Report on the eel stock and fishery in Belgium 2007

BE.A Authors

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BE.B Introduction

This report is written in preparation of the EIFAC/ICES Working Group on Eel meeting at Leuven (3–9 September 2008). For description of the river basins in Belgium see the 2006 Country Report Belpaire (2006).

BE.C Fishing capacity

Professional coastal and sea fisheries

Following a global European downward tendency, the Belgian fleet consisted in 2005 of in all 121 motorized vessels, with a power of 65 643 and a gross registered tonnage of 22 694. 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) (EC, 2006). The fleet consists mostly of beam trawlers, the remainder being otter trawlers. There are data available on fishing effort.

Estuarine fisheries on the Scheldt

Fishing capacity has decreased last 5 five years. 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 recently boat fishing has been prohibited, and only fyke fishing is permitted. The number of licensed fishers decreased from 17 in 1999 to nine licenses in the last three years. See Figure BE.1 for a time-series between 1992 and 2008. A license allows a fisher to use a maximum of five fykenets, which means that at most 45 legal fykenets are used in the estuary.

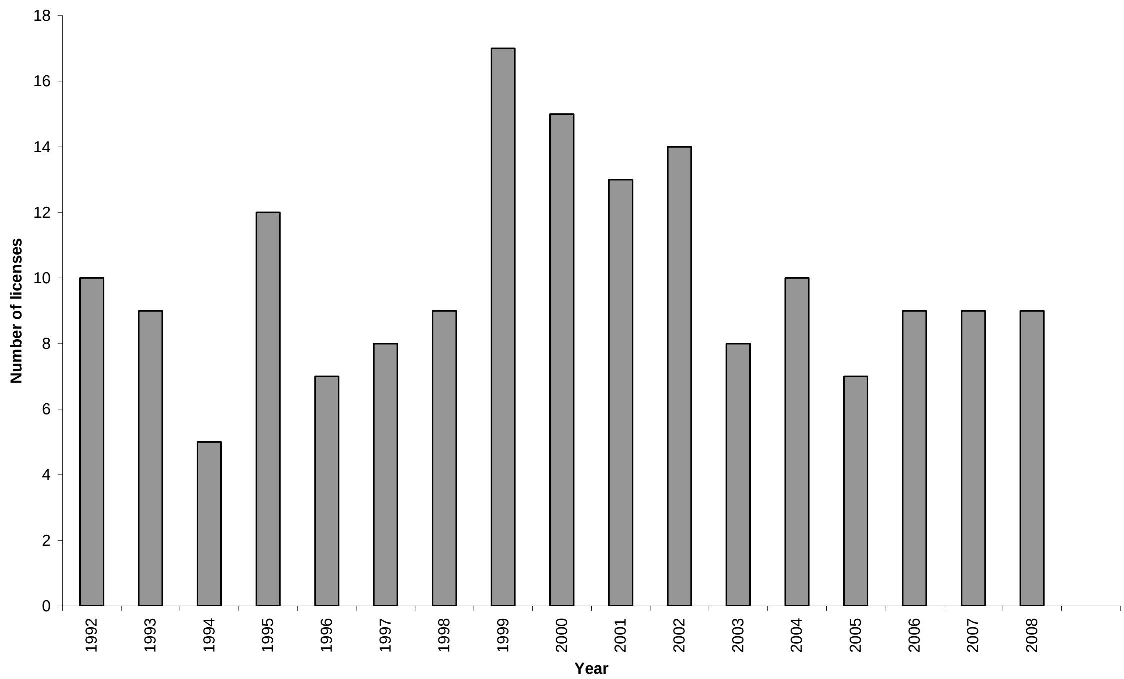

Figure BE.1 Time series of the number of licensed semi professional fishers on the Scheldt from 1992 to 2008 (Data Section Forest and Green, AMINAL).

Recreational fisheries in the Flemish Region

The number of licensed anglers was 60 520 in 2004, 58 347 in 2005, 56 789 in 2006 and 61 043 in 2007. The time-series demonstrates a general decreasing trend from 1983 (Figure BE.2). However in 2007 there was again an increase in the number of Flemish anglers (+7.5% compared to 2006). From an inquiry among anglers it was estimated that ca. 8% were eel fishers (Vandecruys, 2004).

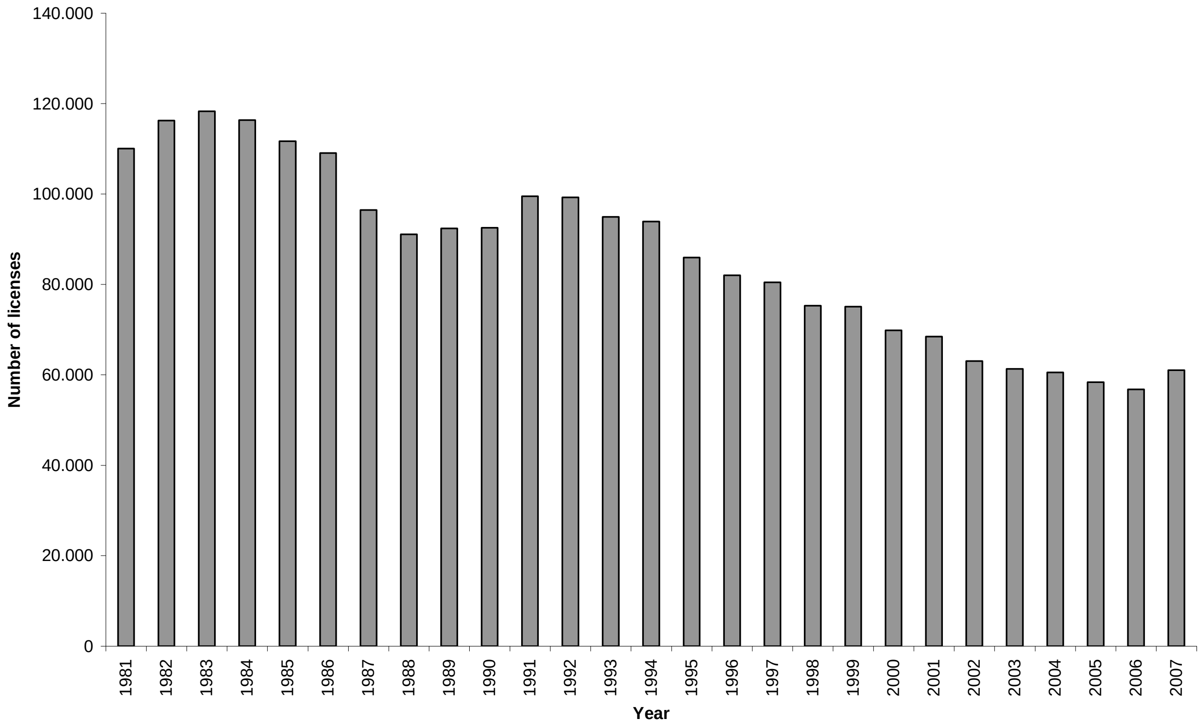

Figure BE.2 Time series of the number of licensed anglers in Flanders since 1980 (Data Agency for Nature and Forests).

Recreational fisheries in the Walloon Region

Although in constant decline since the nineties, fishers are still a well represented community in the Walloon region. The number of licensed anglers was 65 687 in 2004, 63 145 in 2005, 59 490 in 2006. For the year 2007, 60 404 fishing licenses were attributed for fishing activity in rivers, ponds and lakes (Figure BE.3). As in Flanders, the decreasing trend in the numbers of anglers seems to stop; there was a (slight) increase compared to 2006 (+1.5%). According to estimations given by the Nature and Forestry Division (DNF) of the Walloon Environment and Natural Resources DG (DGRNE), approximately 50 000 persons exercise fishing activity in private waters and closed ponds dedicated to recreational angling.

Figure BE.3. Number of fishing licences issued in the Walloon region since 1995 (Source MRW-DGRNE-DNF)

Recreational fisheries in the Brussels-Capital

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

In total, there are approximately 123 000 licensed recreational fishers in Belgium for 2007, which is an increase of ca. 4% compared to 2006. It was not possible to split out this information per RBD; however this is feasible as databases exist concerning the localities where licenses were emitted.

BE.D Fishing effort

No specific data. See also under Section BE.C.

BE.E Catches and landings, restocking and aquaculture

Catches and landings-Professional coastal and sea fisheries

Professional coastal and sea fisheries are of minor relevance with respect to eel catches as this fisheries is targeted on sole, plaice, turbot and cod, and bycatch of eels is of minor importance. Eel catches are small and unpredictable. Usually these eels are sold directly on the quay. Only exceptionally, eels are presented for selling in the fish market and reported in these statistics.

Catches and landings-Estuarine fisheries on river Scheld

No official landing statistics for the fyke fisheries are available. Last year's report estimated on the basis of some fishers' logbooks and on the basis of cpue data on scientific monitoring, the total landings of eels by fyke fishers roughly at five tonnes per year around 2000. New data were available from a volunteer network (unpublished data; data collected in the framework of a study about diadromous fish in the Scheldt estuary, funded by the mobility and public works department, maritime access division). In 2007, a volunteer network was started to monitor the fish community in the Scheldt estuary using fykenets. Volunteers were asked to regularly control a fykenet that is deployed at the low-tide level. Fish are identified, counted and measured. Based on the results of two sampling stations in the Lower-Zeescheldt in 2007 (see for locations Figure BE.4), the impact of fykenetting on the eel population can be estimated for the estuary. Figure BE.5 gives an overview of the temporal trends in the eel catches (weight and number) from the two locations in the Lower-Zeescheldt. The fykenet at Kennedytunnel (KT) was checked daily, the fykenet at Liefkenshoektunnel (LhT) once every two days. If assumed that eel are caught between 1 March and 15 November and the fykes are emptied daily, a fisher can catch between 62 kg (Liefkenshoektunnel) and 277 kg (Kennedytunnel) eel per year per fyke. Extrapolated to 45 licensed fykenets in the Zeescheldt, this results in a total annual catch of 2.8 to 12.4 tons of eel. The assumption that the fykenets are continuously used throughout the fishing season and emptied daily is an overestimation. Based on a fishing effort of 2 days a week, the total catch fluctuates between 3.8 and 0.4 tons of eel per year. The preliminary results for 2008 suggest that the total catch of eel is about 50% lower that in 2007.

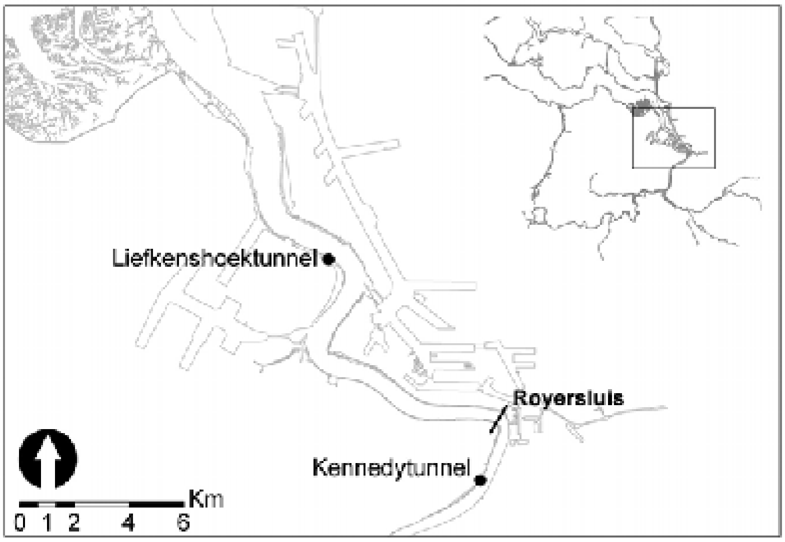

Figure BE.4 Locations in the Zeescheldt that are monitored in the framework of the volunteer network. Licensed fishers are only allowed to deploy fykenets downstream of the Royersluis.

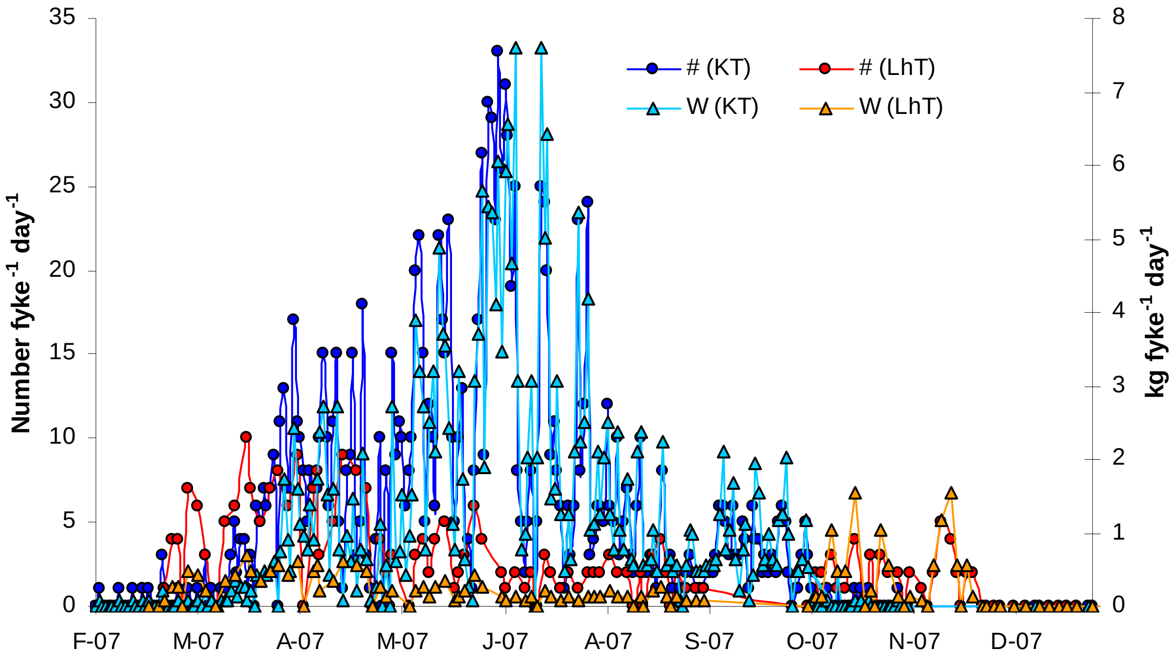

Figure BE.5 Number (left axis) and weight (kg; right axis) of eel per day per fykenet at the locations near Liefkenshoektunnel (LhT) and Kennedytunnel (KT) in 2007.

Catches and landings-Recreational fisheries

Recreational catches of eels are not recorded; data exist on number of licenses per region, and results of inquiries.

As will be clear from the information below there is a big gap in knowledge concerning the recording of eel landings from recreational fisheries in Belgium. Data available are only rough estimates.

Recreational fisheries in the Flemish Region

We repeat here the information of last year's report.

There are no official data on the catches of eels. A recent estimate of the total amount of fish (all species) taken from Flemish waters by recreational anglers was 431 tonnes. 28% or 121 tonnes of the total number of extracted fish are eels (De Vocht and De Pauw, 2005). However, the catches and the number of extracted eels have been considerably influenced by a catch and release obligation for eels. This law was brought out as a result of the high PCB levels measured in most Flemish eels.

Another estimate can be deduced from data from Bilau *et al.*, 2007. In 2003, 61 245 individuals in Flanders had a fishing license for public waters. A survey on specific aspects of recreational fisheries, including the issue of taking home a catch, was carried out (Vandecruys, 2004). The survey included questions on the fish species caught and taken home as well as the number and the weight of the fish caught and taken home. A total number of 3001 of the licensed anglers (out of 9492 contacted) completed a questionnaire about recreational fishing. Respectively 1.9% and 5.3% of these anglers indicated that they "always" (group A) or "sometimes" (on average: 1 out of 5 eels caught) (group B) take home the eel they have caught. Based on extrapolation to all licensed fishers, the number of people taking home the eel, caught in Flemish public waters is estimated to be 4429 (7.2% of licensed anglers). Considering the catch and release obligation for eels in all public waters in Flanders, this is a large proportion, and an underestimate of the situation where all eels may legally taken home.

Based on the number of fishing occasions (average of 41.67 and 42.03 trips/year, respectively for group A and B), the number of eels caught per occasion (average of 4.14 and 3.12, respectively for group A and B) and a mean weight of edible portion per eel (150 g), it has been calculated that individuals in group A take home on average 25.9 kg of edible eel per year or a mean of 498 g week^{-1}. For group B it was calculated to be 3.9 kg per year or 76 g week^{-1} (Bilau *et al*., 2007). The total estimate for Flanders is thus 43 tonnes of eels per annum, which is approximately one third of the estimate by De Vocht and De Bruyn, 2005 (Table BE.1).

Table BE.1 Rough estimate of the catch (in kg) of recreational fisheries in Belgium.

Country		drainage area km2		Estimate for the 1.9% or 1164 anglers each taking 25.9 kg eel per annum	Estimate for the 5.3 % or 3246 anglers each taking 3.9 kg per annum	Total estimate	
BE	Flanders	13.521		30148	12659	42807	
	Wallonia	16.845		no data	no data	no data	
	Brussels	162		no data	no data	no data	
BE	sum	30.528					

Recreational fisheries in the Walloon Region

Although eel has traditionally been caught by anglers in the Walloon region, mainly in the Meuse, but also in the lower and middle Ourthe and the Semois, there are no official estimates about the catches of eels in the Walloon region. Precise quantitative figures of fishing catches are thus lacking.

However, in 2002, a survey by the Federation of Anglers in Wallonia estimated that 60% of the anglers considered the eel as a valuable species, 34% of the anglers specifically fished for eels, and 8% never did. In 63% of the fishing efforts, the eels were kept for human consumption.

This survey demonstrated that 41% of the anglers still considered, at that time, that eels were commonly caught. More then half the anglers catch them and the others rarely. In 61% of the fishing occasions one eel is caught, in 26% of the cases two are caught, in 11% of the cases 3 eels are caught. In 1% of the fishing occasions more then 3 eels are caught. 63% of the eels are eaten. (Data from an inquiry from the Federation of Anglers in Wallonia).

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 now 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.

Stocking

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, as a consequence of 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 BE.5). Glass eel restocking will be proposed as a future management measure in the EMP for Flanders.

In recent years the glass eel restocking could not be done each year as a consequence of the high market prices. Only in 2003 and 2006 respectively 108 and 110 kg of glass eel was stocked in Flanders (Figure BE.5 and Table BE.2). In 2008 117 kg of glass eel from UK origin (rivers Parrett, Taw and Severn) was stocked in Flemish water bodies.

Table BE.2 Re-stocking of glass eel in Belgium (Flanders) since 1994, in kg of glass eel.

Decade			
Year	**1980**	**1990**	**2000**
0			0
1			54
2			0
3			108
4		175	0
5		157,5	0
6		169	110
7		144	0
8		0	117
9		251,5	

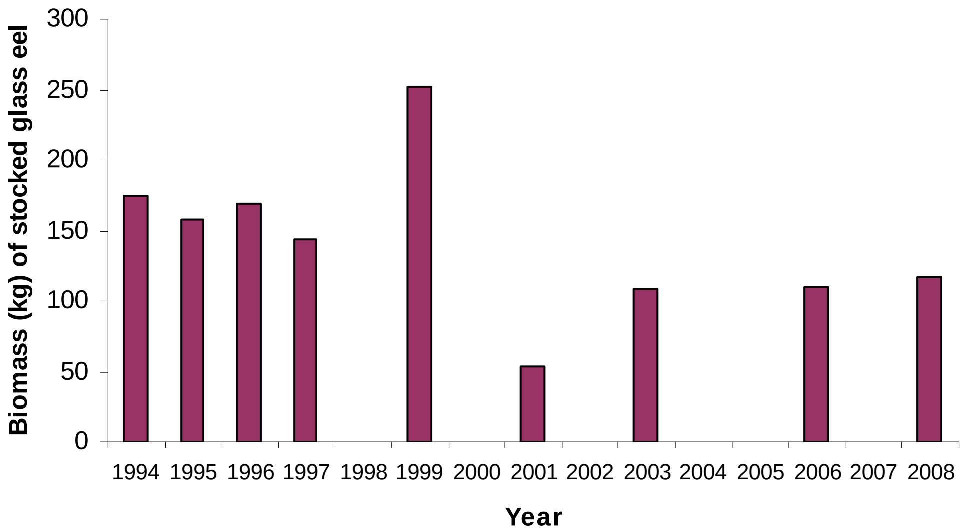

Figure BE.6. Re-stocking of glass eel in Belgium (Flanders) since 1994, in kg of glass eel.

Stocking in Wallonia

Restocking data for yellow eel were made available by the Service de la Pêche of the Walloon Region. Restocked eels were yellow eels from length classes <15 cm (not glass eel), 15–25 cm and >30 cm (Figure BE.7 and Table BE.3).

Where during the period 2000–2005 restocked biomass over Walloon Rivers, lakes and canals fluctuated between 100 and 500 kg, no eel restocking was performed in 2006 or in 2007 in the Walloon region.

Table BE.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
0			535
1			355
2			105
3			101
4			311
5			324
6			0
7			0
8			
9		1268	

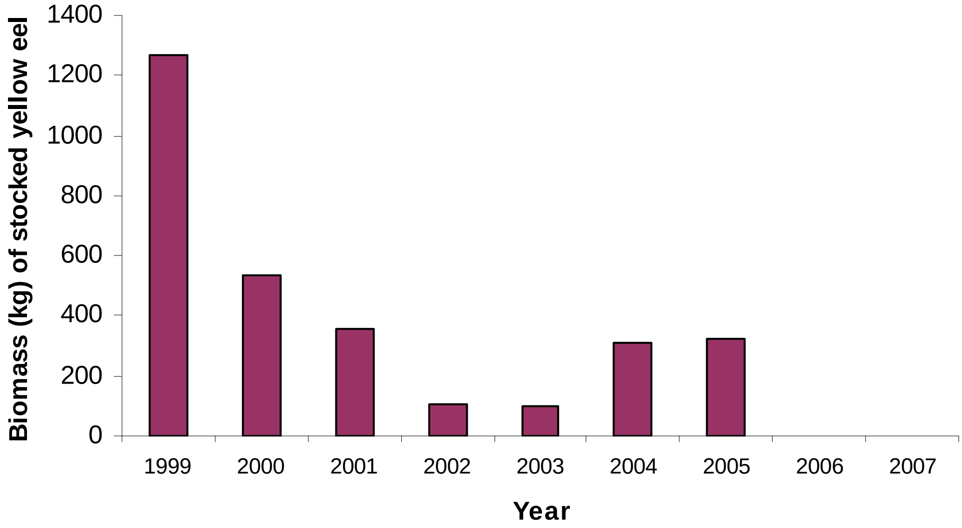

Figure BE.7. Restocking of yellow eel in Belgium (Walloon region) over the period 1999 to 2007, in kg of yellow eel. For 2000 and 2001 data were provided as partly biomass and partly numbers. In this case total restocked biomass was calculated using an expected mean weight of 10 g for eels <15 cm, of 20 g for eels 15–25 cm and 100 g for eels >30 cm. (Data Service de la Pêche, Walloon Region).

Stocking has also been performed by recreational fisheries. Below is reported stocking information provided by federations of recreational fisheries societies in the Walloon region.

Year	Fishing Society	Stocking location	Stocking quantity
1961	Commission piscicole provinciale du Hainaut	Dendre downstream Deux-Acren	100.000 glass eels from Holland
1967	Fédération des Sociétés de Pêche et de Pisciculture du Centre	Canal Charleroi-Bruxelles	380kg (approx 25 eels/kg)
1967	Union des Pêcheurs des Bassins de l'Escaut et de l'Yser	Canal de Willebroek	100kg (20/30 units per kg)
		Canal Charleroi-Brussels-Hal	300kg (20/30 units per kg)
		Canal Charleroi-Hal-Faucquez	200kg (20/30 units per kg)
		Canal Leuven-Malines	500kg (20/30 units per kg)
1974	Ligue des Pêcheurs de l'Est	Lac de Butgenbach	80.000 glass eels
1976	Fédération des Pêcheurs du Brabant	Canal Charleroi-Brussels-Hal	?
1978	Commission piscicole provinciale du Brabant	?	50kg of glass eels from Yser estuary
1986	Amicale des Pêcheurs de la Haute Meuse Liègeoise	Meuse	
		Ile de Bas-Oha (Meuse)	2.250 glass eels
		Spawning ground Ampsin (Meuse)	2.250 glass eels
		Darse (Meuse)	2.250 glass eels
		Engis (Meuse)	2.250 glass eels
1986	Amicale des Pêcheurs du Brabant	Ruisbroek-Lembeek	Glass eels from Nieuwpoort
1987	Fédération des Sociétés de Pêche et de Pisciculture du Centre	Old Canal Charleroi-Brussels	300kg of eels (20/30 units per kg)
1988	Fédération des Sociétés de Pêche et de Pisciculture du Centre	Old Canal Charleroi-Brussels	300kg of eels (20/30 units per kg)
1991	Fédération Royale des Sociétés de Pêche et de Pisciculture du Centre	Old Canal Charleroi-Brussels	313kg of eels (20/30 units per kg)
1991	Amicale des Pêcheurs du Brabant	Canal of Charleroi (between Ruisbroek and Hal)	150kg of “small eels”
1992	Fédération Royale des Sociétés de Pêche et de Pisciculture du Centre	Old Canal Charleroi-Brussels	314kg of (20/30cm eels)

YEAR	FISHING SOCIETY	STOCKING LOCATION	STOCKING QUANTITY
1993	Fédération Royale des Sociétés de Pêche et de Pisciculture du Centre	Old Canal Charleroi-Brussels	275kg of (20/30cm eels)
1996	Amicale des Pêcheurs du Brabant	Canal of Charleroi (Brussels)	« Small eels » no qtty info
1998	Amicale des Pêcheurs du Brabant	Canal of Charleroi-Leeuw-St-Pierre-Lembeek	100kg no stage info
1999	Amicale des Pêcheurs du Brabant	Canal of Charleroi	2kg glass eels
2000	Amicale des Pêcheurs du Brabant	Canal of Charleroi (between Ruisbroek and Hal)	2kg glass eels
2001	Amicale des Pêcheurs du Brabant	Canal of Charleroi (between Ruisbroek and Hal)	2kg glass eels
2003	Amicale des Pêcheurs du Brabant	Wachte Beek de Leeuw-St-Pierre	Glass eels (no qtty info)

Data collected from the official publication of Federation Sportive des Pêcheurs Francophones de Belgique.

Other stocking data-from telephonic survey of other Federations. Not presented as table because of data heterogeneity. (Period 1971 to 2002.)

Schelde RBD

Sambre: stocking of 82 kg of eels measuring 20/30 cm in 1993 between lac du Ry Jaune and lac de Féronval.

Upper Escaut: no stocking reported.

Petite* and *Grande Gette: no stocking reported.

Haine* and *Trouille: no stocking reported.

Meuse RBD

Meuse: main stocking operations downstream of Pont de Wandre (to a lesser extent Berwinne downstream Val Dieu).

1971 to 1974-40 000 glass eels per year.

1978-67 500 glass eels per year.

1979 and 1980 -20 kg glass eels per year.

End of stocking since 1981.

Semois

1966: more than 100 000 glass eels from Oostende stocked in Alle-sur-Semois.

1988: stocking of unknown quantity (info on price 330 Belgian francs/kg).

1992: 20 kg of 30 cm yellow eels in Alle-Sur Semois (from pisciculture Dos Santos).

1993: 20 kg in Alle-Sur Semois.

1994 and 1995: 30 kg in Alle-Sur Semois.

1996–2000: no stocking.

2001: 20,7 kg (896 individuals stocked in Alle-484 individuals stocked in Bohan) (from PibaS.A-indicative price was 19 Belgian francs).

2002: 23 kg (eels of 20 cm length).

Aquaculture

Actual eel production through aquaculture in Belgium is zero.

Flanders

Although around 2000, two farms for intensive production of eels in recirculation systems were operating for a total production of 125 tonnes per annum (Belpaire and Gerard, 1994), eel culture has stopped completely around 2004.

Wallonia

The only eel farming society (Pi.B.A. S.A.) in the Walloon region started its activities in 2000 and ceased in 2005. No feedback was obtained from the owner or controlling authorities as to the activities and results of this society.

BE.F Catch per unit of effort

We repeat here the information of last year's country report.

There are some data on the catch per unit of effort for the estuarine fyke fisheries on the Scheldt. These cpue data were collected from scientific monitoring. The cpue is strongly influenced by temporal and regional variation. Figure BE.8 gives the trend in cpue of estuarine fyke fishing from 1995 to 2007 in the Scheldt estuary. Additional data of other sampling stations along the estuary are available.

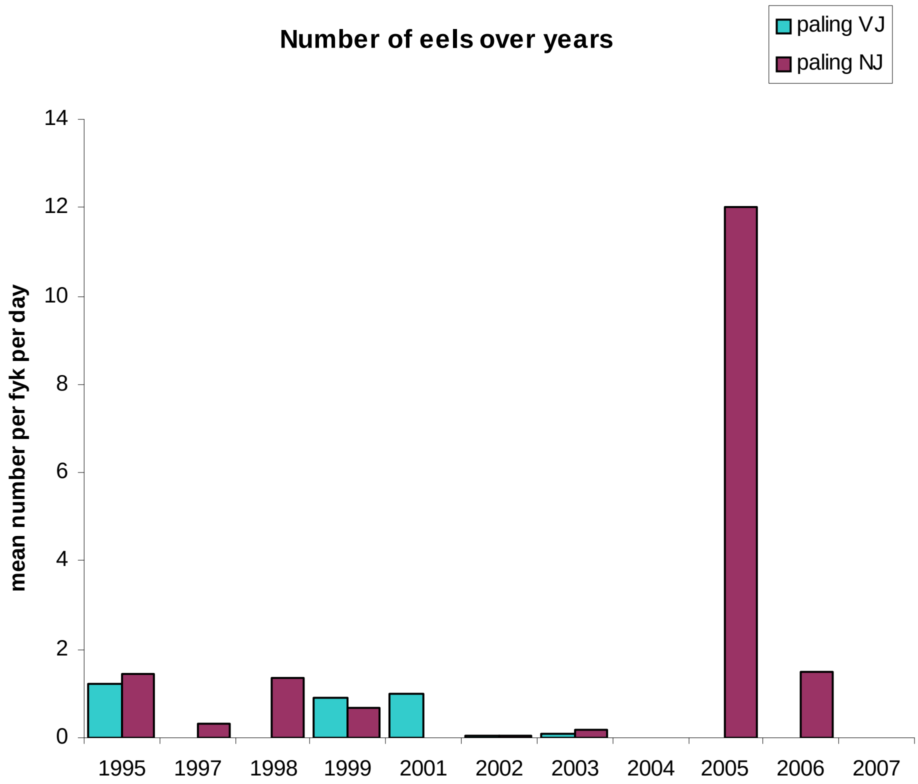

Figure BE.8 Mean number of eel per day per fyke from 1995 to 2007 in the Scheldt estuary at Zandvliet (Cuveliers *et al.*, 2007).

Additional recent information about catches per unit of effort has been provided under "5-Catches and landings, Estuarine fisheries on the river Scheldt" (see Figure BE.5 for fluctuations of eels per fyke per day through the fishing season).

BE.G Scientific surveys of the stock

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

Fisheries on glass eel are carried out by the Flemish government. The glass eels are used exclusively for restocking in inland waters in Flanders. In Belgium, commercial glass eel fisheries are forbidden by law.

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 BE.7 and Table BE.3 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 2008.

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

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

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

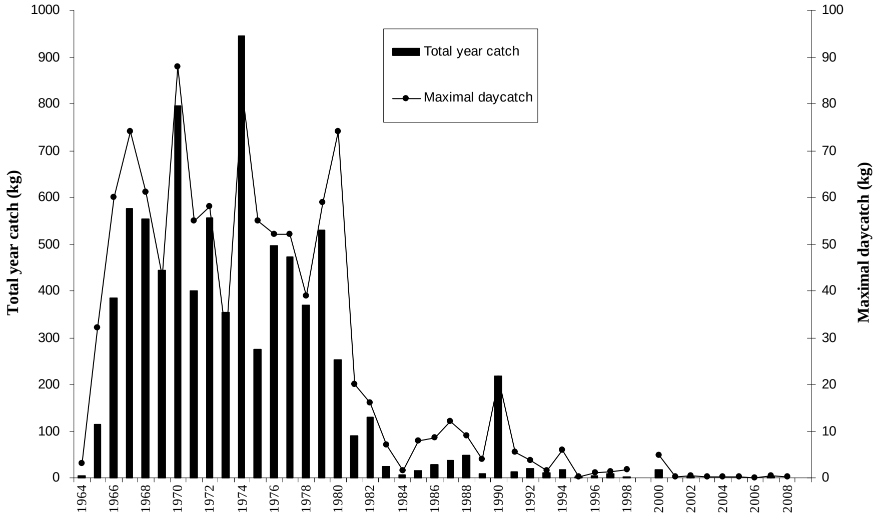

Figure BE.9 Annual variation in glass eel catches at river Yser using the dipnet catches in the ship lock at Nieuwpoort (total year catches and maximum day catch per season). Data Provincial Fisheries Commission West-Vlaanderen.

Table BE.4 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 BE.4 the presented data are the total year catches. Data Provincial Fisheries Commission West-Vlaanderen.

Decade					
Year	1960	1970	1980	1990	2000
0		795	252	218,2	17,85
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		

Other glass eel recruitment studies

From April to July 2007 the immigration of glass eels in the Scheldt estuary was studied using artificial substrates as described by Silberschneider, 2001-(unpublished data; data collected in the framework of a study about diadromous fish in the Scheldt estuary, funded by the mobility and public works department, maritime access division). Substrates were deployed at the outlet of sewage treatment plants and drainage systems in the Zeescheldt and tributaries (Rupel, Lower Nete and Kleine Nete) and were checked once every two days for glass eels. Figure BE.10 gives an overview of the relative number of glass eels that were caught at each of the locations. Numbers were generally very low (on average 1 or 2 glass eels per substrate per day). Probably, glass eel densities in the Scheldt estuary were too low for an optimal use of the substrate method. In addition, catches in 2007 from a permanent sampling station more upstream in the Zeescheldt suggest that the glass eel recruitment was very low in 2007. At this station, glass eels are caught by a volunteer at the effluent of a sewage treatment plant. The glass eels hide under stones in the effluent canal, where they are caught with a small hand net. Data that were collected in this way are available since 2004.

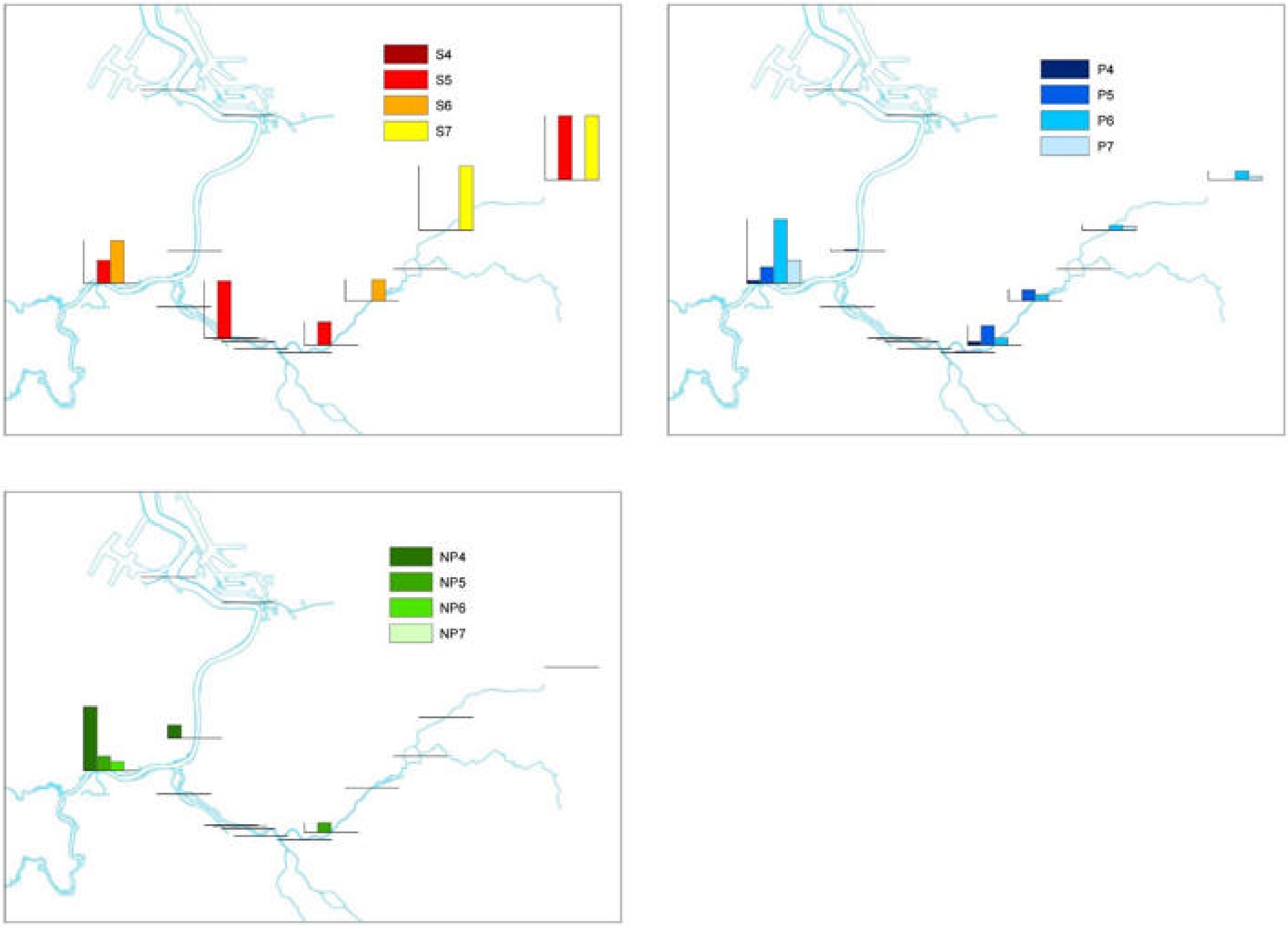

Figure BE.10 Relative number of glass eels caught in artificial substrates in 2008. NP = Not pigmented; P = Pigmented and S = newly metamorphosed eels. The color of the bars represents the month (4 = April to 7 = July).

The results from the hand net sampling at the sewage treatment plant were compared to the results from the glass eel catches in the River Yser (unpublished data; data kindly provided by the Agency of Nature and Forest, fisheries commission West-Vlaanderen). In Figure BE.11 the daily total catches (number day^{-1}) in the Yser (IJ) and the Zeescheldt (ZS) from the last 5 years are compared. Both stations are about 195 km apart. The graph demonstrates that the peak of the glass eel recruitment in the Zeescheldt (half May) occurs approximately 50 days after the peak in the Yser (end of March). In addition, Figure BE.12 shows that the average yearly catches at both stations are quite well synchronized: 2005 and 2007 were 'good' years for glass eel catches, whereas 2006 and 2008 were 'bad' years.

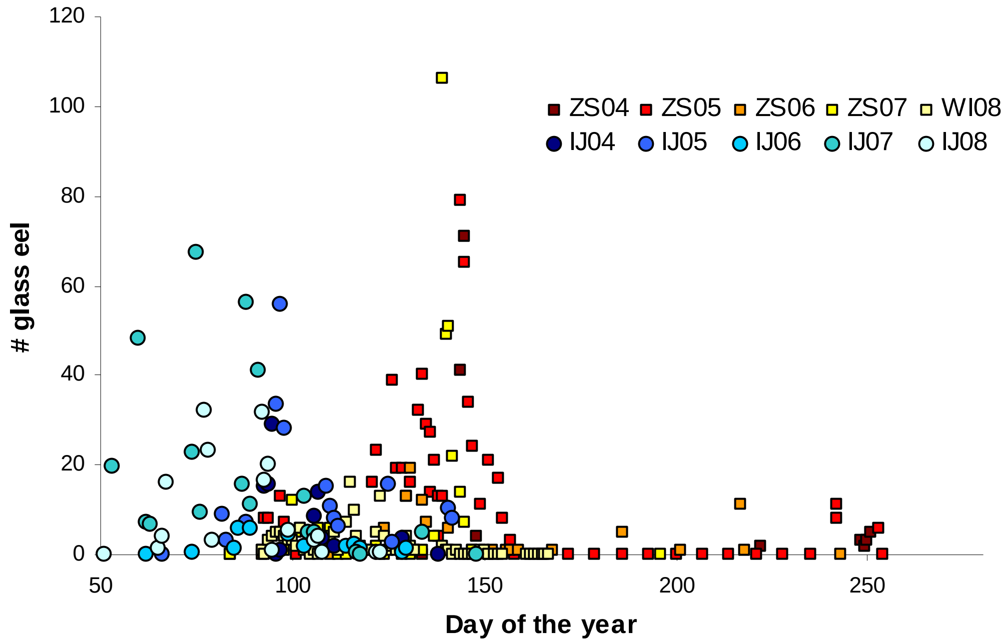

Figure BE.11 Number of glass eels caught per day at the sampling stations in the Yser (IJ) and in the Zeescheldt (ZS) between 2004 and 2008. A different sampling method was used in both stations. In the Zeescheldt glass eels were caught with a hand net, in the Yser using a dipnet.

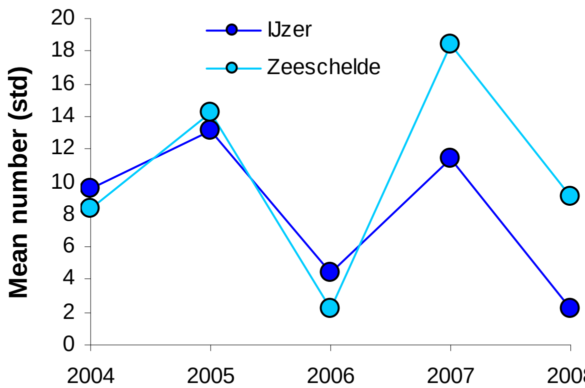

Figure BE.12. Average number of glass eels caught at the sampling stations in the Yser and the Zeescheldt.

BE.G.1 Eel impingement at the power station at Doel on the Lower Scheldt (Scheldt basin)

The Catholic University of Leuven is 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 BE.13.

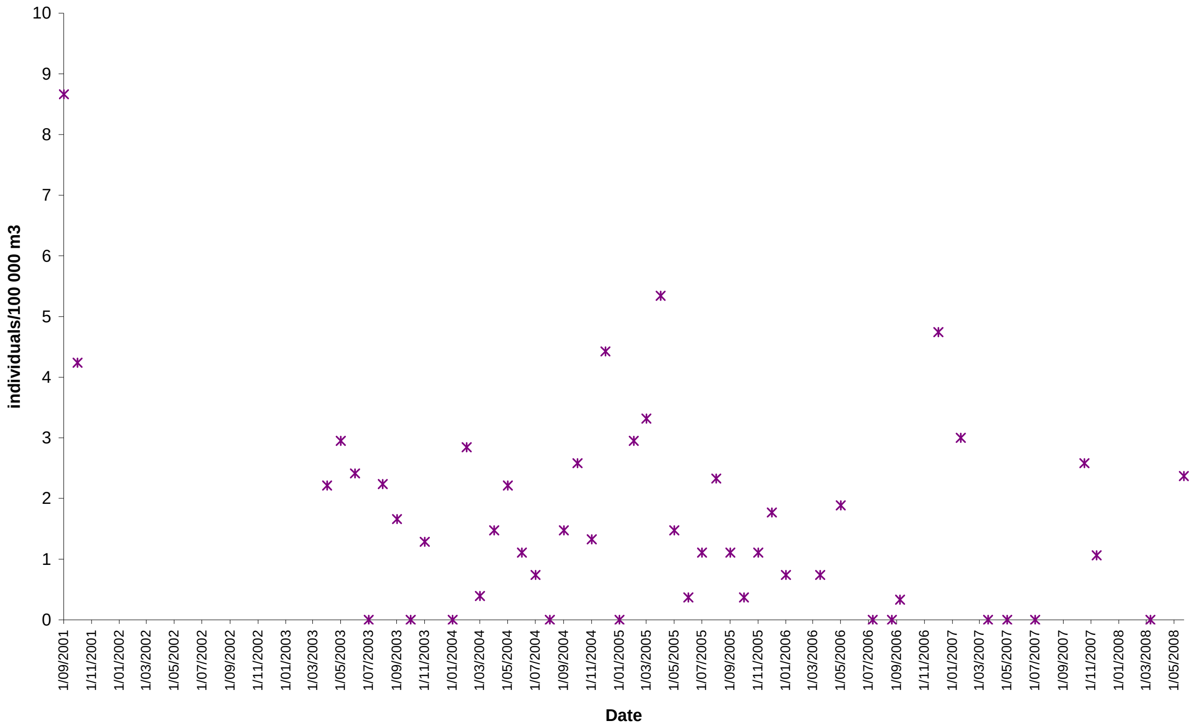

Figure BE.13 Annual and seasonal variation in the number of impinged eels at the power station of Doel (Lower Scheldt, nearby Antwerp). Numbers are expressed as individuals impinged per 100 000 m³ water. Data Katholieke Universiteit Leuven, Laboratory of Animal Diversity and Systematics.

BE.G.2 Silver eel migration study on the river Meuse

Downstream migration of female European silver eel *Anguilla anguilla* was studied in the River Meuse using NEDAP TRAIL® detection stations. Detection stations are distributed on the lower part of the Meuse along the migration route. Female silver eels (N= 31) were captured at different locations in and out of the River Meuse basin, tagged with TRAIL® transponders and translocated in 2007 to the River Berwijn, a small Belgian tributary of the River Meuse, 326 km from the North Sea. From August 2007 till April 2008 13 of the eels (42%) were detected at two or more stations and were supposed to have started their downstream migration. Only two eels (15%) arrived at the North Sea, the others being held up or killed at power stations, caught by fishers or stopped their migration and settled in the river delta. A majority of the eels (58%) did not start their migration and could be located by manual tracking. It was recommended to incorporate protocols to evaluate the proportion of these non-migrants within studies assessing migration success of silver eels. (Verbiest *et al.*, submitted).

BE.G.3 Eel surveys in the Walloon region (Meuse basin)

At the Walloon region scale, the European eel demonstrates recent demographic degradation in the Meuse river basin where the species could still be encountered with fair abundance. Other basins have faced eel stock depletion for a long time because of multiple factors including (**1**) pollution (Scheldt, Sambre), (**2**) obstacles caused by dams (basins of the Chiers, the Semois and the Viroin, upstream Nisramont dam oriental and occidental Ourthe, and the Amblève upstream Coo) and (**3**) the suspension since 1980 of restocking with wild glass eels (from the Yser), yellow, or silver eels obtained from the wild and farmed before release.

On the Meuse, the University of Liège is monitoring the amount of ascending young eels in a fish-pass. From 1992 to 2008 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.*, 2004; Philippart and Rimbaud, 2005) (Figure BE.14).

The data for 2005 and 2006 were low: respectively 758 and 559 (Philippart, 2006), whereas 661 eels were caught in 2007 (Philippart, pers. comm.). Only partial data are available for 2008 (until 31/07): 2567 eels were caught. 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 allowed passage of eels situated downwards the sluice. But we can not rule out that recruitment of elvers increased (Philippart, pers. comm.).

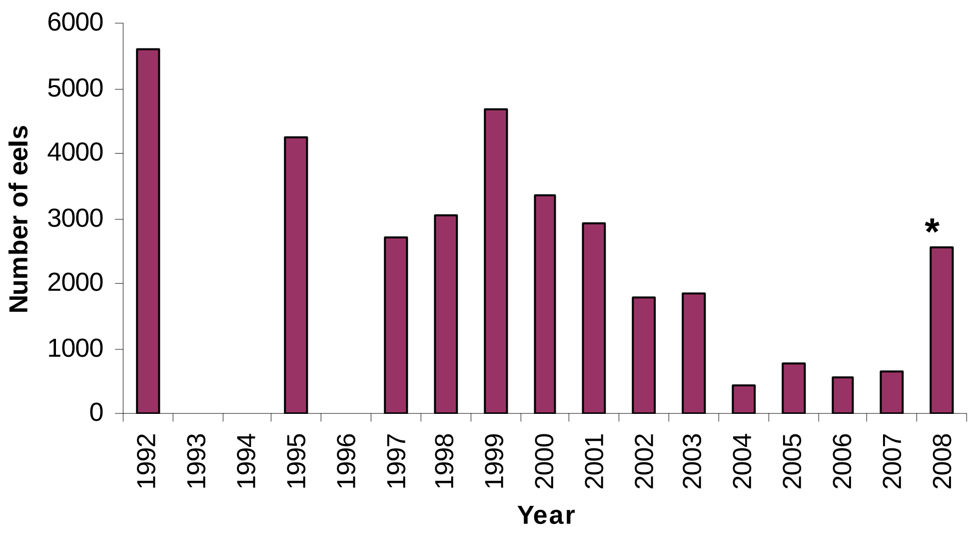

Figure BE.14 Variation in the number of ascending young yellow eels trapped at the fish trap of the Visé-Lixhe dam. Data from University of Liège (J.C. Philippart) in Philippart and Rimbaud, 2005; Philippart, 2006; Philippart, pers. comm. * Data incomplete, catches until 31/07/08.

Scientific samplings of resident eels (counts from the Méhaigne, in Hosdent, from 1985 to 2005; Figure BE.15) and migrating eels (upstream migrating in the Meuse at the Lixhe dam, from 1992 to 2006) demonstrate a clear and critical demographic collapse. This could lead before 2010 to the disruption of recruitment of young individuals at the gates of the Mosan basin in Wallonia, straightly leading for decades to a drastic reduction in continental populations, and eventually, to their extinction within twenty years. No recent data from the Méhaigne were available yet for 2008.

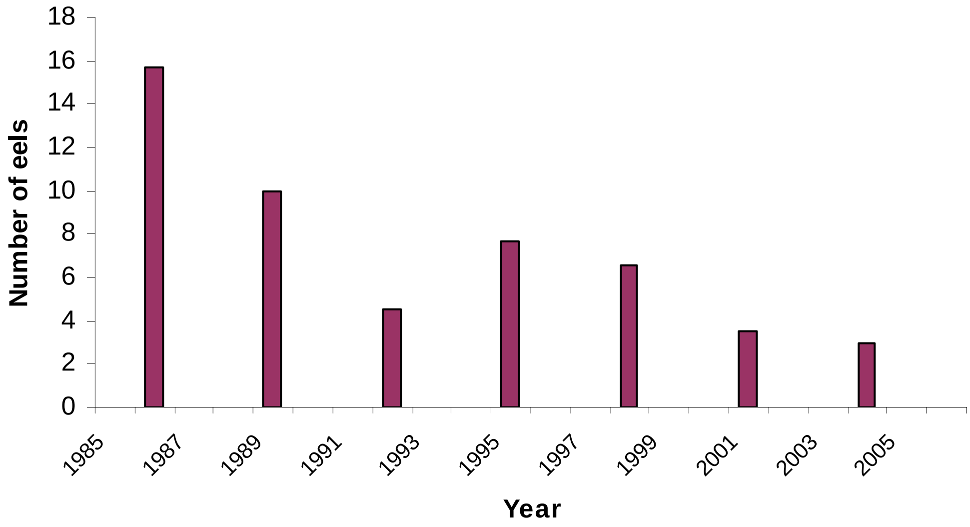

Figure BE.15 Number (x 100) of resident eels sampled by electric fishing in the Méhaigne in Hosdent-Latinne between 1985 and 2005 (Phillipart, 2006).

Table BE.5 Number of yellow eels captured swimming upstream in the fish ladder unit of the Lixhe dam between 1992 and 2006, and number (x 100) of resident eels sampled by electric fishing in the Méhaigne in Hosdent-Latinne between 1985 and 2005 (Phillipart, 2006) and Philippart, pers. comm. * 2008 Data incomplete, catches until 31/07/08.

	MEUSE	MEHAIGNE (X 100)
1985		
1986		1570
1987		
1988		
1989		1000
1990		
1991		
1992	5613	450
1993		
1994		
1995	4240	770
1996		
1997	2706	
1998	3061	660
1999	4664	
2000	3365	
2001	2915	350
2002	1790	
2003	1842	
2004	423	300
2005	758	

2006	559
2007	6619
2008	2567*

BE.H Catch composition by age and length

Age is usually not recorded in Belgium.

Flanders

An extensive database on length and weight is available at INBO, based on surveys with electrofishing and fykenetting. Many data are also available on the Internet at http://vis.milieuinfo.be/

Wallonia

An extensive database on length and weight is available at GIPPA, based on fish stock surveys in Wallonia.

BE.I Other biological sampling

BE.I.1 Length and weight and growth (DCR)

An extensive database on length and weight is available at INBO, based on surveys with electrofishing and fykenetting. Many data are also available on the Internet at http://vis.milieuinfo.be/

Figures BE.16 and BE.17 present the relationship between length and weight (log_{10}-transformed in Figure BE.17) of 11 114 eels sampled in Flanders during surveys between 1995 and 2007.

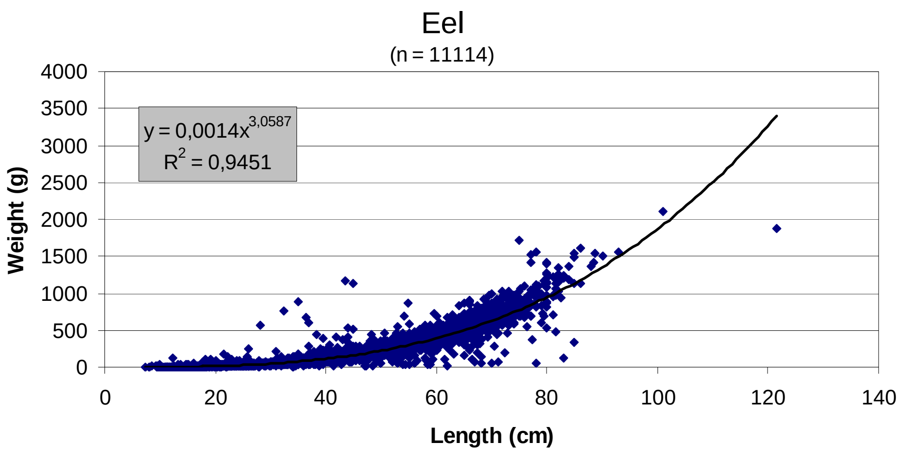

Figure BE.16 Length-weight relation for 11 114 Flemish eels (both sexes) caught between 1995 and 2007 (lengths and weights not corrected for typing/measuring errors).

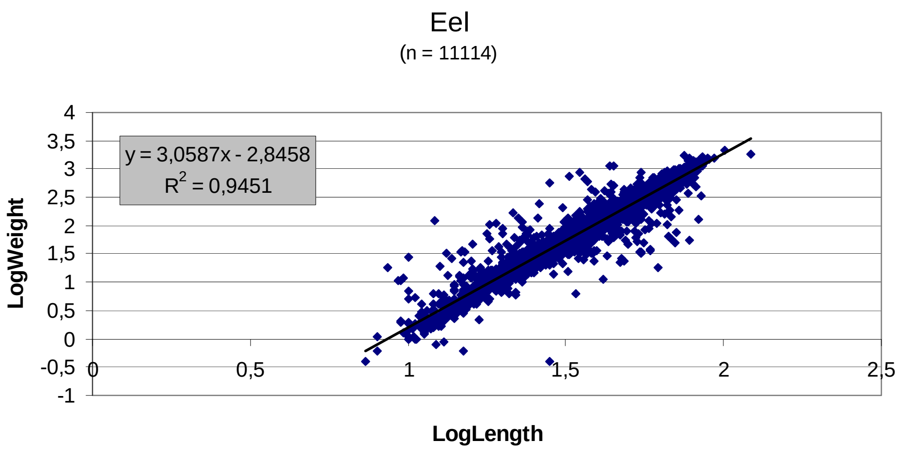

Figure BE.17 Log_{10}-transformed length-weight relation for 11 114 Flemish eels (both sexes) caught between 1995 and 2007 (lengths and weights not corrected for typing/measuring errors).

Growth is studied in a population of eels at lake Weerde, a man made lake, but is not reported yet. In Wallonia length and weight data from scientific surveys is available at GIPPA.

BE.I.2 Parasites

No new information compared to last year's report (cf. Belgian country report 2007).

BE.I.3 Contaminants

Extensive information has already been provided in the WG Eel 2006, and 2007 reports (Belpaire, 2006; Belpaire *et al.*, 2007). Recently, Belpaire, 2008 compiled an overview of research on contaminants in Flanders. We focus hereby on status and trends and on the potential role of contamination in the collapse of the stock.

BE.I.3.1 Status and trends (Belpaire, 2008)

Flanders (INBO) is operating an Eel Pollution Monitoring Network (EPMN) which allows to get a comprehensive overview of the contamination in Flemish waters (and in eels) fully covering the area of Flanders. Within this EPMN a number of contaminants in eel are analysed in a standardized way (Goemans *et al.*, 2003). Because the network is running now for 14 years, and many sites have been sampled twice or more, it becomes possible to draw trends (see last years report for trend figures). The maps and the database VIS allow now to analyse in detail the status and the trends for a specific contaminant, or a group of contaminants. They also allow detailed analysis of status and trends of contamination on a certain spatial scale (site, river, catchment, town, province, region). In VIS these trends can be viewed in reports via predefined queries on the database. Maps have been generated of contamination in eel for ca. 30 PCBs, pesticides and heavy metals (Goemans *et al.*, 2008). As an example the distribution of PCB 156 in eel is represented in Figure BE.18.

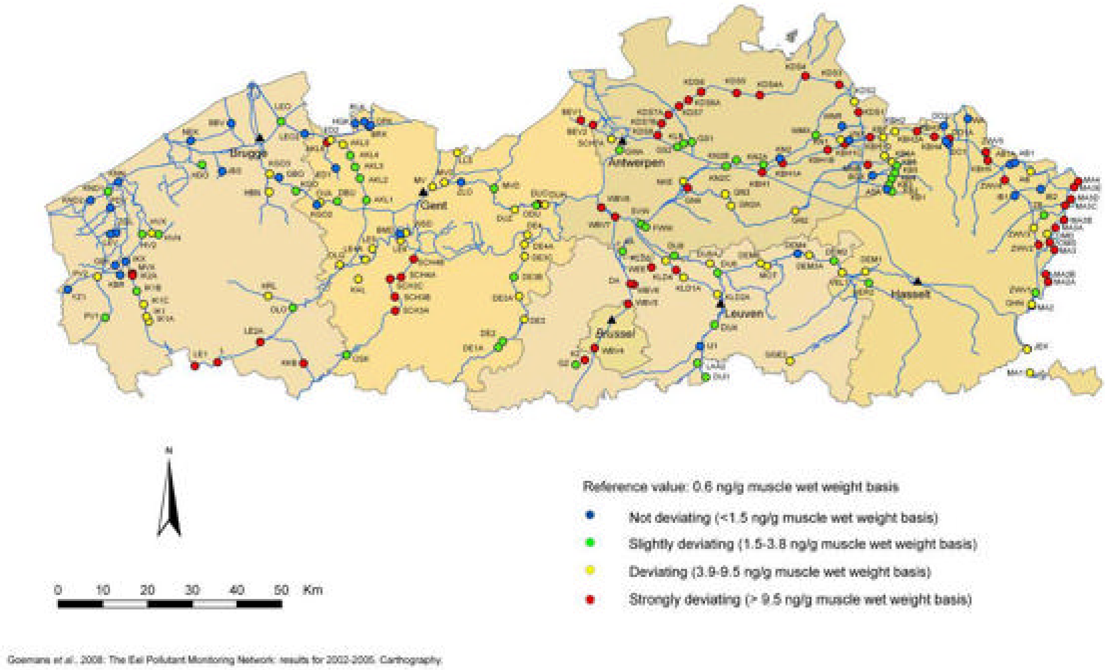

Figure BE.18 Distribution of PCB 156 in yellow eel in Flanders (2002–2005); means on muscle wet weight basis, classified following the deviation from the reference value (Goemans *et al.*, 2008).

The 2006 EU Water Framework Directive has proposed to monitor a selection of priority substances in the aquatic phase, including lipophilic substances. However, there are strong arguments for measuring the latter in biota. Yellow eel is a good candidate because it is widespread, sedentary and accumulates many lipophilic substances in its muscle tissue. Several authors have described the indicative value of measured concentrations, yet few studies have investigated to which extent the spectrum of contaminants present characterizes the local environmental pollution pressure. To evaluate the value of the pollution profile of an eel as a fingerprint of the chemical status of the local environment, two datasets were selected from the Flemish Eel Pollutant Network database, one set from a small catchment area to investigate site-specific profiles, and one from seven large Flemish rivers to investigate river-specific profiles. The pollution profiles of persistent organic pollutants in individual eels along a river (even at distances <5 km) proved to be significantly different. Analysis of pooled contaminant data from multiple sites and sampling years within rivers allows characterization of river-specific chemical pressures. The results highlight the usefulness of eel as a bio-indicator for monitoring pollution with lipophilic chemicals like polychlorinated biphenyls and organochlorine pesticides in rivers. It was concluded that, as such, eel may be used effectively within the monitoring programme for a selection of priority substances referred to in the Water Framework Directive. (Belpaire *et al.*, 2008).

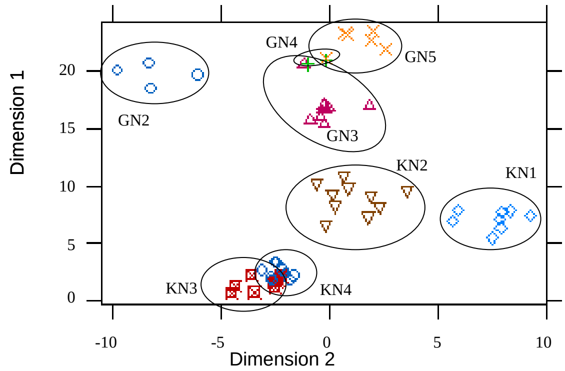

Figure BE.19. Canonical discriminant analysis of eels collected at eight sites in the Grote Nete and Kleine Nete on the basis of their PCB and OCP concentrations (N= 61). Distance between locations varied between 4 and 20 km.

High peaks of some substances in eel tissue confirmed the previously known high pollution load of some specific areas e.g. the high lead and cadmium pollution in the canal Kanaal van Beverlo, historically related to the metallurgy activities. In many cases however, eel analyses revealed unknown environmental problems, like for instance the presence of 1, two-dimensionalibromo-3-chloropropane in eels from two canals (Albertkanaal and Leuvense Vaart) and 1, two-dimensionalichlorobenzene in eels of some sites along the River Leie, indicating some point sources. In a few cases analysis of eels from a specific location has demonstrated unsuspected high pollution levels of several contaminants, this was the case for Lake Weerde, possibly indicating local spilling or dumping of contaminated material. Other compounds measured in eels had distribution patterns which can be explained by specific agricultural or industrial pressures (e.g. lindane in the basins of Yser, Demer and Dijle or HCB in the sub-basin of the Grote Nete). But several contaminants were omnipresent in Flemish eels. BTEX (benzene, toluene, ethylbenzene and the xylenes) compounds were found at all places. This was also the case for PCBs and some very persistent OCPs like DDTs which were banned a long time ago. From the profiles of DDT and derivatives it was concluded that in some river basins, DDT must still be in use (see below). But maybe the most striking and threatening observations are the very high levels of some BFRs measured in eels at several sites along the rivers Leie and Scheldt, peaking at Oudenaarde (River Scheldt). This eel contamination is most likely related to the intensive textile industry from this area.

Eels from different river basins differ in contamination. Belpaire *et al.*, 2008 presented PCB and OCP contamination profiles for some basins. Eels from the river Yser are characterized by high OCPs, especially dieldrin and lindane (γ-HCH), and low PCB levels. River Leie reveals a distinctive profile of PCBs, with a large proportion of lower chlorinated congeners. Rivers Dender and Scheldt fingerprints are generally intermediate compared to the other rivers, but demonstrate considerably high PCB levels. River Demer eels usually have high lindane and DDT levels, whereas eels from River Grote Nete are characterized by peaking HCB and high DDT concentrations. In the River Maas, PCB concentrations are peaking, and the PCB profile is totally different from that in the River Leie. It is dominated by the higher chlorinated PCBs. OCP levels in the River Maas eels are low.

Results of measurements of dioxins on eight locations indicate some reason for concern. Dioxin concentration in eel varies considerably between sampling sites, indicating that they are good indicators of local pollution levels. The European Commission has set maximum levels of 4 pg TEQ g^{-1} fresh weight for the sum of dioxins (WHO-

PCDD/F TEQ) and 12 pg TEQ g^{-1} fresh weight for the total-TEQ i.e. the sum of dioxins and dioxin-like PCBs (WHO-PCDD/F-PCB TEQ) in muscle meat of eel and products thereof (Directive 2002/69/EC). Half of the sampling sites demonstrate especially DL-PCB levels exceeding the European consumption level (with a factor 3 on average). The levels of PCDD/FS AND DL-PCBS measured in some sites gave rise to serious concern about the reproduction potential for the eels from these sites. Human consumption of eels, especially in these highly contaminated sites, seems unjustified (Geeraerts *et al*., 2008, in press).

Table BE.6. Overview of the mean length (cm), the mean weight (g) and the muscle lipid content of the eels, the dioxin concentrations (ΣPCDD/F; pg WHO TEQ g^{-1} w.w.), the sum of dioxin-like PCB concentration (ΣDL-PCB; pg WHO TEQ g^{-1} w.w.), and the total-TEQ concentration (ΣPCDD/F and DL-PCB; pg WHO TEQ g^{-1} w.w.) at 8 locations in Flanders (2001–2005) (Geeraerts *et al.*, 2008).

Code	Water	Sampling year	Mean length (cm)	Mean weight (g)	Fat %	ΣPCDD/Fs (pg WHO TEQ g-1 w.w.)	ΣDL-PCBs (pg WHO TEQ g-1 w.w.)	ΣPCDD/F and DL-PCB (pg WHO TEQ g-1 w.w.)	% DL-PCBs of total Σ
COM	Congovaart + lagoon	2001	43.2	162.3	10.64	3.33	138.53	141.86	97.65
IB1	Itterbeek	2005	38.3	109.3	5.49	0.33	1.39	1.72	80.89
KB2	Canal of Beverlo	2005	41.2	110.1	3.58	0.30	2.04	2.35	87.04
KBH1B	Canal Bocholt-Herentals	2002	41.3	115.1	10.19	2.82	81.48	84.30	96.65
KNN	Creek of Nieuwendamme	2002	35.3	77.8	9.96	0.26	1.61	1.87	86.19
KZ	klein Zuunbekken	2002	39.6	107.0	15.01	1.64	23.39	25.03	93.46
ODU	Oude Durme	2002	38.6	99.6	8.93	0.62	3.98	4.60	86.44
WBV6	Willebroekse vaart	2002	39.7	103.1	10.1	0.69	24.04	24.72	97.23

Trend analysis (Maes *et al*., 2008) over the period 1994–2005 indicated that there were significant decreases in the average wet weight concentration of all PCB congeners, nearly all pesticides and four metals. The observed decline of PCBs in eel tissue was in agreement with other studies reporting on time-series of contaminants in fish. PCBs were banned from the EU in 1985 and since then, several time-series have indicated decreasing levels of contamination. Also concentrations of most pesticides decreased significantly over time. This was especially evident for α-HCH and lindane, demonstrating that the ban of lindane in 2002 has positive effects on the accumulation in biota. Similar reductions were modelled for HCB, dieldrin and endrin; however these compounds were banned many years ago. Unexpectedly, concentrations of *p,p'*-DDT increased while at the same time, *p,p'*-DDD and *p,p'*-DDE revealed significant decreases. At first sight, the ratio of DDE over DDT was in all eels analysed >1, suggesting that remaining DDT had not been recently reapplied. However, at some locations in Flanders (Kanaal Dessel Schoten, Handzamevaart and Ieperkanaal) the ratio of DDE over DDT rapidly decreased over a few years by an order of magnitude of three. Such a steep decrease, even if the ratio was higher than one, probably indicates recent application of DDT and reveals that not all stock was depleted. These results, as well as the recent observation that human blood samples, particularly of the juvenile population living outside urban areas, still contain DDT (Schroijen *et al*., 2008) urged regional policy-makers to make a serious attempt in order to collect the remaining stock of banned pesticides. Also for some heavy metals, concentrations decreased in the eel. Especially lead, arsenic, nickel and chromium were notably reduced. The concentration of lead in eel muscle tissue was consistently decreasing between 1994 and 2005, which possibly is related to the gradual changeover from leaded to unleaded fuels and a reduction of industrial emissions. For arsenic, nickel and chromium, the trend may be biased as data were available only since 2000. Cadmium and mercury, however, did not demonstrate decreasing trends and remain common environmental pollutants in the industrialized region of Flanders.

Following the very high levels of BFRs encountered in eels from Oudenaarde, new measurements were carried out in 2006 (Roosens *et al*., 2008). A descending trend in the contamination with BFRs was observed from 2000 to 2006 on this site. For PBDEs, levels have decreased by a factor 35 (26 500 to 780 ng g^{-1} LW), whereas for hexabromocyclododecane (HBCD), the decrease was less conspicuous, (35 000 to 10 000 ng g^{-1} LW). Based on these results we can conclude that in 2006 fish seem to be less exposed to PBDEs than 6 years earlier. This is probably as a consequence of the restriction regarding the use of the penta-BDE technical mixture (since 2004), a better environmental management and a raising awareness concerning PBDEs. However, because there are no restrictions regarding its usage, HBCD can still be detected in large quantities, especially in aquatic environmental samples taken next to industrialized areas, where it is used in specific applications. The slight decrease in the concentrations of HBCDs in eels observed between 2000 and 2006 might indicate that HBCD is slowly being replaced by other BFRs for which no risk assessment is available. BFR levels have decreased in the Oudenaarde area, but still remained higher than in other locations in Flanders. Also compared to several European studies the reported PBDE levels are still one order of magnitude higher in Oudenaarde eels. The textile industry is likely the cause of elevated BFR levels in fish on this part of the river Scheldt, but further studies should be set up to determine the exact origin and how far this contaminated area extends over the whole river.

We may conclude that the results from the Flemish Eel Pollution Monitoring Network allow getting a comprehensive overview of a set of contaminants indicating environmental pressure over Flanders, and they are able to document the temporal evolution of some of these pressures. The intensity of pollution, at least at some sites, may well indicate potential negative effect on the health of these contaminated eels.

BE.I.3.2 Contamination in eel and its role in the collapse of the stock (Belpaire, 2008)

We summarize the main findings of work in this field in the following section and draw some conclusions related to the potential role of contamination in the collapse of the stock.

In the eel, the impacts of contaminants on metabolic functions and on behaviour of the eel are widely divergent and act through various mechanisms (Geeraerts and Belpaire, in prep.). Endocrine disruption seems a widely distributed phenomenon among fresh-water fish. Also in Flanders this was recently documented in a comprehensive study (Berckmans *et al*., 2007) assessing reproductive functions in Flemish roach (*Rutilus rutilus*). This study demonstrated that in 50% of male roach, testes were feminized. In eel, Versonnen *et al*., 2004 investigated potential effects of xenoestrogens, and measured plasma vitellogenin (VTG) content in 142 eels sampled at 20 different locations of variable pollution levels. The plasma VTG content of eels was very low, despite a very high internal load of endocrine disrupters. Therefore, no indications were found for estrogenic effects to occur in natural fresh-water eel populations in Flanders. These results suggest that immature yellow European eel might not be the best sentinel species to study the effects of estrogenic compounds on VTG levels of wild fish populations. Most probably, endocrine disrupting effects of pollutants related with reproduction, will only become apparent during the maturing silver eel stage.

Maes *et al*., 2005a studied the effects of pollutants on the genome of eels with variable metal load. They analysed the relationship between heavy metal bioaccumulation, fitness (condition) and genetic variability. A significant negative correlation between heavy metal pollution load and condition was observed, suggesting an impact of pollution on the health of subadult eels. In general, a reduced genetic variability was observed in strongly polluted eels, as well as a negative correlation between levels of bioaccumulation and allozymatic multi-locus heterozygosity.

Van Campenhout *et al*., 2008 studied the effect of metal exposure on the accumulation and cytosolic speciation of metals in livers of European eel by measuring metallothioneins (MT) induction. This research was carried out in four sampling sites in Flanders revealing different degrees of heavy metal contamination (Cd, Cu, Ni, Pb and Zn). It was concluded that the metals, rather than other stress factors, are the major factor determining MT induction. The effects of perfluorooctane sulfonic acids (PFOS) in Flemish eels were studied by Hoff *et al*., 2005, indicating that PFOS induces liver damage.

Geeraerts *et al*., 2007 analysed our extensive dataset of contaminants by statistical modelling and concluded that PCBs, especially the higher chlorinated ones, and DDTs, have a negative impact on lipid content of the eel. It was further demonstrated that fat stores and condition decreased significantly during the last 15 years in eels in Flanders (Geeraerts *et al*., 2007) and in The Netherlands (Belpaire *et al*., 2008), jeopardizing a normal migration and successful reproduction.

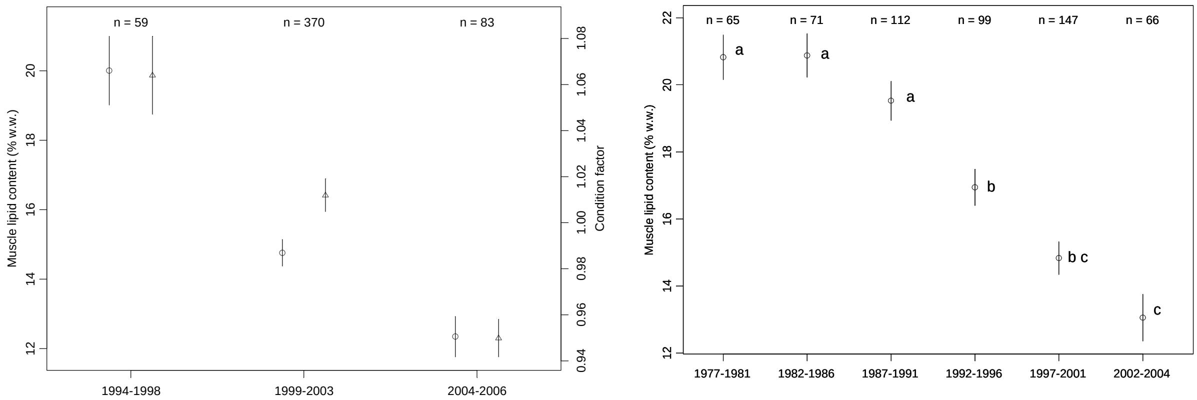

Figure BE.20 Temporal trend in fat contents (% of wet muscle weight) of yellow eels in Belgium (left panel) and The Netherlands (right panel) (means, bars indicating standard errors). The number of sites is indicated. Means of periods with the same letter are not significantly different from each other (Tukey test, 95% simultaneous confidence intervals). For the Belgian eels also condition factor is presented. (Belpaire *et al.*, 2008)

Belpaire, 2008 concluded that pollution is of utmost importance for eel management, and may represent a key element in the search for understanding the causes of the decline of the eel. He postulates that contaminant pressure is a very plausible causative factor for the collapse of the eel stocks and summarizes major arguments and hypotheses to underpin this.

1) Contamination has been demonstrated as the cause of population collapse of many other biota from the 1970s on (e.g. the collapse of several birds of prey in the 1960s as a consequence of DDT).

Many chemicals have been developed and put on the market, simultaneous with the intensification of agricultural and industrial activities during the 1970s. The timing of this increase in the production and release of chemicals may fit with the timing of the decrease in recruitment from 1980 on.

Eels bioaccumulate many chemicals to a very high extent.

The more or less simultaneous decreases in recruitment in the Northern-hemisphere *Anguilla* species, like *A. rostrata* and *A. japonica*, during the last 30 years, is an additional argument endorsing the idea that some new contaminants quickly spreading over the industrialized world, are key elements in the decline.

Many reports have been dealing with direct adverse effects of contamination on individual, population and community level in fish. In eel, many detrimental effects of contaminants on the individual level have been demonstrated, including impact on cellular, tissue and organ level. Also genetic diversity seems to be lowered by pollution pressure.

Considering the high levels of contamination in eels from many areas, endocrine disruption in mature silver eels might be expected, jeopardizing normal reproduction. Dioxin-like contaminants have been reported to hamper normal larval development.

Fat levels in eels have decreased considerably over the past 15 years, suggesting failure of successful migration and reproduction. This decrease is mainly induced by contamination.

Figure BE21 shows a simplified conceptual model of the effects of pollution exposure on the population structure of the European eel. Adapted from Lawrence and Elliott, 2003.

Considering (1) that the effects of contaminants on biota in general and on eel specifically are better known and seem to be of utmost importance for the reproduction success of the species, (2) that the pollution in eels is impressively varying between sites within and between member countries, (3) that the level of pollution in eel in many cases surpasses binding human consumption maximum allowed levels or advisory consumption limits and thus has an effect on fisheries management and regulation, we strongly recommend that at community level initiatives are taken to collate information, to set up comparative monitoring actions, to set up a pan-European database, to set up studies on effects.

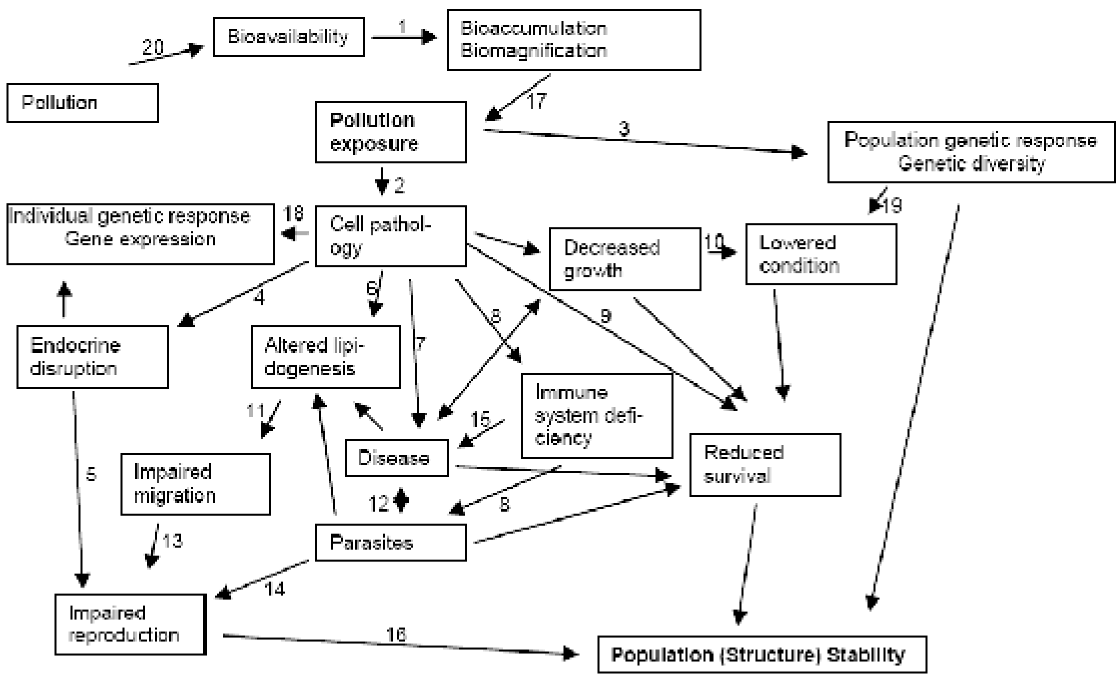

Figure BE.21: A simplified conceptual model of the effects of pollution exposure on the population structure of the European eel, *A. anguilla*. Adapted from Lawrence and Elliott, 2003. Numbers refer to references: (1) Vollestad, 1992; (2) Tuurula and Soivio, 1982; Svobodova *et al.*, 1994; Azzalis *et al.*, 1995; Stohs and Bagghi, 1995; Sanch *et al.*, 1997; Ibuki and Goto, 2002; Pacheco and Santos, 2002; (3) Nigro *et al.*, 2002; Jha, 2004; Maes *et al.*, 2005; Nogueira *et al.*, 2006; (4) McKinney and Waller, 1994; Versonnen *et al.*, 2004; (5) Jobling *et al.*, 2002b; (6) Jimenez and Burtis, 1989; Ceron *et al.*, 1996; Sancho *et al.*, 1998; Fernandez-Vega *et al.*, 1999; Robinet and Feunteun, 2002; Hu *et al.*, 2003; Pierron *et al.*, 2007a; (7) Roche *et al.*, 2002; (8) Sures and Knopf, 2004; Sures, 2006; (9) Sancho *et al.*, 1997; (10) Gony, 1987; (11) Ceron *et al.*, 2003; van den Thillart *et al.*, 2005; (12) Van Ginneken *et al.*, 2005; (13) Johnson *et al.*, 1998; Palstra *et al.*, 2007; (14) Sures, 2006; (15) Van Ginneken *et al.*, 2005; (16) Corsi *et al.*, 2003; (17) Van Campenhout *et al.*, 2008; (18) Ahmad *et al.*, 2006; Maria *et al.*, 2006; (19) Jha, 2004; Maes *et al.*, 2005; (20) Belpaire *et al.*, 2003.

Wallonia

Facing the contamination analyses performed on eels sampled in several waterways in the Walloon region, a Walloon jurisdiction aiming to prohibit consumption of eels fished from Walloon Rivers was published in June 2006 (Walloon Government, 2006).

The health risk associated to the consumption of fish originating in Walloon Rivers was assessed through the study of fish sampled in 61 stations situated on 30 different waterways between 2001 and 2004. The amounts of PCB dioxins and furans encountered in eel tissues were compared with the standard values applied to human health (Thomé *et al*., 2004). These are set to 75 ng g^{-1} fresh weight for PCBs (Royal Order from 6th March 2002 modifying the previous Royal Order (19th May 2000)), establishing maximal dioxin and PCB levels in several foodstuffs. Levels concern PCB congeners (28, 52, 101, 118, 138, 153 and 180) and 12 pg TEQ-WHO g^{-1} (TEQ-WHO or Toxic Equivalents-World Health Organization) of fresh weight for dioxins and furans (European Council regulation of the 29th November 2001).

Eel contamination by dioxins and furans stays in safe levels; encountered values never exceed the 12 pg TEQ-WHO g^{-1} fresh weight.

However, the situation of PCB contamination is far more alarming. Eels reveal PCB concentrations between 40 and 1761 ng g^{-1} fresh weight. Such results are particularly disturbing because they nearly systematically exceed the defined value for human consumption. The highest contamination levels are encountered in the lower Meuse, the Albertkanaal and the Vesdre. It is to be feared that a regular consumption of eel meat should reveal a threat to human health.

BE.I.4 Predators

We refer to last year's report for data on cormorants. No new data available.

BE.J Other sampling

BE.K Stock assessment

BE.K.1 Stock assessments in Flanders (Yser, Scheldt and Meuse basin)

To examine temporal trends in eel stocks in Flanders an INBO dataset with eel densities from 487 sites in Flanders was used. Each site was fished with electrofishing or fyke fishing during period 1 (1995–2000) and period 2 (2001–2005). Fishing procedures were standardized. From the 487 sites 124 were situated on canals and 363 on running waters.

These data allow quantification of the abundance of eels in Flandrian water bodies, over space and time. Figures BE.22–24 give the distribution and abundance of eels in Flanders (electrofishing data) for 1332 stations, respectively in running waters, canals and polder waters and ponds and lakes (Belpaire *et al*., 2003).

In general, it could be concluded that the number of sites where fish was present increased from 74.7% to 82.5%, given an indication of the general increase in water quality in Flanders.

The same was found for the presence of eel. The number of sites where eel was present increased from 34% in 1995–2000 to 42.5% in 2001–2005. This increase is statistically significant. The increase is mainly as a consequence of an increase in water quality, but also the building of fish ladders had a positive effect on eel colonization. A striking example of the positive evolution in water quality has been the recent report by INBO of eel and other fish on the River Zenne, a river flowing through Brussels, and considered as dead since beginning of 1900.

However the densities of the eel collected both by electrofishing and by fyke fishing are low. Density data even tend to decrease between period 1 and 2. The decrease is significant for the electrofishing data.

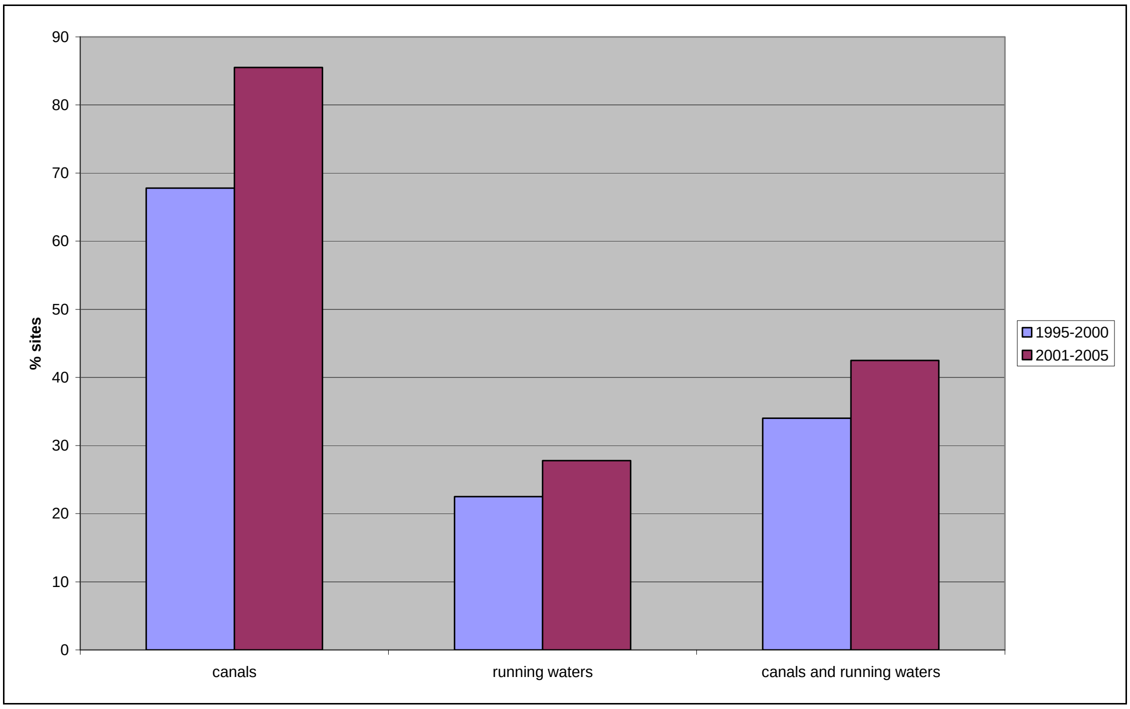

Figure BE.22 Presence of eels from 487 surveys in canals and running water in period 1: 1995–2000 and period 2: 2001–2005 (the same locations were fished in period 1 vs. period 2).

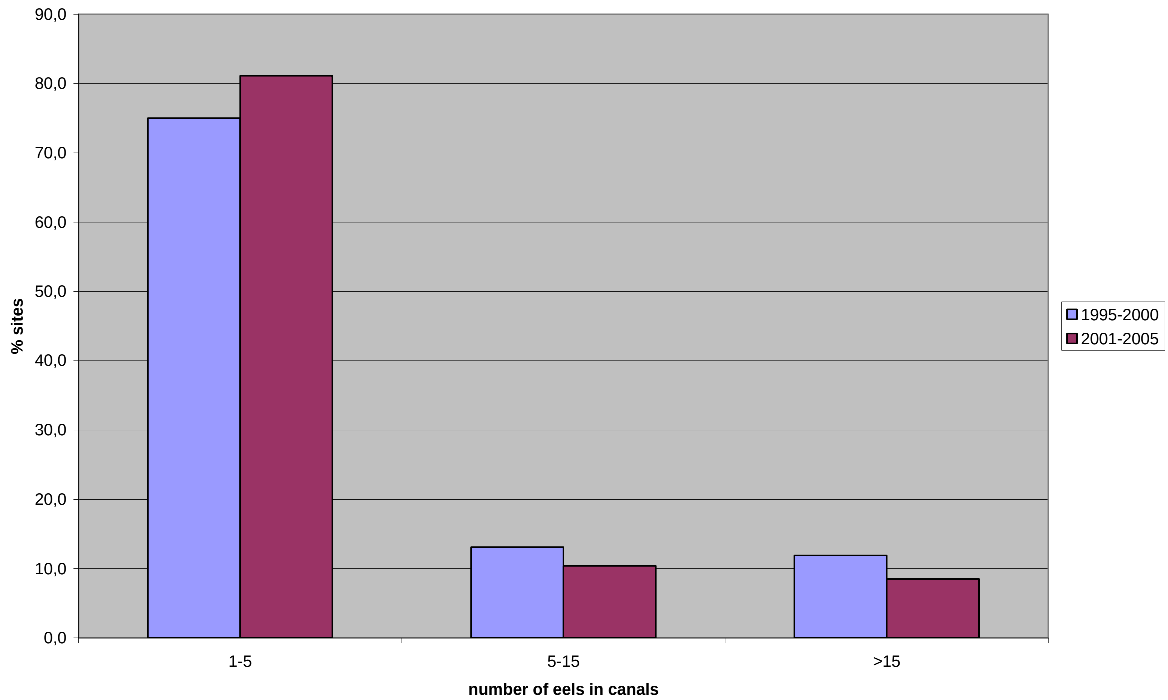

Figure BE.23 Abundance of eels (number of eels/100 m EF and number of eels/fyke/24 h) on sites where eels are present in canals in period 1: 1995–2000 and period 2: 2001–2005 (the same locations were fished in period 1 vs. period 2).

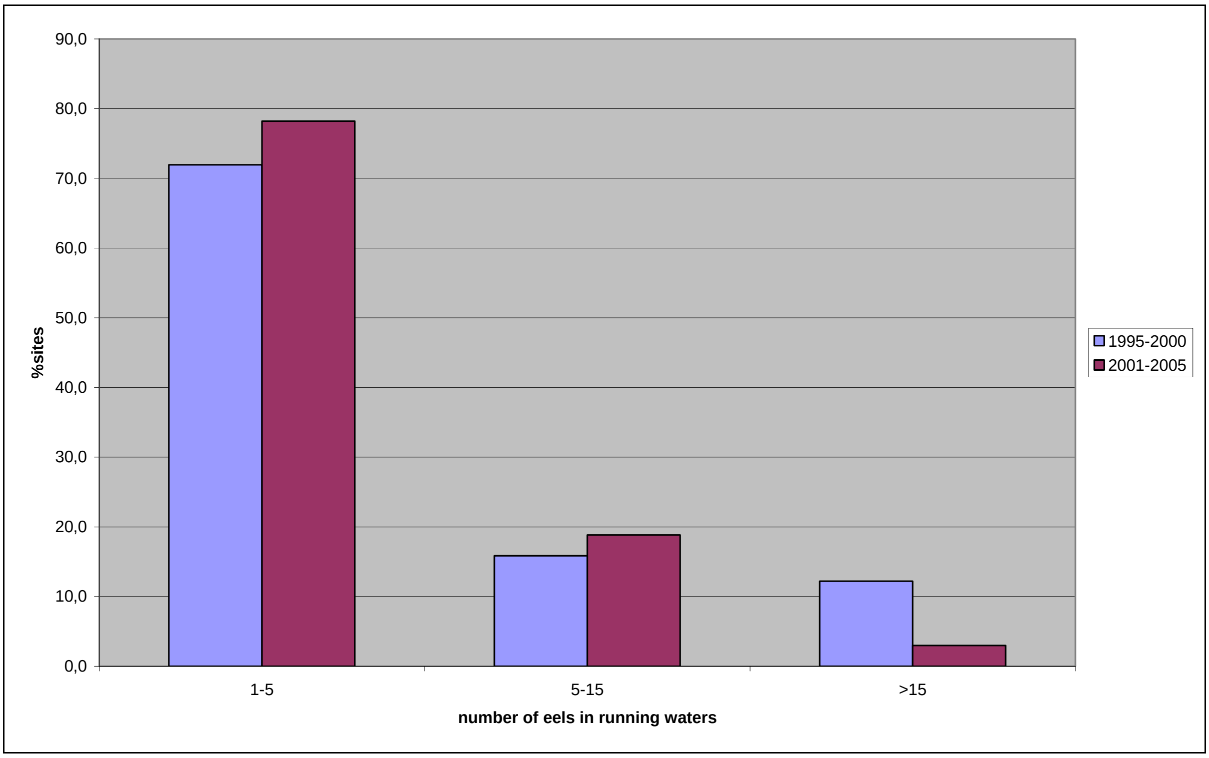

Figure BE.24 Abundance of eels (number of eels/100 m EF and number of eels/fyke/24 h) on sites where eels are present in running water in period 1: 1995–2000 and period 2: 2001–2005 (the same locations were fished in period 1 vs. period 2).

BE.K.2 Stock assessments in Wallonia (Meuse basin)

Fish stock assessments programmes in Wallonian Rivers are carried out by the Centre de Recherche de la Nature, des Forêts et du Bois (CRNFB). Table BE 7 is providing eel catches for 2007.

Table BE.7. Eel catches from fish stock surveys in the Walloon Region in 2007 (Data from the Hydrobiology Database of the CRNFB, contact Thierry Demol for details and survey techniques).

Date	Lmin	Lmax	Kg	number	Water mass	Surf ha	x	y
24.09.07	595	740	4244	7	Noue du Colébi		187 023	100 868
11.09.07	380	570	5950	6	Canal Charleroi Bruxelles	0,11	141 080	142 940
02.05.07			2,092	6	la Meuse	0,05	242 770	156 292
04.09.07	530	790	2,737	5	la Meuse	0,220	201 828	131 780
12.09.07	480	700	2,315	5	la Meuse	0,200	242 770	156 292
16.10.07	580	730	4,37	5	la Lesse	0,523	191 195	100 985
21.09.07	620	900	3,798	4	la Lhomme	0,149	206 852	92 353
01.08.07	575	890	2,384	3	la Mache	0,158	199 990	76 280
10.09.07			0,595	3	la Lys	0,14	50 544	161 281
31.08.07	275	400	0,147	2	la Dendre	0,09	114 126	158 760
03.09.07			0	2	la Meuse	0,22	182 700	100 617
24.07.07	833	833	1,317	1	la Biesme	0,100	165 530	121 610
06.09.07	430	460	0,421	1	l' Escaut	0,13	82 857	134 696
19.09.07	775	775	0,93	1	la Semois	0,441	187 136	61 735

26.09.07	725	725	0,585	1	la Lesse	0,480	204 941	76 782
03.10.07	650	650	0,053	1	la Lienne	0,184	249 480	122 680
07.09.07			0	1	canal ATH BLATON	0,12	109 000	145 520
14.09.07		50	0	1	la Molignée	0,08	184 449	111 948

In the frame of the National Action Plan for eel stock preservation, scientific surveys of eel numbers will be increasingly performed in the coming years.

BE.L Sampling intensity and precision

BE.M Standardisation and harmonization of methodology

BE.M.1 Survey techniques

Flemish region

Glass eel survey techniques

At the Nieuwpoort station the glass eel fishing is starting at the end of February and continues till the beginning of May. Fishing is not carried out every day, but is mainly dependent of weather conditions and tide. Usually there are 20 to 30 fishing nights per season. Fishing is starting ca. 2–3 hours before high tide and is continued until high tide is attained.

The time-series has been achieved by fishing in the ship lock of the Iepersluis at Nieuwpoort. Two to three hours before high tide the outer (sea side) doors of the ship lock are opened to allow glass eel entering the ship lock. A 5 m long steeled dipnet is held vertical from the ship lock quay and pulled forward, just under the surface, for the length of the ship lock. The dipnet has a width of 80 cm and is 60 cm high. Glass eel has been monitored in this way since 1964.

On the Scheldt (see Section BE.G.2) the immigration of glass eels was studied using artificial substrates (Silberschneider, 2001). Substrates were deployed at the outlet of sewage treatment plants and drainage systems in the Zeescheldt and tributaries (Rupel, Lower Nete and Kleine Nete) and were checked once every two days for glass eels.

Data available are daily glass eel catches (kg), date and starting and ending hours of the fishing period. Temperature, tide data and other external factors (weather, etc.) are also recorded. Catches are presented as total annual yield or can be presented as maximum daily catch or mean daily catch. Catch per haul are recorded. The Research Institute for Nature and Forest is keeping up to date a database with the catches.

Yellow eel

Since 1995, INBO runs a fresh-water 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 year 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 3 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. A detailed description of the sampling methodology is given in Table BE.8. 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^{-1}) and density (individual's ha^{-1}) 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.

Table BE.8. Description of the techniques used for fish stock assessments in Flandrian water bodies by INBO.

WATERTYPE	TECHNIQUES USED
Running waters <1.5 m	100 m electrofishing with 1 anode
Running waters 1.5–4 m	100 m electrofishing with 2 anodes
Running waters 4–6 m	100 m electrofishing with 3 anodes
Running waters 6–8 m	100 m electrofishing with 4 anodes
Running waters >8 m	Combination of: 500 m boat electrofishing (2 x 250 m on both river banks) fykes and/or gillnets
Closed river arms and ponds Polder drainage systems	Combination of : seine netting boat electrofishing (both river banks) fykes and/or gillnets

Walloon region

No detailed information.

BE.M.2 Sampling commercial catches

Not carried out.

BE.M.3 Sampling

BE.M.4 Age analysis

Not carried out.

BE.M.5 Life stages

See Sections BE.G.1 and G.2 for glass eel, and BE.K.1 and K.2 for yellow eel.

See Verbiest *et al*., subm. for silver eel.

BE.M.6 Sex determinations

No sex determination.

BE.N Overview, conclusions and recommendations

The national eel management plans is actually being worked out in Belgium. There are major critical points where considerable efforts still have to be made, essentially on water quality and pollution, and on habitat restoration and restoration of the migration possibilities.

New evidence has been presented that contaminants might have an adverse impact on the eel. An alarming decrease in fat levels in yellow eel over the last 15 years was described for Belgium and The Netherlands.

Many pressures have been suggested or demonstrated to negatively impact the eel stock. Maybe these pressures acted in a synergetic way, resulting in the collapse of the stock. Dekker, 2004 suggested that the most likely proximate cause of the collapse in recruitment observed in the European eel after a prolonged period of gradually declining abundance in continental waters is caused by an insufficient quantity of spawners. From the evidence presented under BE.I.3, *we may conclude that not only the quantity, but also the quality of the potential spawners leaving continental waters, is insufficient, and has contributed to the decline of the stock*. Contaminant pressure in continental waters seems to represent a major threat for the European eel stock and will limit the possibilities of restoration of the stock. Hence, we believe that within the (inter)national eel restoration plans, measures to decrease contaminant pressure are an essential issue (Belpaire, 2008).

Considering (1) that the effects of contaminants on biota in general and on eel specifically are better known and seem to be of utmost importance for the reproduction success of the species, (2) that the pollution in eels is impressively varying between sites within and between member countries, (3) that the level of pollution in eel in many cases surpasses binding human consumption maximum allowed levels or advisory consumption limits and thus has an effect on fisheries management and regulation, we strongly recommend that at community level initiatives are taken to collate information, to set up comparative monitoring actions, to set up a pan-European database, to set up studies on effects.

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