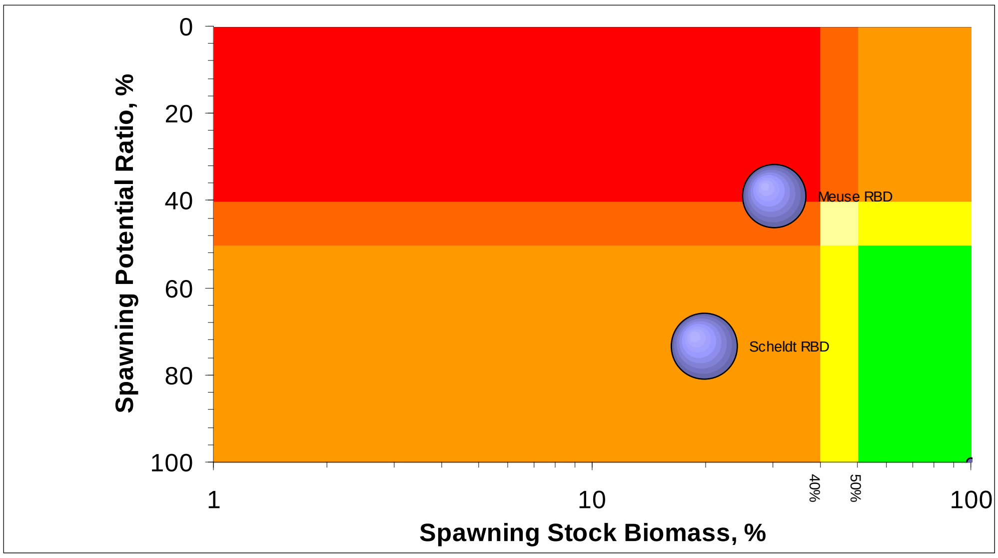
Source : Belgian EMP

BE.13.2.2.3 Current escapement

EMU Scheldt (only Belgian part): 33 tons silver eel

EMU Meuse (only Belgian part): 16 tons silver eel

Source : Belgian EMP



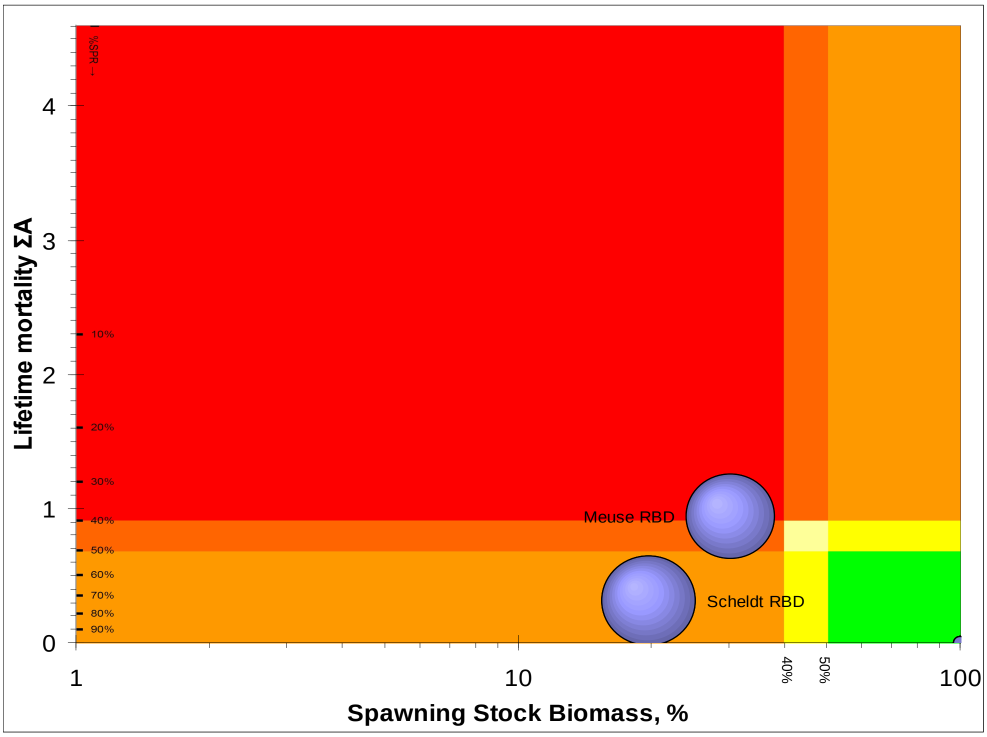


Figure 20. Precautionary diagrams Spawning Potential Ratio (above) and Lifetime Mortality (below) vs. Spawning–Stock Biomass estimated for Scheldt and Meuse river basin districts (Source Belgian EMP).

BE.13.2.2.4 Production values e.g. kg/ha

Production values of silver eel were calculated on following basis:

EMU Scheldt: 10 kg silver eel production/ha

EMU Meuse: 10 kg silver eel production/ha

BE.13.2.2.5 Impacts

The impact of several pressures on silver eel have been estimated in Flanders for the Scheldt and the Meuse RBD (Stevens *et al.*, 2009). See Tables 4 and 5, for an overview. These data are only for the Flemish part of the Meuse and Scheldt RBD.

Table 4. Estimated mortality of silver eel by predation, fisheries, pumps and hydropower in the Flemish part of the Scheldt RBD (Stevens *et al.*, 2009).

Sub-basin	Predation	Fyke fishing	Recreational fishing	Pumps	Turbines
Lower Scheldt	0.34	0.91	2.08	0.38	
Upper Scheldt	0.02		0.03		
Brugse polders	0.42		0.60	0.31	
Demer	0.03		0.03		
Dender	0.00		0.02	0.00	
Dijle	0.04		0.14	0.00	0.07
Gentse kanalen	0.21		0.25	0.34	
Yzer	0.34		0.32	1.08	
Leie	0.05		0.05		
Nete	0.27		0.78	0.04	
Total	1.72	0.91	4.30	2.15	0.07

Table 5. Estimated mortality of silver eel by predation, fisheries, pumps and hydropower in the Flemish part of the Meuse RBD (Stevens *et al.*, 2009).

Sub-basin	Predation	Fyke fishing	Recreational fishing	Pumps	Turbines
Meuse	0.21		0.69		0.24

BE.13.2.2.6 Stocking requirement eels <20 cm

The Belgian EMP describes an evaluation of the biomass of eels <20 cm required to stock Belgian waters. Figures are based on a restocking rate of 1 kg/ha.

Table 4. Amounts of eel required annually for restocking in Belgium.

Region	Surface suited for restocking	Restocking rate	Amount required
Flemish Region	1500 ha	1 kg/ha	1500 kg glass eel
Walloon region	700 ha	1 kg/ha	700 kg eel <20 cm

BE.13.2.2.7 Data quality issues

BE.14 Sampling intensity and precision

See under Section 11.1: Until now, no special eel stock assessment in the framework of the Belgian Eel Management Plan has been set up.

BE.15 Standardization and harmonization of methodology

See under Section 11.1: Until now, no special sampling or eel stock assessment in the framework of the Belgian Eel Management Plan has been set up.

BE.15.1 Survey techniques

BE.15.2 Sampling commercial catches

BE.15.3 Sampling

BE.15.4 Age analysis

BE.15.5 Life stages

BE.15.6 Sex determinations

BE.16 Overview, conclusions and recommendations

Conclusion

All recent (2011) data from recruitment-series or other scientific stock indicators in Belgium indicate a further decrease of the stock, even compared to 2008 and 2009. Recruitment-series stay at extremely low levels.

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, restocking practices 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.

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 programmes 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.

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 in the 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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Report on the eel stock and fishery in Canada 2010/'11

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Reporting Period: This report was completed in August 2011, and contains data up to 2010.

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CA.2 Introduction

In Canada, the American eel (*Anguilla rostrata*) was designated in 2006 as a species of Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). This designation did not give any legal protection since the species has not been included on the official list of Wildlife Species at Risk under Canadian federal law. Nevertheless, in the province of Ontario, at the extremity of its distribution range in Canada, the species has been listed as an Endangered Species under the provincial law provincial law (Endangered Species Act, 2007 available at www.e-laws.gov.on.ca) and a draft recovery strategy was published in 2010 (http://www.mnr.gov.on.ca/en/Business/Species/index.html).

Since the COSEWIC status report in 2006, research programmes, management and action plans were initiated throughout provincial and federal jurisdictions. Coordinated action plans were developed with hydroelectric companies in Québec and Ontario to reduce or mitigate turbine passage mortality for migrating silver eel and to facilitate upstream access at dam to juvenile eel. Glass eel/elver stocking was performed and monitoring was initiated to document the impact of this action. Buyout of many commercial licences in Québec waters was achieved with the aim to reduce fishing mortality by half. Topics of research activities included investigation of the genetic panmixia hypothesis investigation, impact of contamination on spawning migration and reproduction, and acoustic tracking of yellow and silver eel in the St Lawrence River and Estuary.

Concerns about the genetic structure of the population and population trends required a revision of the 2006 Status Report and a new assessment of the species in Canada was undertaken in 2011. Information update for this new status was used as a primary source of information for the next sections.

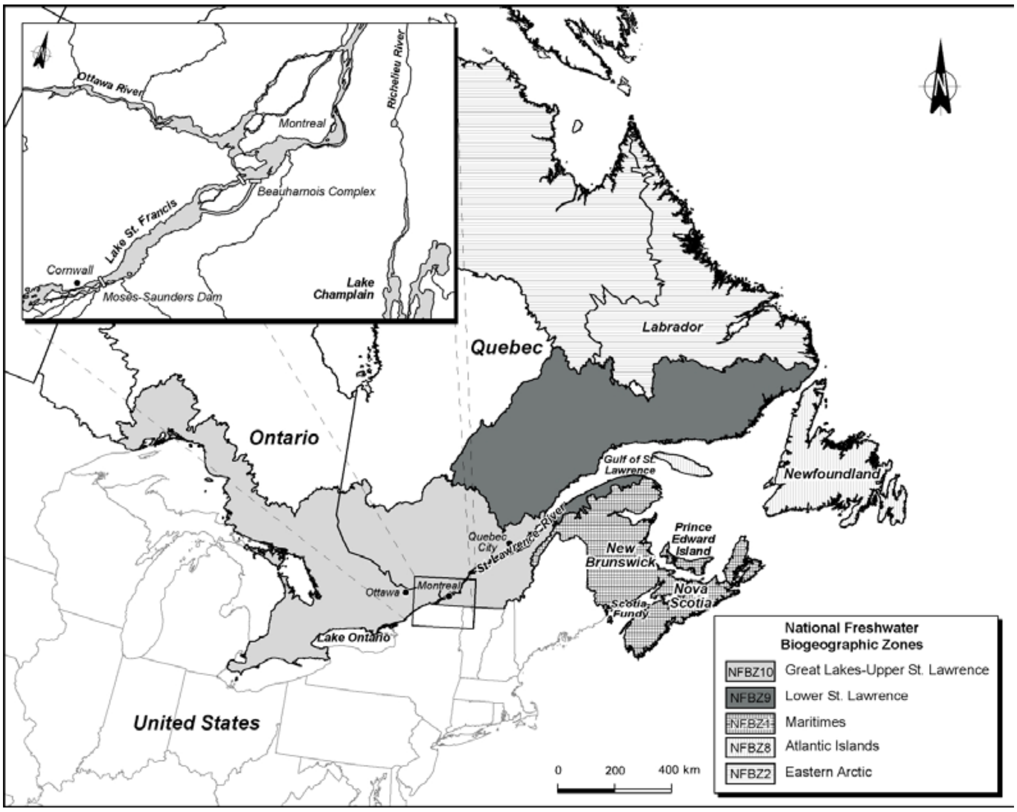

Figure 1. National Freshwater Biogeographic Zones (NFBZ) used for American eel in Canada.

In Canada, the American eel is managed under different jurisdictions. Ontario and Québec are responsible for the species management in their waters, whereas the Canadian government is responsible for the management in the Atlantic Provinces (New Brunswick, Prince Edward Island, Nova Scotia and Newfoundland & Labrador. For the COSEWIC Status Report, five designated zones (NFBZ) were used to describe population trends and status (Figure 1).

CA.3 Time-series data

CA.3.1 Recruitment-series and associated effort

CA.3.1.1 Glass eel

Glass eel recruitment monitoring is available from the Atlantic Scotia–Fundy region in New Brunswick and Nova Scotia (NFBZ 1). Initiated in 1989, a commercial fishery operates on the Atlantic seaboard and on the shore of the Bay of Fundy. Nine commercial licences are issued annually, and total annual catch is limited to 1000 kg per licence. The only fishery-independent monitoring is located in the same region, on the East River Chester (Nova Scotia) and it was initiated in 1996, abandoned between 2003 and 2007, and operated again since 2008.

CA.3.1.1.1 Commercial

Table 1. Commercial landings statistics for the Scotia–Fundy elver fishery.

Year	Landings (t)
1989	0.03
1990	0.17
1991	0.07
1992	0.23
1993	0.71
1994	1.57
1995	3.24
1996	2.86
1997	4.13
1998	2.05
1999	0.48
2000	0.68
2001	1.84
2002	2.40
2003	1.85
2004	1.51
2005	3.16
2006	2.46
2007	1.97
2008	
2009	
2010	

CA.3.1.1.2 Fishery-independent

Table 2. Fishery-independent monitoring from East River Chester (Nova Scotia).

Year	Total run (n)
1995	
1996	1 217 825
1997	1 605 627
1998	515 241
1999	450 418
2000	791 553
2001	600 196
2002	1 686 592
2003	-
2004	-
2005	-
2006	-
2007	-
2008	1 920 294
2009	1 140 461
2010	617 849

CA.3.1.2 Yellow eel recruitment

Long-term datasets on recruitment of yellow eels originate from various sources, some are targeting specifically juvenile eels and others use eel bycatch as index. The main sources are: the eel ladders, the Lake Ontario trawling and indices derived from juvenile salmon electrofishing monitoring and salmon counting fences.

Direct monitoring for yellow eel is achieved at eel ladders on the St Lawrence River and two tributaries (Richelieu and Sud-Ouest rivers) in Ontario and Québec. Two other series targeting yellow eel exist: the Bay of Quinte trawl survey, starting in 1972, and, a standardized electrofishing series in Lake Ontario which was started in 1984.

Indirect fisheries-independent abundance estimators are derived from counting facilities or electrofishing surveys done for juvenile Atlantic salmon (*Salmo salar*) in rivers. Targeting primarily salmon, yellow eels abundance index have been derived from four rivers in Newfoundland and Labrador (NFBZ 8 and 2), and six rivers in the Maritimes (NFBZ 1) in New Brunswick and Nova Scotia.

CA.3.1.2.1 Commercial

No available data.

CA.3.1.2.2 Recreational

No available data.

CA.3.1.2.3 Fishery-independent

Fishery-independent datasets include eel ladders on Moses-Saunders and Beauharnois dams on the St Lawrence River, on the Chambly dam on the Richelieu River, and on the Sud-Ouest River ladder. In Lake Ontario, Bay of Quinte trawling and Lake Ontario electrofishing indices have been routinely done since 1972. In the Atlantic Provinces, abundance indices are derived from annual fishpass counting and electrofishing surveys primarily done for salmonids.

Total count and mean length of juvenile eels ascending ladders at the Moses-Saunders dam

An eel ladder first built in 1974 and operated by Ontario Power Generation is located on the Canadian side of the Moses-Saunders Power Dam and represents the longest-term dataset on yellow eel recruitment in the St Lawrence River system. In 2006, a second ladder was put in operation, on the US side of the power dam: respectively 8184, 13 144 and 25 932 eels transited this new passage facility in 2006, 2007 and 2008 (Milieu, 2009). At this dam, numbers of eels moving up the ladders have declined by three orders of magnitude over the past 23 years, from over 1 million in 1982 and 1983 to 944 in 2001. Since then, numbers have increased and the size of eels has decreased in recent years.

Table 3. Annual total count and mean length for juvenile eels at Moses-Saunders ladders.

Year	Total number	Mean length (mm)
1974	130 000	
1975	936 128	347
1976	659 478	348
1977	966 800	368
1978	794 600	319
1979	869 135	
1980	253 758	373
1981	748 724	363
1982	1 013 848	375
1983	1 313 570	367
1984	647 480	382
1985	935 320	404
1986	230 570	406
1987	465 364	410
1988	213 187	404
1989	258 622	458
1990	121 907	430
1991	40 241	434
1992	11 534	
1993	8289	414
1994	163 518	493
1995	35 076	
1996		
1997	6117	471
1998	3432	472
1999	1860	458
2000	2895	457
2001	944	455
2002	2663	469
2003	2876	479
2004	11 325	456
2005	14 891	414
2006	17 144	384
2007	14 204	387
2008	32 323	367
2009	20 214	325
2010	39 124	366

Total count of ascending juvenile eels in the Beauharnois Power Dam ladders from 1994 to 2010

At the Beauharnois Power Dam, 85 km downstream from the Moses-Saunders Dam, two eel ladders are operated and total counts are routinely monitored by Hydro-Québec. The abundance trend is increasing but current numbers are still low compared to what would be needed to support historical fisheries in the watershed.

Table 4. Annual total count for juvenile eels at Beauharnois Dam ladders.

Year	West ladder	East ladder	Total
1994	24 721	-	24 721
1995	17 072	-	17 072
1996	-	-	-
1997	-	-	-
1998	5441	-	5441
1999	10 692	-	10 692
2000	6881	-	6881
2001	13 099	-	13 099
2002	10 503	32 608	43 111
2003	32 684	26 885	59 569
2004	42 635	15 951	58 586
2005	51 694	2932	54 626
2006	50 389	28 127	78 516
2007	52 969	1	52 970
2008	87 942	811	88 753
2009	61 321	12	61 333
2010	79 312	7	79 319

Total count of ascending juvenile eels in the Chambly ladder from 1998 to 2010

On the Richelieu River (NFBZ 10), the Chambly eel ladder has been operated at a dam during upstream migration since 1998. Total annual count was 9875 during the first year and decreased rapidly the following years, most probably representing a pluriannual accumulation of young eels in front of the dam before the opening of the eel ladder. The annual counts for 2010 (6476) is certainly insufficient to support annual historical landings of silver eel (ca. 35 t). Eel stocking performed upstream of the ladder from 2005 to 2008 with a total of 2 767 500 glass eels released has an impact on total count at this site since 38.3% of eels sampled in 2009 originated from the stocking operations.

Table 5. Annual total count and for juvenile eels at Chambly Dam ladder.

Year	Total number
1998	9875
1999	3695
2000	239
2001	357
2002	240
2003	3336
2004	727
2005	2177
2006	434
2007	1340
2008	3333
2009	619
2010	6476

Numbers of eels captured in Bay of Quinte trawls and electrofishing conducted in eastern Lake Ontario

Two other indices for yellow eels are in place in Lake Ontario and their results can be related to the decline of eel passage at Moses-Saunders. Both the Bay of Quinte trawling index and an electrofishing index in the eastern part of Lake Ontario have declined by 1 and 2 orders of magnitude since the 1980s and are currently not significantly different from zero. Although available information and indices cannot be combined into a quantitative assessment of the overall population abundance, they clearly reveal a general decline as a consequence of reduced recruitment and reduction of distribution area.

Table 6. Juvenile eels captured by trawl in the Bay of Quinte and electrofishing in eastern Lake Ontario.

Year	BQ trawling	Electrofishing
	(Cpue)	(n)
1972	1.87	-
1973	1.62	-
1974	1.00	-
1975	1.54	-
1976	1.29	-
1977	1.06	-
1978	0.42	-
1979	0.77	-
1980	0.25	-
1981	1.53	-
1982	1.88	-
1983	0.56	-
1984	0.33	85.6
1985	0.78	63.1
1986	0.87	82.9
1987	1.55	89
1988	0.30	68.8
1989	0.95	93
1990	0.36	64.1
1991	0.45	38.5
1992	0.58	44.4
1993	0.43	22.7
1994	1.16	30
1995	0.09	10.5
1996	0.36	14.9
1997	0.08	7.3
1998	0.12	12.9
1999	0.07	21.6
2000	0.05	9.37
2001	0.01	6.82
2002	0.01	3.36
2003	0.00	0.65
2004	0.00	0.52
2005	0.00	1.23
2006	0.00	0.492
2007	0.00	0.208
2008	0.00	0.148
2009	0.00	0.192
2010	0.00	0.321

Year-class strength index for American eel, Sud-Ouest River, Québec

In the most downstream location (NFBZ 9), on the Sud-Ouest River, a continuing juvenile year-class strength index (YCSI) was developed and has been maintained since 1996. This index allows the evaluation of the relative contribution of each cohort ascending this river. The YCSI reveals a general decline in cohort relative abundance which is possibly related to a general decline of the overall recruitment of the species in this ecological freshwater area.

Table 7. Year-class strength index measure for juvenile eel in the Sud-Ouest River.

Year	YCSI
1996	1.19
1997	0.91
1998	0.91
1999	1.33
2000	0.98
2001	1.27
2002	1.04
2003	1.01
2004	0.76
2005	0.59

Abundance of yellow eels in six rivers in the southern Gulf of St Lawrence and Scotia-Fundy, from electrofishing surveys

The longest fisheries-independent time-series for American eel abundance come from electrofishing surveys in the southern Gulf of St Lawrence (NFBZ 1). These include Restigouche River (from 1970), and the Miramichi River (from 1952) (Table 8). The values for the Restigouche and Miramichi Rivers are densities (eels/100 m²). The values for the other rivers are number of eel counted/100 m² in the first electrofishing sweep. The series with the greatest sampling intensity is that of the Miramichi, which shows stable trends in the 1950s and 1960s, a peak in the 1970s, a trough in the late 1980s and early 1990s, and a subsequent increasing trend.

Table 8. Yellow eel abundance in six rivers in Atlantic Provinces.

Year	Restigouche River	Miramichi River	Nashwaak River	Big Salmon River	St. Marys River	LaHave River
1952		0.56				
1953		1.13				
1954		0.30				
1955		0.57				
1956		0.40				
1957		0.25				
1958		0.28				
1959		2.00				
1960		0.87				
1961		0.34				
1962		0.14				
1963		0.44				
1964		1.17				
1965		0.87				

Year	Restigouche River	Miramichi River	Nashwaak River	Big Salmon River	St. Marys River	LaHave River
1966		1.07				
1967		1.02				
1968		1.42				
1969		0.62				
1970		0.31				
1971		1.90				
1972	0.43	1.46				
1973	0.50	1.25				
1974	0.35	1.57				
1975	1.01	1.23				
1976	0.23	1.06				
1977	0.37	1.24				
1978	0.28	0.65				
1979	0.10	0.16				
1980	0.48	0.15				
1981	0.09	0.37				
1982	0.09	0.89				
1983	0.51	0.94				
1984		0.47				
1985	0.32	0.18			6.89	
1986	0.48	0.15			6.48	
1987	0.29	0.18				
1988	0.76	0.27				
1989	0.60	0.07				
1990	0.36	0.25				
1991	0.21	0.00	3.10			
1992	0.06	0.16	0.73			
1993	0.00	0.64	1.18			
1994	0.31	0.21	0.39			
1995	0.00	0.07	0.61		6.61	0.81
1996	0.00	0.67	1.40	0.34	3.51	
1997	0.00	0.32	1.03	4.38	5.04	1.60
1998	0.22	0.51	1.23		8.45	
1999	0.43	0.87	0.92	3.16	5.42	
2000	0.46	0.59	1.38	2.98	1.66	3.64
2001	2.05	1.36	1.53	0.80	1.68	1.90
2002	2.45	0.57	1.38	1.62	1.40	1.86
2003	0.40	0.55	0.66	1.88	1.83	0.57
2004	0.86	0.79	2.13	1.02	0.47	0.46
2005	1.08	0.98	1.57	1.94	1.41	0.45
2006	1.41	0.68	0.89	1.41	1.11	0.31
2007	0.67	1.46	1.43	1.20	1.90	0.05
2008	0.43	0.43	1.23	1.80	0.80	0.18
2009	0.39	0.77	0.84	1.97	1.03	0.44
2010		0.75				

Numbers of yellow eels at counting fences in rivers in Newfoundland

In Newfoundland, more recent fisheries-independent indices are derived from counting fences operated primarily for salmonids in three rivers: Campbellton River (1993–2007), Conne River (1986–2008), and Western Arm Brook (1994–2008). In Labrador, data are scarce and eel numbers collected during salmonids surveys are not very useful to detect any population trends.

Table 9. Annual count for yellow eels in Newfoundland.

Year	Campbellton R.	Conne R.	W. Arm Brook
1986		5	
1987		16	
1988		27	
1989		45	
1990		13	
1991		24	
1992		30	
1993	18	52	
1994	40	50	54
1995	31	99	64
1996	2	68	95
1997	91	27	73
1998	73	24	177
1999	3	17	73
2000	85	48	87
2001	86	21	42
2002	25	16	110
2003	20	14	39
2004	40	7	23
2005	10	0	10
2006	4	58	52
2007	3	48	63
2008		76	46

CA.3.2 Yellow eel landings

CA.3.2.1 Commercial

In Québec and Ontario, separate landings statistics are available for yellow and silver eels. In the Atlantic Provinces, available statistics lump yellow and silver catches.

Table 10. Landing statistics (tons) for yellow eel commercial catch in Ontario and Québec. Note that the eel fishery in Ontario was closed in 2004.

Year	Ontario	Québec
1950	13	10
1951	22	12
1952	29	13
1953	26	12
1954	35	15
1955	31	19
1956	19	14
1957	45	15
1958	54	23
1959	56	20

Year	Ontario	Québec
1960	50	20
1961	59	23
1962	49	29
1963	77	29
1964	111	30
1965	86	30
1966	65	28
1967	62	27
1968	78	30
1969	77	28
1970	66	10
1971	76	6
1972	123	30
1973	85	22
1974	101	28
1975	168	27
1976	155	34
1977	188	24
1978	231	29
1979	223	28
1980	165	25
1981	109	31
1982	29	25
1983	76	25
1984	123	31
1985	105	0
1986	117	27
1987	104	21
1988	106	20
1989	122	28
1990	120	34
1991	118	30
1992	124	25
1993	106	21
1994	83	21
1995	63	23
1996	57	30
1997	41	27
1998	19	23
1999	19	20
2000	27	37
2001	26	35
2002	11	35
2003	13	31
2004	0	38
2005	0	21
2006	0	10
2007	0	7
2008	0	3
2009	0	3
2010	0	3

Table 11. Landing statistics (tons) for yellow/silver eel commercial catch in the Southern Gulf of St Lawrence, Scotia-Fundy and Newfoundland & Labrador.

Year	Southern Gulf	Scotia-Fundy	Newfoundland & Labrador
1950	48	39	
1951	40	28	
1952	33	44	
1953	27	62	
1954	43	61	
1955	68	107	
1956	30	51	
1957	31	27	
1958	47	46	
1959	61	20	
1960	86	22	
1961	103	34	0
1962	121	33	24
1963	93	54	37
1964	109	53	13
1965	128	32	3
1966	147	48	0
1967	222	18	0
1968	310	34	0
1969	447	84	0
1970	580	83	0
1971	723	116	44
1972	596	60	79
1973	406	47	31
1974	286	35	21
1975	253	64	7
1976	231	87	11
1977	214	109	19
1978	208	96	16
1979	226	141	23
1980	280	54	83
1981	419	55	42
1982	338	20	37
1983	258	19	28
1984	296	11	14
1985	347	80	25
1986	472	61	27
1987	335	63	31
1988	383	150	61
1989	309	122	84
1990	294	95	147
1991	292	127	134

Year	Southern Gulf	Scotia-Fundy	Newfoundland & Labrador
1992	230	129	90
1993	252	188	116
1994	156	230	111
1995	111	230	85
1996	96	174	94
1997	85	175	72
1998	88	163	73
1999	91	195	55
2000	147	159	70
2001	137	133	37
2002	220	116	65
2003	220	94	65
2004	196	114	64
2005	191	92	71
2006	174	113	80
2007	219	49	66
2008	150		45
2009	173		33
2010	174		

CA.3.2.2 Recreational

No available data.

CA.3.3 Silver eel landings

CA.3.3.1 Commercial

The silver eel is specifically targeted by the fishermen in the Richelieu River, the St Lawrence Estuary and Lake St Pierre, Québec. Silver eel is fished during the seaward migration in late summer and fall. Annual landings statistics exist since 1920. Decreased landings in recent years reflects a lesser abundance of seaward migrants and a major decline in fishing licences following a buyout between 2002 and 2009 (see Sections 5.2 and 5.3).

Table 12. Silver eel commercial catch in Québec waters, 1959–2010.

Year	Richelieu R.	St. Lawrence Estuary	Lake St Pierre
	(t)	(t)	(t)
1950	33.3	244.8	10.7
1951	24.2	300.6	14.0
1952	12.4	350.5	15.2
1953	18.6	356.0	15.6
1954	12.6	304.3	20.7
1955	16.9	336.1	28.6
1956	28.3	334.3	17.4
1957	30.2	499.2	16.1
1958	18.1	399.7	36.6
1959	33.1	298.5	36.1
1960	19.1	389.7	33.0

Year	Richelieu R.	St. Lawrence Estuary	Lake St Pierre
1961	17.0	304.7	37.1
1962	26.3	285.5	42.5
1963	35.5	351.1	53.0
1964	44.4	311.1	61.5
1965	51.6	406.4	59.9
1966	49.9	351.9	57.6
1967	37.2	315.5	55.5
1968	36.0	369.9	61.7
1969	22.8	405.5	56.8
1970	1.1	283.1	19.6
1971	24.4	270.7	12.3
1972	7.6	209.8	61.2
1973	1.0	231.0	46.5
1974	34.1	266.1	60.0
1975	41.4	401.7	54.8
1976	20.0	295.1	68.6
1977	47.3	383.8	51.6
1978	37.2	398.1	61.3
1979	43.0	376.3	57.9
1980	66.3	451.7	52.2
1981	72.9	434.5	61.7
1982	48.9	258.8	49.0
1983	33.0	243.3	50.8
1984	21.9	297.7	61.3
1985	47.5	342.0	0.0
1986	48.1	317.0	47.8
1987	36.7	327.6	34.1
1988	33.3	340.8	30.2
1989	25.9	337.6	38.7
1990	19.0	384.3	36.6
1991	21.9	307.9	34.3
1992	19.7	248.2	29.7
1993	14.1	259.1	35.8
1994	8.4	221.4	31.7
1995	12.6	217.4	25.5
1996	20.1	162.9	31.3
1997	4.7	147.8	22.2
1998	0.0	181.1	23.7
1999	0.0	140.1	17.7
2000	0.0	127.8	27.0
2001	0.0	121.5	17.7
2002	0.0	111.9	21.0
2003	0.0	92.9	13.4
2004	0.0	86.2	16.9
2005	0.0	89.4	8.6
2006	0.0	91.3	7.5
2007	0.0	73.6	7.8
2008	0.0	68.4	4.2
2009	0.0	50.4	4.5
2010	0.0	46.1	-

CA.3.3.2 Recreational

No available data.

CA.3.4 Aquaculture production

CA.3.4.1 Seed supply

The only seed supply for glass eel and elver is from the Atlantic Scotia–Fundy region in New Brunswick and Nova Scotia. Initiated in 1989 a commercial fishery operates with nine licences on the Atlantic seaboard and on the shore of the Bay of Fundy. The individual quota is set at 900 kg but an additional 100 kg/licence can be caught if this catch is devoted to conservation stocking in Canadian waters.

CA.3.4.2 Production

No available data.

CA.3.5 Stocking

CA.3.5.1 Amount stocked

Conservation stocking is limited to the upper parts of the St Lawrence system. The stocking programme started in the upper Richelieu River in 2005 and in upper St Lawrence River and Lake Ontario in 2006. Over 7 million individuals were stocked in both locations. Prior to their introduction in receiving waters glass eels and elvers were tested for parasite and pathogens in quarantine facilities and marked in batch with oxytetracycline. The stocking programme is now discontinued following recent findings of escaping silver eels originating from stocked eels.

Table 13. Eel stocking number and biomass in Canada.

Year	Richelieu River/Lake Champlain		Upper St Lawrence River/Lake Ontario	
2005	600 000	105 kg	-	-
2006	1 000 000	200 kg	167 000	100 kg
2007	421 500	74.2 kg	437 000	90 kg
2008	746 000	145 kg	2 001 000	375 kg
2009	0	0	1 303 000	300 kg
2010	0	0	143 000	-

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

No available data.

CA.4 Fishing capacity

Eel fishing effort is unevenly distributed within the Canadian range of the American eel. In some areas, there are intensive fisheries while in others, eels are totally unexploited. The stage targeted by fisheries (glass eel, elver, yellow eel, and silver eel) also varies geographically.

There has been no commercial eel fishery in Ontario since 2004. In Québec, there was a major fishery in the lower St Lawrence River and estuary (NFBZ1) which targeted mainly silver eels. Following a major buyout programme in 2009, the 67 commercial silver eel licence holders (156 traps allowed) were reduced to 21 with 52 eel traps. In

Lake St Pierre, a buyout programme initiated in 2002 led to an important reduction of licence holders, from 42 to six. Eels originating in the NFBZ2 portion of Québec are not exploited, except in the Magdalen Islands where a small unlicensed fishery exists.

In the southern Gulf of St Lawrence (NFBZ3), commercial fisheries target primarily yellow eels in tidal waters. Yellow eels are fished extensively in coastal waters and estuaries of New Brunswick and Prince Edward Island, and to a lesser extent in tidal and freshwaters of Nova Scotia. There are 535 commercial eel licences in this area, but most of these licences are inactive. Winter recreational spear fisheries also contribute to anthropogenic mortality of yellow eels in the Southern Gulf of St Lawrence but no estimation for this fishery is available.

In the Atlantic and Fundy drainages of Nova Scotia and New Brunswick (known as the Scotia–Fundy area), eel fishing occurs in both fresh and marine waters, but many rivers and coastal areas are not fished. There are 423 commercial eel licences in this area, but many are inactive. The only elver fishery in Canada occurs in Scotia–Fundy, where nine licences are held. Three of these are restricted to aquaculture use. Elver fisheries are generally not permitted in rivers in which an active fishery for larger eels exists; each license has a quota of up to 1 tonne, with a limit of 300 kg from any given river. The total allowable catch (TAC) has never been attained since this fishery began. A conservation quota (10% of TAC) is devoted exclusively for stocking operations.

In Newfoundland (NFBZ4), yellow and silver eels are fished principally in rivers, but many rivers are not exploited. There are 154 commercial eel licences. Landings for Labrador were reported only in 1985 (4.3 tons) and in 1993 (0.1 tonne). Currently there are no commercial eel licences in Labrador.

CA.4.1 Glass eel

Nine licence are issued for the glass eel fishery for Scotia–Fundy.

CA.4.2 Yellow eel

Table 14. Number of commercial eel fishing licences in Canada.

		Number of licences	
Province/Region		Yellow eel	Yellow and Silver eel
NFBZ 10	Ontario		0
NFBZ 10	Quebec	34	
NFBZ 9	Quebec		0
NFBZ 1	Gulf of St Lawrence, New Brunwick		181
NFBZ 1	Gulf of St Lawrence, Nova Scotia		150
NFBZ 1	Gulf of St Lawrence, Prince Edward Island		204
NFBZ 1	Atlantic and Fundy drainages, Nova Scotia & New Brunswick		423
NFBZ 8	Island of Newfoundland		144
NFBZ 5	Labrador		0

CA.4.3 Silver eel

Table 15. Number of commercial eel fishing licences in Canada for silver eel.

		Number of licences
Province/Region		Silver eel
NFBZ 10	Ontario	0
NFBZ 10	Quebec	21
NFBZ 9	Quebec	0

CA.4.4 Marine fishery

No available data.

CA.5 Fishing effort

Fishing effort is routinely estimated from number of licences issued on an annual basis. For the Maritimes, Scotia–Fundy, Southern Gulf and Newfoundland, logbook information is used for effort estimation. For the St Lawrence silver eel fishery, effort is estimated as total length of soaked leader for tidal trap, fishing season does not vary from year to year.

CA.5.1 Glass eel

No available data.

CA.5.2 Yellow eel

See Section 4.2.

CA.5.3 Silver eel

In the St Lawrence estuary, the fishery targets only migrant silver eels and accurate data on effort and harvest are recorded annually since 1996.

Table 16. Fishing effort for the Lower St Lawrence Estuary Silver Eel Fishery.

Year	Effort
	(m of net)
1996	34 858
1997	34 833
1998	31 873
1999	27 579
2000	21 545
2001	20 359
2002	16 782
2003	16 443
2004	13 470
2005	13 583
2006	12 804
2007	12 490
2008	9447
2009	5774
2010	5652

CA.5.4 Marine fishery

No available data.

CA.6 Catches and landings

See information in Section 3.

CA.6.1 Glass eel

See information in Section 3.1.1.

CA.6.2 Yellow eel

See information in Section 3.2.

CA.6.3 Silver eel

See information in Section 3.3.

CA.6.4 Marine fishery

No available data.

CA.7 Catch per unit of effort

CA.7.1 Glass eel

No available data.

CA.7.2 Yellow eel

Table 17. Catch and effort in the commercial spear fishery in Nova Scotia Gulf (NSG) region and commercial fykenet fishery of Prince Edward Island (PEI) and NSG regions have been recorded by volunteer logkeepers since 1996. Cpue is expressed as kg/gear/day.

Year	NSG Fyke	NSG Spear	PEI Fyke
1996	-	-	0.29
1997	1.73	2.33	0.26
1998	0.93	3.30	0.48
1999			0.85
2000	1.23	1.81	0.84
2001	1.34	1.10	0.59
2002	1.74	3.18	0.71
2003	1.31	2.91	0.80
2004	2.43	3.41	1.06
2005	2.26	3.73	0.95
2006	2.33	4.76	0.82
2007	2.95	5.64	1.37
2008	2.66	6.00	1.47
2009	2.61	3.01	1.01
2010	-	-	1.20

Table 18. Eel cpue is derived from total landings and licences numbers since 1989 in Newfoundland. Cpue is expressed as tons /licence/year.

Year	Landings (t)	Licence numbers	Cpue
1989	83.5	74	1.13
1990	146.6	105	1.40
1991	133.9	131	1.02
1992	89.9	124	0.73
1993	116.1	105	1.11
1994	110.9	-	-
1995	85.4	-	-
1996	94.4	-	-
1997	71.7	138	0.52
1998	73.0	229	0.32
1999	54.5	190	0.29
2000	69.8	167	0.42
2001	36.7	168	0.22
2002	65.5	169	0.39
2003	64.6	167	0.39
2004	64.1	171	0.37
2005	71.1	161	0.44
2006	80.0	160	0.50
2007	66.0	155	0.43
2008	45.0	154	0.29
2009	33.0	144	0.23
2010	-	-	-

CA.7.3 Silver eel

Despite a drastic decline in annual landings in recent years, cpue did not decrease due in part to fishing effort reduction. Cpue does not appear to be a good parameter for stock assessment for this specific fishery.

Table 19. Catch, effort and cpue for the Lower St Lawrence Estuary silver eel fishery.

Year	Catch	Effort	Cpue
	(m.t.)	(m of net)	(kg eels/ m of net)
1996	107.2	34 858	3.07
1997	99.9	34 833	2.87
1998	127.2	31 873	3.99
1999	93.7	27 579	3.40
2000	74.7	21 545	3.47
2001	70.9	20 359	3.48
2002	68.9	16 782	4.11
2003	59.6	16 443	3.63
2004	51.1	13 470	3.79
2005	54.7	13 583	4.03
2006	46.7	12 804	3.64
2007	39.4	12 490	3.15
2008	31.5	9447	3.33
2009	23.8	5774	4.12
2010	28.2	5652	4.99

CA.7.4 Marine fishery

No available data.

CA.8 Other anthropogenic impacts

American eel mortality has increased substantially since previous centuries due to various anthropogenic sources and their cumulative effects. Among them, barriers, turbine passage, fishing, habitat modification and contaminant bioaccumulation acting in synergy have been identified as major causes in the population decline.

Researchers and managers are conducting a study with the aim to identify and prioritize watersheds with barriers that have to be reopened to give access to growth habitat by developing a GIS tool. This approach is being implemented in Ontario, Québec and the Maritimes Provinces to locate dams to mitigate and estimate habitat lost. The database is now used in Québec to assess passability of each dam and rank them to setting priorities for mitigation among dams in a specific watershed and also among watersheds in the province.

Turbine passage is a major cause of mortality for seaward migrants of rivers in which eel are able to ascend past hydro dams. Turbine mortality in the two dams on the St Lawrence River mainstem can reach 26% at a single dam and cumulates at least 40% for silver eel migrating from Lake Ontario to the Estuary. Cumulative mortalities have been estimated for the Ottawa and its tributary, the Mississippi. Survival of eel ascending this system is estimated to be as low as 2.8% due to turbine mortality alone. While preventing turbine passage can be achieved for dams with small discharge (<50 m^3/s), it becomes more difficult for large hydro-complex with high discharge like those on the St Lawrence River (>6000 m^3/s). A trap & transfer pilot study has been undertaken in the vicinity of the two largest hydrocomplex in the St Lawrence River since 2008 to evaluate the impact on silver eel survival and escapement. First results show that 67.1% of large yellow/silver eels are completing their migration to the Middle Estuary within two years after being transferred and show similar energy content and sexual development than non-transferred silver eel. Fish-friendly turbine are being developed but their implementation in existing facilities is not cost-effective.

CA.9 Scientific surveys of the stock

CA.9.1 Recruitment surveys; glass eel

No available data.

CA.9.2 Stock surveys; yellow eel

Post-stocking effectiveness monitoring in upper St Lawrence River and Lake Ontario was set in 2009 and 2010 to assess eel recovery in this areas. Results clearly suggest an increase in abundance related to stocking programme.

Table 20. Mean density and biomass of eel originating from stocking.

	Mean density (eels/ha)		Mean biomass (kg/ha)	
Stocking area	2009	2010	2009	2010
Upper St Lawrence River	25.7 (6.4)	53.1 (12.3)	0.3 (0.1)	3.1 (1.1)
Bay of Quinte	30.0 (7.6)	61.5 (9.3)	0.1 (0.03)	0.8 (0.1)
Lake Ontario	-	0.0 (0.0)	-	0.0 (0.0)

On the south shore of the St Lawrence estuary, annual monitoring of upstream migrant elvers has been maintained since 1999. Age structure is measured and the relative abundance of each cohort is assessed. In this river, the migrating population is comprises up to nine cohorts every year.

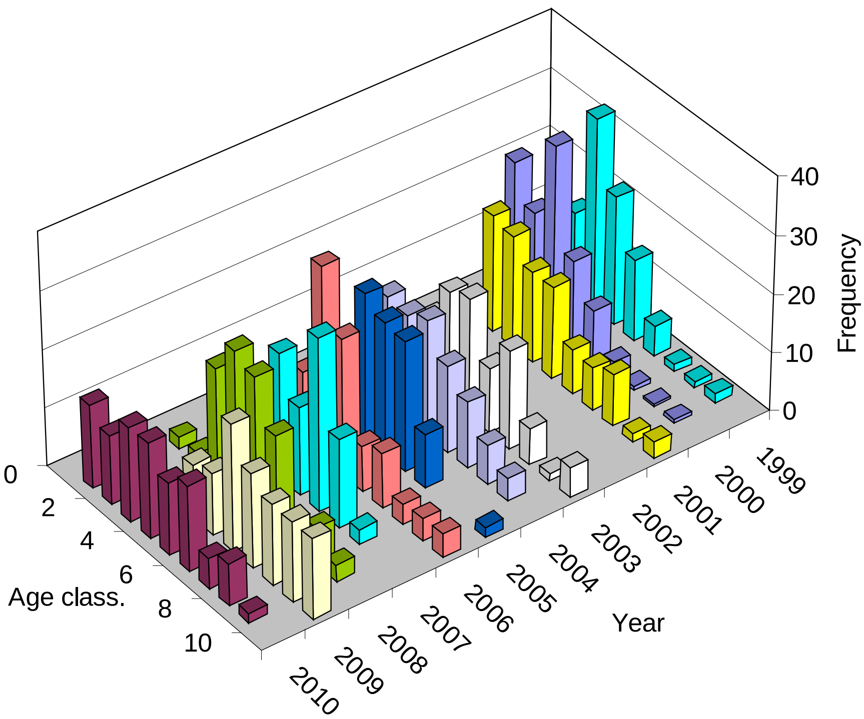

Figure 2. Age-class structure of juvenile eels ascending the ladder at the Sud-Ouest River 1999–2010.

CA.9.3 Silver eel

In 2010, exploitation rates and abundance of migrating silver eel were estimated as a performance measure for the major buyout programme carried out in the St Lawrence River and estuary. A mark–recapture experiment was performed and results show a 50% decrease in fishing mortality but also a 66% decline in spawner abundance in comparison with the 1996–1997 estimates.

Table 21. Abundance estimates (Pooled Peterson) and exploitation rates for silver eel, St Lawrence River and Estuary.

Year	Abundance (c.i.)	Exploitation rates (c.i.)
1996	492 845 (383 693–633 091)	19.0% (13.0–28.0)
1997	410 895 (353 591–477 492)	24.0% (18.0–30.0)
2010	153 044 (116 480–189 608)	10.5% (8.5–13.8)

CA.10 Catch composition by age and length

Catch composition by age or length is routinely done only for specific research or monitoring needs in the St Lawrence River and estuary. For 2010, the only length frequency for commercial catch originate from the silver eel fishery.

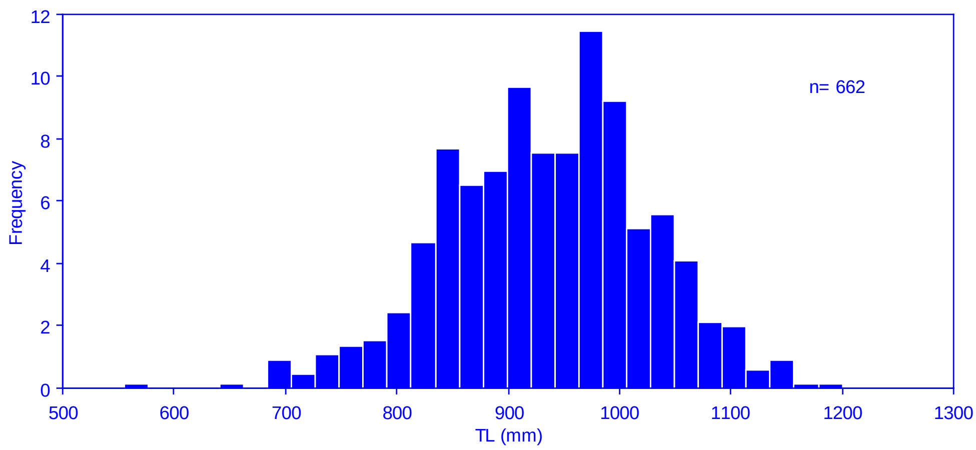

Figure 3. Length–frequency for migrating silver eel in the St Lawrence River caught in the experimental trap in Cap-Santé during mark-recapture experiment in 2010.

Catch composition is steadily increasing since more than a decade and annual mean weight shows a 50% increase compare to what it was in 1996.

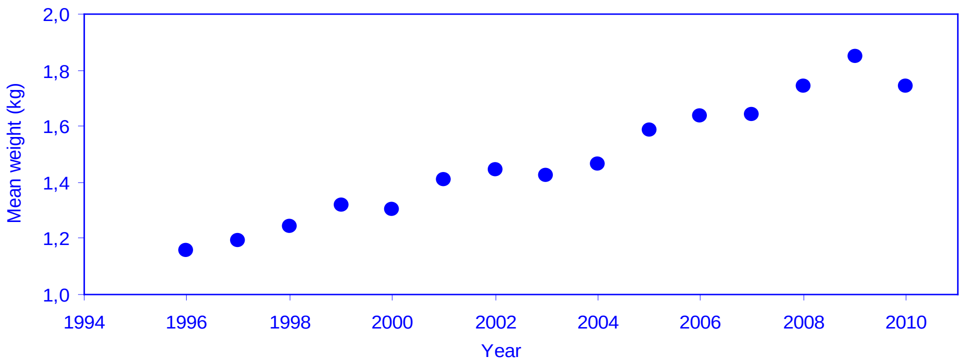

Figure 4. Annual mean weight of silver eel in the St Lawrence estuary fishery, 1996–2010.

Intensive monitoring of this fishery allowed sampling unusually small silver eels originating from stocking programmes for a second successive year. These small migrants show a bright yellow oxytetracycline mark on the otolith, a distinctive feature of stocked elvers in the St Lawrence watershed.

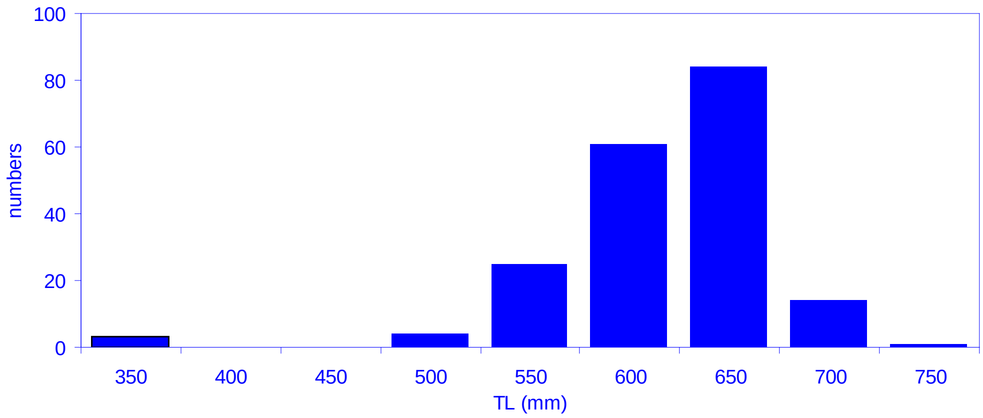

Figure 5. Length–frequency of silver eel originating from stocking programmes in the St Lawrence estuary fishery in 2010.

CA.11 Other biological sampling

There is no routine programme for measuring growth rates, measurements are taken for specific research and monitoring purposes.

CA.11.1 Length and weight and growth (DCF)

Post-stocking monitoring in upper St Lawrence River and Lake Ontario give insights on growth for these transplanted animal. Results show rapid growth, especially for autumn sampling. High growth rate was also reported for eels stocked in the Richelieu River and the Upper part of the St Lawrence systems and recaptured in the commercial fishery of the St Lawrence estuary, four and five years later.

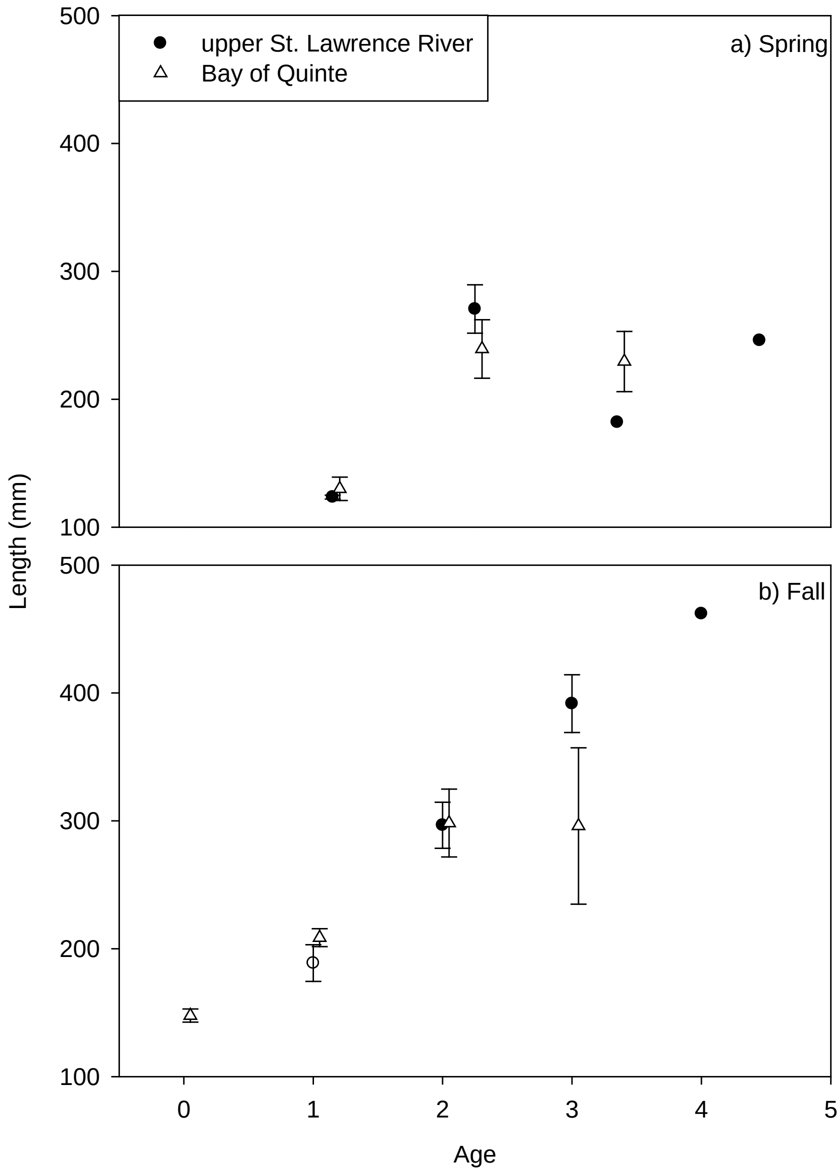

Figure 6. Mean length-at-age for stocked American eel captured in spring (upper panel) and fall (lower panel) from the upper St Lawrence River (black circle) and Bay of Quinte (open triangle) stocking locations. Error bars represent ± standard error.

CA.11.2 Parasites and pathogens

No available data.

CA.11.3 Contaminants

No available data.

CA.11.4 Predators

No available data.

CA.12 Other sampling

No available data.

CA.13 Stock assessment

CA.13.1 Local stock assessment

No available data.

CA.13.2 International stock assessment

No available data.

CA.13.2.1 Habitat wetted area; lacustrine

CA.13.2.1.1 Historical production

No available data.

CA.13.2.1.2 Current production

The current production is only available for the St Lawrence River segment above the estuary. A mark–recapture experiment done in 2010 gave an abundance estimate of 155 395 (C.I.: 95%: 118 831–191 959) silver eel escaping the River. This estimate represents only 30% of the numbers (±450 000) estimated in previous studies in 1996–1997. The mark–recapture experiment is repeated again in 2011.

CA.13.2.1.3 Current escapement

Abundance estimate for 2010 is used to assess current escapement by subtracting annual harvest in the commercial fishery (28.2 m.t.). This calculation leads to an escapement estimate of 140 000 silver eels for the St Lawrence River above Quebec City.

CA.13.2.1.4 Production values e.g. kg/ha

No available data.

CA.13.2.1.5 Impacts

Hydropower impact on downstream migrants is well documented for large hydrodams in the St Lawrence River since the late nineties (~40%) and is thought to be same. Exploitation rates decreased in the St Lawrence River and Estuary following important buyout programme for the commercial fishery. For the silver eel estuarine fishery, exploitation rates decreased by half; from 21% in 1996–1997 to 10.5% in 2010. There are no current estimates for recreational or commercial fishery in other NFBZ in Canada.

CA.13.2.1.6 Stocking requirement eels <20 cm

No available data.

CA.13.2.1.7 Summary data on glass eel

No available data.

CA.13.2.1.8 Data quality issues

CA.14 Sampling intensity and precision

Post-stocking monitoring in upper St Lawrence River and Lake Ontario gave the opportunity of testing the sampling effort needed to detect changes in abundance of juvenile eels. In this experiment, number of transects required to detect a 50% change in American eel densities was lower for LO than the USLR (Figure 7). To achieve the recommended power of 80% probability of detection, 27, 59, 83, and 112 transects would have to be performed based on the LO fall, LO spring, USLR spring and USLR autumn samples, respectively. Across all areas and seasons, 104 samples would be required to detect a 50% change in American eel densities.

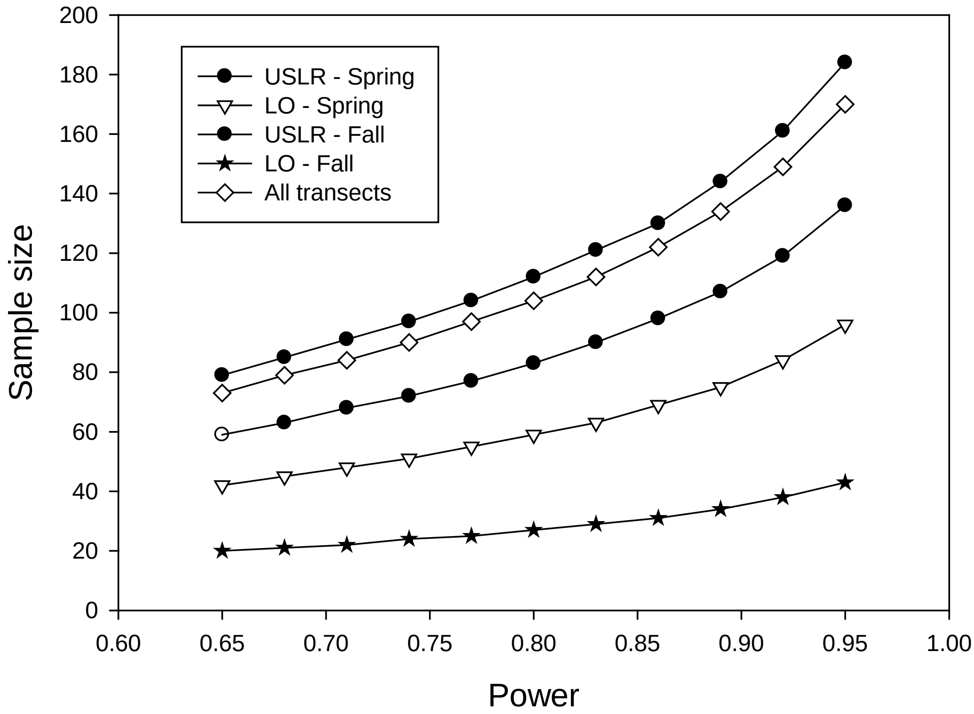

Figure 7. Results of a power analysis to detect a 50% change in stocked American eel abundance from the Upper St Lawrence River (USLR) and Lake Ontario (LO) sampling locations, along with an overall assessment, based on means and variances collected from spring and autumn sampling efforts in those locations in 2009.

CA.15 Standardization and harmonization of methodology

A survey made in 2011 on the results of the operation of twelve fish passage structures in Quebec shown that eight fishways of various types, generally designed to facilitate Atlantic salmon upstream passage, could also be also used by eels but, with the exception of the Vianney-Legendre fishway on the Richelieu River, their efficiency has never been evaluated.

CA.15.1 Survey techniques

CA.15.2 Sampling commercial catches

Routinely done for the silver eel commercial fishery in the St Lawrence Estuary.

CA.15.3 Sampling

CA.15.4 Age analysis

CA.15.5 Life stages

CA.15.6 Sex determinations

CA.16 Overview, conclusions and recommendations

In the distribution range of American eel in Canada, indices show that abundance relative to the 1980s is very low for the Great Lakes and upper St Lawrence River area according to fisheries-independent data. According to 2010 estimates, escapement rate would have decreased of 65% since 1996–1997 in the St Lawrence River above Québec City, in spite of an important reduction of exploitation rates. Changes in American Eel dataseries were evaluated between years prior to 1980, and 2000–2009. Three of the Canadian series are commercial landings, two are from indices in Moses-Saunders total counts and Bay of Quinte trawl, one is from electrofishing in Lake Ontario, two are from research electrofishing in the Restigouche and Miramichi rivers. Percent change between the early and recent periods ranged from -98.8% to +149.2%. Out of the eight series allowing percent change evaluation from 1950s to 1970s to 2000s, seven showed negative values (from -24.1 to -98.8). All of the four landings series showed negative change. The long-term management goal is to rebuild overall abundance of American Eel in Canada to its level reached in the mid-1980s and in the short term, reducing anthropogenic mortality by 50% relative to the 1997 to 2002 average.

CA Literature references

Report on the eel stock and fishery in Denmark 2010/'11

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Reporting Period: This report was completed in September 2011, and contains data up to 2010 and some provisional data for 2011.

DK.2 Introduction

The eel can be found in fresh and marine waters all along the ca. 7000 km Danish coastline. In the marine areas relatively dense eel populations are found in shallow water on the protected coast (e.g. in Bays and Lagoons) contrary to the open coast where assumed fewer eels are present. In inland waters eels may be found in ponds, lakes and streams throughout the country.

The economical important eel fisheries are concentrated in the southern and eastern parts of Denmark. Here local and Baltic silver eels are exploited during the spawning migration while passing through the Danish straits heading to the North Sea. These fisheries catch the emigrating eel by poundnets out to the 10+ meter depth line.

A combined yellow and silver eel fishery takes place, throughout the country, in shallow Fjords, Bays, Lagoons and Inland waters. Most of the catch ca. 97% is reported from marine areas. Only the catch by professional fisheries are registered suggesting that professional fisheries in freshwater are few compared to the marine.

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 licenses and landings and number and type of gear must be registered with the Fisheries Directorate. The professional fishermen in saline areas are given a licence to use a limited number of gear (fykenets, poundnets and hooklines) 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 are given 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 months 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.

DK3 Time-series data

DK3.1 Recruitment-series and associated effort

No data.

DK3.1.1 Glass eel

No data.

DK3.1.2 Commercial

No data; glass eel fishery is forbidden.

DK3.1.3 Fishery-independent

No data.

DK3.1.4 Yellow eel recruitment

The recruitment of young eels to Danish freshwater is currently monitored in pass-traps at Harte hydropower stations 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 using an annual population surveys (electrofishing four sections three times a year) in a small brook by the Wadden Sea. Further details in Pedersen (2002).

At Harte Hydro power 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).

Table 3.1.2. Recruitment data from Tange and Harte Hydropower stations and Vester Vedsted brook.

Year	Tange	Harte	Vester Vedsted brook Density eel/m²		Year	Tange	Harte	Vester Vedsted brook Density eel/m²	
	Kg	Kg	Mean	Max (season)		Kg	Kg	Mean	Max (season)
1967		500	-	-	1990	367	101	-	-
1968		200	-	-	1991	434	44	-	-
1969		175	-	-	1992	53	40	-	-
1970		235	-	-	1993	93	26	-	-
1971		59	-	-	1994	312	35	-	-
1973		117	-	-	1995	83	23	2,6	2,6
1974		212	-	-	1996	56	6	4,6	6,8
1975		325	-	-	1997	390	9	0,7	1
1976		91	-	-	1998	29	18	0,3	0,4
1977		386	-	-	1999	346	15	0,4	0,5
1978		334	-	-	2000	88	18	0,6	0,7
1979		291	2,8	6,5	2001	239	11	0,6	0,8
1980	93	522	7	13	2002	278	17	0,5	0,6
1981	187	279	7,8	13	2003	260	9	0,6	0,7
1982	257	239	-	-	2004	246	9	0,3	0,4
1983	146	164	-	-	2005	88	7	0,5	0,5
1984	84	172	-	-	2006	123	7	0,3	0,7
1985	315	446	-	-	2007	62	7	0.4	0.5
1986	676	260	-	-	2008	131	0.9	0.2	0.2
1987	145	105	-	-	2009	20	1.3	0.2	0.2
1988	252	253	-	-	2010	14	5	0.2	0.4
1989	354	145	-	-					

DK.3.1.4.1 Commercial

No data.

DK.3.1.4.2 Recreational

No data.

DK.3.1.5 Recreational

No data.

DK.3.2 Yellow eel landings

DK.3.2.1 Commercial

The time-series on yellow eel landings are found below in Section.

DK3.2.1.1 Fishery-independent

No data

DK.3.3 Silver eel landings

DK3.3.1 Commercial

The official data on separate landings of yellow and silver eel in fresh and salt water are given below. The data are catch reports by commercial fishermen. From the middle of 2009 catches are only reported from those given a licence to fish for eel.

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

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

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

Year	Silver	Yellow	Total	Year	Silver	Yellow	Total
1960	2756	1967	4509	1986	818	734	1432
1961	2098	1777	3640	1987	538	651	1099
1962	2132	1775	3692	1988	799	960	1640
1963	1837	2091	3690	1989	785	797	1468
1964	1417	1865	3059	1990	834	734	1461
1965	1498	1699	2992	1991	724	642	1267
1966	1829	1861	3479	1992	687	655	1233
1967	1673	1763	3193	1993	523	500	966
1968	2063	2155	3960	1994	509	631	1080
1969	1552	2072	3370	1995	408	432	788
1970	1470	1839	3060	1996	381	336,5	684
1971	1490	1705	3012	1997	375	383	719
1972	1662	1567	3029	1998	306	251	517
1973	1697	1758	3254	1999	380	307	657
1974	1378	1436	2651	2000	382	218	572
1975	1534	1691	2965	2001	446	225	635
1976	1477	1399	2698	2002	365	217	555
1977	1141	1182	2144	2003	437	188	601
1978	1187	1148	2178	2004	343	187	516
1979	887	939	1748	2005	372	149	506
1980	911	1230	1994	2006	427	154	567
1981	897	1190	1947	2007	411	115	515
1982	1003	1375	2215	2008	364	93	448
1983	884	1119	1887	2009	367	87	454
1984	830	915	1619	2010	304	105	409
1985	793	726	1408				

DK.3.3.2 Recreational

An interview study among recreational marine fishermen revealed they landed 100 tons eel in 2009. Recreational fishermen are only allowed to use fykenets and the catch supposedly consist mostly of yellow eels.

DK.3.4 Aquaculture production

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

Table. 3.4. Annual aquaculture eel production (1984–2010).

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

Table 3.4.1. Aquaculture production 2010 (Source: Fisheries directorate).

Usage / size		Biomass kilo
Live export	Large fish	505 211
	Small/young fish	10 240
Consumption	Large fish	998 340
To nature	Small/young fish (stocking export)	12 252
	Dk stocking (3,5 g)	5460
Dead/destroyed	Large fish	5209
Total		1 536 712

Seed supply

Glass eels to Danish aquaculture are imported from France and England. The eel farmers have reported to the Fisheries directorate that 4443 kg of young eel was imported during 2010. That is possibly glass eel used as seed stock for the production presented in Table 3.4.1. The reporting is incomplete and the correct figure is somewhat larger, around 6–7 tons of glass eels.

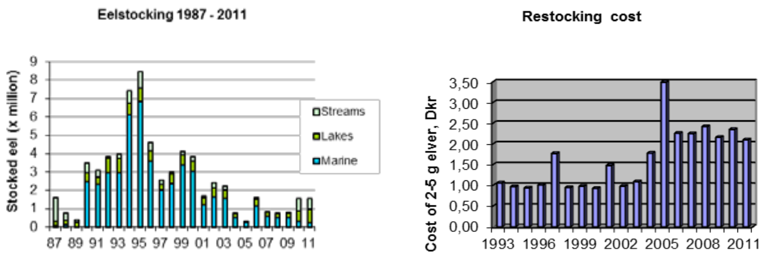
DK.3.5 Stocking

DK.3.5.1 Amount stocked

Restocking has taken place for decades by fishermen in inland waters, in places where recruitment of young eel was limited or absent, because of migration barriers or distance to the ocean. From mid 1960s to the end of the 1980s a number of licences were given to sell young eels for restocking. These eels were captured at passtraps and glass eels at the sluices in the Wadden Sea. This is now forbidden due to the low recruitment. In 1987 a restocking programme has been financed by the Danish Government and the eel fishermen. Since 1994 the restocking programme has been financed solely by the recreational licence fee.

The eels stocked today are imported, as glass eels mostly from France and are grown to a weight of 2–5 gramme in heated culture before they are stocked. The amount stocked has been decreasing during the last years because the price for stocked eel has increased dramatically in the same period.

In 2011 a total of 1.36 million eels of size 2–5 gramme were stocked in lakes and rivers as a management measure.



Figures 3.5.1. Restocking of elvers (2–5g) in marine and freshwaters from 1987–2011 (numbers in millions) and cost per stocked eel.

Table 3.5.1. Restocking of elvers (2–5g) in marine and freshwaters from 1987–2010. Numbers of eels stocked (in millions) and cost per stocked eel.

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

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

No data not allowed.

DK.4 Fishing capacity

DK.4.1 Glass eel

No data; not allowed.

DK.4.2 Yellow and silver eel

No data.

DK.4.3 Marine and freshwater fishery

From 1st July 2009, commercial eel fishing operations in marine and freshwaters are based on licences, and all gear must be registered with the Fisheries Directorate. Licences are divided into four groups A, B, C and BC. Licences are provisionally issued until 31st December 2013, however further reductions may be implemented pending developments in the European eel stock.

A-licence

For fishermen and entities with reported and registered eel catches of a minimum total of 600 kg or 30 000 DKK in the reference period 2004–2006 and a minimum of 200 kg or 10 000 DKK in 2007, the following conditions apply:

- The licence only allows a maximum level of fishing activity equal to the effort documented in 2007.
- Only the following gear types are allowed in marine eel fishing: fykenets, poundnets and hooklines.

B-licence

For fishermen and entities with reported and registered eel catches from documented fykenet fishing in the reference period 2004–2006 and in 2007.

- The B-licence allows only for the use of up to 20 fykenets.

C-licence

For fishermen and entities with reported and registered eel catches from documented use of more than one poundnet in the reference period 2004–2006 and in 2007, the following conditions apply:

- The C-licence allows only for a maximum level of fishing activity equal to 50% of the number of poundnets registered with the Directorate of Fisheries in 2007.

BC-licence

For fishermen and entities with reported and registered eel catches from documented use of more than one poundnet and fykenet in the reference period 2004–2006 and in 2007. The licence allows only for a maximum level of fishing activity equal to 50% of the number of poundnets registered with the Directorate of Fisheries in 2007.

- The licence allows only for the use of up to 20 fykenets.

Recreational fishing capacity

Recreational fishermen and commercial fishermen and entities not eligible for either an A, B, C or BC licence.

The following conditions apply:

- The eel fishing season is closed from May 10th until July 31st.
- Each licence holder is allowed a maximum of six fykenets during the fishing season.
- Hooklines are prohibited from May 1st until September 30th.

- Commercial fishermen and entities must register with the Directorate of Fisheries before initiating fishing activities.

Table 4.4. Number of fishermen and information on gear in operation from July 2009. Recreational fishermen are prohibited fishing in the time period from 16 October to 31 July. Professional fishermen have only limitations on number of gear to be used.

Location Fishermen	Fishermen with licence	Fykenets	Small poundnet	Large poundnet	Hookline
Marine Professional	384	35 438	1108	1165	1932
Freshwater Professional	17	914	214	0	na
Marine Recreational	*18 768	na	Not allowed	Not allowed	na
Recreational	-	na	Not allowed	Not allowed	-

***) Estimated from questionnaire in 1997; na = not available**

DK.5 Fishing effort

DK.5.1 Glass eel

No data.

DK.5.2 Yellow eel

No data.

DK.5.3 Silver eel

DK.5.4 Marine fishery

DK.6 Catches and landings

DK.6.1 Glass eel

Not allowed.

The data given below are the official landings reported to the ministry.

DK.6.2 Freshwater landings

The annual landings in freshwater have been decreasing relatively more than marine landings during the last ten years. The freshwater landings make up 13 tonnes and the catch is only 2–3 % relative to the marine landings.

Table 6.2. Freshwater landings (tonne) from 1997.

YEAR	SILVER	YELLOW	TOTAL
1997	-	-	39
1998	-	-	40
1999	-	-	30
2000	4	24	28
2001	2	34	36
2002	5	27	27
2003	2	21	24
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

DK.6.3 Marine landings

The annual landings of eel (yellow and silver eels) in the marine area have been fairly constant during the last decade. There is a trend that more silver eels than yellow eels are being captured, suggesting yellow eels are less exploited.

Table and Figure 6.3.1. Marine landings (tonne).

YEAR	SILVER	YELLOW	TOTAL
1997	375	383	758
1998	306	251	557
1999	380	307	687
2000	382	218	600
2001	446	225	671
2002	365	217	582
2003	437	188	625
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

DK. 7 Catch per unit of effort

DK.7.1 Glass eel

No data.

DK.7.2 Yellow eel

No data.

DK.7.3 Silver eel

No data.

DK.7.4 Marine fishery

DK.8 Other anthropogenic impacts

No data.

DK.9 Scientific surveys of the stock

DK.9.1 Glass eel monitoring

Weirs in streams are in a process to be cancelled as a part of National river restoration projects. This also takes place in River Kolding Å where a monitoring station is situated at Harte power station. Terminating weirs reduces the possibility of monitoring young eel recruitment the traditionally way, using eel passtraps. New methods and locations are urgently needed in order to monitor the effect of the EU regulation in terms of recruitment from the ocean. In Vester Vedsted brook (Section 3.1) where monitoring using electrofishing has been ongoing most years since 1979; recruitment of glass eel to the brook has been reduced and glass eel have been rare in recent years.

In 2008 three small brooks on the North Sea coast of Jutland were selected for monitoring in a pilot project. All three brooks have a recruitment of glass eel. At each brook between one and three stations of 10–20 m length (close to the shoreline <1000 m) are electrofished at three different times from May to August and the number of eel at each station is calculated (removal method). The brooks have a water depth <50 cm and a width of <4 m.

The aim is to have this type of monitoring replacing eel passtraps 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?

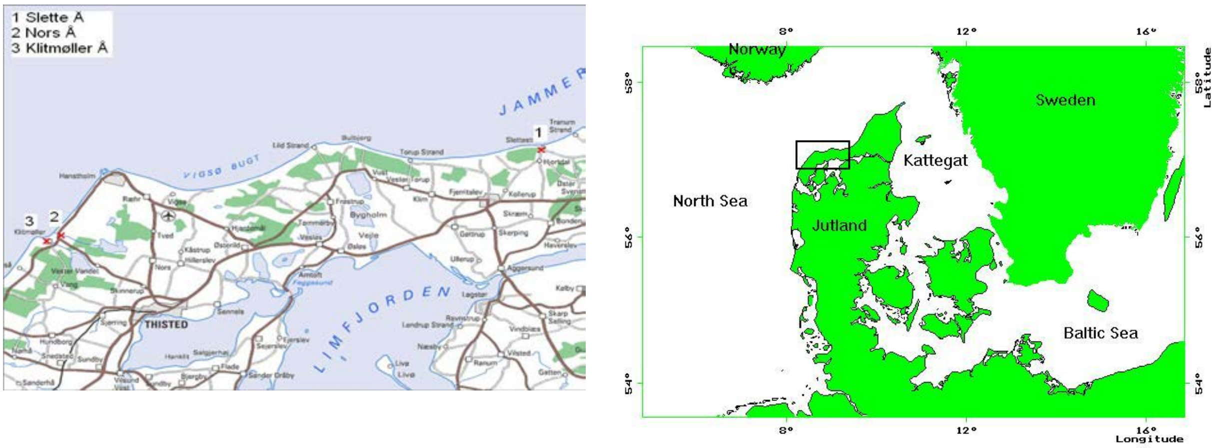


Figure 8. New glass eel monitoring sites (1, 2 and 3) in the North Sea.

DK.9.2 Silver eel escapement from rivers

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

DK.10 Catch composition by age and length

Age and length data are collected at different sites (Arresø, Isefjord and Ringkøbing Fjord and other sites) as part of the DCF programme.

DK.11 Other biological sampling

DK.11.1 Length and weight and growth (DCR)

No relevant data.

DK.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. This was started in 1987 and 1988. The number of Anguillicola infected eels (prevalence) is relatively constant during 1987–2010 at all three locations.

Table 11.2.1. Anguillicola monitoring data for 2010.

Location	Salinity ppt	Coordinates	Year	Total	Infected	Prevalence	Intensity
				N	n	%	n
Arresø	0	55.59N;11.57E	2010	100	60	60	4.1333
Isefjord	18	55.50N;11.50E	2010	0	-	-	-
Ringk. Fj	5–10	55.55N;08.20E	2010	104	67	64.4	5.2089

DK. 11.3 Contaminants

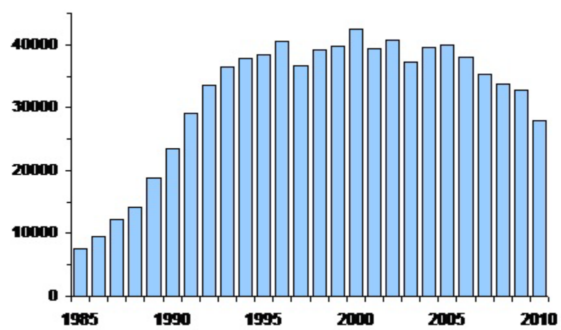
No new data available.

DK.11.4 Predators

Cormorants

The number of cormorants is estimated throughout the country every year by the Ministry of Environment Figure 11.4. Cormorant's predation on flatfish, trout and salmon smolt and eels have been studied using various tagging methods e.g. floy tags, coded wire tags and radio tags in Ringkøbing Fjord (55,55'N;08,20'E). In a study of cormorant predation on eel a total of 10 163 eels (10 gramme) were coded wire tagged and released in Ringkøbing Fjord in 2003. In the same year 5.734 regurgitate were analysed and 21 coded wire tags were found. From these data it was estimated that 43% of the tagged eels were eaten by the cormorants. However, in general the cormorants do not seem to eat many eels. The frequency of occurrence of eel otoliths found in regurgitate in 2005 was only 0,12% (Sonnesen, 2007) suggesting that wild eels are not important as food in Ringkøbing Fjord. Recent work from Hirsholmene (57.29'N;10.37'E) a cormorant colony in Kattegat suggested that of 350 regurgitate eel otoliths occurred with a frequency of 0,3% (Poul Hald, 2007). The population of nesting birds has reduced during the last year. This is believed to be due to a low food supply in coastal areas and also the cold winter in 2009–2010.

Figure 11.4. Number of nesting birds in Denmark. Data from NERI. University of Århus.



DK.12 Other sampling

No data.

DK.13 Stock assessment

DK.13.1 Local stock assessment

No data.

DK.13.2 International stock assessment

DK.13.2.1 Habitat

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. Historical information suggests that before draining and land reclamation took place (during the 18th and 19th century) inland waters (i.e. permanent and temporary areas) covered 25% relative to the total Danish landmass. The present inland waters of 60 000 ha cover approximately 1.5% of the present landmass.

DK.13.2.2 Silver eel production

DK.13.2.2.1 Historical production

In determining potential silver eel escapement prior to the 1980s surveys using production models and mark–recapture studies have been used.

Silver eel production in Danish streams

Silver eel production in Køge Lellinge stream was estimated at about 105 kg /ha river (wetted area) (Rasmussen and Therkildsen, 1979). The estimate was based on the density of resident yellow eel, observed growth (derived from age reading) and mortality with data collected during the period 1965–1968. The estimate is therefore based on glass eel recruitment during the period from the late 1950s and early to mid 1960s, one eel generation earlier. The population in Køge Lellinge stream consisted mostly of males with a mean silver eel weight of 100 grammes. The experiment was undertaken in the lowest part of the stream and downstream of a weir; the estimate therefore cannot be taken as representative of silver eel escapement for the catchment as a whole, but only for the lower part of the river.

Silver eel production in River Brede was estimated at 49 kg/ha river (wetted area) (Nielsen, 1982). The silver eel were caught in autumn 1981 using fykenets; escapement was estimated using mark-recapture and is thus based on the recruitment of glass eel during the period 1965–1975. The population of silver eel was 82% males and 18% females. Average weight of silver eels was 120 grammes.

Silver eel production in the River Bjornsholm was in 1988 estimated in the range 9–39 kg /ha river (wetted area) (Bisgaard and Pedersen, 1990). Densities of resident yellow eel, observed growth rate (derived from age reading) and mortality produced an estimate of 39 kg /ha river (wetted area). This compares to an estimate of 9 kg /ha river (wetted area) from mark-recapture on silver eel carried out in August and September and therefore should be considered a minimum estimate of escapement. Sex ratios of silver eel were 40% males and 60% females. The average weight of the silver eels was 280 grammes.

From the above studies it is proposed that 50 kg/ha (wetted area) represents "prestine" escapement for the freshwater environment. This translates into the 40% EU escapement target of 20 kg/ha (wetted area) of silver eel.

Silver eel production in Danish lakes

Silver eel escapement from lakes is estimated based on fisheries yield prior to 1980. Fisheries yield were then in the range of 3–5 kg/ha. Assuming fisheries mortality of F = 0.5 the production is roughly in the range of 6–10 kg/ha.

Potential silver eel escapement

The potential silver eel escapement from freshwater in the absence of anthropogenic mortality is estimated at 1110 tons, prior to the 1980s. The figure is based on the present area of inland water.

Table 13.2.2.1. Potential silver eel escapement prior to the 1980s.

Inland water	Area (ha)	Silver eel production (kg/ha)	Total production (tons)
Running water	15 000	50	750
Lakes	45 000	8	360
Total	60 000		1110

Stocking

To meet the 40% escapement target for silver eel in fresh and marine waters annual stocking of 5–6 tons glass eel in freshwater and 33 tons of glass eel in marine waters are needed.

DK.13.2.2.2 Current production

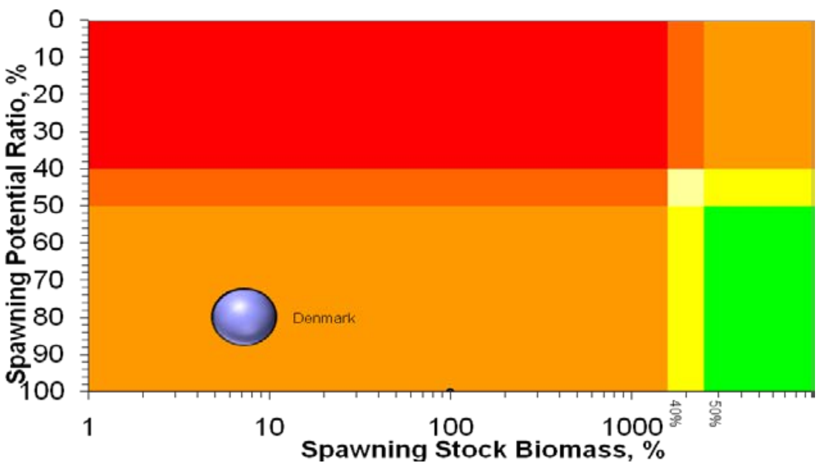
Current silver eel production

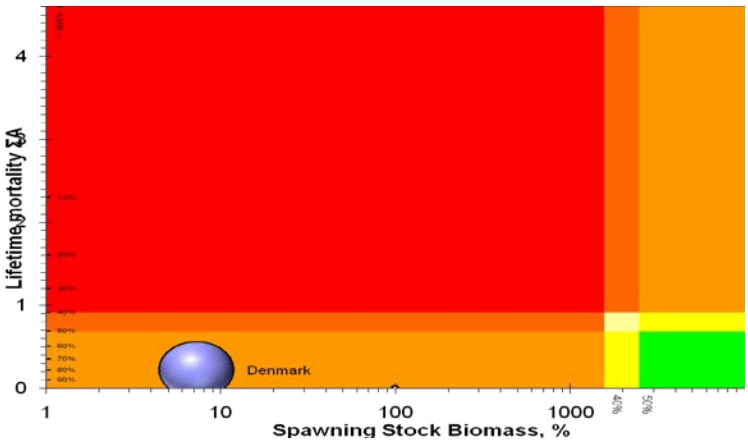
A single study in a river basin on the west coast of Denmark has been conducted. In river Ribe Å a commercial silver eel fishery is situated in the lower part of the river basin. In autumn 2010 a total of 52 silver eels were tagged with telemetric tags and released upstream the fishery. The movement of eels to the outlet of the river was recorded by listening stations. The study used the fishery statistics and the recapture rate of tagged eels, in the fishery, to calculate a production of 12,8 kg/ha of silver eels. The escapement in autumn 2010 was 3294–2773 kg silver eels.

Modified Precautionary Diagram

The plots below show ICES Precautionary Diagram modified by Willem Dekker. The figures show the Spawning-stock biomass plotted against Spawning Potential Ratio (%) and Lifetime Mortality. The idea is to visualize the stock situation in the Danish Eel Management Unit (Freshwater). The interpretation is that the Danish situation can be improved by improving silver eel escapement.

The figures are made from input data of the pristine production (no anthropogenic mortality) of silver eel (B_o=1110 t). The best estimate of the current production of silver eels (B_{best}=100 t) and finally the actual estimated escapement (B_{actual} = 80 t). For further explanation see International stock assessment Section 3.3 in the main report WGEEL 2010.





Marine

There are no surveys of silver eel production in the marine waters prior to 1980 or later. The fisheries yield today is about 500 tonne per year compared to former level in the 1960s of about 4000 tons. It is estimated that 7000 tons of silver eel was produced annually, in the Danish territory, during the period between 1920 and 1960 when the fisheries yield were stable. Current silver eel production is estimated at 600 tons.

DK.13.2.2.3 Current escapement

No data available, but for freshwater is assumed <69 tons. For marine assumed 600 tons.

DK.13.2.2.4 Production values e.g. kg/ha

No new data available but see historical production.

DK.13.2.2.5 Impacts

In the river Gudenå impacts of fisheries and hydropower seem high. Surveys are in progress.

DK.13.2.2.6 Stocking requirement eels <20 cm

In **freshwater**: To meet the 40% target within one eel generation of approximately 15 years in freshwater , it is necessary to stock 3–4 tonnes of glass eel per year, combined with the termination of all eel fishing activities in freshwater and free (non-fisheries) migration routes along the coastline to-wards the Sargasso Sea.

In **salt water:** To meet the 40% target within one eel generation of approximately 15 years, it is necessary to stock ca. 33 tonnes of glass eel per year.

DK.13.3 Data quality issues

No data.

DK.14 Sampling intensity and precision

No data.

DK.15 Standardization and harmonization of methodology

No data.

DK.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 and recruitment of yellow eel in three river basins using eel pass traps and electro fishing. Data for maximum allowed fishing capacity (fishing gear) is reported but no data for actual effort is available. Scientific surveys include a project evaluating silver eel escapement in the Gudenå river and River Ribe Å system focusing on anthropogenic mortality due to fishing and turbines and predation.

Eel fisheries are planned to be 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. 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. The Baltic eel passing through the Danish Belts and the Sound are managed as if they were local Danish eels, however they should be managed in agreement with the other Baltic countries.

Glass eel monitoring is becoming more and more difficult because of river restoration projects removing barriers where pass traps traditionally have been used in the past. It is currently considered to monitor glass eel/yellow eel recruitment in selected index systems by electrofishing as a supplement to the traditional pass traps.

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Report on the eel stock and fishery in Estonia 2010/'11

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Reporting Period: This report was completed in August 2011, and the data for 2011 are incomplete.

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

EE.2 Introduction

EE.2.1 General overview

Eel fisheries in Estonia occur in Lake Võrtsjärv (10–100 t) and in coastal waters (4–30 t). Annual catch from small lakes and rivers mostly in L. Peipsi basin and L. Peipsi itself is 2–5 t. Eel catches by amateur fishermen constitute about 0,1–1 t from brackish water and about 1–1,5 t from inland waterbodies. According to the fishery statistics during the last decade the total annual catch of eel from Estonian waters was nearly 50 tons, but diminished remarkably during last three years (in 2008: 32 tons, 2009: 21 tons and 2010 only 19 tons). During the first half of previous century eel was very abundant and one of the most important commercial fish in western coastal waters of Estonia. At that time annual catch of eel 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 eel or farmed eel into L. Võrtsjärv, it has become one of the most important commercial fish in this lake. According to latest investigation 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 of Ministry of Agriculture give out fishing licences. There are gear and size restrictions. Since 2011 Lake Võrtsjärv Fisheries Development Agency (FDA) will be 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 fish in the lake. Professional fishing gears are fykenets and longlines are used by recreational fishermen. Every fisherman has own individual licence. The eel production of L. Võrtsjärv is entirely based on stocking with wild-caught elvers or farmed eels (2–20 g).

During the half hundred years (1956–2010) 47 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 22–49 t, in 2000s 10–37 tons, was much smaller than real catch (estimated catch was 80% higher). Nearly half of their incomes professional fishermen get from eel, despite their annual investments (>100 000 € annually). 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 five years ago. During 1970–1998, the number of professional fishermen varied between 20–25, followed by an increase to 32 in 2003 and over 40 in 2004–2010. 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 have increased (from 3–10 t in 1991–1995 to 20–28 t in 1999–2003), but from 2004 decreased again up to 4 t in 2010. Along the shore of the Baltics eel 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.

3) Small lakes in Peipsi basin, where eel has migrated from L. Võrtsjärv and was additionally stocked consistently during last eight 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. For fishing of eel in small lakes mostly fykenets were used.

EE.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 sub-basins. Basins and sub-basins are not connected directly with one river, as in European scale Estonian rivers are very small, except Narva River and its watershed area (1/3 of territory of Estonia and shared with Russia). 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;

1) West-Estonian Basin District (coastal waters and West-Estonian inland waterbodies)–natural population of eel.

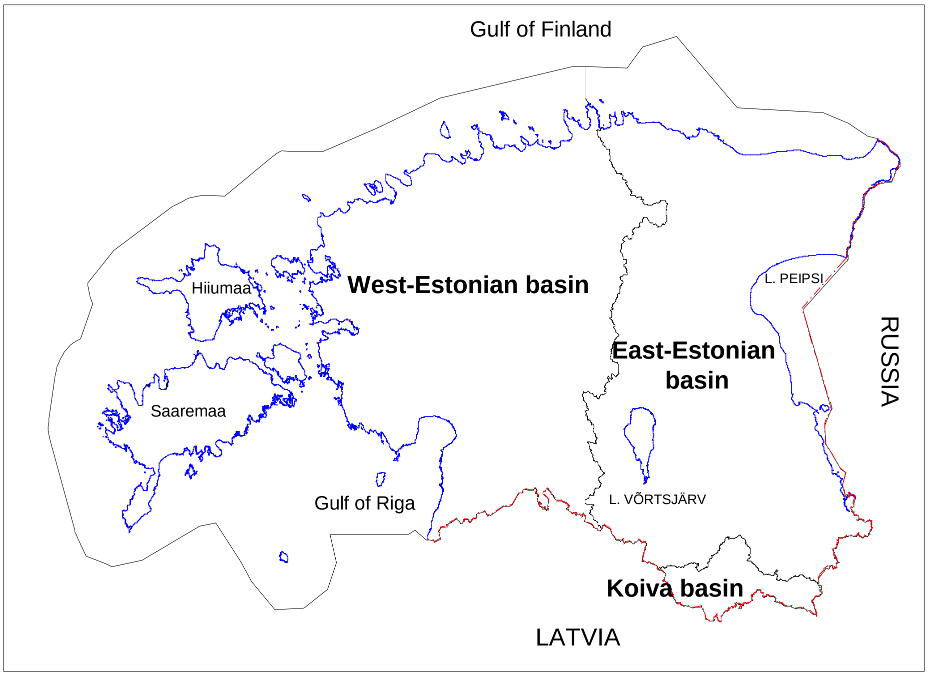

Figure 1. Map of basins.

EE.3 Time-series data

EE.3.1 Recruitment-series and associated effort

EE.3.1.1 Glass eel

EE.3.1.1.1 Commercial

Glass eel does not occur in Estonian waters.

EE.3.1.1.2 Recreational

Glass eel does not occur in Estonian waters.

EE.3.1.1.3 Fishery-independent

Glass eel does not occur in Estonian waters.

EE.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 waterbodies of Estonia was 27–32 cm and age 4–7 years (Herm and Dementjeva, 1949).

No data.

EE.3.1.2.1 Commercial

No time-series are available.

EE.3.1.2.2 Recreational

No time-series are available.

EE.3.1.2.3 Fishery-independent

No time-series are available.

EE.3.2 Yellow eel landings

EE.3.2.1 Commercial

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

EE.3.2.2 Recreational

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

EE.3.3 Silver eel landings

EE.3.3.1 Commercial

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

EE.3.3.2 Recreational

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

EE.3.4 Aquaculture production

At present there are two 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 eel).

Aquaculture production of eel in Estonia.

2002	2003	2004	2005	2006	2007	2008	2009	2010
10	20	25	40	50	50	45	30	20

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 eel). 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 waterbodies 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 eel 306.5 kg of glass eel in total.

EE.3.5 Stocking

EE.3.5.1 Amount stocked

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

In Soviet time government using state money has organized stocking. Since the beginning of 1990s 75–100% was financed by fishermen. During the last ten years 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 eel 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 eel were stocked (UK glass eel).

In 1956 stocking of glass eel into L. Võrtsjärv was started. However, stocking has been irregular (Table 1). The stocking rate with glass eel 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 eel occurred in the early 1980s. As a result, during the following eight to 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 2.

Table 1. Stocking of glass eel and young yellow eel in Estonia (in millions).

	1950		1960		1970		1980		1990		2000		2010	2010
		young		young		young		young		young		young		young
	glass	yellow	glass	yellow	glass	yellow	glass	yellow	glass	yellow	glass	yellow	glass	yellow
Year	eel	eel	eel	eel	eel	eel	eel	eel	eel	eel	eel	eel	eel	eel
0			0,6		1		1,3				1,1			0,21
1							2,7		2			0,44	0,68	
2			0,9		0,1		3		2,5			0,36		
3							2,5					0,54		
4			0,2		1,8		1,8		1,9			0,44		
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 2. Stocking number of young yellow eel (10^3) into the lakes of Narva River Basin and stocking density in 2002–2010.

	Area											Stocking density	
Lake	(ha)	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total	sp/ha	sp/ha/year
Võrtsjärv	27 000	285	408	483	330	330	290	175	370	178	2849	106	12
Saadjärv	707	50	36	29,4	15	15	10	8,3	20,5	12,5	197	278	31
Kaiavere	250	20	25	22	10	10	10	4,5	12,1	7,5	121	484	54
Kuremaa	397	0	30	11,2	10	10	10	3	7,5	5,3	87	219	24
Vagula	519	6	20	19,6	10	10	8,1	2,6	8,4	5,7	90	174	19

Table 3. Stocking of glass eel in 1956–2000, yield 1964–2008 and recapture percentage in L. Võrts-järv.

	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.

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

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

EE.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 focused on eel specially.

Table 4a. 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 fykenets	30	30	80	250	30	487	130	1037	11	37
Fykenets (1–3 m)*	20	75	61	65	85	131	265	702	7	38,7**
Fykenets up to 1 m*	12	29	101	1000	70	315	197	1724	18	
Small fykenets 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 1m and 1–3 m mouth height.**

In 2012 the number of gear will be the same as in Table 4a, except the number of small fykenets in line (Table 4b).

Table 4b. 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	2013
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 5. 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. Peipsi and Narva reservoir eel type of fishing gear are not used specially for the catch of eel (Table 5).

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 5).

In recreational fishing there are only longlines and harpoon allowed to use 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. In 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 lakes 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.

The proportion of amateur fishery from total eel catch in inland waters in 2005–2007 was 3,9%.

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.

EE.4.1 Glass eel

There is no glass eel fishery in Estonia.

EE.4.2 Yellow eel

EE.4.3 Silver eel

EE.4.4 Marine fishery

EE.5 Fishing effort

EE.5.1 Glass eel

There is no glass eel fishery in Estonia.

EE.5.2 Yellow eel

EE.5.3 Silver eel

EE.5.4 Marine fishery

EE.6 Catches and landings

EE.6.1 Glass eel

There is no glass eel fishery in Estonia.

EE.6.2 Yellow eel

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

Table 6. 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

EE.6.3 Silver eel

50–80% of total eel catch in Estonia based on stocking (Table 7). 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 7. Catch of eel (in tons per year) 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		4,9	18,8	81

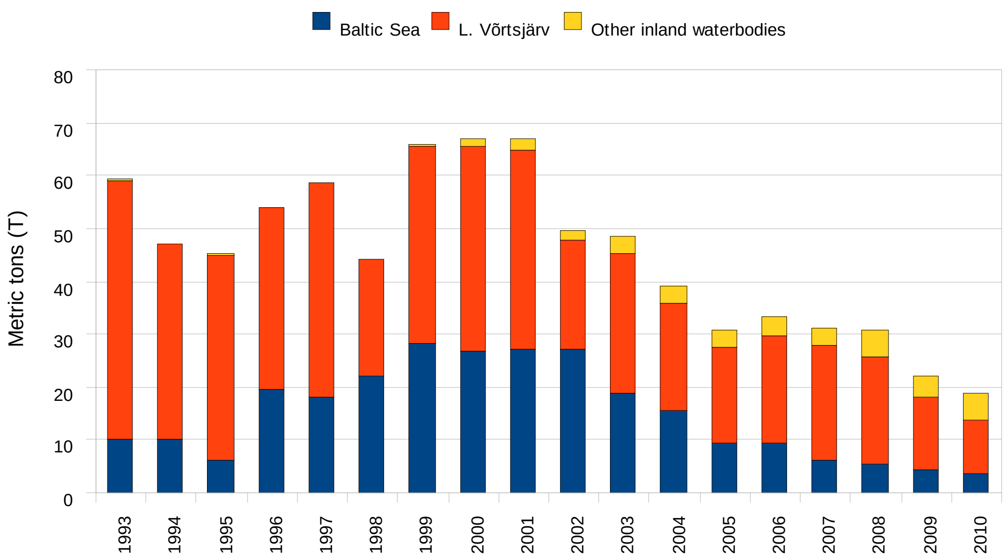

Figure 2. Catch of eel in Estonian waters in 1993–2010.

Table 8. Annual landings (in tons) from Lake Võrtsjärv.

Year	1933–39	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	
2		0	16,4	10,8	31	20,4	
3		0	21,3	24,5	49	26,3	
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	

EE.6.4 Marine fishery

Eel catches by amateur fishermen, using mostly longlines, constitute totally 0.2–0.5 t from brackish water and about 0,7–1 t from inland waterbodies. Statistics of non-commercial catches is incomplete.

Table 9. Non-commercial catches (kg) of eel in ICES subdivisions in Estonian coastal waters in 2005–2007.

Year	28-2	28-5	29-2	29-4	32-1	32-2	Total
2005	46	231	88	57	49	9	480
2006	35	120	17	33	24	0	229
2007	37	84	32	18	30	1	202
Total	118	435	137	108	103	10	911
%	13	47,7	15	11,9	11,3	1,1	

EE.7 Catch per unit of effort

EE.7.1 Glass eel

There is no glass eel fishery in Estonia.

EE.7.2 Yellow eel

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

EE.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 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 10. Cpue (catch in grammes per 100 hooks per night during June–August) of longlines in inland waterbodies of different river basins (data from 2001–2008).

River basin	Cpue g	Number of longlines	Catch kg	Sub-basin	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

EE.7.4 Marine fishery

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

Table 11. Cpue (catch in grammes per 100 hooks per night during June–August) of longlines 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

EE.8 Scientific surveys of the stock

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

EE.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 eel in commercial catch in L. Võrtsjärv are silver eel. In Vooremaa lakes this proportion reaches up to 80%.

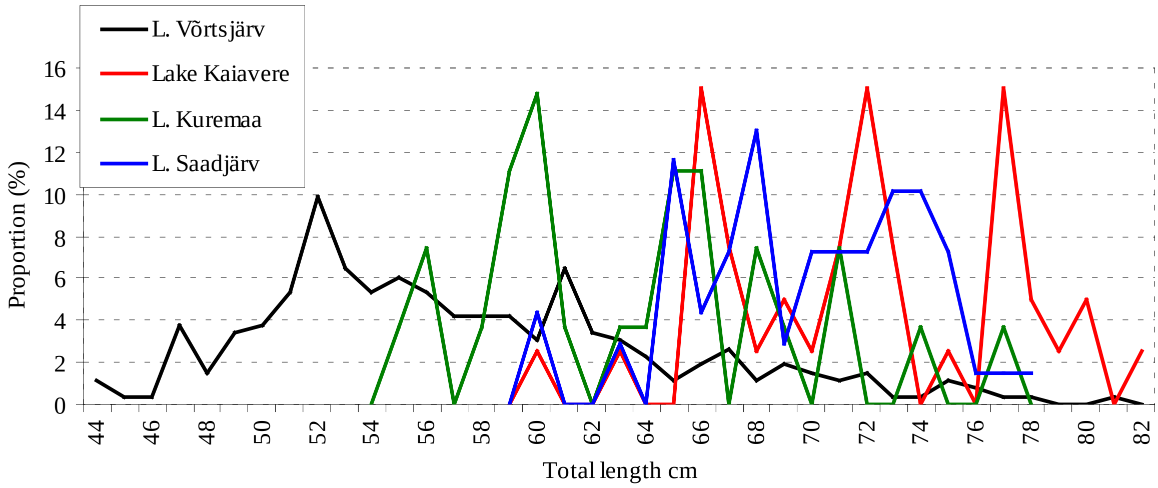

Figure 2. Length distribution of eel in fykenet catches in L. Võrtsjärv and in the lakes of Vooremaa district in September 2008.

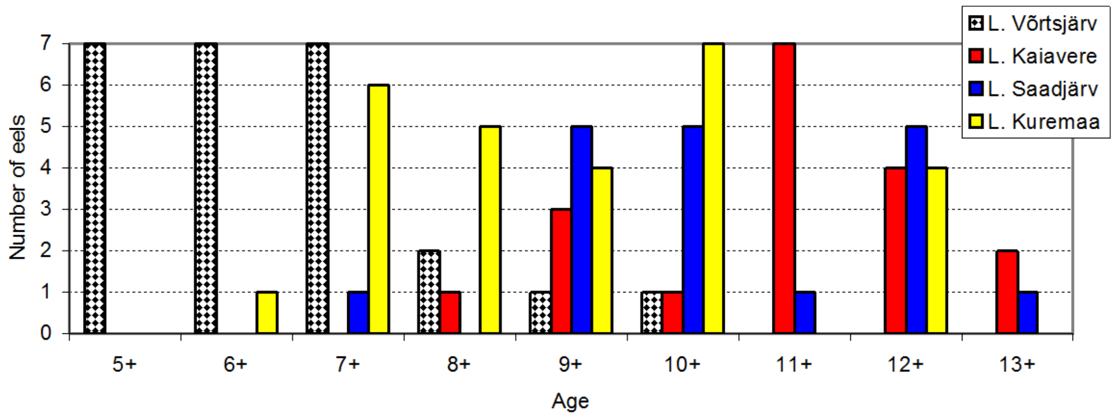

Figure 3. Age composition of eel in fykenet catches in L. Võrtsjärv and in the lakes of Vooremaa district in 2008.

EE.10 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 cathes of yellow and silver eel were investigated in many lakes and rivers all over Estonia. Main source of the information for the eel were official catches and special longline fykenet catches and electrofishing in rivers (multispecies survey in more than 300 stations every year, relative abundance). Special survey of eel in coastal waters was not done in Estonia.

EE.10.1 Length and weight and growth (DCR)

There is a sampling programme including measuring of length, weight and age determination of eel in L. Võrtsjärv and in small lakes. In coastal waters it is occasional.

EE.10.2 Parasites and pathogens

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

EE.10.3 Contaminants

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

EE.10.4 Predators

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

In 2002–2011 was investigated feeding of pike in winter and the proportion of eel in it.

EE.11 Other sampling

Estonia has the state programme of reproduction and re-stocking of fish (2002–2010) including European eel. In connection with this programme we have finished and ongoing special investigations and monitoring projects concerning eel in Estonia financed by Ministry of Environment and ERDF:

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.

Registration of fishing efforts, investigation of catch composition, etc. is well organized 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 more detail; specially survival using marking of the whole amount of stocking material. Silver eel migration is necessary to continue and start with a pilot study for quantifying angling catch and effort.

EE.12 Stock assessment

EE.12.1Local stock assessment

EE.12.1.1 Habitat

EE.12.1.2 Silver eel production

EE.12.1.2.1 Historical 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 tonne and continues to decline up to 20 t in the end of 1970s. In 1980s the eel catch increased again up to 30 tons (Figure 13). Shallow coastal waters close to western inlands and

Väinameri (Figure 12) 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 especially high values (8,4–8,7%) were noticed at 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.

EE.12.1.2.2 Current production

In spring 2007 was stocked 81 Carlin-tagged eels over legal size (>55 cm) into L. Võrtsjärv (Table 11). 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 Finland. 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 100–500 kg yr^{-1} (Table 7). For the calculation of abundance of fishable stock of eel in L. Võrtsjärv the Lincoln-Petersen method was used (Ricker, 1975; Pollock jt., 1990).

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

Table 12. 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.

Year	Tagged eels in the lake	Number of recapture	Percentage of recapture	Annual catch kg	Mean weight of eel g	Yield in number	Total number of eels (>50 cm)
2007	81	12	14,8	21 500	430	50 000	315 390
2008	96	12	13,2	19 900	425	46 824	349 387
2009	150	10	6,7	12 580	500	25 160	345 391
2010	232	19	8,2	9700	421	23 040	255 645

EE.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 of going 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 (82g) 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 loss in weight was 44 g (initial weight 126 g). As most of tagged eels were yellow eels, the recapture outside the lake of release is still low, except Narva reservoir (Table 13, Figure 4).

In November 2007 there was observed also survival and behaviour of seven eel 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 months 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 13. Release of tagged eels in Estonian inland waterbodies, recapture and repeated recapture in the same lake or outside the waterbody of release in 2006–2011.

Water body of release	Number of tagged eels	First recapture	Second recapture	Third recapture	Total recapture	Percentage of recapture	Recapture outside 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	609	84	7	0	91	14,9	2
Lake Saadjärv	198	16	0	0	16	8,1	0
Lake Kuremaa	213	33	5	1	39	18,3	1
Lake Kaiavere	53	4	0	0	4	7,5	0
Lake Vagula	38	1	0	0	1	2,6	0
River Emajõgi	25	0	0	0	0	0,0	0
Total	1282	150	12	1	163	12,7	11

Figure 4. Waterbodies of release (blue: L. Võrtsjärv; red: L. Kuremaa; yellow: Narva reservoir) and recapture of eel outside Narva RBD.

EE.12.1.2.4 Production values e.g. kg/ha

No information available.

EE.12.1.2.5 Impacts

No information available.

EE.12.1.2.6 Stocking requirement eel <20 cm

Since 2001 there was stocked only farmed eel, mean weight 5 g. According to the plan, there is requirement to stock at least 0,6 million farmed or 2,5 million glass eel into Estonian lakes.

EE.12.1.2.7 Data quality issues

No information available.

EE.13 Sampling intensity and precision

No information available.

EE.14 Standardization and harmonization of methodology

On the basis of cpue of longlines catches in lakes and coastal waters were estimated relative abundance in different areas (Tables 10 and 11).

EE.14.1 Survey techniques

No surveys or samples are done.

EE.14.2 Sampling commercial catches

Section 9.

EE.14.3 Sampling

No surveys or samples are done.

EE.14.4 Age analysis

Section 9.

EE.14.5 Life stages

No surveys or samples are done.

EE.14.6 Sex determinations

No surveys or samples are done.

EE.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 for 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. In 2009 the number of licences of small fykes in line where diminished approximately 15% already. For 2013 this number will diminish up to 45% of present number. 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 4.8 tons, in 2008. In spite of this there will be diminished licences of small fykes 55%. In case of the increase of eel catches in coastal waters of Estonia the number of licences of small fykes will be diminished up to zero or additionally will diminished other types of fykenets, mostly fykes with mouth height up to 1 m.

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Report on the eel stock and fishery in Finland 2010/'11

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Reporting Period: This report was completed in August 2011, and contains data up to 2010 and some provisional data for 2011.

FI.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 freshwaters 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 eels 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 South coast of Finland.

FI.3 Time-series data

FI.3.1 Recruitment-series and associated effort

FI.3.1.1 Glass eel

No glass eel recruitment at all.

FI.3.1.1.1 Commercial

FI.3.1.1.2 Recreational

FI.3.1.1.3 Fishery-independent

FI.3.1.2 Yellow eel recruitment

No available data.

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

FI.3.1.2.1 Commercial

FI.3.1.2.2 Recreational

FI.3.1.2.3 Fishery-independent

FI.3.2 Yellow eel landings

No available data.

FI.3.2.1 Commercial

FI.3.2.2 Recreational

FI.3.3 Silver eel landings

No available data.

FI.3.3.1 Commercial

FI.3.3.2 Recreational

FI.3.4 Aquaculture production

No aquaculture production.

FI.3.4.1 Seed supply

FI.3.4.2 Production

FI.3.5 Stocking

FI.3.5.1 Amount stocked

Table 1. Eel stockings in Finland in 1961–2011 (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

	Glass eels	Quarantined/on grown glass eels	Bootlace	Origin
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
1978	368 000		12 000	France, Denmark, Germany
1979			75 000	Denmark, Germany
1980–1988	no	introductions	allowed	
1989		9700		River Severn (Swedish quarantine)
1990		58 840		River Severn (Swedish quarantine)
1991		108 515		River Severn (Swedish quarantine)
1992		102 450		River Severn (Swedish quarantine)
1993		105 000		River Severn (Swedish quarantine)
1994		103 500		River Severn (Swedish quarantine)
1995		216 600		River Severn (Swedish quarantine)
1996		74 580		River Severn (Swedish quarantine)
1997		82 200		River Severn (Swedish quarantine)
1998		77 550		River Severn (Swedish quarantine)
1999		62 500		River Severn (Swedish quarantine)
2000		61 015		River Severn (Swedish quarantine)

	Glass eels	Quarantined/on grown glass eels	Bootlace	Origin
2001		45 500		River Severn (Swedish quarantine)
2002		55 000		River Severn (Swedish quarantine)
2003		0		
2004		63 500		River Severn (Swedish quarantine)
2005		64 000		River Severn (Swedish quarantine)
2006		55 000		River Severn (Swedish quarantine)
2007		107 000		River Severn (Swedish quarantine)
2008		206 000		River Severn (Swedish quarantine)
2009		117 500		River Severn (Swedish quarantine)
2010		153 000		River Severn (Swedish quarantine)
2011		306 000		River Severn, France (Swedish quarantine)

FI.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.

FI.4 Fishing capacity

There is 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 side-catch. Therefore the recreational fisheries mainly catch the eels. 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 are a surprising bycatch.

FI.4.1 Glass eel

FI.4.2 Yellow eel

FI.4.3 Silver eel

FI.4.4 Marine fishery

FI.5 Fishing effort

No available data.

FI.5.1 Glass eel

FI.5.2 Yellow eel

FI.5.3 Silver eel

FI.5.4 Marine fishery

FI.6 Catches and landings

The re-stockings in the late sixties and in 1970s gave a catch of 60–80 tonnes a year at 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 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 give nowadays a catch between 5–10 tonnes/year. Figures in the professional fisheries columns in Table 2 are based on logbook data and in the recreational fisheries data on questionnaires. Results of the latest questionnaire concerning year 2010 are ready in September 2011.

Table 2. Eel catches in Finland 1975–2010 (x1000 kg). The statistical data are collected by the FGFRI.

	Marine fisheries		Freshwater fisheries		
Year	Professional	Recreational	Professional	Recreational	Total catch
1975	0	0	0	0	0
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	?	?	?	0,2+?
1988	0,4	?	?	?	0,4+?
1988–1995	?	?	?	?	?
1996	?	1	?	21	22+?
1997–2002	?	?	?	?	?
2003	0,4	?	?	?	0,4+?
2004	1,1	?	?	?	1,1+?
2005	0,4	?	?	?	0,4+?
2006	0,2	?	?	?	0,2+?
2007	0,5	?	?	?	0,5+?
2008	1,0	13	?	4	17
2009	1,8	?	?	?	1,8+?
2010	2,2	ready 09.2011	?	ready 09.2011	

FI.6.1 Glass eel

No catches.

FI.6.2 Yellow eel

No available data.

FI.6.3 Silver eel

No available data.

FI.6.4 Marine fishery

No available data.

FI.7 Catch per unit of effort

No available data.

FI.7.1 Glass eel

FI.7.2 Yellow eel

FI.7.3 Silver eel

FI.7.4 Marine fishery

FI.8 Other anthropogenic impacts

No available data.

FI.9 Scientific surveys of the stock

No available data.

FI.10 Catch composition by age and length

No data available.

FI.11 Other biological sampling

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 on 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. Considering eel's low status for fisheries and low economic value in Finland, it is obvious that collecting data more effective is difficult.

FI.12 Other sampling

No other sampling is going on.

FI.13 Stock assessment

FI.13.1 Local stock assessment

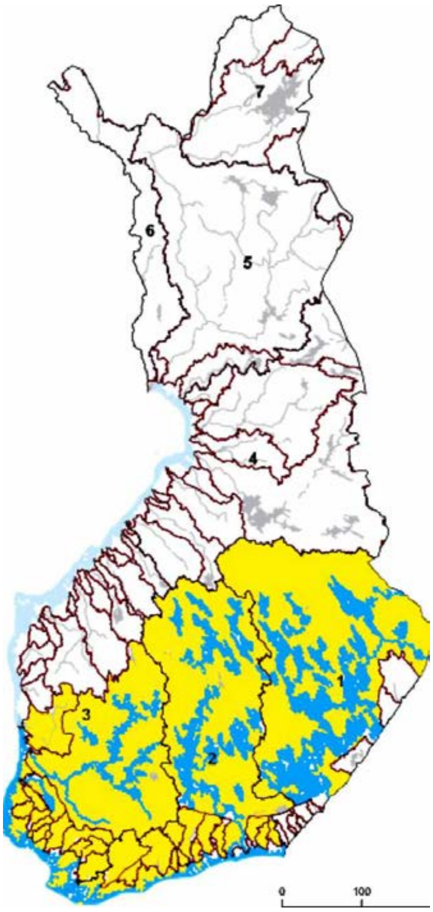
There is not a routine assessment of local stocks. Neither there is any formal advice on fisheries management.

FI.13.2 International stock assessment

FI.13.2.1 Habitat

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.

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.

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.

FI.13.2.2 Silver eel production

FI.13.2.2.1 Historic production

No data available.

FI.13.2.2.2 Current production

No data available.

FI.13.2.2.3 Current escapement

No data available.

FI.13.2.2.4 Production values e.g. kg/ha

No data available.

FI.13.2.2.5 Impacts

No exact data available. Impact of fishery is very low both in freshwaters and in the Baltic. Impact of hydropower in freshwaters is high.

FI.13.2.2.6 Stocking requirement eels <20 cm

According to the EMP 537 000 glass eels will be stocked annually in the first years in the main management area for eel (area of free migration (A), category b). After few years the stocking volume doubles to 1 074 000 individuals. In 2011 only 200 000 individuals were stocked (37% of the amount in EMP)

FI.13.2.2.7 Summary data on glass eel

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

FI.13.2.2.8 Data quality issues

No data available.

FI.14 Sampling intensity and precision

No data available.

FI.15 Standardization and harmonization of methodology

FI.15.1 Survey techniques

No data available.

FI.15.2 Sampling commercial catches

No data available.

FI.15.3 Other biological sampling

Done by FGFRI since 1974 with longlines and fykenets in lakes and eel traps in the rivers. In 2006–2009 samples were collected in freshwaters 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 otoliths have been removed and gut examined for Anguillicola.

For every fish 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).

In 2010 and 2011 there has been no organized sampling due to lack of funding.

FI.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.

FI.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.

FI.15.6 Sex determinations

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

FI.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 has 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's 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 come true.

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Report on the eel stock and fishery in France 2010/'11

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Reporting Period: This report was revised and completed in August 2011. For lack of availability many data can't be updated. We thus deleted all parts that haven't been updated. We refer the reader to the last report (Beaulaton *et al.*, 2010) for any old data.

FR.2 Introduction

FR.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 a). 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 to the Mediterranean lagoons.

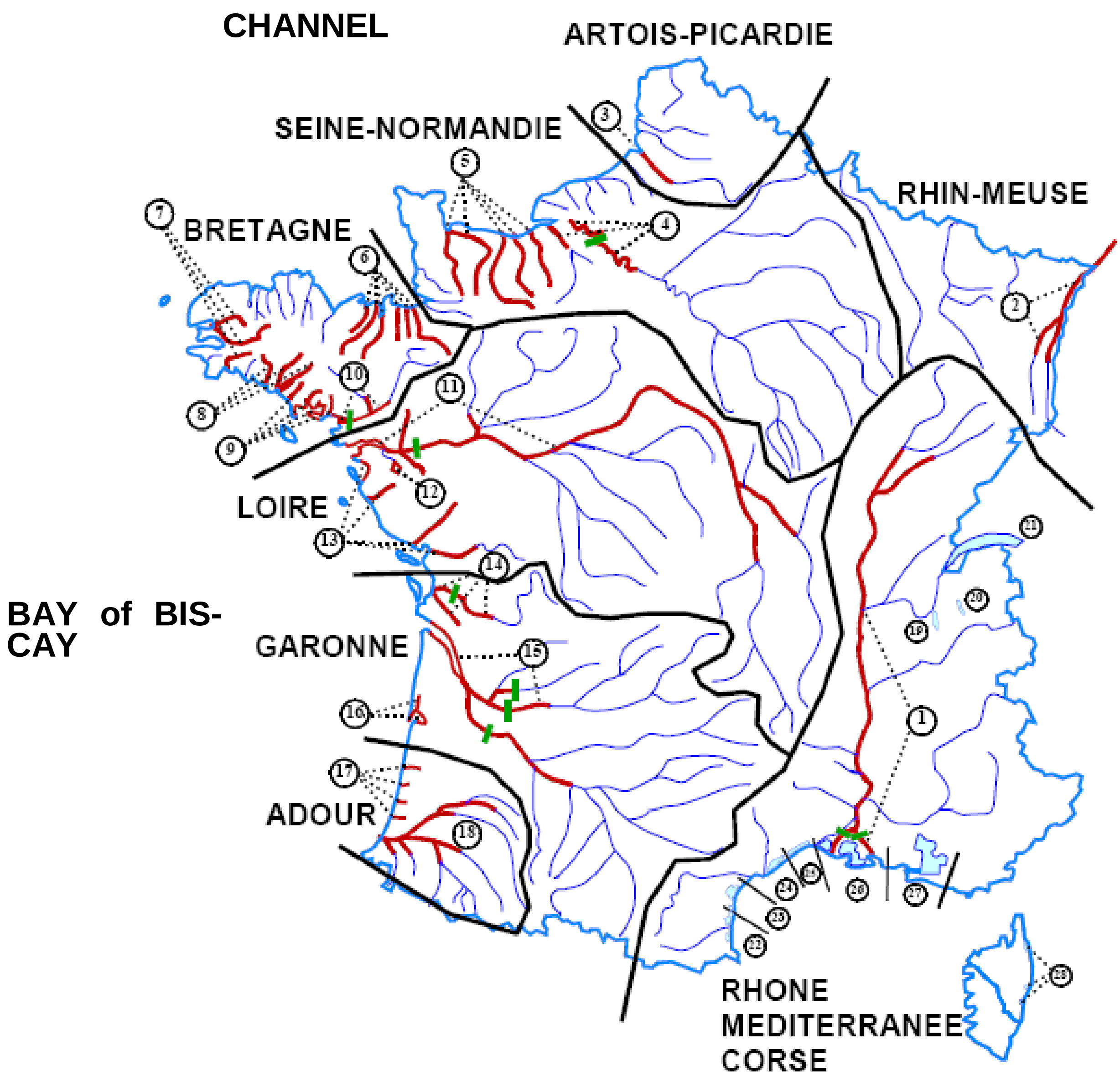


Figure FR 1. Inland waters in France (eel fisheries in red; tidal limits in green). The numbers correspond to the list of fishing zones in Table FR a. The management unit names and limits are in black (redrawn from Castelnaud, 2000).

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 for commercial purpose. Their number and the amount of their catches had never been clearly quantified.

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

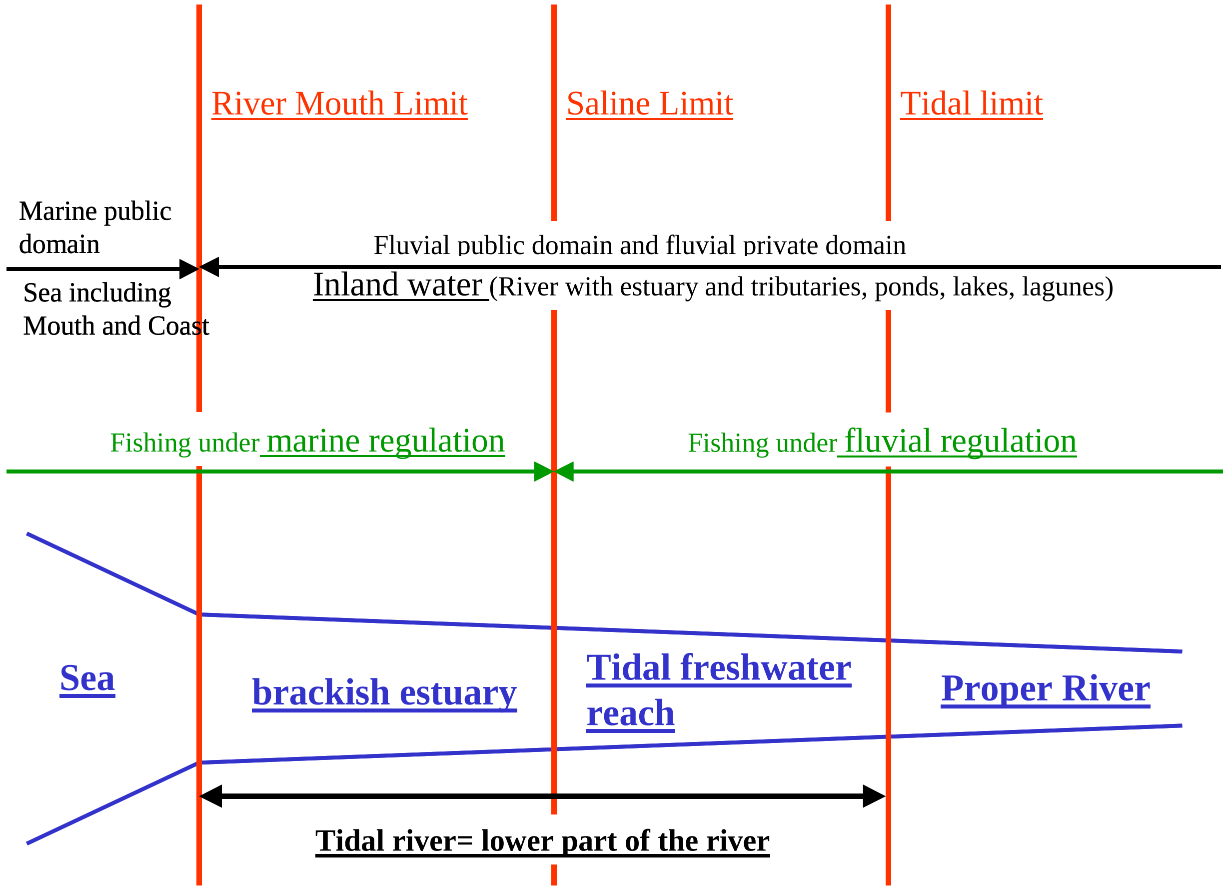
(Number from Figure FR 2) Fishing zone – Surface for lagoons	COGEPOMI
(1) Delta du Rhône	Rhône-Méditerranée Corse
(1) Fleuve Rhône aval et amont, Saône, Doubs	Rhône-Méditerranée Corse
(2) Fleuve Rhin, Ill	Rhin Meuse
(3) Estuaire Somme	Artois-Picardie
(4) Estuaire Seine, Fleuve Seine aval	Seine Normandie
(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

(Number from Figure FR 2) Fishing zone – Surface for lagoons	COGEPOMI
(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

FR.2.2 Management and monitoring system

The administrative saline limit separates two different fishery regulations: marine and fluvial (freshwater) (Figure FR 1). 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 inland waters. The glass eel fishery is limited with quotas of glass eel stamps and the silver eel fishery is limited by personal authorizations. In the Mediterranean lagoons, where glass eel fishing is forbidden, there are also limitations in the number of marine professional fishermen and fishing capacities but no system of licences exists.



Fishermen category	Marine professional fisherman=MP Marine amateur fisherman with or without boat =MA	Marine professional fisherman=MP River professional fisherman =FP River amateur fisherman with gears with or without boat =FA Anglers (with rods and sometines with gears) =AN
Fishing rights	MP : quota of licences CIPE (quota of glass eels stamps) MA : no licences, gears limited by rules	MP et FP : quota of licences (quota of glass eels stamps) FA : quota of licences AN : rod licence and quota of licences for gears

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, meaning that yellow and silver eels cannot be separated.

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 compulsory declarations of captures and effort (logbooks) using similar fishing forms collected monthly (Table FR. b) with the help of some local data collectors.

Beside these obligatory systems, for which reliability, accuracy and availability of data are variable, local scientific monitoring are developed in the Gironde, the Adour and the Vilaine basin for instance. Also data on annual captures are provided for some sectors by the local fishery administrations: Directions "Départementales des Affaires Maritimes (DDAM), Directions Départementales de l'Agriculture et de la Forêt (DDAF)". At some occasions, some punctual occasion made by scientific institute, local fishery administration or fishermen themselves are available.

Table FR b. Official administrative monitoring systems in France.

SEA	INLAND WATERS	
Salt water	**Brackish water**	**Freshwater**
Marine Public domain: Sea Coast	**Marine Public domain: Estuaries**	**Fluvial Public domain: parts of rivers above estuaries, lakes**
Professionnal fishermen	Professionnal fishermen	Professionnal fishermen
no specific license	Quota of licenses by estuary (specific for glass eel since 1993 and for eel since 2005)	Quota of licenses by river section and by lake (specific for glass eel since 1988)
Logbook for sea fishing	Compulsory logbook (by day, by gear) since 1993 treated by CNTS (ex-CRTS) and Ifremer until 2001, no more data available	Compulsory logbook (by day, by gear) since 1999 treated by ONEMA (ex-CSP) until 2002
Few oriented fishery on eel, few data available		Local scientific monitoring of landings and effort since 1978, Cemagref, evalution of productions by some DDAF Services
Non professionnal fishermen, amateurs and anglers	Local scientific monitoring of landings and effort since 1978, Cemagref, Ifremer, IAV, evalution of productions by some Affaires Maritimes Services	
No licence, no logbook		Non professionnal fishermen, amateurs and anglers
	Non professionnal fishermen, amateurs and anglers	since 1988)
	No licence, no logbook	Compulsory logbook (by day, by gear) 1999-2002 treated by ONEMA (ex-CSP)
	Marine Public domain: Mediterranean lagoons	
	Professionnal fishermen	Anglers
	No license but limitation of the number of fishermen by lagoon No logbook, some technical and scientific surveys	Licenses per departement No logbook, ponctual estimates (ONEMA, ex- CSP)
	Non professionnal fishermen, amateurs and anglers	**Private domain: others parts of rivers above estuaries, others parts of lakes**
	No licence, no logbook	Professionnal fishermen No licence, no logbook, ponctual estimate of effort (ONEMA, ex-
		Non professionnal fishermen, amateurs and anglers Licenses per departement No logbook, ponctual estimate of effort (ONEMA, ex- CSP)

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 eight 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 a). They gather representatives of fishermen organizations, administrations and research centers. 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 now, 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.

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).

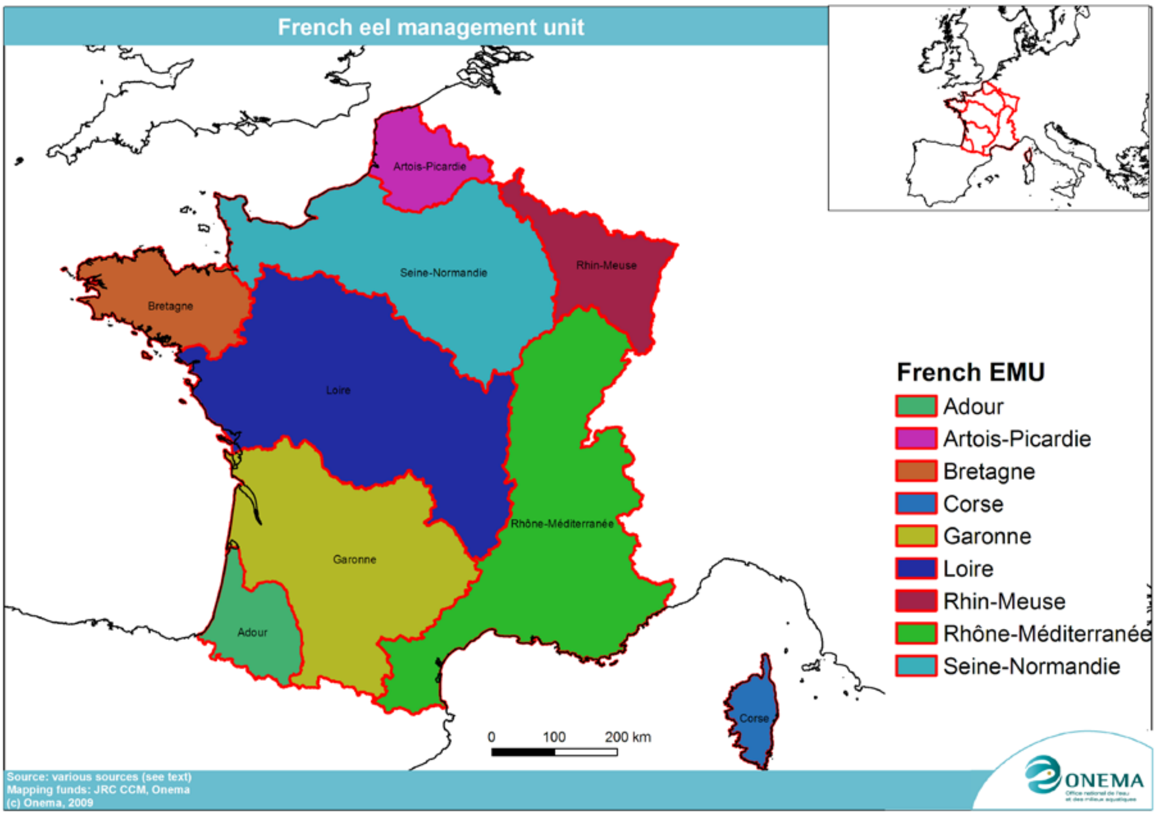


Figure FR 3. French eel management unit.

FR.3 Time-series data

FR.3.1 Recruitment-series and associated effort

FR.3.1.1 Glass eel recruitment

Eight time-series are available in France for recruitment monitoring, corresponding to five locations. Seven recruitment-series correspond to commercial catch data. Those will probably be disturbed in future due to implementation of the European eel regulation.

In 2008, WGEEL has analysed recruitment data and has categorized them for analysis. The French series were categorized as commercial catch or commercial cpue except for the Vilaine where the recruitment-series includes an estimation of recruitment after the end of the fishing season. In 2010, the Gironde scientific survey of the stock has been added to the series (Table FR c).

The Vilaine series corresponds to total catches of the fishery during the fishing season, to which is added estimation of late arrivals after the fishing season (Briand, 2009). It represents the full estuarine recruitment and therefore was labelled as "trapping all" during WGEEL analysis in 2008 (Briand, 2009). The Vilaine catch series is not continued before 1971, as at that date the construction of the Arzal has changed the fishing condition drastically. For 2009, the drop in recruitment parallels the drop in landings in France (see Section 6.1.3.). Due to the new management by EMU, Vilaine catch data are grouped with Brittany catch data. We update the series considering that catches in the Vilaine estuary represent 90% of Brittany catches.

The Loire series corresponds to an estimate of total landings of marine and river professional fishermen (t). Beware this series, often used in long-term analysis of the trends in stock is considered as inaccurate as it has been collected by various administrations and authors across time. Due to the new management by EMU, larger than the Loire river, it is difficult to obtain catch data for marine fishermen at that scale.

The Sèvre Niortaise series has been computed by Gascuel (1987), and corresponds to cpue calculated from logbooks. It has been stopped in 1984. A recent calculation of cpue in 2008 shows that it has dropped from 6 kg/day in 1983 to 1,93 kg/day. The Sèvre Niortaise is in the same EMU than Loire and for the same reason it will be difficult to update this series.

The Gironde comprises three series: landings of marine and river professional fishermen (catch, t), cpue of marine professional fishermen with large pushnet "pibalour" (kg/day^{-1} boat^{-1}) and scientific survey. The cpue series corresponds to a glm analysis of the Gironde catch series, see Beaulaton (2008) for details. Fishermen data from those series come from a specific network of cooperative fishermen (Beaulaton and Castelnaud, 2009). The scientific survey (glass eel/1000 m^3) is conducted by CEMAGREF (see Section 9.1.1 for details).

The Adour series comprise one series of catch of marine professional fishermen (t) and one series of commercial cpue of marine professional fishermen (kg.day^{-1}.boat^{-1}). Those are computed by Ifremer scientific institute from logbooks which in this estuary are considered of good quality. With the change in marine declaration system and Adour EMU being larger than Adour river, it will be difficult to update this series.

Table FR c. Recruitment-series in France. 2009 means 2008–2009 migration season.

EMU	Bretagne	Loire		Garonne-Dordogne-Charente-Seudre-Leyre			Adour – Cours d'eau cotiers	
year	Vilaine Arzal trapping all	Loire Estuary com.[1] catch	Sèvres Niortaise Estuary com. [1] cpue	Gironde (catch) com. [1] catch	Gironde pibalour (cpue) com. [1] cpue	Gironde scient. Estim.	Adour Estuary (catch) com. [1] catch	Adour Estuary (cpue) com. [1] 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						
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

EMU	Bretagne	Loire		Garonne-Dordogne-Charente-Seudre-Leyre			Adour – Cours d'eau cotiers	
year	Vilaine Arzal trapping all	Loire Estuary com.[1] catch	Sèvres Niortaise Estuary com.[1] cpue	Gironde (catch) com.[1] catch	Gironde pibalour (cpue) com.[1] cpue	Gironde scient. Estim.	Adour Estuary (catch) com.[1] catch	Adour Estuary (cpue) com.[1] cpue
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			
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		1.93	10	2.6	0.28	1.7	1.05
2009	2.2			3.5	1.4	0.44		
2010	3.8					0.10		
2011	3.7							

[1] **Com. = commercial.**

FR.3.1.2 Yellow eel recruitment

FR.3.1.2.1 Commercial

No available data.

FR.3.1.2.2 Recreational

No available data.

FR.3.1.2.3 Fishery-independent

A database of migration at barriers is currently under construction, and will provide time-series for next year.

For the next years, in the framework of the French management plan, a network of index rivers (one for each EMU) will be set up in order to monitor ascending recruitment (glass eels or elvers) and migrating silver eels (Table FR d). The preselected rivers are presented in the table. The protocol details should be fixed.

Table FR d. Preselected river for a river index network.

EMU	Preselected river
Adour	Gave de Pau (mountain fluvial basin < 1000 km^2) or La Nivelle (fluvial basin < 1000 km^2)
Gironde	Canal des étangs (estuary) or La Seudre (marshes)
Loire	Vendée (fluvial basin < 1000 km^2)/Sèvre Niortaise (marshes) or La Vie (fluvial basin < 1000 km^2)
Bretagne	Le Frémur (fluvial basin < 1000 km^2)
Seine-Normandie	La Bresle (fluvial basin < 1000 km^2)
Artois-Picardie	La Somme (fluvial basin >1000 km^2) or L'Authie (fluvial basin > 1000 km^2)
Rhone Méditerranée Corse	A lagoon or Le Rhône (fluvial basin >1000 km^2) A river in Corsica (fluvial basin <1000 km^2)
Rhin Meuse	Le Rhin (fluvial basin >1000 km^2) or La Meuse (fluvial basin >1000 km^2)

As an example on the Bresle River from the Seine Normandie EMU (close to the Artois-Picardie EMU), a small river of 70 km long 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 4 and Table FR e). The proportion of eel that use the fish compared to other way of passage is under evaluation. Since three years, nine marking–recapture campaigns have been made. The provisional recapture rate is 14% (min=1%; max=40%). 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.

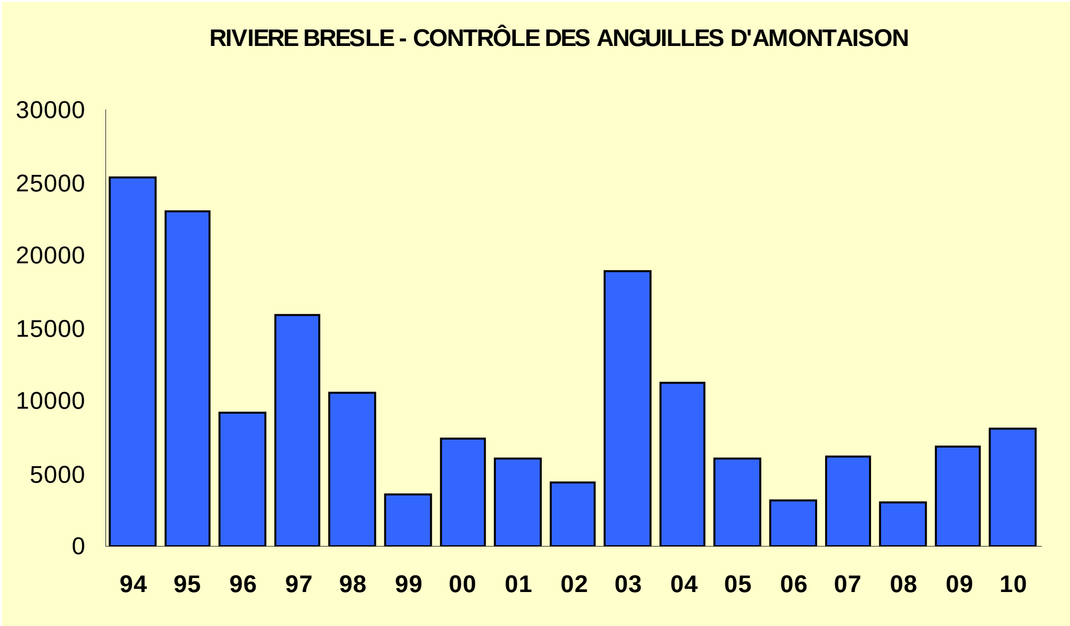


Figure FR 4. Annual evolution (1994–2010) of fish number in the eel ladder trap on the Bresle River (data ONEMA). 2003: change in ladder device.

Table FR e. Annual evolution (1994–2010) of fish number in the eel ladder trap on the Bresle River (data ONEMA). 2003: change in ladder device.

1994	25 277
1995	23 068
1996	9140
1997	15 849
1998	10 547
1999	3558
2000	7403
2001	5980
2002	4394
2003	18 932
2004	11 178
2005	5976
2006	3206
2007	6132
2008	3010
2009	6911
2010	8097

It is also possible to analyse the fish characteristics. For example, eel length ranges between 55 mm and 305 mm with 90% of fish being between 75 mm and 115 mm among more than 28 000 eel measured. The mean eel length has slightly increased since 1994 (Figure FR 5), with a decrease of the proportion of glass eels and small eels (<90 mm, from 56% to less than 30%), the overall mean length is 96.7 mm.

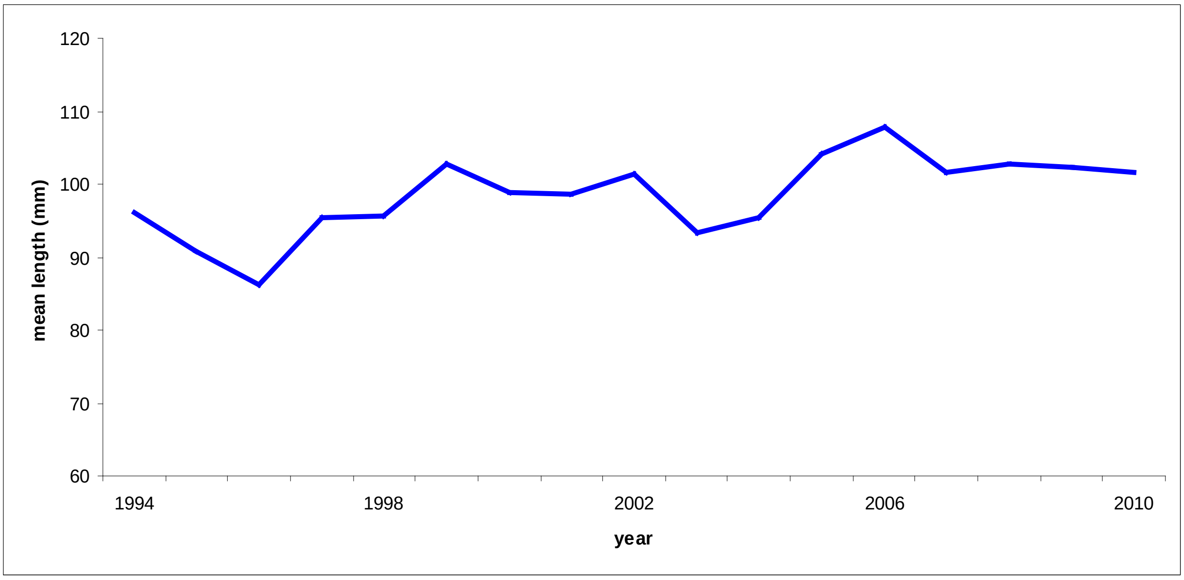


Figure FR 5. Annual evolution of mean length in the eel ladder trap on the Bresle River (data ONEMA).

In 2009, for the first time the silver escapement has been survey all the year-round in the Bresle River. This survey is carried out 15 km from the sea. Even if two alternative passages are available, the station is assessed to control 74% of wetted area. Only eels longer than 350 mm can be caught by the device. Among 365 days, the trap has been operated for 309 days, but some days the traps have been overflowed (Figure FR 6). 863 eels (521 kg) have been caught in 2009. Catch have been greater than 15 eels for ten days representing 41% of the total, the rest have been caught in 137 days, all the year-round. 99% of eel are identified as silver eels according to silver index (Durif *et al*., 2005 and 2009). 98% are greater than 500 mm and thus assumed to be female. The mean length is 668 mm (sd=94 mm) for a mean weight of 604 g (sd=12 g).

A marking–recapture campaign has taken place in October with 80 eels from the trap marked and release upstream. 16% have been recaptured. A provisional estimate of the total silver eels run above the trapping station range from 6400 to 7200 silver eels (3,86 to 4.35 t).

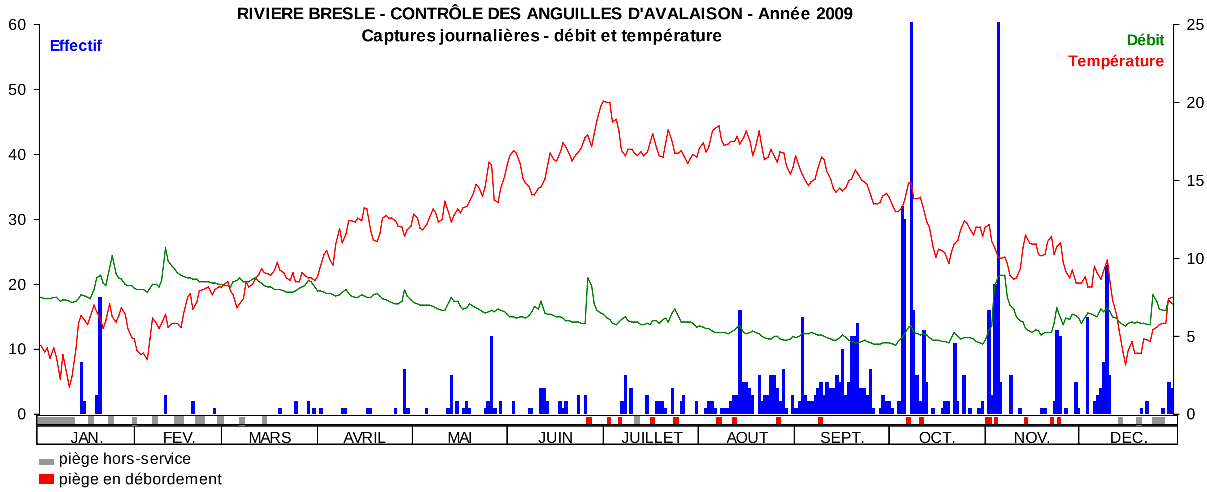


Figure FR 6. 2009 silver eel surveys in the Bresle River. Blue bar = silver eels number, red = temperature, green = discharge. Grey days = trap not operating, red days = trap operating but overflowed.

FR.3.2 Glass eel landings time-series

FR.3.2.1 Brittany EMU

The main fishery for glass eel is the well known Vilaine glass eel fishery. Other glass eel fishery are scattered among the many coastal streams of Brittany.

FR.3.2.1.1 The Vilaine

The fishing conditions in the Vilaine do not depend on environment factors other than tide levels (Briand, 2009). The catch during the fishing season is equivalent to total recruitment. The only change brought in the time-series has been a reduction in the fishing season from 1996 but this is corrected in the current series by estimates of "late arrivals". Therefore, the following graph is labelled "glass eel recruitment-series" though it amounts more or less to total catch, as escapement in the Vilaine is of little importance when compared to the landings.

Sources of data vary as follows:

1977–1990: Castelnaud, 2002;

1999–1995: local marine authority (trade survey);

1996–2008: Briand, trade survey + escapement;

2009–2011: Briand, catch statistics + escapement.

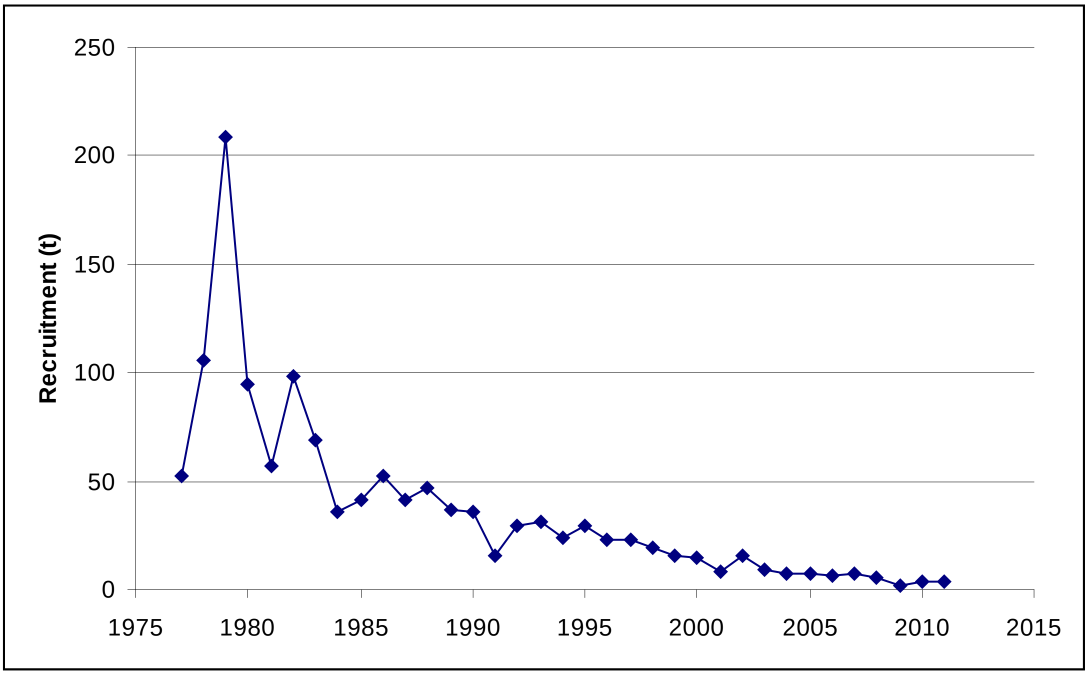


Figure FR 7. Historical series of glass eel landings in the Vilaine estuary.

FR.3.2.2 Garonne EMU

FR.3.2.2.1 The Garonne

The Gironde series is collected by the CEMAGREF (Girardin and Castelnaud, 2010) 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").

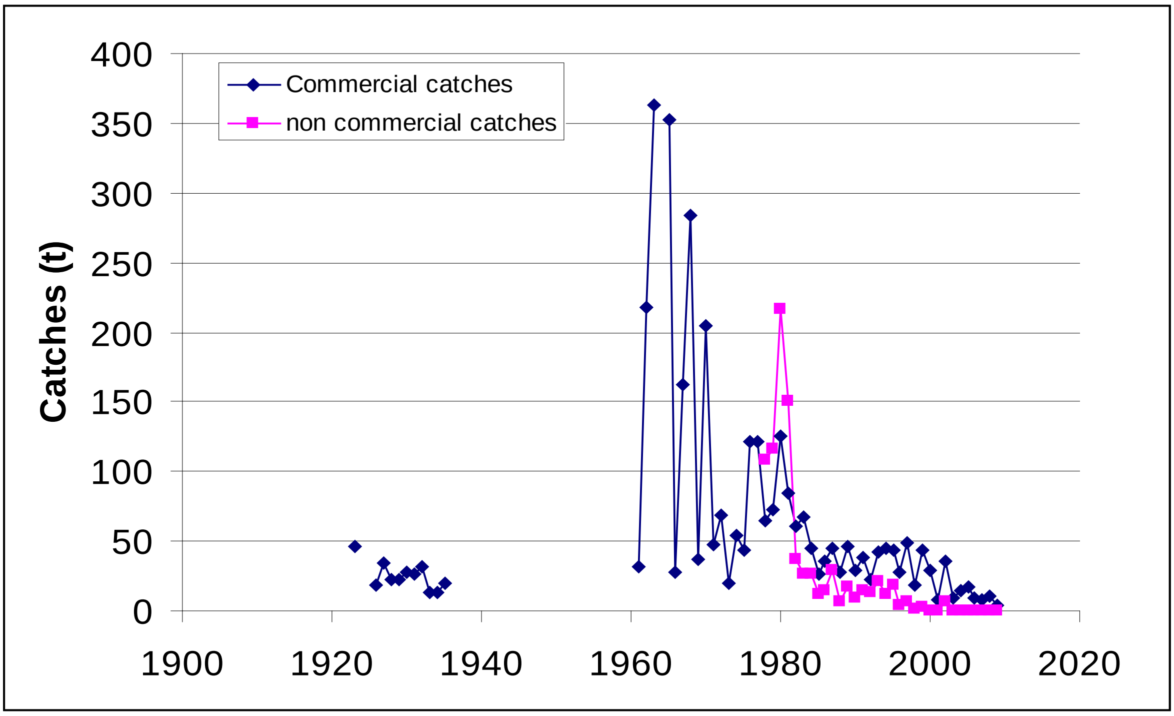


Figure FR 8. Glass eel landings in the Gironde (Garonne EMU).

FR.3.2.3 France overview

Table FR f 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 f. 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.

	COMMERCIAL FISHERMEN CATCH (TONS)								NON COMM; FISHERMEN CATCH (TONS)			
	Adour		Gironde		Loire		Vilaine	Total France (1)	Adour	Gironde	Loire	Total France (2)
Season	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	5	13	4	17	3	7	89	0	0	0	2
2006	2	3	8	1	15	3	7	67	0		0	
2007	1	2	7	1	21	3	8	77	0	0	0	
2008	3	2	6	2	19	3	5	71	0			
2009						1	2		0			
2010		1		0		3	4	41*				
2011		1		0		1	4	31				

FR.3.3 Yellow eel landings time-series

FR.3.3.1 Commercial

FR.3.3.1.1 Garonne EMU

The Gironde series has been collected by the CEMAGREF (Girardin and Castelnaud, 2010) 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 small number of fishermen that may explain high variability from these years (Figure FR 9). The fisheries also shift 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 decrease over the last twenty years from 158 t in average between 1978–1986 to less than 25 t since 2002.

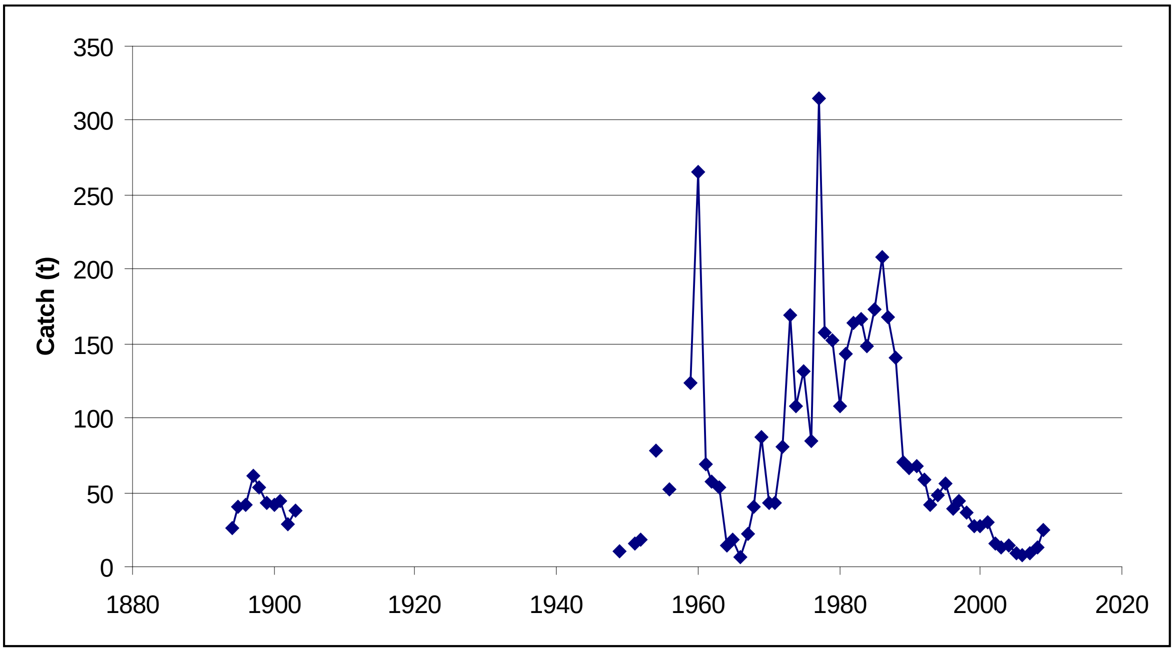


Figure FR 9. Marine and river professional yellow eel landings in the Gironde basin (brackish and freshwater estuary).

FR.3.3.2 Recreational

No data available.

FR.3.4 Silver eel landings

FR.3.4.1 Commercial

No new data.

FR.3.4.2 Recreational

No data available.

FR.3.5 Aquaculture production

No data available.

FR.3.6 Stocking

FR.3.6.1 Amount stocked

A public tender for 2 million Euros has been made 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. Glass eel comes from a CITES seizure.

In 2011, eleven projects have been selected for a total amount of 4024 kg. Finally 733 kg was really restocked, partly because of late selection process and partly because of supply.

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

The Table FR g gives 2010–2011 catches of glass eel and their destination. These figures are official data and still provisional.

Table FR g. Total catch of glass eel, amount reserved for stocking, from which amount stocked in France for 2010–2011.

	Catch (kg)			Reserved for stocking (kg) ****	
EMU	MP*	PF**	Total	stocked in FR	Total
Rhin-Meuse	0	0	0	-	-
Artois-Picardie	281	0	281	45	168
Seine-Normandie	405	0	405	130	174
Brittany	3817	0	3817	200	1284
Loire	20 439	1325	21 764	313	2007
Garonne	5648	239	5887	45	1652
Adour	1655	932	2587		262
Rhône-Méditerranée	0	0	0	-	-
Corse	0	0	0	-	-
Total	32 291.9 ***	2496	34 788	733	5547

*** as transmitted by fishery ministry (08/06/2011);**
**** Onema data (02/08/2011);**
***** EMU not determined for 47 kg;**
****** as transmitted by fishery ministry (08/06/2011).**

FR.4 Fishing capacity

There is not a full and up-to-date national register of fishing capacity in France. Until now the annual number of fishing licenses for eel is produced each year by the marine fishermen organization but nothing similar exists for river fishermen. The type of gears used is known but apart the glass eel scoop net for which the size is the same everywhere in France, the size of the glass eel pushnets vary with the location and the fishermen. The number of pots for yellow and silver eels varies in the same manner. Even, the size of the net of the special gear for silver eel in the Loire River can be different from one fisherman to another.

Before the entry into force of the French EMP, there was no special license for yellow (and silver) eels fishermen. Only the total number of licences can be given (Tables FR h, i, j) for professional and amateurs fishermen with nets and anglers (the number of licences is superior to the number of fishermen for professionals and amateurs, 1 fishermen = 1 or several licences in the EMU). It's interesting to compare the large number of anglers with the number of professional fishers. It should however be noticed that many anglers practice in area where there is no or few eels (see Table FR.o. from 2008 French report). The number of fishers in all categories declined over the period

Table FR h. Number of licences for professional fishermen per EMU from 1993 to 2011 – incomplete data in 2011 (Source CSP-ONEMA and CONAPPED).

Year	Adour	Garonne-Dordogne	Loire and Bretagne	Maritimes and Loire-Atlantique	Loire	Rhin-Meuse	Rhône-Méditer-ranée	Lacs Alpins (Rhône)	Seine-Normandie and Artois-Picardie	TOTAL
1993	190	181	36	147		8	55	105	5	727
1994	206	177	40	137		7	53	107	3	730
1995	207	176	34	154		7	54	92	4	728
1996	207	166	34	155		7	56	86	6	717
1997	208	174	33	157		8	60	86	5	731
1998	189	180	33	161		8	63	83	5	722
1999	189	165	31	157		10	53	79	5	689
2000	190	156	32	161		10	58	79	5	691
2001	183	160	27	155		9	50	79	5	668
2002	180	149	26	138		9	45	81	6	634
2003	169	158	24	129		10	47	82	7	626
2004	157	146	23	129		10	42	80	6	593
2005	168	146	25	116		10	47	77	4	593
2006	166	139	26	132		6	52	75	4	600
2007										
2008										
2009	98	148			125	11	45	54	4	485
2010	86	93			66	2	33	61	4	345
2011	75	89			62	4	30	60	4	324

Table FR i. Number of licences for anglers per EMU from 1995 to 2006 (Source CSP-ONEMA).

Year	Adour	Artois-Picardie	Bretagne	Corse	Garonne-Dordogne	Loire	Meuse	Rhin	Rhône-Méditerranée	Seine-Normandie	TOTAL
1995	55 255	111 047	68 590	5 217	286 183	394 271	33 864	116 772	392 934	246 758	1 710 891
1996	54 082	107 753	66 233	5 698	276 181	381 649	32 896	113 562	382 756	235 462	1 656 272
1997	54 428	102 035	61 062	5 216	267 560	364 960	31 769	109 613	366 768	226 556	1 589 967
1998	53 191	99 307	59 013	4 628	261 471	359 880	30 318	105 564	353 162	217 377	1 543 911
1999	51 733	100 044	57 649	5 215	254 395	351 443	29 226	102 937	340 856	210 785	1 504 283
2000	49 929	94 778	55 547	4 972	236 931	330 770	26 991	96 372	323 342	192 274	1 411 906
2001	49 302	87 552	53 516	5 451	237 756	316 881	26 056	93 703	317 123	180 360	1 367 700
2002	48 788	86 426	50 956	5 081	235 852	315 283	25 547	93 066	309 762	177 988	1 348 749
2003	47 926	87 031	50 954	5 715	230 420	314 891	25 192	90 990	306 549	178 011	1 337 679
2004	44 352	83 882	45 837	5 342	214 377	294 534	23 565	86 202	288 517	165 279	1 251 887
2005	41 299	80 388	43 661	4 937	199 115	278 949	22 418	84 534	273 195	158 307	1 186 803
2006	39 804	75 069	41 369	4 970	193 017	266 120	21 270	77 566	262 068	147 666	1 128 919

Table FR j. Number of licences for amateur fishers with gears per EMU from 1993 to 2006 (Source CSP-ONEMA).

Year	Adour	Artois-Picardie	Bretagne	Corse	Garonne-Dordogne	Loire	Meuse	Rhin	Rhône-Méditerranée	Seine-Normandie	TOTAL
1993	274	0	231	0	3 693	3 084	0	52	914	15	8 263
1994	271	0	259	0	3 666	2 864	0	48	857	10	7 975
1995	284	0	258	0	3 704	2 912	0	49	840	9	8 056
1996	283	0	265	0	3 615	2 815	0	48	826	7	7 859
1997	285	0	256	0	3 509	2 731	0	46	767	10	7 604
1998	261	0	260	0	3 380	2 699	0	15	746	7	7 368
1999	264	0	254	0	3 322	2 676	0	41	729	5	7 291
2000	253	0	238	0	3 100	2 497	0	39	722	6	6 855
2001	251	0	239	0	3 073	2 469	0	41	726	8	6 807
2002	235	0	238	0	2 898	2 434	0	43	708	9	6 565
2003	231	0	232	0	3 085	2 440	0	42	714	9	6 753
2004	217	0	227	0	2 869	2 315	0	44	723	9	6 404
2005	202	0	224	0	3 016	2 196	0	47	750	9	6 444
2006	195	0	221	0	3 032	2 118	0	45	719	9	6 339

Since the entry into force of the French EMP, special rights for eel fishing by biological stage has been designed. One professional fisher can buy several rights in different areas. Thus the number of rights is not equal to the number of fishers.

Table FR k. Number of eel fishing rights for professional fishers. Mp by feet: glass eel fisher along the Aquitaine coast. MP Atl/Med: Marine fisher in Atlantic ocean and estuaries/Mediterranean lagoons. Yellow eel PF 2011: provisional figure, overestimated. (Source: CNPMEM, Conapped).

	Glass eel			Yellow eel					Eel fishing entreprise		
	MP	MP by feet	PF	MP Atl	MP Med	PF	MP Med	PF	MP Atl	MP Med	PF
2006	853		371								
2007	862		343								
2008	814		328								
2009	753		205	309					762		
2010	643	25	180	268		161		41	650		249
2011	573	21	158	245	249	177	239	37	583	250	225

FR.4.1 Glass eel

FR.4.1.1 For commercial fishermen

FR.4.1.1.1 Licenses and number of fishermen

For marine commercial fishermen the quota of seasonal licenses for glass eel has been limited historically to 1137. In 2001 the number of licences delivered was 1050, it has reduced to 843 in 2008 and will decrease to around 700 licences in 2009. Data on river professional licences is available from 1993 to 2011 with a gap in 2007 and 2008 (Table FR h); the number of river professional fishermen is only available from1993 to 2007 (Table FR p) and also show a decrease. The number of river fisher (in the Loire one fisher can have many licenses) is 238 in 2007, making with marine professional fishermen a total of 1119 professional fishermen potentially targeting glass eel (Table FR l).

Table FR l. Specific fishing rights requested and CMEA licenses granted at the 15 of March 2011 (source CNPMEM).

<table>
<tr><th>Regional Board of fisheries</th><th>Glass eel</th><th>Yellow eel</th><th>No. licences</th></tr>
<tr><td>Nord-Pas-de-Calais-Picardie</td><td>12</td><td>1</td><td>12</td></tr>
<tr><td>Basse et Haute Normandie</td><td>16</td><td>10</td><td>18</td></tr>
<tr><td>Bretagne « Nord »</td><td>12</td><td>1</td><td>8</td></tr>
<tr><td>Bretagne « sud »</td><td>24</td><td>5</td><td>15</td></tr>
<tr><td>Bretagne « Vilaine »</td><td>91</td><td>12</td><td>76</td></tr>
<tr><td>Pays de Loire « Loire »</td><td>127</td><td>30</td><td rowspan="2">189</td></tr>
<tr><td>Pays de Loire « Vendée »</td><td>163</td><td>4</td></tr>
<tr><td>Poitou-Charentes</td><td>93</td><td>82</td><td>146</td></tr>
<tr><td>Aquitaine « Gironde »</td><td>66</td><td>60</td><td>27</td></tr>
<tr><td>Aquitaine « Arcachon »</td><td>40</td><td>45</td><td>48</td></tr>
<tr><td>Aquitaine « Adour »</td><td>36</td><td>24</td><td>36</td></tr>
<tr><td>Total</td><td>680</td><td>274</td><td>575</td></tr>
</table>

Table FR m. Total number by COGEPOMI of the couples ship(s)/fisherman authorized to fish glass eel in 2006, 2007 and 2008 (source CNPM Conapped). For 2006 and 2008, marine professional fishermen only, 2007 river professional fishermen is added.

EMU	basin stamps	2006	2007	2008
Adour	Adour	69	68 + 119	62
Gironde	Arcachon, Gironde et/ou Charente	260	254+86	239
Loire	Loire et/ou Vendée	370	353+33	344
Bretagne	Nord, Sud Bretagne et/ou Vilaine	163	159	154
Seine-Normandie	Normandie	29	29	29
Artois-Picardie	Nord-Pas de Calais-Picardie	19	18	15
Total		910	881 +238	843

The trend in nominal effort is consistent between the licences issued (Table FR i k) and the number of boats having made at least one declaration of catch (Table FR jl), and has shown a decrease of about 20% since 2008 (Table FR im and Table FR jn).

Table FR n. Change in the number of licences delivered by the regional boards of fisheries from 2008.[1]

Number of licences (stamps)				
EMU	2008	2011	change	change (%)
Artois Picardie	15	12	-3	-20%
Seine normandie	29	16	-13	-45%
Bretagne	154	127	-27	-18%
Loire et Côtiers Vendéens	344	290	-54	-16%
Garonne-Dordogne-Charente	239	199	-40	-17%
Adour et Landes	62	36	-26	-42%
France	**843**	**680**	**-163**	**-19%**

Table FR o. Change in the number of fishermen having declared a catch between 2008 and 2011.

Number of marine fishermen having reported a catch				
EMU	2008	2011	change	change (%)
Artois Picardie	28	12	18	+64%
Seine normandie		34		
Bretagne	154	74	-80	-52%
Loire et Côtiers Vendéens	341	327	-14	-4%
Garonne-Dordogne-Charente	212	139	-73	-34%
Adour et Landes	92	92	0	0%
France	**827**	**678**	**-149**	**-18%**

[1] The limits of the boards of fishery do not coincide with EMU and this might explain the difference between this table and the next (number of boats having effectively fished).

Table FR p .Number of glass-eel river professional licences per EMU from 1993 to 2007 (Source CSP-ONEMA except for 2007, CONAPPED).

Year	Rhin	Seine-Normandie and Artois-Picardie	Adour	GaronneEMU	Lacs Alpins (Rhône)	Loire and Bretagne	Maritimes and Loire-Atlantique	Loire	Rhône-Méditerranée	Total
1993	0	0	187	101	0	3	127		0	418
1994	0	0	204	93	0	0	125		0	422
1995	0	0	203	102	0	0	140		0	445
1996	0	0	203	103	0	0	140		0	446
1997	0	0	204	112	0	1	140		0	457
1998	0	0	185	117	0	1	145		0	448
1999	0	0	185	101	0	0	144		0	430
2000	0	0	186	99	0	1	146		0	432
2001	0	0	180	94	0	1	138		0	413
2002	0	0	178	98	0	1	122		0	399
2003	0	0	166	97	0	0	115		0	378
2004	0	0	155	88	0	0	115		0	358
2005	0	0	167	92	0	0	101		0	360
2006	0	0	165	88	0	0	118		0	371
2007			119	86				33*		238

***For Loire 2007, number of fishers. For the rest, number of licences.**

FR.4.1.1.2 Fishing fleet

Table FR q shows characteristics of marine fishermen boats in 2008. Note that 40% of them are concentrated within the Loire EMU.

Table FR q. Technical characteristics of the glass eel marine fishing fleet in 2007 (Ships registered in the fishing fleet file - source: SIH- Ifremer).

Length class	Number of ships	Length	Puissance moyenne	Mean Age (year)	Mean number
< à 7 m	174	6	45	18	1.1
7 à 9 m	236	8	73	24	1.1
9 à 12 m	227	10.2	89	26	1.5
12 à 16 m	1	12.2	87	38	1

FR.4.1.2 For recreational fishermen

For legal river amateur fishermen, the number of licenses was stable from 1993 to 1999 with an average of 617 (Table FR r). Since 1999, the number of legal river amateur fishermen has decreased to 285 in 2005 and 193 in 2006. The amateur glass eel fishery has been banned in 2006 in the Loire River. The French eel management plan has totally banned recreational glass eel fisheries.

Table FR r. Number of licences for glass-eel amateur fishers per EMU from 1993 to 2006 (Source CSP-ONEMA).

Year	Adour	Artois-Picardie	Bretagne	Corse	Garonne EMU	Loire	Meuse	Rhin	Rhône-Méditerranée	Seine-Normandie	TOTAL
1993	166	0	0	0	302	138	0	0	0	0	606
1994	156	0	0	0	303	91	0	0	0	0	550
1995	150	0	0	0	369	127	0	0	0	0	646
1996	153	0	0	0	377	118	0	0	0	0	648
1997	153	0	0	0	382	122	0	0	0	0	657
1998	150	0	0	0	388	136	0	0	0	0	674
1999	140	0	0	0	281	120	0	0	0	0	541
2000	133	0	0	0	206	86	0	0	0	0	425
2001	134	0	0	0	180	76	0	0	0	0	390
2002	122	0	0	0	171	62	0	0	0	0	355
2003	122	0	0	0	128	84	0	0	0	0	334
2004	116	0	0	0	135	61	0	0	0	0	312
2005	101	0	0	0	126	58	0	0	0	0	285
2006	98	0	0	0	95	0	0	0	0	0	193

FR.4.2 Yellow eel

FR.4.2.1.1 Channel and Atlantic fisheries (both marine and freshwater)

Yellow eel fisheries was not under specific quotas of stamps like glass eel fisheries. Fishermen often target yellow and silver eels indistinctly.

The inland fisheries for yellow eels are scattered and involve professional fishermen, amateur fishermen with gears and anglers with rods.

Whatever the category, the number of fishermen has been decreasing since 1987 (Briand *et al.*, 2005).In 2001 only a part of the 450 professionals fishermen fishing diadromous species in inland waters target eel at yellow and silver stages (Castelnaud, 2000), their number is evaluated at 128 marine and 107 river professional fishermen. The most part of these marine professional fishermen and two third of these river fishermen also target glass eel.

Since the French EMP there is specific yellow eel fishing stamps (see Table FR k).

FR.4.2.1.2 Mediterranean lagoon fisheries

Since 1988, the number of 400 to 500 marine professional fishermen targeting eel in the Mediterranean lagoons was regularly announced. Nevertheless, a strong decrease of the population was noticed: 63% between 1969 and 1994 on the Palavasiens lagoons (fishing zone 25, see Table FR a) (Ruiz, 1994) and 33% between 1986 and 1996 on the Gruissan and Bages-Sigean lagoons (Loste and Dusserre, 1996; Dusserre and Loste, 1997).

For the Rhône-Méditerranée EMU, the most reliable data were collected by the Cépralmar in the Languedoc-Roussillon region which landed the main part of French Mediterranean eels and totalised 430 marine professional fishermen targeting eel in 2002, 208 in 2003 and 2004 and 244 in 2005 (Loste and Dusserre, 1996; Dusserre and Loste, 1997; CEPRALMAR, 2003, 2004, 2005, 2006). In 2009 a quota of eel licences have created with an amount of 500 licences in 2009, 350 in 2010 and 320 in 2011. However only 204, 218 and 185 (provisional figures) licences have been really attributed respectively between 2009 and 2011.

More recently, the Pôle relais lagunes méditerranéennes (2009) has estimated a total of 41 fishermen in the PACA region in 2008 (the other region concerned by eel Rhone EMU).

For the Corse EMU, French eel management plan census 21 fishermen in Corse Mediterranean lagoons.

The previous evaluation (Castelnaud *et al*., 2000) estimated that 513 marine professional fishermen were fishing yellow eel in 1997 in all the French Mediterranean lagoons. With the most recent data, a rough estimation of the number of fishermen in Mediterranean is 280 fishermen.

Since the French EMP there is specific yellow eel fishing stamps (see Table FR k).

FR.4.3 Silver eel

FR.4.3.1.1 Channel and Atlantic fisheries (both marine and freshwater)

The only significant fishery targeted especially silver eel is in the Loire basin (Loire EMU), with seven to nine fishermen using the special gear called "dideau". Apart from this fishery, some fishermen fish during period and use gears those allow catching silver eels such as fykenets. The number of such fishermen is unknown, but at least the seven fishermen from Grand Lieu Lake (Loire EMU) enter in that category. Some marine fishermen might also catch silver eel.

In 2002, the special five years authorizations for fishing silver eel in private waters by amateur fishermen was stopped by the local fishery administration (more than 200 authorizations existed yet in 2000 from Changeux, 2001).

The silver eel fishery is no longer practised in the Vilaine where it was historically present.

The French EMP recognized the following professional silver eel fisheries in the river area: in the Bretagne EMU: the Vilaine river and in the Loire EMU: the Loire river, the Grandlieu lake and the Erdre river with Mazerolles area. The professional silver eel fisheries in the marine part have been banned, as well has all amateur silver eel fisheries. Specific silver eel fishing stamps are given in Table FR k.

FR.4.3.1.2 Mediterranean fisheries

A large part of the 280 fishermen in the Mediterranean lagoons catching yellow eels (see Section 4.2.1.2) also catch silver eels. The exact number was unknown.

The French EMP has recognized those silver eel fisheries as well as a silver eel fisheries the lower part of the Rhone river. The specific silver eel fishing stamps are given in Table FR k.

FR.5 Fishing effort

FR.5.1 Glass eel (2011)

FR.5.1.1 Professional fishermen

Fishing effort for the glass eel fisheries should ideally be measured by the volume filtered by the fishery. When compared to the volume of the fishing area, it provides an estimate of the fishing efficiency (Beaulaton and Briand, 2007). In the following paragraphs, we describe the surface of the nets and the number of fishing days per fishing areas. Data on the fishing duration and the fishing speed are also necessary to compile an estimate of the true filtration and are not reported there as they are lacking in some places and require a thorough analysis.

FR.5.1.1.1 Gears

Table FR s. Size and dimensions of the nets allowed in the French inland waters to professional fishermen. The numbers in bracket correspond to the EMU in Figure FR 3 (source Castelnaud, 2002).

Type	Shape	Total fishing surface (2 nets)	Basins and regulations, m=marine , f=freshwater; EMU
Pushnet	Circular	2.262 m²	Nord pas de Calais (m), Artois-Picardie Picardie (m), Artois-Picardie Normandie (m), Seine-Normandie Bretagne (m), Bretagne Loire (m + f), Loire Baie de Bourneuf (m), Loire Garonne, Dordogne, Isle (f), Garonne Adour (f), Adour
Large pushnet (Pibalour)	Rectangular	8 to 14 m²	Gironde (m), Garonne Charente (m), Garonne Seudre (m), Garonne
Handed scoopnet	Oval	Close to 2.262 m	Arcachon (m), Garonne Garonne, Dordogne, Isle (f), Garonne Courants Landais, Adour (m), Adour
Pushnet	Square	2.88 m²	Lay (m), Loire
Pushnet	Rectangular	4.32 m²	Sèvre Niortaise (m), Loire
Pushnet	Rectangular	3.60 m²	Vie(m), Loire

The classical and basic gear used to fish glass eel is the scoopnet of different sizes and shapes. Scoopnets are handled from the river bank for amateur fishermen (one scoopnet of small size) or handled from a boat for professional fishermen (one scoopnet of large size and oval) or pushed by a boat (two scoopnets of large size and circular). They are called “pibalour” when they are rectangular, wider and pushed by a boat.

For amateur fishermen, the scoopnet dimension is 0,19 m² in all basins.

The poachers with or without boat can use the different gears and techniques described but also special poaching devices like very large nets called “chaussette” or passive traps called “caisse à civelles” (see Luneau *et al*., 2003 for more details).

FR.5.1.1.2 Fishing effort in number of trips per day

The glass eel fishing effort has been analysed from marine fishermen reports and river fishermen. Boats larger than 10 m report in logbooks, and those data were not available at the time of the report. In each fishing area, the fishing effort has been extracted through a selection process. Several screenings where applied with the objective to extract "daily" data from the database and to discard aggregated data. In this screening process, some catches, that were effectively daily catches, might have been discarded. Daily mean catch where calculated per EMU as *the detail of the estuary of the catch is no longer available in the French database*. So there is a real loss when we compare to the previous reports and the existing dataseries are **at a risk to be discontinued.**

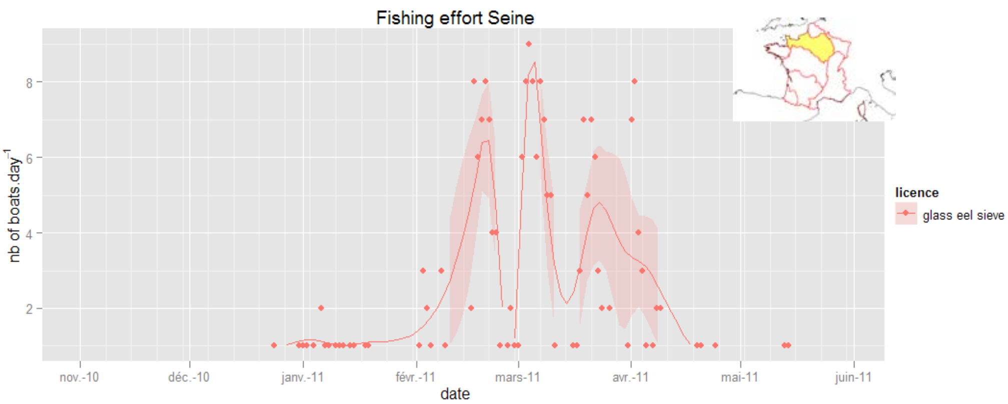


Figure FR 10. Trend in daily mean fishing effort of marine commercial glass eel fish in the Seine EMU in the Channel in 2011, 213 trips out of 247 trips, based on 34 boats with daily catch report.

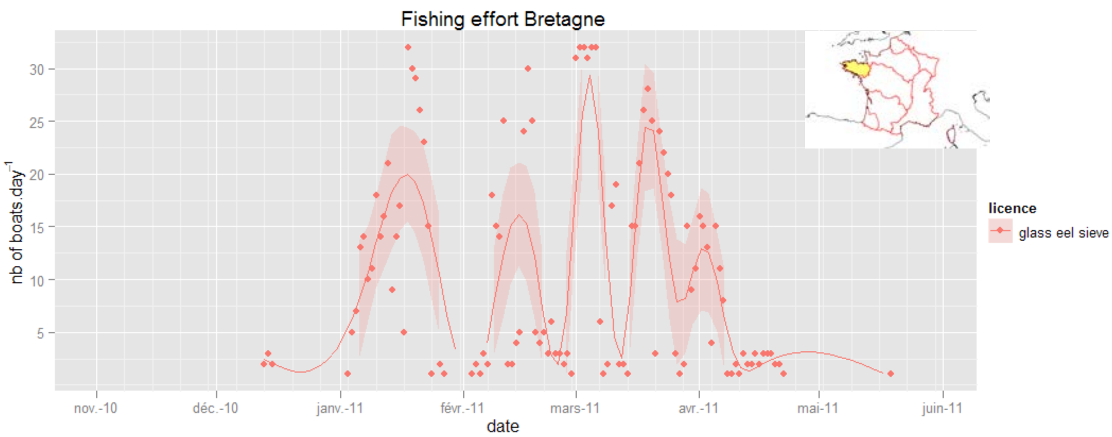


Figure FR 11. Trend in daily mean fishing effort of marine commercial glass eel fishermen in Brittany in 2011, based on a selection of 72 boats.

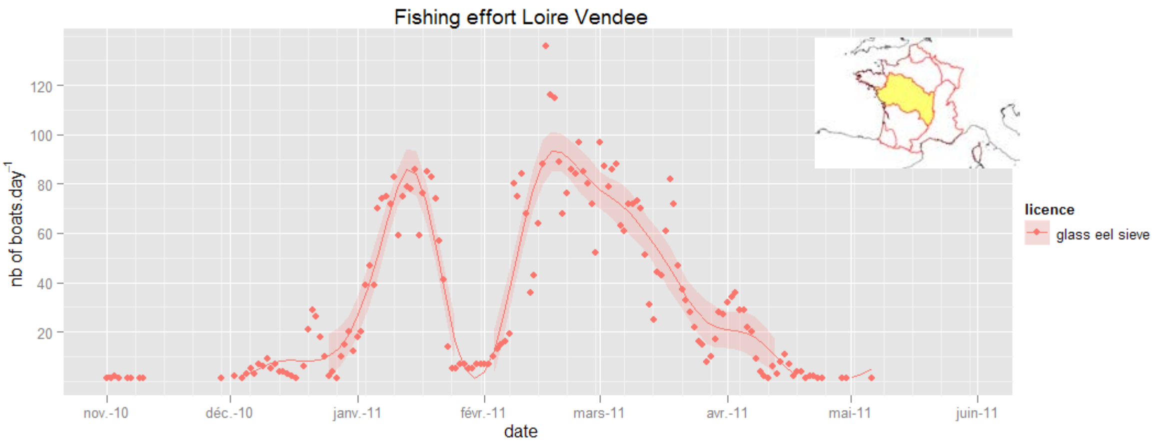


Figure FR 12. Trend in daily mean fishing effort of marine commercial glass eel fishermen in the Loire Eel Management Unit in 2011, based on a selection of 322 boats.

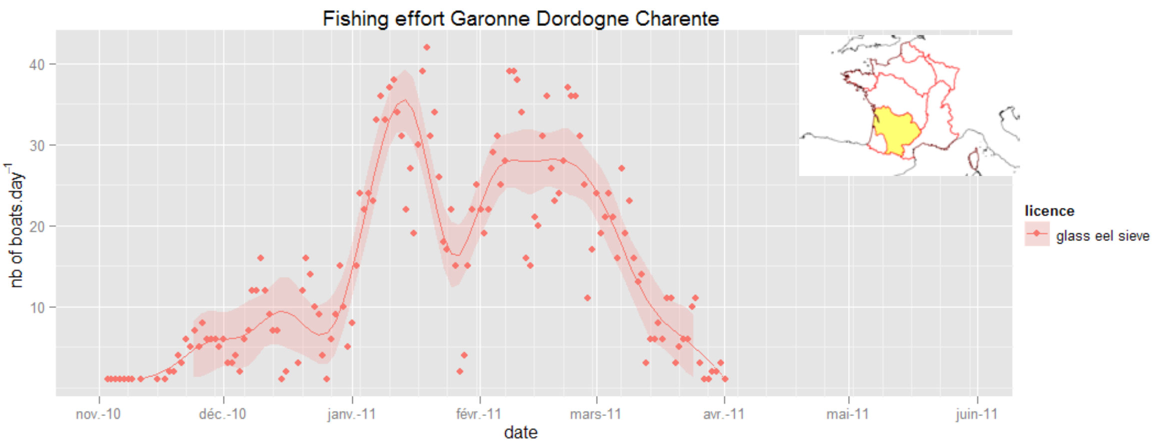


Figure FR 13. Trend in daily mean fishing effort of marine commercial glass eel fishermen in the Garonne Eel Management Unit in 2011, based on a selection of 135 boats.

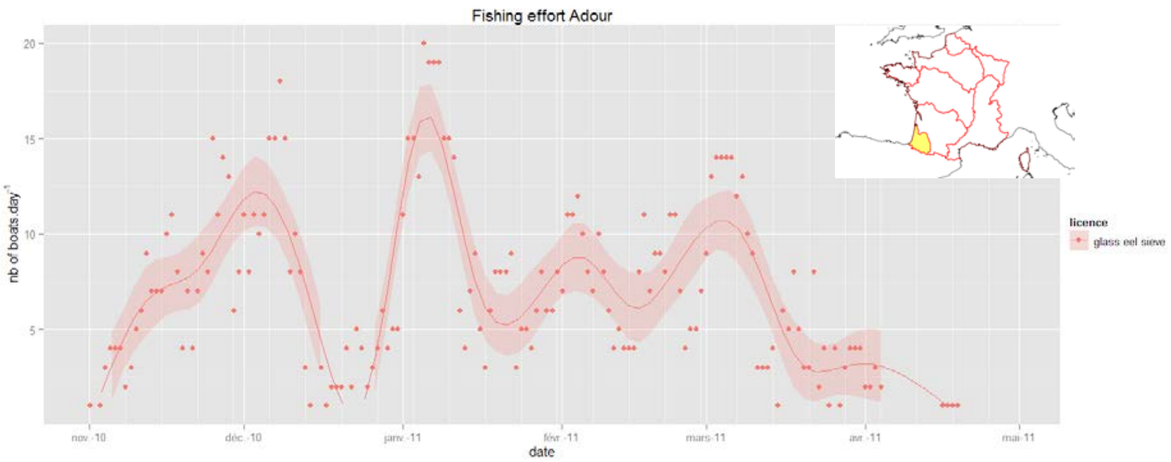


Figure FR 14. Trend in daily mean fishing effort of marine commercial glass eel fishermen in the Adour Eel Management Unit in 2011, based on a selection of 91 boats.

A synthesis of the total number of trips is built on all data available. The trend in effort is compared to the overview of 2008.

Table FR t. Number of trips for the commercial fishermen. Source OFIMER.

Number of trips commercial marine fishermen				
EMU	2008	2011	change	change (%)
Artois Picardie	858	169	-442	-52%
Seine normandie		247		
Bretagne	4 954	1664	-3290	-66%
Loire et Côtiers Vendéens	16 009	8739	-7270	-45%
Garonne-Dordogne-Charente	7 576	3085	-4491	-59%
Adour et Landes	2 450	1300	-1150	-47%
France	**31847**	**15204**	**-16643**	**-52%**

FR.5.2 Yellow eel

In inland waters, the eel pot (10 mm mesh size minimum, last entrance larger than 40 mm) is the common fishing gear used by all categories of fishermen to fish yellow eel. The shapes are very diversified according to the basin and also the fishing zone; the eel pots are not always baited. The fykenet is also used by the professionals only, with a 10 mm mesh size minimum. A barrier can be associated. Others gears exist: deep-lines, lift nets, “vermée” for anglers….

The main fishing gear used in Mediterranean lagoons is a fykenet (mesh size 10 mm) transformed with wings (“ganguis”) and with three chambers (“capéchade”). In some places, fixed fisheries are made of batteries of fykenets. These fixed fisheries have to let a passage for the migration from the lagoons to the sea of euryhalines species which are mostly captured (sea breams in particular).

FR.5.3 Silver eel

The special gear called “dideau” used to fish silver eel in the Loire basin was introduced from large rivers in the Netherlands in the early 20th century. It is a sort of trawl used from a fixed boat. The net measures 25 m of length with a mouth of 10 m width and 5 m height. The mesh size starts at 16 cm at the mouth and ends at 10 mm.

Silver eel are also catch with gears cited above for yellow eels, particularly fykenets, “ganguis” and “capéchade”.

FR.5.4 Marine fishery

Data not available.

FR.6 Catches and landings

FR.6.1 Glass eel

FR.6.1.1 Commercial fishermen

The landings were processed from the database from OFIMER for marine fishermen and ONEMA for fluvial fishermen. The catch of marine fishermen has decreased by 60% from 2008 while the fishing effort reduction is 52%. This does not necessarily indicate stability in recruitment as large changes in fishing effort in heavily fished area (for instance the Vilaine) have little effect on the total catch. No data are available for 2009/2010. Only data for 2010–2011 are available for commercial river fishermen.

Table FR u. Total landings of glass eel in kg for commercial marine fishermen for three fishing seasons.

EMU	2007/2008 (1)	2009/2010 (2)	2010/2011 (3)	(3)–(1)	(3)–(1)/(1)
Artois-Picardie	1175	460	278	-497	-42%
Seine-Normandie		860	400		
Bretagne	5864	4095	3619	-2245	-38%
Loire et côtiers vendéens	42 816	24 761	17 415	-25 401	-59%
Garonne-Dordogne-Charente	17 031	6423	5352	-11 679	-69%
Adour et Landes	4519	537	1353	-3166	-70%
France	71 405	37 136	28 417	-42 988	-60%

Table FR v. Total landings of glass eel in kg for commercial fluvial fishermen for 2010–2011 season.

	2010/2011
Loire	1325
Garonne-Dordogne-Charente	239
Adour-Landes	931
Total	2496

FR.6.1.2 Recreational fishermen

The French EMP has banned all recreational glass eel fisheries.

FR.6.1.3 National overview from 2008 and comparison with trade data

Three sources of data can be used: landings, trader statistics (unofficial) and EU trade statistics. Landings data are not available for 2009. Data for 2010 are "official data" but detailed data have never been made available to the working group. The previous report (WGEEL 2009; 2010) showed a decrease of around 60% of landings between 2008 and 2009 so this was reported for commercial data although no data are available. Trade to Asia has been specially disrupted.

Table FR w. Comparison of different sources of glass eel landings (t) for seasons between 2007–2008 and 2010–2011.

	2007/2008	2008/2009	2009/2010	2010/201
Estimated trade from eurostat (T)	51.7	25.5	41.8	33.7
glass eel traders (CONAPED estimate, T)	68-72	31-32		
Export to Hong-Kong China (T)	39	6.9	13.7	0
Commercial landings (T)	71.4*	42.8 ? **	40.7	30.9
* no data available for fluvial fishermen ** ICES 2009 concluded to a 60% drop in landings				

FR.6.2 Yellow eel

FR.6.2.1 Professional fisheries

FR.6.2.1.1 Garonne EMU

River fishermen for eel in the Charente River caught less than 1 t (Onema). Marine fishermen fish along the Coast facing Charente estuary (Pertuis Charentais) caught for a mean amount of 2 t (EPTB Charente; 2003–2006 average).

Marine and river fishermen from the Gironde fish 8.7 t in 2007, 12.4 t in 2008 and 24.2 t in 2009 (Cemagref).

River fishermen from Dordogne and Garonne Rivers have declared 1.3 t in 2007 (3.2 t Cemagref estimate) and 1.9 t in 2008 (3.5t Cemagref estimate).

Finally, marine fishermen declared 18 t of eel in 2007 and 16 t in 2008 (Ifremer).

Finally, marine fishermen in Arcachon Bay declared 18 t in 2007 and 16 t in 2008 (Ifremer).

FR.6.2.1.2 Rhône EMU

Some fisheries restrictions have been taken in the Rhône River for river fishermen due to PCB. They have declared in 2007 0.9 t of eels (Onema).

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). In 2007, catches in PACA lagoons are estimated at 111 t (Pôle relais lagunes méditerranéennes, 2009).

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).

Our estimation is that about 500–600 t in Languedoc-Roussillon lagoons and about 200 t in PACA lagoons are caught mixing together yellow and silver eels, which make a total retained at 750 t.

FR.6.2.2 Recreational fisheries

No new data.

FR.6.3 Silver eel

No new data.

FR.6.4 Marine fishery

See professional fisheries (Section 6.2.1)

FR.7 Catch per unit of effort

FR.7.1 Glass eel

FR.7.1.1 Marine commercial glass eel fisheries

An overview of the trends in cpue was provided for 2008. The trend from 2008 is difficult to interpret as glass eel catch data are no longer reported per ICES regional square. An increase in the Brittany cpue is consistent with the large reduction in fishing effort in the Vilaine. Cpue in the Adour are stable or slightly diminishing, they have increased in the Channel (Artois Picardie and Seine Normandie).

An indication of the trends in cpue for the Adour, Sèvre Niortaise and Gironde basins is provided in Recruitment Series and associated effort (0). However this analysis should be moderated as gears used can be different from one estuary to the other (Section 5.1.1.1).

Table FR x. Cpue for commercial marine fishermen in 2008 and 2011. Source OFIMER.

CPUE commercial marine fishermen			
EMU		2007/2008 (1)	2010/2011 (2)
Artois Picardie		0.94	1.49
Seine normandie			1.42
Bretagne		1.01	1.84
Vilaine		1.07	
Loire et Côtiers Vendéens	Loire	2.28	1.73
	Vendée	1.70	
Garonne-Dordogne-Charente	Garonne	1.50	1.58
	Charente	1.72	
Adour et Landes		0.90	0.86

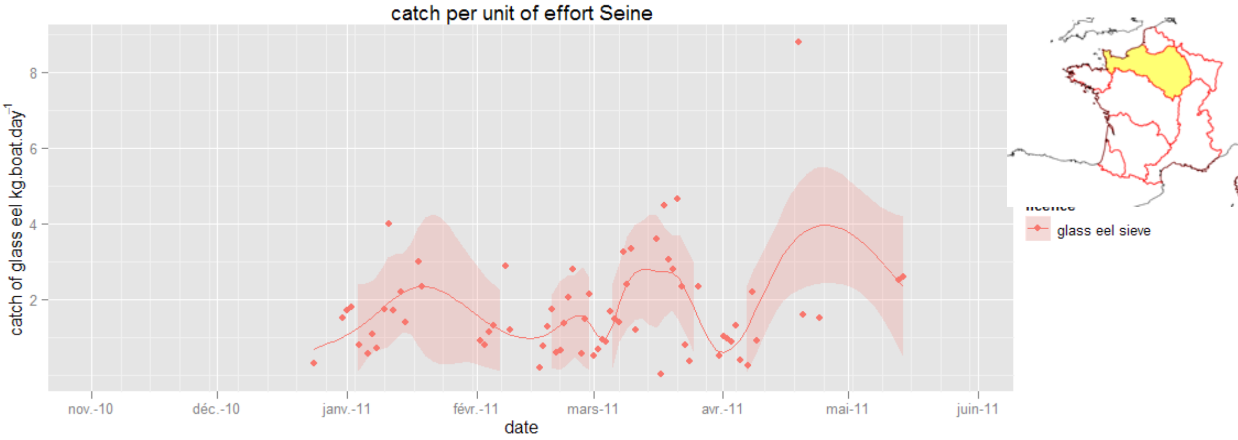


Figure FR 15. Trend in cpue for the Seine Basin. 213 trips selected out of 247 catch report.

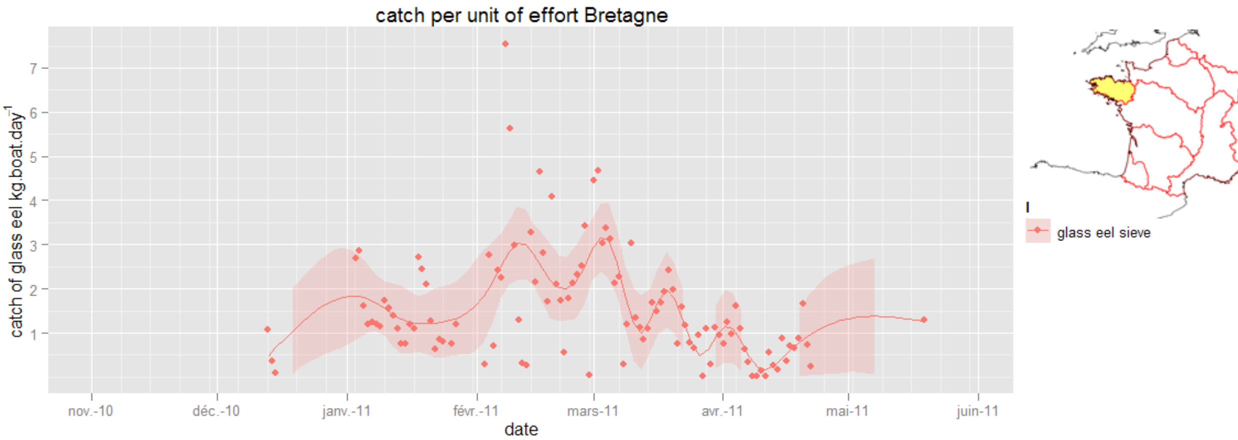


Figure FR 16. Trend in cpue for the Brittany Basin. 1661 trips selected out of 1664 catch report.

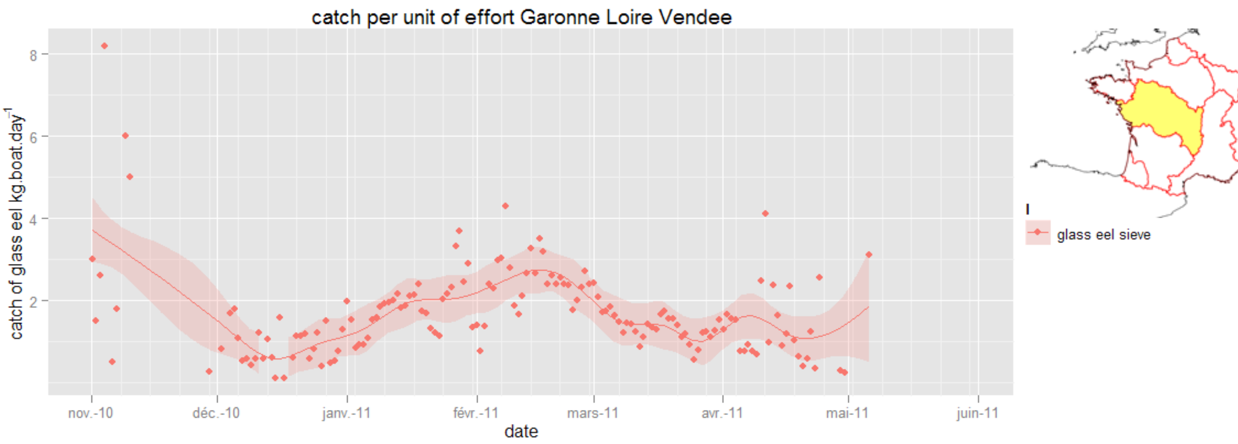


Figure FR 17. Trend in cpue for the Loire Vendee EMU. 5296 selected from 8739 catch reports.

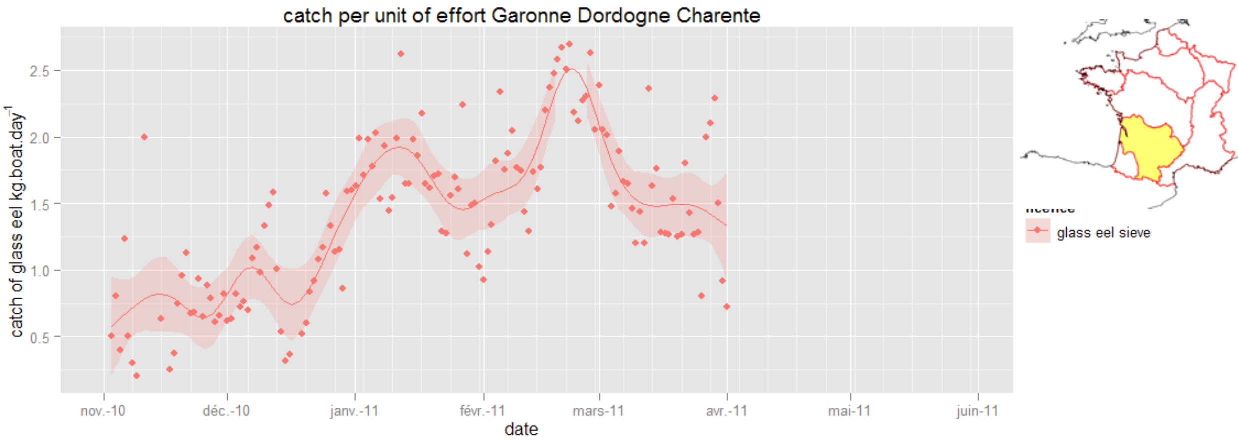


Figure FR 18. Trend in cpue for the Garonne EMU. 2168 selected from 3085 catch reports.

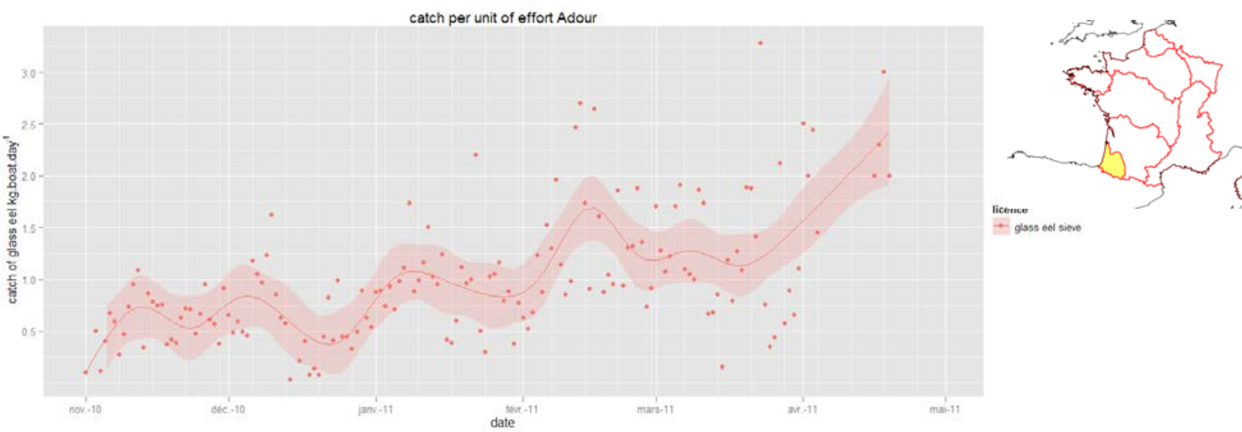


Figure FR 19. Trend in cpue for the Adour EMU. 1123 selected from 1300 catch reports.

FR.7.1.2 Glass eel cpue in the 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 Cemagref statistical monitoring system and have been studied recently by Beaulaton (2008).

One of the notable features of the glass eel fishery in the Gironde during the 1978–2003 periods is the major shift from scoopnet catches in favour of large pushnet catches (Figure FR 20 and Table FR y). The fishery is currently very largely a large pushnet fishery in the estuary, whereas formerly it was a scoopnet fishery in freshwater estuary.

After a strong decrease of the glass eel abundance in the Gironde basin between 1981 and 1985, the situation at present seems stationary, at a very low level (Figure FR 20 and Table FR y). The 2003 season is close to the worst historical level (2001).

Table FR y. 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: Cemagref). "-" : 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	-	363.0	-	?	
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	-	69.0	-	?	
1972–1973	-	20.0	-	?	
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	39.0	82.6	-	?	11.7
1977–1978	22.1	42.6	-	107.8	15.6
1978–1979	25.9	47.3	-	116.2	12.1
1979–1980	38.1	86.6	-	217.1	22.9
1980–1981	36.1	48.8	-	150.6	15.4
1981–1982	39.4	21.6	-	36.5	10.9
1982–1983	48.1	18.6	-	26.9	10.2
1983–1984	31.6	13.4	-	26	10.7
1984–1985	21.0	6.0	-	11.8	6.6
1985–1986	26.6	8.7	-	14.4	6.6
1986–1987	25.9	18.7	-	28.6	6.8
1987–1988	21.5	6.4	-	6.7	6.1

YEAR	TOTAL CATCH (T)				CPUE (KG/DAY)
	PRO. LPN	PRO. SN	PRO. SPN	NONPRO. SN	PRO. LPN
1988–1989	31.8	14.1	-	17.3	5.4
1989–1990	23.0	6.2	-	9	4.2
1990–1991	29.9	8.5	-	14.5	6.3
1991–1992	14.8	7.7	-	12.8	3.3
1992–1993	33.0	9.4	-	21.7	6.1
1993–1994	40.2	5.3	-	12.4	6.6
1994–1995	35.5	8.0	-	18.9	6.2
1995–1996	24.7	1.5	1.7	4.2	3.9
1996–1997	36.0	3.3	10.1	6.4	5.9
1997–1998	16.5	0.3	1.6	1	3.2
1998–1999	35.4	0.9	6.7	2.7	6.2
1999–2000	25.3	0.1	3.1	0.3	6.5
2000–2001	8.0	0.0	0.2	0.1	1.7
2001–2002	24.7	6.4	4.0	6.2	4.4
2002–2003	9.0	0.1	0.6	0.1	2.1
2003–2004	13.3	0.1	1.0	0.1	2.5
2004–2005	12.9	0.8	3.6	0.5	2.7
2005–2006	8.1	0.0	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

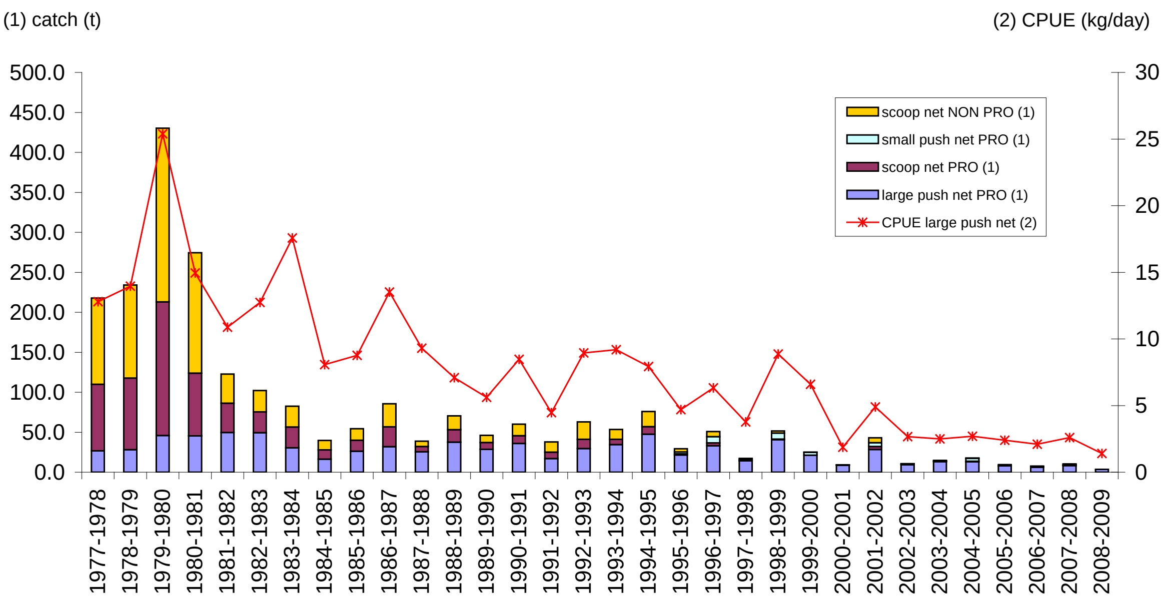


Figure FR 20. Cumulated capture of glass eel for non professional and professional fishermen for 1978–2008, cpue of large pushnet professional fishermen on the Gironde basin for 1978–2008 (Source: Cemagref).

FR.7.2 Yellow eel

FR.7.2.1 Yellow eel cpue in the Garonne EMU

Yellow eel cpue for the Gironde basin have been extended by Beaulaton (2008). The eel pot cpue increase in the 1970s, mainly because of change of eel pot (from wooden to plastic). Then the eel pot cpue for yellow eel has fallen since the middle of the 1980s, slightly increased until 1998 before decreasing again until 2007 (Table FR z; Figure FR 21). 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.

We will also apply GLM methods on eel pot cpue, to precise and verify the tendency of yellow eel abundance.

Table FR z. Catches of yellow eel for professional and non professional (from 1978 onwards only) yellow eel fishermen, cpue on the Gironde basin for 1894–2008 (Source: Cemagref).

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		1.0
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

YEAR	TOTAL CATCH (T)		CPUE (KG/EELPOT/MONTH)
	PRO.	NON PRO.	PRO.
1967	21.5		0.9
1968	40.8		0.8
1969	87.8		3.3
1970	42.4		1.4
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	166.0	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	140.0	97.7	1.9
1989	70.4	40.2	1.0
1990	67.0	28.3	1.0
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	1.0
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

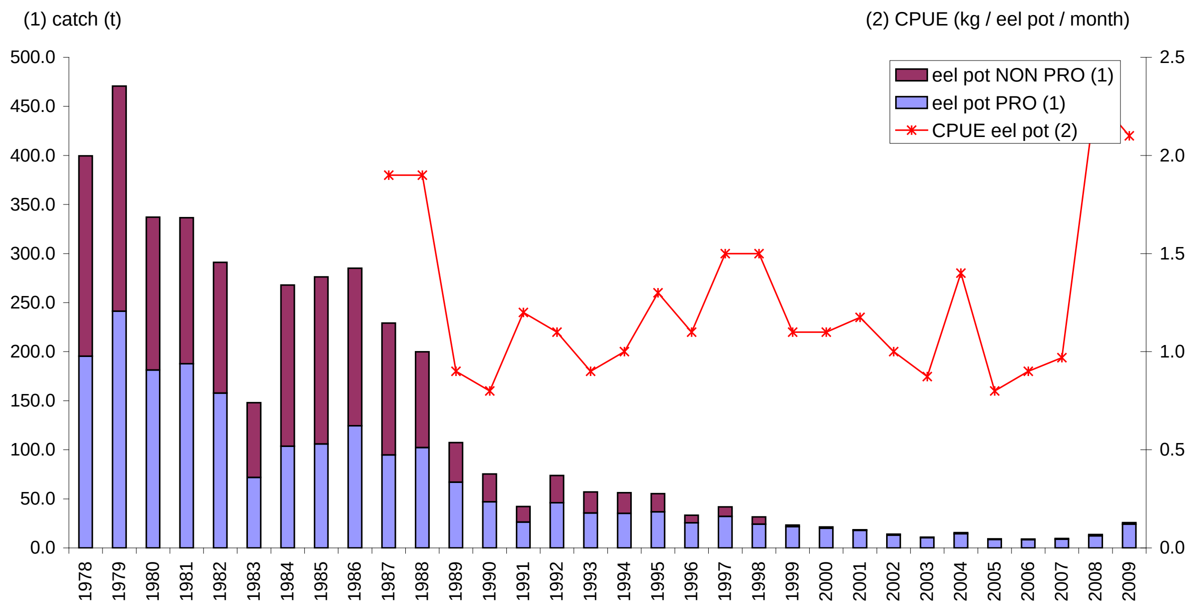


Figure FR 21. Cumulated catch of yellow eel for professional and non professional fishermen, cpue on the Gironde basin for 1894–2008 (Source: Cemagref).

FR.7.3 Silver eel

No new data.

FR.8 Other anthropogenic impacts

Use this section to detail types of impact (e.g.. Turbine) and quantify the level of impact, for example & mortality of escapement and estimate of escapement killed in tones, or the amount of wetted area above each barrier. Refer to EMPs for management actions and estimated reductions in mortality with a time-scale.

FR.9 Scientific surveys of the stock

FR.9.1 Recruitment surveys, glass eel

FR.9.1.1 Recruitment survey, the Gironde

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 22) and aims at evaluating the abundance variations of the juveniles of fish and crustacean and the adults of small species.

Figure FR 22. "L'Estuarial" boat used for scientific survey in the Gironde (Source: Cemagref).

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. In the main, this analysis confirms results coming from fishery data (Figure FR 20 and Figure FR 23) even if some little differences remain to analyse.

Table FR aa. 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, 2010).

Season (n–1,n)	1990	2000	2010
0		1.00	0.10
1		0.36	
2	1.75	1.02	
3	2.83	0.28	
4	2.20	0.30	
5	2.92	0.53	
6	2.07	0.27	
7	3.14	0.14	
8		0.28	
9	3.49	0.44	

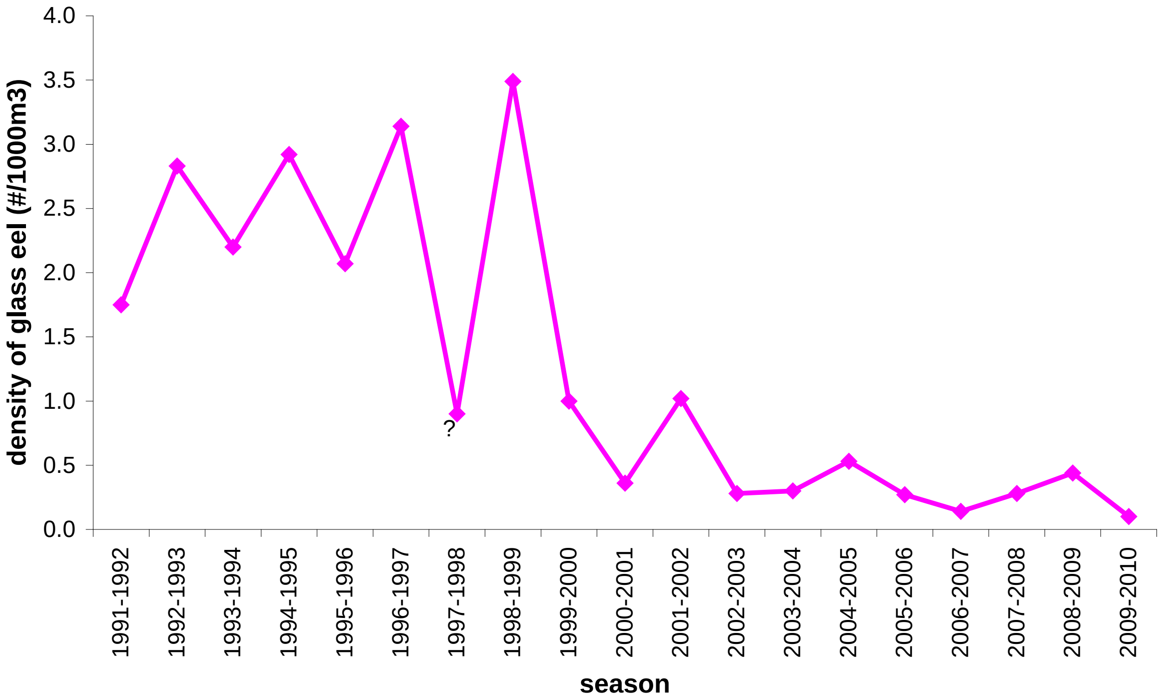


Figure FR 23. Results of the glass eel recruitment survey in the Gironde (? Indicates a suspect data from missing sampling in January).

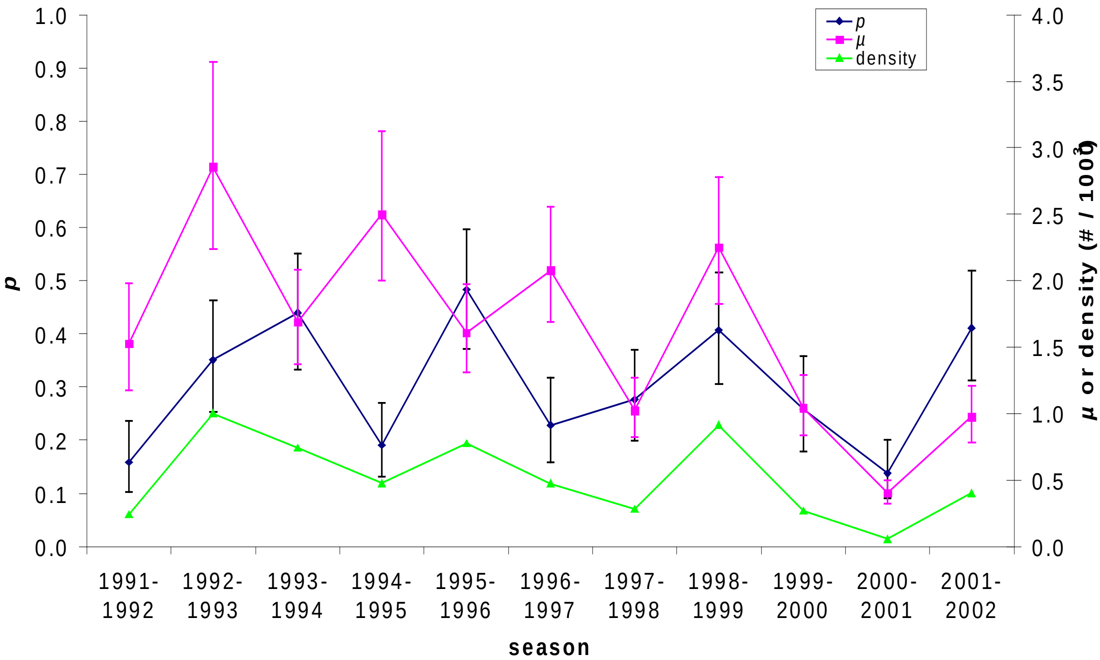


Figure FR 24. Results for glass eel of a delta-gamma analysis for season effect (p=probability of positive capture, μ=mean capture for only positive capture, density=p*μ) (extracted from Lambert, 2005).

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 24) show some peculiar seasons like 2000–2001 for which glass eels were rarely caught (low p) and when caught, in small number (low μ), resulting in a very low density.

FR.9.2 Stock surveys, yellow eel

Specific stock surveys were performed in small basin (Frémur, Oir). General fish monitoring is also made by Onema (Reseau hydrobiologique et piscicole – RHP). The results are in previous ICES reports.

FR.9.3 Silver eel

Silver eel fluxes to the sea were assessed using the sequential fishery in the Loire basin following a mark–recapture protocol (Boury and Feunteun, unpublished).

No other information is available on silver eel stock.

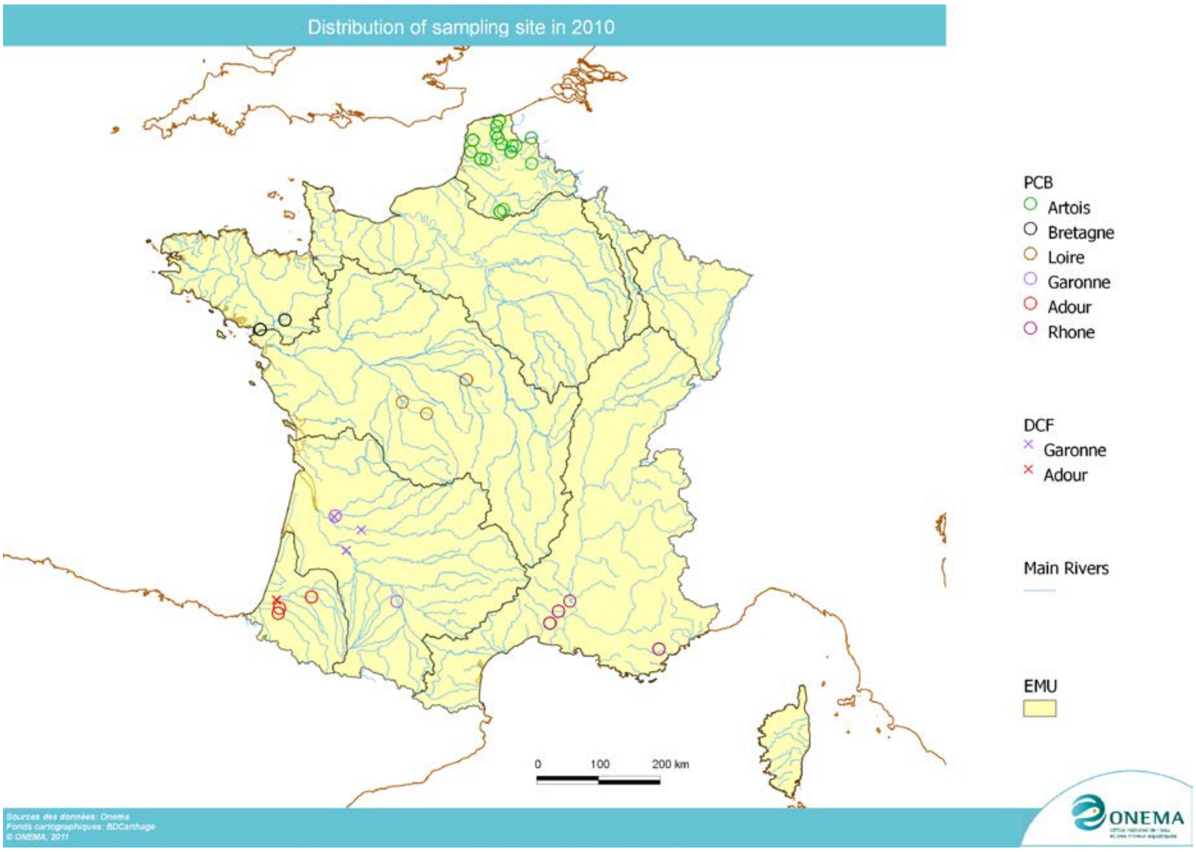
FR.10 Catch composition by age and length

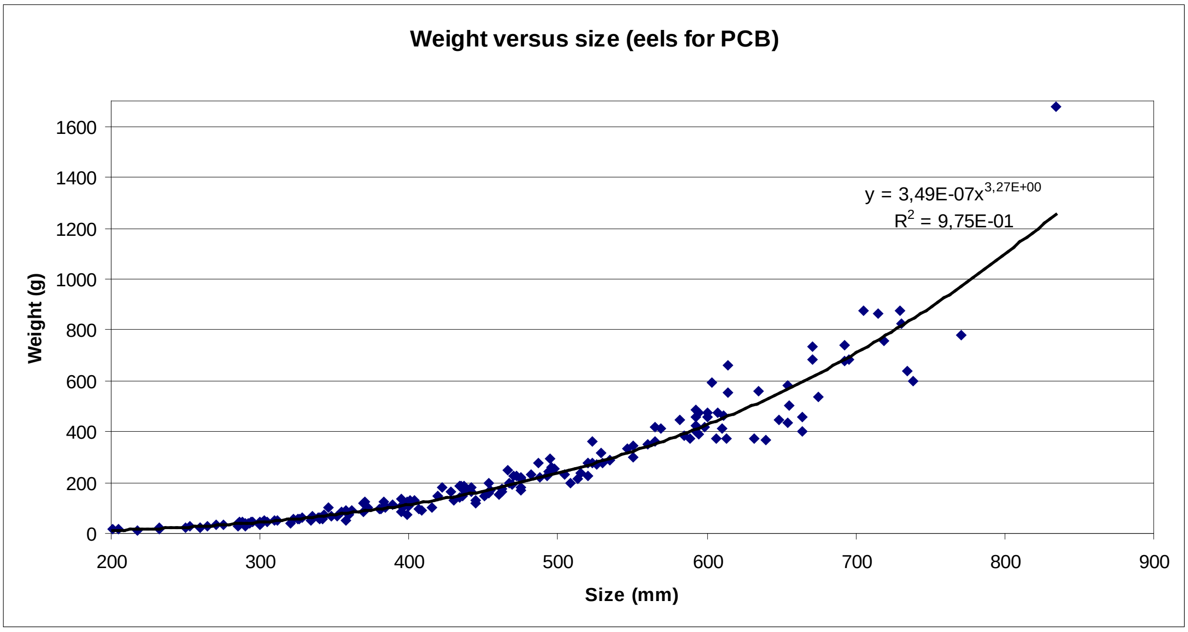
There is no routine programme measuring the catch composition by age and length in France.

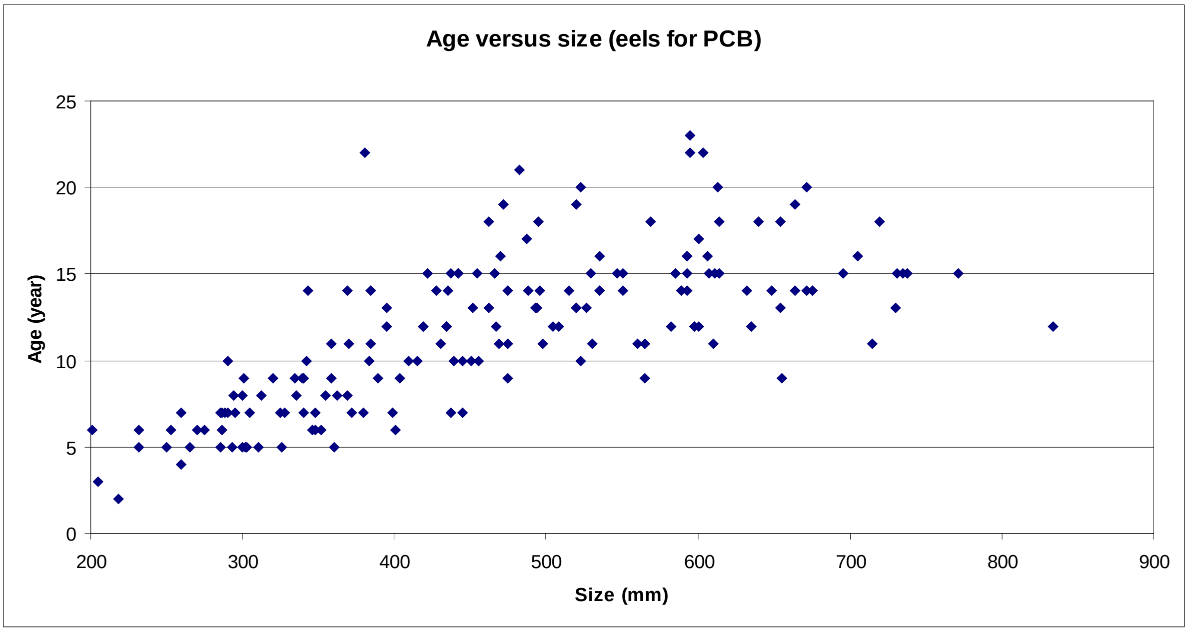
FR.11 Other biological sampling

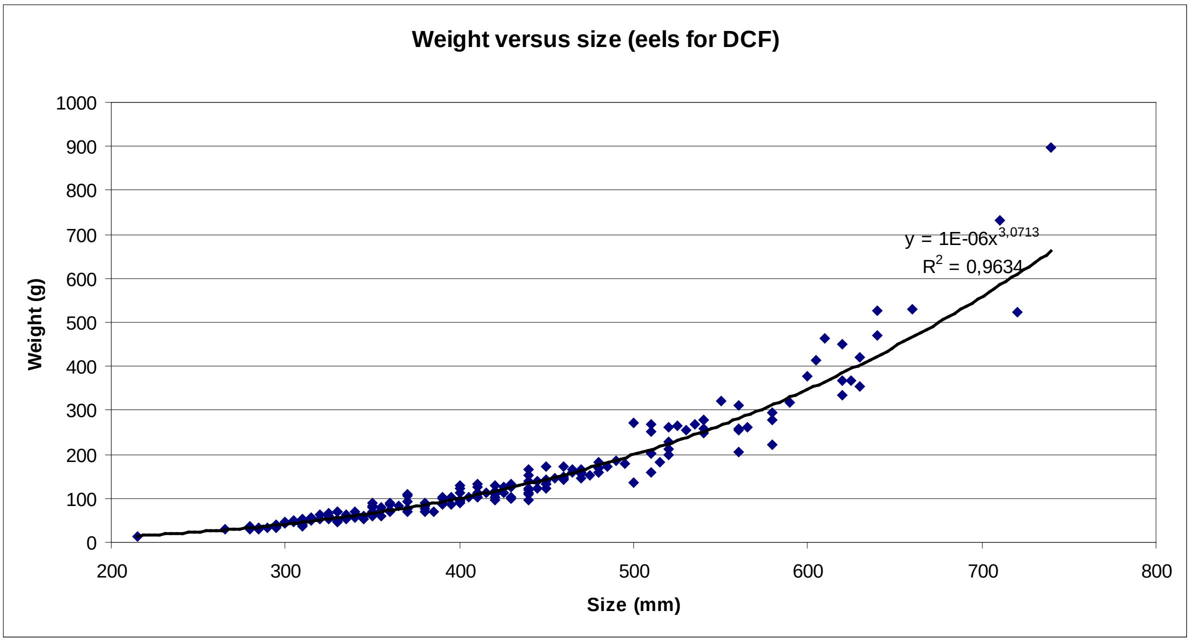
FR.11.1 Length and weight and growth (DCF)

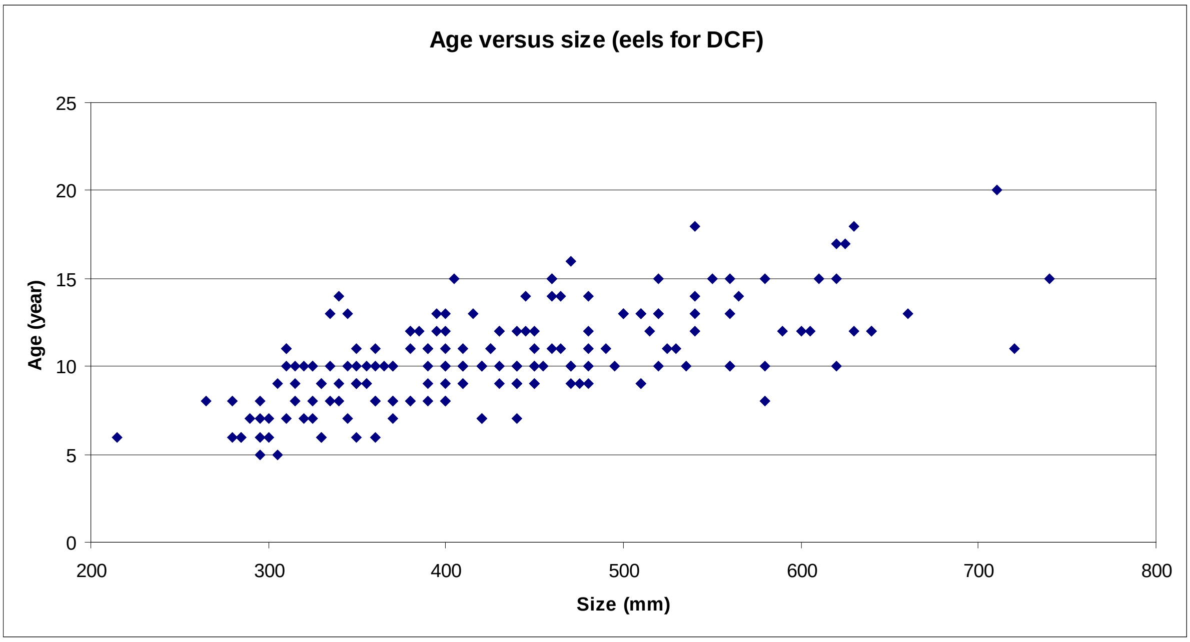
A survey has been set up by ONEMA in 2010. 348 eels' otoliths were analysed (185 in the context of DCF analyses and 183 for PCB analysis). Field sampling of fishermen catches for DCF and sampling for PCB analysis has been organized by ONEMA and age reading has been performed by Cemagref.


Distribution of sampling site in 2010
PCB
Artois
Bretagne
Loire
Garonne
Adour
Rhone
DCF
Garonne
Adour
Main Rivers
EMU
0
100
200 km
Sources des données: Onema
Fonds cartographiques: BDCarthage
© ONEMA, 2011
ONEMA


Weight versus size (eels for PCB)
y = 3,49E-07x^3,27E+00
R^2 = 9,75E-01
Weight (g)
1600
1400
1200
1000
800
600
400
200
0
200
300
400
500
600
700
800
900
Size (mm)


Age versus size (eels for PCB)
Age (year)
25
20
15
10
5
0
200
300
400
500
600
700
800
900
Size (mm)


Weight versus size (eels for DCF)
Weight (g)
1000
900
800
700
600
500
400
300
200
100
0
200
300
400
500
600
700
800
Size (mm)
y = 1E-06x^3,0713
R^2 = 0,9634



FR.11.2 Parasites and pathogens

A review was done by Elie and Girard (2009).

FR.11.3 Contaminants

See the review of Elie and Girard (2009).

A campaign of PCB analysis in eel (among five other fish) was set up by the French Ministry of Agriculture in order to prioritize sectors of intervention to reduce risk for human food. Results of the first set of analyses are awaited.

FR.11.4 Predators

No data on eel predators are currently summarized.

FR.12 Other sampling

No data available.

FR.13 Stock assessment

FR.13.1 Local stock assessment

No new data.

FR.13.2 International stock assessment

FR.13.2.1 Habitat

No new data.

FR.13.2.2 Silver eel escapement and production

No new data.

FR.13.2.3 Impacts

No new data.

FR.13.2.4 Stocking requirement eels <20 cm

No new data.

FR.13.2.5 Data quality issues

A national plan against PCBs including eel sampling have been set up since 2008. All details and data can be found here (http://www.pollutions.eaufrance.fr/pcb/). For example, Figure FR 25 gives sampling site in 2009. Some samples have also been analysed for mercury. Data can be accessed through http://www.pollutions.eaufrance.fr/pcb/resultats-xls.html and http://pollutions.eaufrance.fr/Demo/Resultats_hydro.aspx. Following those analyses some fisheries ban have been taken (Figure FR 26); since October 2010 (last map) more fishing ban have been taken, the last being for Tarn-et-Garonne area (August 2011).

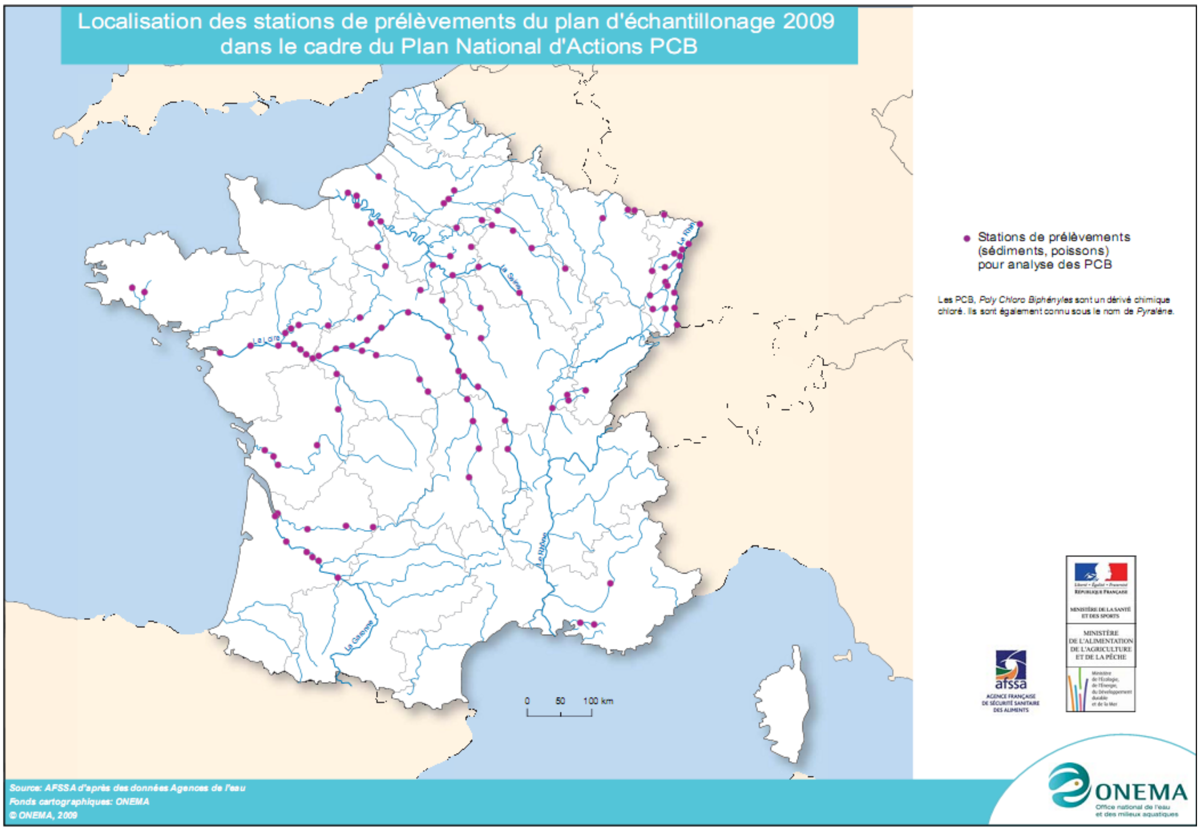


Figure FR 25. PCB sampling location in 2009.

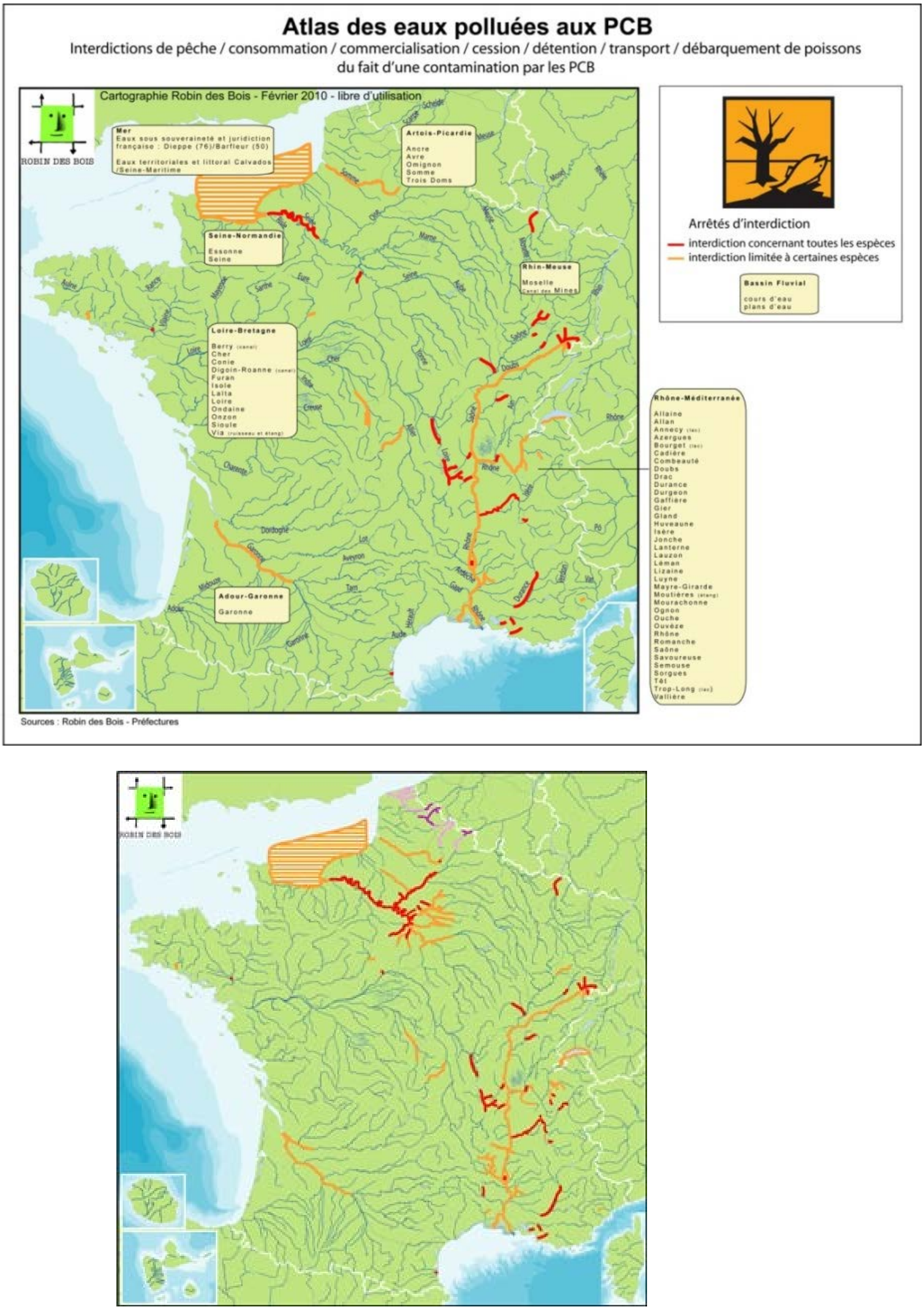


Figure FR 26 Fisheries ban due to PCB in France in February 2010 (above) and in October 2010 (below) (Source: http://www.robindesbois.org/PCB/PCB_peche/restrictions_peche.html).

FR.14 Sampling intensity and precision

No data available.

FR.15 Standardization and harmonization of methodology

No data available.

FR.15.1 Survey techniques

FR.15.2 Sampling commercial catches

FR.15.3 Sampling

FR.15.4 Age analysis

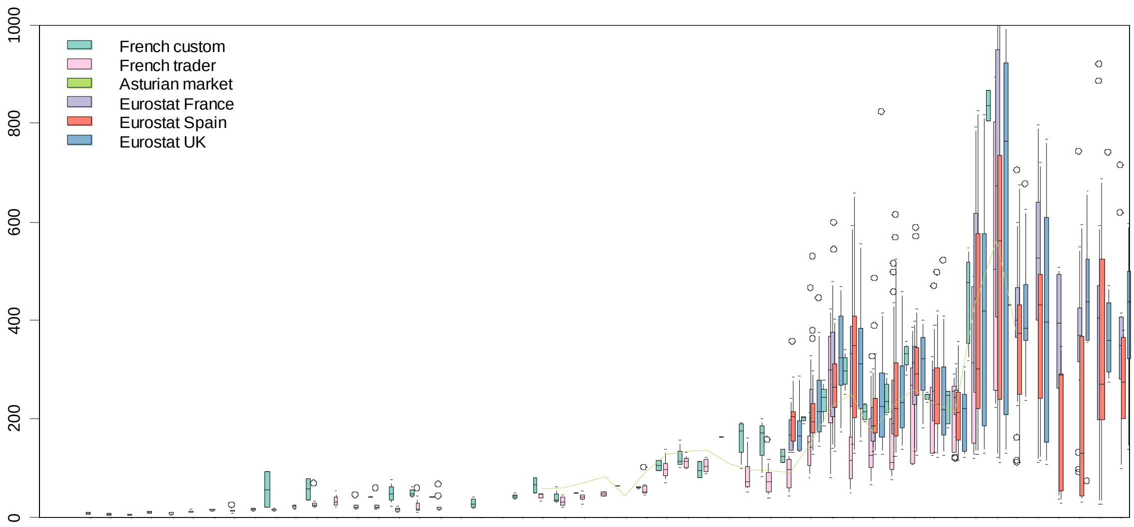
FR.15.5 Life stages

FR.15.6 Sex determinations

FR.16 Overview, conclusions and recommendations

Trade.

Trend in glass price.


French custom
French trader
Asturian market
Eurostat France
Eurostat Spain
Eurostat UK
0
200
400
600
800
1000

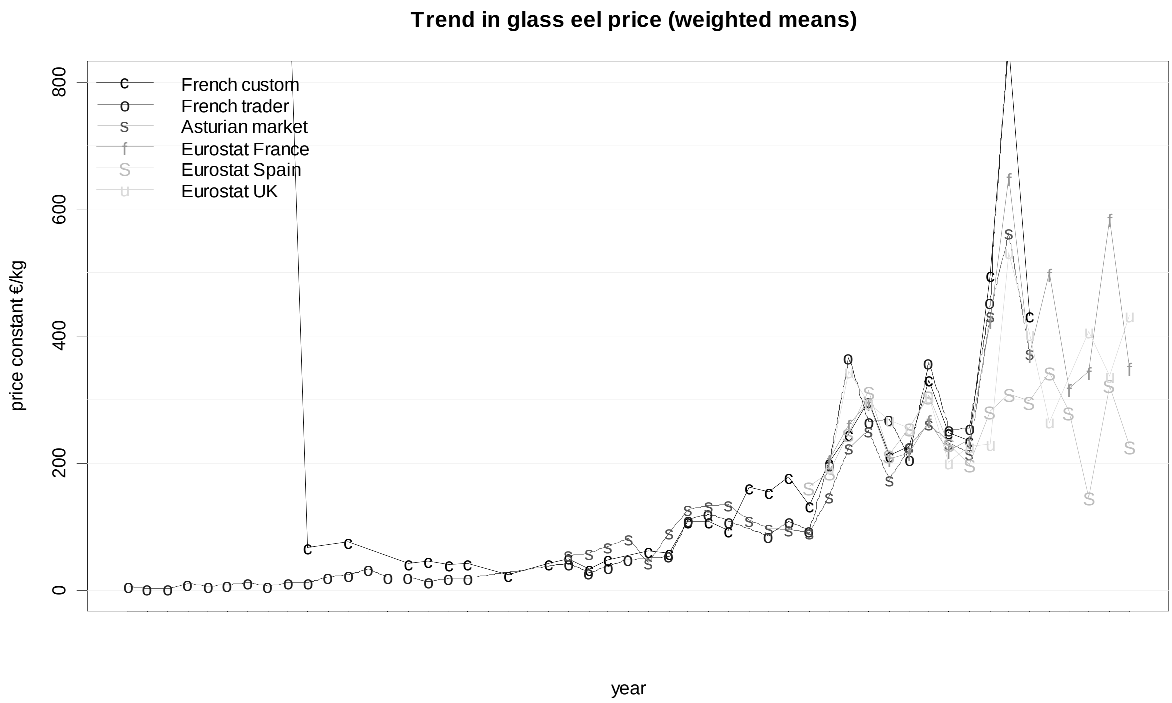

Trend in glass eel price (weighted means)
French custom
French trader
Asturian market
Eurostat France
Eurostat Spain
Eurostat UK
price constant €/kg
0
200
400
600
800
year

Table FR bb. Weighted means of glass eel price in Euro per reporter (EuroStat).

YEAR	EUROSTAT FRANCE	EUROSTAT ESPAGNE	EUROSTAT ROYAUME UNI
1996	206.4	185.8	193.4
1997	260.6	247.0	344.8
1998	295.6	313.6	294.9
1999	208.1	214.2	267.8
2000	216.3	254.7	254.6
2001	267.4	306.7	304.1
2002	220.4	230.8	202.8
2003	236.7	199.2	226.1
2004	423.5	282.4	229.9
2005	648.7	308.7	531.1
2006	370.3	297.4	404.4
2007	499.2	343.5	265.0
2008	316.3	281.9	
2009	344.5	146.6	408.1
2010	584.3	322.7	338.7
2011	351.5	228.0	431.3

The sum of export from France is 33.7 t. Export is mostly to the Netherlands, Denmark, Spain and the UK. The import of glass eel to France was reported as null this year.

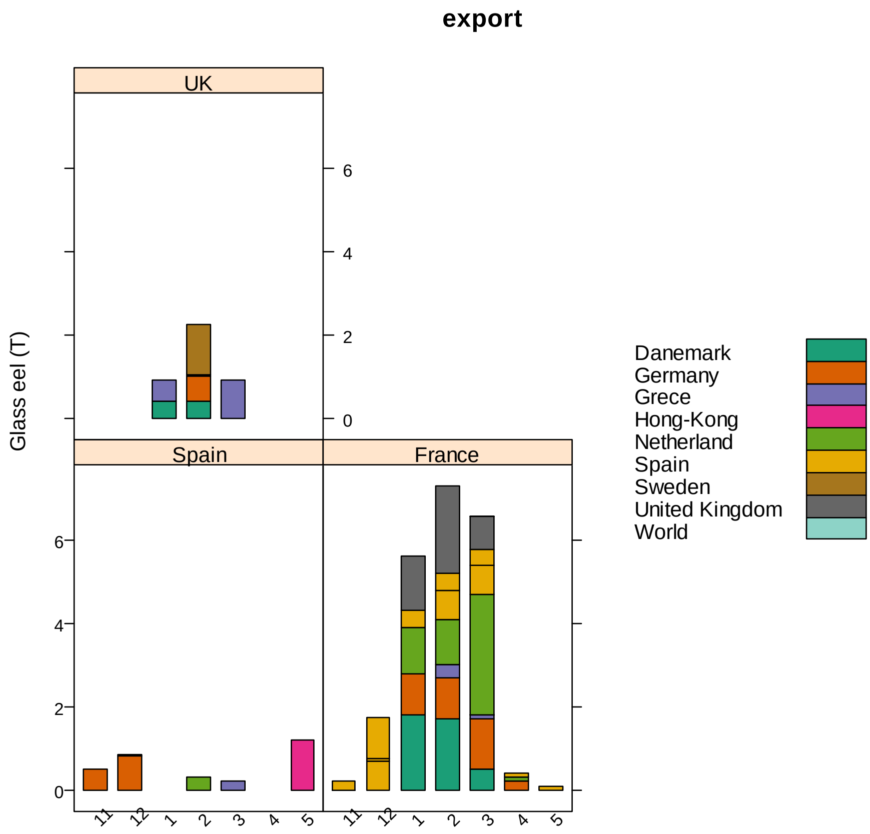


Figure FR 27. Export trade in 2011 analysed from EuroStat database for France as reporter.[2].

[2] Not shown in this graph, there is additional trade to other European countries, 2.5 ton in January, 8.8 tons in April, and 0.4 ton in May.

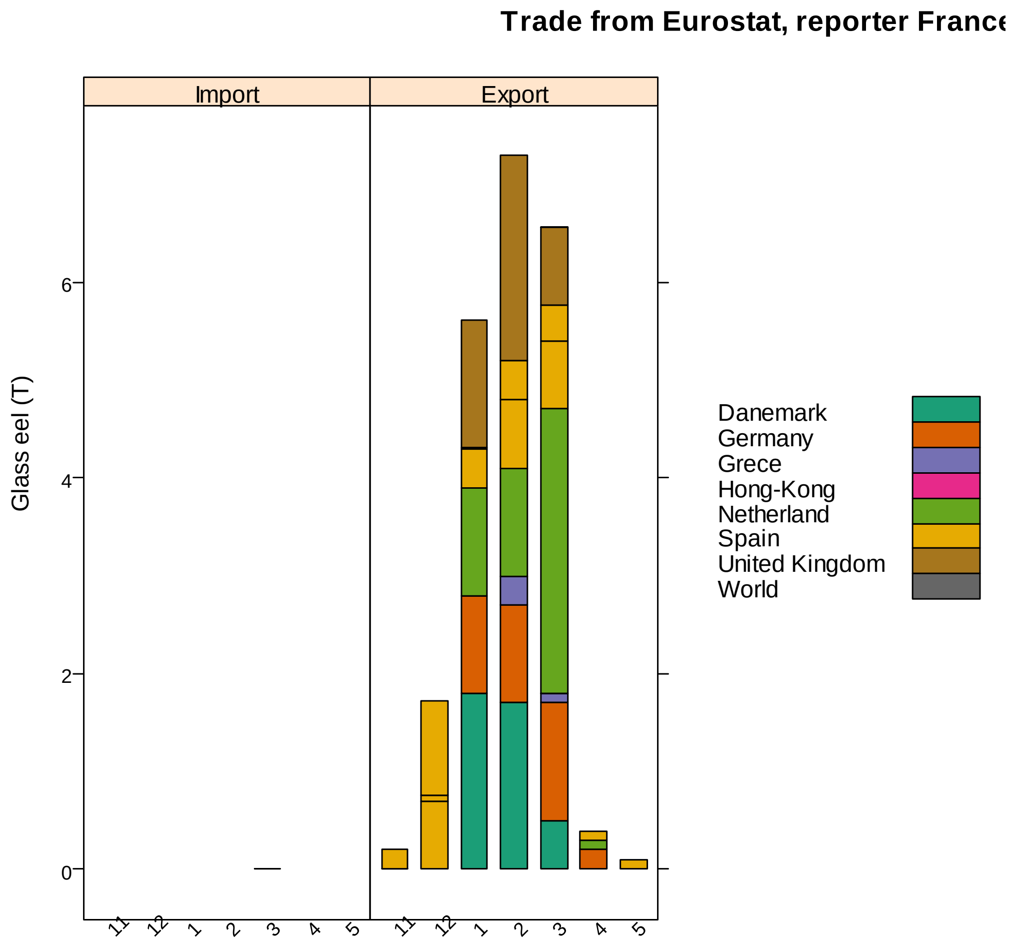


Figure FR 28. Import and export trade in 2011 analysed from EuroStat database for France as reporter.

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Report on the eel stock and fishery in Germany 2010/'11

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Reporting Period: This report was completed in August 2011, and contains data up to 2010 (and some provisional data for 2011).

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DE.2 Introduction

This report provides the most recent information about ell stocks, eel fishery and eel surveys in Germany. For the development of the Eel Management Plans according to the EU Regulation 1100/2007, the member states of the European Union had to collect data on their eel habitats, eel stocks and fisheries and they had to develop models to predict former and present silver eel escapement. For Germany, this has been done for the years up to 2007/2008. There is, however, no permanent new calculation of escapement for each year. The first report on the implementation of the Eel Management Plans and on the development of the stock has to be provided to the European Commission in 2012. The responsible authorities mainly focus on this report and not on providing detailed data on an annual basis. Therefore, the available amount of "really new" data will be rather low before 2012, 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 report also gives data from some scientific surveys, but most parameters on production, wetted areas, silver eel escapement, etc. have not been calculated new. For the purpose of practicability, in these cases the information from last year (i.e. from the Eel Management Plans, EMP) is repeated in the relevant chapters.

DE.2.1 Eel management plans

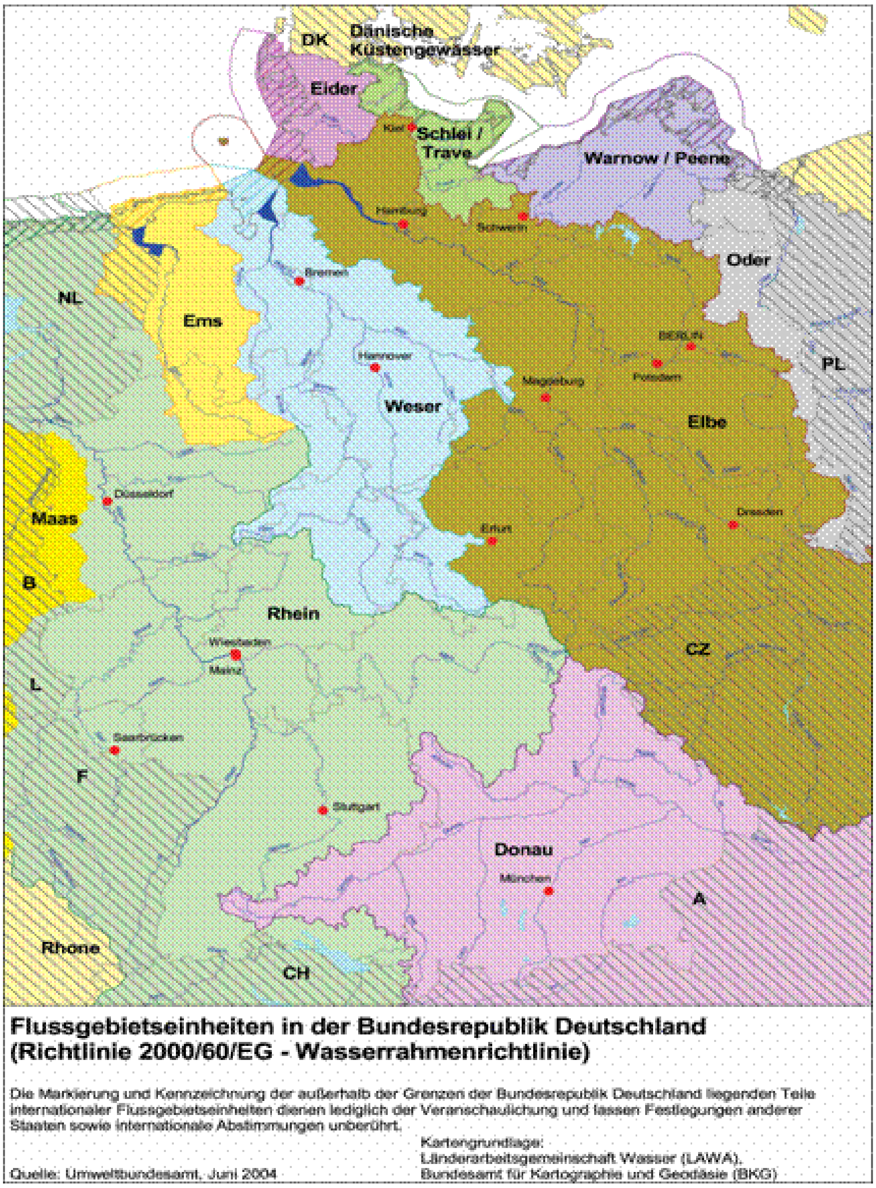

Figure 1. River Basin Districts (RBD) in the Federal Republic of Germany: Eider, Schlei/Trave, Elbe, Warnow/Peene, Oder, Weser, Ems, Rhine, Meuse and Danube.

In December 2008, Germany has submitted Eel Management Plans for its RBD's as required by the EU Council Regulation 1100/2007. The plans had been prepared for nine RBD's (Eider, Elbe, Ems, Meuse, Oder, Rhine, Schlei/Trave, Warnow/Peene and Weser). No plan was prepared for the river Danube, since according to a decision of the European Commission the Danube does not constitute a natural distribution area for eel in the sense of the Council Regulation 1100/2007.

In Germany, inland fishery is under the legal competence and responsibility of the federal states ("Bundesländer"). Therefore, nine single plans have been prepared, which, however, all have a common structure. These nine plans where submitted to the European Commission together with a German "frame" providing a short summary of the results of the estimates for escapement (including a balance for whole Germany) and of common aspects, which should not be repeated in each single plan. Yet, the measures for the stock management were decided for each RBD and consequently differ (slightly) between the rivers. Therefore, they were not presented in the frame part.

The main measures proposed in the EMP's are:

- increase minimum size limits to 45 cm or 50 cm (different between the "*Bundesländer*");
- maintain and, if possible, increase re-stocking of eels (not all RBD's), see details in Chapter 13.2.2.6;
- closed seasons (different periods);
- attempts to reduce mortality at turbines, etc. (a position paper of the union of the bigger hydropower companies (BDEW) exists, in which they declare their willingness to cooperate in this question), e. g. by catch-and-carry projects or innovative technical solutions;
- actions to reduce mortality by cormorants (depending on the conditions in the respective RBD/Bundesland).

Meanwhile, some further restrictions have been established, e. g. in parts of the river Rhine commercial fishing for eel is forbidden due to contaminant concentrations. Additionally in some RBD's there are special restrictions, which are limited to one or two states, e. g. removal of stationary eel traps, if possible. These were not included into the list of "main measures".

In April 2010, the German EMP's have been approved by the European Commission. Following this approval, the states started the implementation of the plans. However, the states do this by different ways. Some establish special eel regulations, whereas others only change some aspects of existing legal frameworks.

In Germany, the authorities of the States in cooperation with the Federal Ministry for Food, Agriculture and Consumer Protection have already established a working group for the preparation of the 2012 report to the European Commission. It would be very useful, if the European Commission would provide a guidance document about content and structure of the report.

DE.2.2 Eel data collection under the DCF

Sampling of European Eel data in freshwaters is now mandatory under the DCR. In Germany, sampling has started in spring 2009 and the first DCR-report has been submitted to the EU. The results of the biological sampling of eels in the freshwaters have also been presented as an Annex to the Country Report in 2010. The most recent data are included in an Annex to this Country Report. The first two 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. An exemption is the RBD Maas (Meuse), where no commercial fishery exists in the German part of the RBD. Consequently, sampling is not required by the DCF. 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 *Anguillicoloides crassus* infestation and also concentration of some contaminants. However, these additional investigations are not mandatory under the DCF. Since the number of eels investigated, which is required by the DCF is not very high (200 individuals per RBD), sampling in Germany is mainly conducted only on a few locations, preferably rather downstream in the system.

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.

DE.3 Time-series data

DE.3.1 Recruitment-series and associated effort

DE.3.1.1 Glass eel

DE.3.1.1.1 Commercial

There is no glass eel fishery in Germany.

DE.3.1.1.2 Recreational

There is no recreational fishery for glass eel in Germany.

DE.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 Section 3.1.2.3).

In the course of the implementation of the eel management plans, however, it is likely that additional glass eel and/or elver monitoring stations will be established at some rivers in northern Germany. Yet, there are no further results available in the moment.

DE.3.1.2 Yellow eel recruitment

DE.3.1.2.1 Commercial

There is no data time-series on yellow eel recruitment available based on commercial catches.

DE.3.1.2.2 Recreational

There is no data time-series on yellow eel recruitment available based on recreational catches.

DE.3.1.2.3 Fishery-independent

In the last years, monitoring on immigration and upstream migration of young eels on some locations in Mecklenburg-Pomerania was initiated. The monitoring stations were established in waters of the RBD's Warnow/Peene (both Baltic Sea) and Elbe (North Sea).

The few data available indicate that the numbers of glass eels arriving are very low if compared to former data and that the numbers did not significantly differ during recent years (Lemcke, 2003; Schaarschmidt, 2005; Schaarschmidt *et al*., 2007; Ubl *et al*., 2007; Table 1). The mean lengths of the upstream migrating eels during the years 2002–2009 were in the range from 10.0 cm (Mühlengrube/Wismar) to 22.0 cm (Oelmühlenbach/Neubrandenburg, Ubl and Dorow, 2010). There is an obvious relation between distance to coast and mean length of immigrating eel.

Recruitment to the rivers of the Baltic Sea is considerably lower than in the rivers draining into the North Sea (Ubl and Dorow, 2010; 2011).

Table 1. Comparison of standardized catches of upstream migrating eels 2001–2008 in several rivers in Mecklenburg-Pomerania (number of eels per fishing gear between May and October; Ubl 2009, Ubl and Dorow, 2010; 2011).

River	Station	Distance to coast	Gear/Relation	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Baltic Sea													
Warnow	Bützow	53 km	per eel ladder	37	230	73	56	76	40	35	Not sampled	Not sampled	Not sampled
Hellbach	Mühle	7 km	per eel ladder	not sampled	25	33	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	not sampled	173	153	123	296	509	238	614
Mühlengrube	Wismar (Ziegenmarkt)	0.1 km	per eel ladder	not sampled	not sampled	not sampled	not sampled	not sampled	17	19	81	4	0
Uecker	Torgelow (Wehr)	52 km (Oder estuary) or 83 km (Peene estuary)	per eel ladder	not sampled	70	33	---	---	53	32	25	37	37
Plastbach (or Farpener Bach)	Alt Farpen (Stausee/Speicher)	4.8	per eel ladder	not sampled	not sampled	not sampled	not sampled	not sampled	---	101	67	25	29
North Sea													
Müritz-Elde-Wasserstraße	Dömitz (Fischpass)	224 km	per fykenet	not sampled	5934	2365	3145	2861	3124	2440	1395	Not sampled	2659
			per eel collector	not sampled	not sampled	not sampled	not sampled	not sampled	9	---	Not sampled	Not sampled	Not sampled
Dove Elbe	Dömitz (Wehr)	224 km	per eel ladder	not sampled	not sampled	1981	676	721	1035	890	542	Not sampled	62
			per eel collector	not sampled	not sampled	not sampled	not sampled	not sampled	11	---	Not sampled	Not sampled	Not sampled

DE.3.2 Yellow eel landings

DE.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 re presented in Chapter 6.

DE.3.2.2 Recreational

There are no time-series on recreational catches of yellow eel available.

DE.3.3 Silver eel landings

DE.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 re presented in Chapter 6.

DE.3.3.2 Recreational

There are no time-series on recreational catches of silver eel available.

DE.3.4 Aquaculture production

DE.3.4.1 Seed supply

Data on seed supply for aquaculture so far are not available. Possibly, the situation may change during the implementation of the EMP's and in relation to the requirements of the CITES-listing of eel. However, the legal situation regarding the availability of the data appears to be a bit unclear.

DE.3.4.2 Production

Table 2. Production of eel in recirculation systems.

YEAR	PRODUCTION (T)
2000	422
2001	347
2002	381
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 stocking size eel)

DE.3.5 Stocking

DE.3.5.1 Amount stocked

The available data on re-stocking are not complete. There is so far no central database on re-stocking in Germany. Here the available information on re-stocking is presented by RBD/EMU.

Eider: No re-stocking. Natural immigration is considered sufficient by fishermen and administration.

Elbe: In the Brandenburg part of the catchment (probably mainly in the river Havel), the following amounts of eel have been stocked in the last years:

2009: Glass eel: 32 kg (from France):

Ongrown eel: 17.073 kg (from Denmark and Germany);

Yellow eel: 6.925 kg (around 35 g weight, unknown provenance).

2010: Glass eel: 5 kg (unknown provenance), 615 kg (France), 493 kg (Spain); total: 1.113 kg:

Ongrown eel: 14.186 kg (Germany, Denmark), 417 kg (unknown provenance), total: 14.603 kg;

Yellow eel (about 35 g): 7.573 kg (unknown provenance).

2011: Glass eel: 18 kg (unknown provenance), 550 kg (France), total: 568 kg:

Ongrown eel: 15.736 kg (Germany, Denmark);

In the Mecklenburg-Pomeranian part of the RBD Elbe, the following amounts have been stocked in 2009 and 2010 (Dorow and Ubl, 2010; 2011):

2009: Ongrown eel: 2.9 t (241.500 individuals);

2010: Ongrown eel: 2.860 kg (mean density 15.2 ind./ha).

In Saxony, the following amount has been stocked in 2009 (2010 and 2011 data not yet available):

2009: Ongrown eel: 0.27 Mio individuals, (roughly 2.000 kg).

In the Berlin part of the RBD/EMU the following amounts of eels have been stocked in the last years:

2009: Ongrown eel: 3.661 kg (Denmark);

2010: Ongrown eel: 3.661 kg (Denmark);

2011: Ongrown eel: 3.443 kg (Denmark).

The mean weight was probably around 6–10 g.

In the Saxony-Anhalt part of the catchment, the following amount of eel was stocked in the last years:

2009: Ongrown eel: 2.531 kg (Germany, Denmark);

2010: Ongrown eel: 2.677 kg (Germany, Denmark);

2011: Ongrown eel: 2.683 kg (Germany, Denmark).

In the Lower-Saxonian part of the RBD Elbe, the following amounts have been stocked in 2009 and 2010 (Diekmann 2010):

2009: Ongrown eel: 1.298 kg;

2010: Ongrown eel: 1.154 kg.

In addition, in the tidal areas of this RBD, about 40–50 kg ongrown eels are stocked annually by angling clubs.

Ems: In the Nordrhein-Westfalen part of this RBD, the following amounts of eel have been stocked in 2009 and 2010 (2011 data not yet available):

2009: Glass eel: 1 kg:

Ongrown eel: 348 kg.

2010: Glass eel: 10 kg:

Ongrown eel: 90 kg.

Maas (Meuse): In the Nordrhein-Westfalen part of this RBD, the following amounts of eel have been stocked in 2009 and 2010 (2011 data not yet available):

2009: Ongrown eel: 32 kg;

2010: Ongrown eel: 30 kg.

Oder: In the Mecklenburg-Pomeranian part of the RBD, 0.8 t of ongrown eels (approximately 64 400 individuals) were stocked in 2009 (Dorow and Ubl, 2010). In 2010, 552 kg were stocked at a mean density of 58.0 ind/ha (Dorow and Ubl, 2011).

In the Brandenburg part of the catchment, the following amounts of eel have been stocked in the last years:

2009: Ongrown eel: 702 kg (unknown provenance);

Yellow eel: 1.329 kg (around 35 g weight, unknown provenance).

2010: Ongrown eel: 100 kg (unknown provenance);

Yellow eel (about 35 g): 1.646 kg (unknown provenance).

Rhein (Rhine): For the Baden-Württemberg part of the catchment, including the main river (Rhine), some tributaries and a part of Lake Constance, data are available for 2009 (data for 2010 and 2011 not yet available):

2009: Glass eel: 16 kg

Ongrown eel: 1.1 t (approximately 111 500 individuals).

In the Nordrhein-Westfalen part of this RBD, the following amounts of eel have been stocked in 2009 and 2010 (2011 data not yet available):

2009: Glass eel: 3 kg;

Ongrown eel: 2.058 kg.

2010: Glass eel: 10 kg;

Ongrown eel: 1.120 kg.

Schlei/Trave: In the Mecklenburg-Pomeranian part of the RBD, the following amounts of eel have been stocked in the last years.

2009: Ongrown eel: 60 kg (approximately 5240 individuals; Dorow and Ubl, 2010).

2010: Ongrown eel: 87.5 kg (mean density 21.9 ind./ha, mean weight ca. 6–7 g; Dorow and Ubl, 2011).

In the Schleswig-Holstein part of the RBD, 80 kg of glass eel (from UK) were stocked in April 2011. No stocking in 2009 and 2010.

Warnow/Peene: In the Mecklenburg-Pomeranian part of the RBD, the following amounts of eel have been stocked in the last years.

2009: Ongrown eels: 2.9 t (ca. 239 000 ind.; Dorow and Ubl, 2010).

2010: Ongrown eel: 2.817 kg (mean density 32.2 ind./ha, Dorow and Ubl, 2011).

Weser: In the Nordrhein-Westfalen part of this RBD, the following amounts of eel have been stocked in 2009 and 2010 (2011 data not yet available):

2009: Glass eel: 1 kg;

Ongrown eel: 1.020 kg.

2010: Glass eel: 30 kg;

Ongrown eel: 310 kg.

Price information for glass eels

The price for glass eels was given (for Brandenburg catchments) as 445 €/kg in 2010 and 400 €/kg in 2011.

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

There is no glass eel fishery in Germany.

DE.4 Fishing capacity

Data on fishing capacity have been obtained during the development of the EMP's. According to the Regulation 1100/2007 a list with fishermen and eel traders has to be made available to the European Commission. However, since the implementation of the German EMP's started with a delay due to the late approval of the plans by the Commission, the completed lists (or summarized data) are still not available here. Therefore, the information from the EMP's is given here. However, the numbers of companies, etc. will not have changed very much since 2007/2008.

In the moment these data are not sampled within the frame of the DCF in Germany.

DE.4.1 Glass eel

There is no glass eel fishery in Germany.

DE.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 (although some gears are more special-ized for one of the stages). Furthermore, so far there was no obligation to report catches separately for yellow and silver eel, respectively. Therefore, fishing capacity is given combined for yellow and silver eels. The data for 2007 were taken from the EMP's. A new update of these figures will become available with the 2012 report on the implementation of the EMP's to the European Commission.

RBD Eider

- 69 full-time (68 coastal, one inland water), 146 part-time, 300 hobby fishermen (1200 fykenets allowed);
- about 20 000 anglers.

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);
- 343 566 anglers (valid licences).

RBD Ems

- four full-time and five part-time fishermen (using fykenets and stownets);
- about 28 000 anglers.

RBD Maas

- -Fishery of no importance (no details available).

RBD Oder

- 89 full- and part-time fishermen/fishing enterprises (using 2116 fykenets, seven stownets, 23 electrofishing gears, five stationary eel traps);
- 38 488 anglers (valid licences).

RBD Rhein

- approximately 288 full- and part-time fishermen (fykenets and a few stownets);
- about 88 000 anglers.

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.

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);

- about 45 000 anglers.

Weser

- 17 full-time fishermen, four cooperatives, 99 part-time fishermen (using stownets, fykenets, traps);
- approximately 122 000 anglers.

DE.4.3 Silver eel

See Section 4.2.

DE.4.4 Marine fishery

These data are included in the previous section (Section 4.2).

DE.5 Fishing effort

The data on fishing effort are still not available. Under the EU Council Regulation 1100/2007 these data would have to be reported by the fishermen starting in 2009. However, due to the late approval of the German EMP, the implementation in the States started with a delay. Meanwhile, the commercial fishermen have started to document the fishing effort at least in some States. However, it remains a bit unclear how and in which frequency the data will be collected by the authorities, and how they will become available for scientific analyses.

DE.5.1 Glass eel

There is no glass eel fishery in Germany.

DE.5.2 Yellow eel

Data are not yet available.

DE.5.3 Silver eel

Data are not yet available.

DE.5.4 Marine fishery

Data are not yet available. However, there is very little marine fishery for eel in the North Sea. Only in the Baltic Sea.

DE.6 Catches and landings

At present, only for a few States, the catches are reported separately for yellow and silver eel. The obligation to deliver the catch statistics separate for both stages has only recently been established in most of the States. Hence, better data can be expected in future.

Furthermore, it is also 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), but it is not clear, if the authorities will have the capacities to analyse or summarize the data, at least in a regular scheme.

DE.6.1 Glass eel

There is no glass eel fishery in Germany.

DE.6.2 Yellow eel

The separate documentation of yellow and silver eel catches is in a beginning stage and is not available for all catchments. Therefore, in this (sub-)chapter, only combined data for yellow and silver eels are given in some cases.

Table 3. Combined catches of yellow and silver eels (t) by the German inland fishery in 2010.

„Bundesland“ (State)		Commercial fishery		Recreational fishery
	Yellow eel	Silver eel	Combined (yellow + silver + undifferentiated)	
Baden-Württemberg		8.7 (mainly silver eel)	8.7	6
Bayern	5.6 t (but 4.7 t of them transported downstream (trap & truck)), **so real yield was 0.9 t**		0.9	No data
Berlin			12.8	5.7
Brandenburg	88	22	110	40
Bremen			3.0	4.6
Hamburg	8.0	0.4	10.0	0.8
Hessen	7.7 (mainly recreational fishery, but some commercial catch included)			
Mecklenburg-Vorpommern	21.2	13.1	62.4	1.5 t (without angler catches) + 50.4*
Niedersachsen	11.6	12.9	25.5	35.8
Nordrhein-Westfalen	1	1.9	2.9	20
Rheinland-Pfalz	8.1	(3.6 for trap & truck)	8.1	19.1
Saarland	0	0	0	<1
Sachsen	1.2	0.9	2.1	6.3
Sachsen-Anhalt	2.1	1.0	3.1	12.7
Schleswig-Holstein			16.4	47.2 (data taken from EMP 2008)
Thüringen	0	0	0	3.1
Total	**141.2**	**61.8**	**265.9**	**261.9***

*** For comparison: Data from EMP (2008), angler catches: 50.4 t.**

Table 4. Development of eel catches from the inland fishery in the last 15 years.

Year	Eel catches (t)
1995	369.3
1996	300.2
1997	280.7
1998	251.9
1999	261.0
2000	276.4
2001	239.3
2002	236.9
2003	170.9
2004	168.6
2005	174,4
2006	185,6
2007	206.0
2008	299.3
2009	Ca. 300
2010	265.9

DE.6.3 Silver eel

Silver eels are included in Section 6.2.

At the River Mosel, which is heavily influenced by hydropower turbines, a trap & truck initiative of the State Rheinland-Pfalz (Rhineland-Palatinate) and the RWE Power AG has been active since 1995. About ten fishermen catch silver eels, which are transported downstream to the lower Rhine. During the last decade about 4–7 t silver eel have been transported downstream every year (Lothar Kroll, Landesamt für Umwelt, Wasserwirtschaft und Gewerbeaufsicht Rheinland-Pfalz; personal communication).

In Bavaria, a project has been started in the river Main (RBD Rhine). Eels are caught with Schokkers (only downstream migrating fish caught). In 2009, 5.7 t were caught and transported, in 2010 4.7 t (Jan Baer, Fisheries Research Station Baden-Württemberg, pers. comm.).

In the river Neckar (RBD Rhine, State Baden-Württemberg) a project has been initiated in 2009. The fish are caught by electrofishing and determined as yellow or silver eels by measuring eye diameter, etc. Only silver eels are transported downstream to avoid that the fish migrate upstream again. In 2010, about 6–7 tons were caught in total but only about 10% were silver eels. So the amount of transported eels was about 600 kg. It has to be noted that this is an area quite upstream, above plenty of hydropower plants - so the low biomass of transported eels from this area is not surprising. The project is planned for five years (Jan Baer, Fisheries Research Station Baden-Württemberg, pers. comm.).

A new project will be started in autumn 2011 in Schleswig-Holstein, a coastal state. Silver eels will be caught from inland fisheries and released into the estuary of the river Eider (North Sea). The financial volume for 2011 and 2012 is about 140 000 € (in total).

DE.6.4 Marine fishery

Table 5. 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	
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	

	North Sea						Baltic Sea		
Year	Lower Saxony (incl. stocking size eel)		Schleswig-Holstein		Schleswig-Holstein Stocking size eel		Schleswig-Holstein		Mecklenburg-Pomerania
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	17.5*		0				13.4	87,529	61

*** These catches do not reflect real "marine" fishery. Instead, they represent catches from the lower reaches and estuaries of rivers draining into the North Sea. They come from transitional waters according to the WFD, but in the fisheries legislation they are counted as "coastal fishery".**

DE.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. Hence, a calculation of catch per unit of effort data would be possible. However, there was a delay in the approval of the plans and hence, the implementation started also with delay. It can be expected that such data will be available to the local or regional authorities in the next years. However, as mentioned previously, due to the limited capacities of the authorities it is not clear, when and how the information will become available to the WGEEL. On the other hand, the data will probably be used for the first report to the European Commission on the plans in 2012.

DE.7.1 Glass eel

There exists no glass eel fishery in Germany.

DE.7.2 Yellow eel

There are no data on cpue available.

DE.7.3 Silver eel

There are no data on cpue available.

DE.7.4 Marine fishery

There are no data on cpue available.

DE.8 Other anthropogenic impacts

There are no new eel specific data on other anthropogenic impacts available.

DE.9 Scientific surveys of the stock

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

(See also Section 3.1.2.3 for studies in Mecklenburg-Pomerania.)

DE.9.2 Stock surveys, yellow eel

DE.9.3 Silver eel

To support the assessment of silver eel escapement and to evaluate the results of the eel model used for the preparation of the EMP for the RBD Warnow/Peene, a fishery-independent study with a stownet and ark-recapture experiments had been initiated in Mecklenburg-Vorpommern in 2006 (Ubl and Dorow, 2011; Annex 3: Beprobung der Hamenfangstation an der Warnow, Ortslage Kessin (Dolk and Schulz, 2011)).

In total 1286 eels were caught in 2010, including 172 recaptures of marked fish from the previous years. In 2010, the authors marked 938 silver eels and 138 yellow eels. 171 of the recaptured eels got an additional mark to the one already existing.

The seasonality of the migration peaks differed between the years and it was not possible to find a simple explanation (moon phase, discharge). Probably, the development of silver eel migration peaks is influenced by several factors.

The mean cpue (eels per stownet per day) was 4.06, 4.14 and 6.04 in 2008, 2009 and 2010, respectively, indicating at least a stable silver eel escapement (Ubl and Dorow, 2011; Annex 3: Beprobung der Hamenfangstation an der Warnow, Ortslage Kessin (Dolk and Schulz, 2011)).

DE.10 Catch composition by age and length

Data obtained during the DCF-sampling are reported in a separate Annex to this report.

Since the Regulation 1100/2007 requires a substantial documentation of fishing capacities, efforts and yields, it was decided in Germany to focus on the biological sampling in the frame of the DCR/DCF. In a pilot phase in 2009 and 2010 all relevant RBD’s were sampled. Results were presented in the last years report. In 2011, the sampling scheme was slightly changed and there are not many detailed results available so far. A more detailed presentation and analysis of these results will be available in 2012.

DE.11 Other biological sampling

DE.11.1 Length and weight and growth

Results of the sampling in the frame of the DCF are presented in a separate Annex. In this chapter, information from other biological studies is given.

Simon (2011) analysed age structure and growth of 574 European eels from 17 water-bodies in the State Mecklenburg-Pomerania. Annual growth ranged between 0.6 cm and 14.5 cm. The best growth was found for female yellow eels in the Wismar Bucht/Salzhaff and in the Darß-Zingster Boddenkette with back-calculated 6.3 cm/year. The slowest growth was found in Lake Plauer See with 4.4 cm/year. Growth in the coastal waters of the Baltic Sea was 6.0 cm/year (inner and outer coastal waters considered together). According to the results, female eels in the studied water bodies achieve the minimum size limit for fisheries (50 cm) at the earliest at an age of six years, but usually only with 7–9 years. Silvering starts with 9–12 years age in males and at 10–21 years in females. In Table 6 the data are presented (partly summarized). Based on the age and growth data, Simon (2011) calculated the Standard Growth Rates as presented in Table 7.

Table 6. Growth of female yellow eels from different inland and coastal waters in Mecklenburg-Pomerania (Simon, 2011).

Habitat Type	Water Body / Segment	n	Range of age groups	Mean annual length increment (back-calculated)				L∞ (cm)
				1st year	5th year	10th year	Mean of year 1–7	
Inland waters	Kölpinsee	14	2+ - 11+	8.3	3.8	---	5.3	75
	Specker Seen	14	9 - 19	7.6	4.3	2.6	5.0	70
	Warnow/Kessin	16	7 – 13+	8.2	4.7	3.0	5.5	80
Baltic Sea / Inner Coastal Waters	Bodden/ Rügen	26	2+ - 10+	10.7	4.9	---	5.9	65
	Darß-Zingster Boddenkette	28	2+ - 9	10.8	6.0	---	6.3	70
	Peenestrom/ Achterwasser	28	1+ - 8+	8.3	4.9	---	5.6	75
	Wismarbucht/Salzhaff	32	2+ - 11+	9.5	5.1	---	6.3	90
Baltic Sea / Outer Coastal Waters	Außenstrand east of Darßer Schwelle	46	4+ - 12+	9.1	4.3	---	5.9	90
	Außenstrand west of Darßer Schwelle	108	2+ - 15+	9.5	4.9	---	6.1	85
	Baltic Sea, north and east of Rügen	56	3+ - 14+	10.6	4.6	---	5.9	65

Table 7. Mean Standard Growth Rate of female yellow eels from different waters in Mecklenburg-Pomerania by age (Simon, 2011).

	n	Standard Growth Rate (%/d) by age									
		1	2	3	4	5	6	7	8	9	10
Inland Waters	71	0.57	0.28	0.19	0.13	0.10	0.09	0.07	0.06	0.05	0.05
Coastal Waters	324	0.78	0.35	0.22	0.16	0.13	0.11	0.10	0.08	0.07	0.05

DE.11.2 Parasites and pathogens

There are no new results available. New findings will likely be included in the 2012 report to the European Commission and will hence be available for the 2012 Country Report.

DE.11.3 Contaminants

Nagel *et al*. (2011) examined metabolites of polycyclic aromatic hydrocarbons (PAH's) in the bile of eels from twelve German rivers and discussed their use as biomarkers. In total, 170 yellow eels were analysed. The authors found significant differences in concentration of PAH metabolites between the rivers. Furthermore, they found huge differences in the ratio of different PAH metabolites. For all rivers, the dominant PAH metabolite was 1-OH-hydroxypyrene. The individual results for this metabolite ranged from <22.5 ng/ml in the river Uecker to 3724.5 ng/ml in the river Trave. More detailed information should be taken directly from the article (Nagel *et al.*, 2011).

In the frame of an environmental monitoring, five eels from Lake Constance and 15 eels from the River Rhine in the State Baden-Württemberg have been analysed in 2008 for dioxins, PCB's, heavy metals and pesticides (Wahl *et al.*, 2011). Whereas all eels from Lake Constance were below the legal threshold for the sum of dioxins and dioxin-like PCB's, the majority of the eels from the Rhine were above the threshold. Yet, at present the eel fishery at the Rhine is closed completely for management purposes and consequently, it is not allowed to sell these fish. The highest values for dioxins and dl-PCB's were found in the samples from river-km 299. At each location, five eels were analysed and the values within each location were similar. The authors noted that fat content differed considerably. This influences the results.

For heavy metals, all eels were below the legal thresholds. The eels from Lake Constance had lower concentrations of mercury than the eels from the Rhine. The mercury concentrations at km 299 and 364 were comparable at a mean of 0.4 mg/kg (Wahl *et al.*, 2011).

In the frame of a monitoring programme, ten eels were analysed for contaminant concentrations in three rivers in the State Niedersachsen (Lower Saxony; rivers Elbe, Weser, Ems). The concentrations for the sum of dioxins and dl-PCB's of nine eels were above the threshold of 12 pg WHO-PCDD/F-PCB-TEQ/g fresh weight and only one eel (from river Ems) was below the threshold (ML Niedersachsen 2011). It was also noted that the threshold was exceeded mainly to high concentrations of dl-PCB's, which were about ten times higher than those of dioxins. In some cases the concentrations of chlorinated hydrocarbons, e.g. DDT and its metabolites and Hexachlorbenzene were also above the limits for consumption. The limits were not exceeded for mercury, lead and cadmium.

DE.11.4 Predators

From November 2006 to October 2009, the diet of cormorants was studied by Simon (2011) at two Lakes in the State Brandenburg. In total, the stomach contents of 253 cormorants were analysed. Most of them had been shot, but a few had been killed in gillnets of fishermen. 44 cormorants had an empty stomach. The majority of the remaining 209 birds had only one prey fish in the stomach (usually rather large prey). Yet, the largest number of prey fish found in one stomach was 67. The mean fish biomass found in the stomachs was 169 g (empty stomachs excluded; range 3–553 g). The most important prey species by weight were bream, roach and pikeperch. Of the 209 cormorants with fish in their stomachs, 21 birds had eaten 24 eels. The biomass proportion of eel in the diet of cormorants was 4.9% in spring, 11.9% in summer and 14.6% in autumn. In winter no eel was found. The mean proportion of eel over all four seasons was 7.8%. The mean length of eel in the diet was 35.9 cm (18.0–61.0 cm).

DE.12 Other sampling

As a consequence of a single detection of *Anguilla rostrata* in Mecklenburg-Vorpommern (Northeast Germany) a genetic screening monitoring programme was implemented. From 2005 to 2009, in total 5505 eels were examined with molecular biological methods Frankowski *et al.*, 2011). The test used allowed a clear differentiation between European and American eel (Frankowski and Bastrop, 2010). Whereas the proportion of *A. rostrata* in rivers and coastal waters was 0.2–0.6%, a value of

22.2% was found in lakes (Frankowski *et al*., 2011). Based on this result, a continuous sampling of the relevant lakes was started and the development of *A. rostrata* in these lakes could be documented. The investigations showed a clearly decreasing proportion of *A. rostrata* in the total catch. This indicates that *A. rostrata* had been stocked a few times in some lakes, probably unintentionally. During the study period, the proportion of *A. rostrata* within the silver eels increased from 1.5% to 4.4%, indicating that an increasing part of these fish is leaving the system. The authors conclude that, if no new stocking of *A. rostrata* occurs, all American eel will have left the lakes around at the latest in the 2020s.

DE.13 Stock assessment

DE.13.1 Local stock assessment

The results of the approaches to assess the size of the stock and spawner escapement from German waters are presented in the following sections. In the EMP's, which were submitted in December 2008 and approved by the European Commission in April 2010, management measures have been proposed based on the results. The stock assessment tools (models, etc.) will have to be further developed and improved in future. For this purpose, several studies on certain questions (mortalities, aspects of re-stocking; monitoring projects) have been started recently.

Since the eel management plans had been developed and submitted, no new calculation of the parameters in this chapter has been conducted. Therefore, the data from the EMP's are presented here.

DE.13.2 International stock assessment

DE.13.2.1 Habitat

These data were taken from the EMP's and have been given also in the last years report. They have not changed but for the reason of practical working with the report, they are given here again.

Table 8. Habitat types (ha) per RBD.

HABITAT TYPE	LACUSTRINE	RIVERINE	TRANSITIONAL & LAGOON	COASTAL	TOTAL
RBD					
Eider	4978	2899	1662	459 244	468 783
Elbe	136 662	18 097	46 260	Not included	201 019
Ems	1194	6633	36 164	Not included	43 991
Maas	0	892	Not included	Not included	892
Oder	49 205	2654	28 507	Not included	80 366
Rhein	14 400	44 531	Not included	Not included	58 931
Schlei/Trave	20 546	2483	0	310 761	333 790
Warnow/Peene	30 175	4647	0	310 080	344 902
Weser	4962	15 096	34 650	Not included	54 708

DE.13.2.2 Silver eel production

DE.13.2.2.1 Historic production

Table 9. "Historic" spawner escapement by RBD. Data were taken from the EMP's of the respective RBD's. The data represent estimates for the pre-1980s and are results of modelling, taking into account recruitment estimates for the relevant periods but excluding anthropogenic impacts. These data were also given in the last years report. So far, there is no new calculation of these values. Possibly this will be done during the preparation of the 2012 report to the European Commission.

RBD		Detail	Total production of silver eel (t)	Relative production of silver eel (kg/ha)
Eider	North Sea	Inland waters	91	9.5
		Coastal waters	149	0.3
Elbe	North Sea	Inland and transitional waters	1381	6.9
Ems	North Sea	Inland and transitional waters	406	9.2
Maas	North Sea	Inland waters	4	4.2
Oder	Baltic Sea	Inland and transitional waters	195	2.4
Rhein	North Sea	Inland waters	252	4.2
Schlei/Trave	Baltic Sea	Inland waters	200	8.7
		Coastal waters	441	1.4
Warnow/Peene	Baltic Sea	Inland waters	73	2.1
		Coastal waters	961	3.1
Weser	North Sea	Inland and transitional waters	424	7.7
Total			**4573**	

DE.13.2.2.2 Current production

Data on this parameter were not provided in the EMP's. Possibly a calculation of this parameter will be done for the 2012 report to the European Commission.

DE.13.2.2.3 Current escapement

Table 10. Present spawner escapement by RBD. Data were taken from the EMP's of the respective RBD's. The data are results of modelling, taking into account recruitment estimates for the relevant periods and also estimates or data for all anthropogenic impacts. A new calculation will be done for the 2012 report to the European Commission.

RBD		DETAIL	TOTAL PRODUCTION OF SILVER EEL (T)	RELATIVE PRODUCTION OF SILVER EEL (KG/HA)
Eider	North Sea	Inland waters	37	3.9
		Coastal waters	90	0.2
Elbe	North Sea	Inland and transitional waters	425	2.1
Ems	North Sea	Inland and transitional waters	284	6.5
Maas	North Sea	Inland waters	0	0.1
Oder	Baltic Sea	Inland and transitional waters	100	1.2
Rhein	North Sea	Inland waters	173	2.9
Schlei/Trave	Baltic Sea	Inland waters	66	2.9
		Coastal waters	292	0.9
Warnow/Peene	Baltic Sea	Inland waters	20	0.6
		Coastal waters	802	2.6
Weser	North Sea	Inland and transitional waters	261	4.8
Total			**2550**	

DE.13.2.2.4 Production values e.g. kg/ha

See Table 10 (Section 13.2.2.3).

In addition to the estimates of historic and current escapement, some additional estimates were available for the best achievable escapement (B_{best}) under present recruitment and without any anthropogenic impacts (i.e. present recruitment levels, no re-stocking, full accessibility of habitats, no fishery, no turbine mortality, etc.). They were estimated with the same model used for the calculation of current and historic escapement in the respective RBD's/EMU's, by setting the anthropogenic impacts as zero. Calculations were available for six out of nine RBD's:

Elbe:	323 000 kg
Ems:	170 800 kg
Oder:	59 600 kg
Rhine:	39 700 kg
Warnow/Peene:	932 600 kg
Weser:	118 200 kg

In all cases the calculated current escapement (data from EMP's) would be higher than this "best achievable" silver eel escapement. This indicates the important role of re-stocking for the present eel stocks in German waters. In future, the data (and model assumptions) will have to be assessed and possibly improved to put the calculations and the discussion of the data on a more solid ground and to achieve a higher reliability.

DE.13.2.2.5 Impacts

Information about the impacts on the eel stocks in the RBD's were calculated for the EMP's. Since 2008, no new calculation has been done, but this will be conducted for the 2012 report to the European Commission. Furthermore, there are some scientific studies, which will help to assess the estimates and assumptions used in the model for the EMP's. But these results are not yet available.

Table 11. Impacts on the eel stocks per RBD (2007). Data were taken from the EMP's and include catch statistics, estimates and calculations.

RBD	Impact (mortality in tons)			
	Commercial fishery (inland and coastal)	Recreational fishery (inland and coastal)	Mortality at technical constructions (turbines, pumping stations etc.)	Predation by cormorants
Eider	21	32	12	12
Elbe	195	110	134	102
Ems	9	16	3	2
Maas	0	0	0	0
Oder	18	12	2	53
Rhein	48	92	210	19
Schlei/Trave	88	57	23	90
Warnow/Peene	104	50	0	83
Weser	32	62	47	3
Total	**515**	**431**	**431**	**364**

DE.13.2.2.6 Stocking requirement eels <20 cm

From the nine EMP's for the relevant German RBD's/EMU's, the following stocking requirements could be extracted.

Table 12. Stocking requirements in Germany according to the Eel Management Plans.

RBD/EMU	Glass eel	Elvers (farmed, pre-grown)	bootlace eels (wild catches)
Elbe	---	5 250 000 to 9 000 000	---
Eider	---	---	---
Ems	150 000	500 000	---
Maas	10 000	10 000	---
Oder	---	75 000	45 000
Rhein	750 000	1 100 000	---
Schlei/Trave *	3 000 000–3 750 000	---	---
Warnow/Peene	---	1 000 000	100 000
Weser	50 000	1 000 000	---
Total	3 960 000–4 710 000**	8 935 000–12 685 000	145 000

*** 1 t glass eel equivalents increasing to 1.25 t;**

**** In future, and depending on availability and price of glass eels, alone in the RBD Weser, stocking of 6 Mio glass eels is intended.**

From the data in the table, a rough estimate of the required amount of glass eels could be made. Since bootlace eels are wild catches of small eels up to 30 cm, which are caught in the lower reaches of the rivers and transported to other rivers in Germany, they are not included.

For the calculation of glass eel numbers from elver numbers (pre-grown in farms) a mortality rate of 33% was assumed. This means that from three glass eel two elvers would be obtained, thus leading to a ratio of "1 elver = 1.5 glass eel". Hence, to achieve the required numbers of elvers, 13 402 500–19 027 500 glass eel would be needed. If the mortality rate in the farms is lower, the numbers would decrease accordingly.

Overall, the German stocking requirements sum up to at least 13 Mio eel of different size, increasing to about 18 Mio (4 Mio glass eel + 9 Mio elvers; increasing to 5 Mio glass eel + 13 Mio elvers).

Expressed as glass eel equivalents and by using the ratio "1 elver = 1.5 glass eel", it would be 17 362 500 (3 9600 000 + 13 402 500) increasing to 23 737 500 (4 710 000 + 19 027 500) glass eel (equivalents).

This would be a biomass of 5.8 to 7.9 t glass eel.

If these targets can be achieved, largely depends on the availability and the price of glass eel.

DE.13.2.2.7 Summary data on glass eel

There is only a very limited amount of information available. The so far reported amount of glass eel purchased for re-stocking was 53 kg in 2009, 1163 kg in 2010 and 568 kg in 2011. However, the information is most likely incomplete and refers only to direct glass eel stocking. There is so far no information available on the amount of glass eel purchased by fish farms.

DE.13.2.2.8 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 assumptions (in the EMP's) will have to be evaluated in future, but in the absence of better data, these assumptions were necessary to estimate the parameters required by the EU Regulation 1100/2007.

DE.14 Sampling intensity and precision

No available data.

DE.15 Standardization and harmonization of methodology

DE.15.1 Survey techniques

Stock assessment in coastal waters

In the last years, a monitoring approach for eel in coastal waters in the Baltic Sea was tested by the Institute for Fisheries of the State Research Centre Mecklenburg-Vorpommern for Agriculture and Fishery (Dorow and Ubl, 2011). Based on a habitat characterization in total nine reference stations were identified by the authors, covering all different habitat types. After the evaluation of possible eel monitoring approaches, which should allow the sampling of the different habitat types, a transportable fykenet system was developed. The fykenet system consists of a square external leader net weir with a fykenet chamber in each corner. The net square encloses a total fished area of 1 ha. Additionally, six chains of eel traps were deployed in the fished area to increase the likelihood of catching all eel above a certain size (defined by the used mesh size) that are within the net weir. To test this monitoring system, 98 different stations were sampled in 2008 and 2009, with each station being fished for 48 h. During the test phase of the fykenet system in 2008 and 2009, in total 321 eel were caught. After analysing the effects of the water temperatures on the efficiency of the fykenet system only stations fished at a water temperature 10°C and higher were considered in the further analysis. To further account for the size selectivity of the fykenet system only eel with a length over 36 cm entered the analysis on the eel density. The results indicate that the eel density differs along the Baltic coastline. Higher eel densities were observed in the external coastal parts compared to the internal parts. Regarding the tested habitat parameters salinity, water depth and the degree of structure had a significant influence on the observed eel density in the reference stations. Therefore, the authors concluded that eel prefer to colonize certain habitat types. The new fykenet system was judged to be a suitable approach for sampling eel in different habitat types with a standardized method. Hence, the system could provide a good and standardized method for the monitoring of eel densities in the coastal waters of the Baltic Sea. The results further indicate that the estimation of the eel stock size in the coastal waters of the Baltic should take the different habitats characteristics into account. (All information in this paragraph was taken from Dorow and Ubl, 2011. In this article, more detailed information can be found).

DE.15.2 Sampling commercial catches

No data available. See Annex for DCF-sampling.

DE.15.3 Sampling

No data available.

DE.15.4 Age analysis

The colleagues, who are mainly involved in age reading studies, participated at the relevant ICES workshops and hence, are experienced in standard age reading procedures in eel.

DE.15.5 Life stages

No data available.

DE.15.6 Sex determinations

No data available.

DE.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. Following this approval, the implementation in the States (*Bundesländer*) started. The measures, which were established in the EMP’s are now transferred into the relevant fisheries legislation and the structures of new documentation rules are and will be further developed (statistics for effort, separate catch statistics for yellow and silver eels and so on).

The Regulation 1100/2007 requires a much more detailed documentation of the eel fishery from fishermen and Member States. However, the capacities of the fisheries authorities are limited and it appears not clear, if and how the big amount of data that could be expected, will be analysed and used in future.

In the EMP's, a first estimate of spawner escapement (historical and recent) has been conducted. The modelling tools will be further developed and improved in future and it can be expected that a better and more detailed assessment of the stock and of the effects of the management measures will be possible in the next years. These efforts will be supported by the new data, which become available through the sampling of eel under the DCF. The first report on the EMP's and on the stock development, which has to be submitted to the European Commission in June 2012, will form the next milestone for the responsible authorities and scientists. Meanwhile, a working group has already started to collate all relevant information for the preparation of the 2012 report.

In Germany, in the last years, several projects and studies have been started, which will improve the availability of data on important population parameters in future. The results of the biological sampling in the frame of the DCF will also help to improve 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, although 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.

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Annex: German National Data Collection of European eel (*Anguilla anguilla*) 2010–2011

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Introduction

Following the „pilot" project in 2009/2010 (see Annex to the 2010 Country Report), sampling of the European eel (*Anguilla anguilla*) in German River Basin Districts (RBD) is continued as part of the EU Data Collection Framework (DCF). Data will be collected and reports will be provided on an annual basis ((EC) No 199/2008), starting in 2011.

Material and methods

Sampling in 2011 started in April and is still in progress. Sampling locations are given in Figure 1, sample sizes, fishing gear and time of sampling are summarized in Table 1.

Figure 1. Numbers indicate sampling locations within the RBD's. 1&2: Ems, 3–10: Elbe, 11: Eider, 12–15: Schlei/Trave.

Table 1. Numbers of sampled eels (as of 06.09.2011), fishing gear and time of sampling according to German RBD'S. Stage is indicated by S (Silver), Y (Yellow) and T (Transition).

RBD	Stage	Female	Male	Undiff.	Total	Gear	Sampl. Time
Elbe	**S**	5	2	1	8	fykenet electrofishing stownet	June–August '11
	Y	143	10	17	170		
	T	32	1		33		
	SUM	180	13	18	211		
Eider	**S**	5	3		8	fykenet	August '11
	Y	28	1	5	34		
	T	10	1		11		
	SUM	43	5	5	53		
Ems	**S**	1			1	fykenet	April '11
	Y	75	2	20	97		
	T						
	SUM	76	2	20	98		
Schlei Trave	**S**	16			16	fykenet	Jul–August'11
	Y	27		3	30		
	T	27			27		
	SUM	70		3	73		
Total	**S**	27	5	1	33	fykenet electrofishing stownet	April–Aug '11
	Y	273	13	45	331		
	T	69	2	0	71		
	SUM	369	20	46	435		

Methods and analysed parameters are similar to those described in the Annex of the 2010 country report with few exceptions:

a) River Elbe was sampled at eight locations all along the German part of the river from the Czech border to the estuary;

b) When staging eels from there outer appearance, a transition stage (T) was introduced, describing eels with characteristics of both, yellow (Y) and silver (S) eels.

Since at this point no or few data are available on age, infestation with *Anguillicoloides crassus* (e.g. Hartmann, 1994) and Silvering Index (SI, Durif *et al.*, 2005) they are not yet included in the results. Whenever referred to a stage (Y,S,T) it is solely based on the outer appearance of the eel and not referring to the SI.

Results

A total of 435 eels were sampled from four different RBD's. Mean length in the RBD'S were 55,7 cm (SD: 11,1 cm), 51,1 cm (SD: 11,5 cm), 53,1 cm (SD: 10,5 cm), 64,9 cm (SD: 10 cm) for RBD's Elbe, Eider, Ems and Schlei/Trave.

Length distributions for the different RBD's (pooled Y, S and T) are given in Figures 2a–d. Note that length distributions are biased by e.g. the selectivity of the respective fishing gear or differences in minimum size limits between locations. Especially in the rivers Elbe and Eider, a relatively large proportion of eels <40 cm were caught since fishermen were allowed to catch fish below the minimum size limit, e.g. for restocking purposes.

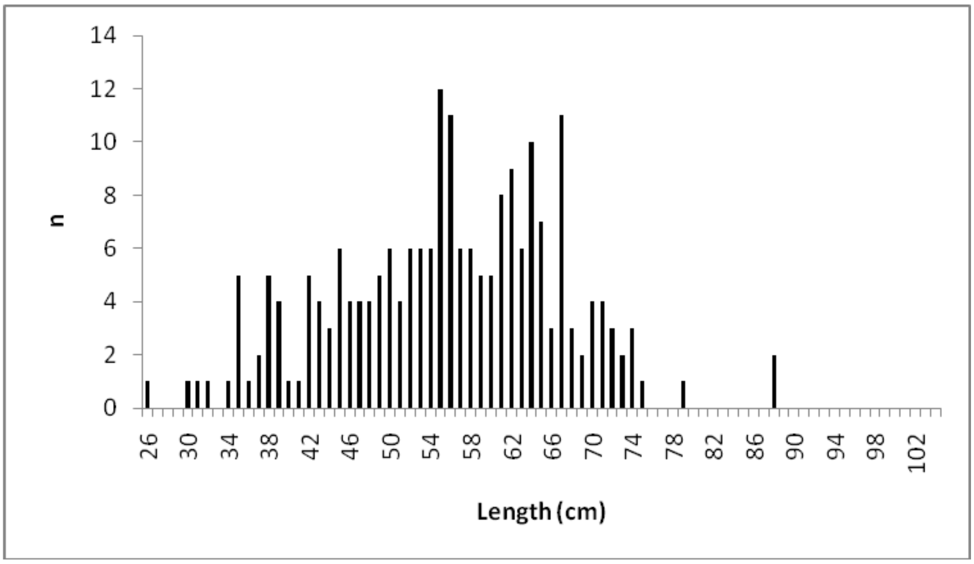

Figure 2a. Length distribution of eel samples from the RBD Elbe (n=211).

Figure 2b. Length distribution of eel samples from the RBD Eider (n=53).

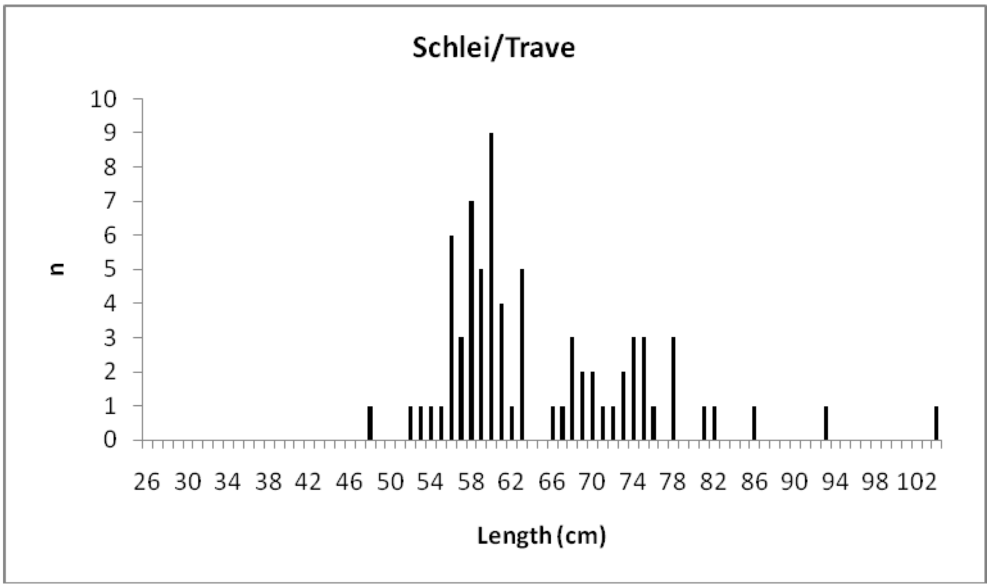

Figure 2c. Length distribution of eel samples from the RBD Ems (n=98).

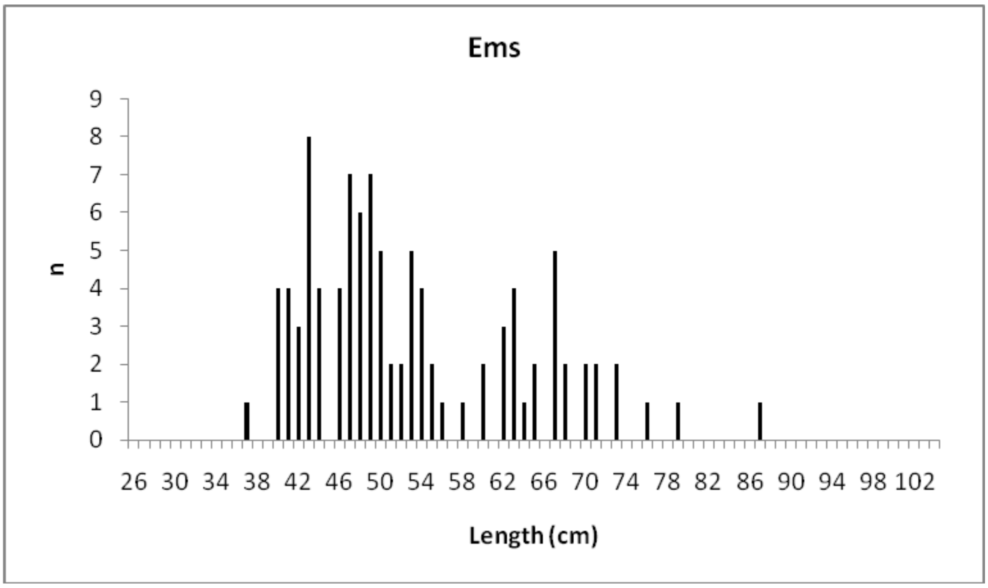

Figure 2d. Length distribution of eel samples from the RBD Schlei/Trave (n=71).

Figures 3a–d summarize the length–mass relationship in the different RBD's. Due to the overall small sample sizes and the lack of an appropriate staging, all available samples within a RBD were pooled. The relationship was well described by a power function ($L = aW^b$) for all RBD's and ranged from near isometric (Elbe: b=3,06) to positive allometric growth (Schlei/Trave: b=3,41).

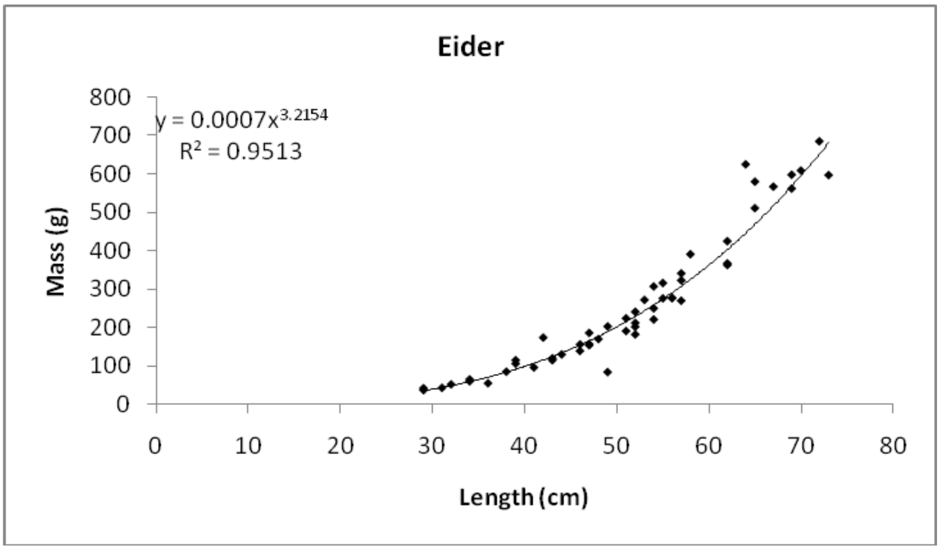

Figure 3a. Length–mass relationship of eel samples from the RBD Elbe (n=211).

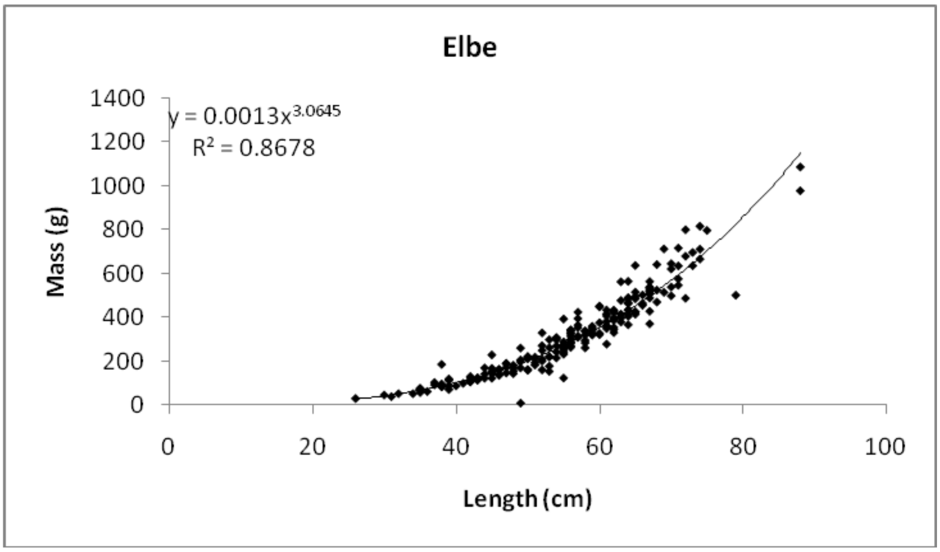

Figure 3b. Length–mass relationship of eel samples from the RBD Eider (n=53).

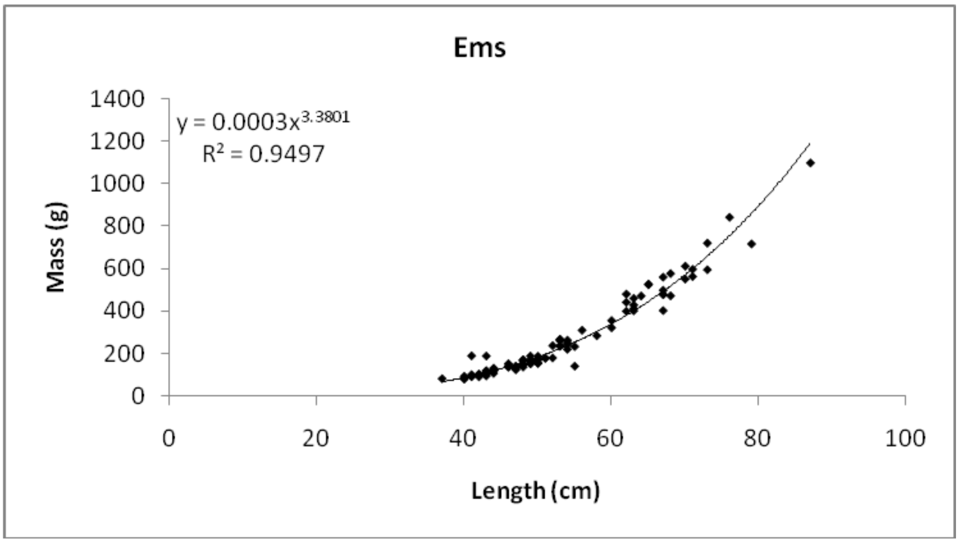

Figure 3c. Length–mass relationship of eel samples from the RBD Ems (n=98).

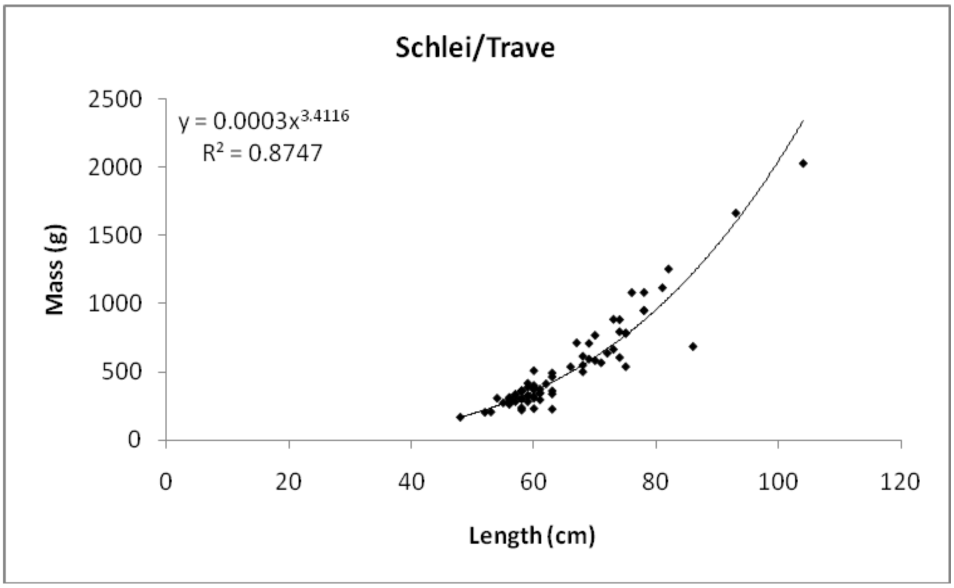

Figure 3d. Length–mass relationship of eel samples from the RBD Schlei/Trave (n=71).

Discussion

Since data collection is still in progress, the presented results do not deliver the basis for a reasonable interpretation at this point.

Anyhow it is striking that the exponent in the length–weight relationship shows considerable variation between different RBD's. This however might very well be a result of the different sample sizes and size ranges covered at the different locations. Especially in the Schlei/Trave system, with the highest exponent, no eels below 45 cm were sampled, while at the same time some of the largest specimens were caught. Thus, the length–weight relationship is more likely to be biased by single specimen that showed exceptional weight growth and at the same time excludes small eels (which grow faster in length) from the growth function, both of which might lead to an increase in the exponent.

Generally, eel sampling in the RBD's suffers from problems, which impose considerable restrictions on the informative value. Especially due to the migratory behaviour of eels and restocking it is difficult to link eels to their sampling location. These problems are further enhanced by the above mentioned sources of error like e.g. different selectivity of sampling gears between locations.

However, if these problems are appropriately accounted for when interpreting the data, long-term sampling of eels in freshwater can significantly contributes to improvements in European eel management.

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Report on the eel stock and fishery in Ireland 2010/'11

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Reporting Period: This report was completed 1 September 2011, and contains data up to the end of 2010 and some provisional data for 2011. Only data available by 30th August 2011 was included in the analysis.

Contributors to the report: Inland Fisheries Ireland; Marine Institute; Electricity Supply Board; Dept. of Zoology, National University of Ireland, Galway; Irish Standing Scientific Committee for Eel.

IR.2 Introduction

This report continues the sequence of reporting annual national eel data to 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.

IR.2.1 The Irish National Programme

The Irish National Programme is conducted in close cooperation between the following organizations, although the details in relation eel and inland fisheries have yet to be established.

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. DEHLG is responsible for CITES.

The Marine Institute (MI)

The MI is a semi-state marine research organization 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

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. 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.

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 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.

IR.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. The following is the Executive Summary from the National Report (Irish EMPs) to the EU.

IR.2.2.1 Introduction

The latest scientific advice from the International Council for the Exploration of the Sea (ICES) concerning European eel is that the stock is outside safe biological limits and that current fisheries are not sustainable. ICES have recommended that a recovery plan be developed for the whole stock of European eel as a matter of urgency and that exploitation and other human activities affecting the stock be reduced to as close to zero as possible. 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.

IR.2.2.2 Organization 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).

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.

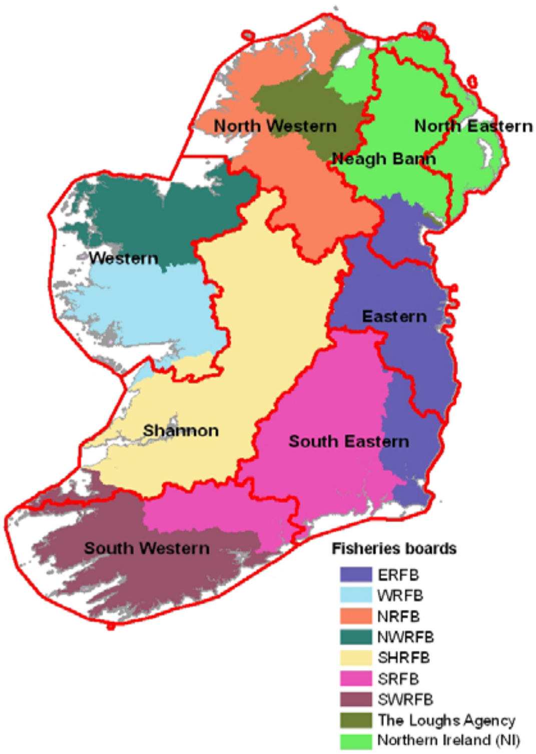

Figure 2-1. Map showing the Waterframework River Basin Districts and Regional Fishery Board areas.

IR.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 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. Four Northern Ireland catchments have now been included in this quantification in support of the NWIRBD transboundary management plan. It is likely that eels 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 881ha. 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 characterized 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 characterization 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.

Preliminary analysis of information available on the presence of *Anguillicola* in different catchments would indicate that approximately 50% of the wetted area is now potentially infected by the parasite and that it continues to spread.

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. It is intended that immediate measures will be put in place to mitigate against turbine mortality, including 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.

IR.2.2.4 The eel fishery

Glass eel and elver fishing in Ireland is prohibited by law (1959 Fisheries Act). The commercial eel fishery involves harvesting both brown and silver eel in freshwater and in estuarine or tidal waters. Brown eel are fished using a variety of techniques, the most common of which are baited longline, fykenets and baited pots. When silver eel are migrating downstream, they 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 underestimate. 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.

Monitoring of elver migrating at Ardnacrusha (Shannon) and Cathleens Falls (Erne) is undertaken by the ESB. Indications are that recruitment is low.

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 brown and silver eel. Analysis of the impact of implementing a brown 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 brown 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 eel fishery was closed in Ireland in 2009 and possession of eel caught in the State was deemed illegal.

IR.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 freshwaters.

No estimates of truly pristine escapement exist for Irish eel 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 freshwaters 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 595 t per annum.

Current silver eel production 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 140 t. Irish escapement expressed as a percent of historic production (EU target = 40%) range from 8% in the ShIRBD to 64% in the SWRBD. The national percent escapement is 24%.

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 time frame for recovering the predicted downward trend in escapement in the absence of knowing what the European recruitment levels will be in future and in the absence of a clear time frame from the EU. To facilitate setting a time-scale 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 time-scale than full historical recruitment.

IR.2.2.6 Stocking

Currently in Ireland there are two types of stocking carried out, both coming under the heading of "assisted migration" upstream. Purchase of glass eel for stocking from outside the state does not currently take place. During the monitoring programme, 2009–2011, an evaluation of recruitment levels will take place. This will facilitate an assessment of possible stocking strategies as a useful tool to aid in the recovery of the stock and any stocking taking place can, and will, be included in the assessment of the local stocks and the modelling of escapement and stock recovery. 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). It is proposed to **continue** this operation. Currently, small amounts of glass eel and elver are taken in the Shannon estuary and in neighbouring catchments and these are stocked into the Shannon above Ardnacrusha and Parteen. Given the widespread presence of *Anguillicola* and the move towards risk averse management strategies at low recruitment levels, this practice will be **discontinued**. It is proposed that in the event of recovering recruitment, a stocking strategy will be developed by stocking "surplus" recruits into good quality (e.g. low contaminants, no *Anguillicola*) catchments where stocks are identified to be low. Stocking will be for conservation and will be undertaken in a risk averse manner.

IR.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 Regulation and submitted a provisional plan for 2009 and 2010 to the EU. Given the cessation of the fishery there will be no obligation to undertake sampling under the DCR.

IR.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.

Eel traceability and catch and sales reporting will not be required under the management option of a ceased fishery and a closed market. Compliance with CITES will only be relevant where a fishery expects to export outside the EU and this will require a scientific non-detriment finding declaration. Given the cessation of the fishery this will not be an issue in the immediate future.

RBD eel management and eel fishermen will be engaged in investigating possible diversification schemes for the former commercial fishermen.

IR.2.2.9 Summary

Irish silver eel escapement from freshwaters expressed as a percent of historic production (EU target = 40%) ranges from 8% in the ShIRBD to 64% in the SWRBD. The national percent escapement is 24%.

Management actions described will contribute to achieving a recovery in recruitment in 90 years (assuming an equivalent EU wide action), thereby aiming to achieve the EU escapement target in less than that time frame. It is imperative that equivalent EU-wide action is taken at this level so as not to diminish the impact of Ireland's contribution.

IR.3 Time-series data

Figure 3.1 gives the locations for the recruitment and silver eel time-series.

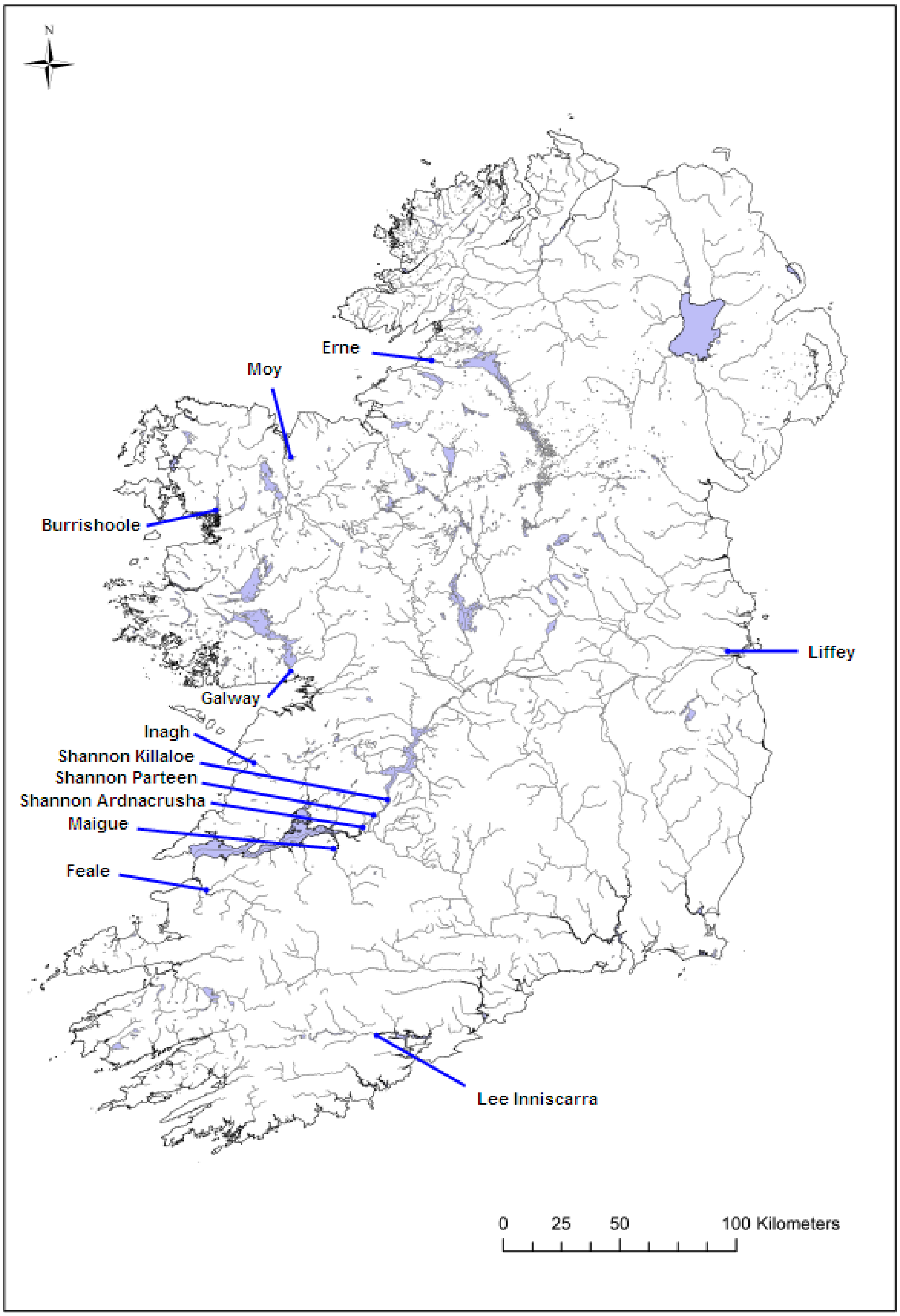

Figure 1-1. Locations of recruitment and silver eel time-series monitoring stations.

IR.3.1 Recruitment-series and associated effort

Recruitment monitoring of 0+ age glass eel (elvers) takes place on the Shannon at Ardnacrusha and the Erne at Cathaleen's Fall 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. New stations have been put in place on the Lee (south coast) and the Liffey (east coast).

IR.3.1.1 Glass eel

IR.3.1.1.1 Commercial

There is no authorized commercial catch of juvenile eel in Ireland as glass eel and elver fishing in Ireland is prohibited by law (1959 Fisheries Act, Section 173).

IR.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, Section 173).

IR.3.1.1.3 Fishery-independent

There is no authorized commercial catch of juvenile eel in Ireland, but some fishing has been authorized 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). Recruitment remained low in 2010.

Full trapping of elvers on the Erne commenced in 1980. Some discrepancies in the time-series came to light in 2009. The Erne elver dataset has now been double checked and the presented data has been agreed by DCAL and AFBINI, the ESB, NRFB and MI. Any discrepancies were not major and the data trend and pattern has not changed.

Monitoring of elver migrating takes place at Ardnacrusha (Shannon), Cathaleen's Fall (Erne), the Feale, Inagh and Maigue Rivers and fishing is also undertaken by IFI in the Shannon Estuary for glass eels (Tables 3.1–3.2). Indications are that recruitment remains low. Catches in 2004 for both Erne and Shannon were the second lowest recorded and while there is no effort data available, the total catch for all stations in 2004 was the lowest yet recorded. Elver catches in 2005 were much 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). Elver numbers reported for 2008 to 2010 were particularly poor and there was little or no improvement in 2011. A small improvement was noted on the Inagh.

All catches reported in Tables 3.1–3.2 are transported upstream and used in restocking.

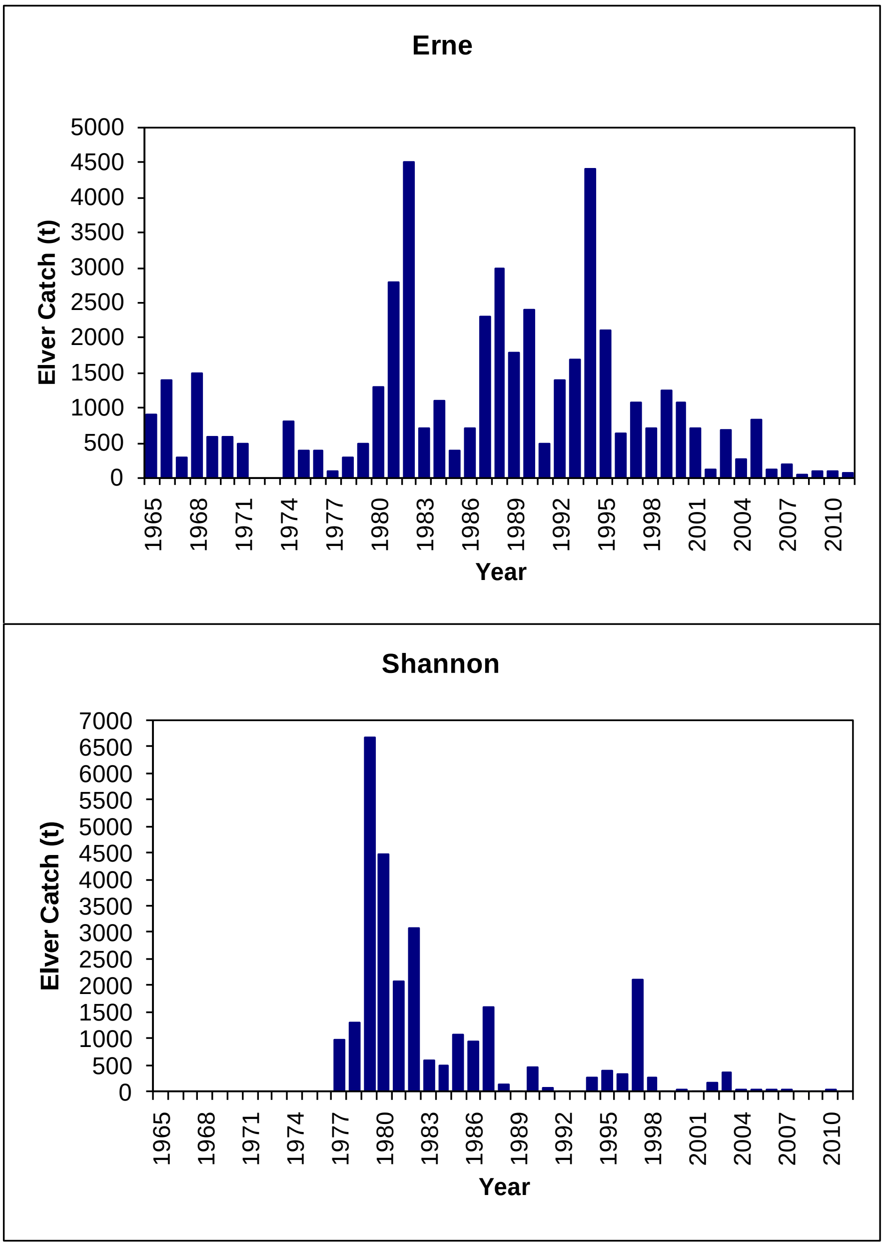

Figure 1-2. Annual elver catches (t) in the traps at Ardnacrusha (Shannon) and Cathaleen's Fall (Erne) – data from ESB. Full trapping of elvers took place on the Erne from 1980 onwards.

Data Quality Issues: these largely relate to a change from weighing the catch in lbs (and subsequently converting to kg); the catch is now weighed in kgs. In addition, periodic upgrades to the trap, particularly in the Shannon in the early 1990s, may have caused differences in trapping efficiency.

Table 3.1. Annual elver catches (kg) in the traps at Ardnacrusha (Shannon) and Cathaleen's Fall (Erne).

Year	Erne (kg)	Shannon (kg)
1959	244	
1960	1229	
1961	625	
1962	2469	
1963	426	
1964	208	
1965	900	
1966	1400	
1967	300	
1968	1500	
1969	600	
1970	600	
1971	500	
1972		
1973		
1974	800	
1975	400	
1976	400	
1977	100	1000
1978	300	1300
1979	500	6700
1980	1300	4500
1981	2800	2100
1982	4500	3100
1983	700	600
1984	1100	500
1985	400	1093
1986	700	948
1987	2300	1610
1988	3000	145
1989	1800	27
1990	2400	467
1991	500	90
1992	1400	32
1993	1700	24
1994	4400	287
1995	2100	398
1996	646.8	332
1997	1087	2120
1998	782	275
1999	1246	18
2000	1074	39
2001	699	3
2002	113.2	178
2003	693	378
2004	290	58.1
2005	836.3	41.4
2006	117.5	42
2007	189	45
2008	33	7
2009	88.3	7.75
2010	93.86	49.73
2011	65.3	6.88

A number of additional trapping stations were fished with fixed traps in the Shannon Region; the Feale, the Maigue and the Inagh. The Maigue and Inagh were not fished in 2009 (Table 3.2).

Table 3.2. Glass eel catches (kg), 1985 to 2010 (blanks = not fished).

Year	Erne	Erne Estuary	Moy Estuary	Shannon Ardnacrusha	R Feale	R Maigue	Inagh R	Sh. Estuary	R. Lee Inniscarra
1985	400			1093	503				
1986	700			948					
1987	2300			1610					
1988	3000			145					
1989	1800			27					
1990	2400			467					
1991	500			90					
1992	1400			32					
1993	1700			24					
1994	4400			287	70	14			
1995	2100			398	0	194			
1996	647			332	0	34	140		
1997	1087			2120	407	467	188	616	
1998	723	46		275	81	8	11	484	
1999	1246	441		18	135	0	0	416	
2000	1074	188		39	174	0	120	43	
2001	699		13	27	58	2	18	1	
2002	113		21	178	116	5		37	
2003	580		36	378	36	72	111	147	
2004	269		0	58	0	0	24	1	
2005	836		13.5	41.36	0	1	0	41	
2006	118		0	41.53	1	0	4	3.1	
2007	189		0	45	0	0	39	11.5	
2008	38.7		0	6.846	0	0	82.5	2.313	
2009	88.3		0.5	7.75	42				
2010	93.86		6.5	49.73	20.1	2.8	1.3	2.742	<1kg
2011	65.3		0	6.88	4.8	5.3*	8.1*		24

*** Improvements were made to these traps**

Data Quality Issues: these largely relate to a change from weighing the catch in lbs (converting to kg); now the catch is weighed in kgs and periodic upgrades to various traps.

IR.3.1.2 Yellow eel recruitment

IR.3.1.2.1 Commercial

There is no authorized commercial catch of juvenile eel in Ireland as glass eel and elver fishing in Ireland is prohibited by law (1959 Fisheries Act, Section 173).

IR.3.1.2.2 Recreational

There is no authorized recreational catch of juvenile eel in Ireland as glass eel and elver fishing in Ireland is prohibited by law (1959 Fisheries Act, Section 173).

IR.3.1.2.3 Fishery-independent

Monitoring of juvenile yellow eel migrating at Parteen Regulating Weir (Shannon) takes place using a fixed brush trap. The data are presented in Table 3.3. 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 partly accounted for the poor catches recorded in those two years at Parteen.

Table 3.3. Juvenile yellow eel catches (kg), 1985 to 2011.

	Shannon
Year	Parteen
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
2011	91.7

IR.3.2 Yellow eel landings

There are no true index series for yellow eel landings. Most of the data are aggregated by RBD.

IR.3.2.1 Commercial

There is no new data for 2009 or 2010 as the commercial fisheries were closed.

IR.3.2.2 Recreational

There is no data available for yellow eel caught by recreational fishermen; mostly rod anglers.

IR.3.3 Silver eel landings

Historical commercial catch records for silver eel fisheries were available for the five catchments of the Corrib, Moy, Garavogue, Erne and Shannon but only Corrib and Shannon have research fisheries continuing after 2008. Care should be taken in using the historical Shannon data as silver eel production and catch may have already been compromised by the hydropower barrier and fisheries policy in the catchment.

The dataseries for the Shannon (Killaloe) and the Corrib were continued in 2009 as research fisheries with catch and release, while all other commercial fisheries were ceased. Fishing continued on the Shannon (Killaloe) in 2010 but the Galway Fishery (Corrib) was closed in 2010.

IR.3.3.1 Commercial silver

Commercial Fisheries were closed in 2009 and 2010.

IR.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 3.3; Table 3.4). 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 brown eel catches vs. those in upper catchment lakes.

The silver eel catch in 2004/05 in Killaloe was 5.02 t and upstream of Killaloe it was 32.09 t, giving a total silver eel catch for the river of 37.12 t. This was more than double the catch recorded in 2003/2004.

The silver eel catch in 2005/2006 in Killaloe was 1.53 t and upstream of Killaloe it was 19.27 t, giving a total silver eel catch for the river of 20.80 t.

The silver eel catch in 2006/2007 in Killaloe was 7.87 t and upstream of Killaloe it was 26.61 t, giving a total silver eel catch for the river of 34.48 t. This was almost as high as the catch recorded in 2004/2005 and may have been helped by relatively high water levels throughout the early winter period.

The silver eel catch in 2007/2008 in Killaloe was 4.1 t, upstream of Killaloe it was 14.0 t, giving a total silver eel catch for the river of 18.1 t. 3.7 t were released downstream of the turbine.

The silver eel catch in 2008/2009 in Killaloe was 10.5 t, upstream of Killaloe it was 16.7 t, giving a total silver eel catch for the river of 27.2 t. 10.5 t were released downstream of the turbine.

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. 23.73 t were released downstream of the turbine. 1.17 t was lost in a flood back into the river and the remainder was 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. 27.768 t were released downstream of the turbine. The remainder was taken as samples and 490 kg were returned to the river for tracking studies.

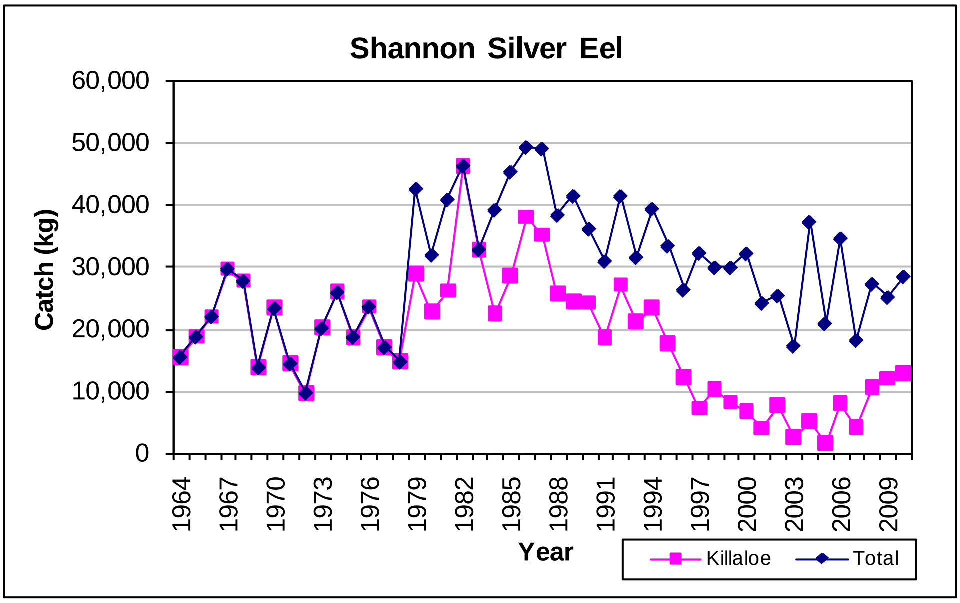

Figure 3-3. Silver eel catches from the Killaloe eel weir and the total Shannon system, for 1964 to 2010. Note that the totals for the Shannon in 2009 and 2010 are for a conservation fishery with reduced effort: Killaloe effort remains comparable.

IR.3.3.1.2 Corrib

The Galway Fishery comprises a weir with 14 coghill nets. These are fished throughout the dark moon phases and may 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 3.4; Table 3.4) 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. Table 3.4 gives the data for the Galway Fishery and Shannon silver eel trends. The data in 1976 and 1977 for the Galway Fishery are estimates.

The Galway Fishery was not fished in 2010 due to structural health and safety issues.

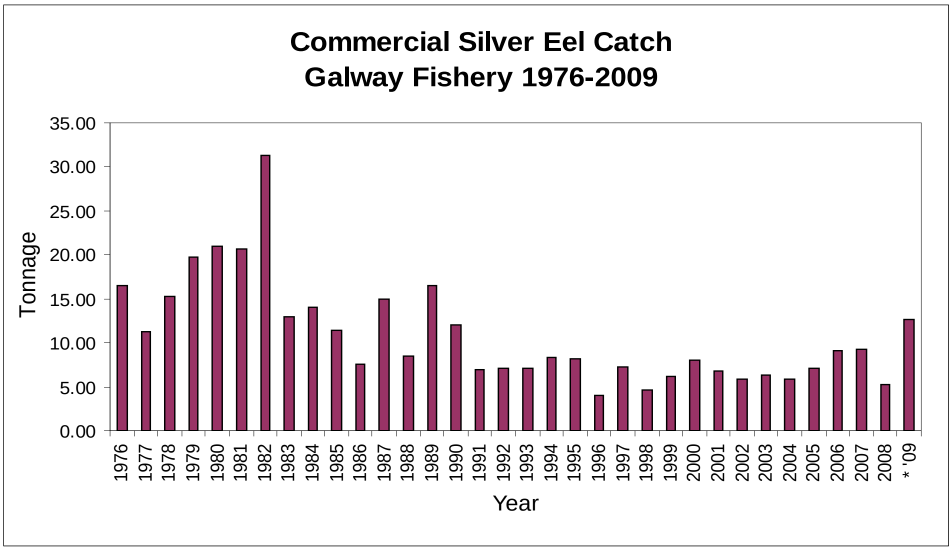

Figure 3-4. Annual silver eel catch (t) in the commercial Galway Fishery, Corrib System, for 1976 to 2009. *Note the fishery was operated as a research catch & release fishery in 2009 and was closed in 2010.

Table 3.4. Annual silver eel catch (t) in the commercial Galway Fishery, Corrib System and for the Killaloe Fishery and total Shannon catch. Note: 2009 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	16.50	23.5	23.5
1977/78	1977	11.30	17.0	17.0
1978/79	1978	15.30	14.6	14.6
1979/80	1979	19.70	28.8	42.4
1980/81	1980	20.90	22.7	31.8
1981/82	1981	20.60	26.0	40.7
1982/83	1982	31.30	46.1	46.1
1983/84	1983	13.00	32.7	32.7
1884/85	1984	14.00	22.5	39.0
1985/86	1985	11.40	28.4	45.1
1986/87	1986	7.50	37.9	49.1
1987/88	1987	15.00	35.0	48.9
1988/89	1988	8.50	25.6	38.2
1989/90	1989	16.54	24.2	41.3
1990/91	1990	12.05	24.1	36.0
1991/92	1991	7.00	18.5	30.8
1992/93	1992	7.15	27.0	41.2
1993/94	1993	7.14	21.0	31.4
1994/95	1994	8.32	23.2	39.2
1995/96	1995	8.16	17.5	33.3
1996/97	1996	4.07	12.1	26.2
1997/98	1997	7.29	7.2	32.1
1998/99	1998	4.62	10.3	29.8
1999/00	1999	6.10	8.1	29.8
2000/01	2000	7.95	6.7	32.0
2001/02	2001	6.84	4.0	24.1
2002/03	2002	5.81	7.6	25.2
2003/04	2003	6.27	2.5	17.2
2004/05	2004	5.83	5.0	37.1
2005/06	2005	7.15	1.5	20.8
2006/07	2006	9.16	7.9	34.5
2007/08	2007	9.32	4.1	18.1
2008/09	2008	5.24	10.5	27.2
2009/10	2009	12.65	12.0	25.0
2010/11	2010	nf	12.7	28.3

IR.3.3.2 Recreational silver

There is no recreational silver eel fishing in Ireland. All silver eel fishing is authorized and recorded under the commercial effort.

IR.3.3.3 Fishery-independent silver

The Burrishoole System in the West of Ireland is a relatively oligotrophic river and lake system with a catchment area of 8379 ha. The eel population is unexploited and the total freshwater silver eel production is trapped in downstream Wolf type traps. The silver eel catch is not included in the National commercial catch as the entire catch is released downstream. The Burrishoole silver eel migration is equivalent to approximately 1% of the National silver catch, by weight, but is indicative of eel production from a considerable number of low productivity Irish river systems where eel densities are relatively low and growth rates are slow, often <2 $cm.yr^{-1}$. The Burrishoole silver eel data, summarized in Table 3.5, has indicated a average pre 1980 production rate of silvers of 0.9 $kg.ha^{-1}$ (post-1980–1.3 $kg.ha^{-1}$) with possible density-dependent changes to female number (sex ratio) and size.

Total catches of silver eel in the trap between the years 1971 (when records began) and 1982 averaged 4400 individuals, fell to 2200 between 1983 and 1989 and increased again to above 3000 in the 1990s (Figure 3.5). The catch in 2001 of 3875 eel was the second highest recorded since 1982. The catch in 2005 was 2590 and in 2006 it was 2180 individual eels. Unusually high water levels in 2006 made trapping particularly difficult and some losses may have occurred.

Table 3.5. Summary statistics for the Burrishoole silver eel census showing pre 1980 and post 1996 silver eel numbers, biomass and production figures. Also included are the average number of females and average biomass of females for the same periods.

Silver Eel	1971–1980	1996–2008	2009–10
Average count	4409	2808	2506
Biomass (kg)	436	609	506
Production (kg/ha)	0.9	1.3	1.1
Number of females	1626	1932	1613
Biomass of Females	318	518	416
Av Lt Fem	46.1	53.2	51.0
Av lt Males	37.1	36.1	35.7

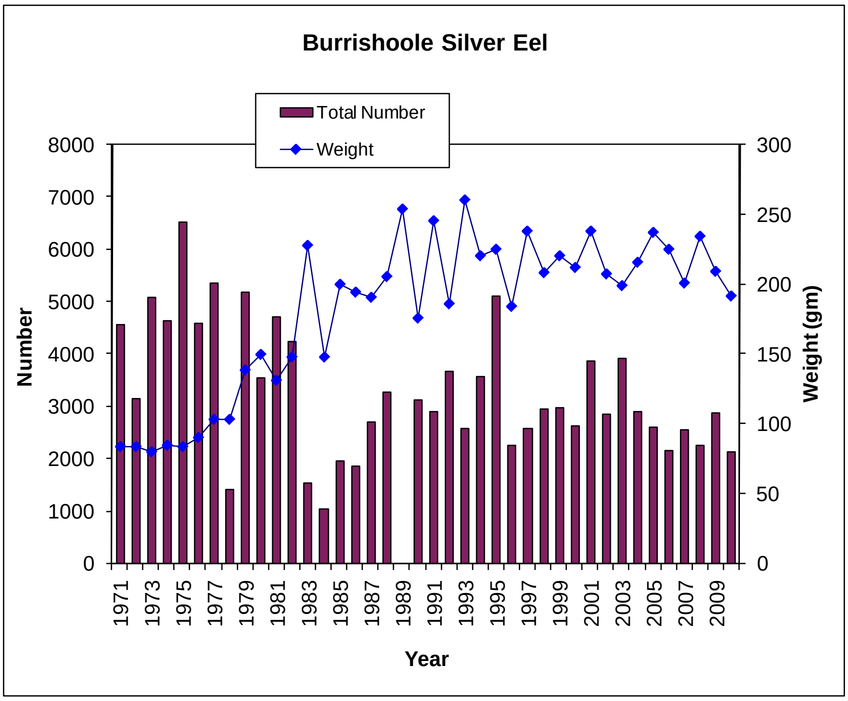

Figure 3-5. Annual silver eel catch, and mean weight (gm) in the Burrishoole System for 1971 to 2010.

IR.3.4 Aquaculture production

Not applicable; no culture in Ireland.

IR.3.4.1 Seed supply

Not relevant.

IR.3.4.2 Production

Not applicable; no culture in Ireland.

IR.3.5 Stocking

IR.3.5.1 Amount stocked

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 are moved upstream.

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

There is no catch of eel <12 cm and therefore no proportion retained.

IR.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 brown eel under 30 cm 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 longline licences 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 authorizations 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 southeast, fykenets were used during the weaker tides and baited pots were used when the tides were too strong for fykenets.

2009–2012 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 bye-law (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 revoke the previous bye-laws enacted in 2008.

IR.4.1 Glass eel

There is no authorized commercial fishing of juvenile eel in Ireland as glass eel and elver fishing in Ireland is prohibited by law (1959 Fisheries Act, Section 173).

IR.4.2 Yellow eel

Yellow eel were fished for using either standard or deeper ("other") fykenets, usually 20 per licence, longlines, usually limited to 1000 hooks per licence or baited pots (17 per licence) (Table 4.1 in 2009 CR). No data are available for the effort of each licence in terms of nights fished or comparisons between gear types or amounts.

Since 2001 there was an increase in the number of licences issued and in the number being actively fished for yellow eel.

No licences were issued in 2009 or 2010.

IR.4.3 Silver eel

Silver eel were fished using fykenets, fixed v-wing nets and coghill nets (Table 4.2 in 2009 CR), although standard fyke licences were only listed in the table for yellow eel (Table 4.1 in 2009 CR). Effort was often targeted at short-time windows in autumn and winter during optimum conditions, such as dark moon and high water. No data are available for the effort of each licence in terms of nights fished or comparisons between gear types or amounts. (Note: coghill nets above Killaloe in the Shannon have been grouped under "v-wing fykes").

Since 2001 there was an increase there has been an increase in the number of licences issued and in the number being actively fished for silver eel with a steadying in 2007.

No licences were issued in 2009 or 2010.

IR.4.4 Marine fishery

There is no authorized marine fishery in Ireland. Fishing took place in transitional estuaries and lagoons and this effort was licensed with the inland fisheries. The areas targeted for transitional fisheries were almost exclusively in the SERBD and SWRBD where there were almost no freshwater fisheries.

No licences were issued in 2009 or 2010.

IR.5 Fishing effort

In May 2008, the Minister for Communications, Energy and Natural Resources introduced a bye-law (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 have been made to improve on the data collection by circulating an agreed catch reporting form which may lead to data discontinuity.

A preliminary analysis of the number of licences issued the number of end of year catch reports submitted and from that, the number of licences that fished and submitted a catch record was undertaken. The number of "actively fished" licences, grouped by gear type and by RBD, was examined as a proxy for "effort". This has been presented for the national catch in Chapter 7 but the data were not suitable for analysis at a smaller scale.

In May 2009, the Minister for Communications, Energy and Natural Resources introduced bylaws 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 (Chapter 4).

IR.5.1 Glass eel

There is no authorized commercial effort for juvenile eel in Ireland as glass eel and elver fishing in Ireland is prohibited by law (1959 Fisheries Act, Section 173).

No licences were issued in 2009 or 2010.

IR.5.2 Yellow eel

Refer to Section 4.2 for the number of active licences.

No licences were issued in 2009 or 2010.

IR.5.3 Silver eel

Refer to Section 4.3 for the number of active licences.

No licences were issued in 2009 or 2010.

IR.5.4 Marine fishery

There was no authorized marine fishery in Ireland. Fishing took place in transitional estuaries and lagoons and this effort was licensed with the inland fisheries.

No licences were issued in 2009 or 2010.

IR.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 underreporting is probably widespread. Reported catches were available on an annual basis at the Fisheries Regional Level (Figure 6.1), with most RFBs reporting on a District basis. The introduction of the new catch reporting form led to considerable improvement in the system since 2005.

For the Eel Management Plans, catches (RoI) of yellow and silver eel have been collated from the District returns and are presented in Table 6.1, 6.2 and 6.4 for 2001 to 2008 for each Eel Management Unit (RBD) (see Figure 2.1 for locations). Also included are the catches for the N. Ireland part of the NWIRBD on the Erne supplied by DCAL and AFBINI.

Mortalities in the catch were not consistently reported and the data have only been requested since 2005. Therefore, the landings reported here are for the declared catch sold. Mortalities in 2006, 2007 and 2008 were 0.3%, 1.3% and 0.6% respectively.

Also presented, in Tables 6.3 and 6.5, are the catch data sorted by Fisheries Region as originally presented in the Country Reports and also updated with the confirmed data as included in the Irish Eel Management Plans. The differences were relatively minor in most cases.

It would appear from the declared catch data that the conservation bye-laws 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 season 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 in 2009 was thought to be relatively low (SEG, 2010).

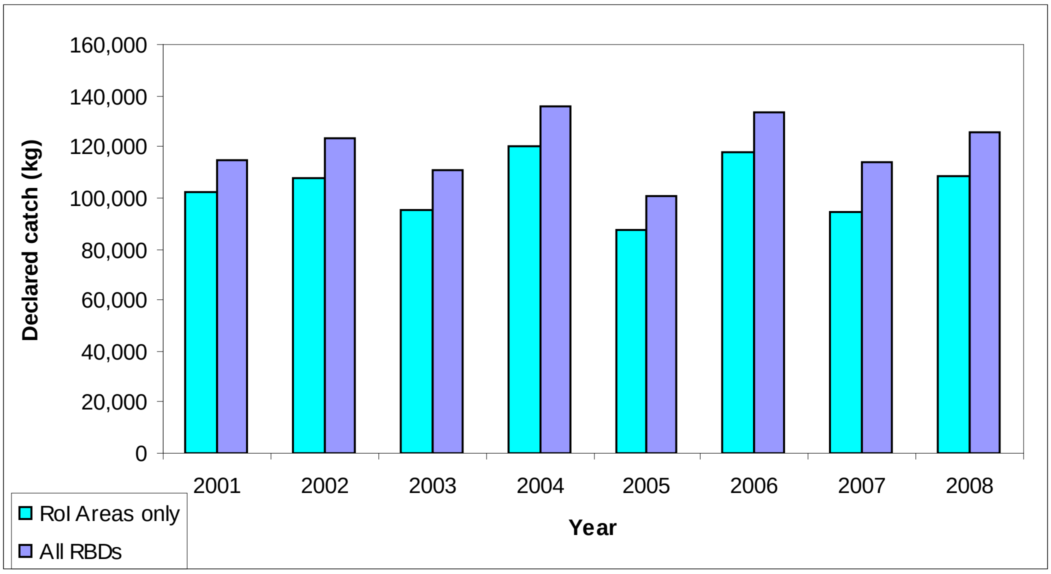

Figure 6-1. Total declared catch (kg) of yellow and silver eel combined for both the RoI and the total for RoI and NI part of the NWIRBD (data supplied by DCAL & AFBINI) for the years 2001 to 2008.

Table 6.1. Total declared catch for the RoI and the total including the NI part of the NWIRBD (data supplied by DCAL & AFBINI).

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Total RoI	102,175	107,892	94,876	120,288	87,167	117,729	94,086	108,249	0	0
Total*	114,475	123,192	111,036	135,988	100,767	133,429	113,686	125,481	0**	0

*** Total NWIRBD ** No data for NI part of NWIRBD**

IR.6.1 Glass eel

There is no authorized commercial catch of juvenile eel in Ireland as glass eel and elver fishing in Ireland is prohibited by law (1959 Fisheries Act, Section 173).

IR.6.2 Yellow eel

The declared catch data for yellow eel is presented in Figure 6.2 for both the RoI and for the total for RoI and NI part of the NWIRBD (data supplied by DCAL & AFBINI) and in Table 6.2.

It would appear from the declared catch data that the conservation bye-laws implemented in 2008 had little impact on the catch of yellow eel. 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.

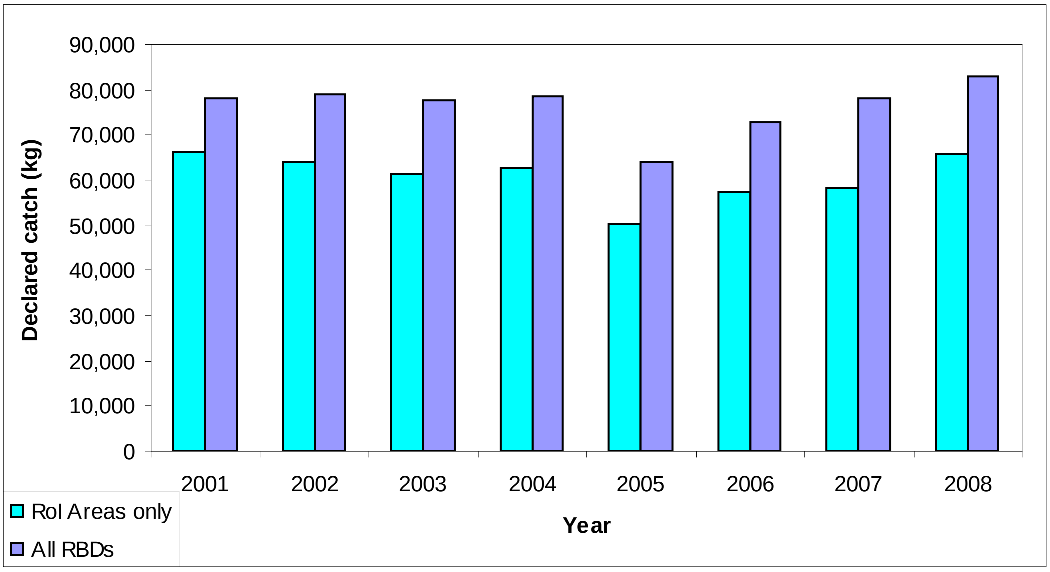

Figure 6-2. Declared catch (kg) of yellow eel for both the RoI and the total for RoI and NI part of the NWIRBD (data supplied by DCAL & AFBINI) for the years 2001 to 2008.

Table 6.2. Total declared catch for yellow eel for the river basin districts, the RoI portion of the NWIRBD and the NI part of the NWIRBD (data supplied by DCAL & AFBINI). NR = no reported data.

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
EEMU	5500	7806	6060	5420	841	953	1487	4448	0	0
SERBD	17 055	13 027	9786	7753	5569	3327	4413	3591	0	0
SWRBD	552	960	70	35	22	250	NR	0	0	0
SHIRBD	15 983	18 116	22 196	21 535	18 736	17 591	24 635	32 306	0	0
WRBD	22 126	15 043	23 415	21 142	17 851	18 276	17 922	12 410	0	0
NWIRBD*	4743	8911	NR	6793	7311	16 865	9929	13 121	0	0
NWIRBD**	12 300	15 300	16 160	15 700	13 600	15 700	19 600	17 232	NR	0
NWIRBD***	17 043	24 211	16 160	22 493	20 911	32 564	29 529	30 353	NR	0
Total RoI	65 959	63 863	61 527	62 678	50 330	57 262	58 386	65 876	0	0
Total	78 259	79 163	77 687	78 378	63 930	72 962	77 986	83 108	NR	0

***RoI only**

****NI only**

*****Total NWIRBD**

IR.6.3 Silver eel

The declared silver catch is presented in Figure 6.3 and Table 6.4.

From 2001 to 2008 the ESB undertook a pilot programme of transporting a proportion of the silver eels captured in the Shannon silver eel fishery around the dams and releasing them for onward migration to the sea. These released eel are included in the data presented in Table 6.4 and this has ranged from 5% to 39% of the total silver eel catch on the Shannon.

In 2009, a comprehensive national trap and transport programme was initiated on the Shannon, Erne and Lee (Section 8.3).

Reporting of silver eel catch in the NWIRBD ceased after 1997, although it is understood that some fishing may have continued through the following years.

It would appear from the declared catch data that the conservation bye-laws implemented in 2008 had little impact on the catch of silver eel although this is difficult to assess given the variation in the seasonality and amounts of silver eel migrations. In the Burrishoole in 2008, 31% of the silvers were counted before the 1st October and 50% before the 2nd October, so it is likely that the bye-laws did reduce the silver eel catch.

IR.6.4 Marine fishery

There was no authorized marine fishery in Ireland. Fishing took place in transitional estuaries and lagoons and this effort was licensed with the inland fisheries. The areas targeted for transitional fisheries are almost exclusively in the SERBD and SWRBD. The season for these fisheries was reduced by the 2008 bye-law and was closed in 2009.

No requirement to implement the EU 50% reduction as fishery closed.

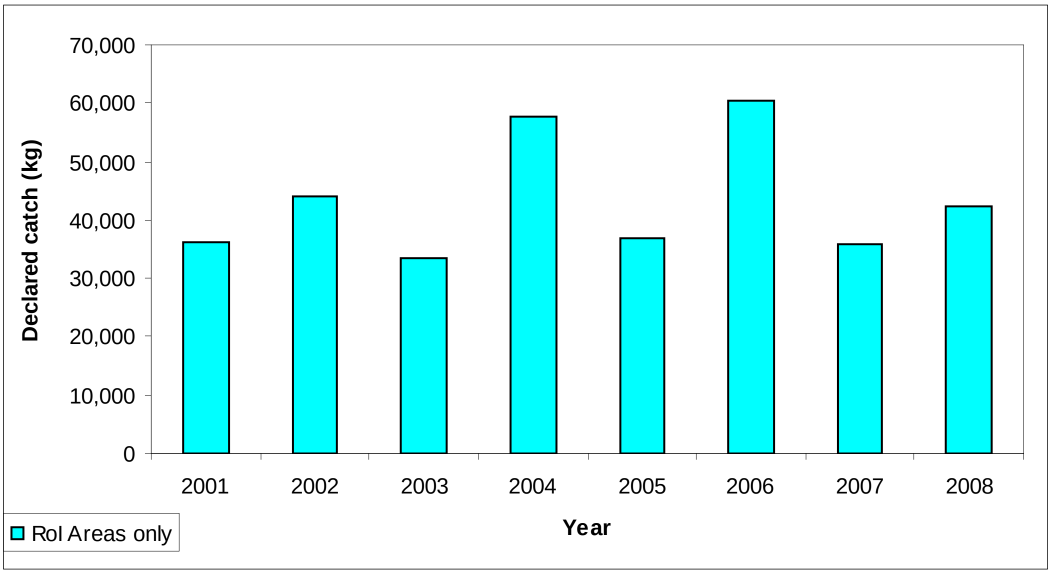

Figure 6-3. Declared catch (kg) of silver eel for the RoI only for 2001–2008.

Table 6.4. Total declared catch for silver eel for the river basin districts, the RoI portion of the NWIRBD and the NI part of the NWIRBD (data supplied by AFBINI). NR = no reported data.

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
EEMU	2500	2360	2460	1810	396	364	90	40	0	0
SERBD	0	2004	1218	800	260	840	0	318	0	0
SWRBD	0	0	0	35	22	250	0	1060	0	0
SHIRBD	24 107	25 248	17 075	37 116	21 535	34 478	18 122	27 158	0	0
[1]Catch rel.	1300 (5)	3900 (15)	1600 (9)	2900 (8)	1500 (7)	7700 (22)	3 665 (20)	10 460 (39)	@	@
WRBD	9581	14 386	12 596	17 849	14 624	23 971	16 541	13 797	0	0
NWIRBD*	28	31	NR	NR	NR	564	947	0	0	0
NWIRBD**	NR	NR	NR	NR	NR	NR	NR	0	0	0
NWIRBD***	28	31	NR	NR	NR	564	947	0	0	0
Total RoI	36 216	44 029	33 349	57 610	36 837	60 467	35 700	42 373	0	0
Total	36 216	44 029	33 349	57 610	36 837	60 467	35 700	42 373	0	0

***RoI only**

**** NI only**

***** Total NWIRBD**

@ See Section 8.3

IR.7 Catch per unit of effort

IR.7.1 Glass eel

There is no authorized commercial catch of juvenile eel in Ireland as glass eel and elver fishing in Ireland is prohibited by law (1959 Fisheries Act, Section 173).

IR.7.2 Yellow eel

No new data; refer to 2009 Country Report.

IR.7.3 Silver eel

No new data; refer to 2009 Country Report.

IR.7.4 Marine fishery

No new data; refer to 2009 Country Report.

IR.8 Other anthropogenic impacts

IR.8.1 Hydropower in Ireland

Six catchments in Ireland have major hydropower installations in the lower catchments (Figure 8.1). The Shannon also has flow regulation throughout the catchment. These are as follows:

The Shannon (ShRBD)

The Erne (NWIRBD)

The Liffey (EEMP)

The Lee (SWRBD)

The Clady/Crolly (NWIRBD)

The Ballysadare (WRBD)

Table 8.1 gives the wetted areas in each catchment with major hydropower. Almost 50% of the available wetted habitat is above major barriers (Figure 8.2), although there will be a greater proportion of the potential silver eel production when the differences in relative productivity are taken into account. This is included in the Regional EMPs and in the estimates of pristine and current escapement.

Table 8.1. Wetted areas (ha) for lakes and fluvial area above major hydropower installations.

	Lake area (ha)	Fluvial area (ha)		Total wetted area	Pristine escapement
		>1st order	1st order	ha	kg/ha
Total wetted area	132 275	18 780	2826	153 881	594 408
Total impacted	66 844	5203	959	73 006	265 427
Shannon	38 771	3304	391	42 466	200 839
Erne	24 848	1098	251	26 197	116 633
Ballisadare	1556	29	227	1812	8239
Liffey	-	424	39	464	2012
Clady/Crolly	391	20	5	416	505
Lee	1278	327	46	1651	753

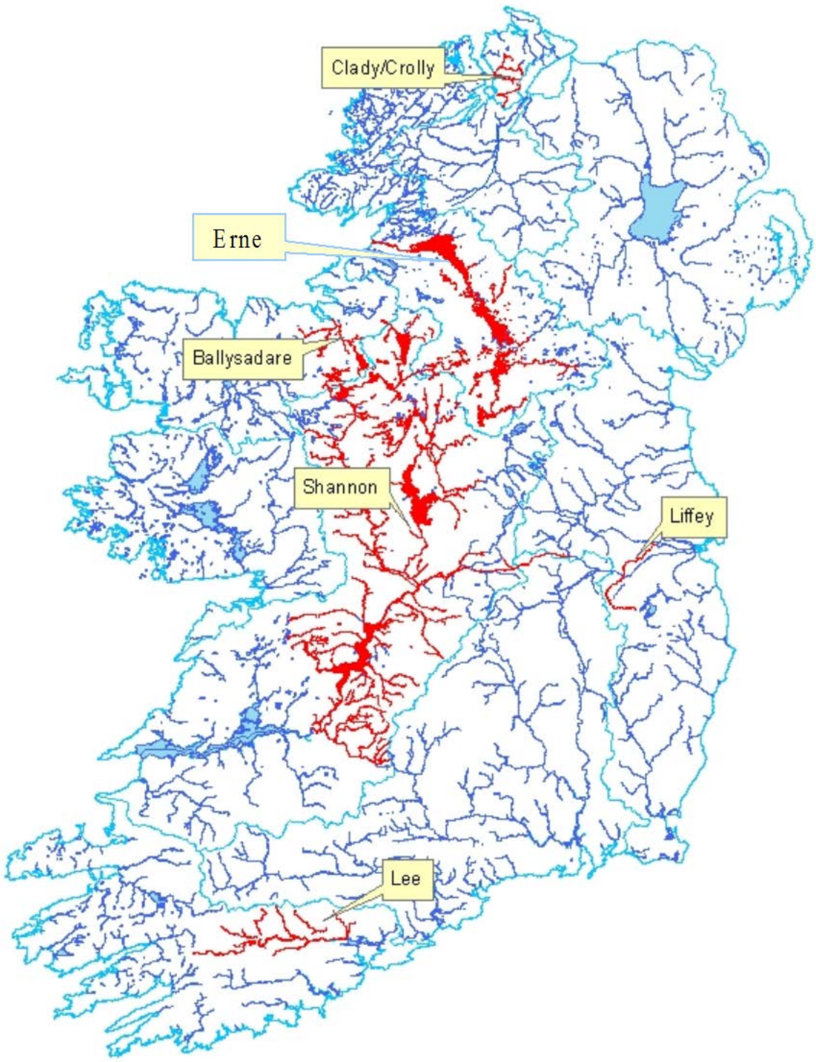

Figure 8-1. Map showing location of catchments where major hydropower installations occur. Waterbodies upstream of hydropower stations are shown in red.

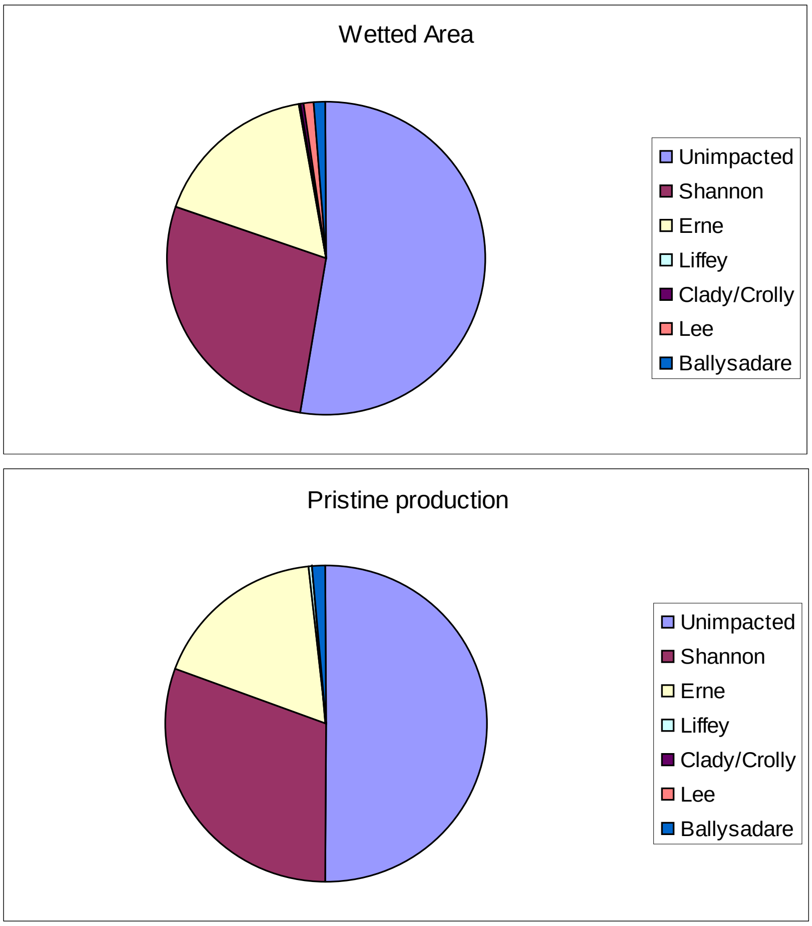

Figure 8-2. Proportions of wetted area and estimated pristine production for the catchments above major hydropower installations.

IR.8.2 Hydropower impact

IR.8.2.1 From Eel Management Plan

Hydropower impacts on approximately 46% of the wetted area accounted for in the six EMPs (Section 8.1). At the time of writing the Eel Management Plans no direct measurement of hydropower mortality or morbidity was available for Ireland. However, there have been a number of studies carried out elsewhere that suggested an average mortality rate of 28.5% across all length classes per hydropower installation (ICES 2003). Therefore, the probability of surviving passage through 'n' number of hydropower installations is $(0.715)^n$. Where bypass estimates exist (i.e. 30% on the Shannon) these were incorporated in the model.

IR.8.3 Trap and transport

The target set for the trap and transport system in the Irish Eel Management Plan was as follows:

Shannon: Trap and transport 30% of the annual run.

	CATCH TARGET (T)	% OF EXPECTED SILVER EEL RUN	PROPORTION OF EU H ACHIEVED – FISHERY CLOSED	APPROX. TIME FRAME TO RECOVERY (Y)
2009	not defined	30	0.045	95
2010	not defined	30	0.045	95
2011	not defined	30	0.045	95

Erne: Trap and transport the following*.

	CATCH TARGET (T)	% OF EXPECTED SILVER EEL RUN	PROPORTION OF EU H ACHIEVED – FISHERY CLOSED	APPROX. TIME FRAME TO RECOVERY (Y)
2009	22	36	0.092	200
2010	34	54	0.075	140
2011	39	63	0.05	100

***Erne Fishery not closed in N. Ireland in 2009.**

Lee: Trap and transport 500kg of the annual escapement.

	CATCH TARGET (T)	% OF EXPECTED SILVER EEL RUN	PROPORTION OF EU H ACHIEVED – FISHERY CLOSED	APPROX. TIME FRAME TO RECOVERY (Y)
2009	0.5	34	0.007	80
2010	0.5	34	0.007	80
2011	0.5	34	0.007	80

The amounts captured and transported in 2010 by the Electricity Supply Board (ESB) for the Rivers Shannon, Erne and Lee are shown below. There was a total catch of 47 379 kg between these three catchments. The level of fishing mortalities was reported to be very low (<0.1%). Catches were transported downstream as soon as possible using a series of custom made fibreglass fish transport tanks with a bottled gas aeration system. The release sites were located downstream of each of the rivers systems lowermost hydroelectric power stations. The release sites were located at Ballyshannon town (for the Erne catches), below Parteen Regulating Weir (for the R. Shannon) and below Iniscarra station for the R. Lee. Transport mortality levels were also very low (<0.1%). Releases were also observed by IFI staff.

IR.8.3.1 Shannon

Five locations were fished on the Shannon in 2010. A total of 27 768 kg were trapped and transported on the Shannon, including 12 144 kg at Killaloe. This exceeds the target set of 30% of the estimated run.

NUIG estimate the production from the Shannon to be 70 271 kg (30% = 22.3 t) or the escapement to be 60 244 kg (30% = 20 900 kg). Therefore the T&T amount is likely to be 39.5% of the total silver eel production. The estimated production in the EMP was 85 659 kg in 2008.

IR.8.3.2 Erne

Six locations were fished on the Erne in 2010. A total catch of 19 334 kg of silver eel were trapped and transported to the estuary. The target (33 750 kg) was, therefore, not met in 2010.

IR.8.3.3 Lee

The R. Lee was fished by one crew at a number of locations above the stations and a total of 278 kg was captured and transported downstream. The target (500 kg) was not met in 2010. In 2009, unusually high flood conditions interrupted fishing efforts but in contrast, unseasonably low water conditions hindered fishing in 2010 where there was almost no flow through the system making it difficult to fish silver eel nets efficiently.

IR.9 Scientific surveys of the stock:

IR.9.1 Introduction

A close link between the management actions and eel-stock targets will be established by implementing a comprehensive monitoring and stock assessment programme. This will allow for a direct feedback to management based on the response of the stock to implemented management actions and changes in recruitment.

IR.9.2 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 Corrib, Erne, Shannon and Burrishoole catchments, all of which have a long-term history of eel catch and data collection. Trials are also being carried out at other locations identified in the EMP using coghill nets, mark–recapture and technology options such as electronic counters or DIDSON technology.

IR.9.2.1 Corrib

The Galway Fishery comprises a weir with 14 coghill nets. These are fished throughout the dark moon phases and may be lifted during periods of very high water. The fishery was purchased by the state in 1978 and has been fished continually since then. The weir was operated as a scientific silver eel fishery in 2009 but was not fished in 2010 due to structural issues with the weir.

IR.9.2.2 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 and 2010, commercial silver eel fishing was 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 2010 was 12 144 kg. Fishing was also undertaken by four ESB contracted crews upstream of Killaloe and their catches (15 624 kg) were also transported downstream.

NUIG/ESB give a preliminary estimated production in 2010, using mark–recapture cumulated floy tag recoveries, for the Shannon of 70.271 t and an escapement of 60.244 t (with 22.5% turbine mortality). This conservative estimate assumes no escapement via the 'old' river channel, due to extremely low spillage levels, pending detailed analysis of hydrometric records. Likewise, as a result of a technical fault at Killaloe weir, the capture efficiency is most likely underestimated by the precautionary mark-recapture model. The 2010 estimate compares to a steady-state current production estimate of 86 000 kg in the EMP.

IR.9.2.3 Burrishoole

Silver eel trapping was continued in Burrishoole in 2010. The main run occurred in September, October and November with only four eels were recorded in December probably due to very low water temperatures. The total run amounted to 2137 individual eels or 410 kg. The average weight of the eels in the catches has been steadily increasing from 0.095 kg in the early 1970s to 0.215 kg in both the 1990s and the 2000s.

The observed changes from a male dominated eel run (average 66% male 1971–1975) to a much larger proportion of female eels in recent years (average 29% male 2003–2008) along with an increase in mean size, particularly for female eels has meant that the biomass of silver eels being produced has been roughly maintained over the trapping time period (1971–2010). This may be a density-dependent response to falling recruitment and increased catchment productivity.

IR.9.2.4 Erne

In addition to an experimental fishery established by NUIG at Roscor Bridge, five sites fished by ESB contract crews on the Erne system during 2010/2011. All sites contributed catches to the ESB silver eel trap and transport system. The NUIG experimental fishery was intensively monitored, as part of a comprehensive study of lower River Erne silver eel migration and escapement. A series of Mark–Recapture experiments were undertaken using both Floy and PIT tags and populations were also investigated by means of DIDSON acoustic camera surveys.

NUIG investigated the production of silver eels in the Erne system, and stated this as 41.232 t and that escapement was of the order of 37.942 t. A higher preliminary value (84 t) which was determined on a provisional basis using DIDSON counts in 2009, was shown to be unreliable and that the productivity of the system may have been significantly overestimated. In 2010 a fully monitored Experimental Fishing site at Roscor Bridge was used, for validation of Roscor Point DIDSON survey results and this enabled the complexity and variable capture efficiency of the Ferny Gap site to be confirmed. The current River Erne system silver eel production estimate determined by NUIG, of approximately 1.6 kg/ha, may appear to be low and also differs from that used in the EMP model. Additional investigations will continue at this catchment in 2011/2012.

IR.9.3 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. Yellow eel monitoring also provides a means of evaluating post-management changes and forecasting the effects of these changes on silver eel escapement. These data are held by IFI and are available to the WG on request. 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. A long-term tagging programme was initiated in three lakes in 2009. All yellow eels captured in the fykenets in Lower Lough Corrib, Lower Lough Derg and Lough Feeagh were tagged using PIT tags. The detection of these tagged eels in the silver eel run over subsequent years will provide information regarding the maturation rate of the yellow eel population.

IR.9.3.1 2010 Fykenet survey

IR.9.3.1.1 Lakes

In 2010 intensive sampling of yellow eels took place at seven locations (L. Feeagh, Bunaveela L., Upper L. Corrib, Upper L. Derg, Upper L. Erne and Upper and Lower L. Ree). 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 2010 consisted of setting approximately 50 chains of five fykenets during two or three monthly sessions of two or three nights per session.

Of the lakes sampled, upper Lough Derg and lower Lough Ree had the highest cpue (2.83 and 1.68, respectively). Overall, Lough Feeagh had the longest and heaviest of any eel recorded during sampling (89.1 cm and 1.66 kgs, respectively). Upper Lough Erne and upper Lough Derg had the highest percentage prevalence of *A. crassus* (66.7% and 62.1%, respectively). Upper Lough Ree and upper Lough Derg had the largest mean infection intensity (3.53 and 2.93 parasites per eel, respectively).

IR.9.3.1.2 Transboundary

Lough Erne is a transboundary catchment in the Northwestern River Basin District. Upper Lough Erne has a surface area of 1552 ha. It is a particularly shallow lake with a mean depth of 1.87 m across the sampling sites. Upper Lough Erne was sampled over six nights in June and August 2010 (three nights per session). A total of 493 eel were caught during sampling, with a cpue of 1.64. The eel ranged in length from 28.9 cm to 78.7 cm and in weight from 0.035 to 0.950 kgs. In total, 90 eel were sacrificed from upper Lough Erne. Of these, 99% were female. There was a 67% prevalence rate for *A. crassus* and a mean infection intensity of three parasites per eel.

In 2010, four transboundary lakes were sampled by the Water Framework Directive; Lough Lattone, Macnean Upper and Lower and Upper Lough Erne. The surveys were carried out in collaboration with IFI Swords and Ballyshannon, DCAL and AFBI.

IR.9.3.1.3 Transitional Waters

A comprehensive fykenet survey, including mark–recapture was undertaken in the transitional waters of the Slaney in Wexford Harbour. In order to determine the population density within an important eel habitat a spatially explicit mark–recapture experiment was carried out in the Waterford Harbour in July 2010.

In total 240 eel of the 350 caught were tagged. The eel ranged in length from 22.7 cm to 57.9 with an average length of 33.9 cm. A low recapture rate was recorded for the Slaney Estuary (1%). Two eel were recaptured (one twice and one three times). The recaptured eels travelled less than 400 m. Due to the small number of eels captured none were taken back to the laboratory for further analysis. Moriarty (1986) concluded that recapture rates of 5.5–18.5% could be expected if a population was non-migratory, with rates below 2% indicating a very mobile population.

An additional survey was carried out in the South Sloblands, an area previously intensively surveyed by Moriarty in the 1970s. Chains of ten fykenets were set in the early surveys, whereas the EMP set chains of five fykenets. In 2010 the South Sloblands was fished for one night using two chain lengths. Two chains were set with ten nets and two chains were set with five nets. In total 23 eel were caught in 30 net nights giving a catch per unit of effort of 0.77. The cpue from 2010 is low compared with the historical values recorded for the area. The South Sloblands were intensively commercially fished in 1971. In the following years a recovery of the stock was observed with the increase in cpue from 1972 to 1975.

IR.9.3.2 Comparison with previous surveys

Extensive eel survey work was carried out on eels throughout Ireland from 1968 until the late 1990s. These surveys covered all water body types (rivers, lakes and transitional waters) and valuable time-series were created. The raw data were available to the Marine Institute and the Inland Fisheries Ireland and a large section of this historical data were collated into a national eel database under the NDP 'Eel Plan' Project, (Compilation of Habitat bases catchment information and historical eel data in support of eel management plans, 2010). Objective 5 of the National Eel Management Plan is to compare current and historic yellow eel stocks and the FRC datasets will be used in these comparisons.

In 2010 IFI resurveyed areas where historical data are available including Upper Lough Derg (1986), Lough Ree (1986), Upper Lough Corrib (1968), Upper Lough Erne (1972) and the South Sloblands (1970–1975). There are historical data available for all of these locations. It is proposed to have a full comparison between the current surveys and the historical data carried out for the 2012 Eel Management Review.

IR.9.4 Water Framework Directive Surveys 2008 and 2009

A key step in the WFD process is for EU Member States to assess the health of their surface waters through national monitoring programmes. Monitoring of all biological elements including fish is the main tool used to classify the status (high, good, moderate, poor and bad) of each waterbody. A national fish stock surveillance monitoring programme has been initiated at specified locations in a three year rolling cycle. In the programme for fish under the Water Framework Directive, fifty-six lakes were sampled in 2008 and 2009. In 2009 all lakes surveyed recorded eel as present. No eels were caught in Lough Skeeagh upper in 2008 but all other lake surveyed had eel present. One hundred and thirty seven river sites were sampled in both 2008 and 2009. No eels were recorded at 20 sites in 2008 and eleven sites in 2009. Fifty-five transitional waters were sampled in 2008 and 2009. Eel were recorded in all but three transitional waters in 2009 (no eel were captured in Inner Donegal Bay, Swilly Estuary and Loch an tSaile). In 2008 no eel were recorded in eleven transitional waters (Argideen, Maigue, Colligan, Harpers island (Lough Mahon), Lough Mahon, Ilen, Lee (Tralee), Lower Lee, Bridge Lough, Tullaghan Estuary, Westport estuary).

IR.10 Catch composition by age and length

With the closure of the fisheries in 2009 and 2010, there is no sampling of commercial catches in Ireland.

The national monitoring programme described in Chapter 9 includes sampling length and age and these data are available to the WGEEL if required. All eel captured in the eel specific fykenet surveys and in the WFD surveys will be measured for length and samples of otoliths will be taken every three years from waters surveyed.

IR.11 Other biological sampling

With the closure of the fisheries in 2009 and 2010, there is no sampling of commercial catches in Ireland.

The monitoring programme described in Chapter 9 includes sampling length and weight and these data are available to the WGEEL if required. All eel captured in the eel specific fykenet surveys and in the WFD surveys that are sacrificed for age determination will also be sexed and examined for parasites.

IR.11.1 Length and weight and growth (DCF)

Sampling does not take place for DCF. Eel captured in the scientific surveys are measured for length and weight and growth will be determined from the otoliths.

IR.11.2 Parasites and pathogens

All eel captured in the eel specific fykenet surveys and in the WFD surveys that are sacrificed for age determination will also be sexed and examined for parasites.

Parasite data will be supplied to the EEQD.

IR.11.3 Contaminants

No new data in 2010.

IR.11.4 Predators

No new data in 2010.

IR.12 Other sampling

All eel captured in the surveys are measured for determining their silvering status (see Section 9.5). Measurements taken include eye diameter and pectoral fin length.

IR.13 Stock assessment

IR.13.1 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 some eel specific surveys.

A national programme of stock assessment and monitoring is outlined in the Eel Management Plan and the 2009 programme is described in Chapter 9. It is intended to determine the current silver eel production and escapement on a three year rolling average in line with the reporting requirements of the EU Regulation. The information reported in this Country Report (Chapter 9–13) should therefore be taken as preliminary.

IR.13.2 International stock assessment

The following sections are drawn from the National Eel Management Report to the EU which accompanied the EMPs. It provides data thought to be useful for international stock assessment, including habitat and silver eel production data.

IR.13.2.1 Habitat

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). 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 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 has 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 >= one 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.

IR.13.2.2 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*., in press).

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*., in press). 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 geographic areas.

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 (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 (Figure 13.1).

It is intend to refine this database in 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 eel.

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) (McGinnity *et al.*, 2003).

* Data supplied by Central Fisheries Board, Compass Informatics, the Loughs Agency and EHS Water Management Unit, Northern Ireland.

Table 13.1. Total 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).

	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

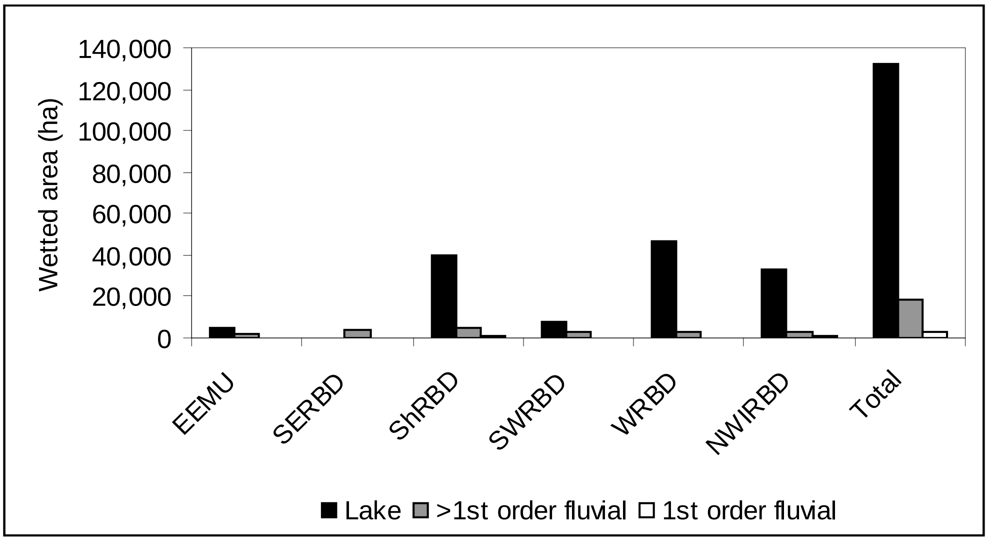

Figure 13-1. Total wetted areas (ha) for lake, first order fluvial and greater than first order fluvial habitat for each River Basin District, including Northern Ireland (Erne, Drowes, Foyle, Roe and Faughan).

The area of transitional and coastal waters is summarized in Table 13.2 for each RBD. These areas 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 13.2. 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 (km^2)	795	12 984	13 780

***excludes the RoI part of NBIRBD.**

IR.13.2.3 Silver eel production

The methods for determining silver eel production are fully described in the Irish Eel Management Plan, in the 2008 WGEEL report and in the 2009 Country Report to ICES.

IR.13.2.3.1 Historic production (B_0)

B_0, the biomass of the silver eel escapement in the pristine state. (SGIPEE) = to pristine silver eel production.

The total EMU and B_0 is given in Table 13.3.

Table 13.3. Table of historic silver eel production (B_0) in kg for each eel management unit; freshwater only.

	REGRESSION BASED ON GROWTH RATES CALIBRATED WITH HISTORICAL CATCH OR TOTAL COUNT DATA, INCLUDING CATCHMENT SPECIFIC DATA WHERE AVAILABLE
	Pristine silver eel production (kg)
EEMU	21 742
NWIRBD	146 538
SERBD	15 700
SHIRBD	213 895
SWRBD	25 924
WRBD	170 397
Grand Total	***594 196***

IR.13.2.3.2 Current production (B_{best}) and escapement (B_{pre})

B_{best}, the estimated biomass in the assessment year, based on the recently observed recruitment, but assuming no anthropogenic impacts have occurred (neither positive nor negative impacts). (SGIPEE).

B_{pre}, the biomass of the escapement in the assessment year (SGIPEE) before management actions were applied (2008).

Historic production and current (2008) potential production were calculated for the fresh (non-transitional) waters within each catchment based on the national models described above (Table 13.4 for RBD totals). The potential production was summated by River Basin District and current escapement estimated by including the effects of anthropogenic impacts (i.e. fisheries and hydro-power installations). Current escapements are presented below as a percent of the pristine escapement to determine where Irish RBDs are currently in relation to the 40% target defined in the EU Regulation.

Note: transitional and tidal waters were not included in the models.

Table 13.4. Estimates of historic production (t), current production (t) and current escapement (t) of silver eel and the % escapement for freshwater catchments. Current refers to 2008. Note the EU target is 40%.

	Historic Production (t) B_O	Current Production (t) B_{BEST}	Current Escapement (t) B_{PRE}	Current Escapement as % of historic escapement
EEMU	22	14	7	33
SERBD	16	10	9	55
SWRBD	26	17	17	64
SHIRBD	214	95	18	8
WRBD	170	97	51	30
NWIRBD	147	104	38	26
National*	595	337	140	24

*** including transboundary waters with UK NWIRBD.**

IR.13.2.3.3 Current escapement (B_{post})

B_{post}, the biomass of the escapement in the assessment year (SGIPEE) after management actions have been applied. This has not been determined for Ireland in 2009. Projected changes are illustrated in the EMP.

IR.13.2.3.4 Production values e.g. kg/ha

The estimated historic spawner escapement (production) ranged from 0.9 to 5.5 kg/ha and the current production ranged from 1.3 to 2.7 kg/ha (Tables 13.5 and 13.6).

Table 13.5. Estimated pristine spawner productivity from five Irish catchments based on either direct measurement and/or catch data.

	Moy	Garavogue	Erne	Corrib	Burrishoole
Years	'42–52	'62–75	'55–82	'76–82	'71–80
Silver catch at weir	3.4	0.9	9.2	19.4	0.0
Escapement past weir	6.8	4.4	51.3**	38.8	427.5
Reported brown catch upstream	4.0	1.7	13.4	9.0	0.0
Non-reported brown catch upstream	3.0	1.2	23.4	6.5	0.0
Reported silver catch upstream		0.0		18.6	0.0
Non-reported silver catch upstream	29.1*	1.2	9.2	13.4	0.0
Potential production	46.4	9.6	116.6	97.5	0.4
Wetted area (ha)	8418.0	1783.0	25 959.6	28 869.0	475.0
Productivity (kg/ha)	*5.5*	*5.4*	*4.5*	*3.4*	*0.9*
% non-calcareous	25.7	19.5	0.0	18.5	96.2

***upstream Verscoyle weir efficiency estimated at seven times that of the recording station (North Western Regional Fisheries Board).**

****occurs following recording station (therefore, ignored in calculation of productivity).**

Table 13.6. Current escapement (t) and current potential productivity (kg/ha) estimates for index catchments 2001–2007. Note: Units in tonnes except for productivity.

	Shannon	Corrib	Ennell*	Burrishoole
Silver catch at weir	4.6	7.2		0.0
Escapement past weir	*11.0***	*13.4*		*616*
Reported brown catch upstream	19.5	9.0		0.0
Non-reported brown catch upstream	14.4	6.5		0.0
Reported silver catch upstream	20.6	7.2		0.0
Non-reported silver catch upstream	15.5	5.2		0.0
Hydropower impact	2.1	0.0		0.0
Potential production	85.7	48.5	3.8	0.6
Wetted area (ha)	42 466	28 869	1404	474
Productivity (kg/ha)	*2.0*	*1.7*	*2.7*	*1.3*
% non-calcareous	7.9	18.5	0	96.2

*** Summarized data provided by McCarthy pers. comm.**

**** Hydropower impact occurs downstream of recording station (estimated 2.1 tonnes killed).**

IR.13.2.3.5 Impacts

See Chapter 8.1 and 8.2 for hydropower impact.

IR.13.2.3.6 Stocking requirement eels <20 cm

A stocking requirement hasn't been calculated for Ireland and is not included in the first three years of the eel management plan.

IR.13.2.3.7 Data quality issues

To be discussed:

Reporting of historical fisheries catch;
changes in elver time-series;
national database qc.

IR.13.2.3.8 ICES precautionary diagrams

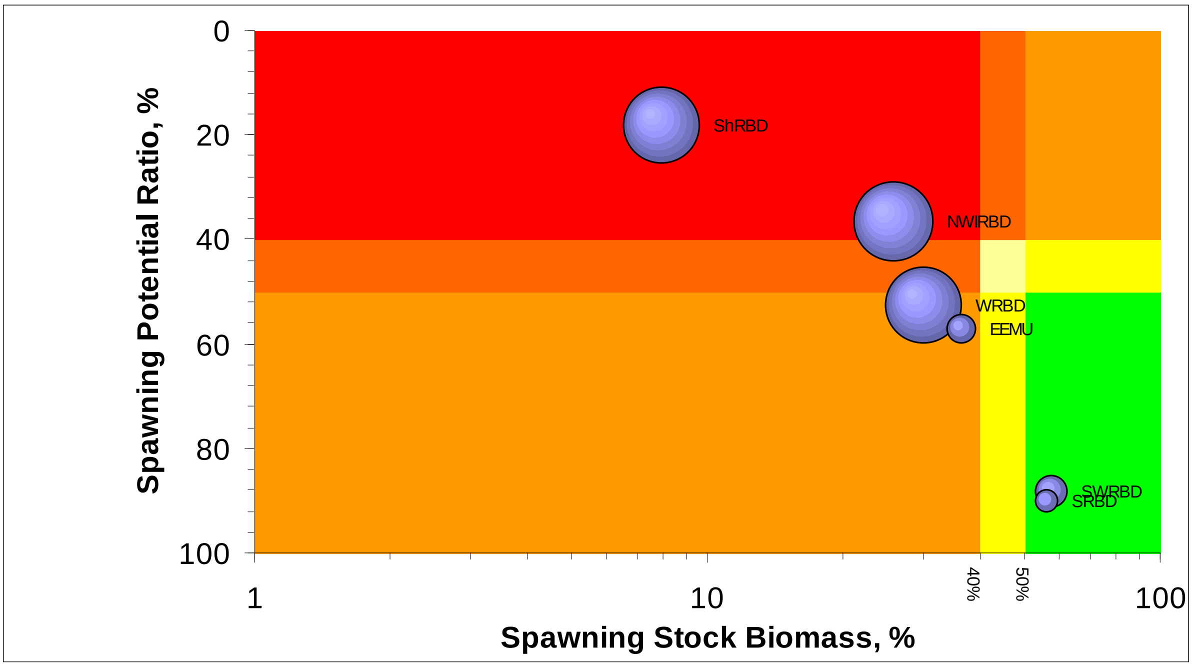

Figure 13-2. Precautionary diagram showing spawning potential ratio against spawning–stock biomass for Irish Eel Management Units, using data current at 2008 from the EMPs.

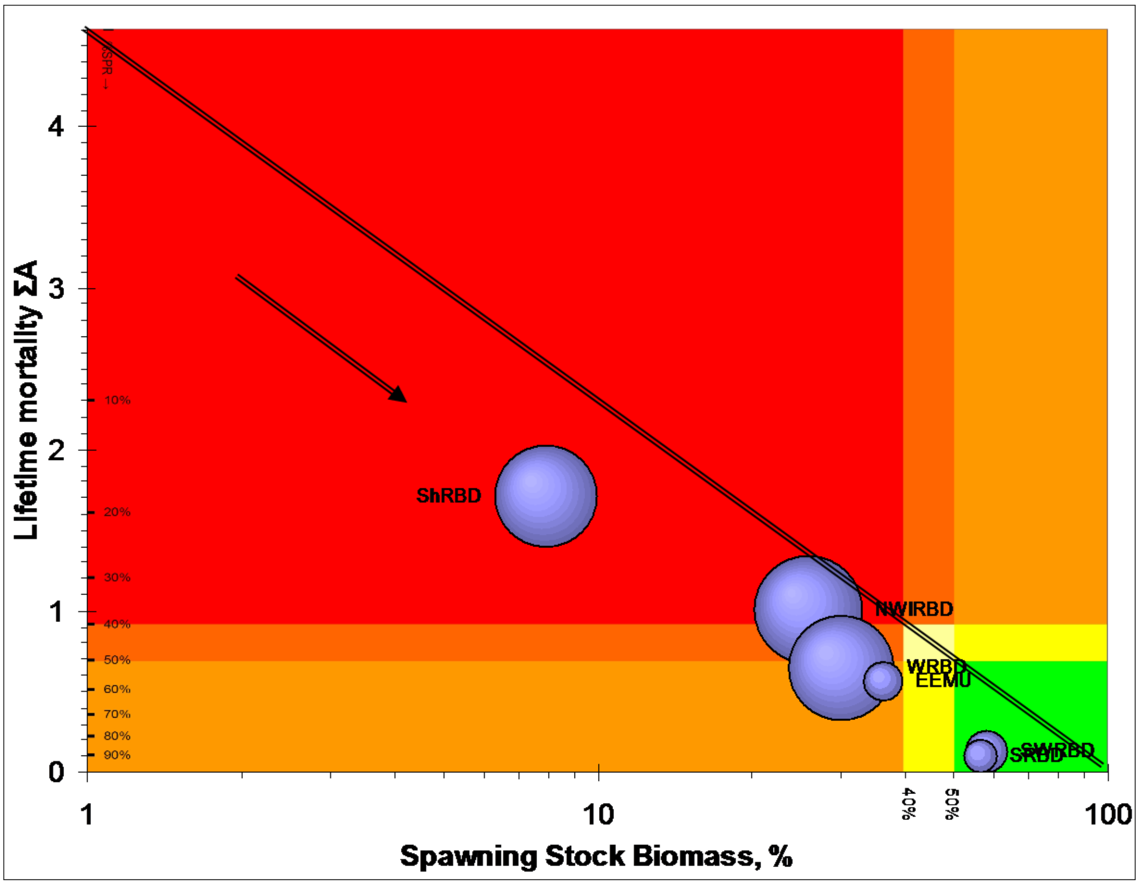

Figure 13-3. Precautionary diagram showing lifetime mortality against spawning–stock biomass for Irish Eel Management Units, using data current at 2008 from the EMPs.

Data used in the precautionary diagrams:

Indicators and reference points quantified here			
	2008		
Label	$\mathbf{B_{current}}$	$\mathbf{B_{best}}$	$\mathbf{B_0}$
NWIRBD	38	104	147
ShRBD	17	94	214
WRBD	51	97	170
EEMU	8	14	22
SWRBD	15	17	26
SRBD	9	10	16

IR.14 Sampling intensity and precision

IR.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 eel were captured in fykenets, marked and released in the Burrishoole (Poole and Reynolds, 1996a). The proportion of these eel 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 data from >20 000 net-nights, 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.

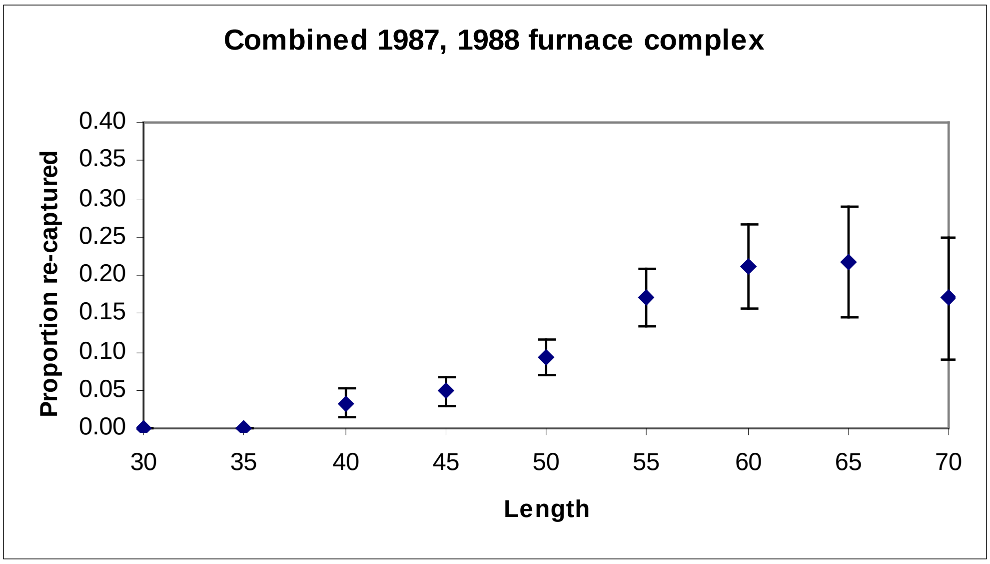

Figure 14-1. Proportion of European eels re-captured in fykenets in relation to length.

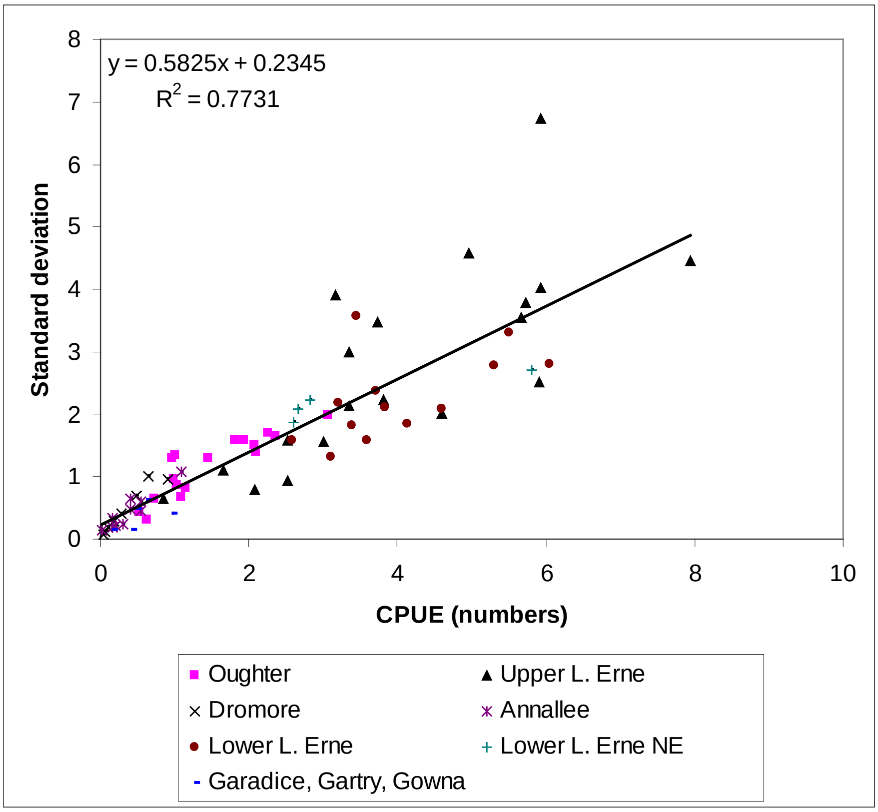

Figure 14-2. Relation between the standard deviation of five fyke chain cpue and cpue.

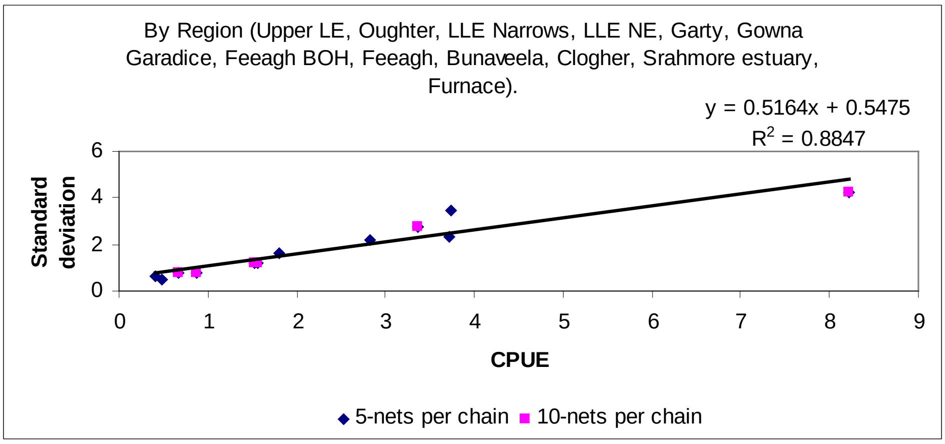

Figure 14-3. Relation between standard deviation and cpue for fykenets with five and ten nets per chain.

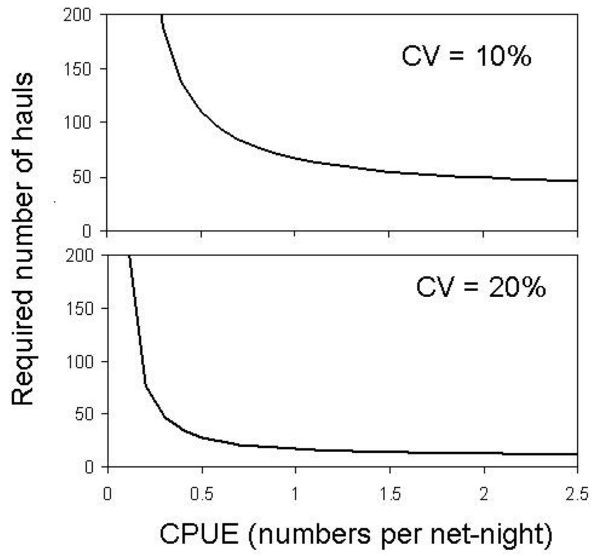

Figure 14-4. Power analysis of the number of hauls required to achieve precision levels in cpue consistent with indicated co-efficients of variation. The required sample size is highly sensitive to the population density (assuming cpue is directly related to density).

IR.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, 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.

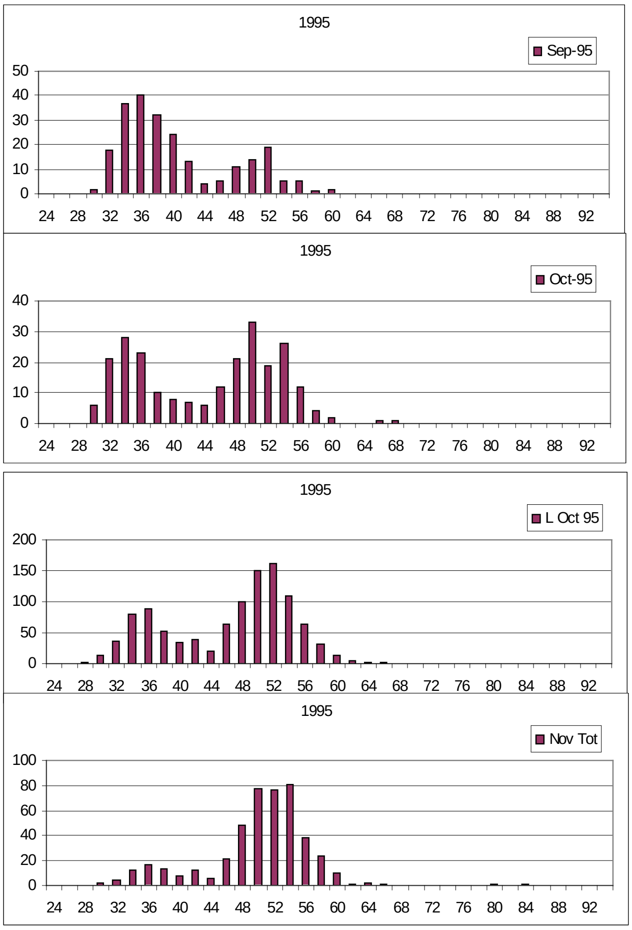

Figure 14-5. Monthly length distributions, taken for each lunar phase, for Burrishoole silver eels.

IR.15 Standardization and harmonization of methodology

IR.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 eel, or weight, per net (pair of traps) per night fished.

Fykenets are the standard tool for the 2009–2011 monitoring programme.

Longlines – Longlines have not been extensively used as a survey tool in Ireland. On the Shannon (McCarthy and Cullen, 2000) longlines have been standarised and the bait is 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.

IR.15.2 Sampling commercial catches

There was no National programme for sampling commercial catches in Ireland.

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 standardization. Eel were stored in keepnets or boxes similar to those used by commercial fishermen. Eel 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 authorized 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 logbooks, 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.

IR.15.3 Sampling

Catch sampling is normally carried out on anaesthetized eel, although some samples may be taken from either freshly sacrificed or frozen samples. Lengths measured to ±0.1 cm and weights to ±5 g. Otoliths are stored dry in paper envelopes.

IR.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).

It is intended to adopt the recommendations of ICES Workshop on Eel Age WKAREA 2009. An initial training workshop was held in Central Fisheries Board/IFI in February, 2010, using the WKAREA information as a guideline.

IR.15.5 Life stages

Glass eel/elver life stages are determined the pigmentation classification using that published by Elie *et al*. (1982).

Brown eel and silver eel are categorized by a combination of capture method and season, colouration and eye size. Silver eels are generally captured during their downstream migration, or can be recognized in the brown eel catch by the enlarged eyes and onset of coloration change.

IR.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 eel 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.

IR.16 Overview, conclusions and recommendations

Recruitment time-series are effort-independent and up to date.

Catch statistics are up to date to 2008 and with the closure of the fisheries in 2009, these data cease to exist.

Ireland submitted an EMP and this was accepted in July 2009.

Ireland has implemented its management actions in 2009 and 2010 and commenced the National Monitoring programme also in 2009.

Ireland intends determining current escapement on a three year rolling average (2009–2011) in line with the reporting schedule laid out in the EU Regulation. Where available historic production estimates, wetted areas, etc will also be improved and updated for 2012.

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Report on the eel stock and fishery in Italy 2010/11

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Reporting Period: This report was completed in August 2011, and contains data up to 2010 and some provisional data for 2011.

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IT.2 Introduction

The years 2010 and 2011 have been important transitional years in Italy with regards to eel management.

It is established that eel (*Anguilla anguilla* L.) exploitation in Italy has a long standing tradition, and is still present, 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 a few 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 1500 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 artificial 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 restockings, 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, still allowed on the whole national territory, were common in some specific regions in relation to local traditions, and are still present with a patchy pattern.

Administrative responsibility for eel fisheries is relatively dispersed: sea fisheries and sea fishing up to river mouths come under the remit of central government (Ministry of Agricultural, Food and Forestry Policy - Directorate-General for Sea Fishing and Aquaculture), whilst the Regions are responsible for freshwater fisheries, including eel fishing, since 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 the glass eel fisheries practised 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 regulations, none specific for eel. Up to now, 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 authorized times and places. For the nets, mesh sizes and minimum and maximum dimensions of gears are listed.

Professional glass eel fisheries did occur in many river mouths, and in many channel mouths as well, while glass eel catch for recreational purposes is forbidden everywhere. Most of the glass eel yield was from the Central and Southern Thyrrenhian area. 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.

This management framework has influenced the setting up of the Eel National Management Plan (IT-EMP) foreseen by Regulation 1100/2007. IT-EMP takes into account the complexity of the situation in the country.

The drawing up of the IT-EMP was based on the purpose of identifying a clear strategy aiming at supporting eel conservation while contributing to stock recovery, focusing as well on the sustainability of the socio-economic activities associated with it. Certain typical features of the exploitation methods and traditional management strategies could in fact prove to be key factors. Traditional management practices in coastal lagoons and the ecological features of the lagoons themselves throughout the whole Mediterranean, but in Italy in particular, have always favoured the support of local stocks through stocking activities, and in the past this led to high silver eel output levels, though their escapement was dramatically reduced by the fixed eel traps. And so the lagoon management model appears to be a viable option, based on a rational approach to use of the glass eels still available locally and the possibility of replenishment quotas at local level, with a view to contributing to the migration of spawners to the open sea.

For all the above reasons, the IT-EMP 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 the eel fishing is foreseen starting from the year 2009. The remaining nine regions have drawn up their own Regional Eel Management Plans, that were done 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.

The IT-EMP was produced by the Directorate-General for Sea Fishing and Aquaculture of the Ministry of Agricultural, Food and Forestry Policy, with the help of experts from the scientific community and of regional representatives. In fact, the work was carried out jointly with the regional administrations in order to coordinate activities, through a series of meetings during 2008 and 2009.

Figure IT.1 shows the geographical distribution of the regions identified as suitable 'key regions'. It can be seen that all the areas identified are those of particular importance for eel fishing, 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 the remainder of the national territory, in other words the remaining regions which were not identified as key centres and which did not consider it necessary to take part in the process of drawing up management plans, the working assumption is that commercial eel fishing will stop completely. Recreational fisheries are still allowed on the whole national territory, i.e. in all the regions.

For each of these key regions (Lombardia, Veneto, Friuli-Venezia Giulia, Emilia-Romagna, Toscana, Lazio, Umbria, Puglia and Sardegna, see Table II for Regional and EMU codes), an individual plan has been produced which has been tailored to the local situation whilst remaining an integral part of the overall national framework. The regional plans have been drawn up by the regional governments, who have brought in their own chosen technical advisors, under overall national coordination.

Table IT.1. The administrative Regions (EMU) which have produced a Regional Eel Management Plan (green) and the Regions where the eel fishing has closed definitively (red).

Region	Total ha (wetted area)	Key centre	Piano Gestione Regionale	Name of EMU
Valle d'Aosta	1620	no		
Piemonte	11970	no		
Lombardia	50277	yes	x	EMU_LOM
Trentino Alto Adige	8803	no		
Friuli Venezia Giulia	16085	yes	x	EMU_FVG
Veneto	90754	yes	x	EMU_VEN
Liguria	2437	no		
Emilia Romagna	21953	yes	x	EMU_EMR
Toscana	12489	yes	x	EMU_TOS
Marche	3370	no		
Umbria	16459	yes	x	EMU_UMB
Lazio	28142	yes	x	EMU_LAZ
Abruzzo	4352	no		
Molise	3638	no		
Campania	4211	no		
Basilicata	5742	no		
Puglia	14394	yes	x	EMU_PUG
Calabria	8077	no		
Sicilia	10656	no		
Sardegna	32623	yes	x	EMU_SAR

Figure IT.1. The nine Regions (EMU) identified as 'key centres', that have produced a Eel Regional Management Plan (green), and the eleven Regions that have closed professional eel fisheries (white), where only recreational fisheries are still allowed.

A first draft was submitted in December 2008, and a definitive IT-EMP was submitted in September 2009, and was accepted by the Commission and forwarded to ICES for technical evaluation. ICES evaluation was available in April 2010. ICES identified some issues to resolve, the most crucial concerning the level of pristine escapement calculated in the Plan, that ICES believed to be too low. The Commission required some amendments to be made with regards to this point. Therefore, after new meetings with the Regional representatives and with officers of the European Commission, a amendment text based on a new calculation was prepared, also including other ICES recommendations. This text was submitted September 30, 2010. In the meanwhile, most Regions are already implementing their Regional Plans that have also provided with resources for the implementation of the measures envisaged within their Plans. Definite approval by the Commission was issued in July 2011.

The most distinctive features of the IT-EMP, that shall reflect on management at the national level, are two. One concerns the reforming of the regulation for glass eel fishing. The IT-EMP, in agreement with the individual Regional Management Plans, envisages continuing fishing of glass eel (eel <15 cm), however the legislation governing this type of fishing has been radically changed. .A new legislation has been introduced, that came into force in 2011, governing the fishing and sale of glass eels. It 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 authorized to fish glass eel, allocation of quotas and the obligation to submit catch returns and figures regarding sales and purchases.

The second feature concerns the definition of the Eel Management Units (EMU). In the context of the situation described above, which illustrates the highly fragmented distribution of responsibilities in Italy, it would have been be difficult in practice to coordinate, implement and monitor the measures defined if the eel management plans and the regulations implementing them are drawn up on the basis of river basin units, as defined in Article 2(1) of Regulation (EC) No 1100/2007. Italy has therefore 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 has proposed the regional administrations as Eel Management Units, point accepted by the Commission.

The drafting of the IT-EM and of the Regional Plans has brought about the gathering of a certain amount of information on eel fisheries, yields and stock. Furthermore, Italy has now established its Data Collection Framework for Eel, as foreseen by the Regulation 199/2008 that has been included in the Italian National Programme. A pilot project aimed at establishing a methodology for Eel Data Collection has been completed by October 15th 2009, and 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 2010 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.

In this report, time-series are presented only when available, and derived by the official statistical system (ISTAT) in place up to 2004 for the marine compartment and to 2008 for inland fisheries, now replaced by 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, even if some work of collecting case studies dataseries is at present underway for assessment to be done for the Report 2012.

Table IT.2. Legends of the Region names, Region codes and EMU names used in the Italian National Plan and in the present CR.

REGION	CODE	NAME OF EMU
Valle d'Aosta	VDA	
Piemonte	PIE	
Lombardia	LOM	EMU_LOM
Trentino Alto Adige	TAA	
Friuli Venezia Giulia	FVG	EMU_FVG
Veneto	VEN	EMU_VEN
Liguria	LIG	
Emilia Romagna	EMR	EMU_EMR
Toscana	TOS	EMU_TOS
Marche	MAR	
Umbria	UMB	EMU_UMB
Lazio	LAZ	EMU_LAZ
Abruzzo	ABR	
Molise	MOL	
Campania	CAM	
Basilicata	BAS	
Puglia	PUG	EMU_PUG
Calabria	CAL	
Sicilia	SIC	
Sardegna	SAR	EMU_SAR

HABITAT	CODE
River	RIV
Lake	LAK
Lagoon	LGN
Managed lagoon	MLG

IT.3 Time-series data

IT.3.1 Recruitment-series and associated effort

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 projects have stopped, and this monitoring has ceased as well. As the fishery has stopped to exist, no monitoring is at present in place and no information can be derived. No monitoring programmes of recruitment are foreseen in the immediate future, but some specific evaluations are foreseen by some EMUs for assessing recruitment sites and potential glass eel fisheries sites.

IT.3.1.1 Glass eel

Na.

IT.3.1.1.1 Commercial

IT.3.1.1.2 Recreational

IT.3.1.1.3 Fishery-independent

IT.3.1.2 Yellow eel recruitment

Na.

IT.3.1.2.1 Commercial

IT.3.1.2.2 Recreational

IT.3.1.2.3 Fishery-independent

IT.3.2 Yellow eel landings

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. At present, therefore, only dataseries from the old statistical system (ISTAT) are available, that are national catches (also available at the Region disaggregated level) separated for inland and coastal waters. These time-series for Italy landings are available at present only 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 2010 are reported in Figure IT.2; 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).

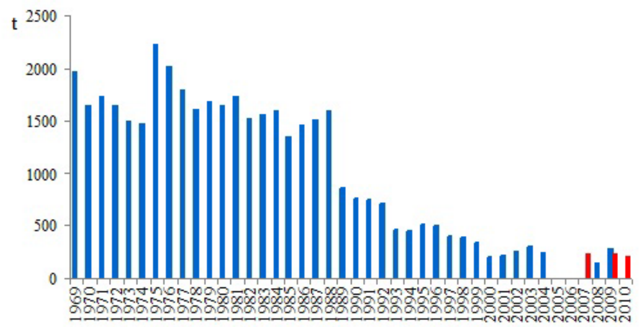


Figure IT.2. Eel landings (yellow and silver cumulated) in Italy, period 1969–20010, from coastal lagoon fisheries (Istituto Nazionale di Statistica 1969–2004, blue; Unimar, 2007, and DCF, 2009 and 2010, red).

Inland waters eel landings from 1969 to 2010 are reported in Figure IT.3; statistics refer only to lakes and artificial basins for the ISTAT dataseries (green), and include rivers for the 2007–2010 DCF data (red).

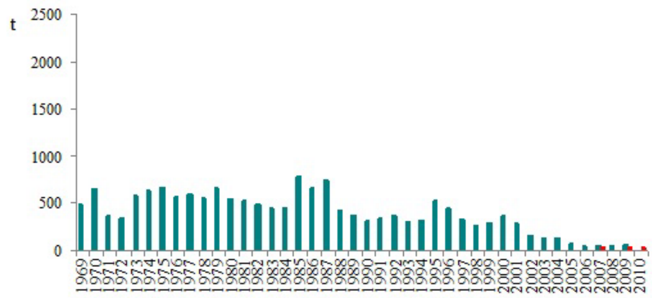


Figure IT.4. Eel landings (yellow and silver cumulated) in Italy, period 1969–2006, from lakes and artificial basins (Istituto Nazionale di Statistica).

The above statistics refer to yields cumulated for all Italy, but landing data split at the Regional level (corresponding to EMU) are also available. In some years there has been an overlap (2007, 2009) and figures are comparable, even if the methodology was quite different (data from the markets for the ISTAT system, interview to the fishermen in the DCF). Therefore, the landings time dataseries from the ISTAT system, even if less detailed, must be considered reliable and useful. In Table IT.3 the DCF dataseries from 2009 is presented, with data disaggregated by stage, with the 2007 value from the Unimar (2007) pilot study.

Table IT.3. DCF new catch dataseries: landings disaggregated by stage, and 2007 value from the Unimar (2007) pilot study.

YEAR	INLAND WATERS			COASTAL WATERS			*NATIONAL*
	Yellow	Silver	Total	Yellow	Silver	Total	
2007	25 078	19 702	44 782	151 817	81 786	232 318	*277,1*
2008	Na	na	na	na	na	na	*na*
2009	23 578	19 993	43 574	149 274	88 333	236 546	*280,12*
2010	22 136	18,4	40 536	73 127	135 727	208 854	*249,39*

IT.3.2.1 Commercial

Na.

IT.3.2.2 Recreational

Na.

IT.3.3 Silver eel landings

See previous section.

IT.3.3.1 Commercial

IT.3.3.2 Recreational

IT.3.4 Aquaculture production

In Italy, total aquaculture production accounts for 587 t in 2009, with extensive production accounting for 278 t and intensive for 309 t.

IT.3.4.1 Seed supply

Na.

IT.3.4.2 Production

Aquaculture production in Italy from 2002 to 2007 is given in Figure IT.5.

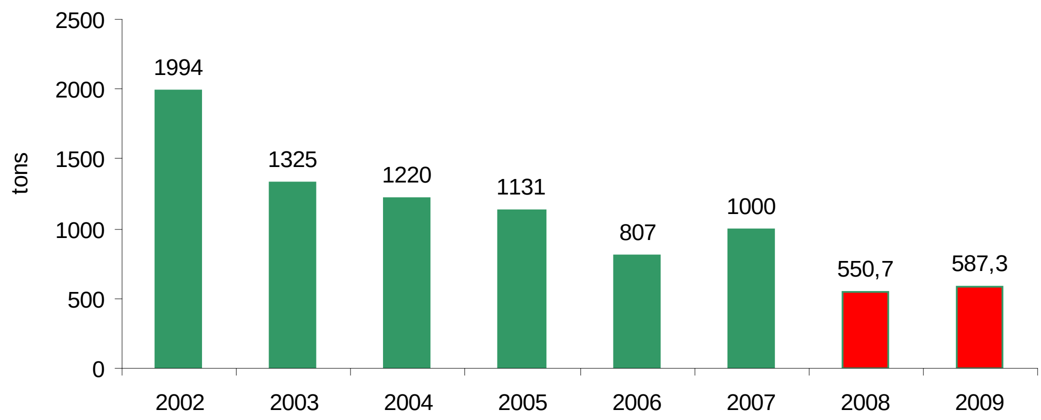


Figure IT.5. Aquaculture production in Italy from 2002 to 2007 (Source: Idroconsult, 2002–2007, green; Unimar, 2008–2009, red).

IT.3.5 Stocking

IT.3.5.1 Amount stocked

Na.

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

The new 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 new system, together with reinforced controls by the Corpo Forestale dello

Stato, shall 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. In 2010, the new regulation was not in force, its definite approval being achieved in 2011, no licenses were issued in 2010, therefore there were no catches and no information on quantities used for restocking.

IT.4 Fishing capacity

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, and for authorized glass eel fishers in coastal waters. At the moment, for inland waters eel fishing is allowed only in the nine EMU, and is prohibited in the remaining eleven Regions. Glass eel fishing in coastal waters is allowed by authorization on a yearly basis, both in coastal and inland waters, in the nine EMU. For 2010 the new regulation was not in force yet, and hence no authorization was issued.

For the fishing capacity relative to the nine EMU, the best estimates are data from Unimar (2007) that within a specific project carried out a national census of eel fisheries in Italy. This study constituted the basis for the drafting of the Italian EMP, both national and regional.

Commercial eel fisheries were ascertained in nine 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 differ 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, 1.152 operators have been estimated to be involved in eel fishing, that include fishermen in the 9 Regions, all typologies included (see Table IT.4). 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 has been performed, on all the fishermen operating in rivers lakes and lagoons, i.e. 432 fishermen (managed lagoons have been left out because of some differences in their activity). For 77,1% of the fishermen, eel represents at most the 15% of total catch (Table IT.5), in detail for 22,9% of the fishermen eel is less that 1% of total catch.

For recreational fisheries, potential fishing capacity coincides with all licensed fishers, that amount to over 530 000 in the whole national territory, all Regions included (Table IT.6). The effective number of recreational fishermen effectively involved in eel fishing is quite lower. Within the DCF programme, the effective number estimated for 2010 amounts to 6.392 (see following section).

Table IT.4. Total number of fishermen, by EMU and by habitat typology, from the Unimar (2007) pilot study.

Region name	EMU	River	Lake	Lagoon	Managed lagoon	total/ EMU	%
Lombardia	EMU_LOM		22			22	*1,9*
Friuli V. Giulia	EMU_FVG	n.a.		48	4	52	*4,5*
Veneto	EMU_VEN	17	10	118	20	165	*14,3*
Emilia Romagna	EMU_EMR	5		5	8	18	*1,6*
Toscana	EMU_TOS	6	3		30	39	*3,4*
Umbria	EMU_UMB		33			33	*2,9*
Lazio	EMU_LAZ	7	36	44	6	93	*8,1*
Puglia	EMU_PUG			59	4	63	*5,5*
Sardegna	EMU_SAR	6		13	648	667	*57,9*
total/HT		41	104	287	720	1.152	*100*
%		*3,6*	*9*	*24,9*	*62,5*		*100*

Table IT.5. Relative role of eel with respect to other fish species for commercial fishermen, from the Unimar (2007) pilot study.

Region name	EMU	Relative role (%) of eel with respect to other fish species													Tot.
		<1	1-5	5,1-10	10,1-15	15,1-20	20,1-30	30,1-40	40,1-50	50,1-60	60,1-70	70,1-80	<80%	n.d.	
Veneto		38	89	7	4		2		1				4		145
Friuli V. Giulia		38		10											48
Lombardia		18	2		2										22
Emilia Romagana		1	3	2									2	2	10
Toscana									6					3	9
Umbria				33											33
Lazio				26	41	9	2		4			2	3		87
Puglia							22	24		1	6	5	1		59
Sardegna		1			8		1	1						8	19
Totale		96	94	78	55	9	27	25	11	1	6	7	10	13	432
%		22,9	22,4	18,6	13,1	2,1	6,4	6	2,6	0,2	1,4	1,7	2,4		100

Table IT.6. Total number of recreational fishermen in the 21 Regions (DCF, 2010).

REGION	CODE	TOTAL N/REGION
Valle d'Aosta	VDA	0
Piemonte	PIE	40.000
Lombardia	LOM	85.000
Trentino Alto Adige	TAA	33.000
Friuli Venezia Giulia	FVG	20.646
Veneto	VEN	86.000
Liguria	LIG	5.568
Emilia Romagna	EMR	72.000
Toscana	TOS	47.000
Marche	MAR	9.500
Umbria	UMB	15.386
Lazio	LAZ	48.492
Abruzzo	ABR	12.027
Molise	MOL	2.600
Campania	CAM	18.242
Basilicata	BAS	2.870
Puglia	PUG	1.350
Calabria	CAL	17.000
Sicilia	SIC	4.949
Sardegna	SAR	15.030
Total		*536.660*

IT.4.1 Glass eel

Na.

IT.4.2 Yellow eel

Na.

IT.4.3 Silver eel

Na.

IT.4.4 Marine fishery

Na.

IT.5 Fishing effort

Fishing effort is assessed under the DCF programme. The methodology is based on direct and detailed interviews to a sample of fishermen, extracted on a statistical basis for each stratum (strata being habitat typologies for each EMU). In Table IT.7 the sample of fishermen to which interviews have been submitted in 2010 is presented. Number of fishermen interviewed for 2010 amounts to 706 fishermen, data from the interviews have then been used to infer data for the whole strata.

Table IT.6. Total number of commercial fishermen, by EMU and by habitat typology, from the Unimar (2007) pilot study, and number of fishermen interviewed in samples from each EMU, and for each habitat typology each EMU, and for each habitat typology.

Stratum	EMU Region_Habitat	Region name	Habitat	N. total units	N. sample units
				(N_h)	(n_h)
1	EMU_LOM_LAK	Lombardia	lake	71	20
2	EMU_FVG_LGN	Friuli Venezia Giulia	river	112	13
3	EMU_FVG_RIV	Friuli Venezia Giulia	lagoon	63	9
4	EMU_FVG_MLG	Friuli Venezia Giulia	managed lagoon	4	6
5	EMU_VEN_RIV	Veneto	river	17	10
6	EMU_VEN_LAK	Veneto	lake	40	12
7	EMU_VEN_LGN	Veneto	lagoon	103	12
8	EMU_VEN_MLG	Veneto	managed lagoon	20	8
9	EMU_EMR_RIV	Emilia Romagna	river	5	3
10	EMU_EMR_LGN	Emilia Romagna	lagoon	5	3
11	EMU_EMR_MLG	Emilia Romagna	managed lagoon	8	5
12	EMU_TOS_RIV	Toscana	river	6	4
13	EMU_TOS_LAK	Toscana	lake	3	2
14	EMU_TOS_MLG	Toscana	managed lagoon	30	18
15	EMU_UMB_LAK	Umbria	lake	33	22
16	EMU_LAZ_RIV	Lazio	river	7	7
17	EMU_LAZ_LAK	Lazio	lake	36	10
18	EMU_LAZ_LGN	Lazio	lagoon	45	13
19	EMU_LAZ_MLG	Lazio	managed lagoon	6	6
20	EMU_PUG_LGN	Puglia	lagoon	59	27
21	EMU_PUG_MLG	Puglia	managed lagoon	4	3
22	EMU_SAR_RIV	Sardegna	river	6	4
23	EMU_SAR_LGN	Sardegna	lagoon	13	9
24	EMU_SAR_MLG	Sardegna	managed lagoon	652	480
Total				1.348	706

The same methodology (interviews to a sample of fishermen) has been used to assess data for recreational fishermen. As a preliminary step, through the sport associations that group recreational fishermen, an evaluation of eel recreational fishermen has been carried out. This has allowed to ascertain that of the whole number of licensed recreational fishermen, 536 660, only a small fraction, 1,2%, is involved in eel fishing. In fact, 6392 are the fishermen that have declared to catch eel. The distribution of these fishermen is quite sparse; they are present only in certain specific areas where traditional interest towards eel is still present. Most are from Veneto, and a certain number are operating on the lakes of Lombardia, in the remaining Regions they are quite few.

Table IT.7. Effective number of recreational fishers involved in eel fishing in 2010 (DCF, 2010).

Region	Code	n/Region
Valle d'Aosta	VDA	0
Piemonte	PIE	8
Lombardia	LOM	1.207
Trentino Alto Adige	TAA	0
Friuli Venezia Giulia	FVG	4
Veneto	VEN	3.748
Liguria	LIG	340
Emilia Romagna	EMR	671
Toscana	TOS	101
Marche	MAR	40
Umbria	UMB	96
Lazio	LAZ	42
Abruzzo	ABR	0
Molise	MOL	0
Campania	CAM	74
Basilicata	BAS	0
Puglia	PUG	0
Calabria	CAL	0
Sicilia	SIC	61
Sardegna	SAR	0
Total		6.392

Total number of boats involved in eel commercial fisheries for each of the nine EMU, and also disaggregated for habitat types, are reported in Table IT.8 and Figure IT.6, total number for Italy amounting to 365. These are small boats, mean length 6,1 m, range between 2 m and 10 m. Most boats (89,6%) are boats 5–7 m long.

Table IT.8. Number of boats involved in commercial eel fishing in 2010 (DCF, 2010).

Region name	EMU	*Habitat type*				*Total/EMU*
		LAK	LGN	MLG	RIV	

Lombardia	EMU_LOM	15				*15*
Friuli VG	EMU_FVG		25			*25*
Veneto	EMU_VEN	3	19		8	*30*
Emilia Romagna	EMU_EMR		1	2	5	*8*
Toscana	EMU_TOS		1	21	0	*22*
Umbria	EMU_UMB	22				*22*
Lazio	EMU_LAZ	42	14		7	*63*
Puglia	EMU_PUG		34	2		*36*
Sardegna	EMU_SAR		5	123	16	*144*
	Total/HT	***82***	***99***	***148***	***36***	***365***

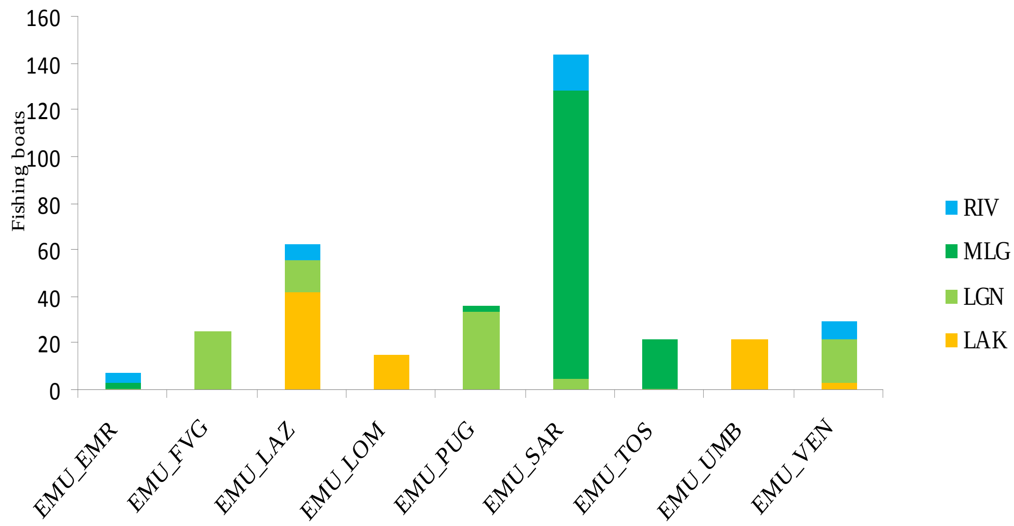


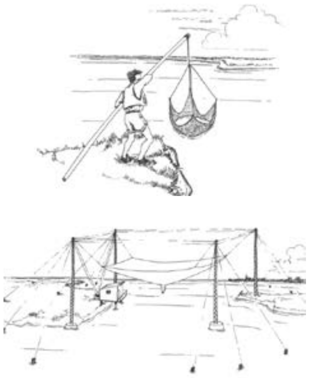
Figure IT.6. Number of boats involved in commercial eel fishing in 2010 (DCF, 2010), by Region and habitat typology.

In Table IT.9 the gears used for eel fishing in Italy, recreational and commercial, is reported, as assessed under the DCF Programme 2010.

Table IT.9. List of gears used for eel fishing in Italy (DCF, 2010).

FISHING GEAR	CODE	DESCRIPTION	Commercial Fishery	Recreational Fishery
SHORE LIFT NET	SLN	***BILANCIA and BILANCIONE***		x
FISHING ROD	FRD	***CANNA***		x
SPEAR FISHING	SPF	***FIOCINA***	x	x
TRAPS FYKE NETS	FYK	**FYKE NETS** ***BERTOVELLO*** **and** ***NETS BARRIER***	x	
GLASS EEL GEAR	GEG	**GLASS EEL GEAR**	x	
BARRIER	BAR	***LAVORIERO***	x	
UMBRELLA	UMB	***OMBRELLO***		x
NETS	NTS	**OTHER NETS** ***NASSA***	x	x
EEL LONGLINES	ELL	***PALANGARO***	x	

Table IT.10. Description of gears used for eel fishing in Italy (Pellizzato Regione Veneto).



SHORE LIFT NET *BILANCIA AND BILANCIONE*

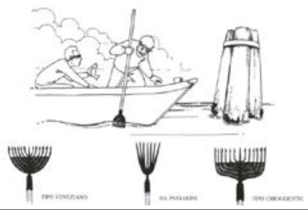
Strumenti costituiti da una struttura metallica a forma di "X " che sorregge e tende un panno di rete orizzontale. La struttura metallica, grazie ad un occhiello centrale, è fissata tramite una corda ad un'asta che consente di calarla sul fondale e risollevarla velocemente.

Le piccole bilance hanno un lato di 1,5 m (maglia 10 mm), sono montate su un palo di manovra, sono azionate manualmente e possono essere spostate agevolmente.

Le grandi bilance sono realizzate su postazioni fisse lungo i canali di marea o nel tratto terminale di alcuni fiumi. Il bilancione fisso è costituito da una rete a forma quadrangolare montata su un sistema di sollevamento con piattaforma di manovra. I lati della rete non possono superare i 15 m (maglia ≥ 20 mm).

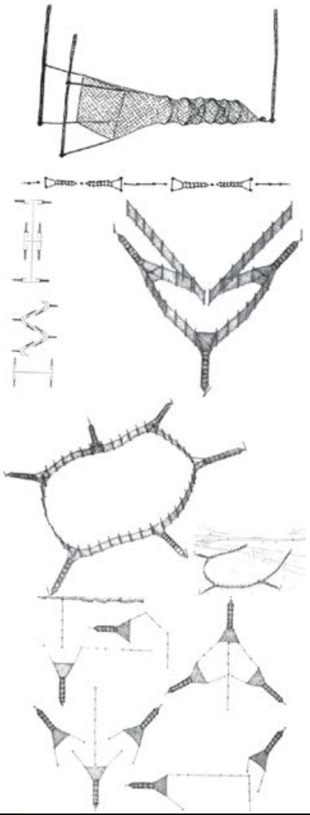
FISHING ROD *CANNA*

Canne da pesca di diverso modello, dimensione e materiale con o senza mulinello che consente il lancio e il recupero meccanico della lenza.



SPEAR FISHING *FIOCINA*

Attrezzo largamente utilizzato in passato dai pescatori delle lagune, i quali utilizzavano la fiocina con una sorgente luminosa per la pesca notturna di differenti specie ittiche.

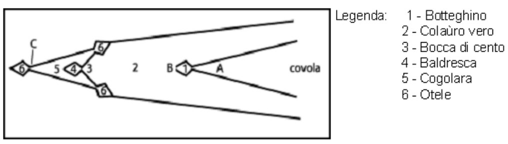


TRAPS FYKENETS *BERTOVELLO*

Rappresenta lo strumento più diffuso nella pesca dell'anguilla, utilizzato in acque poco profonde, a volte è integrato con strutture fisse, quali arginature e sbarramenti costituiti da pannelli di rete. Esistono molti tipi di bertovello diversi per dimensione, forma, apertura della maglia, numero di camera interne.

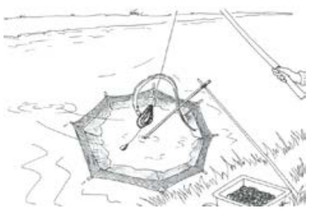
Ha una bocca cilindrica o semicircolare, costituita da una rete montata su anelli di diverso materiale (ferro, plastica). La trappola vera e propria è costituita da una serie di camere, al cui interno, una rete a forma d'imbuto, favorisce l'entrata del pesce, ma ne impedisce la fuga e lo conduce alla camera terminale chiusa.

Può essere posato in pesca singolarmente o in file, generalmente utilizzati nei fiumi. In zone estuarine e lagunari possono essere allestiti sistemi più articolati, composti da sbarramenti in rete perpendicolari alla riva, che presentano più bracci secondari che terminano con un bertovello.



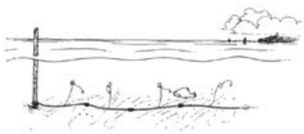
BARRIER *LAVORIERO*

Opera fissa per la pesca tipica delle valli e delle lagune mediterranee, essa è costituito da un attrezzo installato presso i canali di marea degli ambienti umidi costieri. Realizzata in cemento, legno o plastica, consente la montata del pesce novello, impedendo il ritorno al mare degli stadi immaturi ed adulti.



UMBRELLA

Attrezzatura costituita da una canna, munita di robusto spago o lenza, piombo e ombrello rivestito di rete fine ed elastica. Quando il pesce si attacca alla lenza, la canna viene sollevata rapidamente estraendo il pesce dall'acqua, che in breve tende a staccarsi dall'esca e a ricadere dentro la rete dell'ombrello, da dove viene facilmente catturato.



EEL LONGLINES *PALANGARO*

Utilizzato principalmente nei laghi e nelle lagune è formato da un filo in nylon di lunghezza molto variabile al quale sono legati una gran quantità di terminali con ami innescati.

In Table IT.11 the number of nets of the different types used for eel commercial fishing in Italy in 2010, disaggregated by EMU and habitat typology (DCF, 2010), referred to the samples from each stratum. Most eel catch is from fykenet fisheries, used in all habitat typologies in all EMUs, fish barriers are used in managed lagoons, longlines are used only in some lakes and in some lagoons in the south. For recreational fisheries, the number of gears involved cannot be assessed.

Table IT.11. Number of nets of the different types used for eel commercial fishing in Italy in 2010, disaggregated by EMU and habitat typology (DCF, 2010).

EMU_Region_*Habitat*	FYK_*TRAPS FYKE NETS*			BAR_*BARRIER*			ELL_*EEL LONGLINES*			NTS_*NETS*		
	Fishing days/year (mean)	Fyke/day (mean)	TOTAL n° FYK	Fishing days/year (mean)	Day (mean)	TOTAL n° BAR	Fishing days/year	Hooks/day	TOTAL n° ELL	Fishing days/year	Net/day	TOTAL n° NTS
EMU_LOM_LAK	n.a.	n.a.	n.a.	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
EMU_FVG_LGN	264	65	1.618	-	-	-	100	200	2.000	100	n.a.	1
EMU_VEN_LAK	180	15	n.a.	-	-	-	n.a.	n.a.	2.000			
EMU_VEN_LGN	142	93	n.a.	n.a.	n.a.	3				n.a.	n.a.	1
EMU_VEN_RIV	93	124	n.a.	-	-	-						
EMU_EMR_LGN	65	115	230	-	-	-						
EMU_EMR_MLG	110	3	6	24	n.a.	2						
EMU_EMR_RIV	67	104	622	-	-	-						
EMU_TOS_LAK	n.a.	n.a.	n.a.	-		-						
EMU_TOS_MLG	123	35	1.329	n.a.	n.a.	3						
EMU_UMB_LAK	134	25	700	-	-	-	157	n.a.	4.180			
EMU_TOS_RIV	71	4	134	-	-	-						
EMU_LAZ_LAK	96	20	365	-	-	-						
EMU_LAZ_LGN	74	25	n.a.	n.a.	n.a.	1	119	429	6.000			
EMU_LAZ_RIV	183	125	n.a.	-	-	-						
EMU_PUG_LGN	93	61	1.820	-	-	-	40	1.000	1.000			
EMU_PUG_MLG	40	30	n.a.	-	-	-						
EMU_SAR_LGN	98	8	75	-	-	-						
EMU_SAR_MLG	89	8	3.066	29	n.a.	126	93	n.a.	670	200	n.a.	10
EMU_SAR_RIV	71	4	134	-	-	-				365	n.a.	360
			10.099			135			15.850			372

IT.5.1 Glass eel

No glass eel fishery took place in 2010 because the old regulation was discontinued, and the new regulation to be implemented under the Eel Management Plan was not in force yet.

IT.5.2 Yellow eel

See above.

IT.5.3 Silver eel

See above.

IT.5.4 Marine fishery

No marine fisheries occur in Italy.

IT.6 Catches and landings

Annual catch by life stage for commercial fisheries in the year 2010, as evaluated under the DCF programme, is reported in Table IT.12, by EMU, and by stratum (EMU_Habitat typology) in Table IT.13. Only yellow and silver eel catches were assessed, glass eel fisheries being closed in 2010.

Total catch by life stage for recreational fisheries by Region is reported in Table IT.14, relative to 2010, evaluated under the DCF Programme.

Table IT.12. Yellow and silver eel commercial catches, and total for the two stages cumulated, for 2010, disaggregated by EMU (DCF, 2010).

	KG YELLOW EELS	KG SILVER EELS	TOTAL (KG)	TOTAL (T)
EMU_LOM	250,28	2.034,15	2.284,43	*2,28*
EMU_FVG	3.769,92	19.264,00	23.033,92	*23,03*
EMU_VEN	14.323,39	14.492,99	28.816,38	*28,82*
EMU_EMR	2.202,33	18.705,17	20.907,50	*20,91*
EMU_TOS	13.402,38	35.704,73	49.107,12	*49,11*
EMU_UMB	7.317,39	0,00	7.317,39	*7,32*
EMU_LAZ	14.349,78	16.345,87	30.695,65	*30,70*
EMU_PUG	4.736,50	7.787,66	12.524,16	*12,52*
EMU_SAR	34.910,70	39.792,54	74.703,24	*74,70*
Total	*95.262,68*	*154.127,10*	*249.389,77*	*249,39*

Table IT.13. Yellow and silver eel commercial catches, and total for the two stages cumulated, for 2010, disaggregated by stratum (EMU and habitat typology) (DCF, 2010).

EMU REGION_*HABITAT*	KG YELLOW EEL	KG SILVER EEL	TOTAL Y+S (KG)	TOTAL Y+S (T)
EMU_LOM_LAK	250	2.034	2.284	*2,3*
EMU_FVG_LGN	3.770	19.264	23.034	*23,0*
EMU_FVG_RIV	0	0	0	*0,0*
EMU_FVG_MLG	0	0	0	*0,0*
EMU_VEN_RIV	1.067	2.956	4.023	*4,0*
EMU_VEN_LAK	1.600	400	2.000	*2,0*
EMU_VEN_LGN	11.656	11.137	22.793	*22,8*
EMU_VEN_MLG	0	0	0	*0,0*
EMU_EMR_RIV	658	109	768	*0,8*
EMU_EMR_LGN	900	100	1.000	*1,0*
EMU_EMR_MLG	644	18.496	19.140	*19,1*
EMU_TOS_RIV	0	0	0	*0,0*
EMU_TOS_LAK	0	0	0	*0,0*
EMU_TOS_MLG	13.402	35.705	49.107	*49,1*
EMU_UMB_LAK	7.317	0	7.317	*7,3*
EMU_LAZ_RIV	5.880	455	6.335	*6,3*
EMU_LAZ_LAK	5.095	12.201	17.296	*17,3*
EMU_LAZ_LGN	3.375	3.690	7.065	*7,1*
EMU_LAZ_MLG	0	0	0	*0,0*
EMU_PUG_LGN	4.337	6.588	10.924	*10,9*
EMU_PUG_MLG	400	1.200	1.600	*1,6*
EMU_SAR_RIV	268	245	513	*0,5*
EMU_SAR_LGN	770	199	969	*1,0*
EMU_SAR_MLG	33.873	39.349	73.221	*73,2*
Total	*95.263*	*154.127*	*249.390*	*249,4*

Table IT.14. Yellow and silver eel catches, and total for the two stages cumulated, from recreational fisheries in 2010, disaggregated by Region (DCF, 2010).

Region	Code	Habitat	Yellow eel	Silver eel	Y+S (kg)	Y+S (t)
Valle d'Aosta	VDA		0	0	0	0
Piemonte	PIE	RIV	95	0	95	0
Lombardia	LOM	LAK	23.129	0	23.129	23
		RIV	18.940	0	18.940	19
Trentino Alto Adige	TAA		0	0	0	0
Friuli Venezia Giulia	FVG	RIV	0	120	120	0
Veneto	VEN	RIV	2.943	0	2.943	3
		RIV-LGN	65.595	2.760	68.355	68
Liguria	LIG	RIV	10.262	0	10.262	10
Emilia Romagna	EMR	RIV	9.348	7.200	16.548	17
Toscana	TOS	RIV	686	630	1.316	1
Marche	MAR	RIV	738	0	738	1
Umbria	UMB	LAK	3.429	0	3.429	3
Lazio	LAZ	RIV	0	1.260	1.260	1
Abruzzo	ABR		0	0	0	0
Molise	MOL		0	0	0	0
Campania	CAM	RIV	888	840	1.728	2
		LAK	36	0	36	0
Basilicata	BAS		0	0	0	0
Puglia	PUG		0	0	0	0
Calabria	CAL		0	0	0	0
Sicilia	SIC	RIV	640	0	640	1
Sardegna	SAR		0	0	0	0
Total			***136.728,6***	***12.810,0***	***149.538,6***	***149,5***

IT.6.1 Glass el

No glass eel catch occurred in 2010 because the old regulation was discontinued, and the new regulation to be implemented under the Eel Management Plan was not in force yet.

IT.6.2 Yellow eel

See above.

IT.6.3 Silver eel

See above.

IT.6.4 Marine fishery

No marine fisheries occur in Italy.

IT.7 Catch per unit of effort

Catch per unit of effort has been assessed under the DCF Programme for year 2010, only for commercial fisheries. Cpue has been calculated as mean catch for 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 IT.15, annual mean cpue for 2010 are reported by stratum (EMU_Habitat typology), for commercial landings.

Table IT.15. Yellow and silver eel cpue (kg/fisherman) and for the two stages cumulated, for 2010, disaggregated by stratum (EMU and habitat typology) (DCF, 2010).

EMU REGION_*HABITAT*	YELLOW EEL	SILVER EEL	Y&S
EMU_LOM_LAK	3,5	28,7	32,2
EMU_FVG_LGN	59,8	305,8	365,6
EMU_FVG_RIV	0,0	0,0	0,0
EMU_FVG_MLG	0,0	0,0	0,0
EMU_VEN_RIV	62,8	173,9	236,7
EMU_VEN_LAK	40,0	10,0	50,0
EMU_VEN_LGN	113,2	108,1	221,3
EMU_VEN_MLG	0,0	0,0	0,0
EMU_EMR_RIV	131,7	21,8	127,9
EMU_EMR_LGN	180,0	20,0	200,0
EMU_EMR_MLG	80,5	2312,0	2392,5
EMU_TOS_RIV	0,0	0,0	0,0
EMU_TOS_LAK	0,0	0,0	0,0
EMU_TOS_MLG	446,7	1190,2	1636,9
EMU_UMB_LAK	221,7	0,0	221,7
EMU_LAZ_RIV	840,0	65,0	905,0
EMU_LAZ_LAK	141,5	338,9	480,4
EMU_LAZ_LGN	75,0	82,0	157,0
EMU_LAZ_MLG	0,0	0,0	0,0
EMU_PUG_LGN	73,5	111,7	185,2
EMU_PUG_MLG	100,0	300,0	400,0
EMU_SAR_RIV	44,7	40,8	85,4
EMU_SAR_LGN	59,2	15,3	74,6
EMU_SAR_MLG	52,0	60,4	112,3

IT.7.1 Glass eel

No glass eel catch occurred in 2010 because the old regulation was discontinued, and the new regulation to be implemented under the Eel Management Plan was not in force yet.

IT.7.2 Yellow eel

See above.

IT.7.3 Silver eel

See above.

IT.7.4 Marine fishery

No marine fisheries occur in Italy.

IT.8 Other anthropogenic impacts

Na.

IT.9 Scientific surveys of the stock

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 carried out for every EMU (Region), in a site, lagoon or catchment representative of the EMU, and samples are obtained from local commercial fisheries (See Section 13).

Other samplings are carried out within regional monitoring and programmes, and within specific research programmes, and a central coordination is foreseen among the actions for the Eel Management Plan implementation, and for the specific assessment implemented by the Ministry of Agriculture within a specific Programme (Università Tor Vergata, Università di Parma), in view of the 2012 Report as requested by Article 9 of the Regulation 1100/2007.

No definitive data are available at the moment that can be used for the purpose of the present Report.

IT.10 Catch composition by age and length

In DCF, this refers to commercial catches, not to research. This Section should include both DCF and research sampling.

IT.11 Other biological sampling

Other biological samplings are carried out within specific research programmes, but no routine monitoring is in place for any "quality" issue, such as parasites infection, not even *Anguillicola crassus*, or contamination. Some analyses are currently being performed within a scientific collaboration coordinated by the University of Padova, in which the University of Rome Tor Vergata and the University of Antwerp are involved.

IT.11.1 Length and weight and growth (DCF)

Biological data regarding variables such as length, weight, age, growth and parasitism are collected regularly as part of DCF programme from the commercial fisheries in each EMU. The Department of Biology of Tor Vergata University, Rome is responsible for collecting these data. In Table IT.16 the sampling programme for the 2009–2010 DCF programme is summarized.

Table IT.16. Yellow and silver eel cpue (kg/fisherman) and for the two stages cumulated, for 2010, disaggregated by stratum (EMU and habitat typology) (DCF, 2010).

No.	Sampling site	Yellow/Silver eel	EMU	Habitat	Fishing gear	Year of sampling	Sample size (n)

1	Fogliano lagoon	Y and S	EMU_LAZ	Brackishwater	Fykenets	2009	120
2	Comacchio lagoon	Y and S	EMU_EMR	Brackishwater	Fykenets	2010	151
3	Orbetello lagoon	Y and S	EMU_TOS	Brackishwater	Fykenets	2010	202
4	Cabras lagoon	Y and S	EMU_SAR	Brackishwater	Fykenets	2010	183
5	Varano lagoon	Y and S	EMU_PUG	Brackishwater	Fykenets	2010	104
6	Venice lagoon	Y	EMU_VEN	Brackishwater	Fykenets	2010	75
7	Tiber river	Y and S	EMU_LAZ	Freshwater	Fykenets	2009	120
8	Bolsena lake	Y and S	EMU_LAZ	Freshwater	Fykenets	2009	120
9	Trasimeno lake	Y and S	EMU_UMB	Freshwater	Fykenets	2010	107
10	Garda lake	S	EMU_LOM	Freshwater	Fykenets	2010	60

Figure IT.7. Map of eel sampling sites in the Italian Eel Management Units (EMUs). Red dots: Location of sites where eel samples were collected commercial eel catches (see Table IT.16).

A pilot sampling programme started in 2009 in one EMU (EMU_LAZ, Lazio) that foresaw three samples from three different habitat typologies (Tiber river, Fogliano lagoon, Bolsena lake), that gave insight for the methodological and statistical requirements of further samplings. In 2010 the samplings was completed by including other seven EMUs. For each EMU the sampling has been carried out in the most representative commercial fisheries site, where catches were > 20 t (Figure IT.7).

Length distributions by sex of both yellow and silver eels from the different sampling sites were compared (Figure IT.8).

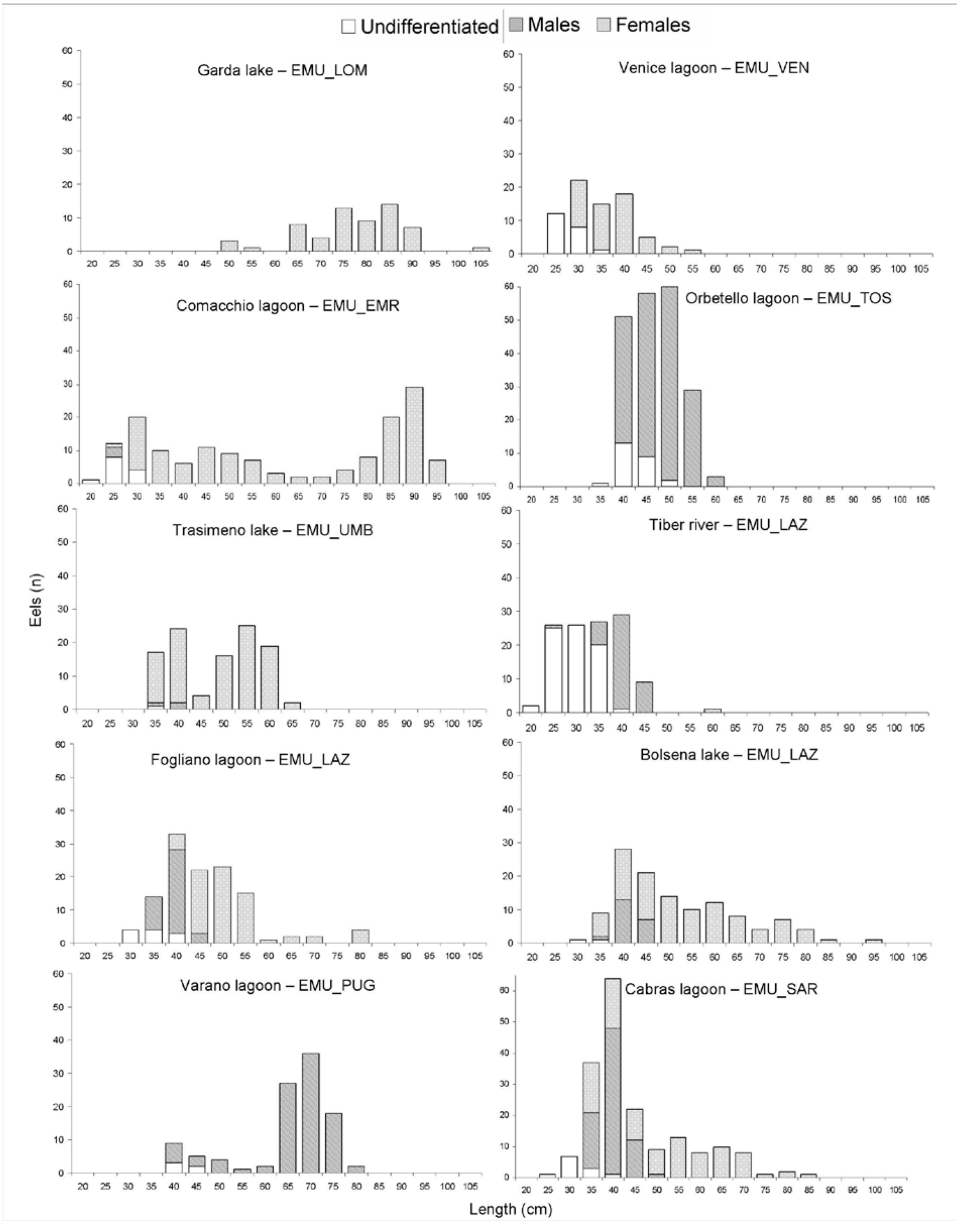


Figure IT.8. Length distributions by sex in the sampling sites from different habitat typologies in six Italian EMUs.

Length (cm) and condition factor-at-age (calculated as W*1000/Lt^3; W = somatic weight in g; Lt = total length in cm) were analysed separately for freshwater and brackish water habitats (Figures IT.9 and IT.10).

The length-at-age tended to be higher in samples from brackish water habitats, i.e. lagoons, compared to samples from freshwater habitats as lakes and rivers. On the contrary, somatic condition factor-at-age does not seem to increase with age.

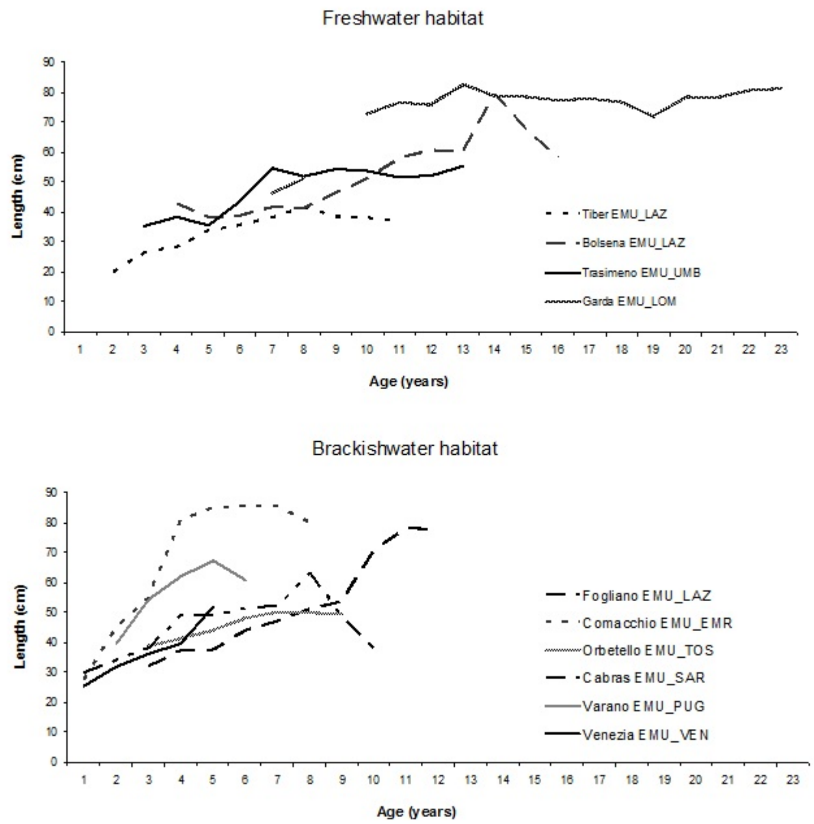


Figure IT.9. Length-at-age of yellow and silver eel from samples collected for the DCF among commercial fykenet catches in 2009 and 2010, from six EMU in Italy, in freshwater (upper graph) and brackish water (lower graph) habitats.

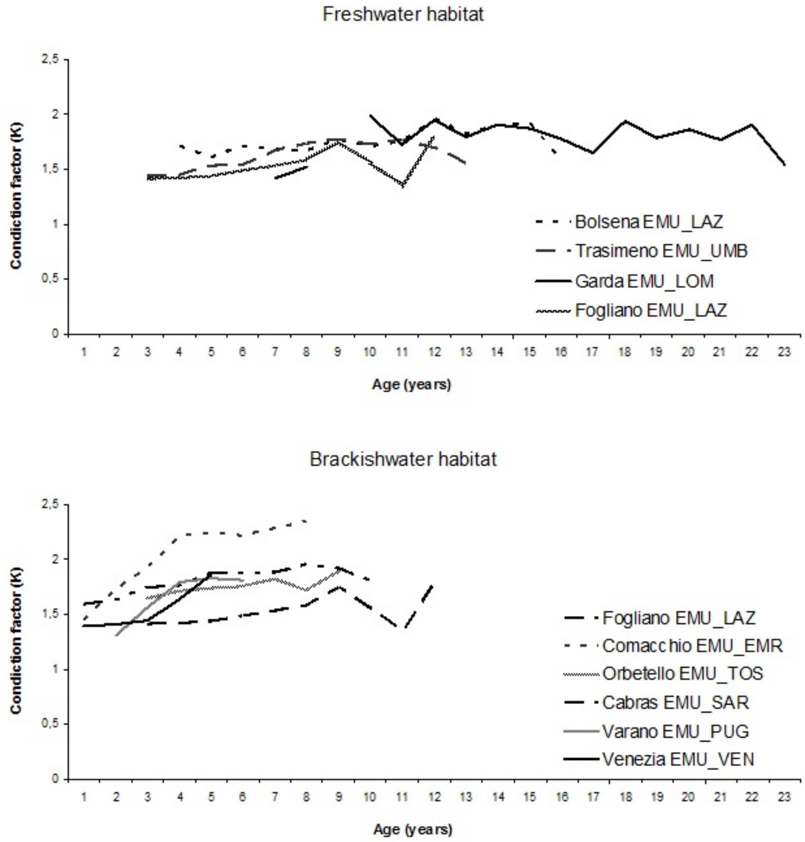


Figure IT.10. Condition factor-at-age of yellow and silver eel from samples collected for the DCF among commercial fykenets catches in 2009 and 2010, from 6 EMU in Italy, in freshwater (upper graph) and brackish water (lower graph) habitats.

IT.11.2 Parasites and pathogens

Na.

IT.11.3 Contaminants

Na.

IT.11.4 Predators

Na.

IT.12 Other sampling

Na.

IT.13 Stock assessment

IT.13.1 Local stock assessment

At the present moment, there is no routine methodology for local stock assessment in Italian waters, nor routine evaluations. over For the purposes of the Italian EMP, local stock assessment was performed at the eel management unit level (i.e. regions) for wetted areas, also taking into account specific habitat typologies (see Table IT.2), by means of a demographic model tuned on available data on recruitment, fishing effort and age/size structure. The model (DemCam) developed by Bevacqua *et al*. from

University of Parma and Politecnico di Milano was used, specifically revised for the purposes of.

IT.13.1.1 Summary

DemCam was developed specifically for the assessment of eel stock and catches in spatially implicit environments such as lagoons, lower water system or uniform traits of rivers. A general formulation makes it suitable to describe the demography of other different eel stocks, provided that a sufficient number of data are available for parameter calibration. The model covers the whole continental phase of European eel's life cycle, from the recruitment at the glass eel stage until the escapement of silver eels migrating. It defines the eel stock and the harvest structured by age, length, sex and maturation stage (yellow or silver) on an annual basis.

IT.13.1.2 The considered processes

The model takes specifically into account:

- recruitment variability from year to year;
- system carrying capacity and consequent density-dependent survival of glass eels, and adults;
- density-dependent sex ratio;
- distinct growth paths for undifferentiated, male and female eels;
- sex and size dependent natural mortality;
- sex and size dependent sexual maturation;
- fishing mortality depending on fishing effort and fish size as a result of gear selectivity and/or minimum landing size;
- possible extra mortality on silver eels during migration.

The model can be used to simulate efficacy of different scenarios relevant to juvenile recruitment, fishing pressure and obstacles to migration.

IT.13.1.3 Detailed description

The model mimic population dynamics of different cohort of eels with annual time-step t. Eel population is structured in age and maturation stage with state variable given by N(t,x,s) indicating the abundance, at time t, of eels having age x and in maturation stage s (maturation stage can be undifferentiated, yellow males, yellow females, silver males, silver females).

IT.13.1.4 Juvenile recruitment

Any considered system is characterized by a settlement carrying capacity S_{MAX} representing the maximum number of settlers that the system can annually sustain. This is a key parameter that determines density levels and consequent sex ratios (values of S_{MAX} usually range between 500–2000 elver/ha according to the system productivity).

Every year a glass eel recruitment/stocking of R individuals occurs in the system. The stocking of an elver is assumed to correspond to that of four glass eel considered that a glass eel have ¼ of probability to attain the elver stage (Dekker, 2000).

In case of artificial stocking of elvers, the corresponding value.

Whatever the value of glass eel recruitment $R(t)$, no more than S_{MAX} elvers can enter the system and contribute to cohort strength. In fact, survival probability of recruited glass eel to the elver stage is computed as $1/(1+R/S_{MAX})$ and consequently the effective number of settlers is computed as $S(t) = R(t)*1/(1+R(t)/S_{MAX})$.

IT.13.1.5 Sex ratio

The fraction of males in the entering cohort is set as: 0.25 if $S(t)/S_{MAX} < 0.25$; 0.75 if $S(t)/S_{MAX} > 0.75$; $S(t)/S_{MAX}$ otherwise.

IT.13.1.6 Body growth

Body growth has been estimated following the approach of Andrello *et al*. (2011) who adopted the body growth model of Melià *et al*. (2006) to any other eel stock, provided to know age and length at silvering of males and females (See Andrello *et al*., 2011 for details).

Individual weight w [g] is estimated from body length l [cm] as $w = a*l^b$ where $a = 8.34\ 10^{-4}$ and $b = 3.17$ (average parameters for *A. anguilla* obtained from Bevacqua *et al*., 2011)

IT.13.1.7 Natural mortality

Natural mortality was estimated through the model proposed by Bevacqua *et al*. (2011) who allows estimating mortality rates as a function of sex, size, temperature and density level. Water temperature is assumed as annual average water temperature and density level at time t is computed as a function of standing stock density $N(t)$ and elver carrying capacity S_{MAX}. Particularly, if $N(t)/S_{MAX} < 1$ density is assumed as low, if $1 < N(t)/S_{MAX} < 2$ density is assumed as average and if $N(t)/S_{MAX} >= 2$ density is assumed as high (see Bevacqua *et al*., 2011 for details).

IT.13.1.8 Fishing mortality

Fishing mortality rate is estimated as $F = q*E(t)*$□ where q is catchability (a parameter representing eel susceptibility to the fishing gear), E is fishing effort (measured as number of gears per day per hectare) and □ is gear selectivity, which ranges from 0 to 1, depends on mesh size and increases with fish size (see Bevacqua *et al*., 2009 for details). In presence of a minimum landing size MLS, □ is assumed equal to 0 for fish sizes < MLS. Note that if the data provider is able to provide a reliable assessment of fishing mortality rate $F(t)$, data of E and q are not needed.

IT.13.1.9 Sexual maturation

Probability of an individual to undergo sexual maturation is computed according to the model of Bevacqua *et al*. (2006) with parameters modified according to average maturation size and age observed in the considered system as in Andrello *et al*. (2011).

IT.13.1.10 Migration mortality

The model allows adding extra mortality to silver eel due to susceptibility to obstacles to migration. In this case an extra survival fraction for silver eel can be considered before estimating the effectively migrating spawning stock.

IT.13.1.11 Data requirement

The model requires two kind of data to be run, time variable data which might vary between years and constant data which mainly reflects characteristics of the system and, for sake of simplicity and absence of reliable data, are erroneously considered as constant.

IT.13.1.12 Time-dependent data

- habitat availability at year *t* (ha)
- glass eel recruitment + stocking at year *t* (kg)
- elver recruitment + stocking at year *t* (kg)
- fishing effort at year *t* (# gears per day)

IT.13.1.13 Constant data

- first year of simulation
- last year of simulation
- system carrying capacity (elvers per year per hectare)
- survival probability from glass to elver stage (needed to convert elver to glass eel stocking)
- annual average water temperature
- average weight of a glass eel
- average weight of an elver
- parameters *a* and *b* used in the allometric relationship w=a*l^b
- stretched mesh size (mm)
- minimum landing size (mm)
- yellow eel catchability q_Y
- silver eel catchability q_S
- average age for male silvering (yr)
- average age for female silvering (yr)
- average length for male silvering (mm)
- average length for female silvering (mm)

IT.13.1.14 Output

The model assesses stock abundance and structure in terms of age, sex and maturation stage during the all simulation time. The state variable is initially set as equal to zero, hence all age classes are fully represented in the modelled stock when a *n* years passed since model running, where *n* corresponds to the maximum age observed in the system.

IT.13.1.15 Model applications

Italy presented a mixed EMP that includes a National EMP and nine Regional EMPS. The former deals only with coastal waters, and hence only with glass eel fisheries. The nine EMPs take account of the eel local stock, and hence assessment were made for each Region. Within each Region, a habitat based approach was used for assessments, considering separately lake, river and estuarine waters and lagoon surfaces, and the DemCam model was applied to each of these strata.

IT.13.2 International stock assessment

IT.13.2.1 Habitat

For the entire national level, the contribute of different habitat was summed up by considering the overall extension of the different habitats.

Wetted Area: lacustrine: 147 688 ha

riverine: 79 296 ha

transitional and lagoon: 101 650 ha

A more precise evaluation of European eel habitat is at present being done, within a specific project (University of Rome, Tor Vergata-University of Parma), aimed at performing the assessments required by Article 9 of the Regulation 1100/2007 and in view of the preparation of the 2012 Report. This is done using a GIS technology, also considering the bathimetry of lakes and the hydrodynamic information about rivers, and additional ancient literature and grey literature that has been brought forward in the meantime.

As preliminary results, it is possible to say that the suitable area of lakes is far lower than the whole wetted surface considered (~10%) as eels have been rarely found in deep waters. Riverine surface seems to be overestimated, because second or higher order rivers have a minor or null production that was such also in pristine times. On the contrary available lagoon extension might be larger (~150%).

The results of this detailed analysis will be included in the report of 2012.

Table IT.17. Surface areas of inland water bodies (rivers and natural and man-made lakes) and transitional waterbodies (open lagoons, lagoons with fixed eel traps and privately owned lagoons) by administrative region for Italy 20 regions (EMU).

	Water body type				
	Freshwater		Salt or brackish water		
Region	Rivers total area (m²)***	Natural & man-made lakes (ha)****	Lagoons with no fixed eel trap****	Lagoons with fixed eel trap	Private
Valle d'Aosta	8082343	812	0	0	0
Piedmont	76846186	4285	0	0	0
Lombardy*	53780639	44899	0	0	0
Trentino Alto Adige	36957411	5107	0	0	0
Friuli-Venezia Giulia	20361237	789	11555	0	1705
Veneto**	39678055	37031	31245	0	18510
Liguria	20501820	386	0	0	0
Emilia-Romagna	53599783	637	0	1659	14298
Tuscany	76903234	1933	0	2866	0
Marche	29539077	416	0	0	0
Umbria	27167787	13742	0	0	0
Lazio	49002249	22077	0	1164	0
Abruzzi	24357815	1916	0	0	0
Molise	12990615	2339	0	0	0
Campania	31985483	624	99	289	0
Basilicata	29408633	2802	0	0	0
Apulia	22883981	382	6541	5182	0
Calabria	47817123	3296	0	0	0
Sicily	55684885	4706	381	0	0
Sardinia	75212990	12274	5521	7307	0
Total	***792761346***	***160454***	***55342***	***18467***	***34513***

Key:

*** The whole of Lake Maggiore was assigned to the Lombardia region.**

**** The whole of Lake Garda was assigned to the Veneto region.**

***** Calculated on the basis of the water bodies (rivers) as represented on official IGM 1:250 000 scale maps [Istituto Geografico Militare: Military Geography Institute); the values were calculated by multiplying the length of the river by 5 metres, where 5 metres is taken as the average width of Italy's rivers.**

****** Calculated on the basis of the water bodies (lakes) as represented on official IGM 1:250 000 scale maps.**

IT.13.2.3 Silver eel production

IT.13.2.3.1 Historic production

B_0 = 6960 tons

Data on pristine production of Italian wetted area are lacking, even if within the project mentioned above some new insights are being brought forward. Most of the available data rely on catch of silver eel fisheries. An estimation of the historical production can only be given with an approximation, as it has been done for the implementation of the Italian EMP. Analysing the variety and the distribution of the different habitats, most of them are medium and high productive lagoons, it is possible to guess an historical production, on average, of 20 kg/ha. This means an historical production of 6960 tons of silver eels each year.

In the next future the analysis of historical silver eels catches, especially in those cases where fishing gear (e.g. *lavorieri*) allowed fishing only, and entirely, the migrating silver eels, associated with the few literature data and the extensive use of the model DemCam (assuming an eel settlement equal to the carrying capacity of the system S_{MAX} and absence of anthropogenic sources of mortality) will be necessary to adjust this first estimation.

A first analysis of literature and fisheries data confirm an average production of 20 kg/ha but the whole production is strongly affected by the surface considered. Considering the preliminary results of suitable areas the corrected production might be lower.

IT.13.2.3.2 Current production

B_{best} = 663 tons

For the implementation of the Italian EMP the current production was evaluated for each Region. For all those Regions where there is no EMP, the production was calculated using catches data from ISTAT, corrected with the hypothesis of Moriarty & Dekker (1997) of a 100% unreported catches. This was a requirement from ICES within the exchanges and adjustments made for the IT-EMP evaluation, but there is evidence that this assumption is not true for adult eel, Illegal and unreported catches being limited to glass eels in Italy. There are no historical data available. For these Regions the estimate of silver eel production is 187 tons. For all other Regions literature and fisheries data were used for the evaluation of the current production with a total amount of 476 tons of silver eel per year.

With the actions for implementation and coordination of IT-EMP, all watersheds will be monitored in order to have a better estimation of the current production. The best estimate of escaping biomass will be also assessed by the demographic model, inferring actual recruitment from specific surveys or international indices of recruitment abundance over the last decades, and setting to zero all the anthropogenic mortalities.

IT.13.2.3.3 Current escapement

At the present moment, no evaluation of the actual escapement of silver eel is available, except for those Regions where fishing pressure has stopped (the eleven Regions with no EMP). Here the escapement is equal to the production estimated in the previous section (187 tons). The monitoring phase scheduled will allow an assessment of the actual escapement from the nine key Regions endowed of the Regional EMPs. Current estimate of escaping biomass will be also assessed by the demographic model by inferring actual recruitment from specific surveys or international indices of recruitment abundance over the last decades, and explicitly considering the effect of all the anthropogenic mortalities.

IT.13.2.3.4 Production values e.g. kg/ha

Historical production: 20 kg/ha

Preliminary results from literature and fisheries data analysis:

North Adriatic lagoons:	14.0 kg/ha (DeLeo and Gatto, 1995);
South Adriatic lagoons:	83.6 kg/ha (Lumare and Villani, 1989);
Tyrrhenian lagoons:	57.5 kg/ha (Innamorati and Melillo, 2004);
Sardinia lagoons:	28.6 kg/ha (Cannas PNR Sardinia, 2007);
Lakes:	4.2 kg/ha (European mean, Moriary and Dekker, 1997);
Rivers:	3.4 kg/ha (Shannon river, Moriarty and Dekk er, 1997).

Current production

No EMP Regions:	2.88 kg/ha
EMP Regions:	1.80 kg/ha

IT.13.2.3.5 Impacts

In the Italian situation where most of the spawning stock comes from lagoons, the main impact to eel production is fishery, loss of habitat (e.g. land reclamation), pollution and presence of the parasite *Anguillicoloides crassus* which is absent in salt waters (ca. >25).

In this context, dams and other obstacles to upstream migration can be considered as a minor impact to the potential eel production of the Italian water system, as eel stock is largely concentrated in low stream waters.

IT.13.2.3.6 Stocking requirement eel <20 cm

Table IT.18. Glass eel (and bootlace for Lombardia) requirements for stocking, for the purposes of the IT-EMP.

Region	EMU	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*
Lombardia	EMU_LOM	t (bootlac	t (bootlac	t (bootlac	t (bootlac	t (bootlac	t (bootlac	t (bootlac	t (bootlac	t (bootlac	t (bootlac	t (bootlace)		
Friuli	EMU_FVG	100,0	300,0	500,0	500,0	500,0	750,0	750,0	1.000,0			2.020,0		
Veneto	EMU_VEN	2.600,0	2.600,0	2.600,0	2.600,0	2.600,0	2.600,0	2.600,0						
Emilia Romagna	EMU_EMR	638,3	638,3	638,3	638,3	638,3	638,3	638,3						
Umbria	EMU_TOS	35,0	45,0	60,0	70,0	110,0	150,0	200,0	230,0	290,0	320,0	360,0	380,0	405,0
Lazio	EMU_UMB	1.124,2	1.124,2	1.124,2	1.124,2	1.124,2	1.124,2	1.124,2						
Toscana	EMU_LAZ	540,0	540,0	540,0	540,0	540,0	540,0	540,0						
Puglia	EMU_PUG	552,0	552,0	552,0	552,0	552,0	552,0	552,0						
Sardegna	EMU_SAR	739,0	739,0	739,0	739,0	739,0	739,0	739,0						
Total kg glass eel		**8.338,5**	**8.549,5**	**8.765,5**	**8.776,5**	**8.817,5**	**9.108,5**	**9.159,5**	**3.247,0**	**2.308,0**	**2.339,0**			
Total kg bootlace (Lombardia)		7.000,0	7.000,0	7.000,0	7.000,0	7.000,0	7.000,0	7.000,0	7.000,0	7.000,0	7.000,0	7.000,0	7.000,0	7.000,0

In order to sustain and increase spawner production in the next years. Italian EMP implies stocking of glass eels (6–7 cm) in the next years as reported in the following table. The entire amount of glass eel to be stocked in the next five years is around 6 tons plus 6 tons of bootlace (ca. 15 cm).

IT.13.2.3.7 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

IT.13.2.3.8 Data quality issues

Na.

IT.14 Sampling intensity and precision

Na.

IT.15 Standardization and harmonization of methodology

In all samplings, those under the DCF Italian Programme as well as those carried out within specific research programmes, standard methodologies are usually followed, according to the most recent literature and /or debated within specific working groups. The following information concerns standardized methodologies carried out within recent national programmes that have involved some research groups (University of Rome Tor Vergata, University of Parma, University of Padova), but not necessarily all monitoring and researches in the country, especially at local levels, follow the same methodology. It is as a matter of fact possible that some monitoring and scientific activities take place that follow other methodologies.

IT.15.1 Survey techniques

Usually surveys rely on professional fishermen, hence traditional fykenets have mostly been used in all recent surveys. Fykenets are usually used in chains of ten nets each, or organized in a triangle arrangement with a net in each vertex. A traditional fykenet consists of three chambers and a codend with knot to knot mesh sizes of 30, 12, 10, and 8 mm respectively. The diameter of the trap entrance is usually around 30 cm and the outer ring of each trap is O or D shaped.

IT.15.2 Sampling commercial catches

The sampling scheme under DCF National Programme foresees to perform biological samplings by local commercial fishers. For 2009–2010, the sampling scheme has foreseen to sample from three different habitat typologies (Tiber river, Fogliano lagoon, Bolsena lake) in one EMU (EMU_LAZ was chosen), in order to have insight on the methodological and statistical requirements of further samplings. In 2010 the samplings was completed by including other seven EMUs. For each EMU the sampling has been carried out in the most representative commercial fisheries site, where catches were >20 t (Table IT.16, Figure IT.7). A definitive sampling scheme has been presented in the 2011–2013 Italian National Program under Council Regulation N° 199/2008 and Commission Regulation (EC) N° 665/2008.

IT.15.3 Sampling

Sampling is usually carried out by taking a random batch of eel 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 scarified or frozen for other analyses. Length is measured usually to the precision level of ±0.1 cm and weight to ±1 g. When gonadal tissue is taken, it is fixed in Bouin liquid or buffered formaline. Otoliths are stored dry in *eppendorf*.

IT.15.4 Age analysis

Age analysis of eel in Italy usually relies on the grinding & polishing method (Daverat, 2005). Otoliths are extracted and cleaned to eliminate any remainder of organic tissues. Then the right otolith is embedded in resin and mounted in a slide. Polishing is done with water on a series of abrasive paper with decreasing roughness and finishing with 1 um alumina paste on a polishing cloth. The process is checked frequently under light microscope to reach exactly the primordium. Last step foresees a decalcification process of the grinded otolith surface with acid attack (EDTA 5%) and staining with toluidine blue (5%). Otolith reading is performed under a microscope with high resolution power. The reading is facilitated if a video camera and monitor are coupled to the microscope. There is no specific formal validation or quality control, besides those carried out within ICES coordinated actions such as WKAREA I and II.

IT.15.5 Life stages

Glass Eel/elver stages are determined by evaluating pigmentation using the classification by Strubberg (1913), and/or the one by Elie *et al*. (1982).

Yellow eel and silver eel are categorized by a combination of different approaches: skin colouration, the ocular area index (Punkhurst, 1982), the silvering index (Durif, 2005) and gonads histological analysis. Silver eels are generally captured during their downstream migration, or can be recognized in the brown eel catch by the enlarged eyes and onset of coloration change.

IT.15.6 Sex determinations

Yellow eel <25 cm are considered undifferentiated. Eel >25 cm are sexed by dissection and histological analysis following the protocol of Colombo and Grandi (1996).

IT.16 Overview, conclusions and recommendations

In the present report an overview of the European eel stock and fisheries is presented for Italy, that takes account of all the activities that has taken place in 2010 among the actions for the implementation of the IT-EMP (under Regulation 1100/2007), that has been approved in July 2011 and hence in force. Furthermore, data are now available owing to the implementation of the DCF Programme for Eel that includes data collection also for recreational fisheries.

In the next future (2011–2012), a number of coordinated actions will take place in view of the definite implementation of the IT-EMP. A national project aiming at collecting data and providing a resource assessment is currently going on, in order to provide data for the 2012 Report expected under Article 9 of Regulation 1100/2007.

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Report on the eel stock and fishery in Latvia 2010/'11

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Reporting Period: This report was completed in August 2011, and contains data up to 2010 and some provisional data for 2011.

Contributors to the report: Janis Birzaks.

LT.2 Introduction

Latvia's system of fishing regulation and catch recording has been adapted from the respective legislation of the former USSR, when the private sector in fisheries was almost non-existent. Therefore these requirements in Latvia are tighter than in the majority of EU Member States. This is the reason why it is not necessary to change the principles and control system of fishing in inland waters in accordance with Article 10 of EC 1100/2007, as the existing fishing regulatory and control system covers both public and private waters. More it reflects to the coastal waters where the direct eel fisheries are not conducted at all.

LT.2.1 Principles of eel fishing regulation

Fishery Law determines the commercial fisheries and self consumption fisheries (. It is forbidden to sell the fish caught in self consumption fisheries. Limits on eel fishing gear are allocated only for commercial fisheries.

The number of eel fishing gear units (traps or eel weirs) is set individually for each waterbody (fishing gear limit). Such practice of fishing regulations in eel fisheries has established since 1999 (in some lakes, since 2000). In order to conduct commercial fishing, an operator needs:

1) in public waters or waters where fishing rights belongs to state, a fishing right lease agreement, which has been concluded with the local municipality;
2) a permit for commercial entrepreneur activities issued by the local municipality;
3) fishing licence issued by Marine and Inland Waters Administration (MIWA) regional control sector.

These requirements apply both to public and private waters. Fishing regulations determine specifications of fishing gear (size, mesh size), fishing seasons, fishing areas and eel size limits in fishing, provisions apply to all waters, including the privately owned waters.

Landings are reported in monthly logbooks by the date, number and type of gear, catch/landing in kg.

Since 2010 the number of commercial fishing gears in inland waters is fixed. Every change of gear number should be accepted by BIOR (as adviser) and Ministry of Agriculture and finally approved by Cabinet of Ministers for a one year period.

LT.2.2 Collection of fishing data

Every person fished by gear used in commercial fishing obligates fill up the logbook. Logbooks are based on registration of fishing occasions.

Logbooks from coastal and inland fisheries were collected by local Boards of MIWA and transmitted to BIOR for data summarization and storing. All logbooks data were verified by BIOR.

National sea and coastal fisheries database (ICIS) are administrated by Department of Fisheries Ministry of Agriculture. ICIS is connected with vessels register.

Inland fisheries data maintained by BIOR and at once in quarter handed to State Board of Statistics (SBS).

ICIS data and data from SBS are used as official data.

LT.3 Time-series data

Only time-series of landings (yellow and solver eel mixed) and restocking available.

LT.3.1 Recruitment-series and associated effort

Na.

LT.3.1.1 Glass eel

LT.3.1.1.1 Commercial

LT.3.1.1.2 Recreational

LT.3.1.1.3 Fishery-independent

LT.3.1.2 Yellow eel recruitment

LT.3.1.2.1 Commercial

LT.3.1.2.2 Recreational

LT.3.1.2.3 Fishery-independent

LT.3.2 Yellow eel landings

Eel landings are not separated by yellow and silver eel. Dataseries on eel landings (mixed) available for:

- eight lakes restocked by eel. These lakes are not accessible for natural eel. Time-series available of all species landings since 1945–1946 till now;
- one lake and one lake system of four connected lakes without eel restocking before 2011. These lakes are accessible for eel. Time-series available of all species landings since 1945–1946 till now.

Coastal waters time-series of all species landings from 1924 till now (except World War II years).

LT.3.2.1 Commercial

Only data on commercial fishing is available.

LT.3.2.2 Recreational

Only eel angling is allowed in Latvia for recreational purposes, no data, except inquiry. Limits of eel fishing gear of the type used in commercial fishery for self consumption fishing have not been allocated.

The data on the amount of eel caught in angling in inland waters have been evaluated on the basis of the questionnaire of 2007. The values used in the evaluation are displayed in Table. The evaluation of catches by anglers' place of residence and direct registration of catches in angling sites showed that the total quantity of eels caught in angling in Latvia ranged from 1.9–4 t a year. These indicators apply to the entire territory of Latvia, but it may be presumed that the proportion of eels in anglers' catches is higher in the major eel stocked production lakes of Latvia's RBDs.

Angling impact evaluation according to the results of questionnaire of 2007.

The number of anglers in Latvia	100 000
The number of respondents	3223
The average number of angling days and the average catch per year (all species)	49 days and 58kg
The number of eel anglers (N%)	77/4.1
The proportion of eels in catches	<1%
The quantity of eels in catches according to the questionnaire results	~4 t
The number of the respondents in angling sites	1386
The proportion of eels in catches	1 or 0.2%
The quantity of eels in catches according to the direct registration in angling sites	~1.9 t

The questionnaire results show that the proportion of eel anglers is insignificant: only 4.1% of respondents name the eel as one of their target species. The proportion of eel in catches is 0.2%. The quantity of eel caught in angling ranges from 2–4 t.

LT.3.3 Silver eel landings

Only from the year 1992 is possible to divide eel landings by gears, assuming that eel landed by eel weirs or traps in lakes outlets targeting mostly silver eel. Currently these data are not ready made.

LT.3.3.1 Commercial

LT.3.3.2 Recreational

LT.3.4 Aquaculture production

No eel aquaculture enterprises in Latvia.

LT.3.4.1 Seed supply

LT.3.4.2 Production

LT.3.5 Stocking

All stocking of any species in natural waterbodies must be reported by special protocol to Ministry of Agriculture.

LT.3.5.1 Amount stocked

Number of eel by age groups stocked in Latvia:

Year	Number of eel*1000	
	glass eel	ongrown
2008	0	3
2009	0	0
2010		7,7
2011	308	

Restocking time-series data were presented to WGEEL previously.

Glass eel supplier in 2011

Marten Business Group s.r.o.
Mezibranska 1579/4,
110 00 Praha 1 – Nove Mesto,
Czech Republic
IČO (company registration no.): 28989821
DIČ (VATno.): CZ28989821

Elvers?

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

No eel less than 12 cm fishery in Latvia.

LT.4 Fishing capacity

There is no fishing targeting the eel in Latvia's coastal waters. In 2011 64 fishermen (legal and physical entities) reported caught eels with total amount of 1.04 t. All persons, fishing rights leaseholders are registered in national database (ICIS).

In total 51 fishermen's enterprises/legal persons (mostly family enterprises) operated with eel gear in inland waters of Latvia. All together eel fishing in 2011 carried out in 16 lakes and one artificial reservoir; only three of them are accessible for natural eel. Logbooks information: waterbody, municipality, fisherman identity, gear, number of days in operation, landing are registered in database managed by BIOR.

LT.4.1 Glass eel

LT.4.2 Yellow eel

LT.4.3 Silver eel

LT.4.4 Marine fishery

No eel marine fishery in Latvia.

LT.5 Fishing effort

Gear types-inland waters

Earlier eels were mainly caught with bottom anchored longlines using fish (herrings, roaches and sandeels) and earthworms for a bait. Today eel are caught with different types of traps, fykenets and eel weirs of various types. It should be mentioned that direct eel fisheries in Latvia is conducted only in inland waters and only with stationary fishing gears; traps and eel weirs.

Fykenets in lakes. They are stationary, small-size fykenet with a 6–10m long fence and a cage or trap fastened at both ends. These traps are connected with each other in setlines. Such gears are used in big quantities, up to 300, in eel stocked production Lake Rāzna located in the Daugava RBD. They are only up to 1m high and are used in the depth close to the bottom.

Eel trap construction is identical with a common fish trap, except allowed mesh size. It consists of a fence with one (parallel with the fence) or two (perpendicular to the fence) cage(s) or trap(s) at its end. Depending on the length of the fence, there are two categories of these traps; traps with a fence up to 30 m long and longer than 30 m. These eel traps are used for fishing in the area from the littoral zone towards the open part of the lake at the depth of 5–6 m. The allowable mesh size for eel traps used in lakes may not be less than 12 mm (the distance between two knots of the netting).

Eel traps in the river outlets at lakes consist from two wings with a cage or trap placed between them. To keep access for fish migration it is forbidden to cross more than 50% of the river width with the traps of this type. The mesh size of such fishing gear shall not be less than 12 mm.

There are two types of **eel weirs**, and they are used in river outlets at lakes. An eel weir is a fundamental construction: it is a dam that has two functions; water level control in the lake and eel catching. Before start the eel fishing the water in the lake is held up, but on the beginning of fishing activity water is leaded through the eel weir. Such manipulations with the water levels and flow facilitate eels' migration downstream. The lower part of the eel weir consists from a chamber, where eels are caught using a "tale" or codend made from the netting. Eel weirs were built to earn the maximum fishable production from eel stocked production lakes.

For purpose of fishery regulatory measures since 1990s the term 'eel weir' is also used to designate the eel traps where it is allowed to cross a river outlet from the lake along its entire width. However, their efficiency in fishing seems to be lower than that of stationary eel weirs.

Until 2004 bottom longlines were often used in eel fishing in the inland waters. Later they were totally prohibited to use.

Gear types– coastal waters

No direct eel fishing is conducted in coastal fisheries today. According to catch statistics, eels are caught as bycatch mainly during fishing with small fish traps (traps for herring, smelt, perch) with the mesh size 18 to 30 mm and in flounder fishing with longlines. Eel are also caught during direct eelpout fishing with eelpout traps and in small amounts in herring trapnets.

Number of gear/eel fishing/inland waters

Number of eel fishing gears in Latvia inland waters.

GEAR TYPE			NUMBER OF GEAR
Eel weir- stationary			4
Eel weir- trap			4
Trapnets- in lakes outlets			25

Fykenets in lakes			176
Trapnets, with side arm >30 m in lakes			15

Data on number of gear by issued licenses and gear in operation available from 1999 and included in LV_EMP.

LT.5.1 Glass eel

LT.5.2 Yellow eel

LT.5.3 Silver eel

LT.5.4 Marine fishery

LT.6 Catches and landings

Eel landings LV

	Coastal waters	Inland waters
1924	**23.2**	
1925	14.5	
1926	21.5	
1927	28.6	
1928	20.8	
1929	46.9	
1930	42.4	
1931	42.3	
1932	37.4	
1933	50.1	
1934	111.2	
1935	46.9	
1936	67	
1937	**95.7**	
1938	**133.9**	
1939		
1940		
1941		
1942		
1943		
1944		
1945		
1946		1.1
1947	10	
1948	10	
1949	9	**2.1**
1950	10	**3.5**
1951	10	**3**
1952	10	**4.1**
1953	20	**10.3**

	Coastal waters	Inland waters
1954	20	**4.2**
1955	40	**6.9**
1956	20	**5.7**
1957	20	**5.3**
1958	20	**6.8**
1959	24	5.5
1960	37	6.6
1961	43	6.7
1962	41	4.7
1963	56	8.1
1964	37	6.4
1965	35	5.9
1966	33	9.8
1967	39	6.6
1968	28	6.4
1969	36	7
1970	21	8
1971	17	12
1972	15	10
1973	19	8
1974	12	8
1975	10	9
1976	12	12
1977	10	6
1978	6	12
1979	6	15
1980	1	8
1981	2	8
1982	2	10
1983	1	8
1984	1	11
1985	2	16
1986	1	18
1987	2	23
1988	1	14
1989	1	12
1990	1	12
1991	1	13
1992	1	16
1993	1	18
1994	1	18
1995	1	37
1996	2	22
1997	1	24

	Coastal waters	Inland waters
1998	2	28
1999	2	24
2000	2	15
2001	2	13
2002	2	17
2003	2	9
2004	2	8.7
2005	2.6	8
2006	2.1	5.9
2007	1.2	8.6
2008	1	12
2009	0.8	4.2
2010	1	8.2

LT.6.1 Glass eel

LT.6.2 Yellow eel

LT.6.3 Silver eel

LT.6.4 Marine fishery

No reduction of gear in coastal fisheries.

LT.7 Catch per unit of effort

Not calculated, number of gear days and catches available from national or BIOR d_bases, series from 1990s. Angling data are not available.

Data geographical range-separate inland waterbody or coastal municipality (shore length* by 2 nautical miles).

LT.7.1 Glass eel

LT.7.2 Yellow eel

LT.7.3 Silver eel

LT.7.4 Marine fishery

LT.8 Other anthropogenic impacts

All together at least 700 artificial obstacles stand on rivers of Latvia as at 2011. Largest part of them is the mill dams, ~140 HPS and dams build for water level regulation in lakes. Estimated, that 60% from country territory inland waterbodies are not accessible for migratory fish. Register of artificial obstacles in Latvia's rivers will complete in 2011.

LT.9 Scientific surveys of the stock

River fish monitoring

The overall monitoring results in Latvia's rivers show that at present the quantity of eel in rivers is small. Therefore the population density apparently is less than 1 ind./ha.

Fish monitoring effort and results in rivers

Year	Fishing area (ha)	Number of rivers surveyed	Number of sites	Number of eels caught (spec.)
2005	0,77	23	71	0
2006	1,31	44	117	3
2007	2,35	48	118	0
2008	3,03	52	128	3
2009	2,63	47	115	6
2010	1,95	28	77	0

LT.10 Catch composition by age and length

Only DCF sampling carried out in Latvia.

LT.11 Other biological sampling

LT.11.1 Length and weight and growth (DCF)

LT.11.2 Parasites and pathogens

Data from DCF samples handed for EEQD.

LT.11.3 Contaminants

LT.11.4 Predators

The first nesting of cormorants in Latvia proved in 1989. From thence number of cormorant in Latvia increased up to 1000 pairs who are distributed between ~20 colonies. Survey of four cormorant colonies carried out in 2009 to assess the birds' impact on fish assemblages in lakes. All together eel were found 0,6% from preyed fish number or 2,6% from biomass, more common prey was bleak, eelpout and perch. Prey composition demonstrated that birds nesting in lagoon type lakes close to the sea feed also in coastal waters. All together 850 pairs of nested cormorants consumed about 50 t of fish.

LT.12 Other sampling

Tagging

998 eel (probably silver eel) caught by eel weir in lake Usma outlet (57'14'36.44N; 22'05'04.23E) tagged and released in 2010:

- river Venta (Main Baltic ICES Subdivision 28) 56'58'18.58N; 21'58'34.35E);
- river Daugava (Gulf of the Riga ICES Subdivision 28) 56'46'15.18N; 24'37'33.86E.

Type of tags:

- T- bar anchor tags in 2010.

The lake Usma eels used in tagging.

	Lenght (cm)	W (g)
AVG	58,2	347,4
STD	7,5	140,8
Median	59	344
N	998	996

Eel tagged/released in Latvia 2010.

	River	
	Venta	Daugava*
April	49	
May	393	
June	309	
September		247
Sum	751	247

***- upstream from Riga HPS.**

Releasing/recapture of eel.

Date of releasing	Place of releasing	Date of recapture	Place of recapture
31.09.2010.	Daugava, upstream HPS	10.2010.	river Daugava, Riga city
31.09.2010.	Daugava, upstream HPS	23.10.2010.	river Daugava, Riga city
03.06.2010.	river Venta	01.12.2010.	Denmark
16.06.2010.	river Venta	02.05.2011.	Sønderborg,Flensburg Fiord
31.09.2010.	Daugava, upstream HPS	05.2011.	Gulf of Riga
03.06.2010.	river Venta	29.11.2010.	Germany, Fehrmarn islend
03.06.2010.	river Venta	03.08.2011.	river Venta
16.06.2010.	river Venta	12.2010.	river Venta, lamprey weir

LT.13 Stock assessment

LT.13.1 Local stock assessment

LT.13.2 International stock assessment

LT.13.2.1 Habitat

Wetted Area: lacustrine-16 102;

Riverine-7476;

transitional and lagoon

coastal and transitional-89 776

Distribution of habitats accessible for eels by RBD, coastal waters and transitional waters.

RBD	Rivers		Lakes	
	number	area (ha)	number	area (ha)
Daugava	5	3883	5	3071
Gauja	6	1401	9	1162
Lielupe	4	1255	2	2815
Venta	12	937	7	9054
Inland waters, total[1]	27	7476	25	16 102
Coastal and transitional waters				89 776
Habitats accessible to eels, total				113 354

[1] **– The table contains only major rivers and lakes.**

In Latvia the habitats accessible to the eel species *Anguilla anguilla* constitute an area of 113 354 ha. Int. al. 7476 ha in rivers, 16 102 ha in lakes and about 89 776 ha along the coastline of the Gulf of Riga and the Baltic Sea (ICES Subdivision 28).

LT.13.2.2 Silver eel production

LT.13.2.2.1 Historic production

LT.13.2.2.2 Current production

LT.13.2.2.3 Current escapement

LT.13.2.2.4 Production values e.g. kg/ha

Production values of silver eel.

		Area (ha)	Prod./ha		
			max_observed	avg from 1980s	
Coastal waters*		89 000	0.7	0.01	
Lakes, acessible for eel[2]		5419	2	0.1	
Lakes restocked by eel[1]		22 375	5.6	0.6	

***- till 10 m depth.**

[1]- ten lakes, restocked by eel.

[2]- lakes with commercial fishery data from 1946.

LT.13.2.2.5 Impacts

LT.13.2.2.6 Stocking requirement eels <20 cm

LT.13.2.2.7 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.

LT.13.2.2.8 Data quality issues

LT.14 Sampling intensity and precision

LT.15 Standardization and harmonization of methodology

Eel sampling area: Area- near the river Daugava outlet (Gulf of Riga, ICES Subdivision.28) 57’03’57.11N; 24’01’31.28E.

One trapnet, checked 2–3 times per week from 1st of May till 1st of October.

Sampling carried out by local fisherman (trained for sampling) engaged by BIOR for data collection.

Eel sampling (100–200 specimens per year- all eel landed from one trap):

- fresh eel, killed;

- length (mm), weight (g), length of pectoral fin (mm), eye diameter (mm) (vertical and horizontal), sex by macroscopic examination, otholiths, *Anguillicolla* (presence or absence).

Also all eel caught by longlines and/or fykenets used in coastal fisheries research by BIOR staff sampled as describe above.

No eel age reading in LV.

Eel sampled from coastal fisheries in Latvia.

YEAR	NUM.	LENGHT/STDEV	WEIGHT/STDEV
2008	59	845/69	1208/308
2009	103	831/92	1159/377
2010	155	830/92	1137/418

LT.15.1 Survey techniques

LT.15.2 Sampling commercial catches

LT.15.3 Sampling

LT.15.4 Age analysis

LT.15.5 Life stages

LT.15.6 Sex determinations

LT.16 Overview, conclusions and recommendations

Only actions planed for EMP implementation financed in Latvia.

LT.17 Literature references

Report on the eel stock and fishery in Morocco 2010/'11

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Reporting Period: This report was completed in August 2011, and contains data up to 2010 and some provisional data for 2011.

MA.2 Introduction

MA.2.1 Status of this report

In response to the council regulation of the European commission (CE1100/2007) and because Morocco has ratified the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the Moroccan High Commissioner's Office for Waters, Forests and Desert Control (MHCOWFDC) responsible of fisheries has run an urgent programme concerning the assessment and the monitoring of eel stocks (yellow eel, silver eel and elvers) and the recruitment of glass eel at five important Moroccan fishing sites of this species: Sebou river, Loukkos river, Drader river, Moulouya river and Merja Zerga lagoon (Permanent Biological Reserve, Ramsar Site in 1980). This study started on August 2010 and will cover two successive seasons according to the annual fishing report of MHCOWFDC (2010–2011). Thus, the report of the eel management plan (EMP) will be provided to the European Commission on 2012.

On March 17th, 2011 the committee meeting of fishing in inland waters of Morocco has set urgent measures (changing the close seasons, reducing the quota of eel fishing (cf. Legislation), controlling the aquaculture companies of eels…) which will improve the management and the conservation of eels.

After listing eel in Appendix II of CITES on March 13th 2009, the export and the import of this species for the trade to Europe have to be licensed by the authorities of MHCOWFDC as well as an importation document which must be delivered by the authorities of the country concerned.

MA.2.2 Overview of eel fisheries in Morocco

Morocco is the southern limit of eel distribution (28°N at Dr'a river (Qninba *et al.*, 2011) (Figure 1), which means that this source is extremely vulnerable and incurs dangers. In the absence of security measures for protecting eels in Morocco, this fish species could follow a probable disappearance like Moroccan Shad (*Alosa alosa*). Eel remains one of the most overly exploited species in Morocco. Fishing campaigns and surveys have been carried out to show that eel populations are at their lowest level, though they are still fished.

Figure 1. Map of the north Moroccan basins showing the distribution of eels, the main areas of eel fishing sites and the southern limit of eel (Dr'a river (28°N)).

Eel fisheries in Morocco occur in inland waters (rivers, estuaries and lagoons) as well as in coastal. Sebou estuary, Loukkos estuary and Merja Zerga lagoon are considered as the main important fishing sites of eel (Figure 1). In Moroccan inland waters, the large commercial fishing is assigned to eel and glass eel fisheries and they are exclusively attributed to the leased fishing companies.

Fishing frequency

In Europe, the decline of European eel populations has been registered since the 1980s (Moriarty and Dekker, 1997). However declining stocks in Moroccan waters, the meridional limit for this species distribution, only began to be recorded following the peak catches in 1997 (Figure 2).

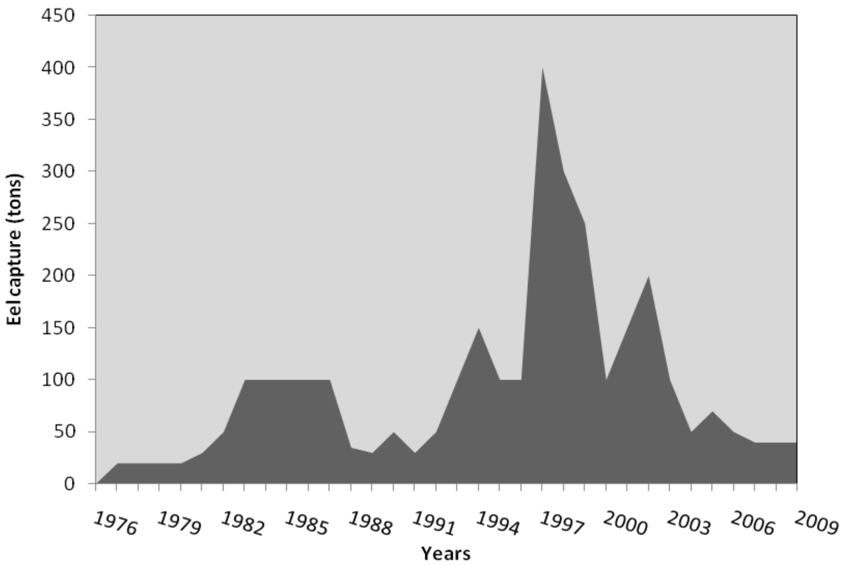


Figure 2. Evolution of eel catches in Moroccan continental waters (FishStat Plus V.2.32, FAO).

In less than 20 years, eel production in continental waters has diminished to more than 75%. For example, in 2006 eel production (50 tons in continental waters and 50 tons in aquacultures) remains inferior to the one estimated by Fontenelle in 1987 (400 tons of eel and 200 tons of glass eel in inland waters (Figure 3).

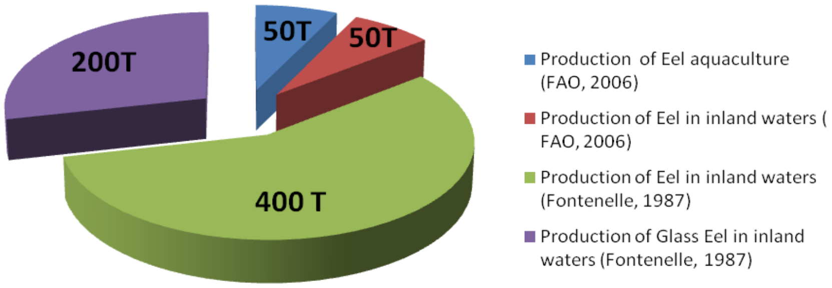


Figure 3. Eel production in Morocco (tons).

Eel and glass eel commercialization

Fish are sold to leased fishing sites who then sell them to eel farms. The fish from there are directly exported or kept until they get bigger and then exported. On a national level the eel are exported for consumption or for production in eel farms (Figure 4).

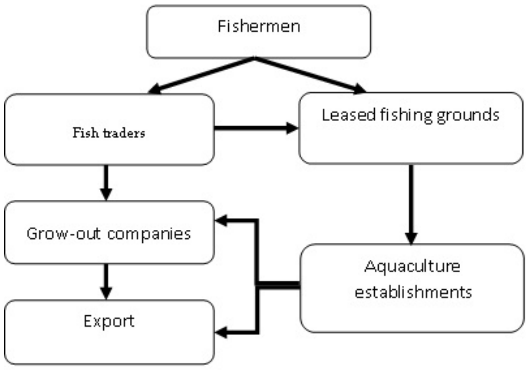


Figure 4. Commercial schema of eel in Morocco.

Legislation

Before 2010, eel and glass eel fishing was authorized everyday from October to June, putting no limitations on size and quantities caught. Commercial use of glass eels was authorized only to leased fishing grounds equipped with normalized breeding infrastructures and written authorization. Exportation of eels from non-regulated sites is unauthorized.

In the period 2010–2011, the Moroccan High Commissioner's Office for Water, Forests and Desert Control set catch quotas[3] to regulate eel and glass eel catches in freshwater. The amount of catches allowed from Sebou, Drader and Loukkos as well as their

3 In the order released by authorities, "fishing quota" signifies: the maximum quantity of catches effectuated at a given site. The quantity was determined by the MHCOWFDC following consensus of CITES's national scientific authorities. The fishing quota is the mass of live weight measured in tons or kilograms.

tributaries for the 2010–2011 fishing season are set at 2400 kg for glass eels 10 centimetres long or less and at 40 tons for indigenous eel.

For the period 2011–2012, these quotas of glass eel catches are set at 2500 kg for glass of 10 centimetres long or less and at 28 tons for indigenous eel of 30 centimetres long or more, according to the Article 14 of the decree of the Moroccan High Commissioner's Office for Water, Forests and Desert Control (2011–2012). The Article 14, of the Moroccan legislation, has set the allowed minimal length for yellow eel to 30 centimetres. Quotas set for the three areas are shown on Table 1.

Table 1. Fishing quotas of glass eel and eel from leased fishing sites 2011–2012.

SITE	ALLOWABLE CATCH FOR GLASS EELS (KG)	ALLOWABLE CATCH FOR EEL (TONS)
Sebou river	2000	22
Drader river	150	2
Loukkos river	350	4
Total	2500	28

The quotas for each area have been divided into subquotas for certified leased fishing sites. The subquota is calculated based on the mean catches declared over the past three years and the production of grow-out unities. For a given year, the declared quantity corresponds to the sum of the quantities caught and weighed in kilograms. This sum is then validated and certified by authorities.

A technical committee is designated by the Moroccan High Commissioner's Office for Water, Forests and Desert Control to assess the production of grow-out unities to determine the corresponding subquotas. When a leased fishing site meets or exceeds their subquota, fishing of the target species is prohibited. The assessed subquota may not be carried over to the next fishing season. Once the eel fishing season is open (Table 2), authorities permit daily eel fishing.

Table 2. Opening and closing dates for eel and glass eel fishing in Morocco.

OPENING DATE AT SUNRISE	CLOSING DATE AT SUNSET	NUMBER OF FISH AUTHORIZED	OBSERVATIONS
March 14, 2010 November 28, 2010	May 2, 2010 April 30, 2011	According to the attributed quota	Exploitation, reserved exclusively to leased fishing grounds
March 18, 2011 December 11, 2011	June 12, 2011 June 10, 2012	According to the attributed quota	Exploitation reserved exclusively to leased fishing grounds

MA.2.3 Subdivision of eel fishing area

The majority of yellow and silver eel and glass eel are caught in lagoons and estuaries located in the northwest of Morocco (Figure 1).

Sebou estuary

This estuary is located on the Moroccan Atlantic coast 34°27'N/6°64'W. The Lalla Aicha guard dam is located 40 km upstream (Figure 5). The Sebou drainage basin has a surface area of 40 000 km^2. Eel and glass eel are fished throughout the estuary, an ecosystem heavily influenced by urban, agricultural and industrial sewage. To this day in Morocco, eel are exploited during several of its life's stages: glass eel, yellow eel, and silver eel. Glass eels are the most targeted due to its commercial importance. In some cases, the fishing activity has gone to extremes and thus is illegal due to inefficient controls. In 2006, 10 tons of eels and 5 tons of glass eels were fished by local fishermen.

Figure 5. Sebou estuary.

Loukkos estuary

These wetlands are part of the estuarine complex of the Bas Loukkos, which were designated as a Ramsar site in June 2005. The Loukkos 35°15'N/6°09'W empties out into the Atlantic Ocean and 20 km upstream a guard dam was implanted. Its water originates from the Rif Mountains and the surface area of this drainage basin is 3730 km^2 (Figure 6).

Glass eel and eel (yellow and silver) are fished from a fish outlet just at the edge of the dam. Unfortunately this passage is very narrow and badly maintained and monitored as a result fish get trapped rather than allowing them to swim through it freely.

One company has the licence for fishing eel and glass eel according to the quota limited by the authorities by leasing the entire river. In 2006, only 0.2 tonne of eel (yellow and silver eel) and 0.75 tonne of glass eel were caught.

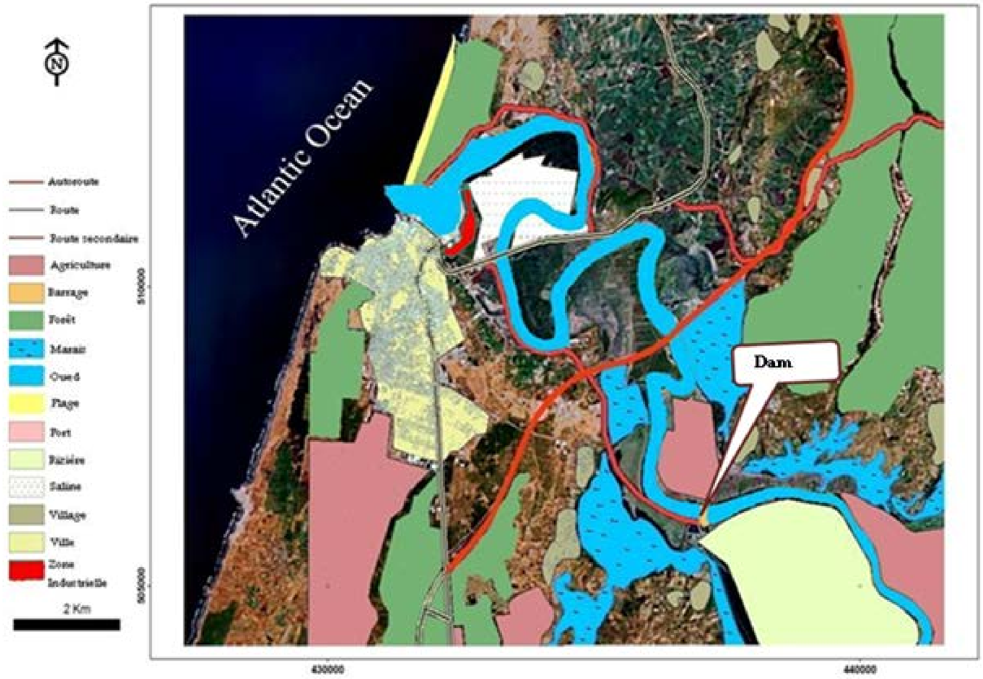


Figure 6. Loukkos estuary.

Merja Zerga lagoon

Merja Zerga 34°86’N/06°28’W Permanent Biological Reserve, Ramsar Site (1980) is a tidal lagoon located 70 km north of Kenitra on the Atlantic coast (Figure 7). The outlet to the ocean lies at the seaside resort and fishing village of Moulay Bousselham: hence the site’s alternative name of Moulay Bousselham lagoon. In addition to its tidal inflow, the lagoon receives freshwater from the Oued Drader and the underlying water-table, which is very close to the surface here. The lagoon itself covers 4500 ha, of which 30% is open water, and has an average depth of 1.5 m.

In 2006, 16 tons of eels were fished but none of glass eels.

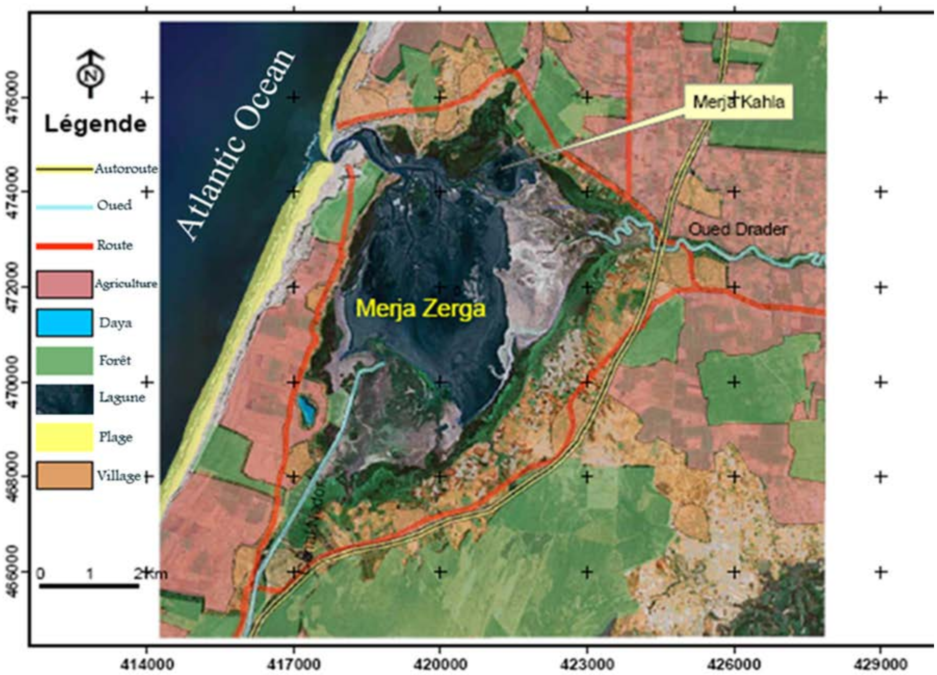


Figure 7. Merja Zerga lagoon.

MA.3 Time-series Data

MA.3.1 Recruitment-series and associated effort

MA.3.1.1 Glass eel

MA.3.1.1.1 Commercial

Glass eel fishery is practised only by companies which have the licence of leased fishing ground. Glass eel fishery is limited with quotas by the Moroccan High Commissioner's Office for Waters, Forests and Desert.

For the period 2011–2012, these quotas for glass eel catches are set at 2500 kg for glass eel of 10 centimetres long or less.

MA.3.1.1.2 Recreational

Recreational glass eel fisheries are not allowed.

MA.3.1.1.3 Fishery-independent

No data available.

MA.3.1.2 Yellow eel recruitment

For the period 2011–2012, the quotas for wild eel catches are set at 28 tons for wild eel of 30 centimetres long or more (cf Chap. 6).

MA.3.1.2.1 Commercial

Recreational yellow eel fisheries are not allowed.

MA.3.1.2.2 Recreational

No recreational yellow eel landing has occurred.

MA.3.1.2.3 Fishery-independent

No data available.

MA.3.2 Yellow eel landings

No data are available.

MA.3.2.1 Commercial

No data are available.

MA.3.2.2 Recreational

No recreational data are available.

MA.3.3 Silver eel landings

No data are available.

MA.3.3.1 Commercial

No data are available.

MA.3.3.2 Recreational

No recreational data are available.

MA.3.4 Aquaculture production

There are four fish farms in Morocco that produce eel and have the right to fish glass eel and eel and dispose of grow-out's units: Aquastar, Aquagruppen, NouneMaroc and Morocco pêcherie Ibérique (Table 3).

- Aquastar company near Moulay Bousselham lagoon (Drader river). The production of this farm was at 34.5 tons (2004), 40 tons (2005), 16 tons (2007) and 13 tons (2008).
- Aquagruppen company near Sebou estuary, produced 10 tons (2004), 3 tons (2005), 3 tons (2007), 6 tons (2008).
- NouneMaroc, new farm company has started recently in 2008, with a capacity to produce 120 tons. They have produced 19.5 tons (2008), 60 tons (2009) and 76 tons (2010).
- Morocco pêcherie Ibérique is an ancient company and the only one lease the right of Loukkos river for eel and glass eel fishing. The capacity of production of this company is 10 tons; in 2010 the production was only about 280 Kg.

In 2003, eel production began increasing after authorities released an order limiting glass eel farming only in aquacultures normalized breeding infrastructures but from this time on, eel farms began meeting difficulties, such as decreasing glass eel supplies.

MA.3.4.1 Seed supply

Local fishers sell glass eels to the farm companies; a part of these glass eel is used for their Grow-out station and the other one's is destined to the export.

There is no quantitative data.

MA.3.4.2 Production

The mean production per year is given in Table 3.

Table 3. Aquaculture production (tons) in Morocco per company (according to the annual status of report of the MHCOWFDC).

FARM COMPANY	AQUASTAR (MERJA ZERGA)	AQUAGRUPPEN (SEBOU)	NOUNE MAROC (SEBOU)	TOTAL
	Production weight (t)	Production weight (t)	Production weight (t)	Production weight (t)
1999–2000	13	13	-	26
2000–2001	12	-	-	12
2001–2002	23	-	-	23
2002–2003	40	-	-	40
2003–2004	-	-	-	-
2004–2005	34.5	10	-	44.5
2005–2006	40	3	-	43
2006–2007	16	3	-	19
2008–2009	13	6	19.5	38.5
2009–2010	-	-	60	60
2010–2011	-	-	76	76

In 2003, eel production began increasing after authorities released an order limiting glass eel farming only in aquacultures normalized breeding infrastructures (Figure 8).

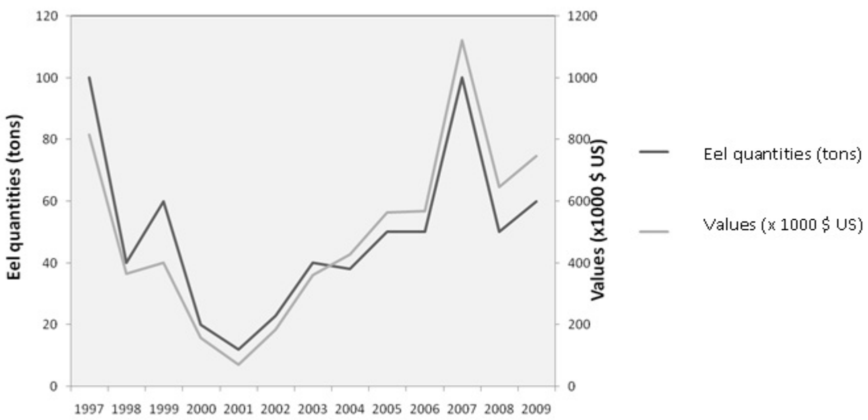


Figure 8. Evolution of eel quantities and values produced in farms in Morocco (FishStat Plus V.2.32, FAO).

MA.3.5 Stocking

No available data.

MA.3.5.1 Amount stocked

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

The catch of eel <30 cm is prohibited by the law.

MA.4 Fishing capacity

MA.4.1 Glass eel

Glass eel fishery is practised only by companies getting the licence of leased fishing in Sebou and Loukkos.

MA.4.2 Yellow eel

Traditional fishing boats (Tables 4 and 5).

In the inland freshwaters eel is fished using artisanal methods (Yahyaoui, 1991; Melhaoui, 1994).

The estuarine fishermen mainly fish for eel using boats. In the Merja Zerga area they have flat bottoms that allow them to glide easily over muddy zones and shallow parts. Approximately 100 operational boats have been registered.

In the Sebou estuary, 240 artisanal fishing boats have been registered and six in the Loukkos estuary (Table 4). Among the three areas, boats are relatively similar in size (about 4 m long and 1.5 m wide). Their price ranges between 2000 DH and 3500 DH, while annual maintenance fees average is 575 DH. Depending on the amount of use, the boats last from five to 13 years.

Table 4. Fishing boat characteristics.

	Number of boats	Length (m)	Width (m)	Price (DH)	Maintenance (DH/year)	Average age (year)
Loukkos	6	4.00	1.50	2000 (174€)	-	13
Merja Zerga	100	4.24	1.44	3500 (304€)	600 (52€)	5.13
Sebou	240	4.07	1.54	3416 (297€)	550 (48€)	6

Table 5. Fykenets characteristics and trapping periods.

Area	Number of traps/fisherman	Mesh (mm)	Fishing period	Duration of traps (years)	Price (DH)
Loukkos	60	5	October–January (4 months)	3	-
Merja Zerga	36	5	September–May (9 months)	3	100 (8.7€)
Sebou	30	5	September–June (10 months)	2	70 (6€)

Data concerning the local fishing population

In the Merja Zerga area, prior data shows that the number of fishermen has increased between the 1930s and the 1990s (Figure 9). Ever since the 1990s the population has been decreasing, which may be explained by the decline in economical performance, forcing many to find a more stable profession.

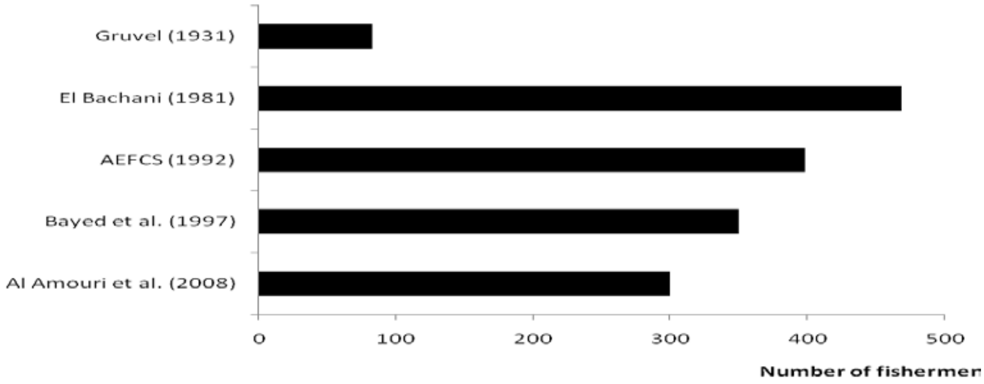


Figure 9. Evolution of the number of fishermen in the Merja Zerga area (between 1931 and 2006).

The age group of fishermen in the Merja Zerga and Sebou areas ranges between 20 and 29 years old and between 30 and 39 in the Loukkos area (Figure 10).

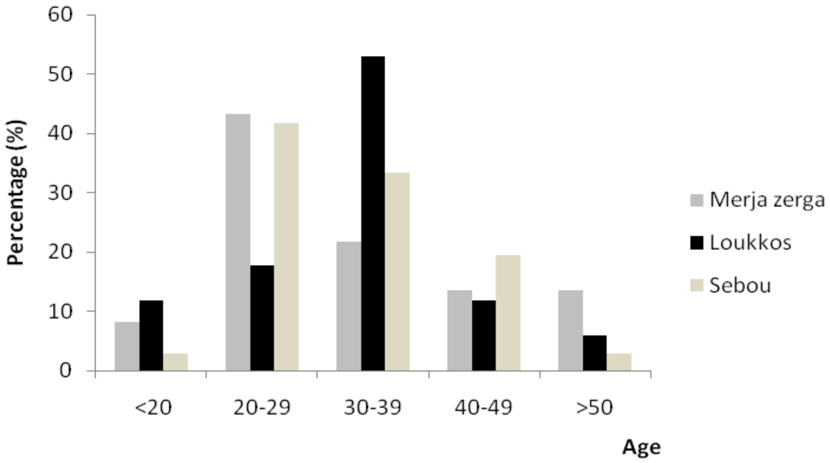


Figure 10. Different age groups of fishermen.

According to Table 6, the average fisherman age increases with time which shows that there is no new turnover for fisherman over 40 years old. Perhaps, fishermen at a certain age abandon this activity to seek financial stability or to emigrate to the city or to another country.

Table 6. Evolution of the average age group of fisherman.

	EL BACHANI (1989)	KARZARI (1988)	TOUZANI (2001)	AL AMOURI ET *AL.* 2008
Mean Age group(years)	25–30	27.9	27.7	32

During the season of 2010–2011, in the Loukkos, 16 fishermen are working for the company Morocco pêcherie Ibérique. In Sebou more than 400 fishermen fish for AquaGruppen and NouneMaroc and in the Merja Zerga and Drader river, more than 200 fishermen are working for Aquastar company.

MA.4.3 Silver eel

The same fishermen fish indifferently yellow and silver eels with same techniques.

MA.4.4 Marine fishery

No data are available. Eel fishing in the sea is negligibly small.

MA.5 Fishing effort

MA.5.1 Glass eel

MA.5.1.1 Glass eel fishing methods

Fish traps are most commonly used between the two estuarine and lagoon areas. Dipnets are also used in the Sebou and Loukkos estuaries. Finally, in the larger parts of the Sebou area, large nets known as « damnets » are more adapted (Table 7).

Table 7. Fishing methods of glass eel.

Fishing material	Local name	Estuarine area
Stopnet	Chebka	Sebou
Dipnet	Gherbal	Sebou and Loukkos

In the Loukkos estuary, there are twice as many fishing traps used per fishermen compared to other two sites. Even more, as described in Table 5, the traps are used during certain periods of the year, depending on the area. For example in the Loukkos Estuary traps are set out between October and January whereas in Sebou estuary and Merja Zerga lagoon, they're used respectively between September and June, according to the rules. The costs of traps range between 70 (6.25€) and 100DH (9.93€), and they usually last up to three years.

MA.5.2 Yellow Eel

Yellow and silver eel are fished by using fykenets in all the area of fishing (Lachheb, 2004).

Table 8. Fishing activity data recorded in 2006.

Area	Number fishing days/year	Number of outings/day	Average length of outing (hours)	Total fishing hours/year
Merja Zerga	303.67	1	3h 49min	1159
Sebou	264.45	1.72	1h 24min	637
Loukkos	117	1	3h	351

MA.5.3 Silver eel

Data are mixed with yellow eel.

MA.5.4 Marine fishery

No data are available. Eel fishing in the sea is negligibly small.

MA.6 Catches and landings

MA.6.1 Glass eel

In the Sebou estuary, annual glass eel catches are the highest (5 tons) followed by the Loukkos estuary (0.75 tons) (Table 9). The quantities of catches in Loukkos are dramatically decreasing.

Table 9. Glass eel catches in major Moroccan fishing areas.

	Glass eel (tons)		
	Merja Zerga	Sebou	Loukkos
Fontenelle (1987); Sabatié and Fontenelle (2003)	-	150	40
Al Amouri (2006)	-	5	0.75
2007	-	-	0.11
Al Amouri *et al*. (2008)	-	-	0.10
2009	-	0.10	0.14
2010	-	0.21	0.05
2011	-	0.36	0.03

MA.6.2 Yellow eel

Eel catches of both stages (yellow and silver) is highest in the Merja Zerga area (16 t) and lowest in the Loukkos (0.2 t). When comparing production estimated in 1987 and 2003 (Table 10), we can easily notice how eel stock in Morocco has been declining at alarming rates. In less than 20 years, eel stocks in the Sebou estuary have declined to 2.5% and less than 3.5% for glass eel stocks.

Table 10. Eel catches in major Moroccan fishing areas.

	Eel (tons)		
	Merja Zerga	Sebou	Loukkos
Fontenelle (1987); Sabatié and Fontenelle (2003)	12–15	420	-
Al Amouri (2006)	16	10	0.2
Survey of 2011	2.7	12.34	0.12

MA.6.3 Silver Eel

Data of yellow and silver eel are mixed.

MA.6.4 Marine fishery

No data are available. Eel fishing in the sea is negligibly small.

MA.7 Catch per unit of effort

Estimated data are collected from questionnaires.

MA.7.1 Glass eel

Table 11. Cpue of glass eel in Loukkos estuary.

Year	Total catch (Kg)	Total effort (days)*	CPUE (Kg/days)
2003	40 000	-	-
2006	750	56	13.39
2007	111	56	1.98
2008	100	56	1.79
2009	140	56	2.50
2010	50	56	0.89
2011	30	56	0.54

***: The mean number of fishing days per fishing season.**

Table 12. Cpue of glass eel in Sebou estuary.

Year	Total catch (Kg)	Total effort (days)*	CPUE (Kg/days)
1987	150 000	-	-
2006	5000	56	89.29
2009	100	56	1.79
2010	210	56	3.75
2011	360	56	6.43

***: The mean number of fishing days per fishing season.**

MA.7.2 Yellow eel

Table 13. Cpue of eel (yellow and silver combined) in Merja Zerga lagoon, in Sebou estuary and in Loukkos estuary.

Year	Site	Total catch (Kg)	Total effort (days)*	CPUE (Kg/days)
2003	Merja Zerga	13 500	-	-

	Sebou estuary	420 000	-	-
	Loukkos estuary	-	-	-
2006	Merja Zerga	16 000	304	52.63
	Sebou estuary	10 000	264	37.88
	Loukkos estuary	200	117	1.71
2011	Merja Zerga	2700	304	8.88
	Sebou estuary	12 340	264	46.74
	Loukkos estuary	120	117	1.03

***: The mean number of fishing days per fishing season.**

MA.7.3 Silver eel

Data of yellow and silver eel are combined.

MA.7.4 Marine fishery

No data are available. Eel fishing in the sea is negligibly small.

MA.8 Other anthropogenic impacts

The most common causes of eel decline in Morocco may be due to:

- Diseases such as the one caused by the hematophagous parasite, *Anguilli-coloïdes crassus*, which was found in Moroccan continental waters in 1990 (El Hilali *et al.*, 1996).
- Illegal fishing (poaching and the use of illicit fishing nets).
- Hydraulic infrastructures such as dams without fish passages, embankments, diversions, pumping from rivers, gravel extracting, etc., all of which deteriorate or destruct eel habitats, especially their growth space.
- Pollution from agricultural, industrial, and domestic activities.

In addition, commercial fishing activities, such as artificial reproduction and eel farming which are restocked only with wild species in their elver stage, contribute to the species' decline. Eel is of great commercial importance and is probably the only fish to be exploited at all its life cycle stages by man. Due to the increasing amount of eel farming and decreasing populations caused by overfishing, prices have increased along with fishing activity.

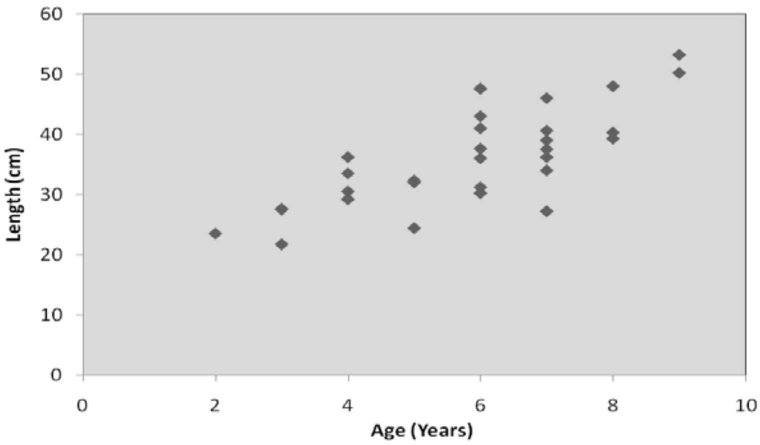
MA.9 Scientific surveys of the stock

No routine surveys of eels are performed in Morocco.

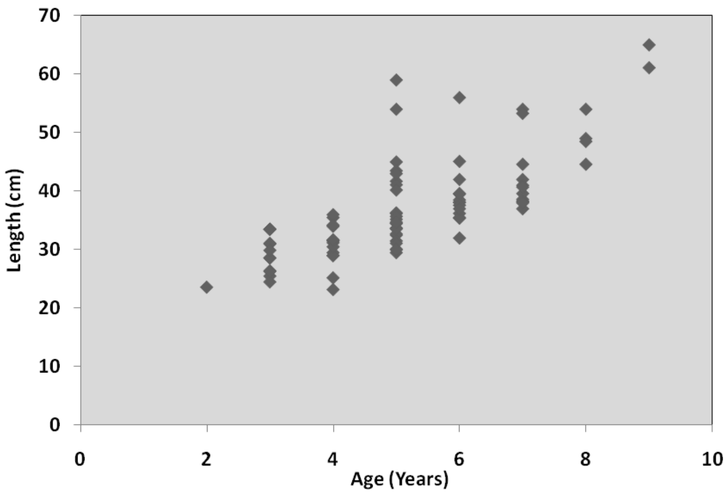
MA.10 Catch composition by age and length

The otolithometry method used for this age reading is cracking and burning methods for both Sebou and Loukkos samples.

The results show that most of eels from Sebou are younger than those caught in Loukkos. Most of eel are ranged between six and eight years for Loukkos samples and for those of Sebou they are ranged between five and six years.



(a)

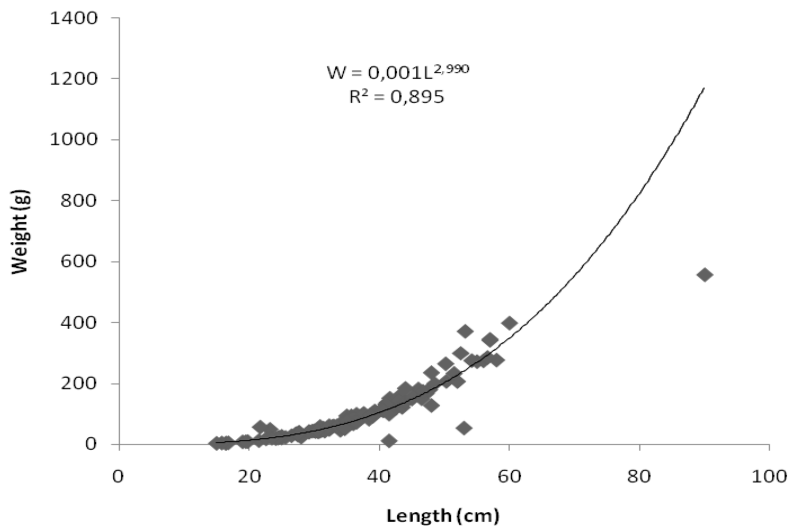


(b)

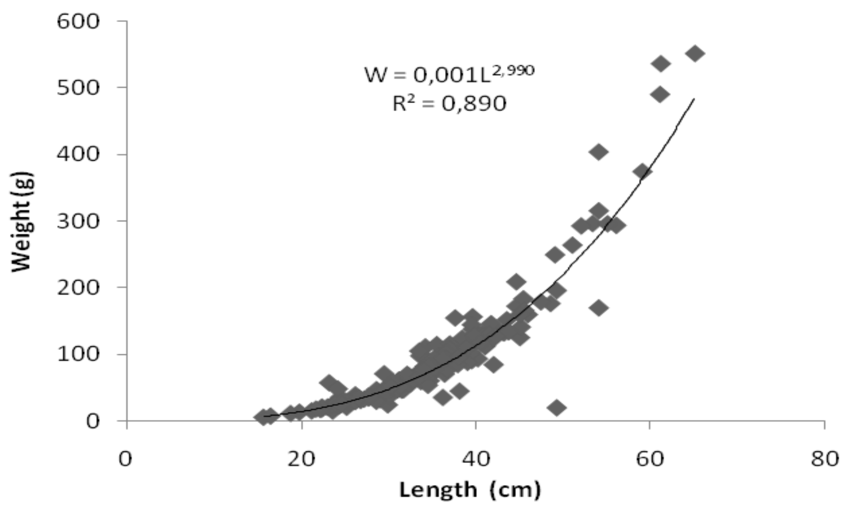
Figure 11 (a, b). Distribution of the age (years) according to the length (cm) of eels caught in 2008 in Loukkos estuary (a) and Sebou estuary (b) (Wariaghli *et al.*, 2010; unpublished data).

MA.11 Other biological sampling

MA.11.1 Length and weight and growth (DCF)



(a)



(b)

Figure 12 (a, b). Distribution of the length (cm) according to the weight (g) of eels caught in Loukkos estuary (a) and Sebou estuary (b) showing their growth factor and the correlation between these two parameters (Wariaghli *et al.*, 2010; unpublished data).

MA.11.2 Parasites and pathogens

Epidemiological data of the swimbladder nematode *Anguillicoloïdes crassus* in Moroccan rivers was initially described by El Hilali *et al.* (1996); Lachheb (1997); Kheyyali *et al.* (1999); El Hilali *et al*. (2005); Wariaghli (2006); Zouhir (2006) and Loukili and Belghyti (2007).

The way of introduction of *Anguillicoloïdes crassus* is still unknown, since Morocco has never imported live eels but does only export them. This parasite is still spreading over all Moroccan eel fishing areas. The prevalence of the swimbladder *A. crassus* is still spreading in Moroccan waters, but within sites there is a trend for stabilization or even decrease in prevalence values. Figure 13 shows the mean of prevalence, intensity and abundance of eels (yellow and silver eels) caught in Sebou estuary between 2004 and 2009.

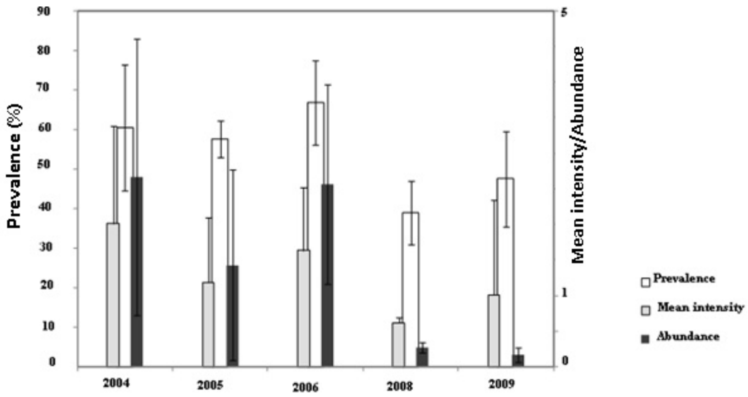
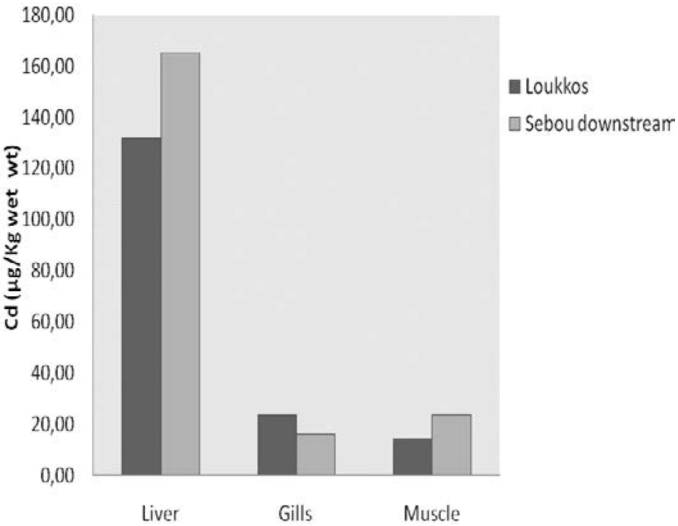


Figure 13. Prevalence (%), mean intensity ± SD and abundance ± SD of *Anguillicoloïdes crassus* for eels caught in Sebou estuary 2004–2009 (Wariaghli *et al., 2011*; submit).

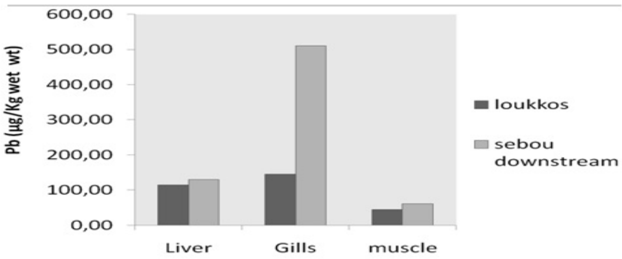
MA.11.3 Contaminants

Heavy metals assessment

This work involves an assessment of the degree of heavy metal contamination (Pb, Cd and Cr) in liver, gills and muscle of eel (*Anguilla anguilla*) inhabiting two ecosystems along the Moroccan Atlantic coast: the Sebou and Loukkos estuaries (Figure 14). In these areas *A. anguilla* is widespread and a common predator at the top of the food chain. In this study, heavy metals were determined with flame atomic absorption spectrometry. Metal concentrations reveal high and widespread tissue contamination in eel caught from Sebou estuary than in Loukkos, with preferential accumulation in liver for Cd (chronic accumulation) and in gills for Cr and Pb (recent accumulation).



(a)



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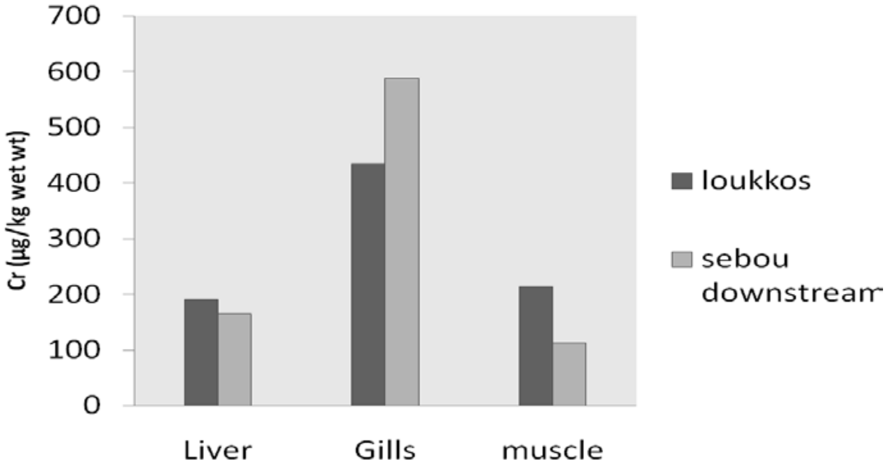

(c)

Figure 14 (a, b, c). The concentrations of lead cadmium and chromium (µg/g wet wt), in liver, gills and muscle of eels caught from Loukkos and Sebou rivers (Wariaghli *et al.*, 2010; unpublished data).

PAH metabolites

This study investigated in the usefulness of biliary polycyclic aromatic hydrocarbon (PAHs) metabolites of European eel (*Anguilla anguilla*) as bio-indicator of pollution in Moroccan sites. Eels were collected at two locations (upstream and downstream) in the river Sebou and in the Loukkos estuary. October and November 2009. Biliary 1-Hydroxypyrene, 1-Hydroxyphenantrene and 3-hydroxybenzo[a]pyrene metabolites were measured in eel by HPLC analysis with fluorescence detection. Only 1-OH pyrene and 1-OH phynantrene were detected while 3-OH benzo[a]pyrene was not detected. No statistical differences between the sexes and ages for any of the PAH metabolites or biological parameters could be detected. Data from the three trawls were therefore pooled (Figure 15).These results show significant differences between Sebou upstream and Loukkos sites in mean concentration of 1-OH pyr and 1-OH phen metabolites ($p<0.05$, two sample t-tests), as well as between Sebou downstream and sebou upstream sites ($p<0.05$) which had similar concentrations of PAH metabolites. Increasing levels of biliary PAH metabolites in eel suggest higher pollution levels downstream in the river Sebou and Loukkos.

Linear regression analysis of the individual data found significant relationships between the concentrations of 1-OH pyrene measured and biliverdin concentrations in the bile ($P=0.001$, $p<0.05$).

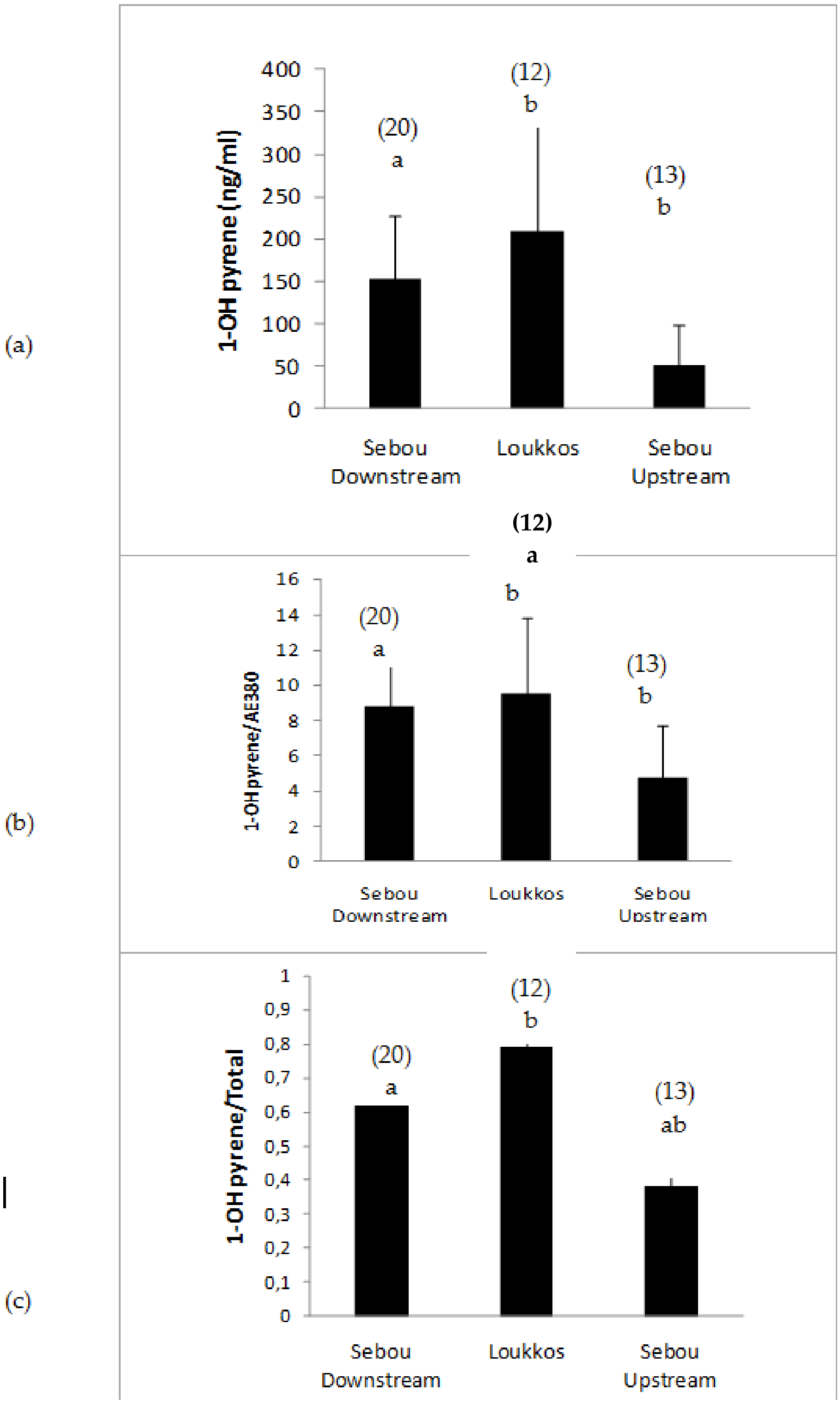

Figure 15 (a,b,c). Mean (±SE) of the concentration of 1-OH Pyrene concentration (ng/ml) in the bile of eel (*Anguilla anguilla*) in three sampling stations in autumn 2009: Without normalization (a), after normalization (dividing) of the values for the absorbance at 380 nm (b), and after normalization of the values at the total concentration of PAH (c). Columns labels with different letters differ significantly from each other (p<0.05), (Wariaghli *et al.*, 2010; unpublished data).

MA.11.4 Predators

The cormorants are the most common predators of eels in Morocco.

MA.12 Other sampling

There were no routine biological sampling programmes or eel research projects, the results are the scientific work of thesis of researcher students interested in working on this thematic. In this period a project was run by the government in order to provide an EMP and to start the implementation of this plan.

MA.13 Stock assessment

MA.13.1 Local stock assessment

Non available data.

MA.13.2 International stock assessment

Non available data.

MA.13.2.1 Habitat

Wetted Area: Lacustrine (0%)

Riverine (19%)

transitional and lagoon (80%)

coastal (≤1%)

MA.13.2.2 Silver eel production

MA.13.2.2.1 Historic production

MA.13.2.2.2 Current production

MA.13.2.2.3 Current escapement

MA.13.2.2.4 Production values e.g. kg/ha

MA.13.2.2.5 Impacts

Natural threats: Climate change, parasites (especially *Anguillicoloides crassus*), predators (cormorants).

- Anthropic threats: Water pollution, habitat deterioration and/or destruction, migration hurdles (dams guards in estuaries), fishing and poaching.

MA.13.2.2.6 Stocking requirement eels <20 cm

So far, no restocking process has taken place.

MA.13.2.2.7 Summary data on glass eel

Table 14. Quantities of glass eel caught in the commercial fishery.

Year	Quantity (kg)
2009	240
2010	260
2011	390

Quantities of glass eel exported to Asia: no data available.

***Quantities of glass eel used in stocking: No stocking is done for glass eel.**

***Quantities of glass eel used in aquaculture for direct consumption: Badly consumed in Morocco (0.1%).**

***Mortalities of glass eel: No data available.**

MA.13.2.2.8 Data quality issues

MA.14 Sampling intensity and precision

MA.15 Standardization and harmonization of methodology

MA.15.1 Survey techniques

MA.15.2 Sampling commercial catches

- Eels (yellow and silver eel) are caught using fykenets by the fishermen working for the Aquaculture companies.
- Glass eels are fished using the dipnet in Loukkos river, and in Sebou river they are caught by trapnets and dipnet.

MA.15.3 Sampling

Catch sampling are carried out to the laboratory then they are frozen until they could be examined and dissected in the laboratory. The length (mm±0.1) and weight (g±0.01) is recorded for each eel. Otoliths are extracted and stored dry in paper envelopes. After the dissection the swimbladder was removed and macroscopically examined for the presence of adult and pre-adult *Anguillicoloïdes crassus* (lumen worms). The prevalence, the mean intensity and the mean abundance were calculated according to Bush *et al*. (1997).

MA.15.4 Age analysis

Staining of otoliths

Otoliths prepared for ageing are embedded in a synthetic resin (polyester) then grounded on the convex side and polished with 600–1200 abrasive papers and then stained with a few drops of a 50% solution of 1% EDTA (ethylene-diamine-tetra-acetic acid) and 5% toluidine blue. After five minutes the solution was wiped off with damp tissue paper leaving the protein (otolin) in annuli and supernumerary checks stained a deep blue (Liew, 1974; Richter and McDermott, 1990; Panfili and Ximénès, 1994).

Cracking and burning techniques

Both otoliths were extracted from all eels and placed, concave side up, and held securely in position by covering them with transparent adhesive tape (Graynoth, 1999). One of each pair was then sawn along the transverse plane through the nucleus with a fine scalpel blade. The otolith halves were heated on a scalpel blade under for 20–25 seconds using a Bunsen burner. Burnt otoliths were examined under reflected and transmitted light, respectively using Olympus (50–400 X).

MA.15.5 Life stages

- Silver eel: sides of the colour of silver or copper;
- Yellow eel: sides brown, grey, green, belly brown, green, grey, yellow;
- Eye diameter (the enlarged eyes are belonging to silver eels).

MA.15.6 Sex determinations

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

MA.16 Overview, conclusions and recommendations

Since the end of the 1990s, eel stocks have been declining at alarming rates. The growing fisherman population lacks awareness on the ecological importance of eel and prizes them only for their economical value.

Since the end of the 1990s, eel stocks have been declining at alarming rates. The growing fisherman population lacks awareness on the ecological importance of eel and prizes them only for their economical value.

Thus it is urgent to:

- Restore and improve the quality of eel habitats by:
    - Restoring migration paths (rendering fish outlets more efficient in dams) in order to allow elvers to reach growth habitats and to allow silver eel to reach the sea.
    - Reducing harmful effects of pollution (remediation, reduction of pesticide and fertilizer use…)
    - Reducing effects from climate changes on river flow and on the quality of habitats (by prohibiting pumping and draining water from rivers).
    - Reduce the introduction of allotchonous species to avoid habitat degradation and new diseases.
- Prevent heavy exploitation of eel by:
    - Improving fishermen’s living conditions and developing normalized, fishing infrastructures and recognizing the importance of the upkeeping of local fishing practices to ensure diversified production.
    - Applying stricter measures concerning the repopulation of some areas with young eels and the way sliver eels are transferred from confined areas to habitats from which they will migrate out to sea.
    - Regulating eel fishing: shortening eel fishing periods in order to reduce anthropic mortality. Establishing set fishing periods according to their developmental stages and controlling production methods.

    - Taking necessary measures in order to determine the origins of eel and to trace their commercialization from Morocco.
- Establish a regular follow-up of social and economical impacts of eel fishing and the evolution of their stock in order to assess the efficiency of the proposed eel management measures. Without a management programme, eel may disappear from the southern limit of its distribution area as shad did in Moroccan freshwaters.

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Report on the eel stock and fishery in The Netherlands 2010/'11

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Reporting Period: This report was completed in August 2011, and contains data up to 2010 and glass eel recruitment data for 2011.

Contributors to the report: Contributions: The following persons and institutions provided information for this report: Nicola Tien (ACTMON data analysis), Arjan Heinen (Combinatie van Beroepsvissers; stocking data), Jaap van der Meer (NIOZ: yellow eel data NIOZ fyke), Michiel Kotterman (IMARES; eel contaminants), William Swinkels (DUPAN, glass eel data and eel aquaculture production), Olga Haenen and Marc Engelsma (CVI; parasites and pathogens).

NL.2 Introduction

NL.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, a general registration of fishing efforts has not been implemented yet. 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 Plans. 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 involves 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 ~50 fishing companies catching 170 tonnes of eel in 2010, roughly a third of the annual landings of inland waters in the Netherlands. For details on the closure, visit the following website; http://www.rijksoverheid.nl/ministeries/eleni/nieuws/2011/03/31/vangstverbod-paling-en-wolhandkrab-vanaf-1-april-van-kracht.html.

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, Agriculture & Innovation).

NL.2.2 Spatial subdivision of the territory

The fishing areas can be categorized into 5 groups:

i) The Waddensea; 53ºN 5ºE; 2591 km². This is an estuarine-like area, shielded from the North Sea by a series of islands. The inflow of seawater at the western side mainly consists of the outflow of the river Rhine, which explains the estuarine character of the Waddensea. The fishery in the Waddensea is permitted to licence holders and assigns specific fishing sites to individual licensees. Fishing gears include fykenets and poundnets; the traditional use of eelpots is in rapid decline. The fishery in the Waddensea 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.

ii) Lake IJsselmeer; 52º40'N 5º25'E; now 1820 km². Lake IJsselmeer is a shallow, eutrophic freshwater lake, which was reclaimed from the Waddensea in 1932 by a dike (Afsluitdijk), substituting the estuarine area known before as the Zuiderzee. The surface of the lake was stepwise reduced 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 Waddensea 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 EL&I. There are 70 fishing licenses, owned by ca. 30 companies. The total number of gears allowed in 2010 was: fixed fykes 1579, train fykes 6386, eel boxes 7415 and unknown numbers of longlines.

iii) Main rivers; 180 km^2 of water surface. The Rivers Rhine and Meuse flow from Germany and Belgium respectively, and constitute a network of dividing and joining river branches in the Netherlands. 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 efforts is required. There are 28 fishing companies, using an estimated number of 318 fixed fykes, 2433 train fykes, 551 eel boxes, and unknown quantities of other gears (electric dipnet, longlines, etc). This fishery has been almost completely stopped due to the introduction 1/4/2011 of a total fishing ban on eel and Chinese mitten crab in rivers polluted with dioxins. Since 1 April 2011 the eel fishery on the main rivers has been closed due to high levels of pollutants in eel (Figure 1).

iv) Zeeland; 965 km^2. 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 freshwater. Fishing is licensed to individual fishermen, mostly spatially restricted. Fishing gears are dominated by fykenets. Management is partially based on marine, partly on freshwater 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 of eel and Chinese mitten crab fishery in the closed (dioxine) areas.

v) Remaining waters; inland 1340 km^2. This comprises 636 km^2 of lakes (average surface: 12.5 km^2); 386 km^2 of canals (> 6 m wide, 27 590 km total length); 289 km^2 of ditches (< 6 m wide, 144 605 km total length); and 28 km^2 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 licenses 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 approximately 100 companies, using unknown quantities of gears of all types.

The Water Framework Directive subdivides the Netherlands into four separate River Basin District all of which extend beyond our borders. These are:

a) the River Ems (Eems), 53º20'N 7º10'E (=river mouth), shared with Germany. This RBD includes the northeastern Province Groningen, and the eastern part of Province Drente. Drainage area: 18 000 km², of which 2400 km² in the Netherlands.

b) 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.

c) the River Meuse (Maas), 51º55'N 4º00'E, shared with Belgium, Luxemburg, France and Germany. Drainage area: 35 000 km² , of which 8000 km² in the Netherlands.

d) the River Scheldt (Schelde), 51º30'N 3º25'E, shared with Belgium and France. Most of the southwestern Province Zeeland used to belong to this RBD, but water reclamation has changed the situation dramatically. Drainage area: 22 000 km², of which 1860 km² in the Netherlands.

Within the Netherlands, all rivers tend to intertwine and confluent. Rivers Rhine and Meuse have a complete anastomosis at several places, while 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.

NL.2.3 Dutch Eel Management Plan

The Ministry of Economic Affairs, Agriculture and Innovation (responsible for fisheries) has submitted an Eel Management Plan (MinLNV 2008); the initial version (December 2008) has been replaced by a second version (April 2009), which in turn has been replaced by a new decision in July 2009 (decision published 14 July 2009, approved by EU on 20 October 2010). Major elements of this plan are:

1. One single Eel Management Plan for the whole territory, including coastal areas.

2. Target escapement for Lake IJsselmeer estimated at 3080 t (length structured model, auction statistics), for the whole country at 4000–6000 t (historical landings per surface area, 1950s data, recent surfaces). Following the initial version of the EMP, the calculations have been reviewed by a committee, and targets are now set at 2600–8100 t, “most probably lower than the previous” calculations.

3. Current escapement is estimated at 400 t, half of which is silver eels from upstream, only passing through Dutch territory.

4. Fisheries for yellow and silver eel currently occurs in almost all waters, see previous section. Relative impact on the stock is unknown.

5. Other mortalities are omnipresent, but unquantified. Minimum estimates (including fishing) are: 1000 t for yellow eel, and 345 t for silver eel.

6. Restocking of approx 0.2 million individuals (mostly bootlace); future restocking of 1–1.6 t of glass eel is foreseen.
7. Management measures planned as follows:
    a. Reduction of mortality at pumping stations. Within the framework of the WFD, a budget of 200 M€ is available.
    b. The hydropower industry will be asked to reduce mortality by 35%. On new installations, a migration passage is obligatory.
    c. Fishery-free zones near barriers and sluices, presumably extending 500 m up- and downstream.
    d. Release of angler catches; this is a voluntary measure by the recreational fisheries.
    e. Ban on recreational fishing (a few fykenets per person) in coastal areas from 2011.
    f. Stop on sniggle licences in state owned waters.
    g. For the fishery, version 1 of the EMP set a closed season in Sept+Oct (yellow & silver eel, total ca. 50% of the annual catch).; version 2 decided to trap and transport 157 t of silver eels (of which 50 t from unpolluted waters) for release into the sea, but no closed season; and the July 2009 decision returns to a closed season (2009: Oct+Nov; 2010 onwards: Sept+Oct+Nov).
    h. The time until recovery depends very much on the immigration of glass eels in the years to come. Assuming that glass eel recruitment will have recovered by 2027, the targets set for silver eel escapement will be met.

NL.3 Time-series data

NL.3.1 Recruitment-series and associated effort

NL.3.1.1 Glass eel

NL.3.1.1.1 Commercial

Glass eel fisheries is forbidden. No available data.

NL.3.1.1.2 Recreational

Glass eel fisheries is forbidden. No available data.

NL.3.1.1.3 Fishery-independent

Recruitment of glass eel in Dutch waters is monitored at Den Oever and 11 other sites along the coast (Figure NL. 2; see Dekker, 2002 for a full description). In Den Oever (Figure NL.3), 2011 recruitment was lower than 2010 and similar to levels observed during the first part of the decade. The data at the other sites (Figure NL.3) 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.

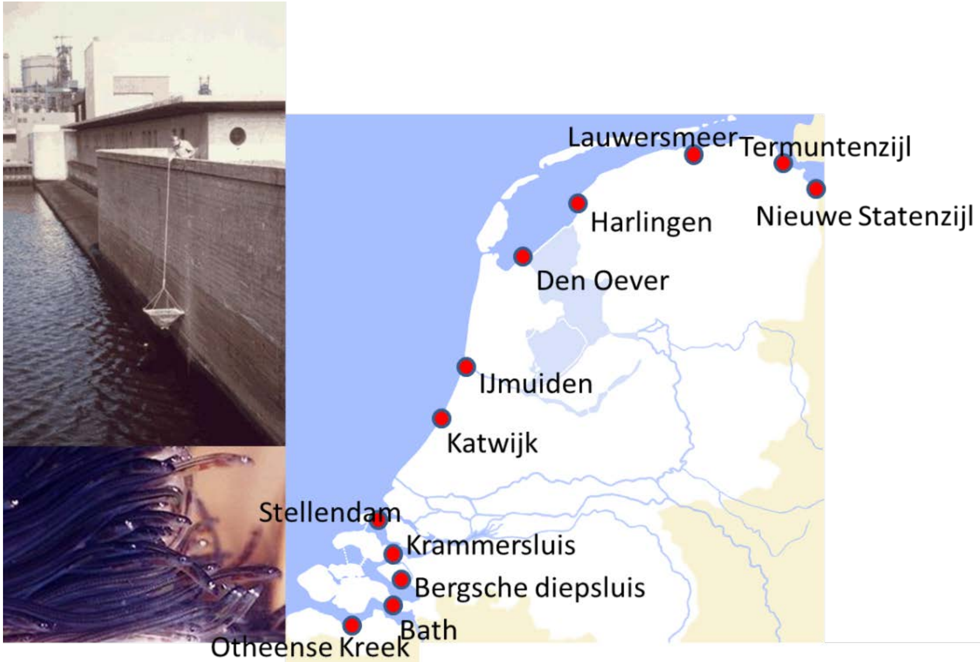

Figure NL.2. Locations of glass eel monitoring in the Netherlands.

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	
3		13.7	21.1	123.7	18.8	14.7	3.5	1.3	
4		46.1	38.8	58.1	63.0	31.6	5.4	2.1	
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	2.4	0.5	
9	71.5	6.6	67.6	27.1	87.7	4.8	3.7	0.9	

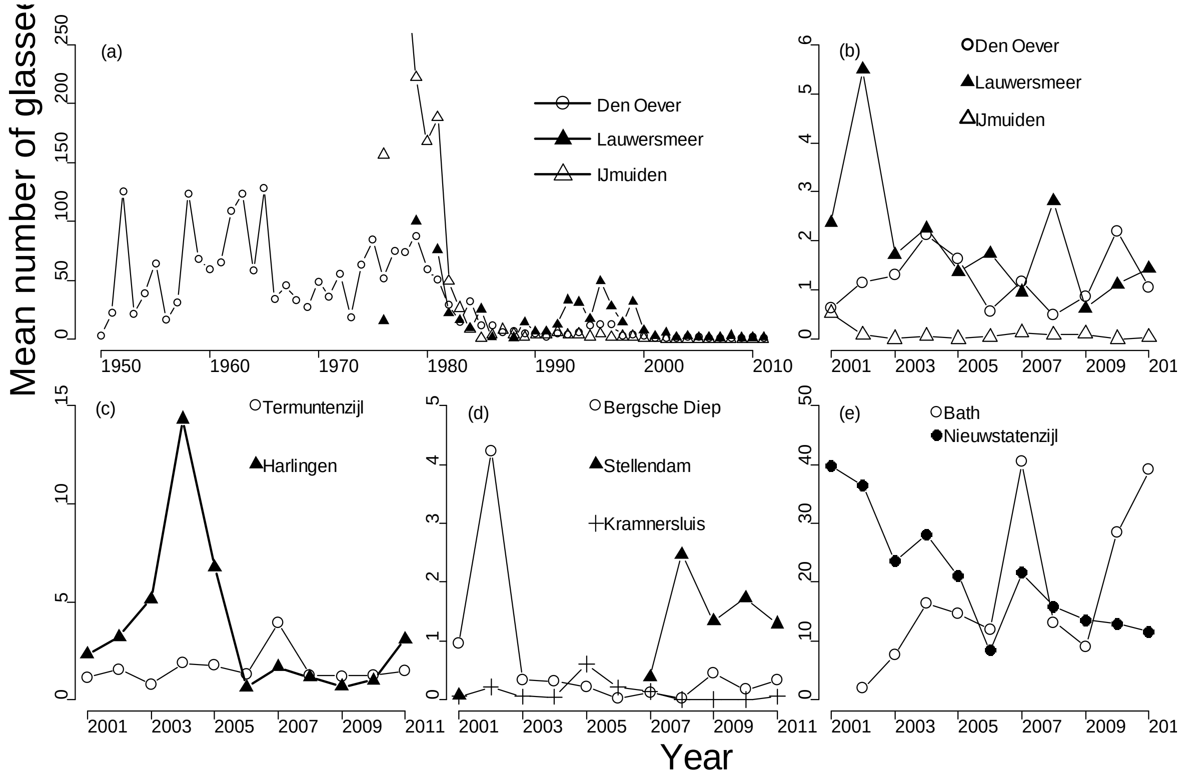

Figure NL.3. Trend indices (mean number per haul in April and May) of glass eel recruitment at different locations along the coast of the Netherlands.

Table NL.b. Average number of glass eel caught per lift net haul in the period April–May at twelve sites in the Netherlands. If five or less hauls were conducted it was recorded as NA. * = very early season (warm spring), sampling stopped early (start of May), small number of empty samples. ** = sampling took place in part of the season.

	OTHEENSE KREEK	BATH	KRAMMERS LUIS	BERGSCHE DIEP	STELLENDA M	KATWIJK	IJMUIDEN	DEN OEVER (SCHIPLOC	HARLINGEN	LAUWERSM EER	NIEUWSTAT EN-ZIIL	TERMUNTE N-ZIIL
RBD	Scheldt	Scheldt	Meuse	Meuse	Meuse	Rhine	Rhine	Rhine	Rhine	Rhine	Ems	Ems
1969	NA	NA	NA	NA	NA	NA	50.8	NA	NA	NA	NA	NA
1970	NA	NA	NA	NA	NA	NA	28.0	NA	NA	NA	NA	NA
1971	NA	NA	NA	NA	18.4	NA	NA	NA	NA	NA	NA	NA
1972	NA	NA	NA	NA	5.6	NA	NA	NA	NA	NA	NA	NA
1973	NA	NA	NA	NA	NA	NA	30.7	NA	NA	NA	NA	NA
1974	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1975	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1976	NA	NA	NA	NA	NA	NA	156.6	NA	NA	15.4	NA	NA
1977	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1978	NA	NA	NA	NA	NA	NA	332.4	NA	NA	NA	NA	NA
1979	NA	NA	NA	NA	NA	NA	222.3	NA	NA	100.4	NA	NA
1980	NA	NA	NA	NA	NA	NA	168.0	NA	NA	NA	NA	NA
1981	NA	NA	NA	NA	NA	NA	188.7	NA	NA	75.9	NA	NA
1982	NA	NA	NA	NA	NA	NA	49.2	NA	NA	21.6	NA	NA
1983	NA	NA	NA	NA	NA	NA	26.2	NA	NA	15.8	NA	NA
1984	NA	NA	NA	NA	NA	NA	8.1	NA	NA	9.5	NA	NA
1985	NA	NA	NA	NA	NA	NA	0.6	NA	NA	25.2	NA	NA
1986	NA	NA	NA	NA	NA	NA	3.3	NA	NA	1.3	NA	NA
1987	NA	NA	NA	NA	NA	NA	7.7	NA	NA	NA	NA	NA
1988	NA	NA	NA	NA	13.8	NA	4.0	NA	NA	1.0	NA	NA
1989	NA	NA	NA	NA	4.4	NA	1.5	NA	NA	14.3	NA	NA
1990	0.3	NA	0.3	NA	10.9	NA	3.2	NA	NA	6.0	NA	NA
1991	0.0	NA	0.2	1.3	3.1	5.1	3.6	NA	NA	6.6	NA	0.5
1992	0.0	14.5	0.4	2.2	16.9	8.1	5.8	NA	16.7	12.1	NA	0.6
1993	0.0	22.7	0.4	NA	10.1	13.5	3.3	NA	NA	33.2	NA	1.2
1994	0.0	14.2	0.5	NA	4.0	15.1	4.0	NA	16.0	31.0	NA	2.8
1995	0.5	17.8	0.4	NA	3.3	29.7	2.0	34.7	6.6	16.9	NA	3.7
1996	1.2	35.3	0.7	NA	0.5	25.3	4.5	11.0	34.2	49.4	27.5	7.7
1997	NA	41.6	0.6	NA	2.8	12.3	1.8	11.4	14.0	27.8	30.0	15.6
1998	0.7	28.2	0.6	NA	1.0	38.8	2.0	6.5	18.3	14.4	21.8	1.4
1999	1.4	29.7	0.5	NA	1.2	122.7	1.9	7.2	19.1	31.7	13.5	10.1
2000	0.8	10.2	1.0	3.8	7.1	11.6	0.7	5.0	2.9	7.2	38.8	8.7
2001	0.4	NA	0.1	0.1	1.0	14.1	0.5	1.7	2.3	2.4	39.7	1.1
2002	NA	1.9	0.2	NA	4.2	12.3	0.1	1.4	3.2	5.5	36.4	1.6
2003	NA	7.5	0.1	NA	0.3	12.7	0.0	4.7	5.1	1.7	23.6	0.8
2004	0.0	16.4**	0.0	NA	0.3	4.5	0.1	NA	14.3**	2.3	28.1	1.9
2005	0.0	14.6	0.6	NA	0.2	5.6	0.0	NA	6.8	1.4	21.1	1.8

	OTHEENSE KREEK	BATH	KRAMMERS LUIS	BERGSCHE DIEP	STELLENDA M	KATWIJK	IJMUIDEN	DEN OEVER (SCHIPLOC	HARLINGEN	LAUWERSM EER	NIEUWSTAT EN-ZIJL	TERMUNTE N-ZIJL
2006	0.0	12.0	0.2	NA	0.0	1.4	0.0	0.28	0.6	1.7	8.3	1.3
2007*	0.0	40.5	0.1	0.4	0.1	24.8	0.1	0	1.7	1.0	21.7	4.0
2008	0.0	13.2	0.0	2.5	0.0	4.1	0.1	0.76	1.1	2.8	15.9	1.3
2009	0.0	9.1	0.0	1.3	0.4	3.5	0.1	NA	0.7	0.6	13.6	1.2
2010	NA	28.4	0.0	1.7	0.2	NA	0.0	1.19	1.0	1.1	13.0	1.2
2011	NA	39.2	0.1	1.3	0.3	NA	0.0	NA	3.1	1.4	11.6	1.4

NL.3.1.2 Yellow Eel Recruitment

NL.3.1.2.1 Commercial

No available data.

NL.3.1.2.2 Recreational

No available data.

NL.3.1.2.3 Fishery-independent

At various places in the Netherlands, facilities have been built to allow glass eel and yellow eel to migrate through or over dykes and sluices. Some of these places monitor the quantities of eel being caught and transported, but these dataseries are currently too short to be used as time-series. There is one noticeable exception: for the eel trap at pumping station Stroink in Vollenhove (52º42’16N 5º28’22E), records have been kept since the late 1950s, but unfortunately, the data prior to 1976 have been lost. Unfortunately no data are available for 2010; check WGEEL 2010 Country Report The Netherlands for further information.

One of the few long time-series for yellow eel is the fyke monitoring at NIOZ (Den Burg, Texel). This dataset shows a familiar pattern of a steep decline in abundance since the 1980s.

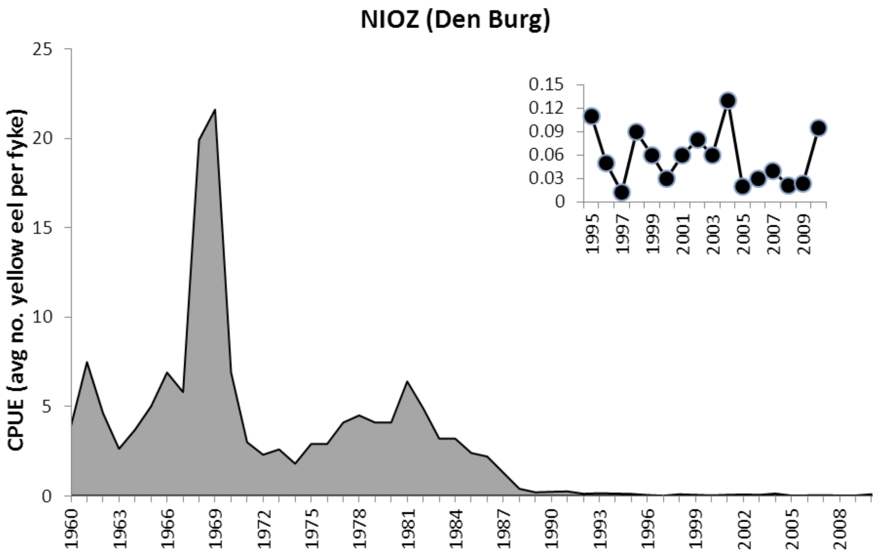

Figure NL.4. Time-series of the mean catch per fyke (numbers) of yellow eel at NIOZ (data from van der Meer, in prep.).

NL.3.2 Yellow eel landings

NL.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. However, 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; see Section NL.6.2.1 for details. An obligatory catch registration system was introduced in the Netherlands in January 2010 by the Ministry of Agriculture, Nature and Food Quality. However, 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.

NL.3.2.2 Recreational

No available data.

NL.3.3 Silver eel landings

NL.3.3.1 Commercial

No reliable long-term time-series of yellow eel landing exist; total landings of yellow and silver eel combined, have been reported. However, 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; see Section NL.6.2.1 for details. An obligatory catch registration system was introduced in the Netherlands in January 2010 by the Ministry of Agriculture, Nature and Food Quality. However, 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.

NL.3.3.2 Recreational

No available data.

NL.3.4 Aquaculture production

NL.3.4.1 Seed supply

Table NL.c. Origin of glass eel used for aquaculture in the Netherlands in 2011 (Source DUPAN).

Season	France	Spain	England	Total (kg)
2010/2011	4725	1890	135	6750

NL.3.4.2 Production

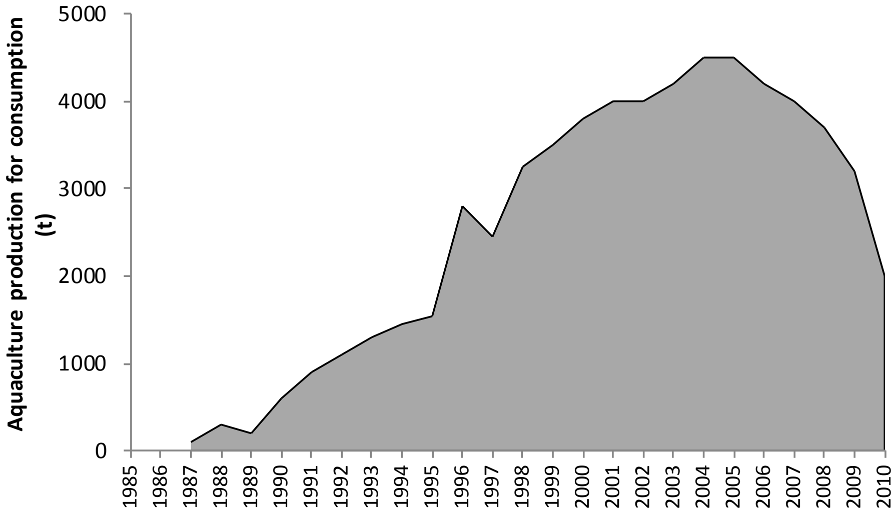

Figure NL.5. Trend in aquaculture production for consumption in the Netherlands (Source DUPAN).

NL.3.5 Stocking

NL.3.5.1 Amount stocked

Glass eel and young yellow eel are used for re-stocking inland waters since time immemorial, mostly by local action of stakeholders. Although a minimum legal size for capture, holding and transport of eels is set in a byelaw, the existing practice of short-range transports has never been prosecuted. Since World War II, the Organisation for the Improvement of Inland Fisheries OVB has organized a re-stocking programme, importing glass eels from France and England, and buying yellow eel from commercial fishermen fishing in the Waddensea. Data on re-stocking quantities in 2011 are listed in Table NL.d.

In recent years, the OVB has merged with the major anglers organization, and subsequently handed over the glass eel importing to the Organisation of Professional Fishermen CvB. Information on recent glass eel imports was made available by the CvB. Restocking of young eel is no longer organized centrally, although trade of small eels (undersized) still occurs. The listed estimates are probably a minimum, not including unregistered trade. Since the government does not keep track of imports and re-stockings anymore, it is not known anymore to what extend re-stocking has been practised by other parties. In 2011, more than ~0.8 million glass eels and ~0.95 million yellow eels have been re-stocked by some parties.

In the earlier decades, young yellow eels were derived from fisheries for wild eel in the Wadden Sea; in recent years, the catches in the Wadden Sea have dropped to almost nothing, and young yellow eels are derived from the aquaculture industry, i.e. eels derived from imported glass eel (England, France).

Table NL.d. Overview of glass eel and young yellow eel stocked in the Netherlands in 2011 (Source CvB, DUPAN). Note that all young yellow eel stocked in 2011 originated from glass eel caught in France and England in 2011 and 2010.

Date	Stocking Location	Type	Origin	Kg	#/kg	#
27/4/2011	Veluwe Randmeer (Harderwijk)	Glass eel	France	113	3000	339 000
16/5/2011	Veluwe Randmeer (Harderwijk)	Glass eel	England	51	3730	190 230
27/4/2011	Friesland	Glass eel	England	20	3420	68 400
27/4/2011	Westeinderplas	Glass eel	England	3	3420	10 260
27/4/2011	Stichtse-Ankeveense plassen	Glass eel	England	14	3420	47 880
27/4/2011	Noord-west Overijssel	Glass eel	England	28	3420	95 760
27/4/2011	Krommenie (Noord-Holand)	Glass eel	England	3	3420	10 260
27/4/2011	Hoorn (Noord-Holland)	Glass eel	England	2	3420	6840
?	?	Glass eel	?	10	3000	30 000
			TOTAL	*244*		*798 630*
16/6/2011	Zuidelijke Randmeer (Almere)	Young yellow eel	Denmark	323	196	63 308
16/6/2011	Zuidelijke Randmeer (Almere)	Young yellow eel	St Anthonis (NL)	517	179	92 543
16/6/2011	Zuidelijke Randmeer (Spakenburg)	Young yellow eel	Nijvis (NL)	555	455	252 376
?	Kampen	Young yellow eel	Nijvis (NL)	1,500	100	150 000
?	Alkmaardermeer	Young yellow eel	?	500	100	50 000
?	Markiezaatsmeer	Young yellow eel	?	1,000	100	100 000
?	Veluwe Randmeer	Young yellow eel	St Anthonis (NL)	1,400	133	186 667
?	Westeinderplas	Young yellow eel	?	200	100	20 000
?	Friesland	Young yellow eel	?	125	100	12 500
?	Noord-Holland	Young yellow eel	?	175	100	17 500
?	Reeuwijkse Plassen	Young yellow eel	Kraan	100	400	40 000
?	Lemster Brekken	Young yellow eel	Kraan	50	225	11 250
			TOTAL	*6445*		*996 293*
?	Duitland	Young yellow eel	Nijvis (NL)	?	?	3 500 000

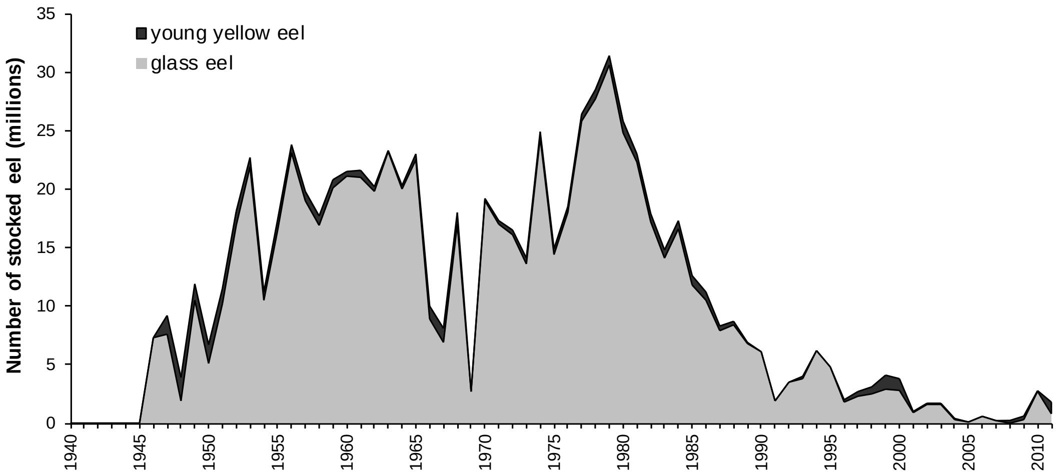

Figure NL.6. Overview of glass eel and young yellow eel stocking in the Netherlands.

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

Catch and retain of eels <28 cm is illegal. There is no organized trap and transport of undersized eels.

NL.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 is lacking. For Lake IJsselmeer, a maximum number of gears per company is enforced (authenticated tags are attached to individual gears), but the actual usage is often much lower, amongst others since restrictions apply on the combinations of types of fishing gears (e.g. no fykenets and gillnets should be operated concurrently, since perch and pikeperch are the target species of the gillnetting, while landing perch and pikeperch from fykenets is prohibited).

NL.5 Fishing effort

For most of the country, fishing capacity is unknown. In areas where fishing capacity is known, no record is kept of the actual usage of fishing gears. Consequently, no information is available on fishing effort. For Lake IJsselmeer, 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 underutilization of the nominal effort probably still exists. The effort in the longline fishery is not restricted, other than by the number of licences.

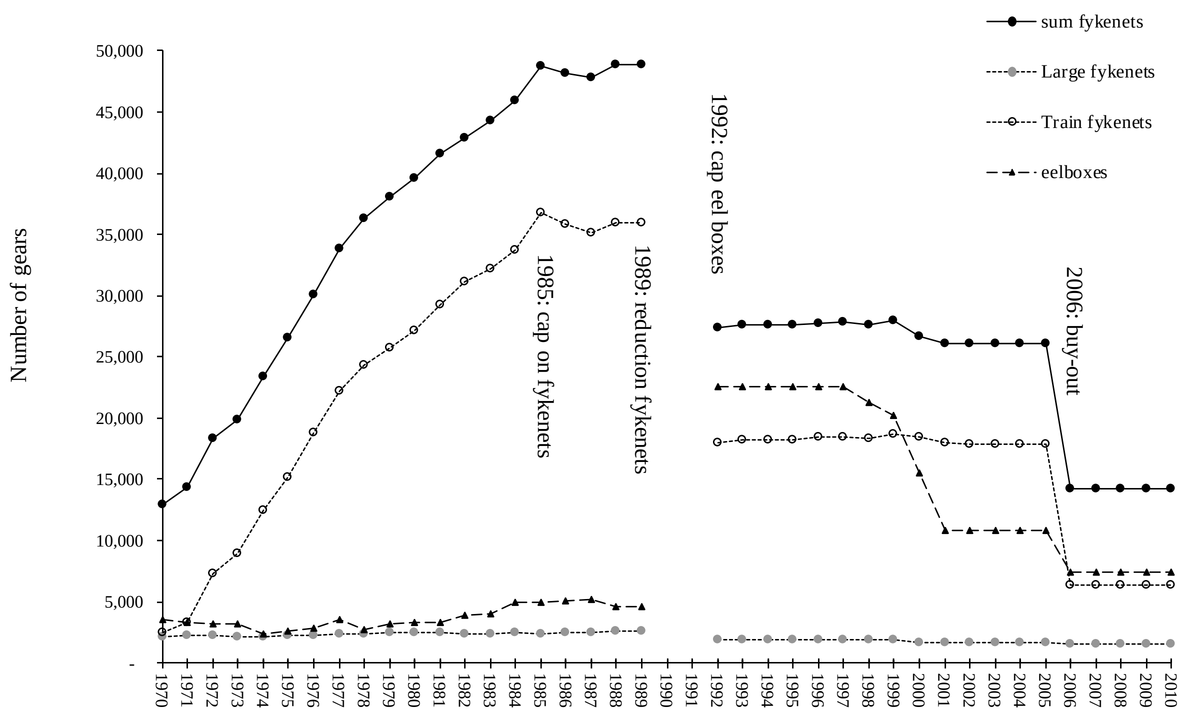

Figure NL.7. Trends in the nominal number of fishing gear employed in the eel fishery on Lake IJsselmeer. Information before 1989 is based on a voluntary inquiry in 1989 (Dekker, 1991); after 1992, the licensed number of gear is shown. The reduction in-between is realistic.

The Ministry of Economic Affairs, Agriculture and Innovation is currently conducting a survey of eel fishing gears used in 2010. In 2012 information on fishing effort will be added to the obligatory catch registration system of the Ministry.

NL.6 Catches and landings

NL.6.1 Glass eel

Glass eel fishing is forbidden, no available data.

NL.6.2 Yellow eel

NL.6.2.1 Catches and landings from Lake IJsselmeer

For Lake IJsselmeer, statistics from the auctions around Lake IJsselmeer are now kept by the Fish Board (Table NL.e); before 1994, the government kept statistics. These statistics are broken down by species, month, harbour and main fishing gear; the quality of this information has deteriorated considerably over the past decade, due to misclassification of gears, and the trading of eel from other areas at IJsselmeer auctions. For example, the estimates for the total number of eel caught in Lake IJsselmeer in 2010 vary from 117 t (registration Min EL&I), 79 t (PO IJsslmeer) to 65 t (Fish Board).

Table NL.e. Landings in tons per 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 are suspect, due to misclassification of catches and trade from areas outside Lake IJsselmeer at the IJsselmeer auctions.

Decade	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990	2000	2010

YEAR											
0	324	620	1157	838	3205	4152	2999	1112	641	472	*368*	*65*
1	387	988	989	941	4563	3661	2460	853	701	573	*381*	
2	514	720	900	1048	3464	3979	1443	857	820	548	*353*	
3	564	679	742	2125	1021	3107	1618	823	914	293	*279*	
4	586	921	846	2688	1845	2085	2068	841	681	330	*245*	
5	415	1285	965	1907	2668	1651	2309	1000	666	*354*	*234*	
6	406	973	879	2405	3492	1817	2339	1172	729	*301*	*230*	
7	526	1280	763	3595	4502	2510	2484	783	512	*285*	*130*	
8	453	1111	877	2588	4750	2677	2222	719	437	*323*	*122*	
9	516	1026	1033	2108	3873	3412	2241	510	525	*332*	*42*	

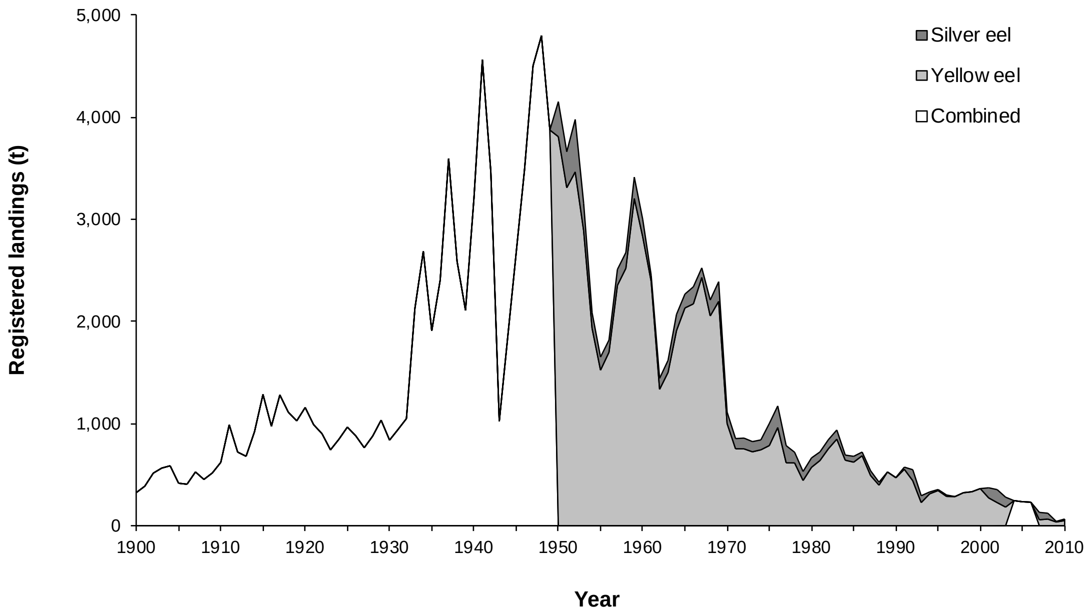

Figure NL.8. Time-trend in the landings from Lake IJsselmeer.

NL.6.2.2 Catches and landings inland waters

For the inland areas outside Lake IJsselmeer, no detailed records of catches and landings were available until 2010. In January 2010 the Ministry of Economic Affairs, Agriculture and Innovation introduced an obligatory catch recording system for inland eel fishers (IJsselmeer and Rivers). Fishermen are required to report their weekly eel catches for each of the 43 so-called Fish Stock Management Committees ['Visstand Beheer Commissies' VBC].

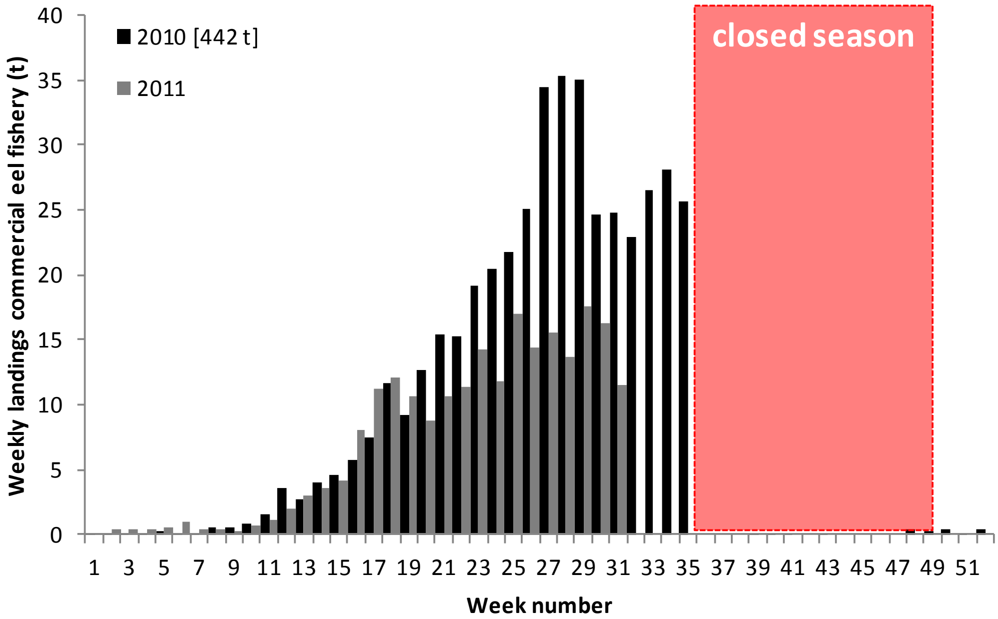

Figure NL.9. Weekly catches in tons of eel (yellow + silver eel combined) by inland fishermen.

NL.6.2.2 Recreational fisheries

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). Preliminary results of the logbook programme indicate that in the Netherlands around ~1 500 000 eels (~200 t) are caught while **553 000 eels (114 t)** are retained by anglers. The result is rather surprising as since a few years it is not forbidden to catch eel but it is forbidden to retain eel in pretty much all inland and coastal water in the Netherlands.

NL.6.3 Silver eel

See Section 6.2 Yellow eel.

NL.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. Registrations are available for the years 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, if their landings per day exceeded 50 kg. That is: in 2001 the number of ships potentially reporting rose, but the actual reporting per ship declined. This change in the regulations was partly driven by changing practices, and vice versa. In practice, the abrupt change in the regulations in 2001 led to a gradually changing reporting practice. Overall, the number of ships reporting in a year declined from 130 before 2001 to 59 thereafter, while the average landing per ship increased from 230 kg/ship/year before 2001 to 436 kg/ship/year thereafter.

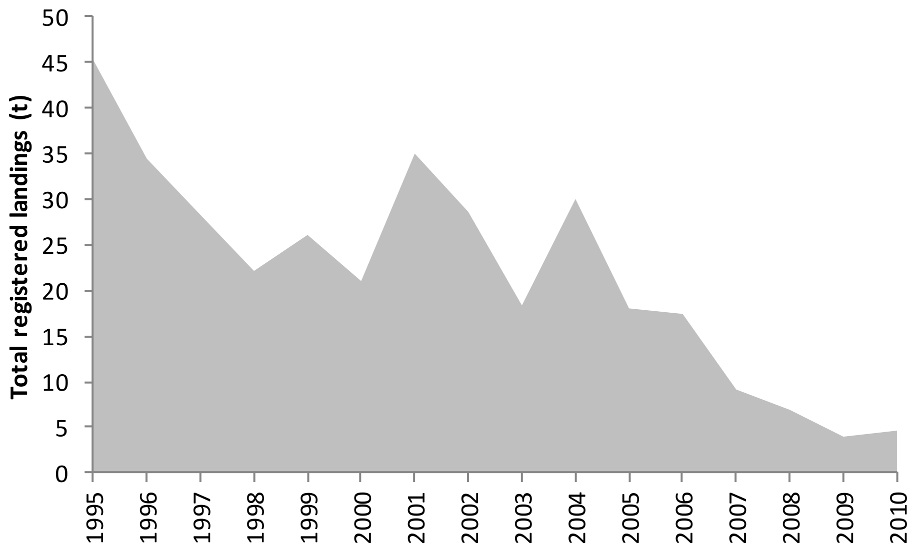

Figure NL.10. Time-trend in the total registered landings from marine waters in Dutch harbours.

NL.7 Catch per unit of effort

No data on cpue are available in the Netherlands.

NL.8 Other anthropogenic impacts

Nothing to report under this heading.

NL.9 Scientific surveys of the stock

NL.9.1 Recruitment surveys, glass eel

See Section 3.1.1.3.

NL.9.2 Stock surveys, (yellow) eel

NL.9.2.1 Lake IJsselmeer (active gear)

Figure NL.11 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.

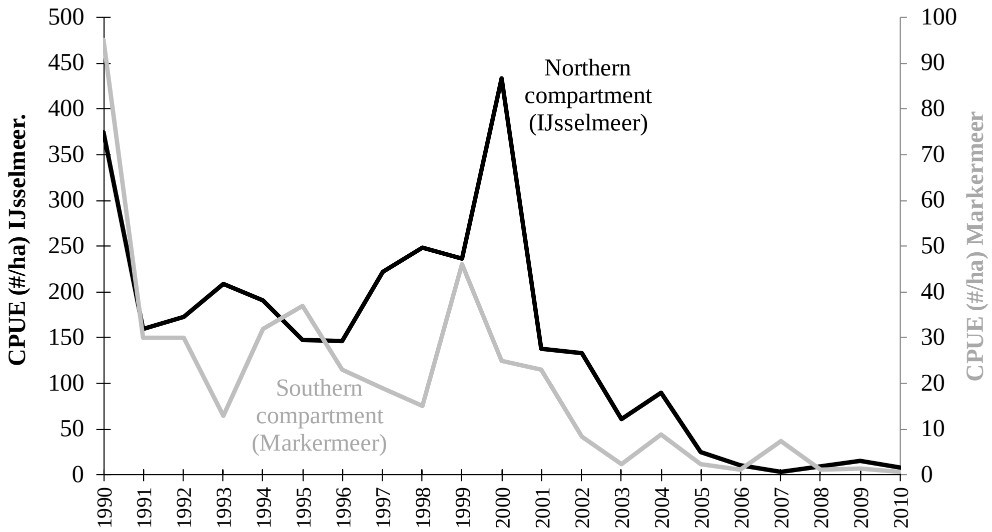

Figure NL.11. Cpue trends in Lake IJsselmeer stock surveys, in number per hectare swept-area, using the electrified trawl. Note: The northern and southern compartments are separated by a dyke.

NL.9.2.2 Main rivers (active gears)

Eel stocks in the main rivers are surveyed yearly since 1998. Within a river, the main stream is sampled with a beam trawl and the river banks are sampled with an electric dipnet. Data are collected annually in eleven river systems, which are clustered in six regions. In Figure NL.12, data are presented for three regions, namely Downstream (consisting of Hollands Diep, Nieuwe Merwede and Oude Maas), Gelderse Poort (consisting of the upstream section of the Rhine, Waal, Nederrijn and Gelderse IJssel, near the German border) and the Grensmaas (a shallow, upstream section of the Maas, near the Belgian border). Downstream is surveyed in September/October (i.e. during the migratory period of the silver eel), Gelderse Poort in March/April, and Grensmaas in May.

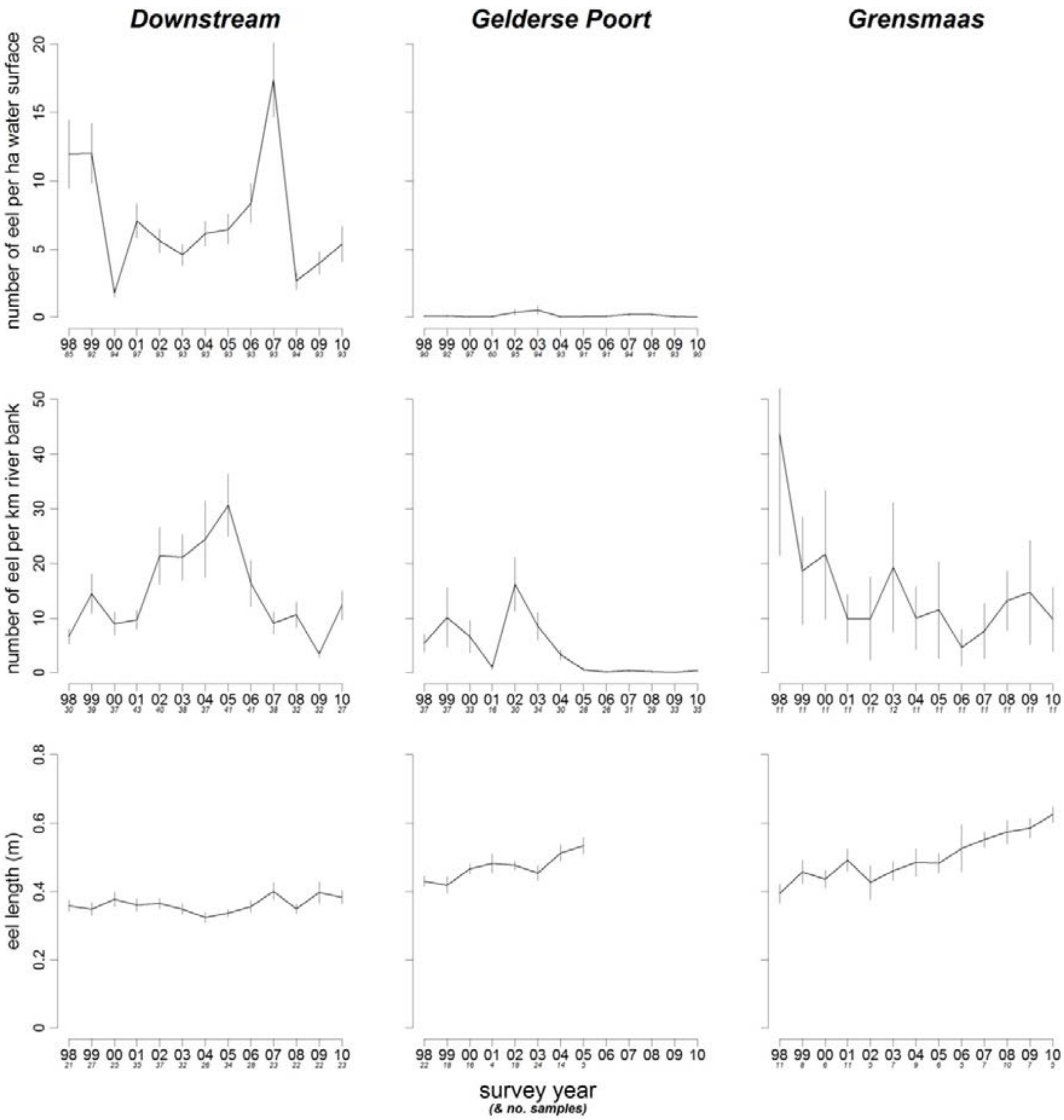

Figure NL.12. Eel stock survey in downstream and upstream (Gelderse Poort; Grensmaas) the main rivers; densities with beam trawl (top graphs), densities with electrofishing (middle graphs) and average length (bottom graphs).

For the downstream region, Figure NL.12 shows high densities of eel, both in the main stream and the river bank. In this region, no trend seems present through the years, in either abundance or length. The upstream location of the Gelderse Poort has very low densities of eel in the main stream, and strongly declining densities in the river banks, with almost no eel detected in the last four years. Also, the average length in the Gelderse Poort seems to increase, for the years in which enough data are available. The trend in the Grensmaas seems to be similar to that in the Gelderse Poort, with decreasing densities and increasing average length.

These data suggest that in the upstream regions the abundance of eel is decreasing while the average length is increasing, which could imply a declining recruitment of young eel in the upstream regions.

NL.9.2.3 Main rivers (passive gear)

Starting in 1993, the fish assemblage in the main rivers and linked waters has been monitored, by means of logbook registration of commercial catch and bycatch, in a restricted number of fykenets (four large fykenets or two pairs of summer fykenets per location), mostly on a weekly basis. For eel, the number of yellow eels and silver eels caught is recorded. Results show a slowly declining trend over the years in the main rivers, but the year-to-year and site-to-site variation is considerable. The closed season (August–October) since 2009 and especially the closing of the fishery in the dioxine areas (indicated blue in Figure 13) caused an interruption of this time-series.

Figure NL.13. Sampling sites for ACTMON and PASMON (4-fyke monitoring of commercial catches and bycatch).

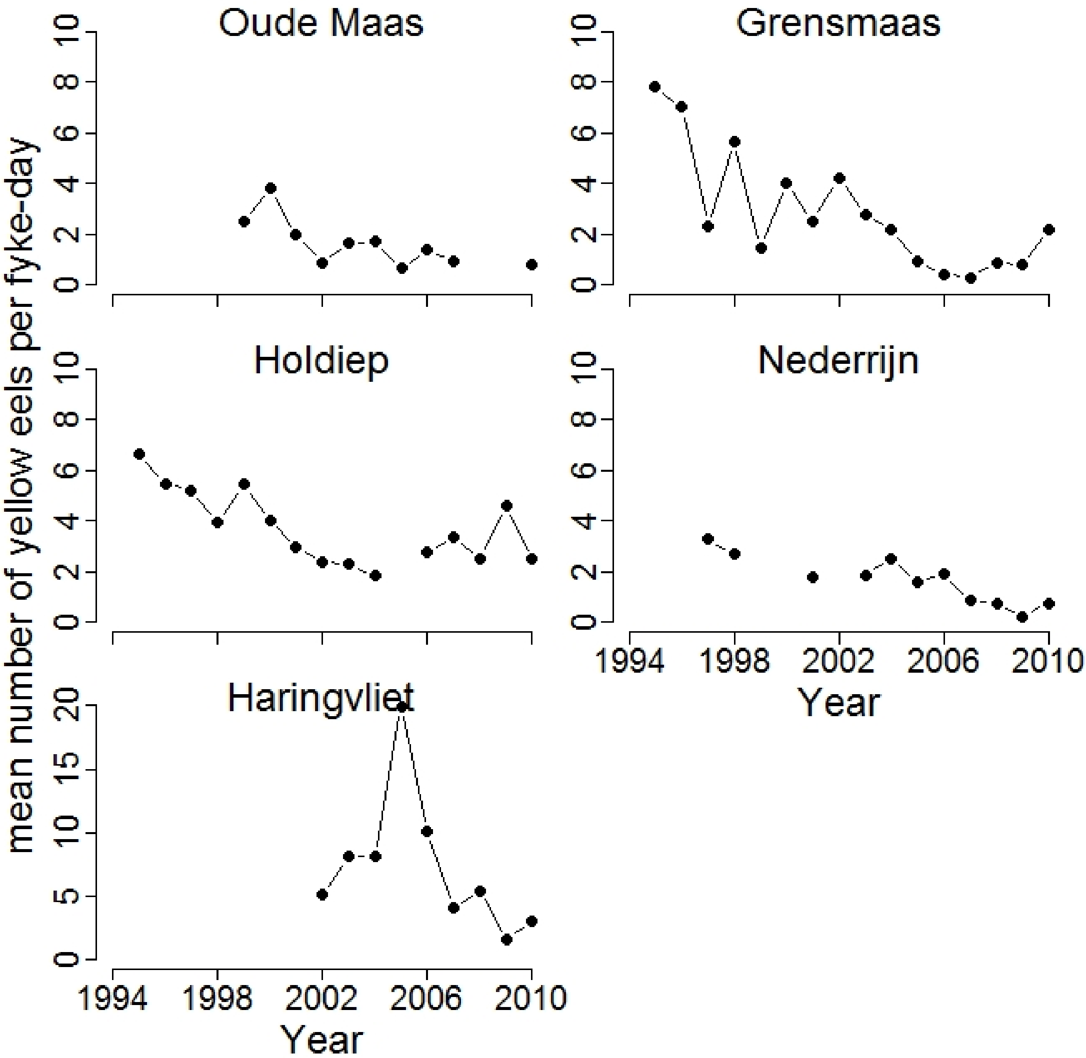

Figure NL.14. Mean number of yellow eel per fyke day in the lower and upper reaches of the rivers Meuse and Rhine in the Netherland.

NL.9.2.4 Coastal waters

No update of the Demersal Fish Survey available.

NL.9.3 Silver eel

There are no routine surveys for silver eel in the Netherlands. *Ad hoc* estimates based on tagging and/or transponder experiments are available from

Klein Breteler, J., Vriese, T., Borcherding, J., Breukelaar, A., Jörgensen, L., Staas, S., de Laak, G., and Ingendahl, D. 2007. Assessment of population size and migration routes of silver eel in the River Rhine based on a 2-year combined mark-recapture and telemetry study. – ICES Journal of Marine Science, 64: 1–7.

Winter, H. V., Jansen, H. M., and Breukelaar, A. W. 2007. Silver eel mortality during downstream migration in the River Meuse, from a population perspective. – ICES Journal of Marine Science, 64(7):1444–1449.

A Silver Eel Index is currently being designed and is expected to be implemented in autumn of 2012.

NL.10 Catch composition by age and length

NL.10.1 Biological composition of eel catches in the Netherlands

In 2009 and 2010, a pilot market sampling survey has been conducted of Dutch eel catches in two areas in The Netherlands: Friesland (fisheries in polders and lakes) and downstream areas of the Rhine and Meuse. From 2011, eel catches will be sampled in all areas of the Netherlands. Estimated numbers at length by sex, maturity-at-length by sex and weight-at-length by sex are given in Tables NL.f (downstream areas of Rhine and Meuse) and Table NL.g (Friesland). Estimates of numbers of eels are expressed as numbers of individuals per metric tonne of commercial eel catches.

Table NL.f. Estimated numbers-at-age by sex, maturity-at-age by sex and mean weight-at-age by sex, in commercial eel catches in downstream areas of the Rhine and Meuse. Estimates of numbers of eels are expressed as numbers of individuals per metric tonne of commercial eel catches.

Length-interval		Numbers of eels		Proportion in Silver eel stage		Mean weight (gramme)	
From (cm)	To (cm)	Male	Female	Male	Female	Male	Female
150	200	1.2	0.4	0	0	4.59	4.85
200	250	8.7	5.0	0	0	15.57	15.15
250	300	114.7	110.6	0	0	39.21	33.42
300	350	278.7	451.2	0.08	0	67.17	61.34
350	400	260.7	763.5	0.18	0.014	100.93	99.10
400	450	118.2	810.4	0.29	0.024	133.34	147.90
450	500	0.0	640.3	0.61	0.039	219.10	206.46
500	550	0.0	556.8		0.059		266.81
550	600	0.0	351.3		0.121		401.70
600	650	0.0	209.4		0.168		482.96
650	700	0.0	106.2		0.266		627.16
700	750	0.0	58.4		0.381		781.10
750	800	0.0	20.5		0.541		1003.37
800	850	0.0	9.1		0.639		1162.05
850	900	0.0	6.8		0.774		1457.17
900	950	0.0	2.3		0.843		1682.50
950	1000	0.0	0.8		0.843		1682.50
1000	1050	0.0	0.0				

Table NL.G. Estimated numbers-at-age by sex, maturity-at-age by sex and mean weight-at-age by sex, in commercial eel catches in Friesland. Estimates of numbers of eels are expressed as numbers of individuals per metric tonne of commercial eel catches.

Length-interval		Numbers of eels		Proportion in Silver eel stage		Mean weight (gramme)	
From (cm)	To (cm)	Male	Female	Male	Female	Male	Female
150	200	0	0				
200	250	0	0				
250	300	13.76	13.27	0.03	0	39.21	33.42
300	350	82.74	133.95	0.08	0	67.17	61.34
350	400	174.07	509.78	0.18	0.014	100.93	99.10
400	450	81.35	557.81	0.29	0.024	133.34	147.90
450	500	0	507.17		0.039	219.10	206.46
500	550	0	453.65		0.059		266.81
550	600	0	365.31		0.121		401.70
600	650	0	228.12		0.168		482.96
650	700	0	163.17		0.266		627.16
700	750	0	108.09		0.381		781.10
750	800	0	61.32		0.541		1003.37
800	850	0	35.86		0.639		1162.05
850	900	0	10.39		0.774		1457.17
900	950	0	8.31		0.843		1682.50
950	1000	0	0		0.843		1682.50
1000	1050	0	0.52				

NL.11 Other biological sampling

NL.11.1 Length and weight and growth (DCF)

The following biological parameters for the Dutch eel stock (downstream areas Rhine and Meuse) have been estimated using measurements on eels collected from the market sampling scheme (sampling of commercial catches):

- Ages of individual eels: determination of growth curves (Figures NL.15 and NL.16).
- Maturity stage frequency-at-length (Figure NL.17.
- Sex-ratio at-length (Figure NL.18).
- A length–weight relationship by sex (Figure NL.19).

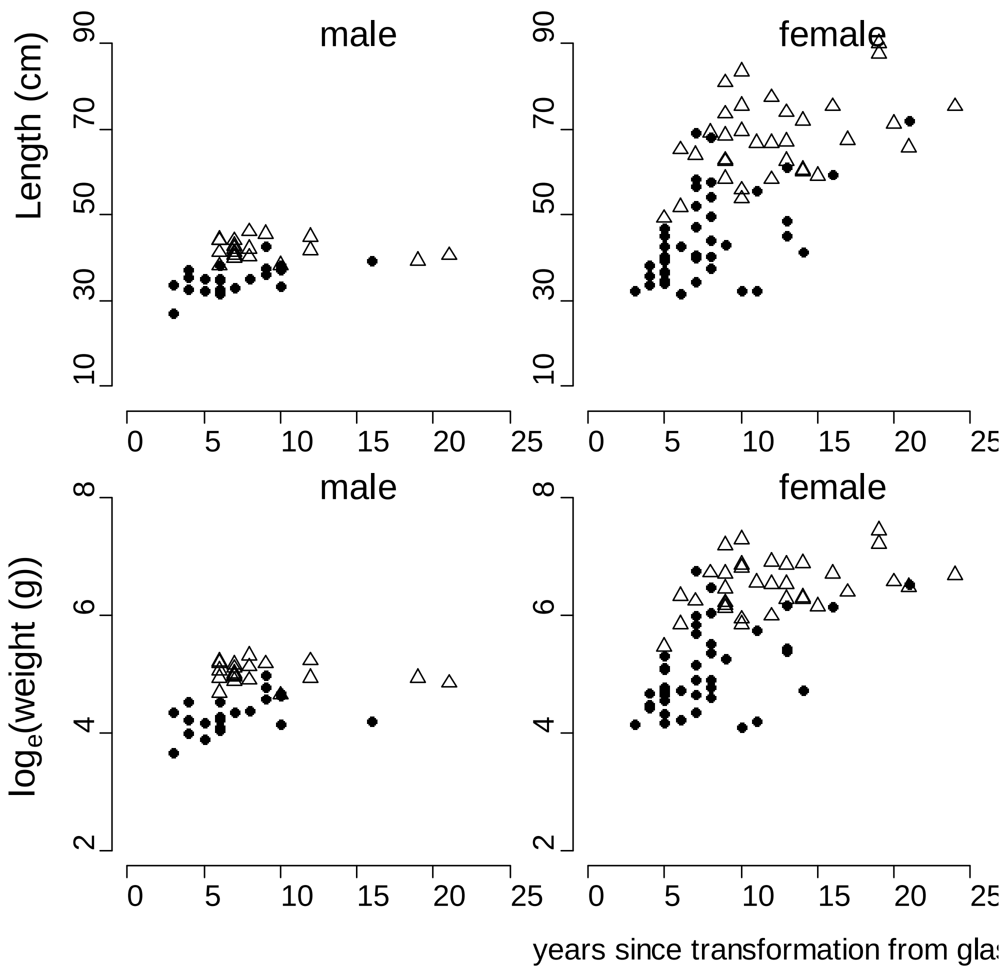

Figure NL.15. Length-at-age and weight-at-age by sex. Open triangles: silver eels, closed circles: yellow eels.

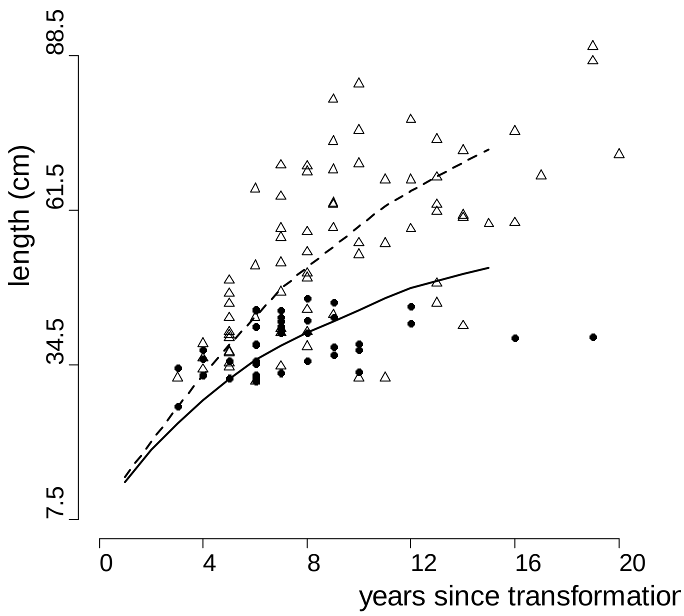

Figure NL.16. Estimated average growth curves for eels in The Netherlands. Closed circles and solid line: males; Open triangles and segmented line: females.

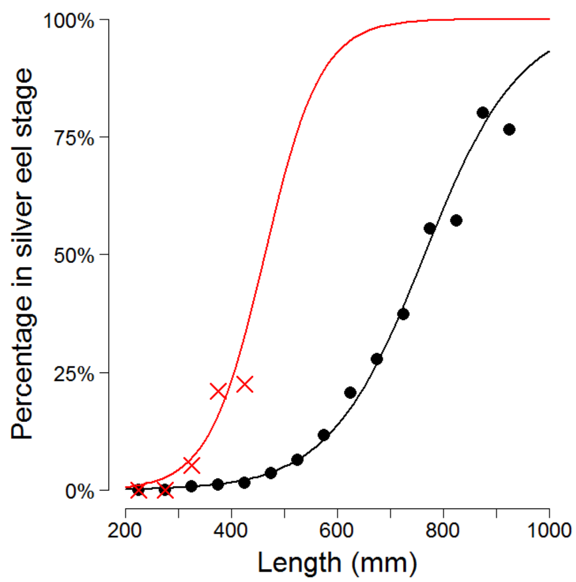

Figure NL.17. Maturity-at-length. Symbols: observed proportions in the silver eel stage per 50 mm length-class. Lines: predicted relationship between length and proportion mature (logistic relationship). Black line: females; red line: males.

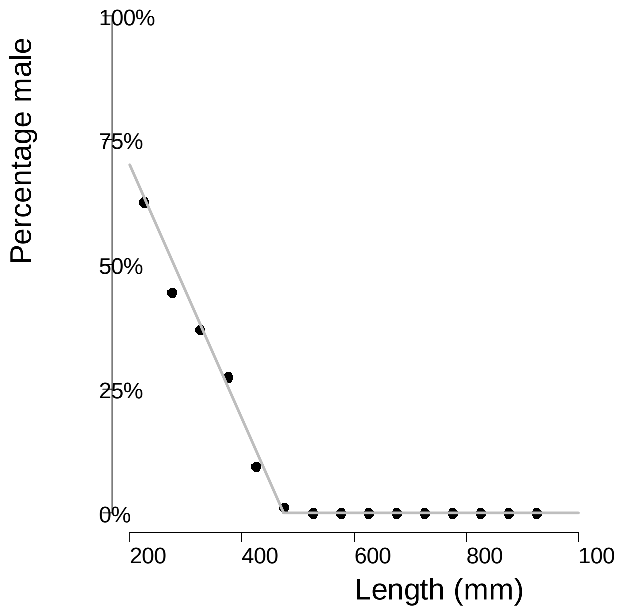

Figure NL.18. Sex ratio-at-length. Symbols: observed proportions of males per 50 mm length-class. Grey line: predicted relationship between length and proportion male proportion ('broken-stick' model).

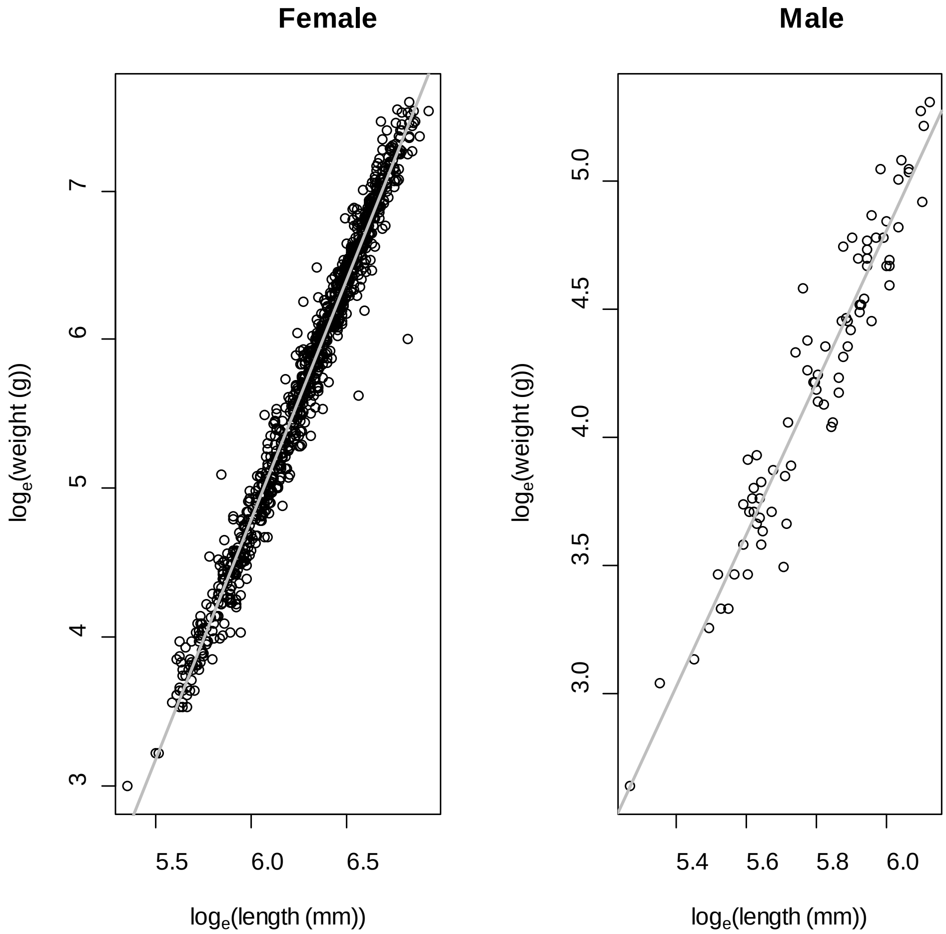

Figure NL.19. Length–weight relationship for males. Symbols: observed lengths and weights on individual eels. Grey lines: predicted relationship from simple linear model.

NL.11.2 Parasites and pathogens

The market sampling for Lake IJsselmeer collects information on the percentage of eels showing *Anguillicoloides crassus* infection based on inspection of the swimbladder by the naked eye). Following the initial break-out in the late 1980s, infection rates have stabilized between 40 and 60%. In recent years, the infection rate was slightly decreasing. As part of the extended market sampling programme in 2009, data on *Anguillicoloides* infection rates was also collected in two other areas (Friesland and Rivers). In both areas the infection rate was similar to the levels observed in Lake IJsselmeer over the past years. No new locations were sampled in 2010. In 2011 the market sampling will be conducted throughout the whole country.

At the Fish & Shellfish Diseases Laboratory of the Central Veterinary Institute of Wageningen UR, in 2010–2011 so far two groups of diseased wild eels (juvenile to adult) were submitted for diagnosis. In August 2010, wild yellow and silver eels from a lake in Friesland (N-Netherlands) showed severe clinical signs: apart from many gill worms *(Pseudodactylogyrus),* the eels had some cestodes in their gut, and some *A. crassus* in their swimbladders. The disease was however caused by two viruses: AngHV-1 (HVA) and EVEX virus, with a bacterial infection by *Edwardsiella tarda*.

In June 2011, wild yellow eels from the Noordzeekanaal had some *Trichodina* as ecto-parasite, *Acanthocephalus* in the gut, and *A. crassus* in their swimbladder, not in large numbers, and virus isolation of these eels was negative. (data: Olga Haenen and Marc Engelsma, pers. comm.)

Parasites

The swimbladder nematode *Anguillicoloides crassus* was introduced in wild stocks of European eels in The Netherlands in the start of the 1980s, from SE-Asia. Wild eels showed high prevalences and intensities (no. of parasites per eel), and an acute reaction of the swimbladder by sometimes severe fibrosis (Banning and Haenen, 1990). It was questioned if these eels with their non-functional swimbladders would be able to reach the spawning grounds (Banning and Haenen, 1990; thesis Haenen, 1995). In the 1990s the prevalence decreased as did the severity of pathology. It seemed, a kind of equilibrium was settling, like it happens with newly introduced parasites.

Borgsteede *et al*. (1999) have described the parasitofauna of 361 wild eels of 17–73 grammes in Volkerak, Marker- en IJsselmeer: Various parasites were found, predominantly *Myxidium* sp. (33%), *Pseudodactylogyrus anguillae* (30%), and *Acanthocephalus clavula* (49%). In 2004–2005 Haenen *et al*. (2010) diagnosed 98 wild silver eels from the lower River Rhine, River Merwede, and the IJsselmeer for pathogens and disease: A quarter of the eels had ectoparasites, mostly *Trichodina* species, *Ichthyophthirius multifiliis*, *Ichthyobodo* species, *Glosattella* species, *Dermocystidium* species (eencelligen), and *Dactylogyrus* species. A quarter also had gut parasites, like cestodes (*Proteocephalus* species, a.o.) and *Acanthocephus* sp.; approximately three quarters had *A.crassus* in their swimbladder, with an intensity of five parasites per swimbladder.

Bacteria

In March and April 1997 seven cases and in June 1997 another case of 'red spot disease' were diagnosed at our laboratory in groups of diseased glass eels *Anguilla anguilla*, originating from Southwestern France and Northern Portugal. In all eight cases *Pseudomonas anguilliseptica* Wakabayashi and Egusa (1972), were isolated. The mortalities varied from lower than 5 to 20% in total, within 2–3 weeks. The isolates were sensitive for a list of antibiotics. After the water temperature was raised to 26–27°C, mortalities stopped (Haenen and Davidse, 2001). In wild silver eels, apart from some secondary skin inflammations, some cases of *Aeromonas hydrophila* and *Aer.sobria* were seen (Haenen *et al*., 2010). In hot summers, eels from rivers with a low water level once had a severe *Edwardsiella tarda* infection.

Viruses

Since 1999, both AngHV-1 (HVA, herpes virus *anguillae*) and EVEX (Eel Virus European X) virus have been found in wild eels in The Netherlands, but not yet EVE (Eel Virus European, also known as IPNV type Ab or VR299). From silver eels from Lake Grevelingen, EVEX and AngHV-1 were isolated, and AngHV_1 was also found in silver eels of Lauwersmeer (Van Ginneken *et al*., 2005, 2004). In silver eels from the lower River Rhine/Merwede AngHV-1 was detected in 44% of 92 eels, without the eels showing disease (Haenen *et al*., 2010). It is however known, that AngHV-1 may cause disease, when eels are stressed, at ambient water temperatures for the virus. Therefore, it was hypothetized, that AngHV-1 may be a factor in the decline of silver eels, carrying the virus, during their migration to the spawning grounds, when they are stressed and swim at ambient water temperatures for exposition of the viral disease (Haenen *et al*., 2010).

In general, some parasites and the viruses are worrisome in the wild eel. The contact with eel farms should be avoided, as EVE might be introduced into wild eels from positive eel farms in The Netherlands.

NL.11.3 Contaminants MICHIEL

As shown in Figure NL.20 it is clear that a substantial decrease in PCB concentrations has been achieved, however, the current rate of decline is low or non-existent. In 2010 four trend locations have been monitored (see graph). Though the concentration in location Hollands Diep seems to decrease the last years, the levels are still comparable to the period 1997–2000. The levels in the other locations have not changed significantly either.

In total 23 locations have been monitored in The Netherlands, see Table NL.h. This clearly shows that locations fed by the river Rhine or Meuse contain eels with elevated PCB (TEQ) levels. Only those water ways not influenced by Rhine, Meuse or local industry can be considered low contaminated.

Table NL.h. Monitoring results 2010 in yellow eel, size class 30–40 cm. Numbers in bold are above regulatory limit of 12 pg/g total TEQ (including 10% uncertainty).

Location	Fat content	Total TEQ	PCB 153
	(%)	pg TEQ/g product	ug/kg product
Amer HD61-63	16	**34**	442
Dortsche Biesbosch	12	**25**	532
IJssel, Deventer	18	**19**	183
IJsselmeer Medemblik	15	5.2	30
Lek, Culemborg	15	**23**	213
Maas, Eijsden	7.8	**14**	173
Rijn, Lobith	11	**33**	248
Volkerak	19	**22**	200
Waal Tiel	11	**25**	220
Hollands Diep	20	**26**	262
Markiezaatsmeer	6.4	2.6	34
Schermerboezem	11	3.1	13
Vossemeer Tholen	13	**15**	131
Westkapelsche Watergang	11	3.0	40
Hoeksche Waard	12	1.5	17
Nieuwkoopse Plassen	25	3.0	17
Hollandse IJssel	24	**73**	974
Binnenbedijkte Maas	21	6.7	41
Veerse Meer	11	2.7	12
Oostvoornse Meer	11	13	171
Brielse Meer	8.4	7.0	60
Oosterschelde	7.7	3.7	18
Grevelingenmeer	17	5.7	27

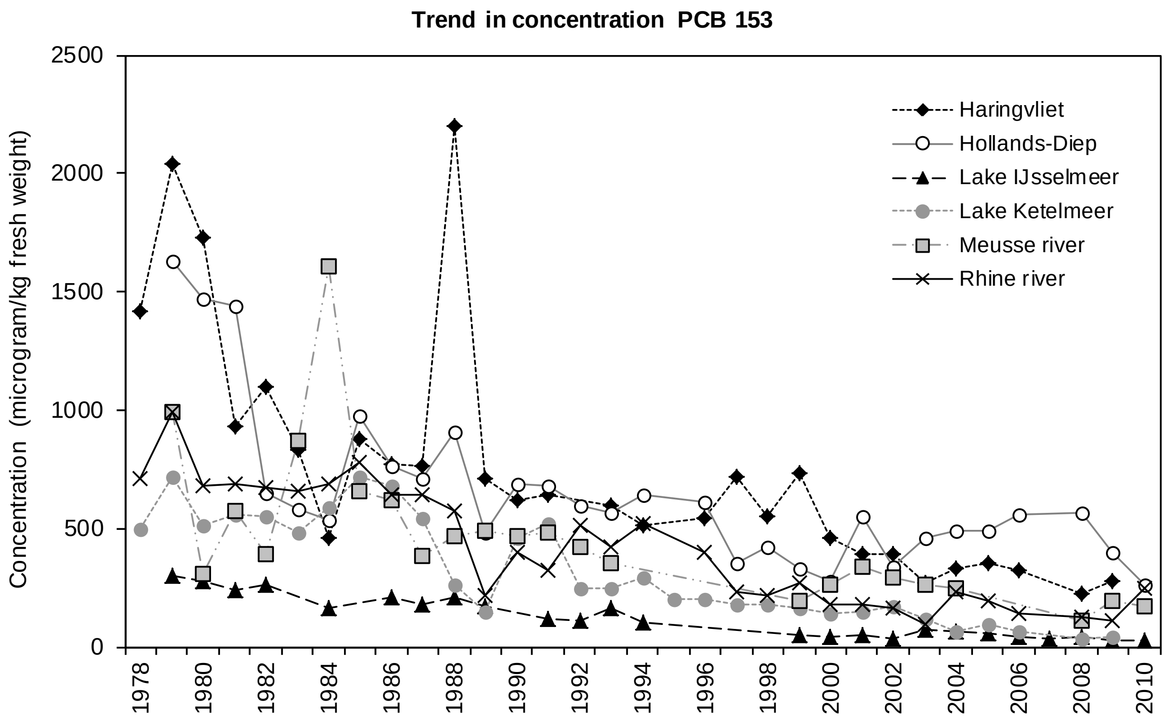

Figure NL.20. Temporal trend in PCB in eel (data from IMARES and RIKILT).

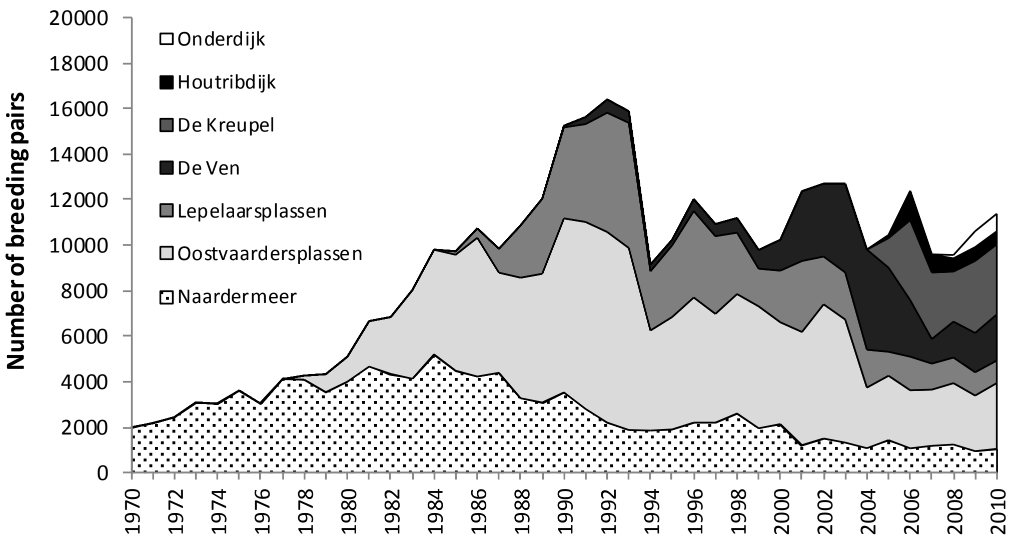

Figure NL. 21. Trends in the number of breeding pairs of cormorants (*Phalacrocorax carbo*) in and around Lake IJsselmeer (Source van Eerden, Waterdienst RWS).

NL.11.4 Predators

Predation of eel by cormorants (*Phalacrocorax carbo*) is much disputed amongst eel fishermen and bird protectionists. The number of cormorant breeding pairs increased rapidly until the early 1990s, and then stabilized (Figure NL.21), remaining stable in recent years. For Lake IJsselmeer, food consumption has been well quantified (van Rijn and van Eerden, 2001; van Rijn, 2004); eel constitutes a minor fraction here. In other waters, neither the abundance, nor the food consumption is accurately known, but predation on eel appears to be a bigger issue here.

NL.12 Other sampling

Nothing to report under this heading.

NL.13 Stock assessment

NL.13.1 Local stock assessment

The basic results of the monitoring programmes in Lake IJsselmeer and the main rivers, the landings statistics and age-and-length sampling of the catch in Lake IJsselmeer are reported to the Ministry of Fisheries in annual status reports; salient details are published in the fishing press.

Dekker (1996, 2000c) developed a VPA-type assessment model for the eel fisheries on Lake IJsselmeer. This model has been applied to data from Lough Derg (Ireland) in the context of FP6-project 022488 SLIME (Dekker *et al.*, 2006).

Growth in eel shows considerable inter-individual variation; individual year classes overlap almost completely in length. Additionally, fisheries, predation mortality (cormorants) and silvering are length-, rather than age-specific. The traditional age-structure of the VPA was therefore replaced by a length-structuring; a length–length transition matrix then replaces the conventional ageing process. Unfortunately, the retrospective application of this deterministic model yielded numerically unstable results (small glitches in the data causing huge shifts in outcome). Dekker (2004a) replaced the deterministic model by a statistical analysis, and included landings and catch-composition data as well as stock survey data. Although this cleared the numerical instability problem, results no longer match the status of the stock in individual years precisely, but reflect the overall trend over the years.

Initial assessment of the status of Lake IJsselmeer eel fishery indicated extremely severe overexploitation ($F \approx 1.0$; Dekker, 1996; 2004a). A 50% reduction in the nominal fishing effort in 1989 resulted in an effective drop in fishing mortality of only 25%. Although assessments were still available, further effort reductions in the 1990s have only loosely been related to monitoring and catch sampling results. In the mid-1990s, the quality of the landing statistics deteriorated, following the transfer of the registration from the Ministry of Fisheries to the Fish Board. Subsequently, the annual assessments have been discontinued. The latest formal management advice dates back to 2000 (an 80% reduction in fishing effort is required to obtain the maximal sustainable yield). Current fishing effort is in the order of 50% of that in 2000, and thus still well above the level of maximum sustainable yield. However, Dekker *et al*. (2008) indicated that the fishing level F_{max} establishing the maximum sustainable yield MSY, is above the level at which the eel stock can be expected to recover (that is: F_{max} still establishes recruitment overfishing): only a further reduction in effort will be in accordance with the EU Eel Regulation. A preliminary estimate of the maximum acceptable effort (reducing F to 0.08) would be a further reduction of fishing gear by 75% of recent effort (since 2006), resulting in 400 fykes, 1600 summer fykes and 1850 eel boxes, or another combination with the same effect.

NL.13.2 International stock assessment

NL.13.2.1 Habitat

An overview of habitats available is presented by Dekker *et al*. (2008), based on the information in Tien and Dekker (2004, 2005), complemented with data from various sources. The summarizing table is reproduced here in Table NL.i.

Table NL.i.

PROVINCE	DITCHES †	CANALS †	LAKES ‡	RIVERS	COASTAL WATERS	SUM
Friesland	5345	7057	9454		-	21 856
Groningen	2003	2040	6905		3843	14 791
Drenthe	657	503	-			1160
Overijssel	1516	1985	1872		-	5372
Gelderland	831	733	-		-	1564
Flevoland	3115	4959	-		-	8074
Utrecht	1699	2349	2699		-	6747
Noord-Holland	5227	7938	1243	-		14 408
Zuid-Holland	4843	6935	7454		-	19 232
Zeeland	2421	2873	17 871		95 745	118 909
Noord-Brabant	1247	1241				2488
Limburg						
Larger water bodies						
Randmeer			16 110			16 110
Ijsselmeer/Markermeer			169 150			169 150
Rijn & Maas				18 067		18 067
kleinere rivieren				2800		2800
Waddenzee, incl Eems					259 214	259 214
Zeeuwse Delta			17 871		95 745	113 616
sum	28 905	38 610	232 758	20 867	358 802	679 942

† For ditches and canals, only the areas less than 1 m above sea level have been considered.

‡ Freshwater areas in the southwestern delta have been included under Lakes, the saline waters under Coastal Waters.

NL.13.2.2 Silver eel production

NL.13.2.2.1 Historic production (B_0=13 000 t)

Table NL.j. Overview of the different estimations of $B_{pristine}$, B_{lim}, $B_{current}$ and B_{best} for eel in Lake IJsselmeer and the Netherlands.

Lake IJsselmeer					Netherlands				
$B_{pristine}$	B_{lim}	$B_{current}$	B_{best}		$B_{pristine}$	B_{lim}	$B_{current}$	B_{best}	
			770 t	Dekker, 2000				min. 1455 t	Dekker *et al.*, 2008b (Table NL.n)
7700 t	3080 t	11 t (1990)		Dekker *et al.*, 2008a	10 000–15 000 t	4000–6.000 t	200 t		Klein Breteler, 2008
						221 t			Combinatie van Beroepsvissers, 2008
						2600–8100 t “probably lower”			Eijsackers *et al.*, 2009
						2600–8100 t “probably lower”			Nederlandse Aalbeheerplan Juli 2009
					13 000 t	5200 t			ICES 2009

NL.13.2.2.2 Current production(B_{best} = 1455 t)

B_{best} is B_{pre} (200 t) + 1255 t (anthropogenic mortality “eel” [yellow + silver] Table NL.xxx) = 1455 t.

NL.13.2.2.3 Current escapement

B_{post} is 200 t (B_{pre}) plus the estimated increase in escapement due to the closed season (target 90% reduction in fishing mortality), therefore B_{post} = 200 t + 90% 280 t silver eel catches (Table NL.XX) = 452 t.

NL.13.2.2.4 Production values e.g. kg/ha

Table NL.k. Production values by water type. Data derived from Dekker *et al.* (2008).

	IJSSELMEER/ MARKERMEER	RIVERS	COASTAL WATERS	OTHER WATERS	TOTAL
Number of fishing companies	73	28	48	ca. 100	249
Surface area, ha	169 150	20 867	354 959	134 966	679 942
Landings, tons	280	150	115	375	920
Surface area per company, ha	2317	745	7395	1350	2731
Landings per company, kg	3836	5357	2396	3750	3695
Landings per surface area, kg/ha	1.66	7.19	0.32	2.78	1.35

NL.13.2.2.5 Impacts

Vriese *et al*. (2007) and Dekker *et al*. (2008) estimated quantities of eel impacted by anthropogenic impacts, from which the summary in Table NL.XXX is compiled. In the majority of cases, the relative impact on the stock is unknown. For Lake IJsselmeer fishery, current fishing mortality F ≈ 0.33 per annum (Dekker *et al*. 2008). For hydropower generation in the main rivers, the impact on the silver eel is estimated at H ≈ 16–34 % per run. For all other factors and other areas, the relative impact is unknown, and consequently, the interaction and overlap between different mortality sources cannot be assessed.

Table NL.l. Estimated quantities of eel, by anthropogenic impact. Data from Vriese *et al.* (2007) and Dekker *et al.* (2008).

IMPACT	YELLOW EEL	SILVER EEL	YELLOW & SILVER
Cormorants	50	0	50
Barriers	?	?	?
Pumping stations	50	40	90
Parasites	?	?	?
Pollution	?	?	?
Inland fishery	640	280	920
Marine fisheries	20	0	20
Sports fishing	200	0	200
Hydropower	4	15	19
Total *(min. est.)*	*970*	*335*	*1305*

NL.13.2.2.6 Stocking requirement eels <20 cm

The Dutch EMP mentions a budget of 300 k€, but additional budget may become available from private sources. It is unclear what quantities of eel will be purchasable for this budget, while a turbulent price development is expected, because of the implementation of CITES restrictions and the impact of restocking programmes on the glass eel market.

NL.13.2.2.7 *Summary facts on glass eel*

Table NL.m. Overview usage of glass eel.

KG	2011	2010	2009
Caught in commercial fishery	**0**	**0**	**0**
Used in stocking	**244**	**904**	**100**
Used in aquaculture for consumption	**6750**	**?**	**?**
Consumed direct	**0**	**0**	**0**
Mortalities	**-**	**-**	**-**

NL.13.2.2.8 *Data quality issues*

Nothing to report.

NL.14 Sampling intensity and precision

Nothing new to report, see Country Report WGEEL 2010.

NL.15 Standardization and harmonization of methodology

NL.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
	10 other locations along the coast	weekly	two hauls at night-time	

Passive Monitoring Programme: Main Rivers and Lake Ijsselmeer.

GEAR	LOCATION	FREQUENCY	PERIOD
Summer fykes (four) (stretched mesh 18–20mm)	34 locations in main rivers, estuaries and lakes	continuous	~May–September
Fykes (four) (stretched mesh 18–20mm)			

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 station ate located in the polluted areas and sampling ceased on 1 April 2011. An alternative programme is currently being developed and will hopefully start in 2012.

Active Monitoring Programme: 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–Sep
Electrofishing (shore area)		20 min, 600 m transect	

Active Monitoring Programme: Lake Ijsselmeer.

Gear	Location	Frequency	Period
Electrotrawl (open water; 3 m beam; 2 mm bar mesh)	20 locations in Lake IJsselmeer, ten locations in Lake Markermeer	two hauls per location, 10 min trawl, ~1000 m transect	October–November
Electrofishing (shore area) Beach-seine (shore area; 18 mm stretched mesh; length 20 m)	seven locations in Lake IJsselmeer, seven locations in Lake Markermeer, 1–3 habitats per location (sand, vegetation, rock)	2–3 sites per habitat per location	August–September

NL.15.2 Sampling commercial catches

Area	No. eels for Length–frequency	Sampling frequency	Locations	Biology (sex, life stage, parasites)	Period
Friesland	150–200 eels per sample	monthly	10	two eel per 10 cm size class	April–August
Main Rivers	150–200 eels per sample	monthly	8	two eel per 10 cm size class	April–August
Lake IJsselmeer	1200 (total per year)	May–June August–September	one (sample collected for each fishing gear: summer fyke, fyke, eelbox, longline)	350	April–August
Lake Markermeer	800 (total per year)	May–June August–September	one (sample collected for each fishing gear: summer fyke, fyke, eelbox, longline)	250	April–August

NL.15.3 Sampling

Nothing to report in this section.

NL.15.4 Age analysis

Age readings were obtained from a total of 150 otoliths, which were collected from eels in six different areas of the Netherlands. The number of annuli was 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 (see Section 11.1).

NL.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.

NL.15.6 Sex determinations

Sex is determined by macroscopic examination of the gonads.

NL.16 Overview, conclusions and recommendations

The availability of data on eel stock and fisheries presented in this report is summarized in Table NL.XX. Overall, the larger, State owned waters are reasonably documented, but the smaller regional waters are not yet. Within the framework of the implementation of the national EMP, various extensions are being developed.

Table NL.n. Overview of the data collection by area, described in this report.

Area Item	Waddensea	IJsselmeer	Main Rivers	Zeeland, waters: open/closed		Smaller inland waters (lakes, polders, small rivers)
C capacity	+	+/-	!	+	!	!
D effort	+	-!	-!	+	-!	-!
E catch	+	+	+	+	-!	+
F CPUE	-	(+)	(+)	-	-	-!
G surveys	+	+	+	+	-!	-!
H age/length	-	+	+	-	-	!
I sex, growth	-	+/-!	+!	-	-	+/-!
J other sampling						
K assessment	-	(+)	!	-	-	!
L precision		+	!			

+ = present, - = absent, +/- = incompletely present, (+) = present, but inadequate, !=under development.

In conclusion: this report provides an update of all dataseries regarding the eel stock in the Netherlands. Almost all dataseries show a further decline of the stock and fishery; anthropogenic impacts are high, or undocumented. In 2010 the highly important catch registration for inland fishers was introduced by the Ministry of EL&I. In 2012 effort registration will be added to the catch registration. In 2011 a range of new eel projects has been implemented including a Red Eel Model, eel ageing, mortality migrating silver eel in rivers and "polders" and nationwide catch sampling programme. In 2012 a few more will be added like the Silver Eel Index and fishery-independent eel monitoring closely linked with Water Framework Directive fish sampling.

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Report on the eel stock and fishery in Norway 2010/'11

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Reporting Period: This report was completed in August 2011, and contains data up to 2011.

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NO.2 Introduction

NO.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).

NO.2.2 Fishing

Eel fishing has mainly taken 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 freshwater. Fykenets are set on soft and muddy bottom, with preference of areas with seagrass beds (eelgrass *Zostera marina*). No distinction is made between yellow and silver eels and they are both caught with eel pots and fykenets. Glass eel fishing is prohibited in Norway. Catch is officially recorded by the Fisheries Directorate, but there is no record of effort by the authorities (only the number of licences). There is a minimum legal size of 37 cm for silver eels and 40 cm for yellow eels.

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).

Fishing for eel has been banned in Norway since January 1st 2010, except for a quota of 50 tons marine 'scientific monitoring' fishery. Several fishers applied to participate in the scientific monitoring fishery, of which 26 received authorization to participate. The fishers are located in Østfold, Oslo/Busker, Vestfold, Telemark, Aust-Agder, Rogaland and Hordaland counties. They have to record their catch and the number of pots/fykenets, the number of eels below and above 45 cm and whether they are yellow or silver. Some of these fish have been collected by the Institute of Marine Research for analyses of biological characteristics (body measurements, age). Some eel samples have also been collected by NIFES (National institute for nutrition and seafood research) for contaminant analyses.

Recreational fishing (prohibited since 2009) was quite important relative to commercial fishing (represented approximately 100 tons: average between 2000–2008). Recreational fishing boats along the south 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 until 6250 Euros/year.

NO.2.3 Management plan

The European eel is included in the Norwegian Red List since May 2006, categorized as critically endangered. In 2007, a working group (with people from the Institute of Marine Research and the Directorate of Fisheries) was appointed with the objective of writing a report on the status of eel in Norway and to draft a subsequent management plan. The report was completed in 2008[4]. Several research needs were identified among which the necessity to investigate the distribution of eels in salt water. The report concluded in two alternative management strategies: 1) that all eel fishing 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. It was finally decided by the fisheries director that there will be a temporary ban of eel fishing. The first evaluation will be in 2012.

All recreational fishing for eel in freshwater and marine waters in Norway was 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 stop of the fishing when this quota was reached. All commercial fisheries were stopped from 1 January 2010. However, in 2010 and onwards, there will be a marine 'scientific fishery' with an annual quota of 50 t, aiming at monitoring eel and collecting scientific catch data. This 'scientific fishery' is financed by the fishers being allowed to keep and sell the catch.

NO.2.4 Eel monitoring

The following monitoring plan (details are available upon request to C. Durif or E. Thorstad) was submitted (by IMR in March 2011) to the authorities (Nature Directorate) to monitor eel in salt water:

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).

[4] 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.

NO.3 Time-series data

NO.3.1 Recruitment-series and associated effort

NO.3.1.1 Glass eel

NO.3.1.1.1 Commercial

No available data.

NO.3.1.1.2 Recreational

No available data.

NO.3.1.1.3 Fishery-independent

Table. Recruitment of elvers at the NINA research station on the River Imsa (see 9 for details).

YEAR	RECRUITMENT (ELVERS)
1975	42 945
1976	48 615
1977	28 518
1978	12 181
1979	2457
1980	34 776
1981	15 477
1982	45 750
1983	14 500
1984	6640
1985	3412
1986	5145
1987	3434
1988	17 500
1989	10 000
1990	32 500
1991	6250
1992	4450
1993	8625
1994	525
1995	1950
1996	1000
1997	5500
1998	1750
1999	3750
2000	1625
2001	1875
2002	1375
2003	3775
2004	375
2005	1550
2006	350
2007	100
2008	1100
2009	5400
2010	1092

NO.3.1.2 Yellow eel recruitment

NO.3.1.2.1 Commercial

No available data.

NO.3.1.2.2 Recreational

No available data.

NO.3.1.2.3 Fishery-independent

See elver data in Section 3.1.1.3.

NO.3.2 Yellow eel landings

NO.3.2.1 Commercial

Table. Cpue (kg.net^{-1}.night^{-1})calculated from fishers logbooks recorded by IMR (see introduction for details).

1975	1.6
1976	2.1
1977	2.3
1978	2.2
1979	3.1
1980	2.7
1981	2.2
1982	13.9
1983	13.0
1984	13.0
1985	18.7
1986	13.3
1987	7.9
1988	26.3
1989	3.5
1990	12.2
1991	5.1
1992	5.2
1993	5.4
1994	7.4
1995	7.2
1996	2.1
1997	4.6
1998	4.3
1999	3.9
2000	7.2
2001	5.6
2002	6.3
2003	5.7
2004	4.7
2005	16.2
2006	16.1
2007	20.0
2008	19.1
2009	14.4
2010	86.4

NO.3.2.2 Recreational

Table 1. Registered landings for recreational eel fishing in Norway.

YEAR	LANDINGS (RECREATIONAL) IN TONS
2000	109
2001	122
2002	130
2003	106
2004	96
2005	104
2006	106
2007	74
2008	79
2009	10*
2010	1*
2011	*

*** Recreational fishing prohibited from 1 July 2009.**

NO.3.3 Silver eel landings

NO.3.3.1 Commercial

There was no differentiation being made between yellow and silver eels. Everything is included in 3.2.

NO.3.3.2 Recreational

There was no differentiation being made between yellow and silver eels. Everything is included in 3.2.

NO.3.4 Aquaculture production

NO.3.4.1 Seed supply

No data available.

NO.3.4.2 Production

It is not known whether any of the licence holders are actually performing any aquaculture production.

YEAR	AQUACULTURE LICENCES
1994	9
1995	14
1996	19
1997	24
1998	28
1999	31
2000	32
2001	29
2002	25
2003	21
2004	22
2005	15
2006	13
2007	12
2008	17
2009	17
2010	16

NO.3.5 Stocking

NO.3.5.1 Amount stocked

There is no stocking.

NO.3.5.2 Catch of eel <12 cm and proportion retained for restocking

There is no catch of eel <12 cm, and there is no stocking of eel in Norway.

NO.4 Fishing capacity

NO.4.1 Glass eel

There is no glass eel fishing.

NO.4.2 Yellow eel

Table. Number of registered commercial eel fishing licences in Norway.

YEAR	NUMBER OF LICENCES
1977	326
1978	313
1979	374
1980	541
1981	501
1982	505
1983	478
1984	434

1985	399
1986	412
1987	425
1988	525
1989	479
1990	468
1991	449
1992	434
1993	404
1994	452
1995	423
1996	417
1997	445
1998	389
1999	429
2000	347
2001	336
2002	327
2003	284
2004	258
2005	241
2006	247
2007	234
2008	218
2009	180
2010	55

The commercial quota for 2009 was 50 t. Similarly, the scientific quota for 2010 and 2011 is 50 t, and fishing is stopped when this quota is reached.

NO.4.3 Silver eel

There is no differentiation between yellow and silver eel.

NO.4.4 Marine fishery

Most of the fisheries are marine.

NO.5 Fishing effort

NO.5.1 Glass eel

There is no glass eel fishery in Norway.

NO.5.2 Yellow eel

Table. A limited number of fishers record their effort (in accordance with the Institute of Marine Research) in number of net-nights since 1975. These data are also available according to each county (fylke), see figure below. (Data belongs to IMR-Flødevigen).

YEAR	NB OF NIGHTS	NB OF NETS	NB OF NET NIGHTS
1975	383	925	38 790
1976	354	1060	36 170
1977	442	1200	51 400
1978	312	965	35 060
1979	329	1160	34 390

1980	453	1142	39 836
1981	460	1275	48 555
1982	2225	2708	233 615
1983	6242	13 820	678 032
1984	3825	16 307	446 096
1985	2751	11 957	282 133
1986	3576	12 118	383 063
1987	2563	10 177	338 784
1988	2804	10 818	333 668
1989	1230	4799	112 537
1990	2711	6333	238 069
1991	2280	5739	217 088
1992	1668	4295	182 001
1993	2095	4825	202 030
1994	1895	7261	194 937
1995	1323	4654	160 984
1996	518	3250	64 920
1997	1001	3700	114 650
1998	1247	3800	121 410
1999	1157	3075	102 245
2000	1759	4833	175 043
2001	1137	4770	135 020
2002	1091	3938	77 852
2003	798	2355	77 370
2004	1153	2719	109 582
2005	2418	2554	70 866
2006	3536	9109	250 874
2007	4850	14 033	309 022
2008	3836	13 190	265 873
2009	2222	6647	160 778
2010	4943	25 656	449 319

NO.5.3 Silver eel

There is no differentiation between yellow and silver eel.

NO.5.4 Marine fishery

Most fisheries are marine. Since we have the data according to each county it may be possible to determine which fisheries are marine/inland.

NO.6 Catches and landings

NO.6.1 Glass eel

NO.6.2 Yellow eel

No differentiation is made between yellow and silver eels.

A quota of 50 tons has been set since 1.1.10.

Table. Registered (by the Fisheries Directorate) eel landings for commercial fisheries in Norway.

YEAR	TOTAL CATCH (TONS)	YEAR	TOTAL CATCH	YEAR	TOTAL CATCH
1908	268	1943	136	1978	347
1909	327	1944	150	1979	374
1910	303	1945	102	1980	387
1911	384	1946	167	1981	369
1912	187	1947	268	1982	385
1913	213	1948	293	1983	324
1914	282	1949	214	1984	310
1915	143	1950	282	1985	352
1916	117	1951	312	1986	272
1917	44	1952	178	1987	282
1918	35	1953	371	1988	513
1919	64	1954	327	1989	313
1920	80	1955	451	1990	336
1921	79	1956	293	1991	323
1922	94	1957	430	1992	372
1923	140	1958	437	1993	340
1924	290	1959	409	1994	472
1925	325	1960	430	1995	454
1926	341	1961	449	1996	353
1927	354	1962	356	1997	467
1928	325	1963	503	1998	331
1929	425	1964	440	1999	447
1930	450	1965	523	2000	281
1931	329	1966	510	2001	304
1932	518	1967	491	2002	311
1933	694	1968	569	2003	240
1934	674	1969	522	2004	237
1935	564	1970	422	2005	249
1936	631	1971	415	2006	293
1937	603	1972	422	2007	194
1938	526	1973	409	2008	211
1939	434	1974	368	2009	69
1940	143	1975	407	2010	32
1941	174	1976	386		
1942	131	1977	352		

Table. Total landings of selected fishers (IMR logbook data).

YEAR	LANDINGS (IMR TONS)
1975	6
1976	6
1977	7
1978	6
1979	6
1980	6
1981	6
1982	22
1983	43
1984	28
1985	26
1986	24
1987	21
1988	45
1989	9
1990	19
1991	15
1992	17
1993	16
1994	17
1995	16
1996	5
1997	15
1998	12
1999	11
2000	10
2001	13
2002	8
2003	9
2004	12
2005	11
2006	26
2007	28
2008	29
2009	16
2010	40

NO.6.3 Silver eel

Included in yellow eel data.

NO.6.4 Marine fishery

Most fisheries are marine. Since we have the data according to each county it may be possible to determine which fisheries are marine/inland.

NO.7 Catch per unit of effort

NO.7.1 Glass eel

No available data.

NO.7.2 Yellow eel

Table. Official catch (Fisheries Directorate) calculated according to the number of licences in Norway (the number of eel pots per licence is not registered).

YEAR	TOTAL CATCH (TONS)	NB OF LICENCES	CATCH (TONNE PER FISHERMAN)
1977	352	326	1.08
1978	347	313	1.11
1979	374	374	1.00
1980	387	541	0.72
1981	369	501	0.74
1982	385	505	0.76
1983	324	478	0.68
1984	310	434	0.71
1985	352	399	0.88
1986	272	412	0.66
1987	282	425	0.66
1988	513	525	0.98
1989	313	479	0.65
1990	336	468	0.72
1991	323	449	0.72
1992	372	434	0.86
1993	340	404	0.84
1994	472	452	1.04
1995	454	423	1.07
1996	353	417	0.85
1997	467	445	1.05
1998	331	389	0.85
1999	447	429	1.04
2000	281	347	0.81
2001	304	336	0.90
2002	311	327	0.95
2003	240	284	0.85
2004	237	258	0.92
2005	249	241	1.03
2006	293	247	1.19
2007	194	234	0.83
2008	211	218	0.97
2009	69	180	0.38
2010	32	55	0.58

Table. Cpue calculated from fishers logbooks recorded by IMR (see introduction for details).

YEAR	CPUE (TONS.DAY^{-1}POT^{-1})
1975	1.6
1976	2.1
1977	2.3
1978	2.2
1979	3.1
1980	2.7
1981	2.2
1982	13.9
1983	13.0
1984	13.0
1985	18.7
1986	13.3
1987	7.9
1988	26.3
1989	3.5
1990	12.2
1991	5.1
1992	5.2
1993	5.4
1994	7.4
1995	7.2
1996	2.1
1997	4.6
1998	4.3
1999	3.9
2000	7.2
2001	5.6
2002	6.3
2003	5.7
2004	4.7
2005	16.2
2006	16.1
2007	20.0
2008	19.1
2009	14.4
2010	86.4

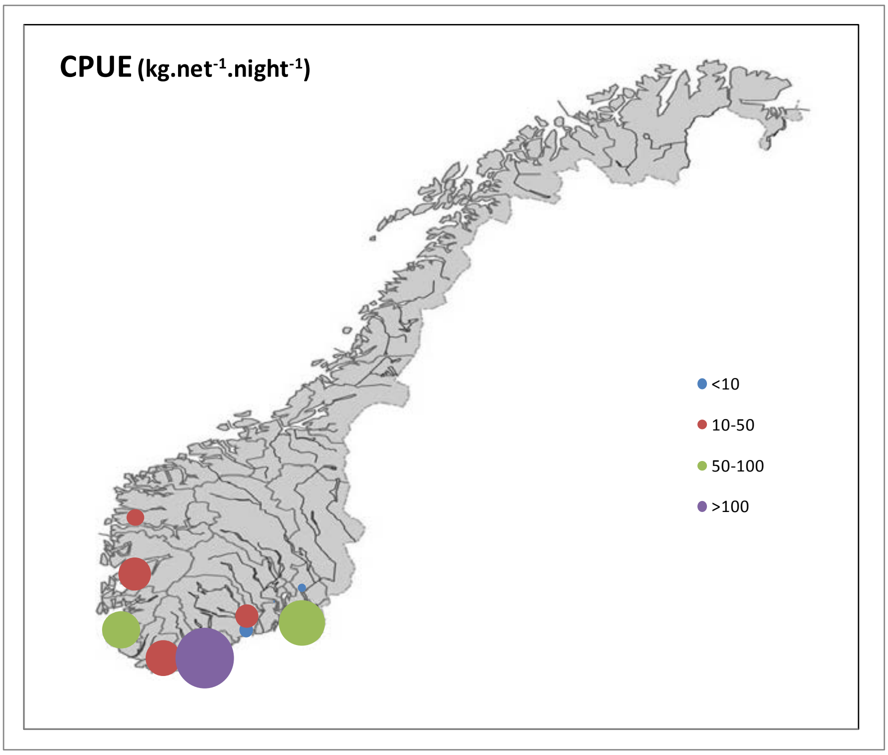

Figure. Cpue per county.

Table. Logbook data according to each county (fylke), see figure above. (Data belongs to IMR-Flødevigen).

FYLKE	CPUE (KG.NET^{-1}.NIGHT^{-1})
Buskerud	0.1
Akershus	1.9
Telemark	7.4
Sogn	10.7
Vestfold	20.1
Hordaland	39.5
Vest-Agder	45.7
Rogaland	51.6
Østfold	77.8
Aust-Agder	128.8

NO.7.3 Silver eel

Included in yellow eel data.

NO.7.4 Marine fishery

Included in yellow eel data.

NO.8 Other anthropogenic impacts

Norway has abundant rivers and lakes, and 6% of the total area of 323 802 km^2 is covered by freshwater. There are 144 river systems with a catchment area ≥200 km^2. 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 many 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). Densities of eel increased more than fourfold after liming when compared with pre-liming levels.

NO.9 Scientific surveys of the stock

NO.9.1 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 have been reported in more coastal habitats).

Figure 1. Map of Norway showing the location of the River Imsa and the Skagerrak coast.

Table. 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).

YEAR	RECRUITMENT (NB OF ELVERS)
1975	42 945
1976	48 615
1977	28 518
1978	12 181
1979	2457
1980	34 776
1981	15 477
1982	45 750
1983	14 500
1984	6640
1985	3412
1986	5145
1987	3434
1988	17 500
1989	10 000
1990	32 500
1991	6250
1992	4450
1993	8625
1994	525
1995	1950
1996	1000
1997	5500
1998	1750
1999	3750
2000	1625
2001	1875
2002	1375
2003	3775
2004	375
2005	1550
2006	350
2007	100
2008	1100
2009	5400
2010	1092

NO.9.2 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 programme 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 programme were conducted in 1904, and during the following years, new sampling stations were added, and a standard routine for the hauls was developed. Approximately 80 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 recently been analysed and compared to oceanic factors (Durif *et al*., 2010).

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*., 2010 for complete details. These calculations (SSC) have not been updated for the most recent figures, but this can be done if needed.

Data from the Skagerrak beach-seine survey. It includes yellow (approximately 70%) and silver eels (30%).

Table. Data from the Skagerrak beach-seine survey.

YEAR	AVERAGE NB OF EELS PER HAUL AND PER SAMPLING AREA	NB OF EELS	YEAR	AVERAGE NB OF EELS PER HAUL AND PER SAMPLING AREA	NB OF EELS
1925	0.065833	4	1969	0.116	16
1926	0.105833	4	1970	0.2425	37
1927	0.149167	10	1971	0.1595	24
1928	0	0	1972	0.091	15
1929	0.105833	7	1973	0.191	20
1930	0.126667	8	1974	0.1905	30
1931	0.226667	13	1975	0.2135	34
1932	0.269167	12	1976	0.1775	27
1933	0.0825	5	1977	0.2805	30
1934	0.144167	8	1978	0.1455	22
1935	0.034615	3	1979	0.117	20
1936	0.215294	17	1980	0.2385	37
1937	0.307647	38	1981	0.335	50
1938	0.304118	39	1982	0.229	27
1939	0.178235	31	1983	0.206	27
1940	0	0	1984	0.1785	29
1941	0	0	1985	0.2	32
1942	0	0	1986	0.2405	33
1943	0.25	1	1987	0.1725	22
1944	0.5	2	1988	0.338	54
1945	0.402941	39	1989	0.295	34
1946	0.25	24	1990	0.1835	21
1947	0.26	33	1991	0.1215	20
1948	0.218235	24	1992	0.2135	29
1949	0.28	24	1993	0.1465	20
1950	0.292353	28	1994	0.22	31
1951	0.253529	30	1995	0.1515	19
1952	0.138824	17	1996	0.3255	45
1953	0.139444	19	1997	0.212	28
1954	0.243889	33	1998	0.236	25

YEAR	AVERAGE NB OF EELS PER HAUL AND PER SAMPLING AREA	NB OF EELS	YEAR	AVERAGE NB OF EELS PER HAUL AND PER SAMPLING AREA	NB OF EELS
1955	0.231667	32	1999	0.141	21
1956	0.222222	30	2000	0.0875	11
1957	0.148333	20	2001	0.1215	17
1958	0.350556	50	2002	0.0675	8
1959	0.122778	20	2003	0.0505	5
1960	0.097778	16	2004	0.0185	2
1961	0.194444	34	2005	0.0265	4
1962	0.0795	12	2006	0.13	14
1963	0.134	18	2007	0	0
1964	0.1635	26	2008	0.022	3
1965	0.062	10	2009	0.093	7
1966	0.1995	30		IN 2009, THE BOAT BROKE DOWN SO SERIES IS TRUNCATED	
1967	0.1115	16	2010	NA	4
1968	0.1405	16			

Table 6. Skagerrak standardized catch: index calculated on selected sampling areas in the beach-seine survey. (See Durif *et al.*, 2010 for details). This trend has not been updated.

YEAR	SSC	YEAR	SSC	YEAR	SSC	YEAR	SSC	YEAR	SSC
1925	-0.67	1947	0.76	1965	-0.37	1983	0.11	2001	-0.26
1926	-0.77	1948	0.14	1966	-0.01	1984	-0.22	2002	-0.69
1927	-0.46	1949	0.20	1967	-0.08	1985	0.05	2003	-0.70
1928	-0.94	1950	0.08	1968	-0.45	1986	0.59	2004	-0.91
1929	-0.15	1951	0.38	1969	-0.31	1987	-0.08	2005	-0.78
1930	-0.20	1952	-0.08	1970	0.29	1988	0.54	2006	-0.04
1931	-0.64	1953	-0.18	1971	-0.14	1989	0.10	2007	-0.94
1932	-0.51	1954	0.67	1972	-0.54	1990	-0.23		
1933	-0.74	1955	0.34	1973	-0.36	1991	0.21		
1934	-0.52	1956	-0.06	1974	-0.10	1992	0.06		
1935	-0.51	1957	-0.32	1975	0.19	1993	-0.07		
1936	-0.24	1958	0.62	1976	0.00	1994	0.61		
1937	0.78	1959	-0.22	1977	0.04	1995	-0.38		
1938	0.20	1960	-0.41	1978	-0.30	1996	0.76		
1939	-0.14	1961	0.23	1979	-0.15	1997	-0.28		
1940–45	NO DATA	1962	-0.49	1980	0.75	1998	-0.04		
1944	0.90	1963	-0.53	1981	0.88	1999	-0.09		
1946	0.15	1964	0.09	1982	0.04	2000	-0.57		

NO.9.3 Silver eel

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.

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) (Figure 3).

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. Number of silver eels counted at the trap on the River Imsa (Sandnes).

YEAR	SILVER EELS
1975	5201
1976	3824
1977	5435
1978	4986
1979	2914
1980	3382
1981	2354
1982	3818
1983	3712
1984	3377
1985	4427
1986	3733
1987	1833
1988	4274
1989	2107
1990	2196
1991	1347
1992	1394
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

NO.10 Catch composition by age and length

Older data are published in Vøllestad (1985, 1986), Bergersen and Klemetsen (1988), Vøllestad (1992) and Vøllestad and Jonsson (1986, 1988).

Body lengths of eels measured during the Skagerrak survey are available between 1993 and 2006.

NO.11 Other biological sampling

It has been decided under the eel management plan to use part of the 50 tons of eels which have been allocated to the fishers, as a scientific fishery to monitor length, weight, parasite infestation, age and otolith microchemistry. Samples have already been collected both in freshwater and salt water but are still being processed.

NO.11.1 Length and weight and growth (DCF)

There is no new data.

NO.11.2 Parasites and pathogens

In 2009, silver eel were collected in the River Halselva in Northern Norway (70°N). None of these were infected by *Anguillicoloides crassus* (Davidsen *et al*., 2011). The parasite has previously been recorded in Southern Norway, as far north as River Imsa (58°N).

NO.11.3 Contaminants

Previous results are being collated by Eva Thorstad and Claude Belpaire.

Sampling is currently being done on eels from coastal Norway (Arne Duinker at NIFES). Results will be available in 2012.

NO.11.4 Predators

There are two species of cormorants in Norway: the great cormorant (*Phalacrocorax carbo*) and the European shag (*P. aristotelis*). Their numbers were respectively 42 000 and 30 000 nesting individuals in 1992, and their stock has increased since. Both species form dense colonies on inaccessible reefs or on steep cliff. After the nesting period (April to August), they spread out along the Norwegian coast in smaller groups. Their diet is 100% fish and consist mainly of cod (20–90% of stomach content depending on the locality) and herring. No estimates have been made on their eel consumption, but it seems to be low given the absence in the documents.

NO.12 Other sampling

No available data.

NO.13 Stock assessment

NO.13.1 Local stock assessment

There is no stock assessment of the eel stock in Norway. Only trends have been analysed in the beach-seine surveys and the time-series collected in the River Imsa described in Chapter 3. Both time-series indicate a decline in the eel stock during the last decades. A working group appointed by the head of the Directorate of Fisheries delivered a report in 2008 with advice on fisheries management. Subsequently, all eel fisheries in Norway were banned from 2010, except for a 50 tonne quota which will be used to scientifically monitor the eel catches.

An effort will be made to try to estimate the proportion of eels with different life histories in freshwater, brackish- or salt water.

NO.13.2 International stock assessment

NO.13.2.1 Habitat

Wetted Area: lacustrine

riverine

transitional and lagoon

coastal

No available data.

NO.13.2.2 Silver eel production

NO.13.2.2.1 Historic production

No available data.

NO.13.2.2.2 Current production

No available data.

NO.13.2.2.3 Current Escapement

No available data.

NO.13.2.2.4 Production values e.g. kg/ha

No available data.

NO.13.2.2.5 Impacts

No available data.

NO.13.2.2.6 Stocking requirement eels <20 cm

No available data.

NO.13.2.2.7 Data quality issues

NO.14 Sampling intensity and precision

No available data.

NO.15 Standardization and harmonization of methodology

NO.15.1 Survey techniques

No available data.

NO.15.2 Sampling commercial catches

No available data.

NO.15.3 Sampling

No available data.

NO.15.4 Age analysis

No available data.

NO.15.5 Life stages

No available data.

NO.15.6 Sex determinations

No available data.

NO.16 Overview, conclusions and recommendations

Only two time-series of eel are available from Norway, which are beach-seine surveys in the Skagerrak (since 1904), and counting of upstream and downstream migrating eel in the River Imsa (since 1975). Both time-series show a decline (Durif *et al.*, 2008), with a collapse in the freshwater 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 to the mean age of silver eels in this river. A collapse in eel numbers was also observed in the Skagerrak time-series, beginning in 1997.

Recreational fishing is prohibited in Norway from 2009, and commercial fishing will be prohibited from 2010.

There is limited data on occurrence, abundance and biological characteristics of eel in Norway, and the knowledge level should generally be increased.

NO.17 Literature references

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Report on the eel stock and fishery in Poland 2010/'11

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Reporting Period: This report was completed in August 2011, and contains data up to 2010 and some provisional data for 2011.

PL.2 Introduction

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.

PL.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.

PL.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.

PL.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).

PL.3 Time-series data

PL.3.1 Recruitment-series and associated effort

PL.3.1.1 Glass eel

Glass eel does not occur in Polish waters.

PL.3.1.1.1 Commercial

Glass eel does not occur in Polish waters.

PL.3.1.1.2 Recreational

Glass eel does not occur in Polish waters.

PL.3.1.1.3 Fishery-independent

Glass eel does not occur in Polish waters.

PL.3.1.2 Yellow eel recruitment

PL.3.1.2.1 Commercial

No commercial dataseries on recruitment exist, minimum landing size is 50 cm.

PL.3.1.2.2 Recreational

No recreational dataseries on recruitment exist.

PL.3.1.2.3 Fishery-independent

No fishery-independent dataseries on recruitment exist, first estimation will be available from 2012.

PL.3.2.1 Yellow eel landings

PL.3.2.1.1 Commercial

No dataseries exist – total landings of yellow and silver eels combined (see Section 6.2).

PL.3.2.1.2 Recreational

No dataseries exist, however some estimation is available. In 2010 NMFRI conducted a special pilot project related to eel recreational fishery (within DCR programme).

Information garnered from 50 respondents exploiting nearly 275 thousand ha of inland waters permitted estimating recreational eel landings in Poland. According to these data, the size of the catches are estimated at 0.28 kg/ha in the Oder basin and 0.15 kg/ha in the Vistula basin. Simple extrapolation to the entire surface area of Polish lakes and reservoirs in these river basins produces the following figures:

Oder basin – 98 285 ha x 0.28 kg/ha = 27.5 tonnes;

Vistula basin – 185 710 ha x 0.15 kg/ha = 27.9 tonnes;

Total – 27.5 t + 27.9 t = 55.4 tonnes

What is striking here is the difference between this estimate and that presented in the Polish Eel Management Plan for recreational catches in both river basins. The PEMP figure for recreational catches was 212 tons, which would mean there has been close to a fivefold decrease in catches of this species. It should be underscored that the data presented in PEMP were based on questionnaires dating from the 2000–2004 period when the abundance of eel in Polish waters was substantially higher. Additionally, calculations included entire river basins without the limitations presented in the current report.

The estimation was verified by conducting a special questionnaire among 88 recreational fishers in 2010 who were fishing the lakes managed by the Lake Enterprise in Ełk, Ltd. The data collected from the questionnaires combined with the number of recreational lake fishing permits sold in 2010 indicate that eel comprised barely 3.3% of the catch, while the total recreational catch was 3248 kg, or 0.64 kg/ha. These data were compared with the size of eel catches made by this enterprise in 2004; the 98 fishing questionnaires analysed indicated that, at the time, eel comprised 5.6% of all catches and total eel catches comprised 3690 kg. Comparison indicates that in the 2004–2010 period eel catches decreased 1.14-fold. Because these data come from concrete recreational fisheries questionnaires, it is plausible to assume that they are more reliable. Considering the results of 50 questionnaires obtained from enterprises exploiting approximately 238 thousand ha of waters in both river basins, as well as data on recreational eel catches in lakes managed by the Lake Enterprise in Ełk, Ltd., it was concluded that the most likely was a fourfold decrease in eel catches during the 2004–2009 period. This indicates that the total recreational catch of eel in 2010 was 70 tonnes, divided by the basins as follows:

Oder basin: 23.1 tonnes

Vistula basin: 46.9 tonnes

Total: 23.2 t + 46.9 t = 70 tonnes

Increase in total recreational catches in comparison to 2009 corresponds to increase in professional eel catches.

PL.3.3.1 Silver eel landings

PL.3.3.1.1 Commercial

No dataseries exist – total landings of yellow and silver eels combined.

PL.3.3.1.2 Recreational

No catches.

PL.3.4 Aquaculture production

PL.3.4.1 Seed supply

PL.3.4.2 Production

Currently, there is just one eel rearing facility in Poland. It produces about 1.5 tonnes of fingerlings annually. The fish are sold exclusively for stocking in Poland. Fingerlings are produced in 2–80 grammes weight gradient.

PL.3.5 Stocking

PL.3.5.1 Amount stocked

Eel stocking was initiated in regions within current Polish borders as early as at the beginning of the 20th, 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 socio-economic 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		2.6*
2	17.6		61.6		21.5		64	0.1	13.8	0.1	0.0	0.6		
3	25.5		41.7		61.9	0.2	25.1	2.3	10.6		0.5	0.5		
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		

***estimation based on previous year + EMP restocking in August 2011.**

Based on information from importers of stocking material, the amount of eel stocking material released into Polish waters was estimated with a high degree of accuracy. See Table 2.

Table 2. European eel stocking in lakes, rivers, and dam reservoirs in Poland in 2010 (data analysed based on information obtained from importers and producers of eel stocking material).

Type of eel stocking material [g/indiv.]	Weight [kg]	Number of specimens [indiv.]	Mean number of individual per kg of stocking material [indiv./kg]
1–4	1757	702 750	400
5–7,5	2334	378 142	160
8–10	2293	251 125	110
15–40	537	26 545	50
90–110	4165	41 650	10
Total	11 086	1 400 212	126

PL.3.5.2 Catch of Eel <12 cm and proportion retained for stocking

There was no catch of eel <12 cm.

PL.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.

PL.4.1 Glass eel

No catches.

PL.4.2 Yellow eel

Estimated data from questionnaires:

ODRA EMU: 250 fishing boats

VISTULA EMU: 470 fishing boats

PL.4.3 Silver eel

See above.

PL.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 2010, the fishing capacity was as follows (boats up to 12 meters)

ICES Subdivision 24 and 25 coastal zone and Szczecin Lagoon – 251 registered boats under the jurisdiction of the District Inspectorates for Marine Fisheries Szczecin and Slupsk, of this figure in 2010, 91 boats reported landing eel;

ICES Subdivision 26 coastal zone and Vistula Lagoon – 340 vessels are registered in ports under the supervision of the District Inspectorates for Marine Fisheries Gdynia, of this number, 121 vessels reported landing eel;

PL.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 comes from questionnaires and are estimated values.

PL.5.1 Glass eel

No catches.

PL.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 3).

Table 3. Fishing effort in inland waters of the Oder EMU.

	Share of gear in eel catches [%]	Estimated exploitation intensity [one gear/ 100 ha lake]
Trap	43	1.14
Towed	2	0.06
Fixed gear on flowing waters	34	0.14
Electric	8	No data
Hook	13	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 4).

Table 4. Fishing effort in inland waters of the Vistula EMU.

	Share of gear in eel catches [%]	Estimated intensity of deployment [one gear/ 100 ha lake]
Trap	45	2.66
Hauled	10	0.07
Fixed gear on flowing waters	24	0.32
Electric	3	No data
Hook	14	No data

PL.5.3 Marine fishery (DCR data)

In coastal waters, eel is most frequently bycatch in catches of other species.

As of 31 December 2010, the monthly fishing effort was as follows:

Table 5. Fishing effort in marine polish waters.

ICES_BAL	Fishing gear code	data	3	4	5	6	7	8	9	10	11	12	total
BAL24	GNS	days			2								2
		No.of gears			50								50
		Total catch			9								9
	FPO	days	10	428	547	257	333	613	562	500	174		3 424
		No.of gears	118	8 223	14 147	6 276	8 282	15 320	14 718	11 002	2 085		80 171
		Total catch	49	1 578	3 046	2 980	3 023	4 317	5 804	7 508	1 484		29 789
	LLS	days				11	7	28	15	1			62
		No.of gears				7 050	22 703	122 600	65 950	500			218 803
		Total catch				56	217	1 177	356	7			1 813
BAL25	GNS	days						1					1
		No.of gears						30					30
		Total catch						30					30
	LLS	days				2	19	43	7				71
		No.of gears				9 000	81 500	188 900	32 200				311 600
		Total catch				133	950	1 751	43				2 877
BAL26	GNS	days		26	2	11	12	6	23	6	10		96
		No.of gears		1 820	44	390	251	116	895	188	284		3 988
		Total catch		198	44	3 233	232	67	243	95	158		4 270
	FPO	days		186	453	162	150	324	395	271	65	2	2 008
		No.of gears		1 334	6 429	3 439	6 291	12 003	7 278	3 365	597	4	40 740
		Total catch		907	3 165	927	1 016	1 992	3 318	1 650	165	3	13 143
	LLS	days					36	60	46	14			156
		No.of gears					86 210	153 000	78 300	18 200			335 710
		Total catch					323	604	378	135			1 440
	SDN	days				3				5			8
		No.of gears				24				30			54
		Total catch				12				7			19
days, total			10	640	1 004	446	557	1 075	1 048	797	249	2	5 828
No. of gears, total			118	11 377	20 670	26 179	205 237	491 969	199 341	33 285	2 966	4	991 146
Total catches			49	2 683	6 264	7 341	5 761	9 938	10 142	9 402	1 807	3	53 390

PL.6 Catches and landings

PL.6.1 Glass eel

There is no glass eel fishery in Poland.

PL.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 approximate 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.

PL.6.3.1 Total landings (time-series)

Table 6. Total landings of eel in entire basins and marine waters (1954–2010).

Decade Year	1950	1960	1970	1980	1990	2000	2010
0		733	847	1221	697	305	178
1		640	722	1018	580	296	
2		663	696	1033	584	236	
3		762	636	822	495	204	
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	

PL.7 Catch per unit of effort

PL.7.1 Glass eel

There is no glass eel fishery in Poland.

PL.7.2 Yellow eel

No data.

PL.7.3 Silver eel

No data.

PL.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).

PL.8 Other anthropogenic impacts

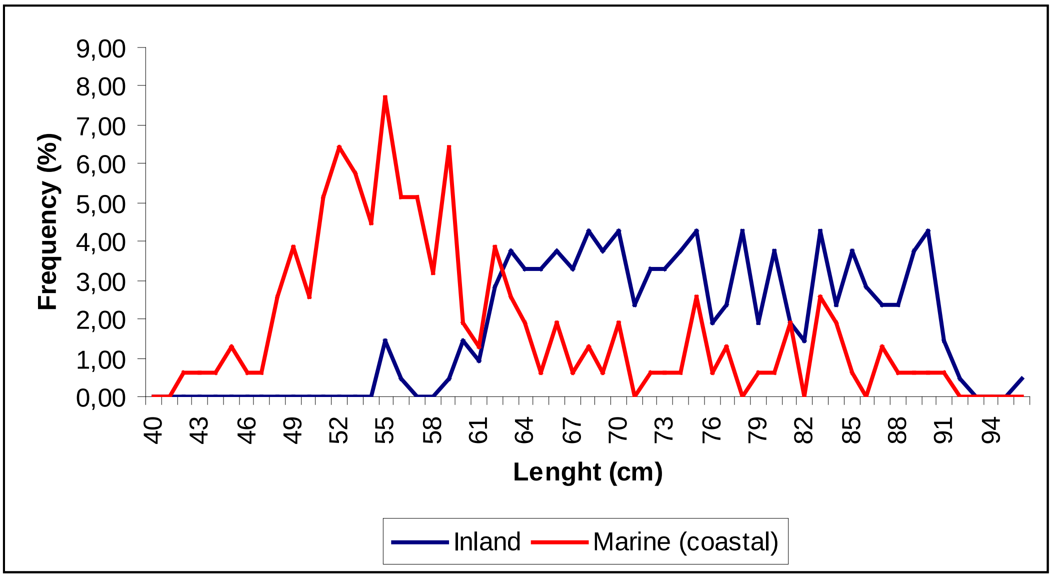
Not applicable.

PL.9 Scientific surveys of the stock

No routine surveys of eel are performed in Poland. Surveys will begin in 2011.

PL.10 Catch composition by age and length (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 are analysed annually. Studies of eel from inland waters started in 2010 as a pilot project. In total 211 fish were sampled in the largest Polish lake; Śniardwy. All of eels were aged. Starting from 2011 sampling of inland catches for length–age data will be conducted by Inland Fisheries Institute in Olsztyn, within EMP framework.



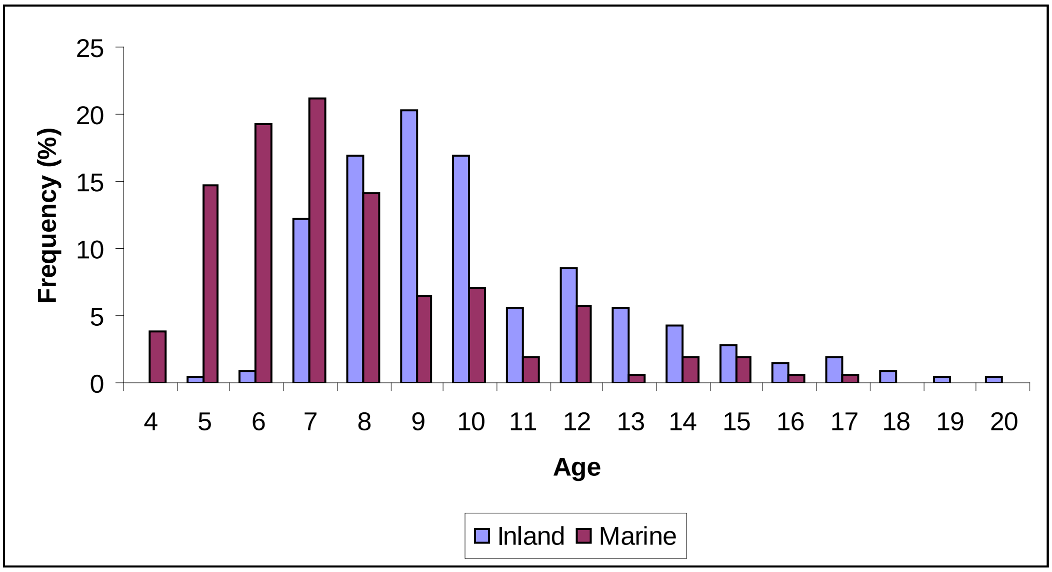


Figure 2. Length and age frequencies of commercial catch in inland and coastal waters in Poland (2010 DCF data).

PL.11 Other biological sampling

PL.11.1 Length and weight and growth (DCF)

Data regarding biological variables such as length, weight, and growth are collected regularly as part of DCF. NMFRI is responsible for collecting these data. See PL. 10 chapter.

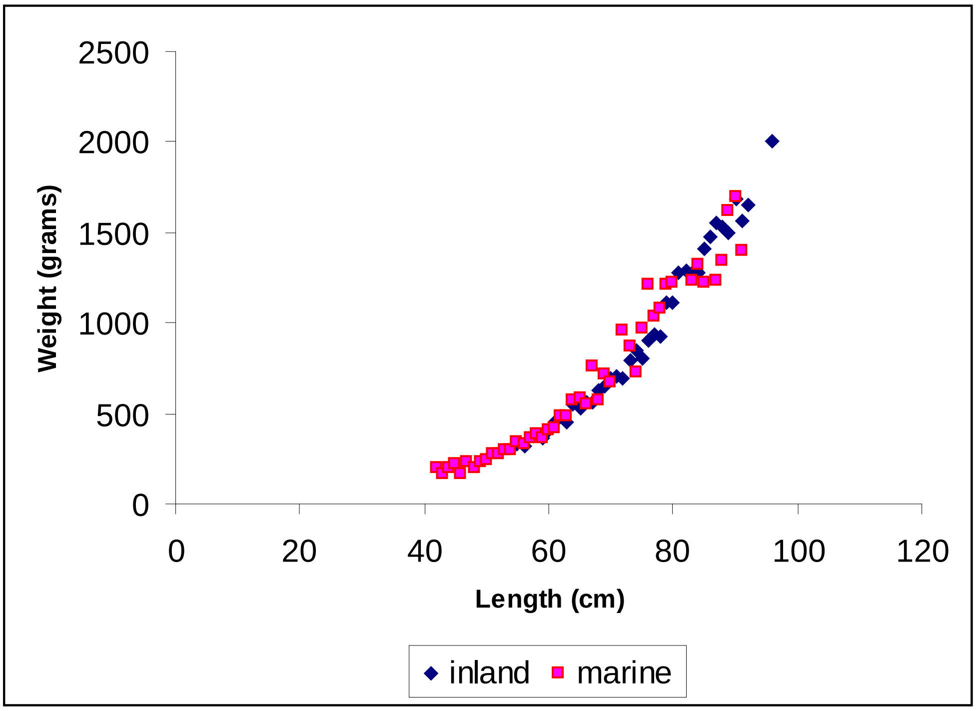


Figure 3. Length–weight of eel from commercial catches conducted in 2010.

PL.11.2 Parasites and pathogens

No new data. See 2009 country report for details.

PL.11.3 Contaminants

No new data. See 2009 country report for details.

PL.11.4 Predators

No new data. See 2009 country report for details.

PL.12 Other sampling

Eel mortality caused by hydroelectric facilities will be studied (probably using telemetry) beginning in 2011. In the same year, the Inland Fisheries Institute in Olsztyn will begin studying cormorant colonies and their impact on eel populations in various individual aquatic basins.

PL.13 Stock assessment

PL.13.1 Local stock assessment

The first assessment of the Polish eel stock was conducted in 2008. Two complementary models were developed:

1. a model for estimating resources and characterizing the history of their dynamics;
2. a model for forecasting eel resources using different scenarios of anthropogenic and environmental conditions.

Additionally, available historical data were analysed to provide preliminary information regarding the state of eel resources in Polish waters, their growth rates, and mortality.

The CAGEAN model (Deriso *et al*., 1985) was adapted to estimate eel resources. This choice was motivated by the significant lack of data regarding the age structure of the catches. Because of this, simplified principles of selectivity distribution and the effect of year in catch mortality were used, which is one of the basic principles of the CAGEAN model.

The forecast was performed based on the model by Astrom and Dekker (2007), which includes the entire eel life cycle, and considers aspects of species biology as well as exploitation.

PL.13.2 International stock assessment

PL.13.2.1 Habitat

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 lake lands situated in northern Poland.

Table 7. 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.**

PL.13.2.2 Silver eel production

PL.13.2.2.1 Historical and current eel escapement

The description of the eel population model used to estimate potential escapement is in Section 13.1. The calculated values of potential escapement during the reference and current period are as follows:

Table 8. Estimated eel escapement for various assumptions in the 1960–1979 and 2005–2007 periods.

	Oder EMU	Vistula EMU

Eel mortality from hydroelectric barriers	30%	44%
Eel escapement numbers [thou. indiv.] 1960–1979* period 2005–2007 potential	 2522 308	 2102 371
With hydroelectric barriers in 2005–2007	216	208
Target (40% of the 1960–1979 period)	1009	841
Ratio of 2005–2007** to the target	0.21	0.25

***/ estimated from natural spawning, without exploitation or barriers.**

****/ hydroelectric barriers included.**

PL.13.2.2.2 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.

Table 9. Causes of mortality in eel other than fishing.

No.	Cause of mortality	Habitat type	Impact
6.1	Hydroelectric power facilities	All	Vistula EMU – 44% Oder EMU – 30% (Appendix 21)
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	No data (possible significant impact)

PL.13.2.2.3 Stocking requirement eels <20 cm

Oder EMU

Of six management strategies analysed, the one chosen stipulates a stocking intensity of 6 million glass eels (2 tons). The equivalent number of reared eel fry with body lengths <20 cm *L.t.* would be 1 200 000 individuals.

Vistula EMU

Of six management strategies analysed, the one chosen stipulates a stocking intensity of 7 million glass eels (2.33 tons). The equivalent number of reared eel fry with body lengths <20 cm *L.t.* would be 1 400 000 individuals.

PL.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 10. 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 metièr (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%.

PL.15 Standardization and harmonization of methodology

PL.15.1 Survey techniques

Annual studies that are independent of fisheries are planned beginning in 2011, as follows:

- studies of the occurrence of young ascending eel in Pomeranian rivers using special traps deployed near hydroelectric facilities;

- studies of eel migration and mortality caused by hydroelectric facilities. A segment of the fish will be fitted with PIT tags to permit tracking their migrations;
- studies of the eel population structure in inland waters using either electrofishing or non-selective trawls;
- studies of population dynamics in transitional waters following intense stocking with three monitoring stations (non-selective fykenets) in the Szczecin and Vistula lagoons and the Puck Bay.

PL.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.

PL.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.

PL.15.4 Life stages

Eel life stage is determined using the method described in Durif *et al*. (2005).

PL.15.5 Sex determinations

Eel sex is determined macroscopically according to established schema of ovary and core build.

PL.16 Overview, conclusions and recommendations

Eel studies in Poland in 2010 were undertaken in marine and inland waters for the Fisheries Data Collection Programme and included only commercial catches. With the acceptance of the Polish Eel Management Plan, which includes a wide-ranging monitoring programme, studies will begin in both Polish river basins and marine waters in 2011. Thus, this report does not comprise new data, and is an update regarding the size of eel catches and stocking and includes data collected as required by the DCR.

Report on the eel stock and fishery in Portugal 2010/'11

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Reporting Period: This report was completed in August 2011, and contains data up to 2010 and some provisional data for 2011.

Contributors to the report: Capitania do Porto de Caminha; Comandancia Naval de Tuy; DGPA (General Directorate of Fisheries and Aquiculture); GNR/SEPNA (National Republican Guard/Service of Nature and Environment Protection); INE (National Institute of Statistics).

PT.2 Introduction

This report is an update of last year´s report and includes some information that despite not obtained during 2010, was identified as being lacking for the general report of this year. Some results obtained by IPIMAR under the DCF are also included in this report, and the "*Final Report of Pilot Study for Eel (2009–2010)*" is presented in an Annex to this country report. Information on the developments of the Transboundary Eel Management Plan for the international part of the River Minho and data collected during its preparation are also presented.

PT.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 fishery, exclusively in River Minho, and yellow eel fishery, all over the country.

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 in individuals of around 25 cm, which is the most appreciated size to fry. There are no fisheries 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 DGPA (General Directorate of Fisheries and Aquiculture) with responsibility in coastal waters, and AFN (National Forestry Authority) with responsibility in inland waters. Both institutions are under the Ministry of Agriculture, Sea, Environment and Planning (MAMAOT), former Ministry of Agriculture, Rural Development and Fisheries (MADRP). 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, in the international section of that river basin. Licences to fish in inland waters are issued by AFN, whereas licences to fish in transitional and coastal waters are issue by DGPA.

After a period of high fishing pressure and intensive poaching of glass eels, glass eel fishery was forbidden in 2000 (*Decreto Regulamentar* nº 7/2000) in all river basins, except in the River Minho where it is still permitted (Decree-Law nº 316, artº 55 of 26/11/81). Despite the enormous efforts of the authorities, which results in the confiscation 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 the fiscalization 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, which are applied to specific fishing areas in inland waters (See Figure 2.1). 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 DGPA have obligatory landing reports, contrary to catches from inland waters, which are not reported, despite the obligation of declaring catches, whenever requested by the Authority. Minimum legal size is 22 cm in coastal waters and varies between 20 and 22 cm in inland waters. In the River Minho it is 20 cm.

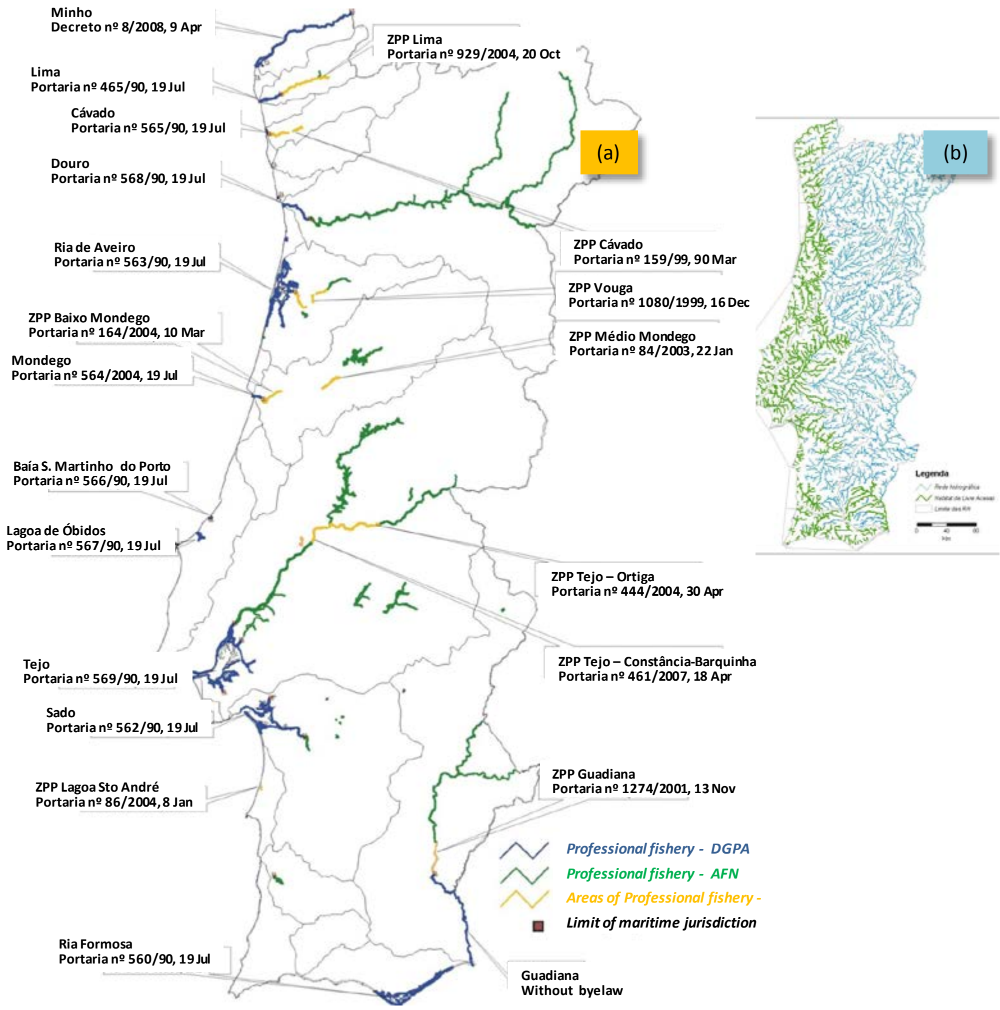


Figure 2.1. Map showing areas where professional fisheries can be conducted both in estuaries and coastal lagoons (jurisdiction of DGPA) and in inland waters (jurisdiction of AFN) (a). The limit of maritime jurisdiction and the byelaws that rule the fisheries at each area are presented in the map (a). (Source: AFN). The habitat that is accessible for the eel is also represented in green (b).

Eel fishery is permitted all year-round in inland waters (jurisdiction of AFN), and a closed season of three months (October, November and December) has been set for waters within the jurisdiction of DGPA, *i.e.* estuaries and coastal lagoons, to increase escapement of silver eels. This ban was set by Portaria nº 928/2010, from 20 September.

PT.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 and will 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 generalized 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. 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.

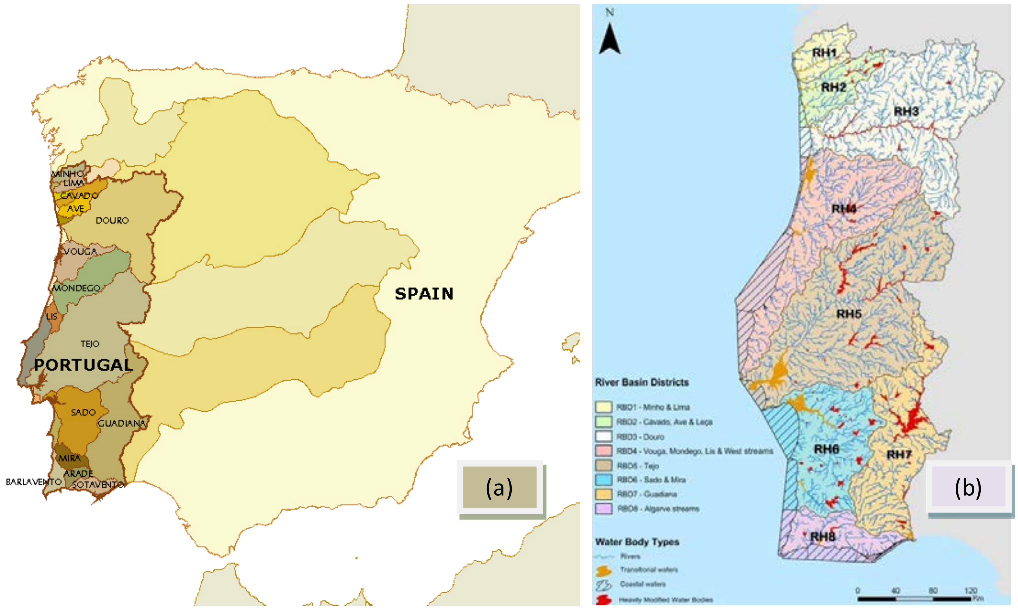


Figure 2.2. Map showing Portuguese River basins including the catchment area extending to Spain (a), and limits of the eight Portuguese River Basin Districts defined according to the Directive 2000/60/EC (b). RBD is labelled as RH in the map.

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 recreational fishery for eels.

The Transboundary EMP was sent to the EC at the beginning of 2011, but no decision has yet been taken.

PT.3 Time-series data

PT.3.1 Recruitment-series and associated effort

PT.3.1.1 Glass eel

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.

PT.3.1.1.1 Commercial

The glass eel fishery is prohibited in all rivers of Portugal (*Decree Regulamentar* nº 7/2000 of May 30) with the exception of the River Minho (Decree-Law 316 artº 55 of 26/11/81). It was in the fishing season 2000/2001 that the fishery became prohibited in all other Portuguese rivers, except for aquaculture and restocking programmes.

Glass eel fishery in the River Minho has been permitted between November and April for many years, but in the last fishing seasons, 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. In the fishing season 2006/2007, fishery was permitted between November and the last New Moon of March, and gradually reduced until last season when it occurred between the 1st November and the 1st 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.

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 annually. However, it is estimated that values are 80% underestimated. A maximum of 50 tons was declared in 1980/81 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 larger 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 auction. In case there is any false declaration there will be consequences, and their licences will not be renewed. For the next fishing season (2011/2012) the catches will have to be reported on a monthly basis, and the same type of logbook has to be delivered by fishermen to the authorities.

Table 3.1. Glass eel recruitment in the River Minho (Portuguese and Spanish parts), 1974 to 2010 (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	Not available	
2010	0.947	Not available	

PT.3.1.1.2 Recreational

Not applicable, as there is no recreational fishery of glass eels in the River Minho.

PT.3.1.1.3 Fishery-independent

No available data. There is no fishery-independent dataseries on glass eel recruitment.

PT.3.1.2 Yellow eel recruitment

PT.3.1.2.1 Commercial

There is no commercial dataseries on yellow eel recruitment.

PT.3.1.2.2 Recreational

Not applicable. Catches are not reported.

PT.3.1.2.3 Fishery-independent

No available data.

PT.3.2 Yellow eel landings

PT.3.2.1 Commercial

No available data. There is no commercial data on yellow eel recruitment.

PT.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.

PT.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.

PT.3.3.1 Commercial

No available data.

PT.3.3.2 Recreational

Not applicable.

PT.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 by-product in aquaculture systems directed towards extensive and semi-intensive sea bass (*Dicentrarchus labrax*) and sea bream (*Sparus aurata*) farming. In freshwater, 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.

PT.3.4.1 Seed supply

Not applicable as the semi-intensive and extensive ponds are naturally colonized by eels.

PT.3.4.2 Production

The production of eels is presented in Table 3.2.

Table 3.2. Aquaculture production of eels (tons) between 1997 and 2010 (Source: DGPA).

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	n/a

PT.3.5 Stocking

There is no stocking of eels in Portugal.

PT.3.5.1 Amount stocked

Not applicable.

PT.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.

PT.4 Fishing capacity

PT.4.1 Glass eel

Glass eel fishery is only permitted in River Minho where fishery is regulated by Decree 8/2008, 9th April 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 are usually very low (Domingos, 1992; Antunes, 1994a), although heavy rain during summer 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. Number of fishing licences issued by *Capitania do Porto de Caminha* are 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 last year a new change was introduced in the licensing process, as licences started to be given 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 can be 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 2010 (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

*** Licences for glass eel fishery are issued by fishing season (1 November to 30 April). In the five last 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) 1st November to 1st February.**

****Total number of licences is only known at the end of the fishing season because fishermen don´t have a time limit to request their licences.**

The Portuguese glass eel catches are mainly sold to Spain for human consumption and aquaculture. In general, the highest prices are attained before Christmas (on 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, which helps 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 (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 during the last two fishing seasons are presented in Table 4.2.

Table 4.2. Number of men and equipment used in monitoring glass eel poaching during the two last fishing seasons. The amount of glass eels confiscated is also presented (Source: SEPNA-GNR).

	FISHING SEASON 2009/10				FISHING SEASON 2010/11			
District	Men (N)	Cars	Boats	Kg	Men (N)	Cars	Boats	Kg
Aveiro	26	10	0	0	86	31	0	22
Beja	239	103	4	8.6	201	63	28	2.15
Braga	32	5	0	7	33	13	5	4
Coimbra	149	54	0	0	209	79	0	1
Faro	8	3	0	0	23	8	0	
Leiria	293	95	0	3.165	155	58	0	13.4
Lisboa	88	33	5	0.75	88	33	5	0.75
Porto	135	46	0	1.8	94	31	0	0
Santarém	106	40	0	3.12	106	31	7	14.12
Setúbal	22	10	0	3	19	8	0	2
V. Castelo	46	17	0	0	57	23	0	0
Vila Real	56	19	0	0	53	23	0	0
Total	1200	435	9	27.435	1124	401	45	59.42

SEPNA has among other competences, the obligation to monitor the illegal activities of fishing and can act on land through CTER). However, another special unit from GNR, the UCC acting close to the coast, obtained the results presented in Table 4.3. for the fishing season 2010/2011. Close to the coast it UCC (GNR whereas another unit (UCC) acts close to the coast.

Table 4.3. 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

PT.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 AFN to fish in these waters but they are not obliged to report their catches. 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 9 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 DGPA 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 DGPA 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.

Table 4.4 presents a list of the number of licences issued by DGPA but to convert this to fishing capacity is impossible, as there is no record of the number of gears per type of fishing gear, and the maximum number of nets permitted by boat varies according to the fishing area. It should be noted that longlines directed to catch demersal fish species can be operated for several species and therefore, the number of licences issued may not reflect a real pressure on the eel stock, but has to be considered as potential fishery usage.

Table 4.4. Number of licences issued by DGPA to use eel fishing gears in transitional waters and coastal lagoons, 1998 to 2010 (Source: DGPA). * It only includes River Lima. Data from River Minho are not available.

River basin district	Fishing gear	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
RBD1*	Longline	3	3	3	3	3	4	5	5	6	7	7	1	2
	Fishing rod	5	5	4	3	3	3	3	3	3	4	4	3	4
RBD2	Longline	2	2	2	1	1	1	1	1	1	1	1	0	0
	Fishing rod	1	1	1	1	1	1	1	1	1	1	1	1	1
RBD3	Fykenet	1	2	2	2	2	2	1	1	1	1	1	0	0
	Sniggle	4	5	5	5	3	3	2	2	2	2	2	1	1
	Longline	58	57	56	51	42	42	43	43	45	42	42	24	24
	Fishing rod	0	0	0	0	1	1	1	1	1	10	20	29	34
RBD4	Fykenet	229	234	222	225	227	233	231	230	209	195	191	121	112
	Beach-seine	292	290	280	280	277	278	269	251	229	215	202	127	116
	Sniggle	206	208	205	206	205	209	206	215	209	202	197	123	119
	Longline	417	419	415	412	419	422	427	445	439	411	425	357	361
	Fishing rod	45	46	47	48	48	52	65	86	100	207	259	312	324
RBD5	Fykenet	119	113	113	122	114	123	122	110	113	103	101	86	81
	Longline	391	371	356	357	338	362	380	362	367	350	356	276	258
	Fishing rod	0	0	0	0	0	0	0	0	17	35	55	62	77
RBD6	Longline	160	158	154	146	139	139	132	129	128	122	123	37	38
	Fishing rod	0	0	0	0	0	0	0	0	0	4	11	22	26
RBD7	Longline	20	53	52	56	57	57	54	53	51	50	51	34	34
	Fishing rod	0	0	0	0	0	0	0	0	0	0	1	2	3
RBD8	Longline	70	66	63	62	65	66	74	80	92	90	93	67	68
	Fishing rod	1	1	1	1	1	4	8	16	25	25	38	41	44

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 of other fisheries.

PT.4.3 Silver eel

Not applicable because there is not a fishery for silver eels.

PT.4.4 Marine fishery

Not applicable. In coastal waters, eels are caught in estuaries and coastal lagoons, but there is not a fishery for eels in marine habitats.

PT.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, longlines and beach-seinenets. Longlines were included in Table 4.3 because despite being selective fishing gears mostly directed to catch demersal fish species, they 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 per licence, although maximum number per fishing area is set by law. The boats used in local fisheries within the jurisdiction of DGPA (estuaries and coastal waters) are small (less than 9 m long) and they are not obliged to keep logbooks. 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.

In inland waters, within the jurisdiction of AFN, there are no obligatory landings, or any reports of catches.

PT.5.1 Glass eel

No available data.

PT.5.2 Yellow eel

No available data.

PT.5.3 Silver eel

No applicable. No fishery directed towards catching silver eels.

PT.5.4 Marine fishery

Not applicable. There is no marine fishery for eels.

PT.6 Catches and landings

PT.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 quite low levels, corresponding to less than 1.5 tons per year, with the exception of 2005, when catches were slightly higher.

Last year (fishing season 2010/2011) a new regulation entered into force obliging fishermen to fill in a logbook and report their catches every three months. In the regulation for next year (fishing season 2011/2012), they have to report their catches on a monthly basis.

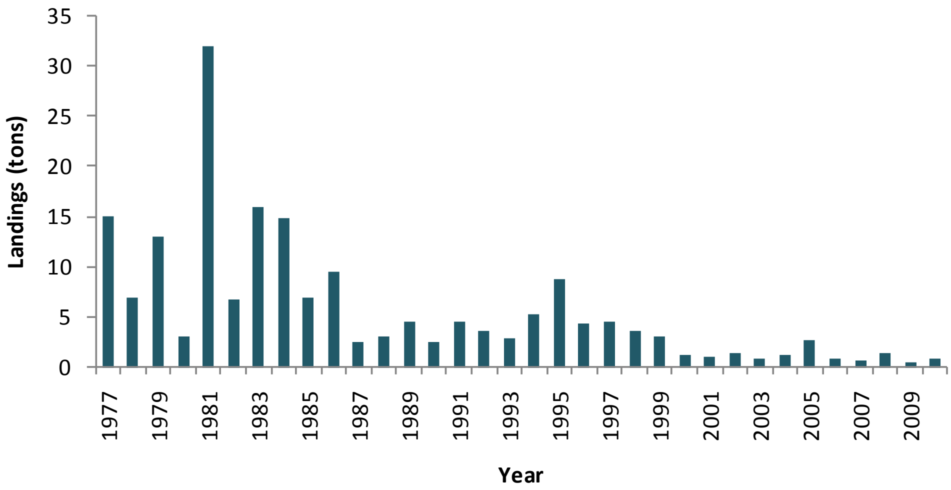


Figure 6.1. Annual landings of glass eel fishery in the Portuguese part of the River Minho, 1974 to 2010 (Source: Capitania do Porto de Caminha).

PT.6.2 Yellow eel

There are no landings in inland waters and fishermen are not obliged to report their catches. Therefore 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) are mostly from yellow eels. As shown in Figure 6.2, there was a decline in catches after 2000 which, despite a peak in 2002, has continued until today.

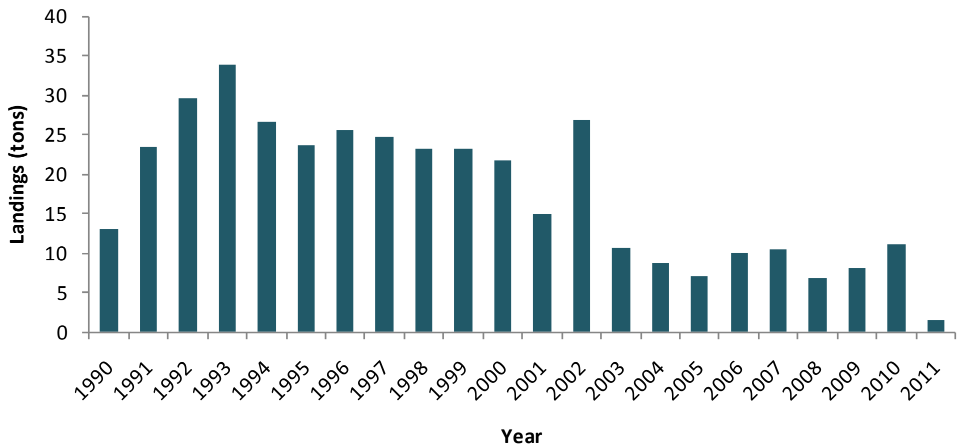


Figure 6.2. Total annual landings of yellow eel fishery in coastal waters (estuaries and coastal lagoons), 1989 to 2011 (Source: DGPA). (Data for 2011 include only five months).

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 228.7 tons were landed between 1989 and 2009. RBD5 includes the Tagus estuary, undoubtedly the most important fishing area. The lowest landings occurred in RBD6 and RBD7. The catches of eels in Portugal are not enough to supply the needs as can be seen in Tables 6.2 and 6.3.

Table 6.1. Annual landings of yellow eel fishery in coastal waters (estuaries and coastal lagoons), by River Basin District and total, 1989 to 2011 (Source: DGPA 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(*)	842	101	2	691	0	0	0	0	1634

(*) Data for 2011, include the first five months of the year.

The commercial circuit of importation (Table 6.2) and exportation (Table 6.3) shows that Portugal is in deficit of eels to supply the internal market as the amount imported largely exceeds the amount exported. Although the possible trade of glass eels in the data may lead to a wrong interpretation when weight is analysed, when looking at the amount of frozen eels, which cannot be glass eels because they have not the same value or interest as when alive, it is clear that the importation is much higher (197 tons) than exportation (84 kg). Additionally it is relevant to note that based on the origin of importation, and assuming European eels are not travelling to the American continent to come back to Europe, there is a trade of American eel.

Table 6.2. Importation of eels: alive, frozen, and fresh and refrigerated fish during 2009 and 2010 (Data from 2010 are not complete) (Source: INE).

	ALIVE EELS		FROZEN EELS		FRESH & REFRIGERATED EELS	
YEAR	ORIGIN	KG	ORIGIN	KG	ORIGIN	KG
2009	USA	30 010	CA	24 255	ES	70 013
	ES	31 538	USA	19 800		
	FR	37 881	ES	10 200		
			FR	47 523		
			NL	59 284		
TOTAL		99 429		161 062		70 013
2010	CA	2987	USA	19 758	ES	55 921
	USA	21 600	ES	4790		
	ES	46 710	FR	11 412		
	FR	50 987				
	NL	790				
TOTAL		123 074		35 960		55 921

Table 6.3. Exportation of eels: alive, frozen, and fresh and refrigerated fish during 2009 and 2010 (Data from 2010 are not complete) (Source: INE).

	ALIVE EELS		FROZEN EELS		FRESH & REFRIGERATED EELS	
YEAR	DESTINATION	KG	DESTINATION	KG	DESTINATION	KG
2009	USA	5	FR	1	CA	12
	ES	5516		1	ES	59
	FR	439				
TOTAL		5960		2		71
2010	USA	45	ES	72	CA	57
	DK	135	FR	10	ES	172
	ES	10 914				
TOTAL		11 094		82		229

PT.6.3 Silver eel

No available data as there is no distinction between yellow and silver eels.

PT.6.4 Marine fishery

Marine fisheries are not directed to catch eels.

PT.7 Catch per unit of effort

PT.7.1 Glass eel

No available data. Cpue cannot be estimated because fishermen report total catches but are 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 next year.

PT.7.2 Yellow eel

No available data. Cpue cannot be estimated because the number of eel fishing gears used per fishing licence is not recorded. However, during the Pilot project under the DCF. IPIMAR distributed logbooks to four volunteer fishermen from Óbidos Lagoon and obtained a cpue varying from 0.112 eels/fykenet/day to 0.233, whereas in the Aveiro Lagoon the cpue varied between 0.343 and 0.485 eels/fykenet/day (two fishermen).

PT.7.3 Silver eel

Not applicable. There is no fishery for silver eels.

PT.7.4 Marine fishery

Not applicable. There is not an eel fishery in marine waters.

PT.8 Other anthropogenic 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.

PT.9 Scientific surveys of the stock

PT.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.

PT.9.2 Stock surveys for yellow eel

No available data, as there are no current surveys of yellow eels.

PT.9.3 Stock surveys for silver eel

No available data, as there are no current surveys of silver eels.

PT.10 Catch composition by age and length

Commercial catch is reported as weight and there is no established sampling to collect data on age and length for the European eel in Portugal. However, IPIMAR has been collecting that information under the Data Collection Framework in the Aveiro Lagoon and in Óbidos Lagoon. Data on age have not been made available so far.

Length frequency distribution of eels from commercial catches using fykenets both in the Óbidos Lagoon and in the Aveiro Lagoon is presented in Figure 10.1.

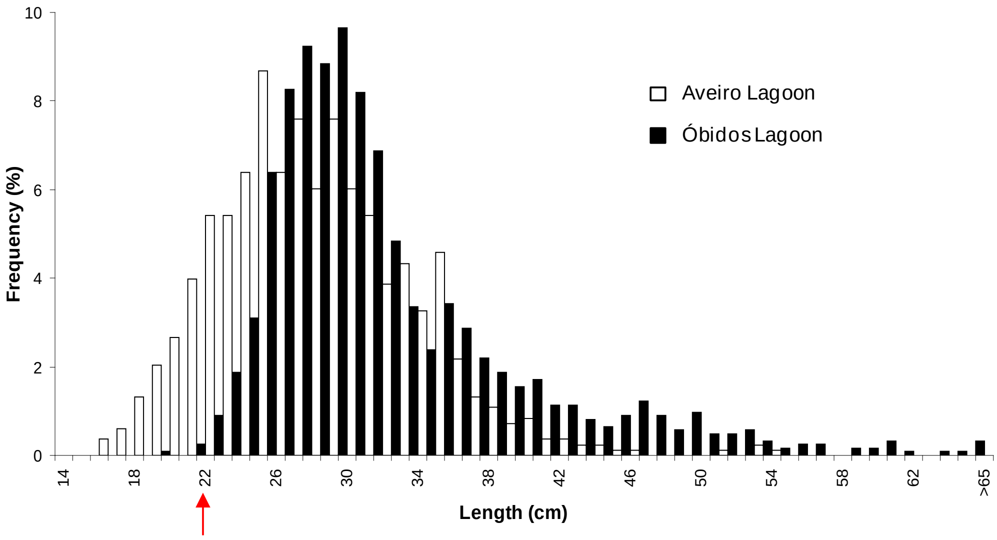


Figure 10.1. Percentage length frequency distribution of eels sampled from commercial catches in the Óbidos Lagoon (n=1222) and Aveiro Lagoon (n=830). Minimum legal size (22 cm). (Source: DCF Report).

As shown in Figure 10.1 part of the catches are under the minimum legal size, i.e. 22 cm. Differences in the population structure are a consequence of differences in the mesh size of the fykenets used in both systems, which is smaller in the Aveiro Lagoon. Additionally, as observed in Table 10.1 some of the catches from the Aveiro Lagoon include silver eels, contrary to the Óbidos Lagoon where only one silver eels was caught.

Length and weight composition of commercial catches from Óbidos Lagoon and Aveiro Lagoon is presented in Table 10.1.

Table 10.1. Length and weight composition of commercial catches sampled in the Óbidos Lagoon and in the Aveiro Lagoon (Mean, maximum and minimum values).

Month	TL (mm)			TW(g)		
	Max	Min	Mean±SD	Max	Min	Mean±SD
Óbidos Lagoon	772	203	328.6 ± 75.1	986	10	68.3 ± 68.2
Aveiro Lagoon	535	160	278.4 ± 56.0	319	6	41.0 ± 29.1
Aveiro Lagoon (Silver eels)	443	298	352.2 ± 31.9	150	41	82.0 ± 22.9

In the River Minho, the capture of eels by electric fishing showed that 45.8% of the eels belong to the length class of 30–45 cm while only 8.7% are longer than 45 cm (Figure 10.2) (River Minho EMP).

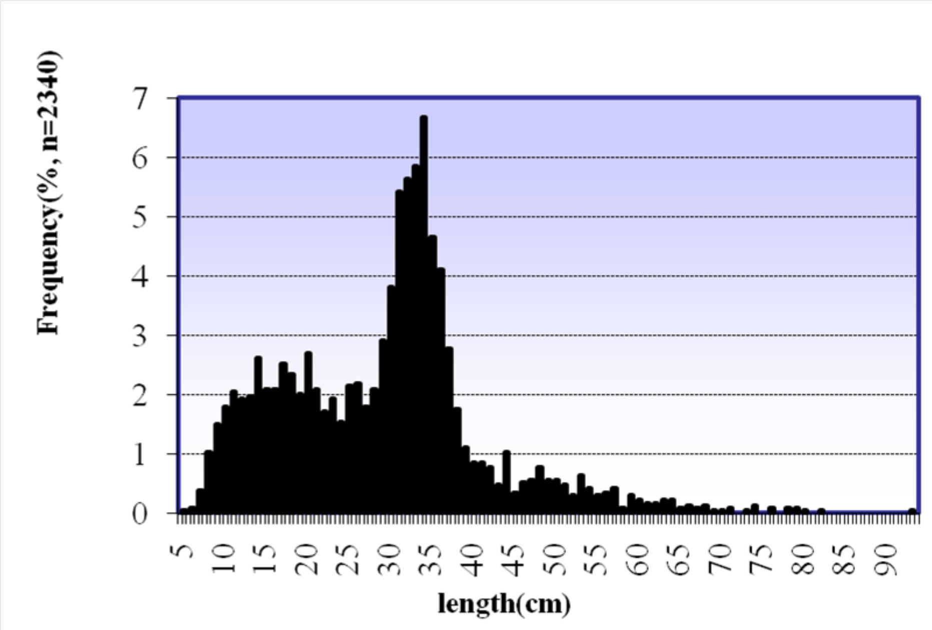


Figure 10.2. Length class distribution of the eels captured in the River Minho tributaries. Class interval=2 cm.

PT.11 Other biological sampling

There was no routine programme to sample eels, except for a Pilot project under the Data Collection Framework, which started in 2009 and lasted for one year. The areas studied included two brackish water systems (Óbidos Lagoon and Aveiro Lagoon).

PT.11.1 Length and weight and growth (DCF)

A mark–recapture study is running in the River Minho. This study has been conducted in the tidal freshwater estuary and eels were marked with pit tags. Preliminary results obtained for yellow eels (see Figure 11.1) show a growth index of 2.9 cm/year and 40 g/year in average (unpublished data).

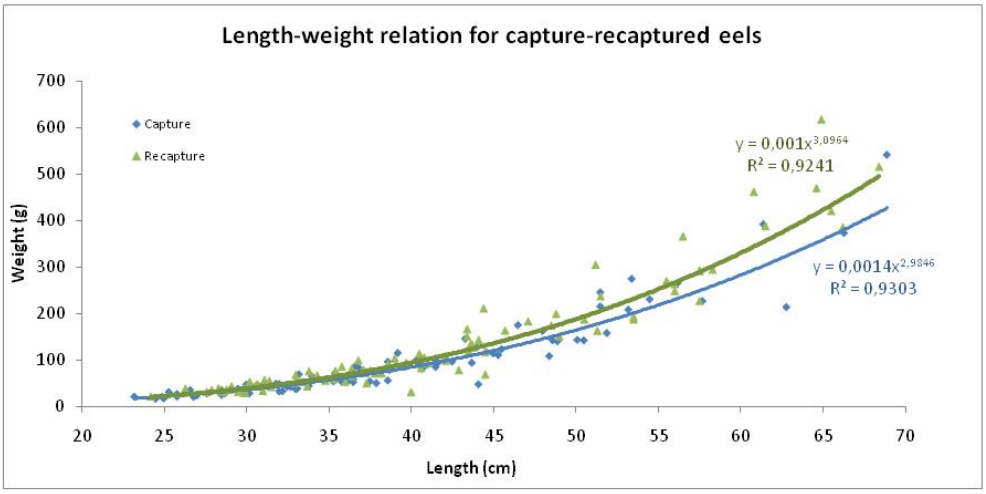


Figure 11.1. Growth of yellow eels marked in the freshwater tidal estuary from the River Minho.

Results of eel growth under the DCF Pilot Project are not yet available. The length–weight relation for eel catches in Ria de Aveiro and Lagoa de Óbidos is given in Figures 11.2 and 11.3 respectively. Significant differences are depicted in the two relations, with eels from Ria de Aveiro being almost 10% heavier for a given size.

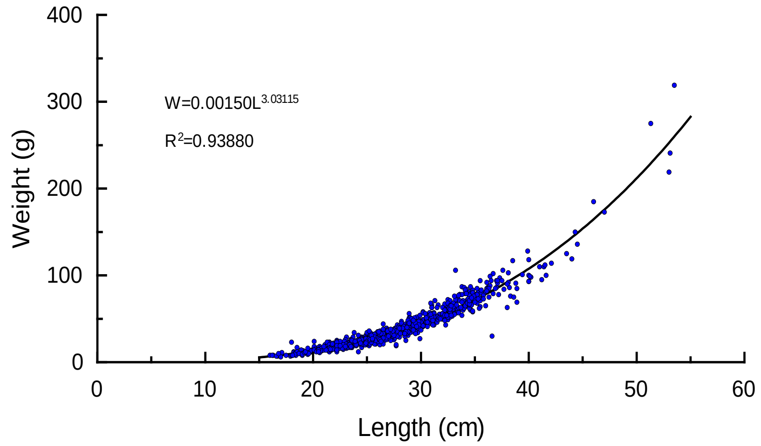


Figure 11.2. Length–weight relation of eels sampled from the Aveiro Lagoon (n=830) between 2009 and 2010 (Source: DCF Report).

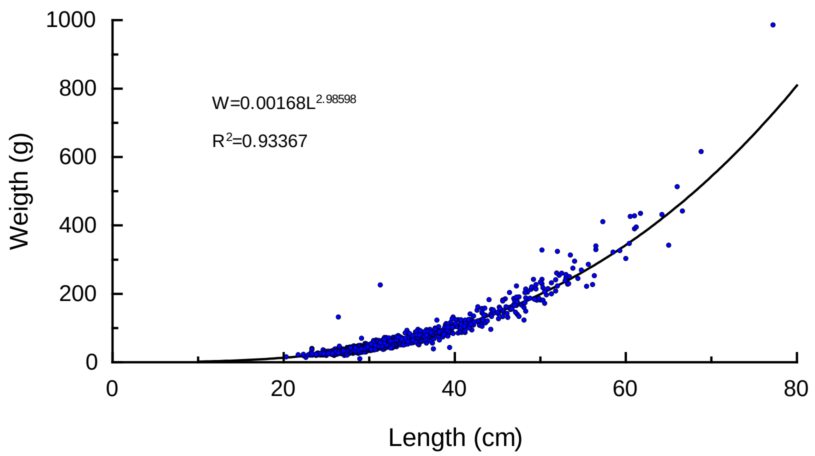


Figure 11.3. Length–weight relation of European eels sampled from Óbidos Lagoon (n=1222) between 2009 and 2010 (Source: DCF Report).

PT.11.2 Parasites and pathogens

There is not a national programme to monitor parasites or pathogens. 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. The map shows the locations where this parasite has been reported so far.

River Minho

Aveiro Lagoon

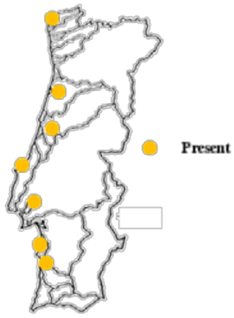
River Mondego

Óbidos Lagoon

River Tagus

Santo André Lagoon

River Mira



PT.11.3 Contaminants

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*., submitted). 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.*, 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.

PT.11.4 Predators

No new data on predators was available for 2010. 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.

PT.12 Other sampling

No other sampling data were available.

PT.13 Stock assessment

PT.13.1 Local stock assessment

There is no stock assessment.

PT.13.2 International stock assessment

PT.13.2.1 Habitat

Eels inhabit all types of habitats, although in some catchments extensive areas have become inaccessible, due to the presence of obstacles lacking fish passages or where fish passages, despite present, are inefficient. Estuarine areas are important and represent a high portion of habitat with complete free access, as there are no dams in tidal areas. The estimated wetted area of free access for the eel is clearly dominated by transitional and coastal habitats in all river basin districts (RBD), except for RH2 (Table 13.1). Total riverine habitat is 43 757 ha, whereas 91 730.2 ha, include transitional and coastal areas. Total wetted area accessible for production is therefore 135 487 ha.

Table 13.1. Estimated total wetted areas (ha) for each river basin district (RBD) accessible for the eel. Riverine habitat is separated from coastal and transitional waters.

RBD	Riverine	Coastal and transitional waters	TOTAL
RH1	7769	3898.5	11 667
RH2	1742	744.0	2486
RH3	2308	830.8	3139
RH4	4165	13 811.5	17 976
RH5	20486	36 911.0	57 397
RH6	1489	21 919.4	23 409
RH7	5297	3579.4	8877
RH8	501	10 035.5	10 536
TOTAL	43 757	91 730.2	135 487

PT.13.2.2 Silver eel production

The estimates 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 is obtained.

PT.13.2.2.1 Historic production

In the absence of data on historical production of silver eels in Portugal it was necessary to make some extrapolations and use information from other countries to estimate this parameter.

The way historical production was calculated is presented in the revised version of the Portuguese EMP (April 2010). The pristine production estimated varied between 47.2 kg/ha and 15.7 kg/ha, assuming that 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*.

PT.13.2.2.2 Current production

The methodology used to estimate 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 freshwater 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 13.2.

Table 13.2. 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 (tonne)	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

In the River Minho EMP the 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.

PT.13.2.2.3 Current escapement

The actual current escapement from the Portuguese river basins is not known. However, given the reduced impact of fisheries on the stock (eight tons reported in landings compared to the 640 tons estimated for production) and the null influence of hydropower installations on escapement (hydropower dams are impassable barriers to migration), it is presumed that escapement is very close to production estimates. Additionally, silver eels are seldom caught in fisheries reducing the direct impact on silver eels. It should however, be mentioned that reported fisheries include only brackish water systems.

For the River Minho, the estimated percentage of escapement of silver eels was 25.41%, representing 9268 kg (River Minho EMP).

PT.13.2.2.4 Production values e.g. kg/ha

Production values are presented in Table 13.2 (see Section 13.2.2.2.). They vary 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.

PT.13.2.2.5 Impacts

No available data. The impacts of anthropogenic activities on the stock namely, poaching of glass eels, contaminants, parasitism and dams were identified in the EMP, but not quantified. As written in the last version of the Portuguese EMP (April 2010), these data will be obtained in the near future.

An inventory of natural and artificial obstacles present in the tributaries of the international area of the River Minho was made for the project NATURA-Minho: *Levantamento do habitat fluvial, os habitats de interesse comunitário, avaliação dos recursos migradores e ordenamento do seu aproveitamento no baixo Minho*". These results are presented in Figure 13.1.

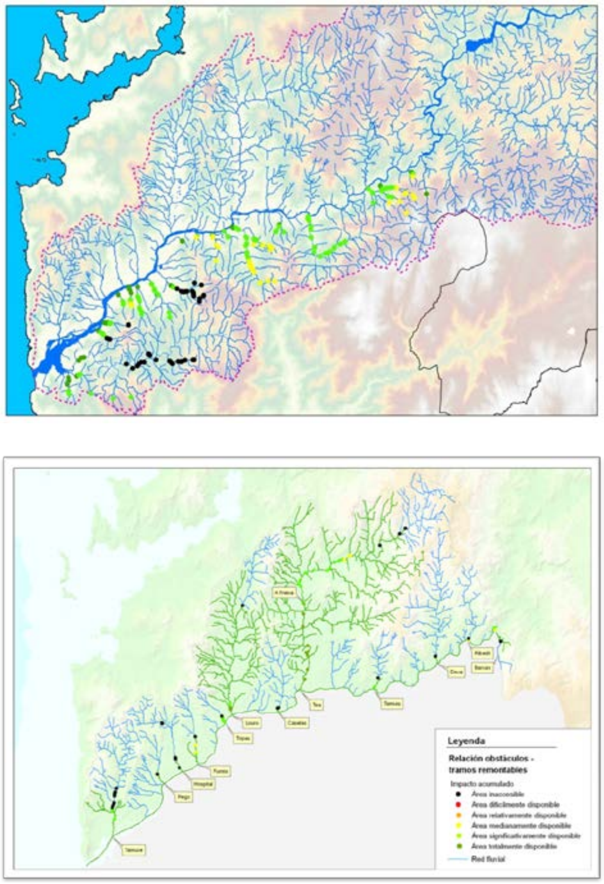


Figure 13.1. Obstacles in the tributaries of the international River Minho, before the first dam (80 km from the river mouth). Black dots represent impassable obstacles for fish (River Minho EMP).

PT.13.2.2.6 Stocking requirement eels <20 cm

The Portuguese EMP does not include a programme of stocking in the measures proposed to recover the population. The same applies to the River Minho because actual recruitment is considered above the carrying capacity of available habitat in the international section of the River Minho (River Minho EMP).

PT.13.2.2.7 Summary data on glass eel

The quantity of glass eels caught in the commercial fishery from the River Minho is presented in Table 13.3.

Table 13.3. Quantity (kg) of glass eels caught in the River Minho between 2009 and 2010.

YEAR	*QUANTITY (kg)*
2009	576.10
2010	947.25
2011	n/a

The destination of these glass eels is probably Spain because glass eels are not eaten in Portugal or used for any other purpose, and fishermen usually sell them to the neighbouring country. Despite having no information on sales (amount and buyer), it is assumed that all glass eel catches have been sold to Spain. Therefore, their final use is unknown.

PT.13.2.2.8 Data quality issues

No information.

PT.14 Sampling intensity and precision

There is no consistent sampling design employed in Portugal.

PT.15 Standardization and harmonization of methodology

There are no protocols applied in Portugal to sample eels. In fact, so far, eels have not been sampled from commercial catches. The methodologies used in scientific studies, have varied according to author, sampling site and objectives of the work.

PT.15.1 Survey techniques

Electric fishing has been the method used in eel surveys in freshwater 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.

PT.15.2 Sampling commercial catches

In Portugal there has not been a routine sampling of commercial catches. Within DCF, a Pilot Project with the duration of one year (2009–2010) was started in January, and includes sampling of commercial catches from two brackish water systems (Aveiro Lagoon and Óbidos Lagoon). This pilot project will be continued through the inclusion of the species in the routine sampling of DCF for the period 2011–2013.

Glass eel monitoring will be 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.

PT.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.

PT.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). In the lack of agreement between both readings, a third reading was performed and if inconsistent, otoliths were excluded from analyses.

INRB/IPIMAR will follow the recommendations of ICES Workshop on Eel Age WKAREA 2009, in the Pilot project under de Data Collection Framework.

PT.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).

PT.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). More recently, Quintella *et al*. (2010) have sexed silver eels by length, to avoid sacrificing animals, considering eels larger than 45 cm as females.

INRB/IPIMAR is determining sex by macroscopic analysis under the Data Collection Framework.

PT.16 Overview, conclusions and recommendations

Portugal has delivered two EMP's to comply with the needs set by the Eel Regulation 1100/2007. One of those plans was established at the national level for the entire country, and the other one was the transboundary EMP for the international part of the River Minho. This latter was produced by the Portuguese and Spanish authorities, sent to the European Commission at the beginning of 2011 (after a reduction of 50% in fishing effort), but no decision has yet been taken.

The Portuguese EMP was approved by the European Commission on the 5th April 2011, following the delivery of the last revised version on the 19th November 2010.

The lack of information on the eel stock in Portuguese waters has been responsible for the delay in its approval.

Some management actions included in the Portuguese EMP have already started. However, the implementation of a programme to collect data on the eel stock in Portuguese waters, one of the measures set in the Portuguese EMP to cope with the need to measure the efficacy of management actions, in line with Article 9 of the Eel Regulation 1100/2007 has not commenced so far.

The information collected within the scope of the DCF is not appropriate to stock assessment and will not substitute the need reported in the EMP to collect information that could enable to estimate silver eel escapement and measure the efficacy of the management actions implemented. The reduced area covered by the DCF (only two coastal lagoons, the Aveiro Lagoon and the Óbidos Lagoon) and the type and amount of data obtained by this framework do not substitute or overcome the needs to collect information on the eel stock in Portuguese waters. Hence, it is recommended that the programme to collect data on the stock starts the earliest possible.

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Report on the eel stock and fishery in Spain 2010/2011

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Reporting Period: This report was completed in August 2011, and contains data up to 2010 and some provisional data for 2011.

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ES.2 Introduction

ES.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 Decrete 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. Spanish RBDs.

Figure 2. Autonomous regions of Spain.

Information of some of the basins included in the present report is given in Table 1.

Table 1. River basins included in this report.

Autonomy	RBD	River Basin	Latitude (N°)*	Longitude *	Drainage area (km²)	River length (km)
Basque	B. Inner basins	Bidasoa	43º19'	1º58'W	700	69
	B. Inner basins	Oria	43º16'	2º06'W	882	77
	B. Inner basins	Urola	43º17'	2º14'W	342	65
	B. Inner basins	Deba	43º19'	2º26'W	530	60
	B. Inner basins	Artibai	43º21'	2º29'W	104	26
	B. Inner basins	Lea	43º22'	2º35'W	99	26
	B. Inner basins	Oka	43º21'	2º40'W	183	27
	B. Inner basins	Butrón	43º23'	2º56'W	172	44
	B. Inner basins	Nervion-Ibaizabal	43º19'	3º00'W	1798	72
	B. Inner basins	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 N	00º 50' W	170	
C. Valenciana	Jucar	Albufera lagoon	39º22'	0º18' E	738	
	Segura	El Hondo lagoon	38º11N	0º46'W	23.9	
	Segura	Santa Pola lagoon	38º11N	0º37'W	25.0	
Catalonia	Ebro	Ebro	40ª41′	0º44′E	85 362	910
	C. Inner basins	Muga	42º14,2′	3º7,6E	758	
		Fluvià	42º12,2′	3º6,7E	974	
		Ter	42º1,4′	3º11,7′E	2955	

ES.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 fish market, 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 modifications that have been already implemented in some of the autonomous regions, while in some others they will be implemented once the management plan is approved.

In Spain the glass eel fishery exists in all the RBDs. 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) and the Albufera (Júcar RBD) from Catalonia and the C. Valenciana respectively. In addition to that, there is an important yellow and silver eel fishery in Galicia, C. Valenciana and Catalonia.

As explained above, the information available from each autonomous region is variable. Until now, there has not been any eel management plan at a national level. Therefore, the compilation of all the data from the different autonomous regions for getting a national overview of the eel fisheries in Spain is a very complicated task.

Below, information available from the different autonomous regions has been summarized.

BASQUE COUNTRY: There is not a professional yellow or silver eel fishery in the Basque Country. Recreational fishery catches were historically insignificant and the fishery was forbidden in 2009.

Glass eel fishery, on the other hand is a very traditional fishery 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 non-professional. Although being the glass eel fishery 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 Cantabrico RBDs (Figure 2).

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 their catches are not for sale. 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 not a professional yellow or silver eel fishery in Asturias, and the recreational fishery was forbidden in 2007.

Glass eel fishery, on the other hand, is a very traditional fishery in this area and affects to 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). Besides that, 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 licenses 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. It will enable comparing catches and sales as in the exploitation plan. 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 non-professional fishing activity has been completely forbidden. Yellow and silver eel fishery activity has been separated. It is a boat fishery where the number of gear types is limited by boat. The boats need to be licensed to the fishing gear that will be used in each fishing trip. They might have more than one fishing gear license, but only one of them can be used in each fishing operation. The number of days each fisherman has been operating is not clear, since the proxies we could consider are not very reliable.

From the resolution that allows the eel fishing plan 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 has been set up to 80, and the fishing period goes 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 these days. 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 introductory section, 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 delimits 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 center 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 web-service is free, and offers statistical and commercial information of several fisheries.

The other river basin mentioned in this report belong is 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 Andalucia 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, but this has not been established yet. At least 60% of this 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. Eels 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 is both, professional and recreational. There are six professional associations of glass eel fishermen distributed between the provinces of Valencia and Castellón, with 168 fishing licenses and 89 fishing points ("postas").

There are two types of professional yellow/silver fisheries depending on the province. In Valencia, there are four fishing associations: in on hand, El Palmar, Silla, Catarroja associations exercise their rights to exploit the yellow and silver eel around the Albufera which is a 2100 ha costal lacuna 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 travelling fishing.

Regarding glass eel fishery, Perelló-Perellonet fishing association has the exploitation rights. 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. Particularly, 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 a professional yellow and silver eel fishery exists.

BALEARIC ISLANDS: There is not any glass eel fishery in the Balearic Islands. Professional eel fishery (>40 cm) is allowed only in Menorca, although there is only one licence. 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 recreational eel fishery.

Spanish government does not compile eel catches data recorded in the different autonomous regions, and there is not any official statistics about landings in Spain. Different autonomous regions have contributed to the present report providing their data; however, as some of the autonomous regions do not record catches data, it is not possible to calculate total landings of Spain.

ES.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 it 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 but it has been not published yet.

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 3). Some individuals can be found in the interior due to restocking.

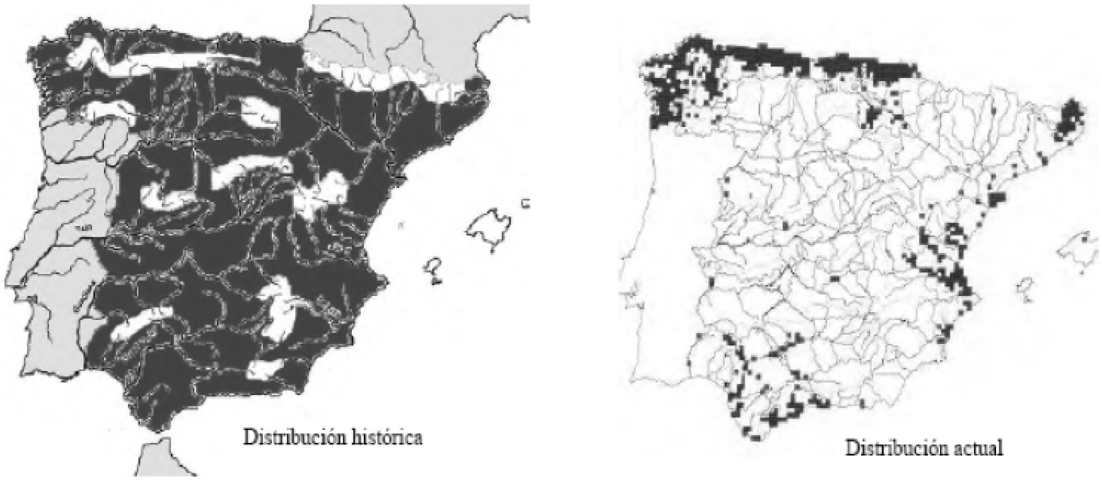

Figure 3. Historic and present distribution of eel in Spain according to Doadrio *et al.* (2001).

Given Spain's national and regional structures, the Spanish management plan is based on a **National Eel Management Plan (EMP) and twelve 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):

- i) EMP of Galicia
- ii) EMP of Asturias
- iii) EMP of Cantabria
- iv) EMP of Basque Country
- v) EMP of Navarra
- vi) EMP of Catalonia
- vii) EMP of the Ebro RBD (only Catalonia)
- viii) EMP of C. Valenciana
- ix) EMP of Castilla La Mancha, only for the eels in the upper part of the Jucar and in coordination with C. Valenciana
- x) EMP of Murcia
- xi) EMP of Balearic Islands
- xii) EMP of Andalucia

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 Administrative Unit** (EAU) 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 EAUs 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 data available 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 situation of the European eel in Spain will be updated on that base. 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 time-scale 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.

ES.3 Time-series data

ES.3.1 Recruitment-series and associated effort

ES.3.1.1 Glass eel

ES.3.1.1.1 Commercial

All the data in this section is obtained from auctions or fishermen guilds. There are four historical dataseries for glass eel catches (Table 2) in Spain:

- San Juan de la Arena Fish market 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 two fishing points (Pujol 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;
- 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 too.
- The Miño. As this RBD is shared with Portugal in includes data from both, Spain and Portugal. The Miño river command compiles this catches data. This year no data regarding the Miño RBD have been provided.

Table 2. Glass eel catches (kg), 1949 to 2011.

	San Juan de la Arena	Asturias*	Puchol Perellonet	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							

	San Juan de la Arena	Asturias*	Puchol Perellonet	Albufera**	Delta del Ebro lagoons	EBRO RBD ***	Catalunya Inner Basins	Miño Spain	Miño Portugal	Miño RBD
1962	17177		11088							
1963	11507		7997							
1964	16139									
1965	20364									
1966	11974				4651					
1967	12977				4937					
1968	20556				8858					
1969	15628				2524					
1970	18753				2947					
1971	17032				2022					
1972	11219				1261					
1973	11056				1129					
1974	24481				1354					
1975	32611				2466			1600	50	1650
1976	55514				5626			5600	5000	10600
1977	37661				-			12500	7500	20000
1978	59918				3400			21600	15000	36600
1979	37468				4177			17300	7000	24300
1980	42110				3514			15400	13000	28400
1981	34645				3800			13000	3000	16000
1982	26295		1309		2636			18000	32000	50000
1983	21837				2327			9700	6700	16400
1984	22541		2387		1815			14000	16000	30000
1985	12839		2980		1690			15300	14800	30100
1986	13544				301			6000	7000	13000
1987	23536		2845		2027			6539	9500	16039
1988	15211		4255		-			5600	2600	8200
1989	13574		2513		-			7359	3000	10359
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	10001
1996	5900	7751	271		409			6523	8700	15223
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	574	574	922	3315	77	1427	1100	2527

	San Juan de la Arena	Asturias*	Puchol Perellonet	Albufera**	Delta del Ebro lagoons	EBRO RBD ***	Catalunya Inner Basins	Miño Spain	Miño Portugal	Miño RBD
2003	1231	2770	411	411	1558	4571	357	1755	1400	3155
2004	506	1351	320	320	564	1504	285	1562	800	2362
2005	914	2875	242	242	298	1805	134	1331	1292	2623
2006	836	2175	208	208	557	1209	147			
2007	615	2265	292	292	611	611	148			
2008	871	2379	129	118	445	1170	79			
2009	272	749	78	78	411	1511	0	1332		
2010	1089	2612	95	125	501	1536	131	2000	320	
2011	1231	2055	140	211	419	1426	101			

*** Includes San Juan de la Arena fishmarket.**

**** Albuferancludes catches from Pujol and Perellonet.**

***** Includes lagoons and river mouth catches.**

The catches have decreased from around 20 tons in early 1950s to less than 1 tons nowadays (Table 1). The recruitment time-series in Spain shows a clear decreasing trend (Figure 4).

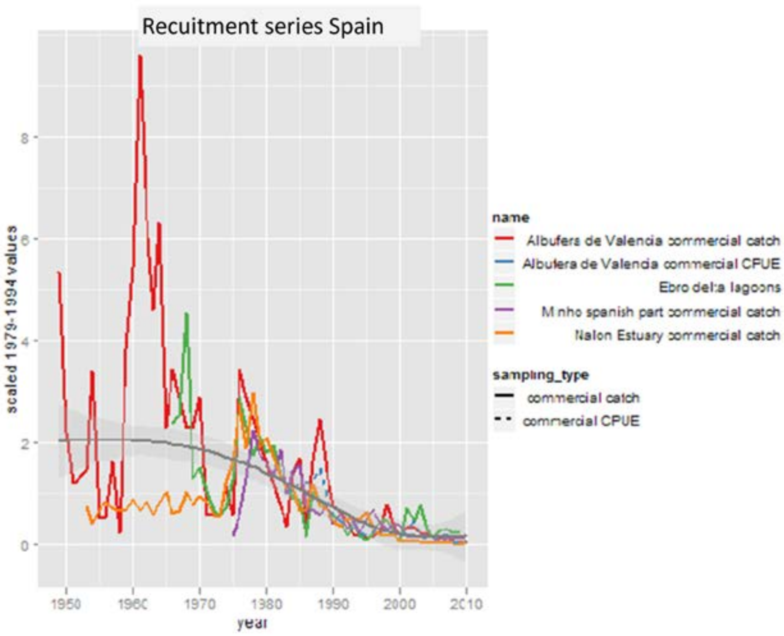

Figure 4. Time-series of monitoring glass recruitment in Spain with dataseries. Each series has been scaled to the 1979–1994 average on a linear scale. The mean values and their bootstrap confidence interval (95%) are represented as black dots and bars. The geometric means are presented in red. The graph has been rescaled to [0.10].

ES.3.1.1.2 Recreational

In the case of the Basque Country glass eel fishing is only recreational. It is obligatory to fill in the Daily Catches report with data regarding catches and effort (Table 3). In Cantabria the fishermen report their data to the local administration.

Table 3. Glass eel recreational catches (kg), 2004 to 2011.

	Basque inner basins RBD	Cantabria
2004	858	
2005	1181	
2006	1282	398
2007	687	341
2008	1205	94
2009	212	0
2010	614	65
2011	376	13

ES.3.1.1.3 Fishery-independent

No historical data are available; only some punctual data from Guadalquivir and Oria rivers which was reported in the 2009 Spanish Country Report.

ES.3.1.2 Yellow eel recruitment

Upstream migration data has been collected since 2005 in the Oria river. In 2010, 3244 silver or yellow eel were counted in the Orbeldi trap (Figure 5). Excluding 2008, when the trap did not work properly, 2009 data were the smallest number of the historical series, which could be related to the very low recruitment in that year. But, apparently, recruitment has increased in 2010, reaching one of the larger numbers of eel in the time-series during this year.

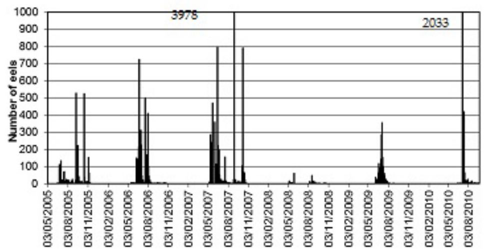

Figure 5. Number of eels collected in the Orbeldi trap (River Oria, Basque Country).

Year	2005	2006	2007	2008	2009	2010
Nº eels	2656	3868	8957	233	1823	3244
Event>1000			3978			2033

ES.3.1.2.1 Commercial

The yellow and silver eel catches come from the Albufera and the Miño river. These data are shown in Section 3.2.1. below.

ES.3.1.2.2 Recreational

No data available.

ES.3.1.2.3 Fishery-independent

All the autonomous regions do multiespecific electrofishing samplings. However, data are not compiled at a national level.

ES.3.2 Yellow eel landings

ES.3.2.1 Commercial

Eel catches are only split up into yellow and silver in Albufera and Miño (Table 4). Additionally, aggregated information exits for other RBDs (Table 5). The data sources are the same described above for glass eel catches in the case of Albufera, Miño and Ebro rivers (Table 2). Data from Marjal and Alicante, (C.Valenciana) are obtained from fisherman guilds, and the ones from Galicia, Baleraric Islands and Murcia, from fish market auctions.

Table 4. Yellow eel catches (kg), 1951 to 2011.

	Albufera	Miño Spain	Miño Portugal	Miño RBD
1951	30000			
1952	38000			
1953	30200			
1954	40400			
1955	30400			
1956	30260			
1957	40000			
1958	40000			
1959	40000			
1960	30000			
1961	30040			
1962	20200			
1963	22400			
1964	18000			
1965	12300			
1966	15000			
1967	59500			
1968	16000			
1969	11200			
1970	12600			
1971	11612			
1972	18300			
1973	12428			
1974	11210			
1975	6570			

	Albufera	Miño Spain	Miño Portugal	Miño RBD
1976	5300			
1977	4668			
1978				
1979				
1980				
1981	6848			
1982	9126			
1983	7697			
1984	3577			
1985	3464	2027	2000	4027
1986	2871	1334	4200	5534
1987	3611	1282	3000	4282
1988	2098	1227	3400	4627
1989		1368	3100	4468
1990	1843			
1991		1037	3000	4037
1992	2330	1275	3800	5075
1993	2349	813	2500	3313
1994	2155	1126	3000	4126
1995	2897	1460	3500	4960
1996	3105	1266	5600	6866
1997	2123	1543	1300	2843
1998	2563	796	1500	2296
1999	2503	780	1200	1980
2000	2047	830	750	1580
2001	1995	903	1600	2503
2002	2126	604	650	1254
2003	2598	614	860	1474
2004	2138	598	320	918
2005	1472	265	670	935
2006	1479	277	1000	1277
2007	1911			
2008	6855			
2009	2615			
2010	1687			
2011	1543			

Table 5. Yellow + silver eel catches (kg), 1951 to 2011.

	Albufera	C.Valenciana *	Galician Coast RBD	Ebro lagoons	Ebro RBD **	Miño Spain	Miño Portugal	Miño RBD	Balearic Islands RBD	Murcia
1951	90000									
1952	102200									
1953	80200									
1954	97700									
1955	102900									
1956	106120									
1957	80000									
1958	115000									
1959	100000									
1960	98000									
1961	95340									
1962	90700									
1963	95400									
1964	91500									
1965	76300									
1966	79000			30662						
1967	79500			36026						
1968	65600			45327						
1969	56500			52046						
1970	42850			81864						
1971	44012			102839						
1972	43800			52591						
1973	33028			45853						
1974	24822			49685						
1975	17190			54872						
1976	13560			46469						
1977	11020									
1978										
1979										
1980										
1981	19117									
1982	15971									
1983	14094									
1984	10972									
1985	14477					2027	2000	4027		
1986	12114					1334	4200	5534		
1987	14839					1282	3000	4282		
1988	9796					1227	3400	4627		
1989						1368	3100	4468		
1990	3843							4037	503	

	Albufera	C.Valenciana *	Galician Coast RBD	Ebro lagoons	Ebro RBD **	Miño Spain	Miño Portugal	Miño RBD	Balearic Islands RBD	Murcia
1991						1037	3000	5075	691	
1992	5330					1275	3800	3313	526	
1993	5349					813	2500	4126	556	
1994	4155					1126	3000	4960	385	
1995	4497					1460	3500	6866	214	
1996	6065					1266	5600	2843	380	
1997	4907			17393		1543	1300	2296	534	
1998	5663	6864	17639	14367		796	1500	1980		
1999	4903	5977	3789	14790	16522	780	1200	1580		12470
2000	3584	4084	4297	13587	17921	830	750	2503		15504
2001	3279	4147	15794	32044	35317	903	1600	1254		35491
2002	3558	4375	50543	23391	26095	604	650	1474		30802
2003	6640	8550	39699	15679	18626	614	860	918		32672
2004	7729	8770	31341	12127	16081	598	320	935		22248
2005	7965	9887	35373	12269	13710	265	670	1277	212	32682
2006	7453	8823	31702	16369	17361	277	1000	-	190	25631
2007	8499	9664	63111	19893	22640	149		-	140	22790
2008	10881	13834	28278	-	-	447		-	44	20314
2009	6386	10164	32768	20793		277		-	-	23962
2010	4847	9787	28497	12016	12016	149	-	-	-	-
2011	4350	7512	10957	18555	19138					18661

*** Includes catches from Albufera.**

**** Includes lagoons and river mouth catches.**

ES.3.2.2 Recreational

No data available.

ES.3.3 Silver eel landings

ES.3.3.1 Commercial

The data from the Albufera are detailed in Table 6. The source of the data is the same detailed above for glass eel catches in Albufera and the Miño and Ebro rivers (Table 2).

Table 6. Silver eel catches (kg), 1951 to 2011.

	Albufera
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
1984	7395
1985	11013
1986	9243
1987	11228
1988	7698

	Albufera
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	6493
2006	5974
2007	6588
2008	4026
2009	3771
2010	3160
2011	2437

ES.3.3.2 Recreational

No data available.

ES.3.4 Aquaculture production

There are six fish farms in Spain that produce eel:

- Two in C. Valenciana, one of them ("C. Valenciana de Acuicultura") produces yearly around 300 tons of eel, and is the main eel producer in Spain. The other one ("Puchades") was created in 2008 with a capacity to produce 150 tons of eel per year;
- A fish farm in the Delta del Ebro (Cataluña), that produces around 60 tons of eel per year;
- An eel farm in the Basque Country, with capacity to produce 60 tons of eel per year;
- A fish farm in Andalucía in the Guadalquivir basin.

Additionally, in the Basque Country, in Aginaga (Oria river basin) there are six companies dedicated to the commercialization of glass eels.

ES.3.4.1 Seed supply

The fish farms from Cataluña buy glass eel to local fishermen and the one from C. Valenciana mainly to the Delta del Ebro, Guadalquivir, Galicia, Asturias fishermen and to a lesser extent to UK and Morocco. Although they plan to give special licences to fish farms in Andalucia, the glass eel fishery has been completely closed since November 2010 and there is not any agreement at the moment.

The companies from the Basque Country have hatcheries in Asturias, C. Valenciana, Catalonia and the Atlantic coast of France to maintain the glass eels they buy to local fishermen until they are transported to the hatcheries in Aginaga.

There is no quantitative data available.

ES.3.4.2 Production

The production is detailed in the Table 7.

Table 7. Aquaculture production (kg) in Spain per autonomous region until 2009 (source: Spanish Ministry of the Environment and Rural and Marine Affairs).

	Basque Country	Cataluña	C. Valenciana	Andalucía	Total
2002		130000	260200	34538	424738
2003		41000	264800	33077	338877
2004		63600	316600	43673	423873
2005		63600	301470	61855	426925
2006	55000	63600	233150	51055	402805
2007	65000	60000	325000	27962	477962
2008			385000		
2009			370000		

ES.3.5 Stocking

In Spain different restocking experiences have been carried out:

- 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. 385 075 young eel, acquired in farms from C. Valenciana, Francia, and Gipuzkoa had been stocked between 1984 and 2008.
- 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 eels are fattened in the public Centre for the Production and Experimentation of Warm Water Fishes until they reach a weight of 8–10 g. In Table 18 the survival ratio obtained in this farm for eel of different weights is given. Fattened eels are released up in the river waters and wetlands of C. Valenciana and even in 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 glass eel kg was 531.8€ in 2010 and 577.8€ in 2011. But there is not any type of monitoring programme for these individuals.

- In Catalonia Inner River Basins and the Ebro RBD, different restocking 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 eels had an average weight 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 last individuals have been used this year (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.

- In Cantabria, a 40% of the total landings of the 2010–2011 season recreational fishery has been used for restocking. The corresponding amounts of glass eel have been obtained daily from the fishermen, and kept alive in tanks by the Consejería de Medio Ambiente. Stocking operations have been carried out weekly along the fishing period in different river basins depending on the source of landings.

  A percentage of these eels (the ones for restocking), has also been kept for fattening and stocking in different stages of their life cycle, aiming to assess the efficiency of each of the methods.

- 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 released up to the Ursuarán river (in Idiazabal, Gipuzkoa). Both rivers belong to the same river basin (Oria river basin). During summer (2011), different electric fishing operations have been carried out aiming to monitor the restocked individuals. For the next year, and within the same project, and amount of glass eels will be kept for fattening in an eel farm and stocking in different stages of their life cycle.

ES.3.5.1 Amount stocked

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

In Table 8 the amount of stocked glass eel is detailed.

Table 8. Restocking of glass and yellow eel in Spain.

	Ebro (Navarra) (eels)	C. Valenciana (n of eels)	C. Valenciana (average weight, g)	C. Valenciana (Kg)	Fluvia (n of glass eels) *	Muga (n of glass eels) *	Ter (n of glass eels)*	Ebro (Cataluña) (n of glass eels)*	Sella & Nalón (n of glass eels) **
1948									
1984	16400								
1985	1200								
1986	45000								
1989		55419	9	528					
1990		26488	10	248					
1991		56948	12	387					
1992		57488	9	459					
1993		167450	6	1021					
1994		121314	6	749					
1995		215539	5	927					
1996	15000	95692	9	789				66290	
1997		143370	10	1278				74934	
1998		86382	11	891	16408	18846		79119	
1999		44219	9	381	66369			94637	
2000	38600	54295	10	561					
2001	24500	62169	9	544	12750				
2002	113000	43038	9	396					
2003	18750	64373	7	351					
2004	100000	64923	8	542	35769	35769			
2005		119647	7	392					
2006		1760	11	19					
2007		20804	9	186			26997		
2008	12625	43352	8	358					30000
2009		15649	9	143					
2010		15062							45000
2011					2900 ***				60000

*** 0.15–0.33 gr.**

**** 4 kg, 6 and 8 kg in total.**

***** 273 kg of eel from the 2008–2009 and 2009-2010 fishing seasons and kept in the IRTA (Instituto de Investigación y Tecnología Agroalimentaria).**

ES.4 Fishing capacity

ES.4.1 Glass eel

In the Basque Country, the number of glass eel fishing licenses decreased until 2010, remaining relatively constant during the last fishing periods (Table 9).

In Asturias boat fishing is only allowed in the Nalón River, and a maximum of 45 licences can be issued according to the new regulation implemented in October 2010.

In C. Valenciana, although there are 168 licences the number of fishermen that really fish is 140.

Table 9. Number of glass eel fishing licences per basin and fishing gear in the last three fishing seasons.

			2008–2009				2009–2010				2010–2011			
	RBD	RB	Boat	Land	Ns	Total	Boat	Land	Ns	Total	Boat	Land	Ns	Total
Basque C.	B. Inner	Barbadun	12		3	15								
		N. Ibaizabal	62		7	69		58		58		53		53
		Butron	84	2	8	94	1	92		93	1	96		97
		Oka	4		2	6		3		3		1		1
		Lea	9		6	15		21		21		13		13
		Artibai	2			2		3		3		5		5
		Deba	113		9	122		99		99		105		105
		Urola	5	18		23	17	6		23	19	5		24
		Oria	74	24	5	103	28	66		94	27	71		98
		Bidasoa	1			1								
		Total	366	44	40	450	46	348	-	394	47	349	-	396
Asturias	Cantábrico	Nalón	45	62	0	107					43	50		93
		Others	0	157	0	157						133		133
		Total	45	219	0	264					43	183		226
C. Valenciana	Júcar	Albufera	ND	ND	ND	ND								
		Total		168		168		140		140		140		140
Catalonia	Ebro	Delta												
	C. Inner	Muga, Fluvia, Ter										10		10
Cantabria		Total										35		35

ND: No data available.

Ns: Non specified.

ES.4.2 Yellow eel

There is not information available for Spain except from Albufera and Marjal Pego-Oliva in C. Valenciana (Table 11). However, this information has not been provided this year, so the corresponding table could not be updated.

ES.4.3 Silver eel

See Section 4.2 above.

ES.4.4 Marine fishery

No data available.

ES.5 Fishing effort

ES.5.1 Glass eel

In the Basque Country, the total number of hours dedicated to glass eel fishing has decreased from preceding fishing seasons (Table 10). As a consequence of the EMP, some of the measures proposed have been already implemented in the Basque Country; for instance, the shortening of the season: before it lasted since the new moon of

October until the new moon of March and now it starts on the 15th November and finishes 31st January. Thus, this reduction in fishing hours was expected, although it is still higher than in the 2008–2009 season. This increase in hours might be caused by the low catches of the 2008–2009 season, which discouraged fishermen for going fishing.

In Asturias both the total days dedicated to fish and the days each fisherman dedicates to fishing have decreased since the preceding season 2008/2009. In the latter season, the time each boat fisherman dedicated to fishing has decreased considerably compared to the decrease experienced by the land fisherman (Table 10).

Table 10. Number of hours (Basque Country) and days (Asturias, C. Valenciana and Catalonia) dedicated to glass eels fishing during the last three fishing season.

			2008–2009				2009–2010				2010–2011			
	RBD	RB	Boat	Land	Ns	Total	Boat	Land	Ns	Total	Boat	Land	Ns	Total
Basque C.	B. Inner	Barbadun		166	0	166								
		Nervion Ibaizabal		941	11	952		1379		1379		945		945
		Butron	39	326	21	387	22	1015		1036	49	1005		1054
		Oka		28		28		26		26		35		35
		Lea		5	19	24		202		202		67		67
		Artibai		2		2		12		12		31		31
		Deba		828	83	911		1820		1820		1404		1404
		Urola	329	41		371	637	146		783	287	50		337
		Oria	540	629	20	1190	1235	737		1973	881	679		1560
		Bidasoa		6		6								
		Total	909	2973	153	4036	1894	5337	0	7231	1217	4227		5444
Asturias	Cantábrico	Nalón	588	393		981					963	690		1653
		Others										1857		
C.Valenciana	Júcar	Albufera		200				105				137		

Ns: Non specified.

ES.5.2 Yellow eel

Data for yellow and silver eel in Marjal Pego-Oliva (C. Valenciana, Jucar RBD) fishing is given in Table 11. No information available for the rest of Spain.

Table 11. Number yellow and silver eel fishing days in Marjal Pego-Oliva during the 1998–2011 period.

YEAR	MARJAL PEGO-OLIVA FISHING DAYS
1998	53
1999	55
2000	23
2001	26
2002	42
2003	73
2004	33
2005	39
2006	44
2007	46
2008	82
2009	57
2010	34
2011	44

ES.5.3 Silver eel

See Section 5.2 above.

ES.5.4 Marine fishery

No data available.

ES.6 Catches and landings

ES.6.1 Glass eel

Glass eel catches continue to be in a very low level. In all the regions glass eel catches decreased during the last fishing season (2010–2011), except in the C. Valenciana, where landings have increased slightly. There catches are still higher that the 2008–2009 season catches, which were the lowest in the time-series.

Table 12. Glass eel catches (in kg) during the last three fishing seasons.

			2008–2009				2009–2010				2010–2011			
	RBD	RB	Boat	Land	Ns	Total	Boat	Land	Ns	Total	Boat	Land	Ns	Total
Basque C.	B. Inner	Barbadun		9		9		0.1		0.1				
		Nervion Ibaizabal		71		71		104		104		85		85
		Butron	0.3	10	1	11	0.6	49		50	1	51		52
		Oka		3		3		2		2		3		3
		Lea		1	0.1	1		13		13		4		4
		Artibai		0.8		0.8						1		1
		Deba		24	6	29		162		161		75		75
		Urola		0.4		9	61	5		66	15	2		17
		Oria	8	24	1	72	190	26		216	112	27		139
		Bidasoa	46	0.1		0.1								
		Total		142	8	205	252	362		613	128	248		376
Asturias	Cantábrico	Nalón	213.1	152.6		365.7				1562	815	416		1231
		Others		383.5		383.5				1050		823		
		Total				749.2				2612	815	1239		2054
C.Valenciana	Júcar	Albufera		78.3		78.3		125		125		211		211
		Others		38.2		38.2		41.31		41.31		30.46		30.46
		Total		116.5		116.5		166.76		166.76		276.37		276.37
Cataluña	Ebro	Ebro		1511		1511		1536		1536		1426		1426
	C. Inner	Muga, Fluviá, Ter Daró		86.7		86.7		131		131		102		102
		Total		1597.7		1597.7		1667		1667		1528		1528

Ns: Non specified.

ES.6.2 Yellow eel

Catches of yellow and silver eel decreased in Galicia and Albufera but remained almost the same in the rest of the C. Valenciana (Table 13).

Table 13. Yellow and silver eel catches (in tonnes) during the last three fishing seasons.

Area	RBD	River Basin	2009	2010	2011	Data source
Galicia	G. Coast	Ferrol	2.0	2.7*	0.7	Auctions
		Eo	1.6		0.008	Auctions
		Vigo	33	20*	8.7	Auctions
		Pontevedra	0.01			Auctions
		Arousa	8.1	5.6*	1.4	Auctions
		Total	28*	11		Auctions
C. Valeciana	Júcar	Albufera	6.4	4.8	4.3	Catches report
		Marjal Pego-Oliva	1.1	1.4	0.46	Catches report
	Segura	El Hondo		0.4	0.8	Catches report
		Salinas de Santa Pola	2.7	3.2	1.9	Catches report
		Total	10.2	10	7.5	Catches report
Catalonia	Ebro	Ebro	22.6	12	19	Auctions

*** These data have been corrected and have changed from the last year report.**

See also Section 3.2 above.

ES.6.3 Silver eel

See Section 6.2 above.

See also Section 3.3 above.

ES.6.4 Marine fishery

No data available.

ES.7 Catch per unit of effort

ES.7.1 Glass eel

Cpues have increased on average in both Basque Country and C. Valenciana autonomous regions (Table 14).

Table 14. Glass eel cpues during the last three fishing seasons.

			2008-2009				2009-2010				2010-2011			
	RBD	RB	Boat	Land	Ns	Total	Boat	Land	Ns	Total	Boat	Land	Ns	Total
Basque C. *	B. Inner	Barbadun		0.057		0.057								
		Nervion Ibaizabal		0.052	0.000	0.050		0.062		0.062		0.086		0.086
		Butron	0.005	0.032	0.013	0.027	0.021	0.041		0.040	0.025	0.043		0.042
		Oka		0.104		0.104		0.066		0.066		0.079		0.079
		Lea		0.000	0.003	0.002		0.073		0.073		0.055		0.055
		Artibai		0.001		0.001		0.060		0.060		0.035		0.035
		Deba		0.021	0.039	0.023		0.090		0.090		0.055		0.055
		Urola	0.018	0.009		0.016	0.091	0.046		0.080	0.043	0.039		0.042
		Oria	0.081	0.023	0.038	0.047	0.134	0.030		0.084	0.109	0.038		0.070
		Bidasoa		0.017		0.017								
		Total	0.052	0.034	0.023	0.037	0.115	0.062		0.074	0.085	0.055		0.061
Asturias**	Cantábrico	Nalón	0.36	0.46		0.75					0.84	0.6		1.44
C. Valenciana**	Júcar	Albufera				0.39				1.2				1.4

The historical records of the glass eel cpues in the Albufera, measured as glass eel catches per fishing day, demonstrate that the number of glass eel arriving to the Albufera has decreased since 1982 (Figure 6).

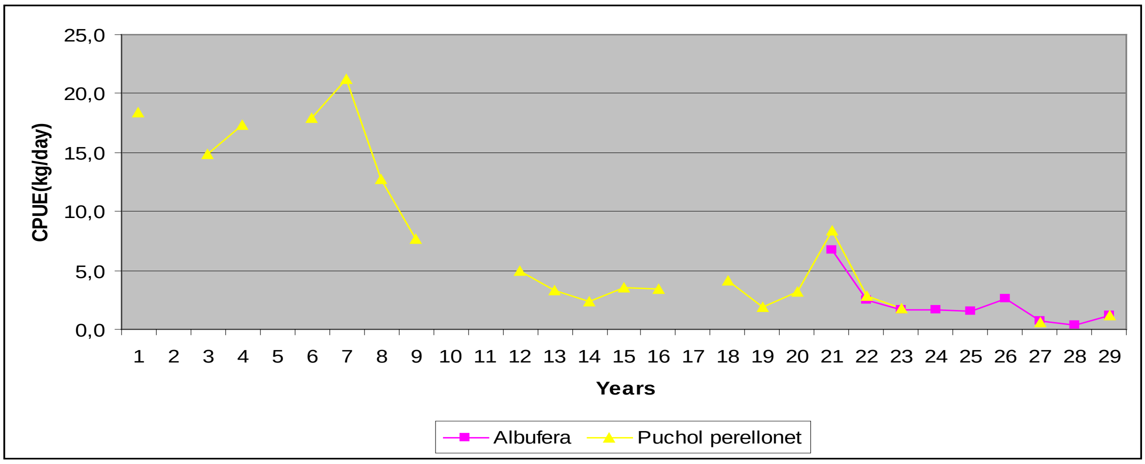

Figure 6. Time-trends in cpues of glass eels in Pujol and Perellonet fishing points (Albufera) since 1982 and the whole Albufera from 2002 on.

Additionally, the government of C.Valenciana has recorded information of the catches obtained for each fixed fishing point and day since 1999 as detailed in Table 16.

Table 15. Temporal trends in catches of glass eel per fishing place and day in C. Valenciana

	ALBUFERA	REST OF VALENCIA
1999		0.026
2000		0.303
2001		0.222
2002	0.222	0.306
2003	0.176	0.251
2004	0.126	0.184
2005	0.086	0.268
2006	0.196	0.288
2007	0.137	0.182
2008	0.039	0.134
2009	0.039	0.110
2010	0.078	0.196
2011	0.104	0.150

ES.7.2 Yellow eel

Only catches from Marjal Pego-Oliva in C. Valenciana are split up between yellow and silver eel (Table 16).

Table. 16. Catches of yellow and silver eel per day of fishing in Marjal Pego-Oliva.

	FISHING DAYS	KG/FISHING DAY	KG/FISHING DAY/FISHING PLACE
1998	53	22.7	7.6
1999	55	19.5	6.5
2000	23	21.7	7.2
2001	26	33.4	11.1
2002	42	19.5	6.5
2003	73	26.2	8.7
2004	33	31.5	10.5
2005	39	49.3	16.4
2006	44	31.1	10.4
2007	46	25.3	8.4
2008	82	17.2	5.7
2009	57	18.9	6.3
2010	34	40.4	13.5
2011	44	30.9	10.3

ES.7.3 Silver eel

See Section 7.2 above.

ES.7.4 Marine fishery

No data available.

ES.8 Other anthropogenic impacts

Major impacts are described in the Spanish EMP but no quantitative data are available.

ES.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 recruitment and potential escapement are monitored in a yearly basis in the Oria river. Some punctual studies have been done by Spanish researches; however a need of collaborative studies to exchange knowledge and methodologies has been constantly detected. Some autonomous regions had promoted punctual studies too, but these data are not gathered anywhere. However, the autonomous regions envisage making silvering eel specific surveys in their management plans.

ES.9.1 Recruitment surveys, glass eel

Glass eel recruitment in the Oria river is sampled in a yearly basis.

ES.9.2 Stock survey, yellow eel

All the autonomous regions make periodic multi specific 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 envisage 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.

ES.9.3 Stock survey, silver eel

The Basque management plan, will determine the spawning potential according to Durif *et al*. (2003; 2005) in the different basins every five years. The spawning potential has already been determined in the Deba and Oria rivers since 2007.

Some of the autonomous regions envisage making silvering eel specific surveys in their management plans.

ES.10 Catch composition by age and length

Until 2011, the DCF was not applied for eel in Spain, and in that year only glass eel catches from the Basque Country (recreational) were reported. Some of the autonomous regions, have measured age and length punctually

ES.10.1 Reported by subcatchment, catchment or EMU

No data available.

ES.11 Other biological sampling

Biological parameters are not sampled routinely in the autonomous regions, although the autonomous regions envisage sampling them in their management plans.

In this respect, Spain made a proposal within DCF to develop a pilot study to analyse the data recovered by the different autonomous regions, and to propose a national sampling protocol in order to comply with the DCF. However, this proposal is still waiting to be approved.

ES.11.1 Length and weight and growth (DCF)

No data recorded for the DCF or any other programme. Murcia made a study to analyse length and age in the catches from the Mar Menor. In Galicia, catches length is monitored yearly. In Valencia, one hundred and twenty European eel females were captured in their reproductive migration from the Albufera Lagoon. Otoliths were extracted and processed, and fish age was determined by counting annual otolith rings (annuli). Mean age of the females was 9.09±0.17 years. This kind of results must be considered for the establishment of management plans of this species.

ES.11.2 Parasites and pathogens

No data recorded for the DCF or any other programme. However, the autonomous regions envisage sampling them in their management plans.

There are some research studies regarding the subject. New data were reported on parasites and pathogens in Spanish Mediterranean basins and Asturias. These studies reported detailed data on life stages L3 and L4, pre-adult and adult stages, but here the data are presented as total load of parasites in individual eels for studies in Mediterranean region and pre-adult and adult stages for Asturias rivers (Table 17).

There is a new study in the Mar Menor Lagoon (Murcia) where the prevalence of *A.crassus* has been analysed in 2010 and 2011, resulting in a very low prevalence of this parasite (2.3% in 168 eels analysed). At the same time, toxicological analysis has been carried out (Pb, Cd, Ar, Hg; see below in Section 11.3) since 2009. In addition to that information, a new peer document has been published this year (Martinez-Carrasco *et al*., 2011) where a total of 109 eels were collected between November 2008 and March 2009 and adult worms were recovered from the swimbladders of infected eels. The detected prevalence in this case was 7.34%.

Table 17. Prevalence, infection intensity and abundance of parasites in different basins from Spain.

RIVER/LAKE		N EELS	YEAR	MEAN WEIGHT (G)	MEAN SIZE(CM)	STAGE	PREVALENCE	MEAN INFECTION INTENSITY	MEAN ABUNDANCE		REFERENCE
Valencia	Albufera	*A. crassus*	2008	121	67.73	25,0	Y	34,7	2,7	1,5	Esteve 2010 pers comm.
Valencia	Albufera	*A. crassus*	2008	10	474.64	57,0	S	40	4	2,5	Esteve 2010 pers comm.
Valencia	Albufera	*A. crassus*	2009	60	74.04			82	2.5	10.52	Muñoz *et al*., 2009
Valencia	Albufera	*Myxidium giardi*	2009	60	74.04			1.78	1		Muñoz *et al*., 2009
Valencia	Albufera	*Eimeeria anguillae*	2009	60	74.04			5.35	ND		Muñoz *et al*., 2009
Valencia	Albufera	*Deropristis inflata*	2009	60	74.04						Muñoz *et al*., 2009
Valencia	Albufera	*Bucephalus anguillae*	2009	60	74.04			1.78	1		Muñoz *et al*., 2009
Valencia	Albufera	*Bothriocephalus spp.*	2009	60	74.04			7.14	1		Muñoz *et al*., 2009
Valencia	Albufera	*Proteocephalus spp.*	2009	60	74.04			3.6	1		Muñoz *et al*., 2009
Murcia	Mar menor	*A. crassus*	2009	109	23.79			3.7	1	3.97	Muñoz *et al*., 2009
Murcia	Mar menor	*Myxidium giardi*	2009	109	23.79						Muñoz *et al*., 2009
Murcia	Mar menor	*Eimeeria anguillae*	2009	109	23.79						Muñoz *et al*., 2009
Murcia	Mar menor	*Deropristis inflata*	2009	109	23.79			3.78	ND		Muñoz *et al*., 2009
Murcia	Mar menor	*Bucephalus anguillae*	2009	109	23.79			42.86	17.92		Muñoz *et al*., 2009

RIVER/LAKE		N EELS	YEAR	MEAN WEIGHT (G)	MEAN SIZE(CM)	STAGE	PREVALENCE	MEAN INFECTION INTENSITY	MEAN ABUNDANCE		REFERENCE
Murcia	Mar menor	*Bothriocephalus spp.*	2009	109	23.79						Muñoz *et al*., 2009
Murcia	Mar menor	*Proteocephalus spp.*	2009	109	23.79						Muñoz *et al*., 2009
Asturias	Estuary	*A. crassus*	2006–2007	162	12.3	16.9		31.6	1.9	0.7	Costa-Dias *et al*., 2010
Asturias	Choudral	*A. crassus*	2006–2007	149	15	19.7		44.6	2	0.9	Costa-Dias *et al*., 2010
Asturias	Chanona	*A. crassus*	2006–2007	130	18.4	21		33.3	1.7	0.6	Costa-Dias *et al*., 2010
Asturias	Viella	*A. crassus*	2006–2007	139	26.1	23.4		0.8	1		Costa-Dias *et al*., 2010
Murcia	Mar Menor	*A.crassus*	2008–2009	109				7.34	5		Martínez-Carrasco *et al*., 2011

ND: No data available.

The prevalence of other infectious diseases has been reported for the Albufera lake in El Palmar (C. Valenciana) (Bandin, pers comm. 2010; Esteve and Alcaide, 2010; Muñoz *et al*., 2009.) and in the Mar Menor Lagoon (Muñoz *et al*., 2009) (Table 18).

Table 18. Prevalence of infectious diseases in Albufera lake.

River/Lake	Year	N eels	Eel size (cm)	Max	Min	Eel Stage	Edwardsiella septicaemia (%)	Vibriosis septicaemia (%)	Aeromonas septicaemia (%)	Herpesviru s anguillae (HVA)- PCR detection (%)	Skin injury (%)
Albufera lake	2003/2004/2005	45	25.0	34.0	29.6	Y	6.7	35.6	8.9		2.2
Albufera lake	2003/2004/2005	46	35.0	46.0	39.7	Y	10.9	6.5	10.9		17.4
Albufera lake	2003/2004/2005	31	49.0	75.0	56.7	S	3.2	12.9	22.6		22.6
Albufera lake	2008	121	25	48	34.3	Y	13.20	7.40	19.80	53.8	12,4
Albufera lake	2008	10	57	74	61.2	S	0	10	10		20
Albufera lake	2009	60	74.04				9,3	1.1.	1.85		ND
Mar Menor	2009	109	23.79				5.5	7.5	0		ND

ND: No data available.

In a study on the *Edwardsiella tarda* reservoirs in Albufera lake, as well as Edwardsiellosis distribution on eels regarding of water physico-chemical parameters, the bacteria was recovered only from the 7,41% water samples and its isolation was related with a high water temperature >20ºC. In addition, percentages of *E.tarda*-positive fish (40–84%) during the warm period (water temperature >20ºC) were also significantly high in comparison with those detected during the cold period (<7.4%). Moreover this 2008 study again remarks that Edwardsiellosis disease is more prevalent in younger eels (25–48 cm) than in silver ones (Table 18).

ES.11.3 Contaminants

In 2009 a programme has been developed for toxicological analysis in Mar Menor lagoon for the first time. In 2010 mercury, plumb, cadmium and arsenic levels obtained where below the maximum limit for toxic waste indicated in Regulation 1881/2006. Liver, kidney and muscles of 16 of these individuals have been analysed, been the total concentration of metals below the maximum toxic residuals level in all the cases.

Table 19. Toxic residuals levels found in the individuals analysed in 2010 in the Mar Menor Lagoon.

	Pb	Cd	As	Hg
Liver	3.02	0.17	2.39	0.01
Kidney	8.92	0.69	1.13	0.1
Muscle	Only three individuals with a significant level (average value around 0.2)	Non-significant levels for all the individuals analysed.	2.06	0.01

ES.11.4 Predators

Several mink individuals were captured in Catalonia inside the stocking areas in order to keep restocked eels save from their predators.

ES.12 Other sampling

No data available.

ES.13 Stock assessment

ES.13.1 Local stock assessment

There is not 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.

ES.13.2 International stock assessment

The following sections are drawn from the National Eel Management Report to the EU which accompanied the EMPs. It provides data thought to be useful for international stock assessment, including habitat and silver eel production data.

ES.13.2.1 Habitat

Wetted area: lacustrine

riverine

transitional & lagoon

coastal

The Spanish EMP includes a series of calculations to define the pristine habitat and escapement, and to compare it with the current situation. 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) to begin the second phase with more accurate estimates. 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 1st 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 1st 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.

ES.13.2.2 Silver eel production

ES.13.2.2.1 Historic production

B_0, the biomass of the silver eel escapement in the pristine state. (SGIPEE) = to pristine silver eel production.

For the internal basins (without EMP in the 1st phase, see Section 2.3) an average pristine productivity of 20 kg/Ha has been assumed in the inland water areas and 50 kg/Ha in transitional waters (ICES 2001). The autonomous communities with EMP in the 1st phase have taken a different approach, based on the information available that best matches their specific environmental and ecological conditions (Table 20). A more detailed explanation might be find is the EMP of each EMU.

Table 20. Historic production, productivity and escapement of the EMUs according to the Spanish EMP.

EMU	Region	RBD	Habitat	Pristine productivity (kg/Ha)	Determination methodology	Pristine wetted area (Ha)	Pristine Escapement (kg)
Galicia	A	GC	F	30	Study	2905.8	87174.0
Galicia	A	GC	C	30	Study	1436.1	43083.0
Galicia	A					4341.9	130257.0
Asturias	A	CHC	F	20	ICES 2001	37.2	744.0
Asturias	A	CHC	F	20	ICES 2001	163.6	3272.2
Asturias	A	CHC	F	20	ICES 2001	87.2	1743.4
Asturias	A	CHC	F	20	ICES 2001	153.4	3067.6
Asturias	A	CHC	F	20	ICES 2001	21.7	434.4
Asturias	A	CHC	F	20	ICES 2001	1181.5	23629.6
Asturias	A	CHC	F	20	ICES 2001	308.4	6167.0
Asturias	A	CHC	F	20	ICES 2001	21.8	435.4
Asturias	A	CHC	F	20	ICES 2001	298.3	5965.8
Asturias	A	CHC	F	20	ICES 2001	33.6	672.8
Asturias	A					2306.6	46132.2
Cantabria	A	CHC	F	20	ICES 2001	286.0	5720.0
Cantabria	A	CHC	F	20	ICES 2001	176.0	3520.0
Cantabria	A	CHC	F	20	ICES 2001	48.0	960.0
Cantabria	A	CHC	F	20	ICES 2001	388.0	7760.0
Cantabria	A	CHC	F	20	ICES 2001	324.0	6480.0
Cantabria	A	CHC	F	20	ICES 2001	164.0	3280.0
Cantabria	A	CHC	F	20	ICES 2001	36.0	720.0
Cantabria	A	CHC	F	20	ICES 2001	318.0	6360.0
Cantabria	A	CHC	F	20	ICES 2001	196.0	3920.0
Cantabria	A					1936.0	38720.0
País Vasco	A	CIPV	F	20	ICES 2001	32.7	653.2
País Vasco	A	CIPV/CHC	F	20	ICES 2001	554.8	11095.6
País Vasco	A	CIPV	F	20	ICES 2001	44.9	897.6
País Vasco	A	CIPV	F	20	ICES 2001	20.5	410.2
País Vasco	A	CIPV	F	20	ICES 2001	21.5	430.6
País Vasco	A	CIPV	F	20	ICES 2001	26.0	520.0
País Vasco	A	CIPV	F	20	ICES 2001	152.2	3043.8

EMU	Region	RBD	Habitat	Pristine productivity (kg/ha)	Determination methodology	Pristine wetted area (ha)	Pristine Escapement (kg)
País Vasco	A	CIPV	F	20	ICES2000	111.4	2228.8
País Vasco	A	CIPV/CHC	F	20	ICES 2001	339.3	6785.5
País Vasco	A	CIPV/CHC	F	20	ICES 2001	107.6	2152.2
País Vasco	A	CIPV	F	20	ICES 2001	22.7	454.1
País Vasco	A					1433.6	28671.6
Catalunya	M	CHE	F + CL	20/77.8	Study/ PGA Islas Baleares	29531.6	643229.2
Catalunya	M	CIC	F	20	ICES 2010	1158.5	23170.0
Catalunya	M	CIC	F	20	ICES 2010	1048.5	20970.0
Catalunya	M	CIC	F	20	ICES 2010	5945.5	118910.0
Catalunya	M	CIC	F	20	ICES 2010	371.5	7430.0
Catalunya	M	CIC	F	20	ICES 2010	534.5	10690.0
Catalunya	M	CIC	F	20	ICES 2010	832.5	16650.0
Catalunya	M	CIC	F	20	ICES 2010	122.0	2440.0
Catalunya	M	CIC	F	20	ICES 2010	123.0	2460.0
Catalunya	M	CIC	F	20	ICES 2010	640.5	12810.0
Catalunya	M					40308.1	858759.2
Valencia	M	CHJ	F	20	ICES 2010	12499.0	249979.0
Valencia	M	CHJ	F				
Valencia	M	CHJ	T	80		1456.7	116539.0
Valencia	M	CHJ	CL	77.8	IB	4261.0	331508.0
Valencia	M					18216.8	698026.0
Castilla-La Mancha			F	20	ICES 2010	576.1	11522.0
Murcia	M	CHS	F	20	ICES 2010	218.6	4371.0
Murcia	M	CHS	HL	1.62	cpue	13518.5	21900.0
Murcia	M					13737.1	26271.0
Illes Balears	M		CL	77.8	cpue	4253.0	330883.4
Andalucía	A	CHG	FW	20	ICES 2001	151414.0	3028280.0
Andalucía	A	CAA	F	20	ICES 2001	30681.0	613620.0
Andalucía	M	CMA	F	20	ICES 2010	4662.0	93240.0
Andalucía	A/M					186757.0	3735140.0
EMPs in the 2nd phase	A/M		F			66868.00	1337355.00
EMPs in the 2nd phase	A/M		T			21657.00	1082850.00

EMU	Region	RBD	Habitat	Pristine productivity (kg/ha)	Determination methodology	Pristine wetted area (ha)	Pristine Escapement (kg)
TOTAL ESPAÑA						362 391.1	8 324 587.4

A = Atlantic Ocean; M = Mediterranean; CIPV = Cuencas Internas del País Vasco; CHC = Cuenca Hidrográfica del Cantábrico; CHE = Cuenca Hidrográfica del Ebro; CIC = Cuencas internas Catalunya; IB = Illes Balears; CHS = Cuenca Hidrográficadel Segura; CHG = Cuenca Hidrográfica del Guadalquivir; CAA = Cuencas Atlánticas de Andalucía; CMA = Cuencas Mediterráneas de Andalucía; CHJ = Cuenca Hidrográfica del Jucar; GC = Galicia Costa; F = Fluvial; T = Transitional; CL = Coastal lagoons; Study = the calculus have been made with studies carried out in the area; cpue = the decrease in the population is the same as that of the cpues in the area; IB = Reference from the Balearic Islands has been used.

ES.13.2.2.2 Current production

B_{best} is the estimated biomass in the assessment year, based on the recently observed recruitment, but assuming no anthropogenic impacts have occurred (neither positive nor negative impacts) (SGIPEE). It is not possible to report these data since anthropogenic mortality has not been quantified in Spain. B_{pre} is the biomass of the escapement in the assessment year (SGIPEE) before management actions were applied (2008). In the case of the Spanish EMU, this will correspond to the escapement in 2009, which is reported in Table 21.

Regarding productivity, some of the autonomous regions have their own studies which have been used to determine it (Table 21). More detailed information of the methodology can be found in their management plans. The autonomous regions that did not have their own studies have used the values obtained in other RBs with similar characteristics. The current production in the internal basins (without EMP in the 1st phase) is 0, since this habitat is not available nowadays for eel.

Table 21. Current production, productivity and escapement of the EMUs according to the Spanish EMP.

EMU	Region	RBD	Habitat	Current wetted area (ha)	Current productivity (kg/ha)	Determination methodology	Current escapement (kg)
Galicia	A	GC	F	1656.1	3.0	Study	4885.5
Galicia	A	GC	C	1436.1	3.0	Study	4236.5
Galicia	A			3092.2			9122.0
Asturias	A	CHC	F	32.4	14.0	Oria	453.8
Asturias	A	CHC	F	159.8	14.0	Oria	2235.0
Asturias	A	CHC	F	78.3	14.0	Oria	1095.0
Asturias	A	CHC	F	132.2	14.0	Oria	1848.9
Asturias	A	CHC	F	16.5	14.0	Oria	231.4
Asturias	A	CHC	F	802.5	6.2	Deba	4935.5
Asturias	A	CHC	F	63.8	14.0	Oria	891.9

EMU	Region	RBD	Habitat	Current wetted area (Ha)	Current productivity (kg/Ha)	Determination methodology	Current escapement (kg)
Asturias	A	CHC	F	26.7	14.0	Oria	304.0
Asturias	A	CHC	F	289.3	14.0	Oria	4047.2
Asturias	A	CHC	F	33.6	14.0	Oria	470.6
Asturias	A			1635.1			16513.3
Cantabria	A	CHC	F	62.0	14.0	Oria/Deba	868.0
Cantabria	A	CHC	F	35.0	10.1	Oria/Deba	352.5
Cantabria	A	CHC	F	24.0	10.1	Oria/Deba	241.7
Cantabria	A	CHC	F	216.0	10.1	Oria/Deba	2175.1
Cantabria	A	CHC	F	102.0	10.1	Oria/Deba	1027.1
Cantabria	A	CHC	F	44.0	10.1	Oria/Deba	443.1
Cantabria	A	CHC	F	21.6	10.1	Oria/Deba	217.5
Cantabria	A	CHC	F	70.0	10.1	Oria/Deba	704.9
Cantabria	A	CHC	F	40.0	10.1	Oria/Deba	402.8
Cantabria	A			614.6			6432.7
País Vasco	A	CIPV	F	32.7	14.0	Oria	456.9
País Vasco	A	CIPV/CHC	F	554.8	5.0	Study	2773.9
País Vasco	A	CIPV	F	44.9	14.0	Oria	627.9
País Vasco	A	CIPV	F	20.5	14.0	Oria	286.9
País Vasco	A	CIPV	F	21.5	14.0	Oria	301.2
País Vasco	A	CIPV	F	26.0	14.0	Oria	363.7
País Vasco	A	CIPV	F	147.2	6.2	Study	905.3
País Vasco	A	CIPV	F	103.6	10.1	Oria/Deba	1043.0
País Vasco	A	CIPV/CHC	F	304.1	14.0	Study	4254.8
País Vasco	A	CIPV/CHC	F	96.6	10.1	Oria/Deba	972.6
País Vasco	A	CIPV	F	22.7	10.1	Oria/Deba	228.6
País Vasco	A			1374.6			12214.9
Catalunya	M	CHE	F + CL	1490.0	14.9/51.9	Study/Cardona *et al*., 2005	47213.0
Catalunya	M	CIC	F	17.5	15.2	Study	265.7
Catalunya	M	CIC	F	2.8	2.6	Study	7.4
Catalunya	M	CIC	F	23.5	0.8	Study	19.6
Catalunya	M	CIC	F	5.5	5.6	Study	30.8
Catalunya	M	CIC	F	14.5	65.1	Study	943.3
Catalunya	M	CIC	F	32.0	39.8	Study	1274.8
Catalunya	M	CIC	F	16.5	8.3	Study	137.6
Catalunya	M	CIC	F	23.0	11.6	Study	266.1
Catalunya	M	CIC	F	35.0	7.5	Study	261.9
Catalunya	M			1660.3			50420.1
Valencia	M	CHJ	F	11587.2	0.0		0.0
Valencia	M	CHJ	F	911.8	33.8	Rhone	30773.0

EMU	Region	RBD	Habitat	Current wetted area (ha)	Current productivity (kg/ha)	Determination methodology	Current escapement (kg)
Valencia	M	CHJ	T	1456.7	78.8	Rhone	114719.0
Valencia	M	CHJ	CL	4261.0	56.3	Rhone	239683.0
Valencia	M			18216.7			385175.0
Castilla-La Mancha	M		F	0.0	0.0		0.0
Murcia	M	CHS	F	218.6	0.0		0.0
Murcia	M	CHS	HL	13500.0	0.8	Study	11170.0
Murcia	M			13718.6			11170.0
Illes Balears	M		CL	4253.0	51.9	Cardona et al., 2005	216540.0
Andalucía	A	CHG	F+ T	38415.0	15.0	Study	282350.0
Andalucía	A	CAA	F	19514.0	15.0	Study	292710.0
Andalucía	M	CMA	F	3406.0	15.0	Study	51090.0
Andalucía	A/M			61335.0			626150.0
EMPs in the 2nd phase	A/M		F	0.0	0.0		0.0
EMPs in the 2nd phase	A/M		T	0.0	0.0		
TOTAL ESPAÑA				105 900.0			1 333 738.0

A = Atlantic Ocean
M = Mediterranean
CIPV = Cuencas Internas del PaísVasco
CHC = Cuenca Hidrográfica del Cantábrico
CHE = Cuenca Hidrográfica del Ebro
CIC = Cuencas internas Catalunya
IB = Illes Balears
CHS = Cuenca Hidrográficadel Segura
CHG = Cuenca Hidrográfica del Guadalquivir
CAA = Cuencas Atlánticas de Andalucía
CMA = Cuencas Mediterráneas de Andalucía
CHJ = Cuenca Hidrográfica del Jucar
GC = Galicia Costa
F = Fluvial
T = Transitional
CL = Coastal lagoons
Study = the calculus have been made with studies carried out in the area
cpue = the decrease in the population is the same as that of the cpues in the area
IB = Reference from the Balearic Islands has been used
Oria = The current productivity in the Oria has been applied
Deba = The current productivity in the Oria has been applied
Oria/Deba = The average productivity of Oria and Deba has been applied
Rhone = The current productivity in the Rhone has been applied

Source : Spanish Ministry of the Environment and Rural and Marine Affairs

ES.13.2.2.3 Current escapement

No data available.

ES.13.2.2.4 Production values e.g. kg/ha

No data available.

ES.13.2.2.5 Impacts

No data available.

ES.13.2.2.6 Stocking requirement eels <20 cm

In Catalonia, fishermen must give 5% of their catches for restocking. Following the regulation, a 45% of the average value of the total catches of the last three fishing seasons will be restocked.

In C. Valenciana both, glass eel and eel fishermen must give a percentage of their catches for stocking. Additionally, they will restock with individuals of all the sizes (and not only <20 cm as required by the regulation). In order to reach the percentages that should be destined to stocking according to the EU regulation, they will use EEUs (Equivalent Units of Eel). To calculate that, they will take into account the rate of survival in the farm of eels of different size as detailed in Table 22. In this way they have estimated that the 35% of catches of glass eel in 2009 will correspond to 369.238 EEU and the 60% in 2013 to 632.980 EEU.

Table 22. Survival rates, and equivalent units of eels used by the C. Valenciana EMP.

Weight (gr)	Survival rate	Eel equivalent units (EEU)	EEU/KG
0.3	1.000	1.000	3333.33
5.0	0.382	2.618	523.6
10.0	0.302	3.311	331.10
15.0	0.263	3.802	253.47
20.0	0.238	4.202	210.10
50.0	0.174	5.747	114.94
100.0	0.137	7.299	72.99
150.0	0.120	8.365	55.77
200.0	0.108	9.229	46.15
250.0	0.100	10.000	40.00
500.0	0.079	12.658	25.32

ES.13.2.2.7 Summary data on glass eel

Quantities caught in the commercial fishery
Exported to Asia
used in stocking
used in aquaculture for consumption
direct consumption
mortalities

ES.13.2.2.8 Data quality issues

ES.14 Sampling intensity and precision

As mentioned in previous section the DCF was not applied for eel until 2009, when only glass eel catches in the recreational glass eel fishery from the Basque Country were reported.

ES.15 Standardization and harmonization of methodology

Since there is not a national survey or sampling programme, standardization and harmonization have been not studied until now

ES.15.1 Survey techniques

ES.15.2 Sampling commercial catches

ES.15.3 Sampling

ES.15.4 Age analysis

ES.15.5 Life stages

ES.15.6 Sex determinations

ES.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, there is not any global study or sampling programme to compile information (fishery data, biological information etc.) in Spain in order to give a Spanish 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, River Basin Districts, and researchers. Also, in those river basin districts that extend over different autonomous regions, the different local administrations should make an effort to coordinate their work in the basin, both concerning management and research.

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Report on the eel stock and fishery in Sweden 2010/'11

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Reporting Period: This report was completed in August 2011, and contains data up to 2010 and some provisional data for 2011.

Data availability: All data presented in this Country Report have been made available in electronic format to the working group meeting.

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SE.2 Introduction

Most of the information presented in this introduction is based on the Eel Management Plan (EMP) Sweden delivered to the EU (COM) in 2008.

The Swedish EMP involves measures in four principal areas:

- Reduction of the fishery;
- Improved possibilities for downstream migration (reduced turbine mortality);
- Stocking of glass eel;
- Control.

SE.2.1 Quantification of the measures

The overall target for the national management plan (EMP) is that 90% of all silver eel that at present would have been produced in Swedish water without anthropogenic mortality shall survive and escape to contribute to reproduction. This shall be achieved by regulation of the fishery, reduction of turbine mortality and increased stocking of imported glass eel. The relative contribution of the different measures is shown in the following table (Table SE. 1). The sign indicates extraction (-) or addition (+) to the production without anthropogenic impact.

Table SE.1. Overview of the quantities of eel produced, and the management actions planned in the EMP.

	Silver eels (*1000)	Percent of production
Present natural production of silver eels in Sweden	2870	
Loss in the fishery before measures	-1470	-51%
Loss in hydro turbines before measures	-280	-10%
Addition from earlier stockings	+210	7%
Reduction of fishing due to regulation 2007	+390	14%
Continued regulation of fishery	+550	19%
Reduction of turbine mortality	+140	5%
Increased stocking	+185	6%
Net anthropogenic mortality after measures	-275	-10%

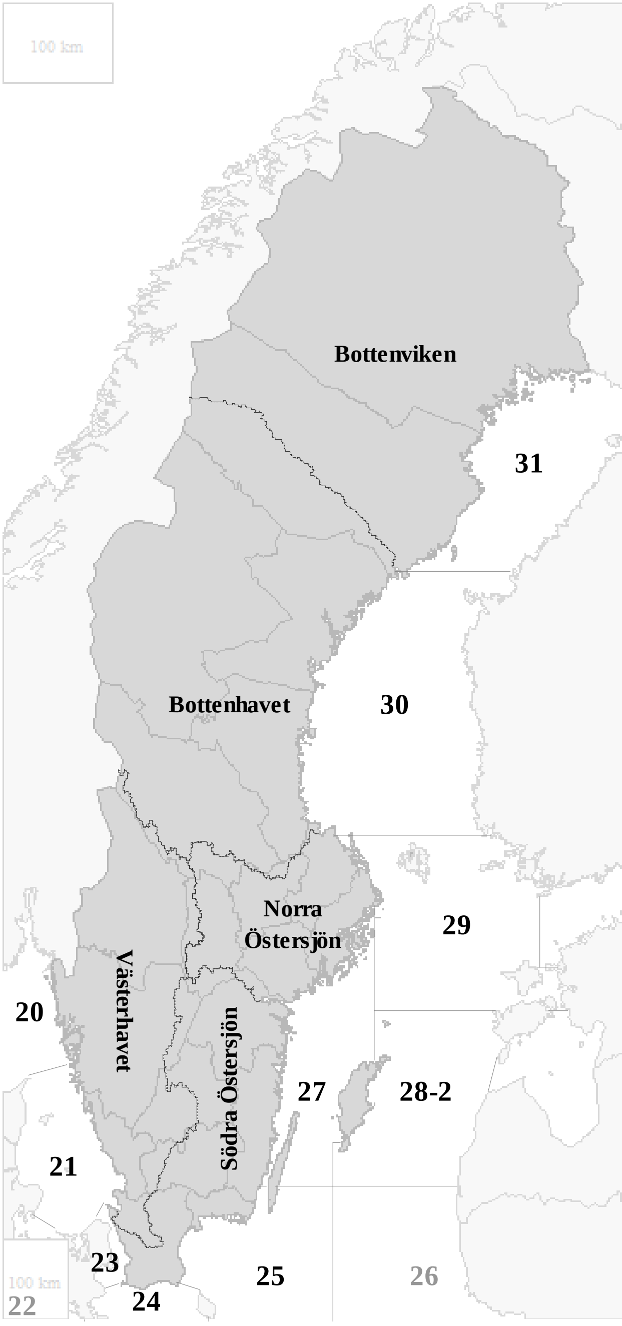


Figure SE.1. ICES subdivisions in coastal waters, and the River Basin Districts in inland waters. County borders are indicated in grey.

The eel fisheries in Sweden can be described as four different types. One is a fykenet fishery for yellow eels along the West Coast of Sweden, i.e. in RBD 5. In the southernmost parts of the country, the Öresund straits included, there is a traditional fishery heading for migrating silver eels only. That is in RBD 4. On the East Coast, i.e. in RBD 3 and 4 there is a combined fishery, heading mainly for silver eels, but also large yellow eels and other species are caught. In some 20 freshwater lakes, eels are caught in a similar combined poundnet fishery, catching not only eels but also other fish species as pike perch, perch, pike, etc.

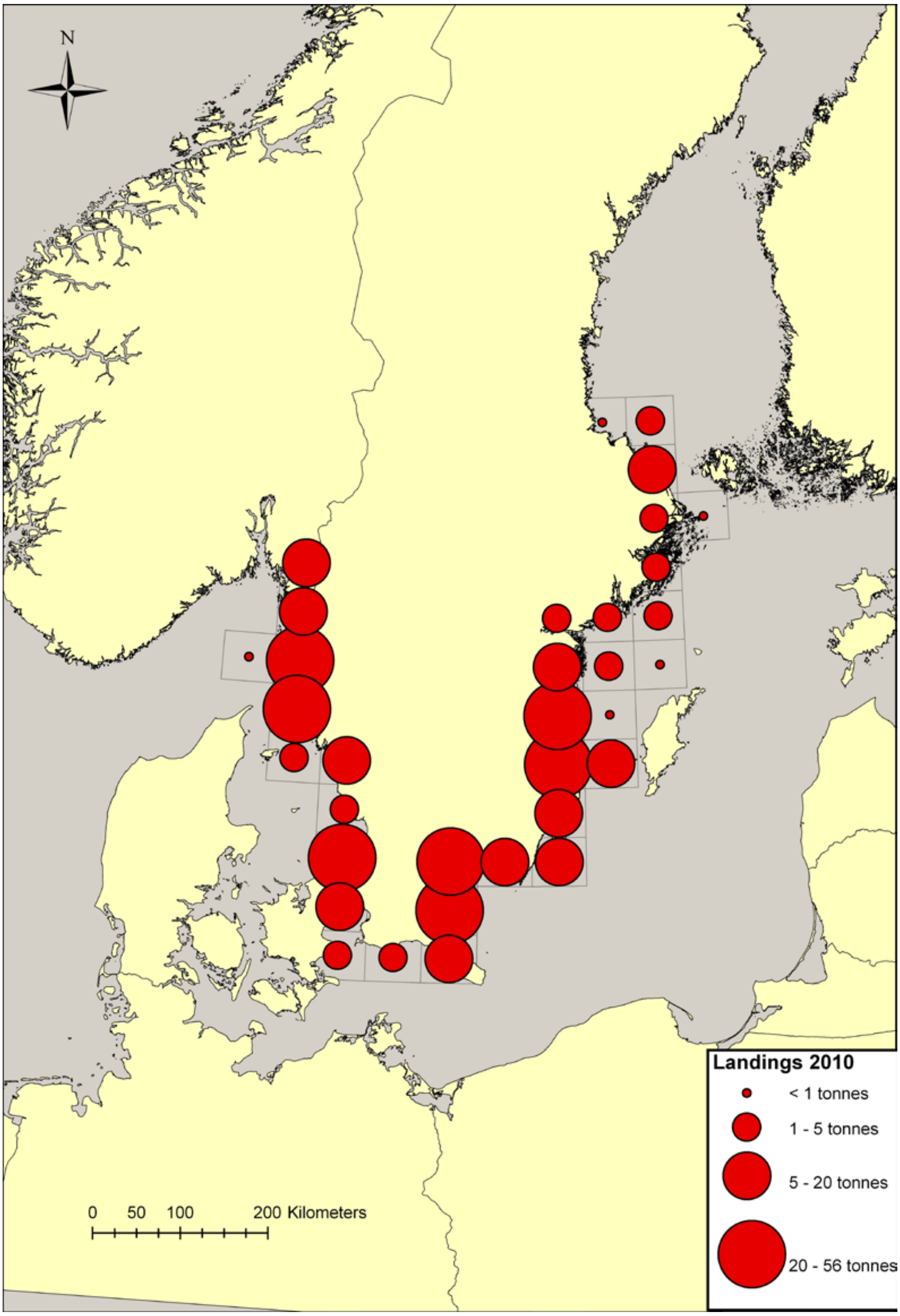


Figure SE.2. The commercial catch in coastal areas in 2010 expressed per ICES statistical rectangle. The sizes of the circles are proportional to the catch.

In 2007 eel fishing in general became prohibited, unless with a special permit. The issuing of licences was based upon landings during a reference period 2003–2005. Licences were given to fishermen that landed 400 kg eel yearly or who had significant income from eel fishery. Exemption from the 400 kg eel per year were given if the fishery was established during the reference period or if fishing had not been possible during the reference period.

In 2008 the legislations was revised so that only licence holders from 2007 could apply for a new eel fishing licence and the application contained information on number and types of gears and fishing area.

In 2009 fishing effort was limited in Kattegat and Skagerrak to between 1 of May and 14 of September and the fykenet fishery limited to 400 single or double fykes. In the Baltic Sea fishery was limited to the same time period or within a continuous 90 days period and in freshwater the fishery was limited to a 120 days continuous period. In 2009 the licence was given on a two year basis (2009/2010) such that the effect of the regulation could be evaluated when the eel management plan is evaluated.

In Kattegat south of the latitude 56°25′00 N (Kullaberg, the border between ICES Subdivision 21 and 23) the allowed fishing period for fixed gear (poundnets) as well as for mobile ones (as double fykes) has decreased to 60 days in 2011. Fishing for eel north of Kullaberg will be prohibited in 2012.

SE.3 Time-series data

SE.3.1 Recruitment-series and associated effort

SE.3.1.1 Glass eel

SE.3.1.1.1 Commercial

No data (no fishery allowed).

SE.3.1.1.2 Recreational

No data (no fishery allowed).

SE.3.1.1.3 Fishery-independent

The abundance of glass eels (truly unpigmented) in the open sea (Kattegat and Skagerrak) are surveyed by trawling with either an Isaacs–Kidd Midwater trawl (IKMT) or with a modified Methot–Isaacs–Kidd Midwater trawl (MIKT). The former trawl is used in a fixed position in the intake canal for cooling water to the condensers at the Ringhals Nuclear Power Station (e.g. Westerberg 1998 a & b). The latter method is used from RV Argos during ICES-International Young Fish Survey (Hagström and Wickström, 1990), (since 1993 called the International Bottom-trawl Survey (IBTS Quarter 1). When the glass eels have settled they and larger eels can be monitored on soft and shallow bottoms using a "Drop Trap" technique (Westerberg *et al.*, 1993; ICES 2009a). This was successfully done during a number of years, and an attempt is now made to restart these series, extending to several river mouths. This approach made it possible to roughly estimate the total recruitment of young eels to the Swedish coast.

From all three methods recruitment-series could be compiled and two of them are shown below:

Recruitment of glass eel (truly unpigmented) to the Swedish west coast is monitored at the intake of cooling water to the nuclear power plant at Ringhals in the Kattegat (Figure SE.3 and Table SE.2). The time of arrival of the glass eels to the sampling site varies between years, probably as a consequence of hydrographical conditions, but the peak in abundance normally occurred in late March to early April. Abundance has decreased by 96% if the recent three years are compared to the peak in 1981–1983.

The sampling at Ringhals is performed twice weekly in February–April, using a modified Isaacs–Kidd Midwater trawl (IKMT). The trawl is fixed in the current of incoming cooling water, fishing passively during entire nights. Sampling is depending on the operation of the power plant and changes in the strength of the current may occur.

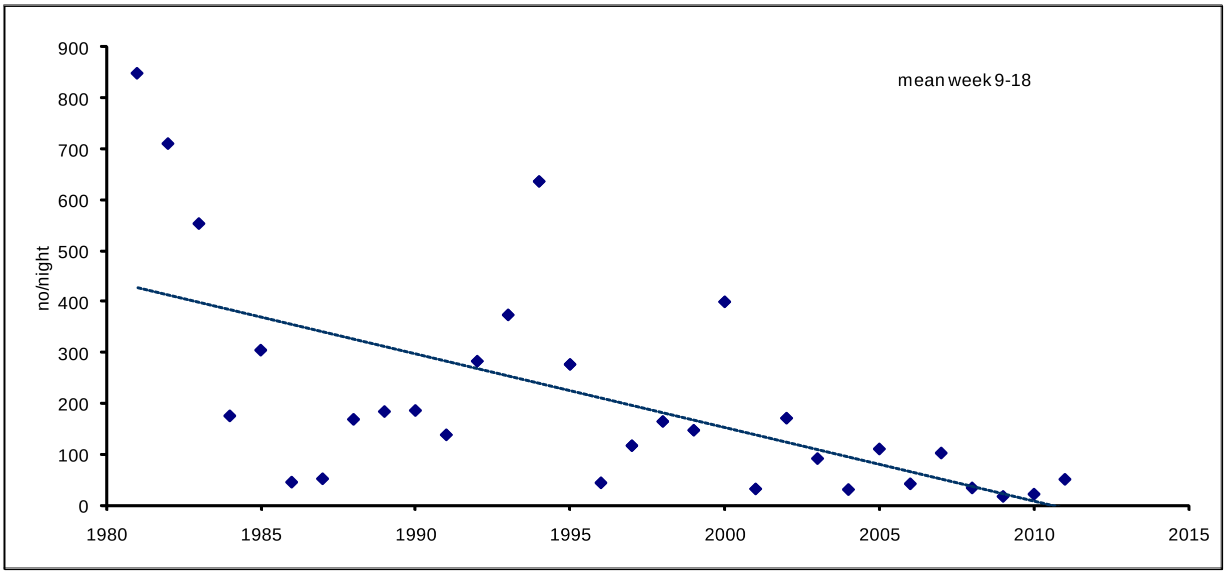


Figure SE.3. Time-trend in glass eel recruitment at the Ringhals nuclear power plant on the Swedish Kattegat Coast.

Table SE.2. Annual indices of glass eel recruitment at the intake canal for cooling water to reactors 1 and 2 at the Ringhals nuclear power plant. Weekly means (n/night) of numbers of glass eels collected with a modified Isaacs–Kidd Midwater trawl during March and April (weeks 9–18). Data were corrected for variations in water flow.

week no	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
3	3													1		
4	0							17			1			4		
5	4							8		15	14	18	30	5	4	0
6								28		27	13	56	45	7	11	0
7								6		22	9	85	331	7	41	0
8	1							34		57	3	44	57	8	48	11
9	187		51			3		36	342	185	3	160	55	3	172	0
10	199	24				2		80	372	150	15	471	118	7	224	4
11	250	130	528	176		4		19	129	150	88	290	130	610	333	13
12	374	806	835	289	14	6	2	16	107	145	42	469	535	400	569	25
13	1886	1258	265	122	109	1	0	72	291	251	110	562	495	1430	331	60
14	2093	1335	469	181	0	3	31	149	121	351	138	151	403	1236	625	33
15	1849		878	112	878		141	603	67	284	414	298	540	1145	91	128
16			925		476		69	416	42	120	254	142	527	619	64	73
17	804		477	171	350		6	127		37	193	231	564	278	80	56
18	0					297	114				124	55				
mean 9-18	849	711	553	175	305	45	52	169	184	186	138	283	374	636	277	44

week no	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
3															
4			0												
5	0	1	0	74	2	27	6	0	20	0	10	0	0	0	
6	1	1	0	142	0	86	5	1	12	2	42	8	1	0	
7	22	9	8	267	3	154	2	2	62	3	4	27	0	0	1
8	3	50	12	115	5	327	5	0	22	2	12	17	4	0	0
9	68	125	62	344	5	117	5	1	15	6	11	10	3	0	1
10	200	100	121	377	3	200	10	3	10	2	29	31	2	2	3
11	198	8	72	533	22	366	44	3	39	1	81	114	3	4	4
12	60	177	158	214	24	530	53	18	162	13	382	38	15	8	34
13	42	220	2	479	16	59	185	35	153	17	186	30	36	4	37
14	77	448	314	942	22	185	192	65	162	55	101	43	37	34	70
15	201	237	377	154	45	184	151	55	202	97	191	26	25	24	179
16	49	96	79	299	25	53	74	90	286	132	20	13	23	91	57
17	44	202	141	257	128	8	158	32	66	62	18	2	11	23	73
18	230	31				9	46	8	10	36	7			28	
mean 9-18	117	164	147	400	32	171	92	31	110	42	102	34	17	22	51

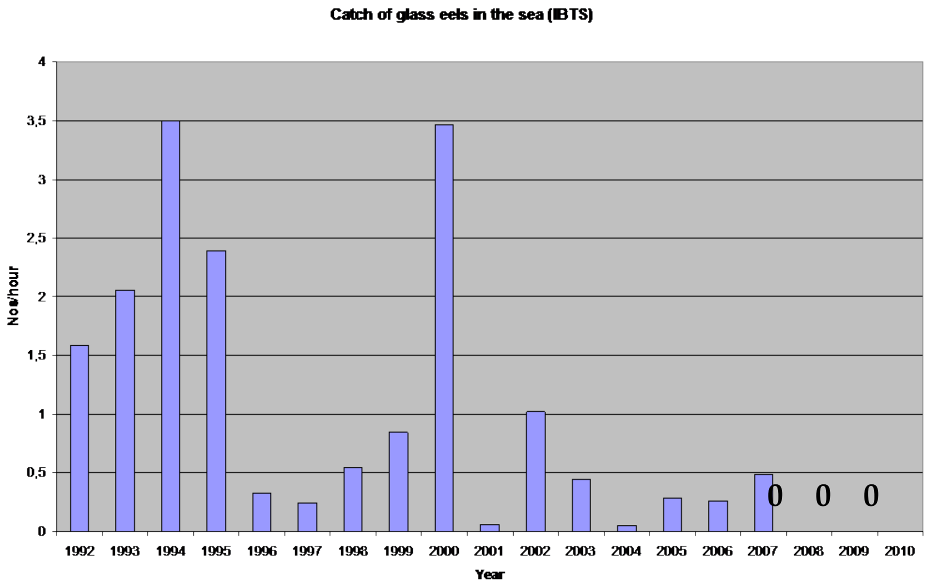


Figure SE.4. Catch of glass eels by a modified Methot–Isaacs–Kidd Midwater trawl (MIKT) in the Skagerrak-Kattegat 1992–2010. Data expressed as total numbers per hour of haul. No glass eels were caught in 2008, 2009 and 2010. In 2011 there was no sampling due to technical problems.

SE.3.1.2 Yellow eel recruitment

SE.3.1.2.1 Commercial

No data (no fishery for undersized eels allowed).

SE.3.1.2.2 Recreational

No data (no fishery allowed).

SE.3.1.2.3 Fishery-independent

The ascent of young eels is monitored in a number of rivers along the Swedish coasts. In the 1970s, these data came from some 20 rivers, but today most of the sites are closed due to lack of eels and therefore lack of interest. The recruitment indices used today are based on the amount of ascending eels in eight rivers from Göta Älv on the Skagerrak coast to River Dalälven on the Baltic Coast. Data are presented both as absolute amounts in weight and as indices based on yearly proportions compared to a common reference period (1971–1980). In most rivers the recruits belong to several age classes, but in River Viskan situated on the West Coast most eels are young-of-the-year recruits, i.e. originates from glass eels arriving at the coast in the same year.

Table SE.3. Amounts of ascending young eels in eight Swedish rivers.

RECRUITMENT DATASERIES FROM SWEDEN (ALL IN KG), DATA FROM 2011 ARE NOT FINAL, NA = NOT AVAILABLE								
YEAR	DALÄLVEN	MOTALA STRÖM	MÖRRUMSÅN	KÄVLINGEÅN	RÖNNEÅ	LAGAN	VISKAN	GÖTA ÄLV
1900								530.00
1901								5 100.00
1902								340.00
1903								858.00
1904								552.00
1905								8 700.00
1906								2 000.00
1907								275.00
1908								na
1909								na
1910								na
1911								5 728.00
1912								6 529.00
1913								20.00
1914								2 828.00
1915								na
1916								na
1917					45.00			na
1918					4.50			na
1919					na			1 465.00
1920					na			800.00
1921					na			1 555.00
1922					na			455.00
1923					na			1 732.00
1924					na			4 551.00
1925					na	331.30		5 463.00
1926					49.00	357.80		3 893.00
1927					445.00	581.10		4 796.00
1928					na	211.90		47.00
1929					na	4.50		756.00
1930					147.00	268.00		5 753.00
1931					na	316.00		2 103.00
1932					na	408.00		7 238.00
1933					na	303.50		6 333.00
1934					na	236.00		6 338.00
1935					na	53.50		1 336.00
1936					na	24.50		2 537.00
1937					na	0.50		8 711.00

RECRUITMENT DATASERIES FROM SWEDEN (ALL IN KG), DATA FROM 2011 ARE NOT FINAL, NA = NOT AVAILABLE								
YEAR	DALÄLVEN	MOTALA STRÖM	MÖRRUMSÅN	KÄVLINGEÅN	RÖNNEÅ	LAGAN	VISKAN	GÖTA ÄLV
1938					na	106.50		3 879.00
1939					na	36.00		4 775.00
1940					na	684.00		1 894.00
1941					na	321.00		2 846.00
1942		14.00			na	454.00		427.00
1943		283.00			na	1 248.00		1 848.00
1944		773.00			na	1 090.00		2 342.00
1945		406.00			na	1 143.00		2 636.00
1946		280.00			29.70	766.50		2 452.00
1947		272.50			5.80	440.80		675.00
1948		120.00			6.00	494.70		1 702.00
1949		43.00			39.40	603.60		1 711.00
1950		304.50			93.50	419.90		2 947.00
1951	210.00	2 713.00			1.00	281.80		1 744.00
1952	324.00	1 543.50			9.10	379.10		3 662.00
1953	241.50	2 698.00			70.00	802.40		5 071.00
1954	508.50	1 030.00			2.70	511.30		1 031.00
1955	550.00	1 871.00			42.60	506.90		2 732.00

YEAR	DALÄLVEN	MOTALA STRÖM	MÖRRUMSÅN	KÄVLINGEÅN	RÖNNEÅ	LAGAN	VISKAN	GÖTA ÄLV
1956	215.00	429.00			14.10	501.60		1 622.00
1957	161.50	826.00			46.80	336.10		1 915.00
1958	336.70	172.00			73.20	497.20		1 675.00
1959	612.60	1 837.00			80.00	910.50		1 745.00
1960	289.00	799.00	29.00		93.00	552.40		1 605.00
1961	303.00	706.00	665.50		143.70	314.80		269.00
1962	289.00	870.00	534.80		113.00	261.90		873.00
1963	445.40	581.00	241.20		32.50	298.10		1 469.00
1964	158.00	181.60	177.80		34.70	27.50		622.00
1965	276.40	500.00	292.30		87.10	28.00		746.00
1966	157.50	1 423.00	196.30		48.50	216.50		1 232.00
1967	331.80	283.00	353.60		6.60	24.40		493.00
1968	265.50	184.00	334.80		398.00	74.40		849.00
1969	333.70	135.00	276.80		85.70	117.10		1 595.00
1970	149.80	2.00	80.40		29.80	24.70		1 046.00
1971	242.00	1.00	141.10		53.30	45.30	12.00	842.00
1972	87.60	51.00	139.90		249.00	106.20	88.00	810.00
1973	159.70	46.00	375.00		282.30	107.10	177.00	1 179.00

YEAR	DALÄLVEN	MOTALA STRÖM	MÖRRUMSÅN	KÄVLINGEÅN	RÖNNEÅ	LAGAN	VISKAN	GÖTA ÄLV
1974	49.50	58.50	65.40		120.70	33.60	13.00	631.00
1975	148.70	224.00	93.30		206.70	78.40	99.00	1 230.00
1976	44.00	24.00	147.20		17.10	20.20	501.00	798.00
1977	176.40	353.00	89.60		32.10	26.40	850.00	256.00
1978	35.10	266.00	168.40		10.80	75.80	532.60	873.00
1979	34.30	112.00	61.40		56.10	165.90	505.20	190.00
1980	71.20	7.00	36.50		165.70	226.00	72.50	906.00
1981	6.80	31.00	72.80		49.20	78.00	513.10	40.00
1982	0.50	22.00	129.00		40.00	90.80	472.00	882.00
1983	112.10	12.00	204.60		37.60	87.80	308.40	113.00
1984	33.90	48.00	189.90		0.50	68.00	20.70	325.00
1985	69.70	15.20	138.10		na	234.10	211.50	77.00
1986	28.40	26.00	220.30		8.60	2.50	150.90	143.00
1987	73.50	201.00	54.50		84.80	69.80	140.90	168.00
1988	69.00	169.50	241.00		4.90	191.70	91.90	475.00
1989	na	35.20	30.00		na	44.00	32.70	598.00
1990	na	21.00	72.50		32.00	21.60	42.10	149.00
1991	na	2.00	151.00		na	161.30	0.40	264.00
1992	9.60	108.00	14.00	12.50	na	42.20	70.30	404.00
1993	6.60	89.00	45.70	25.80	na	8.70	43.40	64.00
1994	71.90	650.00	283.00	4.00	na	30.70	76.10	377.00
1995	7.60	32.00	72.40	2.90	na	11.60	5.50	na
1996	17.50	14.00	51.90	13.50	na	2.80	10.00	277.00
1997	7.50	8.10	148.00	19.40	10.40	31.70	7.60	180.00
1998	14.70	5.50	12.90	15.30	24.00	62.60	5.00	na
1999	15.50	85.00	84.20	22.20	4.20	49.50	1.80	na
2000	12.40	270.10	1.00	5.00	0.09	13.00	14.10	na
2001	8.20	177.50	19.30	34.50	1.80	26.80	1.80	na
2002	58.60	338.80	37.40	19.30	27.00	102.00	26.20	693.00
2003	126.10	19.00	11.00	9.70	9.10	31.70	45.10	266.00
2004	26.40	42.00	1.50	248.30	2.00	29.00	5.00	125.00
2005	30.90	24.80	2.50	3.40	0.06	20.50	25.80	105.00
2006	35.10	25.85	2.50	94.40	0.05	38.10	2.70	0.04
2007	18.50	60.80	112.60	75.80	4.45	77.00	2.10	0.00
2008	30.50	9.70	3.80	4.30	4.05	31.70	3.40	3.81
2009	77.11	26.30	3.70	0.95	1.12	29.00	2.14	0.39
2010	79.63	89.9	25.3	1.85	1.015	58.7	0.03	na
2011		>70		>1.995		>37.7	0.015	

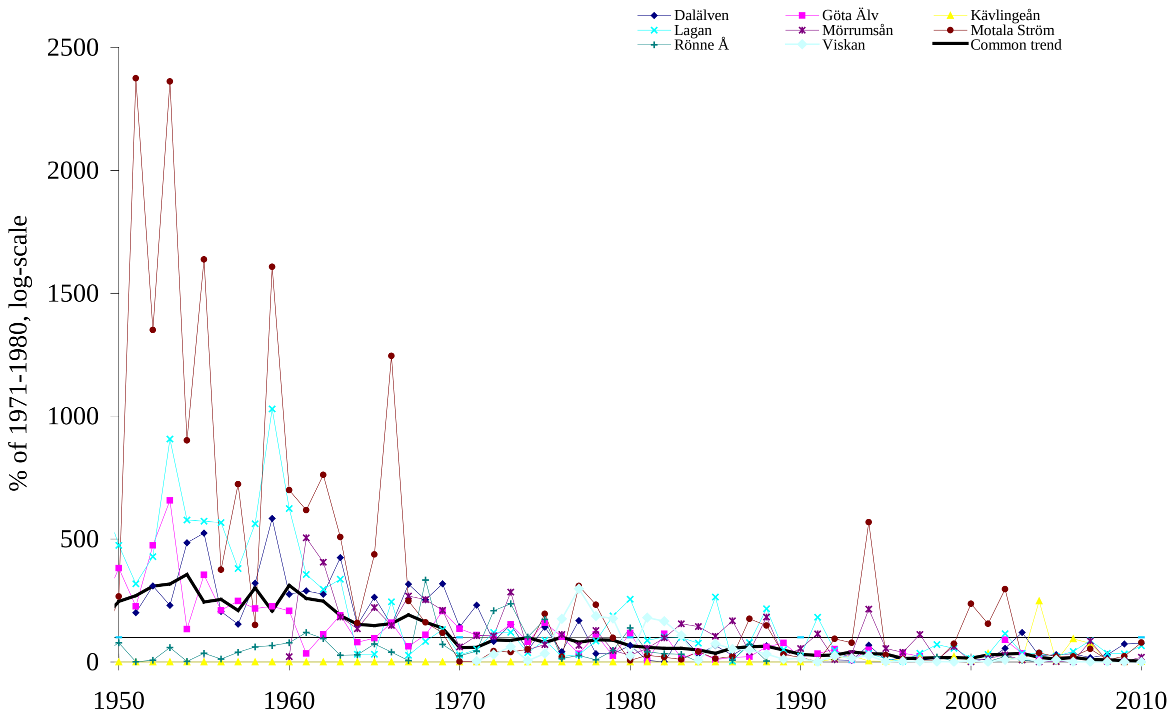


Figure SE.5. The ascent of young eels in seven Swedish rivers (linear scale).

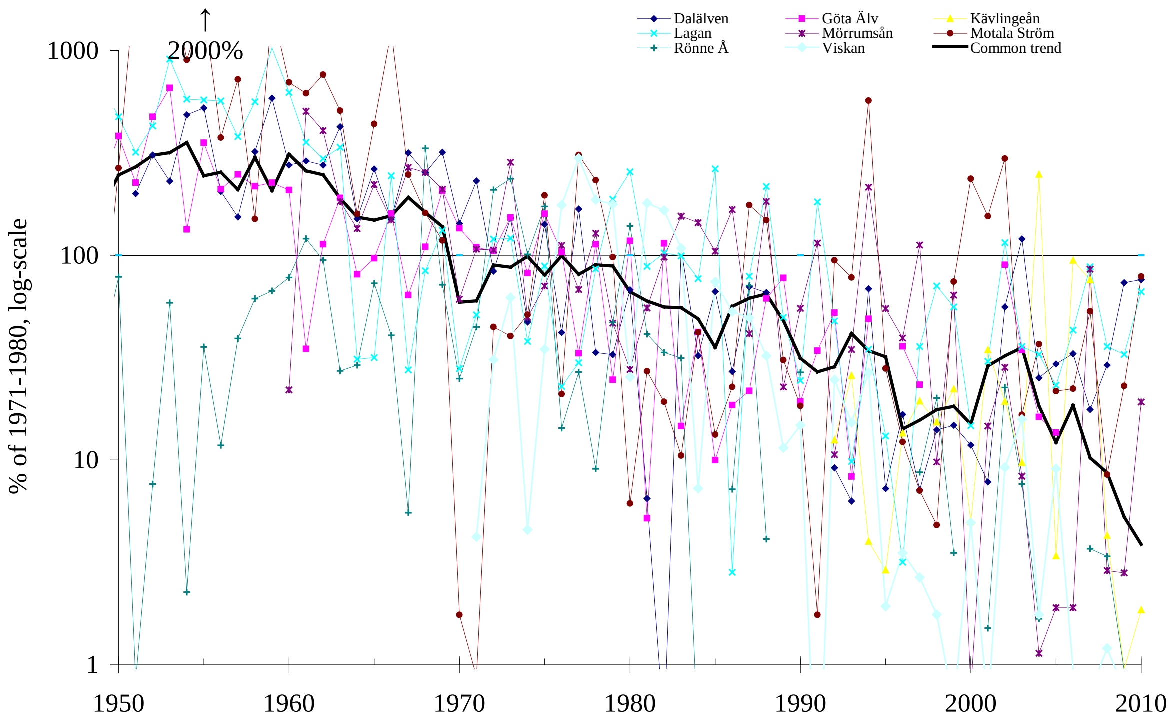


Figure SE.6. The ascent of young eels in seven Swedish rivers (logarithmic scale).

SE.3.2 Yellow eel landings

SE.3.2.1 Commercial

No data on yellow eel separately.

SE.3.2.2 Recreational

No data (no fishery allowed).

SE.3.3 Silver eel landings

SE.3.3.1 Commercial

No data on silver eel separately.

SE.3.3.2 Recreational

No data (no fishery allowed).

SE.3.4 Aquaculture production

SE.3.4.1 Seed supply

For a number of years before 2010 seed was supplied from River Severn in the UK only. In 2009 were 205 kg taken from River Severn. However, in 2010, 870 kg glass eels were imported from Bay of Biscay (Charente-Maritime) in France and in 2011, 1200 kg from the same area.

SE.3.4.2 Production

As there is only one eel farm in Sweden left, their production is not given in the public statistics. However, this farm and importer (Scandinavian Silver Eel AB) kindly supplied adequate information.

For human consumption purposes, 143 tons were produced in 2009. However, this figure might have been calculated in a slightly different way than the earlier official data.

For restocking purposes, 763 000 quarantined ongrown eels were restocked in Sweden and 117 000 abroad.

In 2010, 1 936 000 were stocked in Sweden and 153 000 abroad. The normal size when stocked is about one gramme a piece. Preliminary data from 2011 show that more than 2.6 million ongrown eels were stocked in Sweden and another 306 000 abroad.

In 2010, 82% of the imported glass eels were used for restocking purposes, in contrast to ca. 70% for the period 1984–2010. In 2011 the corresponding figure is 71%.

Table SE.4. Production of eels in aquaculture in Sweden. (*SCB (Statistics Sweden) is the official source of statistics in Sweden).

Aquaculture production (tons/year), source *SCB	
2008	172
2009	139
2010	91

SE.3.5 Stocking

SE.3.5.1 Amount stocked

Source? When the import of glass eels commenced in the late 1970s they were all imported from France. In more recent years glass eels were instead imported from River

Severn in the UK only, but since 2010 exclusively from the Bay of Biscay (Charente-Maritime in France).

Glass eel or ongrown The eels are stocked after 8–10 weeks in quarantine at a weight of about 1 gramme each (yngel). To facilitate the evaluation of stocking programmes all eels stocked in Sweden since 2009 have to be chemically marked with strontium chloride ($SrCl_2$) in their otoliths. From otolith chemistry we know that in several lakes today's eel populations originate to a great extent from stocked eels.

Bootlace; quantity stocked & origin The use of bootlace eels (sättål, medium-sized yellow eels (~40 cm) from the Swedish West coast) for stocking has been phased out and such eels are not used since 2009. The within river basin transfers of ascending young eels are not considered in this connection.

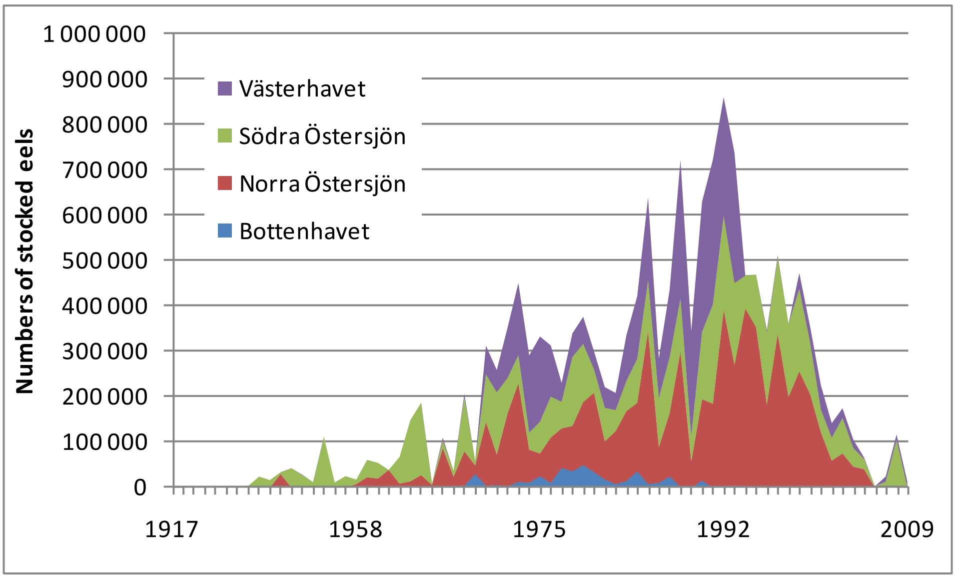


Figure SE.7. Number of indigenous medium-sized yellow eels stocked in freshwater, per RBD.

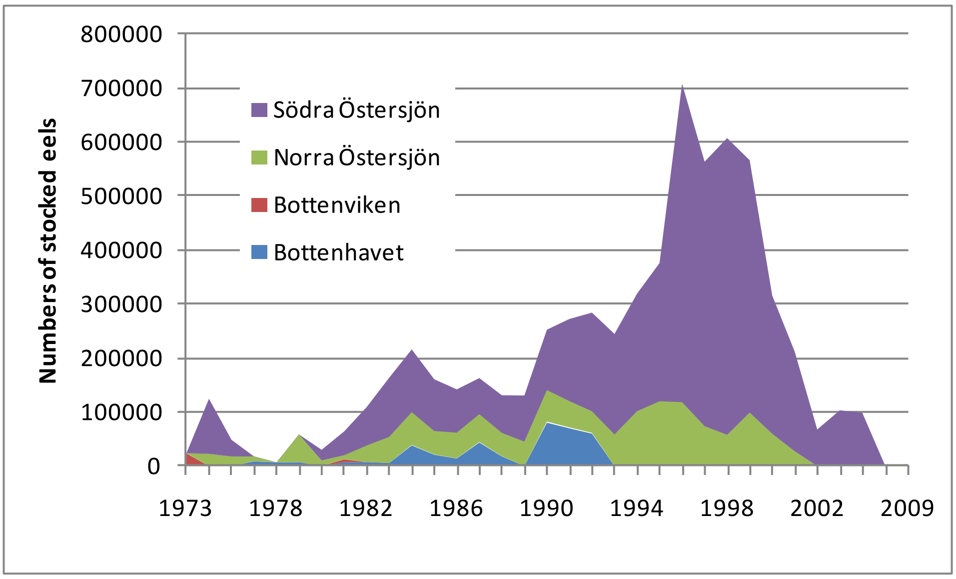


Figure SE.8. Number of indigenous medium-sized yellow eels stocked in coastal waters, per RBD.

Table SE.5. Numbers of ongrown eels stocked in freshwater by RBD since 1985.

Årtal	Bottenhavet	Norra Östersjön	Södra Östersjön	Västerhavet	(tom)	Totalt
1985		273500		360000		633500
1986			14600	65000		79600
1987		12800	141500	130000		284300
1988		205000	94800	91600		391400
1989			76300	20000		96300
1990		498000	167000	66000		731000
1991		294900		32143		327043
1992		300000	9886	11000		320886
1993		505850	5000	116150		627000
1994	59600		463300	1401553		1924453
1995		4000	305070	1352075		1661145
1996	20800	470900	405046	1279821		2176567
1997	12650	353000	463545	1360031		2189226
1998		424575	390670	1043765		1859010
1999	537000	560530	101288	1208215		2407033
2000	43750		233130	845820		1122700
2001	92405	83200	210115	390552		776272
2002	111100	247880	210833	560399		1130212
2003	32000	239000	47960	1736		320696
2004	107340	34383	222468	696179		1060370
2005	118020	119433	245139	399072		881664
2006	73142	228178	315862	352949		970131
2007	103987	128194	276208	288352		796741
2008	51422	118982	356820	482795	3000	1013019
2009	46905	54125	292390	193092		586512
2010	32000	3000	431445	1260065		1726510
Totalt	1442121	5159430	5480375	14008364	3000	26093290

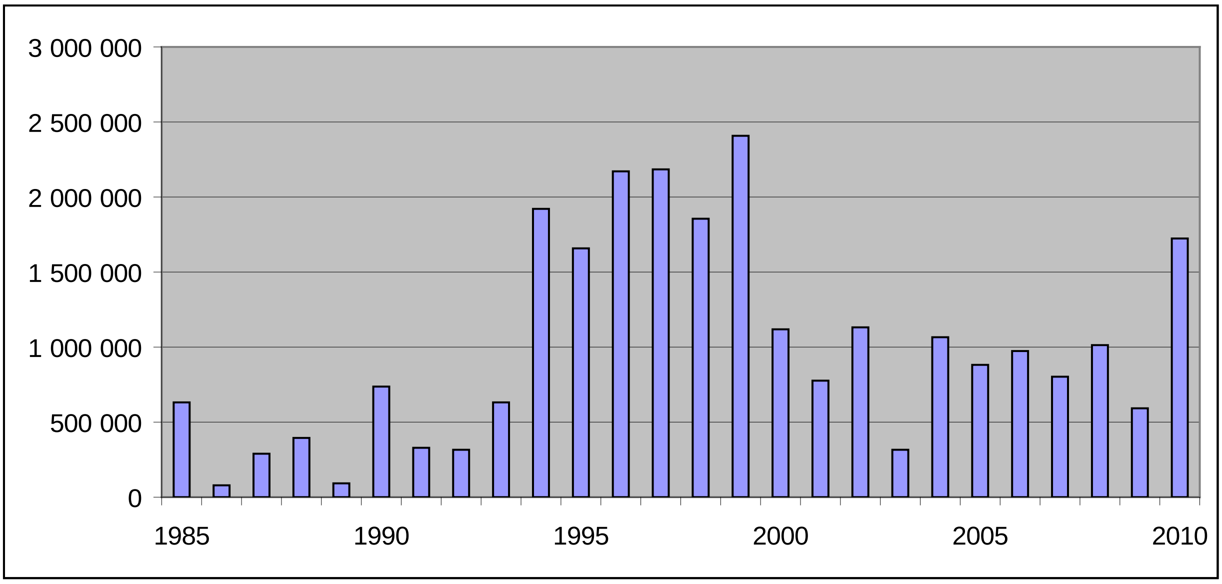


Figure SE.9. Numbers of ongrown eels stocked in freshwater since 1985.

Table SE.6. Numbers of ongrown eels stocked in marine/brackish water since 1985 (by RBD).

Årtal	Bottenhavet	Norra Östersjön	Södra Östersjön	Västerhavet	Totalt
1987			363636		363636
1988			245700		245700
1989		500000	317378		817378
1990			358095		358095
1991			258740		258740
1992				360000	360000
1993				360000	360000
1994			86200	360000	446200
1995				360000	360000
1996		280000		60000	340000
1997		328450			328450
1998		294950			294950
1999		371430			371430
2000		249955			249955
2001		100220			100220
2002	171000	126510	88650		386160
2003	111460	138210	131500		381170
2004	106850	83611	46662	15000	252123
2005		66063	89604		155667
2006	97200	58962	187685		343847
2007	40800	46040	80426	7500	174766
2008	63400	122772	180755		366927
2009	54127	33830	88745		176702
2010			30000	180000	210000
Totalt	644837	2801003	2553776	1702500	7702116

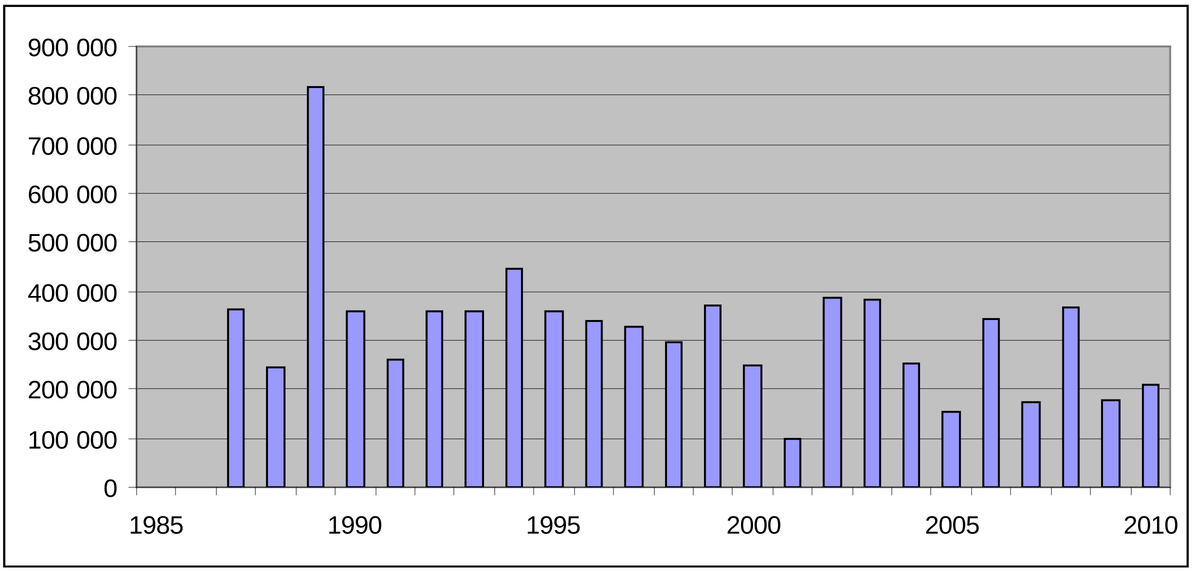


Figure SE.10. Numbers of ongrown eels stocked in brackish/marine water since 1985.

SE.3.5.2 Standardizing restocking units

Restocking seed material has varied from imported glass eels freshly recruited from the ocean to legally sized eel of approximately 6 years old, caught in the commercial fishery on the West Coast. Historical records indicate the source and size of the seed material in most cases, expressed in numbers and/or total weight, but neither of these units makes the different types of seed material comparable to each other (numbers going down with age, while total weight goes up). In order to standardize restocking quantities, all units have been expressed in "glass eel equivalents", following the line of reasoning of Knösche *et al*. (2004).

The glass eel equivalent is defined here as the number of (true) glass eels that would need to be restocked, if (true) glass eels had been used instead of the actual seed material, assuming an average growth and mortality rate in-between the glass eel stage and the actual size used. For a bootlace eel of age *a*, it is assumed that the initial number of glass eels $N_{glass\ eel}$ has declined by natural causes, down to N_a, where

$$N_a = N_{glass\ eel} \times exp^{-a \times M}$$

And hence

$$equivalency\ factor = \frac{N_{glass\ eel}}{N_a} = exp^{+a \times M}$$

Converting data on all types of restocking into numbers, and multiplying by the relevant equivalency factor, all restockings are then expressed as the equivalent number of glass eels. Using these data in an analysis of stock dynamics, these glass eel equivalents should be treated as if they were indeed restocked as glass eel, in year *t-a*, where *t* is the year of restocking. Hence, the stock dynamics analysis will assume that in the first *a* years of their life, they have grown and aged according to the above formula, leaving exactly N_a eels of age *a* in year *t*. That is: the conversion from restocked numbers to glass eel equivalents is exactly un-done. Note that growth and mortality estimates should be equal in the equivalency conversion and the stock dynamics analysis.

In most cases, only the size of the seed material is known (length or weight), and a rough estimate of the corresponding age has been made; see Table SE.7, below. A constant natural mortality rate of M=0.138 was assumed (i.e. 75% mortality over 10 years, as assumed by Dekker, 2000b).

Note that a bootlace eel is equivalent to more than two glass eels, that is: if equal numbers would be restocked, the bootlace would be expected to result in more than double the production. At the same time, however, the individual weight of bootlace eels is 90 gr on average, compared to 0.3 gr for the glass eel. Taking into account the mortality, a single glass eel (equivalent) is assumed to yield nearly 40 gr of bootlace eel biomass. Hence, stocking equal biomasses of glass eels and bootlace eels, the glass eel would be more than 100 times as effective.

Imported glass eels have never been restocked directly into outdoor waters in Sweden, but have been and still are being quarantined in indoor facilities. During their stay indoors, they are fed and they grow. After a few weeks, they are released to outdoor waters, at an average size of 10 cm and 1 gr. At that moment in time, these quarantined elvers have a true age of only a few weeks, but the size of a half year old eel (taking the glass eel stage as the hypothetical age zero). The larger size is assumed to give them a head-start in comparison to true glass eels of the same real age, and therefore these quarantined elvers have a glass eel equivalent of 1.07. That is: for calculating the number of glass eel equivalents, the age is used of a locally wild animal of the same size.

Table SE.7. Types of restocking seed material, their size and age, and the corresponding number of glass eels.

Stage	L (cm)	W (gr)	age	$a \times$ M	N_a	Glass eel equivalent	Total biomass (gr)
Glass eel	7	0.3	0	0	1.000	1.000	0.30
Elver (yngel)	9.5	1	0.5	0.069	0.933	1.071	0.93
Trollhättan eel	15	5	2	0.276	0.759	1.318	3.79
Bootlace (sättål)	40	90	6	0.828	0.437	2.289	39.32

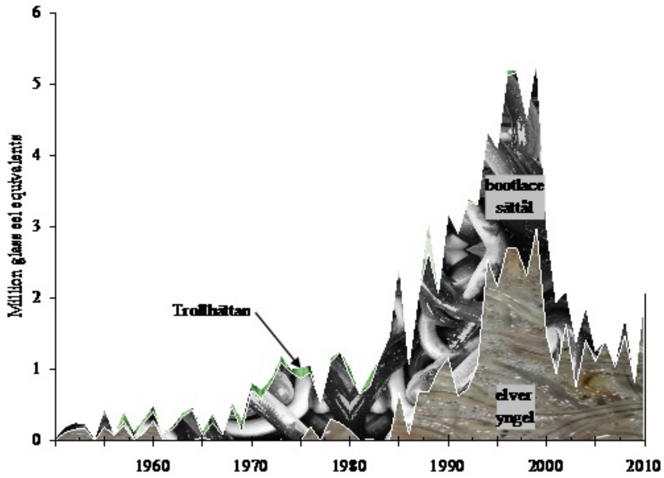


Figure SE.11. Quantity and composition of the eel used for restocking since 1950.

Until the 1990s, the transport of eels from the west coast to the east coast (bootlace, sättål) has dominated the restocking programmes; recently, quarantined glass eel (elver, yngel) restocking is the only action left. Trollhättan eel has always been a small quantity, and this transport has ended completely in 2005.

Figure SE. 12 shows the trend in restocking inland waters. Until 1970, less than 0.5 million glass eel equivalents were restocked. From 1970 to 1990 the quantity gradually increased to 1.5 million, reached 2–3 million in the 1990s, and then went rapidly down to about 1 million again. In 2010 and 2011, nearly 2 million equivalents were restocked. The quantity of eels being taken from west-coast rivers (in Trollhättan) has been very small in comparison to the total quantities being restocked in these rivers.

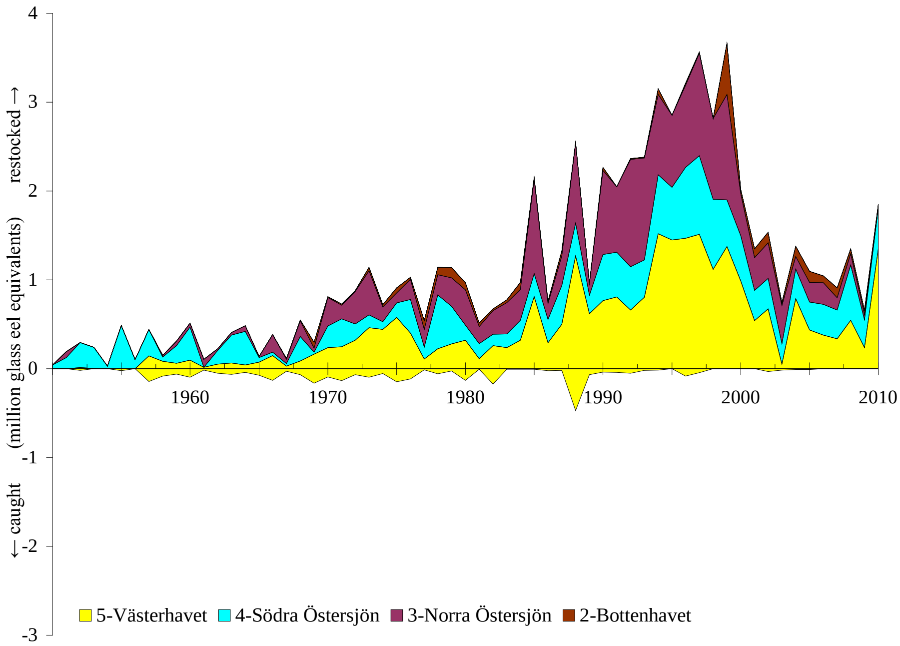


Figure SE.12. Restocking in inland waters, by river basin district. Note that the catch of eels for restocking (in fact Västkusten; West Coast only) is shown below the horizontal axis, while release of eels is shown above.

In coastal waters (Figure SE.13) bootlace eels were caught along the west coast and restocked mostly along the east coast. Since 2000, this transport has come to a halt, and net restocking into coastal waters along the east coast is now small in comparison to the inland restocking.

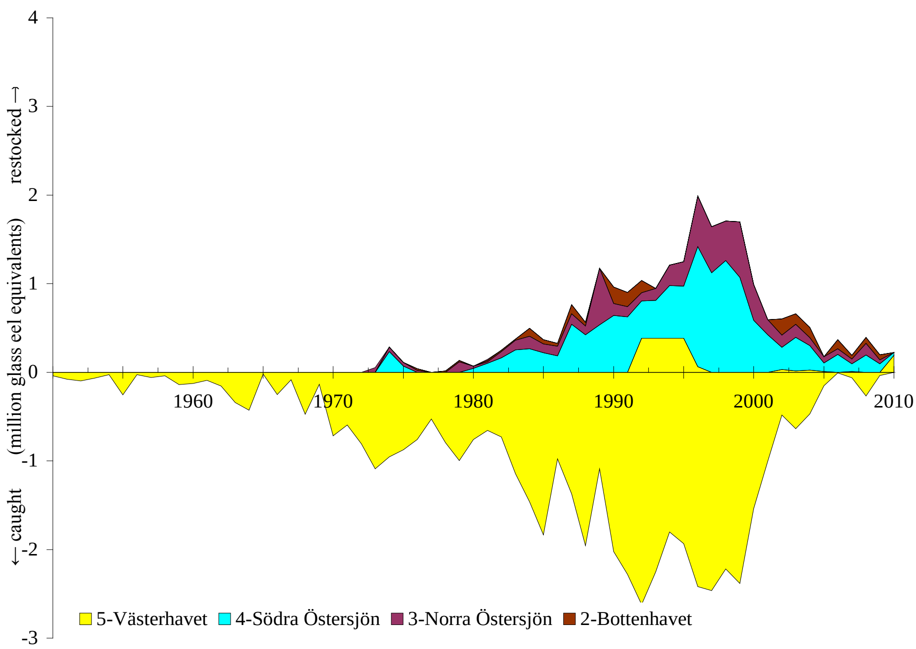


Figure SE.13. Restocking in coastal waters, by river basin district. Note that the catch of eels for restocking (in fact Västkusten; West Coast only) is shown below the horizontal axis, while release of eels is shown above.

SE.3.5.3 Catch of eel <12 cm and proportion retained for restocking

Catch of eels smaller than the minimum legal size is not allowed.

SE.4 Fishing capacity

SE.4.1 Glass eel

No data (no fishery for undersized eels allowed).

SE.4.2 Yellow eel

See below.

SE.4.3 Silver eel

See below.

SE.4.4 Marine and inland fishery

The number of licences issued yearly has decreased since the regulation was implemented in 2007.

Table SE.8. Number of licences issued yearly for coastal and freshwater fishery.

	Total	Coastal	Coastal & Freshwater	Freshwater
2007	434			
2008	408	336	3	69
2009/2010	387	316	3	68
2011	360	285	3	72

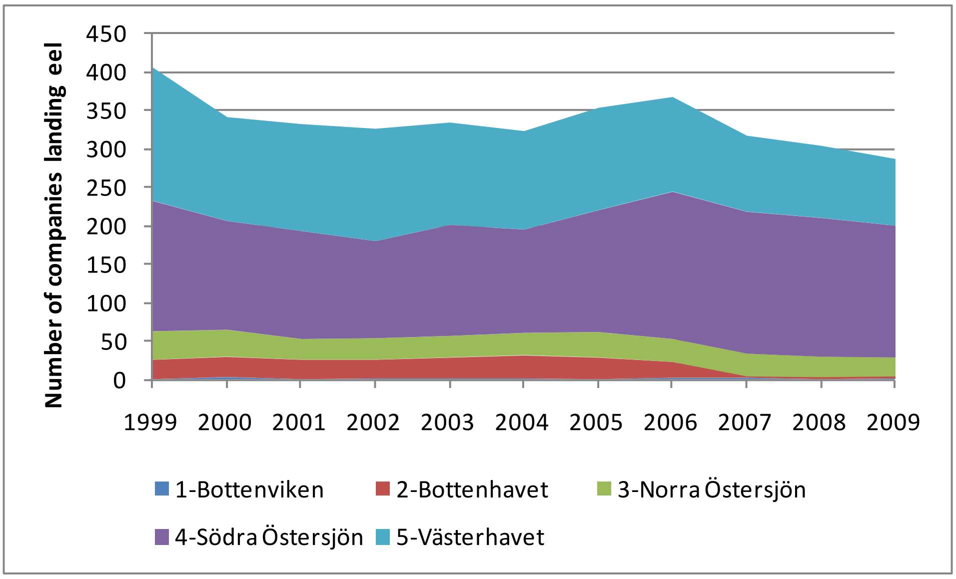


Figure SE.14. Time-trend in the number of fishing companies landing eel from coastal waters, by river basin district.

SE.5 Fishing effort

SE.5.1 Glass eel

No data (no fishery for undersized eels allowed).

SE.5.2 Yellow eel

See below.

SE.5.3 Silver eel

See below.

SE.5.4 Marine and inland fishery

Since 1999, coastal fishermen submitted monthly reports on their activities. These reports do not allow reconstructing fishing capacity and/or effort, but the number of companies actually landing eel can be counted. Table SE. 8 shows these trends per river basin district. In recent years, the number of companies has gone down, primarily in Västerhavet and in Bottenhavet. Since 2006, a minimal landing of 400 kg per year is required to obtain a licence. This has increased the number of companies reporting, especially in Södra Östersjön, but otherwise, the number of companies shows a downward trend here too.

For inland waters, no reliable time-series on fishing capacity or effort exist (cf. Table SE. 8).

SE.6 Catches and landings

SE.6.1 Glass eel

No data (no fishery for undersized eels allowed).

SE.6.2 Yellow eel

See below.

SE.6.3 Silver eel

SE.6.3.1 Freshwater fishery

The proportion of yellow eels is investigated from 2010 on as part of the DCF programme for eel in freshwater. As the eel fishery in freshwater is aiming at migrating silver eels and is mainly done using fixed fishing gears as poundnets, we assume the majority of eels are silver or "half-silver" with a small proportion of large yellow eels paid the same price by the whole-sellers. The DCF-data are not yet fully analysed.

Table SE.9. Commercial catch in freshwater lakes in Sweden.

Year	Mälaren	Hjälmaren	Vänern	Smaller lakes	Total
1962	na	na	8	na	8
1963	na	na	9	na	9
1964	2	na	10	na	12
1965	2	na	9	na	11
1966	2	1	10	na	13
1967	2	1	12	na	15
1968	1	2	15	na	18
1969	1	3	14	na	18
1970	2	2	14	na	18
1971	3	2	14	na	19
1972	4	3	13	na	20
1973	4	4	12	na	20
1974	5	3	12	na	20
1975	8	5	16	na	29
1976	6	5	11	na	22
1977	8	6	14	na	28
1978	7	6	9	na	22
1979	8	6	8	na	22
1980	13	9	10	na	32
1981	13	9	11	na	33
1982	15	12	11	na	38
1983	17	10	12	na	39
1984	18	11	13	na	42
1985	20	11	19	na	50
1986	18	12	17	45	92
1987	22	11	17	38	88
1988	28	19	23	66	136
1989	21	16	19	53	109
1990	28	29	22	49	128
1991	35	25	23	49	132
1992	30	27	19	56	132
1993	31	28	19	51	129
1994	43	35	22	71	171
1995	36	24	19	48	127
1996	35	23	17	33	108
1997	43	30	25	45	143
1998	31	19	21	41	112
1999	44	30	26	40	140
2000	38	20	22	34	114
2001	38	23	25	32	118
2002	34	18	22	29	103
2003	31	16	23	26	96
2004	38	18	23	28	107
2005	42	18	21	29	110
2006	45	21	21	36	123
2007	41	20	19	31	111
2008	47	23	22	20	112
2009	47	14	14	21	96
2010	49	18	14	27	108

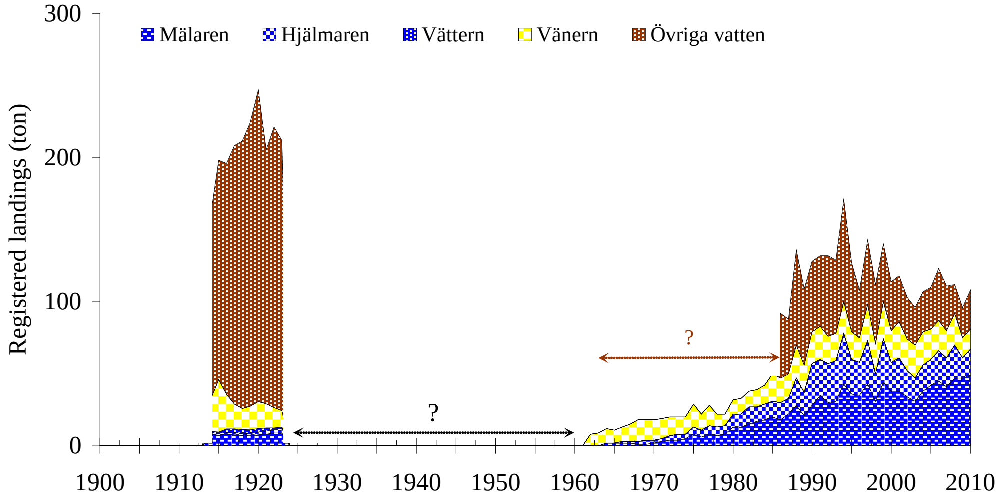


Figure SE.15. Landings from inland waters, for each of the great lakes, and for the sum of all smaller lakes ("övriga vatten"). The statistics were collected by the Statistics Sweden (SCB), based on reports by county fisheries officers; since 1999, statistics are based on monthly reports or log-books, reported by fishers to the Swedish Board of Fisheries; for the in-between period, no records exist. Landings from the smaller lakes ("övriga vatten") were not reported until 1986 and onwards.

SE.6.3.2 Marine fishery

Including information on the 50% reduction

Total eel catches reported to the logbook system averaged 506 tons in 1999–2010. As the system allows reports of undefined eel catches, the relation between life stages is not exactly known. Before 2005 shares of silver and yellow eel were equal and the undefined part was small (3%). Silver eel proportion was larger in 2005–2007 and probably also in 2008 (when the undefined part was 30%), as an increase in landings was recorded in the Baltic proper after 2004. The Baltic eel fishery is strongly dominated by poundnet fishery for silver eel. The duty to present logbooks was not mandatory for fishing on private waters until 2005 (private ownership of fishing rights are common in both inland waters as along the coast). This implies that catches in the Baltic Sea silver eel fishery were underestimated. The degree of underestimation is not known. In addition, the new legislation requiring licence for eel fishing in 2007 has probably reduced underestimation of catches. Logbooks contain information on a daily basis on catches (kg), gears used (number and type) and the fishing time (hours). In the journals information is given on a monthly basis with catches (kg), and effort (nr of gears*days). Both types of data are administrated and stored by the Swedish Board of Fisheries (since 1 July 2011 by the Swedish Agency for Marine and Water management). The Baltic Proper and the Kattegat-Skagerrak area strongly dominate the catches and there is a tendency for an increasing share for the Baltic landings in recent years.

Recreational fishery is prohibited since 2007.

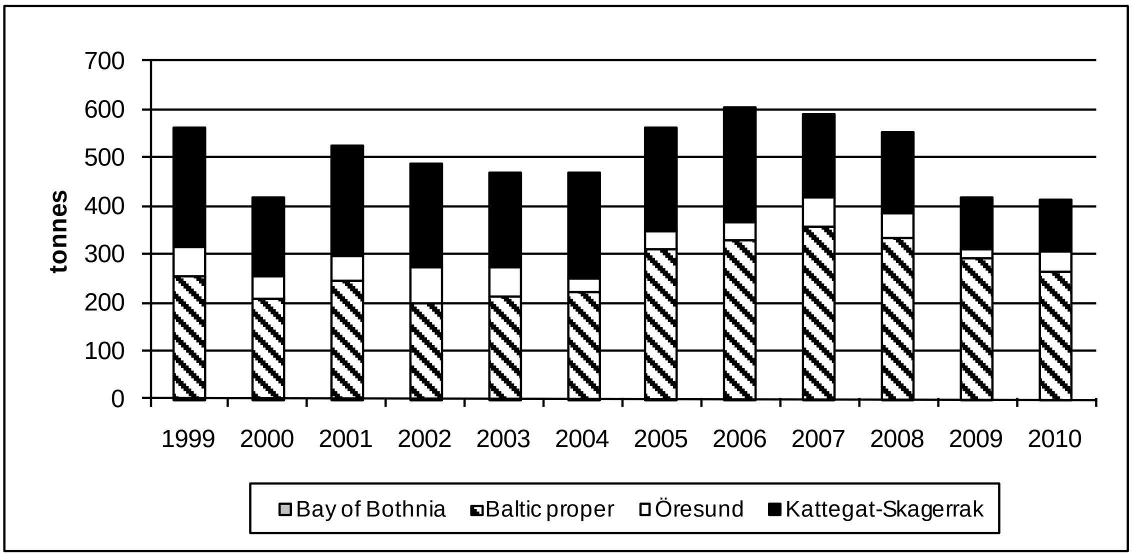


Figure SE.16. Total commercial landings in coastal fishery by main basin.

More than 80% of the reported silver eel landings are taken by poundnets and an additional 10% by fykenets. The fishing mainly takes place in August and September.

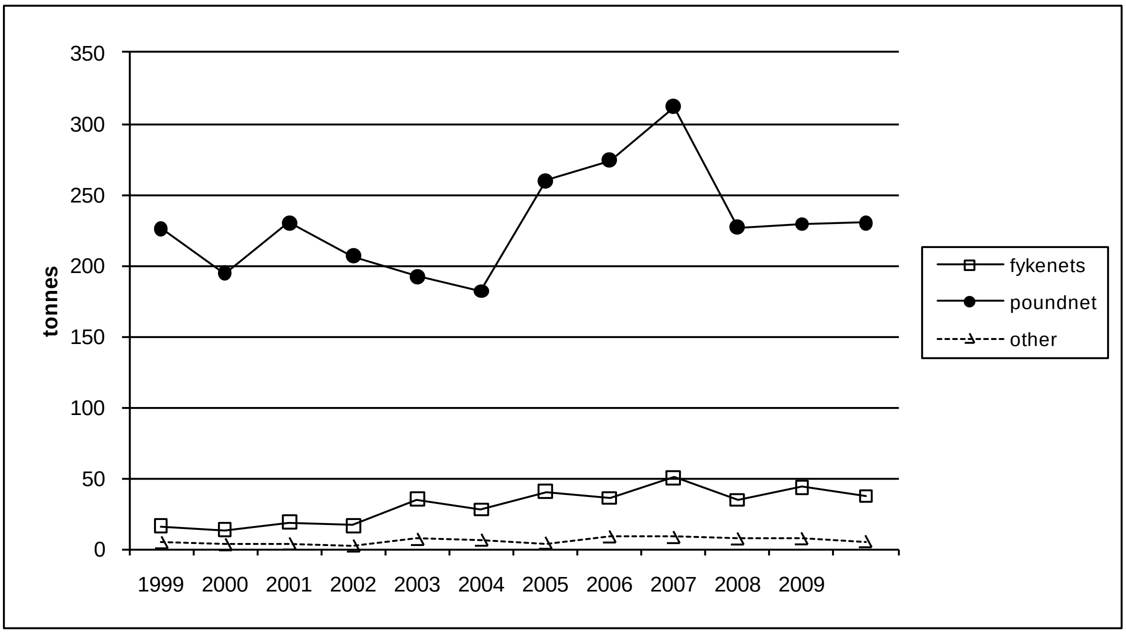


Figure SE.17. Annual silver eel landings reported by gear.

In yellow eel fishery 90% of the catch is reported in fykenets and an additional 5% in pots and 3% in poundnets. The fishing mainly takes place in summer from May till October.

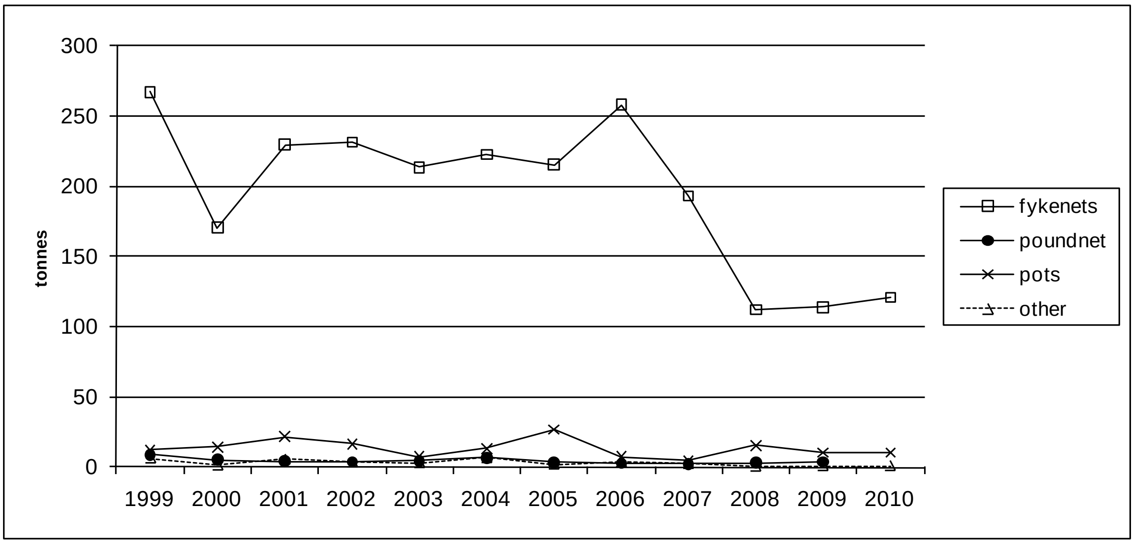


Figure SE.18. Annual yellow eel landings reported by gear.

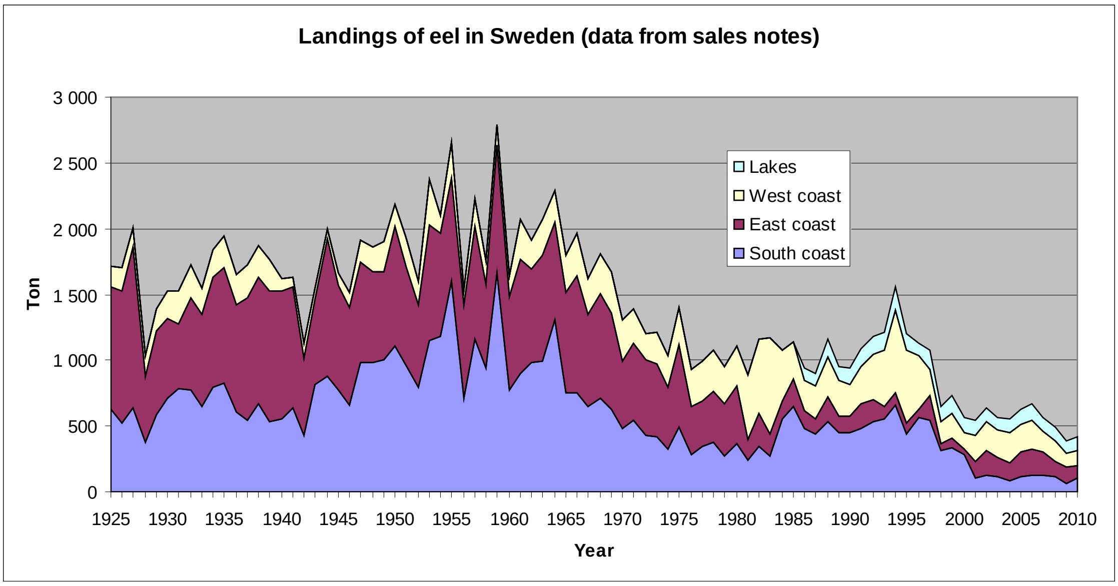


Figure SE.19. Landings as reported through the sales notes system.

There is a discrepancy between the data derived from the traditional sales notes system and the more recent logbook system. During the most recent years this difference was considerable, as in 2010 when sales notes report 313 tons, while the logbooks say 415 tons (all from the marine areas). This discrepancy for 2010 is presented in the official statistics as a "completion increment".

SE.7 Catch per unit of effort

SE.7.1 Glass eel

No data (no fishery for undersized eels allowed).

SE.7.2 Yellow eel

See below.

SE.7.3 Silver eel

See below.

SE.7.4 Marine fishery

Fishermen in the central Baltic have provided detailed records of their catches for several decades, in relation to a monitoring programme related to the nuclear power plant in Oskarshamn. On one site in southern Östergotland archipelago (Figure SE. 20), no change in the catch of yellow or silver eel per unit of effort has been observed since the mid-1970s, though the fishing effort in the 1990s was considerably lower than before. No such decline in effort occurred on a site in northern Kalmar County; no significant change in yellow eel catch occurred here, but catches of silver eel have increased. This might be related to an increased focus on silver eel in recent years.

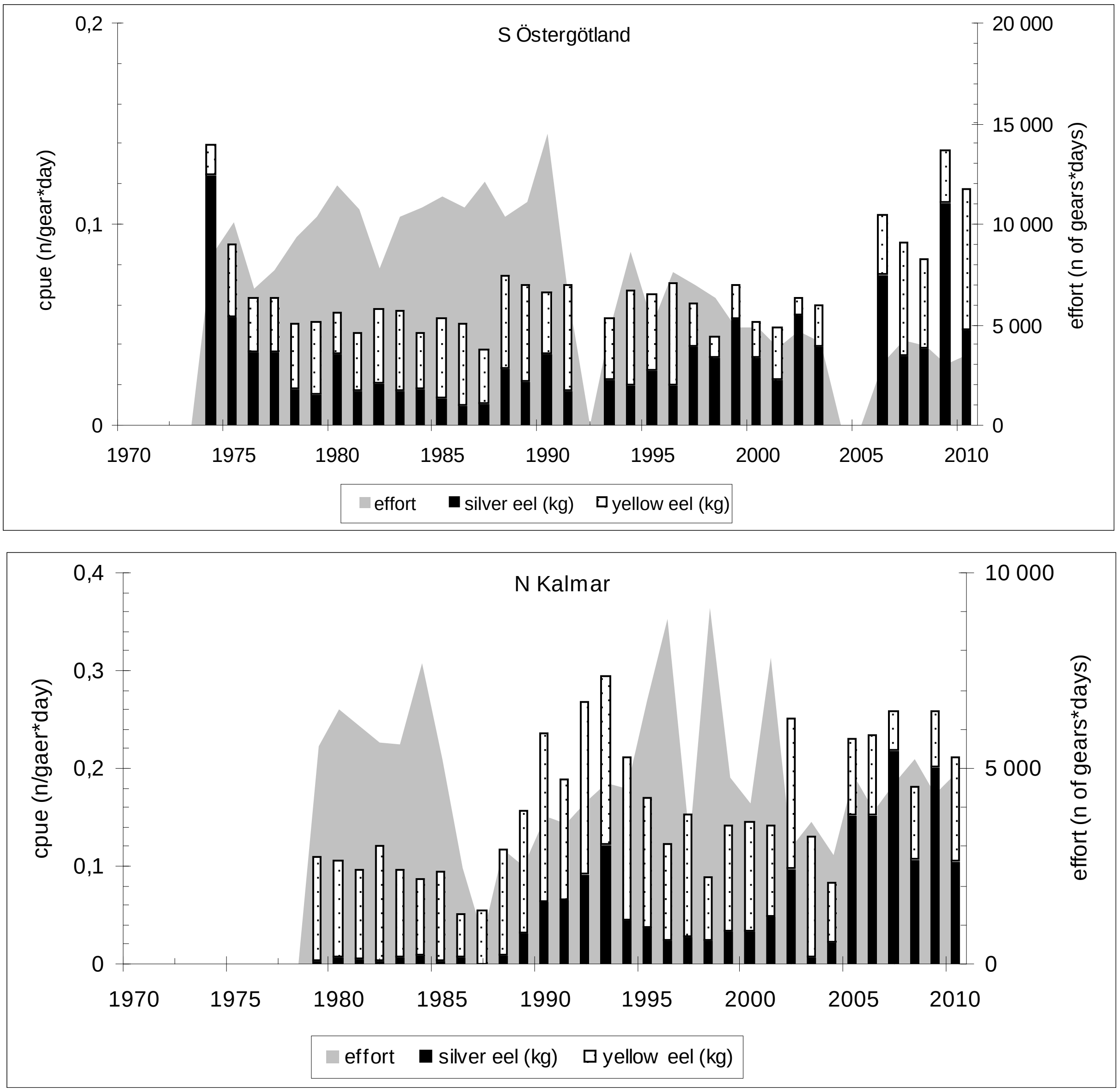


Figure SE.20. Catch per unit of effort for yellow and silver eel, and total annual fishing effort, in fisheries with (small) fykenets in two areas in the central Baltic.

The catch per unit of effort for the poundnet fishery on silver eel in the central Baltic has declined considerably in the 1960s (Figure SE. 21), but has stabilized thereafter. Two of the series ceased around 2000, and the same happened to some of the series in Hanöbukten in the 1990s. In recent years, however, some of the original series resumed, and catches at these sites have been relatively high recently, compared to the 1980s. Note however, that the data presented only represent part of the poundnet fishery in this area.

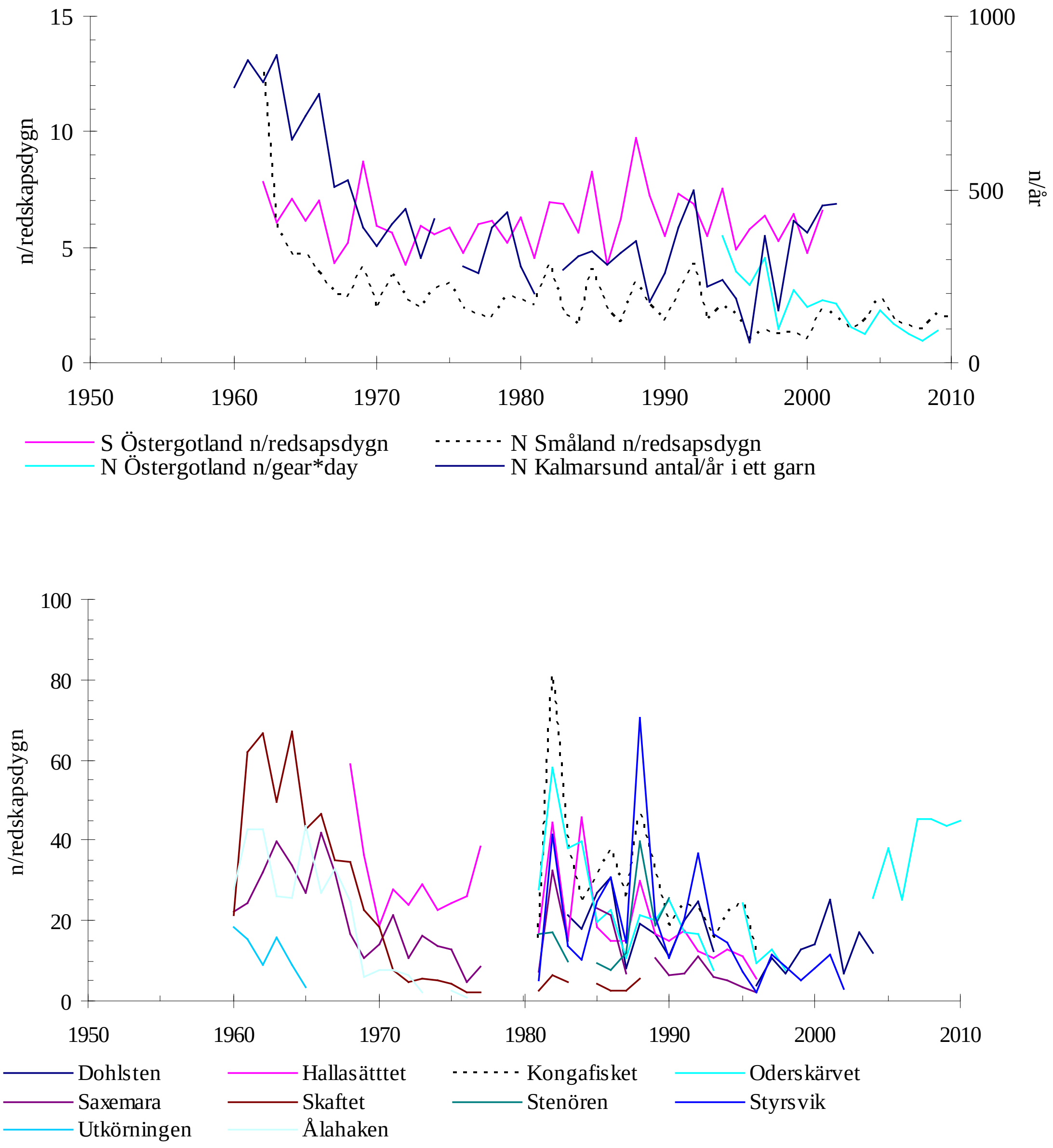


Figure SE.21. Catch per unit of effort in the poundnet fishery for silver eel at four sites in the central Baltic (top) and ten sites in Hanöbukten (below).

SE.8 Other anthropogenic impacts

During their return migration towards the sea, many silver eel encounter barriers in the river, including hydropower stations. Eels often can find their way through the hydropower station, but a large percentage of them do not survive; they can be caught on grids and screens or cut in pieces while passing the turbines, etc. The

Swedish EMP estimates that 70% of the silver eels die upon passing a hydropower station on average, which makes a total of more than 90% mortality for an average silver eel that has to pass several power stations in a row before reaching the sea. The Swedish EMP estimates the impact of hydropower generation, based on estimates of the number of silver eels produced in inland waters. The total impact all over Sweden is estimated at nearly 300 000 silver eels (in number, that is approximately 270 tons), half of which comes from only eleven rivers. The numbers of silver eels for those eleven rivers are shown below (Figure SE. 22).

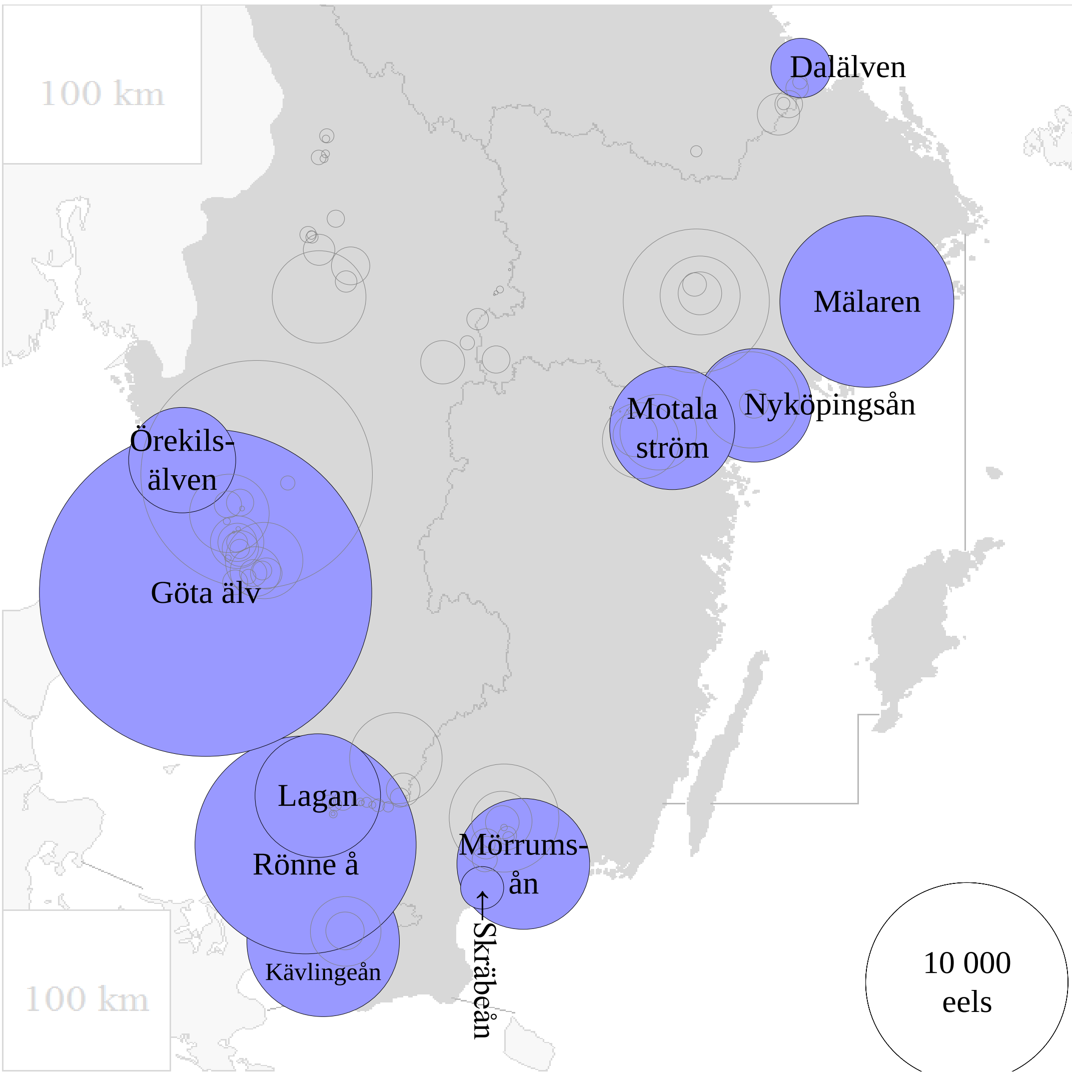


Figure SE.22. Estimated number of silver eels lost due to hydropower mortality, for the top eleven rivers. (colour: river catchment totals; grey: individual power stations).

The impact of hydropower generation on the emigrating eel stock is assessed on the basis of the productivity of inland waters, in combination with an estimated mortality of 70% per hydropower station, corresponding to over 90% mortality for an average eel going down several hydropower stations. The total impact of hydropower is estimated at 270 t, of which 58% comes from rivers draining to the east coast, i.e. 157 t and 42% comes from rivers draining to the west coast, i.e. 113 t.

A Memorandum of Understanding between the Swedish Board of Fisheries and the major hydropower companies was signed in March 2010. This MoU aims at reducing the mortality in HPS from some 90% down to 60% corresponding to another 140 000 silver eels surviving (Table SE. 1). This assignment refers to the whole country as an EMU, i.e. it does not refer to each single river or RBD.

SE.9 Scientific surveys of the stock

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

Recruitment is mainly studied as described above (3.1), i.e. by monitoring ascending young eels in a number of rivers but also by trawling studies in the open Kattegat-Skagerrak area as well as in the cooling water intake to the Ringhals Nuclear Power Plant. To this come extensive data collected by electro-fishing mainly for salmonids in streams all over Sweden. (Figure SE. 23–Figure SE. 26). From 2010 onwards we add to these sites a smaller number of electrofishing stations in areas with a nonsufficient coverage. Some resting series with drop-trapping (ICES 2009a) data has also been reopened and extended from 2010, in order to improve the coverage of samples and quality of recruitment data.

In inland waters, electrofishing surveys have been held in running waters, and data have been compiled in a central register (SERS, Swedish Electrofishing Register, Fiskeriverket Örebro (now Swedish University of Agricultural Sciences, Department of Aquatic Resources)). Time-trends can be shown from 1990 onwards. From SERS the following kind of data were extracted:

SE.9.2 Data on occurrence

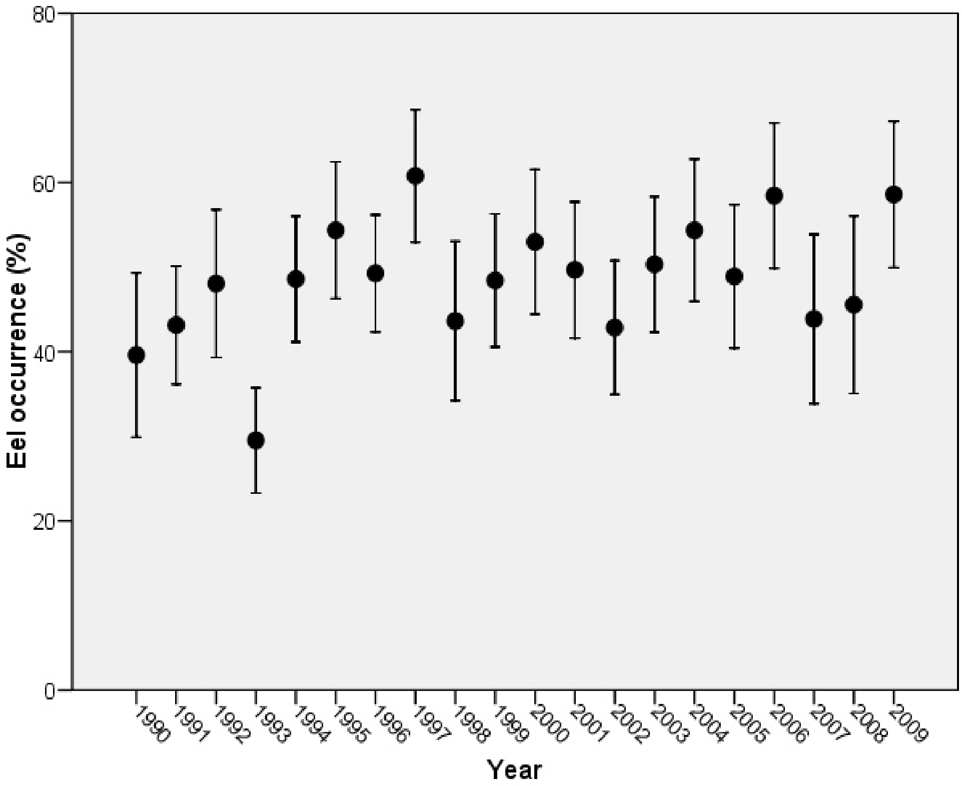


Figure SE.23. Proportion of electrofished stations (%) with eel occurrence (+/- 95% CI) along the West Coast (only the county of Halland). The stations that were fished in 1990–2009 are situated from 0 to 100 m asl. Note that local abundance is not given here, only presence/absence. Data from SERS (Swedish Electrofishing Register). The trend is not significant (Pearson correlation, n=20, r=0,404, p=0,077).

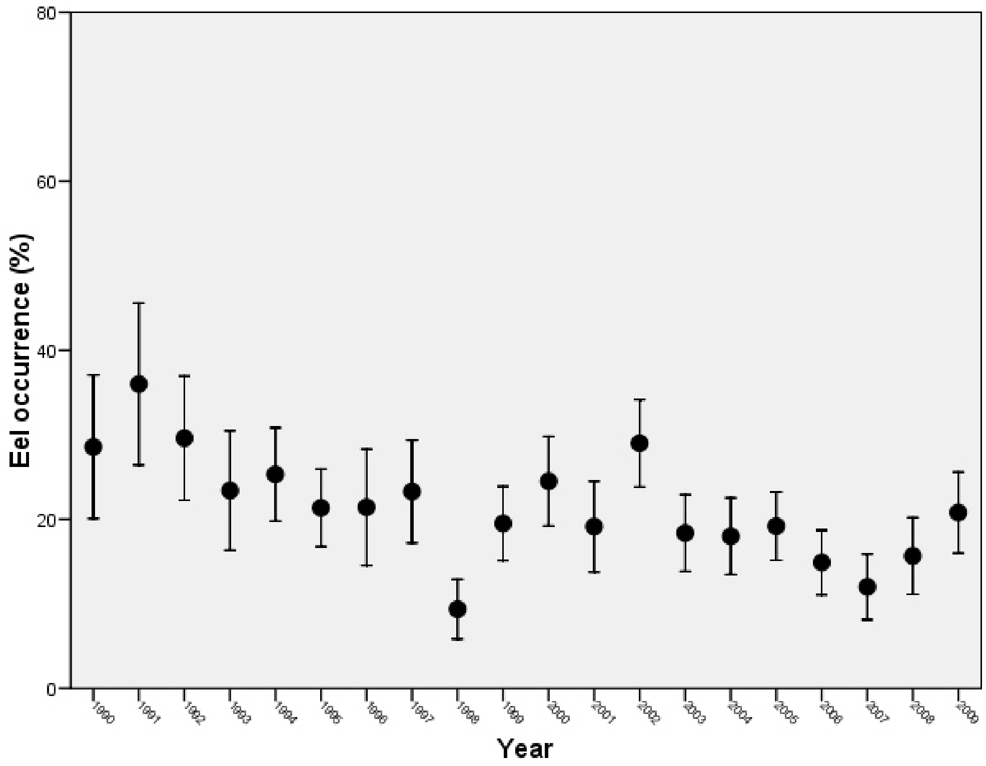


Figure SE.24. Proportion of electrofished stations (%) with eel occurrence (+/- 95% CI) along the East Coast. Stations that were fished in 1990–2009 in this figure are situated from 0 to 100 m asl in seven counties along the Baltic Sea Coast. Note that local abundance is not given here, only presence/absence. Data from SERS (Swedish Electrofishing Register). The negative trend is significant (Pearson correlation, n=20, r=-0,648, p=0,002).

SE.9.3 Data on abundance

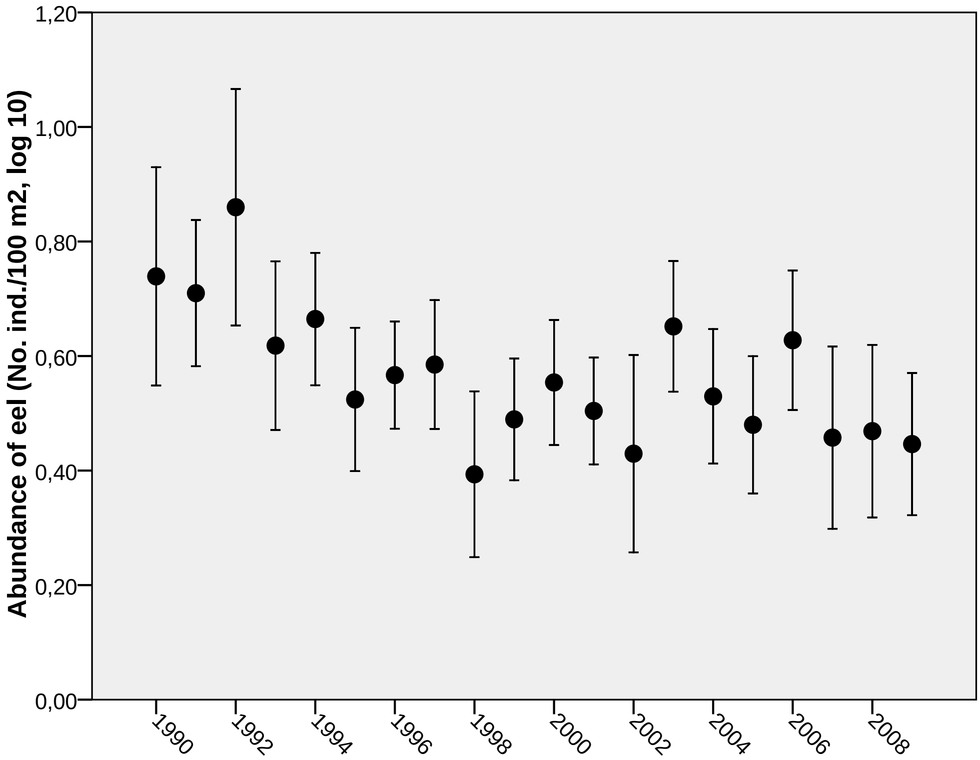


Figure SE.25. Abundance of eel (No. ind./100 m², log 10) along the West Coast (only the county of Halland). The stations that were fished in 1990–2009 are situated from 0 to 100 m asl. Data from SERS (Swedish Electrofishing Register). The negative trend is significant (Pearson correlation, n=20, r=-0,653, p=0,002).

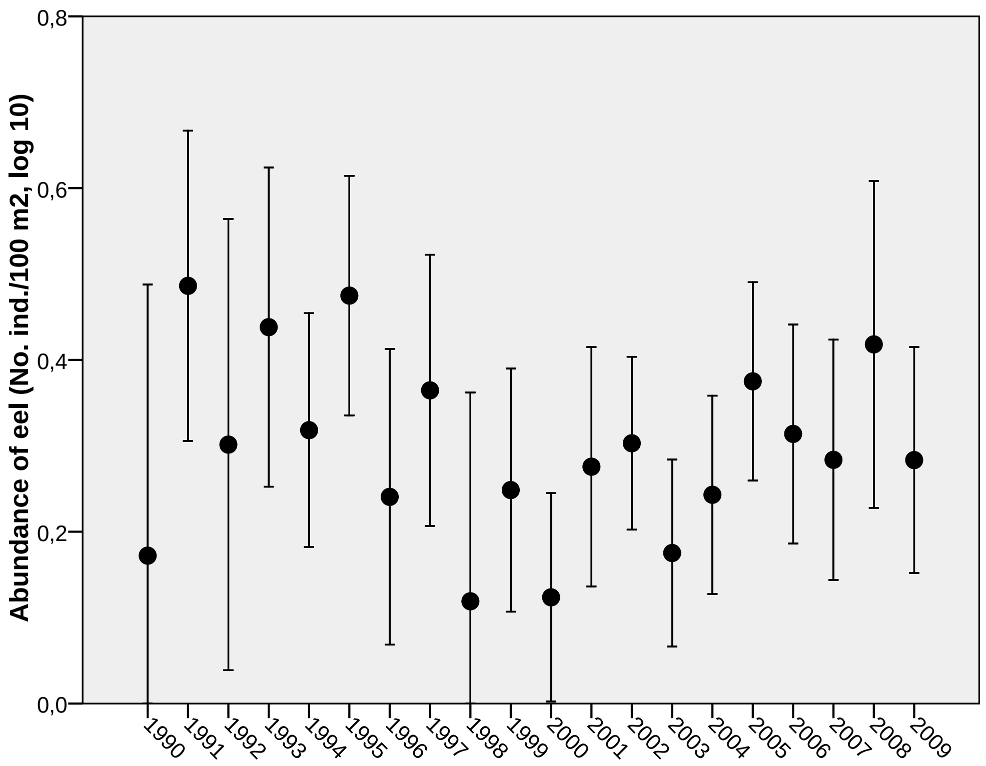


Figure SE.26. Abundance of eel (No. ind/100 m2, log 10) along the East Coast. Stations that were fished in 1990–2009 in this figure are situated from 0 to 100 m asl in seven counties along the Baltic Sea Coast. Data from SERS (Swedish Electrofishing Register). The negative trend is not significant (Pearson correlation, n=20, r=-0,118, p=0,622).

Figure SE. 27 shows these trends by River Basin District, but it should be noted that in doing so, data on many different rivers have been pooled, which might have blurred specific local patterns. Going from the west into the Baltic, the average density of the stock declines from ca. 2.5 eel per 100 m^2, down to only 0.05 eels per 100 m^2. In RBD Västerhavet and in Södra Östersjön, a declining trend is observed over the years; in RBD Norra Östersjön, densities are too low to detect any trend.

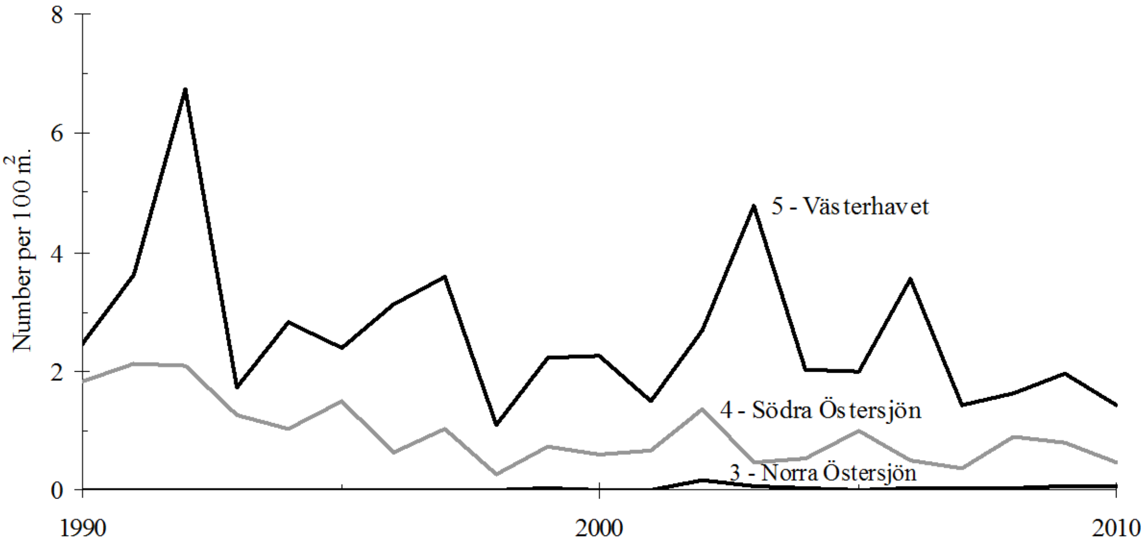


Figure SE.27. Trend in electrofishing survey catches in inland waters, by river basin district. Data before 1990 are absent and/or unreliable.

SE.9.4 Stock surveys, yellow eel

The coastal fish communities on the Swedish west coast are monitored by standardized fishing with fykenets in shallow water (2–5 m). Yellow eel is among the dominating fish species in August most years. The trend for the longest time-series from Vendelsö in N Kattegat is significantly positive (Figure SE. 28). No trend exists in the other long time-series from Barsebäck in the Öresund. No trends exist in other areas, although the tendency is negative in some areas in recent years. The magnitude of cpue though, was similar to that of the longer series. The interannual variations in cpue were influenced by water temperature at the time of sampling. Cpue at Vendelsö was positively correlated with seawater temperature on this site ($p<0,01$, $r2=0,32$ in 1988-2010) and also to catches at Barsebäck ($p<0,05$, $r2=0,21$ in 1988–2009). However, no time-trend in temperature was observed for the period with available data (1988–2010).

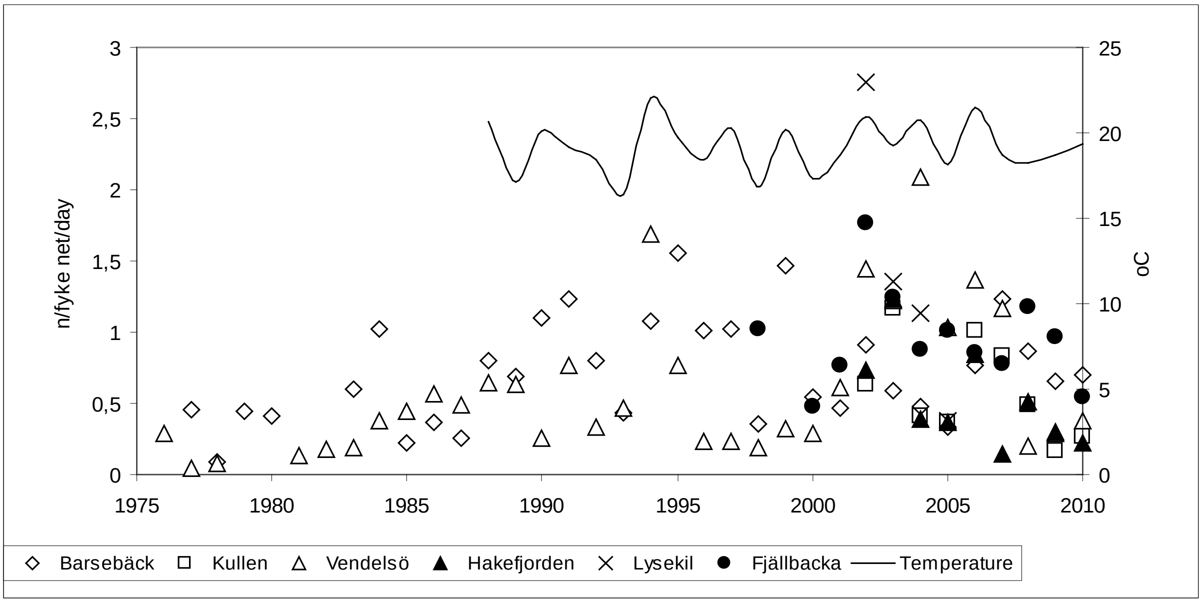


Figure SE.28. Time-trend in the yellow eel catches in coastal fish monitoring with fykenets in August on the Swedish west coast. Annual mean water temperature at the fishing gears is presented for the Vendelsö area in central Kattegat.

The time-series from Barsebäck and Vendelsö are financed by industrial monitoring and thus depend on the operation of two nuclear power plants. The power plant at Barsebäck in the Öresund was closed in 2005 and the Swedish Board of Fisheries expressed the ambition to secure this series for continuing monitoring in this transition area between the Baltic Sea and the Kattegat. Fjällbacka on the northern Skagerrak coast is a reference area in the national programme for environmental monitoring and future funding is considered to be secure. Other reference areas are all depending of annual funding and priority processes within governmental planning.

SE.9.5 Scientific surveys of restocked eels

As part of our national eel research programme some stocked eel populations were for many years continuously studied mainly by test-fishing or by the use of permanent outlet traps (cf. Westin, 2003 and Wickström *et al.*, 1996). In some cases the stocked eels were marked or tagged with $SrCl_2$, Alizarin Red and PIT-tags, respectively. In e.g. Lake Mälaren 5000 glass eels were marked with Alizarin Complexone in 1997 and a few years later marked eels dominated the catch in an experimental test fishing with fykenets at that site (Figure SE. 29). In 2011 some 2000 glass eels were marked also with $BaCl_2$ before being stocked at the same site as in 1997.

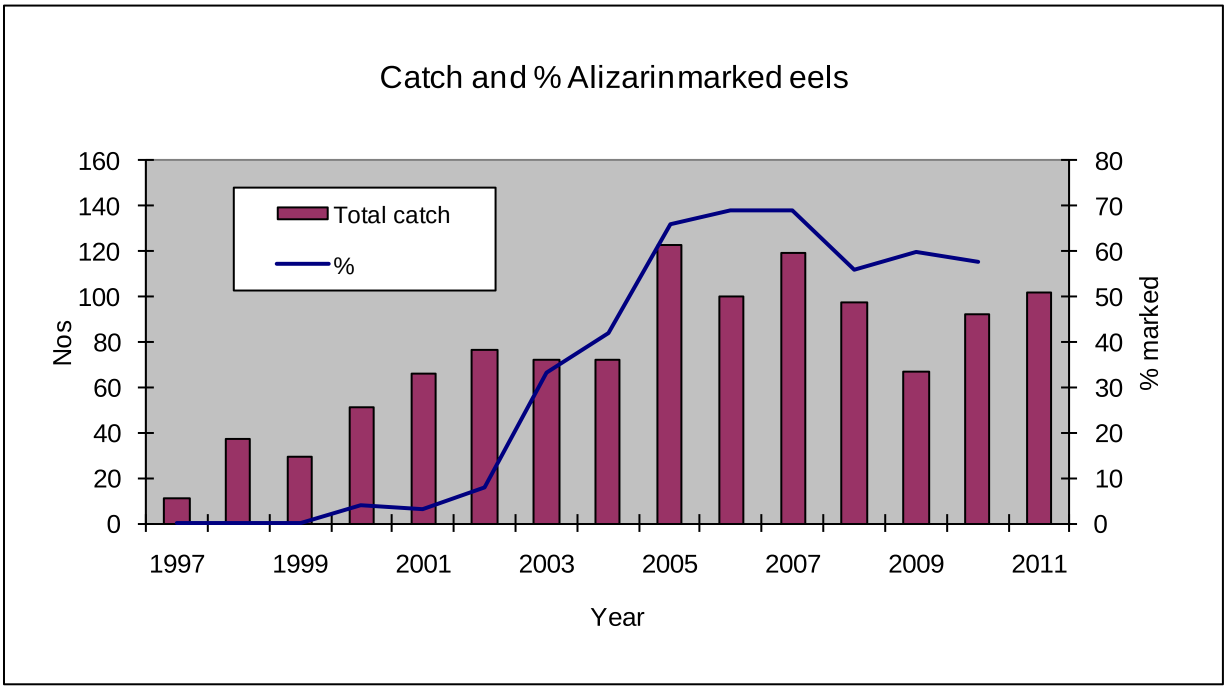


Figure SE.29. Proportions of marked stocked eels in Lake Mälaren.

SE.9.6 Stock surveys, silver eel

C.f. Section SE.12.1.

SE.10 Catch composition by age and length

SE.10.1 Length- and age composition of the catch

Length compositions of fykenet catches sampled in the 2000s along the west coast and in the Öresund are quite comparable (Figure SE. 30): the interval between 40 and 50 cm dominates the catch, and frequencies decline with length to almost zero around 70 cm. The difference between the early and the late 2000s in Skagerrak area and in Öresund might have been related to a change in legal size, changing sampling sites, or be real. Sampling in the central Baltic focused on unsorted catches. Here, the most abundant size class is 50–60 cm, and larger eels are considerably more abundant than on the west coast, while the smaller eels (<40 cm) are relatively scarce.

For the average size of silver eels, there is a clear trend going from the central Baltic towards Öresund, finding smaller and smaller sizes. In the central Baltic, few eels are shorter than legal size (65 cm in 2010), while in Skåne, 40% of the catch is below legal size; here, they are even a bit shorter than in the (northern) Öresund, while in Öresund a legal size of 40 cm applied (2010).

Catches in inland waters consist predominantly of silver eels; their lengths vary from the legal size (65 cm) to 100 cm or more. There is a slight tendency for northern lakes to produce larger eels, but otherwise, the length composition varies from lake to lake without any clear pattern.

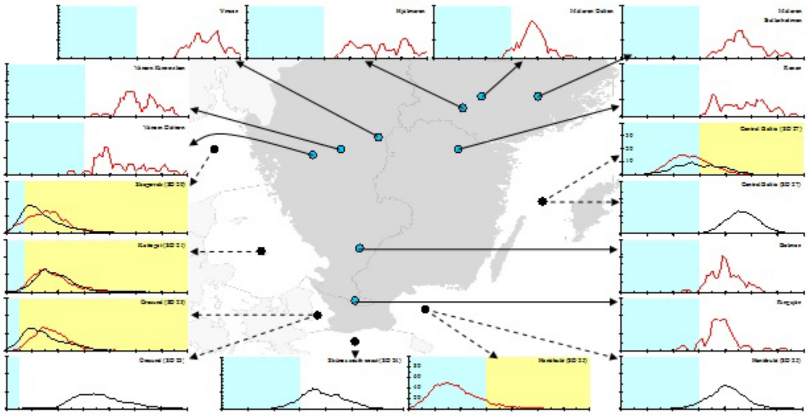


Figure SE.30. Length composition of (sorted or unsorted) commercial catches. All observations have been scaled to 100% over the length classes above the local legal size. The shadowed area marks the legal size. Moving averages over 3 cm; vertical scales for all plots 0–15%, except where otherwise indicated.

For yellow eel, the age composition from commercial catches does not show marked differences between coastal areas (Figure SE. 31). Most yellow eels are between five and 15 years old, all between the inner Baltic and the Skagerrak coast. Differences between years of sampling are small too. Only in Öresund were much younger eels observed than in the other areas.

For silver eel, the age composition varies considerably between the Baltic and Öresund (Figure SE. 31). Samples from poundnets taken in the 2000s have shown eels between five and 25 years old. In the central Baltic and Hanöbukten, ages vary between 10 and 20 years, while along the south coasts of Skåne and in Öresund the eels are a bit younger. A relatively large share of the eels from Öresund was ten years or younger, in both sampling periods.

Silver eel age in inland waters is dominated by age groups between 10 and 20 years old, but the oldest eels can be up to 30 years or more.

In over 6000 yellow eels sampled in 2006–2010, females were absolutely dominating. Males lacked completely in the central Baltic. The relatively largest share of males was found along Skagerrak coast, where approx 4% of 2500 yellow eels analysed were male. In the other areas, less than 1% was male.

In nearly 5000 silver eels sampled in 2007–2010, only 19 males were found, most of them in Öresund, making 1.8%. This will be an overestimate, because sampling in recent years was length-stratified, with a fixed number of eels per cm. Only three males were found along the Baltic coast, all on Skåne's south coast.

In inland waters, catches consist of female eels only, which will relate to the high legal size (males rarely become bigger than 50 cm, legal size is 65 cm). In scientific surveys, a few males have ever been observed, but the total number is still extremely low.

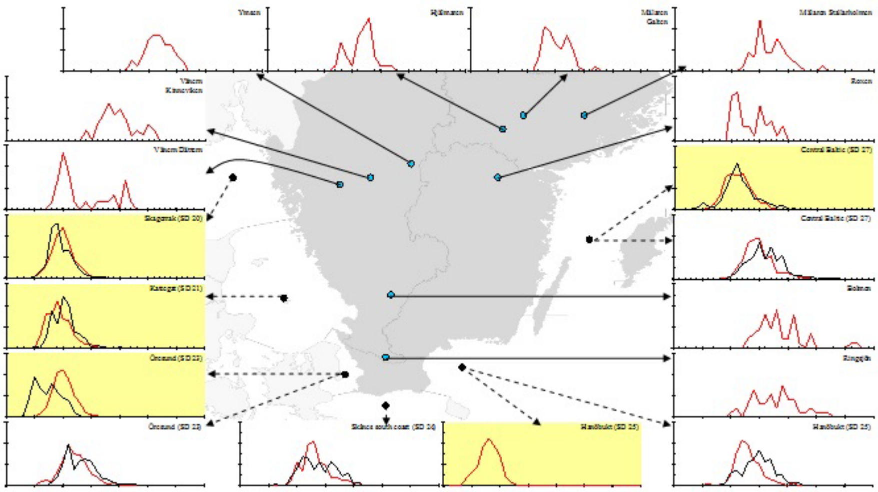
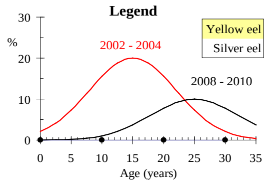


Figure SE.31. Age composition of yellow and silver eel from commercial catches, taken from poundnets. Most samples were unsorted for the legal size. (No moving average; vertical scale for all plots 0-30%)



SE.11 Other biological sampling

SE.11.1 Growth

Annual growth for the yellow eel stage has been calculated as the difference between the final length and the glass eel length, divided by the number of years in between, and averaged over all eels being sampled. In coastal waters, annual growth varied between 45 and 52 mm per year, with a tendency to grow a bit faster in the Baltic proper (Figure SE. 32).

For silver eel, it is less certain than for yellow eel that locally observed average growth rate indeed reflects the local circumstances, because the silver eels might have come from different places. Observed growth rates showed little variation along the east and south coasts; mostly around 50 mm per year, which most closely resembles the growth rate of yellow eel in the Baltic proper.

Growth of silver eel in inland waters varies between 36 and 55 mm per year, without a clear trend; growth can vary from lake to lake. In inland waters, local circumstances apparently determine the growth, even in silver eel.

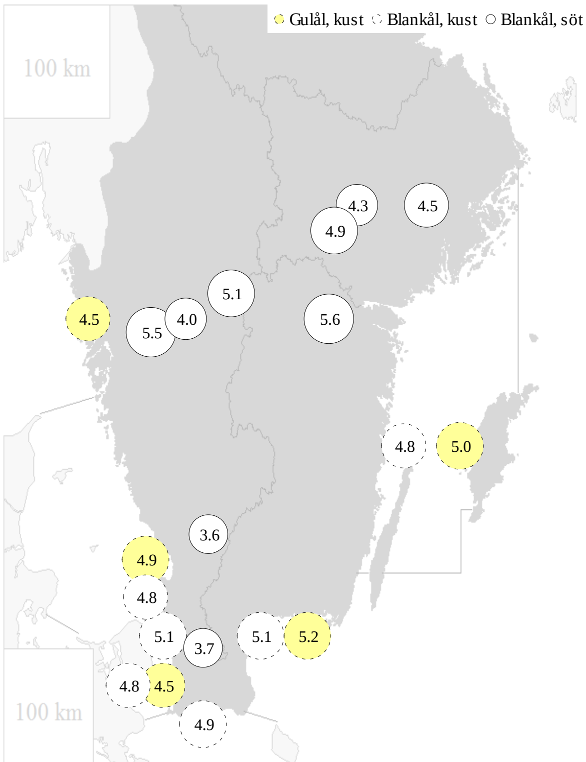


Figure SE.32. Average growth rate in cm per year, for yellow and silver eel, in freshwater and coastal areas.

SE.11.2 Parasites and pathogens

The prevalence of the swimbladder parasite *Anguillicoloides crassus* has been monitored in samples taken from commercial catches, in freshwater and coastal areas. The prevalence in yellow eel was generally lower in marine areas along the west coast, going up to 6% in Skagerrak and 13% in the southern Kattegat, while more than 50% of the yellow eels had parasites in both Baltic areas (Figure SE. 33). Silver eels were less infected in general, and differences between sites were smaller. In inland lakes, prevalence was generally much higher (79–94%), although only 27% of the eels in Lake Hjälmaren were infected.

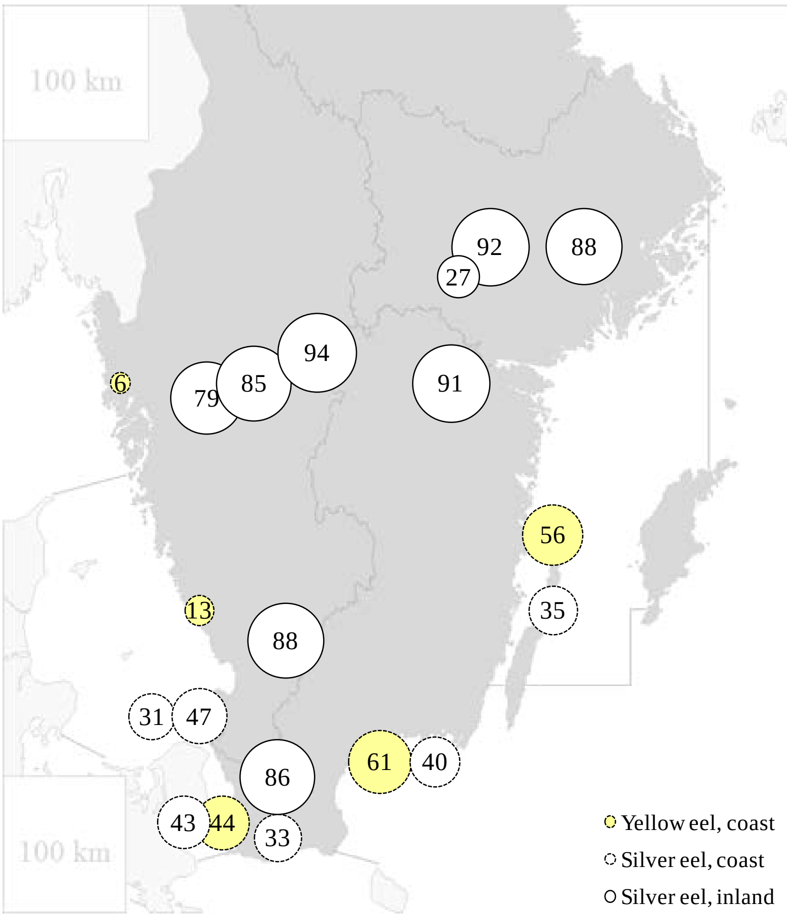


Figure SE.33. Prevalence (%) of the swimbladder parasite *Anguillicoloides crassus* in yellow and silver eel, in the 2000s.

Time-trends for the prevalence of *Anguillicoloides crassus* from eels in two lakes are presented below (Figure SE. 34 and Figure SE. 35).

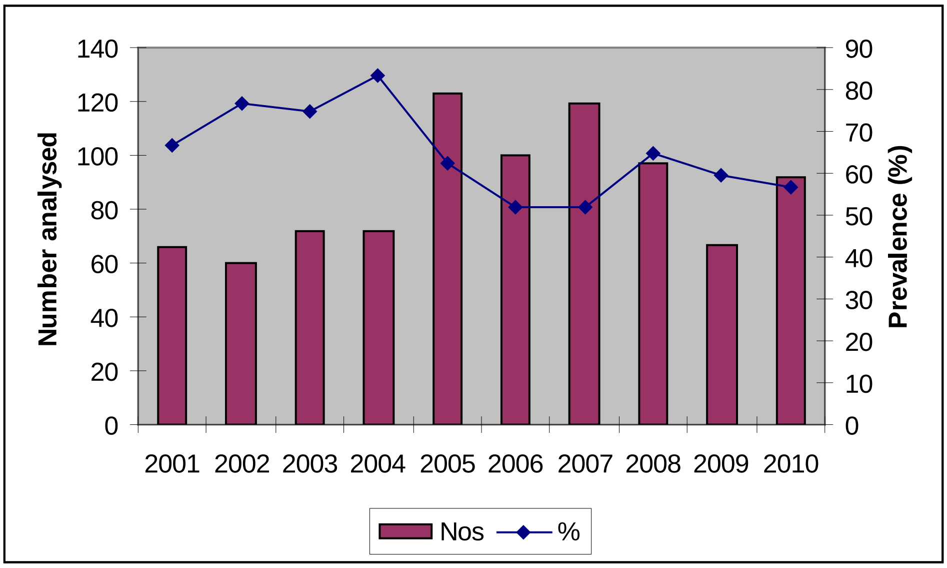


Figure SE.34. *Anguillicoloides crassus* from eels in eels from Lake Mälaren.

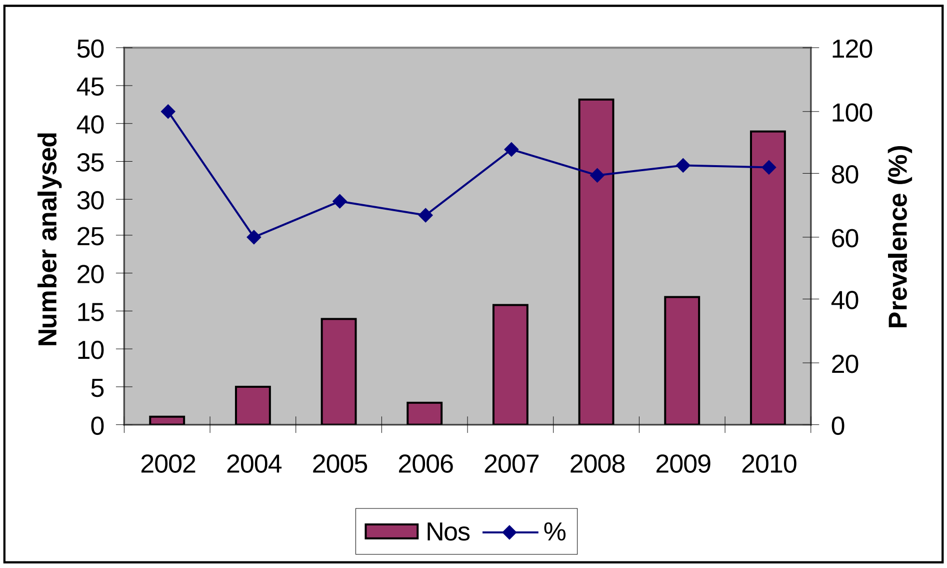


Figure SE.35. ***Anguillicoloides crassus*** **from eels in eels from Lake Ymsen.**

SE.11.3 Contaminants

SLV (the National Food Administration) has analysed two pooled samples of eel from 2010 in Lake Vänern. They were analysed regarding dioxins, furans and PCB. All values were below allowed limits as well as action levels. However, there were significant differences between eels from the two sites in the lake (Gitte Eskhult, SLV, pers. comm.).

SE.11.4 Predation by cormorants

Preliminary analysis of the stomach contents of cormorant that were shot shows considerable differences between areas and seasons. In a sample of 467 stomachs analysed from the west coast, eel made up only 1% of the consumed biomass outside the cormorant breeding season, and around 3% in the cormorant breeding season. The latter value, however, relates to only 10% of the total number of stomachs analysed. The highest percentages of eel were found in 44 stomachs collected in winter in the coastal area around Karlskrona in 2009 and 2010. In that material, eel made up ca. 25% of the stomach content, and some eels up to 70 cm in length were observed. Unlike the west coast, eels did not occur in samples collected during the cormorant breeding season here. In Mönsterås, northern Kalmarsund, only a single eel was found in nearly 200 stomachs being sampled, that was ca. 2% of the diet outside the cormorant breeding season.

To assess the impact of cormorant predation on eel, detailed information on abundance and seasonality of the cormorant stock is required. That information is currently not (yet) available. According to the Swedish Ornithological Society, 45 000 breeding pairs occurred in 2006, and each bird consumed 0.3–0.5 kg of fish food per day. Using these figures, the total fish consumption by cormorants is considerable, and even a small percentage of eel in the diet would already constitute a significant impact on the eel stock, possibly in the order of 100 t or more.

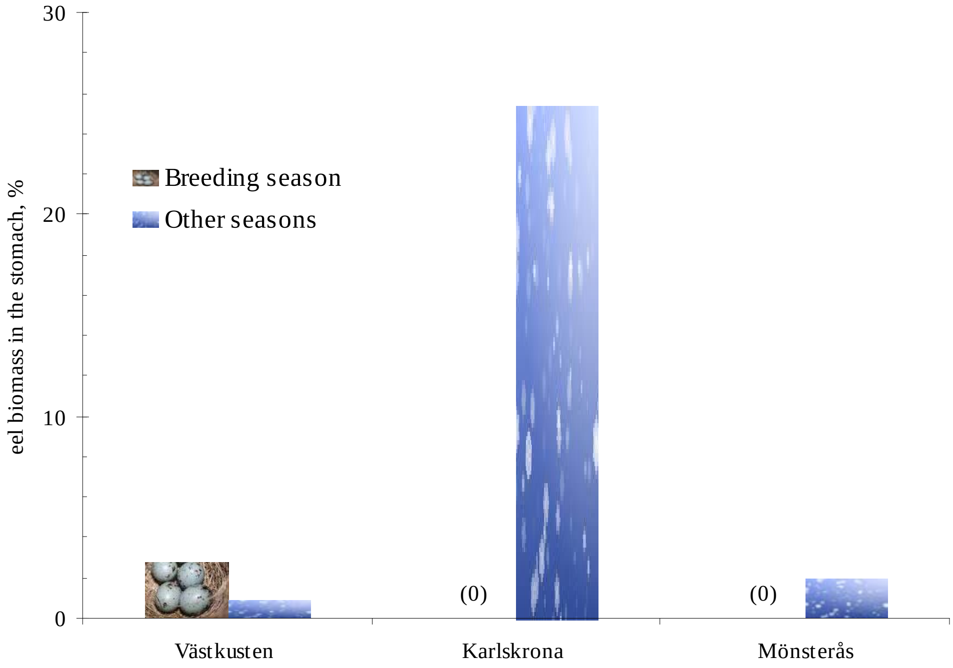


Figure SE.36. The fraction of eel in the diet of cormorants, collected during breeding season and other parts of the year, respectively in coastal areas in 1999–2010 (preliminary data from Swedish Board of Fisheries, Coastal Institute).

SE.11.5 Quality aspects of size and fat content

As previously mentioned eels from the central Baltic Proper (ICES Subdivision 27) as well as eels from important Swedish freshwater lakes have the highest mean body length and weight-at-age. In a recently published study (Clevestam *et al.*, 2011), the effect of body size on the cost of migration is demonstrated. The study shows that a large body size (given a normal body fat level) is crucial to successful migration and/or subsequent reproduction of female silver eels exiting the Baltic Sea making only the large eel probable candidates for reproduction.

SE.12 Other sampling

SE.12.1 Mark-recapture

Since the early 1900s, information on the silver eel migration and fisheries has been obtained by means of mark–recapture experiments. A number of silver eels is caught, a Carlin-type of tag is inserted in their back, and then they are released again. Fishers catching a marked eel were asked to return the tag and/or the eel, and were given a reward. Figure SE. 38 shows the trend in the number of tags released since 1900 and Figure SE. 37 shows the areas where recent releases have been done.

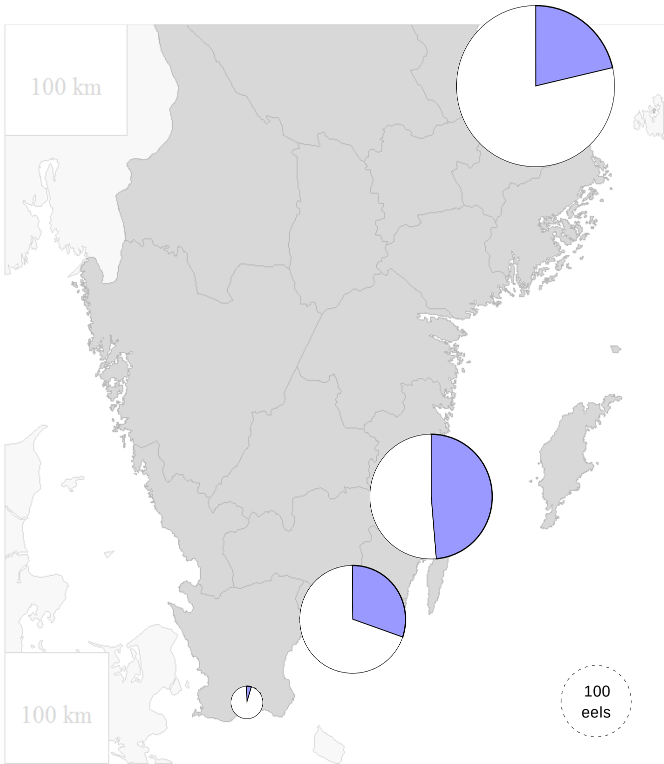


Figure SE.37. Number of silver eels tagged (bubble size) and number recaptured (blue sector) by county in which they were released. This map shows the number of eels being tagged since the year 2000.

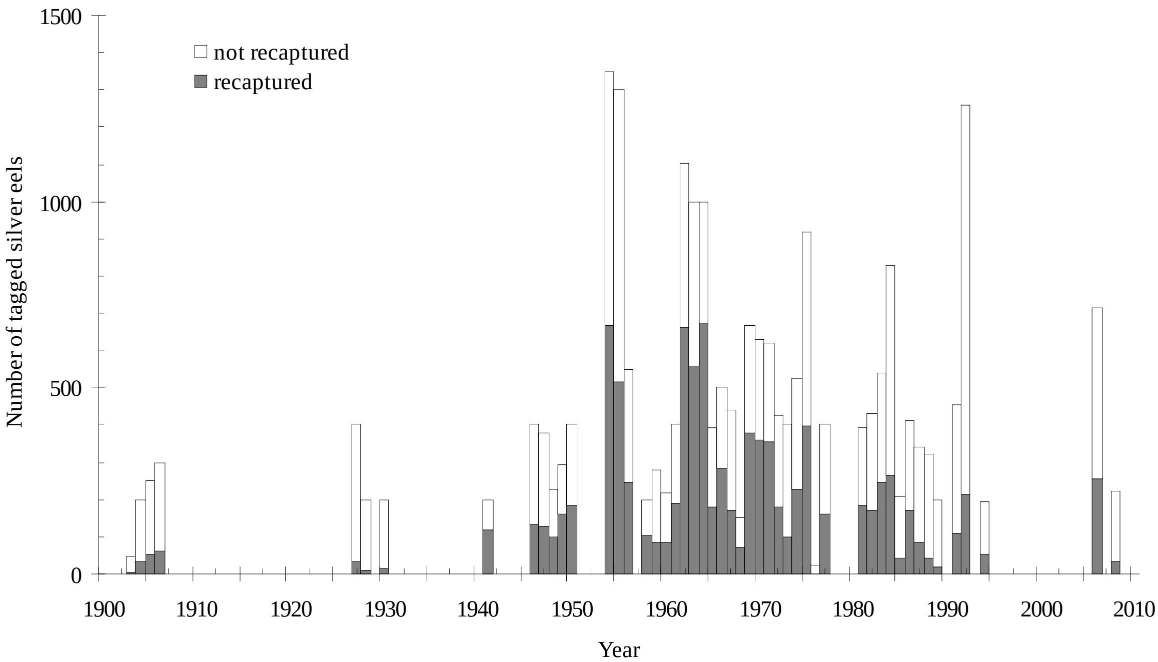


Figure SE.38. The time-trend in the number of silver eels tagged and recaptured.

As part of the EELIAD project (http://www.eeliad.com/) as well as of national projects, silver eels are tagged and followed both in Lake Mälaren, in the Baltic and in the Kattegat-Skagerrak area. From the use of Data Storage Tags (DST) we learn about the migration of silver eels with respect to time, depth and temperature. One silver eel tagged with a DST in the Straits between Sweden and Denmark in November 2008 was recognized (as a tag only) from the Shetland Isles in March 2009, i.e. six months later. The migratory trajectory was characterized by a diurnal diving to great depths and low temperatures. Since then two more recaptures of significance were done, one from Orkney and one from Lofoten (northern Norway), all indicating a northern migration route towards the Atlantic Ocean and verifying those diurnal dives. So far 120 silver eels from Sweden were tagged with different kinds of Data Storage Tags. They were most probable of both natural and of stocked origin.

SE.13 Stock assessment

SE.13.1 Local stock assessment

Pending the post-evaluation in 2012, no updated local assessments have been produced. Data collection and getting an overview of the 2012 requirements and opportunities have had highest priority. For the coastal silver eel fishery, a re-analysis of the mark–recapture data has shown a considerable lower mortality rate than assumed (~10% instead of 30%); pending publications of this improved analysis, the previous and updated estimates will be shown in parallel. Coming winter, updated assessments of yellow eel fisheries, silver eel fisheries and hydropower impact are foreseen.

SE.13.2 Habitat

Wetted Area : lacustrine
riverine
transitional & lagoon
coastal

The Swedish eel stock occurs in coastal waters, rivers and lakes. The abundance of the stock is related to the distance to the sea, the presence of migration obstacles, the ambient temperature and the remoteness of the entrance to the Baltic.

Figure SE. 39 present the surface area available, without correction for related factors.

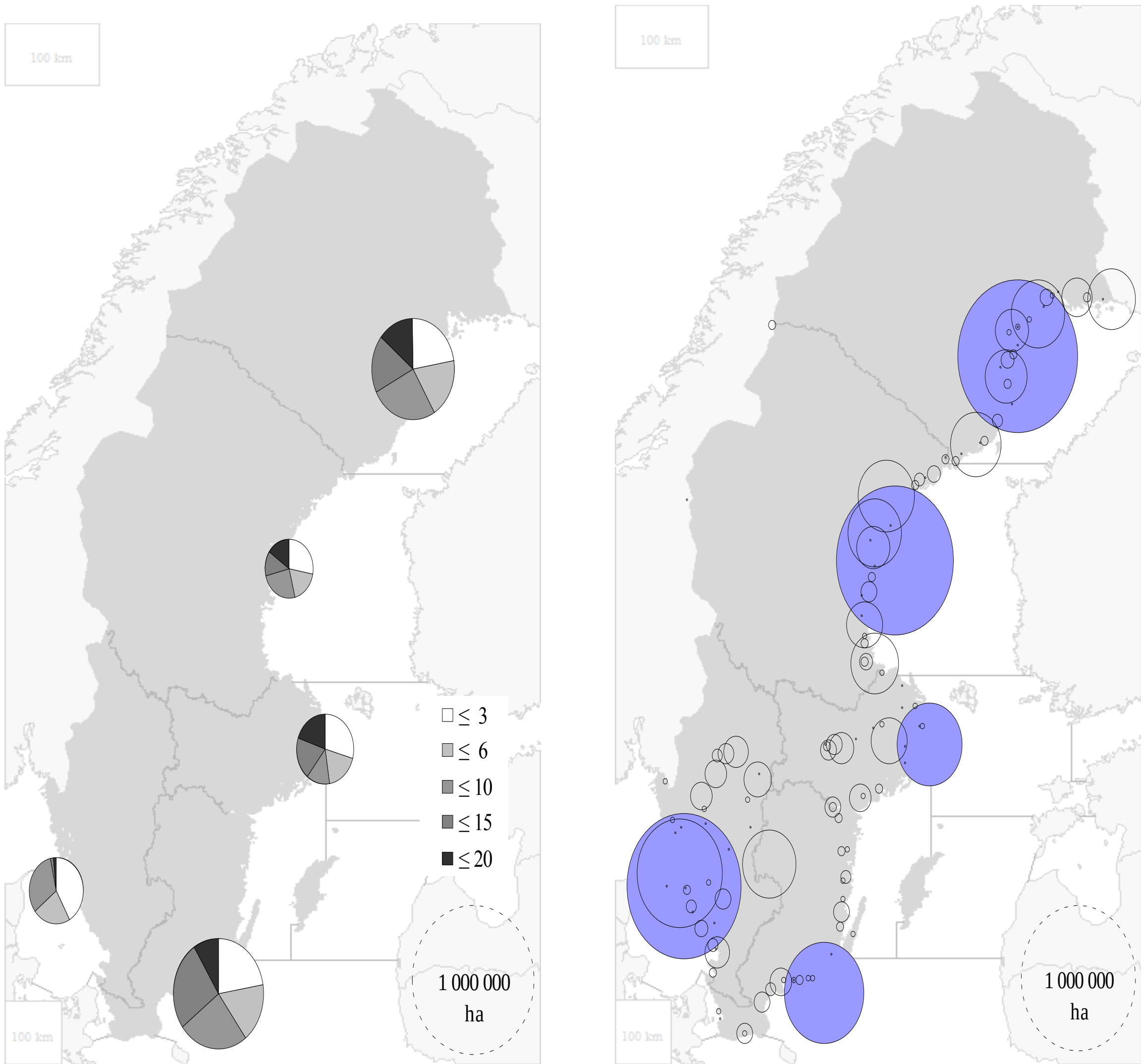


Figure SE.39. Surface area of habitats by river basin district. Left: coastal habitats by depth zone, right: freshwater (colour=river basin district, grey=individual rivers).

SE.13.3 Productivity of inland waters

The biological production of eel in inland waters is estimated in the Swedish EMP on the basis of the surface areas of habitats and the relation between known productivity (local fishing yield) and temperature, nutrients and distance to the sea/Skagerrak. Production has been estimated for 32 500 individual lakes; Figure SE. 40 shows the sums per river basin district. The total productivity is estimated at nearly 350 tons. Approximately 42% of this comes from lakes draining to the west coast; less than 10% from lakes draining to Bottenviken and Bottenhavet; 21% from lakes draining to the northern Baltic and 27% from lakes draining to the southern Baltic.

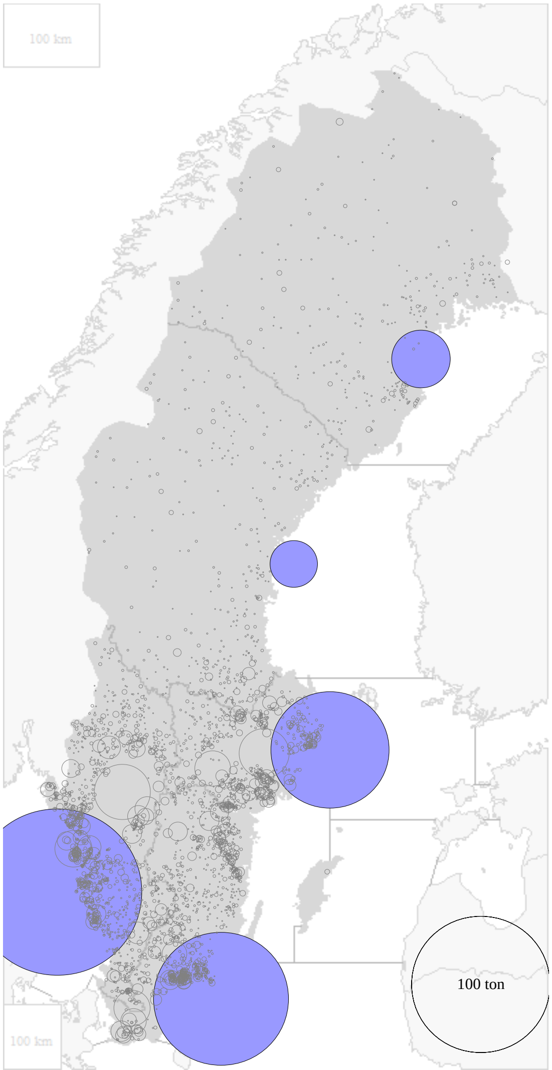


Figure SE.40. Productivity of inland waters, predicted from water surface area, temperature, phosphorus content and distance to the sea/Skagerrak. This map shows the estimated total productivity per river basin district, in tonne per year (colour) and individual lakes (though lakes with total production < 10 kg have been left out).

SE.13.4 Silver eel production

The 2009 EMP estimates productivity of inland waters, the impact of hydropower generation and the catch by (inland and coastal) fisheries. The estimates are summarized in Table SE. 10, below.

Table SE.10. Estimates of habitat productivity, impact of fishing and hydropower, and silver eel escapement, expressed in terms of biomass (tons per year). This table gives the quantity of eel being produced/fished/killed/escaping in the current situation, i.e. at current low recruitment. Data from the EMP, or derived from that.

	West Coast	Inland, west	Inland, east	Baltic coasts	Total
Potential production (ton/yr)	436	132	151	1413	2132
Fisheries					
Yellow eel	190	12	17	40	259
Silver eel	2	35	52	350	438
Hydropower mortality					
Silver eel	-	113	157	-	270
Escapement					
Silver eel, cf EMP 2009	68	5	7	642	722
Silver eel, cf updates				3,328	3407

SE.13.5 Impacts

Table SE.11. Estimates of the impact of fishing and hydropower in mortality terms. This table gives the impact of fishing and hydropower as a percentage of the stock being impacted, resp. as an instantaneous mortality rate. Data from the EMP, or derived from that.

	West Coast	Inland, west	Inland, east	Baltic coasts		Average	
				EMP 2009	updated	EMP 2009	updates
Fisheries							
Percentage mortality %	84	29	29	35	10		
ΣA, cumulative mortality rate	1.86	0.34	0.34	0.44	0.10		
Hydropower mortality							
Percentage mortality %	-	96	96	-			
ΣA, cumulative mortality rate		3.19	3.19				
Total							
Percentage mortality %	84	97	97	35	10	60	24
ΣA, cumulative mortality rate	1.86	3.52	3.55	0.44	0.10	0.93	0.28

SE.13.6 Fisheries mortality

SE.13.6.1 Yellow eel fisheries

On the west coast during the years prior to 2009, the total catch has been 192 t on average, almost exclusively consisting of yellow eel. The length composition of the catches indicates that the fishery exerted a fishing mortality of ca. 27% per year (A=0.31), that is ca. 85% over the whole life time (ΣA=1.86).

On the east coast during the years prior to 2009, the total catch along the east coast has been nearly 400 t, less than 10% of which was yellow eel. Although the length distribution indicates a rather high mortality (only locally?), the landings are so small in comparison to other mortalities, that the Baltic yellow eel fishery is effectively ignored in this assessment.

In inland lakes during the years prior to 2009, the total catch per year has been 115 tons, of which ca. 40% is caught in lakes draining to the west-coast and 60% in lakes draining to the east coast. Less than 25% of this catch is yellow eel. The length frequency distribution indicates that the fishery exerts a fishing mortality of ca. 1% per year (A=0.01), that is ca. 6% over the whole life time (ΣA=0.06), but this mortality may vary considerably from area to area. There is as yet no information to differentiate between fishing mortality in east and west.

SE.13.6.2 Silver eel fisheries

In inland waters during the years prior to 2009, the total catch per year has been 115 tons, of which ca. 40% is caught in lakes draining to the west-coast and 60% in lakes draining to the east coast. Approximately 75% of this catch is silver eel. The total production of silver eel in inland waters is estimated at ca. 282 t. The fishery thus catches ca. 30% of the silver eel (ΣA=0.28). There is as yet no information to differentiate between fishing mortality in east and west.

On the east coast during the years prior to 2009, the total catch has been ca. 400 t, consisting for 90% or more of silver eel. Silver eel tagging experiments in the 1960s indicated that almost 50% of the tagged eel were recaptured; recent tagging experiments showed a return rate of only 30%. The tag return rate prior to 2009 was interpreted as a fishing mortality of 30% (A=0.44). However, closer inspection of the data shows that average fishing mortality is probably much lower, in the order of 10% (A=0.10). The tagging experiments often released silver eel in a far northern position, further north than most of the eel actually occur. Of these northern eel, 30% is recaptured indeed, but this is a rather exceptional situation. Most of the silver eel along the Baltic coast is derived from other countries in the Baltic, and most of these eels hit the Swedish coast only on the southern shores. For those eels on the southern shores, the mortality in the Swedish silver eel fishery is probably much lower than considered before, but the mortality in their area of origin should also be taken into account. In 2010, a start has been made to assess the interaction between eel stocks in different Baltic countries, but this has not yet resulted in quantitative estimates. Following the guidelines of the EU Regulation, only the national impacts will be considered here.

Pending the completion of the analysis of the historical tagging data, both the estimate in the EMP (30%, A=0.44) and the more detailed recent estimate (10%, A=0.10) will be shown in parallel.

SE.13.7 Hydropower mortality

The impact of hydropower generation on the emigrating eel stock is assessed on the basis of the productivity of inland waters, in combination with an estimated mortality of 70% per hydropower station, corresponding to over 90% mortality for an average eel going down several hydropower stations. The total impact of hydropower is estimated at 270 t, of which 58% comes from rivers draining to the east coast, i.e. 157 t and 42% comes from rivers draining to the west coast, i.e. 113 t.

SE.13.8 Overview of stock indicators

The information presented above is summarized here, in order to prepare for the assessment against the limits and targets of the management plans in the next section.

The escapement for the whole of Sweden is completely dominated by the silver eel migrating along the Baltic coast. The uncertainty about the actual size of this stock component is fully reflected in the estimated totals. Assuming an average impact of the coastal fishery of 30% (as in the EMP), total escapement comes at 722 t; the more recent estimate of 10% results in a total escapement of 3407 t.

The information in Table SE. 10 (above) is derived from different sources: production estimates from a statistical model analysing fishing yields, the fisheries catch from landings statistics, the escapement from mortality models using length–composition data and/or mark–recapture models, while the preliminary estimate of cormorant predation has as yet been left out here. Combining these estimates into a single table, it is clear that the match between the sources of information is unsatisfactory.

Biomass-indicators (Table SE. 10) reflect the distribution of the stock over different areas (inland vs. coast, east vs. west), but do not reflect the impact of fishing and hydropower mortality appropriately: low figures indicate a low impact, and/or a declining stock abundance (low recruitment!), and/or an area of natural low stock abundance. The next table (Table SE. 11) shows stock indicators in terms of mortality (percentages and mortality rates), that is: the impact (of fishing and hydropower) relative to the biomass of the stock component they are impacting. This table shows what percentage is caught/impacted, irrespective of the (current) stock abundance.

Mortality in inland areas is dominated by hydropower, while the coastal areas are dominated by fishing. As for the biomasses, the overall average mortality for the whole of Sweden reflects the uncertainty in the size of the Baltic coast stock component.

Table SE. 12 shows the stock indicators listed by SGIPEE, for the Swedish eel stock. For the fishery on the Baltic coast, both the estimate used in the Eel Management Plan and the more recent estimate is shown. For B_0, the biomass of silver eel escaping to the ocean from a healthy stock without anthropogenic impacts, the Eel Management Plan discusses an estimate based on historical landing records from the fishery, but it is noted that this estimate is quite uncertain.

Table SE. 12 follows the same methodology, and it is therefore noted again that the estimates are very uncertain.

Table SE.12. Stock status indicators. This table presents estimates of the quantity of silver eels that currently escapes ($B_{current}$), that could currently escape if no anthropogenic impacts existed (B_{best}), and that would escape if the stock was in a healthy condition (B_0). Data from the 2009 EMP, or derived from that.

	West Coast	Inland, west	Inland, east	Baltic coasts		Total / Average	
				EMP 2009	updated	EMP 2009	updated
B_{2009}	68	5	7	642	3,328	722	3,407
B_{best}	436	164	233	992	3,678	1,825	4,510
B_0	526	403	559	6,453	23,920	7,940	25,407
%SPR percentage survival %	16	3	3	65	90	40	76
ΣA cumulative mortality rate	1.86	3.52	3.55	0.44	0.10	0.93	0.28

SE.13.9 The contribution of restocking and transport to the inland stock

From the 1910s/1920s until the 2000s, the commercial catch in smaller lakes and rivers ("Övriga vatten", Figure SE. 15) has declined from 180 t to ca. 30 t per year; only 15% of the historical catch remains. Declining natural recruitment and obstructed migration routes probably have contributed to this decline. During the same period, the commercial catches in the great lakes (sum of Mälaren, Hjälmaren, Vättern and Vänern, Figure SE. 15) increased from 30 t to 80 t per year. Assuming that recruitment decline and migration obstructions have affected the natural recruitment into the great lakes to the same degree as the smaller lakes, one would expect a catch of ca.

15% of the historical 30 t, that is: only 5 t per year. Are the remaining 75 t of restocked origin?

During their migration into freshwater, eels build up their bones; afterwards "reading" the chemical composition of their bones (the Strontium content in comparison to the Calcium content) provides evidence on their individual history, in particular whether they resided in marine, brackish or freshwater. Were they gradually moving from the sea into inland waters (natural immigrants), or were they suddenly transported from estuaries to freshwater (restocked and/or transported eels)? Detailed analysis of eels from commercial catches in the great lakes has shown, that approximately 95% of them show a Strontium pattern that indicates a restocking/transport background, and only 5% show a natural recruitment pattern. That supports the inference made above, that the majority of catches is made from eels of restocking/transporting origin.

In the 1990s, the number of eels restocked/transported into the great lakes has varied around an average of 3 million glass eel equivalents (see Section 3.5). Assuming a growth rate of 45 mm per year (see Section SE.11) and a natural mortality of 13% (a common assumption), the expected production of these restocked/transported eels comes at ca. 220 t of silver eel, about one-third of which will have been caught (Section 13.6.2) 70 t. That is: the "observed" yield of eels derived from restocking agrees well with the expected quantity.

The level of restocking has declined since 2000, but these later restockings have as yet not contributed substantially to the commercial fishery.

According to the Eel Management Plan 2009, restocking quantities are to be doubled, restoring the level that occurred in the late 1990s. This is expected to increase the production by 185 thousand silver eels, producing between 80 and 160 t of silver eels. What contribution this can make to the overall escapement is hard to express, since historical restockings were made to waters above hydropower stations that were exploited by the fishery; recent restocking has focused on unexploited, unobstructed rivers on the West coast. Without fishery and hydropower impacts, the contribution of restocking would be 25% of B_{best} for the inland stock (B_{best}: the silver eel escapement from the current stock, assuming no impacts from fisheries or hydropower); expressed as a (negative) mortality rate, this comes at -0.22 for the whole inland stock.

These preliminary estimates of the effect of restocking/transporting is tentatively included in the predicted effect of the management measures in the EMP (shown by the arrows in Figure SE.42 and Figure SE.43). Recent restocking is actually focused on rivers draining to the west, and therefore, the expected (negative) mortality effect is shown focused on that area only. Because the natural stock in the westward-draining rivers is only a part of the total inland stock, this focus on these rivers increases the percent-wise (positive) impact restocking has, and thus enlarges the expressed (negative) mortality rate for restocking (that is a mathematical issue, not a biological effect). Comparing east to west for inland areas in Figure SE.42 and Figure SE.43 shows exactly the effect the increased restocking is expected to have. For the overall effect on the whole Swedish stock, the effect is too small to be visible in these figures.

SE.13.10 The limits/targets of the Swedish Eel Management Plan

Figure SE. 41 (below) summarizes the stock indicators and management targets of the Swedish Eel Management Plan. In this figure, all quantities are expressed as (the equivalent of) numbers of silver eels, while above the same quantities have been expressed in terms of weight (biomass in t). This change in units makes a considerable difference only for the west coast fishery, targeting smaller sizes than all other impacts.

If no fishing occurred and hydropower would have no impact, escapement from the current stock is calculated at slightly less than 3 million silver eels (second line in Figure SE.41, best achievable). An anthropogenic impact on the natural stock of less than 0.4 million silver eels will be within the limits set in the Eel Management Plan (third line, limit impact). Continuation and extending the restocking programme will add another 0.5 million, making a total of 0.9 million. The 2008 impact was estimated at 1.7 million; the target for 2012 is to reduce the impacts to 0.9 million silver eels. This will require a 50% reduction in fishing and hydropower impact.

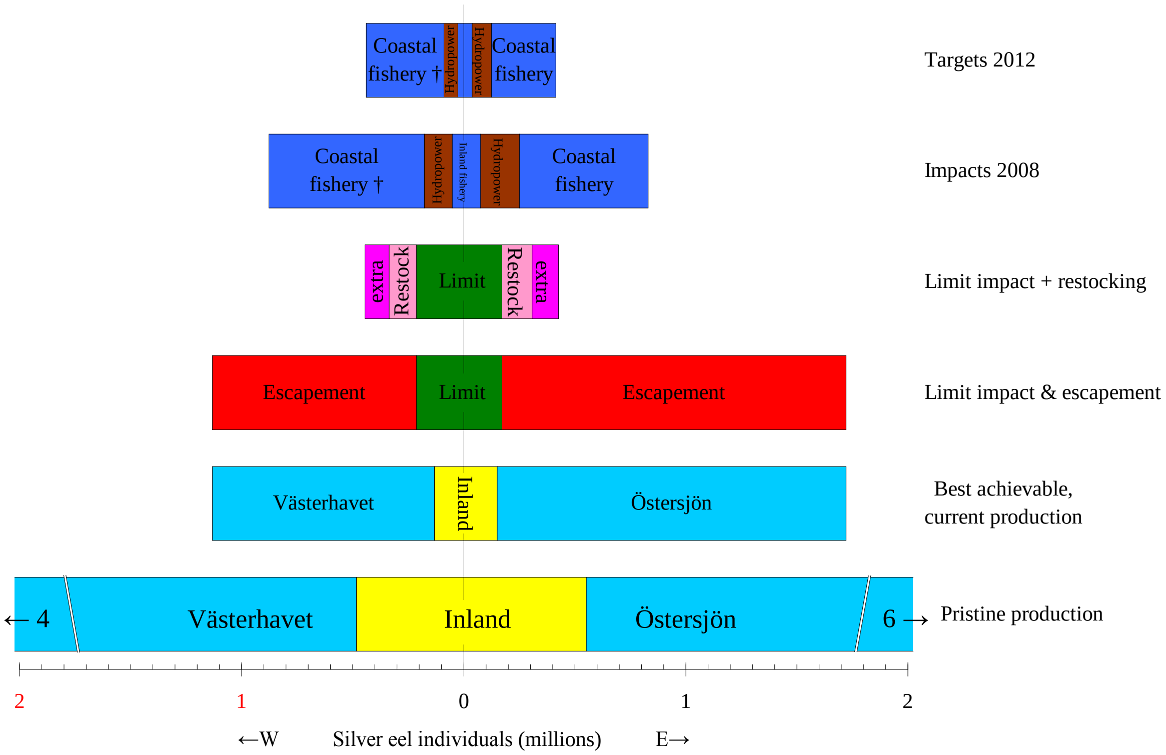


Figure SE.41. Summary of the stock status indicators and management targets of the Swedish Eel Management Plan. The West coast and the inland waters draining towards the west have been plotted to the left, the East to the right. The two bottom bars give the estimated total production from the pristine stock and from the current stock. The third bar indicates the limit on the anthropogenic impact relative to the silver eel escapement. The fourth bar adds the production from restocked eel, at historical (pink) and future (purple) level. The top two bars show the impact of fishing (blue) and hydropower (brown), before and after implementation of the Eel Management Plan. All quantities expressed as (the equivalent of) number of silver eels.

† For the west coast fishery, the impact in numbers is high in comparison to the weight being landed, because of the smaller average size in the catch.

SE.13.11 The stock status in relation to the targets

Figure SE. 42 (below) presents the status for four parts of the stock: the inland and the coastal parts, for (rivers draining to) the west coast and the east coast separately. These diagrams plot the most recent stock assessment, presented in the Swedish Eel

Management Plan (2009); with the exception of the silver eel fishery on the east coast, for which the 2009-version and an updated assessment are presented separately.

The background colours in these diagrams reflect the target of the EU Regulation (the limit of the red zone) and the precautionary advice given by ICES (the target of the green zone)[1]. Additionally, arrows indicate what effect the planned measures of the Eel Management Plan 2009 are expected to have; that is where the bubble is supposed to be in 2012.

The first diagram is based on the data and estimates of the Swedish Eel Management Plan 2009; the second diagram uses the recently updated estimate of the impact by the east coast fishery. However, this updating does not yet take into account the origin of the coastal stock, in particular the anthropogenic impacts in their countries of origin.

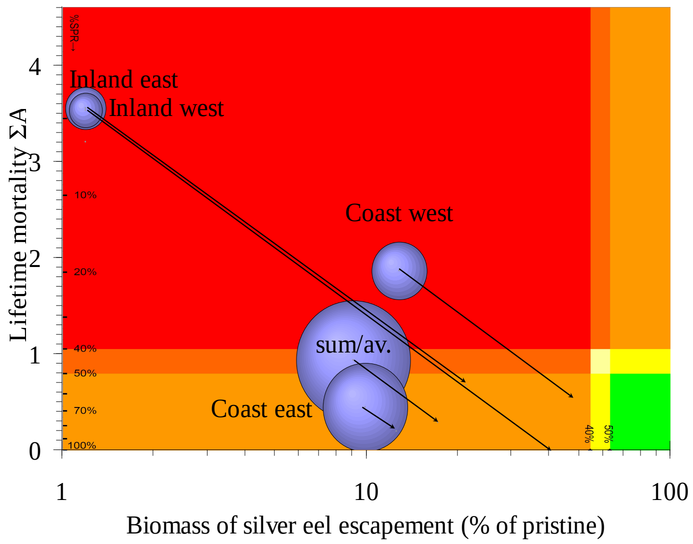


Figure SE.42. Precautionary Diagram summarizing the state of the stock as described in the Swedish Eel Management Plan 2009 (position of the symbols) and the effect the planned management measures will have (endpoint of the arrows). The horizontal axis represents the status of the stock (low vs. high spawning-stock biomass determining whether the stock has full reproductive potential); the vertical axis represents the impact of fishing (low vs. high anthropogenic mortality determining whether the exploitation is sustainable or not); the size of the bubble indicates the relative importance of the parts of the stock, i.e. the best-achievable biomass (current stock, no anthropogenic impacts). Separate estimates are given for the inland and coastal waters, draining to the east respectively to the west; "sum/av." indicates the sum of biomasses, at the average mortality. It is assumed that extra restocking takes place in unobstructed and unexploited inland waters draining to the west.

[1] The orange zones in the ICES precautionary diagram reflect statistical uncertainty in the stock assessment. For eel stock assessments, the magnitude of the statistical uncertainties is simply unknown. The oranges zones in Figure SE. 42 and Figure SE. 43 reflect the difference between the ICES advice and the political decision taken by EU.

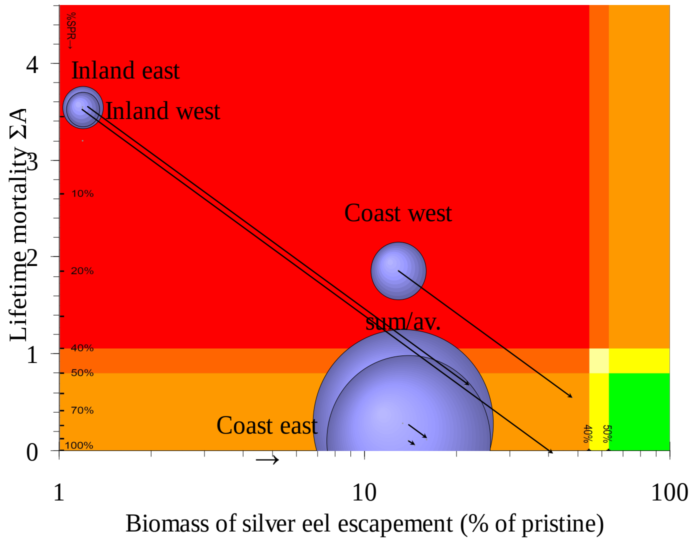


Figure SE.43. Precautionary Diagram, using an updated estimate for the east coast fishery updating the (position and size of the symbols for east coast and the sum/average). Otherwise, this diagram copies the previous diagram (Figure SE.42).

SE.13.12 Stocking requirement eels <20 cm

The Swedish EMP calculates with a doubling of the present level of stocking, i.e. a proposed total of 2.0–2.5 million glass eels. This level was considered as realistic although the actual need to fully utilize all suitable areas for eel production is much higher.

SE.13.13 Summary data on glass eel

For each year for the last 2-3 years

quantities caught in the commercial fishery

No catch allowed

exported to Asia

No catch allowed, i.e. no export

used in stocking

In 2009 205 kg were imported from River Severn in the UK and 870 kg and 1200 kg glass eels were imported from France in 2010 and 2011, respectively. About 70–80% were used for the production of eels for stocking.

used in aquaculture for consumption

143 tons were produced for consumption in 2009

consumed direct

Data not available

mortalities

Data not available

SE.14 Sampling intensity and precision

No new information.

SE.15 Standardization and harmonization of methodology

No new information.

SE.15.1 Survey techniques

No new information available.

SE.15.2 Sampling commercial catches

No new information available.

SE.15.3 Sampling

No new information available.

SE.15.4 Age analysis

No new information available.

SE.15.5 Life stages

No new information available.

SE.15.6 Sex determinations

No new information available.

SE.16 Overview, conclusions and recommendations

SE.17 Literature references

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Report on the eel stock and fishery in United Kingdom 2010/'11

UK.1 Authors

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Reporting Period: This report was completed in August 2011 for ICES/EIFAAC WGEEL 2011, held in Lisbon, Portugal in early September. It must be noted that most of the data relating to 2011 are provisional and will not be finalized until complete catch data are obtained and records can be fully validated. In compiling the report, some of the provisional data for 2009 and 2010 presented in previous reports have been updated. Where revisions have been made from earlier reports, this is indicated in the text and tables.

UK.2 Introduction

This report is structured according to a specific layout required by ICES for the joint EIFAAC/ICES WG on Eels (WGEEL). As such, some information is repeated between sections.

UK.2.2 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.

Most of the UK Eel Management Plans (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 Northern Irish Northwest plan is a transboundary plan with the Republic of Ireland. There are ten plans for England and Wales, 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).

Figure 1: Map of River Basin Districts for the UK and Northern Ireland

UK.2.2 England and Wales

The Environment Agency is responsible for the management of eel fisheries in England and Wales. Annual licences are issued for a single region and are not transferable other than where estuaries are shared by more than one Environment Agency region (the Thames Estuary, for example). Fisheries are managed by national and local byelaws. National Eel Fishing Byelaws introduced in 2004 authorize the use of six instruments 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 an opening with a maximum diameter of less than 75 cm; moveable or temporary nets or traps with leaders or wings with an opening with a maximum diameter of less than 100 cm (usually fykenets); large fykenets used on the River Severn (Gloucester wingnets), not exceeding 25 m in length and with leaders of up to 7 m; eel trawlnets 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.

The National Eel Byelaws 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 stillwaters 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 of ropes, nets, chains, floats or boats. Fixed traps can be used across the whole of England and Wales, except the Northeast Region, non-tidal rivers in Devon and Cornwall, or in the Border Esk, while small wingless traps and winged traps can be used across the whole of England and Wales except in non-tidal rivers in Devon and Cornwall and parts of Northeast Region. Gloucester Wing nets can only be used in the River Severn, and eel trawls are restricted to a box in the outer Thames Estuary (but they no longer operate). The glass eel fishery is restricted to two zones in parts of Wales and the Northwest and Southwest of England.

New legislation is under development which will improve Agency powers concerning the management and conservation of eels. The Marine and Coastal Access Bill will include powers to limit eel fishing effort, and the implementation of the new Fish Passage Regulation will allow the Agency to improve the migration potential of eels and elvers. In addition, the Environment Agency is consulting on new eel fishing byelaws, with the expectation that some version of these byelaws will be approved and implemented in the near future. The proposals out for consultation focus on fishery control and habitat improvements, and include close seasons for elver, and yellow and silver eel, setting geographical limits for fishing, and controls on fishing methods.

Every licensed instrument must carry an identity tag issued by the Environment Agency and it is a legal requirement that all eel fishermen submit a catch return. Licensees are required to give details of the number of days fished, the location and type of water fished, and the total weight of eel caught and retained, or a statement that no eel have been caught. Annual eel and elver net licence sales and catches are summarized by gear type and Agency region (soon to be RBDs) and reported in their "Salmonid and Freshwater Fisheries Statistics for England and Wales" series (www.environment-agency.gov.uk/research/library/publications/33945.aspx).

UK.2.3 Northern Ireland

Lough Neagh in N. 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 kg^{-1}). 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 staff from the LNFCS is 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 cooperative 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. Approximately 87 million (28 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. 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.

UK.2.4 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.

UK.3 Time-series data

UK.3.1 Recruitment-series and associated effort

UK.3.1.1 Glass eel

UK.3.1.1.1 Commercial

England & Wales

The glass eel fisheries of England and Wales are prosecuted by hand-held dipnets (446 licences in 2011), in estuaries draining into the Bristol Channel, in particular from the Rivers Severn, Wye and Parrett, with smaller fisheries, such as that in Morecambe Bay, Cumbria. Catches reported to the Environment Agency have historically been aggregated and reported to the WG as the catch for England and Wales (Table 1). This is an increase of 77 (20.9%) over the number of licences issued in 2010. The increase in 2011 compared to 2010 is thought to reflect a true increase in the availability of glass eel to the fishery in 2011, despite an increase in the number of licences. However, the catch of UK glass eel remains at the very low levels observed (reported) since the late 1990s (Table 1).

Table 1. Time-series of 'UK' glass eel commercial fishery catch, 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 2011 reported catch is provisional, as of 25th July 2011. From 2010 export data are derived from consignment notes.

Year	Agency Reported catch (t)	HMRC nett export (t)	Year	Agency Reported catch (t)	HMRC nett export / consignent notes (t)
1972	16.7	n/a	1992	5	17.7
1973	28.2	n/a	1993	5.73	20.9
1974	57.5	n/a	1994	9.5	22.3
1975	10.5	n/a	1995	11.9	n/a
1976	13.1	n/a	1996	18.8	23.9
1977	38.6	n/a	1997	8.7	16.2
1978	61.2	n/a	1998	11.2	20.1
1979	67	40.1	1999	n/a	18
1980	40.1	32.8	2000	n/a	7.6
1981	36.9	n/a	2001	0.809	5.4
1982	48	30.4	2002	0.521	5.1
1983	16.9	6.2	2003	1.715	10
1984	25	29	2004	0.97	14.4
1985	20	18.6	2005	1.701	8.8
1986	19	15.5	2006	1.274	8.2
1987	21.3	17.7	2007	2.07	n/a
1988	21.4	23.1	2008	0.816	n/a
1989	20.6	13.5	2009	0.29	n/a
1990	20.9	16	2010	1.24	1.69
1991	1.1	7.8	2011	2.15*	3.25*

Catches are now reported per "nearest waterbody" and, as such, new time-series will be developed reporting catches to basin or more likely RBD level (Table 2).

Table 2. Commercial catches (kg) of glass eel from England and Wales River Basin Districts (RBDs) reported to the Environment Agency, 2005 to 2011. Note that the 2009 catches are updated from the provisional data reported in the 2010 report, the 2011 catches are provisional (as of 25th July 2011), and that no fisheries operate in the other RBDs: Northumbria, Humber, Anglian, Thames and Solway-Tweed.

	Glass eel catch (kg)						
RBD	2005	2006	2007	2008	2009	2010	2011*
Northwest	166.2	116.1	200	91.6	19.6	30.3	67.5
Dee	39	5.5	6.25	2	0.5	4.8	8.4
West Wales	87	37	26	3.8	0	1.1	1.0
Severn	784.8	631.3	1172.5	370.7	76.8	531.7	858.9
Southwest	626.5	482.7	669	348.6	194.5	756.5	1214.4
Southeast	0	1.5	0	0	0	0.0	0.0

Licensed eel fishers are obliged to report their annual catch by weight, effort in terms of days and gears fished, location and water type (coastal, river, stillwater). In addition to these catch returns, annual trade statistics from Her Majesty's Revenue & Customs (HMRC) have provided an alternative indication of catches, for the period 1979–2006. Glass eel are imported into England from France and Spain throughout the winter season (typically November to March) and subsequently reexported. By subtracting imports from exports and adding the quantities of glass eels sold for stocking in England, Wales and Northern Ireland, we arrive at a nett export proxy for the UK catch. However, the HMRC data are collected for live, chilled, frozen and smoked eels, but do not differentiate between life stages. Therefore, we have estimated trade in glass eel according to month, port/airport of export (prior to 1993), country of destination and unit trade value: post-1993 glass eel value has been at least ten times, and on some occasions up to 100 times, that of the trade in yellow/silver eels (Knights, 2001). This approach does not provide a definitive trade statistic for glass eel, but it is anticipated that traceability measures introduced in response to the EU Regulation (1100/2007) and the Convention on Trade in Endangered Species (CITES) will provide a more direct assessment of glass eel trade from 2009 onwards. Comparison between the catch reported to the EA and the nett exports from HM Revenue & Customs (HMRC) data for England and Wales suggests a significant level of underreporting to the Agency, by between five and 15 times, which varied between years. 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; these are reported in Table 1 (for consistency in the time-series);
2) The quantity of glass eel bought by the dealers from the fishermen;
3) The quantity of glass eel exported from the UK and stocked within the UK.

In 2010, a total of 1.26 t was declared caught by the fishermen, compared with a catch of 1.89 t reported from the dealers and therefore suggesting an underreporting rate of 33.3%. A total of 1.71 tons was exported (98%) or used internal (within UK) [Table 3] representing a loss (mortality and shrinkage) of 9.52% by weight.

For 2011, the provisional catch reported to the Environment Agency is 2.15 t, at the time of writing. The quantity of glass eel bought by the dealers was 3.64 t, and 3.25 t was exported or used internally (within UK), representing a loss (mortality and shrinkage) of 10.7% by weight. Of the glass eel caught in the UK, nearly 90% were exported, 10.2% were used internally in the UK, the majority of which (95%) went to Northern Ireland (Table 3).

Table 3. Destination of UK caught glass eel in 2010 and 2011.

Country	Glass eel exported/used within UK (kg)	
	2010	2011
Czech Republic		30.0
Denmark	200.0	515.0
Estonia		306.5
Germany	97.0	882.0
Greece		411.0
Latvia		100.0
Netherlands	1288	593.0
Slovakia	85.0	79.5
UK	36.8	332.3

In 2010 of the 1.71 t of UK caught glass eel, 59.6% were used in stocking and 40.4% for aquaculture. Of the 3.25 t of UK caught glass eel in 2011 used for stocking or aquaculture, 49.2% went for stocking and 50.8% to aquaculture.

In a change from previous years, the glass eels stocked into Lough Neagh, Northern Ireland were sourced from Spanish and French fisheries (Table 4).

Table 4. Quantity of glass eel imported into the UK in 2010 and 2011.

Country	Glass eel (kg)	
	2010	2011
France	1150.0	714.0
Spain	198.0	

Northern Ireland and Scotland

There are no commercial glass eel fisheries in Northern Ireland or Scotland.

UK.3.1.1.2 Recreational

There are no recreational fisheries for glass eel in the UK.

UK.3.1.1.3 Fishery-independent

England & Wales

New time-series of glass eel recruitment are being developed for several regions of England and Wales, notably the Somerset Levels, Thames and Anglian rivers. Upstream migrating glass eel and elvers are caught in passtraps, which are operated in spring and early summer. However, the existing sampling protocols do not allow for a robust enumeration of recruitment.

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 5). In 2006 and 2007, these were 444 kg and 456 kg, respectively, a 50% reduction on 2005 (930 kg) and around 65% of the previous five year average (691 kg). At the time, recruitment in 2008 reached a new historical minimum with only 24 kg (approximately 75 000 eels) caught, yet in 2009, the catch rose to 159 kg, but dropped again in 2010 to 68 kg. However, as of July 2011, recruitment this year has been 16 kg (approximately 48 000 eel).

Table 5. Glass eel recruitment to the River Bann, Northern Ireland, 1960 to 2010.

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		
1977	6442.8	1995	1402.8		

The elver run to the River Erne is monitored by capture at a box at the tidal head based at the foot of the dam of Cathaleens Fall hydropower station and transported to upper and lower Lough Erne. This River Basin District 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 50.5 kg in 2009, 83.5 kg in 2010 and 64.2 kg in 2011 (as of July). The full time-series index of glass eel recruitment to this basin is reported in the Republic of Ireland Country Report.

Scotland

There are no measures of glass eel recruitment in Scotland.

UK.3.1.2 Yellow eel recruitment

UK.3.1.2.1 Commercial

There are no commercial fisheries for larger 'yellow' eel as they recruit into estuaries or freshwater, and therefore no time-series data.

UK.3.1.2.2 Recreational

There are no recreational fisheries for larger 'yellow' eel as they recruit into estuaries or freshwater, and therefore no time-series data.

UK.3.1.2.3 Fishery-independent

There are no long-term, fishery-independent surveys of yellow eel recruitment. Traditionally, eel recruitment in the UK is considered to be at the glass eel stage only, or at least for eels <12 cm. However, studies of eel migrating into freshwater from the Thames and Severn Estuaries in the mid-1980s, and monitoring by the EA (Anglian and Northwest RBDs), Royal Society for the Protection of Birds (RSPB, Northwest RBD) and Zoological Society of London (Thames RBD) since 2000 reveals that larger eels (typically up to about 30 cm) also recruit into freshwater throughout spring and summer. However, as no attempts have been made to quantify such recruitments, the results are not presented here.

UK.3.2 Yellow eel landings

UK.3.2.1 Commercial

England & Wales

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 (see Table 9). Since 2005, catches have been recorded according to the "nearest waterbody" and reported separately for yellow and silver eels. As such, new time-series will be developed for future reports providing yellow eel catches to basin or more likely RBD level.

Northern Ireland

The supplementary stocking of glass eel and the operation of the 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. The catch data are useful for scientific understanding of eel production processes, however, and are presented in Chapter 6.

Scotland

There are no commercial fisheries for yellow eel in Scotland.

UK.3.2.2 Recreational

There are no recreational fisheries specifically targeting eel for consumption in the UK. Eel are caught as bycatch by recreational anglers, most are returned to the water alive but these catches are not reported. A small number (fewer than) of recreational anglers target eel, but they routinely operate catch and release. However, no data are available on post-release mortalities, and this is recognized as an area that warrants research.

UK.3.3 Silver eel landings

UK.3.3.1 Commercial

England & Wales

As noted in Section 3.2.1, 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 (Table 9). Since 2005, catches have been recorded according to the "nearest waterbody" and reported separately for the two eel 'stages'. As such, new time-series will be developed for future reports providing silver eel catches to basin or more likely RBD level.

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. The catch data are useful for scientific understanding of eel production processes, however, and are presented in Chapter 6. On the Erne system, the trap and truck conservation fishery caught approximately 10 t in 2009 and 19.7 t in 2010.

Scotland

There are no commercial fisheries for silver eel in Scotland.

UK.3.3.2 Recreational

There are no recreational fisheries targeting silver eel in the UK.

UK.3.4 Aquaculture production

UK.3.4.1 Seed supply

Although there is no aquaculture of eel in the UK, glass eel are exported to aquaculture facilities in other European countries. No data are available on the fate of glass eel exported from the UK, other than those used for stocking Lough Neagh in Northern Ireland, but implementation of the registration of trade required by the new European Aquatic Animal Health Directive is expected to provide the relevant information in the near future.

UK.3.4.2 Production

There is no aquaculture production of eel in the UK.

UK.3.5 Stocking

UK.3.5.1 Amount stocked

Note that the following all refer to stocking with glass eel. There is no stocking of on-grown eel anywhere in the UK.

England & Wales

Glass eel were stocked into river systems of England and Wales in 2010. The total weight of stocked glass eel in 2010 was 36.8 kg and the provisional figure for 2011 is 12.3 kg.

Northern Ireland

Recruitment of glass eel and elver to Lough Neagh has been supplemented by stocking of purchased glass eel since 1984 (Table 6), and these eel have been sourced from the UK glass eel fishery. However, in 2010 the 996 kg of glass eel purchased from Glass Eel UK originated from fisheries in San Sebastian, Spain and the west coast of France: no UK glass eels were purchased.

Table 6. Weight (kg) of glass eel stocked into Lough Neagh, 1984 to 2011.

Year	Glass eel stocked (kg)	Year	Glass eel stocked (kg)
1984	1334.67	2001	0
1985	3638.51	2002	1007
1986	5935.16	2003	1368.03
1987	4584.07	2004	427.09
1988	2107	2005	718.67
1989	0	2006	330
1990	0	2007	1000
1991	0	2008	428
1992	785.87	2009	215
1993	0	2010	996
1994	771.87	2011	1035
1995	686		
1996	33.19		
1997	70.47		
1998	17.27		
1999	1200		
2000	150.33		

Scotland

There has been no recorded stocking of eel in Scotland.

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

There are no time-series of data for this section. The catch is that reported in Section 3, but there are the issues of underreporting the catch which mean that it is not appropriate to derive a proportion stocked from historical data. New measures to accurately record catch and proportion retained for stocking are being implemented as part of the EMPs.

In 2010 of the 1.71 t of UK caught glass eel, 59.6% were used in stocking and 40.4% for aquaculture. Of the 3.25 t of UK caught glass eel in 2011 used for stocking or aquaculture, 49.2% went for stocking and 50.8% to aquaculture.

UK.4 Fishing capacity

UK.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 sold by the EA each year (Table 7). To date, the Environment Agency has had no powers to refuse the sale of a licence to fish for glass eel in England and Wales, but legislation does limit the areas where fishing can take place. Therefore, potential fishing capacity for glass eel in England and Wales is partly controlled, but in reality capacity is controlled by the fishery. New powers are being sought to limit potential capacity of the fishery through limit to the number of licences that can be sold and further restrictions on the areas where fishing can take place.

Table 7. Numbers of dipnet fishing licences sold by the Environment Agency or predecessors for commercial fishing for glass eel in England and Wales, 1980 to 2010.

Year	Agency dipnet sales	Year	Agency dipnet sales
1980	1367	1996	1682
1981	1303	1997	2450
1982	1288	1998	2480
1983	1537	1999	2207
1984	1192	2000	2100
1985	1026	2001	838
1986	917	2002	899
1987	1162	2003	922
1988	918	2004	957
1989	1087	2005	812
1990	1169	2006	719
1991	960	2007	705
1992	969	2008	656
1993	1000	2009	484
1994	1058	2010	369
1995	1530	2011	446

Northern Ireland

The capture of glass eel and elvers is prohibited in N. Ireland, except under licence from DCAL to help with upstream migration past in-river obstacles on the River Bann.

Scotland

There are no fisheries for glass eel in Scotland.

UK.4.2 Yellow eel

England & Wales

Those wishing to fish commercially for yellow eel in England and Wales must purchase a licence from the Environment Agency. At present the Agency does not have the power to refuse the sale of any licence (but new powers for this are anticipated in the next twelve months). Therefore, the capacity for yellow eel fishing is limited only by demand.

No distinction is made between fishing for yellow or silver eels in the licensing 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 sold for commercial fishing for yellow and silver eels combined (Table 8).

Table 8. Numbers of yellow/silver eel fishing licences sold by the Environment Agency or predecessors, 1983 to 2010. Note that licences are for gears and not per person but the number of licensees is available for 2009 onwards.

Year	Agency licence sales	Number of Licensees	Year	Agency licence sales	Number of Licensees
1983	1523		2000	n/a	
1984	2085		2001	1991	
1985	2624		2002	1992	
1986	1994		2003	1831	
1987	2168		2004	1600	
1988	2443		2005	2369	
1989	2041		2006	2679	
1990	1589		2007	2818	
1991	1704		2008	2799	
1992	1724		2009	3120	225
1993	1859		2010	2970	158
1994	2647				
1995	2648				
1996	2752				
1997	2602				
1998	1825				
1999	1670				

Northern Ireland

In Northern Ireland, longlines and draftnets are authorized 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 method of catching yellow eels was banned in Northern Ireland in 2010.

NI Eastern RBD

There are no eel fisheries in this RBD.

NI Northwest International RBD

There are no eel fisheries in this RBD.

NI Neagh-Bann RBD

Lough Neagh/River Bann comprises a 400 km^2 lake-based system, which produces around 95% of the total Northern Ireland eel catch. Eel fishing on Lough Neagh is controlled by a Registered Company, the LNFCS who license the fishery to 180 fishermen. Around 1990, there were 200 boats 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 45 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 quota-based system (normally 60 kg per boat per day) and a log is kept of each individual boat's daily (Monday–Friday) catch. However, as most fishermen catch their quota every day, the catch is not limited by the size of the eel population, and it is not appropriate to calculate cpue. New technologies such as hydraulic draftnet haulers have been introduced over the last ten years, thereby reducing the labour needed in the fishery. Daily catch statistics and division by method are recorded by the LNFCS. In 2009 fishermen began reporting an increase in the effort required to fulfil daily quotas. Similar reports have been made for the 2010 fishery to date. At the beginning of the 2011 season, fishing was severely curtailed by poor weather conditions in May with 400 fishing days lost to gale force winds and cold temperatures.

Scotland

In Scotland, historic commercial fisheries for yellow eels were largely based in low-lying productive lochs, the eels being sold mainly to local smoke houses. 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 licence applications have been received to date (August 2010).

UK.4.3 Silver eel

England & Wales

See Section 4.2 for silver eel capacity in England and Wales.

Northern Ireland

NI Eastern RBD

There are no silver eel fisheries in the NI ERBD.

NI Northwestern International RBD

Silver eels were trapped at fixed weirs using large coghill nets. Silver eel fisheries let by the State on Lower Lough Erne have been suspended since 2005, but a conservation trap and transport fishery operated in 2009 and 2010, catching approximately 10 t and 19.7 t, respectively.

NI Neagh-Bann RBD

Silver eel catch from Lough Neagh is taken in the River Bann using coghillnets fished on three weirs at two locations. The number of coghillnets fished depends on weather and flow conditions in the river at the time of fishing and normally ranges from 2–4 nets per fishing night. The record of nightly catch is estimated at the time (though rarely accurate) and true catch is only obtained if the catch is processed and sold the following day, otherwise catches are retained in tanks, processed and sold as and when market conditions are more favourable, and therefore a 'single' catch record may be a total for several nights fishing.

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 have been received to date (August 2011).

UK.4.4 Marine fishery

England & Wales

In England and Wales, the Environment Agency licensing requirements extend to targeted eel fishing into coastal waters of the RBDs. There are some licensed fisheries operating off the Anglian and south coasts of England but these are not distinguished from inland fisheries in terms of fishing capacity (see Section 4.2). European eel are occasionally landed as a bycatch by marine-registered vessels, but these vessels are not reported here as a fishing capacity.

Northern Ireland

There are no marine fisheries for eel in Northern Ireland.

Scotland

There are no marine fisheries for eel in Scotland.

UK.5 Fishing effort

In each EMP for England and Wales, the size of the glass, yellow and silver eel fisheries is presented in terms of the number of licensed instruments as opposed to the number of licensed net fishers. This is because licences are issued for gears rather than to named individuals: one fisherman is able to set many traps and/or fykes. The only fishing gears operated by a single person are dipnets, fixed traps, and Gloucester

Wing Nets. As a consequence, fishery size according to number of licences should better reflect potential effort. However, as the administrative management unit for eel net licensing is the Environment Agency Region, rather than the RBD, it is not possible at present to provide a definitive description of fishing effort for several RBDs. For example, it is believed that >90% of the UK glass eel catch is derived from the Severn RBD, but this RBD extends over three EA Regions.

Prior to 2005, no specific effort data were associated with the reported catch data, and catch per licence has been the only proxy for cpue available to eel fishery managers. However, comparison of catch data with information on nett eel exports for England and Wales from HM Revenue & Customs (HMRC) suggested a significant level of underreporting, by between five and 15 times for glass eel and about six times for yellow and silver eel combined, with rates differing from year to year. As such, these data could only provide proxy estimates of recruitment and of home and international market trends (Knights *et al.*, 2001; Knights, 2002). The underreporting of catches needs to be addressed and the quality of data improved, and it is anticipated that this will be achieved through the use of further reporting requirements from dealers.

UK.5.1 Glass eel

England and Wales

To date, there has been no attempt to measure actual, utilized fishing effort for glass eel dipnet fishing in England and Wales. However, glass eel fishermen are since 2005 required to annually report the number of days fished as part of their catch return, and these data will be used to develop more detailed time-series of fishing effort in future reports (see Table 9).

Table 9. Commercial glass eel fishing effort reported to the Environment Agency as days (nights) fished across England and Wales, for 2007 to 2010. 2009 data are updated from the provisional data reported last year. Note that the 2010 data are provisional as the deadline for catch returns was mid-August.

	days fished	licence sales	catch returns	% returns
2007	7380	705		
2008	6346	656	539	0.82
2009	4552	484	401	0.83
2010	3999	369	353	0.96
2011		446		

Northern Ireland

There are no glass eel fisheries in Northern Ireland.

Scotland

There are no glass eel fisheries in Scotland.

UK.5.2 Yellow eel

England & Wales

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 will allow the development of a more detailed time-series of fishing effort. It is important to note that there is no separation of effort into that targeting yellow eel compared to where silver eel is the main focus of the fishery. However, the same Regional reporting issues for glass eel catches and effort extend to yellow eel catch reports. In 2010, a total of 167 fishermen licensed 3076 instruments and fished 102 576 days. This represents a decrease in effort of 17.7% compared to 2009 (124 590 days). Some of this decrease in effort can be explained by the introduction of a close season for eel fishing from October 1st.

Northern Ireland

Fishing effort in Lough Neagh is only represented as capacity, which is reported in Section 4.2.

Scotland

There are no yellow eel fisheries in Scotland.

UK.5.3 Silver eel

England & Wales

See Section 5.2.1.

Northern Ireland

Fishing effort in Lough Neagh is only represented as capacity, which is reported in Section 4.2.

Scotland

There are no silver eel fisheries in Scotland.

UK.5.4 Marine fishery

Not applicable; see Section 4.4.

UK.6 Catches and landings

UK.6.1 Glass eel

England & Wales

Across England and Wales, glass el catch is only reported by weight, so no number or length frequency data are available. Glass eel catch is by dipnet only, and all dipnets should be licensed by the Environment Agency. The aggregated England and Wales reported annual catch weight time-series is presented in Table 1.

Northern Ireland

There are no commercial glass eel fisheries in Northern Ireland.

Scotland

The history of glass eel exploitation in Scotland is largely unknown. Glass eel/elver fisheries in the early 1970s were regarded by Williamson (1976) to be either trivial or non-existent and unlikely to be profitable. During the mid-late 1990s there was a short period of exploitation, in response to the rise in demand and thus prices. Catches were estimated at 1–2 t per annum, mainly from the Northwest and Outer Hebrides. There are not thought to have been any glass eel fisheries in Scotland in recent years. Since January 2009, a licence has been required to conduct any form of eel fishing. No licence applications have been received to date (August 2011).

UK.6.2 Yellow eel

England & Wales

Across England and Wales, yellow eel catch is only reported by weight, so no number or length frequency data are available. Yellow eel catch is mostly by fykenet, and all nets should be licensed by the Environment Agency. The aggregated England and Wales reported annual catch weight time-series for yellow and silver eel combined is presented in Table 10. EA returns for yellow and silver eel fisheries (combined) for 2010 (26.90 t) continue at the low level since 2001. As with the glass eel/elver reported catches, however, these reported data are likely underestimates (by ~six times) of the true catch when compared with nett exports from HMRC data for England and Wales. The annual HMRC nett export of yellow and silver eels has averaged 125.6 t over the period 2003–2007.

From 2005, licensees have been required to report separate catch returns for yellow and silver eels, and these data are available from 2007 (Table 10).

Table 10. Time-series of yellow and silver eel catches for England and Wales reported to the Environment Agency or predecessor agencies. n/a = data not available.

Year	HMRC nett export (t)	Agency returns (t)		
	Yellow + Silver		Yellow (t)	Silver (t)
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		
2006	62	35.91		
2007	n/a	23.32	17.24	6.08
2008	n/a	31.05	25.37	5.68
2009	n/a	28.04	22.29	5.75
2010	n/a	26.90	24.31	2.59

Northern Ireland

NI Eastern RBD

There are no eel fisheries in the Eastern RBD.

NI Northwestern International RBD

There are no eel fisheries in the Eastern RBD.

NI Neagh-Bann RBD

Yellow eel catches in L. Neagh in 2010 amounted to 337 t, continuing the general downward trend since the late 1990s (Table 11) associated with reducing effort in the yellow eel fishery as a function of falling boat numbers. Licences have fallen from 200 active boats in 1990 to a regular fishing fleet of around 90 boats in 2011. 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 Cooperative, implying that sufficient stocks for the number of boats fishing in the Lough are being maintained.

Table 11. Catches of yellow eel in the Lough Neagh fishery, Northern Ireland, from 1965 to 2010. Note that a quota system operates per boat in this fishery.

Year	Yellow eel catch (kg)	Year	Yellow eel catch (kg)
1965	236759.1	1990	613231.8
1966	284772.7	1991	578868.2
1967	327281.8	1992	533240.9
1968	382327.3	1993	535150
1969	368677.3	1994	597418.2
1970	516504.5	1995	659050
1971	610909.1	1996	594045.5
1972	509090.9	1997	554750
1973	562481.8	1998	531968.2
1974	587904.5	1999	556213.6
1975	576354.5	2000	486595.5
1976	481886.4	2001	451309.1
1977	455350	2002	432313.6
1978	544695.5	2003	413763.6
1979	702609.1	2004	363522.7
1980	668945.5	2005	317800
1981	681545.5	2006	242000
1982	705759.1	2007	351000
1983	662709.1	2008	290000
1984	807672.7	2009	345000
1985	616668.2	2010	337000
1986	522359.1		
1987	503777.3		
1988	503236.4		
1989	643395.5		

Scotland

There are no yellow eel fisheries in Scotland.

UK.6.3 Silver eel

England & Wales

Across England and Wales, catch is only reported by weight, so no number or length frequency data are available. Silver eel catch is mostly by fykenet or fixed trap, and all nets and traps should be licensed by the Environment Agency. The England and Wales reported annual catch weight time-series for yellow and silver eel combined is presented in Table 10 above and trends in catch and catch per unit of effort are discussed in Section 6.2.

Northern Ireland

NI Eastern and NW International RBDs

There are no commercial silver eel fisheries in either of these RBDs.

NI Neagh–Bann RBD

Silver eel catches in L. Neagh in 2010 totalled 97 t (Table 12).

Table 12. Catches of silver eel in the River Bann flowing from Lough Neagh, Northern Ireland, from 1965 to 2010.

Year	silver eel catch (kg)	Year	silver eel catch (kg)
1965	329563.6	1990	123600
1966	332800	1991	121381.8
1967	242727.3	1992	148036.4
1968	204618.2	1993	90327.27
1969	238327.3	1994	95200
1970	237345.5	1995	138581.8
1971	233309.1	1996	112290.9
1972	124945.5	1997	109418.2
1973	162400	1998	104545.5
1974	178872.7	1999	113054.5
1975	187527.3	2000	101963.6
1976	144872.7	2001	84000
1977	236690.9	2002	95963.64
1978	280727.3	2003	114327.3
1979	341163.6	2004	99636.36
1980	245272.7	2005	116727.3
1981	228690.9	2006	104000
1982	209890.9	2007	76000
1983	203636.4	2008	76000
1984	165890.9	2009	85000
1985	135054.5	2010	97000
1986	129854.5		
1987	121345.5		
1988	150981.8		
1989	152436.4		

Scotland

There are no silver eel fisheries in Scotland.

UK.6.4 Marine fishery

There are no marine fisheries targeting eel outside the EMUs in the UK.

UK.7 Catch per unit of effort

UK.7.1 Glass eel

England & Wales

No detailed cpue data are available for discrete fisheries from individual rivers, lakes or estuaries in England and Wales.

The variable, apparent underreporting of glass eel/elver catches to the Agency precludes a meaningful analysis of cpue from Agency data alone. The HMRC nett trade data are also limited in value, because the trade statistics do not differentiate between life stages, and trade in glass eel is inferred from unit value calculations: for live and chilled eel, unit values >£200 per kg are assumed to be trade in glass eel. Discussions are currently underway with Customs and Excise to address this and it is hoped that specific export / import codes will be developed which will facilitate reporting by life stage.

Northern Ireland

No standardized cpue data are available for glass eel fishing (for local assisted migration purposes only) on the River Bann.

Scotland

There are no glass eel fisheries in Scotland.

UK.7.2 Yellow eel

England & Wales

No detailed cpue data are available for discrete fisheries from individual rivers, lakes or estuaries in England and Wales.

Northern Ireland

A quota-based catch management system on L. Neagh means it is not possible to calculate cpue. Daily catch statistics and division by method are recorded by the LNFCS.

Scotland

There are no fisheries for yellow eel in Scotland.

UK.7.3 Silver eel

England & Wales

No detailed cpue data are available for discrete fisheries from individual rivers, lakes or estuaries in England and Wales.

Northern Ireland

There are no silver eel fisheries in the Eastern or Northwestern International RBDs. Given that the silver eel fishing operation in the River Bann is such that a night's catch may not be marketed the next day and may thus be amalgamated with several nights' capture before sale (given suitable prices) it is difficult to calculate cpue for the silver eel fisheries in the Bann.

Scotland

There are no fisheries for silver eel in Scotland.

UK.7.4 Marine fishery

There are no marine fisheries targeting eel outside the EMUs in the UK.

UK.8 Other anthropogenic impacts

No information.

UK.9 Scientific surveys of the stock

UK.9.1 Recruitment surveys for glass eel

England & Wales

The Environment Agency is now monitoring glass eel and elver recruitment at a number of sites. The trapping protocols will allow for the development of qualitative time-series of glass eel and elver recruitment in these systems. However, the methods used do not allow for quantitative assessments of recruitment size.

Northern Ireland

In addition to the yearly glass eel surveying undertaken at the Cutts on the River Bann for the Neagh Bann RBD, annual investigations are undertaken within south-eastern regions of the NI Eastern RBD (primarily Carlingford Lough) into the timing of arrival and recruitment strength of glass eel. Glass eel/elvers are sampled twice a month from their arrival in February/March through to April (subject to availability). A sample of 50 juveniles is removed for morphometric analysis, calculation of number per kilo and length frequency analysis. Glass eel arrival is noted at other sites within this EMU but not intensely monitored. This work was not undertaken in 2011 because of staff illness.

Several sites around the Northern Ireland coastline were examined for glass eel in February and March of 2004, 2005 and 2006, using hoop and dragnets. Three of the sample sites were in the Eastern RBD area: Carlingford Lough/Newry Canal, (South Down coastal) Quoile barrage (which soon proved to be too hazardous to fish and was dropped) and Shrigley River (Strangford Lough). In addition, glass eel were sampled at the tidal limit of the River Lagan, at Stranmillis, Belfast, in 2005 and 2006. Samples of the catch were measured for length and weight (Table 13).

The work demonstrated that glass eels were still arriving annually to Northern Ireland's East coast, from Belfast southward. Some sites, particularly Carlingford Lough at the mouth of Newry Canal, had locally significant quantities of glass eel arriving (Table 13).

Table 13. Data on glass eel sampling, Northern Ireland Eastern RBD sites, 2004–2006 (D. Evans, unpublished data). No second survey was conducted at Shrigley in 2005 or 2006.

System ->	Shrigley		Carlingford			Lagan		
Survey ->	1	2	1	2	3	1	2	3
2004 data								
mean length mm	69.2	68.8	69.7	69.4	68.7	not sampled in 2004		
mean individual weight g	0.4	0.38	0.41	0.35	0.31			
number kg^{-1}	2525	2632	2420	2857	3226			
2005 data								
mean length mm	72.4	-	70.2	70.4	69.1	68.4	67.6	68.3
mean individual weight g	0.33	-	0.31	0.32	0.31	0.37	0.33	0.39
number kg^{-1}	3040	-	3225	3125	3225	2703	3030	2564
2006 data								
mean length mm	72.4	-	70.2	70.4	69.1	66.5	no additional samples	
mean individual weight g	0.33		0.31	0.32	0.31	0.38		
number kg^{-1}	3040		3225	3125	3225	2653		

Despite the fact that monitoring of glass eel immigration involves working at night in potentially hazardous conditions, this work has continued annually on an *ad-hoc* basis, at the Carlingford site in particular. While not quantitative, it indicates that there is still annual glass eel supply to this coast (Table 14). In 2010, the Carlingford Lough site was again surveyed several times during February to March, with very few glass eel captured. It is recommended that glass eel spot sampling continues and, resources permitting, is structured to improve the long-term value of the data. There could be merit in fitting permanent structures or traps for counting glass eel and elver where tidal head sluices with a fall exist (e.g. Lagan) for use in annual monitoring and to avoid hazardous night sampling.

Table 14. Experimental glass eel fishing at Carlingford, 3rd to 7th and 20th to 24th April 2004. Cpue based on 3 hours netting and mean 2800 glass eel $kg^{-1}$for 3–7th and 3300 for 20–24th. Note the mean cpue for 20–24th excludes the zero catches on three nights.

DATE	lbs	kg	cpue*	
03/04/2004	11	5		4667
04/04/2004	8	3.6		3360
05/04/2004	7	3.2		2987
06/04/2004	6	2.7		2520
07/04/2004	4	1.8		1680
Total	36	16.3	mean 3043	
20/04/2004	0.5	0.2		249
21/04/2004	0	0		0
22/04/2004	0	0		0
23/04/2004	7	3.2		3492
24/04/2004	0	0		0
Total	7.5	3.4	mean 1871***	

Scotland

There are no scientific surveys of glass eel recruitment in Scotland.

UK.9.2 Yellow eel stock surveys

England & Wales

The EA conducts annual multispecies surveys of fish populations in rivers, lakes and estuaries throughout England and Wales. Prior to 2001, eels were not a target species for these surveys, but some records of presence/absence or more quantitative data are available. From 2001 to 2006, at least the presence/absence of eels was recorded on all surveys. Routine electric fishing surveys for coarse fish and salmonids conducted by the Environment Agency (EA) from 2001 to 2007 show eels are present in nearly all river systems in England and Wales. There are some areas where eels are scarce or absent, particularly the upper reaches of rivers, though some lower reaches of rivers appear devoid of eel whilst the species is present further upstream. This may result from different survey techniques being utilized across a catchment. Eel were present in 43–51% of the survey samples during this period.

More intensive, eel-specific electrofishing surveys have been conducted in a number of basins, yielding more accurate estimates of survey site population biomass, density and length frequency distributions over a number of years. In addition, fykenet surveys have been conducted in still waters and estuaries, yielding length and weight data for eels along with catch per unit of effort indices.

Northern Ireland

The Northsouth Shared Aquatic Resource (NSSHARE) Project covers three river basin districts; Northwestern International River Basin District, Neagh Bann International River Basin District and Northeastern 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, with which a total of 83 lakes have been surveyed to date. The ecological classification tool is currently under development.

NI Eastern RBD

In addition to the recruitment investigations described above, monitoring of yellow eel stocks in this RBD will be harmonized with the Water Framework Directive (WFD) sampling, and salmon management (SMP) electro-fishing programmes. There are no eel fisheries to monitor.

Only one additional site is considered to be required to complete eel monitoring for the RBD, i.e. a new site representing a lake on the Lagan system. This falls outside currently planned and agreed fishery monitoring, and will have to be commissioned separately. Additional surveying of small lakes within this RBD is scheduled for August 2011.

A PhD research project (K. Bodles, Queens University, Belfast) has carried out an intensive sampling programme in regions of the NI Eastern RBD using fykenets. Results will be reported over the coming months that will provide additional information to be incorporated into the eel management plan for this RBD.

The first reporting round collating eel data from WFD and SMP monitoring will be completed for the first review of this EMP in 2012.

NI Northwestern International RBD

A recent intensive fykenet survey into the yellow eel population of Lower Lough Erne has just been completed with samples and results awaiting analysis. The results of this survey will be compared with those of the Erne Eel Enhancement Programme (2001) and viewed against the closure of the yellow eel fishery in this RBD in July 2010.

NI Neagh-Bann RBD

Eels are sampled regularly as part of an ongoing 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 number of fish captured recorded.

Preliminary analysis indicates that a larger proportion of small eels (<40 cm) are captured by draftnets (34%, compared to 21.4% on longlines), and that more of the larger eels (>60 cm) are taken on longlines. The results also indicated there was significant variation in the numbers of small eels captured by longlining dependent upon bait type (earthworm caught more) and hook size (larger hook caught fewer small eels). However, undersized eels are returned to the Lough with hooks in place.

Silver eel catches are sampled over a 12 week period (from October to December). At weekly intervals, the previous night's haul averaging at least 400 fish is measured for length, and ten eels are chosen to reflect all size ranges caught, and analysed for age.

Scotland

Electrofishing surveys by the Fisheries Trusts in Scotland (from 1996–2006) indicate that the eel is widespread in Scotland, though absent from many of the upper reaches of rivers, likely due to difficulties of access. Data are currently available only for the Scotland River Basin District (excluding areas of Galloway and the Tweed in the South). A total of 6651 electrofishing visits were made to 3645 sites. Eels were present at 39.7% of visits, and recorded as present on more than one visit at 44.3% of sites. As these surveys were primarily targeted at salmonids, they likely underestimated local eel abundance and therefore are reported here only in terms of the presence/absence of eels.

The Marine Scotland – Science, Freshwater Laboratory has two long-term, but intermittent, datasets on yellow eels, both from small, upland tributaries. A fish trap has operated on the Girnock Burn, a tributary of the River Dee in Northeast Scotland, since the mid-1960s. The Girnock Burn rises at an altitude of 500 m and flows northwards, joining the River Dee some 70 km above the tidal limit. The stream channel has a largely open aspect, and is typically <5 m wide, depths ranging from a few cm to 0.5 m. Annual trap catch and electrofishing data were collected between 1967 and 1982 and again in 2004 and 2005. Since 2004, eels >200 mm have been PIT-tagged in order to determine movements and growth.

Analysis of these data (Chadwick *et al.*, 2007) shows that, in the late 1960s, the Girnock Burn eel population was comprised of relatively high densities of small (140–180 mm) males and with few females (320–360 mm). Growth rates are currently estimated to be between 8.7 and 17.4 mm y^{-1}, with growth occurring chiefly in summer. Small eels leave the system in late spring/early summer, larger eels in late summer/early autumn. Due to construction of a major barrier to immigration (plus the effects of recruitment declines since the 1980s), the estimated standing stock and declined from 1968 to 2005 by about 80%. The mean population density declined between 1968 and 2005 from 16 to 3 eels per 100 m^2, and biomass from 256 g to 71 g per 100 m^2. Thus, current densities are about 19% of the 1968 level, biomass about 28%. An updated analysis incorporating data from 2005–2009, but excluding winter electrofishing surveys due to their lower capture efficiencies suggests that the decline in density has been less marked than estimated by Chadwick *et al*. (2007) (Marine Scotland, unpublished data). The new analysis suggests peak mean minimum densities of 17.3 eels per 100 m^2 during the period immediately after the barrier to migration was introduced, falling to 9.2 eels per 100 m^2 in the period immediately prior to the recruitment collapse, and standing at 5.5 eels 100 per m^2 from 2004–2009. This amounts to a total decline of 68% since the barrier was introduced, and a decline of only 40% since the period prior to the recruitment collapse. Biomass has probably fallen more slowly than density because the average body length has increased 11% over the 37 year time-series, possibly due to lower in-river densities reducing competition and density-dependent mortality.

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 (source: P. Collen, unpublished data).

The establishment of Fisheries Trusts and the Scottish Fisheries Co-ordination Centre has allowed the coordination of a number of electrofishing surveys, which now represent the principal source of information. The earliest of these data are from 1996, but spatial coverage is adequate only from 1997 onwards. It should be noted that there is considerable variation amongst the reports from individual Trusts in the level of detail that are recorded. Some of the data were collected with funding from Scottish Natural Heritage (SNH) and are their property. Otherwise all data are the property of the relevant Fisheries Trusts which have kindly allowed their use here. There are substantial areas of Scotland RBD for which data are not available, including the catchments of the Rivers Clyde, Don, Ythan, Nairn, Ugie, as well as the entire islands of Skye, Orkney and Shetland, (these latter two island groups are omitted from subsequent maps for reasons of space and clarity).

There are a number of problems with the interpretation of these data because of the variety of survey methods employed and inconsistency in efforts to capture and record eels. As such, a number of assumptions have been made in analysing the data.

All these assumptions are likely to be violated to some extent, compromising the confidence that can be placed in the density estimates and strong confidence can only be placed in the presence/absence data.

The data show no consistent trend in reported eel abundance class over the period 1996–2005. In contrast, an analysis of the percentage of sites where eels were absent on the adjacent Solway Tweed RBD suggests this increased from 12% in 1972–1988, to 24% in 1992–1996, to 44% 1997–2001 and to 46% 2002–2005 (B. Knights, unpublished data), but it is possible that this represents a change in methodology in the early 1990s rather than a genuine decline in distribution.

There was considerable spatial variation in the distribution of eels, with eels being much less likely to be absent from sites in the northwestern parts of Scotland RBD. In the Western Isles, West Sutherland and Wester Ross, eels were absent at approximately 20% of sites, compared with 55% in Scotland RBD as a whole. This probably reflects the proximity of the northwest of Scotland RBD to the continental shelf (Knights *et al.,* 2001).

There is weak evidence that eel densities in Scotland may have declined since 2002. It is possible that this is a spatial rather than a temporal effect, however, because the distribution of sites differed between years, both locally and regionally. A similar pattern of decline in recent years was evident for several individual regions of Scotland RDB for which data were available, but was not universal; in particular West Sutherland in the Northwest showed a trend for an increase in population density.

Since 2008, the Scottish Environment Protection Agency (SEPA) has begun 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).

UK.9.3 Silver eel surveys

England & Wales

There were three assessments of silver eel undertaken in England and Wales during 2010.

1) River Leadon (Severn RBD) - hydroacoustic (DIDSON) assessments in 2009 and 2010 based on the wetted area of habitat available to eels suggested minimum outputs of 0.39 ± 0.09 kg/ha, and 0.23 kg/ha, respectively. The 2010 assessment was based on a single estimate and therefore no confidence limits could be derived. Extrapolating the DIDSON counts over the whole water column (a riskier estimate) gives 0.94 ± 0.2 kg/ha in 2009 and 0.48 kg/ha in 2010.

2) River Leven (Northwest RBD) - the estimate from the resistivity counter was for a escapement of 98 silver eel, which was considerably lower than in the previous three years (Figure 2).

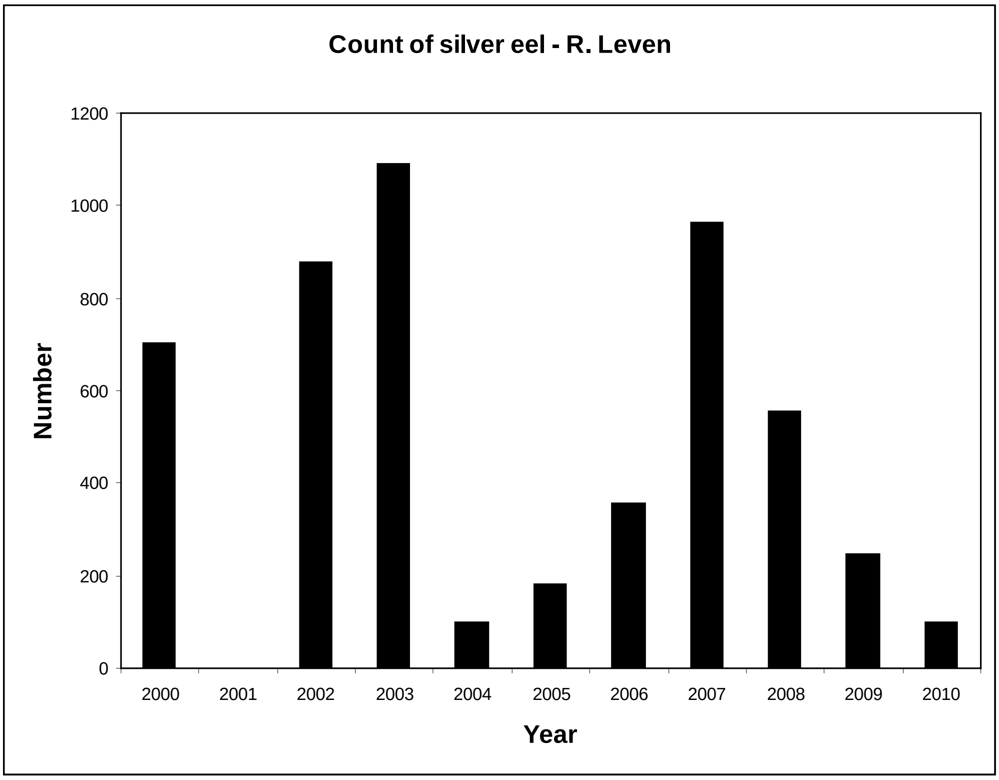

Figure 2. Escapement of silver eel from the River Leven between 2000 and 2010. No data available for 2001; for the period 2004–2006 technical issues prevented a full count, for these years the count represents a minimum estimate.

3) River Stour (Southwest, RBD) - a mark–recapture study was undertaken, during which a total of 194 eel were tagged and 14 were recaptured (7.4%). A total of 718 eel were caught throughout the fishing season, giving an estimated escapement of 9949 eel, with an average weight of 0.403 kg, and hence an escapement biomass estimated of 4014.3 kg. This biomass will be converted to a production rate per unit area once the wetted area of the river basin has been estimated using GIS datasets (Walker, pers. comm.).

Northern Ireland

NI Eastern RBD

No current surveys of silver eels.

NI 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 truck silver eels around hydropower plants within this RBD. The results of this survey work will be presented in the National Report of Ireland.

NI Neagh–Bann RBD

Samples of ten eels chosen to reflect all size ranges caught removed every week over a twelve week period and analysed for age and length. At weekly intervals the previous nights 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, *Anguillicoloides crassus* prevalence and intensity, 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), which it sells and from this the sex ratio and number of silver eels can be estimated.

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 number and biomass of migrating silver eels for each available year are reported in Table 15.

Table 15. Silver eel escapement from three catchments in Scotland (kg.ha^{-1}).

Year	Girnock	Baddoch	Shieldaig
1966	0.53	-	-
1967	0.44	-	-
1968	1.42	-	-
1969	1.02	-	-
1970	0.86	-	-
1971	1.25	-	-
1972	0.84	-	-
1973	1.59	-	-
1974	1.07	-	-
1975	2.23	-	-
1976	1.91	-	-
1977	1.42	-	-
1978	1.25	-	-
1979	1.07	-	-
1980	0.61	-	-
1981	1.02	-	-
1982	-	-	-
1983	-	-	-
1984	-	-	-
1985	-	-	-
1986	-	-	-
1987	-	-	-
1988	-	-	-
1989	-	-	-
1990	-	-	-
1991	-	-	-
1992	-	-	-
1993	-	-	-
1994	-	-	-
1995	-	-	-
1996	-	-	-
1997	-	-	-
1998	-	-	-
1999	-	-	0.57
2000	-	-	-
2001	-	-	-
2002	-	-	0.69
2003	1.05	-	0.51
2004	-	-	-
2005	0.86	-	-
2006	-	0.32	1.59
2007	0.51	0.35	0.63
2008	0.42	0.57	0.55
2009	0.44	0.53	1.00
2010	-	0.10	0.53

UK.10 Catch composition by age and length

UK.10.1 England & Wales

In England and Wales, the commercial catch is reported only as weight, so no age and/or length data are available. Some subsampling of the catch is undertaken and Figure 3 shows the length frequency of silver eel caught on the River Stour in 2010, which suggests that the fishery only catches female eel.

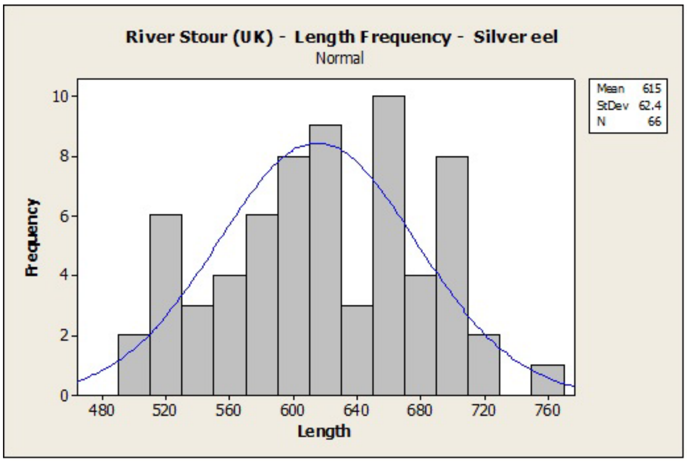

Figure 3. The size of female silver eel caught in the River Stour during 2010.

The mean length, weight and age of silver eel caught in the River Avon in 2010 are shown in Table 16.

Table 16. Mean length, weigh and age of silver eel from the River Avon in 2010.

Parameter	Mean	SE	Range	Number
Length	591.8	5.94	410–845	200
Weight	382.8	12.7	132.4–1120.0	201
Age	18.8	0.27	13–31	188

Since 2008, the Environment Agency fish surveys have recorded the lengths of all eel >100 mm, and counted all the eels <100 mm. Cefas research surveys of eel in Poole Harbour estuary have measured length and weight of all eel captured using fykenets. In both cases, the eels are returned to the waters alive and therefore no age data have been collected. Cefas research sampling of silver eel runs from the Piddle, Stour (Hants) and yellow eels from the Thames Estuary has included the collection of otoliths for age determination and chemical analyses, but these data are not available at this time.

UK.10.2 Northern Ireland

NI Eastern RBD

Eel are known to be present throughout this EMU but there is 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 standardized (CEN) gillnetting 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 Clea Lakes (Strangford Catchment) and Castlewellan lake (South Down coastal). The Castlewellan eels are larger and older; the Clea lakes eels tend to be smaller and younger. This difference probably reflects the characteristics of the two lakes. Castlewellan is further from the sea, and at higher altitude. Clea is close to the sea and lowland, perhaps biologically more productive. It is probable that the Castlewellan data reflects natural partial inaccessibility, and in particular restricted emigration facility for silver eel. There is clearly also a question over recruitment of young eel to Castlewellan. Clea lake is a better index site for the catchment area and reflects continuing recruitment to at least 1992. The methods used should be able to catch eels down to 40 cm or less, leaving a gap in the ability to assess yellow eels smaller than 35–40 cm, dependent on condition.

The age–length profiles of eels from a Quoile river silver eel weir dating from 1983 and 1984 confirm the view that the Castlewellan lake eels may well be partially landlocked, 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 which have retained eels within a brackish impoundment between the two barrages. The small eel (less than 50 cm), as evident from contemporary notes, were mainly in the reach between the two barrages. It should be noted that 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.

Johnstone (2004) noted that it would appear that eel stocks were at a low level in the Quoile system. This was based on two studies: a netting survey carried out on the pondage (Thompson, 1994) did not account for any eels despite the setting of fykenets in an area where commercial eel fishing rights were leased by DARD until 1999. It should be noted, however, that in 2000, a de-oxygenation incident caused by storm driven rapid turnover of a portion of the quoile pondage killed 34 individual eels among other less hardy fish species. Eel are still 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, but they were absent from the majority of sites. The latter observation may be influenced that eel habitat may not be adequately covered in a trout focused survey.

A recent survey undertaken in a small group of mixohaline lakes at Strangford netted 240 yellow eels as part of a fish removal programme. Length frequency analysis of the eels 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 range in eel length being similar but mean length being much larger in Strangford at 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 which given a lake area of 4 ha was equivalent to a standing stock of 17.9 kg ha^{-1}.

A PhD research project (Kenneth Bodles, Queens University, Belfast) has carried out an intensive sampling programme in regions of the NI Eastern RBD using fykenets.

Results will be reported over the coming months that will provide additional information to be incorporated into the reviewed Eel Management Plan for this RBD in 2012.

UK.10.3 Scotland

There are no eel fisheries in Scotland.

UK.11 Other biological sampling

UK.11.1 Length and weight and growth (DCF)

England & Wales

As of 2007, measurements of length are now collected from all eel captured by the Environment Agency during eel-specific and multispecies surveys. A total of 637 lengths were collected in 2007. The 2011 sampling programme is ongoing at the time this report was produced. Length and weight data were obtained for a sample of silver eel (n = 196) from The River Stour (Southwest RBD). However, weight is not routinely measured nor age determined so no growth data are available.

Northern Ireland

In addition to the glass eel sampling at the River Bann, other sampling is undertaken at several other coastal sites in N. Ireland: 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 endohelminths. 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 17). However, in 2008, 2009 and 2010, this trend has reverted to a ratio similar to that recorded in 2004 and 2005 (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 17. 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.

	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	n/a	46	56.7	365	n/a

Scotland

Individual growth rates of PIT tagged eels are measured by Marine Scotland Science in two nearby tributaries of the River Dee. Thus far recorded growth rates for eels with more than a season between recaptures have ranged from 0.8 to 35.2 $mm.yr^{-1}$, with mean ± s.e growth of 10.71 ± 0.70 $mm.yr^{-1}$ (n = 66). On the Baddoch, the range of growth rates was 0.0–14.5 $mm.yr^{-1}$, with mean ± s.e growth rates of 5.62 ± 0.74 $mm.yr^{-1}$ (n = 21). 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. In 2008, a total of 574 elvers ascended into the burn: size range 96–254 mm, mean 155 mm. In 2009, a minimum of 370 elvers ascended (the trap was non-functional for a short period), with a size range of 99–237 mm.

Eel otoliths (ca. 100 pairs) have been collected (by SEPA) and read (by Marine Scotland Science) from a number of sites around Scotland, which will provide some length-at-age and growth-rate data, however these data are not currently available. Historical data for age (estimated from otoliths) and length composition at a variety of sites in Scotland from a survey conducted in the early 1970s are available (Williamson, 1975).

Some Fisheries Trusts collect data on the length of eels captured during routine electrofishing surveys targeted at salmonids (1136 eels have been 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.

UK.11.2 Parasites and pathogens

The following reports new information available in the last twelve months. The historical information, albeit limited, on parasite levels in UK eels has been reviewed in recent UK reports.

England & Wales

Anguillicoloides crassus is now considered ubiquitous throughout England and Wales (Nigel Hewlett, Environment Agency National Fisheries Laboratory, pers. comm.). There is no routine and/or coordinated monitoring of the incidence of parasites or pathogens in eels sampled in England and Wales. Those applying for a licence to move or stock eels in England and Wales must submit a health check of a sample of the fish, which includes a check on parasites and pathogens, but there are very few such applications. Eel herpes virus (HVA) was detected from mortality samples in 2009 and 2010 at:

1) Cromwell Carp Fishery, Nottinghamshire (NGR: SK7968262232); Following an eel specific mortality at the fishery in 2009, one yellow eel (two yellow eels sampled in total; 755–824 mm) tested positive for the virus *Herpesvirus anguillae*. A moderate infection of adult *Anguillicoloides crassus* (nine nematodes present) was also detected in the swimbladder of one eel.
2) Goltho Lake Fishery, Lincolnshire (NGR: TF1165377083); Following an eel specific mortality at the fishery in 2010, both dead and live yellow eels were examined (485–883 mm). These tested positive for HVA. Low level infections of adult *A. crassus* were recorded in the swimbladders of the three live eels (eel 1 = 2; eel 2 = 2; eel 3 = 1 adult *A. crassus*). Heavy infections of a larval nematode, *Daniconema anguillae,* were also noted in the fins.
3) An eel specific mortality was observed at Cliffe Pools (near NGR: TQ71977730) during June 2010. The mortality was short lived and the EA were unable to get a sample to examine.

Health checks from UK Glass Eels with glass eels sourced from the River Severn (one each year dating back to 2009). These eels had no larval *A. crassus* present and no significant parasite burdens or signs of clinical disease.

Northern Ireland

NI Eastern RBD

Anguillicoloides crassus has been recorded from eels examined in this RBD for the first time in 2010 (N = 52, prevalence 30% mean intensity <one worm per infected eel).

NI Northwestern International RBD

A. crassus was first recorded in the swimbladders of eels in Ireland during an extensive fykenet survey of the Erne system in July 1998. A new record for *A. crassus* in a separate catchment within this RBD (the Foyle) was found in 2008 in one eel.

NI Neagh-Bann RBD

A. crassus was found in Lough Neagh yellow and silver eels for the first time in 2003, and its spread has been monitored via the analysis of a total of 2203 yellow and 800 silver eels from 2003 to 2010. By 2005 prevalence had reached a peak of 93% of yellow eels and 100% of silver eels. But by 2008 the prevalence of *A. crassus* had fallen in both yellow and silver eels and was recorded as 67.3% and 86%, respectively, whilst in 2009 it had fallen to 53.6 and 81%, respectively. In 2010 these infection parameters continued to fall for yellow eels, reaching 48.8% however prevalence in silver eels had risen slightly to 80.7%.

Scotland

Prior to 2008, the only reported instance of *A. crassus* in Scottish RBD was from a site near a fishfarm on the Tay catchment (Lyndon and Pieters, 2005), and, while recognizing the absence of any coordinated survey, it was tentatively thought that *A. crassus* was not widespread in Scotland. A survey of *A. crassus* infection has been initiated, examining samples of eel collected in 2008 and 2009 from a range of Scottish sites. A total of 110 eels from 25 sites have been assessed for the presence of adult *A. crassus*. Eels ranged from 245 mm to 535 mm in length. To date, this study has revealed the presence of adult *A. crassus* in the swimbladders of eels from the following catchments: Forth, Leven, and Monikie Burn. In these sites prevalence (based on very small samples) ranged from 25–40%. The small numbers of eels sampled at each site do not allow confident demonstration of the absence of *A. crassus* where none were found at a site. However, it is noteworthy that all four of the catchments now known to be infected, are concentrated in a relatively small part of the east coast of Scotland.

Uk.11.3 Contaminants

The following reports new information available in the last twelve months. The historic information, albeit limited, on contaminant levels in UK eels has been reviewed in recent UK reports.

England & Wales

The Environment Agency provided samples from 35 eels caught in autumn of 2007 in the River Thames between Sunbury and Molesey (upstream of the tidal limit) and in the Thames estuary around Woolwich. These were analysed for 14 organochlorine pesticides and by-products and 41 PCB congeners, including the seven frequently detected congeners commonly used as indicators for PCB contamination (ICES7) (Jurgens, Johnson, Chaemfa, Jones and Hughes, pers comm.). Most of the investigated chemicals were detectable in every one of the samples although they have all been banned or severely restricted many years ago. However, based on the measured chemicals, all the analysed eels would be considered safe to eat.

Northern Ireland

No routine sampling undertaken but available by request.

Scotland

SEPA have begun analysing eel samples for PCBs, DDTs, HCHs, HCBs and BDEs, and initial results have been published (Macgregor *et al.*, 2010). Up to five eel were sampled from 30 sites, minimum eel length was 23 cm, and 80% of eels were >30 cm in length. Sites were not randomly selected, being biased toward sites where high concentrations of pollutants were anticipated. DDT was present in nearly all samples despite having been banned for 30 years. However, comparison of data with previous contaminant analyses from 1986 and 1995 showed considerable decreases in DDE and HCH concentrations. When compared to reported European and North American levels, PCBs levels (138–494 μg/kg) were generally low, whilst BDEs were broadly similar, while DDE levels (1–227 μg/kg) were rather high.

UK.11.4 Predators

England & Wales

Limited studies of the diet of piscivorous birds shot during winter suggest that eels are rare in the diet at this time of the year, but other published information for England and Wales indicates a fairly large proportion of eel at other times.

Northern Ireland

None undertaken and studies into the impacts of predators on the eel stocks of N. Ireland are not likely to form part of Management Plan contents.

Scotland

In Scotland, the breeding population of cormorants is thought to be around 3500 pairs, with a further 4000 non-breeders. The winter population is in the region of 9500 to 11 000 birds (Forrester and Andrews, 2007). In the Scotland RBD, these numbers can be expected to be in the region of 10–20% lower. WGEEL (ICES 2008) estimated that 460 000 cormorants in 19 European countries consumed around 5000 tonnes of eels (with the assumption that eels comprised 6% by weight of the diet of cormorants). Data from Scotland in the mid 1990s (Marquiss *et al.*, 1998) suggested a similar contribution of the eel to cormorant diets (less than a third of stomachs contained eels, and where eels were found they contributed around 23% of food by weight, suggesting eel contributed <7%). We therefore estimate the consumption of eels by cormorants in Scotland RBD to be in the region of ten tonnes per year. This figure should be regarded with great caution as it contains many assumptions and uncertainties. We have no information about the relative contributions of yellow or silver eels to this estimated total.

One long-term study assessed the abundance of eels in the diet of otters inhabiting a pair of freshwater lakes in NE Scotland. These data show a decline of the proportion of eels in the diet after 1990 from being present in ca. 90% of faecal samples to being present in only ca. 25% in recent years (H. Kruuk, pers. comm.).

UK.12 Other sampling

No information available.

UK.13 Stock assessment

UK.13.1 Local stock assessment

The Environment Agency, Marine Scotland (Science) and Agri-Food & Biosciences Institute have applied different methods to assess eel production in England & Wales, Scotland and Northern Ireland, respectively. These methods are outlined below.

England & Wales

Assessment methodologies are being developed to provide the tools required for continued development of Eel Management Plans (EMPs). Several modelling approaches have been developed in the UK: the Reference Condition Model (RCM:

Aprahamian *et al.*, 2007) and the Scenario-based Model for Eel Populations (SMEP: developed for the Department for Environment, Food and Rural Affairs (Defra) by El-Hosaini, Bark, Knights, Williams (Kings College, London) and Kirkwood (Imperial College, London): Aprahamian *et al.*, 2007), and further developed for the Environment Agency by Cefas, resulting in the SMEP II model.

Northern Ireland

An annual mark–recapture programme of silver eel emigrating from Lough Neagh was initiated in October 2003, with the objective of estimating escapement of silver eels past the fishery (weir traps), 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 upstream release and at least one or even two years afterwards. To date 4810 silver eels have been tagged and maximum estimates of escapement, based on the proportion of recaptured Floy™ tagged silver eels, range from 62% to 84% during 2003 to 2009 (Table 18). No tagging was undertaken in 2007 due to the sporadic nature of the silver eel run.

Table 18. Results of mark–recapture estimation of silver eel escapement from the Lough Neagh fishery.

		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	399
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	219
2010	491	167	14	0	181	36.9	97	263

Stock assessment was carried out on the Erne as part of the three year Erne Eel Enhancement Programme which ended in 2001 (Matthews *et al.*, 2001).

Scotland

Stock assessment methods are being developed for the Scotland RBD, based on quantification of upstream and downstream counts of eel at traps on three rivers.

UK.13.2 International stock assessment

UK.13.2.1 Habitat

The wetted area of rivers, lakes, transitional and coastal waters for each RBD/EMU are presented in Table 19. The wetted areas for England and Wales RBDs were calculated from GIS datasets including the 1:50 000 scale river network, a channel width function derived from EA survey data and upstream catchment area profiles, and other datasets created for the Water Framework Directive. The wetted area of rivers and lakes in the Scotland RBD were calculated from O/S 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. The wetted areas for each of the N. Ireland eel management units were calculated from 1:25 000 GIS datasets held within AFBI, the Loughs Agency and the Northern Regional Fisheries Board.

Table 19. Wetted area (ha) of lakes, rivers, transitional waters (estuaries & lagoons) and coastal waters, and total wetted area of habitat potentially available to produce eels within UK RBDs. Data for England and Wales are derived from 1:50 000 scale GIS; for the Scotland RBD from 1:10 000 and 1:1250 scale GIS; and for Northern Ireland from 1:25 000 scale GIS. Note also that assessments for some EMPs have not included all wetted areas of the RBDs.

Country	RBD	lakes (ha)	rivers (ha)	transitional (ha)	coastal (ha)	total (ha)
E&W	Northumbria	3599	3972	2600	70400	80571
	Humber	9732	10671	33700	32900	87003
	Anglian	9538	11541	33200	228600	282879
	Thames	9163	4511	33500	14500	61673
	Southeast	2061	1785	5500	211200	220546
	Southwest	2621	6194	22900	304200	335916
	Severn	6159	9726	54700	0	70585
	West Wales	4271	6202	13500	433100	457073
	Dee	1622	881	10900	0	13403
	Northwest	9790	5152	27900	150900	193742
shared	Solway-Tweed	5186	7791	39000	191300	243277
Scotland	Scotland	138557	48104	-	-	186661
N.I.	Northeastern	640	160			800
	Neagh Bann	38600	1400	0	40000	80000
international	Northwestern	28600	4350	1153	34103	68206

UK.13.2.2 Silver eel production

UK.13.2.2.1 Historic production

The historic production of silver eels from the 'pristine' environment is the estimate from which the 40% escapement target is derived. Estimates of the historic annual production of silver eels from each UK EMP are presented in Table 20.

England & Wales

In the absence of data on historic production of eel in England and Wales, a standard production rate of 16.9 kg per hectare has been applied by the Environment Agency in estimating historic production and hence the 40% target (6.76 kg per hectare). This production rate was selected with reference to estimated production rates for the Bann (Northern Ireland) and Loire (France) catchments, reported by ICES (2008). The application of this area based production rate to the eleven RBDs of England and Wales yields estimates of historic silver eel production ranging from 42 302 to 344 806 kg.

It should be recognized that these values have a high degree of uncertainty and should be viewed with considerable caution until such times as they can be validated using local eel data.

Northern Ireland

The following provides some background information to the estimates for Northern Ireland.

NI Eastern RBD

The area of lakes and rivers available and productive to eel in the NI-ERBD is about 800 ha, of which 640 ha is from the lakes of the Lagan and Quoile catchments, with the addition of an estimated 160 ha of productive river area. In the absence of any historic or recent data on eel production from this RBD, a standard pristine production rate of five kg per hectare has been chosen, (after Moriarty and Dekker, 1994). This rate would yield a "pristine" production of silver eels from full recruitment of 4 t, and hence an EU regulation target compliance escapement of 1.6 t of silver eels.

NI Northwestern International RBD

Using the methodologies of the Republic of Ireland, the historic production of silver eels from this transboundary RBD is estimated at 147 t.

NI Neagh-Bann RBD

The current mean production of silver eels within this RBD points to potential natural outputs in the range of 400 to perhaps 600 tonnes per annum, given historical high natural glass eel supplies. Therefore the target is set according to a 'pristine' production estimate of 500 t, i.e. escapement of 200 t of silver eels per annum.

Scotland

A number of historical/pristine production estimates using different methods were generated in the development of the 2009 EMP for the Scotland RBD. The first two relied on data from Irish catchments (ICES, 2008), whereas the third was based on historical eel data from a single catchment in Scotland (the Girnock). Two further methods, based on the Irish model of silver eel production (ICES 2008), but adapting the equations to survival and growth rates measured in Scotland RBD led to very low estimates of pristine production, and were rejected. The three methods yielded similar estimates of pristine silver eel production, with none having any obvious advantage over the other:

1) Pristine Escapement Estimate 1 (Burrishoole alone): 138 365 kg;
2) Pristine Escapement Estimate 2 (five Irish catchments and underlying geology): 228 302 kg;
3) Pristine escapement estimate 3a (mean historical Girnock): 184 487 kg.

Accordingly, the mean of the three values was adopted, allowing also some rudimentary estimate of uncertainty, and yielding an estimate of total historical/pristine production of silver eels for Scotland RBD of 183 718±25 965 kg.

Table 20. Estimates of historic production, potential present production (in the absence of all anthropogenic impacts) and recent escapement of silver eels from UK RBDs. For England and Wales, all data are for inland waters only, and the estimate of pristine production is based on an arbitrary reference value of 16.9 kg/ha, similar to the pristine production values for the Bann (N. Ireland) and Loire (France) reported in ICES (2008). It is not possible to derive the escapement estimates from present production for RBDs of England and Wales because commercial catch data are not available at the RBD scale. For Scotland, potential present production is estimated from a reduced area of 111 124 ha, taking account of the loss of potential habitat upstream of some hydro schemes, and present escapement is estimated from naturally available habitat at a rate of 0.55 kg/ha. The totals for Northern Ireland at the foot of the table are for the Neagh-Bann and ERBD only, and do not include values for the transboundary NWIRBD, as data for this RBD are used in the data provided by the Republic of Ireland for the international stock assessment. Including the data here would result in 'double accounting' in the international stock assessment.

Country	RBD	Wetted area (ha)	Pristine production (kg)	Present POTENTIAL production (kg/yr)	Present escapement (kg/yr)
E&W	Northumbria	7571	127948	36340	n/a
	Humber	20403	344806	133434	n/a
	Anglian	21079	356230	12647	n/a
	Thames	13673	231079	308333	n/a
	Southeast	3846	65002	81926	n/a
	Southwest	8816	148982	174988	n/a
	Severn	15885	268450	133431	n/a
	West Wales	10473	176987	93206	n/a
	Dee	2503	42302	68	n/a
	Northwest	14942	252525	200227	n/a
shared	Solway-Tweed	12977	219313	118092	n/a
Scotland	Scotland	186661	183718	116481	84933
N.I.	Northeastern	800	4000	4000	n/a
	Neagh Bann	80000	500000	458000	360000
international	Northwestern	In Irish report			
England & Wales		132167	2233624	1292691	1256891
Scotland		186661	183718	116481	84933
Northern Ireland*		80800	504000	462000	360000

UK.13.2.2.2 Current production

The current potential production of silver eels is the estimated biomass in the assessment year, based on the recent levels of recruitment, calculated prior to the impacts of anthropogenic mortality factors, and excluding the contribution of stocked eels. In essence, this is the present potential escapement of silver eels from the available environment, if anthropogenic mortality was immediately reduced to zero.

England & Wales

In England and Wales, present production rates have been estimated according to a probability model of yellow eel to silver eel production, with local eel-specific survey biomasses extrapolated to the entire potential eel-producing wetted area of select, index rivers. This whole river rate was then extrapolated to the wetted area of inland waters in the RBD. Where no index river data were available for an RBD, production rates were used from the neighbouring RBDs. Present potential production biomass varies from 68 to 308 333 kg.

Northern Ireland

NI Eastern RBD

The current silver eel production from the NI ERBD is not known, but is free and unimpeded, as is natural recruitment.

NI Northwestern International RBD

Refer to Ireland Country report.

NI Neagh-Bann RBD

The production rate for the Neagh Bann RBD estimated as 462 000 kg, and is based on production estimates from Lough Neagh.

Scotland

Current estimates of the mean production of silver eels are based on the measured production at three small catchments which occupy different altitude ranges.

This production is extrapolated to the RBD as a whole based on GIS estimates of wetted areas, stratified by altitude bands corresponding to the altitudes occupied by the three study catchments. The total is adjusted for the potential impact of man-made barriers on migration by assuming that barriers defined as impassable for salmonids are also total barriers to eels, and that no additional production occurs downstream as a result of the presence of the barrier. The current production of silver eels is therefore estimated as 84 933 kg.

As it is assumed that no silver eel production occurs upstream of turbines, and there are no fisheries for eel in the Scotland RBD, the value reported in Table 20 is in fact an estimate of escapement, which in itself is possibly an underestimate because it ignores potential production upstream of turbines.

UK.13.2.2.3 Current escapement

The current escapement of silver eels ($B_{current}$) is the estimated biomass in the assessment year, based on the recent levels of recruitment, calculated after accounting for the impacts of anthropogenic mortality factors, and including the contribution of stocked eels.

England & Wales

At present, estimates of current escapement from individual RBDs of England and Wales are not available because production cannot be adjusted for fishery or turbine mortality at this spatial scale. Catch records are reported to EA Region rather than RBD and the Regions do not all correspond to RBDs. The vast majority of hydropower installations in England and Wales have not been assessed for their potential impact on eel mortality, and nor has eel production upstream of these installations been calculated.

However, a national estimate of silver eel escapement from England and Wales has been calculated, taking into account estimates of total catch (silver eel and yellow eel converted to silver-eel-equivalents at a rate of 10%) and turbine mortality. A preliminary analysis of the potential impact of the 59 hydropower installations in West Wales and Northumbria RBDs, assuming a 38% mortality rate at each hydropower installation (ICES, 2008), suggests an average annual loss of 60 kg silver eels per installation. Extrapolating this rate to the 263 installations in England and Wales suggests a total loss in the region of 15.8 t per annum. However, there is a large degree of uncertainty associated with this estimate and it should be regarded with considerable caution.

Northern Ireland

In Northern Ireland, the actual current escapement from the NI ERBD is not known, but as there are no fisheries, hydropower installations or other significant anthropogenic mortality factors, escapement is presumed to equal production (not known). The current escapement of the NW IRBD is dealt with in the Ireland Country report.

The current annual average escapement of silver eel from the Neagh Bann RBD over the 2003 to 2010 period is about 313 t.

Scotland

Current escapement is assumed to be the same as current production (13.2.2.2) because these measures are based on actual numbers of migrating eels at three catchments at different altitudes. Note that because these production rates are applied only to eel-producing habitats downstream of turbines and other man-made barriers to migration, the value reported in Table 17 (84 933 kg) may be an underestimate of actual escapement.

UK.13.2.2.4 Production values e.g. kg/ha

England & Wales

Area based potential production values range from 0.3 to 22.55 kg per ha across the RBDs.

Northern Ireland

Area based potential production values range from 0.85 to 5.7 kg per ha across the RBDs (excluding the NE RBD where production is unknown).

Scotland

Mean current production rates for the three catchments at different altitudes between 2000–2008 were rates of 0.785 $kg.ha^{-1}$ for wetted areas between 0 and 239 m above sea level, 0.663 $kg.ha^{-1}$ for 240 to 415 m, and 0.417 $kg.ha^{-1}$ for areas above 415 m. Mean production rate was 0.76 $kg.ha^{-1}$, while overall mean escapement was estimated at 2000–2008 was 0.55 $kg.ha^{-1}$ (Table 17b). The overall mean escapement for 2009 was 0.68 $kg.ha^{-1}$. Data are not yet available for 2011.

UK.13.2.2.5 Precautionary diagrams

UK.13.2.2.6 Impacts

England & Wales

Fisheries

Commercial fisheries for eel in England and Wales are not currently thought to significantly impact on silver eel production from RBDs. However, it is acknowledged that data are very limited and this is an area that requires further consideration as new data and analyses allow.

To date, catch data have been reported according to the EA Region in which the fishery operated. As not all the EA Regions coincide with RBDs, it has not been possible to assign all historical catch records to RBDs. Therefore, no data are currently available on fishing mortality at the RBD scale. However, the total impact of fishing for England and Wales as a whole has been estimated at about 20 t of silver eel equivalents per annum. This estimate is based on the average reported catches of silver and yellow eels for 2007 to 2009, with the yellow eels converted to silver eel equivalents using a 10% conversion, and assuming a 6x level of underreporting, primarily within for the yellow eel catch.

Hydropower

The vast majority of hydropower installations in England and Wales have not been assessed for their potential impact on eel mortality, and nor has eel production upstream of these installations been calculated. However, a preliminary analysis of the potential impact of the 59 hydropower installations in West Wales and Northumbria RBDs, assuming a 38% mortality rate at each hydropower installation (ICES, 2008), suggests an average annual loss of 60 kg silver eels per installation. Extrapolating this rate to the 263 installations in England and Wales suggests a total loss in the region of 15.8 t per annum.

Others

There are not considered to be any other significant anthropogenic factors that impact on silver eel production in England and Wales.

Northern Ireland

NI Eastern RBD

No fisheries, turbines or other anthropogenic factors impact silver eel production in this RBD.

NI Northwestern RBD

Fisheries

None.

Hydropower

There are two hydroelectric turbine stations at the outflow of the Erne system into the Atlantic. Their impact on silver eel escapement has been assessed and is reported in the Country Report of the Republic of Ireland.

Others

There are not considered to be any other significant anthropogenic factors that impact on silver eel production in this RBD.

NI Neagh-Bann RBD

Fisheries

The large-scale yellow and silver eel fisheries within the system, but these are assessed to not have a significant impact on eel production at present, relative to the escapement target.

Hydropower

There are no hydropower installations in this RBD that impact on silver eel escapement.

Others

There are not considered to be any other significant anthropogenic factors that impact on silver eel production in this RBD.

Scotland

Fisheries

There are no fisheries for eel in Scotland.

Hydropower

The estimated impact of hydropower on eel production is shown in Table 21, based on the assumption that production is directly related to the proportion of total wetted area that hydroschemes either exclude eels from using, or where a fish pass allows eels access, it is assumed that zero escapement occurs from upstream. The total area of habitat from which eels are either excluded by hydroschemes or from which they are exposed to turbine mortality represents 20.6% of total freshwater habitat (24.3% of still water, and 10.1% of running water). These percentages of area lost to eels from hydropower are reduced markedly when taking account of the distribution of natural barriers to eel migration (assuming barriers to salmon are barriers to eel): to 3.4% (all freshwater), 8.1% (still water) and 1.3% (running water). These figures seem relatively low given the land area upstream of hydroscheme barriers, and are currently being reviewed. One possible reason for the low values is a consequence of the siting of some hydroschemes immediately below substantial natural barriers (i.e. waterfalls) to eel migration (in order to utilize the hydraulic head).

Table 21. Estimated impact of hydroelectric schemes on eels: the percentage of freshwater habitat from which eels are either excluded or exposed to turbine-related mortality. *NI = Natural impassable barriers.

Access from sea	Total freshwater habitat in Scotland RBD (ha)	% of area of full digital river network			% of area of 'naturally accessible' channels		
		Total	Still-water	Running water	Total	Still-water	Running water
To full digital river network	186 661	100	100	100			
Up to NI barriers*	153 739	81.4	81.5	81.4	100	100	100
Up to Hydro-barriers	148 166	79.4	75.7	89.9	96.6	91.9	98.7

Others

There are not considered to be any other significant anthropogenic factors that impact on silver eel production in this RBD.

UK.13.2.2.7 Stocking requirement eels <20 cm

England & Wales

Though stocking plans have been produced for each EMP as required by the Regulation, England and Wales is not relying on stocking to meet the escapement target if the RBD is failing for the following reasons:

- There is insufficient stocking material.
- Restocking is not seen as the most sustainable action when compared with improving access. The cost of an eel pass is in the region of £800 equivalent to stocking 4 kg (12 000) glass eel. Where we have installed passes we have recorded thousands of eel moving pass these structures in the first year. We consider this to be the most sustainable management option to engage in.
- England and Wales is not keen to use material caught other than by dip-nets as this achieves the best quality product. Elvers acquired from fisheries that use trawls or large boat assisted seinenets suffer very high mortalities. UK elvers are hand caught and of premium quality.

Northern Ireland

NI Eastern RBD

None.

NI Northwestern RBD

None.

NI Neagh-Bann RBD

The LNFCS stocking target is 6 to 8 million individuals (approximately 2 t) or 150 to 200 elver per hectare (which produces a density of eel that ultimately provides a size of eel that reaches a prime market price). This target is consistent with gaining maximum benefit per elver and on the basis of the input-output analysis will supply a managed fishery and allow adequate escapement.

Of interest also is the effect of stocking level on the proportion of males and females in the emigrating silver eel catch. The gear is not thought to be selective for sex, implying a true record of sex ratio, dependent at least partly on input stock density (Rosell *et al.*, 2005). As male eels leave earlier and are much smaller, this suggests that at high stocking levels the number of silver eels increases but without increase in weight of eel produced, perhaps suggesting habitat saturation at levels above 400 elver per hectare or 12 million individuals for the Lough. In 2010, 996 kg of glass eel (approximately 3 million individuals) were stocked into Lough Neagh, whilst in 2011 it was approximately 1035 kg (about 3.1 million individuals).

Scotland

None.

UK.13.2.2.8 Summary data on glass eel

In 2010, a total of 1.9 t (Table 22) of glass eel were caught in England and Wales, of which 1.71 t was used locally or exported; 59.6% of this was used in stocking and the remainder in aquaculture outside the UK. In 2011, a total of 3.6 t (Table 22) was caught, of which 3.25 t was exported or used locally within the UK; 49.5 was used for stocking and the remainder supplied aquaculture outside the UK. The differences between the catch weights and the amounts used are due to the weight shrinkage of glass eel between capture and trade. No glass eel went for direct consumption in the UK, and neither was any UK glass eel exported outside the European Union.

Table 22. Total quantity (kg) of glass eel caught in the UK between 2009 and 2010.

Year	Quantity (kg)
2009	
2010	1889.6
2011	3642.1

There are no glass eel fisheries in Northern Ireland or Scotland.

UK.13.2.2.9 Data quality issues

No information.

UK.14 Sampling intensity and precision

No new information available. Refer to previous UK Country Reports.

UK.15 Standardization and harmonization of methodology

UK.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.

Northern Ireland

No information.

Scotland

No information.

UK.15.2 Sampling commercial catches

England & Wales

There is no routine sampling of commercial catches, although some sampling has occurred to characterize migrating silver eel populations sampled by commercial eel-rack fisheries (Knights *et al.*, 2001; Bark *et al.*, 2007).

Northern Ireland

Methods described above. No Quality Assurance is undertaken within the sampling of the commercial catches.

Scotland

No commercial catches are reported.

UK.15.3 Sampling

England & Wales

No information.

Northern Ireland

No information.

Scotland

No information.

UK.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 microchemistry analyses.

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 labs in Newport. Results to date indicate mean yellow eel age of 14 years, male silvers 11 years and female silvers 18 years. These findings and the methodologies by which they were calculated were corroborated during ICES Eel Ageing Workshop held in Bordeaux in 2009.

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).

UK.15.5 Life stages

England & Wales

No information.

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.

Scotland

No information available.

UK.15.6 Sex determinations

England & Wales

No information.

Northern Ireland

The correct gender assignment was originally under the guidance of senior fisheries scientists and is based on *in situ* macroscopic examination.

Scotland

No information.

UK.16 Overview, conclusions and recommendations

Recruitment of glass eel to UK waters appears to continue at very low level compared to the highs of the 1970s and early 1980s. Although the reported catch (2.15 t) by the England and Wales fishery was the highest since 1998, it is still less than 10% of typical levels two to three decades ago. Catch alone is not necessarily a good index of glass eel abundance because changes in effort can affect catch independent of abundance. Ideally, trends in abundance should be assessed using catch per unit of effort (cpue) data. Apparent underreporting of glass eel catches in the England & Wales fishery in previous years precludes a robust trend analysis of catch per unit of effort over time. However, the new trade registrations implemented in 2010 appear to have produced better information about the levels of underreporting, and it is anticipated that these levels will reduce in the coming years and therefore the quality of the data will increase.

The 16 kg of glass eel caught in the fishery-independent trap in the River Bann, Northern Ireland in 2011 is the lowest in the current dataseries, which began in 1960.

Assessment methods are still being developed and the assessments presented in this report are expected to change (especially for England and Wales) as better methods become available. Details of the currently applied methods, and assessments can be found in the UK eel management plans that be downloaded from the following Defra website:

http://archive.defra.gov.uk/foodfarm/fisheries/freshwater/eelmp.htm

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