Report on the eel stock and fishery in

Belgium
2005

BE.A. Author

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This report was completed in January 2006, and contains data up to 2005.

BE.B. Introduction:

This report is written in preparation of the EIFAC/ICES Working Group on Eel (Rome, 23-27 January 2006) and presents mostly the data on eel stocks and fisheries as compiled for the Workshop on National Data Collection for the European eel (Stockholm, 2005). An attempt is made to compile the data broken down per River Basin District (RBD), in accordance with the Water Framework Directive. However it became obvious that considerable information is lacking due to the scattered fish management units (due to the specific Belgian administrative and political situation), not at all coinciding with RBD grouping and the absence of a national eel management plan.

BE.B. 1. Eel fisheries, managing administrations

Eel fisheries in Belgium occur in coastal waters, estuaries, rivers, canals, polder watercourses and in small lakes. Professional eel fisheries is essentially coastal and estuarine. Fresh water eel fisheries is mostly recreational by anglers using rods, fykes or square nets. As the management of the fisheries is organised by various services quite differently, it is convenient to categorise as follows (Fig BE.1):

1. Professional coastal and sea fisheries constituted by a small fleet of beam trawlers and otter trawlers. Competence over fisheries regulation has been transferred to the Regional Governments. Regulation of marine fisheries is the responsibility of Marine Fisheries Service of the Agriculture and Fisheries Policy Division (Administration of Agriculture and Horticulture of the Ministry of Flanders). This fisheries is likely to be of minor importance with repect to eel management as eel landings are small and not reported (see below BE.E)).
2. Estuarine fisheries on the Scheldt constituted by trawlers and fyke fisheries. This fisheries is managed by the Flanders' Environment, Nature, Land and Water Management Administration, Section Forest and Green. This fisheries is specifically focused on the catch of eels.
3. Recreational fisheries in the Flemish Region. This fisheries is managed by the Flanders' Environment, Nature, Land and Water Management Administration, Section Forest and Green. This fisheries is concentrated on coarse fish, pike and pike perch, but also eels are popular.

4. Recreational fisheries in the Walloon Region. This fisheries is managed by the Ministry of the Walloon Region, General Directorate of Natural Resources and Environment. It is focused on coarse fish and salmonids.
5. Recreational fisheries in the Brussels-Capital Region. This fisheries is managed by the Brussels Institute for Management of the Environment.

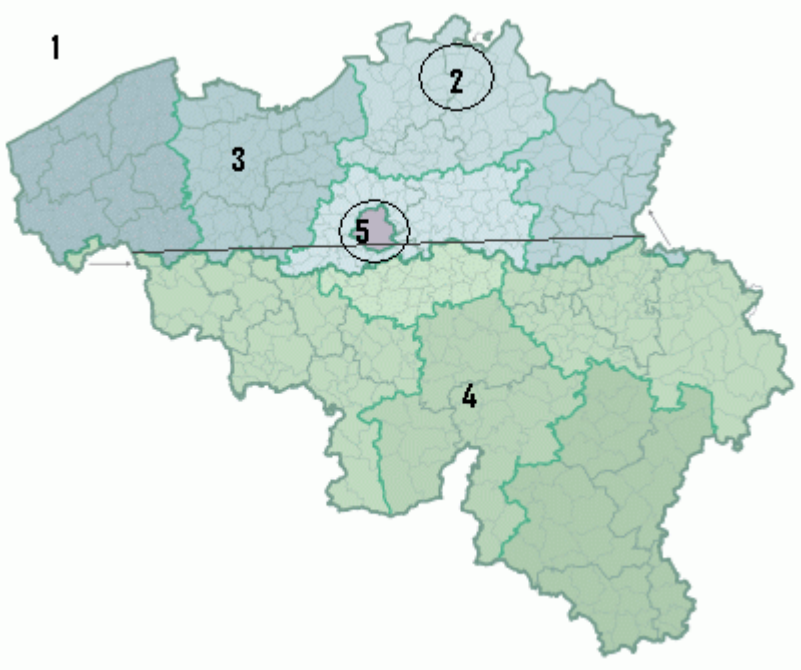


Fig BE.1 Map of the various fisheries in Belgium (for numbers : see text)

BE.B. 2. Water Framework Directive, the River Basin Districts in Belgium

The Water Framework Directive subdivides Belgium into 4 separate River Basin Districts, all of which extend beyond our borders. These are:

a. the River Basin District of the Scheldt (Schelde, Escaut), shared with The Netherlands and France. Drainage area: 37,170 km^2. The international co-ordination of the RBD of the Scheldt is assigned to the International Scheldt Commission (ISC, http://www.isc-cie.com) through the treaties of Ghent (03/12/02).

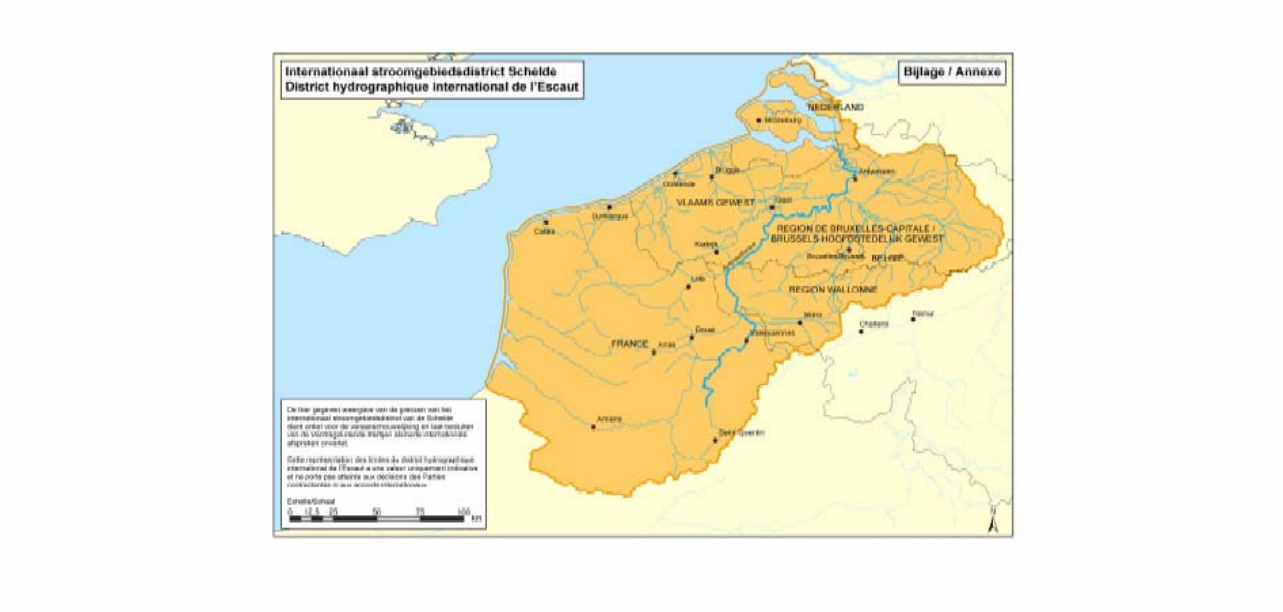


Fig. BE.2 International RBD of the Scheldt.

Fig BE.3 gives a view of the RBD of the Scheldt in Flanders. It includes the River Basins of the Yser (IJzer, Isère), of the Brugse Polders and of the Scheldt.

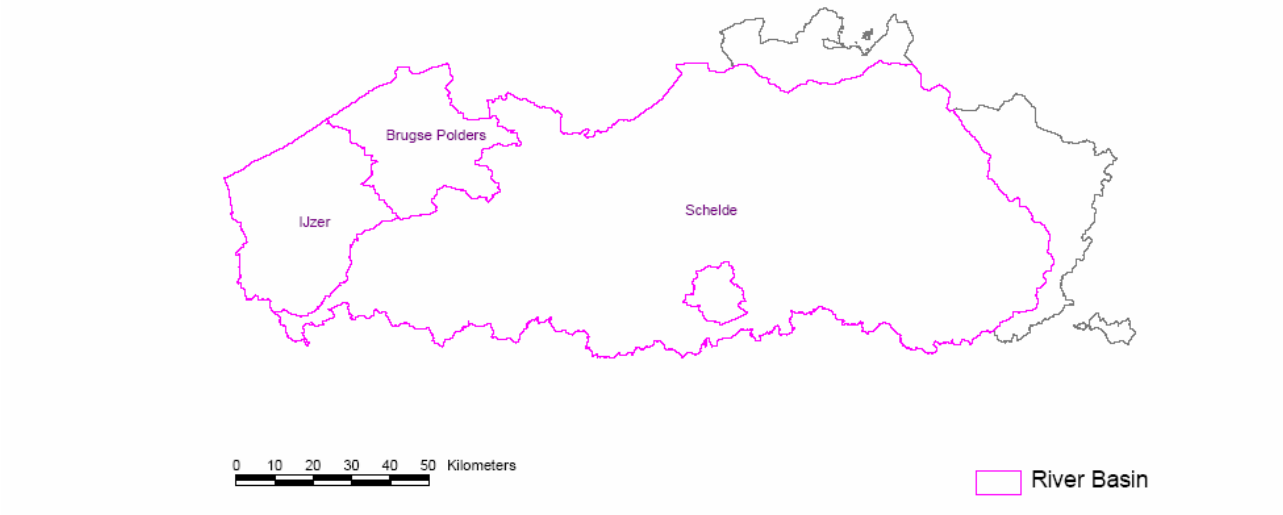


Fig. BE.3 Scheldt RBD area in Flanders.

Fig. BE.4 Scheldt RBD area in Wallonia.

b. the River Basin District of the Meuse (Maas), shared with The Netherlands, Luxemburg, France and Germany. Drainage area: 35,000 km^2 . 28% of the catchment area is situated in France, 41% in Belgium, 12% in Germany, 19% in The Netherlands, and a small portion in Luxembourg The international co-ordination of the RBD of the Meuse is assigned to the International Meuse Commission (IMC, http://www.cipm-icbm.be) through the treaties of Ghent (03/12/02).

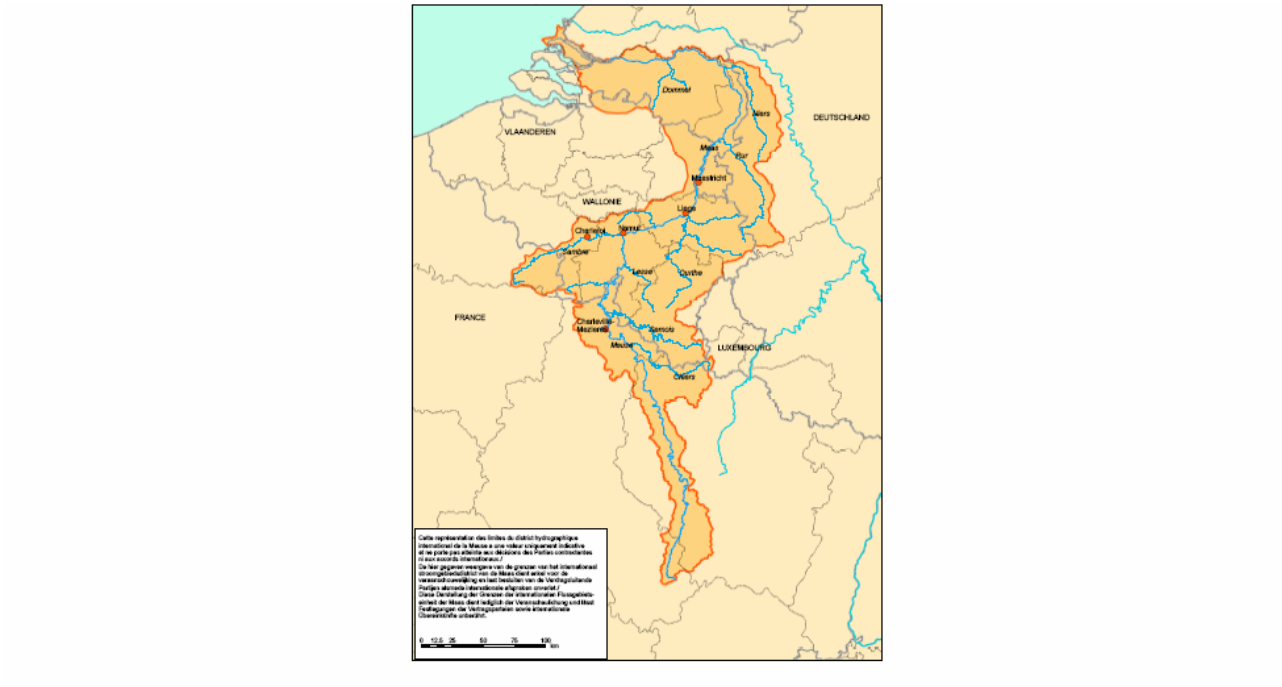


Fig. BE.5 International RBD of the Meuse.

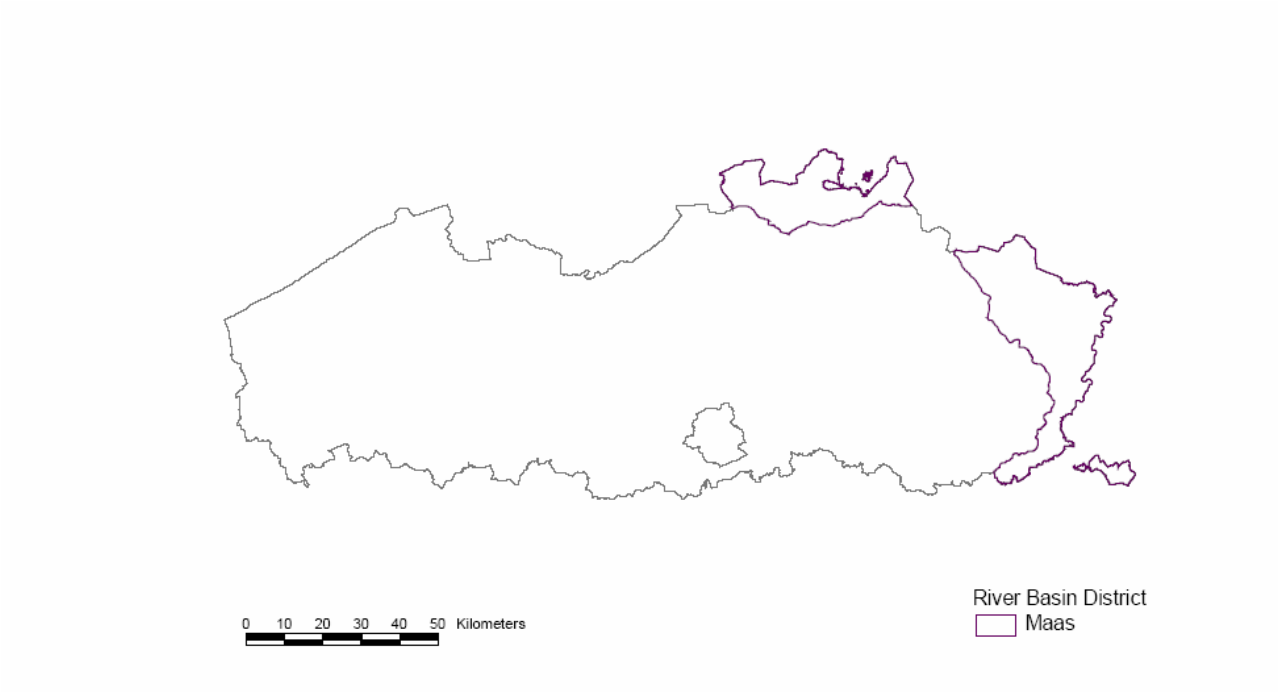


Fig. BE.6 Meuse RBD area in Flanders.

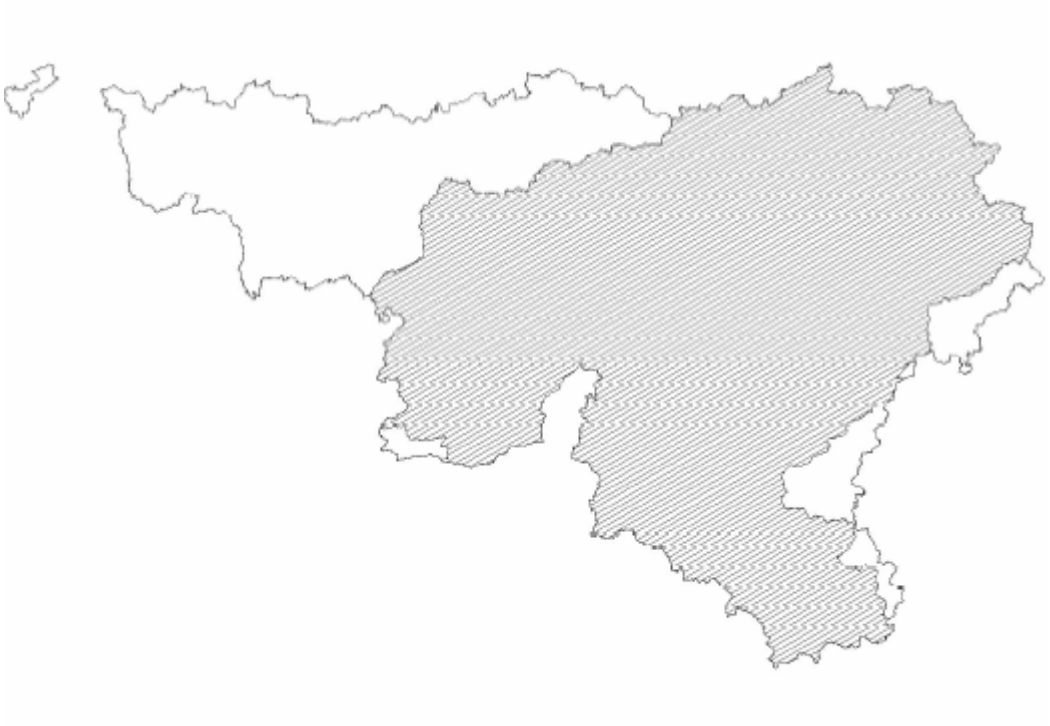


Fig. BE.7 Meuse RBD area in Wallonia.

c. the River Basin District of the Rhine (Rijn), shared with The Netherlands, Germany, Luxemburg, France, Switzerland, Austria, Liechtenstein. Drainage area: 225,000 km^2, of which 760 km^2 in Belgium. All of the Belgian Rhine RBD is situated in Wallonia. It consists of 1 single sub-basin (Moselle).

Fig. BE.8 Rhine RBD area in Wallonia.

d. the River Basin District of the Seine, shared with France. Drainage area: 79,000 km^2, of which a very small part 92 km^2 in Belgium. All of the Belgian Seine RBD is situated in Wallonia. It consists of a single sub-basin of the Oise.

Fig. BE.9 Seine RBD area in Wallonia.

BE.C, D & E. Fishing capacity, fishing effort and catches and landings.

- Professional coastal and sea fisheries.

  In 2003, the Belgian fishing fleet consisted of a total of 125 motorized vessels, with a total power of 66 869 kW and a gross registered tonnage of 23 794. The fleet consists mostly (97 per cent by engine power) of beam trawlers, the remainder being otter trawlers. About half the beam trawlers are of small to medium size, up to 300 hp (<221 kW). There is a time series about the fleet capacity. There are only three fishing harbours in Belgium: Zeebrugge, Oostende and Nieuwpoort. The main fishing grounds of the Belgian fishing fleet are the southern and central North Sea, where accounting for 44% of total catches (all species) in 2003. Other important fishing grounds are the English Channel (26%), the Celtic Sea (18%) and the Irish Sea (8%).

  There are data available on fishing effort. However this information is of minor relevance. By far the most important species in value is sole, representing 49 per cent of the total value of landings in 2003, although only 21 per cent of the landings. Plaice, in contrast, contributed 26 per cent by volume but was only 14 per cent of the total in value. The most valuable species in 2003 was turbot: less than 2 per cent of the landings represented 5 per cent of the value. Cod, the fourth most important species, represented 7 per cent of the landings by volume and nearly 5 per cent by value. There is a by-catch of eels, however those 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.

- Estuarine fisheries on the Scheldt.

  This fisheries is performed by 2 boat trawlers and 30 semi professional fishermen are estimated to fish with fykes. A number of those fyke fishermen are fishing illegally. The boat fisheries consisted of one beam trawler and one otter trawler operating regularly on the river. The number of fykes along the low tide waterline is estimated 150. The trawl fisheries is focused on eel. No data about catches are available.

  No official landing statistics for the fyke fisheries are available. On the basis of some fishermen's logbooks and on the basis of CPUE data on scientific monitoring (see BE.F) the total landings of eels by fyke fishermen are roughly estimated at 5 tonnes per year.

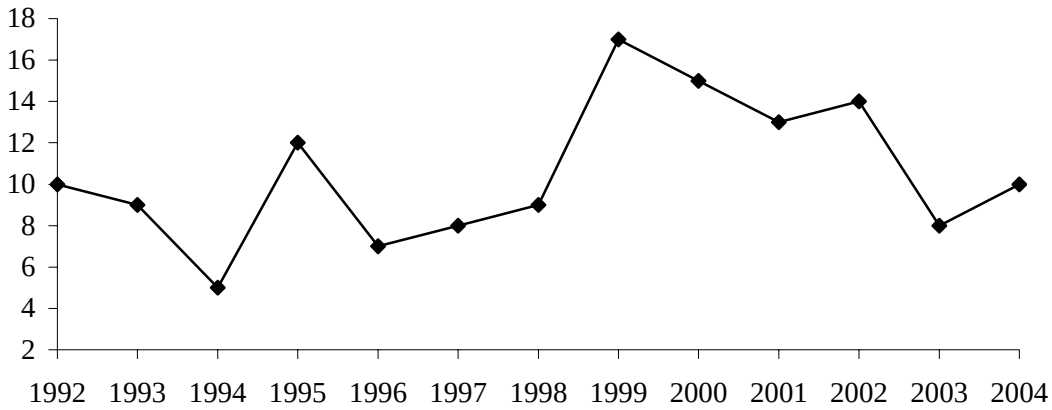
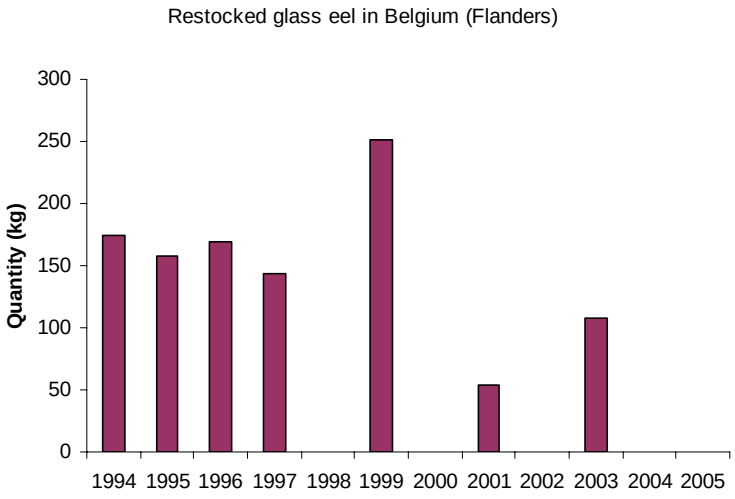


Fig. BE.10 Time series of the number of licensed semi professional fishermen on the Scheldt from 1992 to 2004 (Data Section Forest and Green, AMINAL).

BE.E.2 Restocking

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. In recent years the glass eel restocking could not be done due to the high market prices.

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).



Year	Quantity (kg glass eel)
1994	175
1995	157,5
1996	169
1997	144
1998	0
1999	251,5
2000	0
2001	54
2002	0
2003	108
2004	0
2005	0

Fig BE.11 and Table BE.a Re-stocking of glass eel in Belgium (Flanders) over the period 1994 to 2005, in kg of glasseel.

BE.E.4 Aquaculture

Allthough in recent years, two farm for intensive production of eels in recirculation systems were operating for a total production of 125 tonnes per annum (Belpaire and Gerard, 1994), nowadays eel culture has stopped completely.

BE.E.5 Recreational Fisheries

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

- Recreational fisheries in the Flemish Region.
  The number of licensed anglers was 60 520 in 2004. The time series shows a general decreasing trend from 1983.

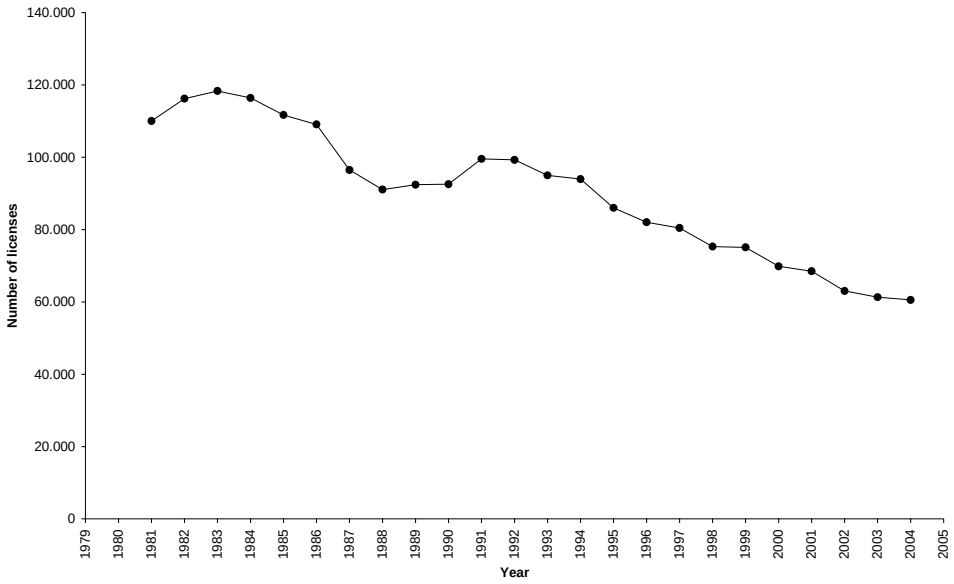


Fig. BE.12 Time series of the number of licensed anglers in Flanders from 1980 to 2004 (Data Section Forest an Green, AMINAL).

- Recreational fisheries in the Walloon Region.

The number of licensed anglers was 65 687 in 2004 (Data Fisheries Service, General Directorate of Natural Resources, Ministry of the Walloon Region).

- Recreational fisheries in the Brussels-Capital.

The number of licensed anglers is approximately 1 400 (Data Brussels Institute for Management of the Environment).

In total, there are approximately 128 000 recreational fishermen in Belgium. It was not possible to split out this information per RBD, however this is feasable as databases exist concerning the localities where licenses were emitted.

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.

There are no official data about 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, (submitted). 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 3,001 of the licensed anglers (out of 9,492 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 fishermen, the number of people taking home the eel, caught in Flemish public waters is estimated to be 4,429 (7.2% of licensed anglers). Considering

the catch and release obligation for eels in all public waters in Flanders, this is a high 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/y, 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. For group B it was calculated to be 3.9 kg per year or 76 g/week (Bilau et al, submitted). 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 Pauw (2005).

Table BE.b Rough estimate of the catch 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.

There are no official estimates about the catches of eels in the Walloon region. A 2002 survey estimated that 8% of the anglers never catch any eels and 33% sometimes catch them. 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 Walloonia).

- Recreational fisheries in Brussels-Capital.

No information on eel catches.

BE.F. Catch per Unit of Effort

There are some data about 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. Fig. BE.4 gives the trend in CPUE of estuarine fyke fishing from 1995 to 2003 in the Scheldt estuary. Additional data of other sampling stations along the estuary are available.

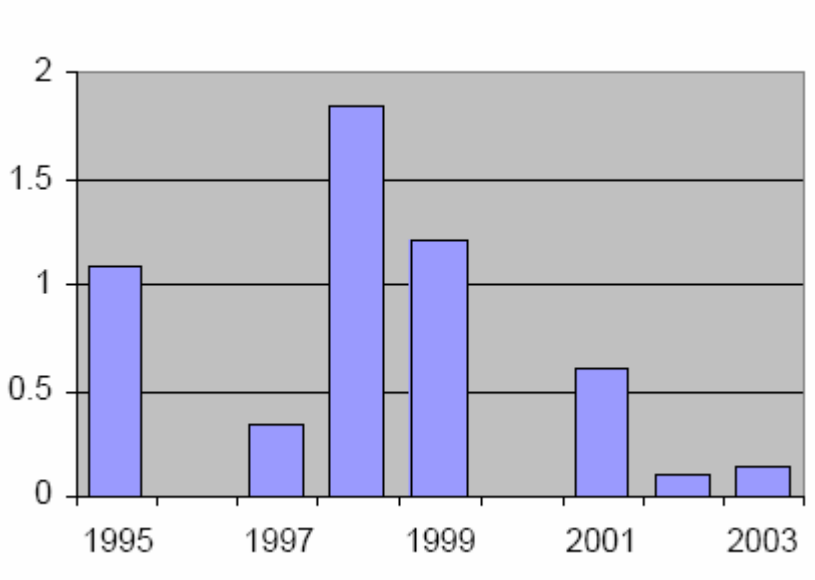


Fig. BE.13 Mean number of eel per day per fyke from 1995 to 2003 in the Scheldt estuary at Zandvliet (Maes et al., 2003)

BE.G. Scientific surveys of the stock

BE.G.1 Recruitment surveys, glass eel

Glass eel.

In Belgium, commercial glass eel fisheries is forbidden by law.
Interest in glass eel recruitment has been limited to the Flemish part of Belgium. Glass eel recruitment studies in the upper part of Belgium (Walloonia) are inexistent, as this region is situated quite far from the coast. Fisheries on glass eel is carried out by the Flemish government. The glass eels are used exclusively for restocking in inland waters.
Long term time series on glass eel recruitment are available for the Nieuwpoort station at the mouth of the river IJzer. Other localities were assessed only occasionally or recently. Although the river Scheldt is the main basin in Flanders and despite the fact that many old reports mention high glass eel recruitment in the past, no quantitative series for the migration of glass eel on this estuary is available.
The IJzer is a relatively small lowland river (length 76 km) having its spring in the north of France and flowing through Flandrian polder area. The whole catchment covers 1400 km^2 and is well known for its eel population attracting many eel (sport)fishermen.
The river has a mean annual discharge of 5 to 6 m^3/s, river flow is regulated by the presence of seasluices at Nieuwpoort. IJzer water flows into a basin called 'Ganzepoot'. The Nieuwpoort monitoring station is situated at the basis of a channel draining waters from several rivers and canals into the North Sea (51°08' N - 2°45' E). The monitoring site is situated at 3.8 km from the sea, both in the ship lock from the IJzer mouth (Iepersluis)(dipnet fisheries), and in the basin Ganzenpoot (boat fisheries). By starting to catch the glass eel at the IJzer mouth in 1964 on an annual basis, a monitoring system for the recruitment of the European stock was unconsciously initiated. The fisheries operations have been sustained untill now.
The IJzer glass eel series is of particular interest as the series goes back to a quite early stage (1964), as the fishing technique and equipment staid identical during the whole period, and as the

fisheries was not biased nor influenced by any other fisheries activity as commercial fisheries or poaching on glass eel do not exist.

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 untill high tide is attained.
The time series has been achieved by fishing in the ship lock of the Iepersluis at Nieuwpoort (Figs BE.20). 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 heigh. This has been done in this way since 1964.

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, …) 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 Institute for Forestry and Game Management is keeping up to date a database with the catches.
Additional glass eel recruitment data have been collected occcasionnally (e.g. morfometrical characteristics of the glass eel, densities of glass eel expressed as numbers per m^3, mark recapture experiments, presence at other stations, capacity to pass the lock gates, influence of tide, e.g. …).

The glass eel season in Belgium is falling mainly in the months march and april.

Time series for the IJzer were presented in the past by Belpaire and Ollevier (1987), Belpaire (1987), Belpaire et al. (1991), Denayer en Belpaire (1992) Belpaire (2002). An updated version for the period 1964-2005 is presented in Fig. BE.6.
It represents variations of the total annual catches of the dipnet fisheries in the Nieuwpoort ship lock and gives the maximum day catch per season. Overall trend of the figure confirms the general tendencies reported in the stock wide recruitment decline in most European rivers with a significant decline of annual total catches in the beginning of the eighties, and subsequent continued low catches.
Catches of the years 1964 and 1965 are low compared with later years, but have to be considered as fragmentary results of preliminary fishing experiences. Therefore, they should not be included in statistical stock wide data analysis.
In the period 1966-1979 the catches are high, mean catch is 511 kg per annum (252-946 kg). Presumably, according to verbal references, in this period the catch data are an underestimation of the recruitment as the duration of the fisheries was shortened when the local glass eel storing capacity was attained. Duration and fishing frequency at that time was influenced by the demand for restocking glass eel all over Belgium, and by the way and frequency catches were collected for transportation throughout Belgium.
As can be seen from the figure the period 1980-1982 was characterised as transitionnal years of decreasing and low recruitment, mean catch is 157 kg per annum (90-252 kg).The subsequent years (period 1983-2000) the catches are very low, mean annual catch is 28 kg per annum (1-218 kg). After 2000 catches were extremely low (2001: 0.7 kg, 2002: 1.4 kg, 2003: 0.5 kg, 2004: 0.4 kg, 2005: 0.8 kg).

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	
7	575	472	36,5	9,8	
8	553,5	370	48,2	2,255	
9	445	530	9,1		

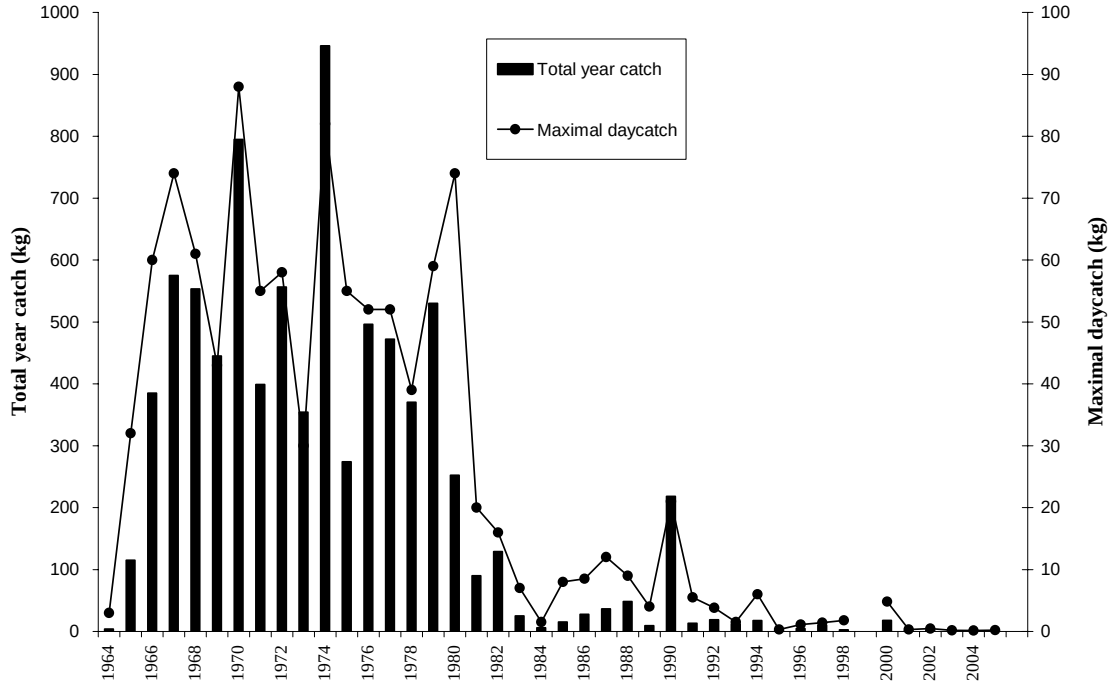


Fig. BE.14 and Table BE.c Annual variation in glass eel catches at river IJzer using the dipnetcatches in the ship lock at Nieuwpoort (dipnet catches)(Total year catches and maximum day catch per season). In Table BE.c the presented data are the total year catches.

Ascending yellow eel as recruitment indicator

Control of impinged fish at cooling water inlet and control of fish traps at fish passes are valuable techniques for monitoring recruitment by following monitoring the ascending young eels. This is particularly the case for the impingement studies at the Doel nuclear power plant on the River Scheldt and at the Liche fish trap at the fish pass on the River Meuse.

BE.G.2 Stock surveys, yellow eel

Since 1995, the Institute of Forestry and Game Management (IFGM) 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 (IJzer, 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 Tab. BE.d. 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.

Table BE.d. Description of the techniques used for fish stock analysis in Flandrian waterbodies by IFGM.

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 mon both river banks) • fykes and/or gill nets
Closed river arms and ponds Polder drainage systems	Combination of : • seine netting • boat electrofishing (both river banks) • fykes and/or gill nets

These data allow quantification of the abundance of eels in Flandrian waterbodies, over space and time. Figures BE.7 to 9 give the distribution and abundance of eels in Flanders (electrofishing data), respectively is running waters, canals and polder waters and ponds and lakes. Figures BE.10 and 11 give a summary on presence and abundance of eels in Flanders for 1332 stations (Belpaire et al., 2003).

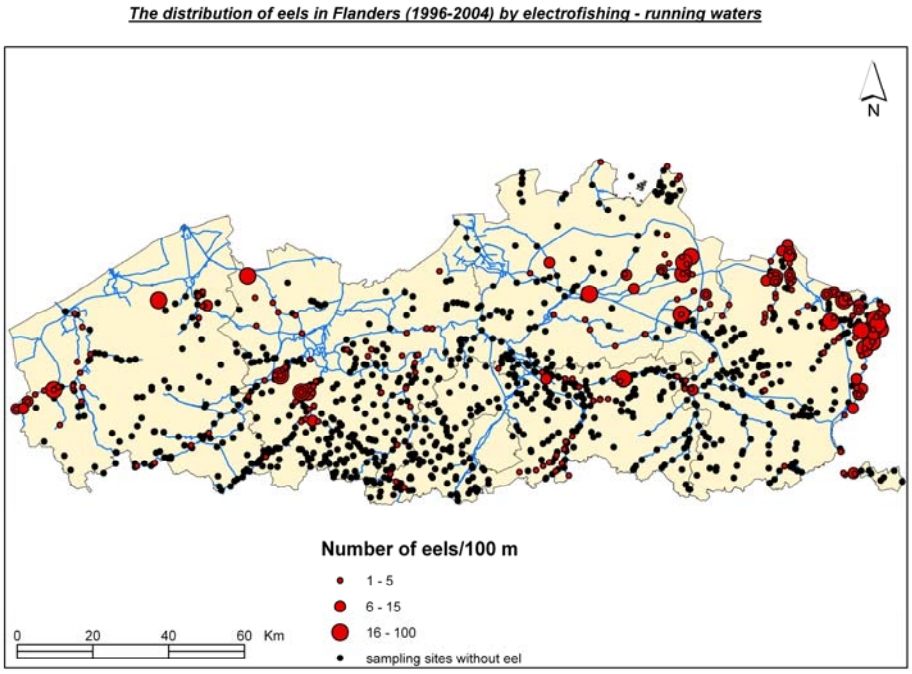


Fig. BE.15 Distribution and abundance of eels in Flanders (electrofishing data) in running waters.

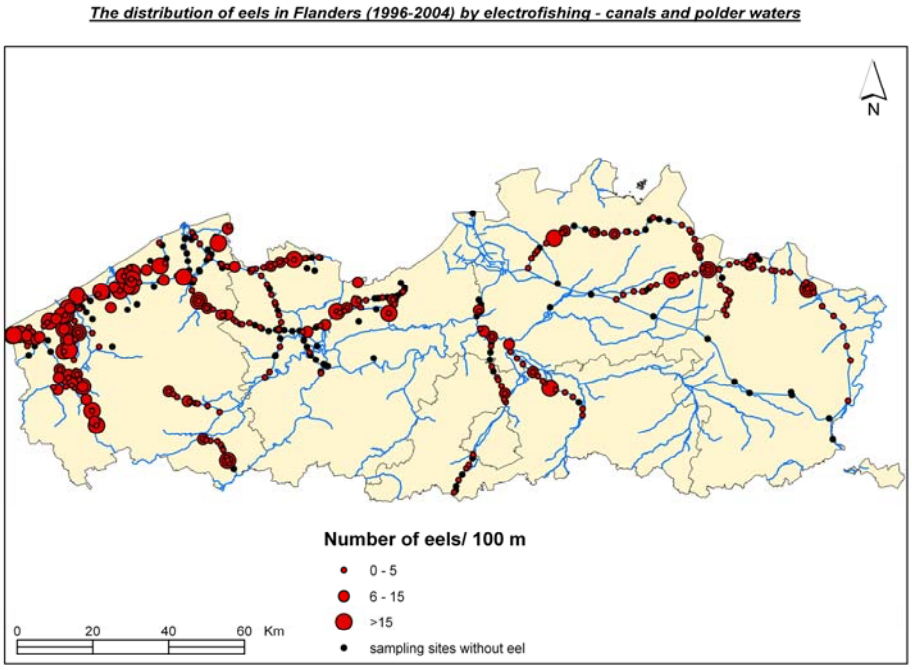


Fig. BE.16 Distribution and abundance of eels in Flanders (electrofishing data) in canals and polder waters.

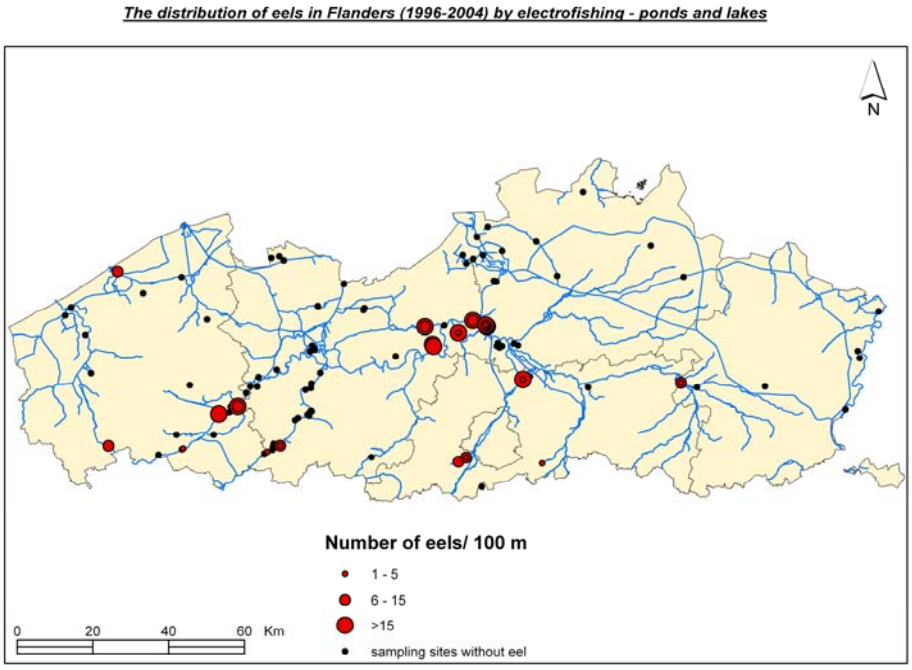


Fig. BE.17 Distribution and abundance of eels in Flanders (electrofishing data) in ponds and lakes.

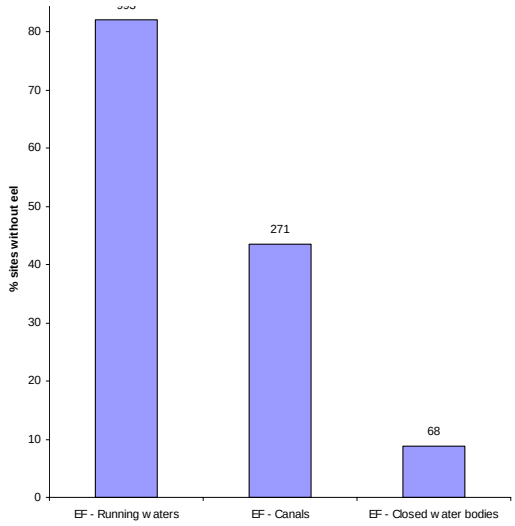


Fig BE.18 Presence of eels from electrofishing surveys on 1332 locations (Flanders) from different typology, expressed as % sites without eel (Rivers and brooks : minority with eels 18%, Canals : ca 50%, Closed water bodies : 91%)(Belpaire et al., 2003).

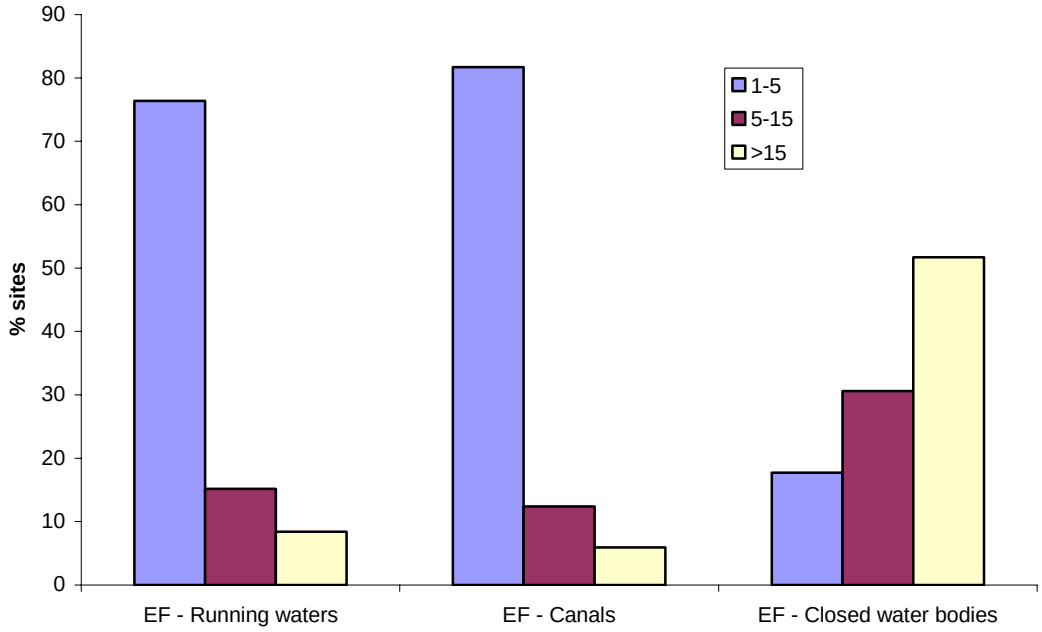


Fig BE.19 Abundance of eels (number of eels/100m EF) on sites where eels are present. Abundance in running waters and canals is usually low (1-5 ind/100m), but higher in closed water bodies (> 15 ind/100m) (Belpaire et al., 2003).

A trend is also available from studies by the University of Louvain on the River Scheldt. Eel densities in the Scheldt estuary were recorded during the period 1991 – 2002 by analysing eels in the cooling water intake of the Doel power station and by a follow up of the fyke net fisheries. The numbers of adult eel (50 – 70 cm) per fyke net per day decrease from 1998 to 2002 and the numbers of pre adult eel (20 cm) per 10^3 m^3 cooling water showed a declining trend.

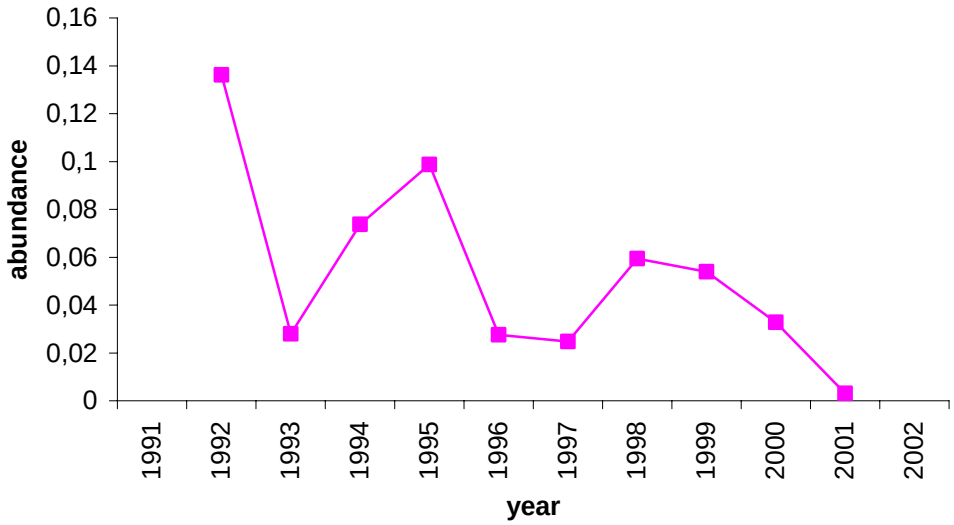


Fig BE.20 Trends in abundance of estuarine eels in River Scheldt (1991-2002) from impingement studies at the cooling water intake of the Doel nuclear power plant. Data from University Louvain (J. Maes), Belpaire et al.(2003).

In the Walloon Region similar fish stock assessment surveys are carried out by the Institut de Recherches Forestières et de Gestion de la Faune, and by universities. Currently, as far as our knowledge, these surveys are not performed on regular basis.

On the Meuse, the University of Liège is monitoring the amount of ascending young eels in a fish-pass. From 1992 to 2004 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 m3/s; summer water temperature 21-26˘rC).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 32157 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. 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).

Fig. BE.21 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

BE.G.3 Silver eel

In Flanders, studies on silver eel populations are quite scarce. A 1994 study on the seaward migration of migrating silver eel from a small shallow lake in the West of Flanders (Blankaart Natural Reserve) estimated a silver eel production of at least 2.5 kg/ha (data from a 3-day survey) (Denayer and Belpaire, 1996). Length frequency distribution of both, male and female cohorts, are available.

There are possibilities to follow silver eel migration by monitoring impinged eels at the cooling water intake of power stations, especially at the Doel nuclear power plant on the Scheldt and at the Langerlo power plant on the Albertkanaal.

BE.H. Catch composition by age and length

Currently, there is no sampling programme for catch composition in commercial catches.
However in scientific monitoring length distribution is routinuously monitored in glass eel and yellow eel (see under BE.G.1 and 2).

BE.I. Other biological sampling (age and growth, weight, sex, maturity, fecundity).

Anguillicola

Anguillicola infection rates were monitored in 1987, 1997 and 2000. The presence of *A. crassus* in Flanders was first discovered in 1985; 2 year later a survey revealed a prevalence of 34.1% and a mean infection intensity of 5.5, based on adult nematodes only, and 10 year later the parasite was present at all 11 sites sampled (Belpaire et al., 1985, 1989, 1990). Prevalence had increased to 62.5% but the mean infection intensity had decreased to 3.9 adults per infected eel. In the year 2000, a third study revealed that *A. crassus* was present in 139 of 140 investigated sites; a further increase in prevalence to 68.7% and a decrease in mean infection intensity to 3.4 adults per infected eel was observed. When all larval stages were taken into account, mean prevalence amounted to 88.1% and mean intensity to 5.5 adults. The high infection level in Flanders is thought to be the result of restocking with glass eel and yellow eel, both of which are susceptible to *A. crassus*. The general infection parameters were similar in all 11 river catchments. It is possible that in Flanders both prevalence and mean infection intensity are stabilizing due to density-dependent regulation of the parasite infrapopulation. Fibrotic swimbladder walls were observed, mainly in large eels, and 20% of the total number of nematodes consisted of encapsulated larvae in the surveys of 1997 and 2000; 8 cases of swimbladder regeneration were observed (Audenaert et al., 2003).

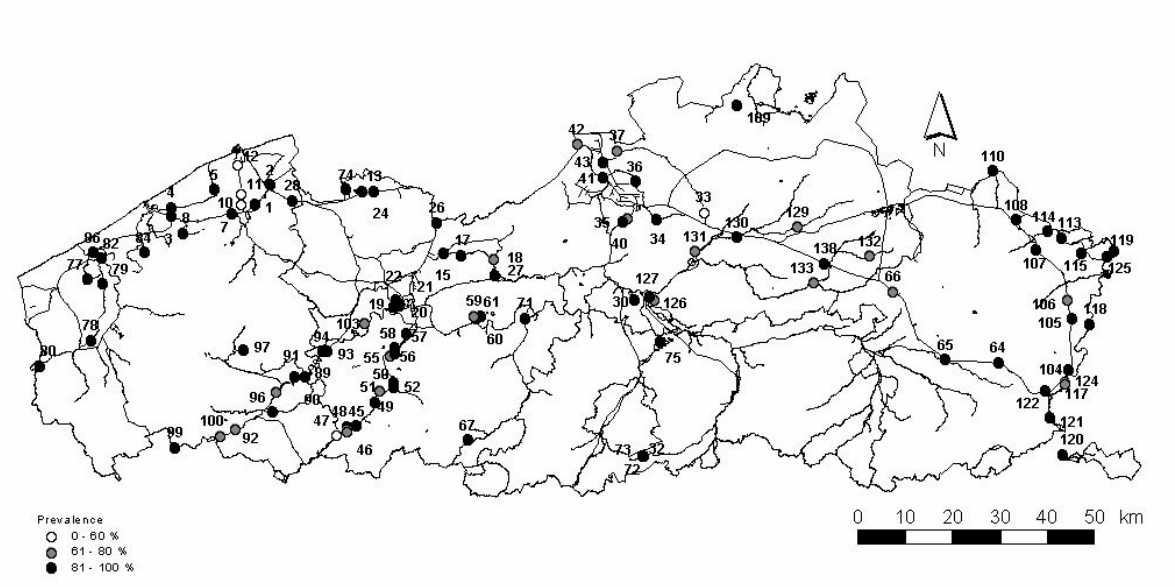


Fig. BE.22 Distribution map of sampling sites of European eel across Flanders and prevalence of the parasitic nematode *A. crassus* in the year 2000 (Audenaert et al., 2003)

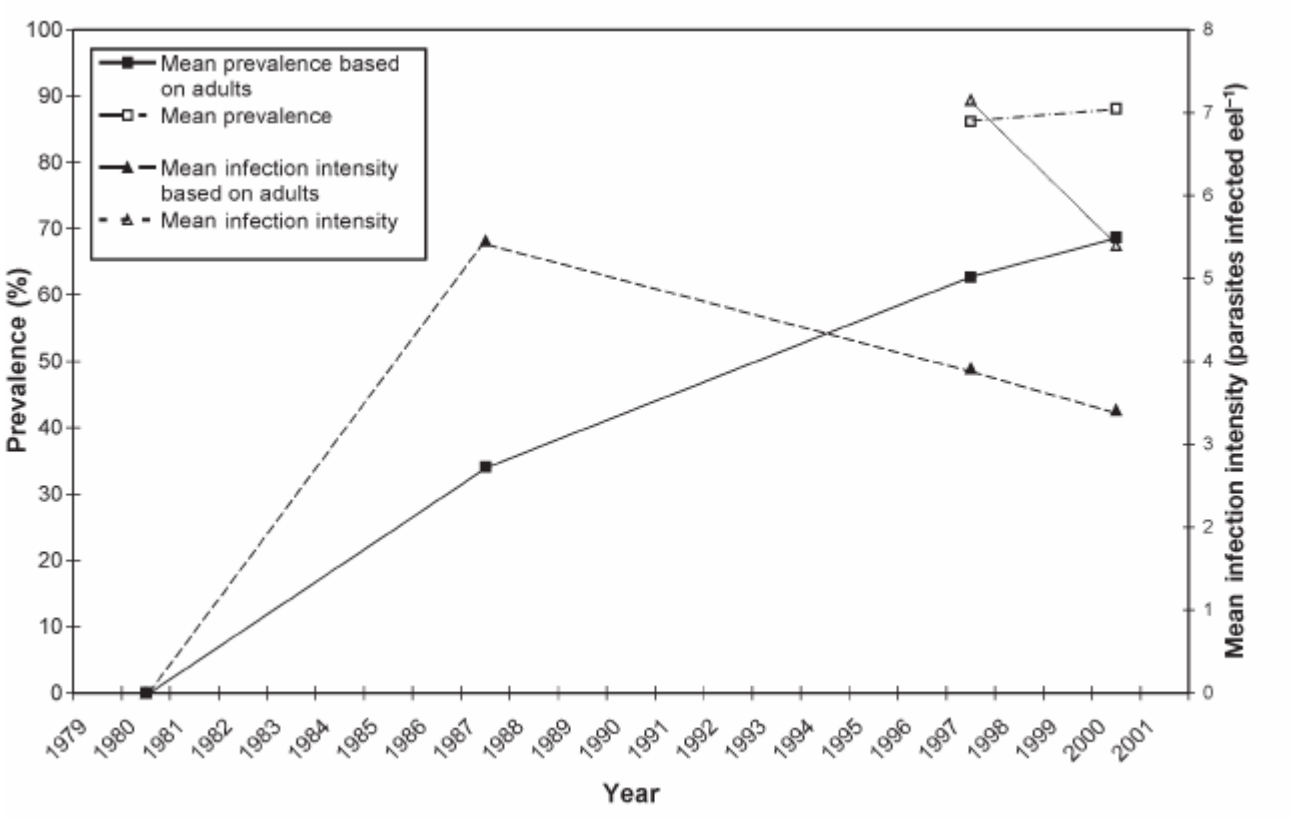


Fig. BE.23 *Anguilla anguilla* infected by *Anguillicola crassus*. Temporal pattern of parasite infection in Flanders between 1979 and 2001 (Audenaert et al., 2003)

Growth rate

There is currently no general monitoring program for growth rates of eel. In the past studies haven been undertaken to follow growth of elvers stocked in ponds (Belpaire et al., 1992). In 2001, a study has been set up to study and monitor growth of tagged eel in a Flandrian lake (Lake Weerde) over 5 years. Results are in process.

Contaminants in eel

Since 1994 the Research Institute for Nature and Forest (INBO) has built out a pollutant monitoring network for public water bodies in Flanders (Belgium) using eel (*Anguilla anguilla*) as a biomonitor. Eel is used for biomonitoring because it is a very fatty fish (strong lipophylic character of a.o. pesticides and PCBs), benthic and sedentary (during the yellow eel phase). Eels are long-living and widespread, occurring in very diverse habitats and even in polluted waters. Their position on the trophic ladder and the absence of an annual reproductive cycle, affecting lipid metabolism, are additional advantages for their use as a sentinel organism.
Contaminants analyzed were heavy metals, PCBs, organochlorine pesticides, brominated flame retardants, volatile organic compounds, ….. and were reported at various occasions (Belpaire et al., 2003, Goemans et al., 2003, Goemans and Belpaire, 2004, Roose et al., 2003, Morris et al., 2004). At present the dataset included results from approximately 2000 individually analyzed eels originating from 325 different localities in Flanders.
The results have been communicated to national managers and especially the high PCB values measured in eels from most of the locations were very concerning. Hence, immediate action has been undertaken to protect the local fishermen's health. A catch and release obligation for every eel caught in Flanders was set by ministerial decree. In some eels PCB values as high as 7,000 ng/g

BW (measured as the sum of the 7 indicator PCBs) were measured, nearly exceeding the national PCB standard (75 ng/g BW) with a factor 100.

In Flanders there exists a clear spatial variation in contamination which can be linked to human interactions and/or land use. On some stations contamination levels are very high, given serious concern for eels health and reproduction success. The variation in contamination levels over the different stations are illustrated in figures BE.24-27 for respectively a heavy metal, a pesticide, PCBs and a brominated flame retardant.

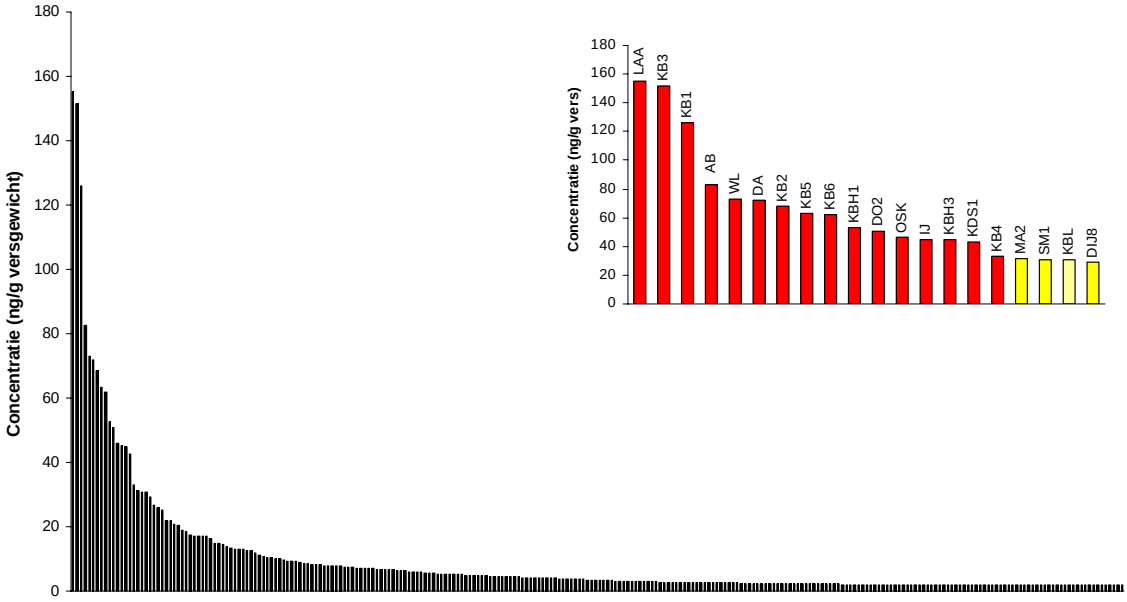


Fig. BE.24 Mean cadmium concentrations in eels from Flanders (260 stations, 1994-2001) (Goemans et al, 2003)

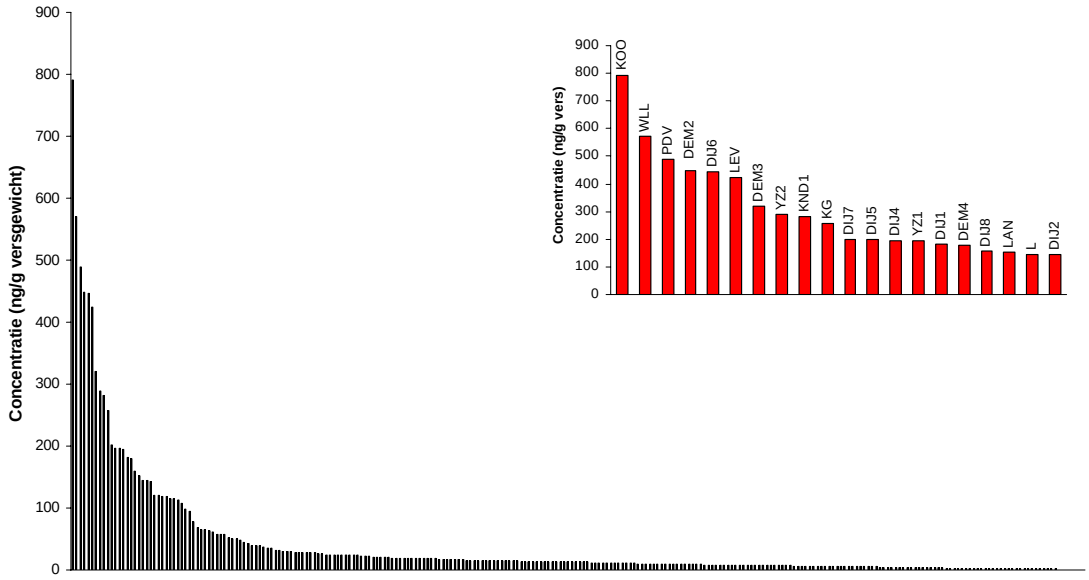


Fig. BE.25 Mean lindane concentrations in eels from Flanders (260 stations, 1994-2001) (Goemans et al, 2003)

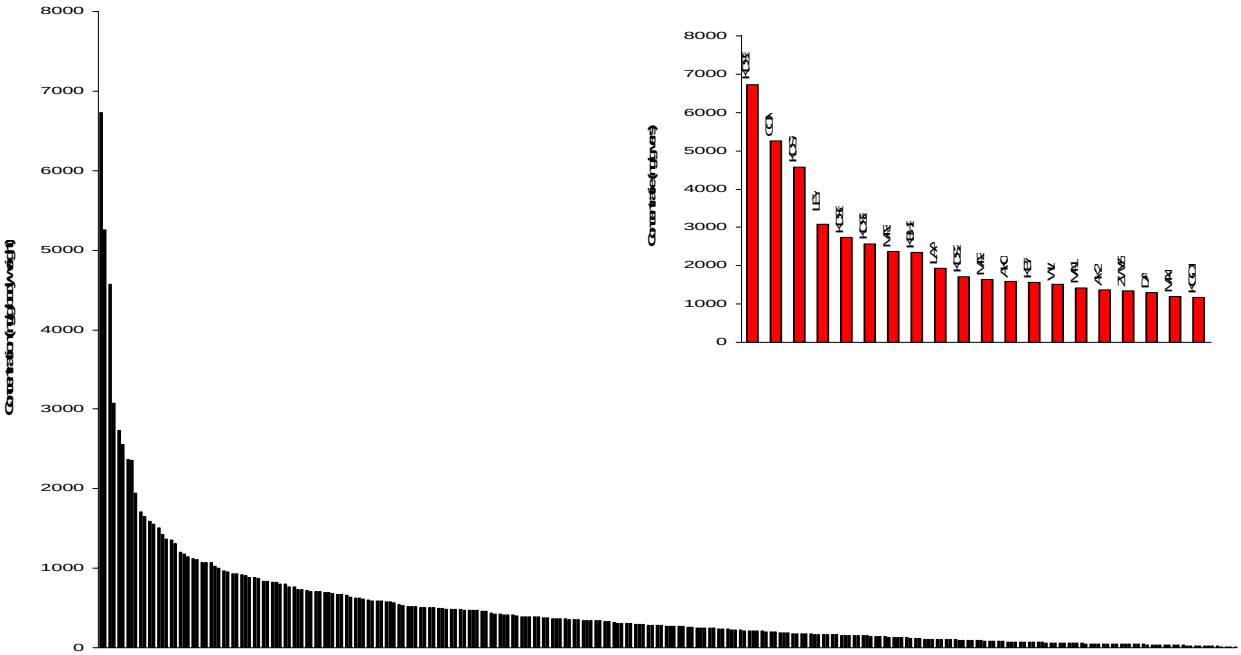


Fig. BE.26 Mean PCB concentrations (ng/g body weight) in eels from Flanders (260 stations, 1994-2001). Belgian maximimu limit is 75 ng/g body weight. (Goemans et al, 2003)

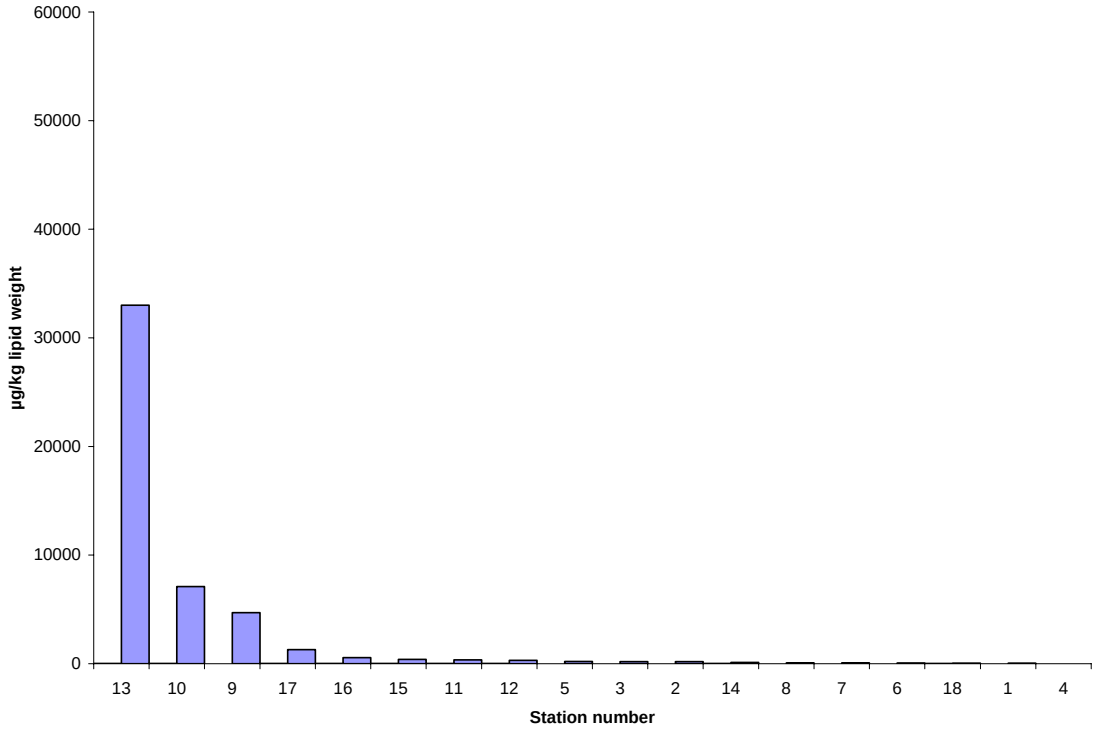


Fig. BE.27 Mean HBCD (a brominated flame retardant) concentrations in eels from Flanders (18 stations, 2000) (Belpaire et al, 2003)

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