Report on the eel stock and fishery in the Netherlands 2010

NL.1 Authors

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Contributions: The following persons and institutions provided information for this report: Arjan Heinen (Combinatie van Beroepsvissers; stocking data), Jan Meijer (Bond van Binnenvissers van Noordwest Overijssel; yellow eel data at Stroink), Pim Wilhelm (Nederlandse Vereniging van Viskwekers; eel aquaculture production). Jaap van der Meer (NIOZ: yellow eel data NIOZ fyke), Michiel Kottermen (IMARES; eel contaminants) and last but not least Willem Dekker. Considerable sections of the text of the 2010 report are from the 2009 report written by Willem Dekker.

NL.2 Introduction

NL.2.1 Status of this report

In 2002 (ICES 2003), the EIFAC/ICES Working Group on Eels recommended that member countries should report annually on trends in their local populations and fisheries to the Working Group. In 2003 (ICES 2004), detailed data reports per country were annexed to the Working Group Report, which have subsequently been updated, refined and restructured to match the set-up of the EU Data Collection Regulation. FAO/ICES (2010) is the most recent version. This report on the status of and trend in the eel stock in the Netherlands updates the information presented before and provides some additional information on developments of catch estimates of eel by the new Recreational Fisheries Programme and the result of a pilot study examining the use of light traps in glass eel monitoring.

NL.2.2 General overview of fisheries

Eel fisheries in the Netherlands occur in coastal waters, estuaries, larger and smaller lakes, rivers, polders, etc. The total fishery involves approx. 200 companies, with an estimated total catch of nearly 1000 tonnes. 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, fishers are currently free to execute the fishery in whatever way they want. There is no general registration of fishing efforts or landings 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.

NL.2.3 Spatial subdivision of the territory

The fishing areas can be categorized into five groups:

1) 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 eel pots 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.

2) 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 fishers 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 80% of the actual total. There are 70 fishing licences, owned by ca. 30 companies. The total number of gears allowed in 2009 was: fixed fykes 1579, train fykes 6386, eel boxes 7415 and unknown numbers of longlines.

3) Main rivers; 180 km² 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 fishers are licensed for specific river stretches, where they execute the sole fishing right. No registration of efforts or landings 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).

4) Zeeland; 965 km². In the Southwest, the Rivers Rhine, Meuse and Scheldt (Belgium) discharge into the North Sea in a complicated network of river branches, lagoon-like waters and estuaries. Following a major storm catastrophe in 1953, most of these waters have been (partially) closed off from

the North Sea, sometimes turning them into freshwater. Fishing is licensed to individual fishers, 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.

5) Remaining waters; inland 1340 km². This comprises 636 km² of lakes (average surface: 12.5 km²); 386 km² of canals (>6 m wide, 27 590 km total length); 289 km² of ditches (<6 m wide, 144 605 km total length); and 28 km² of smaller rivers (all estimates based on areas less than 1 m above sea level, 55% of the total surface; see Tien and Dekker, 2004 for details). Traditional fisheries are based on fykenetting and hook and line. Individual licences permit fisheries in spatially restricted areas, usually comprising a few lakes or canal sections, and the joining ditches. Only the spatial limitation is registered. Eight small companies operating scattered along the North Sea coast have been added to this category. There are approx. 100 companies, using unknown quantities of gears of all types.

The Water Framework Directive subdivides the Netherlands into four separate River Basin Districts, 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.

Table NL.a Overview of water surface, number of commercial companies and their annual landings (2004), by fishing area. Estimates in Italics have been broken down by RBD, assuming that catches are proportional to the number of fishing companies.

		Surface	Estimated landings (t)		Data source
Area	RBD	(km2)	yellow eel	silver eel	
Waddensea	Rhine	2591	37	-	EU logbooks
	Ems	38	3	-	EU logbooks
IJsselmeer	Rhine	1820	240	40	Auction statistics
Rivers	Rhine	120	46	91	Informed guess
	Meuse	60	4	9	Informed guess
Zeeland	Meuse	535	75	?	(EU logbooks)
	Scheldt	428	0		
Others	Rhine	900	222	133	Informed guess
	Ems	86	9	5	Informed guess
	Meuse	288	4	2	Informed guess
	Scheldt	67			
Sum		6528	640	280	

NL.2.4 Dutch Eel Management Plan

The Ministry of Agriculture, Nature and Food Quality (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:

   7.1) Reduction of mortality at pumping stations. Within the framework of the WFD, a budget of 200 M€ is available.

   7.2) The hydropower industry will be asked to reduce mortality by 35%. On new installations, a migration passage is obligatory.

7.3) Fishery-free zones near barriers and sluices, presumably extending 500 m up- and downstream.

7.4) Release of angler catches; this is a voluntary measure by the sport fisheries.

7.5) Ban on recreational fishing (a few fykenets per person) in coastal areas from 2011.

7.6) Stop on sniggle licences in state owned waters.

7.7) For the fishery, version 1 of the EMP set a closed season in September and October (yellow and 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: October and November; 2010 onwards: September, October and November).

7.8) 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 fishing is forbidden.

NL.3.1.1.2 Recreational

Glass eel fishing is forbidden.

NL.3.1.1.3 Fishery independent

Recruitment of glass eel in Dutch waters is monitored at Den Oever and eleven other sites along the coast (see Dekker, 2002 for a full description).

In Den Oever (Figure NL.1), 2010 recruitment was higher than 2009 and similar to levels observed during the first part of the decade. The 2009 immigration season started as usual, but ended early at the beginning of May. The glass eels had a low total length, in the same order as in recent years (Figure NL.2).

The data at the other sites (Figure NL.3) confirm the overall trend, though individual series may deviate.

Table NL.b Number of glass eel caught per lift net haul at the sluices in Den Oever. All observations have been corrected for the time of day and the month of sampling, and averaged per year.

Decade Year	1930	1940	1950	1960	1970	1980	1990	2000	2010
0		18.19	8.71	30.95	56.64	39.66	4.88	2.18	1.81
1		15.79	17.77	53.17	25.01	33.32	1.47	0.72	
2		25.52	113.86	124.33	44.78	21.01	3.94	1.44	
3		16.71	18.82	178.02	32.03	14.07	3.95	1.95	
4		48.72	28.15	55.50	37.26	18.80	6.37	1.96	
5		19.78	38.94	115.22	48.44	19.41	8.85	1.07	
6		8.03	10.22	27.71	39.63	20.56	10.06	0.45	
7		7.89	22.79	42.33	88.85	7.96	16.11	1.41	
8	21.63	6.82	74.50	28.91	56.32	5.91	2.88	0.38	
9	48.53	6.72	40.83	24.82	78.36	4.10	4.35	0.53	

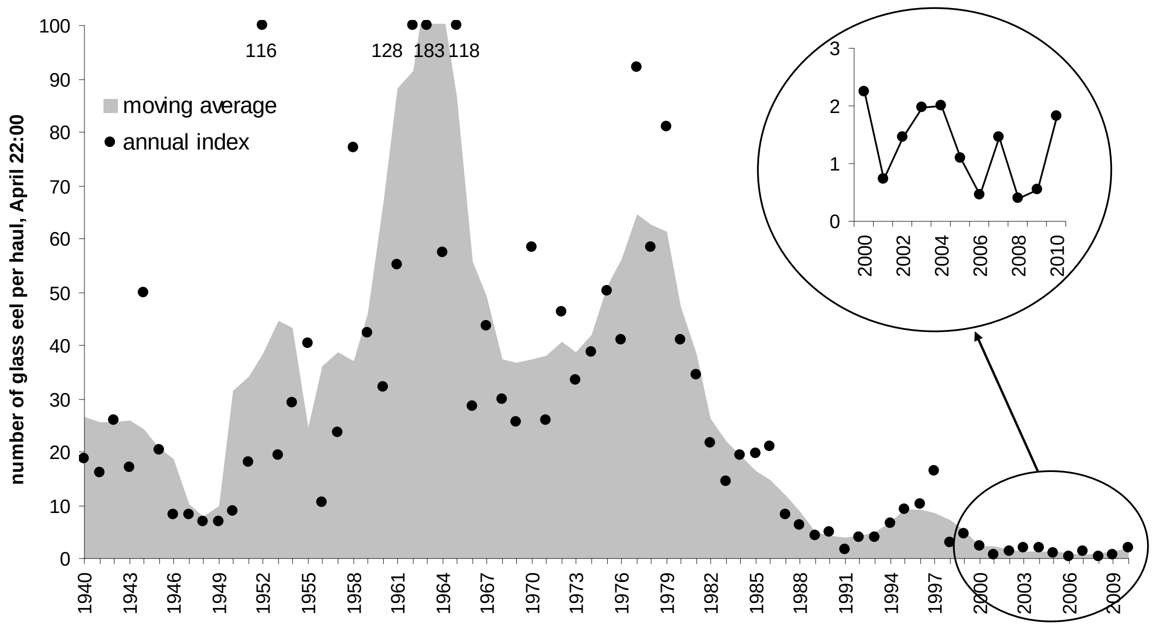


Figure NL.1 Time trend in the glass eel survey at the sluices in Den Oever.

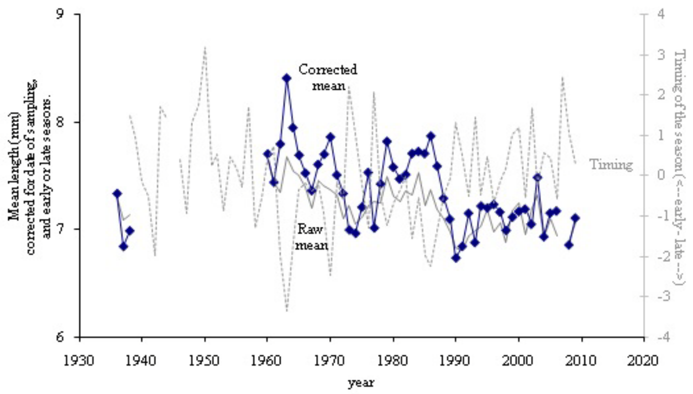


Figure NL.2 Time trend of the length of the glass eel sampled in Den Oever. The measurements have been corrected for the date of sampling within the season, and for the average timing of each season within each year. (Timing for 2006 currently unavailable).

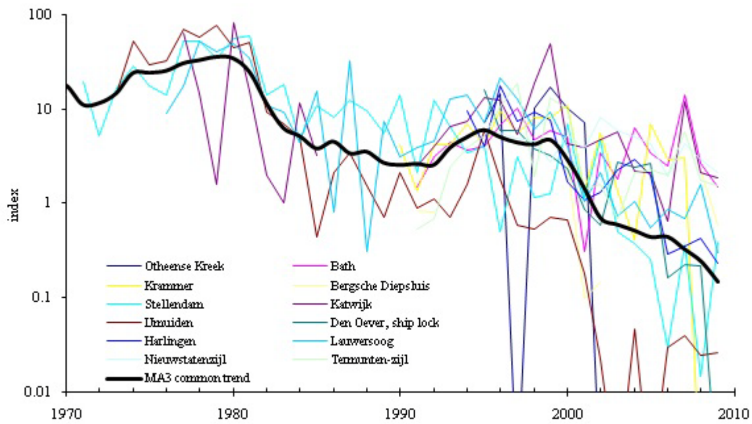


Figure NL.3 Long-term trends in the glass eel catches in the experimental fisheries at various places along the Dutch coast. MA3 indicates the moving average of the geometric mean of all series, averaged over three years.

Table NL.c Annual indices of glass eel recruitment at places in the Netherlands, other than Den Oever. Annual indices are expressed as the mean catch per lift net haul, at whatever time in the night. Most hauls are made in the evening, just in the dark.

Year	Otheense Kreek	Bath	Krammer	Bergsche Diepsluis	Stellendam	Katwijk	IJmuiden	Den Oever ship lock	Harlingen	Lauwersoog	Nieuwstatenzijl	Termunten-zijl
RBD	Scheldt	Scheldt	Meuse	Meuse	Meuse	Rhine	Rhine	Rhine	Rhine	Rhine	Ems	Ems
1969							47.30					
1970							31.50					
1971					15.40							
1972					4.10							
1973					13.10		32.80					
1974					22.80		119.30					
1975					13.90		66.80					
1976					11.30		73.10			14.40		
1977					42.10	130.25	159.20			28.40		
1978					42.10	30.23	131.70			83.90		
1979					27.30	3.23	176.00			66.20		
1980					45.10	171.60	101.50			80.30		
1981					47.30	31.65	113.90			55.10		
1982					11.30	4.13	20.80			17.40		
1983					14.30	2.10	15.60			15.10		
1984					3.80	23.62	11.40			7.10		
1985					8.70	6.67	1.00			25.20		
1986					6.40		4.70			1.30		
1987					9.80	14.00	7.70			52.00		
1988					7.60		3.50			0.50		
1989					4.40	3.67	1.60			12.10		
1990			0.30		11.30		4.70			5.00		
1991		5.90	0.10	1.41	1.70	5.10	2.00			6.30		0.30
1992		12.30	0.30	1.38	9.90	8.20	2.50		14.80	7.30		0.40
1993		17.50	0.30		5.20	13.50	1.60			20.80		1.40
1994		14.60	0.50	7.94	2.70	15.10	3.60		16.00	22.50		2.20
1995	0.50	15.70	0.30		3.20	27.10	13.10	27.80	6.80	11.60		3.00
1996	1.00	26.80	0.70		0.40	25.40	4.00	10.20	29.70	34.40	24.00	6.00
1997	0.00	40.40	0.40	33.33	2.50	10.90	1.30	10.20	12.40	20.90	21.00	10.60
1998	0.70	18.30	0.60		0.90	38.80	1.20	6.50	15.40	9.90	19.90	1.10
1999	1.20	23.10	0.60		1.00	101.30	1.60	5.60	12.70	15.10	11.80	7.50
2000	0.70	20.10	0.80	4.36	5.60	8.80	1.50	4.00	2.80	6.60	23.30	5.70
2001	0.50	(1.2†)	0.10	0.17	0.90	8.10	0.40	1.50	1.80	1.70	16.10	0.80
2002	0.00	13.60	0.40	0.25	3.70	9.80	0.05	1.00	2.20	3.40	35.30	0.90
2003	0.00	7.00	0.10		0.40	11.80	0.00	4.70	3.80	1.20	25.50	0.40
2004	0.00	(24.9†)	0.03		0.30	4.50	0.11	4.10	(4.9†)	1.70	21.70	1.20
2005	0.00	13.40	0.50		0.20	4.40	0.00	4.60	3.30	0.90	18.20	1.30
2006	0.00	9.70	0.21		0.02	1.33	0.07	0.28	0.48	1.39	8.33	1.13
2007‡	0.00	55.86	0.22		0.29	24.77	0.09	0.38	0.59	1.13	18.11	3.26
2008	0.00	10.49	0.00	3.91	0.01	4.31	0.06	0.38	0.71	2.54	12.36	1.00
2009	0.00	5.94	0.00	1.00	0.30	3.79	0.06	0.00	0.38	0.49	8.95	0.88

†Sampling only took place in part of the season.

‡ Very early season (warm spring), sampling stopped early (start of May) --> low number of empty samples.

NL.3.1.2 Yellow eel recruitment

NL.3.1.2.1 Commercial

No commercial dataseries on recruitment exist.

NL.3.1.2.2. Recreational

No recreational dataseries on recruitment exist.

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. The remaining data (Figure NL.**4**, Table NL. d) demonstrate a sharp decline in the late eighties, comparable with the trend in Lake IJsselmeer eel stock, to which the pumping station drains. Until the early 1990s, the trap was of the conventional type (a ramp filled with willow twigs; cf. Dekker, 2002, p. 27), thereafter a new type has been added/replacing (stainless steel kind of fykenet funnel into a hard cover box; see Dekker, 2002, p. 253).

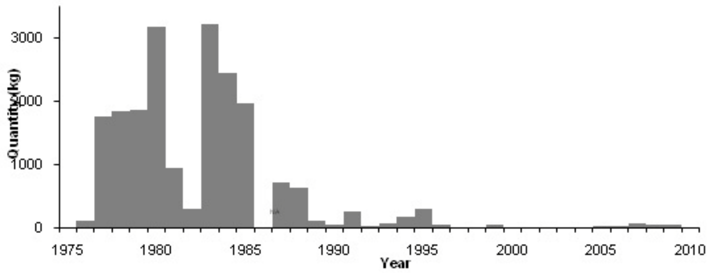


Figure NL.4 Time-series of the quantity of yellow eel caught in the eel trap at Stroink, Vollenhove.

Table NL. d Annual catches of bootlace eel in the eel trap at Stroink, Vollenhove, in kg per year.

Decade Year	1970	1980	1990	2000
0		3180	41	0
1		935	250	0
2		300	5	0
3		3213	75	0
4		2455	175	0
5		1972	300	21
6	100	#N/A	40	3
7	1750	703	0	70
8	1840	628	0	50
9	1860	110	40	50

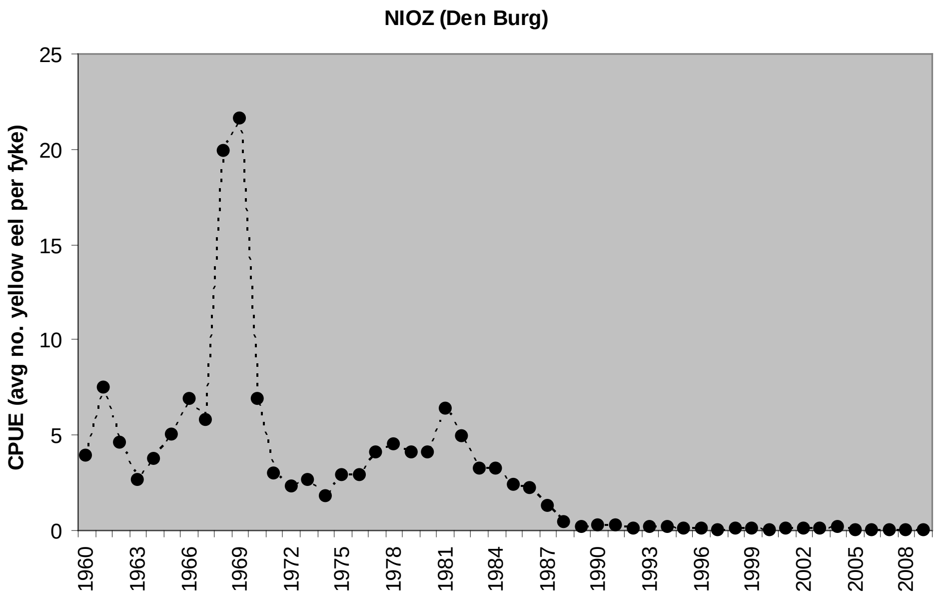


Figure NL.5 Time-series of the mean catch per fyke (numbers) of yellow eel at NIOZ (data from van der Meer, in prep.).

One of the few long time-series for yellow eel is the fyke monitoring at NIOZ (Den Burg, Texel). This dataset demonstrates a familiar pattern of a steep decline in abundance since the 1980s.

NL.3.2 Yellow eel landings

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 Silver eel landings

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.3.4 Aquaculture production

Different sources reported slightly diverging results for the Dutch aquaculture industry (Table NL.e).

Table NL.e Aquaculture production in the Netherlands, as reported by different sources.

	Data source			
	FEAP	wgeel2003	FAO Fishstat	Nevevi
1985		20	20	
1986		100	100	
1987		200	200	100
1988		200	200	300
1989		350	350	200
1990		550	500	600
1991		520	550	900
1992		1250	520	1100
1993		1487	1250	1300
1994		1535	1487	1450
1995		2800	1535	1540
1996	1800	2443	2800	2800
1997	1800	3250	2443	2450
1998	3250	3800	2634	3250
1999	3800	4000	3228	3500
2000	4000	3800	3700	3800
2001	4000	3228	4000	4000
2002	4000		3868	4000
2003			4200	4200
2004			4500	4500
2005			4000	4500
2006				4200
2007				4000
2008				3700
2009				3200
2010				

Nevevi is the national organization of fish farmers; one would expect their own estimates to be the best.

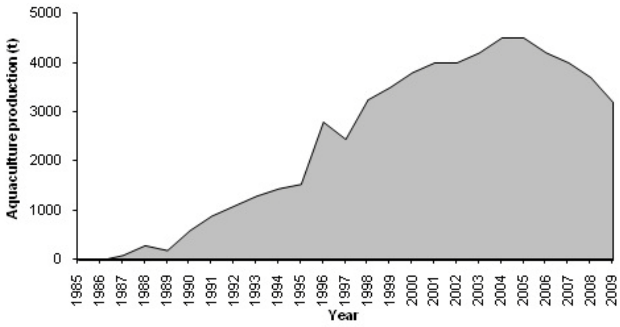


Figure NL. 6 Trend in aquaculture production in the Netherlands.

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 fishers fishing in the Waddensea.

Data on re-stocking quantities are listed in Table NL.f.

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 2009, more than 0.3 million glass eels and 0.3 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.f Re-stocking of glass eel and young yellow eel in the Netherlands, in millions re-stocked†. GE = glass eel, YYE = young yellow eel.

Decade	1940		1950		1960		1970		1980		1990		2000	
Year	GE	YYE	GE	YYE	GE	YYE	GE	YYE	GE	YYE	GE	YYE	GE	YYE
0			5.1	1.6	21.1	0.4	19.0	0.2	24.8	1.0	6.1	0.0	2.8	1.0
1			10.2	1.3	21.0	0.6	17.0	0.3	22.3	0.7	1.9	0.0	0.9	0.1
2			16.9	1.2	19.8	0.4	16.1	0.4	17.2	0.7	3.5	0.0	1.6	0.1
3			21.9	0.8	23.2	0.1	13.6	0.5	14.1	0.7	3.8	0.2	1.6	0.1
4			10.5	0.7	20.0	0.3	24.4	0.5	16.6	0.7	6.2	0.0	0.3	0.1
5			16.5	0.9	22.5	0.5	14.4	0.5	11.8	0.8	4.8	0.0	0.1	0
6	7.3		23.1	0.7	8.9	1.1	18.0	0.5	10.5	0.7	1.8	0.2	0.582	0
7	7.6	1.6	19.0	0.8	6.9	1.2	25.8	0.6	7.9	0.4	2.3	0.4	0.216	0
8	1.9	2.0	16.9	0.8	17.0	1.0	27.7	0.8	8.4	0.3	2.5	0.6	0	0.230
9	10.5	1.4	20.1	0.7	2.7	0.0	30.6	0.8	6.8	0.1	2.9	1.2	>0.3	>0.3

Decade	2010	
Year	GE	YYE
0	2.7	0.06
1		
2		
3		
4		
5		
6		
7		
8		
9		

†Conversion from weight into numbers: it was assumed that there are 3000 glass eels per kg, resp. 30 young yellow eels per kg.

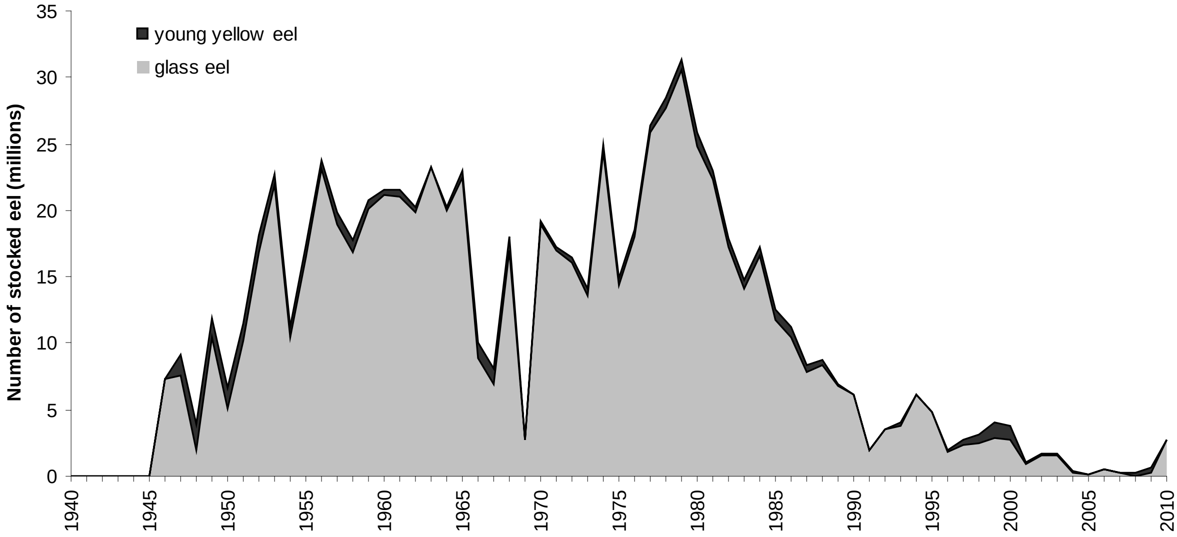


Figure NL. 7 Trend in stocking of glass eel and young yellow eel in the Netherlands.

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

Table NL.a lists the number of fishing companies having a specific eel fishing licence, by fishing area. Most licences are linked to a specific ship. 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 because restrictions apply on the combinations of types of fishing gears (e.g. no fykenets and gillnets should be operated concurrently, because 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. Because 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.

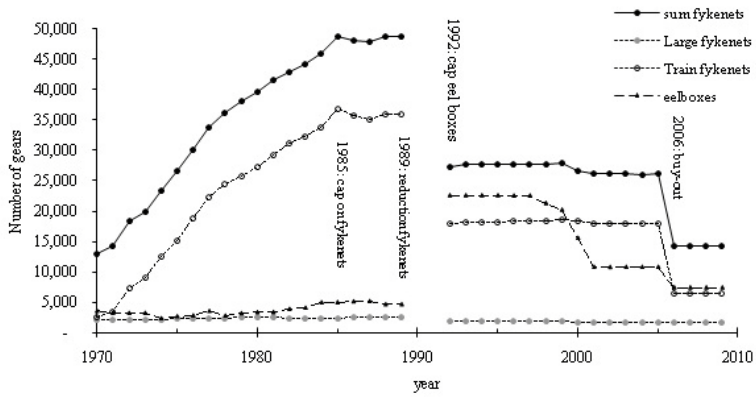


Figure NL.8 Trends in the nominal number of fishing gear employed in the eel fishery on Lake IJsselmeer. Information before 1989 is based on a voluntary inquiry in 1989 (Dekker, 1991); after 1992, the licensed number of gear is shown. The reduction in-between is realistic.

A tentative overview of the number of gears for the whole country is presented in Table NL.g, based on inquiries, interviews and voluntary reporting by fishers. The Ministry of Agriculture, Nature and Food Quality is planning to conduct a survey of eel fishing gears towards the end of 2010.

Table NL.g Overview of the number of fishing gears used. Information from inquiries in 2007. Data from Dekker *et al.*, 2008.

	IJsselmeer/ Markermeer	Rivers	Coastal waters	Elsewhere	Coastal, recreational	Total
Large fyke nets	1,579	155	-	+		>1734
Pound nets		163	574	+		>737
Train fyke nets	6,386	2,433	233	+		>9052
Small fyke nets		51		+	1,956	>2007
Boxes, pots	7,415	551	+	+		>7966
Long lines, hook & line	+	+	+	+		+
Electro-dipnet		+	-	+		+
Otherwise				+		+
Number of companies	73	28	48	ca. 100	978	ca. 250+978

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.h); 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.

Table NL.h 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 Year	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990	2000
0	324	620	1157	838	3205	4152	2999	1112	641	472	368
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

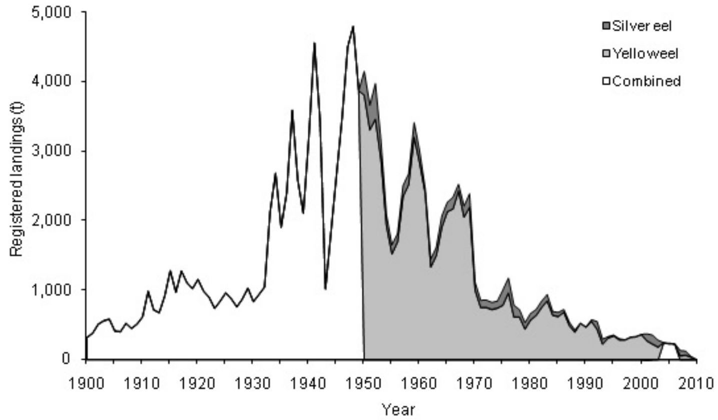


Figure NL.9 Time trend in the landings from Lake IJsselmeer.

NL.6.2.2 Catches and landings from inland waters outside Lake IJsselmeer

For the inland areas outside Lake IJsselmeer, no detailed records of catches and landings were available until 2010. In January 2010 the Ministry of Agriculture, Nature and Food Quality introduced an obligatory catch recording system for inland eel fishers. Fishermen are required to report their weekly eel catches for each of the 43 so-called Fish Stock Management Committees ['Visstand Beheer Commissies' VBC]. Unfortunately, the fishers are not required to provide information on effort (gear type, number of gears, soaking time) or distinguish between yellow eel and silver eel at this point in time.

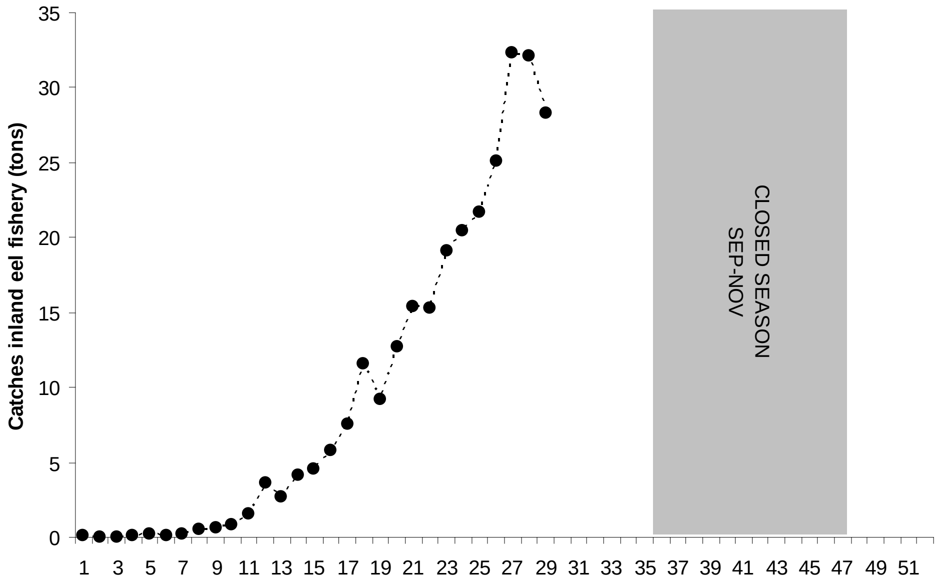


Figure NL.10 Weekly catches in tons of eel (yellow eel + silver eel) by inland fishers during the 2010 season.

Table NL.i Landings inland fishers in tons per year (data the Ministry of Agriculture, Nature and Food Quality.

Decade Year	2010
0	275
1	
2	
3	
4	
5	
6	
7	
8	
9	

NL.6.2.3 Catches and landings, recreational fisheries

Recreational catches of eel are not systematically recorded, and the order of magnitude is not well known. Inquiries related to angler licensing indicate that 350 000 out of 913 000 male anglers fish for eels (in 2003); 57 500 of them take eels back home, in an average annual quantity of 18 specimens, approx. 1 kg per capita per annum. The number of female anglers is much lower, but not exactly reported. The total quantity of eels taken home has recently been analysed (Vriese, Klein Breteler, Kroes and Spierts, 2008), coming to an order of magnitude of 200–400 t per annum. Circumstantial evidence indicates that the true figure is probably close to the lower bound of 200 t.

Additionally, some 1000 individuals are licensed for recreational use of two fykenets per licence in coastal waters. Assuming 50 fishing days per year, and a daily catch of 0.5 kg per fyke, their catch will be in the order of 25 t.

A preliminary breakdown of catches by the type of fishers is given in Table NL.j.

Table NL.j Breakdown of commercial and recreational fishing and landings by the type of fisher. Data from Vriese *et al*. (2008), Dekker *et al*. (2008) and guestimates.

	Individual catch kg/year	Number of individuals	Total catch tonne/year
Full time commercial	7700	100	770
Part time commercial	1000	150	150
Poaching	?	?	?
Recreational (small fykes)	25	1000	25
Snigglers†	2.650	3773	10
Eel anglers	0.863	95 000	82
Other anglers	0.100	1 000 000	100
Non-anglers		15 898 977	
Totals		17 000 000	>1227

† Translation: sniggle=peur.

Since 2009 it is mandatory for all recreational fishers in inland waters where the fishing rights are with the recreational fishers (clubs, federations, etc) and marine waters (federal regulation), to release eel back in the water immediately upon capture.

Details of the new Recreational Fisheries Programme which was started in 2009 will be described in Section NL. 12.

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 Country Report Netherlands 2009. Up to 2001, ships with a total length (LOA) ≥15 m were obliged to report all their eel catches, but smaller ones were not; since 2001, ships with a total length ≥10 m are obliged to report their eel catches, if their landings per day exceeded 50 kg per species. 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 t he regulations in 2001 led to a gradually changing reporting practice, before and after 2001. 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.

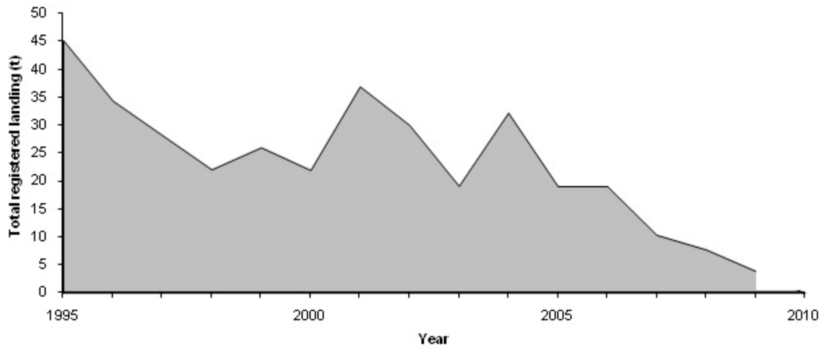


Figure NL.11 Time trend in the total registered landings from marine waters in Dutch harbours.

NL.7 Catch per unit of effort

Data on catch per unit of effort are only available within the framework of a stock monitoring programme in State controlled waters. Starting in 1993, the fish assemblage in the main rivers and linked waters (Figure NL.12) has been monitored, by means of logbook registration of commercial catch and bycatch, in a restricted number of fykenets (4 large fykenets or 2 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 demonstrate a slowly declining trend over the years down to about ⅓ of the earlier value, but the year-to-year and site-to-site variation is considerable. There is no formal application of these data in eel fisheries management, but the perceived lack of a declining trend has frequently been quoted in the debate on the status of the eel stock. The closed season (September–October) in 2009 caused an interruption of this time-series.

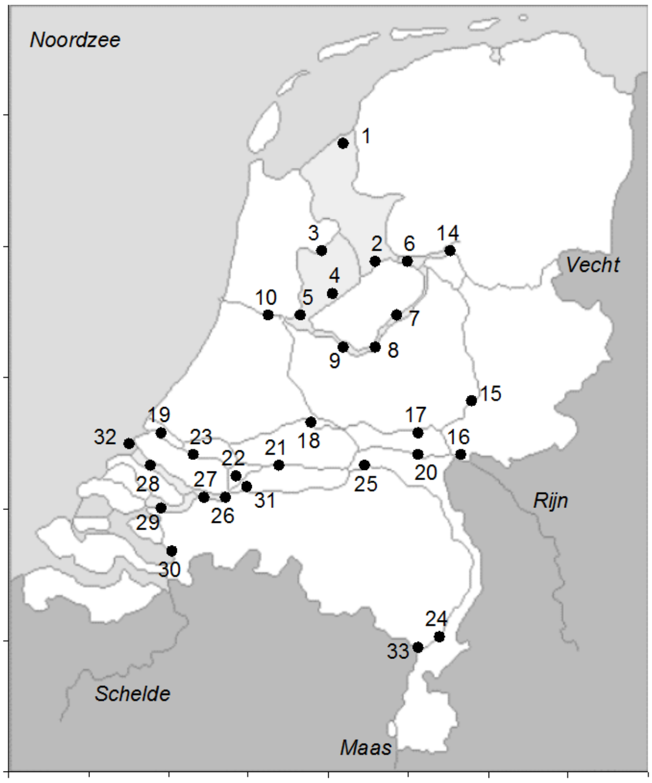


Figure NL.12 Sampling sites for the 4-fyke monitoring of commercial catches and bycatch.

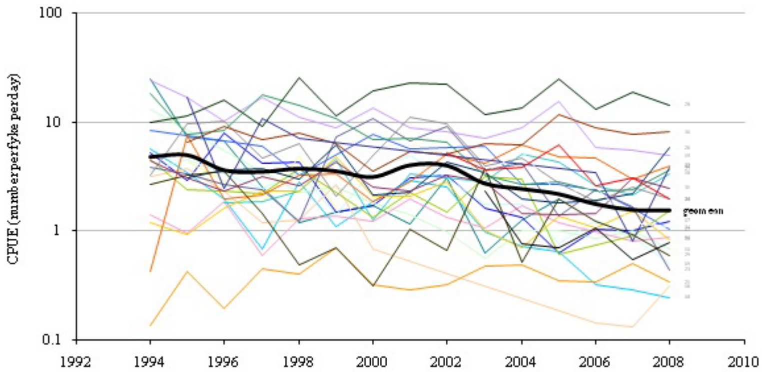


Figure NL.13 Time trends in the 4-fyke monitoring of commercial eel catches per sampling site. The geometric mean (thick line) has been calculated for all available data in each year, irrespective of the spatial coverage.

NL.8 Other anthropogenic impacts

Nothing to report under this heading.

NL.9 Scientific surveys of the stock

NL.9.1 Recruitment surveys

NL.9.2 Yellow eel stock surveys

NL.9.2.1 Yellow eel stock surveys in Lake IJsselmeer

Figure NL.14 presents the trends in cpue for the yellow eel surveys in Lake IJsselmeer, using the electrified trawl. The long-term trend in this survey has been analysed by Dekker (2004a), in a wider setting, using more sources of information. In that long-term analysis, a smooth function over the years was fitted to the data. Figure NL.14 presents the raw data per year.

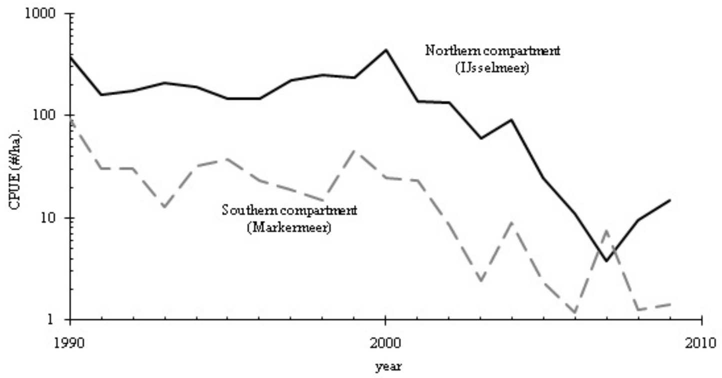
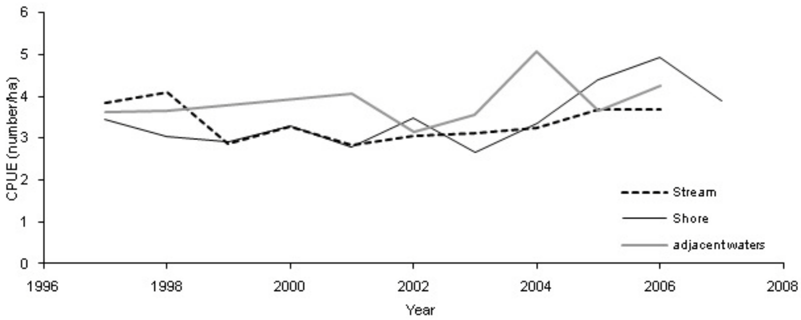


Figure NL.14 Cpue trends in Lake IJsselmeer stock surveys, in number per hectare swept-area, using the electrified trawl. Note: The northern and southern compartments are separated by a dyke.

NL.9.2.2 Yellow eel stock surveys in the Main Rivers

Figure NL.5 presents the trends in the Main Rivers survey, for the common trawl and the hand-held electric dipnet, for the main stream, the shore area, and the oxbow and other adjacent waters separately. None of these series demonstrates a clear upward or downward trend.

Starting in 2008, the execution of these surveys has been granted to another consortium. The basic data are not yet available. The report published by that consortium (Kessel *et al.*, 2008) seems to indicate that the eel stock has declined from 2007 to 2008 by an order of magnitude. This result is so unlikely, that for the time being no update of the dataseries is presented here.



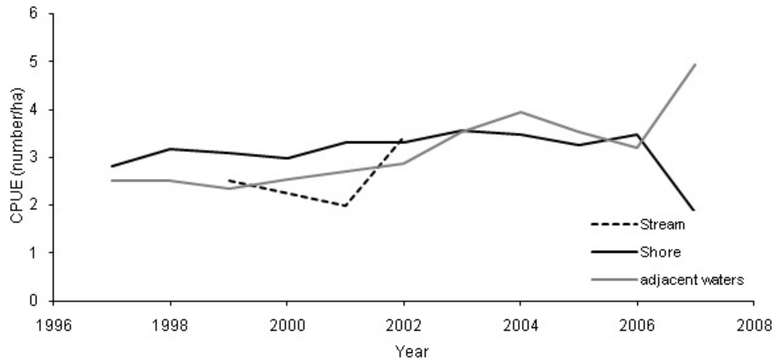


Figure NL.15 Trends in cpue in numbers per hectare, for the trawl (top) and electric dipnet (bottom), in the Main River surveys.

NL.9.2.3 Yellow eel stock surveys in coastal waters

The number of eels caught in coastal surveys (Dutch Young Fish Survey) is presented in Figure NL.6. Until the mid-1980s, considerable catches of eel were observed. Since that time, a gradual decrease is observed.

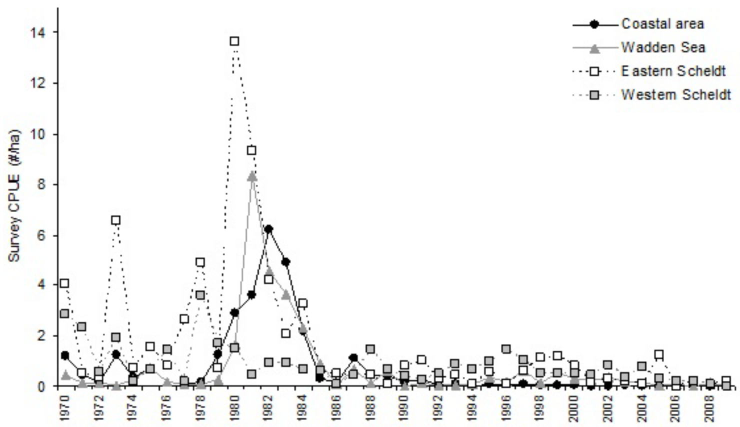


Figure NL.16 Trends in coastal survey cpue. Most of the Wadden Sea belongs to RBD Rhine; Eastern Scheldt is mixed Scheldt and Meuse; Western Scheldt belongs to RBD Scheldt (with an extra inflow from Meuse), Coastal area belongs to RBD Rhine.

A more elaborate statistical analysis of the abundance and length composition of the eel stock in coastal waters is presented in Dekker (2009b).

Overall, the yellow eel surveys are not representative for the whole River Basin Districts or the Country, especially because the smaller water bodies (canals, polders, regional lakes) are not surveyed; these waters cover nearly 25% of the total water surface, but probably constitute the preferred eel habitat. Lake IJsselmeer is extremely overexploited; while fisheries in the remainder of the country is less severe, resulting in larger average sizes being exploited. The Main Rivers Surveys are probably reasonably representative for the rivers. However, Lake IJsselmeer and the Main Rivers differ substantially, and it is not quite clear how the two should be weighted, and how the uncovered waters relate.

NL.9.3 Silver eel surveys

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 2011.

NL.10 Catch composition by age and length

NL.10.1 Long-term trends in length compositions

For Lake IJsselmeer, the landings are regularly sampled at the auctions. Results have indicated extreme overfishing. Because the catch composition did not change much over the years (see Dekker, 2004b), results have not been reported in detail for the past years.

In most recent years, length frequency distributions of commercial catches from Lake IJsselmeer have demonstrated a remarkable shift upwards (Figure NL.17). This shift is observed consistently in all gears, and in several years in a row. This upward shift might be the result of the effort reductions in 2005, of the further decline in recruitment since 2000 now progressing into the commercial sizes (corresponding to a sharp drop in commercial yield now observed), or of increased dependence on eels from other habitats (outside Lake IJsselmeer and/or hitherto unexploited habitats, such as dykes), which are less overexploited.

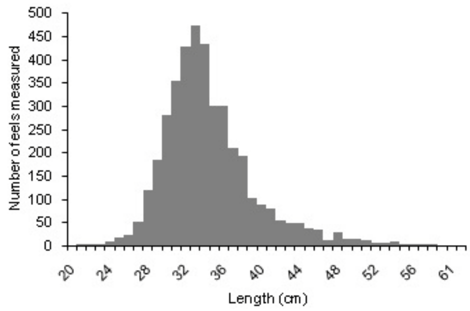


Figure NL.17 Length frequency of fykenet catches in Lake IJsselmeer, in 2006.

NL.11 Other biological sampling

NL.11.1 Length and weight and growth (DCR)

For Lake IJsselmeer, the market sampling described in Section NL.10 comprises measurements of length, weight, sex, maturity, liver weight, stomach content weight, parasitism (*Anguillicola crassus*), and otolith collection; see under NL.H. In addition to the market sampling, an annual sample of 100 specimens is collected during the autumn stock survey on Lake IJsselmeer; see NL.G.2. This survey sampling conforms to the protocol for market samples (NL.10). For market and survey samples, otoliths are collected and stored dry, but no age reading is performed.

For all other areas, no biological sampling of catches has been performed. A pilot study has been started up in 2009, sampling two restricted areas (province Friesland 53ºN 5º45′E, main rivers), which will give insight in the statistical requirements of further sampling (see Section NL. 14). This programme continued in 2010, and will be implemented as a country-wide programme in 2011.

NL.11.2 Parasites

The market sampling for Lake IJsselmeer collects information on the percentage of eels demonstrating *Anguillicola* infection (Figure NL.18, 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 is slightly decreasing. As part of the extended market sampling programme in 2009, data on *Anguillicola* 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.

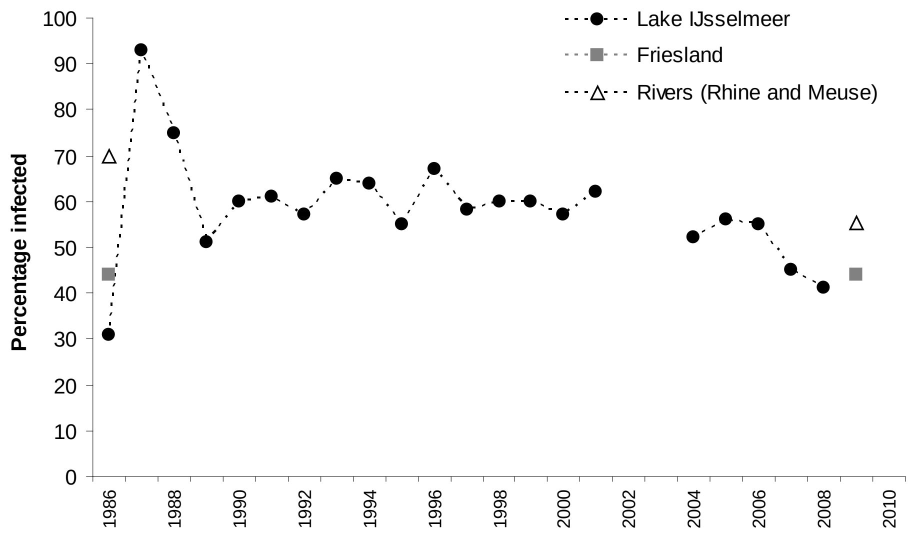


Figure NL.18 Trend in *Anguillicola* infections in Lake IJsselmeer eel, Friesland and Rivers (Rhine and Meuse). Based on visual inspection by the naked eye.

NL.11.3 Contaminants

In the previous Country Report (2009) some overviews were given for PCB contamination levels in eel in the Netherlands see Hoek-van Nieuwenhuizen and Kotterman (2007) and Hoogenboom *et al*. (2007). The current eel monitoring has continued in 2009, and the last data have been added to Figure 20.

The situation has not changed over the years; waterways with input from the river Rhine or Meusse are more heavily polluted than waters without. Sedimentation areas (historically) of these rivers have the highest PCB concentrations. Of the analysed organic contaminants, PCBs are considered the most important contaminant, observed in the highest concentrations.

NL.11.3.1 Spatial pattern

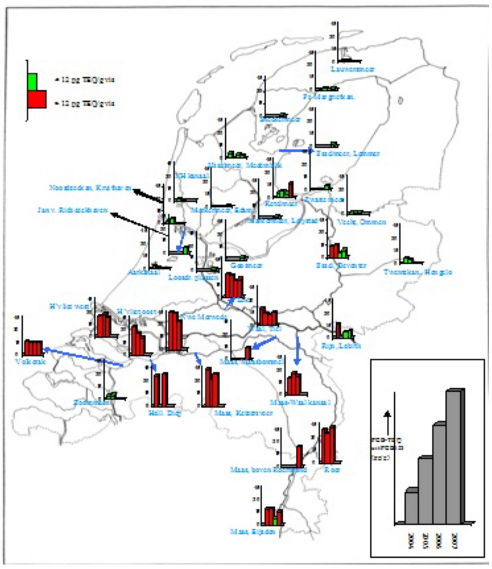


Figure NL.19 Temporal trend in PCB in eel (from Hoek-van Nieuwenhuizen and Kotterman, 2007).

NL.11.3.2 Temporal trend

The temporal trend differs substantially between sampling locations, but overall a decline is observed.

Figure NL.20 shows the trend in eels derived from Lake IJsselmeer and several places in the main rivers.

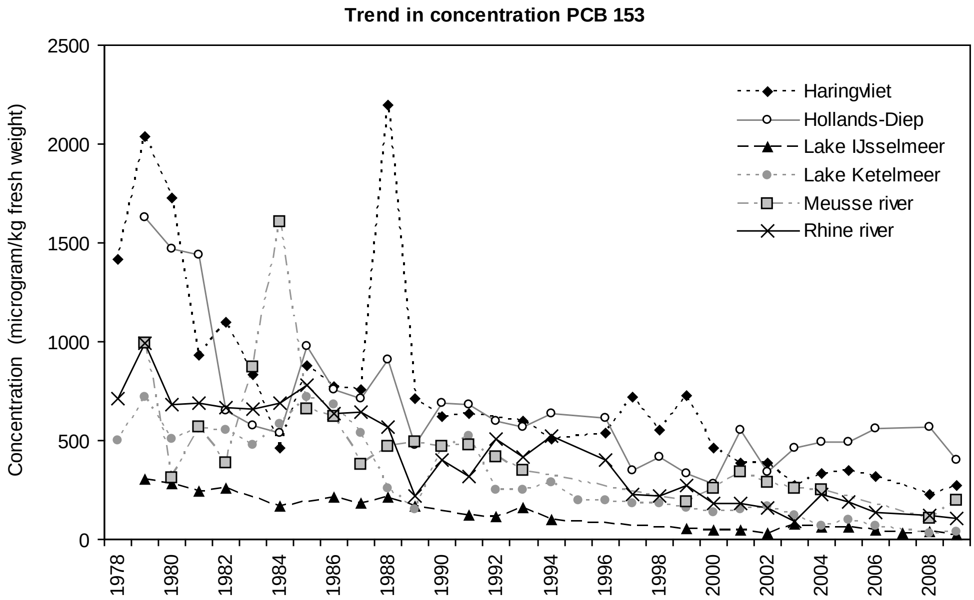


Figure NL.20 Temporal trend in PCB in eel (data from IMARES and RIKILT).

As shown in the 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. The major reduction has been achieved in the eighties and nineties. Compared with industrial contaminants like hexachlorobenzene (HCB) and hexachlorbutadiene (HCBD), both regulated also in the Water Framework Directive (WFD), the extent of decrease in PCBs is low. HCB and HCBD have declined from levels comparable with PCB153 around 1980 to levels as low as 10–20 μg/kg fresh weight in the more polluted areas of the Dutch rivers at the year 2000. This is a residual concentration of only 0.1 %. All these compounds are not being produced any more, but PCBs are clearly more persistent. This could be due to the higher amount produced, lower volatility and higher affinity to particles (organic matter). This results in a slower release to the environment where it can be taken up in the food chain, whereas other chemicals like HCB are washed out more quickly. In fact, the current PCB levels of suspended particulate matter (the future sediment) indicate that PCBs levels in eel will decrease only very slowly in the near future, if any.

NL.11.4 Predators

Predation of eel by cormorants (*Phalacrocorax carbo*) is much disputed amongst eel fishers and bird protectionists. The number of cormorant breeding pairs increased rapidly until the early 1990s, 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.

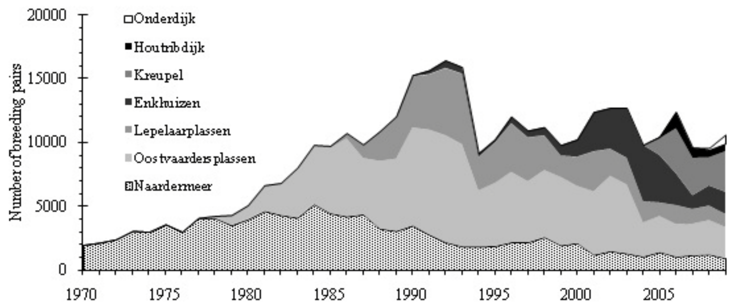


Figure NL.21 Trend in the number of breeding cormorants around Lake IJsselmeer, by breeding place. The breeding places are ordered from south (bottom) to north (top).

NL.12 Other sampling

NL.12.1 Recreational fisheries programme

Recently the EU installed additional regulations, which obliges Member States to estimate and report recreational catches of cod, eel, salmon, sea bass, bluefin tuna, sharks and rays in European waters. To fulfil the requirements of the EU regulations, the Netherlands has implemented a Recreational Fisheries Programme to estimate the recreational catches of cod, eel, sharks and rays.

To collect data on fishing participation (e.g. "Have you fished in the past 12 months?"), assessing attitudes or awareness and/or socio-economic and demographic profiling of recreational fishers, phone or mail recall surveys are straightforward, easy to administer and relatively cost-effective.

However, if detailed information on effort (e.g. "How many days have you fished in the past 12 months?"), catch (e.g. number or size) and/or economic activity is required, recall surveys are of limited applicability due to the impacts of recall bias, non-response bias, digit preference and/or prestige bias (Pollock *et al*., 1994; Lyle *et al*., 2002; Henry and Lyle, 2003; Baharthah, 2006).

The survey comprises of two components following Lyle *et al*. (2002) and Henry and Lyle (2003):

1) **Screening Survey**: identify fishing households, profile fishing households, select participants for a follow-up; and
2) **Diary Survey**: monitoring fishing (and economic) activity through regular contact (monthly) by survey interviewers.

Furthermore, an 'on-site' sampling programme has been implemented to provide additional independent data on catch, size and species composition of recreational fishers along the coast, charter boats and private boats.

In principle the programme will cover all types of recreational fishery in the Netherlands and the information described below will become available for all species caught in recreational fisheries in fresh and marine waters. For eel, also information will become available on the ration caught in marine and freshwater. Screening Surveys (2009, 2011, etc) and 12 month Diary Surveys (2010, 2012, etc) are planned every other year. In 2011, priority will be given to the estimation of recreational catches of North Sea cod. In principle, new estimates of cod, eel and shark catches will be available in 2011, 2013 etc.

Screening survey

The demographics of the frame population (56 730 households) is selected and maintained by one of the largest commercial marketing companies in the Netherlands (TNS-NIPO) to ensure its frame population does not deviate from the demographics of the whole Dutch population as determined by the Central Bureau of Statistics. The Screening Survey was offered 'blind' to the 56 730 households towards the end of December 2009. Every month the commercial marketing company (TNS-NIPO) sends a questionnaire about a range of divers' topics (social, politics, products) to the households in its database. The households do not know what the topics are when they start filling in the online questionnaire and they are not allowed to skip topics or pick and choose topics. The general (including questions on recreational fisheries) online survey of TNS-NIPO in December 2009 was completed by 45 518 households (109 264 people). Preliminary results of the 2009 Screening Survey demonstrated that around 1.7 million people (predominantly males older than 15 years) participated in recreational fishing (Figure NL.22). The number of recreational fishers has remained relatively stable since the mid-1990s.

Diary survey

During the Screening Survey, people were not only asked if they had participated in freshwater and/or marine recreational fisheries and if they wanted to participate in a 12 month Diary Survey but also to indicate roughly how often they had fished in the past 12 months to determine the level of fishing 'avidity' (1–5, 5–10, 10–25, 25–50, >50 annual fishing trips). As expected the level of avidity was higher among the people that indicated to be willing to participate in the 12 month Diary Survey compared with the avidity of all the people in the screening survey. To avoid this type of bias (overestimation of the catch because the participants of the Diary Survey are more fanatic than the average recreational fisher), the demographics (including avidity) of the 2000 people selected for the Diary Survey was similar to the demographics of the recreational fishers as determined during the Screening Survey. Participants of the Diary Survey were asked to maintain to carefully maintain a logbook. Since March 2010 the 2000 participants are approached on a monthly base by staff of TNS-NIPO and requested to transfer the data recorded in their logbooks to online questionnaires. Participants of the Diary Survey record per fishing trip detailed information on the fishing location, gear, catches (species, size), ratio kept-retained, reason released, motivation and satisfaction and expenditure. Preliminary results of the Diary Survey demonstrate that a small percentage of eel are caught (and released) by recreational fishers in both inland and marine waters (Figure NL.23).

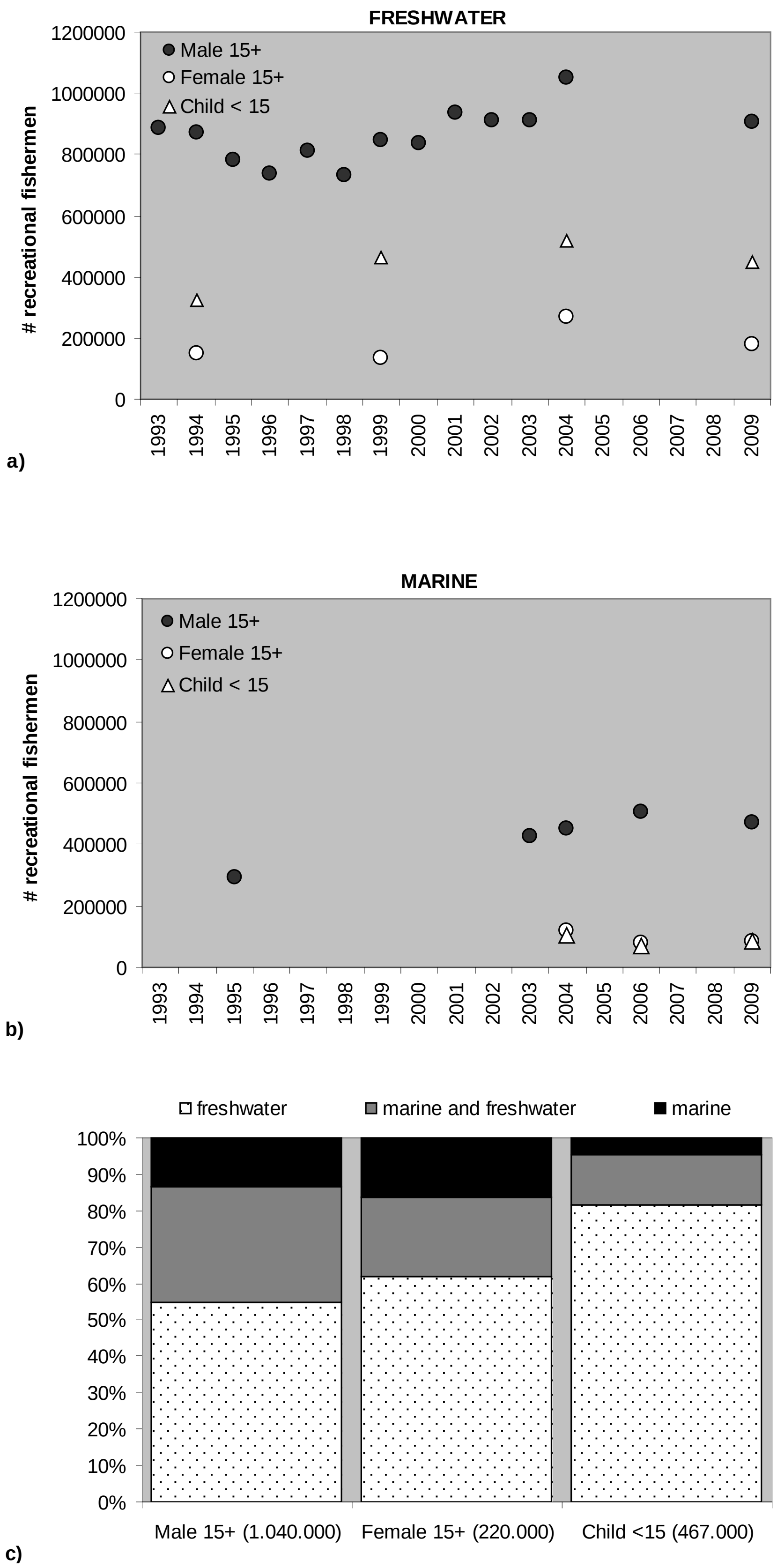
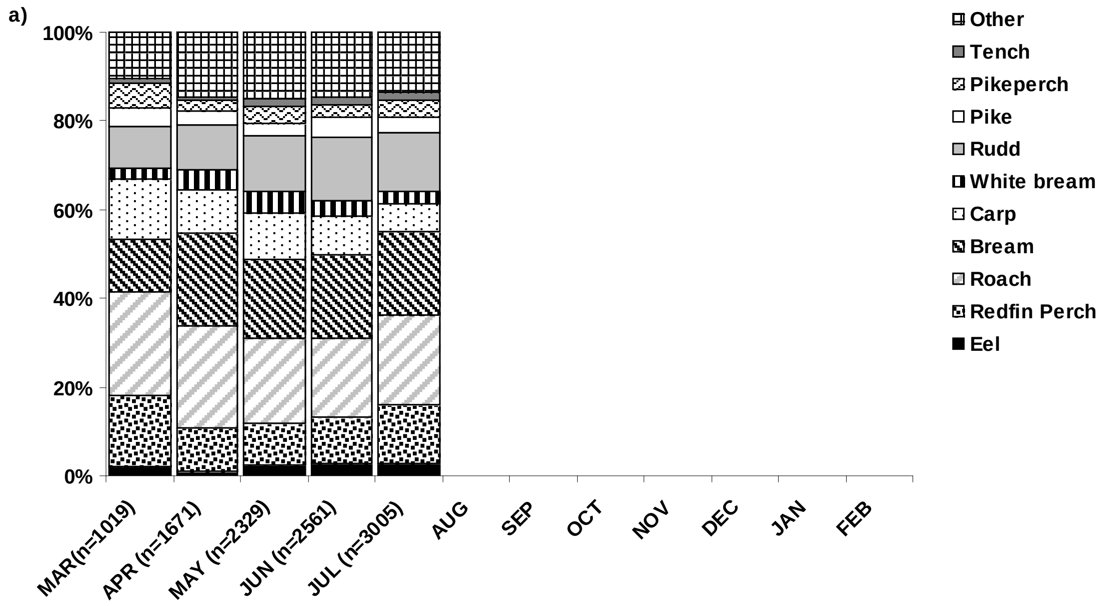


Figure NL.22 Number of recreational fishers in inland (a) and marine (b) waters since the 1990s and (c) the distribution of recreational fishers that fish only in inland waters, only in marine waters or fish in both types of water for each of the major demographic groups.



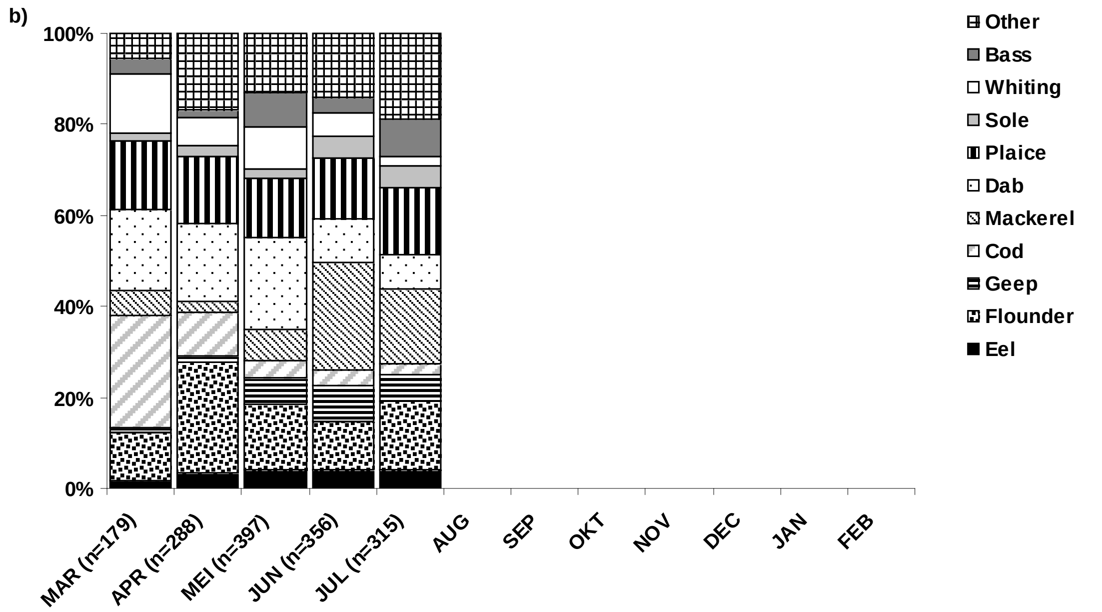


Figure NL.23 Species composition of the recreational fisheries in inland waters (a) and marine waters (b) based on preliminary results of the diary survey of 2000 fishers.

NL.12.2 Use of light traps in glass eel monitoring

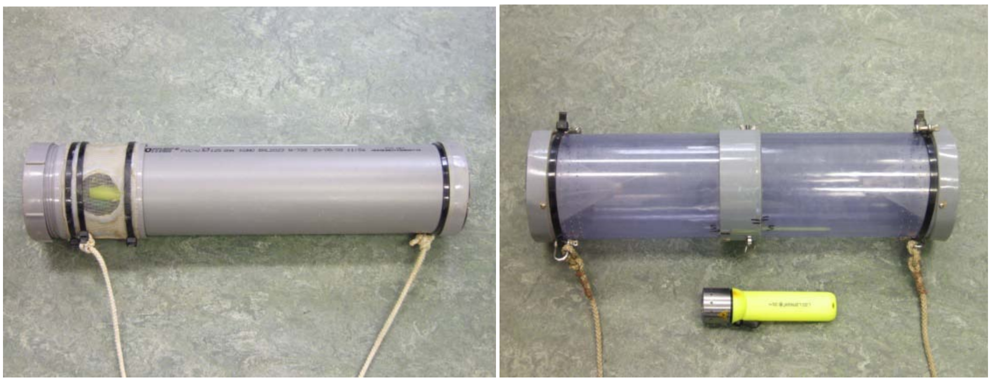


Figure NL.24 The two types of light traps used during the pilot studies in 2009 (left) and 2010 (left and right) to collect glass eel.

Glass eel recruitment has been monitored at Den Oever since 1938 using a liftnet. Due to the dramatic decline of glass eel recruitment, the annual liftnet glass eel monitoring programme is in serious trouble (Dekker, 2004c). Cost of the current labour-intensive liftnet programme are high and the drastic decline of the glass ell catches have serious negative consequences for the statistical reliability of the collected data and for the motivation of the participating field staff. Dekker (2004) concluded that the development of a new, reliable and cost-effective method to monitor the annual glass eel recruitment was of utmost importance for the management of the depleted eel stocks.

Leijzer *et al.* (2009) tested several methods to monitor glass eel and their results indicated that light traps could provide a good alternative for liftnets in the glass eel recruitment programme. The light trap (Figure NL.24 left) developed by Leijzer *et al.* (2009) was cheap, easy to handle by one person and the catches demonstrated similar temporal patterns as the liftnets. Leijzer *et al.* (2009) concluded, however, that before light traps could be deployed in the field to replace the liftnet, the new method required further fine tuning (size and shape, light intensity, optimal position in the water column).

In 2009 glass eel recruitment patterns were similar at Den Oever were similar between the two methods (Figure NL.25b), however, in 2010 the light traps appeared to have failed completely to pick up some of the earlier peaks in glass recruitment in April 2010 (Figure NL.25a). In order to determine the usefulness of light traps to deliver reliable data on absolute numbers of glass eel several retention experiments were conducted. Both types of light traps were filled with 15–20 glass eels and after 48 hours the number of remaining glass eels was determined. Unfortunately the ability of both types of light traps to retain glass eels was low (Figure NL.25c). This unexpected result makes light traps less attractive and suitable to replace the liftnets at several of the locations in the glass eel monitoring programme.

A second problem with the traditional liftnet programme was the increase in the percentage of zero catches (<5% 1960–1980 to 30–40% in recent years) and its negative effect on the reliability of the data. Again, the type of light traps used in these trials will not improve this issue of increasing percentage of zero-catches at low glass eel densities. In 2009 and 2010 the percentage of zero-catches of light traps were even higher at 80 to 90%.

The result of the pilot studies with the two types of light traps clearly demonstrate that these types light traps could, at most, be used to determine relative seasonal patterns in recruitment of glass eel but are no improvement on the current liftnet programme.

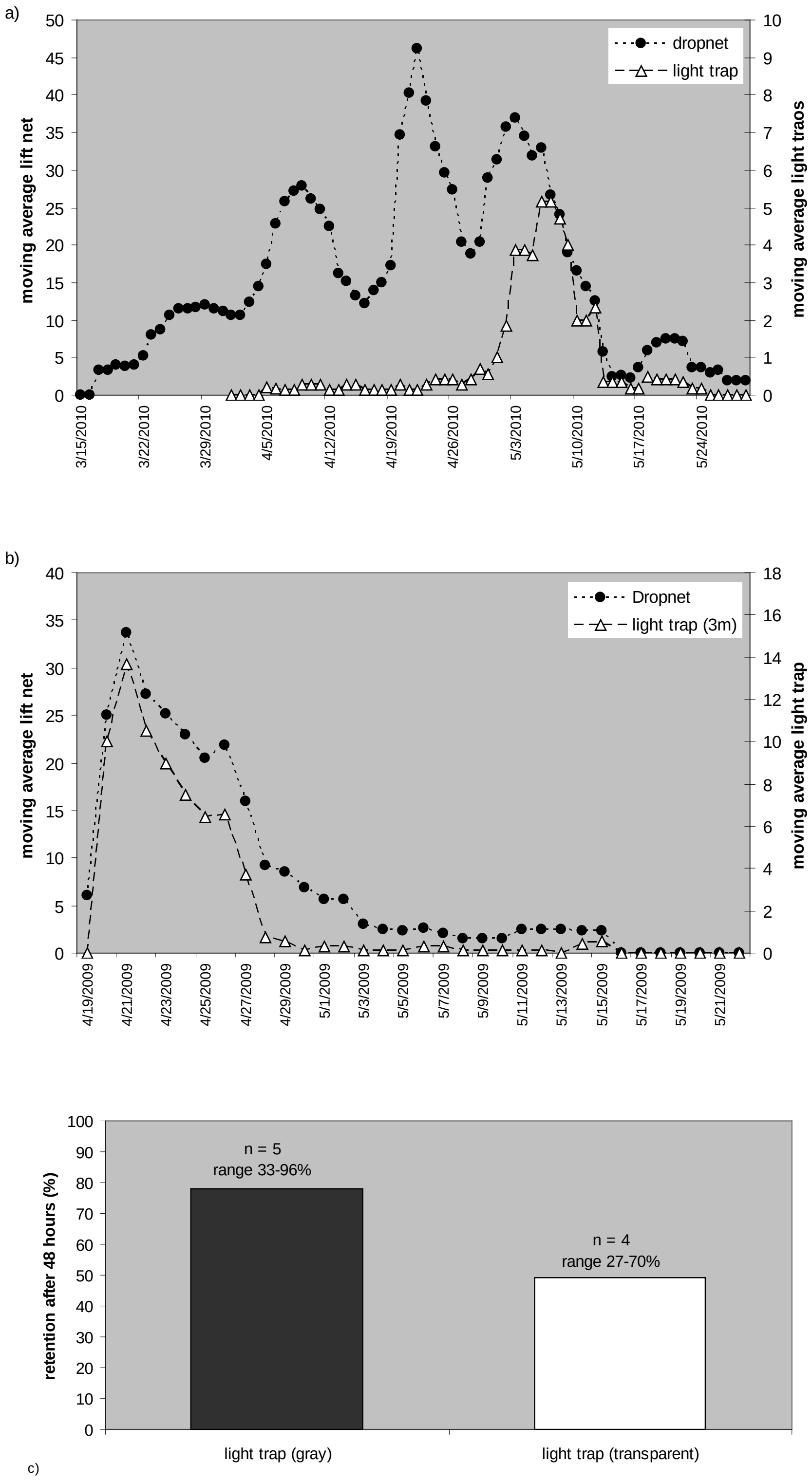


Figure NL.25 Comparison of seasonal changes in glass eel recruitment observed with liftnets and light traps in 2010 (a) and 2009 (b). Retention of glass eels in both types of light traps in 2010 (c).

NL.13Stock 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–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 demonstrates 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.k.

Table NL.k Overview of available water surface in the Netherlands, in hectares.

Province	Ditches †	Canals †	Lakes ‡	Rivers	Coastal waters	sum
Friesland	5,345	7,057	9,454		-	21,856
Groningen	2,003	2,040	6,905		3,843	14,791
Drenthe	657	503	-		-	1,160
Overijssel	1,516	1,985	1,872		-	5,372
Gelderland	831	733	-		-	1,564
Flevoland	3,115	4,959	-		-	8,074
Utrecht	1,699	2,349	2,699		-	6,747
Noord-Holland	5,227	7,938	1,243		-	14,408
Zuid-Holland	4,843	6,935	7,454		-	19,232
Zeeland	2,421	2,873	17,871		95,745	118,909
Noord-Brabant	1,247	1,241	-		-	2,488
Limburg	-	-	-		-	-
Larger water bodies						
Randmeer			16,110		-	16,110
Ijsselmeer/ Markermeer			169,150		-	169,150
Rijn & Maas				18,067	-	18,067
kleinere rivieren				2,800	-	2,800
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.

‡ Fresh water areas in the south-western delta have been included under Lakes, the saline waters under Coastal Waters.

NL.13.2.2 Silver eel production

The IJsselmeer eel stock constitutes approx. 30% of the total stock in the Netherlands (see Table NL.a), and is well documented. For the rest of the country, information is scarce or lacking. Consequently, estimates of silver eel production can only be given for Lake IJsselmeer. According to Dekker *et al*. (2008), historical landings were in the order of 3000 t, 10% of which was made up of silver eel. Based on the assessment of Dekker (1996, 2000c) of the stock in the early 1990s, assuming a linear relationship between recruitment and production, the historic potential production is estimated at approx. 7700 t, 10% of which is made up of males. This historical extrapolation is in reasonable agreement with the historical landings. The actual escapement in the early 1990s was estimated by Dekker (1996, 2000c) to be approx 11 t; current escapement will be somewhat lower, because of declining recruitment; indeed, landings declined in parallel with recruitment. Recent information on silver eel landings is unreliable, due to misclassifications of life stages and/or the trading of eel from other areas at IJsselmeer auctions. According to these statistics, approx. 50% of the current landings (120–130 t) are made up of silver eel.

For the remainder of the country, Klein Breteler (2008) provided an estimate of potential production, based on historical landings per ha of 4 (coastal waters) to 25 (rivers) kg/ha, a minimum production of 10 000–15 000 t is derived.

NL.31.2.2.1 Historical production (B_0 = 13 000 t)

Table NL.l 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	4000–6000 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

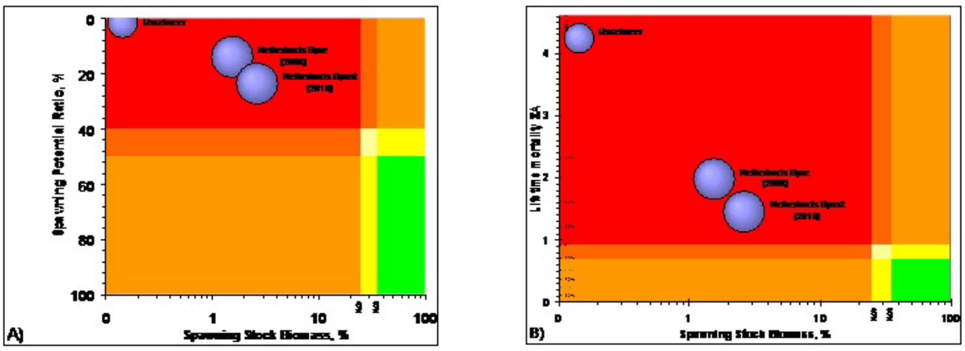


Figure NL.26 Modified Precautionary Diagram for Lake IJsselmeer and the Netherlands (data from Table NL.l).

NL.13.2.2.2 Current production (B_{best} = 1455 t)

NL.13.2.2.3 Current escapement ($B_{post(2009)}$ = 340 t)

B_{post}/2009 is 200 t plus the estimated increase in escapement due to the closed season (target 50% reduction in fishing mortality), therefore B_{post}(2009) = 200 t + 50% 280 t silver eel catches (Table NL.n) = 340 t.

NL.13.2.2.4 Production values

Combining the information on production from Table NL.a with the data on water surfaces from Table NL.k, estimates of productivity result in Table NL.m.

Table NL.m 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	2,317	745	7,395	1,350	2,731
Landings per company, kg	3,836	5,357	2,396	3,750	3,695
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.n 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.n 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 requirements <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 Data quality issues

Nothing to report.

NL.14 Sampling intensity and precision

Dekker (2008) gave an overview of analyses of sampling intensity and precision of sampling programmes based on historical (up to present) data, repeated below. In 2009, a statistical pilot study is being conducted for sampling commercial catches outside Lake IJsselmeer. To this end, samples of 100–200 eels are taken from the catch of some ten fishers each month in the province of Friesland (53ºN 5º45’E); a parallel programme was started up in 2010 in the main rivers.

NL.14.1 Recruitment surveys

The glass eel survey at Den Oever collects between 200 and 500 hauls per year. The statistical properties of these data have been analysed by Dekker (1998, 2004c), including the relation to environmental influences and sampling conditions. Above all, the relation between precision and (expected) mean catch determines the overall precision of the individual observations. Additionally, the number of observations per year is amongst others determined by the average catch: after several weeks without any glass eel, the motivation to continue sampling obviously declines, and the sampling programme is then closed. A lower precision of individual observations in combination with a smaller number of observations per year, results in a drastically expanded confidence limits of the annual mean.

(Since 2004, the sampling is no longer done by sluice personnel while on duty, but by people specifically hired for the job. They replaced the two-hourly sampling by hourly sampling, but did not extend the sampling season).

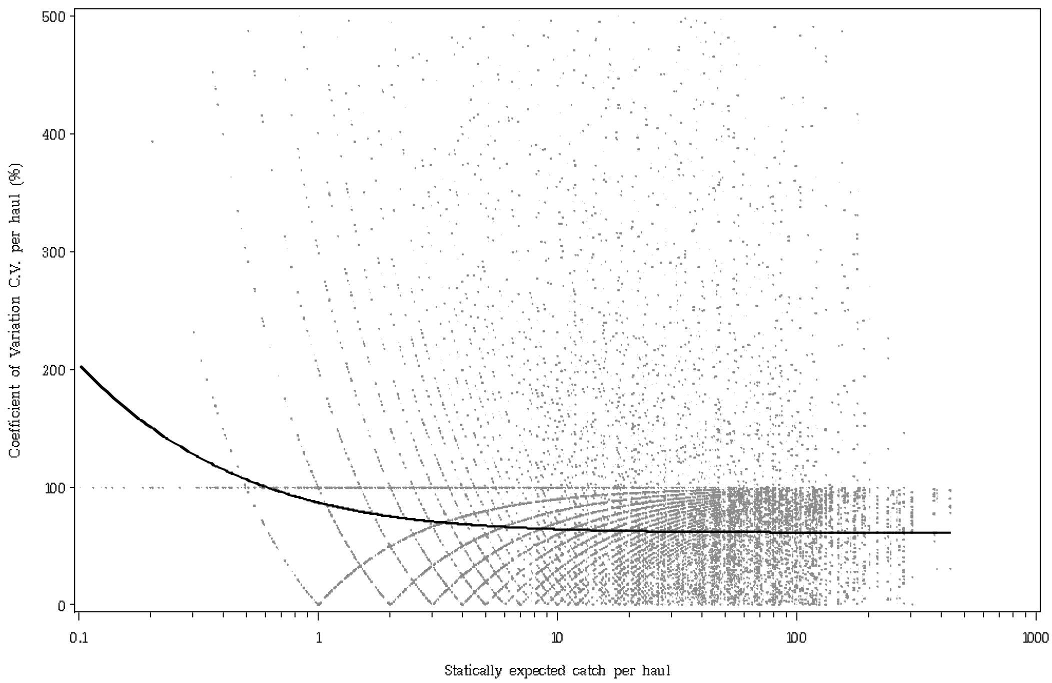


Figure NL.27 Relation between the statistically expected catch (horizontal) and the coefficient of variation (vertical) for the glass eel sampling at Den Oever. The dots represent the individual observations (one haul at a specific hour at a specific day), the line the functional relationship between residual and expectation (Var∞ mean ^{2}+mean). Because the number of glass eels caught is an integer number (0, 1, 2, etc), observations with 1½ or 2 ⅜ glass eels are lacking. Consequently, all observations of exactly 1 glass eel form a conspicuous V-shaped line (hitting the x-axis at 1), and all observations of exactly 2 glass eels too (hitting the x-axis at 2), etc. with no observations in between. The zero observations are on the horizontal line at CV=100%.

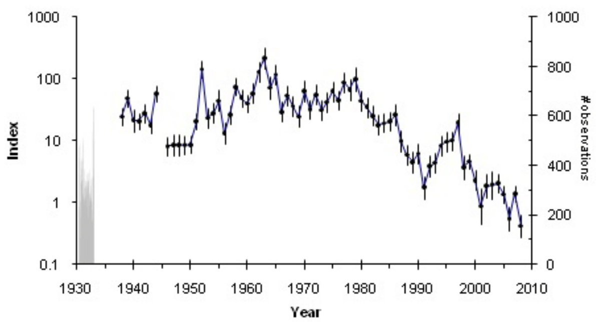


Figure NL.28 Time-series of the recruitment-series in Den Oever, presenting the index and confidence intervals (± 1 SD).

NL.14.2 Yellow eel surveys

The precision of the yellow eel surveys in Lake IJsselmeer has been analysed by Dekker (1998). The same data contributed to the comprehensive analysis of historical data by Dekker (2004a).

The precision of the yellow eel surveys in the main rivers has been analysed by Winter *et al.* (2006).

NL.14.3 Length composition from market sampling: Lake IJsselmeer

The spatial and temporal variation in market sampling of length compositions has been described by Dekker (2005) before, leading to the following results:

NL.14.3.1 Spatial variation

The spatial variation in mean length of fykenet catches was analysed by Dekker (2000a). For Lake IJsselmeer, the mean length varied irrespective of the distance between samples, while for other inland waters, the variation increased considerably from a distance of 10 km upwards (Figure NL.29).

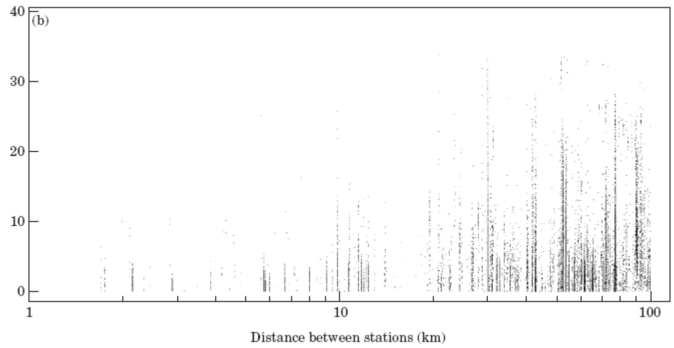


Figure NL.29 Variogram of mean length of yellow eel in fykenets, outside Lake IJsselmeer (Dekker, 2000a). The vertical axis shows the difference in mean length between two samples, the horizontal axis the spatial distance between the two samples.

Figure NL.30 Relative change in size composition of eel landings. Positive values indicate a shift towards larger size classes. In Lake IJsselmeer, effort reductions and the recruitment failure in the 1980s initially shifted the length composition gradually to higher values. When the low recruitment had progressed into even the largest size classes, the mean size restored to normal values. Elsewhere, the data showed less variability. Presumably, sampling ceased before the 1980s recruitment failure had progressed into the exploited length classes.

NL.14.3.2 Temporal variation

The temporal variation in length composition of Lake IJsselmeer eel catches was analysed by Dekker (2000c) in a VPA-type deterministic model, and in combination with survey data by Dekker (2004a) in a statistical model. However, the statistical properties of the sampling protocol were not highlighted.

Re-analyses of the length compositions of market samples from Lake IJsselmeer (Table NL.o), using the multinomial model of Dekker (2004a) indicates that 40% of the explained variance is accounted for by gear type and market selections, while the remaining 60% is related to temporal variation. The unexplained variance, however, is much larger, as usual. The temporal variation is largely due to year-to-year differences in length composition (Table NL.o, Figure NL.30). From 1975 until 1987, a gradual shift towards larger sizes was observed; between 1987 and 1989, a rapid decrease occurred (Figure NL.30).

The quarterly and monthly variation in length composition is much smaller than the interannual variation, and very inconsistent over the years (interactions year*quarter and year*month exceed the main effects quarter and month).

Table NL.o Temporal resolution of market samples. Analysis of variance (type 1) in the length composition of market samples of legal sized eels from Lake IJsselmeer. Data since 1975; 1811 samples; 19657 eels. See Dekker (2004a) for details on the data and statistical model.

source	deviance	d.f.	MS	F	p
gears	4200	5	840.08	632.31	<.0001
market selection	2020	2	1010.02	760.23	<.0001
√mesh	5	1	4.57	3.44	0.0637
year	6310	25	252.40	189.97	<.0001
quarter	32	3	10.81	8.14	<.0001
month	160	6	26.74	20.12	<.0001
year*quarter	1064	49	21.71	16.34	<.0001
year*month	1243	88	14.13	10.63	<.0001
explained	15 035	179	83.99	63.22	<.0001
residual	25 877	19 477	1.33		
total	40 912	19 656	2.08		

NL.14.3.3 Comparison of spatial and temporal variation

The variogram of Figure NL.29 (Dekker, 2000a) is based on sample mean lengths, grouped by decade. Re-analysing the same data, using the multinomial model of Dekker (2004a) allows a comparison of temporal and spatial variation. Figure NL.29 indicates that spatial processes apply at a spatial scale in the order of 10 km. Grouping the data in 10*10 km grid cells, and dropping the decadal grouping, results in a moderately sized model (Table NL.p). The spatial variation in length composition of the catches exceeds the temporal variation by more than a factor 20. However, this dataset was not designed for comparison of spatial and temporal variation; consequently, the co-linearity is relatively large. The interaction between year and spatial grid, however, is relatively small, indicating that the time-trend was largely shared by all areas.

Table NL.p Comparison of temporal and spatial variation in market samples. Analysis of variance (type 3) in the length composition of market samples of legal sized eels, from areas outside Lake IJsselmeer. Data since 1975; 330 samples; 9871 eels. See Dekker (2000a) for details on the data, and Dekker (2004a) for details on the statistical model.

source	deviance	d.f.	MS	F	P
10*10 km grid	3876	27	143.55	106.37	<.0001
year	174	14	12.44	9.22	<.0001
colinearity	1738				
grid*year	645	28	23.03	17.88	<.0001
explained	5789	43	134.62	99.75	<.0001
residual	13 262	9827	1.35		
total	19 051	9870	1.93		

NL.14.3.4 Precision of estimates

The analyses of variance presented in Table NL.o and Table NL.p are based on all historically available information. Therefore, these analyses are not fully representative for data collection under the Data Collection Regulation. However, the results do give an indication of the precision achieved (Figure NL.31). This indicates that the relative abundance of length classes can be estimated with a precision of slightly less than 10% for Lake IJsselmeer, respectively slightly less than 15% elsewhere. However, the consequence of this acquired precision on the assessment of the status of the stock and fisheries is not clear yet.

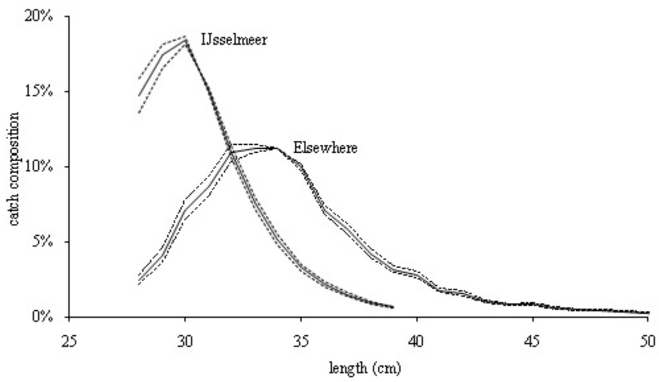


Figure NL.31 Average length composition of fykenet catches, with confidence intervals (±1 std), for Lake IJsselmeer and Elsewhere, based on the entire historical datasets. The presented length distributions conform to the situation in 1990.

Summarising the above findings:

1) the length composition of catches varies considerably between gears and market selections;
2) spatial variation at a 10 km scale plays a dominant role, but not in Lake Ijsselmeer;
3) year-to-year variation is considerable, including gradual trends and sudden transitions;

4) within-year variation is small and inconsistent over the years;

5) spatial differentiation in time-trends appears to be weak; and

6) about $^2/_3$ of the total variance remains unexplained.

NL.14.4 An evaluation of the strategy of the Dutch market sampling programme for eel

The Netherlands are required, as described in the Data Collection Framework (DCF) directive of the European Union, to monitor the catches and effort of eel fishers, as well as perform biological market sampling in order to estimate the biological composition of the catches, most notably the length–frequency composition. The DCF requires that sampling programmes are set up in such a way that length–frequency distributions (LFs) can be estimated with a particular precision level. In order to determine the precision with which LFs can be estimated a pilot project was set up in 2009 in the Netherlands, to determine the sampling intensity. In two areas, Friesland and the Rivierengebied, monthly samples of unsorted landings on a number of locations were taken.

NL.14.4.1 Estimation of precision levels of length frequency distributions

In order to be able to estimate the CV of the LFs, several choices have to be made. The most important choice is the level of detail that is required, in terms of the width of the length class intervals. The LFs will become increasingly smooth (and thus The CVs decrease) for increasing widths of length intervals. This has not been defined in the DCF. We have chosen a length class width interval of two centimetres, given that it is possible that such detailed information is necessary in order to parameterize stock assessment models which include growth. Furthermore, in order to compute the CVs of the whole catch, it is necessary to have an overview of the sampling frame: the combinations of months by locations with eel catches. This sampling frame will however not be available until later in 2010. The statistical methodology which was used to estimate the CVs is given in Appendix A.

A graphical representation of the LFs and the uncertainty surrounding these is given in Figure NL.32 and Figure NL33. The estimated CVs of the LFs for various widths of length class intervals are given in Table NL.q. For Friesland, and widths of length classes of two centimetres, the estimated CV is 9.3%, which is high enough to comply with the demands of the DCF (the DCF requires a maximum of 12.5%). However, for the Rivierengebied, the estimated precision falls just short with 13.5%. However, given that a greater number of months are planned to be included in the sampling programme next year, the expectation is that the precision levels will be sufficient next year.

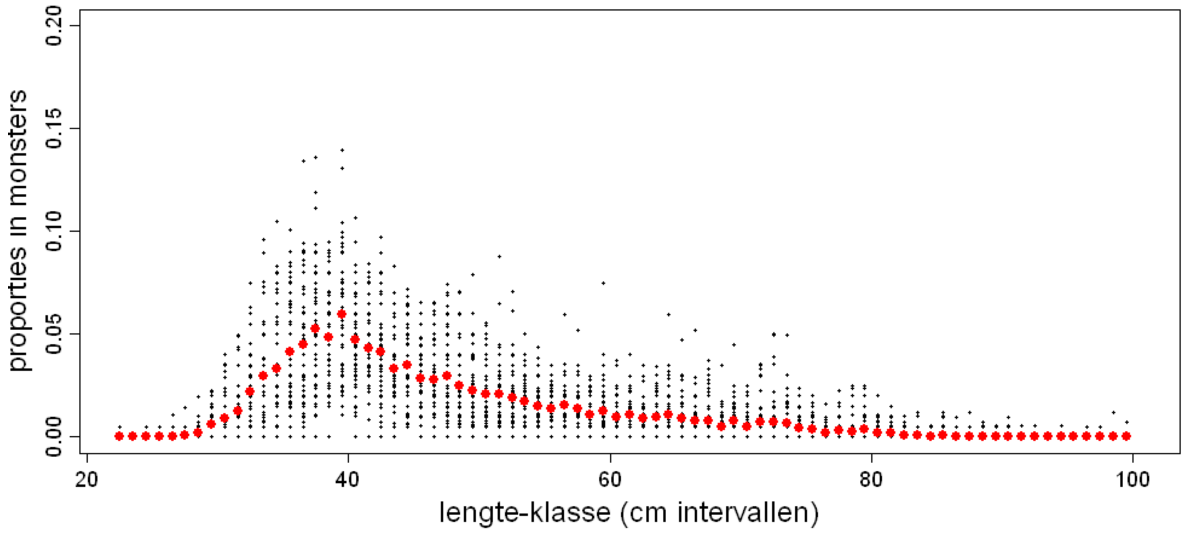


Figure NL.32 Estimated Length-frequency distributions for Friesland. On the horizontal axis length class intervals of one centimetre are given. On the vertical axis, proportions as given in the samples.

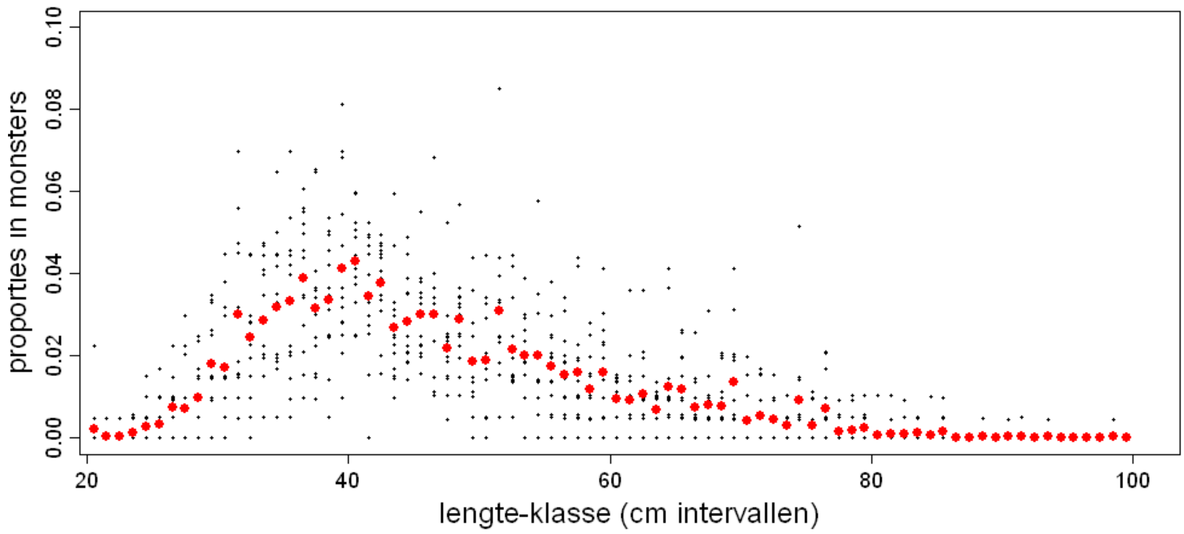


Figure NL.33 Estimated Length-frequency distributions for the Rivierengebied. On the horizontal axis length class intervals of one centimetre are given. On the vertical axis, proportions as given in the samples.

Table NL.q Estimated coefficients of variation of the length–frequency distributions , for three widths of length intervals (1, 2 and 3 centimetres). For the areas of Friesland and the Rivierengebied. The length–frequency distributions become increasingly smooth (and thus The CVs decrease) for increasing widths of length intervals.

Length class	Friesland	Rivierengebied
1 cm	10.9%	17.3%
2 cm	9.3%	13.5%
3 cm	8.3%	12.6%

NL.14.4.2 A simulation study for the evaluation of the sampling strategy

Using the data collected during the pilot study, a simulation study was done to evaluate expected precision levels for various sampling strategies. The sampling strategies varied in the numbers of locations that were included in the survey, as well as the number of eels per sample at each location visit. The simulation study was done by using the length data of eels of the pilot study, and sampling location by month combinations at random with replacement. The sample sizes at each location by month combination were varied from 100 to 200 eels per sample. The results are given in Table NL.r, and indicate that precision increases rapidly with increasing numbers of locations. Instead, precision levels depend to a lesser extent upon the numbers of eels per sample at each location visit. This conclusion is strengthened by a closer investigation of the sources of variation of the data which revealed that month and location effects are important (van Keeken *et al.*, 2009). Thus, our recommendation for the sampling programme is to keep the same numbers of locations, or reduce this only slightly, whereas the numbers of eels sampled per location can be halved. This is in line with sampling theory, in which a rule of thumb is that increasing the number of primary sampling units (locations by month visits in this example) will have a larger effect on precision than increasing the number of secondary sampling units (numbers of eels per sample).

Table NL.r The results of the simulation study to evaluate expected precision levels for various combinations of sample sizes of primary (location by month visits) and secondary (numbers of eels per sample at each location visit) sampling units. Given are CVs of the length–frequency distributions.

	No. locations					
No. eels	5	6	7	8	9	10
100	16.1	14.8	13.7	12.9	12.2	11.5
125	15.3	14.0	13.0	12.3	11.5	10.9
150	14.7	13.6	12.5	11.8	11.1	10.6
175	14.5	13.3	12.3	11.6	10.9	10.3
200	13.4	12.3	11.4	10.7	10.1	9.6

NL.14.4.3 Statistical methodology which was used for estimating the precision levels

The target population is the total catches in the area of interest, whilst the sampling frame is defined as combinations of access points by access times. Access points in this context are eel fishery locations, whilst access times are periods during which eel catches are kept in order for a sample of sufficient size to be taken (usually a few days). The sampling strategy was to take a clustered (multistage) sample, where combinations of access points and times were spaced systematically throughout the fishing season. Then, at each period at each location, a cluster of (if possible) 200 eels were sampled. Here, we use the well-known result from statistical practice that the between-cluster variance estimator is an unbiased estimator of the variance of a linear statistic such as the estimator of the population mean (Cochran, 1977; Williams, 2000; Woodruff, 1971; Pennington, 2002).

Let j be an indicator for the length-class, and i an indicator for location. Then:

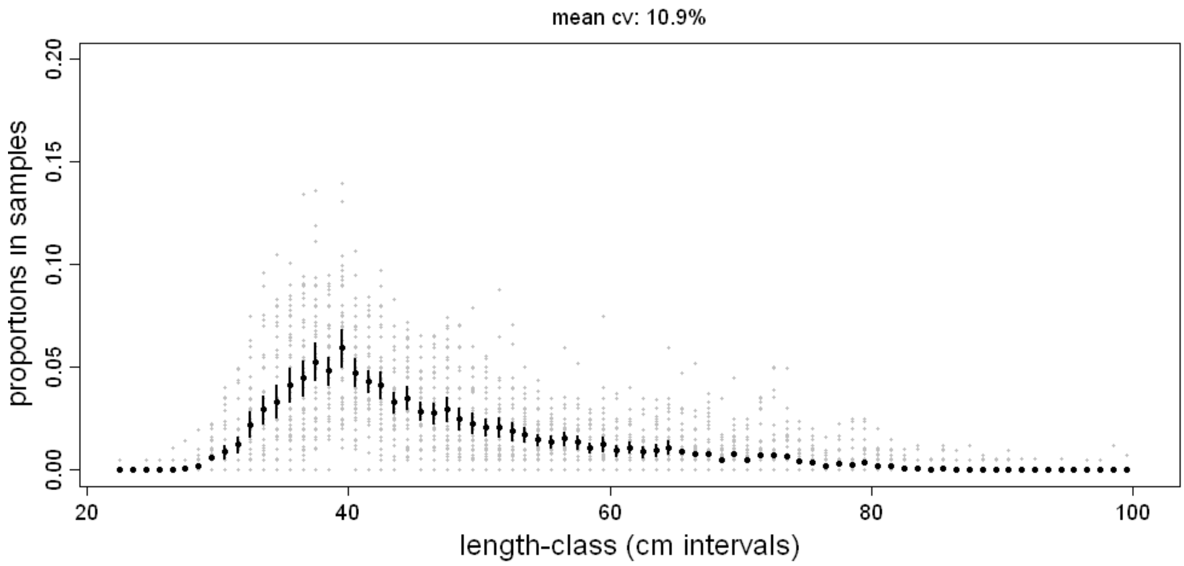
$$\sigma_j = \sqrt{\frac{\sum_i^{n_i}\left(p_{j,i} - \hat{p}_j\right)^2}{(n_i - 1)n_i}}$$

provides an estimate of the standard error of the mean proportion of length class j.

Then, let set A denote the length classes which together constitute the 90% Highest Density Interval of the mean length–frequency, and N_A the number of length classes in set A. Then the average coefficient of variation in the 90% HDI is given by:

$$\overline{CV} = \frac{1}{N_A}\sum_{\in A}\frac{\sigma_j}{\hat{p}_j}$$

Example given, for length intervals of one centimetre:



NL.15 Standardisation 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	5 hauls every 2 hours between 22:00–5:00	~March–May
	10 other locations along the coast	weekly	2 hauls at night-time	

Passive monitoring programme: main rivers and Lake IJsselmeer

Gear	Location	Frequency	Period
Summer fykes (4) (stretched mesh 18–20 mm)	34 locations in main rivers, estuaries and lakes	continuous	~May–September
Fykes (4) (stretched mesh 18–20 mm)			

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, ~1000 m transect	~May–September
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, 10 locations in Lake Markermeer,	2 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)	7 locations in Lake IJsselmeer, 7 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	2 eels per 10 cm size class	April–August
Main Rivers	150–200 eels per sample	monthly	8	2 eels per 10 cm size class	April–August
Lake IJsselmeer	1200 (total per year)	May–June August–September	1 (samples collected for each fishing gear: summer fyke, fyke, eelbox, longline)	350	April–August
Lake Markermeer	800 (total per year)	May–June August–September	1 (samples 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

At present no age analysis is being conducted.

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 determination

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.s. 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.s Overview of the data collection by area, described in this report. + = present, - = absent, +/- = incompletely present, (+) = present, but inadequate, !=under development.

Area Item	Waddensea	IJsselmeer	Main Rivers	Zeeland, waters: open d	close	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		+	!			
M methodology						

In conclusion: this report provides an update of all dataseries regarding the eel stock in the Netherlands. Almost all dataseries demonstrate 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 Agriculture, Nature and Food Quality. In 2011 a range of new eel projects will be implemented including a Silver Eel Index, Red Eel Model, eel ageing and nationwide catch sampling programme.

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Report on the eel stock and fishery in Belgium 2009/'10

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Reporting Period: This report was completed in September 2010, and contains data up to 2009 and some provisional data for 2010.

BE.2 Introduction

This report is written in preparation of the EIFAC/ICES Working Group on Eel meeting at Hamburg (8–14 September 2010). 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 and 2009) and in the Belgian Eel Management Plan (EMP). This report should thus be read in conjunction with those documents.

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.

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).

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;
- making up an inventory of the bottle necks for upstream eel migration (priority and timing for solving migration barriers);
- for downward migration: update inventory of draining pumps and fixing priorities for sanitation;
- controlling poaching;
- achieving WFD goals for water quality.

For the Walloon region

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

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 2010.

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 with 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).

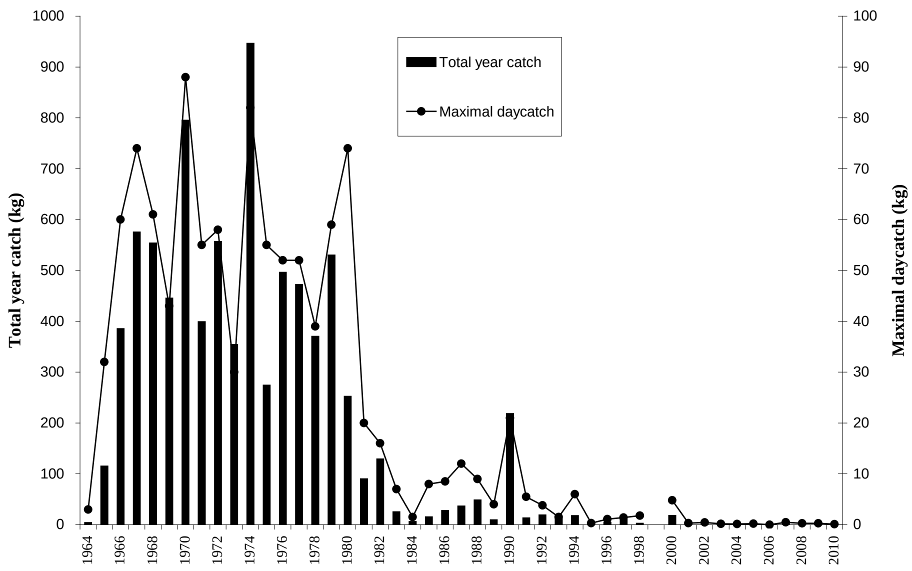


Figure 1. and Table 1. Annual variation in glass eel catches at river Yser using the dipnet catches in the ship lock at Nieuwpoort (total year catches and maximum day catch per season). In Table 1 the presented data are the total year catches between 1964 and 2010. Data Provincial Fisheries Commission 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	
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.

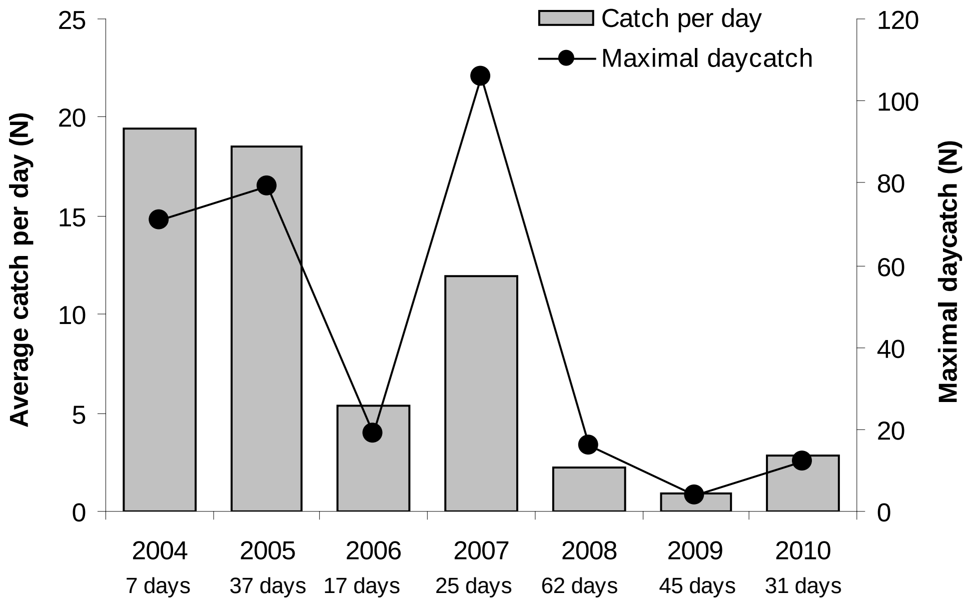


Figure 2. Annual variation in glass eel catches at the sampling station in the Schelde estuary. Data are given as the average number of glass eels caught per day and as the maximal day catch between 1 April and 31 June. The number of sampling days are given below the x-axis.

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 2009 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 32 157 eels was caught (biomass 1.955 kg) with a size from 14 cm to 85 cm and a mean value of 31.6 cm corresponding to yellow eels (data up to 2004). 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 a minimum of 423 in 2004 (Baras *et al*., 1994; Philippart *et al*., 2005; Philippart and Rimbaud, 2005) (Figure 3).

The data for 2005 and 2006 were low: respectively 758 and 559 (Philippart, 2006), whereas 661 eels were caught in 2007 (Philippart, pers. comm.). In 2008 2625 eels were caught (Philippart, pers. comm.). This sudden increase might be explained by the fact that recently (20/12/2007) a fish pass has been opened at the sluice of Borgharen-Maastricht, which enabled passage of eels situated downward the sluice. In 2009 the number of eels are <600, which is low.

In 2010 (incomplete data) eel numbers were at the lowest level (n = 248) ever recorded since the start of the controls (1992, n = 5613). 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.

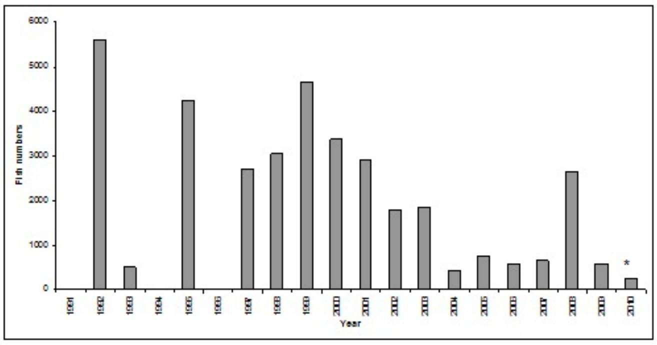


Figure 3. Variation in the number of ascending young yellow eels trapped at the fish trap of the Visé-Lixhe dam between 1992 and 2010. Data from University of Liège (J.C. Philippart) in Philippart and Rimbaud (2005), Philippart (2006) and Philippart (pers. comm.). 2010: Data incomplete.

BE.3.2 Yellow eel landings

BE.3.2.1 Commercial

See 3.1.2.1.

BE.3.2.2 Recreational

No time-series available. See Section 6 for an estimate of the harvest of eel by recreational fishers.

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 in France (Gironde) was stocked in Flanders.

In 2010 (April 20th, 2010) 143 kg has been stocked in Flanders. The glass eel was originating in France (area 20–50 km south of Saint-Nazaire, small rivers nearby the villages of Pornic, Le Collet and Bouin). A certificate of veterinary control and a Cites certificate were delivered.

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

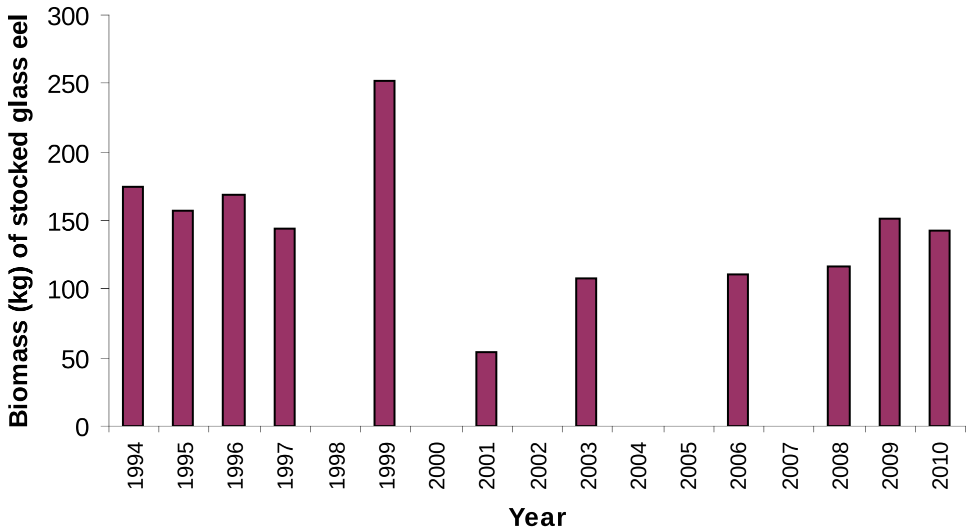


Figure 4. and Table 2. Restocking of glass eel in Belgium (Flanders) since 1994, in kg of glass eel.

Decade / Year	1980	1990	2000	2010
0	0	0	0	143
1	0	0	54	
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	

Stocking in Wallonia

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

Table 3. Restocking of yellow eel in Belgium (Walloon region) over the period 1999 to 2007, 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	
2			105	
3			101	
4			311	
5			324	
6			0	
7			0	
8			0	
9		1268	0	

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

Catching eel <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

Commercial and recreational fishery for glass eels is not 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 the fisheries 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 fishers fishing with fykes (estimated at 150 fykes). The trawl fisheries was focused on eel, but since 2006 boat fishing has been prohibited, and only fyke fishing was permitted until 2009. The number of licensed fishers fishing with fykes decreased from 17 in 1999 to nine licences in the last three years. See Figure 5 for a time-series between

1992 and 2009. A licence allows a fisher 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.

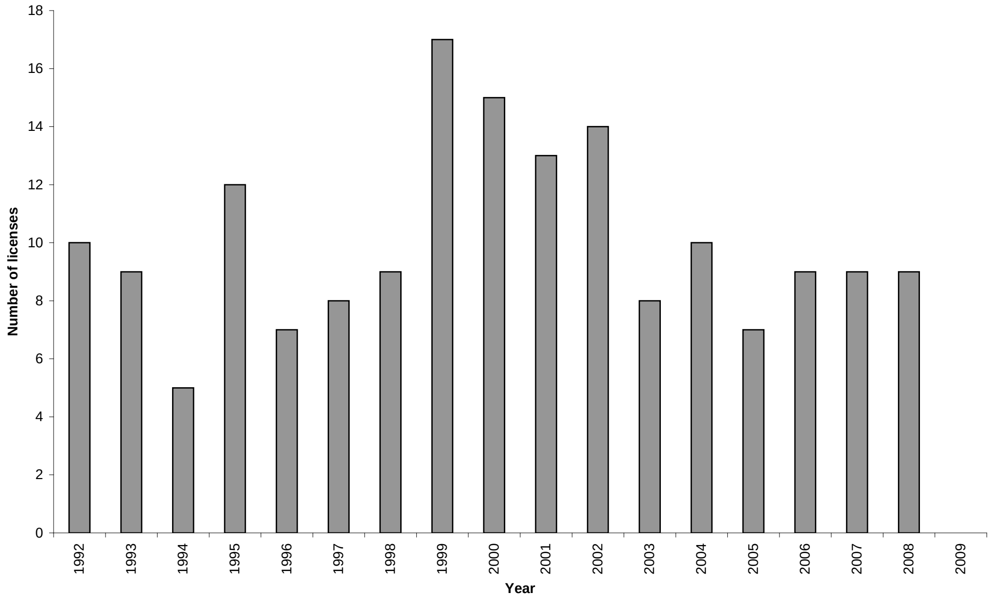


Figure 5. Time-series of the number of licensed semi-professional fishers on the Scheldt from 1992 to 2009 (Data Agency for Nature and Forests).

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 and 60 956 in 2009. The time-series demonstrates 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 with 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.

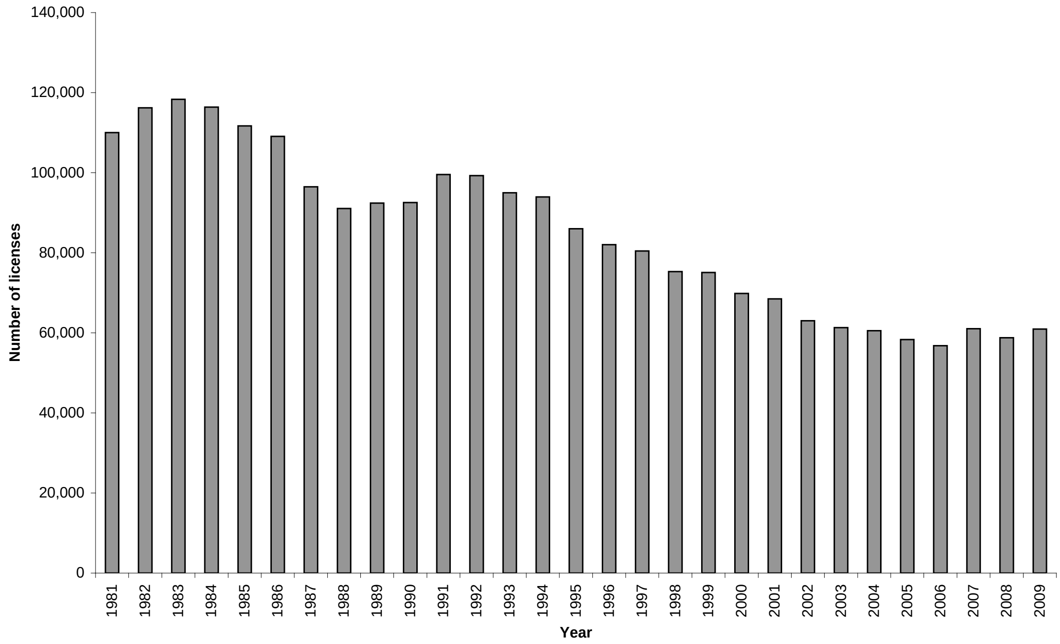


Figure 6. Time-series of the number of licensed anglers in Flanders since 1980 (Data Agency for Nature and Forests**).**

Recreational fisheries in the Walloon Region

For the Walloon region, no new data were made available for 2009. See the 2008 Country Report for a time-trend of former years (Belpaire *et al.*, 2008).

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 Section 4.2 for the number of recreational fishers and the proportion of eel fishers.

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

Commercial and recreational fishery for glass eels is not 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 fishers 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 a inquiry by the Agency for Nature and Forest in public waters in Flanders in 2008, recreational anglers harvest on a yearly basis 33,6 tonnes of eel (Vlietinck, 2010). This figure holds for 2009 too (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).

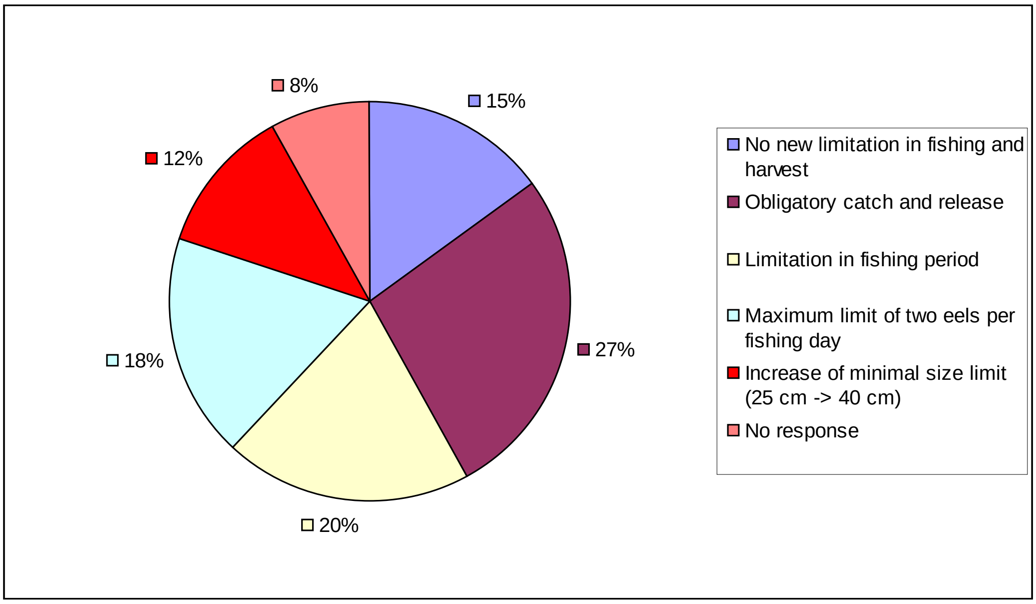


Figure 7. Results of a 2008 inquiry among 10 000 Flemish recreational anglers for their preference in management options for restoring the eel stock. 36% (N = 3627 anglers) responded (Vlietinck, 2010).

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

Commercial and recreational fishery for glass eels is not 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 a inquiry (N=3627 responses) by the Agency for Nature and Forest in public waters in Flanders in 2008 (Vlietinck, 2010). Recreational anglers harvest on a yearly basis 33,6 tonnes of eel. 6.6% of the recreational fishers (N=58 788) are eel fishers. So 3880 eel fishers are catching 33.6 tons, or an average eel fishers 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) end of 2009 all eels disappeared, subsequent monitoring demonstrated 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.

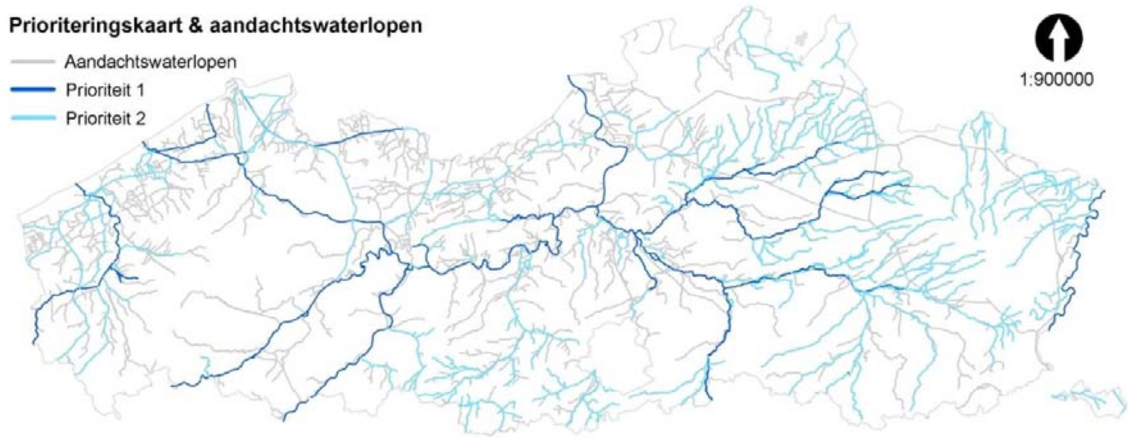


Figure 8. Fish migration prioritization network of Flemish water courses (blue) and water courses of special attention (grey) following the Benelux Decision "Free migration of fish" M(2009)1.

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 liftnets 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 (Buysse *et al.*, in prep). Archimedes screws are believed to be less harmful compared with 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 125 individuals, passage through the larger pump was highest. Mortality rates for the large and smaller pump were respectively 17 and 19%. These data demonstrate 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 (Buysse *et al.*, in prep).

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 is now being jeopardized by the building of two new large hydropower plants in The Netherlands; one in Borgharen-Maastricht (permits already given to the company) and one in Roermond (proposal). The sites are located in a strategic international migration route; the Meuse at the Belgian–Dutch border. The hydropower plant in Borgharen will be built in the place occupied by a river-like fish-pass (in operation since December 2007), which will be replaced by a vertical slot pool fish-pass with unknown performance for small eels. The major impact of this hydropower plant will 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 imposes strict conditions and measures for migratory fish protection. But the problem is what will happen (complete or partial stopping, installation of new protection systems, other solutions) if the hydropower plan is constructed and the fish protection facilities are not working adequately. In such a critical situation more detailed impact studies should have been conducted in order to design a more fish (eel) friendly hydropower plan based on current advanced knowledge of eel migratory behaviour and best available fish (eel) protection technologies (design of water intake, fish friendly turbines, large downstream migration fish pass, etc.).

BE.9 Scientific surveys of the stock

BE.9.1 Glass eel

See 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 2 to 4 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/.

A temporal trend analysis has been performed based on a dataset including fish stock assessments on locations assessed during the periods 1994–2000, 2001–2005 and 2006–2009. 334 locations were assessed in those three periods (30 on canals and 304 on rivers). 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 abundances. Figure 11 shows that eel abundances (in terms of catch per unit of effort) are decreasing considerably during this time spam.

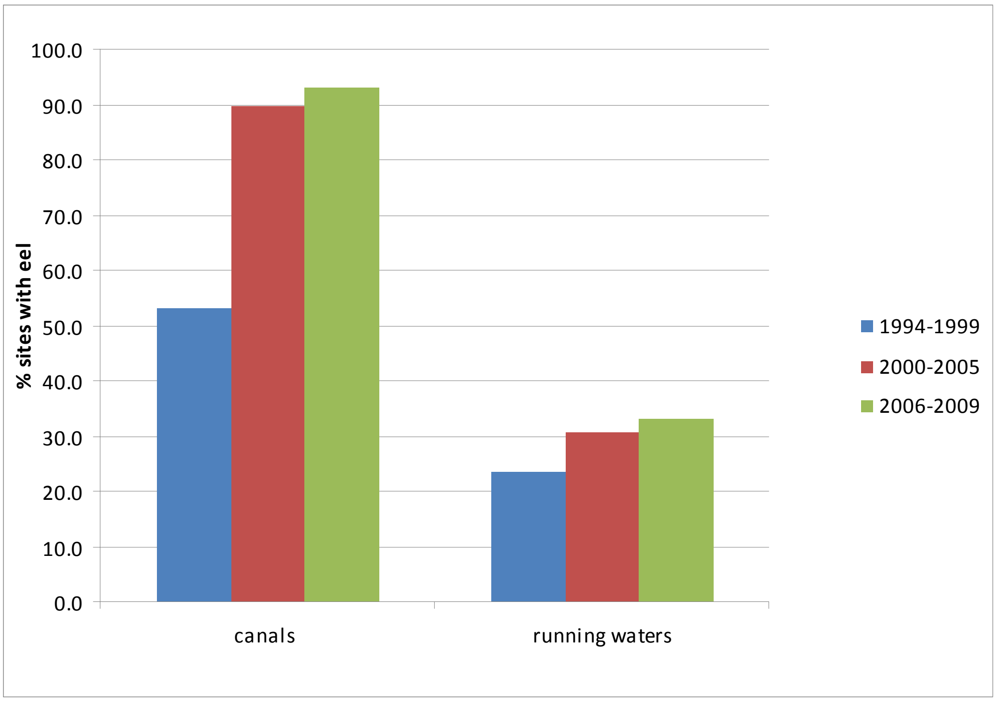


Figure 10. Presence of eels from 334 locations in canals and running water between 1994 and 2009 (the same locations were fished in the three periods) (Source G. Van Thuyne, INBO).

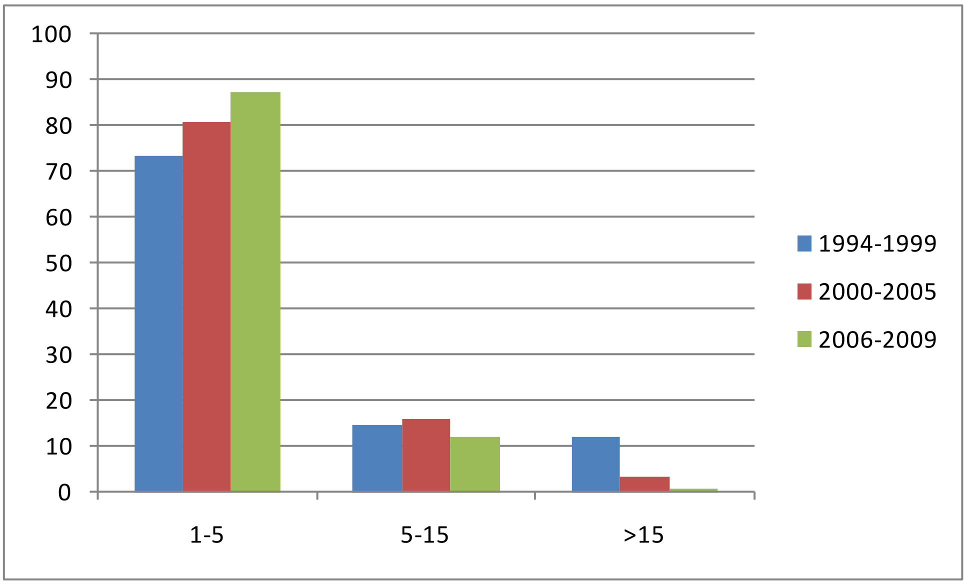
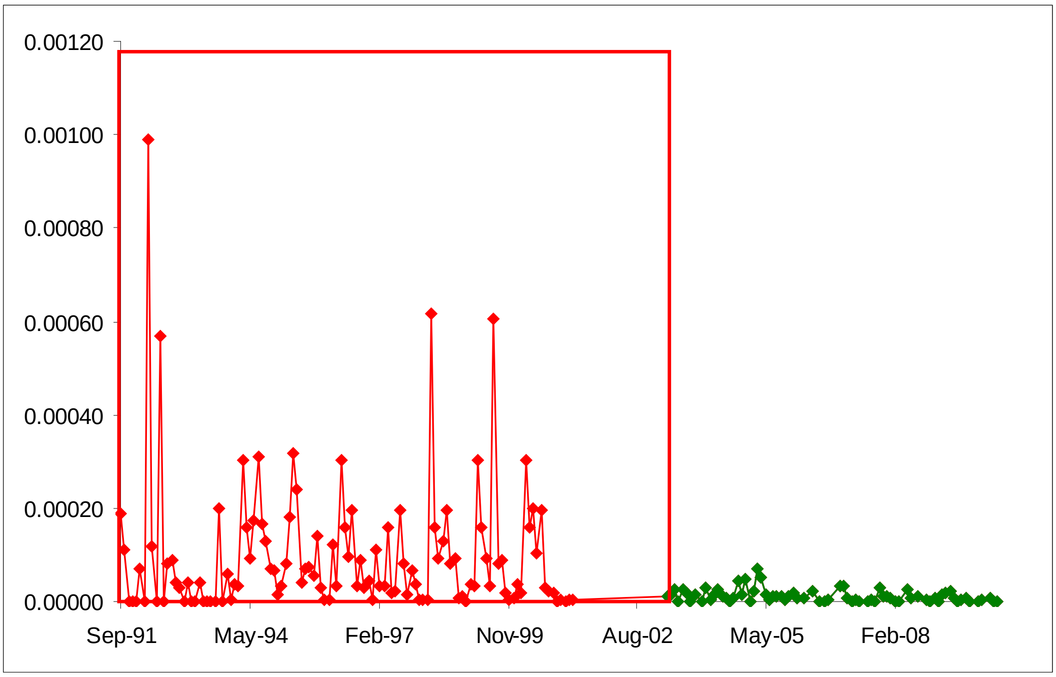


Figure 11. Frequency distribution of the abundance of eels (number of eels/100 m EF and number of eels/fyke/24 u) on sites where eels are present in canals and running waters between 1994 and 2009 (the same locations were fished in the three periods). (Source G. Van Thuyne, INBO).

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 2002–2009 (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 spam around low tide, which was not the case for the sampling during the earlier period.



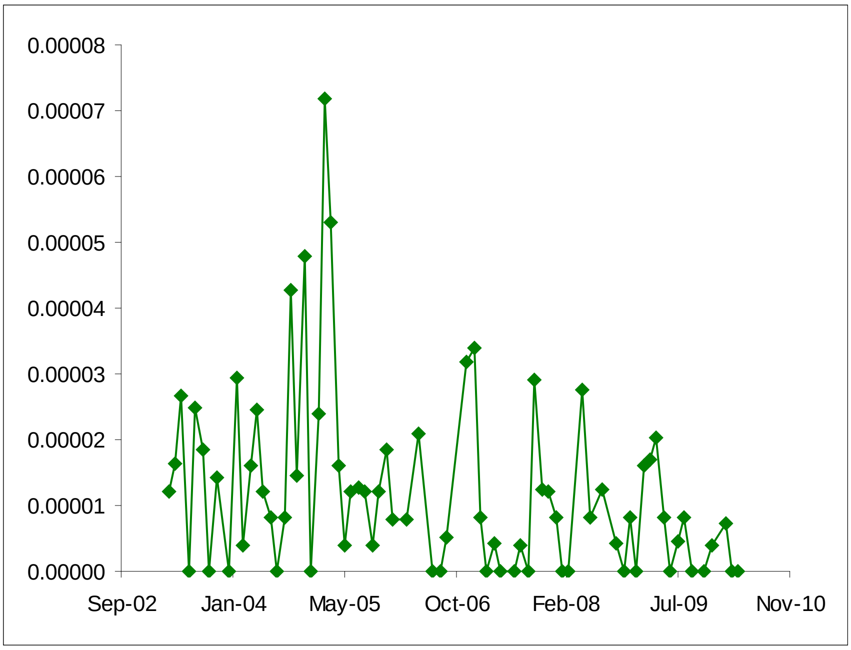


Figure 12. Time trend in the quantities of eels impinged at the Doel power station on the River Scheldt nearby Antwerp (1991–2010). Quantities are expressed as number of individuals per m³ water. Data period 1991–2001 (red) from Maes *et al*. (2005); period 2002–2009 (green) from Wambacq (2010). Data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

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.

BE.9.3 Silver eel

No new data on silver eel escapement are available.

BE10 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.10.1 Length & weight & 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/.

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

In a submitted paper Verreycken *et al*. 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 13).

Following equation was found:

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

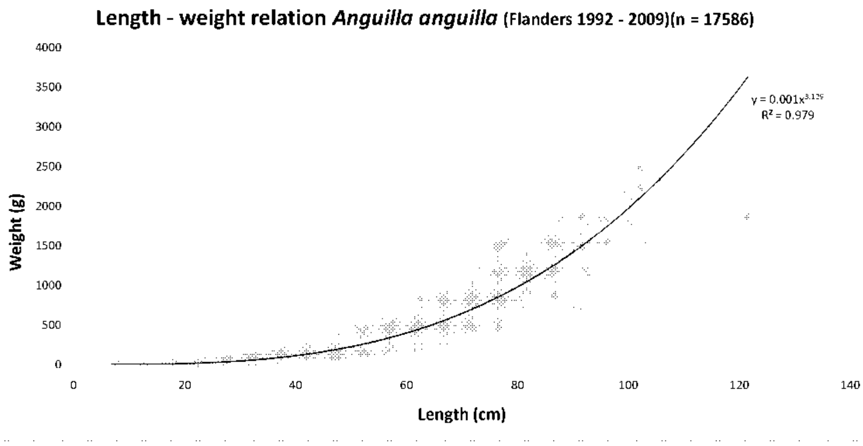


Figure 13. Length–weight relation of European eel (n = 17 586) sampled over Flanders in the period 1992–2009.

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 14).

Our data originate in 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.*, under review).

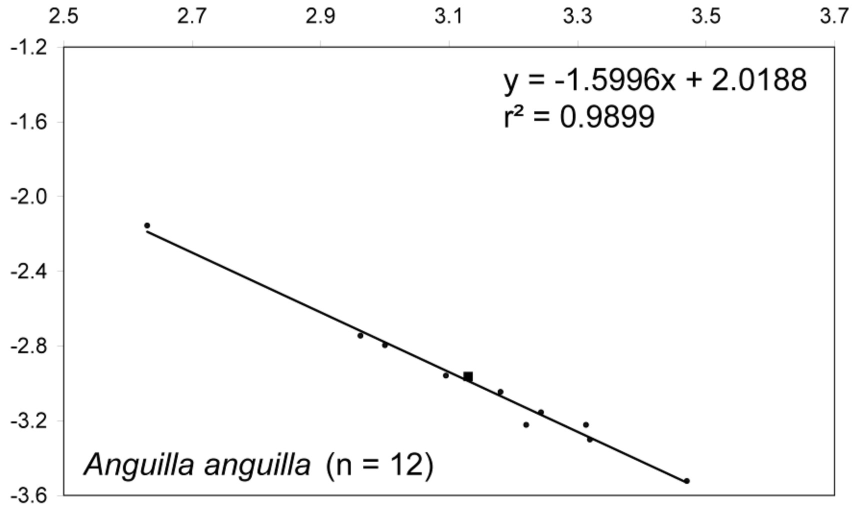


Figure 14. Estimated intercepts ($\log_{10}a$; Y-axis) vs. estimated slope (*b*; X-axis) for the $\log_{10}$ transformed L/W regression and regression line for European eel from European datasets, as available in FishBase (Froese and Pauly, 2010), compared with the Flemish populations (■; 1992–2009). Linear regression equation and r^2 are given (n = number of L/W relationships, including Flanders). (Verreycken *et al.*, under review).

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.11.2 Parasites and pathogens

Flemish region

No new information compared with earlier reports.

Walloon region

No new information compared with earlier reports.

BE.11.3 Contaminants

In last year's Country Report reference was made to 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 15).

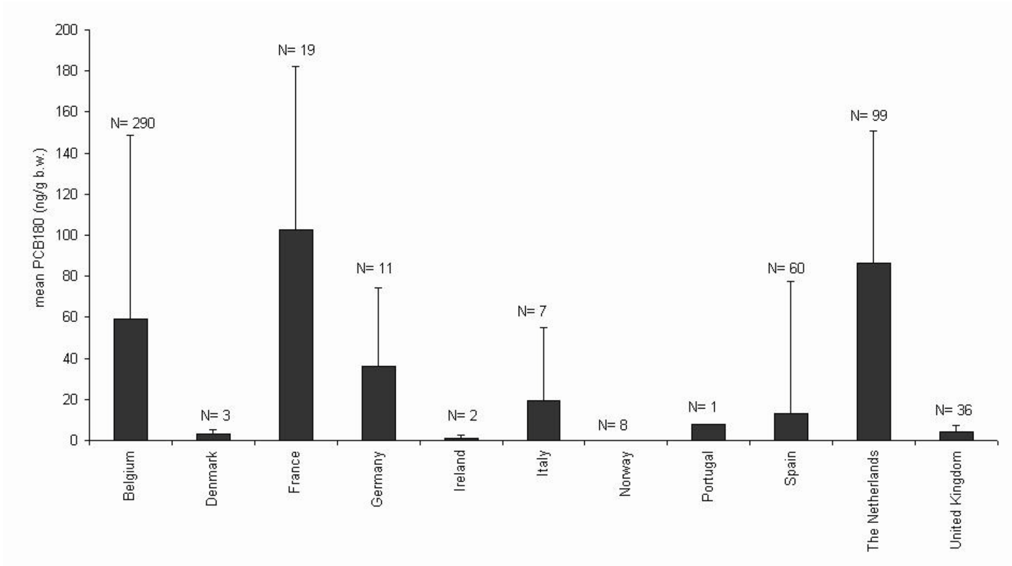


Figure 15. Mean concentration of PCB 180 (ng/g b.w.) in 11 countries in European eel muscle as reported recently (Belgium: INBO Eel Pollution Database (http://visapp.milieuinfo.be/pages/welcome.do); Denmark: Erichsen and *et al.*, 2000 France: Durrieu *et al.*, 2005;Tapie *et al.*, 2006; Germany: Gaumert *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; UK: Foster, 2005. The number of sites is indicated (N). (From Geeraerts and Belpaire, 2010; for full references see this paper).

In last year's Country Report reference was made to an unpublished study by Roosens *et al.*, who 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, w ith a median value of 73 ng/g lw. Comparison with previous studies demonstrates 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 fishers were above reference doses described in literature to induce adverse effects. The Report is now published (Roosens *et al.*, 2010), and these data are now submitted for inclusion in the EEQD.

In a new report Belpaire *et al.* (Belpaire *et al.*, under review) 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 demonstrated 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 with the other European countries (Figure 16). 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 fishers to avoid consumption of their own catch are not effective; an inquiry among 10 000 recreational fishers 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 fishers 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 is now submitted for inclusion in the EEQD (Belpaire *et al.*, under review).

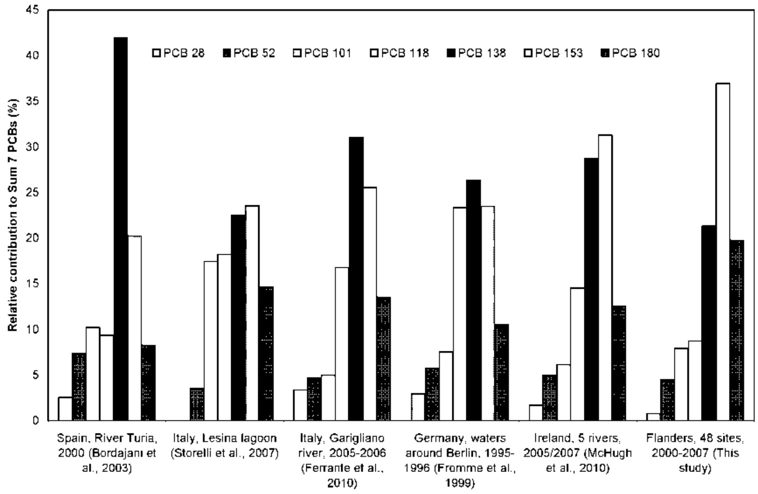


Figure 16. Weight % of the ICES 7 PCB congeners based on Sum 7 PCBs in eels from several European studies. In the case of the Lesina lagoon, PCB ratios were calculated on Sum 6 PCBs, as PCB 28 measurements were not available in this study (Storelli *et al.*, 2007) (From Belpaire *et al.*, under review).

In order to gain insight in the current status of dioxin pollution in Flanders, a baseline study was conducted in (yellow) eel from 38 locations (Geeraerts *et al.*, 2010). Results give an indication of the current dioxin concentrations in Belgian wild eel and hence, in the aquatic environment, 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. Levels found in these eel are believed to be representative for all eel in the catchments in which they were collected (Belpaire *et al.*, 2008). The majority of Flemish eel from this study had levels considered to be detrimental for their reproduction. Field levels of dioxin and DL-PCBs are therefore suggested as a further contributing causal factor in the decline of the European eel. Half of the sampling sites demonstrate especially DL-PCB levels exceeding the European consumption level (with a factor 3 on average; Figure 17). 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 (WHO-PCDD/F-DL-PCB 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 141.86 pg TEQ g^{-1}. In 42% of the sampling sites the limit is exceeded (Figure 17). Palstra *et al.* (2006) reported disrupting effects in the embryonic development of eel, occurring at levels below 4 pg TEQ kg^{-1} gonad. From this, we may deduce that in most Flemish eel (66% >4 pg) reproduction is impaired due to the presence of dioxins and dioxin-like PCBs.

The contribution of the DL-PCBs to the total sum (PCDD/F-DL-PCB) is significant and consistent, regardless of the sampling site (Figure 17). In the Congovaart, the contribution of DL-PCB to the total TEQ is as high as 97% while the lowest contribution is found in the Handzamevaart with 72.5%. DL-PCB congener 126 is the most prominent DL-PCB. ΣDL-PCBs demonstrate an increasing trend from west to east Flanders with remarkably high concentrations at the Congovaart (138,53 pg WHO TEQ g^{-1} fresh weight) en the Canal Bocholt-Herentals (81,48 pg WHO TEQ g^{-1} fresh weight). The ΣPCDD/Fs did not demonstrate such a trend. The Handzamevaart stands out with a striking concentration of 9,79 pg WHO TEQ g^{-1} fresh weight (mean concentration of ΣPCDD/Fs is 1,16 pg WHO TEQ 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 sampling locations, from highly industrialized areas to small rural creeks. 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. The Handzamevaart on the other hand is situated in an agrarian area, known for its strong pesticide pollution. The high levels of ΣPCDD/Fs are surprising and a possible source is unclear.

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 fishers 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*., 2010).

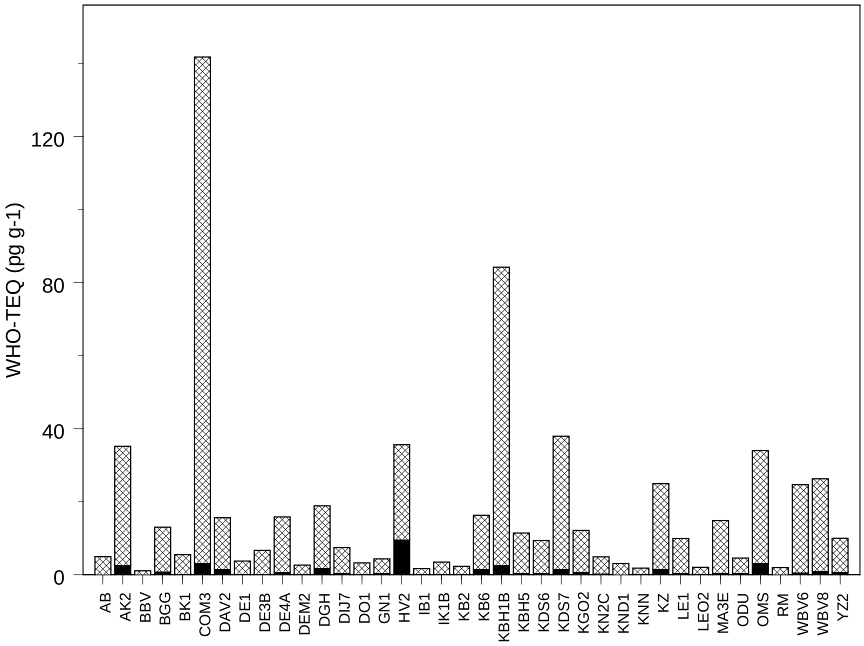


Figure 17. Concentrations of WHO-DL-PCB-TEQ (black) and WHO-PCDD/Fs-TEQ (white) in eel muscle tissue from pool samples in Flanders; (—) maximum level PCDD/Fs= 4 pg g^{-1} fresh weight, (- -) maximum level PCDD/Fs and DL-PCBs= 12 pg g^{-1} fresh weight (Geeraerts *et al.*, 2010).

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.

BE.11.4 Predators

Flemish region

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

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

Walloon region

For the Walloon region, no new data were made available for 2009. 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 & lagoon
coastal

See EMP.

BE.13.2.2 Silver eel production

BE.13.2.2.1 Historical 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

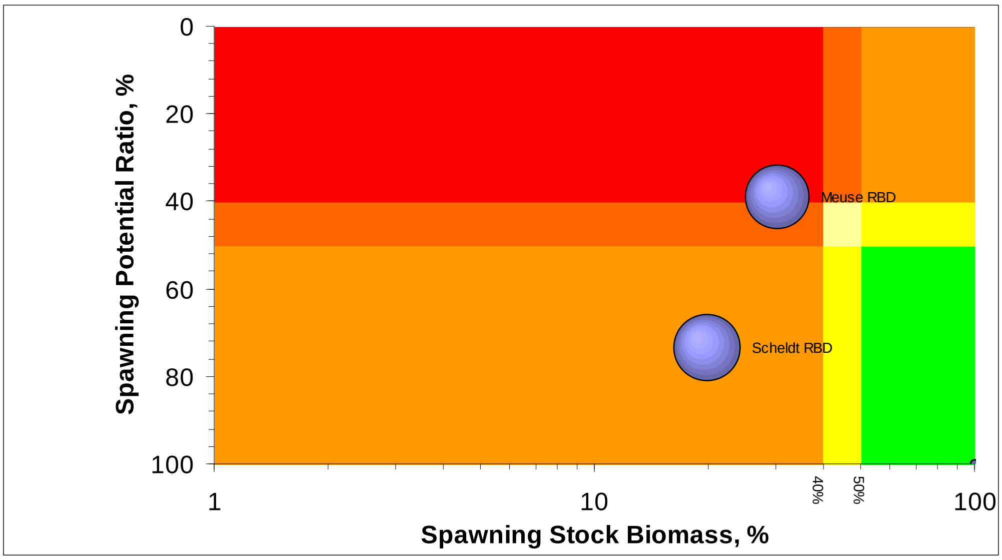
Source : Belgian EMP

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



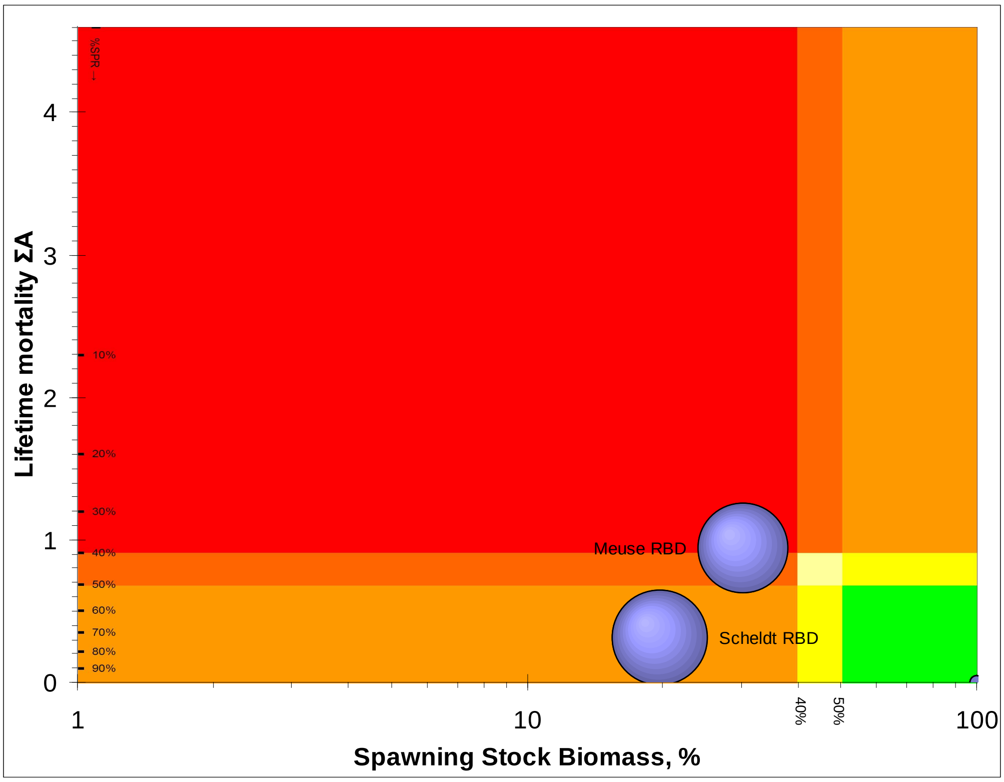


Figure 18. Precautionary diagrams Spawning Potential Ratio (above) and Lifetime Mortality (below) vs. Spawning Stock Biomass estimated for Scheldt and Meuse river basin districts (Source Belgian EMP).

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).

Subbasin	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).

Subbasin	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 Section 13.1: Until now, no special eel stock assessment in the framework of the Belgian Eel Management Plan has been set up.

BE.15 Standardisation and harmonization of methodology

See Section 13.1: 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 (2010) data from recruitment series or other scientific stock indicators in Belgium indicate a further decrease of the stock, even compared with 2008 and 2009.

Special fisheries management actions to restore the stocks in Belgium are confined to the prohibition of the semi professional fyke fisheries in the Lower Scheldt. No other actions related to fisheries have been initiated.

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 no restocking has taken place since 2005.

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 a.s.a.p.

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 fishers 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 fishers are not reluctant for a limitation in eel fishing. Putting in place a catch and release obligation in Flanders would save 33.6 tons of eel on annual basis.

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Report on the eel stock and fishery in Norway 2009/'10

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NO.2 Introduction

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).

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 [1]. 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, 2) that eel fishing be divided by two compared with 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.

1 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. Glass eel fishing is prohibited in Norway.

NO.3.1.1.2 Recreational

No available data. Glass eel fishing is prohibited in Norway.

NO.3.1.1.3 Fishery independent

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 [2].

2 True transparent glass eels do occur in Norway and have reported in more coastal habitats.

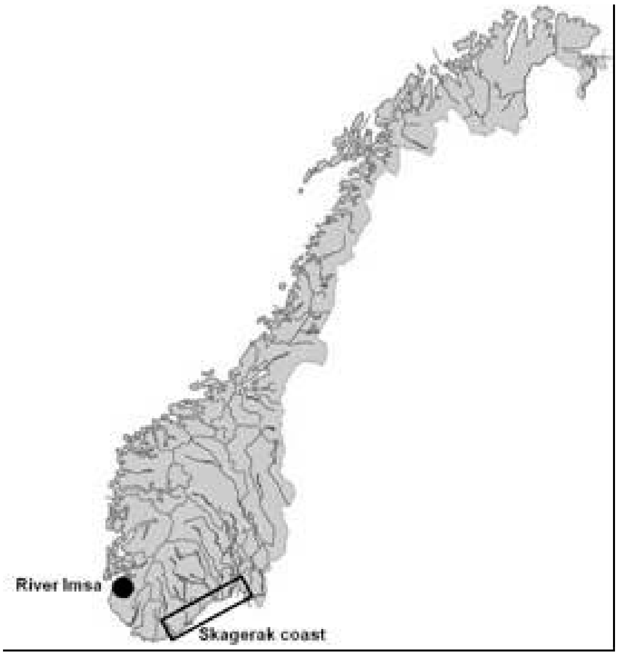

Figure 1. Map of Norway showing the location of the River Imsa and the Skagerrak coast.

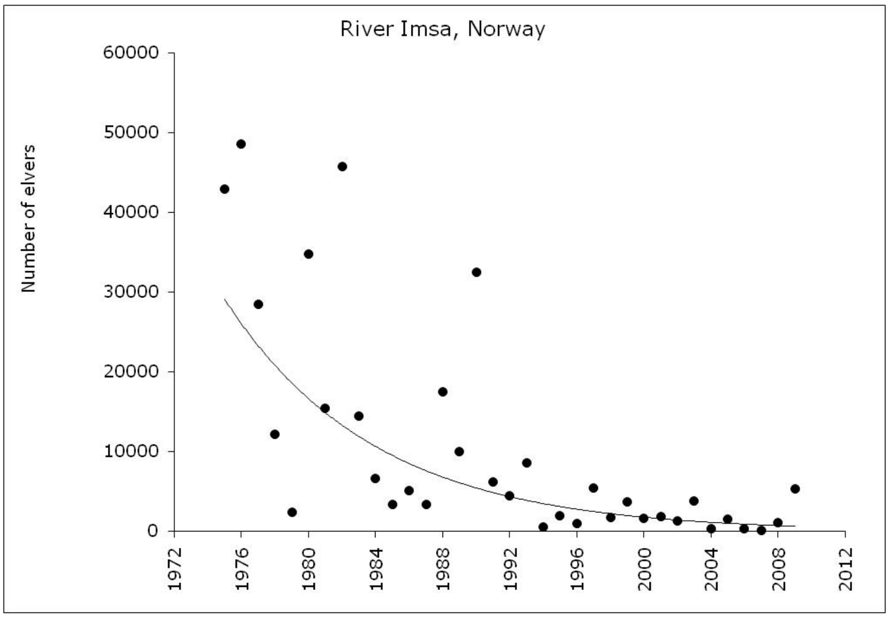

Figure 2. Annual number of elvers ascending the River Imsa during 1975–2009 (exponential fit, r^2 = 0.58). The trap was destroyed during a flood in 2007, and the number of elvers not counted this year.

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

No available data.

NO.3.2 Yellow eel landings

NO.3.2.1 Commercial

Eel fishing has mainly taken place along the coast in southern Norway (Skagerrak coast), in estuarine, brackish and saltwater areas around coastal islands, but also to some extent in freshwater. No distinction is made between yellow and silver eels and they are both caught with eel pots and fykenets. Fykenets are set on soft and muddy bottom, with preference of areas with seagrass beds (eelgrass *Zostera marina*).

Logbooks from some of the fishers have been archived, but have not been analysed. They are available at the Institute of Marine Research-Flødevigen.

NO.3.2.2 Recreational

Recreational fishing boats along the south coast of Norway catch eel and sell them through fishmongers. These fish have represented a smaller volume (mainly due to fishing gear limitation), but still accounted for around 40% of the total catch.

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

NO.3.3 Silver eel landings

NO.3.3.1 Commercial

No data available.

NO.3.3.2 Recreational

No data available.

NO.3.4 Aquaculture production

NO.3.4.1 Seed supply

No data available.

NO.3.4.2 Production

There are 19 eel aquaculture permissions registered for commercial purposes, but nine of these permissions are registered by universities and research institutes that are likely not performing commercial aquaculture production of eel today. For the remaining ten permissions, it is not known whether they have ceased farming or still perform aquaculture production.

NO.3.5 Stocking

NO.3.5.1 Amount stocked

No data available. There is no stocking.

NO.3.5.2 Catch of eel <12 cm and proportion retained for restocking

No data available. 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

No available data. Fishing for glass eel is prohibited.

NO.4.2 Yellow eel

The eel fisheries have mainly been located along the south coast of Norway. There was a minimum legal size of 37 cm for silver eels and 40 cm for yellow eels.

Recreational fishing is prohibited from 1 July 2009. The commercial quota for 2009 was 50 t, and the fishing was stopped when this quota was reached.

NO.4.3 Silver eel

No available data.

NO.4.4 Marine fishery

Recreational fishing is prohibited from 1 July 2009. The commercial quota for 2009 was 50 t, and the fishing was stopped when this quota was reached.

NO.5 Fishing effort

NO.5.1 Glass eel

No available data. There is no glass eel fishery in Norway.

NO.5.2 Yellow eel

There is no registration of fishing effort in terms of number of eel pots per licence.

Table 2. Number of registered commercial eel fishing 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	34 as of September 2nd 2010

NO.5.3 Silver eel

There is no registration of fishing effort in terms of number of eel pots per licence.

NO.5.4 Marine fishery

There is no registration of fishing effort in terms of number of eel pots per licence.

NO.6 Catches and landings

NO.6.1 Glass eel

Elver data from Imsa (see Section 3).

NO.6.2 Yellow eel

No difference is made between yellow and silver eels.

A quota of 50 tons has been set since 1 January 2010.

Table 3. Registered 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		
1941	174	1976	386		
1942	131	1977	352		

NO.6.3 Silver eel

Included in yellow eel data.

NO.6.4 Marine fishery

No available data.

NO.7 Catch per unit of effort

NO.7.1 Glass eel

No available data.

NO.7.2 Yellow eel

Table 4. Cpue 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	cpue
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

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)*

See Section 3.1.1.3.

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 with some 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.

Data from the Skagerrak beach-seine survey. It includes yellow (approximately 70%) and silver eels (30%).

Table 5. 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
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			
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).

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.

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.

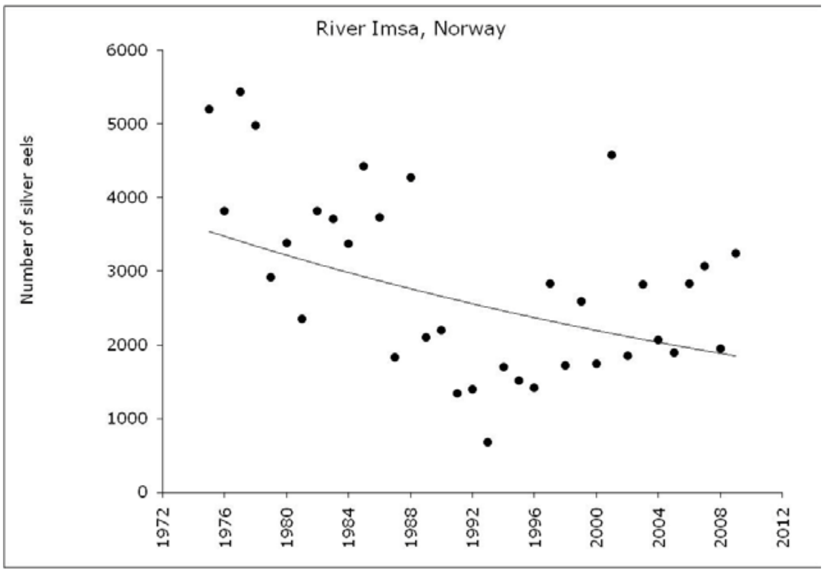

Figure 3. Number of silver eels descending the river Imsa.

NO.10 Catch composition by age and length

There is no new information available. Older data are published in Vøllestad (1985, 1986), Bergersen and Klemetsen (1988), Vøllestad (1992) and Vøllestad and Jonsson (1986, 1988).

NO.11 Other biological sampling

It has been decided under the eel management plan to use part of the 50 tons of eel which have been allocated to the fishers, as a scientific fishery to monitor length, weight, parasite infestation, age and otolith microchemistry. This will start in autumn 2010. Some samples have already been collected by NINA (Eva Thorstad), but have not been processed.

NO.11.1 Length and weight and growth (DCF)

There is no sampling of length, weight or growth data for eel in Norway.

NO.11.2 Parasites and pathogens

No new data since 2009.

NO.11.3 Contaminants

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

NO.11.4 Predators

There is no sampling related to predation on eels in Norway.

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, except the beach-seine surveys and the time-series collected in the River Imsa described in Section 3. These time-series were analysed by Durif *et al*. (2008, 2010), and 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 Historical 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 Standardisation 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 demonstrates 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 demonstrated 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.

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Report on the eel stock and fishery in Sweden 2009/'10

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Reporting Period: This report was completed in September 2010, and contains data up to 2009 including some provisional data for 2010.

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SE.2 Introduction

Most of the information presented in this Country Report 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.

Quantification of the measures

The overall target for the national management plan 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 demonstrated in the following table (SE. 2.1). The sign indicates extraction (-) or addition (+) to the production without anthropogenic impact.

Table SE. 2.1.

	Silver eels (*1000)	Per cent 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%

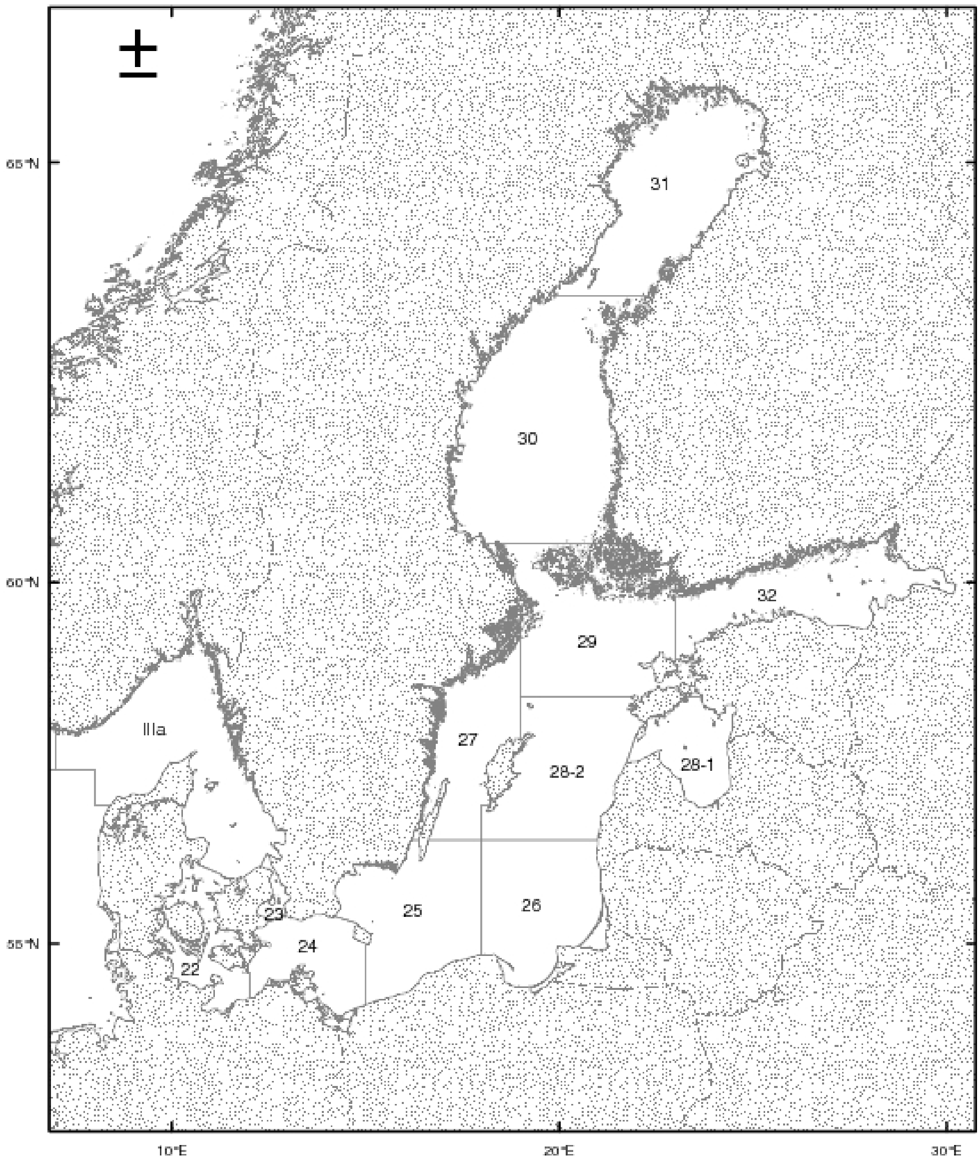

Figure SE. 2.1. ICES SD (subdivisions) in Sweden.

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 very 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. 2.2).

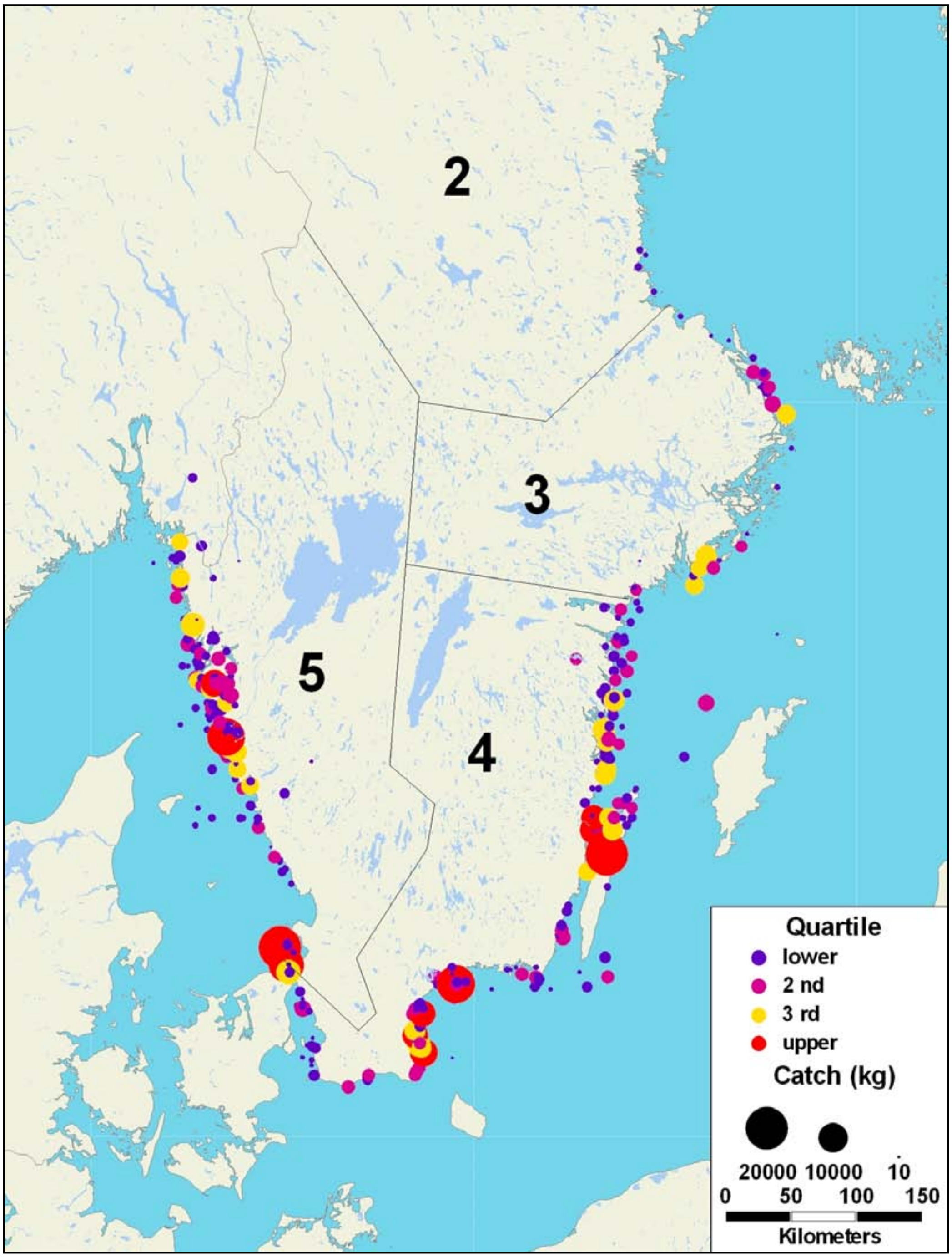

Figure SE. 2.2. The commercial catch in year 2007 expressed per unit area (squares of 1 minute latitude * 1 minute longitude). The sizes of the circles are proportional to the catch. Colour coding indicates where most eels are caught. The River Basin Districts are schematically indicated.

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 available data (no fishery allowed).

SE.3.1.1.2 Recreational

No available data (no fishery allowed).

SE.3.1.1.3 Fishery independent

The abundance of glass eels in the open sea (Kattegat and Skagerrak) is 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 the ICES-International Young Fish Survey (since 1993 called the International Bottom trawl Survey (IBTS Quarter 1) (Hagström and Wickström, 1990). 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 but is now a resting series (cf. 9.1). 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 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.3.1 and Table SE.3.1). 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 with 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.

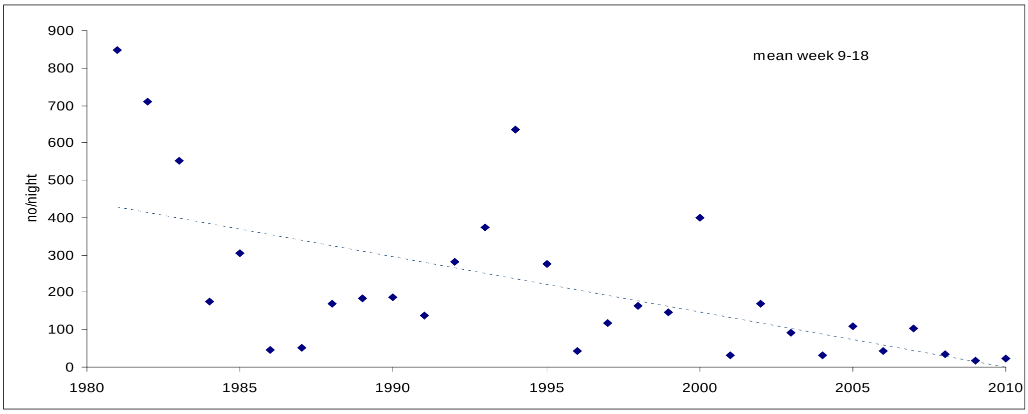

Figure SE.3.1. Time trend in glass eel recruitment at the Ringhals nuclear power plant on the Swedish Kattegat Coast.

Table SE. 3.1. Annual indices of glass eel recruitment at the intake canal for cooling water to reactors 1 and 2 at the Ringhals nuclear power plant. Mean of weekly means 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	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
3	3													1																
4	0							17			1			4					0											
5	4							8		15	14	18	30	5	4	0	0	1	0	74	2	27	6		20		10			
6								28		27	13	56	45	7	11	0	1	1	0	142	0	86	5	1	12	2	42	8	1	
7								6		22	9	85	331	7	41	0	22	9	8	267	3	154	2	2	62	3	4	27		
8	1							34		57	3	44	57	8	48	11	3	50	12	115	5	327	5	0	22	2	12	17	4	
9	187		51			3		36	342	185	3	160	55	3	172	0	68	125	62	344	5	117	5	1	15	6	11	10	3	
10	199	24				2		80	372	150	15	471	118	7	224	4	200	100	121	377	3	200	10	3	10	2	29	31	2	2
11	250	130	528	176		4		19	129	150	88	290	130	610	333	13	198	8	72	533	22	366	44	3	39	1	81	114	3	4
12	374	806	835	289	14	6	2	16	107	145	42	469	535	400	569	25	60	177	158	214	24	530	53	18	162	13	382	38	15	8
13	1886	1258	265	122	109	1	0	72	291	251	110	562	495	1430	331	60	42	220	2	479	16	59	185	35	153	17	186	30	36	4
14	2093	1335	469	181	0	3	31	149	121	351	138	151	403	1236	625	33	77	448	314	942	22	185	192	65	162	55	101	43	37	34
15	1849		878	112	878		141	603	67	284	414	298	540	1145	91	128	201	237	377	154	45	184	151	55	202	97	191	26	25	24
16			925		476		69	416	42	120	254	142	527	619	64	73	49	96	79	299	25	53	74	90	286	132	20	13	23	91
17	804		477	171	350		6	127		37	193	231	564	278	80	56	44	202	141	257	128	8	158	32	66	62	18	2	11	23
18	0					297	114				124	55					230	31				9	46	8	10	36	7			28
mean 9-18	849	711	553	175	305	45	52	169	184	186	138	283	374	636	277	44	117	164	147	400	32	171	92	31	110	42	102	34	17	24

Figure SE.3.2. 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.

SE.3.1.2 Yellow eel recruitment

SE.3.1.2.1 Commercial

No available data (no fishery allowed).

SE.3.1.2.2 Recreational

No available 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 such recruitment data came from some 20 rivers, but today most of them were closed due to lack of eels and therefore also 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 with a time period in common (1971–1980). In most rivers the recruits belong to several age classes, but in River Viskan situated on the West Coast most eels are “YOY”, i.e. originates from glass eels arriving at the coast the same year.

Table SE.3.2. Amounts of ascending young eels in eight Swedish rivers.

Recruitment dataseries from Sweden (all in kg), data from 2010 are not final, na = not available								
Year	Dalälven	Motala Ström	Mörrumsån	Kävlingeån	Rönneå	Lagan	Viskan	Göta Älv
1900								530,00
1901								5100,00
1902								340,00
1903								858,00
1904								552,00

Recruitment dataseries from Sweden (all in kg), data from 2010 are not final, na = not available								
Year	Dalälven	Motala Ström	Mörrumsån	Kävlingeån	Rönneå	Lagan	Viskan	Göta Älv
1905								8700,00
1906								2000,00
1907								275,00
1908								na
1909								na
1910								na
1911								5728,00
1912								6529,00
1913								20,00
1914								2828,00
1915								na
1916								na
1917					45,00			na
1918					4,50			na
1919					na			1465,00
1920					na			800,00
1921					na			1555,00
1922					na			455,00
1923					na			1732,00
1924					na			4551,00
1925					na	331,30		5463,00
1926					49,00	357,80		3893,00
1927					445,00	581,10		4796,00
1928					na	211,90		47,00
1929					na	4,50		756,00
1930					147,00	268,00		5753,00
1931					na	316,00		2103,00
1932					na	408,00		7238,00
1933					na	303,50		6333,00
1934					na	236,00		6338,00
1935					na	53,50		1336,00
1936					na	24,50		2537,00
1937					na	0,50		8711,00
1938					na	106,50		3879,00
1939					na	36,00		4775,00
1940					na	684,00		1894,00
1941					na	321,00		2846,00
1942		14,00			na	454,00		427,00
1943		283,00			na	1248,00		1848,00
1944		773,00			na	1090,00		2342,00
1945		406,00			na	1143,00		2636,00
1946		280,00			29,70	766,50		2452,00
1947		272,50			5,80	440,80		675,00
1948		120,00			6,00	494,70		1702,00

Recruitment dataseries from Sweden (all in kg), data from 2010 are not final, na = not available								
Year	Dalälven	Motala Ström	Mörrumsån	Kävlingeån	Rönneå	Lagan	Viskan	Göta Älv
1949		43,00			39,40	603,60		1711,00
1950		304,50			93,50	419,90		2947,00
1951	210,00	2713,00			1,00	281,80		1744,00
1952	324,00	1543,50			9,10	379,10		3662,00
1953	241,50	2698,00			70,00	802,40		5071,00
1954	508,50	1030,00			2,70	511,30		1031,00
1955	550,00	1871,00			42,60	506,90		2732,00
1956	215,00	429,00			14,10	501,60		1622,00
1957	161,50	826,00			46,80	336,10		1915,00
1958	336,70	172,00			73,20	497,20		1675,00
1959	612,60	1837,00			80,00	910,50		1745,00
1960	289,00	799,00	29,00		93,00	552,40		1605,00
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		1469,00
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	1423,00	196,30		48,50	216,50		1232,00
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		1595,00
1970	149,80	2,00	80,40		29,80	24,70		1046,00
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	1179,00
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	1230,00
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

Recruitment dataseries from Sweden (all in kg), data from 2010 are not final, na = not available								
Year	Dalälven	Motala Ström	Mörrumsån	Kävlingeån	Rönneå	Lagan	Viskan	Göta Älv
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	*>79,6*	*ca 80*	*na*	*>1,6*	*na*	*>41,7*	0,04	*na*

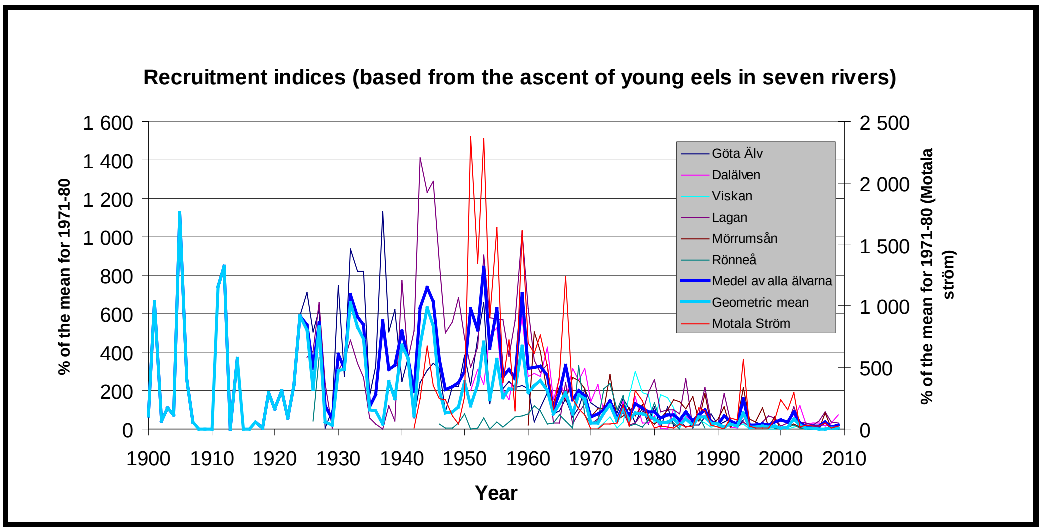

Figure SE.3.3. The ascent of young eels in seven Swedish rivers.

SE.3.2 Yellow eel landings

SE.3.2.1 Commercial

No available data.

SE.3.2.2 Recreational

No available data (no such fishery allowed).

SE.3.3 Silver eel landings

SE.3.3.1 Commercial

No available data.

SE.3.3.2 Recreational

No available data (no such fishery allowed).

SE.3.4 Aquaculture production

SE.3.4.1 Seed supply

In 2010, 870 kg glass eels were imported from Bay of Biscay in France. For a number of years until 2009 seed was supplied from River Severn in the UK only.

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 kindly informs that 143 tons were produced for consumption in 2009.

Their production for stocking purposes was in 2009, 763 000 to 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 per piece.

This year 82% of the imported glass eels were used for restocking purposes, higher than the average of ca. 70% (for the time period 1984–2010).

Table SE.3.3. Production of eels in aquaculture from 1983 in Sweden. (*SCB (Statistics Sweden) is the official source of statistics in Sweden.

Aquaculture production (tons/year), source *SCB	
1983	2
1984	12
1985	41
1986	51
1987	90
1988	203
1989	166
1990	157
1991	141
1992	171
1993	169
1994	160
1995	139
1996	161
1997	189
1998	204
1999	222
2000	273
2001	200
2002	167
2003	170
2004	158
2005	222
2006	191
2007	175
2008	172
2009	143

SE.3.5 Stocking

SE.3.5.1 Amount stocked

Until 2005 medium-sized yellow eels (~37 cm) from the Swedish West coast were in combination with imported glass eels used as stocking material in lakes as well as along the Baltic Coast. However, the proportion of imported glass eels and elvers increased over time because translocation of national eels were not considered as a net contribution to our national eel stock. Since 2006 only imported and quarantined glass eels are eligible for stocking supported with public money. To facilitate the evaluation of stocking programmes all eels stocked in Sweden have since 2009 to be chemically marked with strontium chloride ($SrCl2$) in their otoliths.

When the import of glass eels commenced in the late 1970s they were all imported from France. Later on and due to a serious concern of the risk of introducing (viral) fish diseases with imported eels, only River Severn in the UK was allowed as source until this year (2010) when import from France was again allowed.

During the quarantine phase the eels normally grow to about 1 gramme each before stocking.

From otolith chemistry we know that in several lakes today's eel populations originate to a great extent from stocked eels.

Table SE.3.4. Stocked amounts in freshwater since 1985.

Year	RBD 2	RBD 3	RBD 4	RBD 5	RBD ?	Sum
1985	7 942	609 406	112 946	548 362		1 278 656
1986	10 318	78 700	123 049	168 920		380 987
1987	24 388	152 500	265 151	294 044		736 083
1988	1 760	503 083	209 662	754 256		1 468 761
1989		57 860	131 696	302 356		491 912
1990	15 300	677 300	308 438	382 411		1 383 449
1991		479 326	212 443	383 179		1 074 948
1992	3 190	687 860	211 269	310 875		1 213 194
1993	4 400	770 950	180 296	418 975		1 374 621
1994	59 600	393 855	531 258	1 414 353		2 399 066
1995		356 495	415 730	1 352 075		2 124 300
1996	20 800	653 401	559 486	1 348 861		2 582 548
1997	12 650	691 525	628 039	1 398 943		2 731 157
1998		623 719	518 930	1 043 765		2 186 414
1999	537 000	786 151	253 044	1 242 920		2 819 115
2000	43 750	205 766	297 403	881 438		1 428 357
2001	92 405	204 596	256 733	444 336		998 070
2002	111 100	307 148	238 388	592 640		1 249 276
2003	32 000	314 240	121 715	23 296		491 251
2004	107 340	80 583	260 858	714 648		1 163 429
2005	118 020	159 715	266 303	402 284		946 322
2006	73 142	228 178	315 862	352 949		970 131
2007	103 987	128 194	276 208	288 352		796 741
2008	51 422	118 982	356 820	482 833	3 000	1 013 057
2009	46 905	54 125	288 954	193 092	3 436	586 512
2010	32 000	3 000	431 445	1 257 065	2 000	1 725 510
Total	1 509 419	9 326 658	7 772 126	16 997 228	8 436	35 613 867

Figure SE.3.4. Stocked numbers in freshwater.

Table SE.3.5. Stocked amounts in marine/brackish water since 1985.

Year	RBD 2	RBD 3	RBD 4	RBD 5	Sum
1985	0	0	0		0
1986	0	0	0		0
1987	0	0	363 636		363 636
1988	0	0	245 700		245 700
1989		500 000	317 378		817 378
1990	0	0	358 095		358 095
1991	0	0	258 740		258 740
1992	0	0	0	360 000	360 000
1993		0	0	360 000	360 000
1994		0	86 200	360 000	446 200
1995		0	0	360 000	360 000
1996		280 000	0	60 000	340 000
1997		328 450	-9		328 441
1998		294 950	0		294 950
1999		371 430	0		371 430
2000		249 955	0		249 955
2001		100 220	0		100 220
2002	171 000	126 510	88 650	24 255	410 415
2003	111 460	138 210	131 500	12 502	393 672
2004	106 850	83 611	46 662	21 625	258 748
2005		66 063	89 604	6 195	161 862
2006	97 200	58 962	187 685		343 847
2007	40 800	46 040	80 426	7 500	174 766
2008	63 400	122 772	180 755		366 927
2009	54 127	33 830	88 745		176 702
2010			30 000	180 000	210 000
Total	644 837	2 801 003	2 553 767	1 752 077	7 751 684

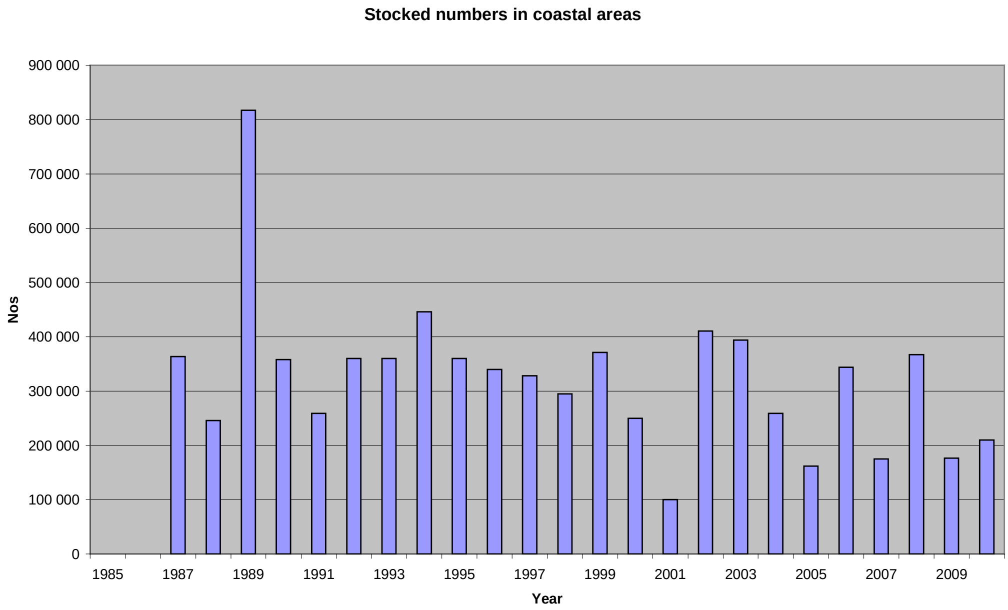

Figure SE.3.5. Stocked numbers in coastal areas.

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

No available data (no such fishery allowed, but ascending young eels are in a few sites trapped and transported upstream in their respective rivers).

SE.4 Fishing capacity

Reported by EMU.

SE.4.1 Glass eel

No available data (no such fishery allowed).

SE.4.2 Yellow eel

See 4.4.

SE.4.3 Silver eel

See 4.4.

SE.4.4 Marine and freshwater fishery

The number of licences issued yearly has decreased since the regulation was implemented in 2007.

Table SE.4.1. Number of licences issued yearly for coastal and freshwater fishery.

	Total	Coastal	Coastal and Freshwater	Freshwater
2007	434			
2008	408	336	3	69
2009/2010	387	316	3	68

In 2007 eel fishing became prohibited without a special permit. The issuing of licences was based upon eel fishery during a reference period 2003–2005. Licences were given to fishers 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 May and 14 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 were 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.

SE.5 Fishing effort

Reported by EMU.

SE.5.1 Glass eel

No available data (no such fishery allowed).

SE.5.2 Yellow eel

See 5.4.

SE.5.3 Silver Eel

See 5.4.

SE.5.4 Marine fishery

Official data on the fishery with information on effort have been collected only at certain points in time during the last century (SCB 1988) and even these data lack higher spatial resolution and does not distinguish between yellow and silver eel. The official reports in daily logbooks (for boats >10 m) and monthly journals both have spatial information and figures on effort, however the monthly journals (where more than 90% of the fishery is reported) was not mandatory before 1999, and fishing for eel on private waters was not reported before 2005. Data from logbooks and journals are stored at the Swedish Board of Fishery.

A first step to regulate the eel fishery in Sweden was made in 2007 when fishing of eel was prohibited without a special permit. At the same time this rule was imposed the minimum legal size was raised from 600 to 650 mm in freshwater and along the Baltic Coast (mainly silver eels). On the Swedish West Coast this size was raised from 370 to 400 mm (mainly yellow eels). These minimum legal sizes now include also silver eels that were earlier exempted. The total number of fykenets allowed is now limited to 400 single or double fykes. Furthermore, in Kattegat and Skagerrak the fishery with mobile gears are limited to between 1 May and 14 September and no catch of silver eel north of 56 25,00 N is allowed.

The number of fishers reporting eel catches in the official logbooks and journals have decreased since 1999 from 395 to 288 reporting in 2009. The mismatch between number of reporting fishers (for example 288 in 2009) and number of licence holders (316 in 2009) is not only due to lack of using the licence but also to the reporting system where fishers can report the catch jointly in the logbook although having individual licences. Looking at a subset of licence holders, the 358 reporting catches (both freshwater and coastal fishery) between 2007 and 2010, the yearly use of fishing licence seems to be over 90%.

Looking at the effort measured as number of gears * number of days for the dominating gears in silver eel fishery (poundnets) and yellow eel fishery (fykenets) (Figure 5.1) show that the use of fykenets has decreased (Spearman rho=-0.71, p<0.05) while there is no trend in poundnets. However it is important to note that poundnets includes several different types of gears that may differ in efficiency but unfortunately are not reported separately.

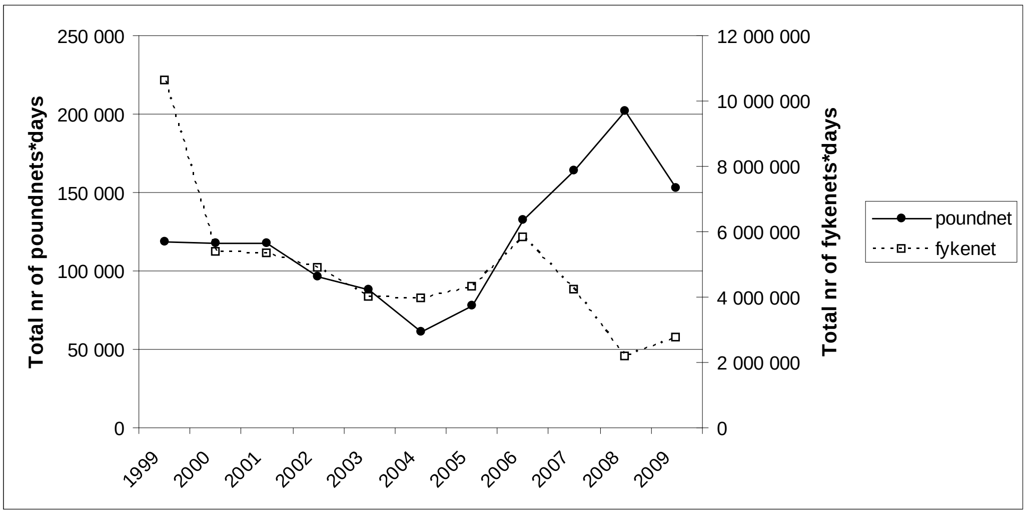

Figure SE.5.1. Effort (nr of gears*days) in poundnet (mainly silver eel) and fykenet (mainly yellow eel) fishery in Sweden.

As mentioned above, the official catch statistics at the present do not give reliable information on the effort in the fishery for eel, especially on a longer time-scale. Detailed information on effort is however available locally from industrial monitoring in some sites in the Baltic. The Baltic eel fishery is dominated by poundnets targeting silver eel, to a great extent on private waters. In one area in the central Baltic, effort, as expressed by numbers of poundnets multiplied by time was reduced from 6000 in the late 1960s to less than 2000 around the turn of the millennium. This change is mainly explained by single enterprises closing down the fishery due to old age. The development is probably representative for the entire region.

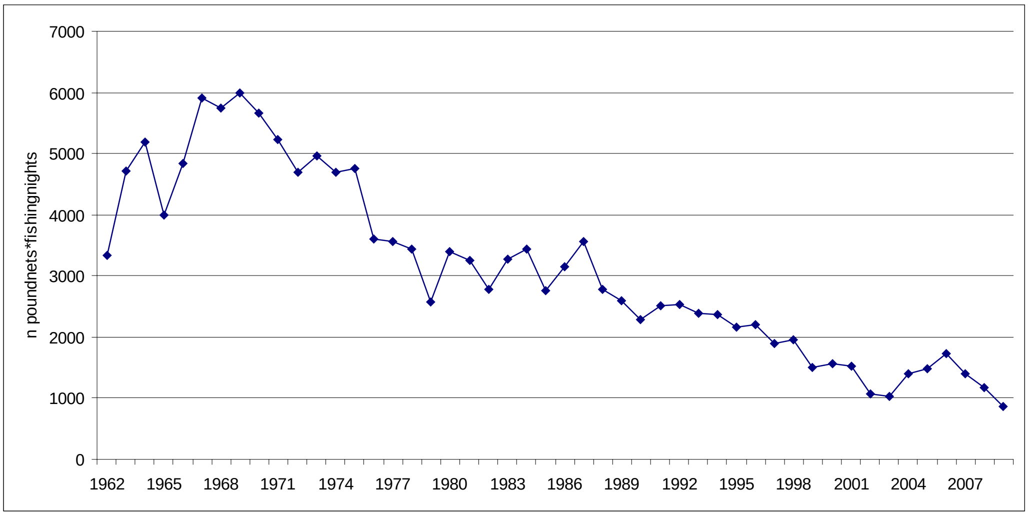

Figure SE.5.2. Fishing effort expressed as numbers of poundnets multiplied by numbers of fishing nights in an area north of Oskarshamn on the Swedish coast of the Baltic proper.

SE.6 Catches and landings

Reported by EMU.

SE.6.1 Glass eel

No available data (no such fishery allowed).

SE.6.2 Yellow eel

See 6.4.

SE.6.3 Silver eel

Freshwater fishery.

The proportion of yellow eels is investigated from this year (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.

Table SE.6.1. Commercial catch in freshwater lakes in Sweden.

	Lakes				
Year	Mälaren	Hjälmaren	Vänern	Smaller lakes	Total
1962			8		8
1963			9		9
1964	2		10		12
1965	2		9		11
1966	2	1	10		13
1967	2	1	12		15
1968	1	2	15		18
1969	1	3	14		18
1970	2	2	14		18
1971	3	2	14		19
1972	4	3	13		20
1973	4	4	12		20
1974	5	3	12		20
1975	8	5	16		29
1976	6	5	11		22
1977	8	6	14		28
1978	7	6	9		22
1979	8	6	8		22
1980	13	9	10		32
1981	13	9	11		33
1982	15	12	11		38
1983	17	10	12		39
1984	18	11	13		42
1985	20	11	19		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

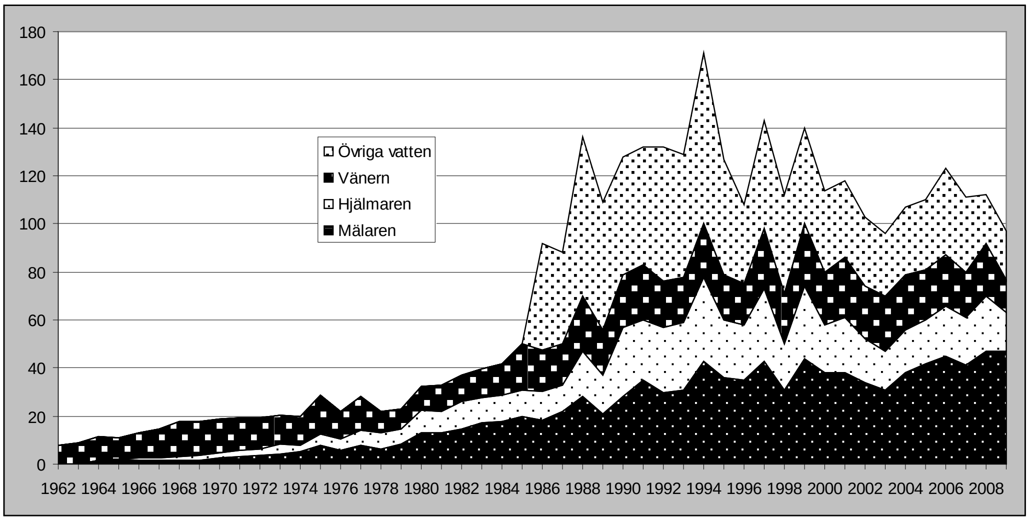

Figure SE.6.1. Commercial catch in freshwater lakes in Sweden (smaller lakes ("Övriga vatten") were not reported until 1986 and onwards).

SE.6.4 Marine fishery

Total eel catches reported to the logbook system averaged 514 tons in 1999–2009. 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. 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 (nr 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. 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.

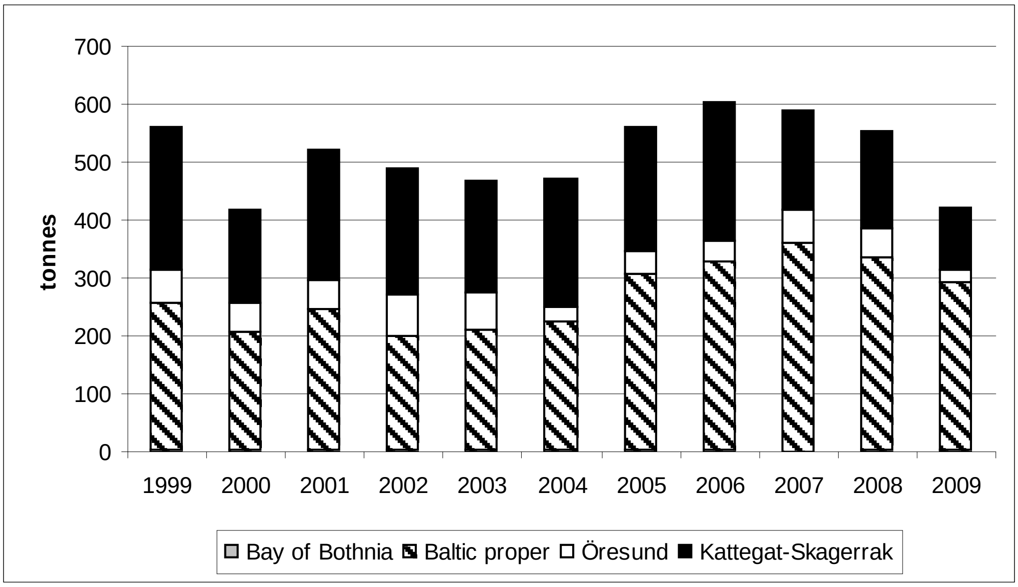

Figure. SE.6.2. Total commercial landings in coastal fishery by main basin. Data per subdivision is available in the Appendix.

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 (see Appendix for details).

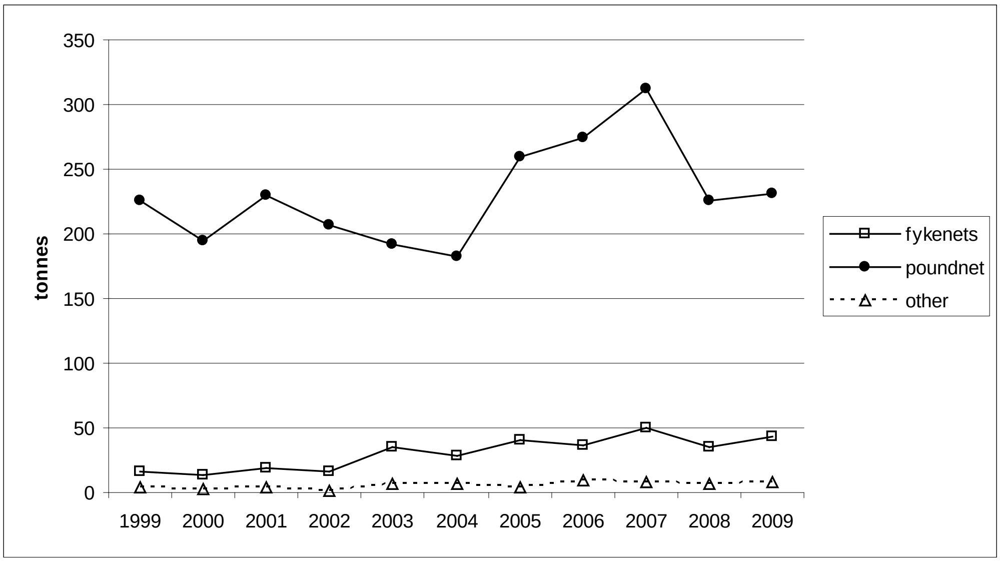

Figure. SE.6.3. Annual silver eel landings reported by gear.

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 (see Appendix SE for details).

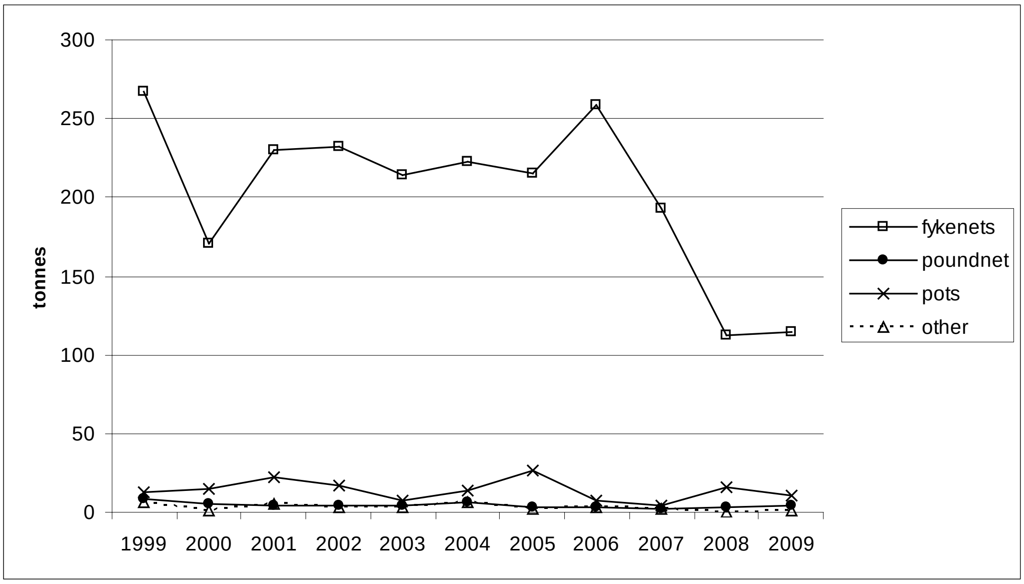

Figure. SE.6.4. Annual yellow eel landings reported by gear.

From the traditional sales notes system the long-term decrease in landings is illustrated:

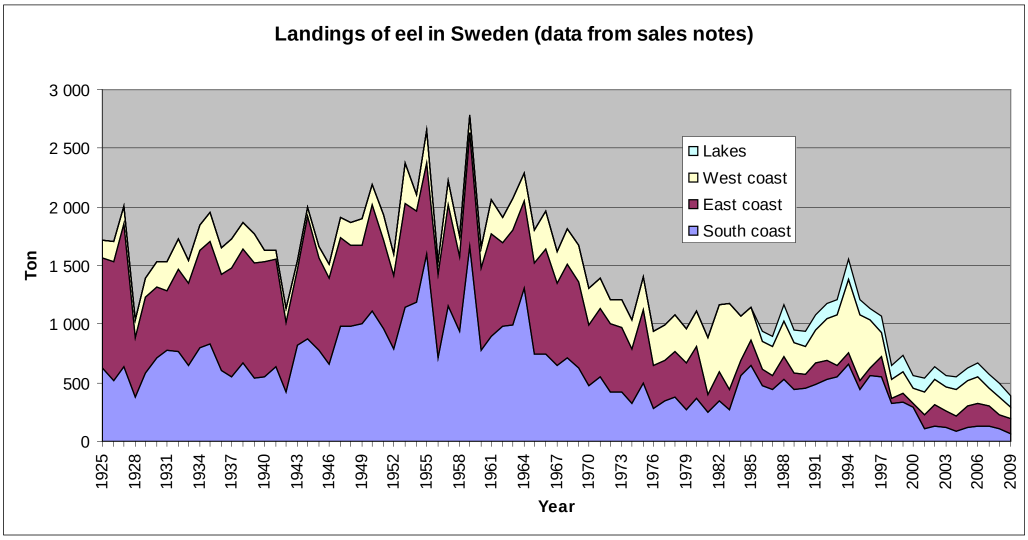

Figure SE.6.5 Landings as reported through the sales notes system.

SE.7 Catch per unit of effort

Reported by EMU.

SE.7.1 Glass eel

No available data (no such fishery allowed).

SE.7.2 Yellow eel

See 7.4.

SE.7.3 Silver eel

See 7.4.

SE.7.4 Marine fishery

7.3.1 Marine areas

Selected companies have provided detailed catch statistics from the poundnet fishery for silver eel in the Baltic Sea since the late 1950s. The fishers deliver daily and site-specific information on numbers and total weight of the two life stages and of effort expressed as the numbers of gears used together with the fishing time in days.

The trend in cpue is negative in the longest time-series from ICES Subdivision 27 (Figure SE.7.1 upper panel, N. Småland and N. Kalmarssund), corresponding to a 50% decrease from the 1960s to recent years. The overall trend is negative also in the Hanöbukten area (Figure SE.7.1 lower panel). In one single site (Oderskärvet), with data from recent years, cpue in recent years recovered to a similar level as at the start of this time-series in the early 1980s.

No trend exists in the southern Östergötland area (Figure SE 7.1 upper panel). The time-series from ICES SD 27 are based on an arithmetic average of a set of fixed fishing stations in all areas but N Kalmarsund. This may induce a bias as a consequence of optimizing the effort over time, such that stations giving lower catches are abandoned. Data from single sites in the S Östergötland area and in the N Småland area are given in Tables 7.4.3 and 7.3.4 in Appendix SE. Significant negative trends since 1972 exist for 40% of the sites used for twenty years or more during this period.

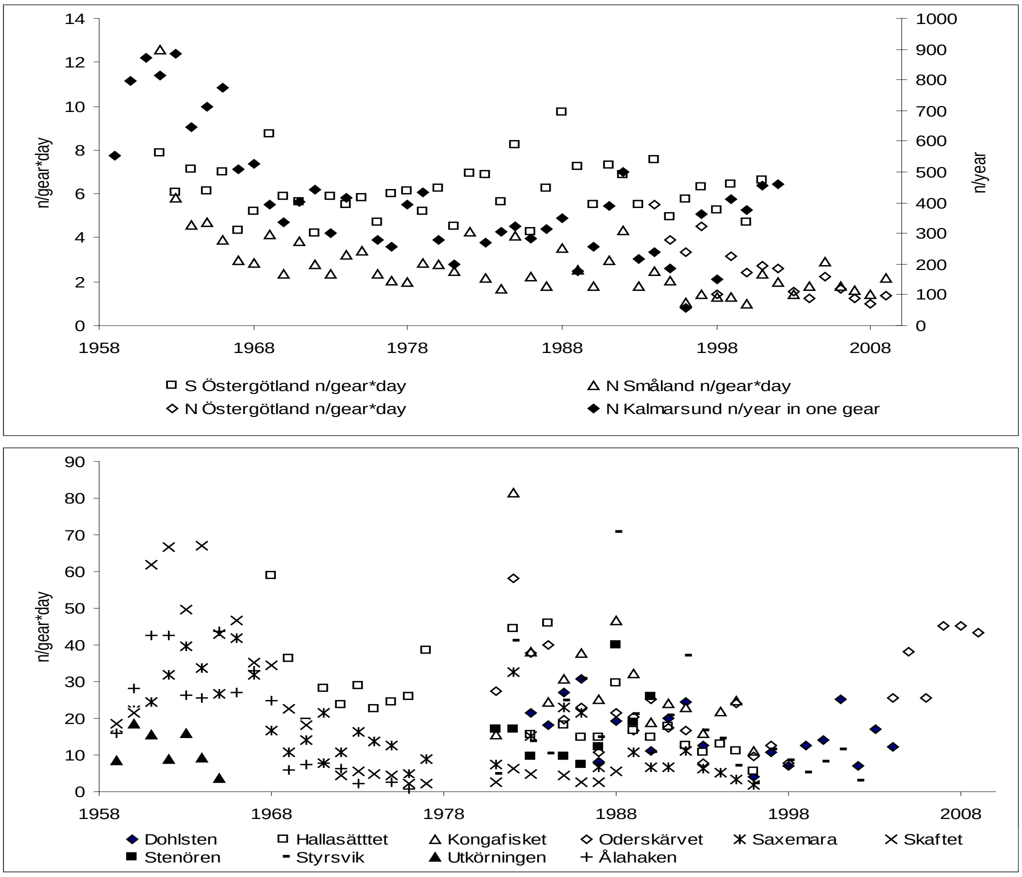

Figure SE.7.1. Time trends in poundnet catches of silver eel in five subareas in Sweden. Four subareas (upper panel) are located in ICES Subdivision 27 on the Swedish coast of the Baltic Proper. The Hanöbukten area (lowest panel) is located in ICES SD 25 on the SE coast of Sweden.

Fishing for eel with fykenets is of minor importance compared with poundnets on the Swedish coast of the Baltic Proper. Nevertheless it operates in a rather conservative way because several decades and long time-series exist from a few companies. Because determination of life stages by the fishers may be influenced by market demands rather than being based on biology, catch per unit of effort is presented for yellow and silver eel together (Figure SE.7.2). The cpue demonstrate no trend in the two areas over the years. In SD 27 north (the southern Östergötland area) yellow eel became less abundant in the mid 1990s, but this decrease was compensated by a larger proportion of silver eels. The cpue in 2006–2009 of both life stages together was the highest since 1974. In SD 27 south (the northern county of Kalmar), silver eel became more abundant in fykenet catches in the early 1990s. In this area the silver eel catches in 2005–2009 were the biggest ever recorded in fykenets, and fishers all over the area reported good catches. The good catches of silver eels in recent years may have induced a change in practice in the fykenet fishery, more towards targeting silver eel. From 1990 the minimum legal size for landing of yellow eel was raised in two steps from 53 to 60 cm. This probably had an influence on the cpue in fykenets. From 1 May 2007 the minimum legal size was raised to 65 cm for both yellow and silver eels. The mean weight of landed yellow eel was 0,6–0,8 kg in recent years.

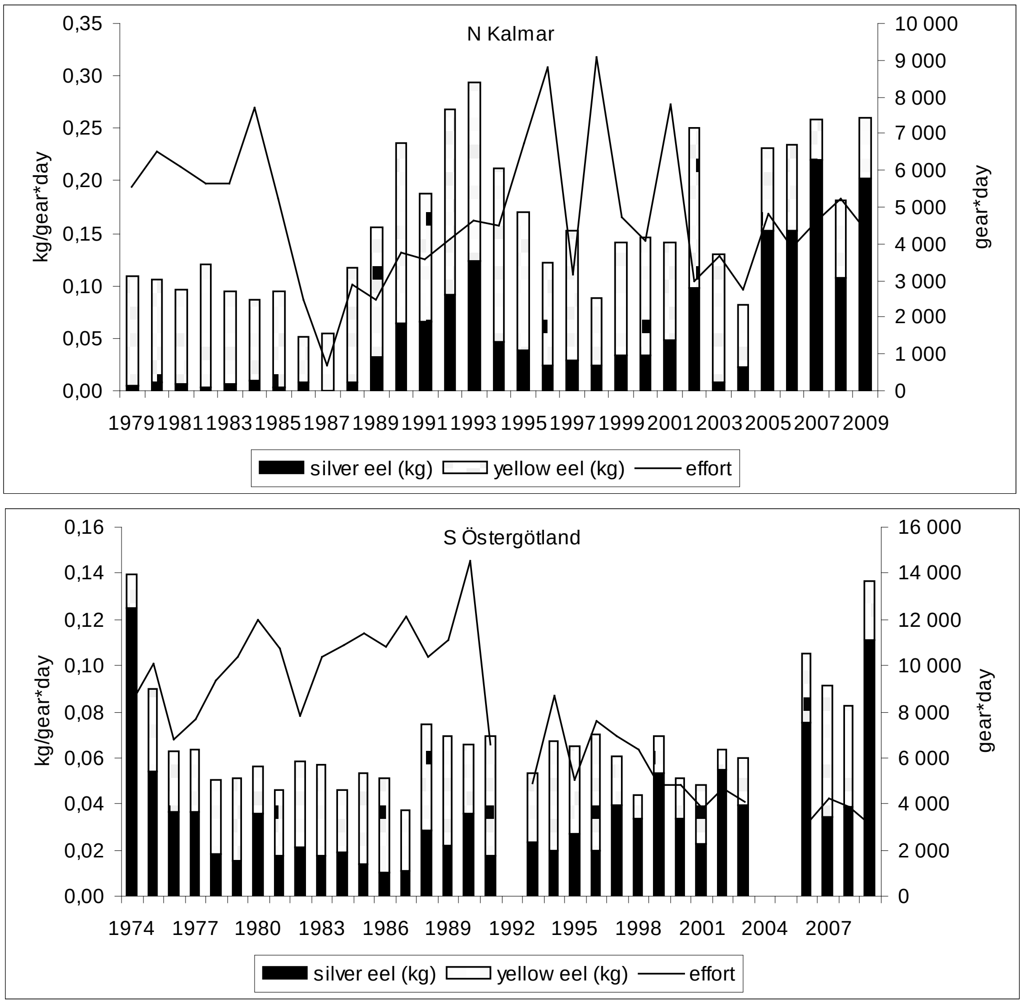

Figure SE.7.2. Time trends in cpue and effort for fykenet catches of silver and yellow eel in two subareas in Swedish RBD 4 (Southern Baltic). The subareas are all located in ICES Subdivision 27 on the Swedish coast of the Baltic Proper. Southern part of the county of Östergötland (upper) and northern part of the county of Kalmar (lower).

SE.8 Other anthropogenic impacts

In the Swedish EMP we estimated the loss from turbines and trash racks at hydropower stations to about 280 000 silver eels, corresponding to 10% of the present production Table SE.2.1). A Memorandum of Understanding between the Swedish Board of Fisheries and the major hydro power 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.2.1). 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 (3.1.2.3), 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. (Figures SE.9.1–9.4). From this year (2010) onwards we add to these sites a smaller number of electro-fishing stations in areas with a nonsufficient coverage. Some resting series with drop-trapping (ICES 2009a) data has also been reopened and extended this year, in order to improve the coverage of samples and quality of recruitment data.

From the Swedish Electro Fishing Register (SERS) the following kind of data were extracted:

SE.9.1.1 Data on occurrence

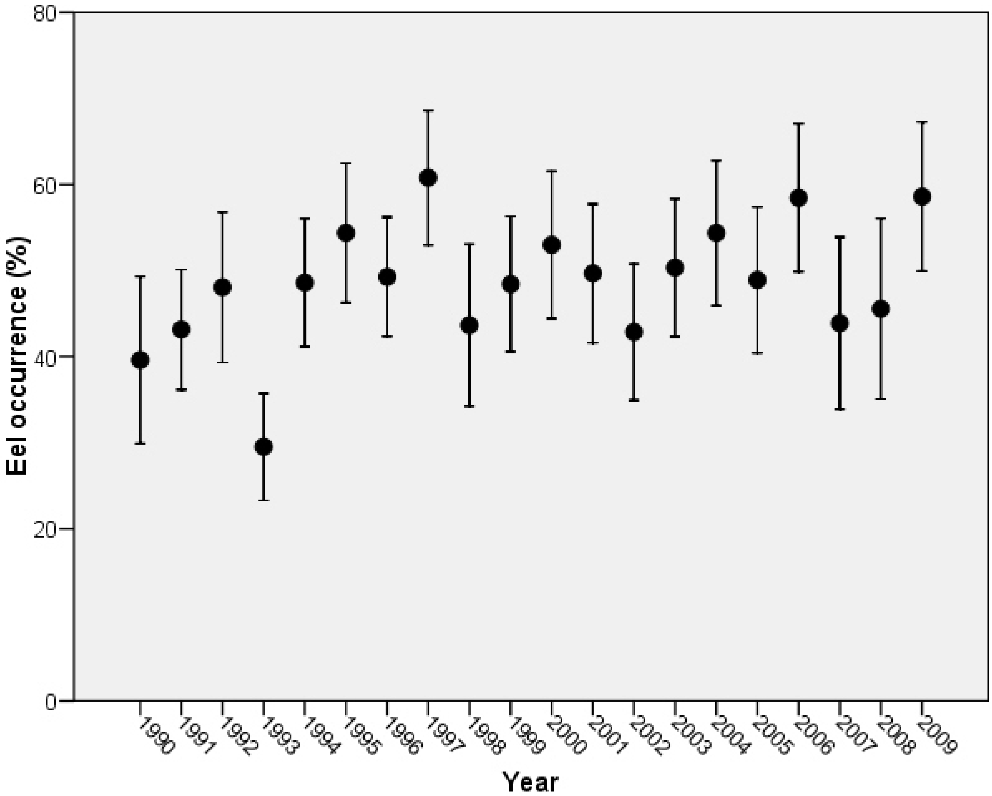

Figure SE.9.1. Proportion of electro-fished stations (%) with eel occurrence (+/- 95% CI) along the West Coast (only the county of Halland). The stations that were fished in 1990–2009 are situated from 0 to 100 m asl. Note that local abundance is not given here, only presence/absence. Data from SERS (Swedish Electrofishing Register). ***The trend is not significant (Pearson correlation, n=20, r=0,404, p=0,077).***

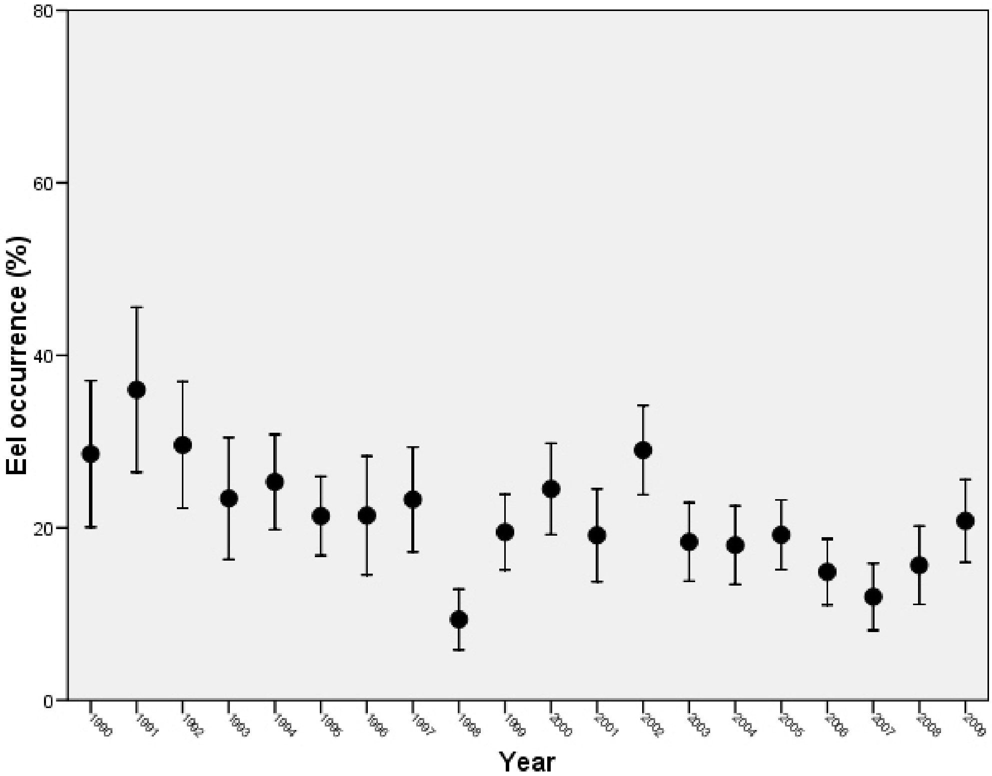

Figure SE.9.2. Proportion of electro-fished stations (%) with eel occurrence (+/- 95% CI) along the East Coast. Stations that were fished in 1990–2009 in this figure are situated from 0 to 100 m asl in seven counties along the Baltic Sea Coast. Note that local abundance is not given here, only presence/absence. Data from SERS (Swedish Electrofishing Register). ***The negative trend is significant (Pearson correlation, n=20, r=-0,648, p=0,002).***

SE.9.1.2 Data on abundance

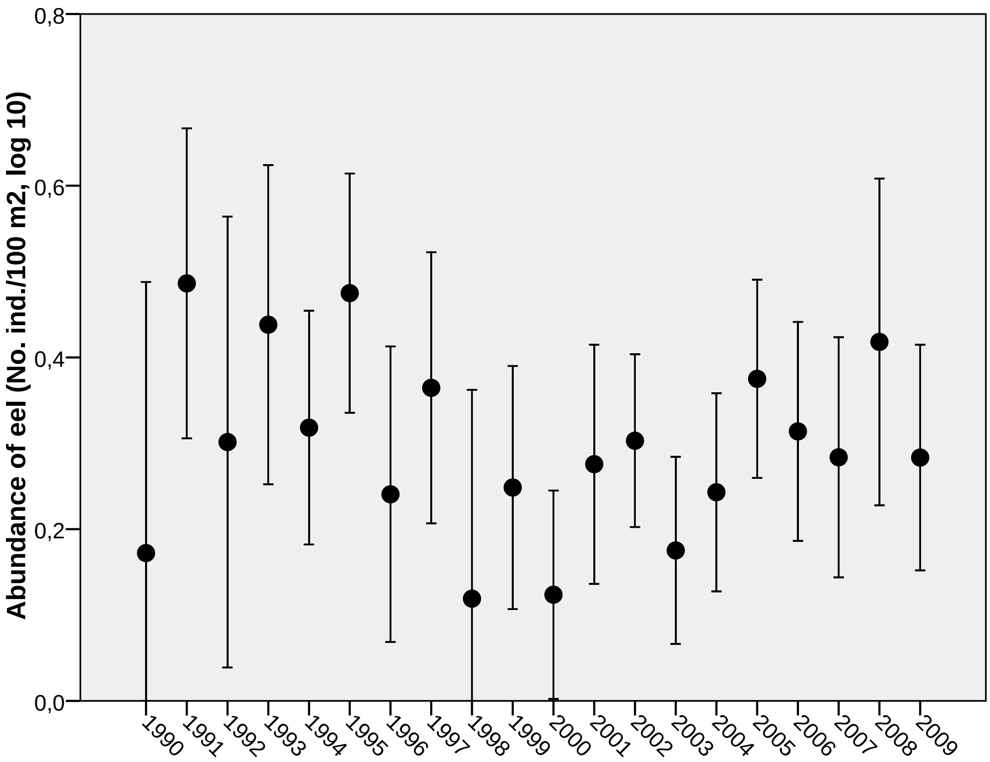

Figure SE.9.3. Abundance of eel (No. ind/100 m², log 10) along the East Coast. Stations that were fished in 1990–2009 in this figure are situated from 0 to 100 m asl in seven counties along the Baltic Sea Coast. Data from SERS (Swedish Electrofishing Register). ***The negative trend is not significant (Pearson correlation, n=20, r=-0,118, p=0,622).***

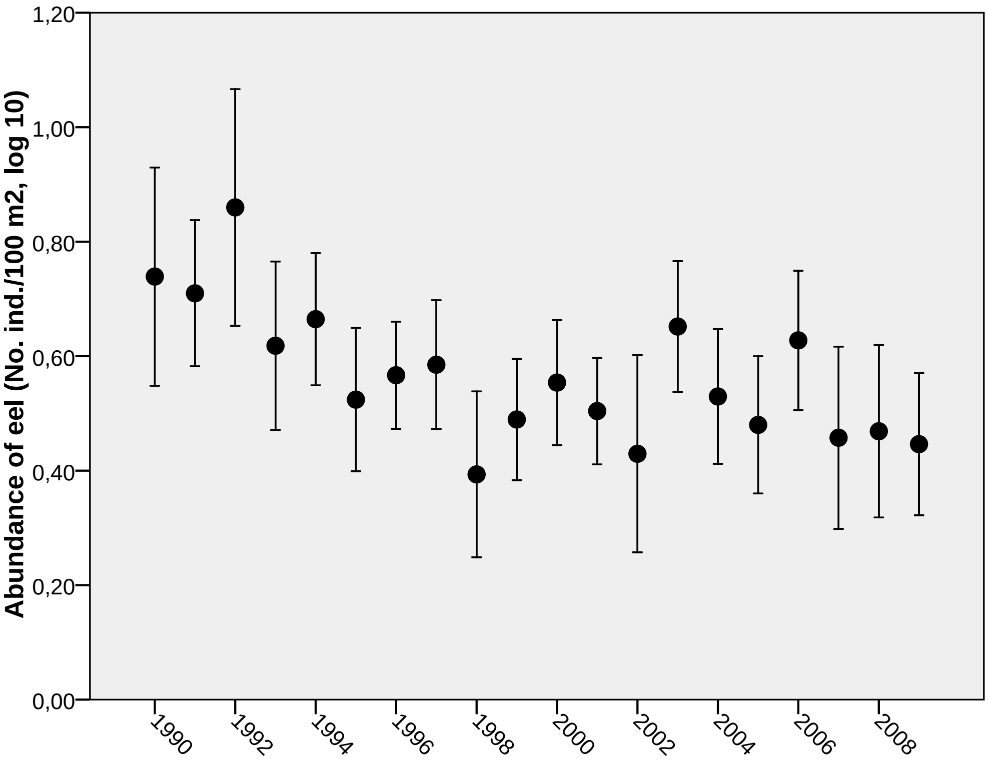

Figure SE.9.4. Abundance of eel (No. ind./100 m², log 10) along the West Coast (only the county of Halland). The stations that were fished in 1990–2009 are situated from 0 to 100 m asl. Data from SERS (Swedish Electrofishing Register). ***The negative trend is significant (Pearson correlation, n=20, r=-0,653, p=0,002).***

SE.9.2 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.9.5). 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. Sea water temperature at Vendelsö was positively correlated with cpue 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).

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 has now 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 the Swedish Board of Fisheries and other government agencies.

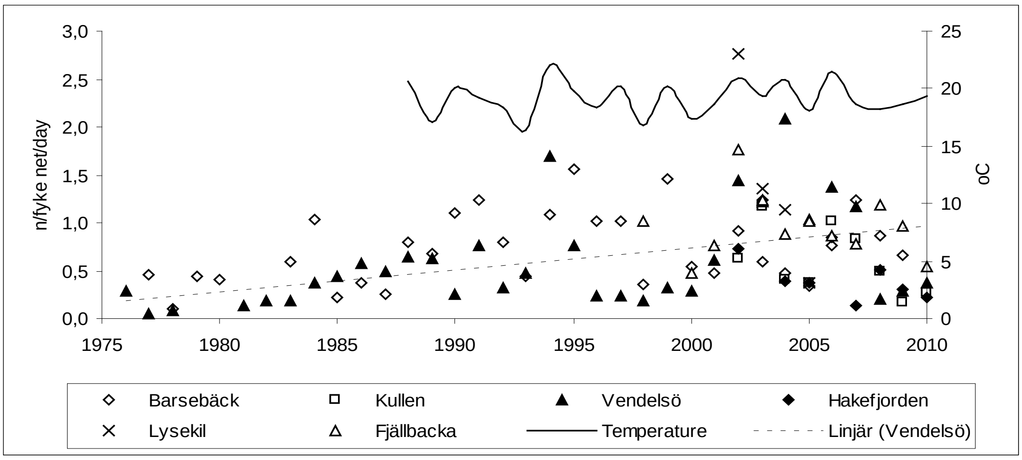

Figure SE.9.5. Time trend in the yellow eel catches in coastal fish monitoring with fykenets in August on the Swedish west coast. The trend is positive for Vendelsö in N Kattegat (linear regression, p<0,01). Annual mean water temperature at the fishing gears is presented for the Vendelsö area in central Kattegat.

As part of our national eel research programme some stocked eel populations are through many years continuously studied mainly by test-fishing or by the use of permanent outlet traps (cf. Westin 2003; Wickström *et al.*, 1996). In some cases the stocked eels are marked or tagged with SrCl2, 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 at that site in an experimental test fishing with fykenets (Figure SE.9.6).

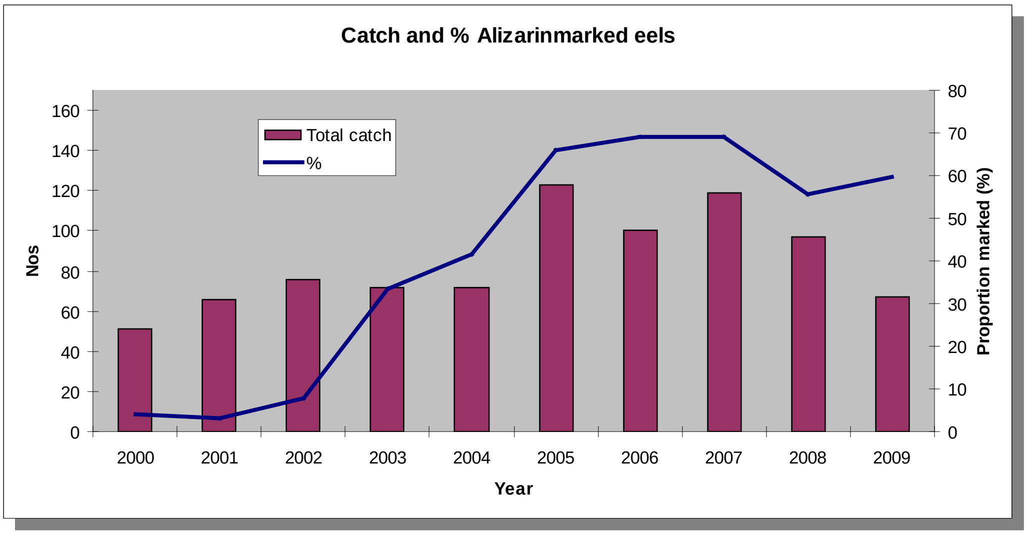

Figure SE.9.6. Proportions of stocked eels in Lake Mälaren.

SE.9.3 Silver eel

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 eels 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.

SE.10 Catch composition by age and length

SE.10.1 Freshwater fishery targeting mainly silver eel

In freshwater a DCF sampling programme was commenced in 2010. By sampling and monitoring the catch from six commercial eel fishers representing the main four eel producing lakes in Sweden we hope to be able to describe the fishery for silver eels in freshwater. No data are yet available. For 2011 an extensive measuring programme is planned aiming at analysing the representativeness in our sampling scheme.

SE.10.2 Marine fykenet fishery targeting yellow eel

The Swedish coastal fykenet fishery since 2009 is sampled for length distribution in unsorted catches (discard included) in ICES Subdivisions 20, 21, 23 and 27, according to the National Programme of the DCF. Length samples are collected on a monthly basis or at the peak of the fishing season. Before 2009 discarded fish was not supposed to be included in the samples from ICES Subdivisions 20, 21 and 23. Samples from 2002–2009 are presented in Table 10.1.1 in Appendix SE, including samples from ICES SD25 in 2002–2004. The eels were smallest in general in ICES SD20 and biggest in ICES SD27, other areas taking a position in between (Figure SE.10.1, Table SE.10.1.2 in Appendix SE).

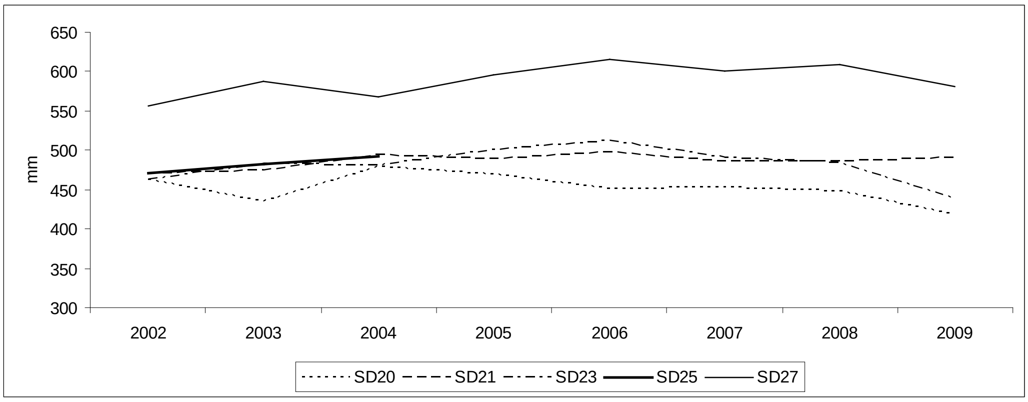

Figure SE.10.1. Mean length of yellow eel from commercial fykenet catches in samples collected in 2002–2009 in the Swedish coastal fishery. Samples from Subdivisions 25 and 27 are based on an unsorted mixture of landings and discard in all years. In 2009 all areas were sampled in this way.

Otoliths were collected in all five subdivisions in 2002–2004. From 2005 on no sampling was done in SD25, due to small landings of yellow eel in this area, but sampling continued in other areas. Age analysis was performed in all west coast areas (SD20, 21 and 23) in 2002–2005 and in 2009. For SD25 age was determined in 2003 and 2004 and for SD27 in 2004, 2005 and 2009. Annual average age in the samples varied between 6.5 years in SD23 in 2009 and 11.2 years in SD27 the same year (Figure SE.10.2). Annual age distribution is given by subdivision in Table SE.10.1.4 in Appendix SE.

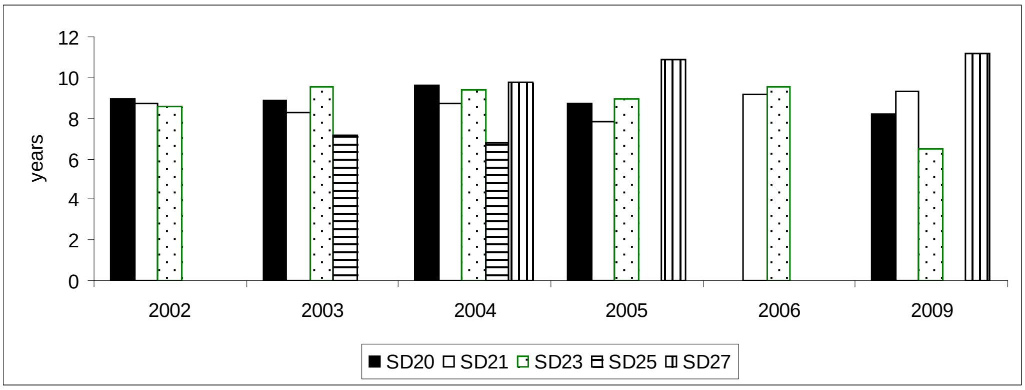

Figure SE.10.2. Annual average age of yellow eel from commercial fykenet catches in samples collected in 2002–2006 and 2009 in the Swedish coastal fishery.

SE.10.3 Marine poundnet fishery targeting silver eel

The Swedish coastal poundnet fishery for silver eel since 2009 is sampled for catch composition monthly during the peak of the fishing season. Sampling of length composition is done by field trips and samples for age composition is purchased aiming at a length–age key for each subdivision based on approximately 200 individuals. Sampling is done according to the National Programme for the DCF. In 2005–2008 random samples for length- and age distribution were purchased from the fishers and all analyses were done in the lab.

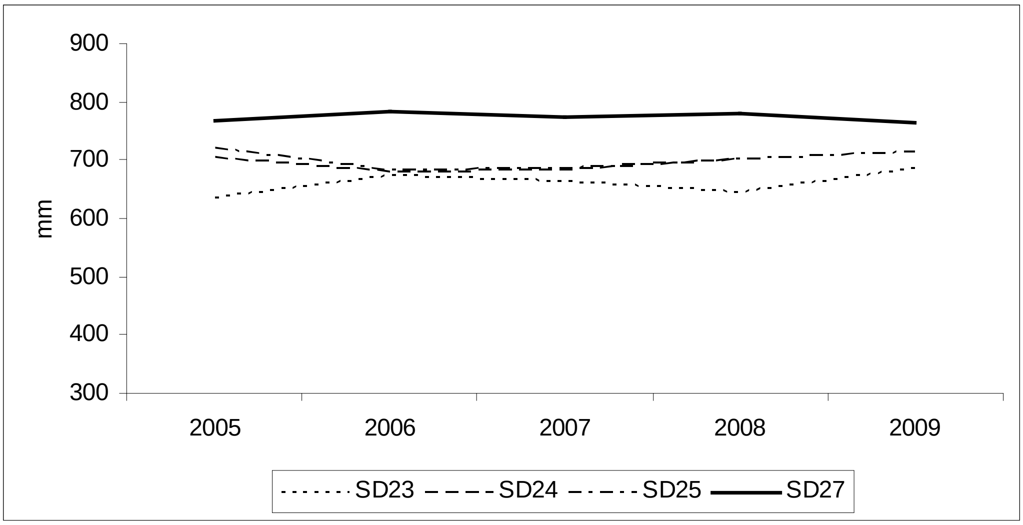

Figure SE.10.3. Mean length of silver eel from commercial poundnet catches in samples collected in 2005–2009 in the Swedish coastal fishery. Samples from all subdivisions are based on an unsorted mixture of landings and discard in all years.

Silver eel from the fishery in the central Baltic Proper (ICES SD27) were consistently bigger than in other areas, having a mean length of 76–78 cm in all years. Eels from the northern Öresund area (ICES SD23) tended to be shorter (63–69 cm) than eel from the south coast of Sweden (ICES SD24 and 25) (Figure SE.10.3). Length distributions from all years and subdivisions are given in Table SE.10.2.1 in Appendix SE. See also ICES 2009a.

Age was determined for 1768 silver eels in 2005, 2006 and 2009, using ground, etched and stained otoliths (Table SE.10.2.3 in Appendix SE). Silver eels tend to be oldest in ICES SD27 (average 14–15 years). In other areas ages averaged 10–13,5 years (Figure SE.10.4). Age distributions in all years and subdivisions are given in Table SE.10.2.5 in Appendix SE.

Figure SE.10.4. Mean age of silver eel from commercial poundnet catches in samples collected in 2005–2009 in the Swedish coastal fishery. Samples from all subdivisions are based on an unsorted mixture of landings and discard in all years.

As part of the EELIAD-project (www.eeliad.com) eels were analysed from a sample taken from the commercial fishery on both sides of Öresund. The main objective with these samples is for genetics including age.

In a sample from 2008 of 529 silver eels from Kullen at the outlet of the Baltic Sea into the Kattegat the mean length for the females was 678,2 mm ±90,8. The corresponding data for six males was 442,7 mm ±14,6. The geographical position is 56° 17′ N, 12° 27′ E.

A similar sample was taken in 2008 at Hjelm Bugt on the Danish side of Öresund, the strait between Sweden and Denmark. The mean length in the 288 females was 708,5 ± 100,1 and there were no males in this sample. The geographical position is 54° 56′ N, 12° 29′ E.

SE.11 Other biological sampling

Reported by sub-catchment, catchment or EMU.

SE.11.1 Length, weight and growth (DCF)

As stated above a sampling programme just started in freshwater, i.e. no data are yet available.

Annual length, total weight and somatic condition factor at age in eels from the marine fisheries are given in Table 11.1.1–11.3 in Appendix SE. Data from the DCF sampling of the coastal fykenet fishery in 2009 indicate a similar situation as in the samples from 2002–2006 (see Country Report SE2009), with the highest length and weight-at-age in ICES SD27 in the central Baltic Proper. Length and weight-at-age tended to be lower on the Skagerrak coast (ICES SD20) (Figure SE.11.1), compared with other areas. This was not the case in 2002–2006. Length increments tend to be linear in all areas.

The somatic condition factor too tended to be highest in ICES SD27 (Figure SE.11.1), increasing with age in a similar way as in the material from 2003 and 2004. As in the previous period, somatic condition tended to be lower in Kattegat and Skagerrak, compared with the central Baltic and Öresund areas. The somatic condition factor is determined as W_s*1000/$L_t{}^3$ (W_s = somatic weight in g; L_t = total length in mm).

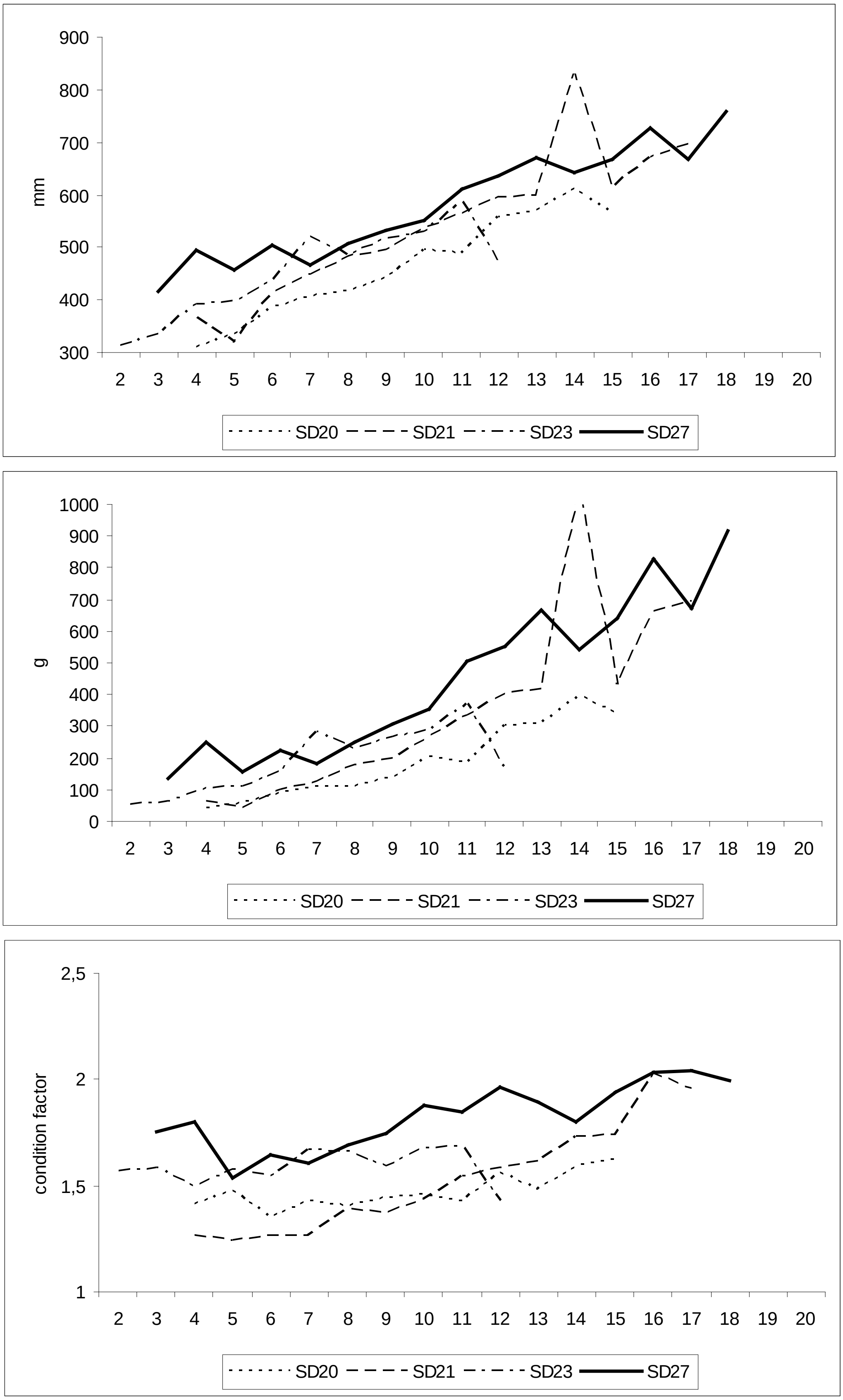

Figure SE.11.1. Length, weight and condition factor at age of yellow eel from commercial fykenet catches in samples collected in 2009 in the Swedish coastal fishery.

Annual length, total weight and condition factor at age of silver eel in the coastal poundnet fishery are given in Table 11.1.4–11.6 in Appendix SE. Length and weight tend to increase with age in silver eel in 2009, but only in ICES Subdivisions 23 and 27 (Figure SE.11.2). No relationship between length or weight and age is seen in SD25 on the SE coast of Sweden.

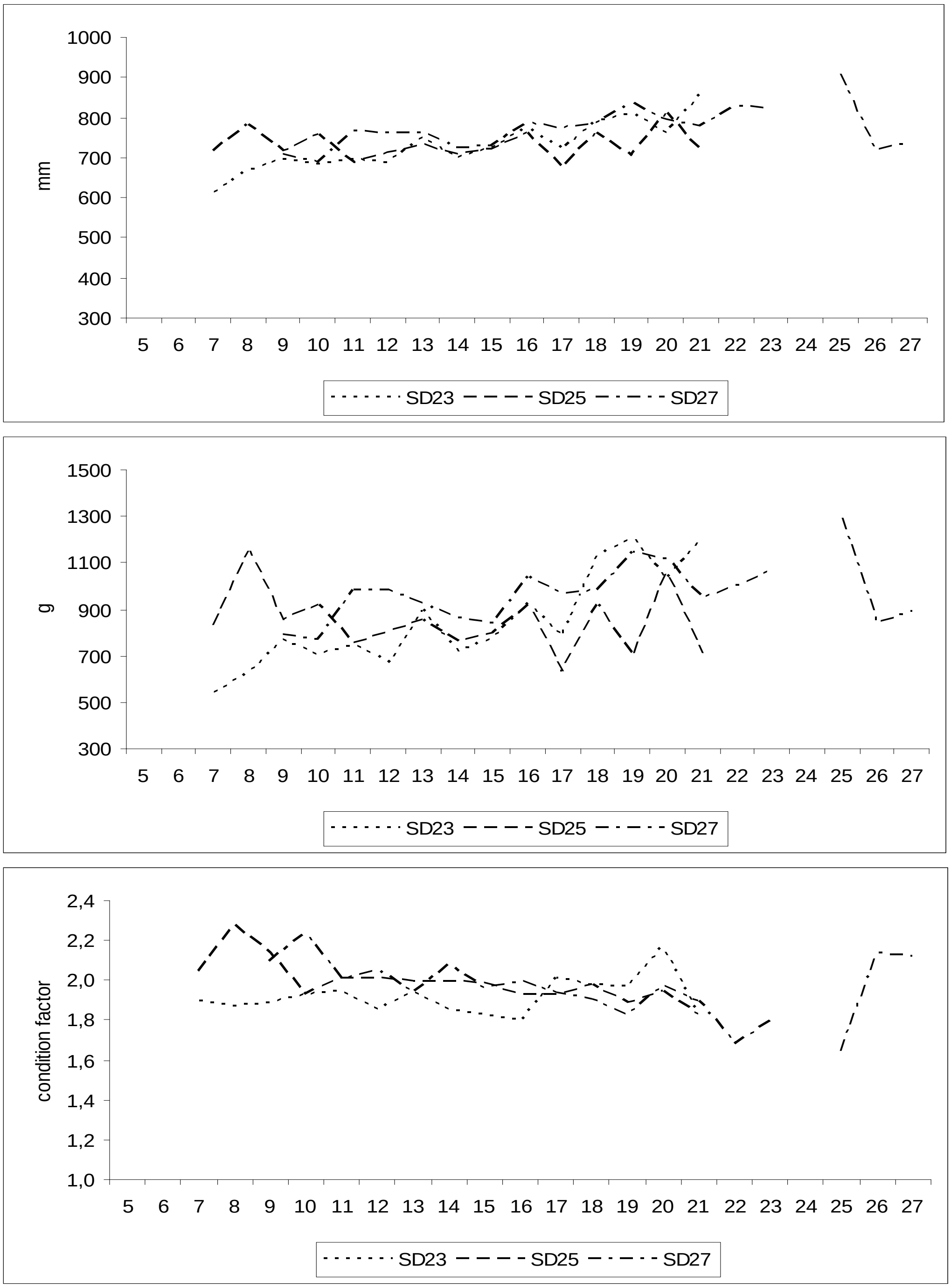

Figure SE.11.2. Length, weight and condition factor at age of silver eel from commercial poundnet catches in samples collected in 2009 in the Swedish coastal fishery.

Time-series of mean weight of silver eel in poundnet catches in the Baltic silver eel fishery exist for a long period of time, starting in the Hanöbukten area in ICES SD25 in 1959. There is a strong increase over time in all areas and a consistent difference between Hanöbukten and the more northern areas Kvädöfjärden, Dragskär and Marsö, all situated in ICES SD27. In the Hanöbukten area the mean weight in the 1950s and 1960s was below 500 g, increasing to close to 800 g in the end of the time-series. In the other areas, the time-series started at 600–700 g, reaching 900–1000 g in the 1990s and staying on that level towards the end of the period (Figure SE.11.3).

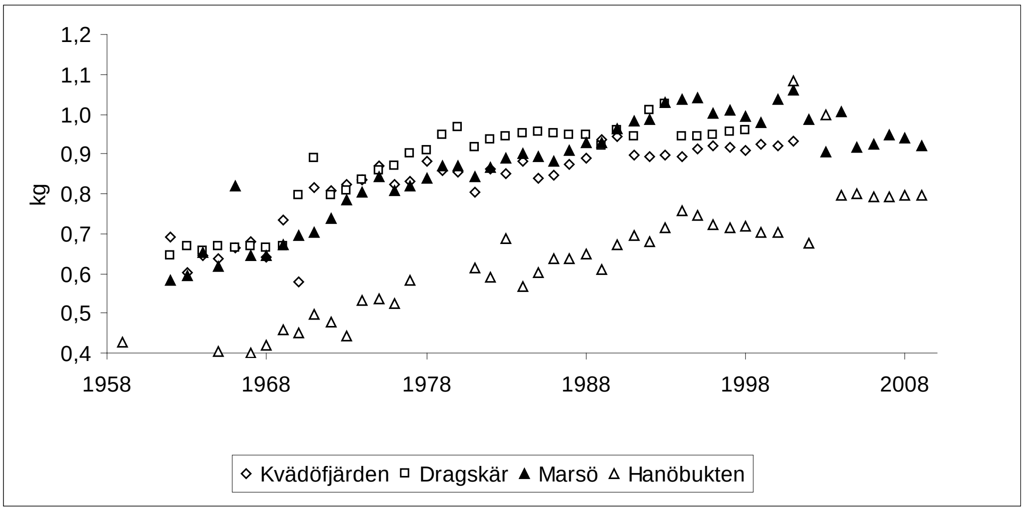

Figure SE.11.3. Mean weight of silver eel in poundnet catches in the Baltic eel fishery in Sweden 1959–2009.

SE.11.2 Parasites and pathogens

Prevalence of the swimbladder parasite *Anguillicoloides crassus* is consistently recorded in all DCF and related sampling in Swedish coastal waters. The observed prevalence is presented by year, life stage and ICES subdivision in Tables 11.2.1–11.2 in Appendix SE. As an average over years with sampling (2002–2009) there is a clear gradient from marine to brackish habitats in yellow eel, with a low prevalence (7%) in the most marine area on the Skagerrak coast to a much higher prevalence (60%) inside the Baltic Sea (Figure SE.11.4). The prevalence in silver eel is generally lower in all areas (30–40%), with no clear gradient from west to east (Figure SE.11.2.1).

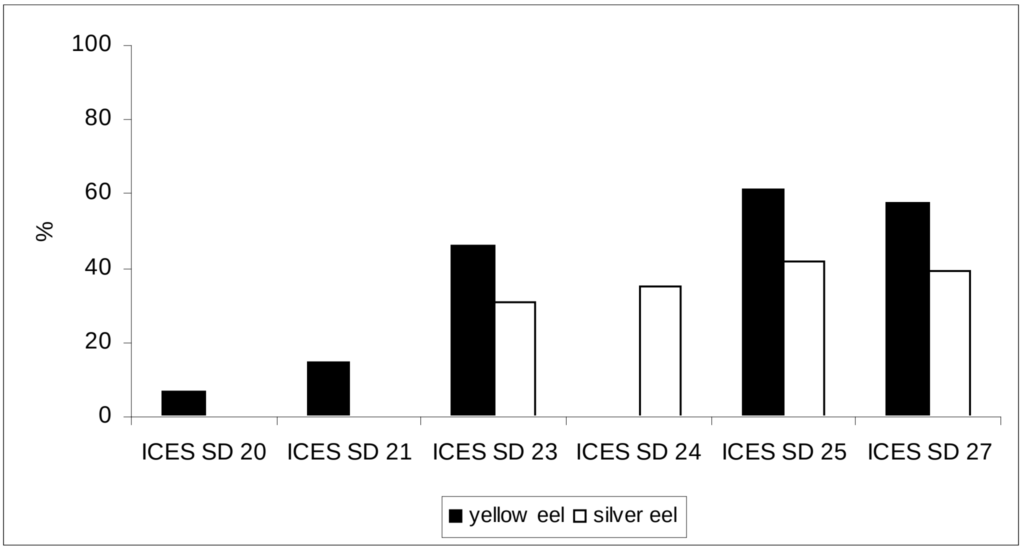

Figure SE.11.4. Prevalence of *Anguillicoloides crassus* in yellow eel and silver eel as an average of all samples collected from the Swedish coastal fishery in 2002–2009.

All sampled eels handled at the Institute of Freshwater Research are analysed with respect to prevalence and intensity of the infestation of *Anguillicoloides crassus*. From 2009 and 2010 118 eels, mainly yellow eels from Lake Mälaren were analysed. The prevalence was 46% and the corresponding intensity 4,2 ± 4,7 (SD).

In conjunction with the EELIAD-project the following eels was sampled and analysed for *Anguillicoloides crassus:*

> From 2009 eleven large silver eels from River Enningdalsälven close to Norway, i.e. in the SW part of Sweden were analysed. 30% were infested with *Anguillicoloides crassus* and the intensity was 2,3 ± 1,5. Also a number of eels grown for several years in aquaculture were analysed. In 24 eels none were infested.
>
> From Hjelm Bugt in Denmark a sample of 288 silver eels were collected in 2008 and analysed in 2010. The prevalence was 44,4 % and the infestation rate was 2,2 ± 4,8.
>
> The same year, i.e. 2008, a sample of silver eels was taken from Kullen in Sweden. Of those eels 40,9% were infested and the intensity was 5,0 ± 6,3.

SE.11.3 Contaminants

The National Food Administration (SLV) has in 2009 analysed two pooled samples of yellow eels from an industrial harbour in Helsingborg (SSW Sweden). Due to high levels of dioxins and PCB's fishing for sale was banned in this area in 2007. Based on new analyses in 2008 and 2009 this ban was lifted in July 2010 (G. Eskhult, SLV pers. comm.).

SE.11.4 Predators

There are more than 40 000 breeding pairs of cormorants (*Phalacrocorax carbo sinensis*) in Sweden. Their predation on eel is studied using stomach analyses. This work is in progress but if the results so far are valid, some 400 tons of eel might be consumed every year, i.e. a most substantial cause of mortality (Sven-Gunnar Lunneryd, Swedish Board of Fisheries, pers. comm.).

Also seals consume eels and some individuals seem to specialise on eels in fykenets (Lunneryd, 2001).

SE.12 Other sampling

A number of eel passes have recently been investigated to learn more about their history, condition, etc. and if the dataseries derived from them seem to represent the recruitment of young eels in different parts of Sweden. This work is still in progress.

Mortality in migrating silver eels passing hydropower installations (turbine and screens) is generally high and few large silver eels will reach the sea if there is a series of turbines to pass. These problems are studied within the Swedish Board of Fisheries as well as at the University of Karlstad. The latter works mainly with modified and inclined trash-racks, while the former searches for simple, passive methods to deflect silver eels from approaching and entering the intake area.

Tracking studies using either ultrasonic or radio-tags are also performed in conjunction with hydropower related projects, including electric cables and Trap and Transport activities (cf. Westerberg and Lagenfelt, 2007 at https://www.fiskeriverket.se/download/18.323810fc116f29ea95a8000355/%C3%85ltelemetri)

SE.13 Stock assessment

SE.13.1 Local stock assessment

During the compilation of the EMP, *ad hoc* assessments of the stock have been made, treating different impacts separately. This comprised: an assessment of the impact of yellow eel fishing using catch-curve analyses; an assessment of the impact of silver eel fishing based on historical tag-return rates; an assessment of the impact of hydropower stations, using local impact estimates and a GIS model of the rivers and hydropower stations across the country.

On the basis of these ad hoc assessments, management targets have been formulated: a reduction of the catches by 20% in 2009, gradually increasing to a reduction by 50% in total at the end of 2012; for the impact of hydropower generation, a Memorandum of Understanding has been signed between the government and the industry, aiming at a reduction of the current mortality (90% on average) to 60% by 2014 (with post-evaluations in 2012 and 2014).

The management targets for the coming years being set, and the data collection now being implemented, no intermediate assessments have been made. That is: the implementation of the management target has been evaluated, but the targets themselves have not been re-evaluated.

In preparation of the post-evaluation in 2012, data collection has been implemented or extended and post-evaluation techniques are being developed.

Major anthropogenic impacts are found in

a) the yellow eel fishery on the West Coast;

b) the hydropower generation;

c) the silver eel fishery on the East Coast.

Because assessment methods for silver eel fisheries seem almost absent while for the others methodology appears to be available, priority in 2010 is being given to the assessment of the impact of silver eel fishing.

SE.13.2 International stock assessment

SE.13.2.1 Habitat

Wetted area: lacustrine: 32 763 km² (less than 20 m deep)

riverine: na (yet, a very rough estimate not used was 1982 km²

transitional and lagoon: na (included in coastal area below)

coastal: 17 843 km²

SE.13.2.2 Silver eel production

Estimates for silver eel production have been derived during the compilation of the EMP, referring to the years 2006–2008. Additionally, the EMP has set an interim target for 2012, which will be detailed here too. Although data collection is being continued/extended, no new assessment of the state of the stock has been compiled, and thus, no updated assessment results will be demonstrated here.

Following the recommendations of SGIPEE 2010, estimates have been derived for the current escapement, the best-achievable escapement from the current stock under no anthropogenic impact, and for the pristine escapement. For the interim targets set in the EMP, it has been assumed that the only change in stock status is caused by the reduction in anthropogenic impacts; that is: neither the trend in recruitment nor a change in restocking has been taken into account. For all anthropogenic impacts, the EMP provides estimates of the total catch in numbers or biomass; these have been converted, using the listed average individual weight. Mortality rates have been taken from the EMP (Appendices), or calculated from the data on catch resp. escapement given in the EMP.

Stock indicators for the years 2006–2008 are summarized in Figure SE.13.1, while stock indicators for the interim targets (2012) are summarized in Figure SE.13.2.

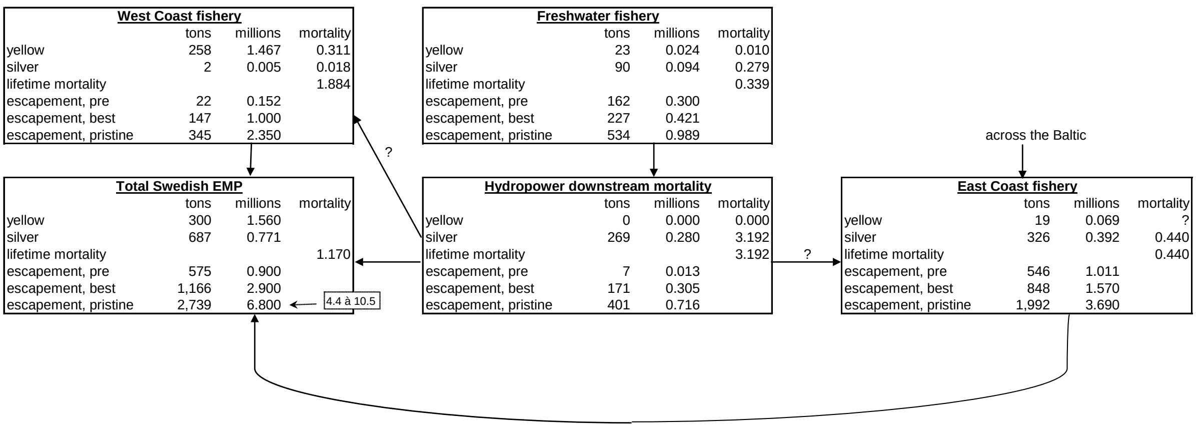

Figure SE.13.1. Schematic overview of the <u>stock status in 2006–2008</u>, the estimates of the pristine stock and the stock indicators. Data from the Swedish Eel Management Plan. The arrows indicate the flow of eels through the system; in the EMP, the potential interactions between the compartments are noted, but left unquantified.

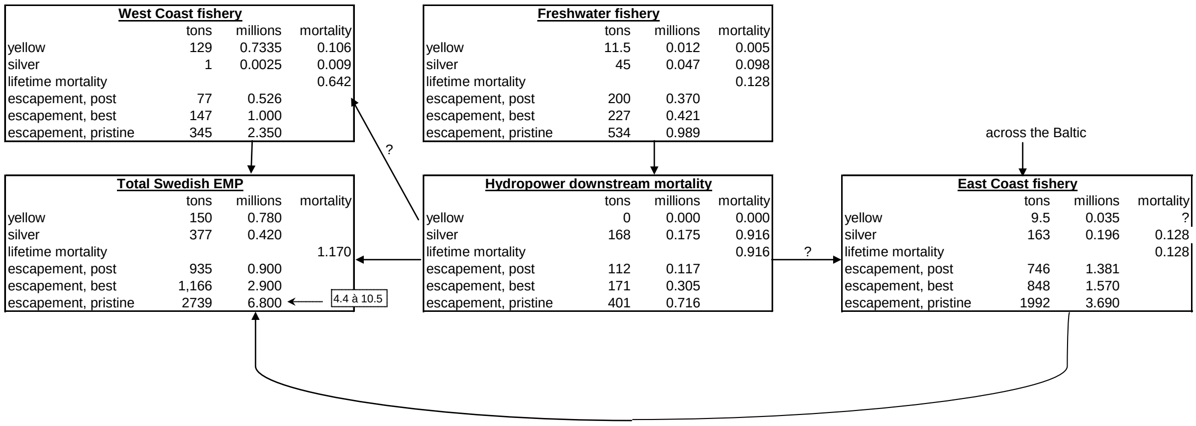

Figure SE.13.2. Schematic overview of the <u>interim targets</u> set in the EMP for 2012, and the expected stock status and indicators. Data from the Swedish Eel Management Plan.

Dekker (2010) suggested to plot stock status indicators in a Modified Precautionary Diagram, and presented two options. In the first option, the vertical axis represents %SPR, the percentage spawner potential, that is the percentage the actual spawner escapement constitutes of the best possible (no anthropogenic impacts) spawner escapement. This is shown in Figure SE.13.3 below, in which estimates for the four compartments are indicated separately from the estimates for the whole of Sweden. The indicator for the whole of Sweden in this graph is the weighted midpoint of the indicators for the compartments, weighted by the best-achievable biomass (current stock, no anthropogenic impacts). This is the option presented in the SGIPEE report.

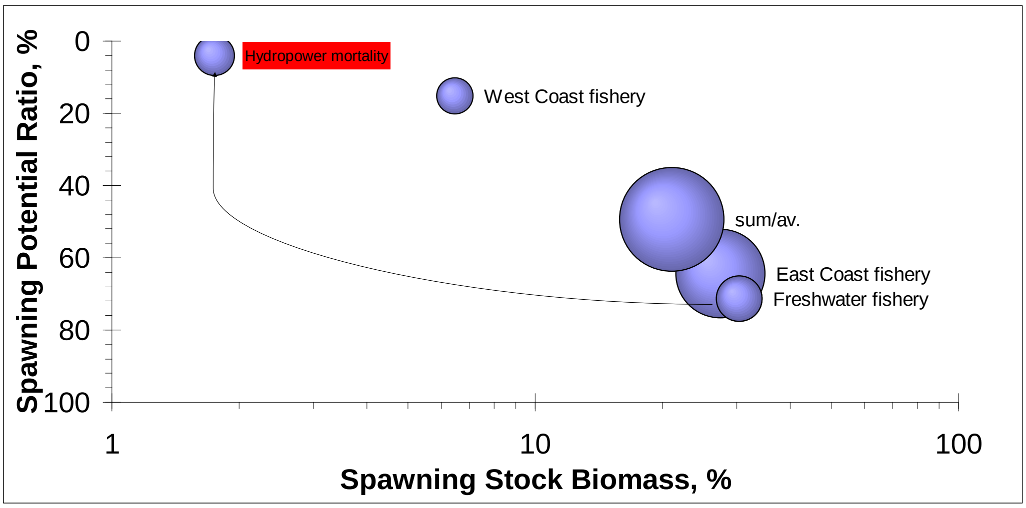

Figure SE.13.3. Modified precautionary diagram for <u>the current eel stock</u> described in the Swedish Eel Management Plan 2009. Separate estimates are given for 4 compartments separately, and for the average resp. sum of the four compartments. In this diagram, the vertical axis shows %SPR; the symbol for the average <u>is</u> in the true geometrical midpoint of the compartments, but the reductions in impacts required do <u>not</u> scale to the vertical axis. The size of the plotted symbols is proportional to the best-achievable biomass (current stock, no anthropogenic impacts).

The second option given by Dekker (2010) plots the cumulative lifetime anthropogenic mortality on the vertical axis. This is shown in Figure SE.13.4 below. In this second plot, the indicator for the whole of Sweden does not appear to represent the actual midpoint (though the calculation is correct). However, this vertical axis presents a better reflection of the anthropogenic impacts. That is: the vertical axis does not scale proportional to the catch taken, but to the corresponding anthropogenic impact (lifetime mortality rate). As such, this second plot gives a better indication of the reductions required to reach a sustainable management.

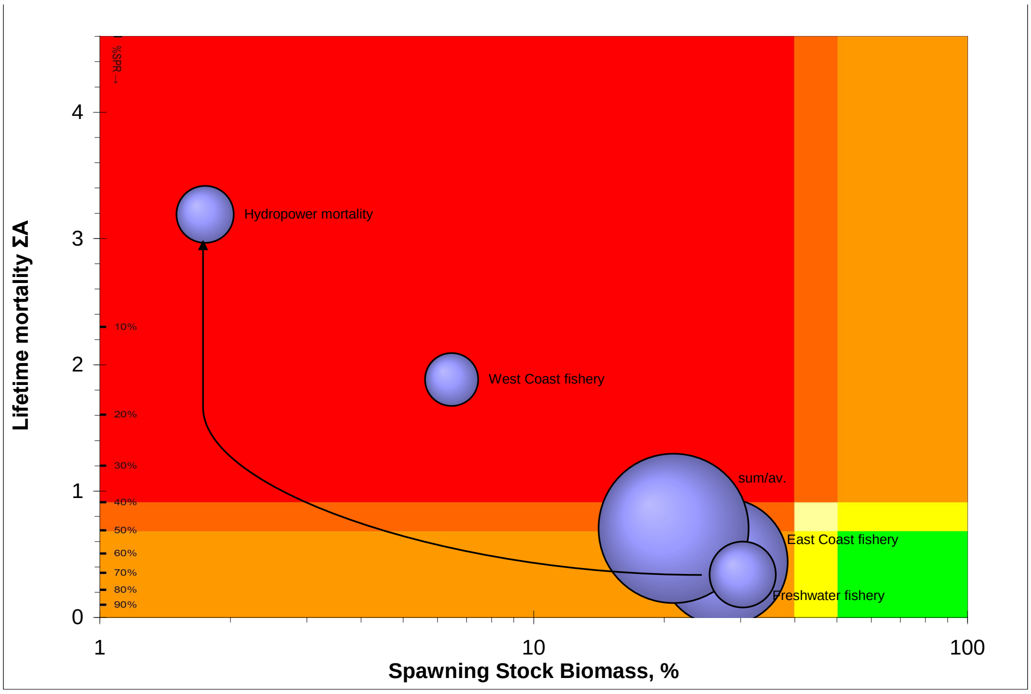

Figure SE.13.4. Modified precautionary diagram for <u>the current eel stock</u> described in the Swedish Eel Management Plan 2009. Separate estimates current are given for 4 compartments separately, and for the average resp. sum of the four compartments. In this diagram, the vertical axis shows the lifetime anthropogenic impact; the symbol for the average is <u>not</u> in the true geometrical midpoint of the compartments, but the reductions in impacts required <u>do</u> scale to the vertical axis. The size of the plotted symbols is proportional to the best-achievable biomass (current stock, no anthropogenic impacts).

The Swedish EMP sets a target deviating from the international target. The analysis by Åström and Dekker (2007) indicates that a recovery of the stock is only expected if anthropogenic mortality is below 0.08 per annum (0.48 per lifetime), and consequently, the Swedish EMP set the target slightly below that level. That conforms to an %SPR of exp(-0.48) = 62%. For comparability, the limits/targets demonstrated here, however, conform to the international target of 40%, including the limit mortality rate of 0.92, i.e. a %SPR of 40%.

Following the implementation of the EMP, anthropogenic impacts will have been reduced, and stock status will have improved. Assuming no further changes in the stock will occur, the diagrams of Figures SE.13.5 and SE.13.6 are expected to apply.

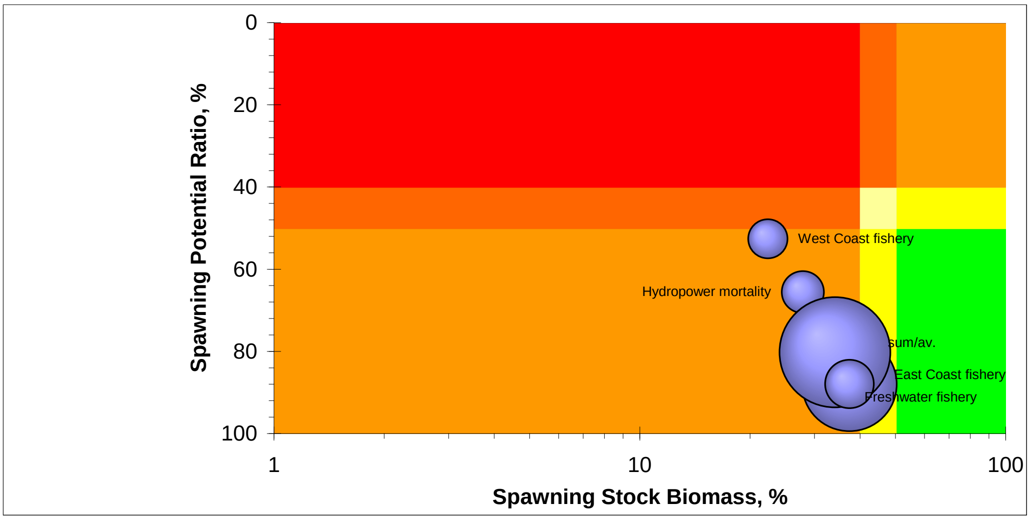

Figure SE.13.5. Modified precautionary diagram for the interim target in 2012 described in the Swedish Eel Management Plan 2009. Separate estimates are given for 4 compartments separately, and for the average resp. sum of the four compartments. In this diagram, the vertical axis shows %SPR; the symbol for the average is in the true geometrical midpoint of the compartments, but the reductions in impacts required do not scale to the vertical axis. The size of the plotted symbols is proportional to the best-achievable biomass (current stock, no anthropogenic impacts).

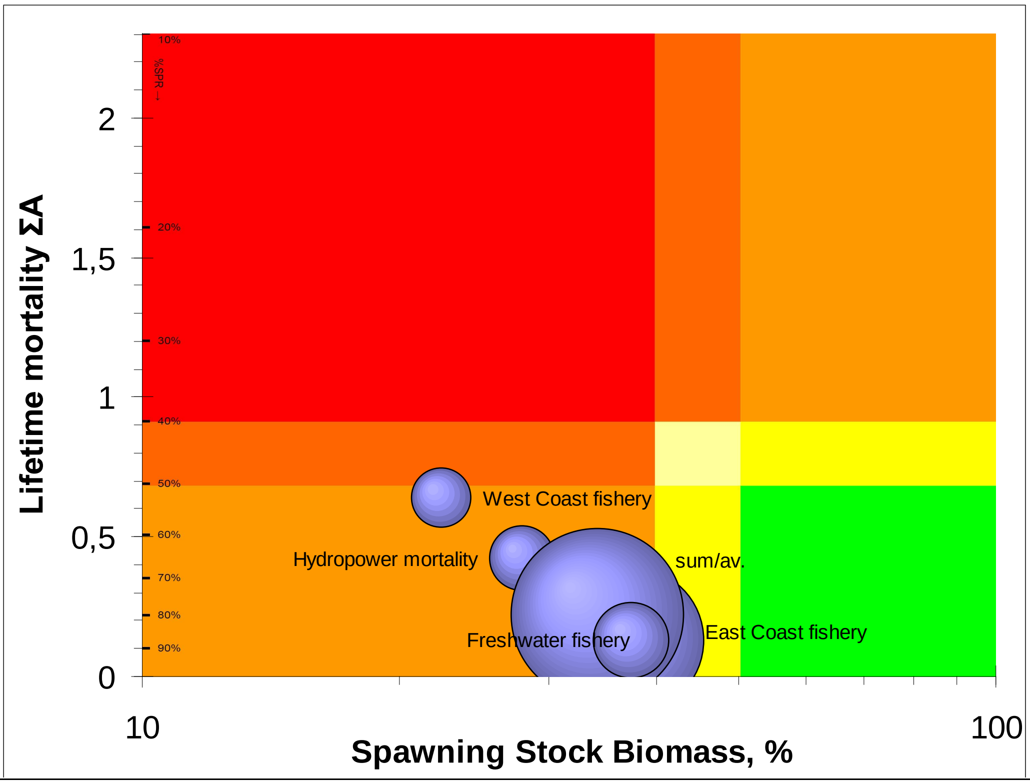

Figure SE.13.6. Modified precautionary diagram for <u>the interim target in 2012</u> described in the Swedish Eel Management Plan 2009. Separate estimates are given for 4 compartments separately, and for the average resp. sum of the four compartments. In this diagram, the vertical axis shows the lifetime anthropogenic impact; the symbol for the average is <u>not</u> in the true geometrical mid-point of the compartments, but the reductions in impacts required <u>do</u> scale to the vertical axis. The size of the plotted symbols is proportional to the best-achievable biomass (current stock, no anthropogenic impacts). In the lower panel, axes have been re-scaled to show more detail.

SE.13.2.2.1 *Historical production*

EMP is formulated in number of eels not biomass. Approximate mean weight 1.1 kg/silver eel. All data from the EMP.

B_0, the biomass of the escapement in the pristine state. (SGIPEE)

x EMU 400 000–10 500 000 silver eels, corresponding to 4000–9500 tonne.

SE.13.2.2.2 *Current production*

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)

x EMU 870 000 silver eels or 2600 tonne.

SE.13.2.2.3 *Current Escapement*

B_{post}, the biomass of the escapement in the assessment year (SGIPEE)

x EMU 2 000 000 eels or 1800 tonnes

SE.13.2.2.4 *Production values e.g. kg/ha*

x EMU 0,067 kg/ha (an average for all areas)

SE.13.2.2.5 *Impacts*

Fisheries, hydropower, etc.

Quantify x EMU

Fisheries: 1 080 000 silver eel equivalents or 980 tonne potential silver eels. Actual catch 680 t, where 240 t is yellow eel with a mean weight of 0.15 kg.

Hydropower: 280 000 eels or 250 t

SE.13.2.2.6 *Stocking requirement eels <20 cm*

x EMU >2 500 000

SE.13.2.2.7 *Data quality issues*

SE.14 Sampling intensity and precision

Including data quality issues.

SE.15 Standardisation and harmonization of methodology

SE.15.1 Survey techniques

There are several techniques applied when studying eels in Sweden. Glass eels are mainly studied and sampled using trawls, drop traps and eel passes (with collecting box). Yellow eels on the other hand, including small migrating age classes, are caught by drop traps, in eel passes, by electro-fishing (in streams) and in fykenets of various kinds and sizes. Finally, silver eels are caught by various fykenets (mainly large poundnets) or in fixed traps in running water.

Coastal surveys with fykenets follow protocols described in Thoresson, 1996 and in Anon, 2010a. Local modifications may occur. The surveys are performed annually and are stratified in season and space and are normally targeting shallow coastal fish communities.

To collect high quality information on cpue in commercial fishery a system for detailed journals and logbooks has been applied for a long time in Sweden. This system has been linked to monitoring of effects of industries or other construction activities in most cases, but a similar system is proposed in the National Programme for the DCF 2011–2013 for the coastal poundnet fishery. Shortly this data collection provides daily information on catch in numbers and weight and effort from selected poundnets during the entire fishing season. The fishers provide the information according to annual contracts and are paid in relation to the amount of information given.

SE.15.2 Sampling commercial catches

From freshwater, samples of the landed commercial catch are bought directly from six selected eel fishers representing the four most important eel fisheries in freshwater. Due to practical reasons eels are often frozen already at the fishers' place or kept on ice before being picked up.

Coastal sampling is directed to the two dominating eel fisheries (métiers), fykenets targeting yellow eel and poundnets targeting silver eel. Unsorted samples of yellow eel (landings and discard) from the fykenet fishery are purchased directly from selected fishers on a monthly basis during the peak of the fishing season. From these samples approximately five individuals per cm-group are selected for age analysis, targeting a length–age key of approximately 200 individuals in each of four ICES Subdivisions (SD20, 21, 23 and 27). ICES Subdivision 20, the Skagerrak coast, submits a dominating part of the Swedish yellow eel landings. In this area age sampling is doubled, with separate age samples from quarters 2 and 3.

The poundnet fishery is sampled separated on ICES Subdivisions 23, 24, 25 and 27. Selected fishers are visited on two or three occasions during the fishing season. The catch is then sampled for length and weight of all fish species, separated on landed and discarded portions. 200 silver eels are purchased at each occasion and brought to the laboratory for length and age sampling on normally frozen fish. A length stratified age sample of approximately 200 individuals is extracted annually from the length samples in each subdivision.

Sampling of both life stages is described in detail in the Swedish National Programme for Collection of fisheries data 2009 and 2010 (Anon, 2010b).

SE.15.3 Sampling

Depending on the purpose of sampling, eel are normally measured in frozen, slightly thawed individuals and data achieved are then corrected for shrinkage (Wickström, 1986 In e.g. tagging experiments, eels are handled after anaesthetization (with bensocaine) or even as live individuals (when less influence and stress is required).

The treatment of the fish before analysis, fresh or frozen, is recorded in coastal sampling. So far no correction for shrinkage was done in the following data analysis.

SE.15.4 Age analysis

Age is normally read from ground and polished sagittal otoliths in the sagittal plane. When appropriate the polished surface is etched and/or dyed with Neutral Red before being read in transmitted light in a compound microscope. When experiencing difficulties in the interpretation of incremental zones also reflected light may be used. Consult e.g. Völlestad *et al*. (1988) and ICES, 2009b for further information on ageing in eels.

SE.15.5 Life stages

The term glass eel is often used in a careless way, for young of the year (YOY) recruiting young eels, even when pigmented. In Sweden migratory young eels between pigmented YOY's up to about 30 cm yellow eels are often cold "ålyngel" ("eel fry"), while being stationary in lakes or along the coast they are called yellow eels ("gulål"). Silver eels ("blankål") are silvery eels caught on their spawning migration, although they may be at an early phase of maturation. When appropriate, external criteria as eye size, length of the pectoral fins and the presence of well developed neuromasts along the lateral line are measured or observed (e.g. Durif *et al*., 2009).

SE.15.6 Sex determinations

Sex is normally determined from macroscopic examination of the gonads. In most populations there is hardly any overlap in size between male and female silver eels, and depending on the purpose of a study sex may in some cases be taken from size only.

SE.16 Overview, conclusions and recommendations

In this section, the above information will be summarized, and will be contrasted to on the one side the obligations of the Data Collection Framework, on the other side the requirements for a proper post-evaluation of the Eel Regulation.

The Data Collection Framework obliges Member States to collect data on fish and fishing.

In the table below, the headlines of the DCF obligations are listed in the vertical (which mostly agree with the headings in this Country Report); the way these data are used is listed in the horizontal; and each cell indicates whether the data are available, currently or in the coming years.

Table SE.16.1.

	Yellow eel fishing			Silver eel fishing			Hydropower
	West coast	**East coast**	**Inland water**	**West coast**	**East coast**	**Inland water**	**Inland water, silver eel**
Capacity & Effort	Part: maximum number of gears and of fishing days is known, but actual usage is generally unknown.						Estimate of #stations in 2009, updates are planned.
Landing 2009 estimate for 2006-2008, EMP	CTD ≈ 250 t	CTD ≈ 20 t	CTD ≈ 20 t	CTD ≈ 2 t	CTD ≈ 320 t	CTD ≈ 90 t	Total impact estimate in 2009 ≈ 270 t, updates are planned.
CPUE	*Part.*	*Part*, n/a	*Part*, n/a	n/a	*Part*	*Part*	*plan*
Independent surveys: Recruits **"Adults"**	*init* *miss*	miss *miss*	See hydro-power. *See hydro-power.*	n/a n/a	n/a miss	n/a miss	Traps at hydropower stations (for Trap & Transport) Electro-fishing CTD, no analysis yet.
Length- and age-composition	CTD	Ctd	Part, a few	n/a	Ctd	*Init*	Part, a few
Biological sampling	*ctd*	Ctd	Part, a few	n/a	*Ctd*	*Init*	Part, a few
Other sampling					MARK-RECAP.	MARK-RECAP.	
Assessment of stock status & target compliance	Estimated in 2009, no recent update, planning for 2012.			n/a	Estimated in 2009, no recent update, planning for 2012.		Memorandum of Understanding Government-industry. Planning of evaluation.
Methodology	Standard methodology (catch curve, maybe VPA), new developments not prioritised.			Method development: Survival Analysis + VPA-type, in prep.			Following MoU, planning for post-evaluation in progress.
Intensity & precision						Pilot study planned.	
Standardisation					Standardisation and integration across the Baltic required!		
Comment					Tagging data not routinely covered by DCF!		Early planning of a substantial assessment effort.

Table (SE. 16.1) legend: PRIMARY INFORMATION (mandatory data for making an assessment) has been given in ALL-CAPS, *secondary information in italics* (independent data verifying the assessment results).

- Part partial, incomplete, local, etc;
- Ctd continued, existing data collection time-series being continued;
- Init initiated, new data collection series, being initiated in relation to the EMP/DCF;
- n/a not applicable (that is different from: not-available, which is coded as miss);

- miss missing, not available;
- plan planning, data collection not initiated yet, but planned or likely to be planned soon.

The Eel Regulation obliges Member States to report on their stock status and the achievements of their Eel Management Plan by 2012, reporting:

- Art 9.a. The proportion of the silver eel biomass that escapes to the sea to spawn (…);
- Art 9.b. The level of fishing effort that catches eel each year, and the reduction effected;
- Art 9.c. Mortality factors outside the fishery, and the reduction effected;
- Art 9.d. The amount of eel less than 12 cm in length (…);
- Art 11.2. On recreational fisheries (…).

To estimate the <u>fishing impact exerted on the yellow eel stocks</u>, a standard approach based on catch-curve analysis and/or VPA-type is foreseen. This approach will probably be followed in several countries. Rather than developing a research-line specific for Sweden, this development has not been prioritized, and international standards will be followed. This will primarily use the data on landings, the length- and age-composition data; secondarily, recruitment trends and cpue-data can be used to verify the results, while (missing) effort series will be required to monitor the direct effect of management measures (compliance).

To estimate the <u>fishing impact exerted on the silver eel</u> migrating towards and along the coast, the total quantity of silver eels being caught is known from the landings statistics, but the mortality (relative impact) will be estimated from ongoing mark-recovery programmes in combination with landings statistics. It is noted that mark-recovery data are not routinely included in the DCF! Methodology to derive estimates of fishing mortality using mark-recovery data is now being developed; this methodology will probably be applicable in other countries too.

To estimate the <u>impact of hydropower-related mortality</u>, a Memorandum of Understanding between the industry and the government has been signed; implementation, prioritization and post-evaluation are now in an early planning phase. An approach based on locally improved passage, a GIS-database of stations (improved and unaltered), and a survey-based estimate of local yellow eel abundance (electro-fishing) is foreseen (cf. EDA, the French model that does so).

Dataseries on fishing capacity and effort (and in parallel: data on the number and type of hydropower stations) are incompletely monitored. The compliance to restrictions in fishing effort (in number or season) cannot be verified, and potential trends in estimated fishing mortality will be hard to interpret.

Landings data are fully registered; all assessment methods make use of these data.

Cpue data are not mandatory for any of the assessments, but can easily serve for verification purposes. Noting that cpue data are relatively easy to collect (landings data are mandatory, trustworthy fishers can monitor their effort), these data constitute the verification data of choice.

Recruit surveys are the prime source of information on the status of the oceanic reproduction. Even though they play a minor role in the national assessments, these are essential to the overall evaluation of the Eel Regulation.

Electro-surveys in inland waters are executed within other research programmes, but these might be used for yellow eel stock assessment too. In coastal waters, no independent survey for yellow eel exists, and noting the extremely low abundance of yellow eel (in extremely wide areas), and the unresolved area of origin of silver eel passing by, will be hard to envisage.

Length and age composition data (and other biological sampling) play a key role in the assessment of yellow eel fishing. For the other impacts (silver eel fishing, hydropower mortality), length and age probably are of secondary importance.

Mark-recapture data for silver eel are the only known source of information for estimation of the impact of silver eel fishing (and maybe hydropower related mortality), which probably holds in all countries. It is noted that DCF does not routinely cover this type of information.

Assessment methodology for yellow eel fishing can be derived from existing fish stock assessment methods; for silver eel fishing, an adaptation of methodology (from medical methods) is in preparation; for hydropower impacts, an adaptation of existing methodology is foreseen.

The remaining data collection items (catch sampling, biological sampling, surveys) completes the insight in stock dynamics, but following an initial number of years, the collection of these data may get a lower priority. The surveys will be most cost-effective, when not only focused on eel, and integrated in a wider ecosystem monitoring programme.

SE.17 Literature references

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Report on the eel stock and fishery in Finland 2009/'10

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FI.2 Introduction

In Finland eels are on their North-Eastern 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 fishers 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. Until now the most numerous introductions were made in the sixties and 1970s. Some 8 000 000 glass eels (originating France) and 700 000 elvers (Denmark, Germany) were introduced in 250 inland lakes and coastal waters (Pursiainen and Toivonen, 1984). 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 1 776 000 glass eels originating in 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

There is only occasional bycatch 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 data available.

FI.3.2.1 Commercial

FI.3.2.2 Recreational

FI.3.3 Silver eel landings

No data available.

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 1961–2009 (number of individuals).

year	Glass eels	Quarantined glass eels	Elvers
1961			53 000
1962			143 000
1963			
1964			83 000
1965			114 000
1966	1 077 000		53 000
1967	3 935 000		
1968	2 803 000		4 000
1969			35 000
1970			30 000
1971–1974	no	introductions	allowed
1975			38 000
1976			19 000
1977			30 000
1978	368 000		12 000
1979			75 000
1980–1988	no	introductions	allowed
1989		9 700	
1990		58 840	
1991		108 515	
1992		102 450	
1993		105 000	
1994		103 500	
1995		216 600	
1996		74 580	
1997		82 200	
1998		77 550	
1999		62 500	
2000		61 015	
2001		45 500	
2002		55 000	
2003		0	
2004		63 500	
2005		64 000	
2006		55 000	
2007		107 000	
2008		206 0000	
2009		117 500	
2010		153 000	

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

There is no eel 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 fishers may have minor income from eels mainly as a bycatch. Therefore the recreational fisheries mainly catch the eels. The number of recreational fishers 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 people, eel is 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 data available.

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 in the end of 1970s and the beginning of 1980s (Pursiainen and Toivonen, 1984). Introductions and re-stockings ceased in 1979, which caused a radical reduction in the annual eel catch (Table 2). After the year 1986 the catch was so low that the eel was not detected as a species in the official statistics, but included into the group “other species”. On the grounds of a query the catch in recreational fisheries in 1996 was estimated to be 22 tn. In 2003–2007 the professional marine fisheries caught only few hundred kilos of eels annually. There is no better data available on the present catch. 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 in 1990s probably give nowadays a catch between 5–10 tonnes/year.

Table 2. Eel catches in Finland 1975–2008, x 1000 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	˜ 0	13	˜ 0	4	17
2009	?	?	?	?	?

FI.6.1 Glass eel

No catches.

FI.6.2 Yellow eel

No data available.

FI.6.3 Silver eel

No data available.

FI.6.4 Marine fishery

No data available.

FI.7 Catch per unit of effort

No data available.

FI.7.1 Glass eel

FI.7.2 Yellow eel

FI.7.3 Silver eel

FI.7.4 Marine fishery

FI.8 Scientific surveys of the stock

No data available.

FI.9 Catch composition by age and length

No data available.

FI.10 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 South-West 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.11 Other sampling

No other sampling is going on.

FI.12 Stock assessment

FI.12.1 Local stock assessment

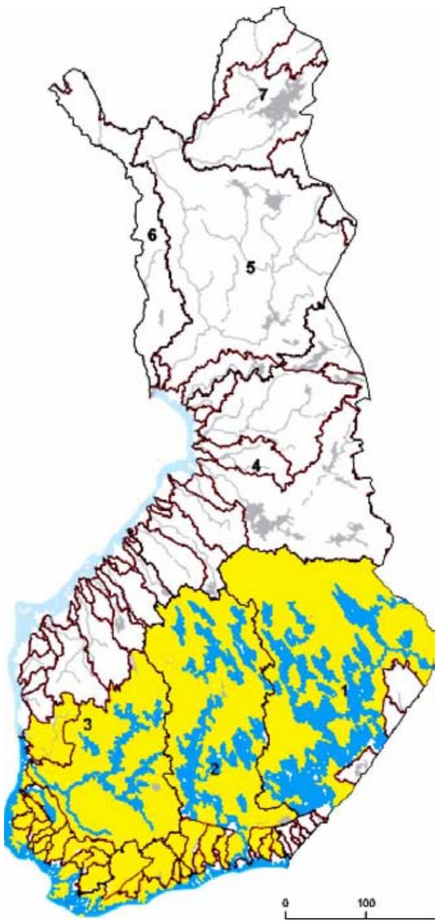
There is not a routine assessment of local stocks. Neither there is any formal advice on fisheries management.

FI.12.2 International stock assessment

FI.12.2.1 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 has 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:

i) Reserve area (the Bothnian Bay area) where eels exist but for climatical and geographical reasons have always been very rare. Light blue area in the map. Total area is 1783 km^2.

ii) Main management area for the eel (the Gulf of Finland and the small undammed riverbasins running to it). Deep blue coastal area in the map Total area is 4677 km^2 for the coastal area and 382 km^2 for the small riverbasins. 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 km^2. No management actions take place in this area.

FI.12.2.2 Silver eel production

It was not possible to complete the Precautionary diagram for Finland. In the EMP there was no estimation (kgs or ind) of historical production, current silver eel production or current silver eel escapement for the whole country, other than that they all have been low and still are low(er).

FI.12.2.2.1 Historical production

No data available.

FI.12.2.2.2 Current production

No data available.

FI.12.2.2.3 Current escapement

No data available.

FI.12.2.2.4 Production values e.g. kg/ha

No data available.

FI.12.2.2.5 Impacts

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

FI.12.2.2.6 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.

FI.12.2.2.7 Data quality issues

No data available.

FI.13 Sampling intensity and precision

No data available.

FI.14 Standardisation and harmonization of methodology

FI.14.1 Survey techniques

No data available.

FI.14.2 Sampling commercial catches

No data available.

FI.14.3 Other biological sampling

Done by FGFRI since 1974 with longlines and fykenets in lakes and eel traps in the rivers. Last four years samples have been collected in freshwaters with the help of local recreational fishers and in the sea by few professional fishers. Fish have been collected mainly alive from the fishers but occasionally also as frozen. In few cases the fishers 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 the following information has been collected:

- Catching date and killing date;
- Catching site;
- Fishing gear;
- Length;
- Weight;
- Sex;
- Colour (sides and belly);
- Diameter of the eye;
- Weight of the gonad (only occasionally);
- *Anguillicola* (no/yes, how many, size).

FI.14.4 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.14.5 Life stages

Silver eel: sides of the colour of silver or copper, glossy, belly white and glossy.

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

FI.14.6 Sex determinations

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

FI.15 Overview, conclusions and recommendations

In the EMP there is 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 eels migration has to be studied;

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

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Report on the eel stock and fishery in Poland 2009/2010

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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.

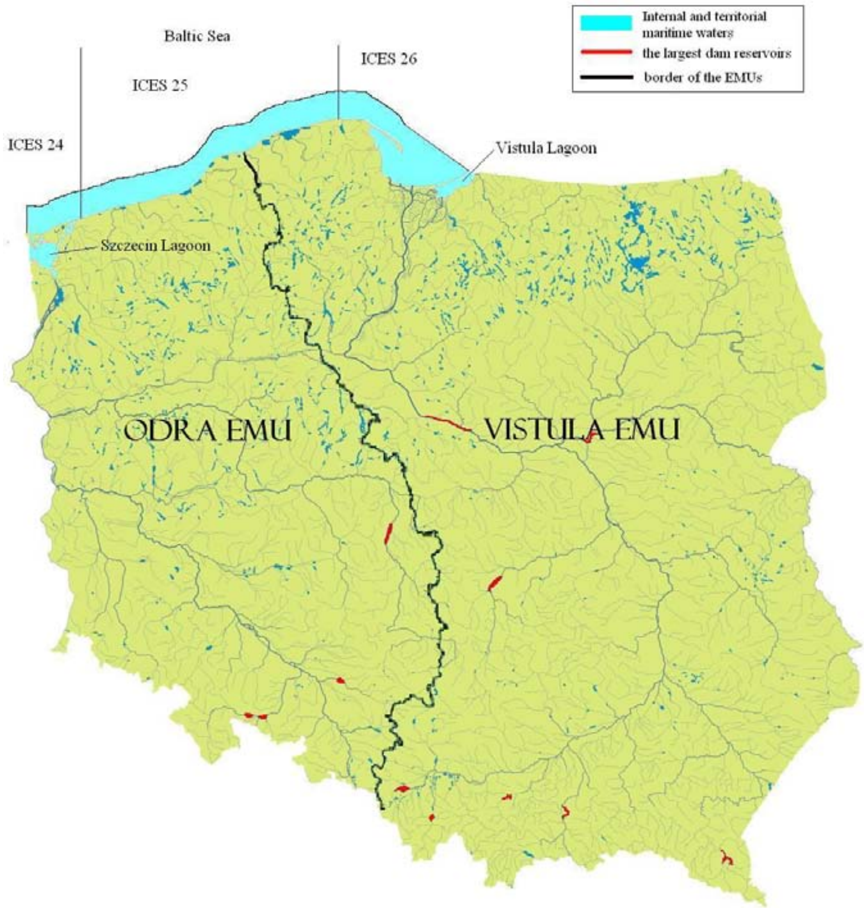

Figure 1. EMU in Poland according to the Polish EMP.

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 will begin in 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.

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.

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.

Information garnered from 55 respondents exploiting nearly 275 thousand ha of inland waters permitted estimating recreational eel landings in Poland. According these data, the size of the catches are estimated at 0.19 kg/ha in the Oder basin and 0.13 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 0.19 kg/ha = 18.7 tonnes;

Vistula basin – 185 710 ha x 0.13 kg/ha = 24.1 tonnes;

Total – 18.7 t + 24.1 t = 42.8 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 100 recreational fishers in 2009 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 2009 indicate that eel comprised barely 1.7% of the catch, while the total recreational catch was 1120 kg, or 0.19 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 2004–2009 period eel catches decreased 3.3-fold. Because these data come from concrete recreational fisheries questionnaires, it is plausible to assume that they are more reliable. Considering the results of 55 questionnaires obtained from enterprises exploiting approximately 275 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 catches of eel in 2009 was 53 tonnes, divided by the basins as follows:

Oder basin: 23.2 tonnes

Vistula basin: 29.8 tonnes

Total: 23.2 t + 29.8 t = 53 tonnes

Such a substantial decrease in recreational eel catches demands comment. Obviously, when eel is more abundant a greater number of recreational fishers aim to catch this species. Declining eel abundance in Polish waters has been noted for nearly the past two decades and it has intensified in recent years; this means that recreational fishers do not especially 'count on' catching this species. Eel has become the bycatch of other, more abundant species. One example comes from the same Lake Enterprise in Ełk, Ltd., where in 2004 pike catches comprised 22.2% of recreational catches, while in 2009 the share of pike in recreational catches increased to 27.2%.

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 fry annually. The fish are sold exclusively for stocking in Poland.

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	1940		1950		1960		1970		1980		1990		2000	
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					65.1		17.4		60.5		1.7	0.1	0.7	0.6
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

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 2009 (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 2009, the fishing capacity was as follows:

Szczecin Lagoon – 155 vessels with licences and special fishing permits;

ICES Subdivision 24 coastal zone – 99 registered boats under the jurisdiction of the District Inspectorates for Marine Fisheries Szczecin, of this figure in 2009, only 15 boats reported landing eel;

ICES Subdivision 25–119 vessels are registered in ports under the supervision of the District Inspectorates for Marine Fisheries Szczecin, of this number, only 20 vessels reported landing eel;

Vistula Lagoon – 109 boats;

Coastal zone ICES Subdivision 26–203 boats registered at ports under the supervision of the District Inspectorates for Marine Fisheries Gdynia; of this number, only 78 boats reported landing eel in 2009.

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	4	0.32
Electric	3	No data
Hook	14	No data

PL.5.3 Marine fishery

In coastal waters, eel is most frequently bycatch in catches of other species.

As of 31 December 2008, the fishing effort was as follows:

Szczecin Lagoon – 184 alhams, 940 eel fykenets, and 67 000 hooks;

ICES Subdivision 24 coastal zone –7 boats reported landing eel with longlines;

ICES Subdivision 25–10 vessels reported landings of eel using longline hooks;

Vistula Lagoon – 3072 fykenet sets (each set has two ends), 20 00 hooks;

Coastal zone ICES Subdivision 26–59 boats reported landing eel with trap gear and longline hooks.

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 (Tables 5 and 6).

ODER EMU

Table 5. Eel landings in the Oder EMU (1954–2008). Estimated values in tones.

Decade Year	1950	1960	1970	1980	1990	2000
0		99	159	216	177	58
1		92	144	142	132	46
2		85	162	168	140	42
3		84	174	196	111	30
4	64	74	176	215	125	10
5	72	105	145	192	114	41
6	58	103	187	223	88	38
7	71	115	206	229	71	36
8	111	102	165	242	63	36
9	64	151	188	176	66	31

VISTULA EMU

Table 6. Eel landings in the Vistula EMU (1954–2008). Estimated values in tones.

Decade Year	1950	1960	1970	1980	1990	2000
0		190	354	523	252	110
1		167	289	550	232	122
2		178	337	595	241	101
3		243	307	464	199	83
4	156	248	416	426	199	82
5	161	206	436	515	190	190
6	154	232	388	478	178	177
7	173	259	470	393	108	170
8	142	272	520	395	127	100
9	121	283	423	257	146	74

PL.6.3 Marine Fishery

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 (Tables 7 and, 8).

ODER EMU (Szczecin Lagoon)

Table 7. Eel landings in the Szczecin Lagoon (1950–2008). Logbook data in tones.

Decade Year	1950	1960	1970	1980	1990	2000
0	250	230	244	85	111	66
1	200	221	222	58	90	67
2	198	231	148	63	75	59
3	196	295	127	61	90	39
4	216	393	107	71	104	35
5	252	230	99	99	100	29
6	259	365	77	113	125	28
7	220	447	82	105	130	27
8	204	416	59	121	133	25
9	186	384	59	140	93	28,7

VISTULA EMU (Vistula Lagoon)

Table 8. Eel landings in the Vistula Lagoon (1950–2008). Logbook data in tonnes.

Decade Year	1950	1960	1970	1980	1990	2000
0	35	214	90	396	158	70
1	28	160	67	269	126	61
2	33	169	50	207	127	34
3	99	140	28	101	95	52
4	174	169	96	119	103	21
5	246	142	113	205	104	23
6	184	104	152	169	108	14
7	153	85	144	146	76	11
8	177	154	201	164	74	12
9	196	116	242	180	100	9,1

PL.6.3.1 Total catch

Total catch in 2009 was 155.6 tonnes.

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

Landings are regularly sampled in marine harbours, and the main gears sampled are fykenets and longlines. Approximately 200–400 fish are analysed annually (DCR). Studies of eel from inland waters began in 2010.

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. The Sea Fisheries Institute in Gdynia is responsible for collecting these data.

PL.11.2 Parasites and pathogens

No new data.

PL.11.3 Contaminants

No new data.

PL.11.4 Predators

No new data.

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:

- a model for estimating resources and characterizing the history of their dynamics;
- 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 9), the only differences are in their importance for the occurrence of eel. Rivers are of the least importance to the occurrence of eel because they are routes for feeding and spawning migrations (silver eel escapement). The most important eel habitats have been and are transitional waters (Vistula and Szczecin lagoons) and lakes which comprise the lakelands situated in northern Poland.

Table 9. 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 10. 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 11. 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 metièrs, 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 12). 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 12. 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 2009 were undertaken only in marine 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.

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Report on the eel stock and fishery in Germany 2009

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DE.2 Introduction

This report covers an "in between period". 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 2007/8. 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 2011/12, 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.

DE.2.1 Eel Management Plans

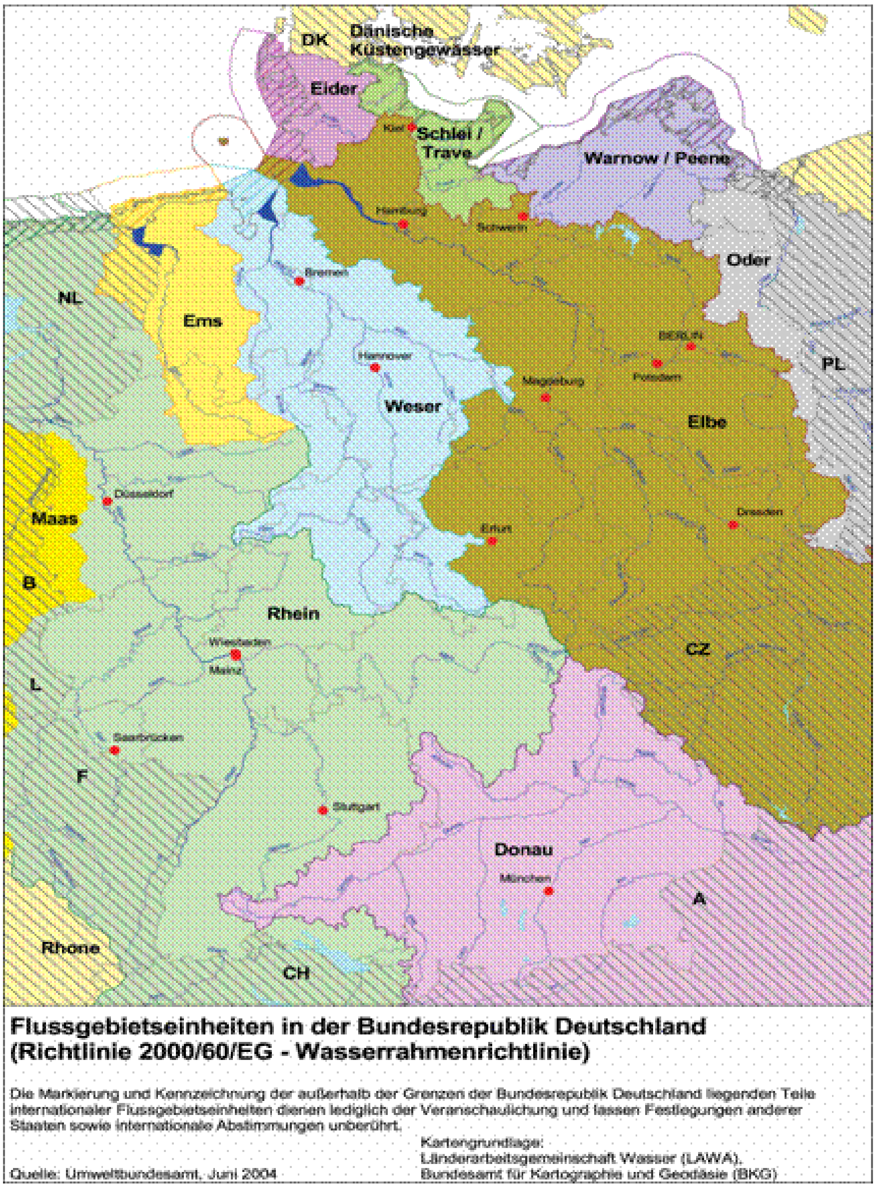

Figure 1. River Basin Districts (RBD) in the Federal Republic of Germany: Eider, Schlei/Trave, Elbe, Warnow/Peene, Oder, Weser, Ems, Rhine, Meuse and Danube.

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, because 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 were 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. 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.

Due to the late approval by the European Commission, the implementation of the plans also started with a delay. In particular, the amount of re-stocking may have been reduced in 2009 because co-funding from EFF finances is only possible in the frame of an accepted Eel Management Plan.

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 Listing of eel in Annex II of CITES

The listing of eel in Annex II of CITES also influences the eel fishery. Although eel fishing is legal in the frame of an accepted EMP, there are several obligations for documentation, resulting from the implementation of the CITES-listing in European and national legislation.

Typical export and import documents for the trade outside the EU have to be obtained from the Federal Agency for Nature Conservation. Within Germany, fishers and eel traders have to provide documentation about incoming and outgoing eels. It is in the responsibility of the States to organize this, there is no Germany-wide regulation. However, at least in some States, there seems to be consensus that it would be sufficient, if the catch statistics of the fishers are detailed enough. If consensus of fisheries authorities and nature/species conservation authorities is not possible, it might be necessary for the fishers to have double documentation (catch statistics and input/output-book).

DE.2.3 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 for eel will be finished in late 2010. The available data are included in an Annex to this Country Report. Because this is the first time of DCR-sampling in freshwaters, the first period is considered as "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) 200 eels (100 yellow and silver eels, respectively) are/will be 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. 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. Because 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 past, a glass eel monitoring was conducted at Herbrum in the River Ems. Due to heavy water works on the River Ems with the consequence of strong currents, which did not exist before, this station is no longer in continuous operation.

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.

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 with 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).

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).

River	Station	Distance to coast	Gear/Relation	2001	2002	2003	2004	2005	2006	2007	2008	2009
Baltic Sea												
Warnow	Bützow	53 km	per eel ladder	37	230	73	56	76	40	35	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
Wallenstein-graben	Wismar (Mühlenteich)	2 km	per eel ladder	not sampled	not sampled	not sampled	173	153	123	296	509	238
Mühlengrube	Wismar (Ziegenmarkt)	0.1 km	per eel ladder	not sampled	not sampled	not sampled	not sampled	not sampled	17	19	81	4
Uecker	Torgelow (Wehr)	52 km (Oder estuary) or 83 km (Peene estuary)	per eel ladder	not sampled	70	33	---	---	53	32	25	37
Plastbach (or Farpener Bach)	Alt Farpen (Stausee/Speicher)	4.8 km	per eel ladder	not sampled	not sampled	not sampled	not sampled	not sampled	---	101	67	25
North Sea												
Müritz-Elde-Wasserstraße	Dömitz (Fischpass)	224 km	per fykenet	not sampled	5934	2365	3145	2861	3124	2440	1395	Not sampled
			per eel collector	not sampled	not sampled	not sampled	not sampled	not sampled	9	---	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
			per eel collector	not sampled	not sampled	not sampled	not sampled	not sampled	11	---	Not sampled	Not sampled

DE.3.1.3 Yellow eel landings

DE.3.1.3.1 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.3.1.3.2 Recreational

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

DE.3.1.4 Silver eel landings

DE.3.1.4.1 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.3.1.4.2 Recreational

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

DE.3.2 Aquaculture production

DE.3.2.1 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.

DE.3.2.2 Production

Table 2. Production of eel in recirculation systems.

Year	Production (t)
1998	appr. 260
1999	appr. 400
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)

DE.3.3 Stocking

DE.3.3.1 Amount stocked (2009)

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 fishers and administration.

Elbe: In the Brandenburg part of the catchment, 16.5 t of ongrown eels (app. 3.7 Mio individuals, mean weight 4.5 g) were stocked in 2009; most of them in the River Havel (Brämick *et al*., 2009).

In the Mecklenburg-Pomeranian part of the RBD Elbe, 2.9 t of ongrown eels (241 500 individuals) have been stocked (Dorow and Ubl, 2010).

In Saxony, 0.27 Mio individuals (ongrown) were stocked into the Elbe catchment in 2009. At a mean weight of 7.5 g, this represents 2 t.

In the Berlin part of the RBD/EMU approximately 3.3 t of ongrown eels were stocked in 2009. At mean weight of about 10 g, this would result in 330 000 individuals.

Information from other States with parts of the Elbe catchment has not been provided so far. Consequently, at least 24.7 t of ongrown eels (approximately 4.5 Mio individuals) have been stocked into the RBD/EMU Elbe in 2009. The real mount will have been even higher.

Ems: Data not yet available.

Maas (Meuse): Data not yet available.

Oder: In the Mecklenburg-Pomeranian part of the RBD, 0.8 t of ongrown eels (app. 64 400 individuals) were stocked in 2009 (Dorow and Ubl, 2010).

Rhein (Rhine): Data have only been provided for the Baden-Württemberg part of the catchment, including the main river (Rhine), some tributaries and a part of Lake Constance. In these waters, 1.1 t of ongrown eel (app. 111 500 individuals) and 16 kg glass eels (48 000 individuals) have been stocked in 2009.

Schlei/Trave: In the Mecklenburg-Pomeranian part of the RBD, 60 kg of ongrown eels (app. 5240 individuals) were stocked in 2009 (Dorow and Ubl, 2010).

Warnow/Peene: In this RBD, 2.9 t of ongrown eels (ca. 239 000 ind.) were stocked in 2009 (Dorow and Ubl, 2010).

Weser: Data not yet available.

Overall, more than 29.6 t (ca. 4.9 Mio individuals) of ongrown eels and 16 kg glass (0.05 Mio individuals) eel have been stocked in German waters in 2009. Because information for some RBD's/EMU's are lacking, the real number will have been higher. A comparison with some available data from 2008 suggests that the level of re-stocking has remained relatively constant.

DE.3.3.2 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 fishers and eel traders has to be made available to the European Commission. However, because 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 2007/8.

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 specialized 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.

RBD Eider

69 full-time (68 coastal, one inland water), 146 part-time, 300 hobby fishers (1200 fykenets allowed);

about 20 000 anglers.

RBD Elbe

413 full- and part-time fishers/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 fishers (using fykenets and stownets);

about 28 000 anglers.

RBD Maas

Fishery of no importance (no details available).

RBD Oder

89 full- and part-time fishers/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 fishers (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 fishers); in total 628 fishing vessels of different size; 808 hobby fishers (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 fishers, 138 part-time fishers, 261 hobby-fishers (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 fishers, four cooperatives, 99 part-time fishers (using stownets, fykenets, traps);

approximately 122 000 anglers.

DE.4.3 Silver eel

See 4.2.

DE.4.4 Marine fishery

These data are included in the previous 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 fishers starting in 2009. However, due to the late approval of the German EMP, the implementation in the States started with a delay. The first data probably could be obtained for 2010, but even then it remains unclear, if and how the information will be made available to the WGEEL, because of limited capacities in the regional authorities.

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 fishers (will) have to deliver the information at least on a monthly basis to the authorities, 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, combined data for yellow and silver eels are given.

Table 3. Combined catches of yellow and silver eels (t) by the German inland fishery in 2009.

„Bundesland“ (State)		Commercial fishery		Recreational fishery
	Yellow eel	Silver eel	combined	
Baden-Württemberg	7	7	14	7
Bayern	No data	No data	6.9	No data
Berlin	8.8	6.6	15.4	6.7
Brandenburg	101	25	126	40
Bremen	No data	No data	No data	No data
Hamburg	No data	No data	No data	No data
Hessen	No data	No data	3.2	No data
Mecklenburg-Vorpommern	No data	No data	55	No data
Niedersachsen		13*	113.5*	
Nordrhein-Westfalen	No data	No data	7	23
Rheinland-Pfalz	3.2	0.6	3.8	No data
Saarland	0	0	0	1
Sachsen	1	0	1	5.2
Sachsen-Anhalt	2.2	2	4.2	1.9
Schleswig-Holstein	3.5	6.2	9.7	No data
Thüringen	0	0	0	1.8
Total	>126.7	>60.4	359.7**	>86.6

*** Including commercial and recreational fishery**

**** Presumed total catch from commercial inland fishery, but contains an unknown amount from recreational fishery in Lower Saxony (Niedersachsen). Total catch in Lower Saxony is estimated to 113.5 t. If the proportion of commercial and recreational fishery is assumed as 50% each, the total catch of German inland fisheries would be approximately 300 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*

*** See explanation above.**

DE.6.3 Silver eel

Silver eels are included in Section 6.2.

DE.6.4 Marine fishery

Table 5. Eel landings from the coastal fishery in North and Baltic Sea by quantities and value.

*** Catches of stocking size eel result exclusively from the rivers Elbe and Eider (North Sea).**

	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	

	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
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	
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		71.1
2009	13.2 *		0.1				8.5		64

*** 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 fishers. 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

Brämick *et al*. (2009) report on studies in seven lakes in the State Brandenburg. There was a controlled stocking with glass eels and ongrown eels. The glass eels had been marked with Oxytetracyclin (OTC) and the ongrown eels had been tagged with decimal coded wire tags (DCWT). Unfortunately, so far the recaptures in some of the lakes were too low to enable a serious estimate of the population size.

Molls (2010) conducted eel stock estimates in 13 waters of the Rhine system by point abundance electrofishing. The mean density of all waters was 0.017 eel/m². This was 22 times lower than reported in earlier studies from the min River Rhine (0.37 eels/m²; Steinmann and Freyhof, 1998). According to Molls (2010), there is now a stabilization on a low population level in this river system. The mean density in the main River Rhine was 0.03 eel/m². Based on this density, the total yellow eel stock in the River Rhine in Northrhine-Westfalia (224 km, 5 m shore width) would be approximately 70 000 individuals. However, no conclusions could be drawn on the offshore areas of the river (just for the electrofished shore part).

Molls (2010) also compared length distributions of his present study and earlier investigations. He found that in the present study smaller length groups tended to occur again (in contrast to the earlier studies) and concluded that this would indicate a slight recovery process due to re-stocking measures.

DE.9.3 Silver eel

In 2009, 230 silver eels were tagged with VIE-elastomer tags during their presumed main migration period in the River Havel in the Elbe RBD (Brämick *et al.*, 2009). The mean length was 63.8 cm, the men weight 512 g. However, calculation of silver eel escapement from this study will be possible at the end of 2010 at the earliest. In an earlier study in this river, silver eel escapement was estimated to be between 0.7 and 6.2 individuals per ha in the respective water bodies Simon and Fladung (2009).

Additionally, in the River Havel, 101 silver eels with a men weight of 1,025 g and a mean length of 78 cm were tagged with acoustic tags. Seven detection stations have been established in the river system, which in the next years are expected to enable conclusions on behaviour and mortality of silver eels during their downstream migration (Brämick *et al.*, 2009).

DE.10 Catch composition by age and length

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

DE.11 Other biological sampling

DE.11.1 Length and weight and growth (DCF)

See Annex with DCF-data.

DE.11.2 Parasites and pathogens

See Annex with DCF-data.

DE.11.3 Contaminants

See Annex with DCF-data.

DE.11.4 Predators

No new data available.

DE.12 Other sampling

Dorow and Ubl (internal abstract) conducted an online (Internet) study on the distinguishing of yellow and silver eel. Photographs of eel were shown to the participants of the study, who should classify the eel as yellow or silver. The silvering index after Durif *et al.*, 2005 was known (but of course not shown to the participants). The study revealed that the classification of yellow and silver eels by optical criteria is difficult and not homogeneous. In very clear cases (high silvering index) the great majority of the participants came to the same (and correct) results. However, in all intermediate stages, the classification by the participants was heterogeneous. The results of this study will be presented by the authors at the WGEEL-meeting 2010 in Hamburg.

Brämick *et al*. (2009) investigated the condition of ongrown eels (from farms), which should be used for re-stocking. They noted that 6% of the eels were infected with *Anguillicoloides crassus.* However, the degree of damage of the swimbladder was low. The mean energy content (brutto energy) of the fish was 8.3 MJ/kg. 11% of the fish had low values between 4–6 MJ/kg, but no individual was below the critical value of 4 MJ/kg (Schreckenbach *et al*., 2001).

In the frame of an elver monitoring (upstream migrating young yellow eels) Brämick *et al*. (2009) investigated 98 eels more detailed. The studied fish had a mean length of 29 cm (17–39 cm). 84% were females and 16% were still sexually undifferentiated. 52% were infected with *A. crassus* but the infection intensity was low (1.9 parasites per infected fish). The degree of damage of the swimbladder was low to medium. The mean energy content (brutto energy) was 7.5 MJ/kg, what is lower than the mean value of 8.7 MJ/kg for eels from Brandenburg waters. However, no individual was below the critical value of 4 MJ/kg.

DE.13Stock 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

Table 6. Habitat types (ha) per RBD.

habitat type	lacustrine	riverine	transitional & lagoon	coastal	total
RBD					
Eider	4,978	2,899	1,662	459,244	468,783
Elbe	136,662	18,097	46,260	Not included	201,019
Ems	1,194	6,633	36,164	Not included	43,991
Maas	0	892	Not included	Not included	892
Oder	49,205	2,654	28,507	Not included	80,366
Rhein	14,400	44,531	Not included	Not included	58,931
Schlei/Trave	20,546	2,483	0	310,761	333,790
Warnow/Peene	30,175	4,647	0	310,080	344,902
Weser	4,962	15,096	34,650	Not included	54,708

DE.13.2.2 Silver eel production

DE.13.2.2.1 Historical production

Table 7. "Historical" 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.

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.

DE.13.2.2.3 Current escapement

Table 8. Present spawner escapement by RBD. Data were taken from the EMP's of the respective RBD's. The data represent estimates for the period 2005–2007 and are results of modelling, taking into account recruitment estimates for the relevant periods and also estimates or data for all anthropogenic impacts.

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 8 (Section 13.2.2.3).

In addition to the estimates and calculations of historical 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/calculated with the same model used for the calculation of current and historical 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. A short discussion of this aspect can be found in the main report of the WGEEL session (Chapter 3, International post-evaluation).

DE.13.2.2.5 Impacts

Table 9. 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 10. 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. Because 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 eels two elvers would be obtained, thus leading to a ratio of “1 elver = 1.5 glass eels”. Hence, to achieve the required numbers of elvers, 13 402 500–19 027 500 glass eels 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 eels of different size, increasing to about 18 Mio (4 Mio glass eels + 9 Mio elvers; increasing to 5 Mio glass eels + 13 Mio elvers).

Expressed as glass eel equivalents and by using the ratio “1 elver = 1.5 glass eels”, 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 eels.

If these targets can be achieved, is largely dependent on the availability and the price of glass eels.

DE.13.2.2.7 Data quality issues

The quality of the available data is not easy to assess. There is no long history of eel stock assessment in Germany and hence the results are based on catch statistics, estimates and model calculations. The reliability of the catch statistics has not been evaluated so far. The model 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 Standardisation and harmonization of methodology

So far, there is no harmonization of methodology.

At present, a monitoring approach for eel in coastal waters in the Baltic Sea is tested by the Institute for Fisheries of the State Research Centre Mecklenburg-Vorpommern for Agriculture and Fishery (Rostock). If this approach will bring good results, it could offer the possibility of standardized eel monitoring in the coastal waters of the Baltic Sea. The approach has been presented by M. Dorow at the 2009 meeting of SGAESAW (Gothenburg, Sweden).

DE.15.1 Survey techniques

No data available.

DE.15.2 Sampling commercial catches

No data available.

DE.15.3 Sampling

No data available.

DE.15.4 Age analysis

No data available.

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 etc.).

The Regulation 1100/2007 requires a much more detailed documentation of the eel fishery from fishers 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.

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 Country Report Germany 2010

German National Data Collection of European Eel (*Anguilla anguilla*) 2009–2010

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Abstract

The abundance of the European eel stock (all stages glass eel, yellow eel and silver eel) is at a historical minimum and continues to decline (ICES 2009). Therefore the European Union Commission adopted a management framework (EU/1100/2007) with the objective to rebuild the eel stock and a multiannual Community programme pursuant to Council Regulation (EC) No 199/2008 establishing a Community framework for the collection, management and use of data in the fisheries sector and support for scientific advice regarding the common fisheries policy (2008/949/EC). Thus, sampling of European Eel data also in freshwaters got mandatory under the data collection framework (DCF). In an 18 month "pilot" project from April 2009 to September 2010 sampling focused on gathering biological parameters of eel in commercial catches of inland fisheries. 200 eels (100 yellow and 100 silver eels) were sampled and investigated from each German river basin district (RBDs). Besides the required parameter length, weight, sex, maturity and age also infestation with *Anguillicoloides crassus* and muscle fat content were examined. In summary, males spend approximately a decade as yellow eels, whereas females spend three years longer before starting downstream migration. Female silver eels from the river Oder (10.67 ± 0.58 years) and Schlei (10.14 ± 1.71 years) start migration significantly earlier than female silver eels from the Rhine (14.63 ± 2.55 years) and Ems (15.76 ± 2.59 years). The infestation with *A.crassus* varied between 56% in the Schlei river and 93.81% in the Peene river. Highest mean nematode abundances per swimbladder could be observed in eels from the Uecker river (10.25 ± 11.8), lowest mean abundances in eels from the Oder river (2.0 ± 3.93). In female silver eels higher abundances of *A.crassus* and increased swimbladder damage (Hartmann classes) could be observed compared with yellow eels. The fat content in female silver eels could be detected between 25.42% ± 3.75 (Schlei) and 29.22% ± 4.47 (Warnow), whereas male silver eels demonstrated a tendency to accumulate more fat in muscle tissue.

This study presents the first comprehensive data collection of European eel in German freshwater habitats and might support the post-evaluation of stock assessment in frame of the national eel management plans in 2012 (EMPs).

Introduction

The stock of the European eel (*Anguilla anguilla* (L.)) is at an historical minimum, continues to decline and is outside safe biological limits (EIFAC/ICES WGEEL Report 2009, 2010). Anthropogenic impacts (habitat loss, migration barriers, pollution), but also natural impacts (cormorants, parasites, ocean climate) are under discussion as possible causes of the decline (Dekker 2005). For a better understanding in the still incomplete knowledge of eel biology further assessment of the biological status of eel requires additional and consistent data. Therefore, the EU Commission has included the eel into the Data Collection Framework (DCF). The German National Programme (NP) 2009-2010 for sampling of eel fisheries data refers to the Community and National Programme defined in the Council Regulation 199/2008 and in the Annex of

Commission Decision 2008/949/EC. Thus, sampling of European eel data also in freshwaters is now mandatory under the DCF.

Material and methods

In Germany, eel sampling has started in spring 2009 and the data evaluation has finished in September 2010 with the first DCF report for European eel. In this first "pilot" phase, sampling focused on gathering biological parameters (see *List of biological variables*) of eel in commercial catches of inland fisheries. 200 eels (if available, see table 1) were sampled and investigated from each German river basin district (according to WFD, see figure 1). An exemption was the RBD Maas (Meuse), where no commercial fishery exists in its German part. Consequently, sampling was not required according to DCF standards.

Yellow eels were collected in spring and silver eels were collected in autumn 2009 (detailed information in Figure 2 and Table 1). Analyses include length, weight, age, sex and maturity (detailed information in the *list of biological variables*). Although not mandatory under DCF regulations, some additional parameters such as infestation with the swimbladder nematode *Anguillicoloides crassus* and fat content of eel muscle tissue have been analysed as well (see *list of biological variables*). Due to the limited number of 200 eels to be investigated per RBD as required by DCF, sampling was restricted to only few locations. To optimize comparability, eels were preferably collected downstream in the system (Figure 2), close to the estuaries. However, for practical reasons, some exemptions from this general approach were necessary (e.g. in the river Rhine yellow eels sampling was performed in a more upstream region, as commercial fisheries on yellow eels are rare in the downstream areas of the German Rhine; a yellow eel sample from the river Havel was included for the RBD Elbe, samples from the river Uecker were included for the RBD Oder, because of limited availability of eel samples from the Oder river itself).

Figure 1. River Basin Districts (RBDs) in the Federal Republic of Germany.

Rhine, Ems, Weser, Eider, Schlei/Trave, Elbe, Oder, Warnow/Peene, Meuse and Danube. According to the Eel Management Plans of Germany (EU Council Regulation

1100/2007), we adopted the nine RBD's (Report on the eel stock and fishery in Germany 2008) for the EU-DCF (Figure 1). The Danube was excluded because 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. Furthermore, an exemption is the RBD Maas (Meuse), where no commercial fishery exists in the German part of the RBD. Consequently, sampling was not required by the DCF.

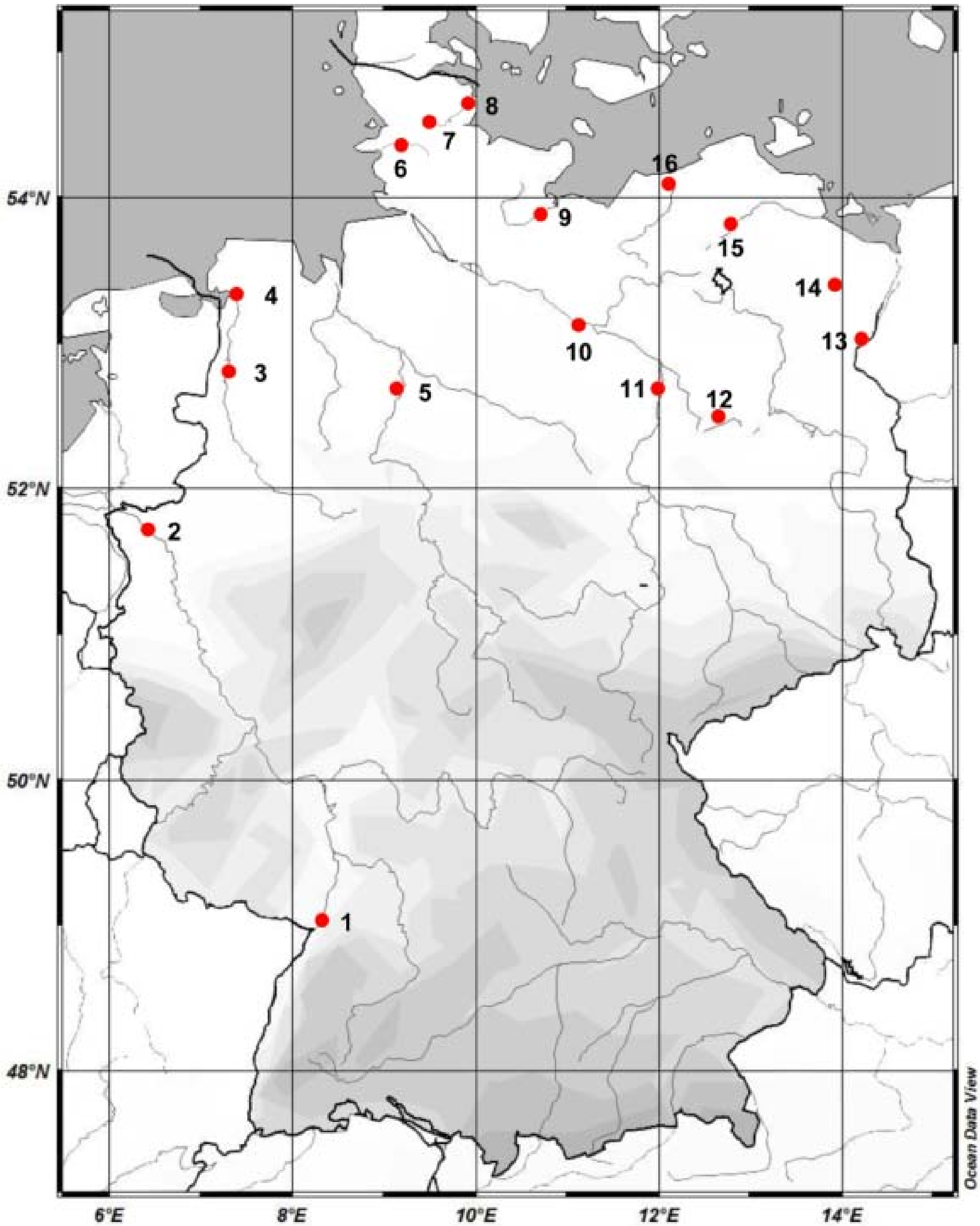

Figure 2. Overview of eel sampling in German River Basin Districts (RBDs). Red dots: Locations of commercial eel catches, where eel samples were collected. Rhine 1 & 2; Ems 3 & 4; Weser 5; Eider 6, Schlei 7 & 8; Trave 9; Elbe: 10 & 11; Havel 12; Oder 13; Uecker 14; Peene 15; Warnow 16.

Table 1. Characteristics of eel samples according to each location in German RBDs.

*** If available, additional eels were gathered in length to increase total number for length distribution analysis (see results).**

No.	RBD	Sample size [n]	Yellow/Silver eel	Time of sampling	Fishing gear
1	Rhine	99	Y	May 2009	electrofishing
2	Rhine	96	S	October 2009	stownet
3	Ems	115	Y	June/Sept. 2009	electrofishing
4	Ems	101	S	October 2009	stownet
5	Weser	111	Y	June 2009	stownet
	Weser	106 (40)*	S	October 2009	stownet
6	Eider	93	Y	July 2009	fykenet
	Eider	101	S	October 2009	fykenet
7	Schlei	53	Y	May 2009	fykenet
8	Schlei	47 (66)*	S	November 2009	fykenet
9	Trave	60	Y	June 2009	fykenet
	Trave	-	S	2010 ?	-
10	Elbe	53 (25)*	Y	June 2009	fykenet
11	Elbe	104 (144)*	S	August 2009	stownet
12	Havel	99	Y	June 2009	fykenet
13	Oder	51	Y	July 2009	eel pots/fykenet
	Oder	-	S	2010 ?	-
14	Uecker	51	Y	June 2009	fykenet
	Uecker	50	S	October 2009	fykenet
15	Peene	50	Y	June 2009	fykenet
	Peene	47	S	September 2009	fykenet
16	Warnow	42	Y	June 2009	stownet
	Warnow	51	S	September 2009	stownet

List of biological variables with European eel sampling specification

length [a], weight [b], sex [c], maturity [d], age [e], parasites (*Anguillicoloides crassus*) infection [f], condition factor [g], fat content [h],

a) total length was determined either immediately after catch (to the nearest 0.5 cm) or after thawing. In the second case the values were corrected by assuming a reduction of 2.5% according to Wickström (1986). Presentation of eel length distribution was performed using 1 cm length classes (e.g. 50.5–51.49 cm).

b) total weight was determined either immediately after catch or after thawing. In the second case the values were corrected by assuming a reduction of 2.8% according to Wickström (1986).

c) sex determination via macroscopic assessment of gonadal development.

d) determination of silvering index according to Durif *et al.* (2005). Indices corresponded to a growth phase including both sexes and immature eels (silvering index 1), only yellow females (silvering index 2), a pre-migrating phase of females (silvering index 3), two migrating phases of females (silvering index 4 and 5) and a migrating phase of males (silvering index 6).

e) according to EU Council Regulation (1100/2007), 200 eels (100 yellow and 100 silver eels separately) were analysed for each RBD. However, not for all RBDs 200 eels were available. Silver eel samples were not available for the rivers Trave and Oder. Age reading of otoliths was performed using a "cutting and burning" protocol (WKAREA, ICES 2009b).

f) eel swimbladder infection with the nematode *A.crassus* was analysed as total prevalence [%], abundances of nematodes per swimbladder [n] and damage degree of the swimbladder due to nematode infection according to Hartmann (1994).

   i) "Hartmann classes" of swimbladder damage:

      1) Swimbladder is normal +/- nematodes;

      2) Swimbladder with mildly thickened wall +/- nematodes and larvae;

      3) Swimbladder with advanced thickened wall +/- nematodes and larvae;

      4) Swimbladder with strongly thickened wall and narrowed lumen, filled with red-brown fluid, secondary infections of surrounding tissues are externally visible as swollen and inflamed abdomen;

      5) Degenerated small swimbladder with a strongly thickened wall, reduced lumen, complete devoid of air, contains exudates and dead worms.

g) condition factor was calculated from total weight and total length of eels by using the formula by Fulton (1904). $K = (\text{weight [g]} * 100) / \text{length}^3 \text{ [cm]}$

h) fat content in eel was measured using the DISTELL FATMETER (www.distell.com).

Statistics

KYPLOT (version 2.0 Beta 15, 1997–2001, Tokyo, Japan) was used to perform statistical analysis of the parameters length, weight, age, growth, nematode infection, fat content and condition factor. Data are given as mean ± standard error of the mean (S.E.M). Intergroup differences were considered significant at $*p < 0.05$ according to one-way ANOVA followed by Tukey's pairwise comparison.

Results

Length distribution

The length distributions of eel catches (pooled yellow and silver eel samples) are given in Figures 1.a–1.l. Note that the length distribution of eels depends on selectivity of the fishing gear (see also Table 1). Eels smaller than 30 cm were only caught in the river Ems using an electro fishing gear (Figure 1.b.), whereas in the river Rhine this method couldn't provide eels smaller than 40 cm (Figure.1.a).

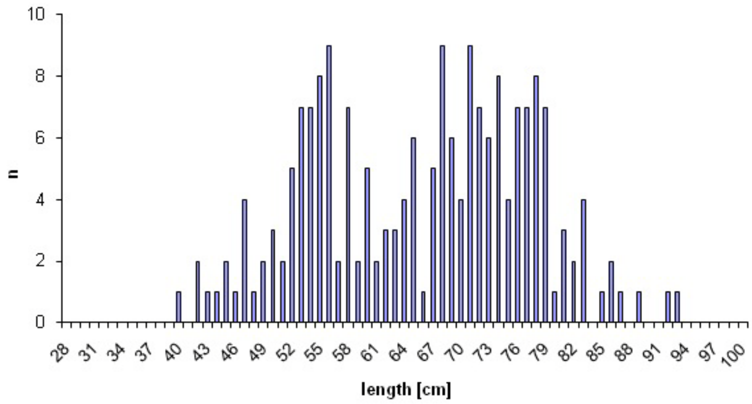

Figure 1.a. Length distribution of eel samples from the river Rhine (n=195).

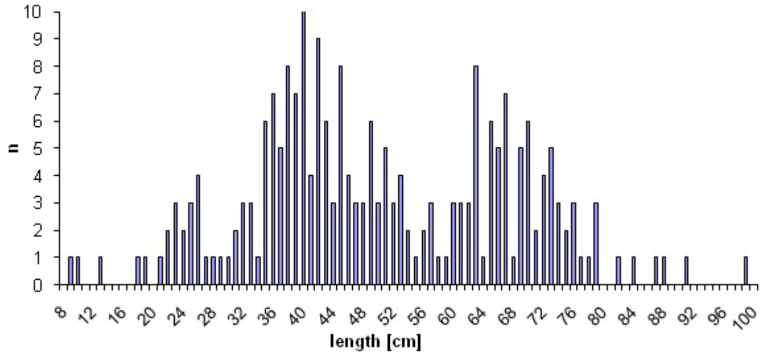

Figure 1.b. Length distribution of eel samples from the river Ems (n=216).

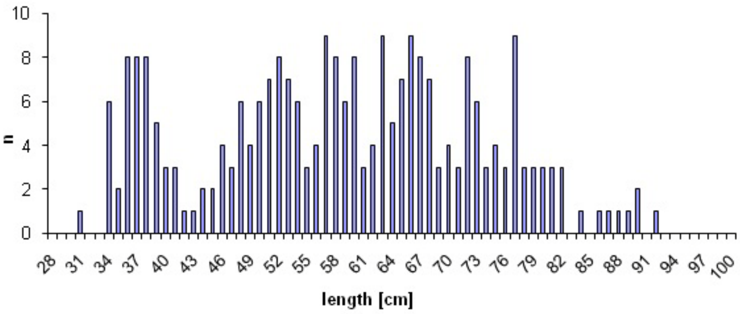

Figure 1.c. Length distribution of eel samples from the river Weser (n=257).

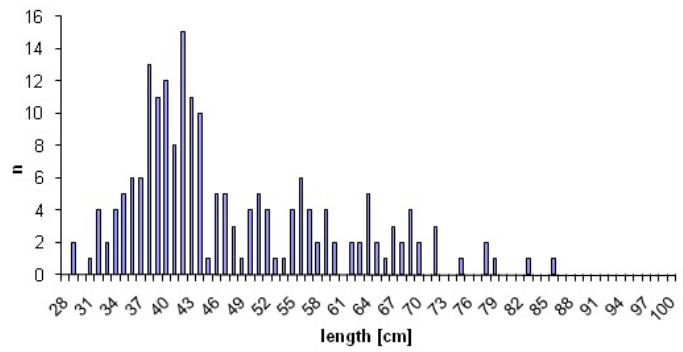

Figure 1.d. Length distribution of eel samples from the river Eider (n=194).

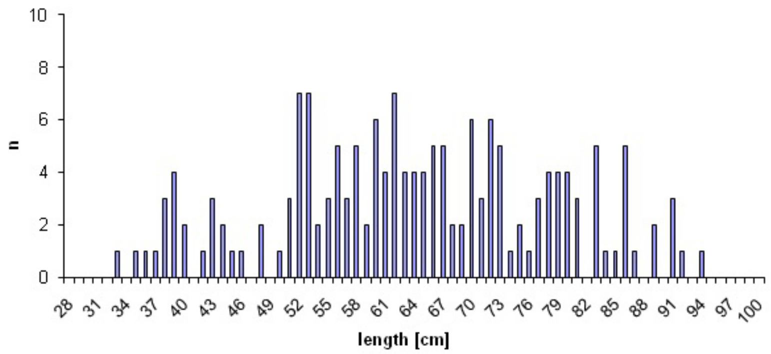

Figure 1.e. Length distribution of eel samples from the river Schlei (n=166).

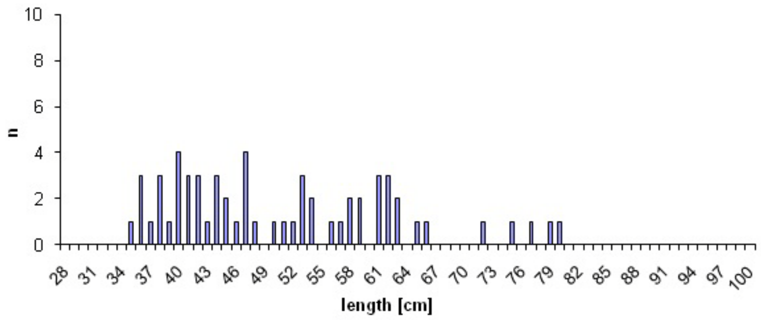

Figure 1.f. Length distribution of eel samples from the river Trave (n=60).

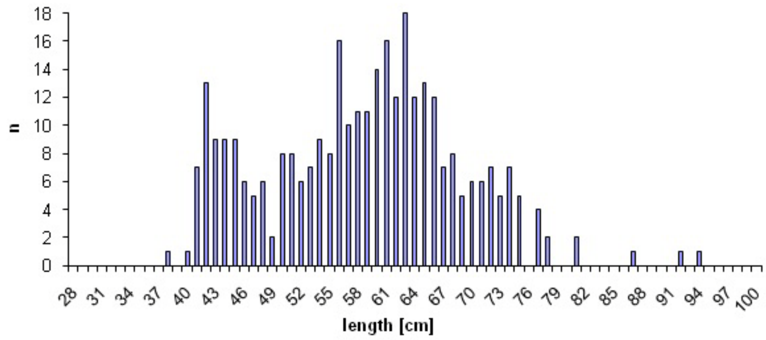

Figure 1.g. Length distribution of eel samples from the river Elbe (n=326).

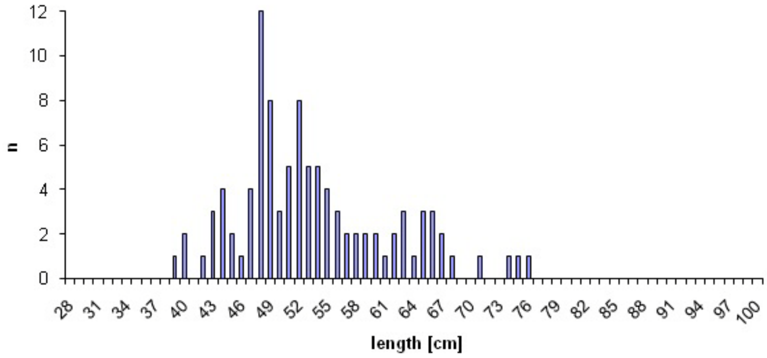

Figure 1.h. Length distribution of eel samples from the river Havel (n=99).

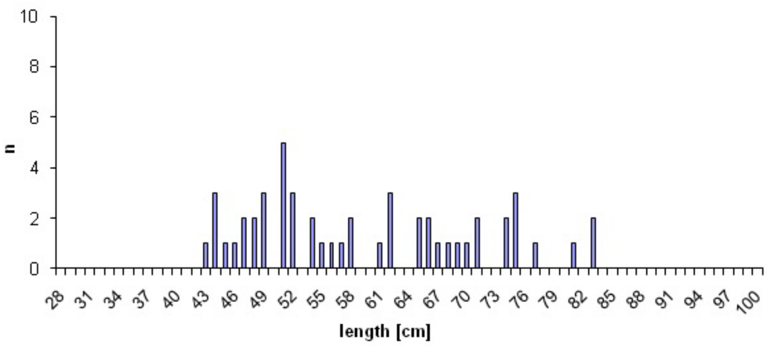

Figure 1.i. Length distribution of eel samples from the river Oder (n=51).

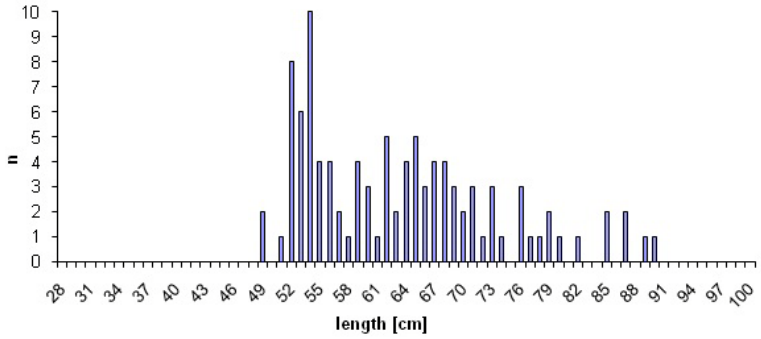

Figure 1.j. Length distribution of eel samples from the river Uecker (n=101).

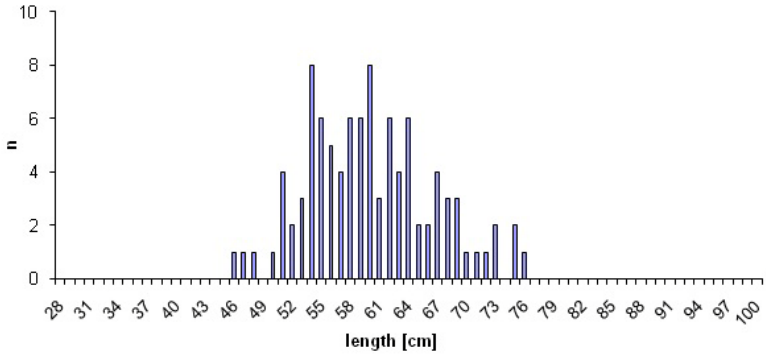

Figure 1.k. Length distribution of eel samples from the river Peene (n=97).

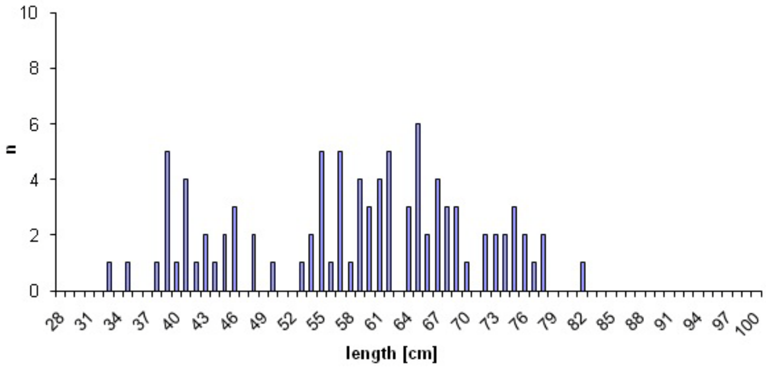

Figure 1.l. Length distribution of eel samples from the river Warnow (n=93).

Length–weight correlation

The length–weight correlation is given in Figures 2.a–2.l. Data points were blotted in different colours and shapes separately for males and females and their maturation degree (undifferentiated yellow eels [SI 1]=black triangles; yellow males [SI 1]=:blue squares; silver males [SI 6]=orange triangles; yellow females [SI 1,2,3]=purple squares; silver females [SI 4-5]=green dots). In general, a power functions fitted to the length - weight data of yellow (SI 1,2,3) and silver females (not shown as a graph) in German freshwater habitats. For the Peene river and the Havel river a polynomial function provides the highest stability index (R^2 – values, see Figures 2.h and 2.k).

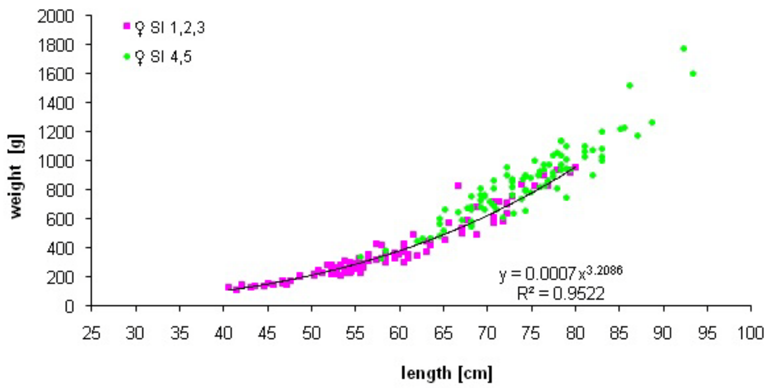

Figure 2.a. Length–weight correlation of eel samples from the river Rhine (n=195).

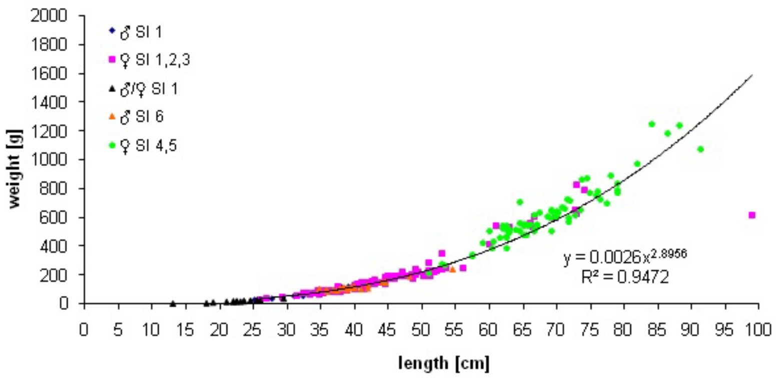

Figure 2.b. Length–weight correlation of eel samples from the river Ems (n=216).

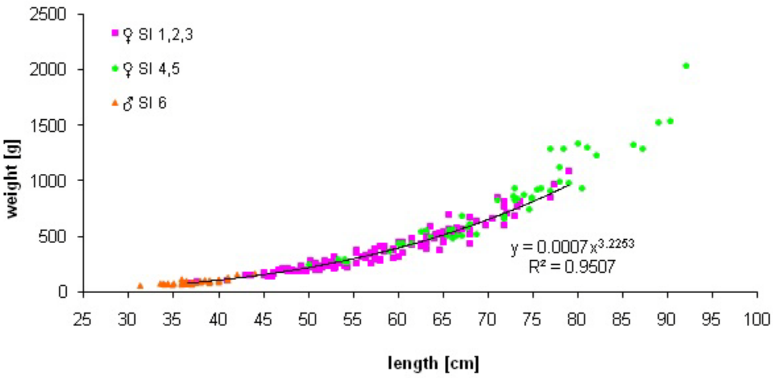

Figure 2.c. Length–weight correlation of eel samples from the river Weser (n=257).

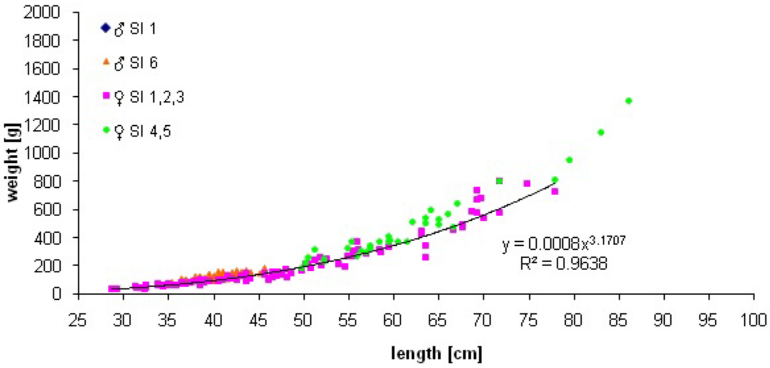

Figure 2.d. Length–weight correlation of eel samples from the river Eider (n=194).

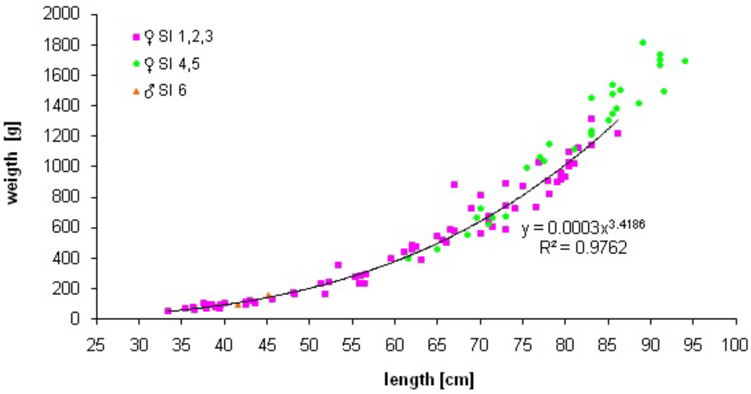

Figure 2.e. Length–weight correlation of eel samples from the river Schlei (n=166).

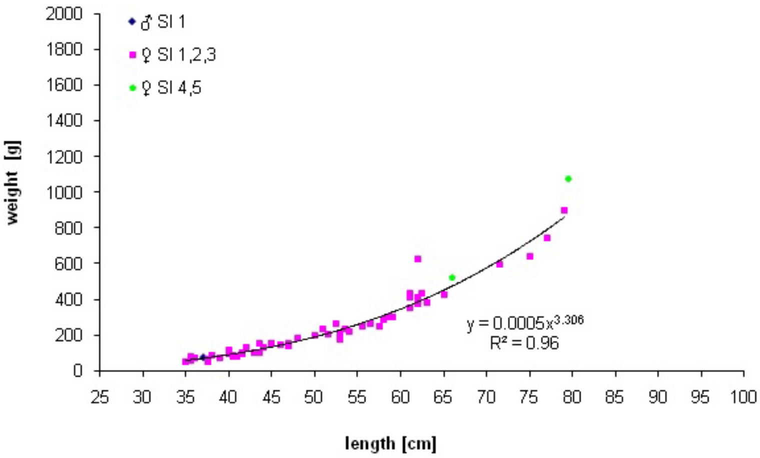

Figure 2.f. Length–weight correlation of eel samples from the river Trave (n=60).

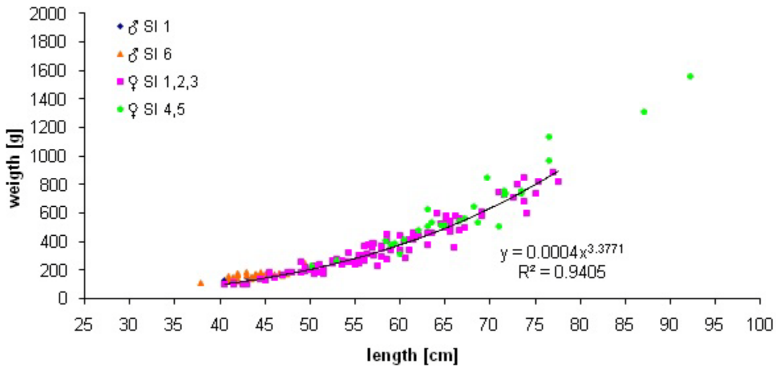

Figure 2.g. Length–weight correlation of eel samples from the river Elbe (n=326).

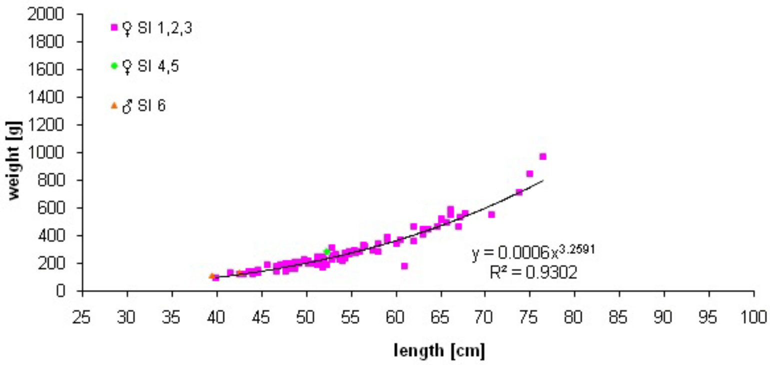

Figure 2.h. Length–weight correlation of eel samples from the river Havel (n=99).

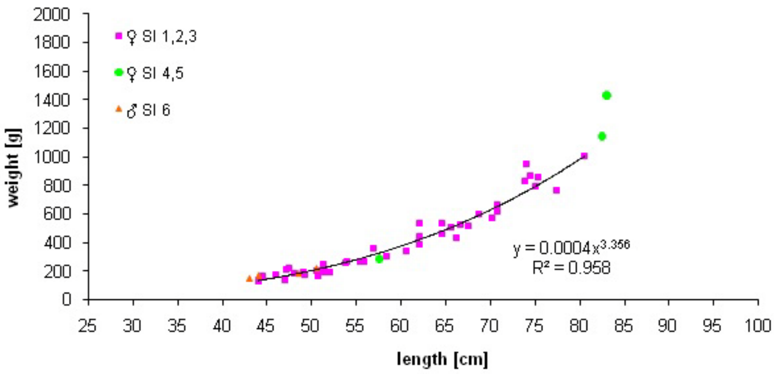

Figure 2.i. Length–weight correlation of eel samples from the river Oder (n=51).

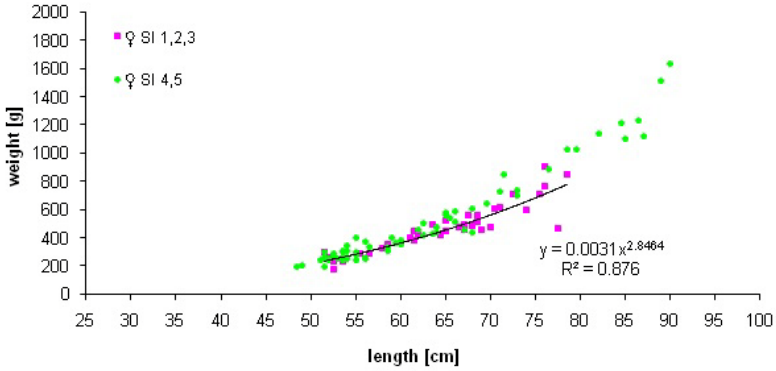

Figure 2.j. Length–weight correlation of eel samples from the river Uecker (n=101).

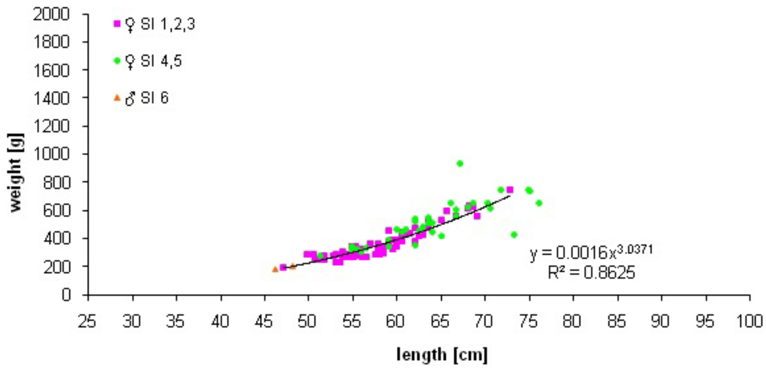

Figure 2.k. Length–weight correlation of eel samples from the river Peene (n=97).

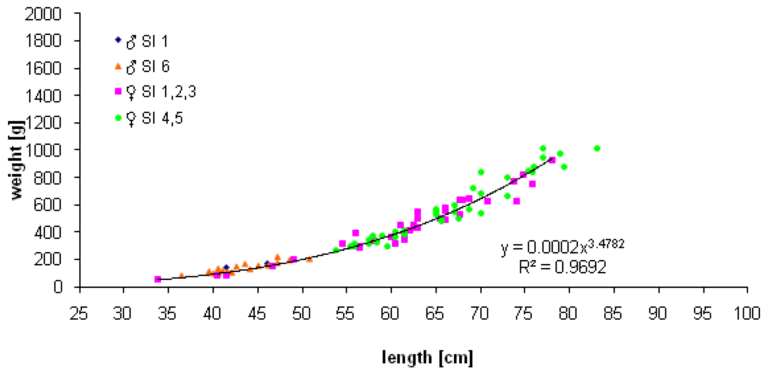

Figure 2.l. Length–weight correlation of eel samples from the river Warnow (n=93).

Age–length correlation

The length–weight correlation is given in Figures 2.a–2.l. Data points were blotted in different colours and shapes separately for males and females and their maturation degree (undifferentiated yellow eels [SI 1]=black triangles; yellow males [SI 1]=blue squares; silver males [SI 6]=orange triangles; yellow females [SI 1,2,3]=purple squares; silver females [SI 4-5]=green dots). In contrast to length–weight correlation the age–length data of yellow females (SI 1, 2, 3) correlated fairly poor. Only in a few cases polynomial functions fit (Trave: R^2= 0.69, Eider: R^2= 0.63). For the other rivers mathematical functions render R^2-values smaller than 0.58. Note the huge variations in individual ages of silver males and females of all rivers were silver eels were available (Figures 3.a, b, c, d, e, g, j, k, l). Mean ages of migrating silver eels were analysed in the section *Age of migration silver eels* (see below).

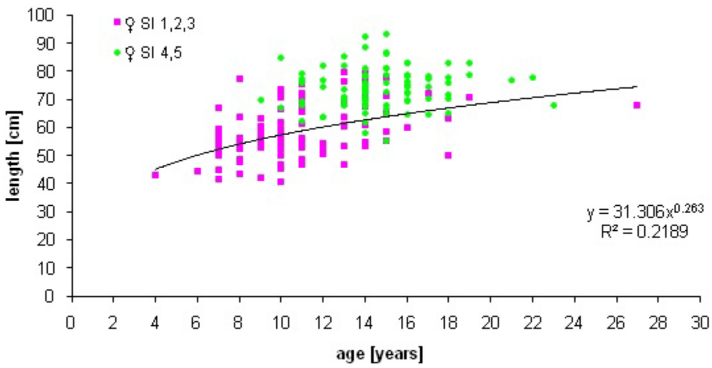

Figure 3.a. Age–length correlation of eel samples from the river Rhine (n=195). A curve is given for female yellow eels (SI 1,2,3, purple squares).

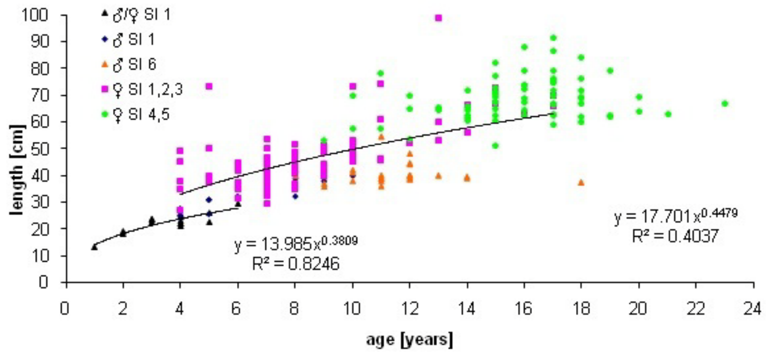

Figure 3.b. Age–length correlation of eel samples from the river Ems (n=216). Besides the power function for female yellow eels (SI 1,2,3, purple squares), a curve (power fct.) for the undifferentiated yellow eels (♂/♀ SI 1) is shown (black triangles). Note the huge variation in age of male (orange triangles) and female (green dots) silver eels.

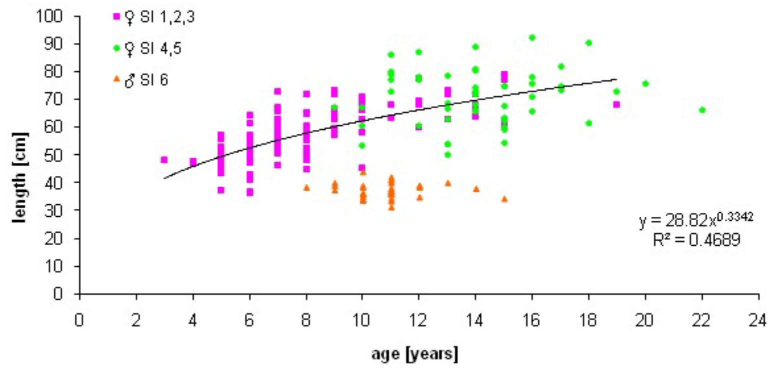

Figure 3.c. Age–length of eel samples from the river Weser (n=257). A curve is given for female yellow eels (SI 1,2,3, purple squares). Note the huge variation in age of male (orange triangles) and female (green dots) silver eels.

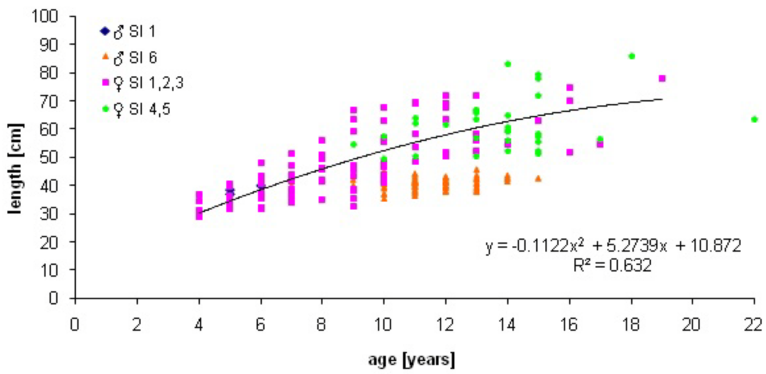

Figure 3.d. Age–length correlation of eel samples from the river Eider (n=194). A curve is given for yellow females (SI 1,2,3, purple squares). Note the huge variation in age of male (orange triangles) and female (green dots) silver eels.

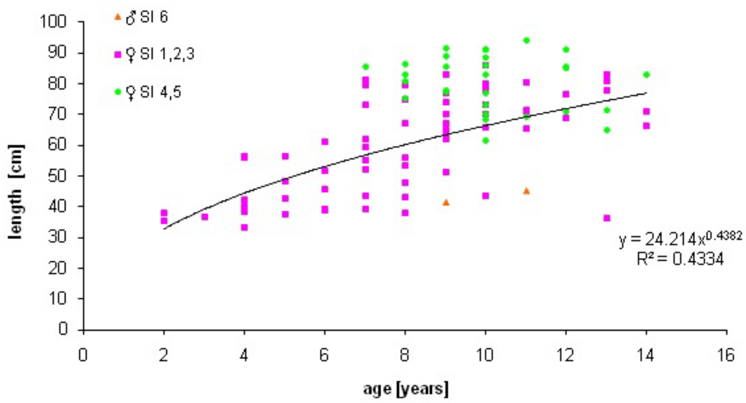

Figure 3.e. Age–length correlation of eel samples from the river Schlei (n=166). A curve is given for female yellow eels (SI 1,2,3, purple squares).

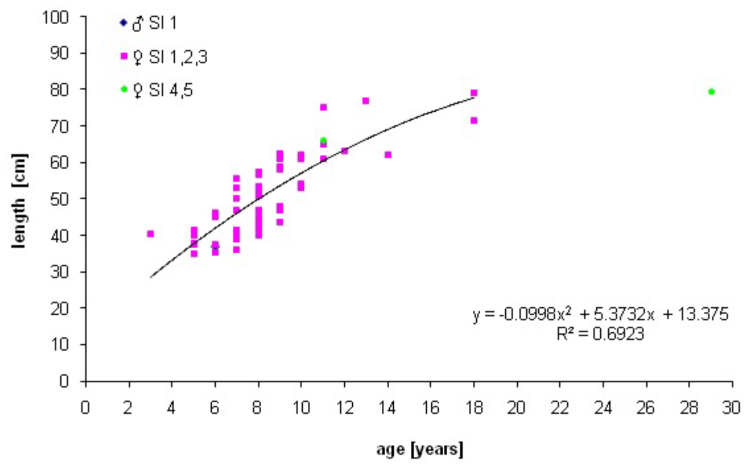

Figure 3.f. Age–length correlation of eel samples from the river Trave (n=60). A curve is given for female yellow eels (SI 1,2,3, purple squares).

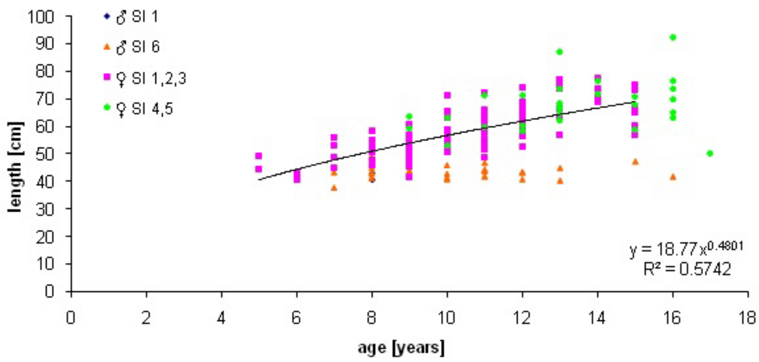

Figure 3.g. Age–length correlation of eel samples from the river Elbe (n=326). A curve is given for female yellow eels (SI 1,2,3, purple squares). Note the huge variation in age of male (orange triangles) and female (green dots) silver eels.

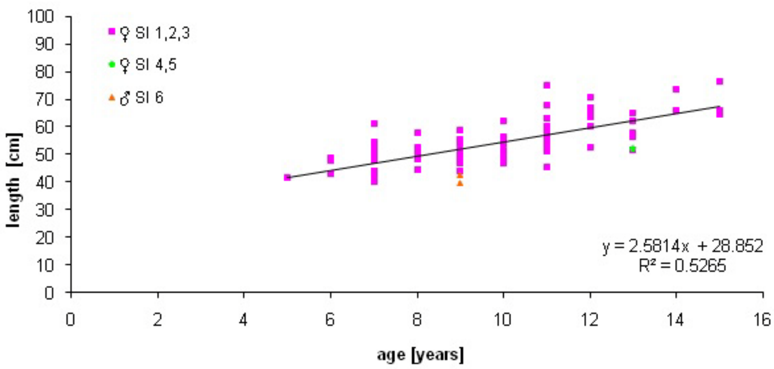

Figure 3.h. Age–length correlation of eel samples from the river Havel (n=99). A curve is given for female yellow eels (SI 1,2,3, purple squares).

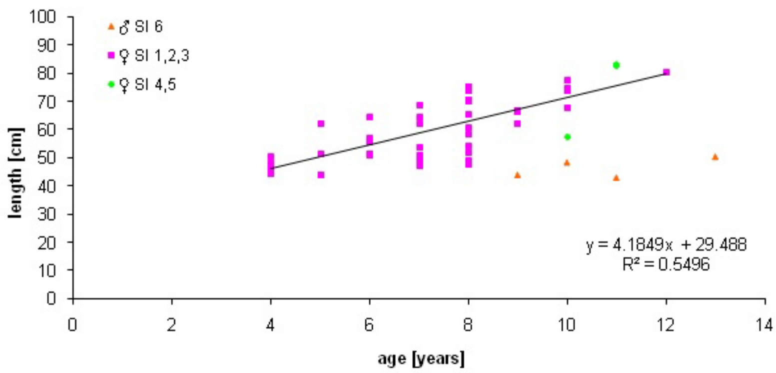

Figure 3.i. Age–length correlation of eel samples from the river Oder (n=51). A curve is given for female yellow eels (SI 1,2,3, purple squares).

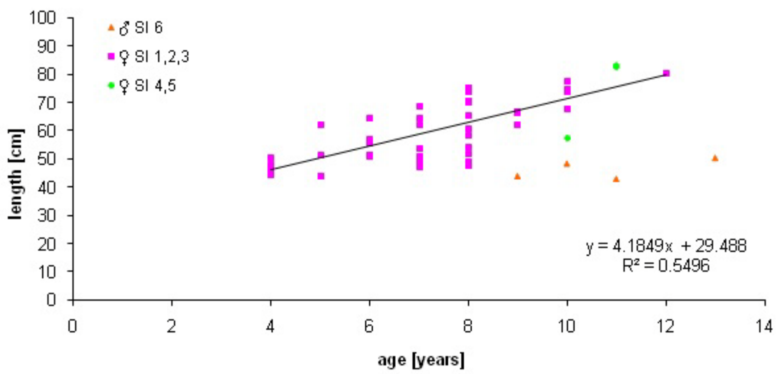

Figure 3.j. Age–length correlation of eel samples from the river Uecker (n=101). A curve is given for female yellow eels (SI 1,2,3, purple squares).

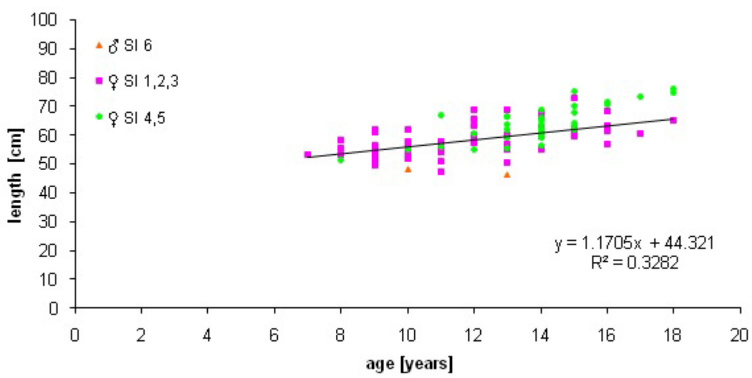

Figure 2.k. Age–length correlation of eel samples from the river Peene (n=97). A curve is given for female yellow eels (SI 1,2,3, purple squares).

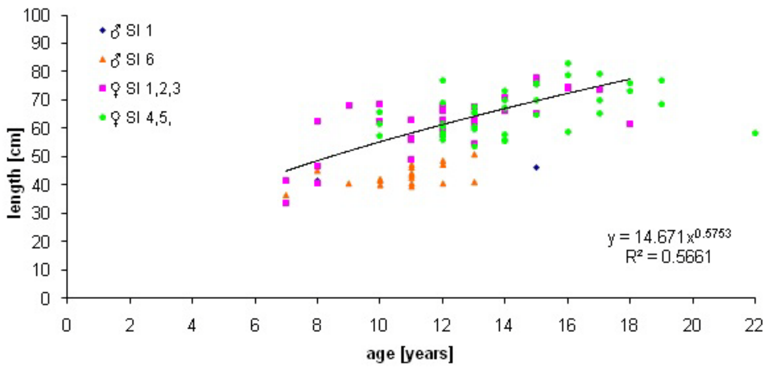

Figure 2.1. Age–length correlation of eel samples from the river Warnow (n=93). A curve is given for female yellow eels. Note the huge variation in age of male (orange triangles) and female (green dots) silver eels.

Length, weight and age of migrating silver eels

The mean total length of female silver eels ranged from 61.82 cm (± 1.62) in the river Eider to 80.83 cm (±1.65) in the river Schlei (Figure 4.a.). For the Havel river only one female silver eel was investigated and therefore not representative. Male silver eels were smallest in the in river Weser (37.54 ± 0.52 cm) and significantly larger in the river Oder (46.53 ± 1.77 cm) and Peene (47.15 ±1.02 cm; Figure4.b.). Male silver eels were not available for the rivers Rhine, Trave and Uecker. An overview about total length of silver eels from German rivers is given in Figure 4.

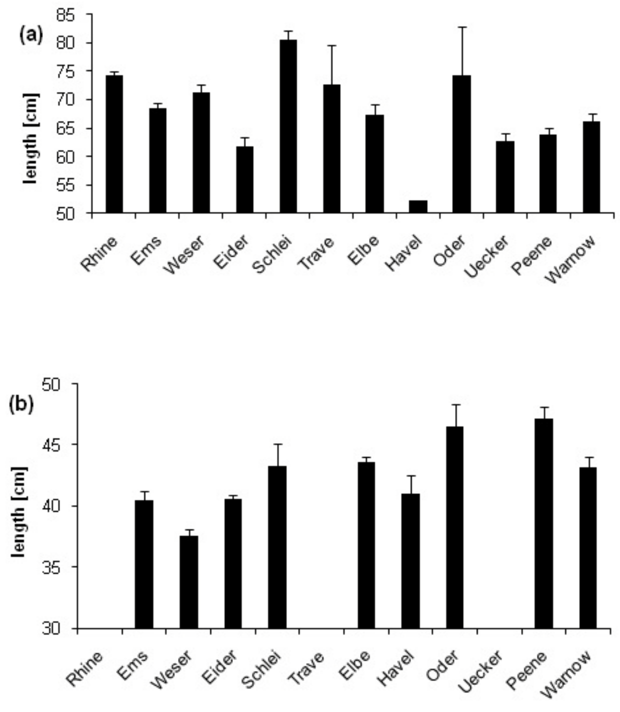

Figure 4. Mean length of female (a) and male (b) silver eels from German rivers. Note that numbers of females were limited for the river Trave, Havel and Oder (n = 1–3). The samples size of females for all other rivers was n ≥ 28. Note further that males were not available for the rivers Rhine, Trave and Uecker. Data on rivers Schlei, Havel, Peene and Oder are based on limited numbers of male individuals (n = 2–4). The samples size of males for all other rivers was n ≥ 26.

The mean total weight of female silver eels varied in a huge range and correlated with the mean total length of female silver eels (Figure 5.a, see also Figure 2.a–2.l.). Eels from the river Eider demonstrated the lowest mean value (483.53 ± 46.98 g) whereas eels from the river Schlei exhibited the highest mean value (1176.88 ± 78.61 g). The length–weight correlation is also a matter of fact for the male silver eels, with the lowest mean weight of males from the river Weser (94.51 ± 5.42 g) and the highest mean weight of males from the river Peene (191.72 ± 11.82 g) and Oder (180.69 ± 13.67 g, see Figure 2.a–2.l.). An overview about total mean weights of silver eels from German rivers is given in Figure 5.

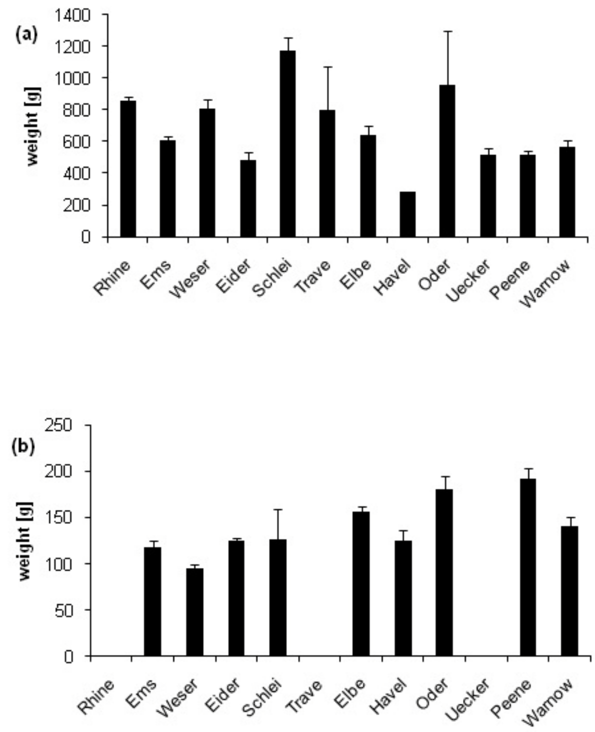

Figure 5. Mean weight of female (a) and male (b) silver eels from German rivers. Note that numbers of females were limited for the river Trave, Havel and Oder (n = 1–3). The samples size of females for all other rivers was n ≥ 28. Note further that males were not available for the rivers Rhine, Trave and Uecker. Data on rivers Schlei, Havel, Peene and Oder are based on limited numbers of male individuals (n = 2–4). The samples size of males for all other rivers was n ≥ 26.

The mean age of male silver eels from all rivers (as far as available) demonstrate that downstream migration starts significantly earlier (10.65 ± 0.27 years) compared with female silver eels (13.97 ± 0.71 years). Comparing the age of males among the rivers, the mean age varied between 9.0 (± 0.0) years for the river Havel and 11.56 (± 0.18) years for the river Eider. Female silver eels from the river Schlei and Oder start their downstream migration significantly earlier than females from the river Ems (15.76 ± 0.31 years) and Trave (20.0 ± 9.0 years). An overview about the mean ages of silver eels from German rivers is given in Figure 6.

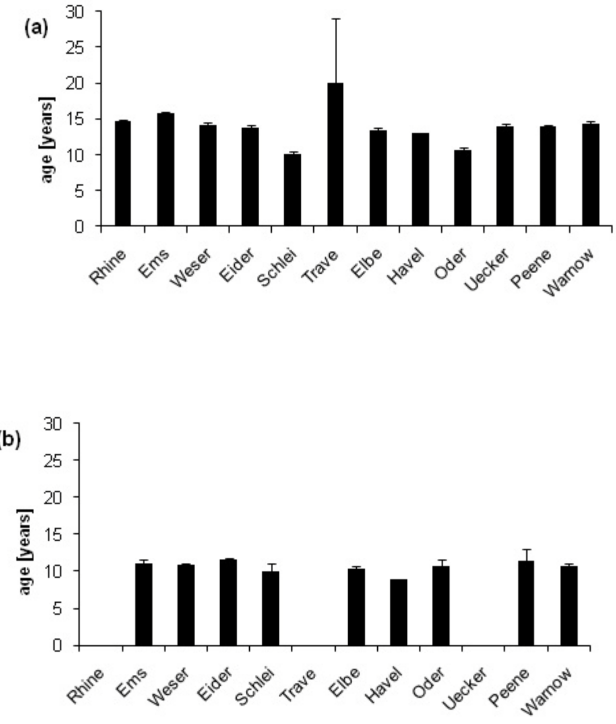

Figure 6. Mean age of female (a) and male (b) silver eels from German rivers. Note that numbers of females were limited for the river Trave, Havel and Oder (n = 1–3). The samples size of females for all other rivers was n ≥ 28. Note further that males were not available for the rivers Rhine, Trave and Uecker. Data on rivers Schlei, Havel, Peene and Oder are based on limited numbers of male individuals (n = 2–4). The samples size of males for all other rivers was n ≥ 26.

Condition of silver eels: condition factor and fat content in muscle tissue

The condition factor of female silver eels ranged between 0.18 in the rivers Uecker (± 0.02) and Warnow (± 0.02) and 0.21 in the rivers Schlei (± 0.03) and Weser (± 0.03). There were no significant differences in the mean condition factor ($p < 0.05$) between female silver eel samples in the different rivers (Figure 7.a.). The mean condition factor of male silver eels was lower compared with females and varied significantly between 0.15 in the river Schlei (± 0.03) to 0.19 in the rivers Elbe (± 0.03) and Eider (± 0.02, Figure 7.b.). The fat content in female silver eel muscle tissue ranged significantly between the lowest value in eels from the Havel river (22.7%, only one female available!) and the highest fat content in eels from the Eider (29.47 ± 0.97%; Figure 8.a.). In contrast to the condition factor the mean fat content in male silver eels was above the mean fat content of females (Figures 8.a and b.) and ranged significantly from 22.7% (± 2.6) in the Schlei river to 33.15% (± 0.64) in the Eider river (Figure. 8.b.).

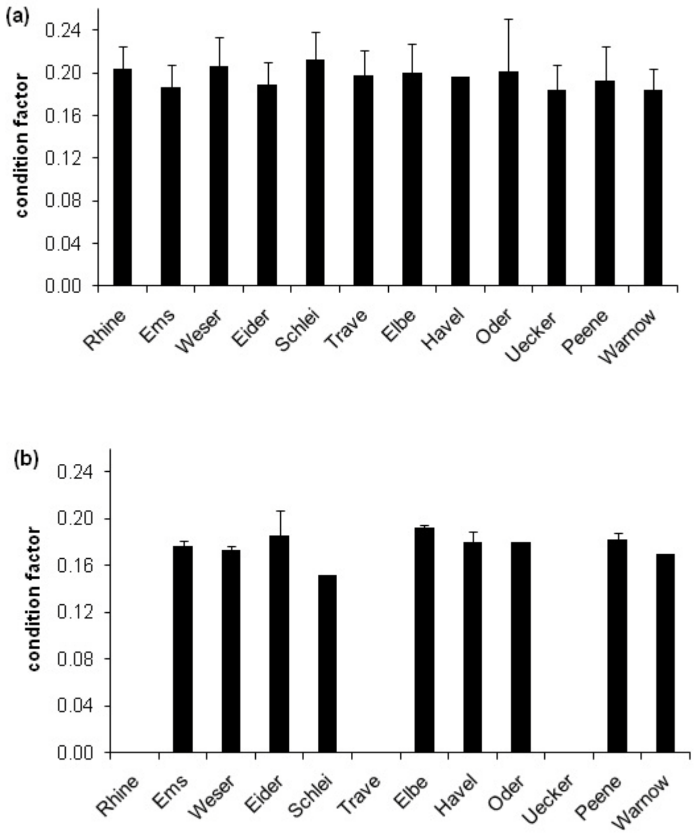

Figure 7. Condition factor of female (a) and male (b) silver eels from German rivers. Note that numbers of females were limited for the river Trave, Havel and Oder (n = 1–3). The samples size of females for all other rivers was n ≥ 28. Note further that males were not available for the rivers Rhine, Trave and Uecker. Data on rivers Schlei, Havel, Peene and Oder are based on limited numbers of male individuals (n = 2–4). The samples size of males for all other rivers was n ≥ 26.

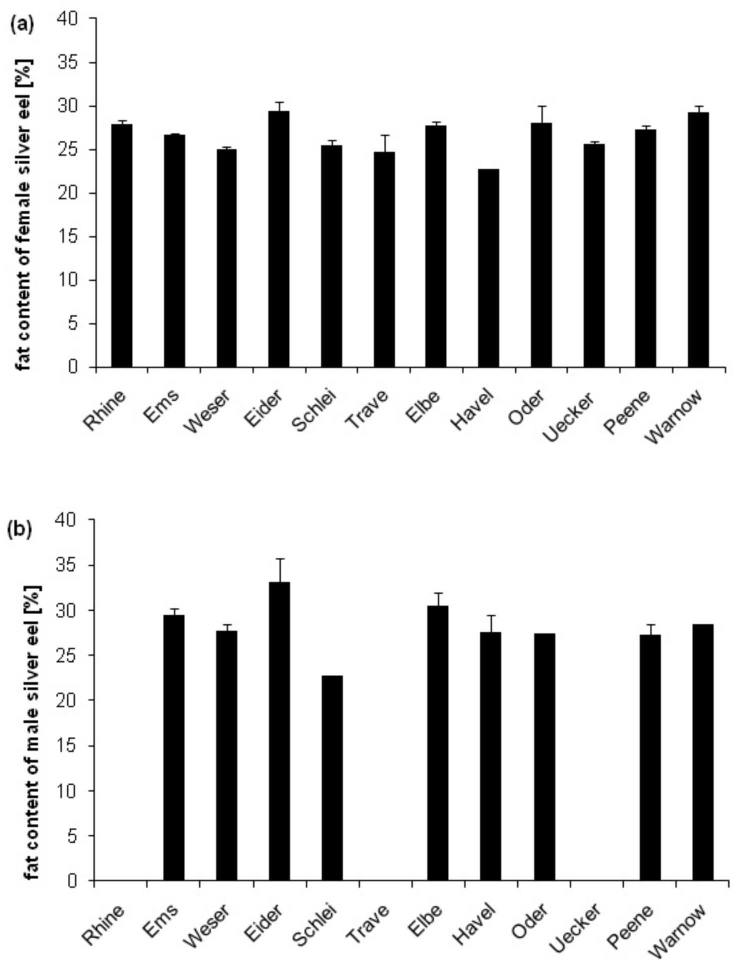

Figure 8. Muscle fat content [%] of female (a) and male (b) silver eels from German rivers. Note that numbers of females were limited for the river Trave, Havel and Oder (n = 1–3). The samples size of females for all other rivers was n ≥ 28. Note further that males were not available for the rivers Rhine, Trave and Uecker. Data on rivers Schlei, Havel, Peene and Oder are based on limited numbers of male individuals (n = 2–4). The samples size of males for all other rivers was n≥ 26.

Infestation with the swimbladder nematode *Anguillicoloides crassus*

Anguillicoloides crassus (and their larvae) was detected in all eel samples from German rivers (Figure 9). The lowest infestation rate could be observed in eels from the river Schlei (56%) and Oder (60.78%), which were significantly lower than highest infestation rates detected in eels from the river Uecker (93.07%) and Peene (93.81%). Analysis of the nematode abundances in eel swimbladder demonstrates more nematodes in female silver eels compared with female yellow eels (Figures 10.a and b). The highest nematode abundances in the swimbladder of female yellow and silver eels were detected in the Uecker river (yellow eels: 8.42 ± 1.71; silver eels: 11.35 ±1.57). The lowest nematode abundances in female yellow eels were found in the river Oder (1.16 ± 0.33). In case of female silver eels the lowest nematode abundance were detected in the river Schlei (2.14 ± 0.53). Nematode abundances in male silver eels ranged between uninfected eels (!) from the river Schlei to numbers of 8.5 ± 4.97 in eels from the river Oder (Figure 10.c.). The overall mean number of nematodes in the swimbladder of female yellow eels was 3.16 (± 0.55) and 6.33 (± 0.73) in female silver eels. The mean nematode abundance in the swimbladder of male silver eels was 4.66 (± 0.91). Details are given in Figures 10.a–10.c. In line with increased abundances of nematodes (Figure 10.b.) a progressive damage of the swimbladder (Hartmann classes, see methods) could be observed in female silver eels (2.76 ± 0.19) compared with female yellow eels (2.13 ± 0.06). For male silver eels the overall mean damage degree of the swimbladder was between the values of female yellow and silver eels (2.44 ± 0.15). Between the rivers, lowest mean degree of swimbladder damage was detected in female yellow eels from the river Oder (1.8 ± 0.12), indicating almost unimpaired swimbladders, and the highest values detected in females from the Peene river (2.46 ± 0.1). In female silver eels nematode induced swimbladder damage ranged between 2.39 (±0.16) in the river Elbe and 3.5 (± 0.5) in the Trave river, which was similar to observations in male silver eels from the Peene river (3.5 ± 0.5). Details are given in Figures 11.a, b and c.

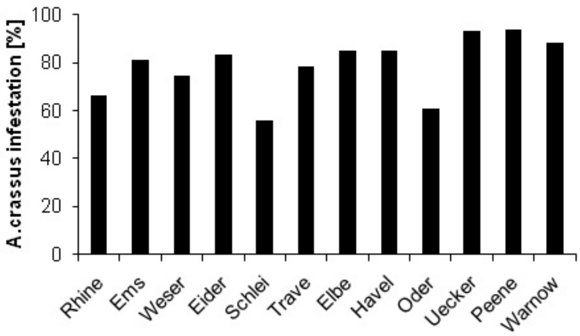

Figure 9. Infestation rates [%] of eel swimbladder with *Anguillicoloides crassus* (including infection with *A. crassus* larvae) in 2009. Pooled samples of male and female yellow and silver eels were investigated for each river (n ≥ 60 for each river).

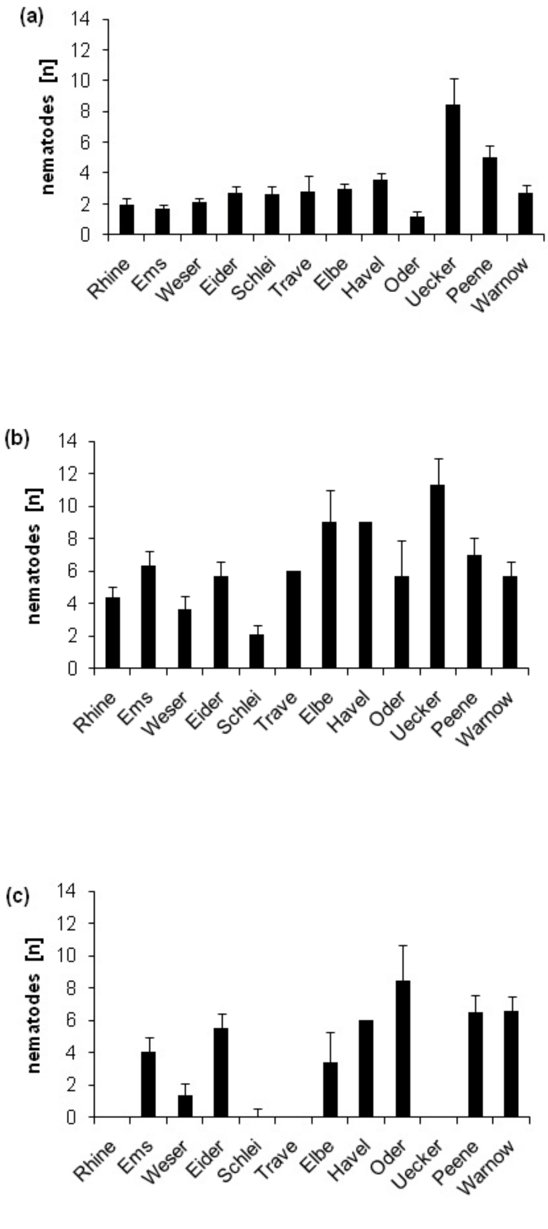

Figure 10. Abundances of *Anguillicoloides crassus* infection of the swimbladder in yellow eels (a), female silver eels (b), and male silver eels (c). Note that numbers of female silver eels were limited for the river Trave, Havel and Oder (n = 1–3). The sample size of female silver eels for all other rivers was n ≥ 28. Note further that males were not available for the rivers Rhine, Trave and Uecker. Data on rivers Schlei, Havel, Peene and Oder are based on limited numbers of male individuals (n = 2–4). The samples size of males for all other rivers was n ≥ 26.

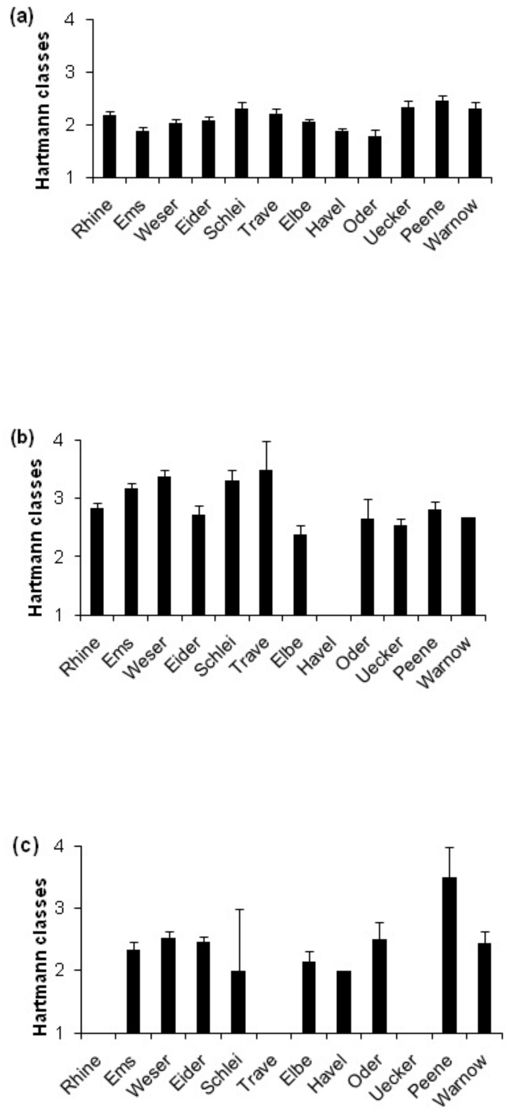

Figure 11. Degree of swimbladder damage by *Anguillicoloides crassus* in yellow eels (a), female silver eels (b) and male silver eels (c). Note that numbers of female silver eels were limited for the river Trave, Havel and Oder (n = 1–3). The samples size of female silver eels for all other rivers was n≥ 28. Note further that males were not available for the rivers Rhine, Trave and Uecker. Data on rivers Schlei, Havel, Peene and Oder are based on limited numbers of male individuals (n = 2–4). The samples size of males for all other rivers was n ≥ 26.

Discussion/Conclusion

At present, no data on the fishery itself were gathered in the frame of the DCF. Fishery catch data collection has to be performed as part of the Eel Management Plans under the administrative constraints of the EU Council Regulation 1100/2007 by German regional authorities. The European Commission has adopted a multiannual Community programme for the collection, management and use of data in the fisheries sector for the period 2011–2013 (2010/93/EU). To further gather biological information on European eel, Germany proposes to continue data collection of its commercial catches. However, to better address the urgent questions for an eel fisheries management, sampling scheme and especially the collected parameters should be adapted as compared with the first sampling phase (2008/949/EU). Besides length, weight, age, sex and maturity of the sampled eels, parasite infestation and especially contamination with harmful substances are important parameters. Several reviews on parasites and contaminants in eels have emphasized their negative influences on migration and reproduction. Therefore, estimation of an effective spawner biomass requires the quantification of the adverse effects of contaminants, parasites, diseases, and low fat levels on the capacity of eels to migrate and successfully spawn (EIFAC/ICES Working Group on Eels 2009, 2010).

In line with the report of the 2009/2010 session of the Joint EIFAC/ICES Working Group on Eels and the ICES Advice (2009) we strongly recommend that eel quality issues like *Anguillicoloides crassus* infestation as well as pollution with harmful contaminants like PCB's, DDT, dieldrin and heavy metals especially for silver eels should be taken into account for the new EU-Data Collection programme (2010/93/EU).

Considering the increasingly limited availability of glass eel for restocking purposes, a comprehensive data collection of these parameters (contaminants, parasites, etc.) under the EU-Data Collection Regulation (2010/93/EU) would significantly contribute to the identification of suitable habitats for the production of high quality eel spawners.

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Report on the eel stock and fishery in Denmark 2009/'10

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Reporting Period: This report was completed in September 2010, and contains data up to 2009 and some provisional data for 2010.

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 with 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 trans-boundary river basins named Kruså and Vidå shared with Germany. Intermediate and coastal waters are treated together with community waters constituting the entire marine area.

From 1st July 2009, professional fishing operations are based on licences and landings and number and type of gear must be registered with the Fisheries Directorate. The professional fishers 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 fishers 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 fishers are given a licence to use a limited number of gears. For landowners and recreational fishers 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 may implement further reductions pending the development in the eel stock.

DK.3 Time-series data

DK.3.1 Recruitment-series and associated effort

No data.

DK.3.1.1 Glass eel

No data.

DK.3.1.2 Commercial

No data; glass eel fishery is forbidden.

DK.3.1.3 Fishery independent

No data.

DK.3.1.4 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 (electro fishing 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		5		
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 3.3.

DK.3.2.1.1 Fishery Independent

No data.

DK.3.3 Silver eel landings

DK.3.3.1 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 fishers. From mid 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	1985	-	-	111
1961	-	-	235	1986	-	-	120
1962	-	-	215	1987	-	-	90
1963	-	-	238	1988	-	-	119
1964	-	-	223	1989	-	-	114
1965	-	-	205	1990	-	-	107
1966	-	-	211	1991	-	-	99
1967	-	-	243	1992	-	-	109
1968	-	-	258	1993	-	-	57
1969	-	-	254	1994	-	-	60
1970	-	-	249	1995	-	-	52
1971	-	-	183	1996	-	-	34
1972	-	-	200	1997	-	-	39
1973	-	-	201	1998	-	-	40
1974	-	-	163	1999	-	-	30
1975	-	-	260	2000	4	24	28
1976	-	-	178	2001	2	34	36
1977	-	-	179	2002	5	27	27
1978	-	-	157	2003	2	21	24
1979	-	-	78	2004	4	12	15
1980	-	-	147	2005	3	10	14
1981	-	-	140	2006	7	8	14
1982	-	-	163	2007	5	6	11
1983	-	-	116	2008	5	4	9
1984	-	-	126	2009	8	5	13

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

DK.3.3.2 Recreational

An interview study in 2009 demonstrated that recreational marine fishers landed 100 tonnes of eel. Recreational fishers are only allowed to use fykenets and the catch supposedly consists 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. Aquaculture production (1984–2009).

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

Table 3.4.1. Aquaculture production by use in Kg (Source: Fisheries directorate).

SIZE	USE	KG
Large eel	Consumption	1 658 646
Young eel	Stocking aquaculture	13 413
Young eel (3.5 g)	Stocking wild in Denmark	5412
Young eel	Stocking wild eksport	21 510
Biomass lost	Dead/destroyed	7638
Total		1 706 619

DK.3.4.1 Seed supply

Glass eels to Danish aquaculture are solely or mainly imported from France.

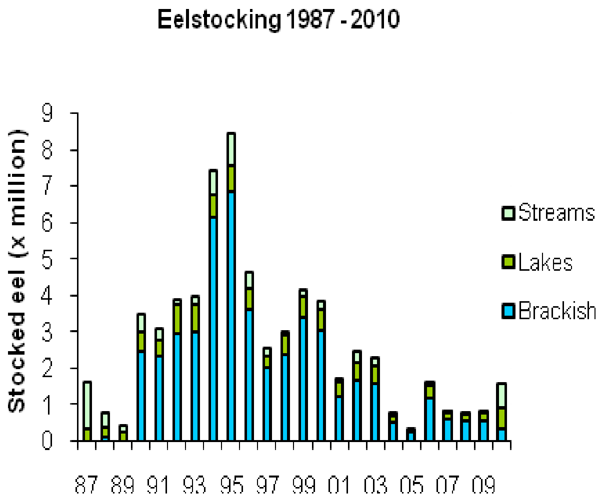
DK.3.5 Stocking

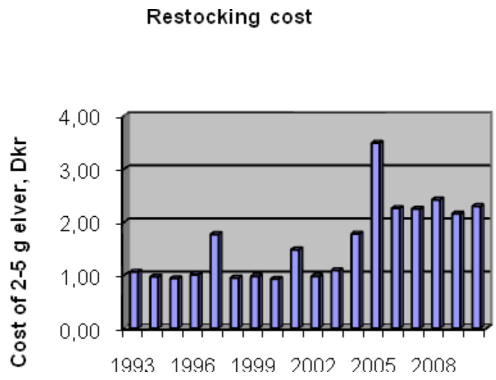
DK.3.5.1 Amount stocked

Restocking has taken place for decades by fishers 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 fishers. 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 2010 a total of 1.24 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 1987–2009. Numbers of eels stocked (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	1999	3.38	0.56	0.18	4.12
1988	0.11	0.24	0.4	0.75	2000	3.02	0.55	0.25	3.83
1989	0	0.24	0.17	0.42	2001	1.2	0.38	0.12	1.7
1990	2.46	0.49	0.51	3.47	2002	1.66	0.47	0.3	2.43
1991	2.3	0.44	0.32	3.06	2003	1.54	0.49	0.22	2.24
1992	2.94	0.81	0.11	3.86	2004	0.52	0.18	0.06	0.75
1993	2.97	0.76	0.23	3.96	2005	0.24	0.06	0	0.3
1994	6.12	0.61	0.67	7.4	2006	1.15	0.35	0.1	1.6
1995	6.83	0.72	0.9	8.44	2007	0.59	0.21	0.02	0.83
1996	3.58	0.58	0.44	4.6	2008	0.52	0.19	0.04	0.75
1997	2.02	0.29	0.22	2.53	2009	0.55	0.20	0.05	0.81
1998	2.35	0.53	0.1	2.98	2010	0.30	0.57	0.67	1.55

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 fishers 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 fishers 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 fishers 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 fishers 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

As of February 2nd 2009 the following measures have been implemented for registered recreational fishers and commercial fishers 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 fishers and entities must register with the Directorate of Fisheries before initiating fishing activities.

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

Location Fishermen	Fishermen with licence	Fykenets	Small poundnet	Large poundnet	Hookline
Marine Professional	384	35438	1108	1165	1932
Freshwater Professional	17	914	214	0	na
Marine Recreational	*18768	Na	Not allowed	Not allowed	na
Recreational	-	Na	Not allowed	Not allowed	-

***) Estimated from questionnaire from 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.

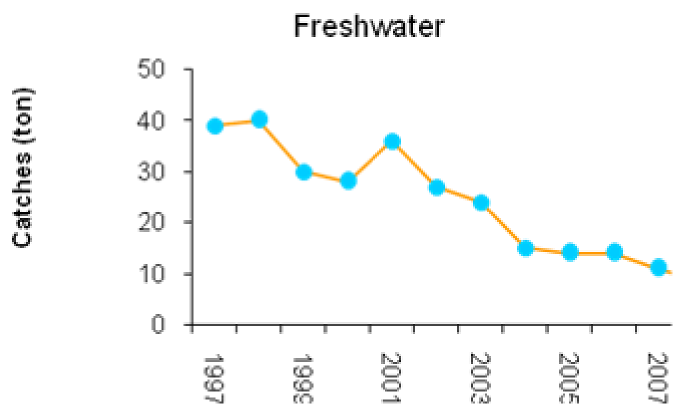
The data given below are the official landings reported to the ministry.

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 and Figure 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

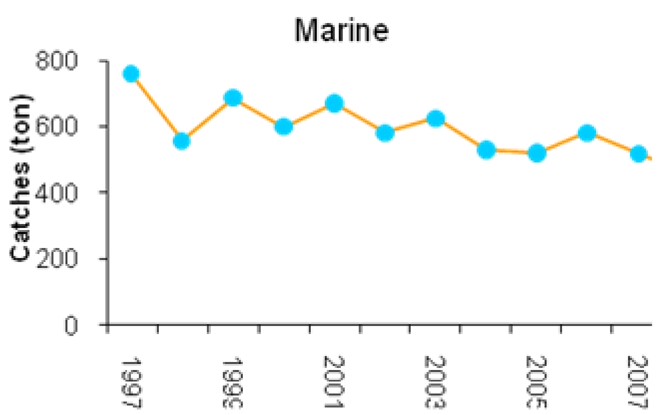


DK.6.3 Marine landings

The annual landings of eel (yellow and silver eels) in the marine area has 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



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 are in a process to be cancelled as a part of National river restoration projects and have been taken place in River Kolding Å where a monitoring station is situated at Harte power station. Terminating weirs reduces the possibility to monitor young eel recruitment the traditionally way, using eel pass traps. 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 eels to the brook has been reduced and glass eels are rare in recent years.

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

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

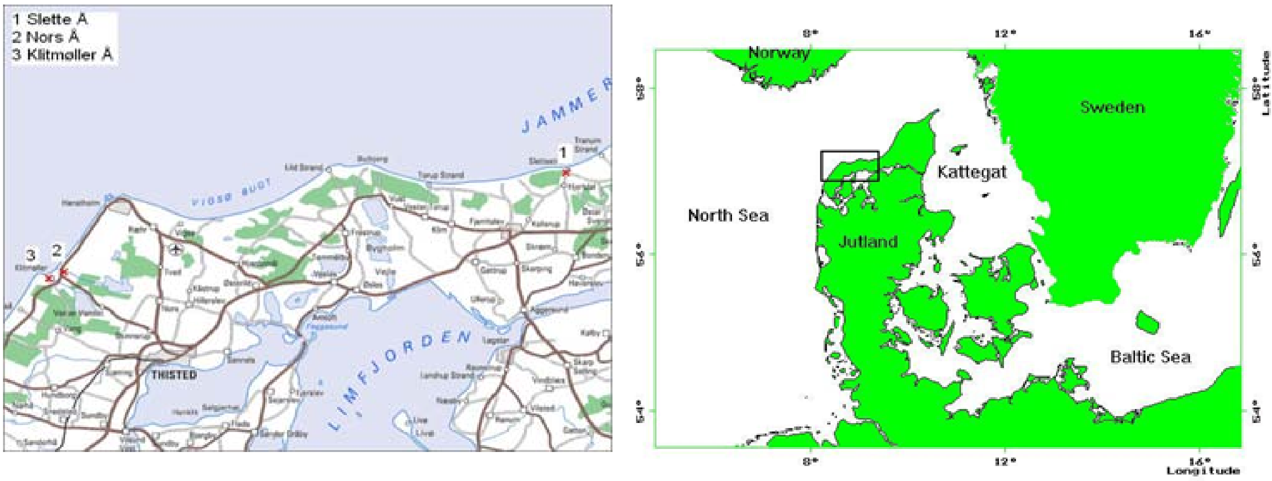


Figure 8. New glass eel monitoring sites (1, 2 and 3) in the North Sea.

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 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 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 starting in 1987 and 1988. The number of Anguillicola infected eels (prevalence) is relatively constant at all three locations.

Table 1. Anguillicola monitoring data for 2009.

Location	Salinity ppt	Coordinates	Year	Total	Infected	Prevalence	Intensity
				N	n	%	n
Arresø	0	55.59N;11.57E	2009	65	40	61.5	3.4
Isefjord	18	55.50N;11.50E	2009	97	39	40	4.5
Ringk. Fj	5–10	55.55N;08.20E	2009	100	73	73	5.1

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 10.4. 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 5734 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, the cormorant do not 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).

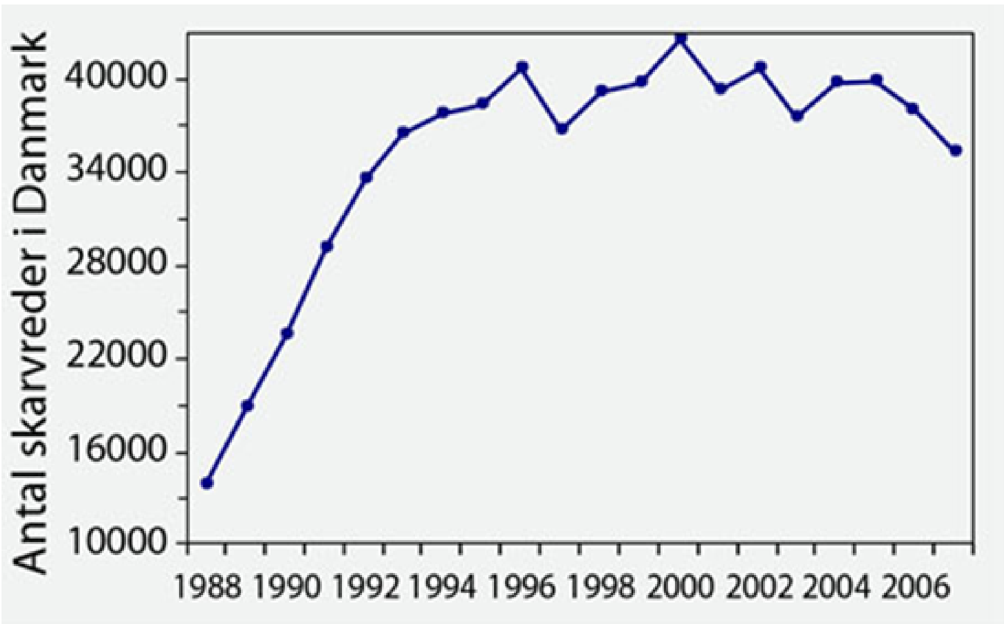


Figure 10.4. Number of nesting birds in Denmark. Data from NERI. University of Århus.

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 app. 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 app. 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 eels, 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 with 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 "pristine" 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 tonnes glass eel in freshwater and 33 tonnes and glass eel in marine waters are needed.

DK.13.2.2.2 Current production

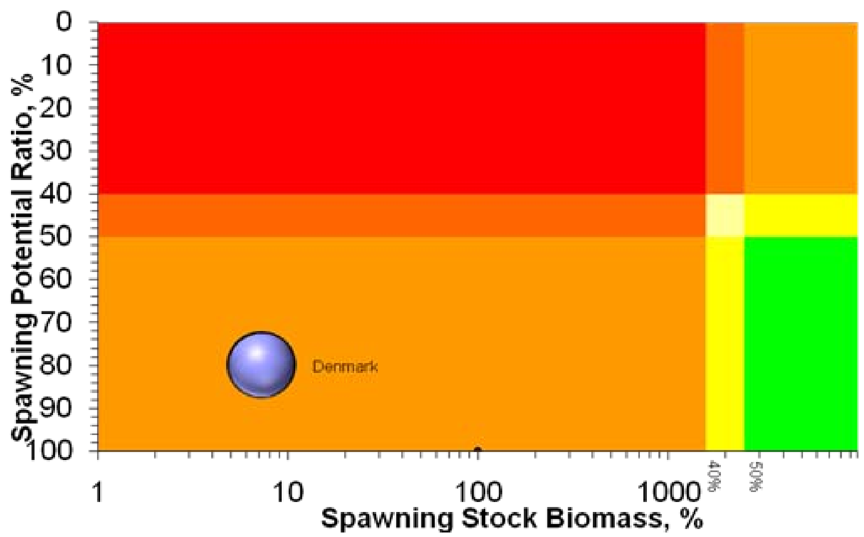
Current silver eel production

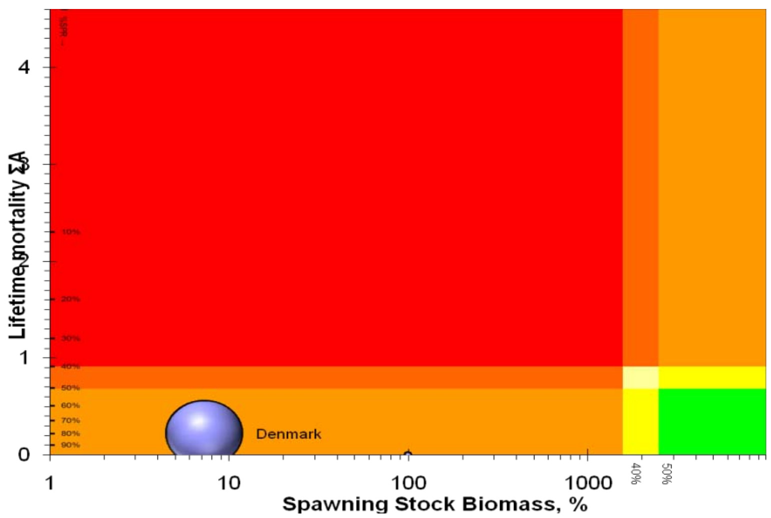
No data on the current silver eel production in inland waters is available. The total fisheries are assumed 20 tonnes in 2010 (reported and unreported). Based on the general trend in recruitment to Scandinavia it is assumed that one eel generation ago (an eel generation in Denmark is set to 15 years) in the mid 1990s the recruitment was app. 10% of the level before 1980. Therefore current silver eel production in freshwater is assumed to be app. 100 tonnes or approx. 0.3 million individuals.

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 prestine production (no anthropogenic mortality) of silver eel (**Bo=1110 t);** The best estimate of the current production of silver eels **(Bbest=100t)** and finally the actual estimated escapement **(Bactual = 80t).** 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 marine area prior to 1980 or later. The fisheries yield today is about 500 tonne per year compared with former level in the 1960s of about 4000 tonnes. It is estimated that 7000 tonnes 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 tonnes.

DK.13.2.2.3 Current escapement

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

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 approx. 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 towards the Sargasso Sea.

In **salt water:** To meet the 40% target within one eel generation of approx. 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 Standardisation 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 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.

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Report on the eel stock and fishery in Ireland 2009/'10

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Reporting Period: This report was completed 1 September 2010, and contains data up to the end of 2009 and some provisional data for 2010. Only data available by 30th August 2010 was included in the analysis.

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IR.2 Introduction

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

An additional data requirement is emerging to support an international assessment of the status of the eel stock. There will be a need to post-evaluate the impact of the EU Regulation on the status of the eel stock commencing with an assessment of the current stock. The development of a tool to support this task was commenced by the WGEEL in 2008 and this will be continued in the 2009 WGEEL. Additional data will be required, along with highlighting existing data and its discontinuities, to support this process and the format of the 2009 Country Report has been modified to assist in this.

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 Waterframework 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 – formerly the Central (CFB) and Regional Fisheries Boards (RFBs)

The CFB was a statutory body, established under the Fisheries Act 1980, operating under the aegis of the DCENR. The principal functions of the CFB were to advise the DCENR on policy relating to the conservation, protection, management, development and improvement of inland fisheries and sea angling, and to support, coordinate and provide specialist support services to the RFBs. The seven statutory RFBs are responsible for maintaining and improving environmental quality and developing and protecting the fisheries resource in their regions. Eel fishing licences and authorizations are issued on a Regional basis.

In July 2010 in accordance with the Inland Fisheries Act 2010, Inland Fisheries Ireland was established in place of the Central and seven Regional Fisheries Boards with obligations in relation to the protection, conservation, management, marketing, development and improvement of the inland fisheries resource 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.

Scientific Eel Group for Inland Fisheries

A scientific subcommittee was established in 2009 for eel in Ireland, comprised of representatives from the relevant State Agencies, 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 Organisation of the Eel Management Units

The Eel Management Plans were established and implemented for River Basin Districts as defined in Directive 2000/60/EC and in accordance with Article 2 of the Eel Regulation. Ireland submitted a National Report encompassing five River Basin EMPs and one transboundary EMP. These are the Eastern EMP, South Eastern RBD EMP, South Western RBD EMP, Shannon IRBD EMP, Western RBD EMP and the transboundary North Western RBD EMP.

Inland and estuarine eel fisheries in Ireland are managed by seven Regional Fisheries Boards, divided into Fisheries Districts, and the Loughs Agency. Fisheries District boundaries largely conform to the arrangement of river catchments. In general, eel fisheries managed on a Fisheries District basis fall naturally within the boundaries of the RBDs.

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 153 881 ha. The 265 "migratory" systems were estimated to contain 132 275 ha of lake habitat and 21 606 ha of fluvial habitat, of which 2826 ha is estimated to be 1st order stream. The ShIRBD, WRBD and NWIRBD are dominated by lacustrine habitat.

The catchments have been 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 for 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 fishers, 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 demonstrated 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.

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 historical 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 (Cathaleens Falls) and of pigmented young eel (bootlace) on the Shannon (Parteen). 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 fishers will be engaged in investigating possible diversification schemes for the former commercial fishers.

IR.2.2.9 Summary

Irish silver eel escapement from freshwaters expressed as a percent of historical 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

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 Cathleens Falls and of >0+ age recruits at Parteen 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 Cathleens Falls (Erne) is undertaken by the ESB (Figure 3.1). 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 up to 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), Cathleens Falls (Erne), the Feale, Inagh and Maigue Rivers and fishing is also undertaken by the ESB/Shannon Regional Fisheries Board 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 and 2009 were particularly poor and have remained low in 2010.

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

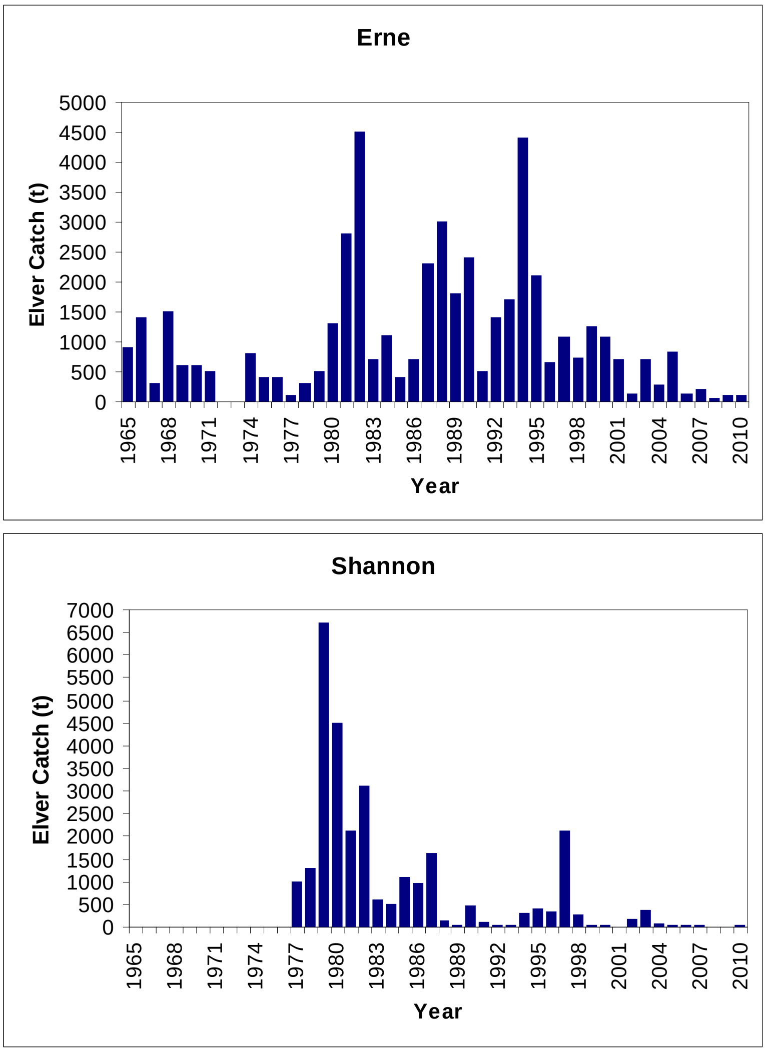

Figure 3.1. Annual elver catches (t) in the traps at Ardnacrusha (Shannon) and Cathleens Falls (Erne); data from ESB. Full trapping of elvers took place on the Erne from 1980 onwards.

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 (t) in the traps at Ardnacrusha (Shannon) and Cathleens Falls (Erne); data from ESB.

Year	Erne	Shannon
	kg	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

Year	Erne	Shannon
	kg	kg
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

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

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 Dam (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 the latter two years at Parteen.

Table 3.3. Juvenile yellow eel catches (kg), 1985 to 2010 (nf = not fished).

	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

*** data provisional**

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 as the commercial fisheries were closed.

IR.3.2.2 Recreational

There is no data available for yellow eel caught by recreational fishers; 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.

IR.3.3.1 Commercial

Commercial Fisheries were closed in 2009.

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 3.2; 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 2003/04.

The silver eel catch in 2005/06 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 2006/07 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 2004/05 and may have been helped by relatively high water levels throughout the early winter period.

The silver eel catch in 2007/08 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 2008/09 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 2009/10 as a conservation fishery for trap and transport around the barriers at Parteen and Ardnacrusha. The silver eel catch in 2009/10 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.

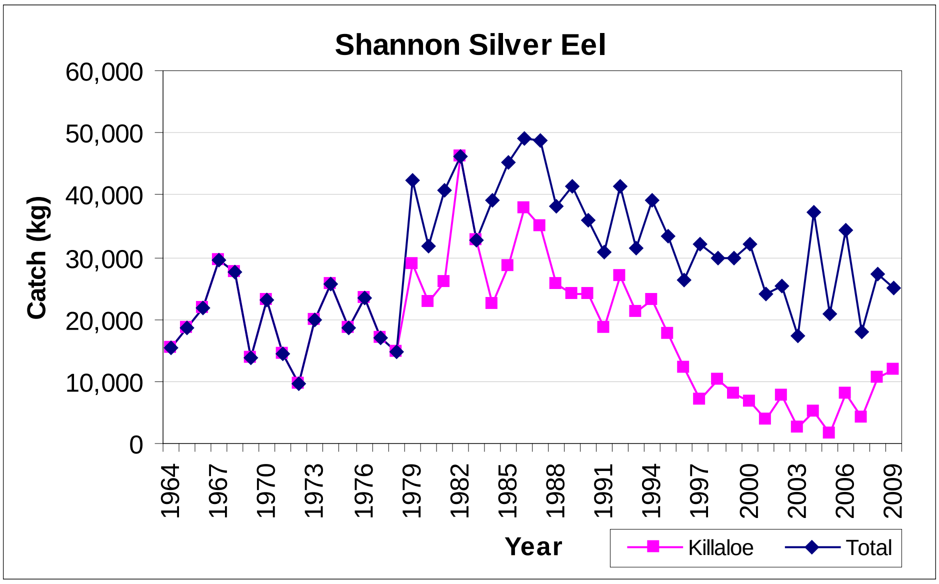

Figure 3.2. Silver eel catches from the Killaloe eel weir and the total Shannon system, for 1964 to 2009. Note that the total for the Shannon in 2009 is a conservation fishery with reduced effort: Killaloe remains comparable.

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 3.3; 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.

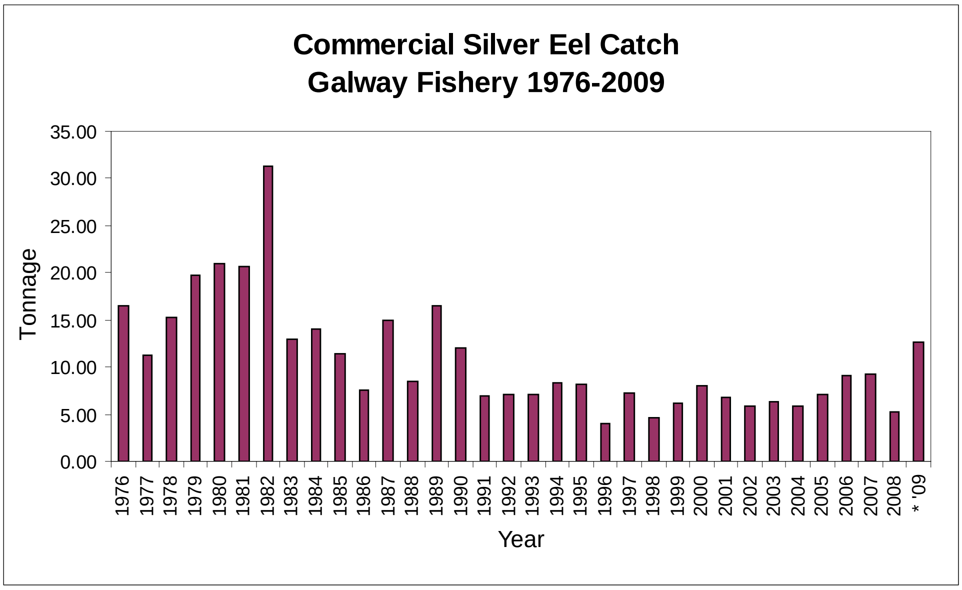

Figure 3.3. Annual silver eel catch (t) in the commercial Galway Fishery, Corrib System, for 1976 to 2009. *Note the fishery was operated as a research catch and release fishery in 2009.

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.

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

Season	Year	Galway Fishery	Shannon Killaloe	Shannon Total
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

IR.3.3.2 Recreational

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

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 <u>not</u> 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 an 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 3.4). 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
Average count		4409	2808	2875
Biomass (kg)		436	602	601
Production (kg/ha)		0.9	1.3	1.3
Number of females		1626	1932	
Biomass of Females		329	529	
Potential No. Ova (1.5 m/kg)		494,127,893	793,735,127	

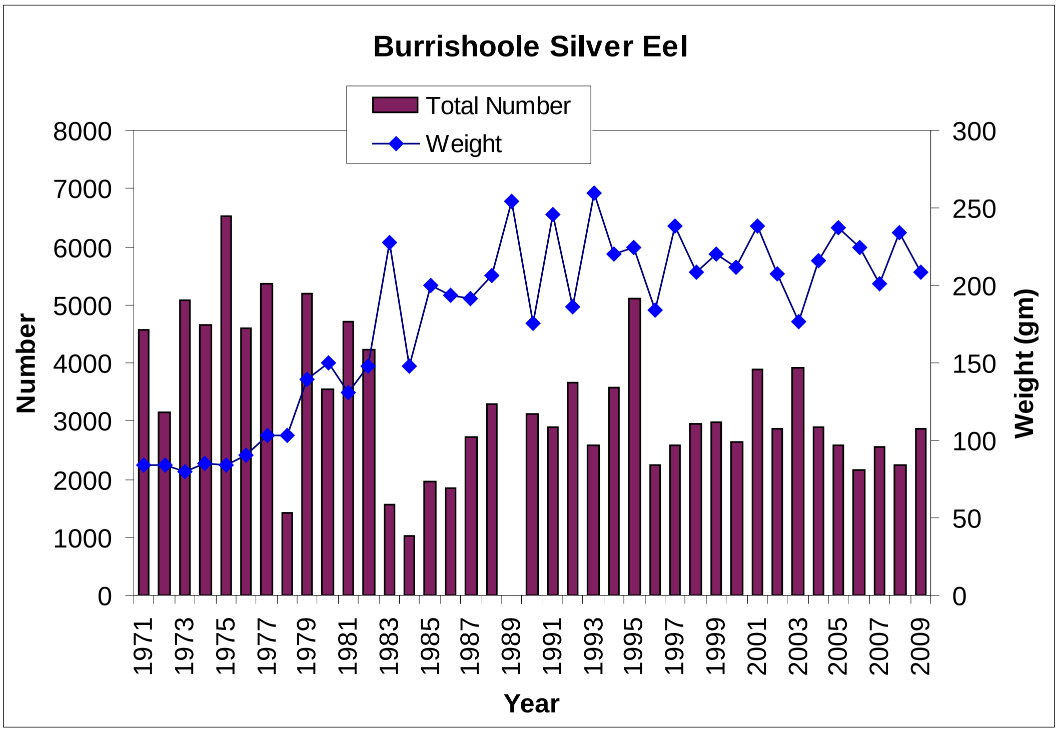

Figure 3.4. Annual silver eel catch, and mean weight (gm) in the Burrishoole System for 1971 to 2009.

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 stocked.

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 fishers 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 byelaw (Conservation of Eel Fishing (Prohibition on Issue of Licences) Bye-Law No. 858, *2009). This Bye-law prohibits the issue of any licences for fishing for eels of the species Anguilla anguilla by any fishing method in any fishery district.*

These two bye-laws 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 eels 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). 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.

IR.4.3 Silver eel

Silver eels were fished using fykenets, fixed v-wing nets and coghill nets (Table 4.2), although standard fyke licences were only listed in the table for yellow eel (Table 4.1). 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.

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.

Table. 4.1. Details of yellow eel licences for each Eel Management Unit, 2001 to 2009. I = number issued, R = number reporting catch & A = the number that actively fished.

Management	Year	Longline			Standard Fyke			Baited pot			Other Fykes			Total		
Unit		I	R	A	I	R	A	I	R	A	I	R	A	I	R	A
NWIRBD	2001	32	10	10	15	4	4							47	14	14
(ROI)	2002	30	11	11	18	8	8							48	19	19
	2003	30	0		16	0								46	0	0
	2004	24	8	8	13	2	2							37	10	10
	2005	25	14	14	18	18	8							43	32	22
	2006	24	20	19	21	15	13							45	35	32
	2007	27	25	16	19	17	11							46	42	27
	2008	26	22	19	24	19	15							50	41	34
	2009	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SERBD	2001				8	0		27	0					35	0	0
	2002				32	13	13	27	0					59	13	13
	2003				16	14	14	20	19	14				36	33	28
	2004				16	16	16	20	10	9				36	26	25
	2005				15	7	5	20	13	10				35	20	15
	2006				13	9	7	20	10	9				33	19	16
	2007				16	12	10	20	13	6				36	25	16
	2008				17	7	7	21	17	14				38	24	21
	2009	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EEMU	2002		7	7		4	4							0	11	11
	2003	4	4	4	3	3	3							7	7	7
	2004	5	5	5	5	5	5							10	10	10
	2005	3	2	2	3	2	1							6	4	3
	2006	4	2	2	3	2	1							7	4	3
	2007	3	3	2	3	2	2							6	5	4
	2008	4	3	3	2	2	1							6	5	4
	2009	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SHIRBD**	2001		14	11		13	13							0	27	24
	2002		19	16		18	15							0	37	31
	2003		13	12		15	13							0	28	25
	2004	24	16	16	23	15	15							47	31	31
	2005	22	18	16	21	19	19							43	37	35
	2006	22	17	2	21	10	1							43	27	3
	2007	22	21	17	21	13	10							43	34	27
	2008**															
	2009	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Management	Year	Longline			Standard Fyke			Baited pot			Other Fykes			Total		
Unit		I	R	A	I	R	A	I	R	A	I	R	A	I	R	A
SWRBD	2001	4	4	0	5	3	3	1	1	1				10	8	4
	2002	4	4	0	7	3	3	1	1	1				12	8	4
	2003	5	0		7	1	1	2	0					14	1	1
	2004				4	1	1	1	0					5	1	1
	2005				10	3	1	1	1	1				11	4	2
	2006				5	2	2	1	0					6	2	2
	2007				4	0		1	0					5	0	0
	2008				3	3	3	1	1	0				4	4	3
	2009	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WRBD	2001	15	0		21	16	11				3	3	3	39	19	14
	2002	8	5	5	22	20	17				3	3	3	33	28	25
	2003	16	15	15	22	17	10				3	3	3	41	35	28
	2004	14	15	11	25	21	17				3	3	3	42	39	31
	2005	15	13	13	25	25	22				3	3	3	43	41	38
	2006	32	13	12	26	19	18				3	3	3	61	35	33
	2007	32	26	19	25	19	16				3	3	3	60	48	38
	2008	32	25	13	25	19	14				3	3	3	60	47	30
	2009	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

*** data may be subject to review**

**** data not available**

Table 4.2. Details of silver eel licences for each Eel Management Unit, 2001 to 2009. I = number issued, R = number reporting catch & A = the number that actively fished.

Management	Year	Coghill			Fixed trap			V-wing fyke*			Total		
Unit		I	R	A	I	R	A	I	R	A	I	R	A
NWIRBD	2001	0									0	0	0
(ROI)	2002	0									0	0	0
	2003	0									0	0	0
	2004	4	0		1						5	0	0
	2005	1	0		1	0					2	0	0
	2006	3	1	0	1	0					4	1	0
	2007	1	1	0							1	1	0
	2008*												
	2009	0	0	0	0	0	0	0	0	0	0	0	0
SERBD	2001										0	0	0
	2002	2	0								2	0	0
	2003	2	2	2							2	2	2
	2004	2	2	2							2	2	2
	2005	2	2	0							2	2	0
	2006	2	2	2							2	2	2

Management	**Year**	**Coghill**			**Fixed trap**			**V-wing fyke***			**Total**		
Unit		I	R	A	I	R	A	I	R	A	I	R	A
	2007	2	2	0							2	2	0
	2008*												
	2009	0	0	0	0	0	0	0	0	0	0	0	0
EEMU	2002		7	7		2	2				0	9	9
	2003	8	6	6	2	2	2				10	8	8
	2004	7	8	7	3	2	2				10	10	9
	2005	7	5	5	0	0	0				7	5	5
	2006	7	7	7	2	2	2				9	9	9
	2007	6	2	2	0						6	2	2
	2008	5	1	1							5	1	1
	2009	0	0	0	0	0	0	0	0	0	0	0	0
SHIRBD	2001		0						19	13	0	19	13
	2002		20	20					19	17	0	39	37
	2003		0						19	16	0	19	16
	2004	26	20	20				21	21	20	47	41	40
	2005	22	21	21				23	23	19	45	44	40
	2006	22	20	20				23	21	19	45	41	39
	2007	22	20	20				23	21	19	45	41	39
	2008*												
	2009	0	0	0	0	0	0	0	0	0	0	0	0
SWRBD	2001										0	0	0
	2002										0	0	0
	2003										0	0	0
	2004										0	0	0
	2005										0	0	0
	2006										0	0	0
Management	Year	Coghill			Fixed trap			V-wing fyke*			Total		
Unit		I	R	A	I	R	A	I	R	A	I	R	A
	2007										0	0	0
	2008										0	0	0
	2009	0	0	0	0	0	0	0	0	0	0	0	0
WRBD	2001	28	19	18	1	0					29	19	18
	2002	27	21	21	1	0					28	21	21
	2003	27	23	19	1	0					28	23	19
	2004	27	27	24							27	27	24
	2005	24	24	17	1	1	1				25	25	18
	2006	26	22	22	1	0					27	22	22
	2007	26	19	19	1	0					27	19	19
	2008	23	17	16	1	0					24	17	16
	2009	0	0	0	0	0	0	0	0	0	0	0	0

*** data may be subject to review**

**** data not available**

IR.5 Fishing effort

In May 2008, the Minister for Communications, Energy and Natural Resources introduced a byelaw (Conservation of Eel Fishing (Annual Close Season) Bye-law No. C.S. 297, 2008) restricting the fishing season for both yellow and silver eel as follows:

a) to take or to attempt to take, or to fish for or to attempt to fish for, or to aid or assist in the taking or fishing for or the attempting to take or fish for, or to be in possession of brown eel during the period;
   - i) from 16 May 2008 to 31 May 2008; and
   - ii) in any year from 1 September to 31 May in the next following year.

b) to take or to attempt to take, or to fish for or to attempt to fish for, or to aid or assist in the taking or fishing for or the attempting to take or fish for, or to be in possession of silver eel during the period;
   - i) from 16 May 2008 to 30 September 2008; and
   - ii) in any year from 1 January to 30 September.

Fishing effort was not monitored in the Irish eel fishery. There was no logbook or compulsory recording system for fishers 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 byelaws prohibiting fishing for eel, or possessing or selling eel caught in a river in Ireland and prohibiting the issue of any licences for fishing for eels of the species *Anguilla anguilla* by any fishing method in any fishery district (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.

IR.5.2 Yellow eel

Refer to Section 4.2 for the number of active licences.

No licences were issued in 2009.

IR.5.3 Silver eel

Refer to Section 4.3 for the number of active licences.

No licences were issued in 2009.

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.

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 Tables 6.1, 6.2 and 6.4 for 2001 to 2008 for each Eel Management Unit (RBD). 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 byelaws implemented in 2008 had little impact on the catch. This may be due to a number of factors, including greater effort in a shorter season, better data reporting and recording since 2005 and changes in reporting practices by fishers.

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).

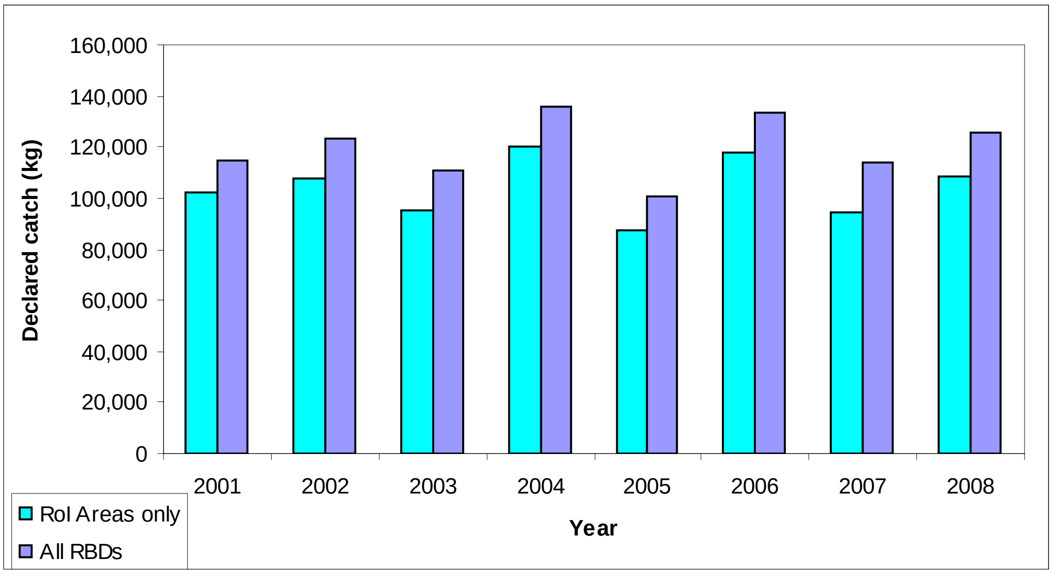

Figure 6.1. Total declared catch (kg) of yellow and silver eel combined for both the RoI and the total for RoI and NI part of the NWIRBD (data supplied by DCAL & AFBINI) for the years 2001 to 2008.

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
Total RoI	102,175	107,892	94,876	120,288	87,167	117,729	94,086	108,249	0
Total***	114,475	123,192	111,036	135,988	100,767	133,429	113,686	125,481	0

***** Total 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. The data are also presented by Fisheries District in Table 6.3.

It would appear from the declared catch data that the conservation byelaws 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 fishers.

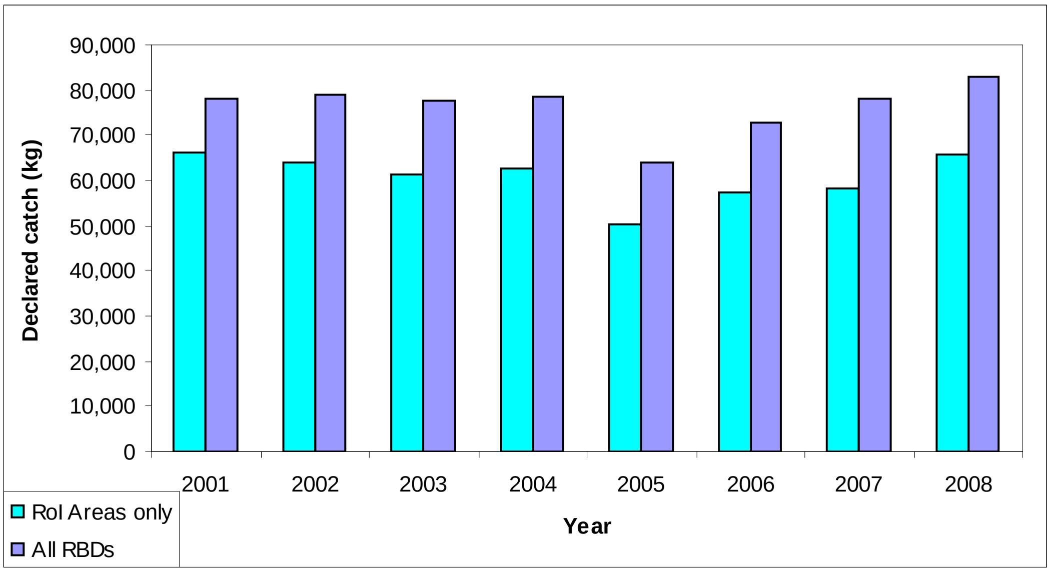

Figure 6.2. Declared catch (kg) of yellow eel for both the RoI and the total for RoI and NI part of the NWIRBD (data supplied by DCAL & AFBINI) for the years 2001 to 2008.

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
EEMU	5500	7,806	6,060	5,420	841	953	1,487	4,448	0
SERBD	17,055	13,027	9,786	7,753	5,569	3,327	4,413	3,591	0
SWRBD	552	960	70	35	22	250	NR	0	0
SHIRBD	15,983	18,116	22,196	21,535	18,736	17,591	24,635	32,306	0
WRBD	22,126	15,043	23,415	21,142	17,851	18,276	17,922	12,410	0
NWIRBD*	4,743	8,911	NR	6,793	7,311	16,865	9,929	13,121	0
NWIRBD**	12,300	15,300	16,160	15,700	13,600	15,700	19,600	17,232	NR
NWIRBD***	17,043	24,211	16,160	22,493	20,911	32,564	29,529	30,353	NR
Total RoI	65,959	63,863	61,527	62,678	50,330	57,262	58,386	65,876	0
Total	78,259	79,163	77,687	78,378	63,930	72,962	77,986	83,108	NR

*** RoI only**

**** NI only**

***** Total NWIRBD**

Table 6.3. Declared Regional catches (t) of yellow eel for 2001–2009.

Fishery Region	2001	2002	2003	2004	2005	2006	2007	2008	2009
Eastern	14.0	16.0	11.3	9.6	1.1	1.0	2.0	4.7	0
Southern	8.6	4.8	4.6	3.6	5.3	3.1	3.9	3.3	0
South Western	0.6	1.0	0.1	0.1	0.1	0.5	0.0	0.0	0
Shannon	15.9	18.1	22.2	21.5	18.7	17.6	24.6	32.3	0
Western	8.9	4.1	12.4	9.8	8.1	11.9	8.0	8.9	0
North Western	13.2	11.0	11.0	11.3	9.7	6.3	9.9	3.5	0
Northern	4.7	8.9	-	6.8	7.3	16.9	9.9	13.1	0
Total	66.0	63.9	61.5	62.7	50.4	57.3	58.4	65.8	0

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 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 eels 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 though the following years.

It would appear from the declared catch data that the conservation byelaws 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 byelaws 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 by-law and was closed in 2009.

No requirement to implement the EU 50% reduction as fishery closed.

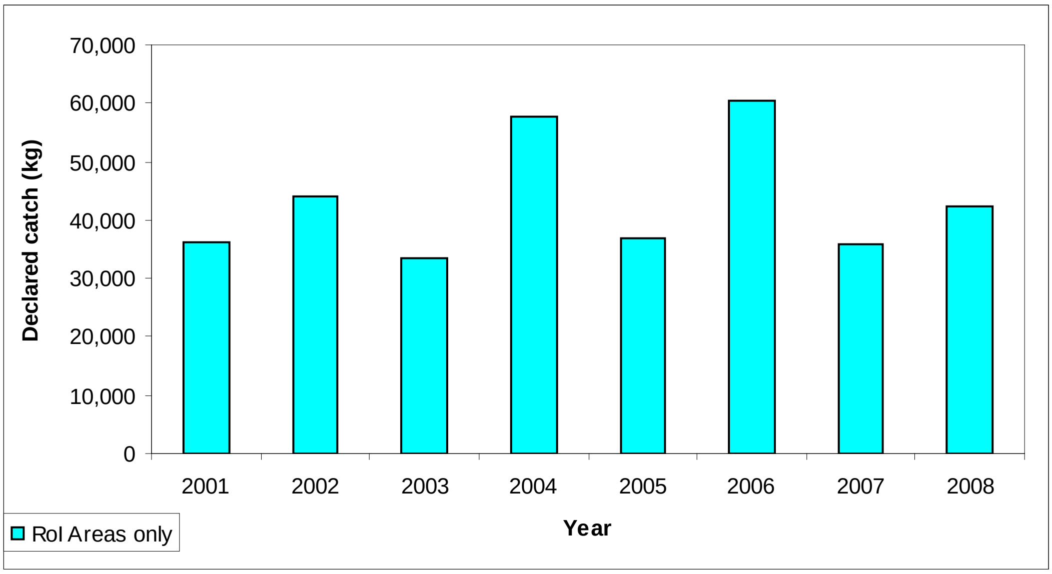

Figure 6.3. Declared catch (kg) of silver eel for the RoI only for 2001–2008.

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
EEMU	2500	2,360	2,460	1,810	396	364	90	40	0
SERBD	0	2,004	1,218	800	260	840	0	318	0
SWRBD	0	0	0	35	22	250	0	1,060	0
SHIRBD	24,107	25,248	17,075	37,116	21,535	34,478	18,122	27,158	0
[1]Catch rel.	1,300 (5)	3,900 (15)	1,600 (9)	2,900 (8)	1,500 (7)	7,700 (22)	3,665 (20)	10,460 (39)	@
WRBD	9,581	14,386	12,596	17,849	14,624	23,971	16,541	13,797	0
NWIRBD *	28	31	NR	NR	NR	564	947	0	0
NWIRBD **	NR	NR	NR	NR	NR	NR	NR	0	0
NWIRBD ***	28	31	NR	NR	NR	564	947	0	0
Total RoI	36,216	44,029	33,349	57,610	36,837	60,467	35,700	42,373	0
Total	36,216	44,029	33,349	57,610	36,837	60,467	35,700	42,373	0

*** RoI only**

**** NI only**

***** Total NWIRBD**

@ See Section 8.3

Table 6.5. Declared Regional catches (t) of silver eel for 2001–2009. * total catch including a proportion released below hydroelectric dam, ** amount released & (% of catch).

Fishery Region	2001	2002	2003	2004	2005	2006	2007	2008
Eastern	2.5	4.3	3.6	2.5	0.7	0.9	0.1	0.4
Southern	0.0	0.1	0.1	0.2	0.0	0.3	0.0	0.0
South Western	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1
Shannon Region					21.5			
Sh'n System *	24.1	25.3	17.1	37.1	20.8	34.5	18.1	27.2
Sh'n Released **	1.3 (5%)	3.9 (15%)	1.6 (9%)	2.9 (8%)	1.5 (7.3%)	7.7 (22.3%)	3.7 (20.4%)	10.5 (39%)
Western	9.4	13.2	10.6	13.9	13.2	21.6	13.4	12.9
North Western	1.4	1.2	2.0	4.0	1.4	2.4	3.1	0.9
Northern	0.1	0.1	-	-	0.0	0.6	1.0	0.0
Total	37.5	44.0	33.3	57.6	37.7	60.3	35.7	42.4

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	2,826	153,881	594,408
Total impacted	66,844	5,203	959	73,006	265,427
Shannon	38,771	3,304	391	42,466	200,839
Erne	24,848	1,098	251	26,197	116,633
Ballisadare	1556	29	227	1,812	8,239
Liffey	-	424	39	464	2,012
Clady/Crolly	391	20	5	416	505
Lee	1,278	327	46	1,651	753

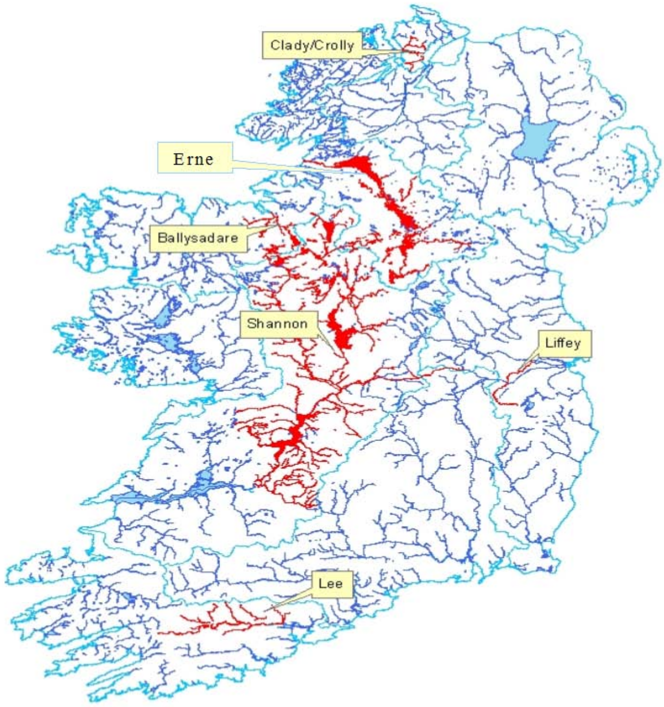

Figure 8.1. Map showing location of catchments where major hydropower installations occur. Water-bodies upstream of hydropower stations are shown in red.

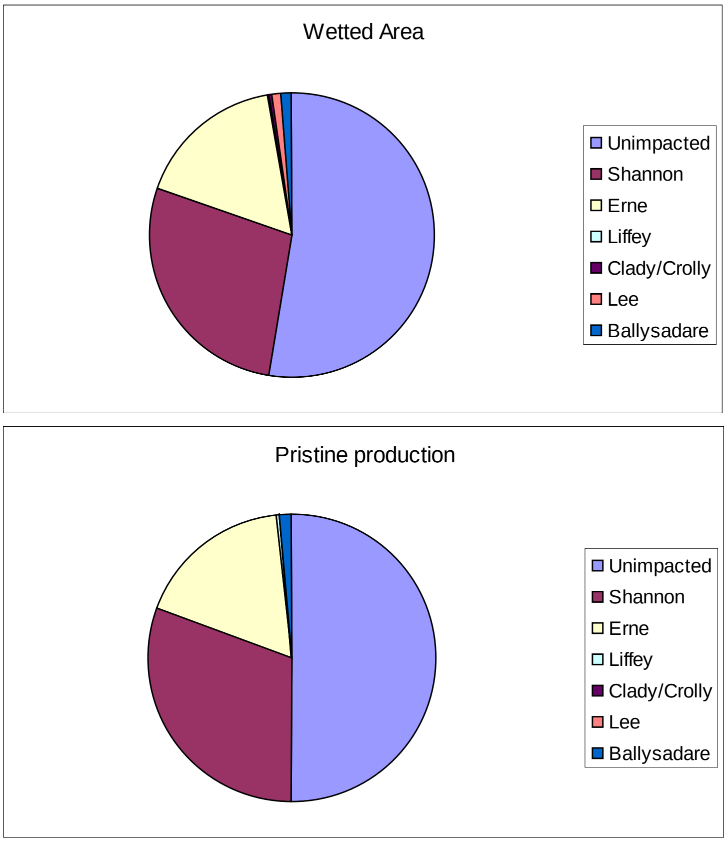

Figure 8.2. Proportions of wetted area and estimated pristine production for the catchments above major hydropower installations.

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.8.2.2 New information

Acoustic telemetry of silver eels (n = 44) passing downstream via the Ardnacrusha electricity generating station in the lower River Shannon area, was undertaken during 2008 and 2009 by NUIG. The results indicated that the mortality rate at the hydropower station was 20.4%. In the EMP, a 28.5% estimate of turbine passage mortality was used. Telemetry studies by NUIG on silver eel route selection, to estimate the proportion of eels passing via the potentially hazardous headrace canal rather than the alternative natural river channel route, indicated that in 2010 a higher than normal number (55% of the biomass) of eels travelled seaward via the natural river ("by-pass") route. In the EMP a lower estimate of the numbers of eels using the "by-pass" route (30% biomass) was used. Results to-date indicate that route selection is strongly influenced by discharge patterns, which reflect electrical generation patterns and the extent of spillage permitted at the Parteen regulating weir. In 2009, due to unusually high River Shannon discharge and flood control measures in November/December, environmental conditions favoured silver eel escapement. Indices of silver eel abundance obtained using of a Didson acoustic camera deployed on the Killaloe eel fishing weir were shown to be correlated with fishing weir catches. These observations provided improved knowledge of diel periodicity of eel migratory activity and it was also possible to estimate potential catches for a period, when due to extreme floods, the fishing weir could not be safely fished. Didson indices of silver eel numbers upstream of Killaloe were used in 2009, together with mark-recapture estimates of the eel weir capture efficiency and daily catch records, to calculate the spawner biomass moving towards the Lower River Shannon section where potential adverse effects of hydropower generation are being investigated.

In 2009 initial telemetry studies, undertaken by NUIG on silver eels (n=20) migrating downstream on the River Erne via the Cliff and Cathleen's Fall hydropower stations, provided provisional estimates for these two generating stations of 7.7% and 22% respectively. No analysis was undertaken in 2009 of the proportion of the downstream migrating silver eel that passed via the dam spill-ways. Spillage levels were low during the eel passage study period, though both stations were generating at close to maximum capacity. However, the telemetry indicated that most of the eels tagged with acoustic transmitters moved rapidly from above the Cliff HPS, and onwards via the intervening Assaroe Lake, and though the Cathleen's Fall HPS to the Erne estuary under these conditions.

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 2009 by the Electricity Supply Board (ESB) for the Rivers Shannon, Erne and Lee are demonstrated below. There was a total catch of 33 192 kg between these three catchments. The level of fishing mortalities was reported to be low (<0.1%). Catches were transported 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 Inniscarra station for the R. Lee. Transport mortality levels were also low (<0.1%). Releases were also observed by Fisheries Board staff.

IR.8.3.1 Shannon

A total of 23 730.5 kg were trapped and transported on the Shannon, including 10 731 kg at Killaloe. This exceeds the target set of 30% of the estimated run.

NUIG estimate the production from the Shannon to be 74 300 kg (30% = 22.3 t) or the escapement to be 69 500 kg (30% = 20 900 kg). Therefore the T&T amount is likely to be 32% of the silver eel production. The estimated production in the EMP was 85 659 kg in 2008 and the projected production for 2009, calculated using the Irish model, was 74 000 kg.

IR.8.3.2 Erne

Two locations were fished on the Erne in 2009, although one location only yielded 20 kg. Difficulties were experienced in setting up additional sites.

A total catch of 9382.5 kg of silver eel were trapped and transported to the estuary. The target (22 000 kg) was, therefore, not met in 2009. The total catch would have been increased if the additional sites had been fished. Some additional silvers would have also been expected if the N. Ireland yellow eel fishery had also been closed in 2009. This will be closed in 2010.

IR.8.3.3 Lee

The R. Lee was fished at Inchigeela and a total of 79 kg was captured and transported downstream. The target (500 kg) was not met in 2009. The target was not met due to a number of local factors, including a delayed start to fishing, inappropriate equipment and unusually high flood levels in the latter part of November.

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 and fished in a similar fashion to the previous commercial fishery although the catch was released downstream. A total catch of 12 600 kg of silver eels were caught in 2009 with an average weight per night between 0.026 kgs and 0.039 kg. This is the highest catch recorded for the Galway eel weir since 1990 when 12 050 kg of silvers were caught. The catch in 2009 was probably contributed to by the cessation of yellow and silver eel fishing in the Corrib Catchment upstream of the Galway Fishery (reported average of 7200 kg for 2001–2007).

To estimate the efficiency of the weir and the silver eel escapement, a two batch Mark Recapture (PIT tags) exercise was carried out at the Galway Fishery which gave an average recapture rate of 35% and an escapement estimate in the order of 36 000 kg. This compares with 48 000 kg estimated current (2001–2007) production reported in the Irish EMP.

IR.9.2.2 Shannon

Eels have been fished on the Shannon in both historical and more recent times. Commercial fishing was initially established by the ESB in 1937. The ESB control the fishing rights as a result of the Shannon Fisheries Acts of 1935 and 1938. In 2009, commercial silver eel fishing was ceased on the Shannon. Fishing at Killaloe was continued and the catch was transported downstream of the turbine. The Killaloe catch in 2009 was 12 020 kg. Fishing was undertaken by four crews upstream of Killaloe and their catches (13 000 kg) were also transported downstream.

NUIG estimated an escapement of 69 500 kg (with 20% turbine mortality) or 67 700 kg (with 28.5% turbine mortality). This compares well with a steady-state current (2008) production estimate of 85 659 kg in the EMP or a projected estimate for 2009 of 74 000 kg using the Irish model.

IR.9.2.3 Burrishoole

Silver eel trapping was continued in Burrishoole in 2009. The main run occurred in August, September and October, dropping off in November with only six eels recorded in December. The total run amounted to 2875 eels (600 kg). The average weight of the eels in the catches has been steadily increasing from 0.095 kg in the early 1970s to 0.216 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 (1971–2009). This may be a density-dependent response to falling recruitment and increased catchment productivity.

IR.9.2.4 Erne

Two sites were fished for the conservation fishery (trap and transport) and for estimating escapement, one of which was fished in the Erne River upstream of Enniskillen with only a minor contribution to the catch. The catch for the Roscor lake site operated in 2009 was 9362 kg with a single additional catch of 20 kg in the River Erne between Upper and Lower Loughs.

A mark-recapture study was undertaken at the lake site using external floy tags but numbers of recaptures were low. The selection of the site and the tagging method may have affected the estimates and it is hoped to improve this in 2010 using Passive Integrated Transponders (PIT) tags.

Estimates of production and escapement for the 2009–2011 period are under current investigation.

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. Such monitoring also provides a means of evaluating post-management changes and forecasting the effects of these changes on silver eel escapement. The monitoring strategy aims to determine, at a local scale, an estimate of relative stock density, the stock's length, age and sex profiles, and the proportion of each length class that migrate as silvers each year. A second objective of the yellow eel study was to carry out an indirect estimation of silver eel escapement. 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 2009 Fykenet survey

In 2009 intensive sampling of yellow eels took place at five locations (Lough Conn, Lower Lough Corrib, Lough Cullin, Lower Lough Derg, Lough Feeagh and

Bunaveela Lough. 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 2009 consisted of setting 60 chains of five fykenets during three monthly sessions of two nights per session.

Of the lakes sampled, Lough Conn and Lower Lough Derg had the highest cpue (2.380 and 2.230 respectively). On average Lough Conn had the highest length with 46 cm and Lough Cullin had the largest weight with 0.2 kg.

A comprehensive fykenet survey, including mark-recapture was undertaken in the transitional waters of Waterford 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 2009. This method consisted of 2–4 grids of 15–20 fykenet, with each fykenet spaced 50 m apart. Fykenets were set in grids along the right and left bank of the transitional waters, avoiding the main shipping channel.

In total 1888 eels were captured in the fykenet survey in the Suir transitional waters with a catch per unit of effort of 11.58. 483 eels were tagged in the upstream site (upstream of bridge) and 712 eels were tagged in the downstream site (downstream of bridge). No eels from the upstream site were recaptured in the downstream site during the study period. Within Site two 30 eels were recaptured over the time period giving a recapture rate of 4%.

In the Barrow transitional waters 1410 eels were captured with a catch per unit of effort of 6.56. 849 eels were tagged and 52 eels were recaptured giving a recapture rate of 6%.

Moriarty (1986) concluded that recapture rates of 5.5–18.5% could be expected if a population was non-migratory, rates below 2% indicating a very mobile population. In the Suir tagged eels were caught at most twice and in the Barrow only three eels were caught three times. This low recapture rate could be due to trap shyness or because the home range of the species in question is greater than the trapping area. The WFD team will sample Waterford Harbour in 2010 and will use a PIT detector to identify any tagged eels from the 2009 survey.

IR.9.3.2 Comparison with previous surveys

Extensive fykenet surveys carried on eels throughout Ireland from 1968 until the late 1990s and these were compared with the findings for L. Conn and Lower L. Corrib in the 2009 survey. Data exists for a comparison in L. Derg and Burrishoole although this has still to be compiled.

In L. Conn, there was an increase in the length of eels over the 37 year period. However the weight peaked in 1988 and decreased in 2009. It was expected that if eel density decreased due to reduced recruitment and reduced competition for food then the eels that were present would be in better condition than those eels captured in 1972 and 1988. It is possible that size related dietary shifts (e.g. to piscivory) and the presence of *Anguillicoloides* have led to a reduction in fish condition in some areas. However this trend is not visible in the weight or condition factor of the Lough Conn eels.

In Lower L. Corrib, the cpue for 2009 was lower than in 1969 and 1990 and there was a significant difference in length between 2009 and 1969 and 1990 with the eels caught in 2009 having a greater median length than the eels captured in both 1969 and 1990.

The trend in smaller eels being less abundant was continued, probably due to low recruitment in recent years.

IR.9.4 Water Framework Directive surveys

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 water body. 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 eels as present. No eels were caught in Lough Skeeagh upper in 2008 but all other lake surveyed had eels 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. Eels were recorded in all but three transitional waters in 2009 (no eels were captured in Inner Donegal Bay, Swilly Estuary and Lough an tSaile). In 2008 no eels 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.9.5 Silvering rates

With the closure of the Irish eel fishery the yellow eel stock that would have been removed from the population will now reach maturation over the coming years (approx. 0–10 years) and add to the required 40% silver eel escapement. The maturation of yellow eels to silvers is an important biological parameter in any model of stock recovery, but there is few data available in Ireland to verify the rate at which yellow eels silver and migrate. It will not be practicable to undertake direct assessments of silver eel escapement in many or all rivers. It is therefore hoped that an indirect method might be developed using yellow eel fykenet surveys and indicators of silvering, such as eye and fin size, to estimate the proportion of yellow eels that might mature and migrate in any one year.

As part of the eel monitoring programme, maturation indices have been measured at a number of sites, with the ultimate objective of being able to determine what proportion of the standing yellow eel stock matures and migrates each year. The most simple maturation index involves comparing mean eye diameter and total length of eel, as an increase in eye diameter is a key indicator of maturation and 'silvering'. During 2008 and 2009, measurements of eye diameter were recorded with commercial yellow eel catches (2008), monitoring surveys (2009) and silver eel catches (2009) allowing some preliminary analysis of the viability of using these measures in future modelling work.

All eye diameter and length measurements recorded in 2008 and 2009 were plotted together to ascertain whether Irish eels exhibited particular differentiation between yellow and silver stages. It seems that there is some differentiation in the eye diameter/length relationship for yellow and silver eels. Eels caught in the Slaney estuary fykenet fishery in 2008 appeared to have very large eyes for the size of their body, and this warrants further investigation. This may due to the estuarine location, but it may also be an indication of a large proportion of presilvering male eels in the fykenet catch.

When all yellow and silver eel measurements are grouped together (with the exception of the Slaney samples) the differentiation is clearer and indicates that there may be some merit in continuing the sampling effort. However it should be noted that there are other significant sources of variation in eye diameter apart from total length, as indicated by the relatively low r^2 values for the regression (0.42 for yellow eel, 0.38 for silvers). Nevertheless, life stage is a significant source of variation in mean eye diameter when corrected for total length.

It is likely that catchment characteristics have a strong effect on the morphological variation in eye diameter and length in eel. In 2008 and 2009, there were four 'sets' of yellow and silver eel data collected that allowed a catchment specific relationship between eye diameter and length be determined for the Burrishoole, Erne, Corrib and Shannon systems. It is clear that there is more differentiation in some catchments than in others, and requires more in depth analysis. However, this initial analysis of two years data suggest that values quoted in the literature may not be applicable to Irish stocks, and will require further evaluation. We recommend that maturation indices continue to be collected for both yellow eel populations and migrating silvers to allow further refinement of the indices.

IR.9.6 Recruitment

Recruitment of glass eel/elver to Ireland will depend on European wide management actions and will not provide a resource to post-evaluate Irish management actions specifically. However, monitoring of recruitment is critical to evaluating the overall success of the eel regulation and is required by ICES for stock assessment. This information is also required to assess and model changes in future Irish eel stocks.

In 2009, five sites were monitored by the Electricity Supply Board and the Regional Fisheries Boards. Monitoring of glass eel (elver) migrating at Ardnacrusha (Shannon) and Cathaleens Fall (Erne) demonstrated that recruitment remained low up to 2009. This was supported by information from the other sites and from N. Ireland.

Monitoring of young yellow eel migrating at Parteen Weir (Shannon) takes place using a fixed brush trap. The catch in 2009 was the third lowest on record, following the second highest in 2008.

The Parteen and Ardnacrusha juvenile eel traps were monitored in 2008–2009 by a postgraduate student (F Egan) from NUIG, who also employed new trap designs and locations at Parteen. 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 the latter two years at Parteen. The size frequency of the catch recorded in June-August 2010 is illustrated in Figure 9.1.

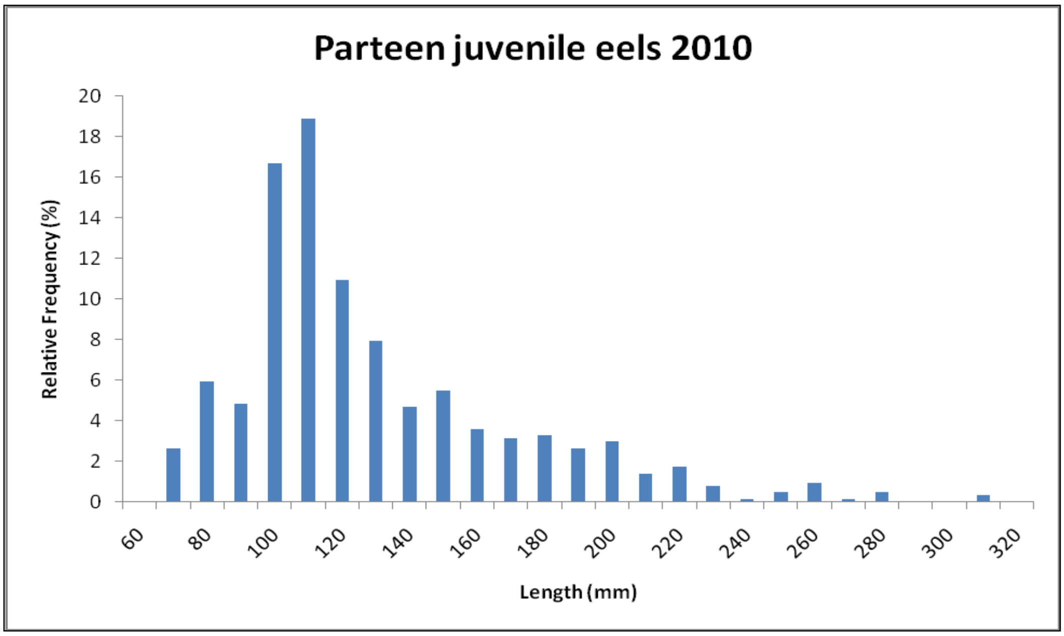

Figure 9.1. Relative length frequency distribution of juvenile eels collected at Parteen in 2010 (n= 641).

IR.10 Catch composition by age and length

With the closure of the fisheries in 2009, 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 eels 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, 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 eels 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. Eels 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 eels 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 2009.

IR.11.4 Predators

No new data in 2009.

IR.12 Other sampling

All eels 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 (Sections 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 >= 1 of the following 3 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 attempts to predict the likely river width along rivers based on a statistical model built from information derived in a GIS.

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. 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 North West 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 2 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.

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 eels.

Habitat quality data using the Amiro (Amiro, 1993) and Rosgen (Rosgen, 1994) gradient classification systems are available. For example, in the Kerry Fisheries District 48% of the potential salmon producing habitat has a gradient of <0.5% (Amiro Class 1) (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	4,861	1,920	262	7,043
SERBD	178	3,626	412	4,216
ShRBD	40,241	4,487	590	45,317
SWRBD	7,534	2,714	419	10,666
WRBD	46,602	2,869	473	49,944
NWIRBD	32,859	3,165	670	36,694
Total	132,275	18,780	2,826	153,881

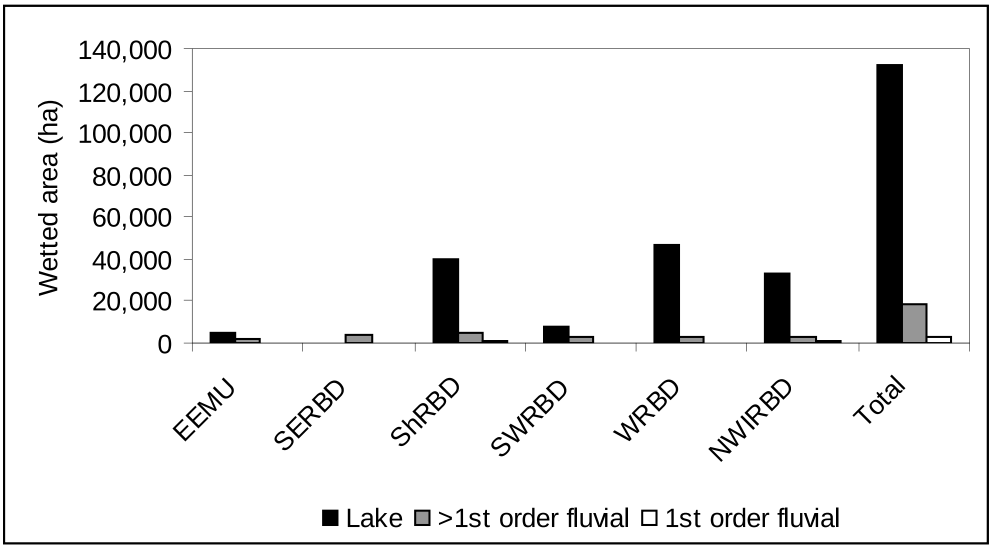

Figure 13.1. Total wetted areas (ha) for lake, first order fluvial and greater than first order fluvial habitat for each River Basin District, including Northern Ireland (Erne, Drowes, Foyle, Roe and Faughan).

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 (km^2) 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	1,024	1,114
ShRBD	250	1220	1,470
SWRBD	166	3,576	3,743
WRBD	133	4,574	4,707
NWIRBD	131	2,230	2,361
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 Historical 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 historical 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}) & Escapement (Bpre)

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).

Historical 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 historical 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%.

	Historical Production (t) Bo	Current Production (t) Bbest	Current Escapement (t) Bpre	Current Escapement as % of historical 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 historical 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	25959.6	28869.0	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)	42466	28869	1404	474
Productivity (kg/ha)	*2.0*	*1.7*	*2.7*	*1.3*
% non-calcareous	7.9	18.5	0	96.2

*** Summarised 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 Chapters 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

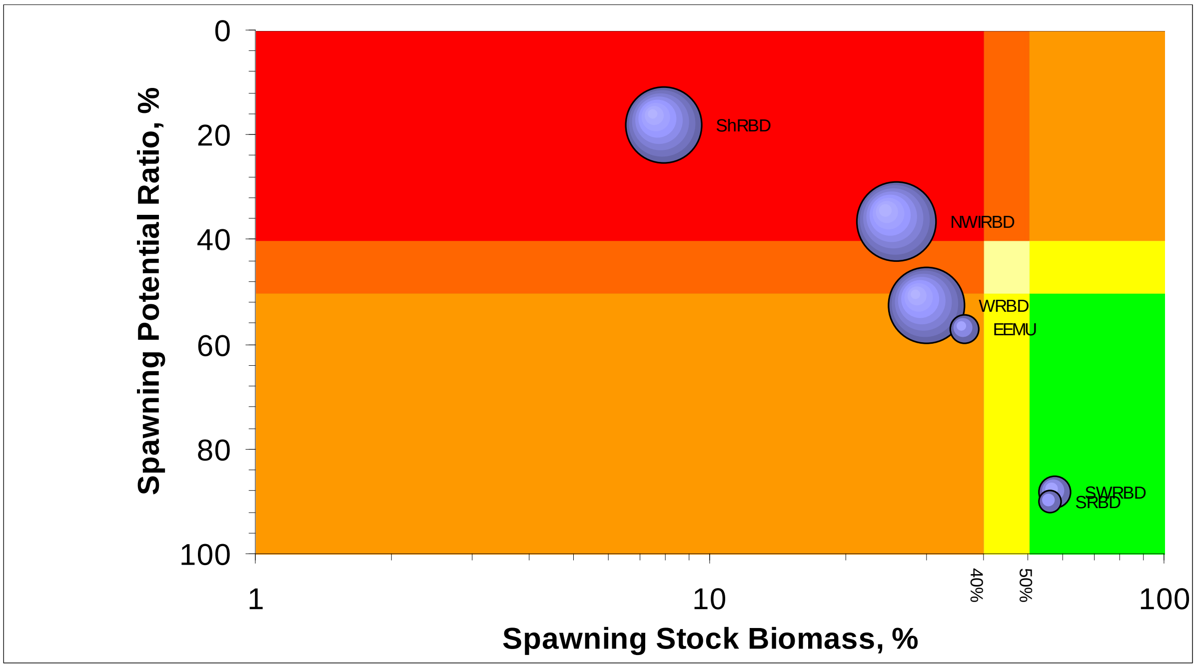

Figure 13.2. Precautionary diagram showing spawning potential ratio against spawning-stock biomass for Irish Eel Management Units, using data current at 2008 from the EMPs.

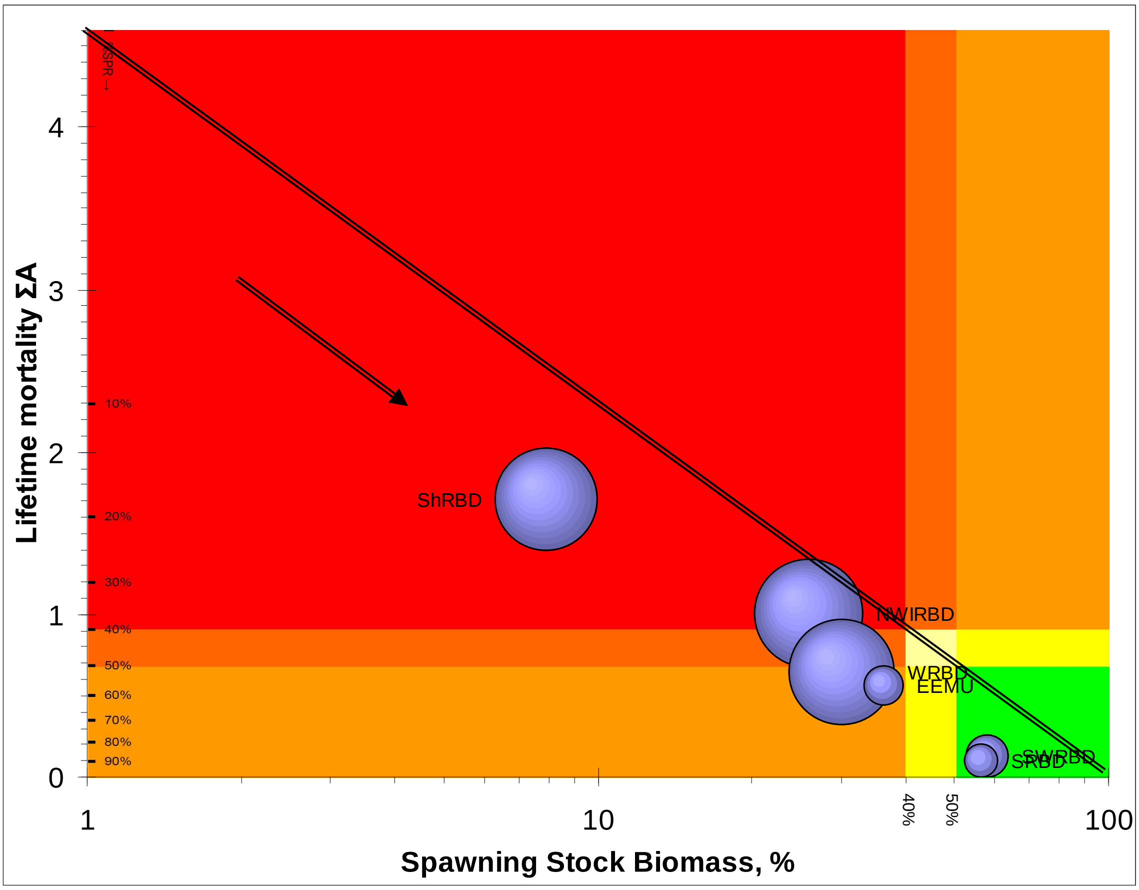

Figure 13.3. Precautionary diagram showing lifetime mortality against spawning-stock biomass for Irish Eel Management Units, using data current at 2008 from the EMPs.

Data used in the precautionary diagrams

Indicators and reference points quantified here			
	2008		
Label	$B_{current}$	B_{best}	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 eels were captured in fykenets, marked and released in the Burrishoole (Poole and Reynolds, 1996a). The proportion of these eels which were recaptured in fykenets increased from nil at length 30–35 cm to over 0.2 at length 60–65 cm (Figure 14.1). This size bias must be accounted for if slopes of length frequency distributions are used to determine biological parameters.

Based 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 10 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.

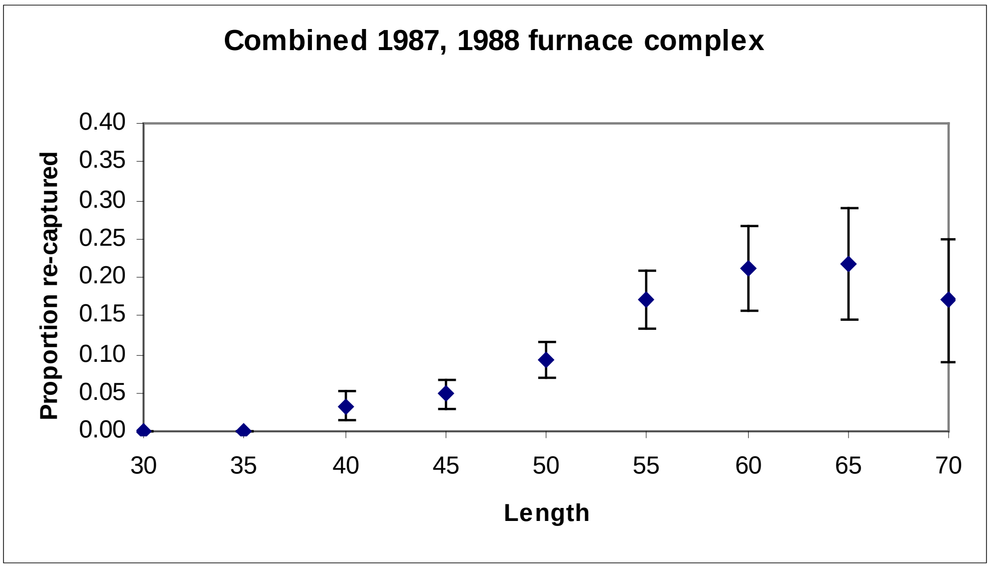

Figure 14.1. Proportion of European eels re-captured in fykenets in relation to length.

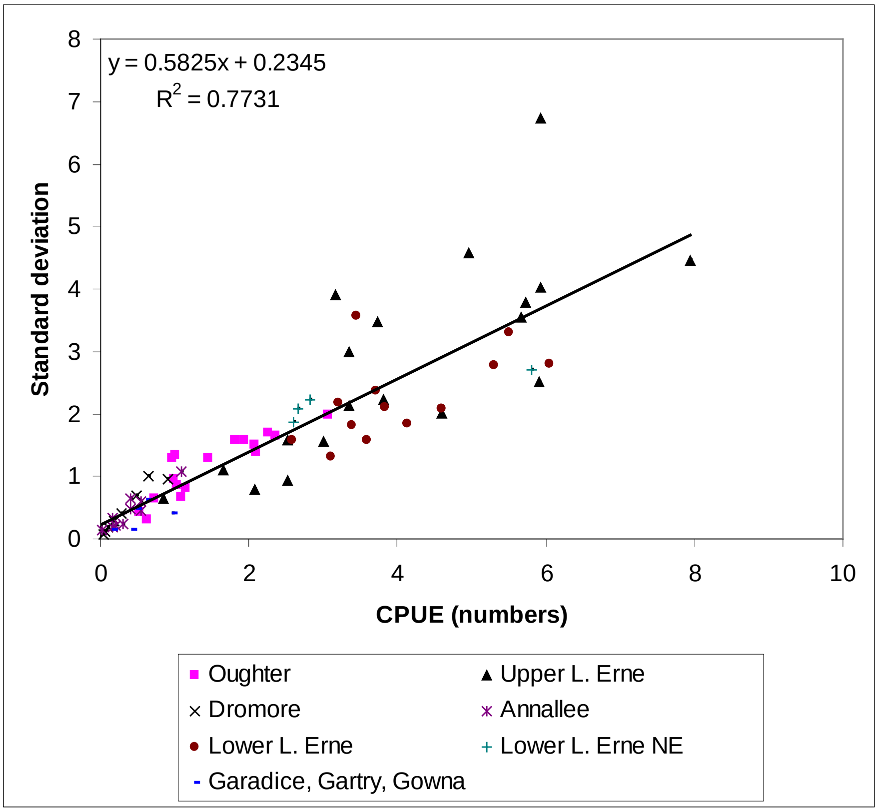

Figure 14.2. Relation between the standard deviation of five fyke chain cpue and cpue.

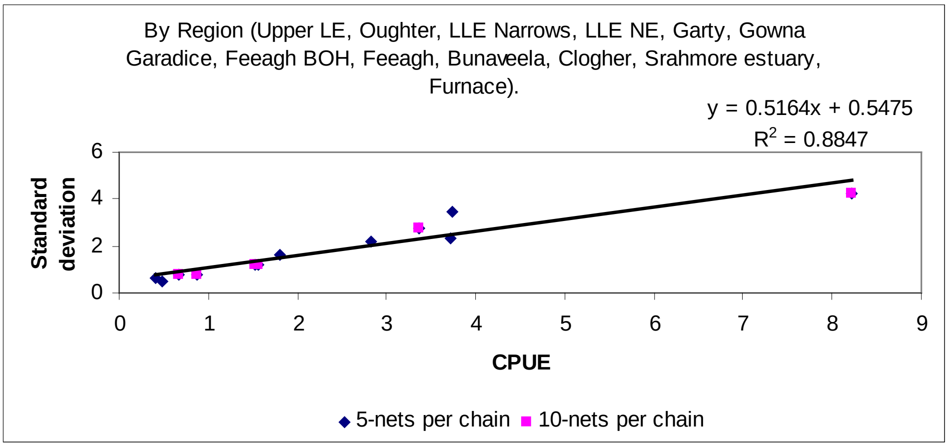

Figure 14.3. Relation between standard deviation and cpue for fykenets with five and ten nets per chain.

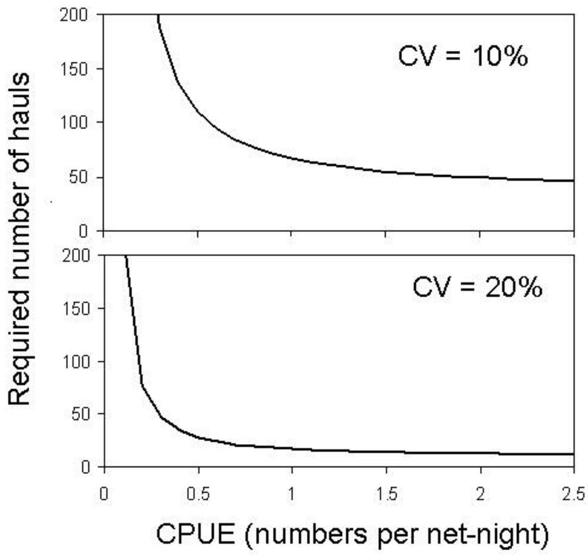

Figure 14.4. Power analysis of the number of hauls required to achieve precision levels in cpue consistent with indicated co-efficients of variation. The required sample size is highly sensitive to the population density (assuming cpue is directly related to density).

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 the change in length distribution of the migrating silver eels (Figure 14.5). This means that careful planning of silver eel sampling is required.

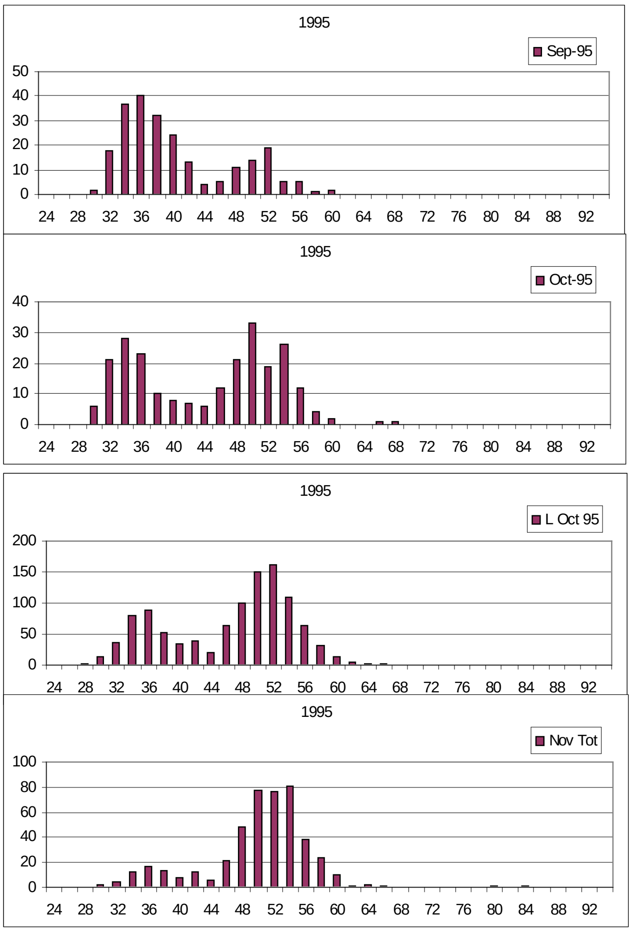

Figure 14.5. Monthly length distributions, taken for each lunar phase, for Burrishoole silver eels.

IR.15 Standardisation 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 eels, 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, despite being fraught with difficulties when applied to eel, with a variety of back-pack portable and bank-side 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. Eels were stored in keep nets or boxes similar to those used by commercial fishers. Eels were graded and sold to eel dealers at the lake shore. The entire catch was sampled prior to grading and the fishers 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 the ICES Workshop on Eel Age WKAREA 2009. An initial training workshop was held in Central Fisheries Board 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 eels between ~38 cm and 48 cm in order to determine the length overlap between the sexes.

Histological verification has not been used to any extent in Ireland.

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 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 historical 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 United Kingdom 2009/'10

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Reporting Period: This report was completed in August 2010 for the ICES/EIFAC WGEEL 2010, held in Hamburg, Germany in early September. It must be noted that most of the data relating to 2010 are provisional and will not be finalized until complete catch data are obtained and records can be fully validated. In compiling the report, the previous year's data are routinely 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 EIFAC/ICES WG on Eels (WGEEL). As such, some information is repeated between sections.

UK.2.1 UK overview

Eel are widespread throughout estuaries, rivers and lakes of the UK, with the possible exception of the upper reaches of some rivers, particularly in Scotland, due to difficulties of access.

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 North West plan is a trans-boundary plan with the Republic of Ireland. There are 10 plans for England and Wales, 1 shared with Scotland, 1 for the remainder of Scotland, and 3 in Northern Ireland including 1 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 wing nets), 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. 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 ten m upstream and 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 North East 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 North East 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 North West and South West 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 early 2011. 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 fishers 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 stocking into L. Neagh. Elvers are also trapped at the same location and stocked into the Lough.

The yellow eel fishery (May–September, five days a week) supports 80–90 boats each with a crew of two men using draftnets and baited longlines. Eels are collected and marketed centrally by the Co-operative. Silver eels are caught in weirs in the Lower River Bann. Profit from the less labour-intensive silver eel fishery sustains the management of the whole co-operative venture, providing working capital for policing, marketing and stocking activity and an out of season bonus payment for yellow eel fishers at Christmas.

Natural recruitment has been supplemented since 1984 by the purchase of glass eel. Approximately 81 million (27 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 with L. Neagh and produces 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 into the Erne lake system for stocking. 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 (369 licences in 2010), 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).

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 2010 reported catch is provisional.

Year	Agency Reported catch (t)	HMRC nett export (t)	Year	Agency Reported catch (t)	HMRC nett export (t)
1972	16.7	n/a	1991	1.1	7.8
1973	28.2	n/a	1992	5	17.7
1974	57.5	n/a	1993	5.73	20.9
1975	10.5	n/a	1994	9.5	22.3
1976	13.1	n/a	1995	11.9	n/a
1977	38.6	n/a	1996	18.8	23.9
1978	61.2	n/a	1997	8.7	16.2
1979	67	40.1	1998	11.2	20.1
1980	40.1	32.8	1999	n/a	18
1981	36.9	n/a	2000	n/a	7.6
1982	48	30.4	2001	0.809	5.4
1983	16.9	6.2	2002	0.521	5.1
1984	25	29	2003	1.715	10
1985	20	18.6	2004	0.97	14.4
1986	19	15.5	2005	1.701	8.8
1987	21.3	17.7	2006	1.274	8.2
1988	21.4	23.1	2007	2.07	n/a
1989	20.6	13.5	2008	0.816	n/a
1990	20.9	16	2009	0.29	n/a
			2010	1.03*	n/a

Catches are now reported per "nearest water body" 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 2010. Note that the 2009 catches are updated from the provisional data reported in the 2009 report, the 2010 catches are provisional, 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
North West	166.2	116.1	200	91.6	19.6	25.4
Dee	39	5.5	6.25	2	0.5	4.8
West Wales	87	37	26	3.8	0	0.0
Severn	784.8	631.3	1172.5	370.7	76.8	442.4
South West	626.5	482.7	669	348.6	194.5	553.8
South East	0	1.5	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. Glass eel are imported into England from France and Spain throughout the winter season (typically November to March) and subsequently re-exported. 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 10 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 5 and 15 times, which varied between years.

For 2010, the provisional catch reported to the Environment Agency is 1.03 t, at the time of writing. The increase compared with 2009 is despite a decrease in the number of licences and therefore is thought to reflect a true increase in the availability of glass eel to the fishery in 2010. However, the catch of UK glass eel remains at the very low levels observed (reported) since the late 1990s (Table 1).

In a change from previous years, the glass eels stocked into Lough Neagh, Northern Ireland were sourced from Spanish and French fisheries.

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 3). 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). Recruitment in 2008 reached a new historical minimum with only 24 kg (approx. 75 000 eels) caught. In 2009, the catch rose to 159 kg, but dropped again in 2010 to 68 kg.

Table 3. 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		
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 in 2007 was 189 kg, 32.8 kg in 2008, 50.5 kg in 2009 and 83.5 kg in 2010. 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 North West RBDs), Royal Society for the Protection of Birds (RSPB, North West 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 8). Since 2005, catches have been recorded according to the "nearest water body" 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 8). Since 2005, catches have been recorded according to the "nearest water body" 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 (the 2010 fishery will commence in autumn, after the 2010 WGEEL has reported).

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

England & Wales

Glass eel were stocked into river systems of England and Wales in 2010. The total weight of stocked glass eel is not available at present but is understood to be a few 10's of kg at most.

Northern Ireland

Recruitment of glass eel and elver to Lough Neagh has been supplemented by stocking of purchased glass eel since 1984 (Table 4), 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 4. Weight (kg) of glass eel stocked into Lough Neagh, 1984 to 2010.

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		
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.

However, as the glass eel stocked into Lough Neagh are all sourced from UK fisheries, this provides a minimum quantity of the UK glass eel catch that are used for stocking purposes (see Table 4).

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 5). 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 5. 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		

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 6).

Table 6. 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 North West International RBD

Fishing capacity is measured in terms of the number of licensed instruments (by type of gear) and is an individual activity with no regulating company. In 2009, there were twelve commercial fishers operating on this catchment, with twelve eel permits (nine longline and 3 fykenets) issued. This fishery was closed in 2010 and the use of fykenets was banned in Northern Ireland.

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 fishers. 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 aging 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 fishers 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 fishers began reporting an increase in the effort required to fulfil daily quotas. Similar reports have been made for the 2010 fishery to date.

Scotland

In Scotland, historical 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 North Western 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, catching about 10 t.

NI Neagh-Bann RBD

Silver eel catch from Lough Neagh is taken in the River Bann using coghill nets fished on three weirs at two locations. The number of coghill nets 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 demonstrate 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 2010).

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 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 fisher 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) suggests a significant level of underreporting, by between 5 and 15 times for glass eel and about 6 times for yellow and silver eel combined, with rates differing from year to year. As such, these data can 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.

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 fishers 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 7).

Table 7. 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	3491	369	264	0.72

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

To date, there has been no attempt to measure actual, utilized fishing effort for yellow eel fykenet fishing in England and Wales. Furthermore, prior to 2005, licensed fishers were not required to separately report catches and associated effort for yellow and silver eel fisheries. 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. However, the same Regional reporting issues for glass eel catches and effort extend to yellow eel catch reports.

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 North West 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 2010).

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 8. EA returns for yellow and silver eel fisheries (combined) for 2009 28.04 t) continue at the low level since 2001. As with the glass eel/elver reported catches, however, these reported data are likely underestimates (by ~6 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 8).

Table 8. 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

Northern Ireland

NI Eastern RBD

There are no eel fisheries in the Eastern RBD.

NI North Western International RBD

In 2009, 124 licences were issued to fish for yellow eels in the Erne system using fykenets and longlines. The declared catch for 2009 is not available at this time. No licences were issued in 2010 as this fishery was closed as per the terms of the NWIRBD Eel Management Plan.

NI Neagh-Bann RBD

Yellow eel catches in L. Neagh in 2009 amounted to 345 t, continuing the general downward trend since the late 1990s (Table 9) 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 85 boats in 2008. 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 draft net fisheries continue to meet daily quotas imposed by the Co-operative, implying that sufficient stocks for the number of boats fishing in the Lough are being maintained. In 2008, a wet autumn meant that yellow eel fishing ceased by early September. This may have been responsible for the decrease in yellow eel catch in 2008 compared with 2007. However, fishing conditions were improved in autumn 2009 (milder and drier) and the fishery continued into October, contributing to an improved yield compared with 2008.

Table 9. 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	n/a
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 8 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 silver eel fisheries in either of these RBDs.

NI Neagh-Bann RBD

Silver eel catches in L. Neagh in 2009 amounted to 85 t (Table 10).

Table 10. 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	n/a
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 stocking 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 North Western International RBDs. Given that the silver eel fishing operation in the River Bann is such that a nights 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 fishery 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. When possible (given glass eel numbers) glass eel/elvers are sampled twice a month from their arrival in February/March through to April when 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.

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 11).

The work demonstrated that glass eels were still arriving annually to Northern Irelands' 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 11).

Table 11. 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 12). 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 12. Experimental glass eel fishing at Carlingford, 3rd to 7th and 20th to 24th April 2004. Cpue based on 3 hrs 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
DATE	lbs	kg	cpue**
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 demonstrate 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 North South Shared Aquatic Resource (NSSHARE) Project covers three river basin districts; North Western International River Basin District, Neagh Bann International River Basin District and North Eastern 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.

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 North Western International RBD

There are no current surveys.

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 with 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 10 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) demonstrates 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 demonstrate 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 Coordination 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 demonstrate 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 North West demonstrated a trend for an increase in population density.

Since 2008, the Scottish Environmental protection Agency (SEPA) have 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

The Environment Agency is planning surveys of silver eel in key rivers, and developments will be reported in future Country Reports.

Northern Ireland

NI Eastern RBD

No current surveys of silver eels.

NI North Western 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 13.

Table 13. 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	-	-	-

UK.10 Catch composition by age and length

UK.10.1 England & Wales

In England and Wales, commercial catch is reported only as weight, so no age and/or length data are available. Environment Agency fish surveys for monitoring purposes have since 2008 recorded length of all eel >100 mm, and numbers of eel <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 compared with 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 eel management plan for this RBD.

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 2010 sampling programme is ongoing at the time this report was produced.

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 catch composition analysis, 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 ratio in the silver eels in 2004 to 2005 were numerically close to 1:1, but changed in 2006 to 0.37:0.63 and 2007 to 0.38:0.62 in favour of females (Table 14). However, in 2008 and 2009 this trend has reverted to a ratio similar to that recorded in 2004 and 2005 (0.52:0.48 and 0.54:0.56) in favour of males). Taking account of differing sizes and weights of males and females, 80% of the recorded silver eel biomass is now female.

Table 14. 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	mean Wt	Age		%	mean L	mean Wt	Age
		(cm)	(g)				(cm)	(g)	
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

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 10.83±1.04 $mm.yr^{-1}$ (n=46) 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).

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.

Northern Ireland

NI Eastern RBD

No introduced parasites or pathogens have been recorded from eels examined in this RBD.

NI North Western 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 2093 yellow and 600 silver eels from 2003 to 2009. In 2008 the prevalence of *A. crassus* in both yellow and silver eels was recorded as 67.3% and 86%, respectively, whilst in 2009 it had fallen to 53,6 and 81%, respectively.

Scotland

Prior to 2008, the only reported instance of *A. crassus* in Scottish RBD was from a site near a fish farm 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 historical 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 eels 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 demonstrated considerable decreases in DDE and HCH concentrations. When compared with 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 demonstrate 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): El-Hosaini *et al*., in prep; Aprahamian *et al*., 2007). The EA is supporting the further development of SMEP as SMEP II (Walker, unpublished).

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 4319 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 15). No tagging was undertaken in 2007 due to the sporadic nature of the silver eel run.

Table 15. 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

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 16. 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 1m 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 16. 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
	South East	2061	1785	5500	211200	220546
	South West	2621	6194	22900	304200	335916
	Severn	6159	9726	54700	0	70585
	West Wales	4271	6202	13500	433100	457073
	Dee	1622	881	10900	0	13403
	North West	9790	5152	27900	150900	193742
shared	Solway-Tweed	5186	7791	39000	191300	243277
Scotland	Scotland	138557	48104	-	-	186661
N.I.	North Eastern	640	160			800
	Neagh Bann	38600	1400	0	40000	80000
international	North Western	28600	4350	1153	34103	68206

UK.13.2.2 Silver eel production

UK.13.2.2.1 Historical production

The historical production of silver eels from the 'pristine' environment is the estimate from which the 40% escapement target is derived. Estimates of the historical annual production of silver eels from each UK EMP are presented in Table 17.

England & Wales

In the absence of data on historical 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 historical 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 11 RBDs of England and Wales yields estimates of historical 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 historical or recent data on eel production from this RBD, a standard pristine production rate of 5 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 North Western International RBD

Using the methodologies of the Republic of Ireland, the historic production of silver eels from this trans-boundary 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 17. Estimates of historical 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
	South East	3846	65002	81926	n/a
	South West	8816	148982	174988	n/a
	Severn	15885	268450	133431	n/a
	West Wales	10473	176987	93206	n/a
	Dee	2503	42302	68	n/a
	North West	14942	252525	200227	n/a
shared	Solway-Tweed	12977	219313	118092	n/a
Scotland	Scotland	186661	183718	116481	84933
N.I.	North Eastern	800	4000	4000	n/a
	Neagh Bann	80000	500000	458000	360000
international	North Western	36694	147000	31300	9700
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 North Western International RBD

Present potential production in the NW IRBD is estimated at 31 300 kg.

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 17 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 eels, and yellow eels 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 estimated at 9.7 t, because this is the amount of silver eels trapped and transported around hydro schemes – though some eels will escape through the schemes so this is an underestimate. The current annual average escapement of silver eel from the Neagh Bann RBD over the 2003 to 2009 period is about 360 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 2010.

UK.13.2.2.5 Precautionary diagrams

The Eel Regulation sets a limit reference for biomass as a percentage (40%) of pristine biomass, and leaves it up to Member States to determine actual reference positions for the part of the European stock produced within their territory. In its advice on fisheries management, ICES (2004) applies a ‘traffic light’ colouring scheme, signalling the status of the stock and impact of exploitation. The information on the stock status and the reference points are summarized in a so-called Precautionary Diagram, summarizing the criteria and status. This diagram presents the status of the stock (horizontal axis, lowvs.high spawning-stock biomass determining whether the stock has achieved full reproductive potential) and the impact of fishing (vertical axis, low vs. high fishing mortality determining whether the exploitation is sustainable or not).

A Modified Precautionary Diagram has been developed for eel (Dekker, 2010; ICES, 2010). In this modified diagram, the spawning-stock biomass is plotted on a logarithmic scale, while the annual fishing mortality is replaced by the cumulative lifetime **anthropogenic** mortality (ΣA) (Dekker, 2010), or % spawner-per-recruit (ICES, 2010).

As in the standard ICES diagram, the horizontal axis quantifies the status of the stock but, in order to allow comparison between RBDs, EMUs and larger geographic scales, the biomass is not plotted in absolute terms (i.e. kg or tons) but as a percentage of pristine biomass. Note that the diagram has been developed primarily for assessment of status of the whole stock so the axis legends may not at first appear appropriate to using the diagram to illustrate the status of national production and escapement. When applied at the RBD or national level, the x-axis represents the biomass production from the RBD or nation, and not the total Spawning Stock Biomass *per se* as this is only derived at the whole stock level.

The vertical axis quantifies the anthropogenic impacts, as opposed to only fishing impacts in the standard ICES diagram. However, the axis scaling has changed from an (exponential) annual mortality rate to an index of liftetime anthropogenic mortality.

The size of the plotted bubbles is proportional to the best-achievable biomass from current conditions (current stock, assuming no anthropogenic impacts).

The construction of the diagram requires estimates of the pristine production of silver eels, the current escepement of silver eels, and the potential production of silver eels from current conditions if no anthropogenic factors were to have impacted that production. Though it is intended that this diagram will eventually be constructed to demonstrate the status of each UK EMP, this is not possible at this time to provide such estimates for all UK EMPs for a variety of reasons. Therefore, the diagram (Figure 2) has been constructed for the three zones (Scotland, England & Wales, and Northern Ireland). Please note that this figure is only for illustrative purposes and should not be taken as the current assessment of the performance of eel production within the UK, because we have yet to determine the best method to quantify current and pristine escapement, and anthropogenic impacts.

Reductions in anthropogenic impacts will be illustrated by a move of the status indicator bubble from top to bottom, and increased silver eel production is indicated by a move from left to right. Therefore, a management decision to reduce the anthropogenic impact will mean that the bubble moves from top-left to bottom-right, i.e. towards the green ‘good status’ segment of the diagram.

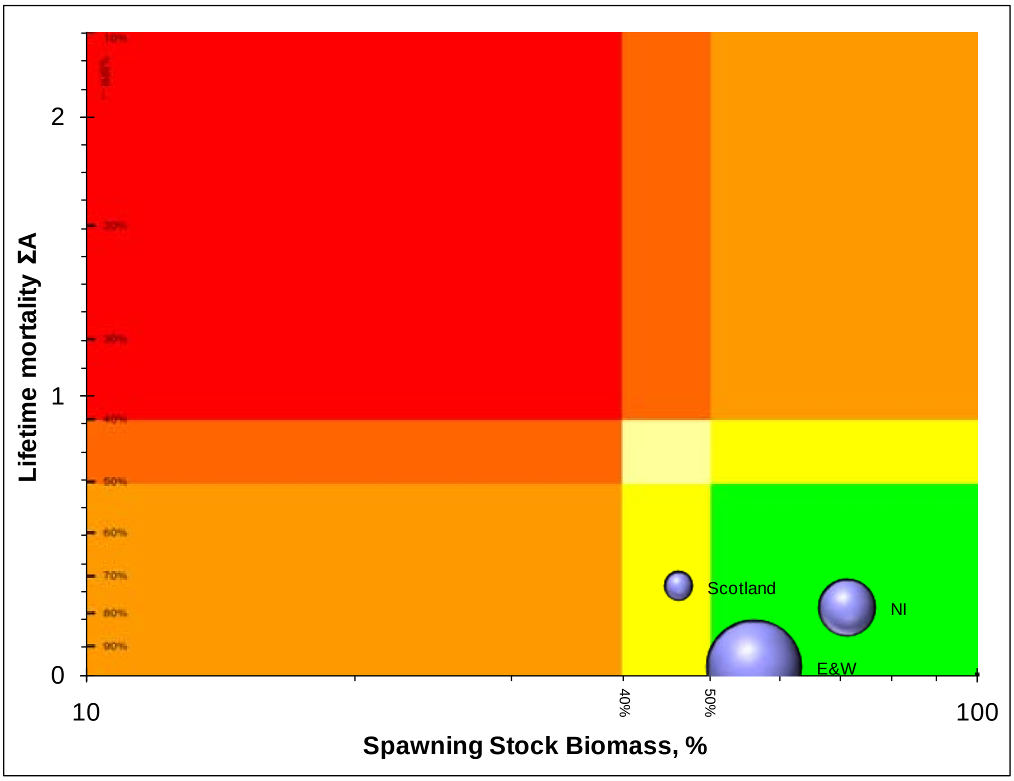

Figure 2. Modified precautionary diagram for the current eel stock described in the UK Eel Management Plans 2010. Separate estimates are given for three regions. The size of the plotted bubbles is proportional to the best-achievable biomass from current conditions (current stock, assuming no anthropogenic impacts). Please note that this figure is only for illustrative purposes and should not be taken as the current assessment of the performance of eel production within the UK, because we have yet to determine the best method to quantify current and pristine escapement, and anthropogenic impacts.

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 North Western 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 is not known at this time.

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 18, based on the assumption that production is directly related to the proportion of total wetted area that hydro-schemes 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 hydro-schemes 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 hydro-scheme barriers, and are currently being reviewed. One possible reason for the low values is a consequence of the siting of some hydro-schemes immediately below substantial natural barriers (i.e. waterfalls) to eel migration (in order to utilize the hydraulic head).

Table 18. Estimated impact of hydroelectric schemes on eels: the percentage of freshwater habitat from which eels are either excluded or exposed to turbine-related mortality.

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

***NI = Natural impassable barriers**

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 North Western RBD

None.

NI Neagh-Bann RBD

The LNFCS stocking target is 6 to 8 million individuals 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 (approx 3 million individuals) were stocked into Lough Neagh.

Scotland

None.

UK.13.2.2.8 Data quality issues

No information.

UK.14 Sampling intensity and precision

No new information available. Refer to previous UK Country Reports.

UK.15 Standardisation 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 Workshop held in Bordeaux in 2009), 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 the 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 Workshop held in Bordeaux in 2009).

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 fishers.

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 with the highs of the 1970s and early 1980s. The reported catch (1.03 t) by the England and Wales fishery was the third lowest in the current dataseries, which began in 1972. 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 some years precludes a robust trend analysis of cpue. It is expected that new trade registrations implemented in 2010 will reduce the level of underreporting. It is noteworthy, therefore, that the cpue for 2010 (2.78 kg per licence) remains in the low range of 0.6 to 2.94 in the 2000s, an order of magnitude lower than the estimated cpue for the 1980s (11 to 29 kg per licence).

Similarly, the 68 kg of glass eel caught in the fishery-independent trap in the River Bann, Northern Ireland, was the second 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://www.defra.gov.uk/foodfarm/fisheries/freshwater/eelmp.htm

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Report on the eel stock and fishery in France 2009/'10

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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.

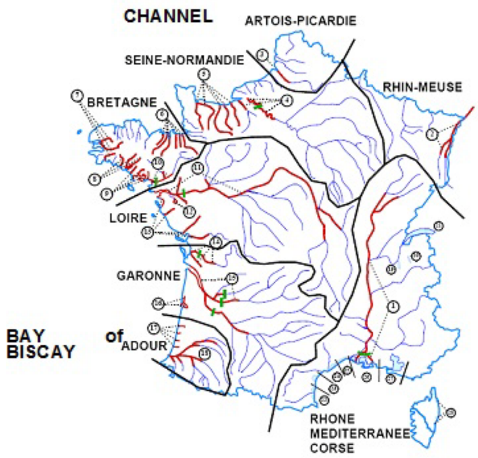


Figure FR.1. Inland waters in France (eel fisheries in red; tidal limits in green). The numbers correspond to the list of fishing zones in Table FR a. The management unit names and limits are in black (redrawn from CASTELNAUD, 2000).

Table FR.a. Fishing zones in French inland waters related to the eight management units (COGEPOMI) (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

(Number from Figure FR 2) Fishing zone – Surface for lagoons	COGEPOMI
(16) Delta d'Arcachon	Garonne
(17) Courants de Mimizan, Contis, Huchet, Vieux-Boucau	Adour
(18) Estuaire Adour, Fleuve Adour, Nive, Bidouze, Gaves de Pau et d'Oloron, Luy	Adour
(19) Lac du Bourget	Rhône-Méditerranée Corse
(20) Lac d'Annecy	Rhône-Méditerranée Corse
(21) Lac Léman	Rhône-Méditerranée Corse
(22) Etang de Canet - 480 ha	Rhône-Méditerranée Corse
(22) Etang de Salses Leucate - 5800 ha	Rhône-Méditerranée Corse
(23) Etang de Lapalme - 600 ha	Rhône-Méditerranée Corse
(23) Etang de Bages-Sigean - 3700 ha	Rhône-Méditerranée Corse
(23) Etang de Campignol – 115 ha	Rhône-Méditerranée Corse
(23) Etang de l'Ayrolle – 1320 ha	Rhône-Méditerranée Corse
(23) Etang de Gruissan – 145 ha	Rhône-Méditerranée Corse
(24) Etang de Thau – 7500 ha	Rhône-Méditerranée Corse
(25) Etang d'Ingril – 685	Rhône-Méditerranée Corse
(25) Etang de Vic – 1255 ha	Rhône-Méditerranée Corse
(25) Etang de Pierre- Blanche – 371 ha	Rhône-Méditerranée Corse
(25) Etang du Prévost – 294 ha	Rhône-Méditerranée Corse
(25) Etang de l'Arnel – 580 ha	Rhône-Méditerranée Corse
(25) Etang du Grec – 270 ha	Rhône-Méditerranée Corse
(25) Etang Latte-Méjean – 747 ha	Rhône-Méditerranée Corse
(25) Etang de l'Or – 3200 ha	Rhône-Méditerranée Corse
(26) Etang du Ponant – 200 ha	Rhône-Méditerranée Corse
(26) Petite Camargue gardoise – 1200 ha	Rhône-Méditerranée Corse
(26) Etang du Vacares et des Impériaux – 12 000 ha	Rhône-Méditerranée Corse

(Number from Figure FR 2) Fishing zone – Surface for lagoons	COGEPOMI
(27) Etang de Berre – 15 500 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

From 1999 to 2001, the total number of professional fishers 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 fishers 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.

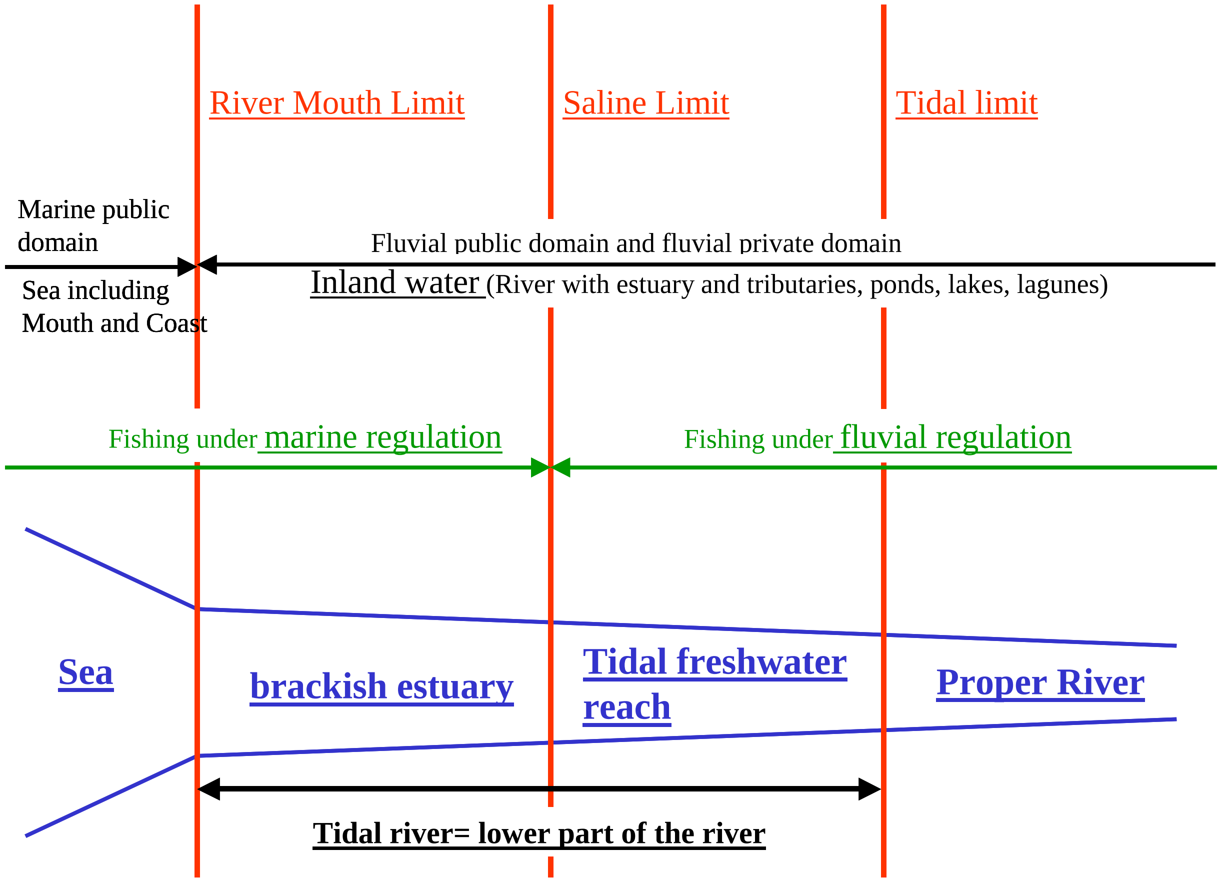
FR.2.2 Management and monitoring system

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 fishers can fish along with river fishers while these are not allowed to go downstream the saline limit.

In brackish and coastal waters within EMU, amateur fishers do not need licences to fish with authorized fishing gears. A system of licences is set up for marine professional fishers, for river professional and amateur fishers 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 fishers and fishing capacities but no system of licences exists.

Outside EMU, eel fishing is forbidden.

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



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, fishers categories and fishing rights by zones (Castelnaud and Beaulaton, 2005, unpublished data).

The marine professional fisheries in Atlantic coastal areas, estuaries and tidal part of rivers in France have been monitored since 1993 by the Centre National de Traitement Statistiques (CNTS, ex-CRTS) depending from the Direction des Pêches Maritimes et de l'Aquaculture (DPMA) of the Ministry of Agriculture and fisheries. This system is evolving and should also include marine professional fishers from Mediterranean lagoons. From this system, glass eels are distinguished from subadult eel, meaning that yellow and silver eels cannot be separated.

The river professional and amateur fishers 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 fishers 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 fishers organizations, administrations and research centres. Each COGEPOMI propose a management plan and funding every five years and has to monitor them. The plan determines conservation and management actions, restocking operations, proposes fishing regulations for both recreational and professional fisheries.

Until 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).

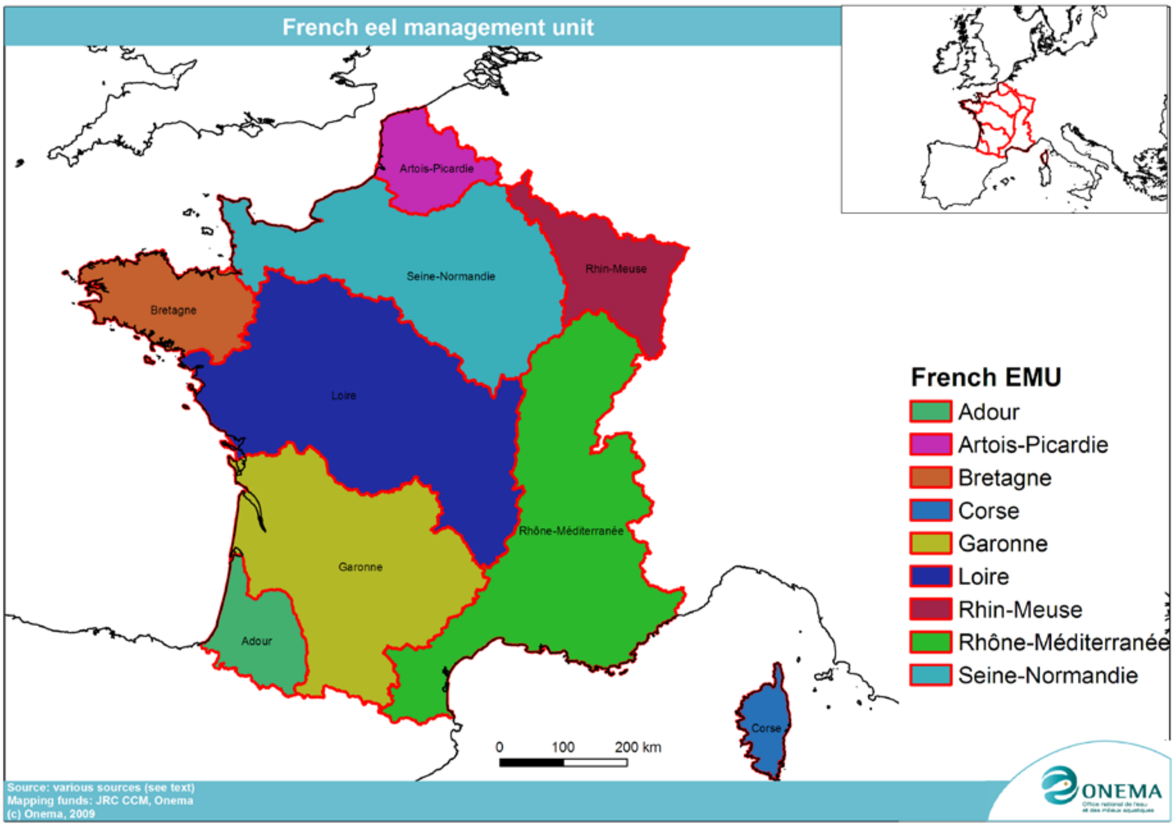


Figure FR.3. French eel management unit.

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 after implementation of the European eel regulation.

In 2008, the 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. This year, the Gironde scientific survey of the stock has been added to the series (Table FR.c and Figure FR.4).

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.).

The Loire series corresponds to an estimate of total landings of marine and river professional fishers (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 (see Section 3.2.4.1).

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 demonstrates that it has dropped from 6 kilograms in 1983 to 1.93.

The Gironde comprises three series: landings of marine and river professional fishers (catch, t), cpue of marine professional fishers 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. 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 fishers (t) and one series of commercial cpue of marine professional fishers (kg.day^{-1}.boat^{-1}). Those are computed by Ifremer scientific institute from logbooks which in this estuary are considered of good quality.

Table FR.c. Recruitment-series in France. 2009 means 2008–2009 migration season. Changes are highlighted in yellow.

EMU	BRETAGNE	LOIRE		GARONNE-DORDOGNE-CHARENTE-SEUDRE-LEYRE			ADOUR - COURS D'EAU COTIERS	
YEAR	VILAINE ARZAL TRAPPING ALL	LOIRE ESTUARY COM. CATCH	SÈVRES NIORTAISE ESTUARY COM. cpue	GIRONDE (CATCH) COM. CATCH	GIRONDE PIBALOUR (cpue) COM. cpue	GIRONDE SCIENT. ESTIM.	ADOUR ESTUARY (CATCH) COM. catch	ADOUR ESTUARY (cpue) COM. cpue
1923				46.0				
1924		65						
1925		70						
1926		90		18.7				
1927		65		34.1				
1928		102		22.4				5
1929				22.5				5.5
1930		1		28.2				6.7
1931				26.9				18.7
1932				31.1				
1933				13.5				
1934		90		13.4				
1935		150		19.7				
1936		30						
1937		7						
1938		15						
1939		17						
1940		27						
1941		21						
1944		10						
1945		66						
1946		43						
1947		178						

EMU	BRETAGNE	LOIRE		GARONNE-DORDOGNE-CHARENTE-SEUDRE-LEYRE			ADOUR - COURS D'EAU COTIERS	
YEAR	VILAINE ARZAL TRAPPING ALL	LOIRE ESTUARY COM. CATCH	SÈVRES NIORTAISE ESTUARY COM. cpue	GIRONDE (CATCH) COM. CATCH	GIRONDE PIBALOUR (cpue) COM. cpue	GIRONDE SCIENT. ESTIM.	ADOUR ESTUARY (CATCH) COM. catch	ADOUR ESTUARY (cpue) COM. cpue
1948		197						
1949		193						
1950		86						
1951		166						
1952		121						
1953		91						
1954		86						
1955		181						
1956		187						
1957		168						
1958		230						
1959		174						
1960		411						
1961		334		32.2	10.47			
1962		185	30	218	30.64			
1963		116	72	363	33.15			
1964		142						
1965		134	17	353	62.74			
1966		253	13	27.6	10.02			5.1
1967		258	8	163	25.46			6.4
1968		712	15	284	38.23			10.1
1969		225	14	36.6	18.52			5
1970		453	15	204	24.98			7.5
1971	44	330	12	47.1	9.12			4.6
1972	38	311	11	69.0	13.73			4.4
1973	78	292	8.5	20.0	29.19			4.5
1974	107	557	9	54.6	21.44			7.4
1975	44	497	8.5	44.1	12.5			5
1976	106	770	17	121	34			11
1977	52	677	15	122	25.38			
1978	106	526	18	64.7	23.17			
1979	209	642	17.5	73.2	18.74			10
1980	95	526	12	125	35.05			5
1981	57	303	9	84.9	32.41			
1982	98	274	8.5	61.0	14.55			
1983	69	260	6	66.7	14.33			
1984	36	183		45.0	13.87			
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

EMU	BRETAGNE	LOIRE		GARONNE-DORDOGNE-CHARENTE-SEUDRE-LEYRE			ADOUR - COURS D'EAU COTIERS	
YEAR	VILAINE ARZAL TRAPPING ALL	LOIRE ESTUARY COM. CATCH	SÈVRES NIORTAISE ESTUARY COM. cpue	GIRONDE (CATCH) COM. CATCH	GIRONDE PIBALOUR (cpue) COM. cpue	GIRONDE SCIENT. ESTIM.	ADOUR ESTUARY (CATCH) COM. catch	ADOUR ESTUARY (cpue) COM. cpue
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					0.44		
2010	3.8							

Com. = Commercial

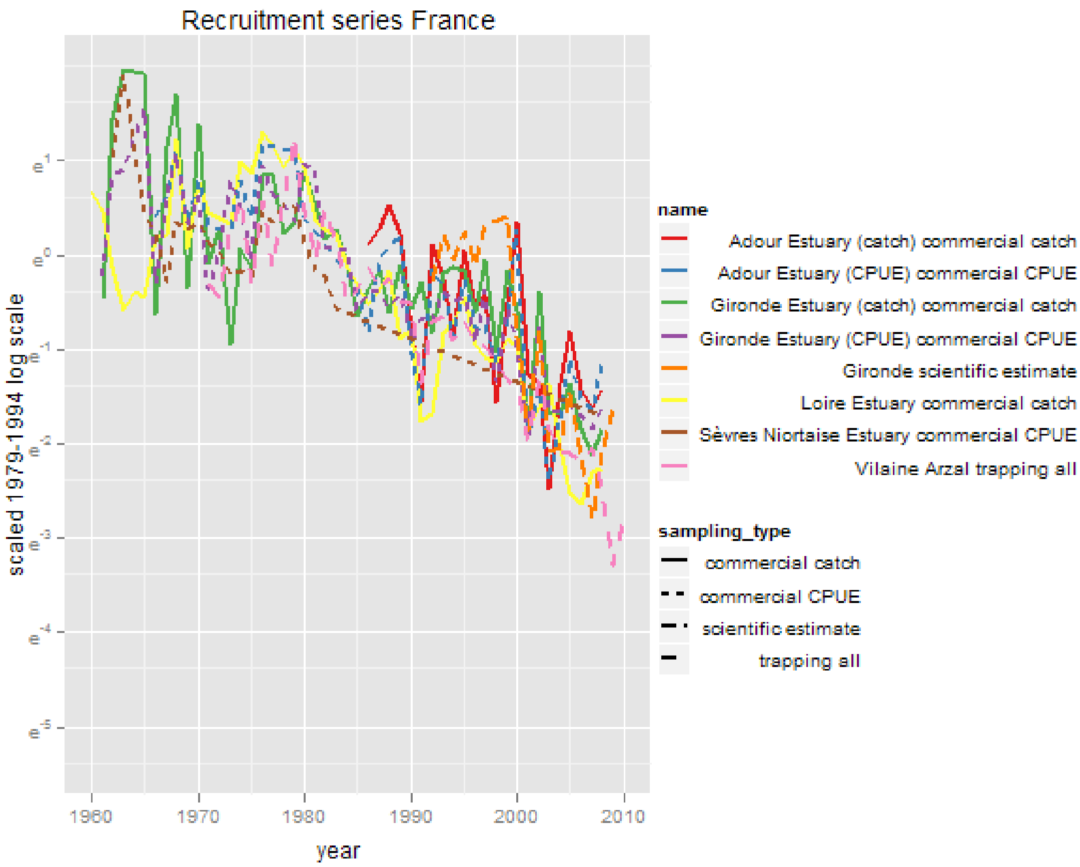


Figure FR.4. Recruitment-series in France (scaled to mean1979–1994 value and after 1950). A smoother has been added to follow the trend. * missing data (considered as biased and retrieved from the dataset).

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. Pre-selected river for a river index network.

EMU	Pre-selected river
Adour	Gave de Pau (mountain fluvial basin < 1000 km²) or La Nivelle (fluvial basin < 1000 km²)
Gironde	Canal des étangs (estuary) or La Seudre (marshes)
Loire	Vendée (fluvial basin < 1000 km²)/Sèvre Niortaise (marshes) or La Vie (fluvial basin < 1000 km²)
Bretagne	Le Frémur (fluvial basin <1000 km²)
Seine-Normandie	La Bresle (fluvial basin < 1000 km²)
Artois-Picardie	La Somme (fluvial basin >1000 km²) or L'Authie (fluvial basin >1000 km²)
Rhone Mediteranée Corse	A lagoon or Le Rhône (fluvial basin >1000 km²) A river in Corsica (fluvial basin <1000 km²)
Rhin Meuse	Le Rhin (fluvial basin >1000 km²) or La Meuse (fluvial basin >1000 km²)

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.5). The proportion of eel that use the fish compared with other way of passage is under evaluation. For 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.

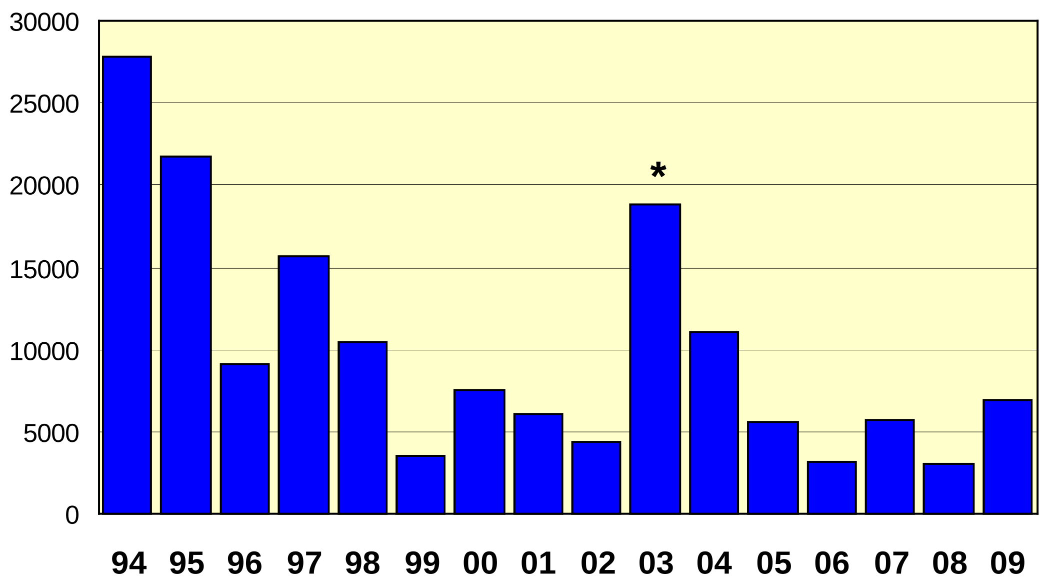


Figure FR.5. Annual evolution of fish number in the eel ladder trap on the Bresle River (data ONEMA). 2003: change in ladder device.

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.6), with a decrease of the proportion of glass eels and small eels (<90 mm, from 56% to less than 30%).

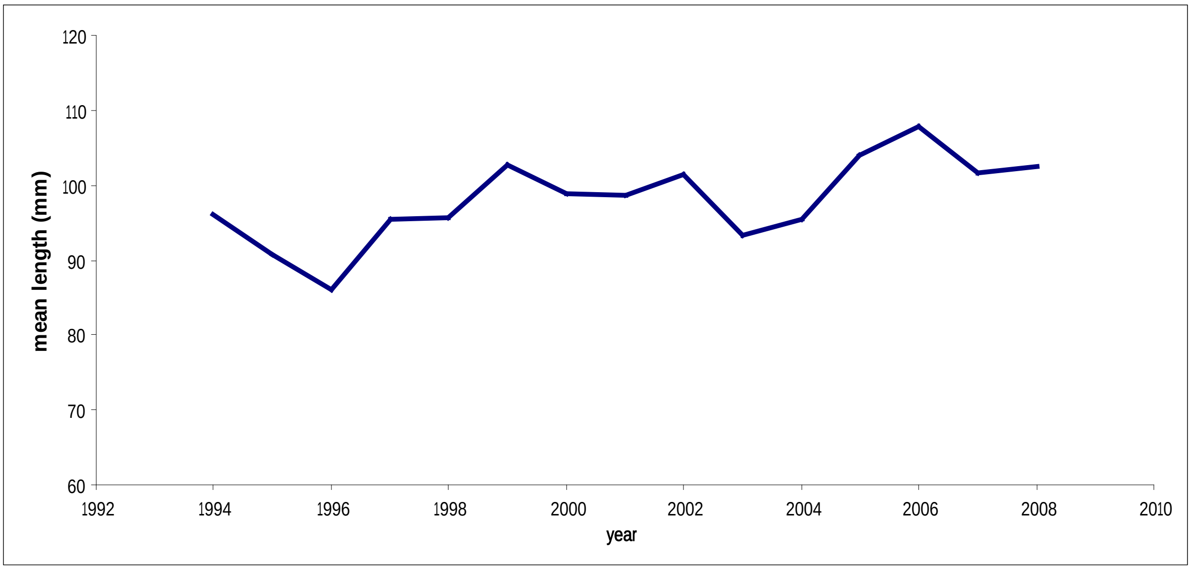


Figure FR.6. Annual evolution of mean length in the eel ladder trap on the Bresle River (data ONEMA).

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.7). 863 eels (521 kg) have been caught in 2009. Catch have been greater than 15 eels for 10 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).

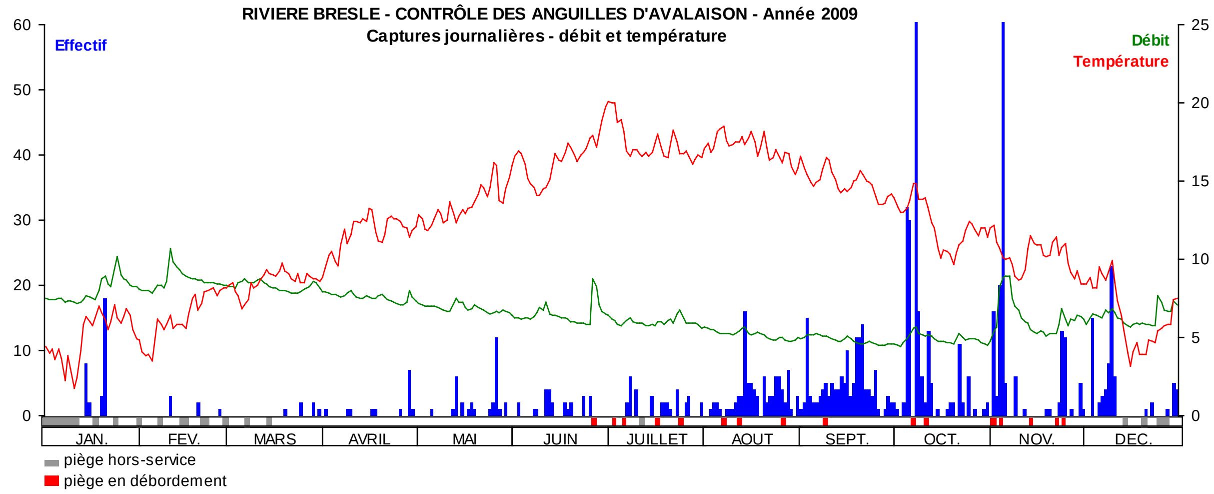


Figure FR.7. 2009 silver eel surveys in the Bresle river. Blue bar = silver eels number, red = temperature, green = discharge. Grey days = trap not operating , red days = trap operating but overflowed.

FR.3.2 Glass eel landings time-series

There are eight EMU in France among which six are concerned with glass eel catches.

FR.3.2.1 Rhine-Meuse EMU

No glass eel there….

FR.3.2.2 Channel: Artois Picardie and Seine Normandie EMU

The channel region is covered by three EMU, Artois Picardie (A-P), Seine Normandie (S-N), and Brittany. In Brittany some catches occur in the north, in the Channel area but they are not very important when compared with western and southern Brittany. The following part covers glass eel catches in the channel apart from Brittany.

Data from the channel come from the Somme fishery (corresponding to a nominal effort of 13 fishers on 15 licences in 2008) and other fisheries including the "Seine" (which sum up to 17 fishers corresponding to 23 licences in 2008). In 2008, the reporting from fishers can be considered as good in the Somme estuary, and of a lesser quality elsewhere due to aggregated catch report. The catch for the Somme estuary sums up to 314 kg in 2008. The catch for the remainder of the channel amounts to 807 kg. The fishing season starts in February and stops in May, and is the latest in France. The time-series, built mostly from data included in the French management plan, is made of landings report from fishers. Data are missing for the Somme estuary in 1994 and 1995, and in 1988–1990 for the Seine and Norman coastal streams. 1986 and 1987 are made from inquiries from Désaunay (1987). They represent the "possible" catch during the 1980 decade, so they are possibly a little bit overestimated.

Glass eel landings (Channel)

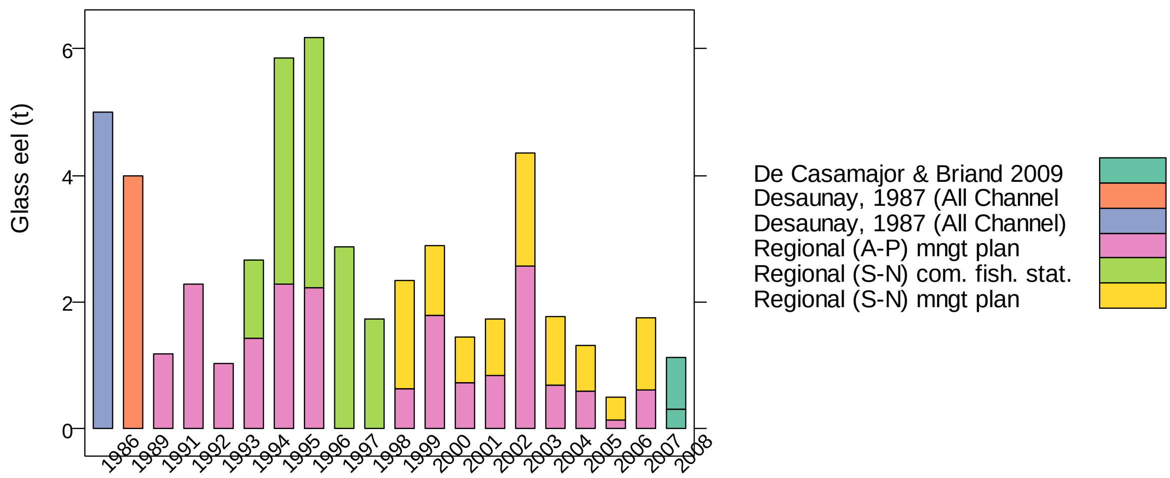


Figure FR.8. Glass eel landings in the channel according to the source of data.

The landings in 2008 are estimated at 1 t 100 (de Casamajor and Briand, 2009) and could possibly represent 1 t 800 when assuming that all licensed fishers are fishing.

FR.3.2.3 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.3.2.3.1 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 with the landings.

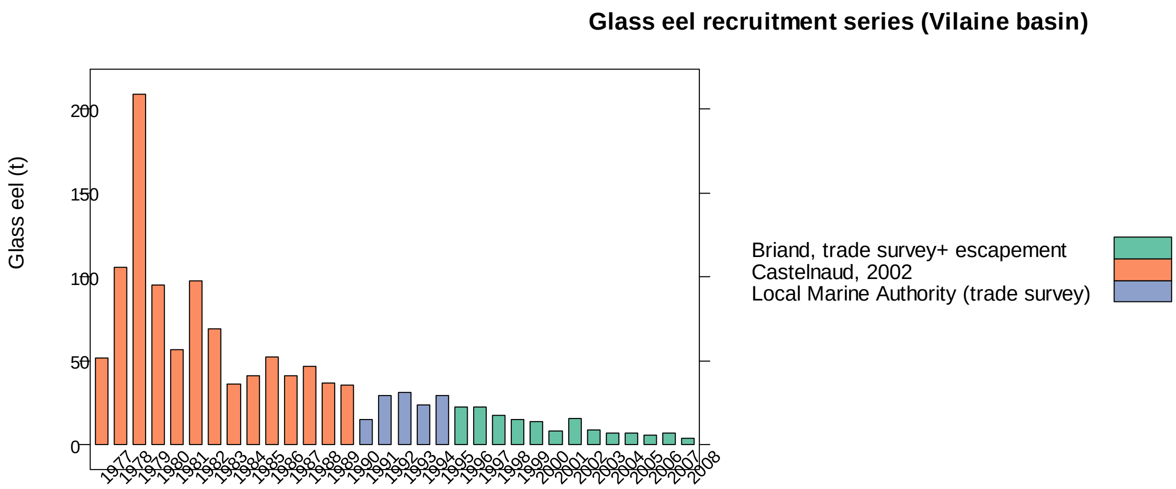


Figure FR.9. Historical series of glass eel landings in the Vilaine estuary according to the source of data.

FR.3.2.3.2 Brittany other than the Vilaine

Aubrun, 1986 includes non professional fishers. Catches from 2002 are collected from fishers logbooks.

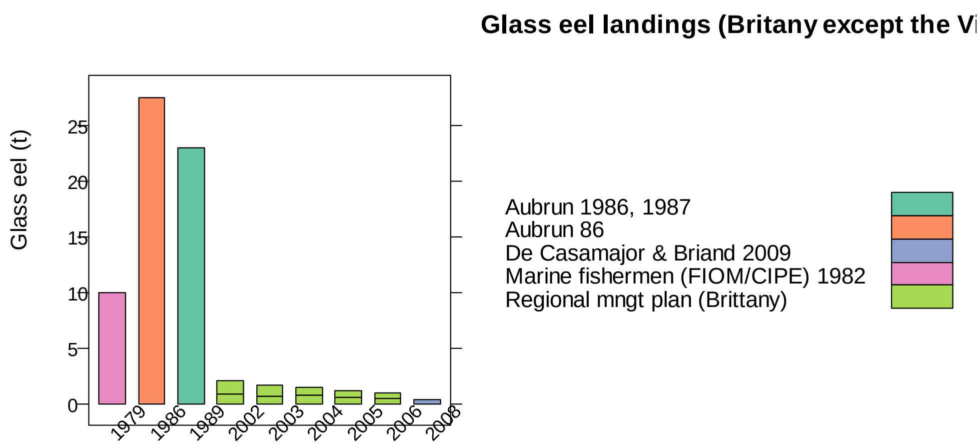


Figure FR.10. Glass eel landings in Brittany.

FR.3.2.4 Loire EMU

FR.3.2.4.1 The Loire Estuary

For the Loire, as for other basins we have gathered data for as many sources as we could. As the Loire is probably one of the most complex cases, we chose to illustrate the process of data selection in Figure FR.11. The data from the Loire come from several areas and two categories of fishers (fluvial and marine fishers). Local rules for access to the fishing areas and licence are quite complex. Catches are made by fluvial fishers upstream, marine fishers downstream and there has historically been a well developed and integrated poaching practice along the banks of the estuary.

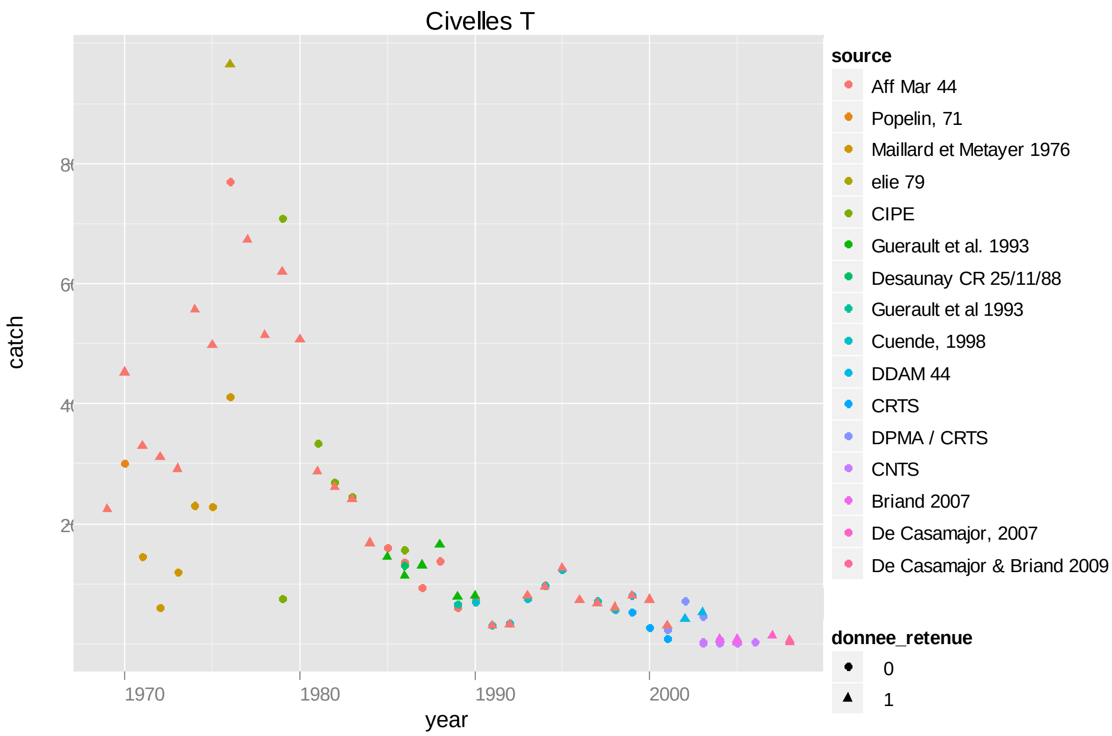


Figure FR.11. Selection of data for the historical series in the Loire estuary, several data can be selected (donnee_retenue=1) for one year provided they concern different categories of fishers or different areas within the basin.

These various sources of data lead to the well known Loire series which should be considered with caution before drawing conclusions on recruitment trend, as it is a series of total landings (hence subject to variations in effort) and built from many sources across time with various reliability.

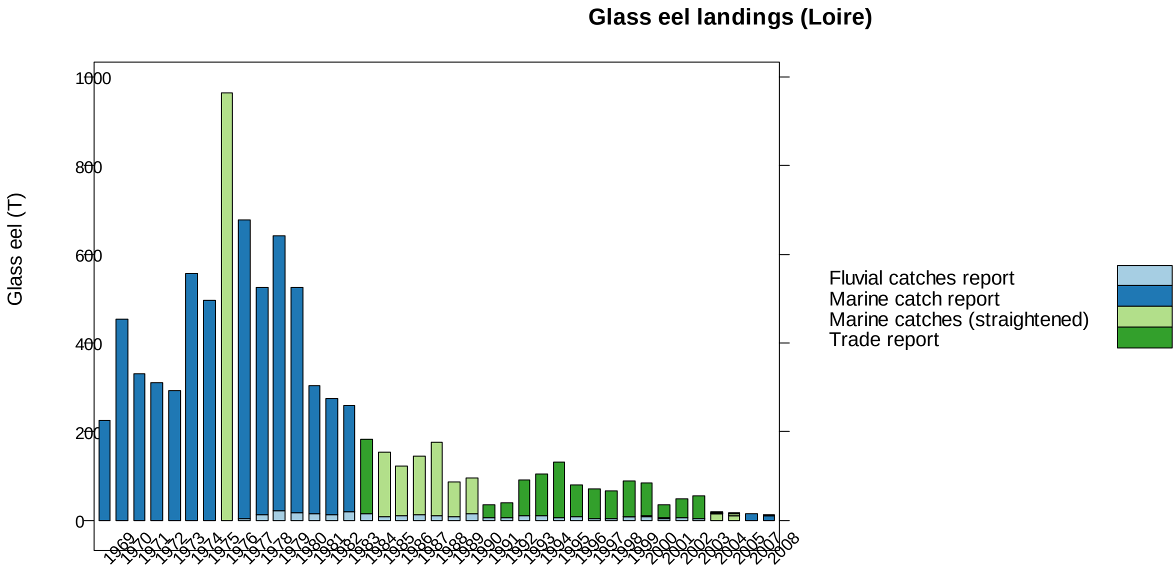


Figure FR.12. These various sources of data can be synthesized in the following graph, fluvial catches have not been included since 2003.

FR.3.2.4.2 The Vendée Estuaries

The Vendée, located south from the Loire is mainly formed of small estuaries, the largest being the Sèvre Niortaise whose fishery was well described by Gascuel (1987). With small streams and estuaries, but large landings, the Vendée is probably the place in France with the largest recruitment and unfortunately the worst series of data. Most data in the Vendée time-series are underestimated, except for data in 1976, 1986, 1989 (Respectively Elie, 1979; Aubrun, 1987; and Aubrun, 1986; 1987; Gascuel, 1987 and Désaunay 1987). Those data also include in 1986 an estimation of catch from non professional fishers in the Lay and Sèvre Niortaise. Some years (1993, 1997), data from the smaller estuaries (but large landings) of the Baie de Bourgneuf might be lacking and explain the low level of catch. 1999–2001 data come from the fishers syndicate. In 2008 the level of landings was estimated as18 t (as shown on this graph) and extrapolated to 22.7 t (using nominal effort, see landings part). This dataseries should not be considered as reliable.

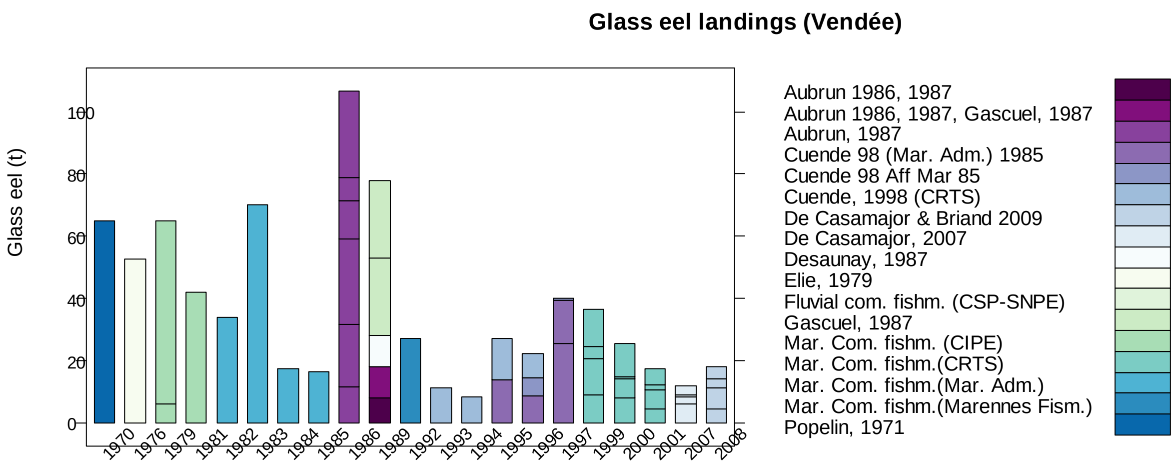


Figure FR.13. Glass eel landings in the Vendée region (Loire EMU), colour according to the source of data.

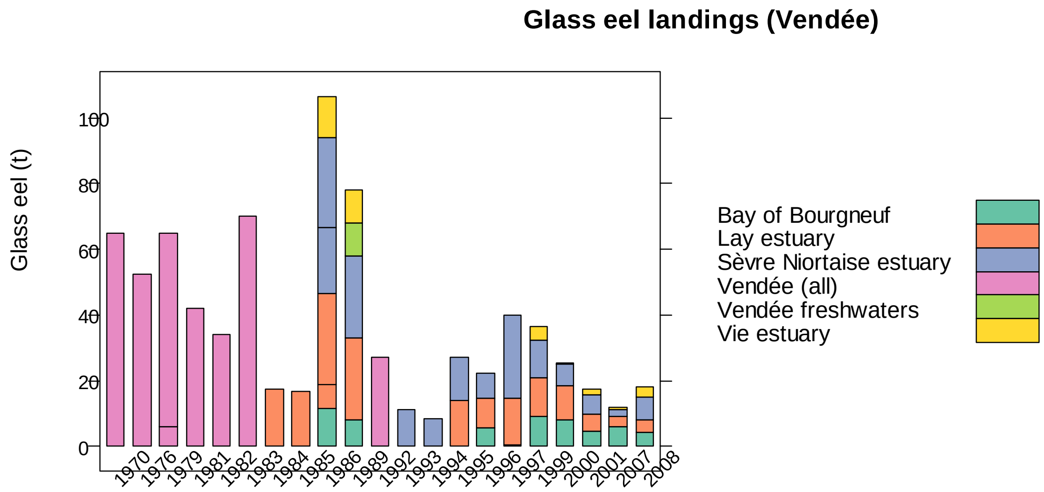


Figure FR.14. Glass eel landings in Vendée (Loire EMU), with colour according to the catch location.

FR.3.2.5 Garonne EMU

FR.3.2.5.1 The Charente and Seudre Estuaries

The Charente and Seudre are two estuaries located north from the Gironde. The fishing areas comprise the Charente, the Seudre, the small Brouage canal (some boats) and catches made in the Oleron Island straight. As in the Gironde, the fishers use large 14 m² push nets with some boats remaining at anchor in the inner part of the Seudre estuary.

As was the case in the Vendée, the historical time-series demonstrates variation with large underestimates some years (1993–1994) which are hardly credible. Fluvial fishers catches are reported some years (1989, and 1999–2001), but they are of little importance when compared with marine fishers catches. There is an estimation of recreational fishers landings one year (1986) by Aubrun (1987).

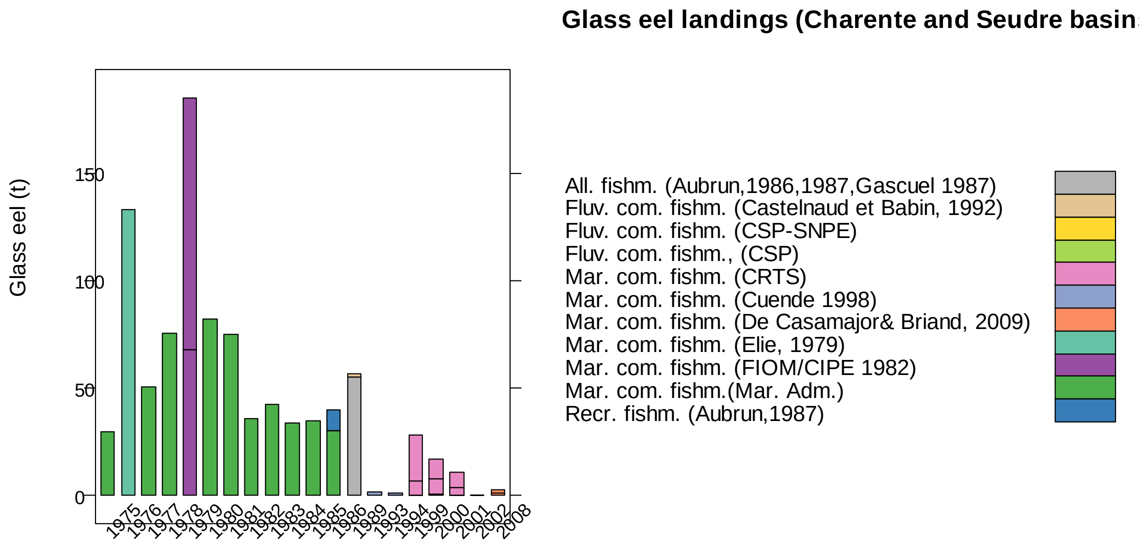


Figure FR.15. Glass eel landings in the Seudre and Charente basins (Loire EMU), with colour according to the source of data.

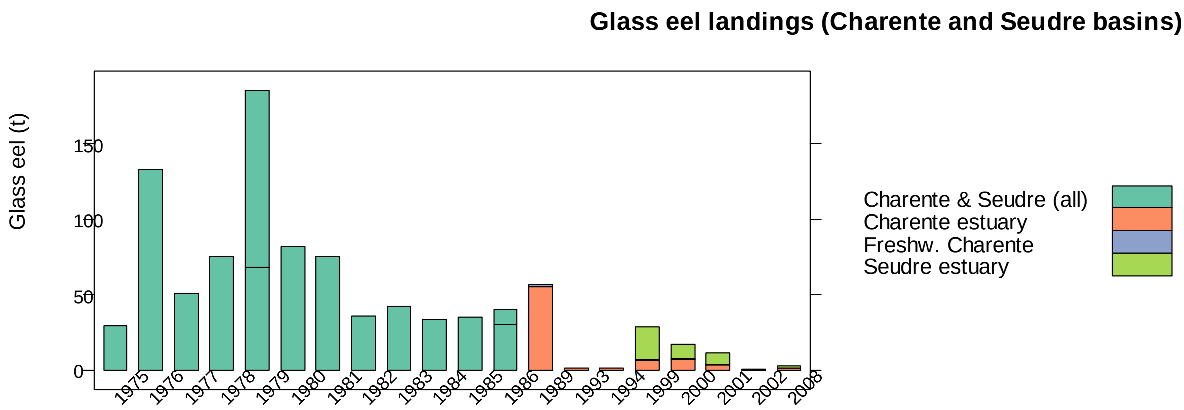


Figure FR.16. Glass eel landings in the Seudre and Charente basins (Loire EMU), with colour according to the location.

FR.3.2.5.2 The Garonne

The Gironde series has been collected by the CEMAGREF and extended by Beaulaton (2008). The Gironde is one of the few estuaries where an estimation of recreational landings is available as a time-series. It was extrapolated from professional landings and number of river amateurs fishers. 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 fishers were larger than those from commercial fishers.

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").

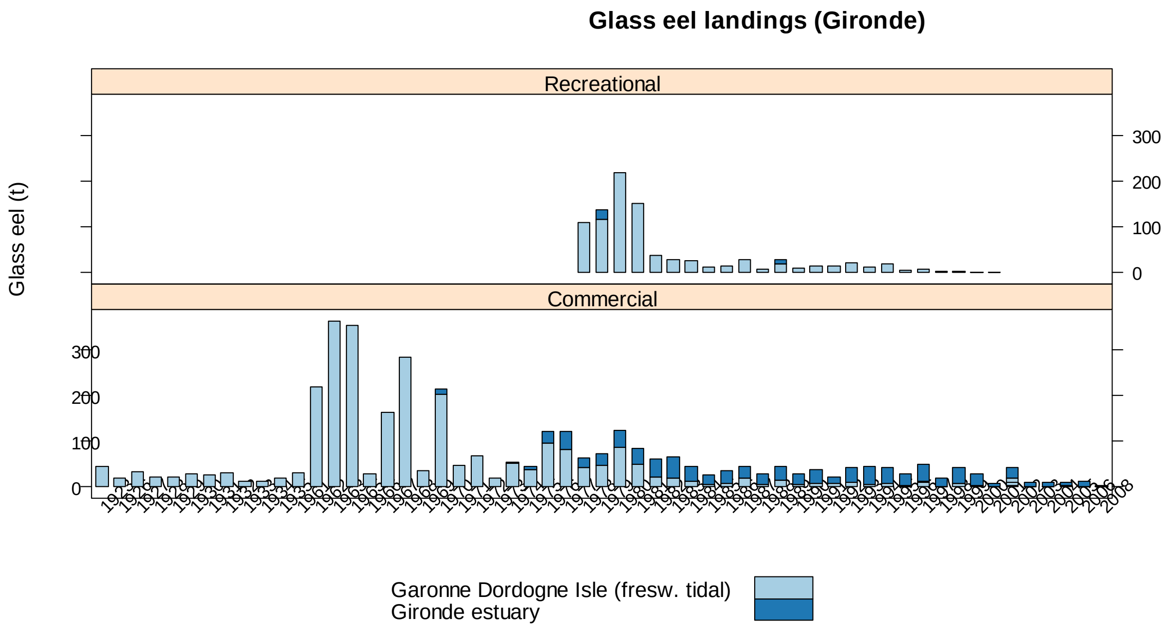


Figure FR.17. Glass eel landings in the Gironde (Garonne EMU), colour according to the catch location.

FR.3.2.5.3 The Arcachon Basin

A small fishery with handnets occurs in the Arcachon basin. It is mostly located in the canal des Etangs. We have only one historical data in 1989 (Aubrun, 1986, 1987) estimating the landings as 12 t. In 2008, the sum of catches was estimated around 1 t for 17 fishers (de Casamajor and Briand, 2009).

FR.3.2.6 Adour and Courants Landais EMU-Adour

The most important fisheries within the EMU are located in the Adour but glass eel fishing also occurs at the coast (wave fishery) and in the small streams of the Landes region. Trying to rebuild a time-series for the Adour EMU, is quite complex. Catches are done by commercial fishers (mandatory report) for both marine and fluvial categories and Recreational fishers whose catch was quite large when estimated in 1986 (Aubrun). The time-series provided to the ICES group for recruitment trend is located in the Adour estuary and only concerns marine fishers. Historical catches were quite large in the 1970s as they were estimated at 280 tons by Popelin (1971).

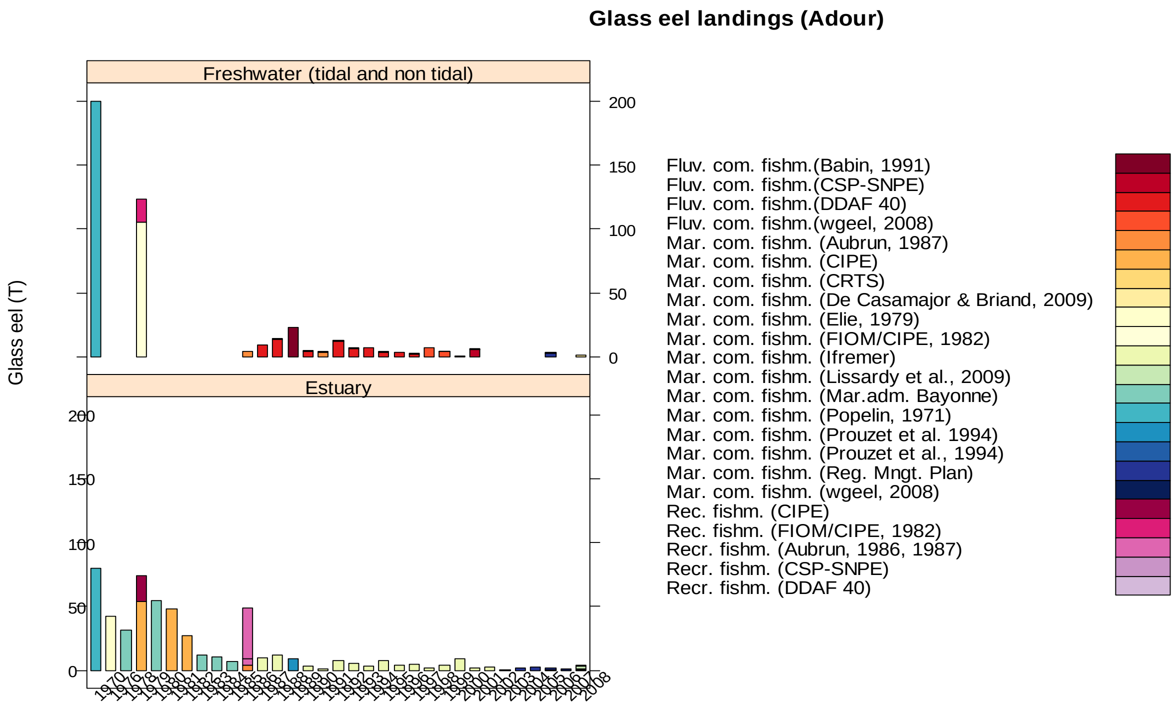


Figure FR.18. Glass eel landings in the Adour and Courants landais (Adour EMU), colour according to the source and fishers (fishm.) type. The figure was split according to the location within the estuary.

FR.3.2.7 Rhône Mediterranean -EMU and Corsica EMU

Catch of glass eel is not authorized in the Mediterranean area.

FR.3.2.8 France overview

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

Table FR.e. 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. Changes are highlighted in yellow.

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

FR.3.3 Yellow eel landings time-series

FR.3.3.1 Commercial

FR.3.3.1.1 Loire EMU

Grand Lieu lake, connected to the lower Loire River is one of the most important fisheries from that basin. Figure FR.19 shows landings series from this lake from 1959 to 2008. Adam (1997) describes historical data, as well as change in exploitation between 1960s 1970s and 1990s and particularly the replacement of traditional eel pots by modern fykenet and the extension of fishing season. Yellow eels and silver eels are only separated since 2002. For those years silver eels represent a mean proportion of 17%.

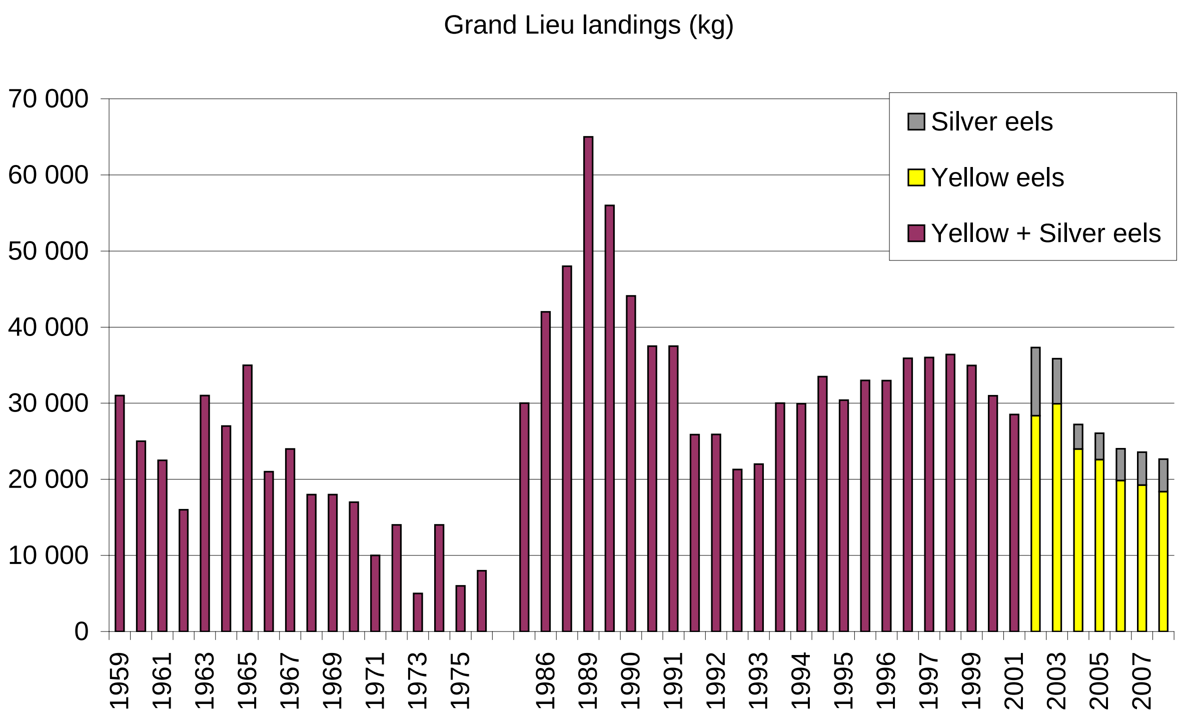


Figure FR.19. Grand Lieu lake (Loire EMU) landings from 1959 to 2008 (Adam, 1997 ; tableau de bord anguille Loire, Boisneau, comm. pers).

FR.3.3.1.2 Garonne EMU

The Gironde series has been collected by the CEMAGREF and concerns landings from professional fishers 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 has been extended by Beaulaton (2008) and continued by Girardin and Castelnaud (2009). One should notice that 1946–1977 data are based on small number of fishers that may explain high variability from these years (Figure FR.20). The fisheries also shift from eel pot made of wood to plastic eel pots. Yellow eel landings clearly decrease over the last twenty years from 158 t in average between 1978–1986 to less than 13 t since 2003.

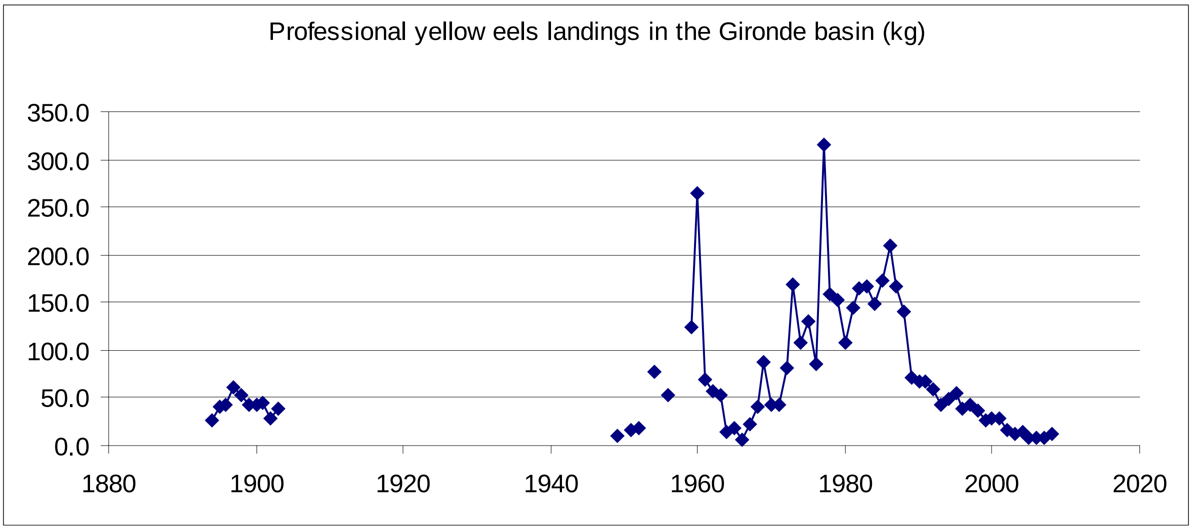


Figure FR.20. Marine and river professional yellow eel landings in the Gironde basin (brackish and freshwater estuary).

FR.3.3.1.3 Adour EMU

The Adour series has been collected by Ifremer since 1986 and concerns professional marine fishers (Morandeau *et al.*, 2009). This series was extended from 1978 using local fisheries administration data. On this estuary the landings decrease from the last thirty years from 15 t in 1978 to 1 t and even less in 2002 and 2008 (Figure FR.21).

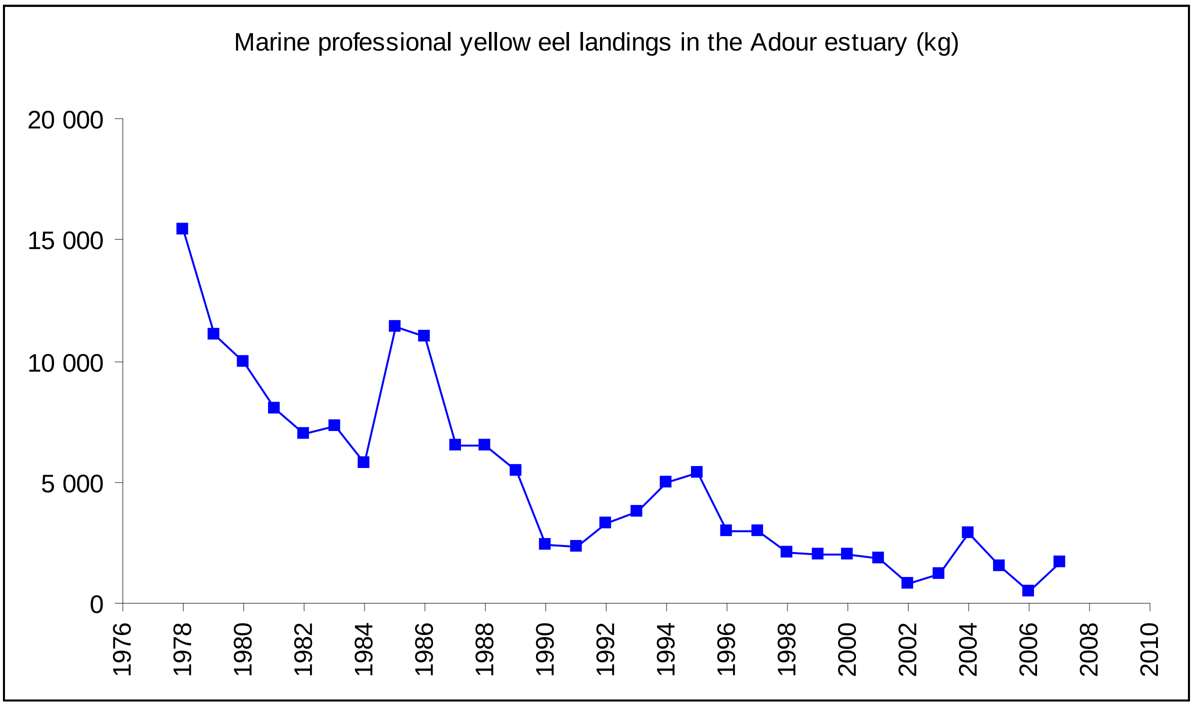


Figure FR.21. Subadult eel landings and associated effort for the Adour estuary from 1978 to 2007.

FR.3.3.1.4 National overview

FR.3.3.2 Recreational

No data available.

FR.3.4 Silver eel landings

FR.3.4.1 Commercial

FR.3.4.1.1 Loire EMU

A short series of silver eel landings from the Loire basin, the only one where this stage is specifically targeted, is now available (Figure FR.22).

On the Loire river reach, above the Grand-Lieu lake, the landings from seven to nine river professionals are similar in 2004 and 2008, after increasing in the between, nearly of double in 2007.

On the Grand-Lieu lake (connected to the Loire river), landings from seven river professionals decrease from 2002 to 2008.

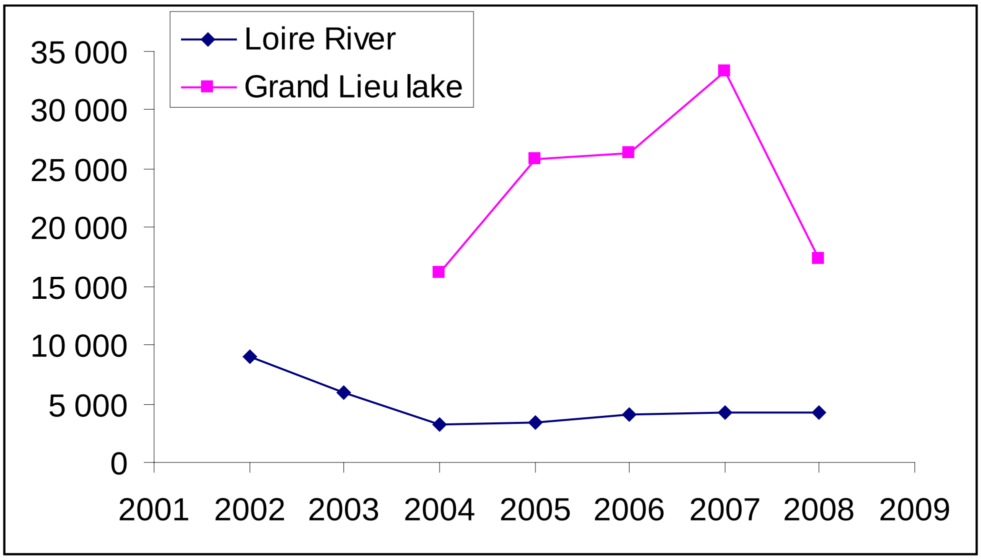


Figure FR.22. Silver eel catches in the Loire EMU (Boisneau P., pers. comm.)

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 0,233g and thus 900 000 glass eels) have been restocked in the Loire River in July 2010. Glass eel comes from a CITES seizure.

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

The Table FR.f gives 2009–2010 catches of glass eel and their destination. These figures are official data and still provisional.

Table FR.f. Total catch of glass eel for 2009–2010.

EMU	Catch (kg)			Reserved for stocking (kg)
	MP*	PF**	Total	
Rhin-Meuse	0	0	0	-
Artois-Picardie	460	0	460	
Seine-Normandie	860	0	860	
Brittany	4 095	0	4 095	
Loire	24 761	3 000	27 761	
Garonne	6 423	21	6 444	
Adour	537	537	1 074	
Rhône-Méditerranée	0	0	0	-
Corse	0	0	0	-
Total	37 177***	3 558	40 735	3 273****

*** as transmitted by fishery ministry (01/07/2010)**

**** Onema data (31/08/2010)**

***** 41 kg EMU not determined**

****** as transmitted by fishery ministry (07/07/2010). A fishers note (20/07/2010) report 10 t.**

FR.4 Fishing capacity

There is not a full and up-to-date register of fishing capacity in France. Until now the annual number of fishing licences for eel is produced each year by the marine fishers organization but nothing similar exists for river fishers. The type of gears used is known but apart the glass eel scoopnet for which the size is the same everywhere in France, the size of the glass eel pushnets vary with the location and the fishers. The number of pots for yellow and silver eel 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 fisher to another.

FR.4.1 Glass eel

FR.4.1.1 For commercial fishers

FR.4.1.1.1 Licences

For marine commercial fishers the quota of seasonal licences 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 and “glass eel stamp" in 2009. Data on river professional licences is only available for 2007. In that year, there were 238 fluvial licences, making with marine professional fishers a total of 1119 professional fishers potentially targeting glass eel.

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

FR.4.1.1.2 Fishing fleet

Table FR.h shows characteristics of marine fishers boats in 2008. Note that 40% of them are concentrated within the Loire EMU. 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 (kW)	Mean Age (year)	Mean number (men)
< 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 fishers

For legal river amateur fishers, the number of licences was stable from 1993 to 1999 with an average of 617. Since 1999, the number of legal river amateur fishers has decreased to 285 in 2005 and 193 in 2006. The amateur glass eel fishery has been banned in 2006 in the Loire River.

FR.4.2 Yellow eel

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

Yellow eel fisheries are 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 fishers, amateur fishers with gears and anglers with rods.

Whatever the category, the number of fishers has been decreasing since 1987 (BRIAND *et al.*, 2005).In 2001 only a part of the 450 professionals fishers 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 fishers (Table FR.i). The most part of these marine professional fishers and two thirds of these river fishers also target glass eel.

FR.4.2.1.2 Mediterranean lagoon fisheries

Since 1988, the number of 400 to 500 marine professional fishers 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 fishers 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). More recently, the Pôle relais lagunes méditerranéennes (2009) has estimated a total of 41 fishers in the PACA region in 2008 (the other region concerned by eel Rhone EMU).

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

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

FR.4.2.2 National overview

Table FR.i. Mean number of yellow eel professional fishers per fishing zone from 1999 to 2001, the most recent period with complete data (Source CSP, CRTS, Cemagref; except [a] 1997, Castelnaud, 2000;[b] 2000, Sauvaget, 2001).

EMU	Fishing zone	Marine professional	Fluvial professional	Total
Artois-Picardie & Seine-Normadie	Manche - Seine-Normandy	5[(a)]	1	6
Bretagne	Bretagne (Vilaine excluded)	13[(b)]		13
Bretagne	Vilaine	2	1	3
Loire	Loire	16	28	44
Loire	Grand Lieu		8	8
Loire	Vendée	5		5
Garonne	Charente-Seudre	1		1
Garonne	Gironde	30	42	72
Garonne	Arcachon	42		42
Adour	Adour + courants landais	14	10	24
Rhône-Méditerranée & Corse	Rhone		4	4
Rhin-Meuse	Rhin		8	8
Rhône-Méditerranée & Corse	Méditerranée	513	5	518
	Total	641	107	748

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

In 2002 the special five years authorizations for fishing silver eel in private waters by amateur fishers were 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.

FR.4.3.1.2 Mediterranean lagoon fisheries

A large part of the 280 fishers catching yellow eel (see Section 4.2.1.2) also catch silver eel. The exact number is unknown.

FR.5 Fishing effort

FR.5.1 Glass eel (2008)

FR.5.1.1 Professional fishers

Fishing effort for the glass eel fisheries should ideally be measured by the volume filtered by the fishery. When compared with 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 about 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.j. Size and dimensions of the nets allowed in the French inland waters to professional fishers. 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 fishers (one scoopnet of small size) or handled from a boat for professional fishers (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 fishers, 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 fishers reports only (river fishers not yet available). 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 for each location, sometimes grouping several small estuaries, and the seasonal trends are often consistent for the whole fishery. Note that the sum for the number of fishers with daily catch (given in the legend) is done per graph, and thus a fisher fishing two places will be counted twice so the sums might differ from those reported in Table FR.g.

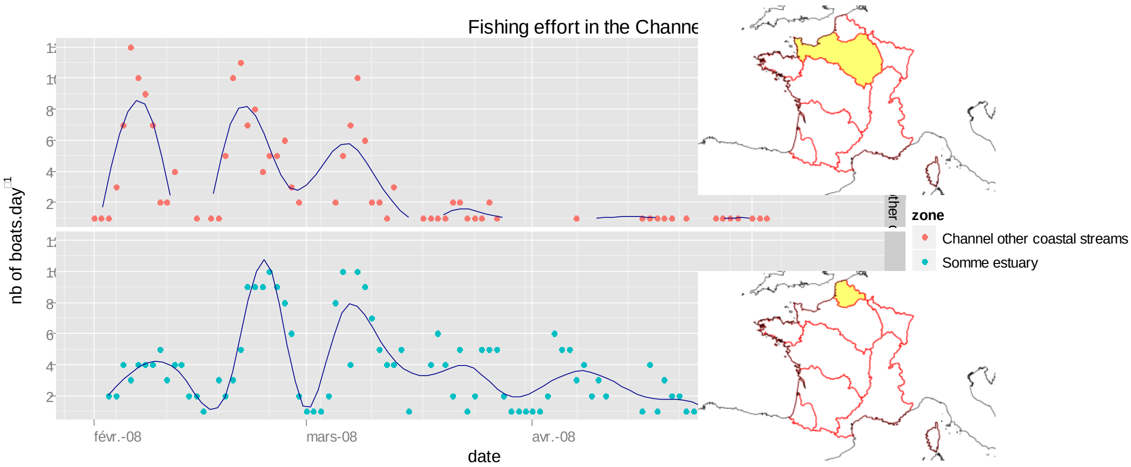


Figure FR.23. Trend in daily mean fishing effort of marine commercial glass eel fishers in the Channel in 2008, based on 28 boats with daily catch report on 44 licences.

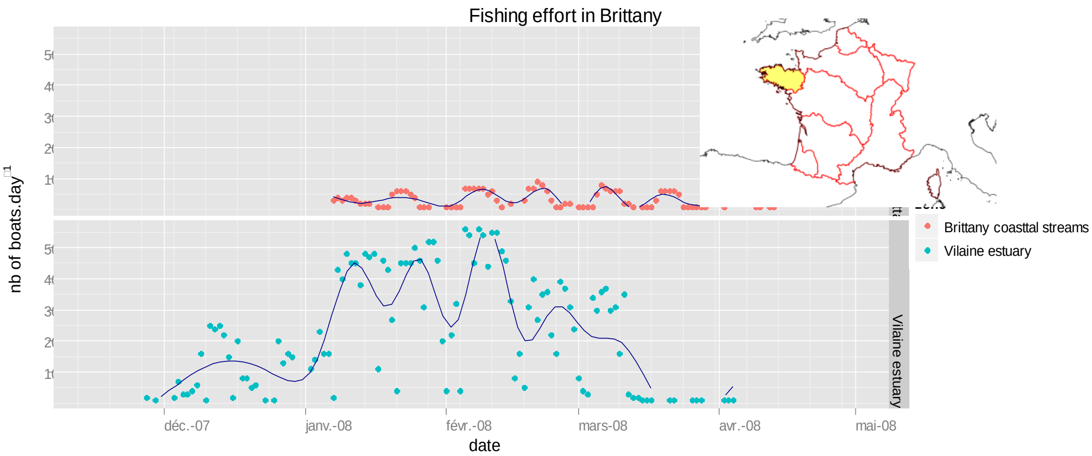


Figure FR.24. Trend in daily mean fishing effort of marine commercial glass eel fishers in Brittany in 2008, based on 74 boats with daily catch report on 154 licences.

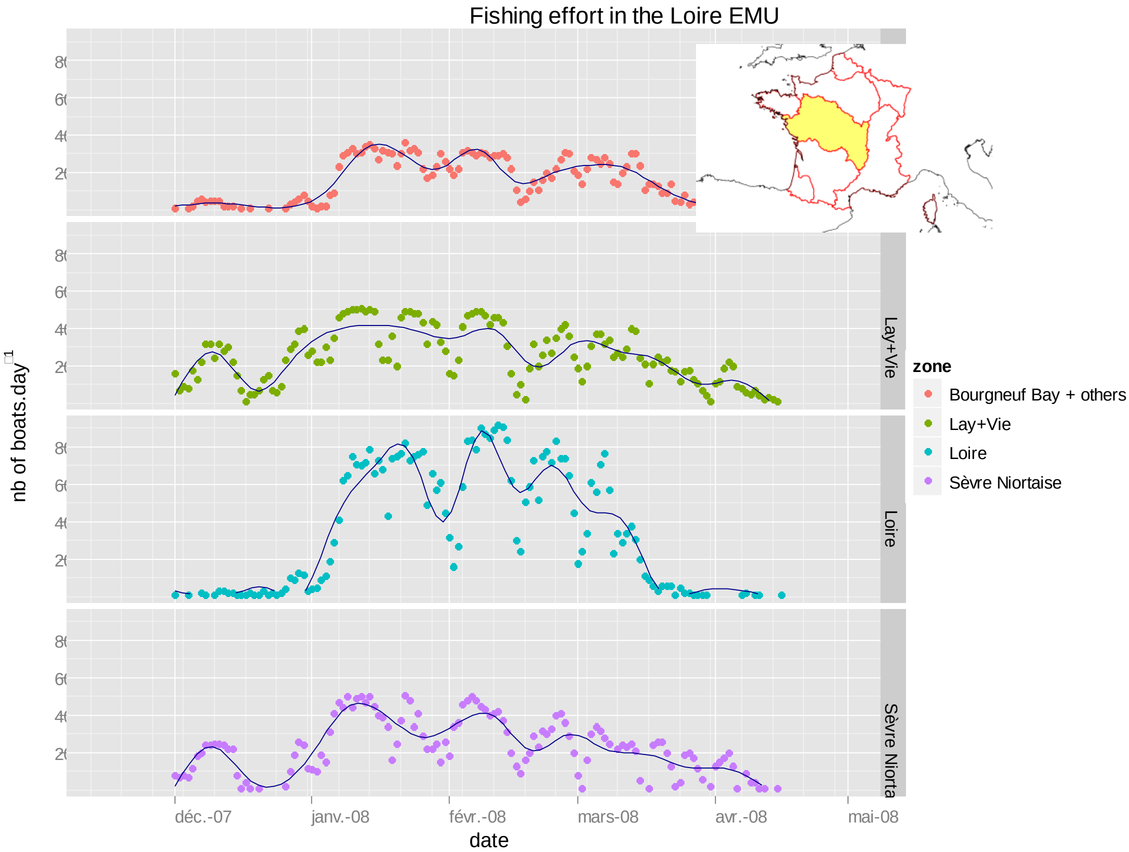


Figure FR.25. Trend in daily mean fishing effort of marine commercial glass eel fishers in the Loire Eel Management Unit in 2008, based on 255 boats with daily catch report out of 344 licences.

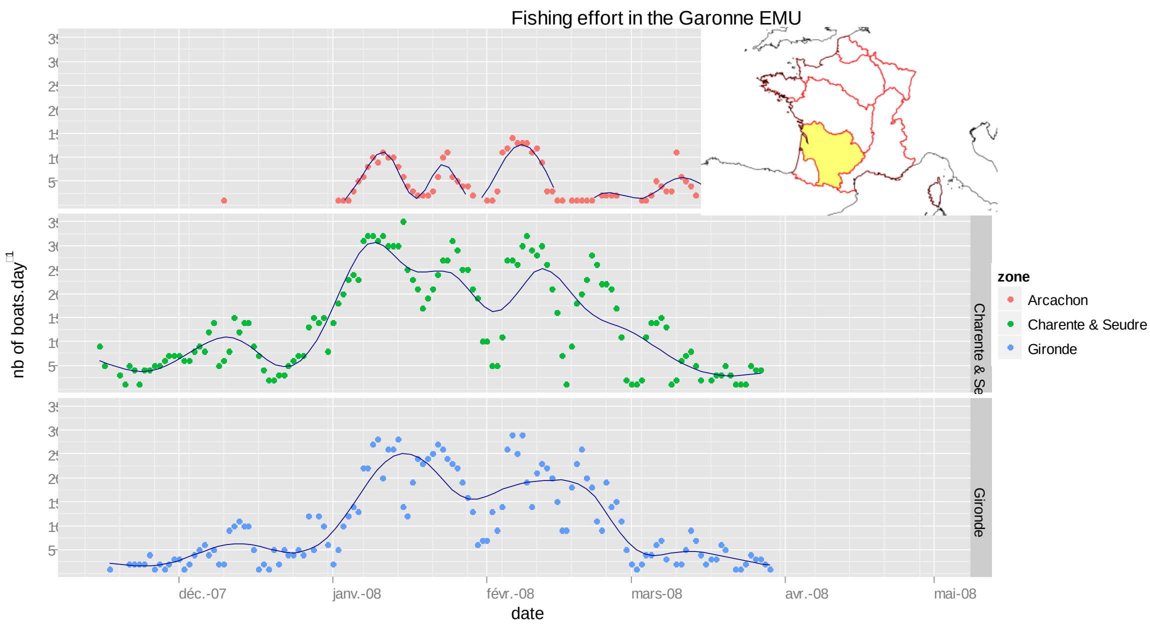


Figure FR.26. Trend in daily mean fishing effort of marine commercial glass eel fishers in the Garonne Eel Management Unit in 2008, based on 85 boats with daily catch report out of 239 licences.

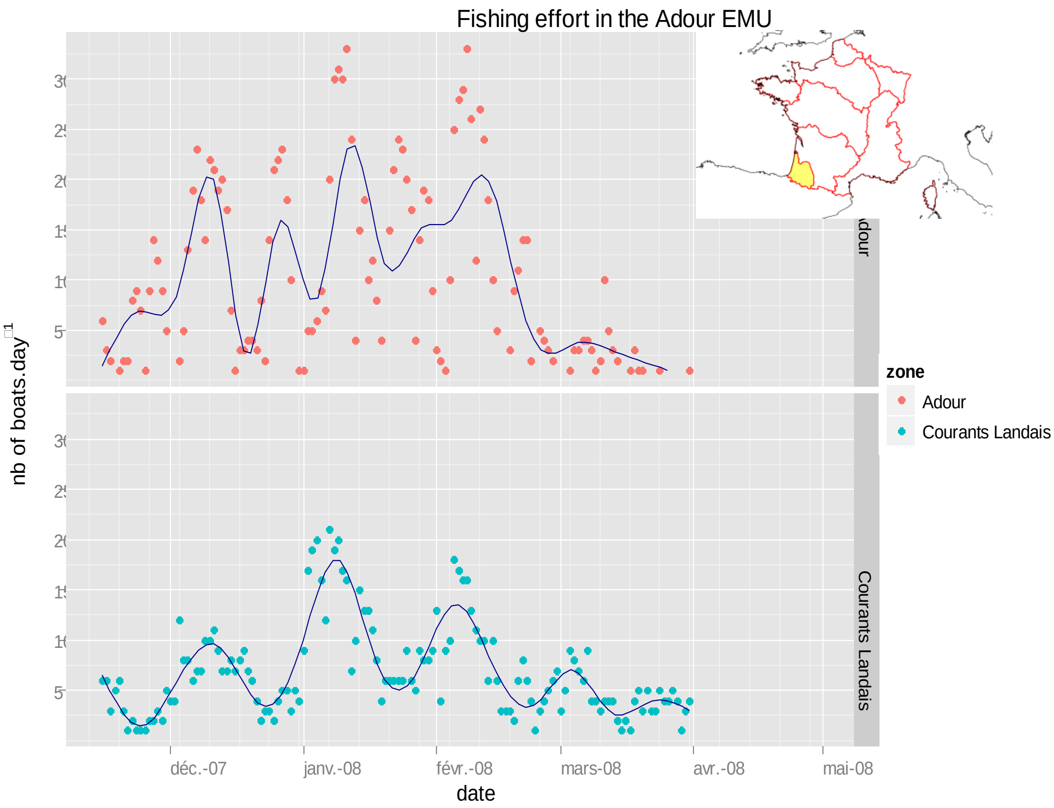


Figure FR.27. Trend in daily mean fishing effort of marine commercial glass eel fishers in the Adour Eel Management Unit in 2008, based on 92 boats with daily catch report out of 62 licences [3].

To synthesize at the national level, the effort was extrapolated to the whole fishery using the number of stamps (fishing authorizations in an estuary). It must be emphasized out again that statistical reports of logbooks boats were not available at the time of the report, and that catches were screened to obtain daily values, so the difference between daily report selection and extrapolated value does not mean underreport.

[3] It might seem surprising that in the case of the Adour, the number of boats is larger than the number of licenses. But indeed, some fisheries in the Adour take place at the coast and in that location the « CIPE » licence was not mandatory.

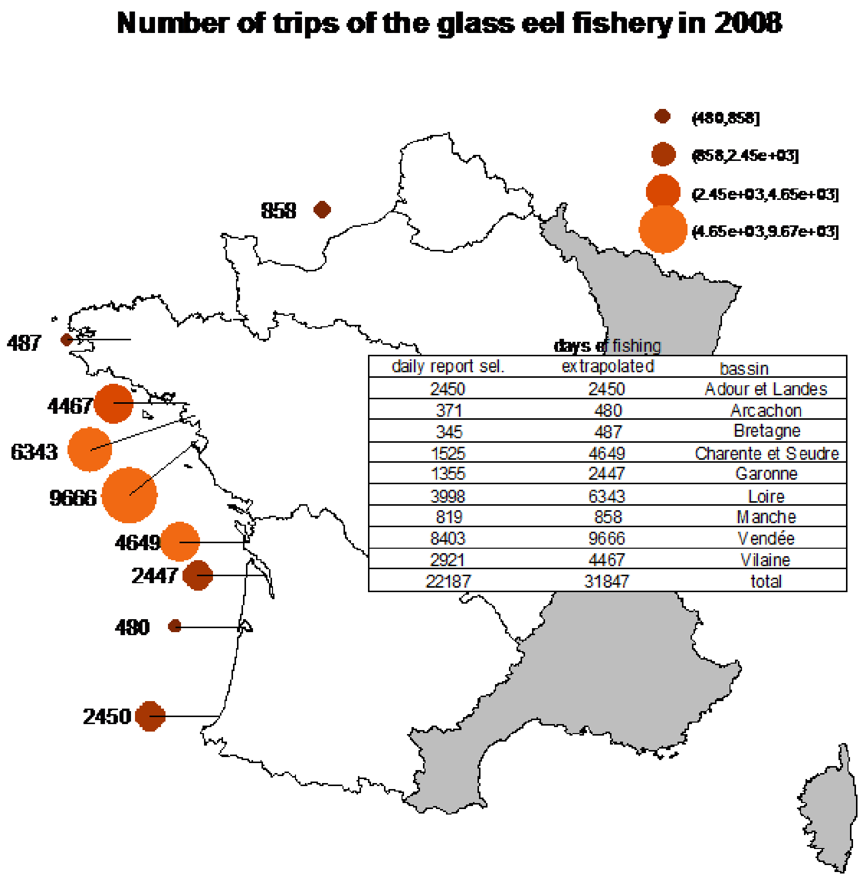


Figure FR.28. Total number of fishing days for marine commercial glass eel fishers in 2008. The value has been extrapolated to the whole fishery (see text this paragraph and in landings for discussion on the method used).

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 fishers 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, liftnets, "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

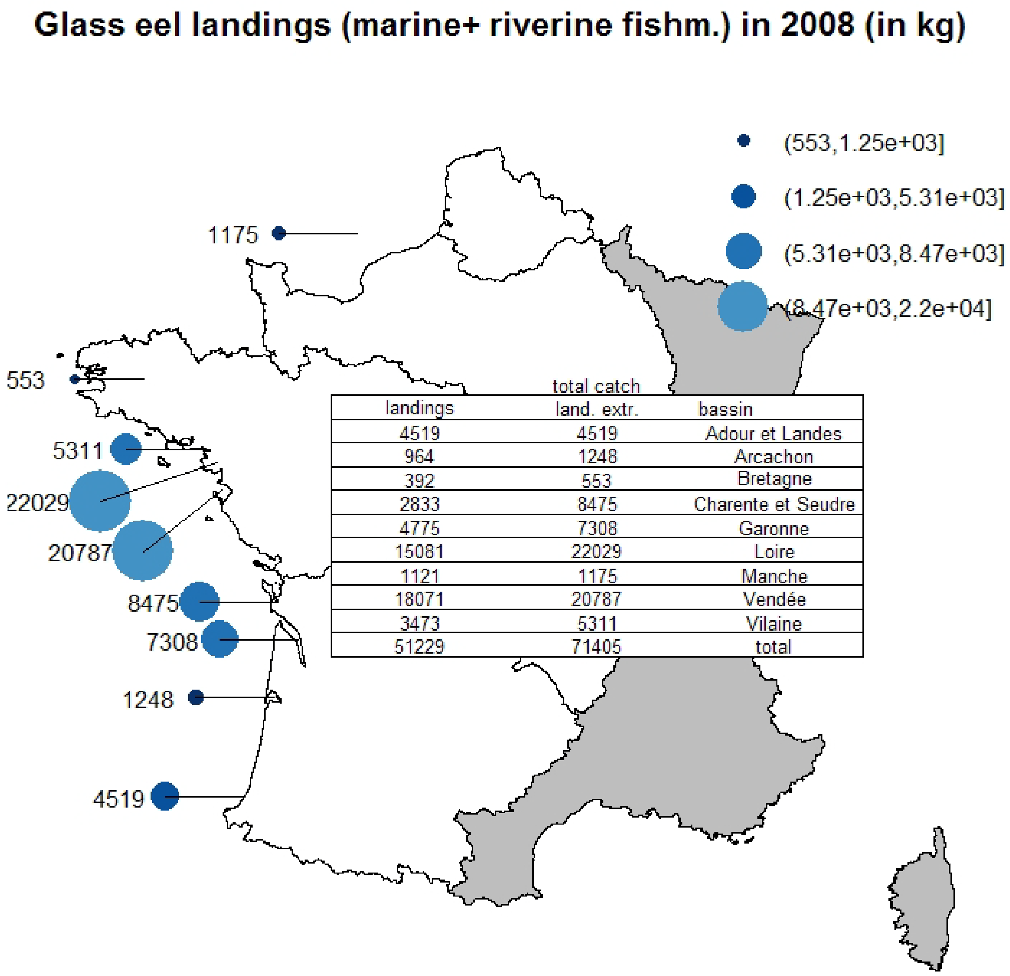
FR.6.1 Glass eel

FR.6.1.1 Professional fishers (2008)

The landings were processed from the small boats without logbooks (boat <10 m) for marine fishers, as the data from logbooks reports were not available at the time of the report. As some data were lacking we have chosen to straighten the total landings using the number of licences. For river fishers compulsory declaration to SNPE are taken.

We think that this method might have been accurate for the two following reasons:

- An extrapolation from these data ends up with catches of 5 t 3 for the Vilaine while a sum of 5 t 1 was collected from fish dealer survey.
- The extrapolation to France gives total of 71 t which is within the estimation of total traded (68–72 t; Table FR.k).



landings	total catch land. extr.	bassin
4519	4519	Adour et Landes
964	1248	Arcachon
392	553	Bretagne
2833	8475	Charente et Seudre
4775	7308	Garonne
15081	22029	Loire
1121	1175	Manche
18071	20787	Vendée
3473	5311	Vilaine
51229	71405	total

Figure FR.29. Total landings estimated for marine and riverine commercial glass eel fishers in 2008 from official declaration. The value has been extrapolated to the whole fishery (see text this paragraph and in effort for discussion on the method used). Cemagref estimate for the Garonne is 9.9 t.

FR.6.1.2 Recreational fishers

No data available.

FR.6.1.3 National overview (glass eel 2008, 2009 and 2010)

Three sources of data can be used: landings, trader statistics (unofficial) and EU trade statistics. Landings data are not yet available for 2009. However landings for 2009 are available in the Vilaine and are a fair estimate of recruitment, especially in 2009 when the fishery has been extended to the end of March. Data for 2010 as official data. All figures are consistent with a decrease of around 60% of landings between 2008 and 2009. Trade to Asia has been specially disrupted, and the increase in trade to Spain is interpreted as mixing of yellow eel in the winter reports.

Table FR.k. Comparison of different sources of glass eel landings for seasons 2007–2008, 2008–2009 and 2009–2010.

	Export from France to Hong Kong Taiwan China (t)	Export from France to Spain (t)	Export from France sum (t)	Professional fishers landings (this report) (t)	glass eel traders (CNPMEM/ CONAPPED estimate) (t) [4]	Vilaine estuary (landings t)
2007–2008	39	12.7	51.7	71.4	68–72	5.1
2008–2009	6.9	18.6	25.5	Not available	31–32	2.2
2009–2010	13.7	11.6[5]	41.8	41.7	[6]	3.7 [7]

FR.6.2 Yellow eel

FR.6.2.1 Professional fisheries

FR.6.2.1.1 Rhin-Meuse EMU

Professional fisheries are only authorized in the Rhine River and its tributary the Ill River. Landings are estimated at 724 kg in 2007 by the French eel management plan.

FR.6.2.1.2 Artois-Picardie EMU

The main freshwater fisheries take place in the Somme River. Landings were estimated to 20 t until PCB pollution restricts this fishery in 2006 (French EMP).

Yellow eel fisheries are also caught in the Channel. Data for 2000 to 2006 are given in the French EMP. The mean of that value is 1.7 t.

4 (including fluvial fishermen)

5 Based on Spain import data

6 Not available

7 Not available in 2010, calculated from Britany data.

FR.6.2.1.3 Seine-Normandie EMU

River professional fishers fish in the Seine River and declare 862 kg in 2007.

Yellow eel fisheries are also caught in the Channel. Declared landings are 13.9 t in 2007 and 680 kg in 2008 (Ifremer and Onema). This large variation is due to PCB restriction.

FR.6.2.1.4 Bretagne EMU

River professional fishers caught some eel in the Vilaine River. This fishery seems to disappear. Marine fishers catch 11 t of eel in 2007 and 1.8 t in 2008 in South Brittany (Ifremer). This large variation is unexplained. They also catch eel in the Vilaine estuary: 1.8 t in 2007 (Ifremer).

FR.6.2.1.5 Loire EMU

River fishers in the Loire river and its tributaries have declared 9 t in 2007, 16 t in 2008 and 15 t in 2009 (Onema-SNPE). Marine fishers in the estuary have declared 12,5 t in 2007 and 7,4 t in 2008 (Ifremer). The local administration (Affaire maritime 44) estimates for those fishers a landing of 21 t for 2007.

Marine fishers also catch eel in Vendée and Pertuis. The declared landing for 2008 is 4 t (Ifremer).

FR.6.2.1.6 Garonne EMU

River fishers for eel in the Charente River caught less than 1 t (Onema). Marine fishers 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 fishers from the Gironde fish 8,7 t in 2007 and 12.4 t in 2008 (Cemagref).

River fishers from Dordogne and Garonne Rivers have declared 1.3 t in 2007 and 1.9 t in 2008 (Cemagref).

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

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

FR.6.2.1.7 Adour EMU

Marine fishers from Adour and Courants landais have declared 1.4 t in 2007 and 0.7 t in 2008 (Ifremer).

River fishers from Adour and its tributaries have declared 0.7 t of eels in 2007, 0.5 t in 2008 and 0.4 t in 2009 (Onema-SNPE).

FR.6.2.1.8 Rhône EMU

Some fisheries restrictions have been taken in the Rhône River for river fishers due to PCB. They have declared in 2007 0.5 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).

FR.6.2.1.9 Corse EMU

For Corsica lagoons, the production is about 31 t for 2007 (Demenache *et al*., 2009).

FR.6.2.1.10 National overview

Table FR.l. National overview of yellow eel fishing in France in 2007 and 2008.

EMU	2007	2008	2009*
Rhin-Meuse	0.7	NA	NA
Artois-Picardie	<2 t	<2 t	NA
Seine-Normandie	13.9	<1t	<1 t
Bretagne	13.0	1.8	NA
Loire	33.9	32.3	15
Garonne	28.0	30.3	NA
Adour	2.1	1.3	<1 t
Rhône	294.5	294.5	NA
Corse	31.0	31.0	NA
Total	418.8	393.5	15.4

***River fishers only in 2009.**

FR.6.2.2 Recreational fisheries

FR.6.2.2.1 National overview

Only recreational gear fisheries in fluvial public domain have an obligation to declare to Onema. Table FR.m gives the number of fishers that declare some yellow eel catches as well as the total number of licences sold. However these licences are not eel specific and allow fishing many other species. Table FR.n gives the declared catch by those fishers.

It should be however noticed that these figure are provisional (all years) as all declaration have not yet being recorded in the database. These figures should thus be considered as minimal figure. Only 30% to 50% of fishers who have a licence declare catches to Onema. Among them, between 42% and 77% have declared eel catches.

Thus at least 15% of recreational gear fisheries (>1000 out of 6500) catch eels for a minimal amount of 15 t. Given the declaration rate, this amount may be multiplied by 2 (30 t) or 3 (45 t) to estimate recreational gear fisheries. Moreover some underdeclaration may exist, but no data are available on this phenomenon.

Table FR.m. Recreational fishers declaring yellow eel catches in France between 2004 and 2009, number of fisher declaring catch whatever the species (total declaration) and number of licences (not eel specific) sold (fluvial public domain). Provisional figures from Onema.

EMU	2004	2005	2006	2007	2008	2009
Rhin-Meuse	15	16	9	8	12	9
Artois-Picardie	NA	NA	NA	NA	NA	NA
Seine-Normandie	NA	NA	1	NA	NA	NA
Bretagne	84	63	54	45	62	22
Loire	910	730	709	642	711	454
Garonne	84	111	414	407	111	52
Adour	36	34	34	47	48	43
Rhône	65	47	45	46	27	14
Corse	NA	NA	NA	NA	NA	NA
Total	1194	1001	1266	1195	971	594
Total declaration	2145	1865	2981	2687	1590	773
Total licences	6404	6444	6339			

Table FR.n. Yellow eel catches (in t) by recreational fishers (declaration) in France between 2004 and 2009 (fluvial public domain). Provisional figures from Onema.

EMU	2004	2005	2006	2007	2008	2009
Rhin-Meuse	0.2	0.3	0.1	0.2	0.2	0.1
Artois-Picardie	NA	NA	NA	NA	NA	NA
Seine-Normandie	NA	NA	<1t	NA	NA	NA
Bretagne	0.8	0.6	0.4	0.5	0.5	0.1
Loire	13.0	9.9	12.6	10.2	11.6	4.2
Garonne	1.1	0.8	3.9	4.5	1.2	0.4
Adour	0.5	0.4	0.5	0.9	1.0	0.6
Rhône	0.2	0.2	0.2	0.3	0.1	0.1
Corse	NA	NA	NA	NA	NA	NA
Total	15.9	12.2	18.0	16.5	14.6	5.5

The total catch of all recreational fisheries in freshwater, including recreational gear fisheries in fluvial public and private domain and anglers, is estimated between 500 t and 2000 t (Briand *et al.*, 2008).

FR.6.3 Silver eel

FR.6.3.1 Loire EMU

Silver eel landing from the Loire River are 33 t in 2007 and 17 t in 2008 (P. Boisneau, pers. Com) (official declaration: 15 t in 2007 and 11 t in 2008 (Onema-SNPE)) and from Grand lieu lake 4.3 t in 2007 and 2008 (P. Boisneau, pers. Com).

FR.6.3.2 Rhone EMU

Silver eel fishing take place in many different lagoons for an average (2003–2005) amount of 241 t (Cepralmar, 2003, 2004, 2005).

FR.6.3.3 National overview

Apart from fisheries listed above, some fishers fish during period and use gears those allow catching silver eels such as fykenets. The catches from these fishers are counted with yellow eels.

Table FR.o. Silver eel catches in France in 2007 and 2008.

EMU	2007	2008
Loire	38	22
Rhône	241	241
total	279	263

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 can be provided for 2008. These cpue are consistent with licences and landings to indicate that the area of main recruitment is the Loire-Vendée. The lower cpue in the Vilaine is consistent with the concentrated effort at that place. An indication of the trends in cpue for the Adour, Sèvre Niortaise and Gironde basins is provided in Recruitment Series and associated effort (Section 3.1). However this analysis should be moderated as gears used can be different from one estuary to the other (Section 5.1.1.1).

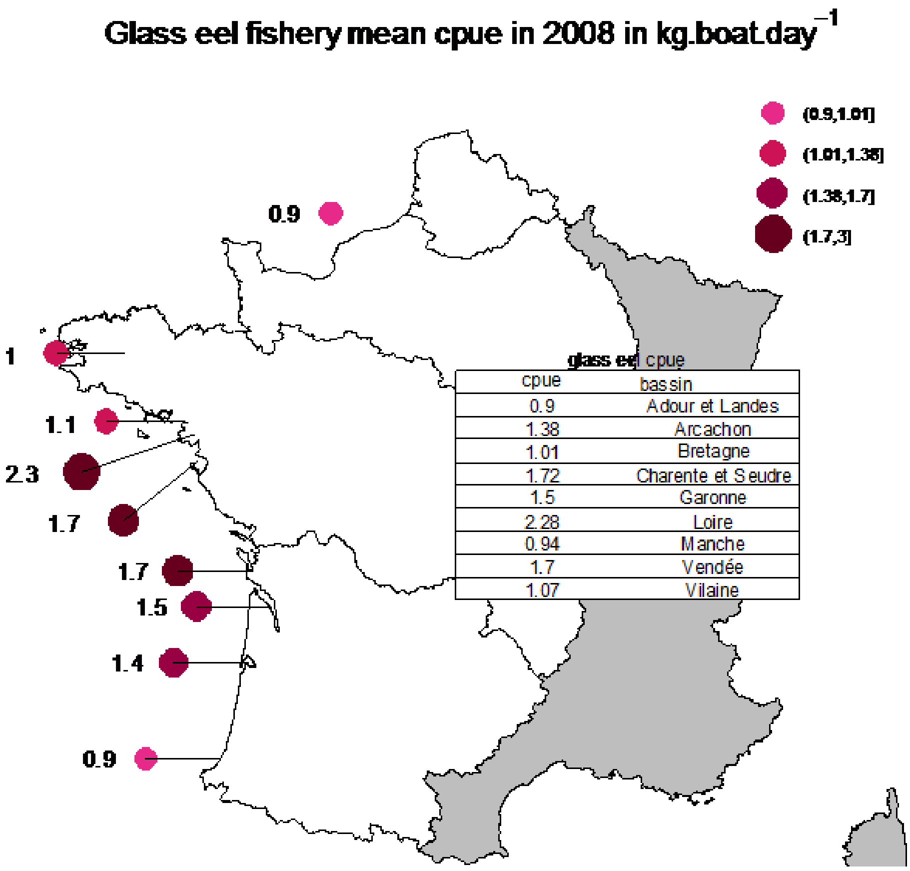


Figure FR.30. Glass eel marine fisheries cpue in 2008 (Ifremer). Garonne cpue as estimated by Cemagref is 2.6 kg/day.

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 period is the major shift from scoopnet catches in favour of large pushnet catches (Figure FR.31 and Table FR.p). 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.31 and Table FR.p). The 2003 season is close to the worst historical level (2001).

Table FR.p. Catches of glass eel for professional large pushnet (LPN), small pushnet (SPN) and scoopnet (SN) and non professional scoopnet fishers, cpue on the Gironde basin for 1961–2008 (Source: Cemagref). "-" : gears not used that year ; "?" unevaluated. Changes are highlighted in yellow.

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
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

Year	Total Catch (t)				cpue (kg/day)
	Pro. LPN	Pro. SN	Pro. SPN	NonPro. SN	Pro. LPN
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

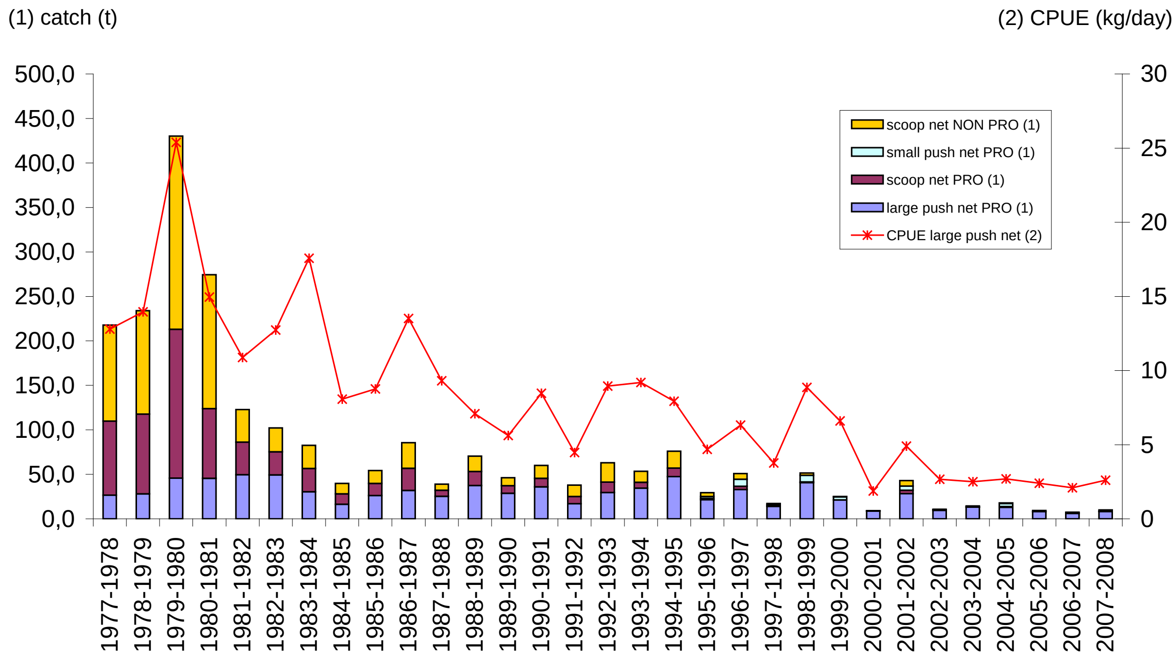


Figure FR.31. Cumulated capture of glass eel for non professional and professional fishers for 1978–2008, cpue of large pushnet professional fishers on the Gironde basin for 1978–2008 (Source: Cemagref).

FR.7.1.3 Glass eel cpue in the Adour EMU

The results are providing by Ifremer in connection with CNTS (Table FR.r).

Table FR.r. Mean, maximum minimum annual cpue (Kg/trip) for the glass eel fishery (handnets) in the Adour estuary (source : Ifremer/CNTS).

Year	cpue mean	cpue Min	cpue Max	Year	cpue mean	cpue Min	cpue Max
1927/1928	5	4.7	5.3	1984/1985	2.4	1.5	3.3
1928/1929	5.5	4.4	7	1985/1986	1.5	0.6	2.1
1929/1930	6.7	4.3	9.9	1986/1987	3.3	0.3	5.3
1930–1931	18.7	10.1	35.2	1987/1988	3.7	1.4	5.6
				1988/1989	4.1	0.9	6.2
1965/1966	5.1	1.3	8.8	1989/1990	1.2	0.2	2.1
1966/1967	6.4	4.1	9.7	1990/1991	0.7	0.15	1.1
1967/1968	10.1	3	23.3	1991/1992	2.9	0.4	4.4
1968/1969	5	0.9	7.8	1992/1993	2.4	1.3	2.3
1969/1970	7.5	3.6	11.2	1993/1994	1.4	0.8	1.9
1970/1971	4.6	2.9	5.6	1994/1995	2.6	0.85	3.9
1971/1972	4.4	1.5	7.8	1995/1996	1.53	0.75	1.8
1972/1973	4.5	3.5	6.8	1996/1997	1.6	1.13	1.97
1973/1974	7.4	4.3	12.3	1997/1998	1.07	0.49	1.31
1974/1975	5	2.2	7.9	1998/1999	1.82	1.05	2.21
1975/1976	11	3.3	16	1999/2000	4.43	2.77	4.34
				2000/2001	0.49	0.53	1.05
1978/1979	10			2001/2002	0.89	0.48	1.23
1979/1980	5			2002/2003	0.31	0.09	0.45
				2003/2004	0.6	0.2	0.9
				2004/2005	1.13	0.42	2.17
				2005/2006	0,72	0,46	0,96
				2006/2007	0,66	0,15	0,91
				2007/2008	0,76	0,04	1,13

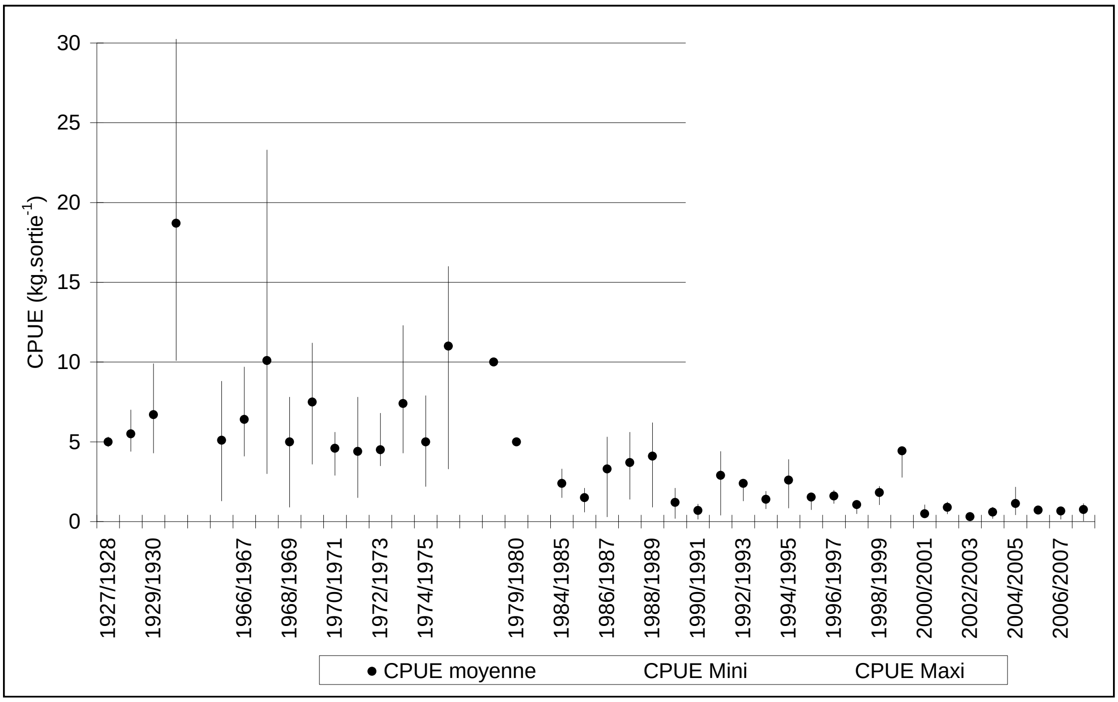


Figure FR.32. Long-term trend of glass eels abundance from fishing with scoopnet by marine fishers on the Adour estuary with mean values of cpue and minimal and maximal values between 1927 and 2007/2008.

The tendencies since the beginning of 1930s are studied from cpue with scoopnet in the Adour estuary by marine fishers. They allow comparing the fishing season 2007/2008 with the previous years, since 1927.

The cpue is the same order of height since the beginning of 2000s, is for a level lower than those observed at the beginning of the series in the 1930s.

Recent period

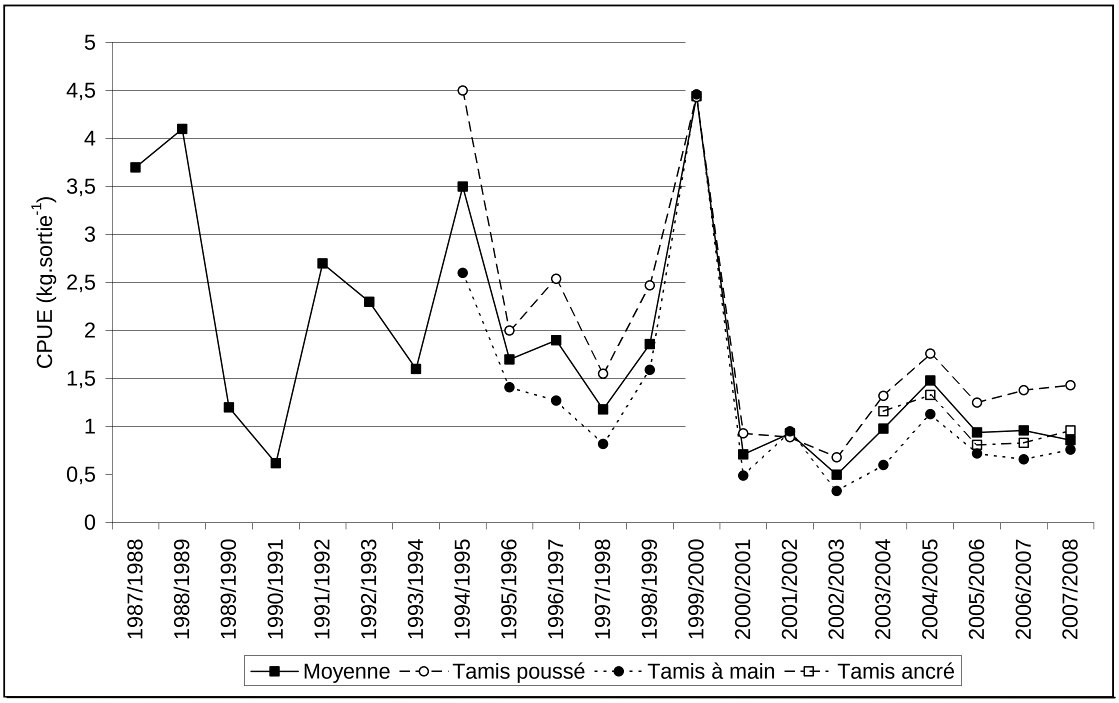


Figure FR.33. Recent Variations of glass eels cpue per type of fishing gears in the Adour estuary. Moyenne = mean, tamis poussé = small pushnet, tamis à main = scoopnet, tamis ancré = fixed scoopnet (Period: 1987/1988 to 2007/2008).

The cpue curves realized from data of the Adour estuary "scoopnet" and "small pushnet" follow appreciably the same fluctuations since 1994/1995, date of appearance of the small pushnet in maritime zone. Since 2001/2002, a new practice of "fixed scoopnet" appeared in fluvial zone (statements are available since the season 2003/2004). In 2007/2008, this practice was widely used. Whatever is the used technique, cpue stays at a low level since the beginning of 2000s.

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.q; Figure FR.34). The total catches have decreased while the number of fishers 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.q. Catches of yellow eel for professional and non professional (from 1978 onwards only) yellow eel fishers, cpue on the Gironde basin for 1894–2008 (Source: Cemagref). Changes are highlighted in yellow.

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
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

Year	Total Catch (t)		cpue (kg/eelpot/month)
	Pro.	Non Pro.	Pro.
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	8.7	0.8	1.3
2008	12.4	1.3	2.3

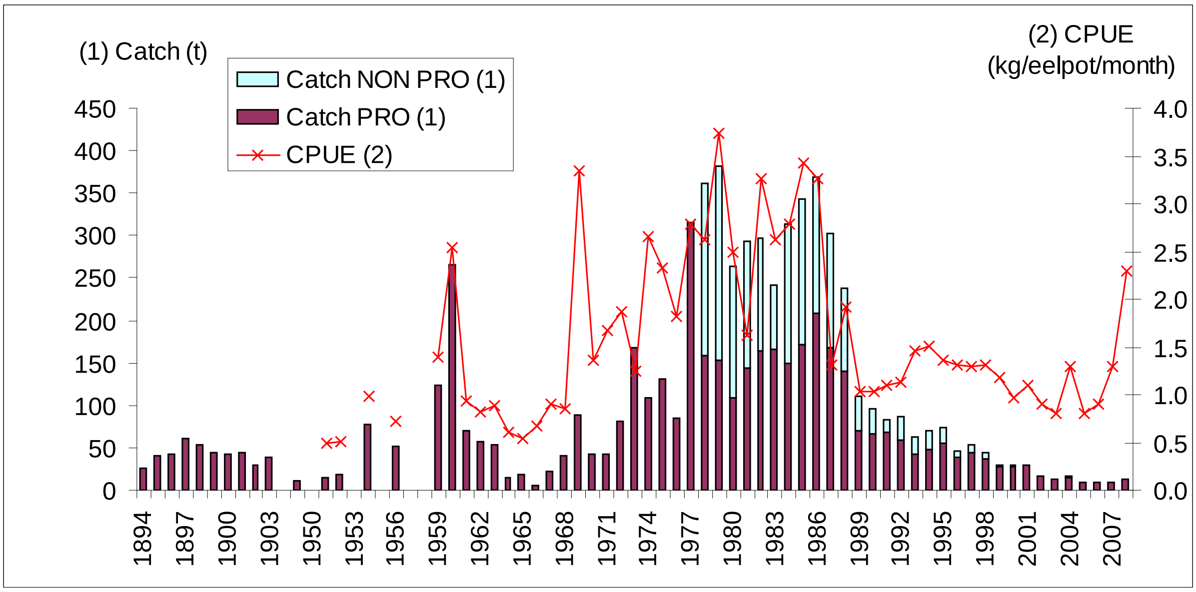


Figure FR.34. Cumulated catch of yellow eel for professional and non professional (from 1978 onwards only) fishers, cpue on the Gironde basin for 1894–2008 (Source: Cemagref).

FR.7.2.2 Yellow eel cpue in the Adour EMU

The number of fishers remained constant with however fluctuations. The production by fishers decreased since the beginning of the records (Figure FR.35).

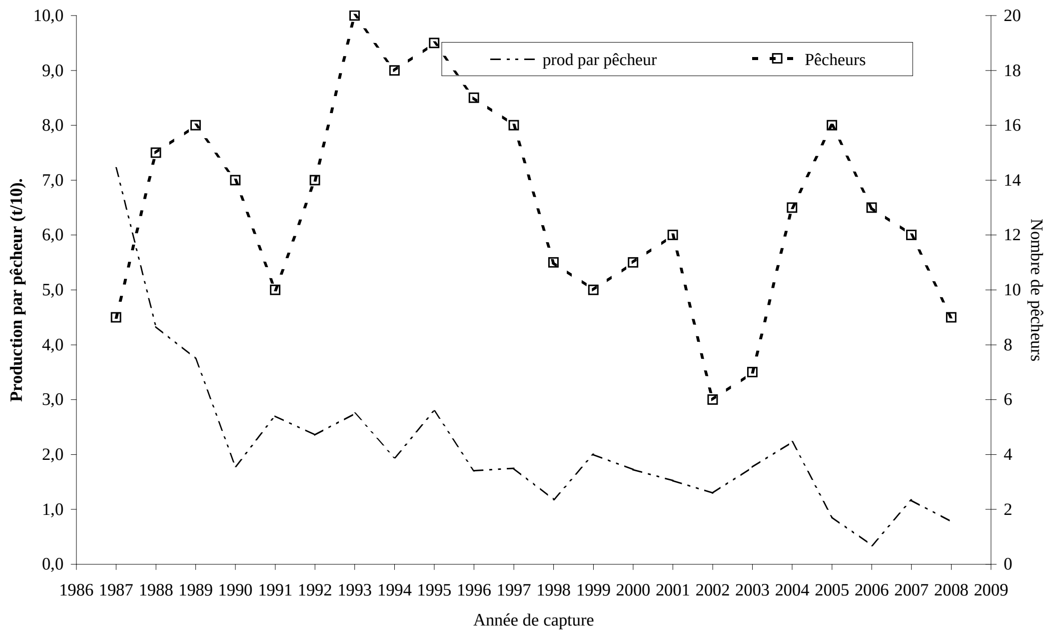


Figure FR.35. Associated effort of subadult eel landing for the Adour estuary. Period: 1986–2008, ***Prod par pêcheur= production per fisher, pêcheurs=nb of fishers.***

FR.7.3 Silver eel

FR.7.3.1 Silver eel cpue in the Loire EMU

The cpue (log cpue +1) of silver eel professional fishers from the Loire River seems to be stable from 1987 to 2002 with high variability. From 2003 onwards the cpue seems to decreased but with the last value in 2007 of the abundance index, no clear trend appears.

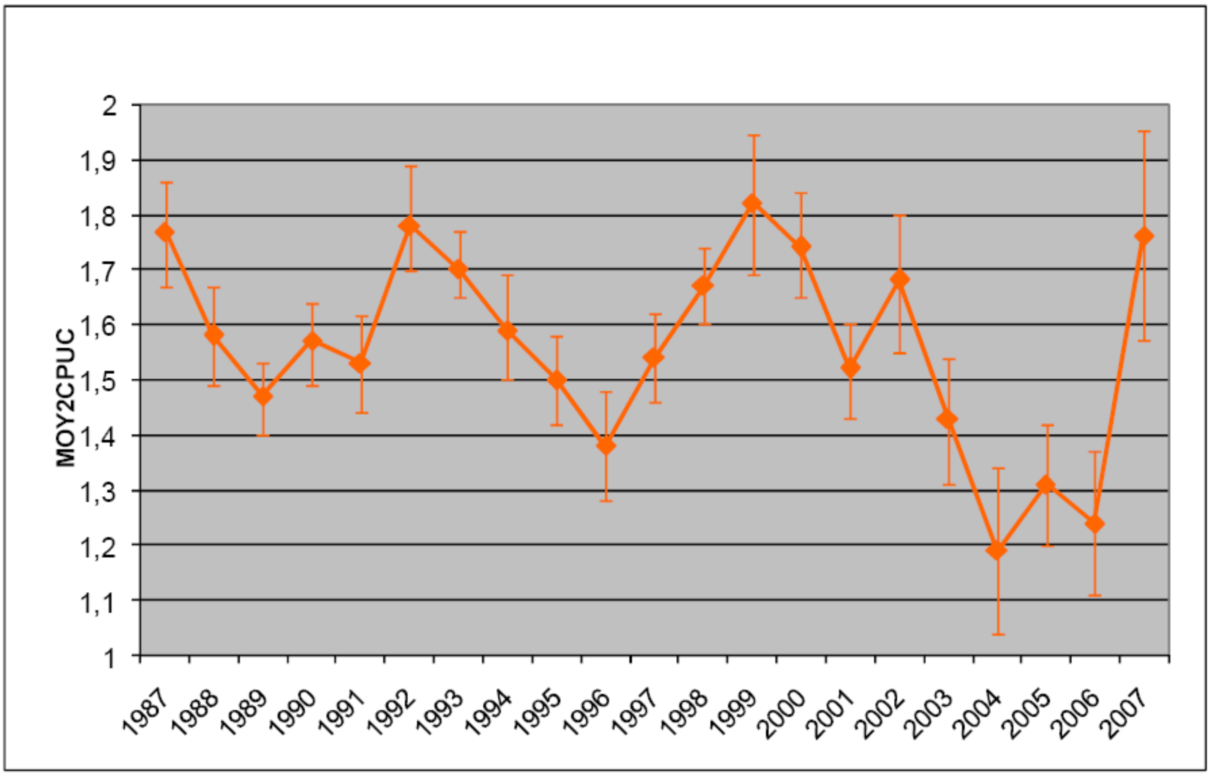


Figure FR.36. Abundance index (log cpue+1) of silver eel for the Loire river silver eel fishers (Bodin *et al.*, 2008).

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 tonnes, 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.37) and aims at evaluating the abundance variations of the juveniles of fish and crustacean and the adults of small species.

Figure FR.37. "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.31 and Figure FR.38) even if some little differences remain to analyse.

Table FR.r. 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, 2009).

Season (n-1,n)	1990	2000
0		1.00
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

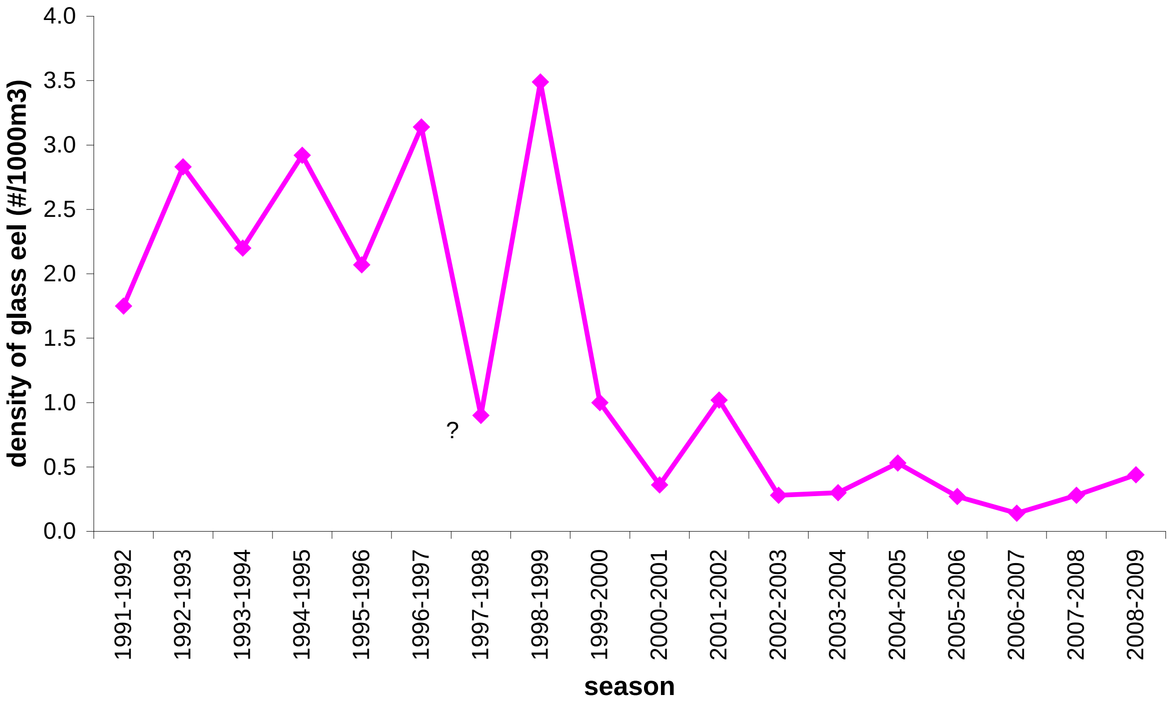


Figure FR.38. Results of the glass eel recruitment survey in the Gironde (? Indicates a suspect data from missing sampling in January).

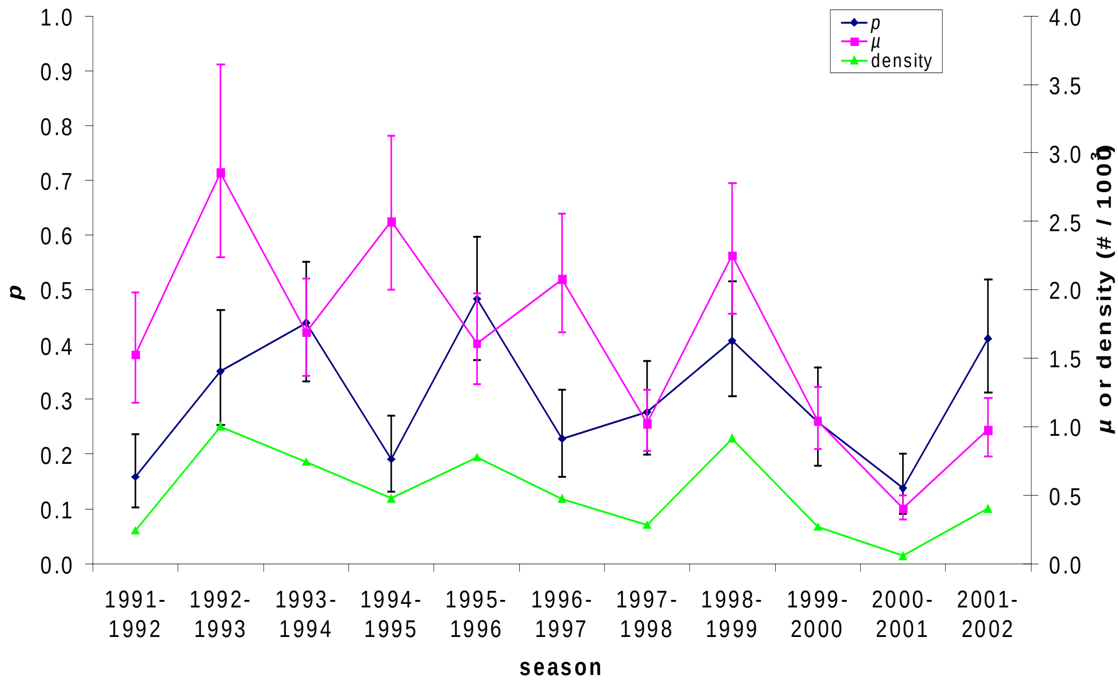


Figure FR.39. Results for glass eel of a delta-gamma analysis for season effect (p=probability of positive capture, μ=mean capture for only positive capture, density=p*μ) (extracted from Lambert, 2005).

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.39) demonstrate 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 will set up by ONEMA in 2010. 500 eels are supposed to be analysed. Field sampling of fishers catches will be organized by ONEMA and age reading will be performed by Cemagref.

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 waited.

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

Local stocks in each EMU are not evaluated. Only yellow eel density and corresponding silver eel escapement at national level are computed (see French management plan and Section 13.2.2). This has been broken down by EMU here.

Table FR.s. Silver eel estimate (in number) by EMU in 2006–2007, from yellow eel density using EDA model.

Rhin-Meuse	26 000
Artois-Picardie	234 000
Seine-Normandie	1 341 000
Bretagne	1 259 000
Loire	1 231 000
Garonne	6 706 000
Adour	1 352 000
Rhône-Méditerranée	2 149 000
Corse	544 000
Total	14 842 000

FR.13.2 International stock assessment

FR.13.2.1 Habitat

Table FR.t summarizes wetted area by EMU as stated in French management plan. For France the total continental wetted area is 6727 km².

Table FR.t. Wetted Area (in km²) of different type of eel habitat by EMU.

Eel Habitat	lacustrine	riverine	transitional & lagoon	coastal
Rhin	63	14	0	0
Meuse	4	33	0	0
Artois Picardie	198	47	151	?
Seine Normandie	390	490	260	1940
Bretagne	83	81	215	?
Loire	132	812	296	32500
Garonne Dordogne Charente Seudre Leyre	126	417	601	600
Adour	136	136	4	?
Rhône-Méditerranéee	?	?	?	?
Corse	?	?	?	?

FR.13.2.2 Silver eel escapement and production

Potential silver eel escapement

In France silver eel escapement was estimated at national level not at the EMU scale. The method is firstly based on an estimation of yellow eel density on river of the drainage basin. This estimation is calculated using the EDA model calibrated on 11 787 electro-fishing operations (6007 stations). Second a guess estimate proportion of yellow eel that silver every year (5%) allows calculating the escapement before silver eel fisheries and mortality in the turbines. This potential escapement per year was equal to 29 millions of silver eels during the period 1997–1999 and 15 million during the period 2006–2007 as stated in French EMP (Table FR.w).

Biological parameters

Some biological parameters (mean weight, age and natural mortalities per stage) are needed to convert number in biomass (or biomass in number), or glass eel and yellow eel in silver eel. We use parameters agreed within Grisam group (Briand *et al.*, 2008, Table FR.u and Table FR.v).

Table FR.u. mean weight and age of silver eel per EMU.

EMU	mean weight of a silver eel (g)	mean age of a silver eel (year)
Rhin-Meuse	800	12
Artois-Picardie	800	12
Seine-Normandie	800	12
Bretagne	800	12
Loire	800	12
Garonne	800	12
Adour	800	12
Rhône-Méditerranée	150	4
Corse	150	4

Table FR.v. Survival rate, mean weight and age of eels per stage and by fisheries.

		survival to silver eel stage	mean weight (g)	mean age
glass eel caught		4%	0.33	0
yellow eel	caught by a non pro.fisher	44%	150	6
	caught by a pro. fisher in Atlantic EMUs	38%	100	5
	caught by a pro. fisher in Mediterranean EMUs	66%	30	1

Current escapement ($B_{current}$)

The silver eel mortalities (e.g. fisheries, turbines, …) should be deduced to this potential to evaluate the current escapement. At the moment, only silver eel fisheries can be assessed and occurred in Loire and Rhône-Méditerranée EMU (Table FR.x). This should thus be considered as a maximum $B_{current}$. For whole France, we estimate current escapement to 13 million silver eel which corresponds to 10 000 t.

Best achievable biomass (B_{best})

We calculate B_{best} by adding to $B_{current}$ the number of silver eel that are removed by anthropogenic mortalities. These silver eel are calculated from glass eel and yellow eel, by calculating the survival from one stage to the next (Table FR.v). For instance, from 100 glass eel, we assume that only four would make it to the silver eel stage. This analysis should only be considered as a minimum as a minimum estimate of anthropogenic impact, as only glass eel, yellow eel and silver eel fisheries mortalities are known (Table FR.x). N_{best} and B_{best} are calculated as 35 million silver eel for 21 000 t.

Pristine Biomass (B_0)

The pristine biomass is assessed (Table FR.w) from B_{best} and the recruitment decline, assuming as in the French EMP that recruitment in 2006–2007 reached 8% of historical recruitment with an exponential decline rate of 0.09 year-1. We thus estimate the pristine escapement to 174 million silver eel for 88 000 t.

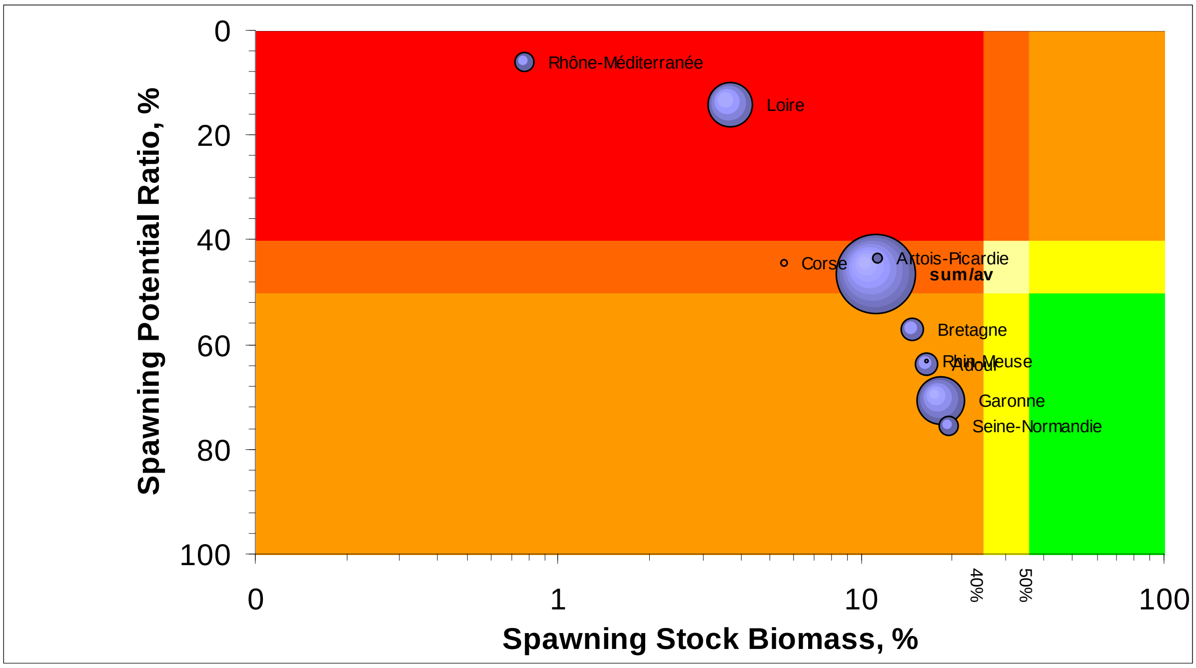
Table FR.w. EMP escapement assessment (number), current, best achievable and pristine (0) number (N) and biomass (B in t).

EMU	EMP assessment	$N_{current}$	$B_{current}$	N_{best}	B_{best}	N_0	B_0
Rhin-Meuse	26 000	26 000	21	41 189	33	158 885	127
Artois-Picardie	234 000	234 000	187	537 046	430	2 071 617	1657
Seine-Normandie	1 341 000	1 341 000	1 073	1 778 281	1 423	6 859 588	5488
Bretagne	1 259 000	1 259 000	1 007	2 202 962	1 762	8 497 762	6798
Loire	1 231 000	1 193 500	955	8 334 807	6 668	32 150 897	25721
Garonne	6 706 000	6 706 000	5 365	9 503 483	7 603	36 658 978	29327
Adour	1 352 000	1 352 000	1 082	2 122 150	1 698	8 186 035	6549
Rhône-Méditerranée	2 149 000	542 333	81	8 876 386	1 331	70 343 785	10552
Corse	544 000	544 000	82	1 228 491	184	9 735 572	1460
Total	14 842 000	13 197 833	9 852	34 624 795	21 132	174 663 119	87 679

Production

Given the extent of continental habitat, the current escapement is 20 silver eel/ha (15 kg/ha), the best achievable escapement is 52 silver eel /ha (31 kg/ha) and pristine escapement is 260 silver eel/ha (130 kg/ha).

These results are presented in an ICES precautionary diagram (ICES 2010) based on these results are presented in Figure FR.40.



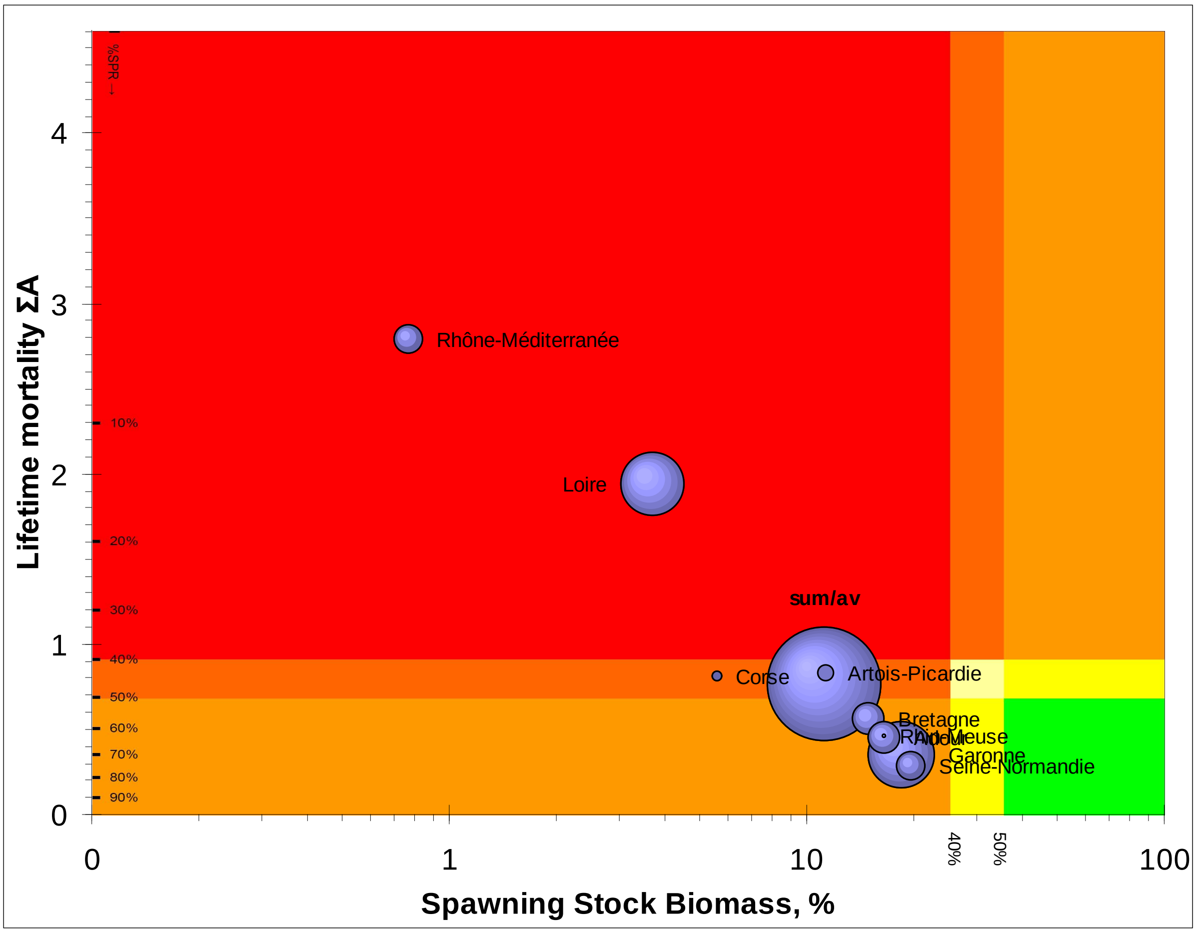


Figure FR.40. Precautionary diagram for French EMU (from ICES 2010).

FR.13.2.3 Impacts

Fisheries

The whole catches for France (including non professional fisheries) is evaluated to 1715 t. Thanks to biological parameters (Table FR.u and Table FR.v), this can be converted to a silver eel equivalent of 21 million silver eels.

Table FR.x. Catch in tons (upper table) and equivalent silver eel number (lower table) by fisheries and EMU. When available, 2007 data or best and recent estimate.

EMU	Pro. Glass eel	Non pro. Yellow eel	Pro. Yellow eel	Pro. Silver eel	Total
Rhin-Meuse	0.0	4.3	0.7	0.0	5.0
Artois-Picardie	0.3	87.5	1.7	0.0	89.5
Seine-Normandie	0.7	101.0	13.9	0.0	115.6
Bretagne	5.9	39.7	13.0	0.0	58.6
Loire	42.8	422.6	48.9	30.0	544.3
Garonne	17.0	142.8	31.4	0.0	191.2
Adour	4.5	55.6	2.1	0.0	62.2
Rhône-Méditerranée	0.0	81.9	294.5	241.0	617.4
Corse	0.0	0.5	31.0	0.0	31.5
Total	71.2	935.9	437.2	271.0	1715.3

EMU	Pro. Glass eel	Non pro. Yellow eel	Pro. Yellow eel	Pro. Silver eel	Total
Rhin-Meuse	0	12 525	2 664	0	15 189
Artois-Picardie	41 705	254 871	6 470	0	303 046
Seine-Normandie	90 183	294 194	52 904	0	437 281
Bretagne	778 845	115 639	49 478	0	943 962
Loire	5 686 737	1 230 956	186 115	37 500	7 141 307
Garonne	2 262 024	415 950	119 509	0	2 797 483
Adour	600 205	161 953	7 993	0	770 150
Rhône-Méditerranée	0	238 560	6 488 826	1 606 667	8 334 052
Corse	0	1 456	683 034	0	684 491
Total	9 459 699	2 726 104	7 596 993	1 644 167	21 426 962

Obstacles

Onema is completing the census of obstacle in France (see http://www.onema.fr/REFERENTIEL-DES-OBSTACLES-A-L and Figure FR.41). Even if the census is not complete more than 35 000 obstacles are already counted. Some of them are equipped with turbines. The assessment of migration impairment will be the next step.

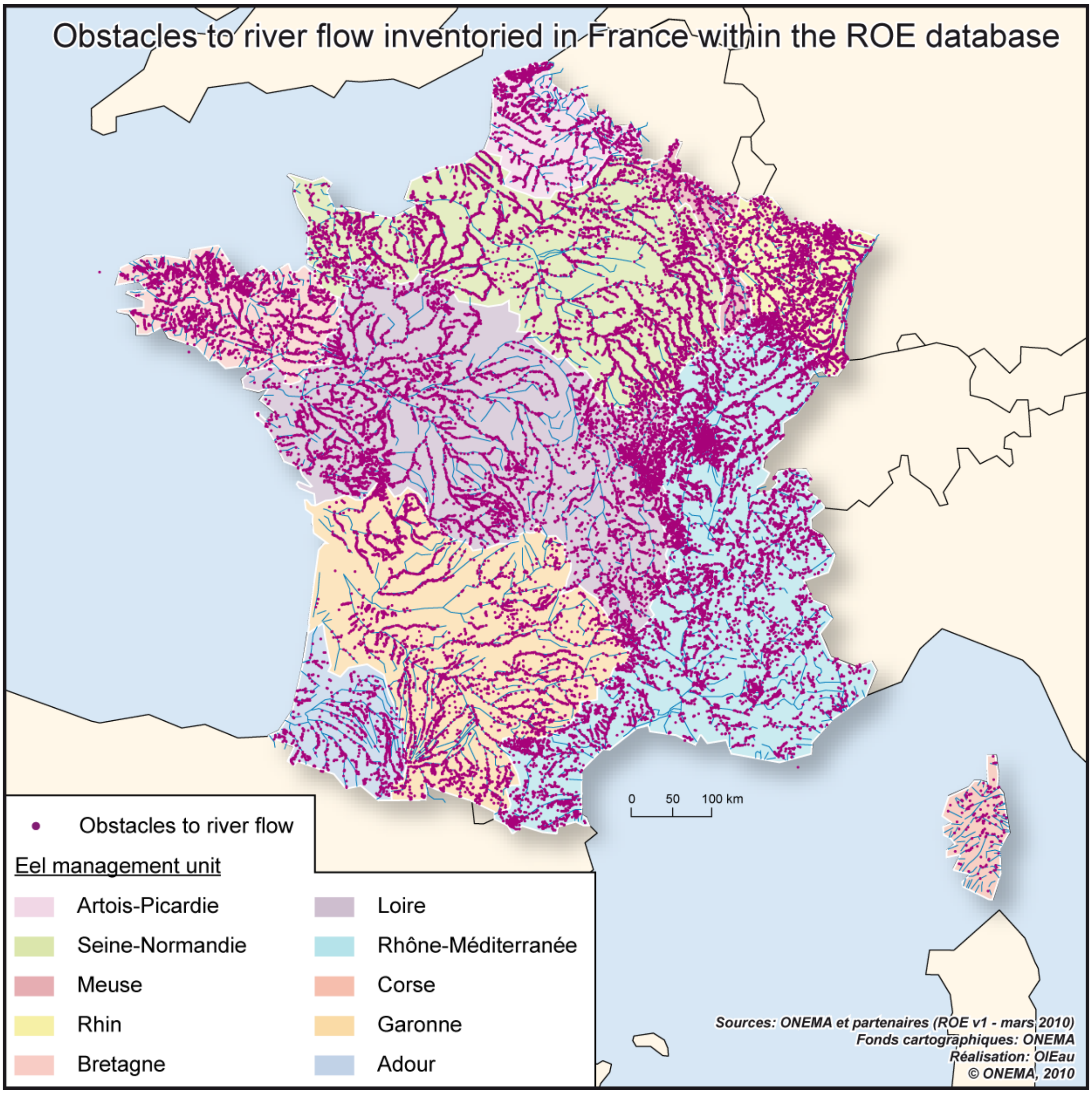


Figure FR.41. Census of obstacle in France (ROE, March 2010).

FR.13.2.4 Stocking requirement eels <20 cm

The objective is to use 5 to 10% of glass eel caught in French estuary for stock in French rivers. In several EMU, surface to be stock and requirement in glass eel are noticed.

	Surf to be stocked (km2)		Quantity (tonne/year)
	Lacustrine	riverine	
Rhin	0.00	15.14	?
Meuse	0.00	0.00	?
Artois Picardie	?	?	?
Seine Normandie	9.62	8.45	?
Bretagne	?	?	?
Loire	?	?	?
Garonne Dordogne Charente Seudre Leyre	0.00	0.19	2.14
Adour	0.00	0.15	1.68
Rhône-Méditerranéee	0.00	0.00	0.00
Corse	0.00	0.00	0.00

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.42 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.43).

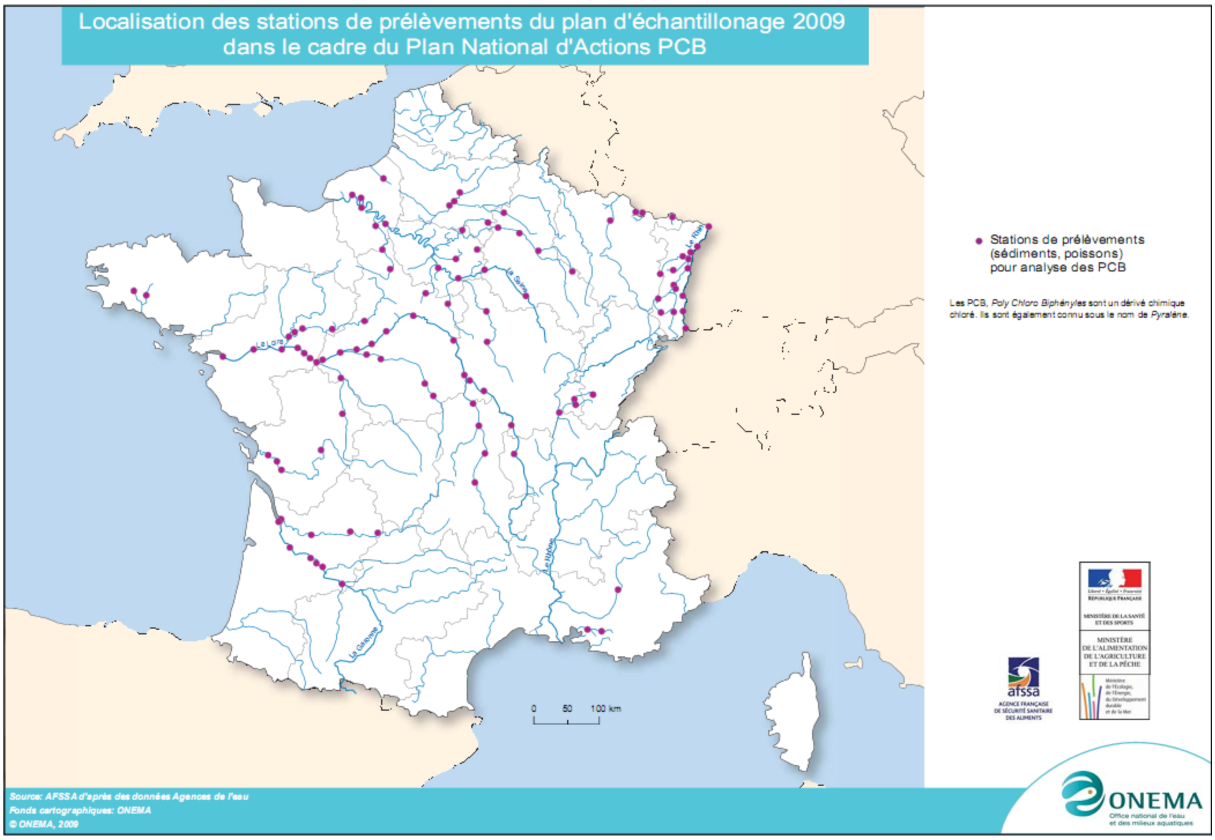


Figure FR.42. PCB sampling location in 2009.

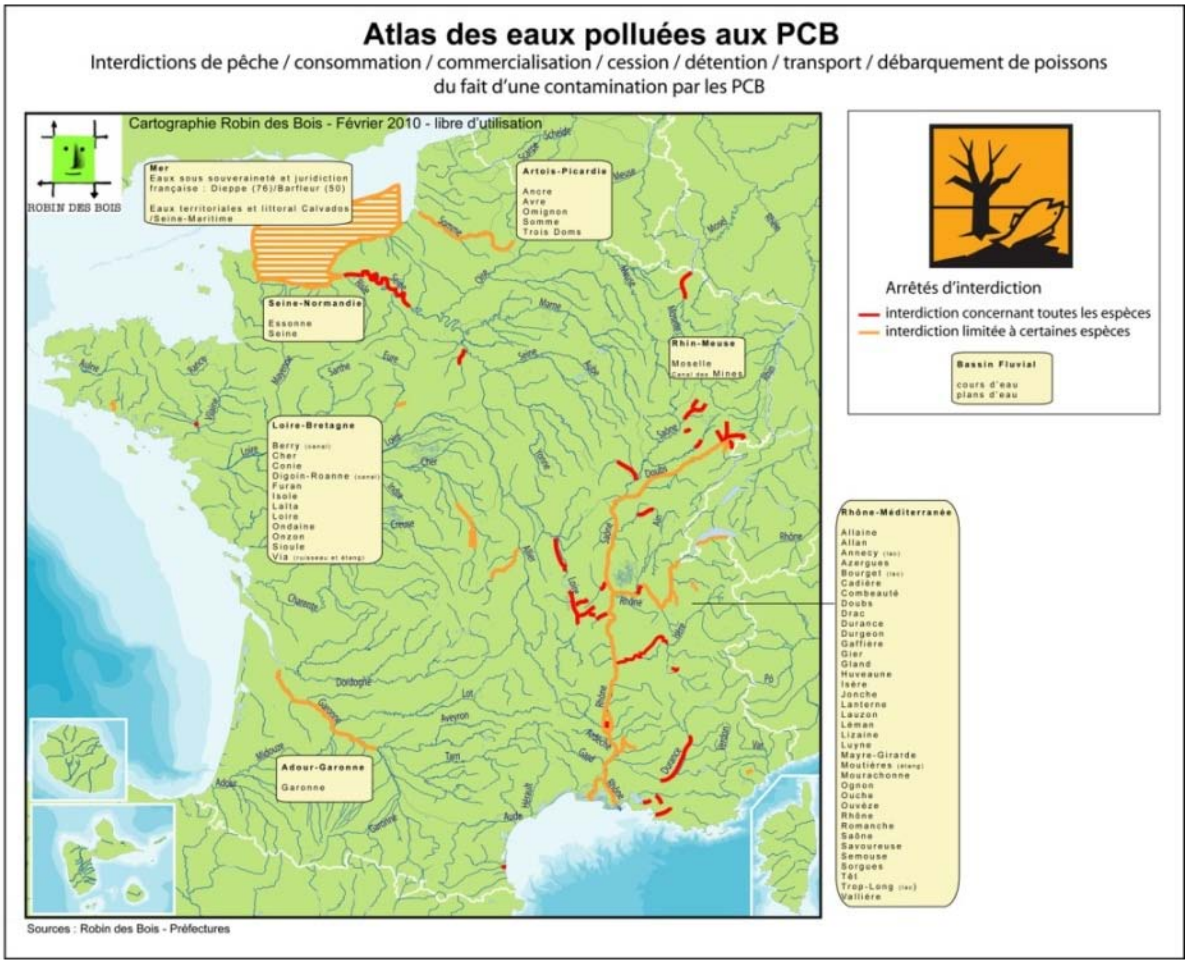


Figure FR.43. Fisheries ban due to PCB in France (Source: http://www.robindesbois.org/PCB/PCB_peche/restrictions_peche.html).

FR.14 Sampling intensity and precision

No data available.

FR.15 Standardisation 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

FR.17 Literature references

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Report on the eel stock and fishery in Spain 2009/'10

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ES.2 Introduction

ES.2.1 Spanish EMUs

The River Basin Districts (RBDs) of Spain, charged of the design of the hydrological plan and the management of continental waters, were defined after the approval of the Royal Decree 125/2007 by which the territorial limits of the RBDs are 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 these RBDs are managed by the autonomous region they belong to. Segura, Jucar, Miño-Sil, Cantábrico, Duero, Tajo, Guadiana, Ebro and Guadalquivir RBDs extend over different autonomous regions and the Ministry of the Environment and Rural and Marine Affairs (MARM) of Spain manages, through 8 hydrographical confederations, these RBDs. Additionally, the RBDs of Miño, Duero, Tajo and Guadiana are shared with Portugal and the Ebro RBD with France.

Figure 1. Spanish RBDs.

Figure 2. Autonomous regions of Spain.

In Table 1 information regarding the basins included in the present report is given.

Table 1. River basins included in the present report.

autonomous region	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	85362	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 charged of the management of fishery in inner waters (including coastal waters). This fact creates great differences among the autonomous regions:

- The amplitude of the historical dataseries is variable among the autonomous regions. It depends 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 in some river basins but not in others.
- In some of the autonomous regions, fishers are professional and have to sell their catches to the fish market, while in others they are non-professional. In this sense, the precision of the information of the 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 the same autonomous region, in many cases, the organizations that are involved in the management of the eel could differ 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 in 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 plans 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 (Cantábrico RBD), the Basque river basins (Basque inner rivers), 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 (Jucar RBD) from C. Valenciana. Additionally, in Galicia, C. Valenciana and Cataluña, there is an important yellow and silver eel fishery.

For the reasons explained above, the available information from each autonomous region is variable. Until now, there has not been any stock management of eel at a national level. Therefore, the compilation of all the data from the different autonomous regions, in order to give a national overview of the eel fisheries in Spain, is a very complicated task.

BASQUE COUNTRY: There is not a professional yellow or silver eel fishery, and the catches of recreational fishery were insignificant and from 2009 on, recreational fishery was forbidden. On the contrary, the glass eel fishery 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). Although the glass eel fishery was very traditional, there was not any managing plan for the 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 a licence per person and fishing basin and that it is obligatory to fill in the Daily Catches report with data regarding catches and effort. Basque fishers cannot sell the catches and therefore should be classified as non professional. The Basque Government collects the information regarding catches, and charges AZTI to analyse this information. In the Basque Country there are a lot of little river basins.

The river mouths of those basins are included in the Basque Inner river basins RBD, but the upper parts of some of these rivers are included in Cantábrico RBDs (Figure 2).

CANTABRIA: There is professional and recreational glass eel fishery. Recreational fishers must have the maritime fishing recreational licence, and catch sales are forbidden. Professional fishers sell their catches in the market or in other licensed establishments. Fishermen fish in land and the only allowed gear is sieve (≤1.2 m). Since 2005 fishers report their catches. There is not a professional yellow or silver eel fishery, and the catches of recreational fishery are insignificant.

ASTURIAS: There is not a professional yellow or silver eel fishery in Asturias, and the recreational fishery was forbidden in 2007. The glass eel fishery is a very traditional fishery in Asturias 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 licences and the glass eel sales data in Asturias using fish auctions. There are 18 fishers guilds in Asturias; in the San Juan de la Arena fisher guild data are available since 1952 and for the other 17, data are available since 1983. In the report from 2006 (ICES, 2006), all the catches from Ribadesella fishers guild were attributed to the Sella river which is the closest one. However, fishers 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 fishers 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. Moreover, in the Nalón River, there is a specific exploitation plan for glass eel since 2004 that limits the number of licences to 70 for land fishing and 50 for boat fishing. Additionally, there is a specific control in this basin, and thanks to this control, information regarding fishing days is available since the exploitation plan started. The rest of fishers guilds are asked to record the glass eel catches 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: Both, the glass eel and the yellow and silver fisheries, exist in Galicia. Both are either recreational or professional. The recreational fishery has not been evaluated, neither for eels (angling in freshwater and coastal waters) nor for glass eel (in the estuaries of Lugo province: Masma-Landro-Ouro, and in some rivers of Coruña province: Anllóns).The Miño River is the most important fishing point. 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 is included together with the data from the Miño River. The catches are established using auctions data from the different fishers guilds, which are assigned to a determined river basin. 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 fishers guilds:

Arousa Estuary: Cambados, Carril, and Rianxo fishers guilds.

Eo River: Asturians fishers guilds.

Ferrol Estuary: Barallobre, Mugardos and Ferrol fishers guilds.

Pontevendra Estuary: Pontevedra fishers guilds.

Vigo Estuary: Arcade and Redondela fishers guilds.

On the other hand, the data from the Ulla river and catches from Miño river are collected by Ximonde centre for fishing preserve and Miño river command respectively. In the Galician fishers guilds, yellow and silver eel catches are not split up. The 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). 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 realized. 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.

ANDALUCÍA: The eel fishery is not specifically regulated although there is a relatively important glass eel fishery in the Guadalquivir. This fishery is considered as "alegal" due to the lack of regulation of oats or fishing devices. The fishery is done using 1 mm meshnets that can be larger than 15 m. Additionally, illegal <1 mm nets are also used ("mosquiteras"). The result is that the fishers practically filtrate all the water volume, and it has been estimated (Sobrino *et al*. (2005) that for each kg of glass eel there is a bycatch of 66.3 kg of other species. The EMP of Andalucia has proposed a ten year moratorium for all phases of eel. The only data regarding glass el catches correspond to a scientific survey (Sobrino *et al*., 2005).

MURCIA: Eel fishery is professional and the minimum keeping eel size is 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: The glass eel fishing is professional while the yellow and silver fishing is either processional or recreational. There are six professional associations of glass eel fishers distributed between the province of Valencia and Castellón, which suppose 168 fishing licences and 89 fishing points ("postas").

There are two types of professional yellow/silver fishing depending on the province. In the province of Valencia, there are 4 fishing associations. 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 Jucar rivers. Molinell association fishes in Pego-Oliva fen which constitutes an agrarian landscape with a traditional economic activity. The fishers community of El Palmar is the fishing organization with the mayor tradition and number of members, and the only one that is allowed to fish in fixed places in the lacuna. The eel fishery in the Albufera has its own regulation and it considers both types of fishing, the fixed place fishing (named "redolins") and the travelling fishing. Regarding glass eel, Perelló-Perellonet fishing association has the exploitation rights. In the province of Alicante, professional fishing is takes place 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 fishers 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 additionally they report the fishing days. Then, Ricardo Garcia, from the Government of Valencia provided this information for the report.

CATALONIA: In Catalonia there are two RBDs; the Catalonia Inner river basins, which include small and medium rivers and the Ebro RBD, which is the second large 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 fishers 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.

BALEAR ISLANDS: There is no glass eel fishery. Professional eel fishery (>40 cm) is allowed only in Menorca, although there is only one licence. Fishermen fish using a "gánguil", a conic pot. 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 a 10 to 20% of them are devoted to recreational eel fishery.

The central government of Spain does not compile the eel catches data recorded in the different autonomous regions, and there is no official statistics of 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) is 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 which can be found at **http://www.mapa.es/es/pesca/pags/comision/comision.htm** including an executive summary in English.

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 lead 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.

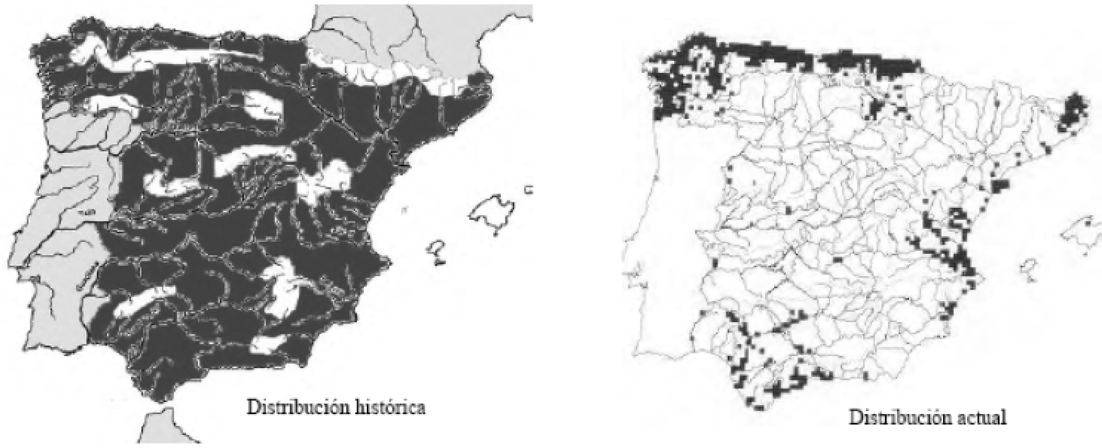


Figure 3. Historical and actual distribution of eel in Spain according to Doadrio *et al*. (2001).

Given Spain's national and regional structures, the management plan in Spain 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):

1) EMP of Galicia;
2) EMP of Asturias;
3) EMP of Cantabria;
4) EMP of Basque Country;
5) EMP of Navarra;
6) EMP of Cataluña;
7) EMP of the Ebro RBD (only Catalunya);
8) EMP of C. Valenciana;
9) EMP of Castilla La Mancha, only for the eels in the upper part of the Jucar and in coordination with C. Valenciana;
10) EMP of Murcia;
11) EMP of Islas Baleares;
12) EMP of Andalucía.

The National EMP defines the structure and methodology, the monitoring and evaluation measures and the objectives at national level. It also contains a summary of the twelve specific EMPs. Each participating Autonomous Community - with exclusive competences on eel fisheries - has been defined as an **Eel 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 Sectoral 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 and more accurate definition of pristine habitat in order to develop specific measures. In addition, 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 newly available data will allow to re-assess the stock situation and to launch the second phase as from 2016 onwards 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. It therefore 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 the 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 regions. The first ones propose the reduction of fishing effort by up to 50% compared with reference periods as the main measure to comply with the objectives of the Regulation. The latter ones mainly focus on restocking measures and maintaining the fishing management measures already set in their legislation. In certain cases, these latter 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. In the case of Andalucia, a moratorium of 10 years with no eel fishing, except for aquaculture purposes, is foreseen.

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 fishers 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 compiles also data from the rest of the fish markets in Asturias. Until the 1970s only land fishing existed, then fishers started to fish in boats, and the catches increased notably.
- The Albufera in C. Valenciana. In the 1949–2000 period data were collected from fishers guilds corresponding to two fishing points (Pujol and Perellonet). From 2001 on, the administration of C. Valenciana compiles also data from other fishing points in the Albufera, and the rest of C. Valenciana.
- The Delta del Ebro lagoons in Cataluña. Data is obtained from the fish markets in the area. Since 1998, the administration from Cataluña compiles data for the fish markets corresponding to the Ebro river mouth also, obtaining total catches in the Ebro. Additionally, since 1998 it compiles information from the rest of Catalonian Rivers.
- 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.

Table 2. Glass eel catches (kg), 1949 to 2010.

	San Juan de la Arena	Asturias*	Pujol 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							
1962	17177		11088							
1963	11507		7997							

	San Juan de la Arena	Asturias*	Pujol Perellonet	Albufera**	Delta del Ebro lagoons	EBRO RBD ***	Catalunya Inner Basins	Miño Spain	Miño Portugal	Miño RBD
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	524	574	922	3315	77	1427	1100	2527
2003	1231	2770	358	411	1558	4571	357	1755	1400	3155
2004	506	1351	232	320	564	1504	285	1562	800	2362

	San Juan de la Arena	Asturias*	Pujol Perellonet	Albufera**	Delta del Ebro lagoons	EBRO RBD ***	Catalunya Inner Basins	Miño Spain	Miño Portugal	Miño RBD
2005	914	2875	214	242	298	1805	134	1331	1292	2623
2006	836	2175	166	208	557	1209	147	320	320	
2007	615	2265	214	292	611	611	148	1140	1140	
2008	871	2379	118	118	445	1170	79	1332	1333	
2009	272	749	58	78	411	1511	0	1178	1178	
2010	1089	2612	95	125	501	1536	131	2000	320	

*** Includes San Juan de la Arena fish market**

**** Albufera includes 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 tonne nowadays (Table 1). The recruitment-series in Spain, demonstrates a clear decreasing trend (Figure 4).

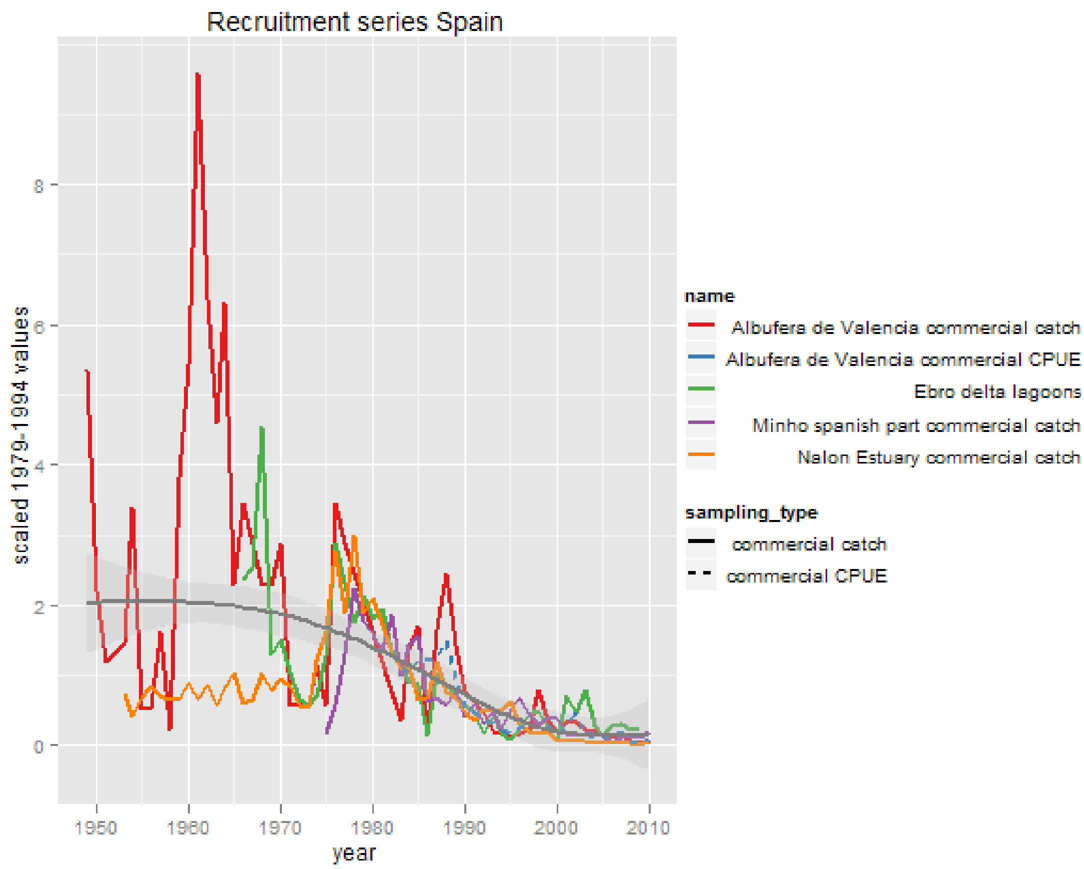


Figure 4. Time-series of monitoring glass recruitment in Spain with dataseries. Each series has been scaled to the 1979–1994 average on a <u>linear scale</u>. The mean values and their bootstrap confidence interval (95%) are represented as black dots and bars. The geometric means are presented in red. 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 fishers report their data to the local administration.

Table 3. Glass eel recreational catches (kg), 2004 to 2010.

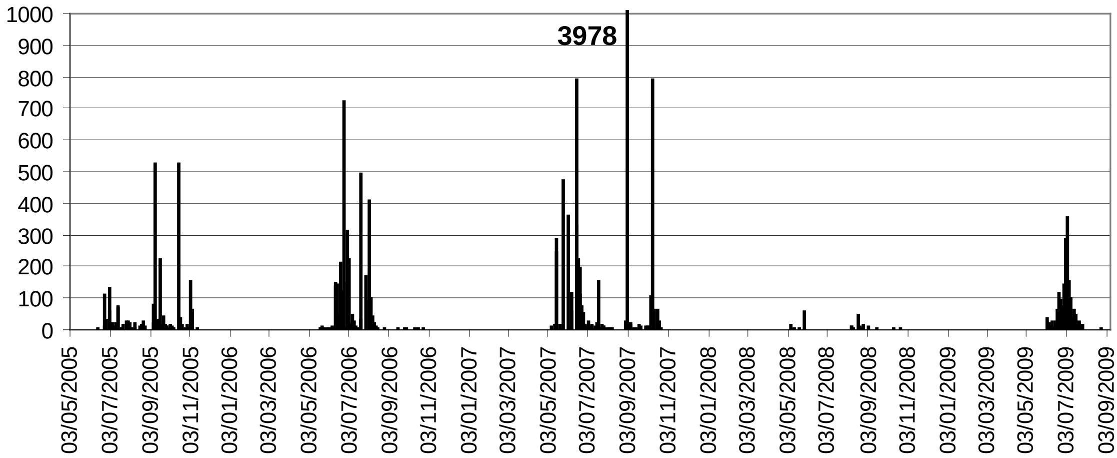
	Basque inner basins RBD	Cantabria
2004	858	
2005	1181	
2006	1282	398
2007	687	341
2008	1205	94
2009	212	0
2010	614	65

ES.3.1.1.3 Fishery independent

No historical data are available; only some punctual data from Gudalquivir and Oria rivers which was reported in previous Spanish Country Report (2009).

ES.3.1.2 Yellow eel recruitment

Upstream migration data has been collected since 2005 in the Oria river. In 2009 a number of 1823 elver or yellow eel passed from the trap of Orbeldi (Figure 5). Excluding 2008 (where the trap did not work during a considerable part of the migration period), this is the smallest number of the series, and could be related to the very low recruitment in 2009.



Año	2005	2006	2007	2008	2009
Anguilas	2656	3868	8957	233	1823

Figure 5. Number of eels collected in the Orbeldi trap (River Oria, Basque Country).

ES.3.1.2.1 Commercial

The yellow and silver eel catches are split up only in the Albufera and the Miño. This data are demonstrated in Section 3.2.1.

ES.3.1.2.2 Recreational

No data available.

ES.3.1.2.3 Fishery independent

All the autonomous regions make multispecific electrofishing. 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, there is information of yellow and silver aggregated data (Table 5). The origin of the data is the same as that of glass eel catches in the case of Albufera, Miño and Ebro rivers (Table 2). Data from Marjal and Alicante, (C. Valenciana) is obtained from fisher guilds and that of Galicia, Baleraric Islands, and Murcia from fish market auctions.

Table 4. Yellow eel catches (kg), 1951 to 2010.

	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			

	Albufera	Miño Spain	Miño Portugal	Miño RBD
1971	11612			
1972	18300			
1973	12428			
1974	11210			
1975	6570			
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			

Table 5. Yellow + silver eel catches (kg), 1951 to 2010.

	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		17639	17393		1543	1300	2296	534	
1998	5663	6864	3789	14367		796	1500	1980		
1999	4903	5977	4297	14790	16522	780	1200	1580		12470
2000	3584	4084	15794	13587	17921	830	750	2503		15504
2001	3279	4147	50543	32044	35317	903	1600	1254		35491
2002	3558	4375	39699	23391	26095	604	650	1474		30802
2003	6640	8550	31341	15679	18626	614	860	918		32672
2004	7729	8770	35373	12127	16081	598	320	935		22248
2005	7965	9887	31702	12269	13710	265	670	1277	212	32682
2006	7453	8823	63111	16369	17361	277	1000	-	190	25631
2007	8499	9664	28278	19893	22640	149		-	140	22790
2008	10881	13834	32768	-	-	447		-	44	20314
2009	6386	10164	45732	20793	-	277	1000	-	-	23962
2010	4847	9787	13045	12016	12016	149	-	-	-	-

**** 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 origin of the data is the same as that of glass eel catches in the case of Albufera, Miño and Ebro Rivers (Table 2).

Table 6. Silver eel catches (kg), 1951 to 2010.

	Albufera
1951	60000
1952	64200
1953	50000
1954	57300
1955	72500
1956	75860

	Albufera
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
1989	
1990	2000
1991	
1992	3000
1993	3000
1994	2000
1995	1600
1996	2960
1997	2784
1998	3100
1999	2400
2000	1537

	Albufera
2001	1284
2002	1432
2003	4042
2004	5591
2005	6493
2006	5974
2007	6588
2008	4026
2009	3771
2010	3160

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. Valencianana de Acuicultura" produces yearly around 300 tonnes of eel, and is the principal eel producer in Spain. The other one, "Puchades" was created in 2008 with capacity to produce 150 tonnes of eel per year.
- A fish farm in the Delta del Ebro (Cataluña) that produces yearly around 60 tonnes of eel per year.
- An eel farm in the Basque Country with capacity to produce 60 tonnes 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 Andalucia, and Cataluña buy glass eel to local fishers and the one from C. Valenciana mainly to the Delta del Ebro, Guadalquivir, Galicia, Asturias fishers and to a lesser extend to UK and Morocco.

The companies from the Basque Country have hatcheries in Asturias, C. Valenciana, Catalonia, and the Atlantic coast of France to maintain the glass eels they buy to local fishers until they are transported to the hatcheries in Aginaga.

There is no quantitative available data.

ES.3.4.2 Production

The production is detailed in the Table 7.

Table 7. Aquaculture production (kg) in Spain per autonomous region.

	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		

Source Spanish Ministry of the Environment and Rural and Marine Affairs.

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 eels, acquired in farms from C. Valenciana, Francia, and Gipuzkoa had been stocked between 1984 and 2008.
- Since 1988, C. Valencianan fishers from the Albufera and Bullent and Molinell rivers must give a percentage of their glass eels catches for restocking. These glass eel are fattened in the public Centre for the Production and Experimentation of Warm Water Fish until they reach a weight of 8–10 g. In Table 18 the survival 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 has presented a stocking plan detailed in Section 12.2.6.6.
- In Asturias, two pilot experiences with glass eel have been carried out. The Head Office of Fishery purchased four kg of glass eels (30 000 individuals per year approximately) in 2007 and 2008 that were released in Sella and Nalón rivers during spring 2008.
- In Catalonia Inner River Basins and Ebro, different restocking experiences have been carried out since 1996. During the 1998–2007 period fishers 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 grs.

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 fishers provided 38 276 eels between 0.65–0.70 gr. The initial biomass was 25.7 kg, and after fattening them biomass was 1617, so biomass increased in 1591.8 kg, and glass eel-yellow eel survival in the farm was 71.4%. The University of Girona made a study in the Fluvia river (Contact person Lluís Zamora: lluis.zamora@udg.edu) in which they monitored the released eels. All the eels were marked with Code wire tags and those >100 gr with PIT tags additionally. In September 2006, 827 and 1601 marked eels were released in riu Llémena and riera de Bianya respectively. The release of eels produced a density of 165 000 eels/Ha and 33 000 eels/Ha respectively. One and nine months later, electrofishings were made in eleven and eight sampling points respectively. One month later the density was 120 eel/Ha and 93 eel/Ha respectively. The fact that recaptured eels have an average size higher than the one corresponding to release, indicates that dispersal and/or mortality was higher in smaller individuals. In October 2007, 336 eels marked with PIT tags were released; 48 hours later these eels were fished with creels in the lower part of the river. Additionally 15 days after, the eel density in the release point was just 1% of the released eels. All these facts indicate immediate dispersion of eels after release. Finally, six eels were marked with radio transmitter in January 2008. These eels were followed during February and March. 32% of the eels stayed in the release point during approximately 60 days, 50% of them stayed during 26–38 days then moved to the lower part of the river, and the rest of them did not survive.

ES.3.5.1 Amount stocked and 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, gr)	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							

*** 0.15–0.33 gr**

**** 4 kg in total.**

ES.4 Fishing capacity

ES.4.1 Glass eel

In the Basque Country, the number of glass eel fishing licences continues decreasing since the glass eel fishing regulation was established in 2004–2005 fishing season (Table 9).

In Asturias boat fishing is only allowed in the Nalón River, and a maximum of 50 licences can be issued according to the Nalón exploitation Plan.

In C. Valenciana, although there are 168 licences, the number of fishers that really fish is 140.

Table 9. Number of glass eel fishing licences per basin and fishing gear in the last three fishing seasons.

			2007–2008				2008–2009				2009–2010			
	RBD	RB	Boat	Land	Ns	Total	Boat	Land	Ns	Total	Boat	Land	Ns	Total
Basque C.	B. Inner	Barbadun		3	10	13	12		3	15	-	-	-	-
		N. Ibaizabal	2	46	1	49	62		7	69		58	-	58
		Butron	1	55	8	64	84	2	8	94	1	92	-	93
		Oka		6	0	6	4		2	6		3	-	3
		Lea		10	2	12	9		6	15		21	-	21
		Artibai		4	0	4	2			2		3	-	3
		Deba		98	6	104	113		9	122		99	-	99
		Urola	17	7	0	24	5	18		23	17	6	-	23
		Oria	22	54	1	77	74	24	5	103	28	66	-	94
		Bidasoa		1	1	2	1			1	-	-	-	-
		Total	42	284	29	355	366	44	40	450	46	348	-	394
Asturias	Cantábrico	Nalón	45	49	0	94	45	62	0	107				
		Others	0	156	0	56	0	157	0	157				
		Total	45	205	0	250	45	219	0	264				
C. Valenciana	Jucar	Albufera	ND	ND	ND	ND	ND	ND	ND	ND				
		Total		168		168		168		168*		140		140
Catalonia	Ebro	Delta	0	283		283								
	C. Inner	Muga, Fluvia, Ter	0	15		15								

ND: No data available

Ns: Non specified.

ES.4.2 Yellow eel

There is not information available for Spain expect from Albufera and Marjal Pego-Oliva in C. Valenciana (Table 10).

Table 10. Number of fishers during the last two seasons.

	albufera	marjal pego-oliva
2008–2009	93	7
2009–2010	80	7

ES.4.3 Silver eel

See Section 4.2.

ES.4.4 Marine fishery

No data available.

ES.5 Fishing effort

ES.5.1 Glass eel

In the Basque Country total number of hours dedicated to glass eel fishing has increased from preceding fishing season, although the number of licences granted has decreased (Table 11). This indicates that on average the fishing effort per fisher is greater. Although the EMP was not still approved, some of the measures proposed have been already implemented in The Basque Country, among them the shortening of the season: before it lasted since the new moon of October until the new moon of March and now it starts in the15th November and finishes in 31st January. Thus, a reduction in fishing hours was expected; this reduction has been observed when comparing with the 2007–2008 season, not in respect to 2008–2009. Probably, this is increase in hours might be caused by the low catches of the last season, which discouraged fishers for going fishing.

In Asturias both the total days dedicated to fish and the days each fisher dedicates to fishing have decreased since the preceding season 2008/2009. In the latter season, the time each boat fisher dedicated to fishing has decreased considerably compared with the decrease experienced by the land fisher (Table 11).

Table 11. Number of hours (Basque Country) and days (Asturias, C. Valenciana and Catalonia) dedicated to glass eels fishing during the last three fishing season.

			2007–2008				2008–2009				2009–2010			
	RBD	RB	Boat	Land	Ns	Total	Boat	Land	Ns	Total	Boat	Land	Ns	Total
Basque C. *	B. Inner	Barbadun	-	317	41	357	-	166	0	166	-	-	-	-
		N. Ibaizabal	-	1016	246	1261	-	941	11	952	-	1379	-	1379
		Butron	32	910	71	1012	39	326	21	387	22	1015	-	1036
		Oka	-	331	0	331	-	28	-	28	-	26	-	26
		Lea	-	132	11	142	-	5	19	24	-	202	-	202
		Artibai	-	24	0	24	-	2	-	2	-	12	-	12
		Deba	96	3182	23	3301	-	828	83	911	-	1820	-	1820

		Urola	1172	148	0	1320	329	41	-	371	637	146	-	783
		Oria	1932	1442	0	3374	540	629	20	1190	1235	737	-	1973
		Bidasoa	*0*	0	0	0	-	6	-	6	-	-	-	-
		Total	3232	7502	392	11122	909	2973	153	4036	1894	5337	0	7231
Asturias**	Cantábrico	Nalón	891	376	-	1267	588	393		981				
C. Valenciana**	Jucar	Albufera	-	195	-	-		200				105		

*** Hours**

**** Days**

ES.5.2 Yellow eel

Data for yellow and silver eel in Marjal Pego-Oliva (C. Valenciana, Jucar RBD) fishing is given in Table 12. No information available for the rest of Spain.

Table 12. Number yellow and silver eel fishing days in Marjal Pego-oliva during 1998–2010 period.

	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

ES.5.3 Silver eel

See Section 5.2.

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. However, in all the regions glass eel catches increased slightly during the 2009–2010 fishing season comparing with 2008–2009 (Table 13); but it has to be taken into account that in 2008–2009 catches were the lowest in the time-series.

Table 13. Glass eel catches during the last three fishing seasons.

			2006–2007				2008–2009				2009–2010			
	RBD	RB	Boat	Land	Ns	Total	Boat	Land	Ns	Total	Boat	Land	Ns	Total
Basque C.	B. Inner	Barbadun	-	14	-	14		9		9		0,1		0,1
		N. Ibaizabal	-	95	13,2	108		71		71		104		104
		Butron	1,8	65	10,1	77	0,3	10	1	11	0,6	49		50
		Oka	-	12	0,2	12		3		3		2		2
		Lea	-	5	3,6	9		1	0,1	1		13		13
		Artibai	-	1	-	1		0,8		0,8				
		Deba	5..3	398	19,1	422		24	6	29		162		161
		Urola	130,9	3	-	134		0,4		9	61	5		66
		Oria	337,3	90	-	427	8	24	1	72	190	26		216
		Bidasoa	-	1	-	1	46	0,1		0,1				
		Total	475,2	683	46,1	1205		142	8	205	252	362		613
Asturias	Cantábrico	Nalón	1053,6	330,6		1384,2	213,1	152,6		365,7				1562
		Others	-	994,8	-	994,8		383,5		383,5				1050
		Total	-	-	-	2379				749,2				2612
C. Valenciana	Jucar	Albufera	-	117,8	-	117,8	-	78,3	-	78,3		125		125
		Others	-	39	-	39	-	38,2	-	38,2		41,31		41,31
		Total	-	156,7	-	156,7		116,5		116,5		166,76		166,76
Cataluña	Ebro	Ebro	-	1170,4	-	1170,4	-	1511	-	1511		1536		1536
	C. inner	Muga, Fluviá, Ter Daró	-	79,1	-	79,1	-	86,7	-	86,7		131		131
		Total	-	1249,5	-	1249,5	-	1597,7	-	1597,7		1667		1667

SC: Still collecting data from fishers

ND: No data available

Ns: Non specified.

ES.6.2 Yellow eel and silver 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 14).

Table 14. Yellow and silver eel catches (tons) during the last three fishing seasons.

Area	RBD	River Basin	2008	2009	2010	Data source
Galicia	G. Coast	Ferrol	2.2	2.0	0.2	Auctions
	G. Coast	Eo	2.5	1.6	0.4	Auctions
	G. Coast	Vigo	23	33	10	Auctions
	G. Coast	Pontevedra	0.01	0.01		Auctions
	G. Coast	Arousa	5.1	8.1	1.3	Auctions
		Total	32.7	44.7	2.9	Auctions
C. Valeciana	Jucar	Albufera	6.4		4.8	Catches report
	Jucar	Marjal Pego-Oliva	1.1		1.4	Catches report
	Segura	El Hondo			0.4	Catches report
	Segura	Salinas de Santa Pola	2.7		3.2	Catches report
		Total	10.2		10	Catches report
Catalonia	Ebro	Ebro	22.6	-	12	Auctions

ES.6.3 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 15).

Table 15. Glass eel cpues during the last three fishing seasons.

			2007-2008				2008-2009				2009-2010			
	RBD	RB	Boat	Land	Ns	Total	Boat	Land	Ns	Total	Boat	Land	Ns	Total
Basque C. *	B. Inner	Barbadun	-	0.015	0.019	0.034	-	0,057	-	0,057	-	-	-	-
		N. Ibaizabal	0.000	0.069	0.036	0.105	-	0,052	0,000	0,050	-	0,062	-	0,062
		Butron	0.072	0.061	0.038	0.172	0,005	0,032	0,013	0,027	0,021	0,041	-	0,040
		Oka	-	0.000	-	0.000	-	0,104	-	0,104	-	0,066	-	0,066
		Lea	-	0.076	-	0.076	-	0,000	0,003	0,002	-	0,073	-	0,073
		Artibai	-	0.044	0.020	0.064	-	0,001	-	0,001	-	0,060	-	0,060
		Deba	-	0.001	-	0.001	-	0,021	0,039	0,023	-	0,090	-	0,090
		Urola	0.044	0.071	0.062	0.178	0,018	0,009	-	0,016	0,091	0,046	-	0,080
		Oria	0.076	0.024	0.010	0.110	0,081	0,023	0,038	0,047	0,134	0,030	-	0,084
		Bidasoa	*0.152*	0.048	0.020	0.220	-	0,017	-	0,017	-	-	-	-
		Total	-	-	0.006	0.006	0,052	0,034	0,023	0,037	0,115	0,062	-	0,074
Asturias**	Cantábrico	Nalón	1,18	0,88	-	1,98	0,36	0,46	-	0,75				
C. Valenciana**	Jucar	Albufera	-	-	-	0,66				0,39				1,200

***: Glass eel (Kg)/ Fishing hour**

****: Glass eel (Kg)/ Fishing days.**

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 4).

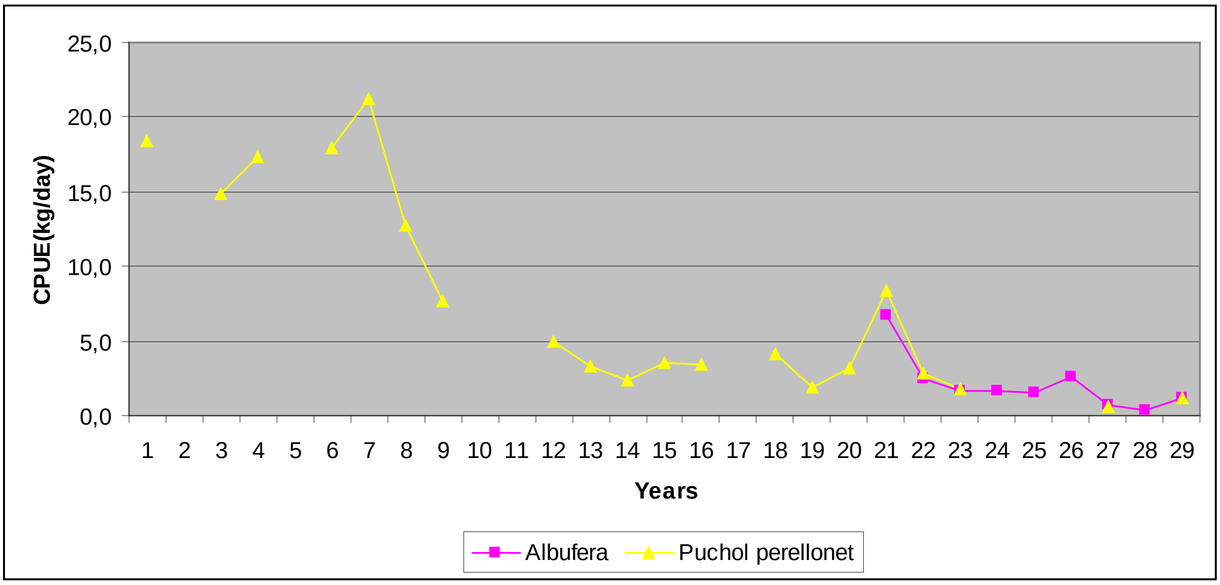


Figure 4. Time trends in cpues of glass eels in Pujol and Perellonet fishing points (Albufera) since 1982 and the whole Albufera from 2002 on.

Additionally, the C. Valencianan government has recorded information of the catches obtained for each fixed fishing point and day since 1999 as detailed in Table 16.

Table 16. Temporal trends in catches of glass eel per fishing place and day in C. Valenciana.

	Albufera	Rest of Valencia
1999		
2000		0.019
2001		0.227
2002		0.166
2003	0.222	0.285
2004	0.176	0.232
2005	0.126	0.169
2006	0.086	0.223
2007	0.196	0.265
2008	0.137	0.171
2009	0.039	0.110
2010	0.078	0.196

ES.7.2 Yellow eel

Only catches from Marjal Pego-Oliva in C. Valenciana are split up between yellow and silver eel (Table 17).

Table. 17. 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

ES.7.3 Silver eel

See Section 7.2.

ES.7.4 Marine fishery

No data available.

ES.8 Other anthropogenic impacts

The major impacts are described in the Spanish EMP but no quantitative data are available.

ES.9 Scientific surveys of the stock

In Spain there is not any national eel specific survey programme. All the autonomous regions have multispecific electrofishing surveys; in addition, some of the autonomous regions have eel specific monitoring programmes. In the Basque Country, 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, but there is not any collaboration study among different researches in Spain. Also some autonomous regions had promoted punctual studies 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 bases.

ES.9.2 Stock survey, yellow eel

All the autonomous regions make periodic multispecific electrofishing surveys for the WFD, but until now, none of them has been directed exclusively to eel. There is not any agreed protocol for sampling, and there is not any compilation of this information at the national level. Some of the autonomous regions envisage making eel specific surveys in their management plans.

Yellow-eel recruitment in the Oria River is sampled on a yearly base in a fish pass in the tidal limit.

ES.9.3 Stock survey, silver eel

The Basque management plan, will determine the spawning potential according to Durif (2003; 2005) *et al*. in the different basins every 5 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 2009, 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.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 has 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. If the proposal is approved, the study will start in 2011.

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 (Figure 5). In Galicia, catches length is monitoring yearly.

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 are 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 18).

Table 18. Prevalence, infection intensity and abundance of parasites in different basins from Spain.

	River/Lake		Year	N eels	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
Murcia	Mar menor	*Bothriocephalus spp.*	2009	109	23.79			-	-		Muñoz *et al.*, 2009

	River/Lake		Year	N eels	Mean weight (g)	Mean Size(cm)	Stage	Prevalence	Mean Infection intensity	Mean Abundance	Reference
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

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 19).

Table 19. Prevalence of infectious diseases in Albufera lake.

River/Lake	Year	N eels	Eel size (cm)	Max	Min	Eel Stage	Edwardsiella septicaemia (%)	Vibriosis senticaemia (%)	Aeromonas septicaemia (%)	Herpesvirus 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	--	No data available
Mar Menor	2009	109	23.79				5.5	7.5	0	--	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 compared 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 19).

ES.11.3 Contaminants

In 2009 a programme has been developed for toxicological analysis in Mar Menor for the first time. Mercury, plumb, cadmium and arsenic levels obtained where below the maximum limit for toxic waste indicated in Regulation 1881/2006.

ES.11.4 Predators

No new data.

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

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 ms in basins with little slopes and 600 ms 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 has 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 compared with the coastal one.

ES.13.2.2 Silver eel production

ES.13.2.2.1 Historical production (B_0)), productivity and escapement (B_0)

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 particular environmental and ecological conditions (Table 20). A more detailed explanation might be find is the EMP of each EMU (http://www.mapa.es/es/pesca/pags/comision/comision.htm)

Table 20. Historical 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		GC	F	30	Study	2905,8	87174,0
Galicia		GC	C	30	Study	1436,1	43083,0
Galicia	A			30		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
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

EMU	Region	RBD	Habitat	Pristine productivity (kg/Ha)	Determination methodology	Pristine wetted area (Ha)	Pristine Escapement (kg)
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

Source Spanish Ministry of the Environment and Rural and Marine Affairs.

A	**Atlantic Ocean**
M	**Mediterranean**
CIPV	**Cuencas Internas del PaísVasco**
CHC	**Cuenca Hirdrográfica del Cantábrido**
CHE	**Cuenca Hirdrográfica del Ebro**
CIC	**Cuencas internas Catalunya**
IB	**Illes Balears**
CHS	**Cuenca Hirdrográfica del Segura**
CHG	**Cuenca Hirdrográfica del Guadalquivir**
CAA	**Cuencas Atlánticas de Andalucía**

CMA	**Cuencas Mediterráneas de Andalucía**
CHJ	**Cuenca Hirdrográfica 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 og the cpues in the area**
IB	**Reference from the Balearic Islands has been used**

ES.13.2.2.2 Current production (Bbest, productivity and escapement (Bpre)

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). It is not possible to report these data because anthropogenic mortality has not been quantified in Spain.

$B_{pre:}$, 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 actual escapement (2009). This 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 might be found in their management plans (http://www.mapa.es/es/pesca/pags/comision/comision.htm). 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, because 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		GC	F	1656,1	3,0	Study	4885,5
Galicia		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
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

EMU	Region	RBD	Habitat	Current wetted area (Ha)	Current productivity (kg/Ha)	Determination methodology	Current escapement (kg)
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
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		

Source Spanish Ministry of the Environment and Rural and Marine Affairs

A	**Atlantic Ocean**
M	**Mediterranean**
CIPV	**Cuencas Internas del PaísVasco**
CHC	**Cuenca Hirdrográfica del Cantábrido**
CHE	**Cuenca Hirdrográfica del Ebro**
CIC	**Cuencas internas Catalunya**
IB	**Illes Balears**
CHS	**Cuenca Hirdrográfica del Segura**
CHG	**Cuenca Hirdrográfica del Guadalquivir**
CAA	**Cuencas Atlánticas de Andalucía**

CMA	**Cuencas Mediterráneas de Andalucía**
CHJ	**Cuenca Hirdrográfica 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 og 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**

ES.13.2.2.3 Antropogenic mortality

Only the fishery mortality is partially known in Spain.

ES.13.2.2.4 Impacts

The main impacts are described in the Spanish EMP but they are not quantified.

ES.13.2.2.5 Stocking requirement eels <20 cm

In Cataluña fishers must give 5% of their catches for restocking.

In C. Valenciana both, glass eel fishers and eel fishers 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). 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

Calculations have been made using data from Polinya Xuquer public aquiculture centre in C. Valenciana.

ES.13.2.2.6 Data quality issues

No data available.

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 Standardisation and harmonization of methodology

As 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 Italy 2009/10

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Reporting Period: This report was completed in September 2010, and contains information up to 2009.

IT.2 Introduction

The years 2009 and 2010 have been important transitional years in Italy with regards to eel management, even if outcomes are still to complete, expected in 2011.

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, that has strongly reduced today (Ciccotti *et al.*, 2000; Ciccotti and Fontenelle, 2001).

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 Apulia, Campania, Latium, Tuscany, Sicily and Sardinia (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 found in main rivers and lakes. Most of the eel catches are from the great Alpine lakes in the northern regions, but the eel is also an important target species for professional fisheries in some volcanic lakes of Central Italy. Professional eel fisheries in rivers are confined today to a very small number, while professional glass eel fisheries take place in a larger number, and in many channel mouths as well. At the moment, most of the glass eel yield comes from the Central and Southern Thyrrenhian area. The main sites of glass eel catches are the estuaries of rivers such as the Arno and Ombrone in Tuscany, the Tiber and the Garigliano in Latium, and the Volturno and Sele in the Campania region. Those sites are frequented not only by local fishers but occasionally also by fry fishers from other regions, who reach those sites with trucks equipped with oxygenated tanks to collect mullet, sea bass, sea bream and eel fry. Local fishers are usually single or Cooperative fishers that are equipped with boats and structures to store the product alive. Fishing instruments vary depending on the characteristics of the site.

Governmental management framework for eel results disjointed, because in Italy the Ministry of Agriculture and Forestry Politics controls salt and brackish waters, while inland waters are under the control of local Administrations, i.e. Regions or Provinces. 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. In most cases, anyway, central and regional regulations are in agreement, glass eel fishery regulation being joined always to the regulation of fishery of finfish and bivalve fry for aquaculture. In both departments, a licence is necessary, which has to be renewed annually, in which quantities to be fished have to be declared. Fishermen must notify their catches and sales. Destination of glass eels ought to be restricted to aquaculture and restocking purposes. However, poaching and black market in some regions remain a problem. In absence of counterchecks, collection of data can prove to be partial, and their reliability doubtful.

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.

This complex 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.

Eel are in fact present in lagoon 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. Administrative responsibility for eel fisheries is also relatively dispersed: sea fisheries and sea fishing of eel 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 have been 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.

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, whilst focusing on the sustainability of the socio-economic activities associated with it. Certain typical features of the exploitation methods and traditional management strategies could 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 stop of the eel fishing is foreseen starting from the year 2009. The remaining nine regions have drawn up their own Regional Eel Management Plan, which was 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.

Table IT.1. The administrative Regions (EMU) which have produced a Regional Eel Management Plan (green) and the Regions where the eel fishing will stop definitively (red).

Region	Total ha	Key Centre	Regional Management plan
Valle d'Aosta	1620	no	
Piedmont	11970	no	
Lombardy	50277	yes	x
Trentino Alto Adige	8803	no	
Friuli-Venezia Giulia	16085	yes	x
Veneto	90754	yes	x
Liguria	2437	no	
Emilia-Romagna	21953	yes	x
Tuscany	12489	yes	x
Marche	3370	no	
Umbria	16459	yes	x
Lazio	28142	yes	x
Abruzzi	4352	no	
Molise	3638	no	
Campania	4211	no	
Basilicata	5742	no	
Apulia	14394	yes	x
Calabria	8077	no	
Sicily	10656	no	
Sardinia	32623	yes	x

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 Venetian 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 (Lombardy, 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 eel fishing will stop completely.

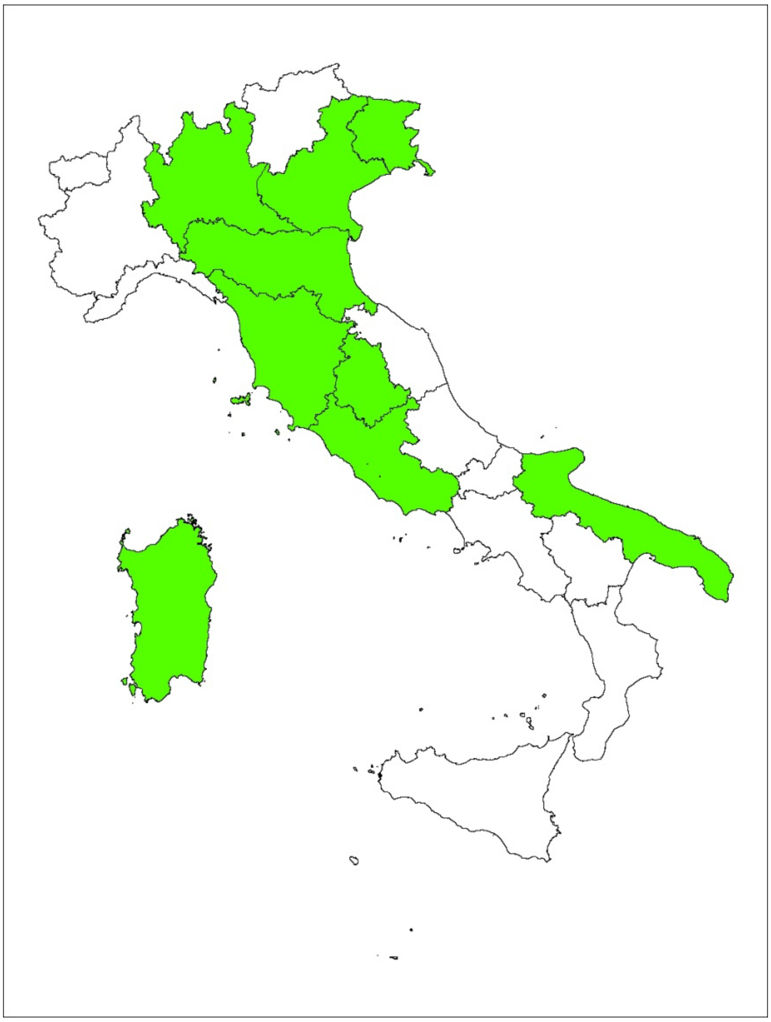

Figure IT.1. The nine Regions (EMU) identified as 'key centres' that have produced a Eel Regional Management Plan.

For each of these regions (Lombardy, Veneto, Friuli-Venezia Giulia, Emilia-Romagna, Tuscany, Lazio, Umbria, Apulia and Sardinia), 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.

A first draft of the IT-EMP was submitted in December 2008, but was not accepted by the Commission, that requested for a new drafting of the Plan. The definitive draft 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 opinion has identified some issues to resolve, the most crucial regards the level of pristine escapement calculated in the Plan that ICES believes to be too low. The Commission has stated that the Plan cannot be adopted unless some amendments are made with regards to this point. Therefore, after new meetings with the Regional representatives and with officers of the European Commission, it has been decided that an amendment text based on a new calculation is prepared, also including other ICES recommendations. This text is in preparation to be submitted by September 30, 2010 as an ultimate deadline. 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.

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 eels (eels <15 cm), however the legislation governing this type of fishing has been changed. .A new legislation has been introduced, due to come into force between 2010–2011, 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 fishers 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 proposes the regional administrations as Eel Management Units. This point has been accepted by the Commission and shall therefore remain in the amended version of the IT-EMP.

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, but these are still to be validated and verified, and are not used in this Report, also because the IT-EM is still to be updated.

On the other hand, Italy is at the moment establishing 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 for Eel Data Collection is currently ongoing, due to be completed by October 15th 2009 that has foreseen the data collection of eel professional fisheries for the year 2007 with detail regarding life stage, sites, fishing effort, catch. Unfortunately data are not available at the present moment to be used for the purposes of the present Report.

The Italian Data Collection (under Reg. 199/2008, DCF) is at present going on, that foresees starting from 2009–2010 two modules (Module III.D: Recreational fisheries of eel; Module III.E.6: Monitoring of commercial eel). Within these modules, the evaluation of eel recreational fisheries in Italy, as well as the biological samplings carried out within the professional fisheries, take place. The methodology for both these modules has been set up in the course of 2009, which has foreseen an important methodological effort because of the mixed management framework split up between State and Regions. Some preliminary data for 2009 have been presented to the European Commission in the National Report for Italy, and activities for 2010 are currently going on. Unfortunately, these documents are still to be approved at both the National and European level, and therefore they cannot be used for the purposes of this report.

Due to this complex situation, in this report data are used derived by the official statistical system (ISTAT) actually in place that will be replaced by the Data Collection Framework. Data presented in this Report are referred to the national level or environmental typology (such as inland or coastal waters), as total landings for the country, and disaggregated by Region (EMU) as well.

IT.3 Time-series data

IT.3.1 Recruitment-series and associated effort

IT.3.1.1 Glass eel

Recruitment dataseries supplied in the past to the Working Group was relative to a fishery-based monitoring on the river Tiber estuary. As the fishery has stopped to exist, this monitoring has ceased. No monitoring is at present in place. No monitoring programmes of recruitment are foreseen in the immediate future.

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

N.a.

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

N.a.

IT.3.2.1 Commercial

IT.3.2.1 Recreational

IT.3.3 Silver eel landings

N.a.

IT.3.3.1 Commercial

IT.3.3.2 Recreational

IT.3.4 Aquaculture production

Aquaculture production in Italy from 2002 to 2007 is given in Figure IT.1.

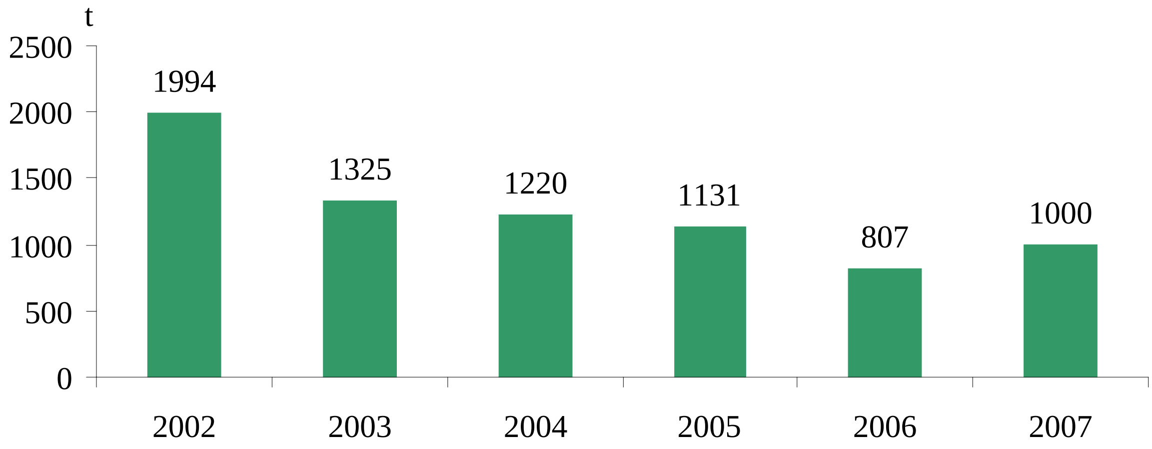

Figure IT.2. Aquaculture production in Italy from 2002 to 2007 (Source: Idroconsult, 2008).

IT.3.4.1 Seed supply

N.a.

IT.3.4.2 Production

N.a.

IT.3.5 Stocking

IT.3.5.1 Amount stocked

N.a.

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

N.a.

IT.4 Fishing capacity

N.a.

IT.4.1 Glass eel

IT.4.2 Yellow eel

IT.4.3 Silver Eel

IT.4.4 Marine fishery

No marine fishery is present in Italy.

IT.5 Fishing effort

N.a. at present, will be under the DCF from next year.

IT.5.1 Glass eel

IT.5.2 Yellow eel

IT.5.3 Silver eel

IT.5.4 Marine fishery

No marine fishery is present in Italy.

IT.6 Catches and landings

Detailed data on catches and landings (by life stage, by type of fishing gear, by EMU, commercial and recreational, etc.) will be available only from 2010, when the DCF will be definitively in place. Time-series will not be available, because data collection in the detailed form as required by Reg. 199/2008 starts only from 2009. At present, only data from the old statistical system (ISTAT) are available, that is limited to inland waters (lakes and reservoirs, riverine fisheries are not registered by this system), updated to 2008. The ISTAT system has discontinued the collection of data from the brackish and marine waters compartment since 2004, and this has been resumed only in 2009 within the DCF. Therefore a discontinuity in the dataseries shall probably remain. Therefore eel landings time-series for Italy landings are available at present only cumulated, i.e. yellow and silver eels.

Eel total landings from lagoon fisheries in Italy from 1969 to 2004 are reported in Figure IT.1. Data refer to coastal lagoons only, no marine fisheries existing.

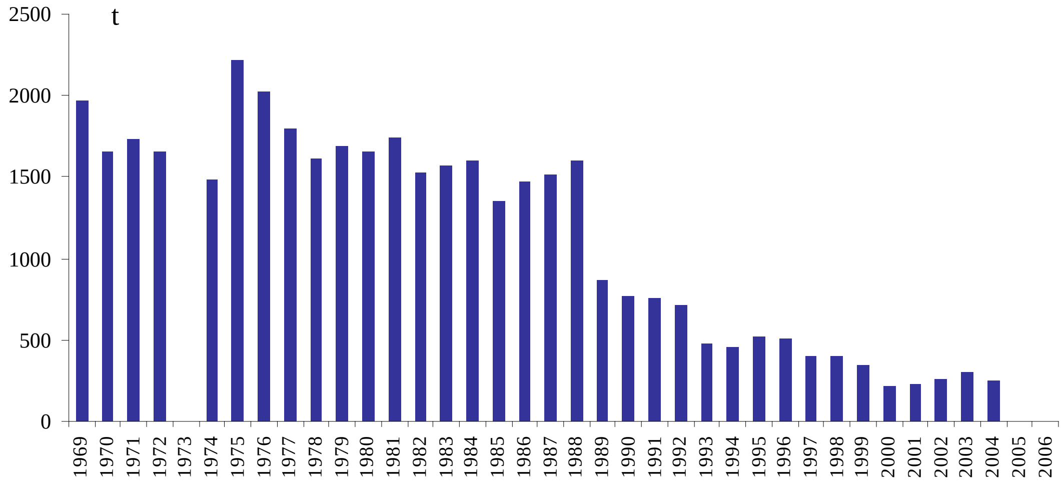

Figure IT.3. Eel landings (yellow and silver cumulated) in Italy, period 1969–2004, from coastal lagoon fisheries (Istituto Nazionale di Statistica).

Inland waters eel landings from 1969 to 2006 are reported in Figure IT.3; statistics refer only to lakes and artificial basins.

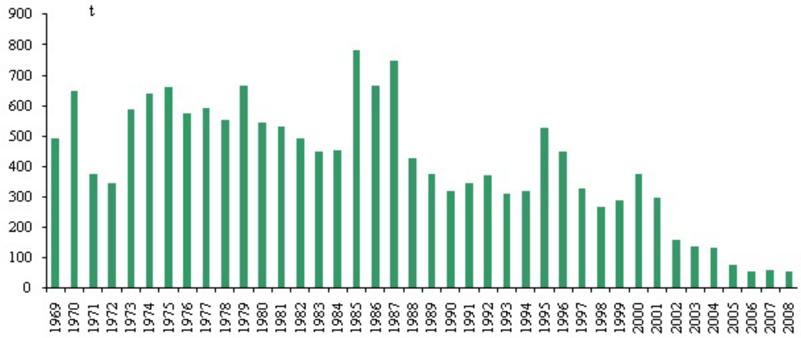

Figure IT.4. Eel landings (yellow and silver cumulated) in Italy, period 1969–2006, from lakes and artificial basins (Istituto Nazionale di Statistica).

The above statistics refer to yields cumulated for all Italy, but landing data split at the Regional level (corresponding to EMU) are also available, given in Tables IT.1 and IT.2 from the year 2000.

Statistics relative to eel catch in coastal areas are up to 2004, after that year the collection of data for marine and lagoon species and fisheries having moved to the National Data Collection Framework. Eel is in the Data Collection only since 2009 (Reg. 199), so there is a discontinuity in the statistics.

Table IT.2. Eel catch from coastal lagoons, period 2000–2004, source ISTAT (Istituto Nazionale di Statistica).

Region (EMU)	2000	2001	2002	2003	2004
Valle d'Aosta					
Piemonte					
Lombardia					
Trentino Alto Adige					
Friuli Venezia Giulia	5,849	2,575	3,201	2,9	4,035
Veneto	21,137	17,055	28,711	32,101	25,745
Liguria	5,034	2,384	6,033	2,202	11,62
Emilia Romagna	16,401	9,914	12,055	3,207	1,246
Toscana	27,697	46,547	10,513	92,852	31,441
Marche	0,193	0,14	0,674	0,099	0,319
Umbria					
Lazio	11,35	4,119	4,79	4,79	2,236
Abruzzo					
Molise					
Campania	14,495	62,237	63,094	66,068	73,172
Basilicata					
Puglia	89,531	67,168	100,498	60,752	69,755
Calabria	6,946	7,841	7,505	8,331	7,937
Sicilia	13,003	1,939	20,489	23,894	16,271
Sardegna	0	0	0	10,999	0,045
Total	211,636	221,919	257,563	308,195	243,822

Statistics relative to eel catch in lakes and reservoirs (river fisheries are not included) are up to 2008, further data were not available at the moment.

Table IT.3. Eel catch from lakes and reservoirs, period 2000–2008, source ISTAT (Istituto Nazionale di Statistica).

Region (EMU)	2000	2001	2002	2003	2004	2005	2006	2007	2008
Valle d'Aosta	-	-	-	-	-	-	-	-	-
Piemonte	1,19	0,73	0,70	0,70	0,30	1,60	0,60	0,70	0,80
Lombardia	46,88	92,50	27,30	36,00	29,60	13,30	5,90	6,50	0,60
Trentino AA	52,41	4,35	4,30	3,60	2,80	2,20	2,00	2,00	1,60
Friuli VG	-	-	-	-	-	-	-	-	-
Veneto	10,79	97,70	13,40	9,40	3,90	9,90	10,00	7,90	6,50
Liguria	0,48	0,21	-	-	-	-	-	-	-
Emilia Romagna	38,61	18,41	23,40	19,00	30,20	8,10	8,70	3,90	6,50
Toscana	4,62	3,24	3,50	0,30	0,30	0,30	0,10	-	0,60
Marche	0,15	0,15	0,10	-	-	0,20	-	0,10	0,10
Umbria	56,33	41,74	58,10	44,60	38,70	22,10	14,20	15,50	16,70
Lazio	159,37	25,16	19,20	18,70	24,60	14,80	13,00	17,10	18,90
Abruzzo	-	0,45	0,10	0,10	-	0,30	0,40	0,20	0,20
Molise	-	-	-	-	-	-	-	-	-
Campania	-	0,06	0,10	-	0,10	-	0,10	-	-
Basilicata	2,84	1,89	1,80	2,30	2,20	0,30	0,30	0,40	0,40
Puglia	2,55	2,70	3,60	3,00	1,80	1,30	0,50	0,50	0,80
Calabria	-	9,00	1,00	0,60	0,60	0,50	0,60	0,60	0,60
Sicilia	-	-	-	-	-	-	-	-	-
Sardegna	0,05	-	-	-	-	-	-	2,70	2,20
total	376,24	298,27	156,80	138,30	135,10	74,90	56,40	58,10	56,50

IT.6.1 Glass eel

N.a.

IT.6.2 Yellow eel

N.a.

IT.6.3 Silver eel

N.a.

IT.6.4 Marine fishery

N.a. No marine fishery is present in Italy.

IT.7 Catch per unit of effort

N.a.

IT.8 Other anthropogenic impacts

N.a.

IT.9 Scientific surveys of the stock

Scientific surveys are currently carried out on a regular basis only under the DCF National Programme 2009–2010. Samplings are foreseen for every EMU (Region), in a site, lagoon or catchment representative of the EMU, and samples are obtained from local commercial fisheries. For 2009, a tentative sampling scheme has foreseen to sample only in one management unit, but in three different habitat typologies (lake, river, coastal lagoon) about 100 individuals in order to assess livery stage, length and weight, age by otoliths examination, sex. This has allowed to obtain stage composition (Y/S), length and age frequency distributions and sex ratio. The samplings are now being replicated in the other eight EMU (regions). A definitive sampling scheme has been presented in the 2011–2013 Italian National Programme under Council Regulation N° 199/2008 and Commission Regulation (EC) N° 665/2008, currently submitted for approval.

Other samplings are carried out within regional monitoring and programmes, and within specific research programmes, but no central coordination is at present being held.

No definitive data are available at the moment that can be used for the purpose of the present Report.

IT.10 Other biological sampling

Other biological 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.10.1 Length and weight and growth (DCF)

N.a.

IT.10.2 Parasites and pathogens

N.a.

IT.10.3 Contaminants

N.a.

IT.10.4 Predators

N.a.

IT.11 Other sampling

N.a.

IT.12 Stock assessment

IT.12.1 Local stock assessment

N.a.

IT.12.2 International stock assessment

N.a.

IT.12.2.1 Habitat

Wetted Area:

lacustrine;

riverine;

transitional and lagoon;

coastal.

Table IT.4. Surface areas of inland water bodies (rivers and natural and man-made lakes) and transitional water bodies (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 Lombardy 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.12.2.2 Silver eel production

IT.12.2.2.1 Historical production

N.a.

IT.12.2.2.2 Current production

N.a.

IT.12.2.2.3 Current escapement

N.a.

IT.12.2.2.4 Production values e.g. kg/ha

N.a.

IT.12.2.2.5 Impacts

N.a.

IT.12.2.2.6 Stocking requirement eels <20 cm

N.a.

IT.12.2.2.7 Data quality issues

N.a.

IT.13 Sampling intensity and precision

N.a.

IT.14 Standardisation 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.14.1 Survey techniques

Usually surveys rely on professional fishers, 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.14.2 Sampling commercial catches

The sampling scheme under DCF National Programme foresees to perform biological samplings by local commercial fishers. For 2009, the tentative sampling scheme has foreseen to sample only in one management unit, but in three different habitat typologies (lake, river, coastal lagoon) about 100 individuals in order to assess livery stage, length and weight, age by otoliths examination, sex. A definitive sampling scheme has been presented in the 2011–2013 Italian National Programme under Council Regulation N° 199/2008 and Commission Regulation (EC) N° 665/2008, currently submitted for approval.

IT.14.3 Sampling

Sampling is usually carried out by taking a random batch of eels from a fisher cumulated catch of the day or of the week. Sample processing foresees different procedures depending on data to be obtained from the samples. Usually length and weight are directly measured on anaesthetized eel, and digital pictures for subsequent specific morphometric measurements are obtained. Samples are released if no other observations are due, or else sacrificed or frozen for 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 formalin. Otoliths are stored dry in *eppendorf*.

IT.14.4 Age analysis

Age analysis of eel in Italy usually relies on the grinding and 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.

IT.14.5 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.

Sex Determination

Yellow eel <25 cm are considered undifferentiated. Eels >25 cm are sexed by dissection and histological analysis following the protocol of Colombo and Grandi (1996).

IT.15 Overview, conclusions and recommendations

In the present report an overview of the European eel stock and fisheries is presented for Italy that is at present highly defective because of the fact that it has not been possible to use data from most recent data sources such as the IT_EMPs (national as well as Regionals) or the preliminary results of the DCF National Programme 2009–2010 Notwithstanding this, a general picture of current activities regarding eel management is given, based on the fact that the years 2009 and 2010 have been important transitional years in Italy with regards to eel management, because the IT-EMP has been prepared and is currently being evaluated, and the DCF National Programme 2009–2010 is being put in place. Hopefully, outcomes will be soon available, expected in 2011, and will allow Italy to attain European standards and hence participate to coordination actions.

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Report on the eel stock and fishery in Portugal 2009/'10

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PT.2 Introduction

This report is an update of last year´s report and includes new developments that have derived from the European Commission requests to clarify or detail some aspects included in the Portuguese EMP, which has not yet been approved.

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 between 20–25 cm individuals, 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. Paradoxically, today, the most exploited phase in all Portuguese rivers, (illegal fishery), is the glass eel, a situation which will hopefully be solved by the entrance into force of the Convention on Trade in Endangered Species (CITES), as international trade of glass eels will become more difficult and will probably discourage poachers.

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, Rural Development and Fisheries (MADRP). The exception is River Minho because as an international river, there is a Commission with representatives from both countries, setting specific rules that are applied to the fishery, in that river basin. Licences to fish in inland waters are issued by AFN, whereas licences to fish in 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 enormous effort from 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.

Although landings do not separate yellow eels from silver eels, the fishing gears used are directed to catch yellow eels, which is the dominant type in landings. In general, yellow eel fishery is ruled by ten specific byelaws applied to ten fishing areas in coastal waters (estuaries and coastal lagoons) and ten other byelaws, which are applied to specific fishing areas in inland waters. These laws set the rules for types and characteristics of fishing gears and in most cases, limit the maximum number of gears per fishing licence. Fishing effort is not recorded. Fisheries managed by DGPA have obligatory landing reports, contrary to catches from inland waters, which are not reported. Minimum legal size is 20 cm in the River Minho, varies between 20 and 22 cm in inland waters, and is 22 cm in coastal waters.

PT.2.2 Portuguese eel management plan

The Portuguese Eel Management Plan has not yet been approved.

In response to Regulation CE 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.

Despite the existence of five river basins extending beyond Portugal (Minho, Lima, Douro, Tagus, and Guadiana) (Figure 2.1a), and included in three different River Basin Districts (Figure 2.1b), 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 no obstacles are present in the Portuguese part of the river basin. 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. However, meetings between the two countries, to establish and implement a Transboundary Eel Management Plan to meet the objectives established by Regulation EC 1100/2007, have already taken place and other measures are being undertaken.

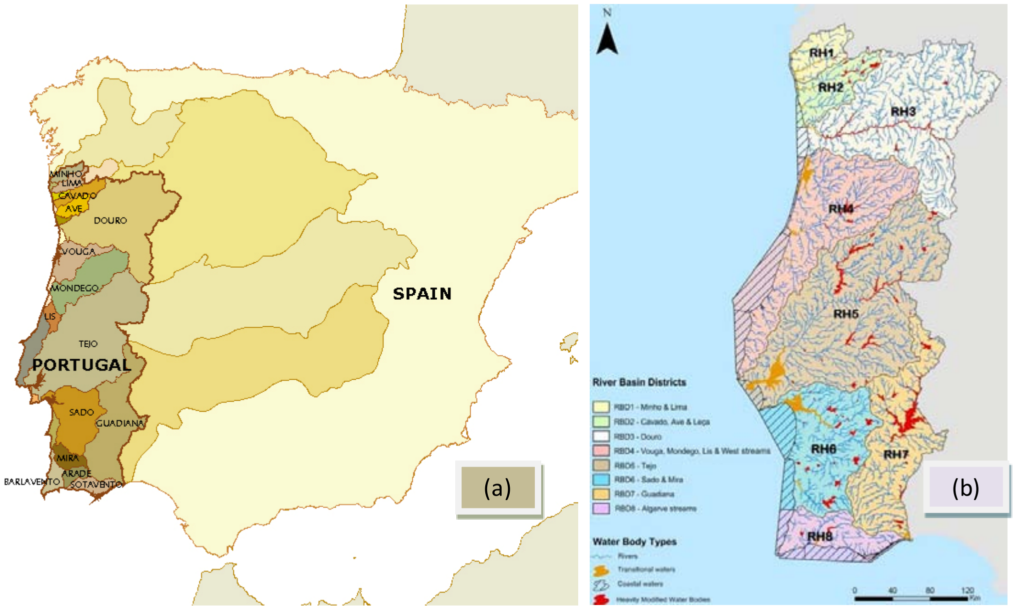


Figure 2.1. Map showing Portuguese River basins including the catchment area extending to Spain (a), and limits of the 8 Portuguese River Basin Districts defined according to the Directive 2000/60/EC (b). RBD is labelled as RH in the map.

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.

Lack of data regarding production of yellow and/or silver eels both in pristine and actual conditions, hampered to completely fulfil the objectives set by Regulation EC 1100/2007 during the elaboration of the Portuguese EMP delivered in December 2008. In view of this, despite the identification of the main threats/problems, the impacts on the population could not be quantified due to lack of data on production and, therefore, the measures set in the plan were not associated with target levels of escapement. The main objective of this first version of the Portuguese Eel Management Plan (December 2008) was to establish a series of measures, to be applied at the national level, which could contribute to reduce mortality and increase silver eel escapement as requested by Regulation 1100/2007.

The main measures proposed in the first version of the Portuguese Eel Management Plan include:

- Restricting professional fishery by setting a limit on the number of fishers and number of gears per fisher in inland waters;
- Closing eel fishery in inland waters except in the areas defined for Professional Fishery (limits defined by ten byelaws);
- Implementing a special permit for eel fishery in inland waters, in which reporting of catches is required as a condition for licence renewal;
- Banning recreational fishery for eel;
- Unifying minimum size to 22 cm;

- Setting a closed fishing season to increase silver eel escapement (October–December);
- Mitigating the impact of obstacles to migration;
- Reinforcing police control on poaching of glass eels;
- Collecting data (habitat and yellow/silver eel production) and use them for modelling.

The European Commission (EC) has asked for extra information which has been delivered in reply of the following requests:

18.03.2009: Main criticisms: The EC considered the plan was lacking elements from article 2º and 7º CE (1100/2007) The main reason for not considering it admissible was lack of effective measures to recover the stock as the measures considered in the plan were mostly preventive and included 5 projects to collect information.

10.06.2009: The plan was considered admissible by the EC and a technical and scientific evaluation conducted by CIEM would follow.

28.09.2009: After the evaluation from CIEM, additional information was requested and the Portuguese Authorities were invited to revise the plan and include:

1) Estimation of silver eel escapement based on data from other neighbouring countries;
2) Measures related to stocking of eels< 12 cm and fighting glass eel poaching;
3) Quantification of the efficacy of each measure, related to fisheries restrictions, to attain the target of 40% of silver eel escapement;
4) A calendar for the application of the measures proposed in the plan and quantify their contribution to attain the objective of the plan;
5) Presentation of more detailed information on monitoring of the plan;
6) Quantification of objectives and presentation of more effective measures supported by organisms;
7) More detailed information on how the collection of data that was missing would be obtained. That included a calendar to implement measures, methodology, personnel and organisms involved in conducting those tasks.

22.03.2010: The EC asks for more detailed information on the quantification of habitats inaccessible for colonization of the river basins; Regulations that rule fisheries; and The Transboundary EMP for River Minho.

12.05.2010: The EC disagrees that no measures are presented by Portugal to allow the migration of silver eels from sites located upstream of dams and that free access to those habitats should be guaranteed. (The Plan had in fact not included measures for silver eels to descend from sites located upstream of dams because they don't have free access to those sites). Free circulation was therefore a request from the EC. Additionally more detailed information on the Minho EMP was requested.

6.07.2010: The EC asks for formal commitments from the Authorities in what concerns measures related to mitigating the effects of dams (revision and clarification of the measures presented in the first version of the EMP9. The reduction of fisheries effort until the implementation of the EMP for River Minho was also requested by the EC. (The reply to the EC is still being prepared as it involves several institutions).

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 fishers 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 Minho River 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, the following season (2007/2008) fishing was permitted between November and last New Moon of February, and the last season (2008/2009) it occurred between the 20th November and 1st of March. This fishing is operated with a stownet.

The fact that a fisher 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 inform the local authorities of their total annual catches. The official fishery statistics are kept by the responsible local authorities – *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 prohibited the fishery during 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.

Table 3.1. Glass eel recruitment in the River Minho (Portuguese and Spanish parts), 1974 to 2009 (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	2.36	Not available	2.36

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. Recreational fishers are not obliged to report their catches or sell the fish.

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.

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. 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 4 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 1996 and 2009 (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

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. Minimum legal size for eel fishery is 22 cm in all estuarine waters and varies between 20 and 22 cm in freshwater. 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. Some meetings involving Fisheries Administrations both from Spain and Portugal took place in Tuy (Spain) and Caminha (Portugal), to decide how to manage the eel in the River Minho. 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 will finish by the end of 2010 (with both countries as partners) is the support to prepare the Transboundary EMP for the River Minho. One of the outputs of this project is the EMP for the River Minho.

PT.4 Fishing capacity

PT.4.1 Glass eel

Glass eel fishery is only permitted in River Minho where fishery is regulated by Decree-Law nº 316, 16th November 1981. 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 netend 2.5 m and mesh size of 1–2 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 1–2 mm.

The fishery, which depends completely on the rising tidal current, is always performed at night around new moon. Depending on 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 fishers 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 fishers were registered for the glass eel fishery. Actually, there are nearly 500 fishers from both countries that have a professional licence to fish glass eels. Number of fishing licences issued by *Capitania do Porto de Caminha* are presented in Table 4.1.

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 2009 (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

*** Licences for glass eel fishery are issued by fishing season (1 November to 30 April). In the three last seasons (1) 1 November to last New Moon of March; (2) 1 November to 12 February; (3) 20 November to 01 March.**

****Total number of licences is only known at the end of the fishing season because fishers 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 (in average-350 €/Kg, although they can be sold at 500 €/Kg). Despite forbidden all over the country, illegal glass eel fishery occurs in all estuarine areas due to the high economic value. The nets used are different from the type used in the River Minho, because there is no need to collect the eels with a dipnet, 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 fishers 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. Table 4.2 shows the results of confiscation of nets during the last three fishing seasons. As can be observed in that table, the highest concentration of nets is found in the North of Portugal, and the lowest in the south. These numbers demonstrate the enormous illegal fishing capacity.

Table 4.2. Number of fishing gears confiscated by the Maritime Police during the fishing seasons from 2006/07, to 2008/2009 and region (Source: DGAM).

			Fishing season 2006/07			Fishing season 2007/08			Fishing season 2008/09		
			North	Center	South	North	Center	South	North	Center	South
Nr. of operations			22	24	1	58	20	2	51	49	3
CONFISCATION		Nr. of fishing gears	122	188	0	461	158	3	100	70	6
		Glass eels (Kg)	190	8.4	0	56.2	9.3	0.5	47	0.5	0
MEANS	MEN	Nr. of men	182	271	4	285	83	20	321	93	9
	EQUIPMENT	CARS	47	45	0	83	20	4	80	41	4
		BOATS	19	33	1	55	13	4	55	16	4

*** Data available until May 2009.**

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 fishers and eel fishing gears they owe/use. Professional and recreational fishers 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 fishers can fish where they choose to according to the type of fishing licence. Professional fishery is ruled by 10 byelaws, which define the river stretches where fishers 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 4.3. 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 fishers use them all, and the number they use is unknown. The type, number and characteristics of eel fishing gears vary according to fishing area. There are ten specific byelaws that set the rules for ten 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 fishers use, contribute as extra difficulties to estimate fishing capacity. Table 4.3 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 pressure on the eel stock, but have to be considered as potential fishery usage.

Table 4.3. Number of licences issued by DGPA to use eel fishing gears in transitional waters and coastal lagoons, 1998 to 2009 (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
RBD1*	Longline	3	3	3	3	3	4	5	5	6	7	7	1
	Fishing rod	5	5	4	3	3	3	3	3	3	4	4	3
RBD2	Longline	2	2	2	1	1	1	1	1	1	1	1	0
	Fishing rod	1	1	1	1	1	1	1	1	1	1	1	1
RBD3	Fyke net	1	2	2	2	2	2	1	1	1	1	1	0
	Sniggle	4	5	5	5	3	3	2	2	2	2	2	1
	Longline	58	57	56	51	42	42	43	43	45	42	42	24
	Fishing rod	0	0	0	0	1	1	1	1	1	10	20	29
RBD4	Fyke net	229	234	222	225	227	233	231	230	209	195	191	121
	Beach seine	292	290	280	280	277	278	269	251	229	215	202	127
	Sniggle	206	208	205	206	205	209	206	215	209	202	197	123
	Longline	417	419	415	412	419	422	427	445	439	411	425	357
	Fishing rod	45	46	47	48	48	52	65	86	100	207	259	312
RBD5	Fyke net	119	113	113	122	114	123	122	110	113	103	101	86
	Longline	391	371	356	357	338	362	380	362	367	350	356	276
	Fishing rod	0	0	0	0	0	0	0	0	17	35	55	62
RBD6	Longline	160	158	154	146	139	139	132	129	128	122	123	37
	Fishing rod	0	0	0	0	0	0	0	0	0	4	11	22
RBD7	Longline	20	53	52	56	57	57	54	53	51	50	51	34
	Fishing rod	0	0	0	0	0	0	0	0	0	0	1	2
RBD8	Longline	70	66	63	62	65	66	74	80	92	90	93	67
	Fishing rod	1	1	1	1	1	4	8	16	25	25	38	41

In the River Minho, the use of fykenets to catch yellow eels was prohibited in the fishing season 2008/09 and remains as such. Longlines are still permitted in the international part of the river (80 km).

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. 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 fishers (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 are 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 and 2009, when catches were slightly higher.

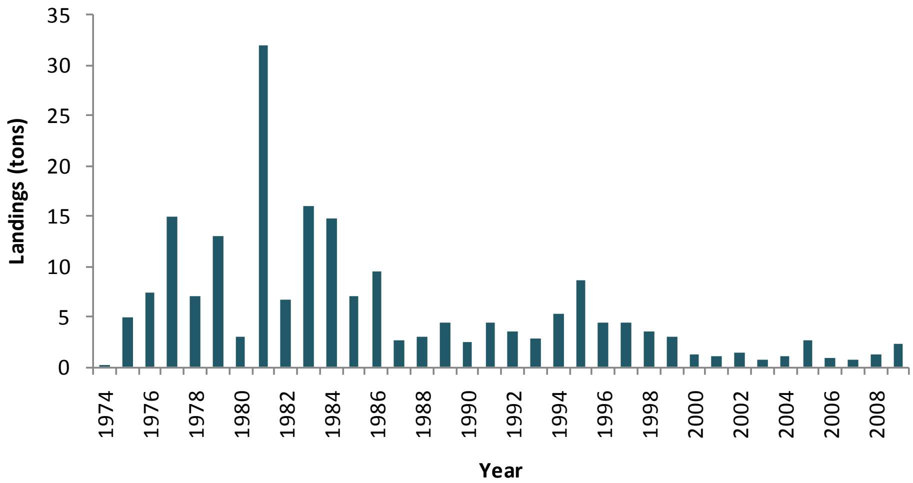


Figure 6.1. Annual landings of glass eel fishery in the Portuguese part of the River Minho, 1974 to 2009 (Source: Capitania do Porto de Caminha).

PT.6.2 Yellow eel

There are no landings in inland waters and fishers are not obliged to report their catches. Therefore the only information on eel fishery is provided by coastal fishery.

There is not a separation between silver eels or yellow eels, although silver eels are seldom caught by fishers. 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.

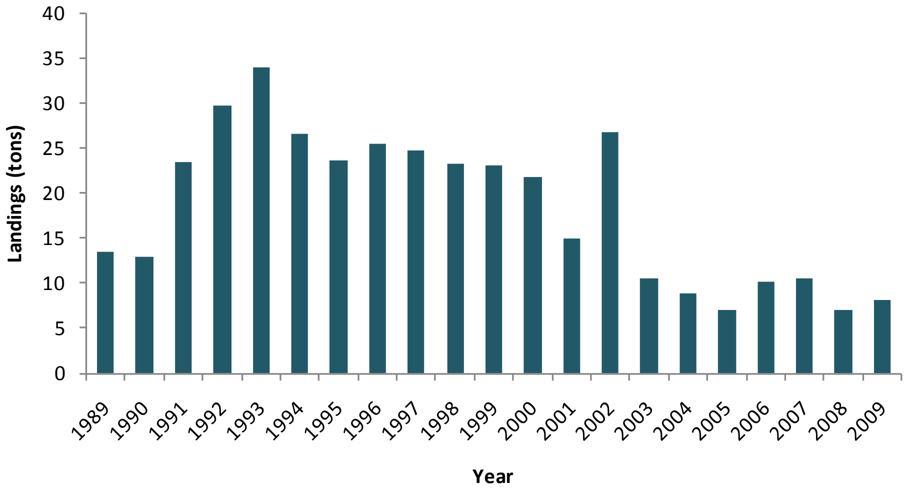


Figure 6.2. Total annual landings of yellow eel fishery in coastal waters (estuaries and coastal lagoons), 1989 to 2009 (Source: DGPA).

Table 6.1. Annual landings of yellow eel fishery in coastal waters (estuaries and coastal lagoons), by River Basin District and total, 1989 to 2009 (Source: DGPA and Capitania do Porto de Caminha).

YEAR	LANDINGS (KG)								
	RBD1	RBD2	RBD3	RBD4	RBD5	RBD6	RBD7	RBD8	TOTAL
1989	3 885	768	821	173	6 311	306	84	1 184	13 532
1990	2 598	1 081	721	1 442	5 720	300	128	1 011	13 000
1991	3 754	612	940	1 410	12 371	3 024	43	1 331	23 486
1992	3 675	878	1 434	918	18 814	2 163	256	1 527	29 665
1993	5 676	1 173	1 692	1 232	20 767	830	604	1 969	33 943
1994	1 435	1 765	1 117	1 029	18 215	801	401	1 790	26 553
1995	1 957	1 499	863	3 953	13 007	501	409	1 520	23 706
1996	1 472	2 228	662	3 177	16 210	378	301	1 139	25 566
1997	1 476	2 099	662	2 776	15 349	1 007	342	997	24 707
1998	1 981	767	1 201	2 752	15 429	81	421	646	23 277
1999	810	897	2 137	2 223	15 734	70	728	545	23 143
2000	898	641	1 431	2 667	15 598	18	221	299	21 772
2001	404	112	775	1 517	12 095	1	57	43	15 003
2002	784	163	1 226	3 039	21 501	3	28	121	26 863
2003	1 095	889	717	3 174	4 646	54	8	47	10 630
2004	1 036	986	428	3 254	3 028	16		100	8 848
2005	1 281	1 235	397	1 612	2 418	1	4	74	7 022
2006	1 970	1 218	361	3 382	2 976	221	2	1	10 131
2007	2 591	825	150	3 953	2 859	127	2	5	10 512
2008	1 200	1 150	345	1 913	2 333	0	6	7	6 954
2009	1 269	1 175	333	1 968	3 363	2	0	59	8 169
TOTAL	39 977	20 985	18 077	45 594	225 380	9 900	4 045	14 354	

The importance of eel landings varies across the country, as can be seen in Table 6.1. There are areas where fishing pressure is higher (see Table 4.3) and landings are in general, correspondingly high, i.e. RBD1 and RBD4. However, the highest landings occurred 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.

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 fishers report total catches but are not obliged to keep a record on fishing intensity.

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.

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. A summary of the sites surveyed and the period of sampling are presented in Table 9.1. Experimental glass eel fishery (yield, abundance, pigmentation stage, biometry) and bycatch analyses was made in the Minho River in the last season (unpublished data).

Table 9.1. Location and period of sampling of glass eels conducted in Portuguese river systems.

Sites of experimental glass eel fishery	Period
Mondego River	1979–1983, 1988–1990
Lis River	1991–1994
Guadiana River	1998–1999
Lima River	2001–2002
Minho River	1981–

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

Data on age have not been made available so far but will be obtained by the end of the Pilot project under the DCF Framework, and will be reported in the next country report. However, preliminary results demonstrate the length composition of 804 eels sampled from commercial catches with fykenets in the Óbidos Lagoon and 443 in the Aveiro Lagoon. Length frequency distribution of eels from commercial catches in the Óbidos Lagoon is presented in Figure 10.1. Monthly variation of length and weight composition of commercial catches from the same system is presented in Table 10.1.

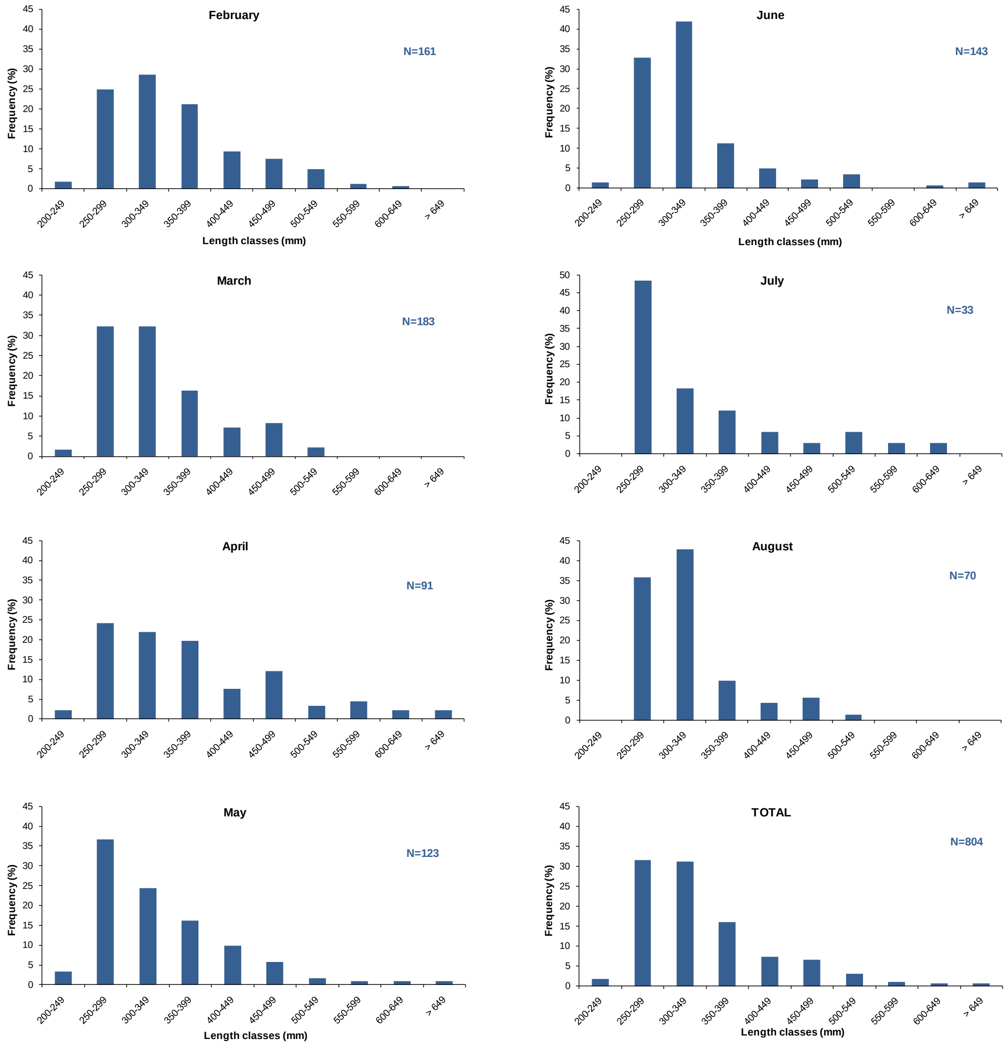


Figure 10.1. Percentage length frequency distribution of eels sampled from commercial catches in the Óbidos Lagoon.

Table 10.1. Monthly variation of length and weight composition of commercial catches sampled in the Óbidos Lagoon (Mean, maximum and minimum values).

Month	TL (mm)			TW(g)		
	Max	Min	Mean±sd	Max	Min	Mean±sd
February	610	200	354.8 ± 77.8	513	20	83.6 ± 71.9
March	534	233	337.1 ± 65.3	250	22	66.8 ± 47.9
April	666	238	376.1 ± 101.3	513	20	111.4 ± 97.2
May	772	226	339.9 ± 772	986	14	81.0 ± 105.5
June	688	233	333.4 ± 76.6	616	20	72.8 ± 77.7
July	612	259	349.0±94.4	395	29	83.9±84.0
August	544	255	327.5±60.3	245	26	59.1±41.7

Length frequency distribution of eels from commercial catches in the Aveiro Lagoon is presented in Figure 10.2. Monthly variation of length and weight composition of commercial catches from the same system is presented in Table 10.2.

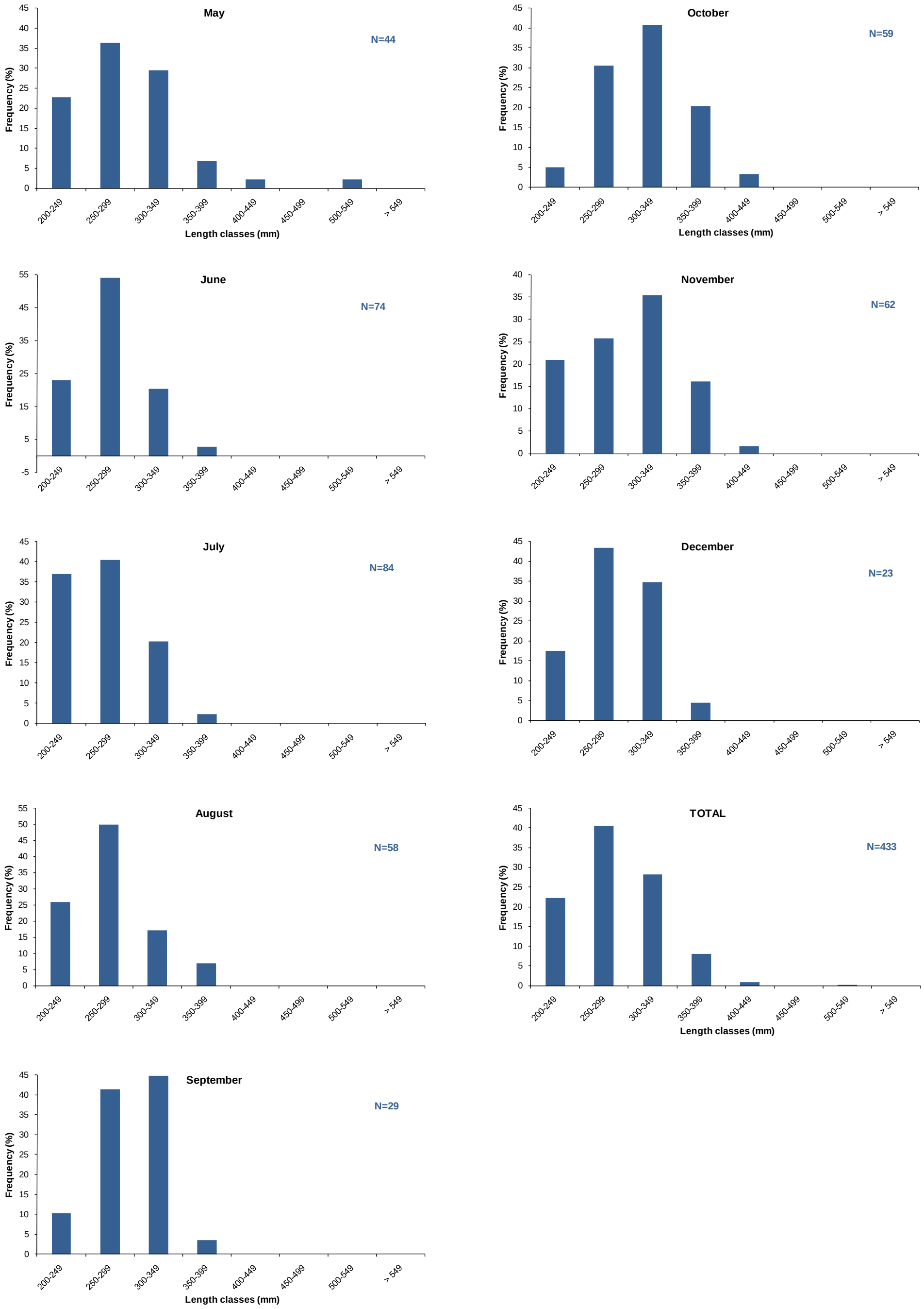


Figure 10.2. Percentage length frequency distribution of eels sampled from commercial catches in the Aveiro lagoon.

Table 10.2. Monthly variation of length and weight composition of commercial catches sampled in the Aveiro Lagoon (Mean, maximum and minimum values).

MONTH	TL (MM)			TW (G)		
	Max	Min	Mean±sd	Max	Min	Mean±sd
May	531	205	291.2±62.1	241	12	43.6 ± 37.9
June	367	201	274.0±34.4	79	17	37.4 ± 14.2
July	367	200	272.6±40.3	102	13	36.1 ± 19.4
August	373	312	276.7±41.0	97	15	37.5 ± 19.1
September	362	214	295.6±37.1	85	18	45.3 ± 18.6
October	412	225	315.4±43.7	117	17	58.2 ± 23.7
November	414	222	304.5±45.6	110	15	50.4 ± 23.0
December	530	220	300.3±63.0	219	16	48.6 ± 40.5

PT.11 Other biological sampling

There was no routine programme to sample eels, except for a Pilot project within the DCF Framework, which started in 2009 and will finish in the end of 2010, and includes two brackish water systems (Óbidos Lagoon and Aveiro Lagoon).

PT.11.1 Length and weight and growth (DCF)

Results of eel growth under the DCF Pilot Project are not yet available as the study is still being conducted.

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) demonstrate a growth index of 2.9 cm/year and 40 g/year in average (unpublished data).

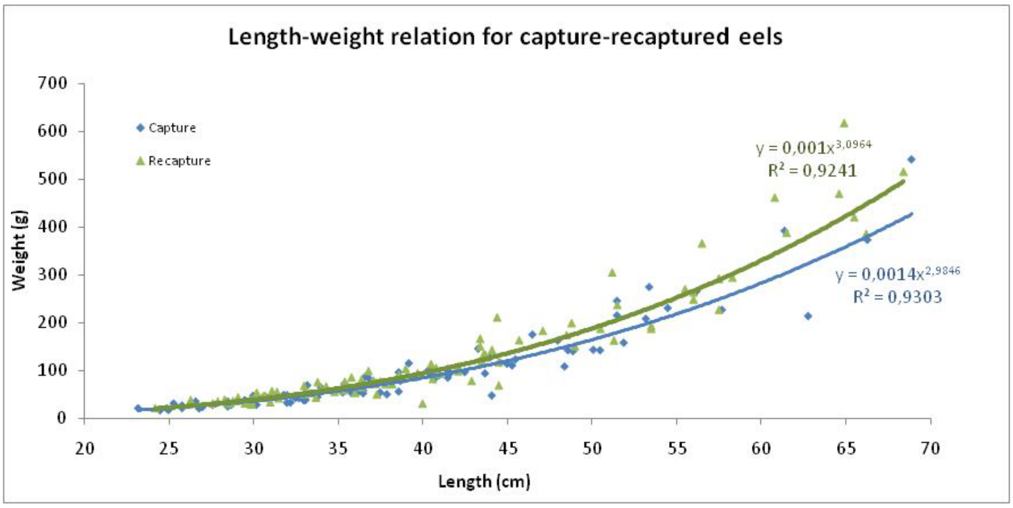


Figure 11.1. Growth of yellow eels marked in the freshwater tidal estuary from the River Minho.

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 a male silver eel caught in the Óbidos lagoon. This eel, infected with four parasites, has probably migrated from any freshwater stream draining into the lagoon as it was the only infected eel found in Óbidos lagoon among a sampling of 110 eels analysed. The fact that only one eel was infected by the parasite, and that it was silver reinforces the idea the infection rate is very low in areas with higher salinities. 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

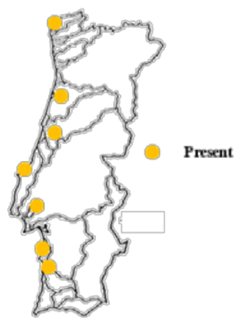
River Mondego

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 with their European congeners (Passos, 2008; Neto, 2008; Neto *et al.*, submitted). The most contaminated eels were obtained from the Tagus estuary.

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 demonstrated 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 2009.

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 & Transitional waters	TOTAL
RH1	7769	3898.5	11667
RH2	1742	744.0	2486
RH3	2308	830.8	3139
RH4	4165	13811.5	17976
RH5	20486	36911.0	57397
RH6	1489	21919.4	23409
RH7	5297	3579.4	8877
RH8	501	10035.5	10536
TOTAL	43757	91730.2	135487

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 Historical 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	640	4.7

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 with 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.

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.

PT.13.2.2.6 Stocking requirement eels <20 cm

Only applicable for River Minho (included in RBD 1) because it is the only river where glass eel fishery is permitted. The Spanish Authorities have during the meeting with the Portuguese Authorities demonstrated the interest in continuing glass eel fisheries. Hence, the establishment of a restocking programme, in accordance with Article 7 of the Eel Regulation (EC Regulation 1100/2007) is still waiting for the results to be obtained by the Project *NATURA-Minho* (Interreg IV).

PT.13.2.2.7 Data quality issues

No available data.

PT.14 Sampling intensity and precision

There is no consistent sampling design employed in Portugal.

PT.15 Standardisation 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 is following the recommendations of the ICES Workshop on Eel Age WKAREA 2009, within the Framework of the DCF pilot project. The final report will be concluded at the beginning of next year, and therefore the results are not available yet.

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).

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 within the Framework of the DCF pilot project.

PT.16 Overview, conclusions and recommendations

The Portuguese EMP has not yet been approved.

The lack of information on the eel stock in Portuguese waters has been responsible for the delay in the process. However, it is strongly recommended that the measures included in the plan to obtain that information missing, as well as the measures aimed at reducing anthropogenic impacts on the stock, start as soon as possible so that in 2012, when each country has to report on the efficacy of those measures, data has been collected to completely fulfil the obligations set by Regulation 1100/2007.

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Report on the eel stock and fishery in Latvia 2009/'10

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LV.2 Introduction

Historically eel fisheries in Latvia occurred in inland and coastal waters. In general eel fishing were not very important share total fisheries economics.

Eel fisheries (amount of landings, gear, market price) were noted in the 19th century economical surveys. The main eel fishing areas were coastal waters, lakes accessible for eel and situated close to the Baltic sea and largest river the Daugava.

In the 1920s by State and fishers' organizations initiative first eel restockings carried out in inland lakes as for support of local fisheries. The first results were highly successful and restocking of eel increased. In 1930s eel landings in the coastal waters amounted to 130 t.

After incorporation in USSR fisheries belonged to the state and carried out by two state owned companies in inland waters and few fishers' cooperatives in coastal waters. From 1970s, when the eel landings in coastal waters decreased, restocking programme increased up to ten times until the late 1980s. Till the late 1980s share of eel fisheries in coastal and inland waters was 2 t to 40 t accordingly.

From 1990s restocking of eel in lakes decreased, as result from early 2000s eel catches in lakes decreased with tendency; 1,4 t per year. At present eel Landings in Latvia are less the 10 t per year.

Fisheries legislation and management principles in force were established in 1990s after the Civil Law (established in 1937) renewal. System where the state is owner of fish (resources) has been changed to system that person how caught the fish owns them. In fact Latvia's fisheries legislation largely was adopted form the Soviet system (for example- catch reporting, logbooks system, etc.) and combined by Civil Law regulating ownerships relations in fisheries. Some new legislative acts developed for regulation of fishing effort. In general fisheries legislation system in Latvia have had conflicting content especially on ownership of water (fishing place) and fishing rights.

Fisheries management and accordingly fisheries information available varied in different periods.

Table 1. Eel fisheries information available in Latvia.

DATA	19TH–1920S	1920S–1940S	1940S–1990S	1990S–TILL NOW
Landings				
Coastal	occasional	reports	Logbooks	Logbooks
Inland	occasional	occasional	Logbooks	Logbooks
Effort				
Coastal	n.a	n.a[1]	n.a	Logbooks
Inland	n.a	n.a	n.a[2]	Logbooks
Number of gear				
Coastal	n.a	reports	n.a.	Logbooks
Inland	n.a	n.a	n.a.	Logbooks
Number of boats	n.a.	Number of boats per local area	n.a.	Logbooks, registers
Number of legal or individual persons in fisheries	n.a.	Number of fishers's per local area	Country statistics in state archive	Logbooks, registers

[1]- number of boats and fishing days in are known but not gear in operation info (on local area level)

[2]- only landings per separate lakes, rivers, reservoirs per year

LV.2.1 Fisheries management

LV.2.1.1 Legislation

Legislation (inland and coastal waters) regulating the fisheries composed from several documents defining general terms and rules also technical measures (gear description, documentation standards, etc.):

- Fishery Law;
- The Cabinet Regulation (2.05.2007.) nr.295 "Regulations on commercial fisheries in inland waters";
- The Cabinet Regulation (22.12.2009.) "Angling regulations";
- The Cabinet Regulations (30.11.2009.) nr.1375 "Regulations on commercial fishing limits and the procedure for their use in coastal waters";
- The Cabinet Regulations (30.11.2009.) nr.1374 "Regulations on commercial fishing limits and the procedure for their use in inland waters";
- The Cabinet Regulation (15.12.1998.) nr.453 "Regulations on the use of fishing rights in private waters";
- The Cabinet Regulation No. 296 2 May 2007 "Regulations on commercial fishing in the territorial waters and the waters of the economic area";
- The provisions for licensed angling in individual water bodies and the relevant binding local municipality regulations.

LV.2.1.2 General rules and obligations for commercial fishers

To get the fishing rights for eel fisheries and gear limits person should follow some bureaucratic procedures and rules:

- Own the registered fisheries enterprise;
- Enter into a contract with local municipality for lease agreement for fishing rights in water body (lake or river);
- Pay the tax for local municipality on gear/gears limit;
- Receive the fishing licence and logbook in local Fisheries control unit;
- Angler should by the "Anglers card" (annual or for three months season).

No eel recreational fishing in Latvia by commercial gear. In terms of legislation part of Latvia's fishing are defined as "self consumption fishing". Fishermen engaged in this fisheries operating with same gear as commercials, the differences is without rights to sell or place on the market fish.

LV.2.2 Technical measures for eel fisheries regulation

Technical measures of eel fisheries

Season- no closed season (eel fishing season generally going on from the end of April to October);

Gear- mesh size (not the less than 12 mm (from knot to knot), length of side- arms, length of fykenet;

Gear setting in place (for rivers and outlets)- stand across the river (weirs), stand across part (50%) of the rivers or outlets- trapnets;

Fishing day- only night-time for traps in the rivers and outlets, in daytime gear should be out from water;

Legal size of eel (both for commercial fisheries and angling)- 40 cm;

Catch limit/bag limit- no catch limit in commercial fisheries, bag limit is per day per angler.

LV.2.3 Latvia river basin districts and EMU

According to the water management law the territory of Latvia has been divided into four river basin districts (RBD's).

Table 2. Latvia's RBD's regarding WFD.

RBD	Area (km²)		Annual discharge (km³)
	In Latvia	Outside Latvia	
Daugava	24700	63200[1]	20.5
Gauja	7920	1160[2]	2.2
Lielupe	8800	8800[3]	3.6
Venta	6600	5200[4]	2.9

1- in Russia Federation, Belorussia, Lithuania;

2- in Estonia;

3- in Lithuania;

4- in Lithuania.

One eel management unit were established in Latvia on the basis of:

- Relatively small territory with identical natural conditions;
- The river Daugava, largest river in Latvia, has been heavily modified by building of 3 HPS dams;
- Other rivers accessible for migratory fish are small by the Community scale;
- Single and centralized national fishing regulation in all country territory.

The EMU in Latvia is defined as "single eel river basin", which includes:

The parts of RBD's accessible (and partially accessible (no obstacles for downstream migration) for eel (all together in rivers and lakes (197 km² lakes, 84 km² rivers habitat);

Coastal waters along coastline 496 km) with width one nautical mile (all together 900 km²).

LV.3 Time-series data

Fisheries data collection changed in different historical periods. Till 1920s collection of fishing information regarding landings, gear, effort, market prices was occasional, carried out for some separate informative reports on fisheries economics and structure in Western part of tsars' Russia.

Regular fisheries data collection in Latvia carried out from 1924 and summarized in Latvian sea fisheries yearbooks. These data were based on volunteers, mostly fishers. Every volunteer reported the main data (monthly) regarding landings by species per local area (fishers' village) and some socio- economic data as number of boats, engines (type and capacity) gears by types, fish prices, value of catch, gear, boats, engines. Looses for local fisheries were estimated as loosed or damaged gear and boats, number of drowned fishers. These data concerns only on fisheries in the sea, mostly coastal waters. Data on eel fishing in the inland waters of 1920s–1945 are occasional, data were not systematically collected. No any eel fishing data on II World war period.

In Soviet period landings data were collected on the monthly basis by state owned fisheries companies and cooperatives. Every cooperative operated in fisheries along the coastline in fishing areas close to small harbours. No any effort data on this period.

Inland fishing of eel in Soviet period was organized on the basis of restocking which was invested by state. Data was collected on the basis of water body- lake, river or reservoir and fishing company (state or cooperative). No effort data on this period, because mostly eel fishing was mixed type- in one lake fishers operated by seines, traps, longlines, weirs, etc. Number of gear in operation is not known.

Landings reporting were obligation, data were collected via cooperatives by registration of landing in harbour or in fish processing factory.

From 1992 fisheries data registration organized on daily basis logbooks, same format for commercial and non- commercial fishers. Registration of landing, gear used, fishing date, company or person data are obligate.

LV.3.1 Recruitment-series and associated effort- no data available

LV.3.1.1 Glass eel

LV.3.1.1.1 Commercial

LV.3.1.1.2 Recreational

LV.3.1.1.3 Fishery independent

LV.3.1.2 Yellow eel recruitment

LV.3.1.2.1 Commercial

LV.3.1.2.2 Recreational

LV.3.1.2.3 Fishery independent

Regular monitoring of species distribution and fish abundance (by numbers and biomass) by electrofishing carried out in the rivers of Latvia since 1992. Data on species, number and biomass collected on all species. Number of caught eels did not exceed few individuals per monitoring season (six eels in 2009, none in 2010).

LV.3.2 Yellow eel landings

Only mixed data are available- yellow eel and silver eel landings together.

LV.3.2.1 Commercial

LV.3.2.2 Recreational

LV.3.3 Silver eel landings

Only for lakes restocked by eel (lakes outside EMU) dataseries are available since 1992.

LV.3.3.1 Commercial

LV.3.3.2 Recreational

LV.3.4 Aquaculture production– no enterprises in Latvia

LV.3.4.1 Seed supply

LV.3.4.2 Production

LV.3.5 Stocking

Restocking of eel in Latvia lakes carried out since 1927. The more intensive restocking accomplished in 1960–1980ies when 20 million eel were released in lakes.

Eel in Soviet period mostly bought in France (probably, because this country is mentioned in some publications) then transported to Belorussia and restocked in Estonia, Latvia, Lithuania and Belorussia inland waters.

After 2005 only ongrown eel imported from Estonia company Triton PR Eel Farm.

Table 3. Number of released eel*1000 by age and by waterbodies type (all historical restocking amount).

AGE	LAKES	RIVERS	RESERVOIRS
Glass eel	32 101	28	2
Ongrown eel	15	0	0

No information on some restockings in 1930s.

Article “Fish restocking in Latvia’s waters 1930–1960” (in Russian). In this article different data sources summarized- reports on commercial activities, popular articles from magazines, reports of nongovernmental organizations (fishers’ society, etc.), reports of Fisheries laboratory of Ministry of Agriculture.

Data source are reports of Baltic Fish Acclimatization station, Inland Waters Fisheries board (1950–1980s), reports of state fishing company “Upesciems”.

Data source from 1990s- persons restocking the fish should report restocking by standardized protocol (Cabinet regulation on fish restocking in natural waters).

LV.3.5.1 Amount stocked

Dataseries by water body, number of eel, life stage of eel. Unfortunately, but additional information like restocking protocols seem to did not archived. Data on eel restocking in 83 lakes, rivers and reservoirs from period of 1927 till now available. In most cases restocked eel are classified as glass eel or ongrown eel.

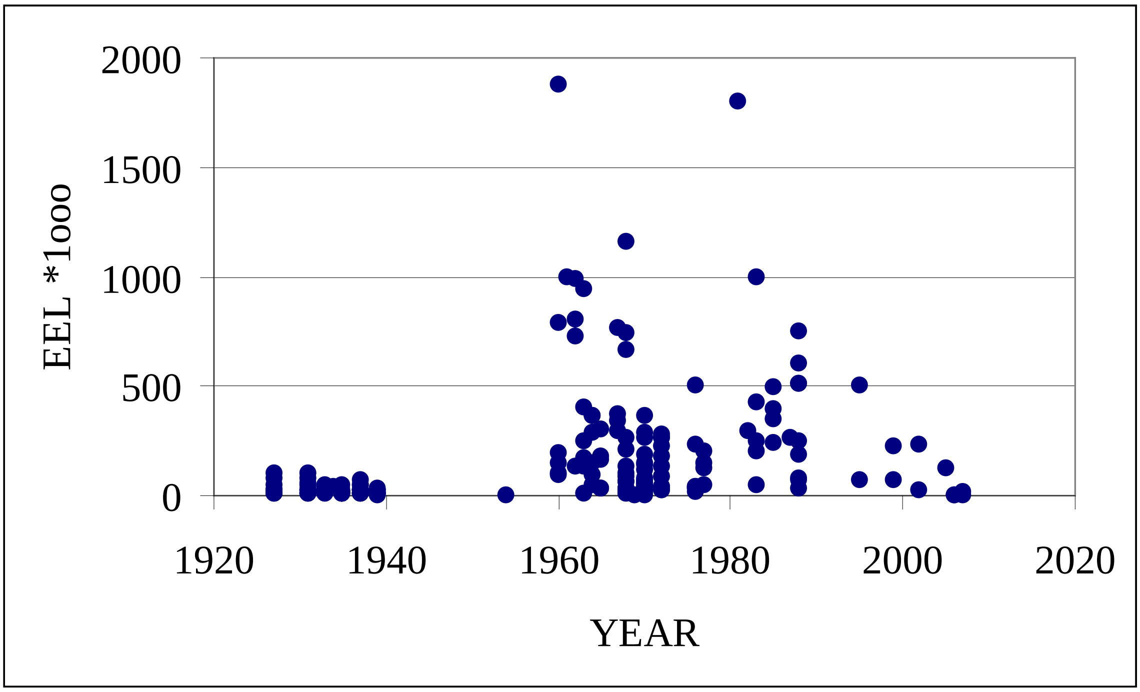

Figure 1. Number of restocked eel in Latvia. Eel source- probably France.

LV.3.5.2 Catch of eel <12 cm and proportion retained for restocking– no fishing of eel <12 cm in Latvia

LV.4 Fishing capacity

Commercial fishing companies are registered by Ministry of Agriculture Fisheries Department. In fact all persons fished by commercial gear are registered in regional Marine and Inland Waters Administration (MIWA) offices when obtain the fishing licences (permission to fish).

Boats used for fishing are registered in Latvian ship register- Fishing vessels and fishing boats (limited registration-permission from Agriculture Ministry necessary). This information together with fishing data is included in Fisheries database- ICIS administered by Fisheries Department of Ministry of Agriculture. All data regarding boat technical parameters- engine, carrying capacity, length, age, etc. are available.

System of fishers and vessels (boats) registration established in 1990s.

There are no fishing companies targeting only for eel in coastal and inland waters in EMU of Latvia. The share of eel in fisheries by different fyke- and trapnets not exceed few % of total catch by these gears. Nevertheless, in fisheries legislation exist the term “eel trap”, gear used for fishing of “small size” species- as perch, smelt, herring and also eel. In some way longlines in coastal waters were dedicated eel fishing gear. However, at present only 10–15% from catches by longlines were eels, other species as flatfish, perch, pikeperch caught by this gear dominate.

Table 4. The number of companies and persons utilizing the gear limit "eel trap" and longlines in coastal and inland waters (LV EMU)

FISHERIES. GRAR	LANDINGS BY "EEL" GEAR (T; 2009)		NUMBER OF LEASEHOLDERS		DATASERIES
	ALL SPECIES	EEL	2008	2009	FROM
Coastal					
Eel trapnets	53,3	0,15	15	17	1992
Fykenets	30,5	0,23	130	181	1992
Longlines	2,9	0,35	42	54	1992
Inland					
Trapnets <30 m	30,6	0,4	19	20	1992

1-only companies fished in EMU waterbodies

2-landings are not divided in yellow and silver eel

In fact, no reason for analyse how fishing capacity linked to eel fishing because there are no fisheries segment targeting mainly eel in Latvia, except lakes with restocked eel.

LV.4.1 Glass eel-no glass eel fishing in Latvia

LV.4.2 Yellow eel-landings statistics are not divided by stages, for total capacity see Table 6.

LV.4.3 Silver eel-landings statistics are not divided by stages, for total capacity see Table 6.

LV.4.4 Marine fishery-no marine fishery of eel in Latvia

LV.5 Fishing effort

There are no fishing targeting only and/or mostly eel in coastal waters and inland waters accessible for eel in Latvia EMU lakes and rivers. Different construction trap-nets (mesh size 18–30 mm) and fykenets (or eelpout pots) and longlines are gear with eel bycatch.

Table 5. Number of EEL GEAR in operation in Latvian EMU.

FISHERIES/GEAR	2008	2009	2010	TIME-SERIES FROM
Coastal				
Eel tarpnets	14	14	14	1992
Fykenets	776	776	849	1992
Longlines (in number of hooks)	43 500	43 500	52 750	1992
Inland waters[1]				
Eel traps <30m	68	68	68	1992

Number of records in logbooks are available for period of 1992 till now. These records means how many times in month fishers checked the gear/gears, but those records are not the same as “days in fishing”.

LV.5.1 Glass eel–no fishing

LV.5.2 Yellow eel–mixed with silver eel

LV.5.3 Silver eel–mixed with yellow eel

LV.5.4 Marine fishery–no fishing

LV.6 Catches and landings

Fisheries legislation in Latvia obligates fishers to fulfil the fisheries logbook in format specified in: noteikumos. monthly logbooks by fishing day report (report would be 0 too if no fish). Type of gear, number of days in fishing between gear checking are, landing, date of fishing are obligate records.

Present fisheries data collecting system was established in 2003. Sea and coastal fishing data expressed as landings are collected by regional Marine and Inland Waters Administration (MIWA) officials. Sea fisheries data input carried out by this institution. Coastal and inland fisheries logbooks are collected by MIWA and delivered to research institution (previous LatFRA, now- Fish resources research department of BIOR). Coastal fisheries data are the part of ICIS database (Integrated Control and Information System) where sea and coastal fisheries logbooks, landing declarations and first sales notes are stored together with fishing vessels Register data.

There are no official inland fishing database in Latvia. All logbooks data, biological sampling data, historical information on catches and monitoring data collected and stored in BIOR Inland waters laboratory.

Table 6. Time-series of eel landings available.

Fisheries/waterbodies/eel stage	Landings	Gear	Effort
Coastal/coastal/mixed	Since 1924, except 1939–1945	From 1992	From 1992
Inland/EMU/mixed	Since 1945–1946	From 1992	From 1992
Inland/Lakes restocked/mixed[1]	Since 1945–1946	From 1992	From 1992

1 if the eel fisheries in lake operate by weir in outlet and fykes in the lake, separate silver and yellow eel landings are available

No reduction of gear in coastal and EMU lakes fishing due to very low share of eel in mixed fishing.

Legislation regulating data registration, etc. described in Section LV.3.

LV.6.1 Glass eel–no fishing

LV.6.2 Yellow eel–mixed with silver eel

LV.6.3 Silver eel–mixed with yellow eel

LV.6.4 Marine fishery–no marine eel fisheries in Latvia

LV.7 Catch per unit of effort

Possible calculate from ICES data (see in Section 6). Data of landings (weight) per gear night or per gear checking available for period from 1992.

Additional estimation possible from the reports of fishers who were involved in biological sampling and commercial fisheries data reporting programmes. Number of these fishers are 5–10 persons/year, collected fishing data (landing, bycatch, discard) was not verified and compared with official landings statistics.

LV.7.1 Glass eel–no fisheries

LV.7.2 Yellow eel–mixed with silver eel

LV.7.3 Silver eel–mixed with yellow eel

LV.7.4 Marine fishery–no fisheries

LV.8 Other anthropogenic impacts

Inventory of artificial barriers by place situated and type must be finished in 2010. At present 734 artificial barriers blocked the large and small rivers of Latvia, of which 151 are HPS dams, others are old mill dams and dams used for water level regulation.

To protect the rivers or river stages important for migratory fish the Cabinet Regulations N.27. on "Rivers (river stages) where construction and renovation of HPS dams are not allowed" established in 2002. In total 126 rivers were included in this regulation.

All together 61% of Latvia's territory is not accessible for migratory fish species.

The number of small HPS dams on the rivers connecting lakes restocked by eel and Baltic sea are at least two to nine. This was concluded in Latvia EMP that silver eel escapement mortality would be high, close to 100%. Last large-scale eel restocking in Latvia carried out in 1988, the catches of silver eel in weirs decreased from year to year. Analyse of pro and cons discussed and presented for Ministry of Agriculture as paper "Recommendations for silver eel transportation and/or compensation of silver eel mortality" for further activities. Main conclusions were:

- Buy and release of silver eel from fishers is expensive;
- Amount of silver eel possible to buy in Latvia is small, not exceed 3–4 t;
- Projecting and installation of facilities to protect silver eel escapement are expensive, effectiveness is unexpected;
- Other measures to increase silver eel escapement would implemented, for example stocking of eel in lakes without migration obstacles and fisheries.

Table7. Rivers and Lakes areas accessible for eel in Latvia.

RBD	Rivers (ha)	Lakes (ha)
Daugava	3883	3071
Gauja	1401	1162
Lielupe	1255	2815
Venta	937	9054
Sum	7476	16 102

LV.9 Scientific surveys of the stock: no eel stock surveys in Latvia

LV.9.1 Recruitment surveys, glass eel

LV.9.2 Stock surveys, yellow eel

Regular river fish monitoring carried out since 1992. Till 2005 salmon and sea trout rivers monitored, later monitoring programme extended to cover by stations network all country territory.

Monitoring stations selected by 50x50 km square grid, in every of squares one river sampled in two places-rithral and potamal habitat. All together ~100 electrofishing stations carried out every ear.

Salmon monitored at permanent stations selected by habitat in three largest rivers Salaca, Gauja and Venta.

Five Natura2000 territories sampled annually 2007–2009.

Table 8. Effort in river fish monitoring.

Year	Area fished (ha)	Number of rivers sampled	Number of places sampled	Number of eel caught
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	2,74	50	119	6

LV.9.3 Silver eel

Silver eel tagging experiment carried out in Latvia in 2010. In total 700 silver eel caught in eel weir in Usmas lake outlet in April- June tagged by T- bar external tags. Eel released in the river Venta. There is no fishing by commercial gear in the river and artificial obstacles. In autumn season 300 silver eels will tagged and released up-stream from one of the river Daugava large HPS to check the mortality survival of silver eel passing turbines.

LV.10 Catch composition by age and length

In frame of Data Collection programme 100–200 eel sampled from commercial eel landings every year. There are no eel age reading specialist/s in Latvia, collected otoliths were not treated. Sampling carried out in ICES Subdivision 28.

Few samples collected from electrofishing in lakes restocked by eel.

Table 9. Eel sampled in Latvia Data Collection Programme.

YEAR	AREA	NUM OF EEL SAMPLED	FISHING SAMPLED
2006	Gulf of the Riga	47	Commercial
2007	Lake Kisezers	153	Commercial
2007	Gulf of the Riga	113	Commercial
2008	Lake Kisezers	118	Commercial
2008	Gulf of the Riga	96	Commercial
2009	Gulf of the Riga	103	Commercial
2010[3]	Lake Razna[1]	36	Electrofishing
2010	Gulf of the Riga	134	Commercial
2010[3]	Lake Usmas[2]	700	Commercial

1- Lake Razna restocked eel, outside EMU, not in DCP.

2- Lake Usmas restocked eel used for tagging, outside EMU, not in DCP.

LV.11 Other biological sampling

In standard sampling procedure body length, total weight, eye diameter, pectoral fin length and presence or absence of Anguicolla registered. Otoliths collected and stored.

LV.11.1 Length and weight and growth (DCF)–no age reading

LV.11.2 Parasites and pathogens

Only presence or absence of Anguicolla registered.

LV.11.3 Contaminants

LV.11.4 Predators

In 2009 research project on "Cormorant harm to Latvia's fisheries". Four cormorant colonies observed to examine:

- food composition;
- food length- weight composition;
- estimate of total consumed fish.

Main results of project were:

- Share of eel in cormorant diet was 0,9% by numbers and 2,5% by biomass;
- Length composition of prey: 11–13 cm modal group, largest specimens 62 cm eel, 45 cm pike;

- 50 t of fish consumed by four colonies with ~830 pairs of nesting cormorants.

LV.12 Other sampling-no other sampling of eel

Research project on silver eel tagging carried out in 2010, the targets of project is:

- collect the data on silver eel migrations from Latvia lakes;
- collect the data on recapture of silver eel in coastal fisheries;
- estimate the pro and cons to silver eel transporting.

Project results will use for preparation of «Recommendations of the best possible practices» for LV EMP implementation.

LV.13 Stock assessment

LV.13.1 Local stock assessment

No stock assessment in Latvia.

LV.13.2 International stock assessment

LV.13.2.1 Habitat

In Latvia eel MP there are two categories of waters included in EMP as present or potential eel habitat:

- Waters accessible for eel (no upstream migration obstacles);
- Priority waters for restocking (with partial upstream migration obstacles-natural (waterfall in the river Venta)) and artificial (old dams foundations, accessible for species good swimmers in high water conditions).

Table 10. Eel habitat in Latvia (km²).

Type	Lacustrine	Riverine	Coastal+transitional	Sum
Accessible	161	75	900	1136
Priority waters	197	84	900[1]	1181

LV.13.2.2 Silver eel production

LV.13.2.2.1 Historical production

Coastal waters:

The highest landings in coastal waters were 0,7 kg eel/ha;

In lakes with restocked eel 4-5 kg/ha ;

In lakes of EMU 2 kg/ha;

In rivers of EMU 1,7 kg/ha ;

B_0 , the biomass of the escapement in the pristine state. (SGIPEE);

x EMU.

LV.13.2.2.2 Current production

In coastal waters 0,1 kg/ha ;

In lakes with restocked eel 0,3 kg/ha;

In lakes of EMU 0,1 kg/ha ;

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);

x EMU.

LV.13.2.2.3 Current Escapement

B_{post} , the biomass of the escapement in the assessment year (SGIPEE)

x EMU

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

x EMU

LV.13.2.2.5 Impacts

Fisheries, hydropower, etc.

Quantify x EMU

LV.13.2.2.6 Stocking requirement eels <20 cm

2,7 million glass eel

x EMU

LV.13.2.2.7 Data quality issues

LV.14 Sampling intensity and precision

Sampling intensity is 100–200 individuals per year. One fisher- all landed eels sampled.

Table. x Average length/stdev of eel landings and research surveys.

YEAR	GOF RIGA[1]	JUGLAS EZ.[1]	KISEZERS[1]	RAZNAS EZERS[2]	USMAS EZERS[2]
2006	77.7/7.2		81,3/7.0		
2007	79.8/8.6	81.1/7.4			
2008	84.2/8.6		82.4/7.0		
2009	83.1/9.2				
2010				47.8/12.0	57.2/7.8.0

Latvia eel samples:

1 in Gulf of Riga and EMU lakes (no restocking);

2 lakes restocked by eel Usmas ezers- 1988, Raznas ezers- 1988, 2003, 2008.

LV.15 Standardisation and harmonization of methodology

Biological samples collected from trapnet fisheries in the Gulf of Riga close to the river Daugava outlet (ICES Subdivision 28). Agreement for sampling of eel was made by BIOR and fishing enterprise operating in this area. Due to low catches all landed eels were sampled. Sampling protocol includes measurements of eel body length, weight, eye diameter (vertical and horizontal), pectoral fin length, sex should be checked, otoliths collected, presence or absence of Anguilicolla recorded (yes or no).

gear-landing

Commercial landings

Fresh eel

No age reading of eel in Latvia

As in "Estimation of reproduction capacity of European eel"

Macroscopic examination

LV.15.1 Survey techniques

LV.15.2 Sampling commercial catches

LV.15.3 Sampling

LV.15.4 Age analysis

LV.15.5 Life stages

LV.15.6 Sex determinations

LV.16 Overview, conclusions and recommendations

LV.17 Literature references

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