

Report on the eel stock and fishery in Portugal 2008

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Reporting period: This report was completed in August 2008 and contains data up to 2007.

PT.B Introduction

In Portugal, the European eel, *Anguilla anguilla*, is an important species for both commercial and recreational fisheries, which occur in different types of water bodies especially in lagoon coastal waters, estuaries and rivers.

The main river basins are international shared between Portugal and Spain, namely:

Minho river, with a total surface area of 17 080 Km² (800 Km² in Portugal, 16 280 Km² in Spain) and 330 Km long; Lima river, with a total surface area of 2480 Km² (1177 Km² in Portugal, 1303 Km² in Spain) and 108 Km long; Douro river, with a total surface area of 97 290 Km² (18 338 Km² in Portugal, 78 952 Km² in Spain) and 897 Km long; Tejo river, with a total surface area of 80 600 Km² (24 850 Km² in Portugal, 55 750 Km² in Spain) and 1007 Km long; Guadiana river, with a total surface area of 66 800 Km² (11 580 Km² in Portugal, 55 220 Km² in Spain) and 810 Km long.

The main national river basins are:

Cávado river, with a total surface area of 1600 Km² and 135 Km long; Ave river, with a total surface area of 1390 Km² and 94 Km long; Vouga river, with a total surface area of 3635 Km² and 148 Km long; Mondego river, with a total surface area of 6644 Km² and 234 Km long; Lis river, with a total surface area of 945 Km² and 39,5 Km long; Sado river, with a total surface area of 7640 Km² and 180 km long; Mira river, with a total surface area of 1600 Km² and 145 Km long; Arade river with a total surface area of 229 Km² and 75 Km long.



Figure1. Main River Basin in Portugal: Minho, Lima, Cávado, Ave, Douro, Vouga, Mondego, Lis, Tejo, Sado, Mira, Arade and Guadiana.

In Portugal, the eel commercial exploitation comprises glass eel (Minho River) and yellow eel (all rivers) phases of its life cycle.

PT.C Fishing capacity

PT.C.1 Glass eel

The glass eel fishing is prohibited in all rivers of Portugal with exception of the Minho River. Because glass eel has a high economical value a strong illegal activity is going on in these rivers.

PT.C.1.1 Minho River

The Minho river which constitutes over 80 Km the northern boundary between Portugal and Spain has become one of the most important glass eel fisheries on the Iberian Peninsula over the last three decades. Management of the eel stock is under the responsibility of the “Ministério da Agricultura, do Desenvolvimento Rural e das Pescas”. Two kinds of laws are implemented in the country concerning glass eels fishery. In the Minho River an agreement between Portuguese and Spanish authorities allow to fish glass eels between November and April (in the past), November and last New Moon of March (2006/2007), November and last New Moon of February (last season) using a stow net. In 2000/2001, the fishery was prohibited in all other Portuguese rivers, except for aquaculture and restocking programmes. The monitoring of glass eel recruitment has been carried out since the mid 1970s based in professional fishers catch values and declared annually to the authorities. The Portuguese catches are mainly sold to Spain for human consumption and aquaculture, and

higher prices are attained before Christmas (on average 350 €/Kg, could attain 500 €/Kg). Because glass eel has a high economical value a strong illegal activity is going on in all other national rivers.

In the Minho River the glass eel fishery is permitted with a stow net. The stow net has the following maximum dimensions: 10 m of floatline, kept at the surface with 10–20 buoys, 8 m height, 15 m leadline, width of netend 2.5 m and mesh size of 1–2mm. Opening area is around 50 m². The net is anchored when the tide is rising, the end fastened to a boat, and glass eels are scooped out with a small dipnet frequently. This gear is exclusively used for glass eel fishing but the bycatch can be very important, including up to 49 species. From the river bank, glass eels can also be fished with a dipnet of 1.5 m maximum diameter and mesh size of 1–2 mm. In 1983 there were 450 licensed fishers in Spain and 750 in Portugal, corresponding to 300–400 nets in total. In 1988 approximately 600 boats in Portugal have permission to fish glass eels with one net each and in 1995, 455 Portuguese boat inscriptions were recorded. In 1999, 251 Spanish fishers were registered for the glass eel fishery. Actually, nearly 500 fishers from both countries have a professional licence to fish glass eel.

The fact that a fisher has a licence to fish glass eels in a certain year does not necessarily mean that he will actually fish. The seasonal occurrence of other, relatively abundant species, like lamprey, influences the effort in the glass eel fisheries in an unpredictable manner.

The fishery is always performed at night around new moon as it depends completely on the rising tidal current. Depending on weather conditions peaks may occur in winter or spring. Catches in summer are very low (Antunes, 1994a).

Fishers are obliged to inform the local authorities of their total annual catches. The official fishery statistics are kept by the responsible local authorities-*Capitania do porto de Caminha*. Total annual statistics have been recorded since 1974. Between 1974 and 2005, 13.4.tons of glass eels were caught annually (however we estimated that values are 80% underestimated). A maximum of 50 tons was declared in 1980/81 followed by a second peak of 30.3 tons in 1984. In the period of 1985 to 1988 the official yield dropped to 9,5 tons with a peak of 15.2 tons in 1995. In 2000/2001 low catches were obtained, probably as a consequence of bad weather conditions that prohibited the fishery during 3 months. After 2001/2002 season until 2006 the values decreased to 2.0 tons. The 2006/2007 season values from Spain are not yet available.



Figure 2. Stow net-“tela”.

Table 1. Official data of glass eel fishery between 1974 and 2007 in the Minho River.

YEAR	PORTUGAL	SPAIN	TOTAL (TONS)
1974	0,05	1,6	1,65
1975	5	5,6	10,6
1976	7,5	12,5	20
1977	15	21,6	36,6
1978	7	17,3	24,3
1979	13	15,4	28,4
1980	2,9	13	15,9
1981	32	18	50
1982	6,7	9,7	16,4
1983	16	14	30
1984	14,8	15,3	30,1
1985	7	6	13
1986	9,5	5,5	15
1987	2,6	5,6	8,2
1988	3	5	8
1989	4,5	4	8,5
1990	2,5	3,6	6,1
1991	4,5	2,4	6,9
1992	3,6	9,8	13,4
1993	2,9	2,1	5
1994	5,3	4,7	10
1995	8,7	6,5	15,2
1996	4,4	4,3	8,7
1997	4,5	2,9	7,4
1998	3,6	3,8	7,4
1999	3	3,8	6,8
2000	1,2	6,5	7,7
2001	1,1		1,1
2002	1,443	7,8	9,243
2003	0,814	1,6	2,414
2004	1,17	1,3	2,47
2005	2,7	0,32	3,02
2006	0,905	1,14	2,05
2007	0,750		

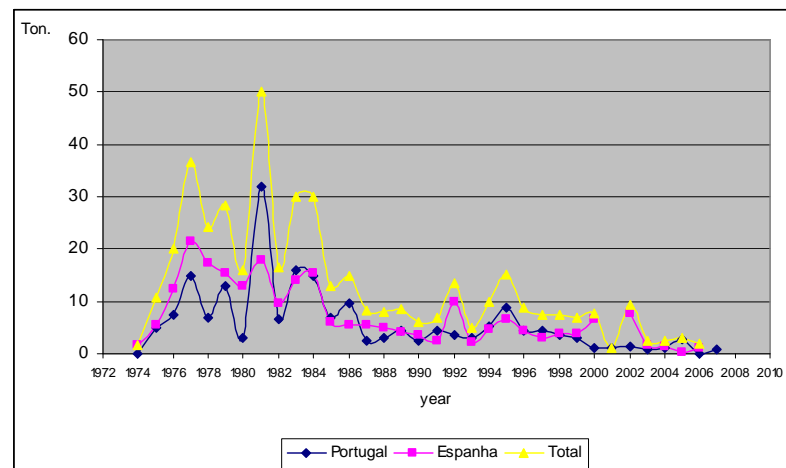


Figure 3. Official data of glass eel fishery between 1974 and 2007 in the Minho River (source: *Capitania do porto de Caminha e Comandancia Naval Tuy*).

PT.C.1.2. Illegal fishing

In the country, in all main rivers basin, with exception of the Minho River basin, an important illegal commercial glass eel fishery exists. In general there is no information concerning data of these fisheries. The information available is obtained directly through fishers and dealers. It is used an “invisible net”-stow net with bag that could be permanently in the water causing an important ecological impact.



Figure 4. Stow net with bag (17 meters long).

PT.C.2. Yellow eel

The yellow eel fishery management is from responsibility of “Ministério da Agricultura, do Desenvolvimento Rural e das Pescas” and there are differences among the national catchment areas. Generally are permitted longlines and fykenets to fish yellow eel, during all year with a minimum size that varies between 20 and 22 cm.

In the 1980s and concerning small-scale (“artesanal”) fishery there was about 10 000 boats (15 000 fishers) which 80% were dedicated to the local fishery and 20% were to the coastal fishery. However, after one decade the number of the fishers was reduced to 12 000 (Franca *et al.*, 1988). We don’t know the total number of professional of fishers fishing yellow eel. Only a partial data are declared, because a low percentage of yellow eel pass in the auction market for fish products.



Figure 5. Fykenet "galricho", Ria de Aveiro, Tejo River (Franca *et al.*, 1998).

Figure 6. Fykenet "nassa", Minho River.

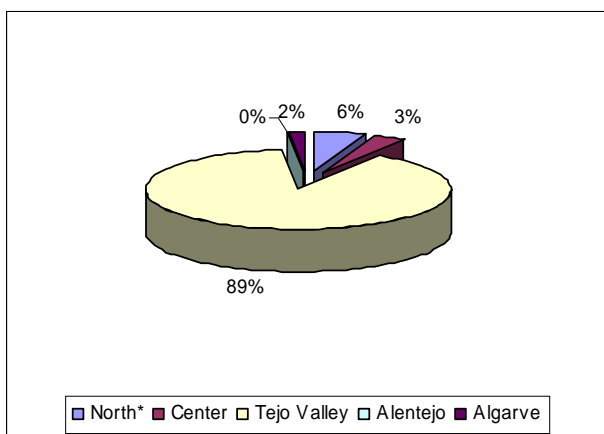


Figure 7. Percentage of declared values per region of the country. Total catch= 35,9 tons; Year-2002.

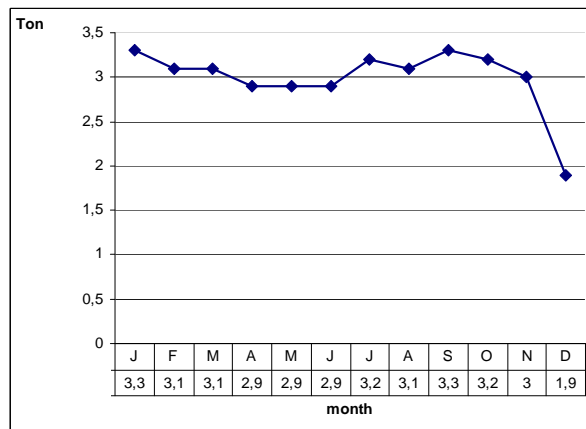


Figure 8. Monthly values declared for in all country regions. Total catch=35,9 tons; Year-2002.

The number of recreative fishers is estimated to be 600 000, of which 50% corresponds to inland fishing involving 100 M€/year.

PT.C.2.1 Minho River

In 1984 there were 1744 Portuguese fishers with licence to fish in the Minho River. The number decreased to around 800 at the beginning of 1990s. Actually the number of Portuguese and Spanish fishers is approximately 900 of which only 50% declared fish captures each year.

The yellow eel is captured using baited hooks and fykenets with the following legal fishing period: all year to the baited hooks and between September and November to fykenets.

Table 2. Yellow eel catch in the Minho River between 1983 and 2007.

YEAR	PORTUGAL	SPAIN	TOTAL
1983	2		2
1984	4,3		4,3
1985	3		3
1986	3,4		3,4
1987	3,1		3,1
1988	3		3
1989	3,8		3,8
1990	2,5		2,5
1991	2,984		2,984
1992	3,5		3,5
1993	5,6		5,6
1994	1,3		1,3
1995	1,5		1,5
1996	1,2		1,2
1997	0,75		0,75
1998	1,6		1,6
1999	0,65		1,02
2000	0,86	0,37	0,86
2001	0,316		0,316
2002	0,671		0,671
2003	1,014	0,265	1,279
2004	0,807	0,277	1,084
2005	0,95	0,32	1,27
2006	1,53	0,1	1,63
2007	1,51		1,51

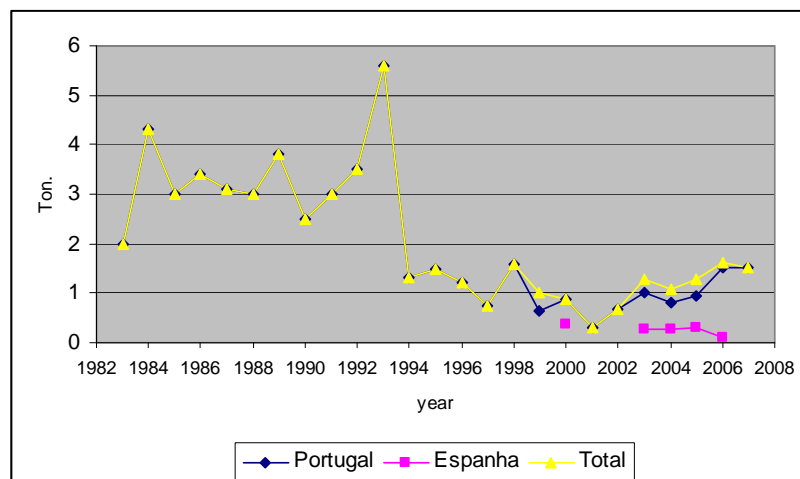


Figure 9. Yellow eel catches in the Minho River between 1983 and 2007 (source: *Capitania do porto de Caminha e Comandancia Naval Tuy*).

PT.D Fishing effort

Landings declarations don't include record for effort or gear. This kind of information is possible asking directly the fishers or dealers.

PT.E Catches and landings

Catch of glass eel-In the Minho River the monitoring of glass eels recruitment has been carried out since de mid 1970s based in professional fishers catch values and declared annually to the authorities.

Catch of yellow eel-There is no real data on landings of yellow eel in the country because usually the fish caught in estuaries and inland waters didn't pass in the auction market.

Aquaculture production-In Portugal the eel culture has no expression. Actually the available data means to extensive aquaculture practised in coastal lagoons and the values declared are below to 10 tons/year.

Re-stocking-There is no national programme for eel re-stocking.

Catch of recreational fisheries-There are no catch statistics from recreational fisheries.

The eel fishing activity in Portugal is not enough to the internal market. The main areas of eel consumption are in the Centre and South of the country, especially in the Tejo Valley region. No data exists about the amounts of eels alive that arriving Portugal from different origin markets like America, Marrocos, Tunisia, Spain, France, Belgium and the Netherlands.

PT.F Catch per unit of effort

Data on catch per unit of effort do not exist.

PT.G Scientific surveys of the stock

PT.G.1 Recruitment

Experimental glass eel fishery in the Minho River was initiated in 1981, supported by grants and projects, and conducted for several purposes, with no fixed stations in general (Weber, 1986; Antunes and Weber, 1990, 1993; Antunes, 1994ab). Occasional studies in Lis River, Mondego River, Guadiana River and Lima River were conducted for short periods (Jorge and Sobral, 1989; Jorge *et al.*, 1990; Domingos, 1992; Bessa, 1992; Bessa and Castro, 1994, 1995; Domingos, 2003). Generally the information available from scientific studies includes fishing time, yield, bycatch, biometric parameters, pigmentation, relation with moon's phase and time of the year.

Sites of experimental glass eel fishery	Period
Mondego River	1979–1983, 1988–1990
Lis River	1991–1994
Guadiana River	1998–1999
Lima River	2001–2002
Minho River	1981-

PT.G.2 Minho River

The statistics on the commercial fishery have been used as indicator of the recruitment strength. Underreporting is rather likely. Nevertheless, they will be indicative for the trend in glass eel recruitment to the Minho River for the past 30 years. Experimental fishing in Minho River has been operated since 1981 in several periods. Although monitoring was not the primary objective, this research has contributed to our knowledge of the fish stock and fisheries. The experimental fishing trend is in agreement with official data. In the last two years experimental fishing was done included in the INDICANG project. The work concerning glass eel entrance comprised:

- monthly experimental glass eel fishery (biometric and pigmentation stage, environmental data and in some periods the bycatch analyses);
- accurate fishing data from fishers to apply in glass eel estimation entrance.

PT.H Catch composition by age and length

Portugal has not sampled the landings/catches of eel.

PT.I Other biological sampling

PT.I.1 Yellow eel

PT.I.1.1 Eco-toxicological

At national level several eco-toxicological studies using eels from different catchment areas, were published, e.g.. Aveiro lagoon (Pacheco and Santos, 2001), Pateira de Fermentelos (Maria *et al.*, 2006; Teles *et al.*, 2007); Iqbal *et al.*, 2004, 2006.

PT.I.1.2 Contaminants

Information about trace metals in several fish species of the Ria de Aveiro, included eels is given by Cid *et al.*, 2001 and PCB's in Minho River by Santillo *et al.*, 2005. Neto, 2008 analysed and compared Cd, Cu, Pb and Zn concentrations in muscle and liver of

eels and sediment of the Tejo estuary.

PT.I.1.3. Parasites

Different works dedicated to eel parasites are available:

Nematoda-Ria de Aveiro (Cruz *et al.*, 1992), Douro River catchment (Saraiva *et al.*, 2002; Saraiva *et al.*, 2002).

Intestinal Helminth communities-Lima, Cavado, Ave and Douro catchment areas (Saraiva *et al.*, 2005).

Protozoa-Âncora, Lima, Cávado, Douro and Tejo catchment areas (Carvalho-Varela, 1984; Cruz and Davies, 1998); Cruz and Eiras, 1997.

Parasite fauna in general including *Anguillicola* – Minho River catchment (Antunes, 1999; Aguiar *et al.*, 2005; Hermida *et al.*, 2006), Tejo river estuary (Neto, 2008), several rivers (Saraiva and Molnar, 1990; Silva, 1994; Saraiva, 1994, 1995, 1996; Saraiva and Chubb, 1996; Saraiva and Eiras, 1996; Rodrigues and Saraiva, 1996; Cardoso and Saraiva, 1998).

PT.I.1.4 Ecology

Age and growth-Aveiro lagoon (Gordo and Jorge, 1991).

Interaction with other species-*Halobatrachus didactylus* in Mira River estuary (Costa *et al.*, 2006).

Population structure, feeding and condition-Minho River basin (Antunes, 1990); Tejo River basin (Costa *et al.*, 2007).

Size structure, spatio-temporal variations-Mondego River (Domingos *et al.*, 2006).

PT.I.1.5 Predators

Great cormorant, *Phalacrocorax carbo* in Minho River estuary during two consecutive wintering periods. The estimates suggest that *P. carbo* ate 2,8 tonne of eels (Dias, 2007).

PT.J Other sampling

No data.

PT.K Stock assessment

No regular stock assessment.

PT.L Sampling intensity and precision

PT.M Standardisation and harmonization of methodology

At national level nothing is done about standardization and harmonization of methodology concerning eel scientific surveys; however the Minho river basin was in the Indicang project. Indicang was a network with participants spreading from UK to Northern Portugal and the main objective was to establish like a “net abundance indicators of European eel in its repartition central area”. One of the most important phases of the project was to publish different methodological guides with the objective to produce scientific and technical basis to estimate, from the descriptors chosen by the project, the relevant indicators to follow and evaluate the status of the eel resources and its environment.

PT.N Overview, conclusions and recommendations

Specific regulations exist in Portugal for the glass eel and yellow eel fisheries but they

are not supported by any kind of management programme.

In the Minho River the fisheries Law was made in agreement between Portuguese and Spanish authorities and the fishers have to declare the catch values annually. These data are the common source concerning management programme.

Because glass eel has a high economical value, the fishery management is difficult in all rivers, being the Minho River the exception, and that is why a strong illegal activity is going on. The Minho is the only river where the “tela”-net is authorized by the two governments. The improvement of the rules associated with efficient surveillance by local authorities will help for a proliferation of illegal nets, as it happen in the other national rivers, and as we know causes eel damages and have a stronger ecological impact compared with “tela”-net. The distribution areas concerning eel migration in inland waters, was reduced by building dams and no re-stocking and fish pass programmes were implemented.

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Reporting period: This report was completed in August 2008; most data are from 2007 and some remains from earlier reports.

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- Berit Sers, Erik Degerman and Erik Petersson, Institute of Freshwater Research and
- Sven Gunnar Lunneryd, Institute of Coastal Research, all within the Swedish Board of Fisheries.

SE.B Introduction

Eel fisheries in Sweden occur in most coastal waters from the Norwegian border in Skagerrak to about 61°N in the Baltic Sea. In the beginning of the 20th century eel fishery was practised also along the northern most parts of the Baltic Sea. There is also a considerable eel fishery in a number of fresh-water lakes. Both yellow and silver eels are fished, but there is no tradition (it is also against the law) to catch glass eels or elvers. The Government manages and controls the fishery in most marine areas and in the five largest lakes using a few management instruments like minimum legal size, gear restrictions, etc. There was also a substantial fishery for eels in privately owned waters both in coastal areas as in fresh water. In most lakes, except the five largest ones, the Government has almost no jurisdiction to regulate the fishery for any species. However, since 1st May, 2007 fishing for eels is prohibited in Sweden. There are some exceptions to this general ban as professional fishers that could prove they have fished more than 400 kg of eel on average during 2003–2005 or had a corresponding income from processed eel products could apply for a special permit (during 2007). At the same time this rule was imposed the minimum legal size was raised from 600 to 650 mm in fresh water and along the Baltic Coast. On the Swedish West Coast this size was raised from 370 to 400 mm. These minimum legal sizes now include also silver eels that were earlier exempted. The total number of fykenets allowed is now limited to 500 single or double fykes. To avoid an unwanted bycatch of eels, fykenets used by non-eel fishers should be equipped with two escape openings in each codend. As the mortality in eels passing several hydropower turbines probably is very high, eel fishing at sites (rivers and lakes) above three turbines without safe passages for descending silver eels is still allowed. In most fisheries the eels are

fished in combination with other species. Depending on the type of water (fresh or brackish, west or east coast, etc.) species as pike-perch, perch, pike, cod, turbot, whitefish and flounders are important bycatch in the eel fisheries, though not worth enough alone for a viable fishery without eel as the main target species. The distribution of the commercial Swedish eel fishery could be simplified as in the following.

SE.B.1 The present division in eel fishing areas

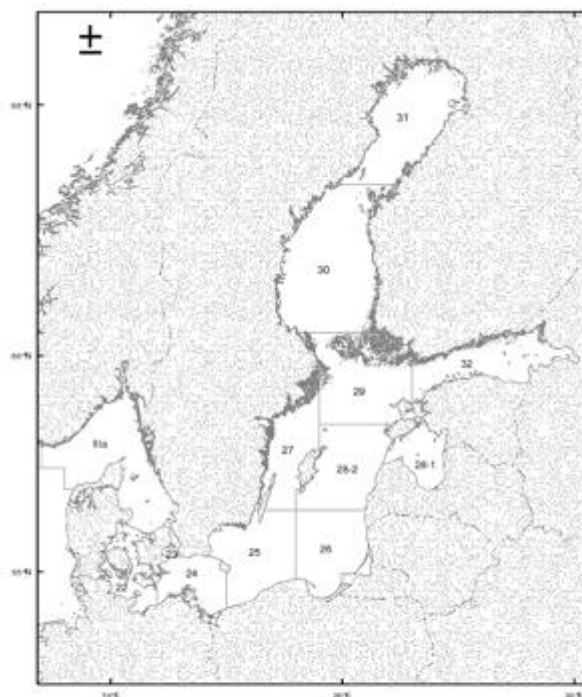


Figure SE.1 ICES Subdivisions in the Baltic area

SE.B.1.1 The Swedish West Coast from the Norwegian border (59°N, 11°E) to Öresund (56°N, 13°E), i.e. 320 km in Skagerrak and Kattegat (ICES Subdivisions 20 and 21)

Along this open coast there is an important fishery for yellow eels. Accordingly the minimum legal size is still as small as 400 mm. Mostly fykenets (single or double) are used, but also baited pots during certain periods of the year. The landings in this fishery are reported through the EU-logbook system as well as from contract notes delivered from authorized wholesaler to the Board of Fisheries. During the last nine years the annual commercial catch of mostly yellow eels was about 210 tons.

SE.B.1.2 Öresund, i.e. a 110 km long Strait between Sweden and Denmark (ICES Subdivision 23)

In this area both yellow and silver eels are caught using fykenets and some large poundnets. The northern part of Öresund is the last place where silver eels originating in the Baltic Sea could be caught before they disappear into the open seas. In recent times about 50 tons of yellow and silver eels were caught annually by Swedish fishers in Öresund. As Öresund is shared with Denmark special rules apply, among other things a very small minimum legal size (350 mm).

SE.B.1.3 The Swedish South Coast from Öresund to about 56°N, 15°E (approximately ICES Subdivisions 24 and 25)

This is a 315 km long coastal stretch of which more than 50% is an open and exposed coast. Silver eels caught in a traditional fishery using large poundnets dominate the catch. This is the “Swedish Eel Coast” where there are a lot of activities, restaurants and tourism based on the eel and the eel fishery. Some yellow eels are also caught, mainly in the archipelagos to the east. The minimum legal size in this area is now 650 mm. In recent years about 113 tons of yellow and silver eels were caught annually by commercial fisheries in this area.

SE.B.1.4 The Swedish East Coast from about 56°N, 15°E to 59°30'N, 18°50'E (approximately ICES Subdivision 27)

Along this 450 km long stretch both silver and yellow eels are fished using both fykenets and large poundnets. Also in this area 650 mm is the new minimum legal size for eels. About 139 tons of yellow and silver eels are caught annually in this area.

SE.B.1.5 Freshwater lakes

There are sparse stocks of eels in most drainage basins all over Sweden except in the high mountain areas. However, nowadays most eels are fished with poundnets in Lakes Mälaren, Vänern and Hjälmaren. A number (at least 17) of smaller lakes, mainly situated in the southern part of the country, add another 25% to the catch in the large lakes. In total about 110 tons of eels are caught annually by the commercial eel fishery in lakes. In the five largest lakes where the Government has jurisdiction 650 mm is the new minimum legal size for both yellow and silver eels.

The fishery in fresh water is probably to a large extent based on stocked eels (about 90% in Lakes Hjälmaren and Mälaren) since the natural immigration to these lakes should be small today. Stocking material is either yellow eels in the size of 0.1 kg that has been caught on the Swedish West Coast or imported newly pigmented eels. In the three large lakes Vänern, Mälaren and Hjälmaren the fishers must have a permit from their respective County Board to fish with fykenets as soon they are deeper than 1,5 m. With that they are also obliged to leave catch statistics to the Board of Fisheries on a monthly basis. In the smaller lakes the professional fishers fish in privately owned waters but as they have a fishing license they have to deliver catch statistics but only on a yearly basis. The fishing is usually carried out from small boats with a length of 5–6 m.

Eel fishing may also occur in additional lakes and some streams where traps have been built. The extent of this fishery is unknown, but it is probably of minor importance today. However, a recent inventory for the European Dipper (*Cinclus cinclus*) discovered numerous eel traps in small streams in Halland and Västra Götaland Counties (Lundberg, 2008). In the investigated area on the Swedish West Coast there was one eeltrap in every km². It has been estimated that those 5000–10 000 traps might catch as much as 25–100 tonne silver eels annually (Westerberg, pers. comm.). Most if not all traps are illegal with the new eel fishing legislation. The recreational fishing of eel in small fresh waters is probably of even smaller importance, even if longline fishing exists in some lakes (cf. the 20 tons mentioned below). Probably most of such eel fisheries have now stopped as a consequence of the new restrictions imposed.

Besides what is described above there is a more or less unknown and uncontrolled fishery by non-commercial fishers, by recreational fishers using professional fishing gears and by true anglers (rod and line). This fishery has been estimated four times

since 1990 by using questionnaires and amounts according to the most recent poll in 2005 to 491 tons of which 388 came from the sea and 103 from fresh water (Fiskeriverket, 2005). As the estimates for eel are based on very few replies the uncertainties are large.

The commercial catch of eels in Sweden in 2004 was then about 473 tons from the sea and 100 tons from fresh water, i.e. about 573 tons in total. The recreational catch adds another 491 tons making a grand total of about 1000 tons. A very recent correction of the estimate of the recreational catch is discussed in Section SE.E.5. In short the new estimate of the recreational catch is 250 tons only. Thus the grand total might be about 800 tons.

Preliminary results from a similar questionnaire for 2006 give ca. 280 tons of eel as total recreational catch of which ca. 20 tons were taken by anglers. This estimate corresponds quite well with the figures from 2004, although the catch was differently distributed between coastal stretches. However, it is stressed that standard errors are very high and that very few recreational fishers reported on eel catches. Most of this fishery is now (since 1st May, 2007) prohibited as a consequence of the new legislation.

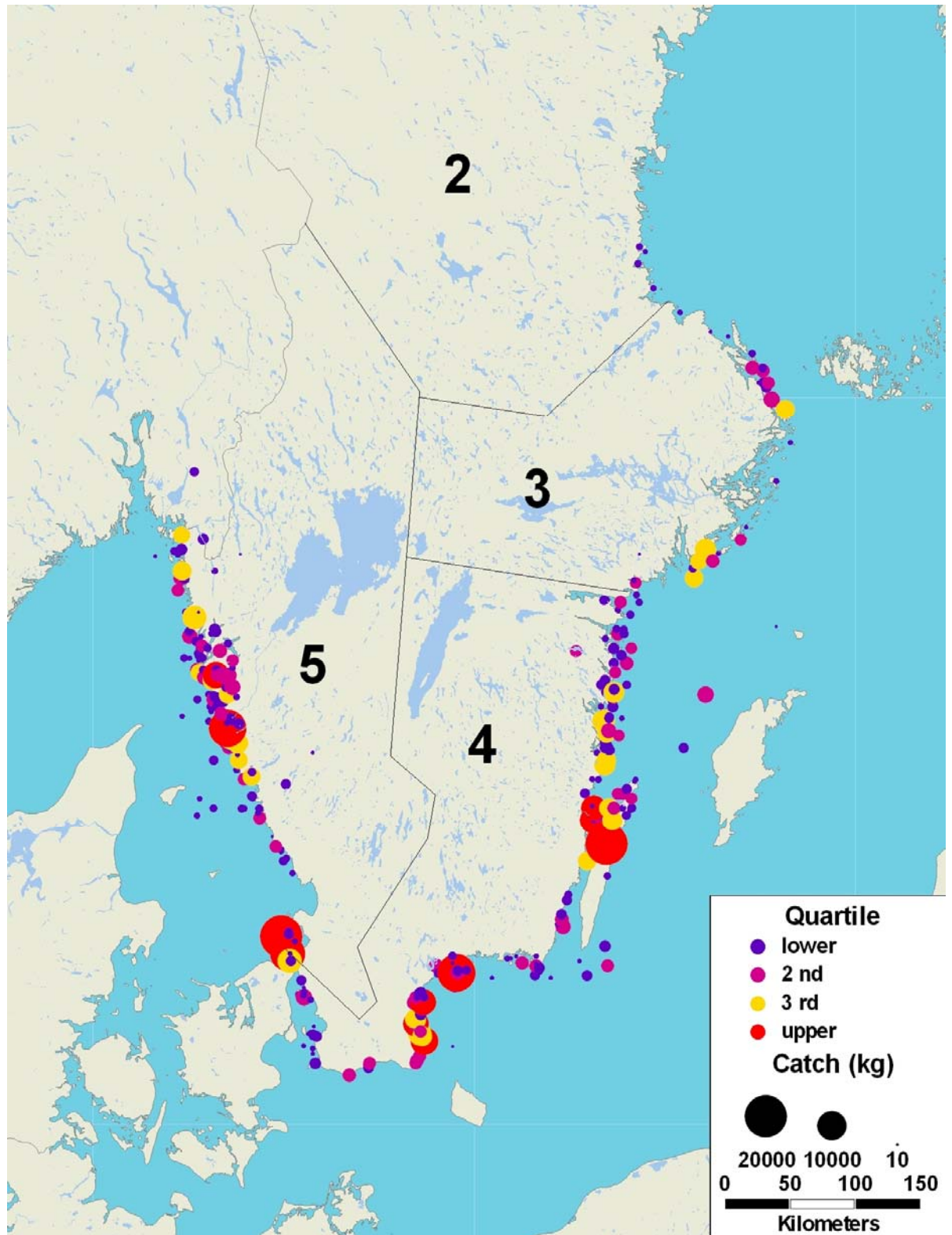


Figure SE.2 The commercial catch in year 2007 expressed per unit area (squares of 1 minute latitude * 1 minute longitude). The sizes of the circles are proportional to the catch. Colour coding indicates where most eels are caught. The River Basin Districts are schematically indicated (as 2-5).

SE.B.2 River Basin Districts (RBD)

The Water Framework Directive subdivides Sweden into five separate River Basin Districts, of which two extend to some importance beyond our borders (Figure SE.2). These are the RBD numbers:

1. **Bottenvikens vattendistrikt** (or BBAY) shared with Finland (small part to the north). This RBD includes all drains to **the northern part of the Gulf of Bothnia**. Eels do occur in this RBD, but are nowadays quite rare. A few successful stocking experiments were performed in this RBD during the 1970s and 1980s. Drainage area: 154 702 km².
2. **Bottenhavets vattendistrikt** (or BSEA) that drains into **the southern part of the Gulf of Bothnia**. Eels occur also in this area. During the early 20th century there was a substantial eel fishery in the southern parts of this RBD. At the present time the commercial catches are small. Drainage area: 146 667 km².
3. **Norra Östersjöns vattendistrikt** (or NBAL) drains **the central parts of Sweden**, including two of the five largest lakes in Sweden. Eels and eel fisheries are quite abundant in this RBD and in addition to a reduced natural recruitment both lakes and coastal areas are frequently stocked with imported elvers. Drainage area: 44 212 km².
4. **Södra Östersjöns vattendistrikt** (“**the Southern Baltic Sea**”) (or SBAL) drains a large part of southern Sweden and includes a vast number of lakes with eel and also the coastal waters where there was and still is an important and traditional fishery for silver eels. Several lakes are stocked annually also in this RBD. Drainage area: 59 939 km².
5. **Västerhavets vattendistrikt** (“**the North Sea**”) (or WEST) shared with Norway (to a minor part). This RBD includes the large Lake Vänern and numerous lakes and streams where eels still are quite abundant. Several lakes are stocked annually in this RBD. Drainage area: 73 330 km².

The main parts of the eel fisheries in Sweden are concentrated to RBD 3, 4 and 5. However, the catch of silver eels along the coast of RBD 4 is known to come from eels that have lived and grown in almost any part of the Baltic Basin. However, a majority have grown up in brackish water. This knowledge is based on tagging studies and otolith chemistry.

SE.C Fishing capacity

SE.C.1 Coastal waters

Table SE.a Number of fishers by RBD with eel landings (all gears).

	BBAY	BSEA	NBAL	SBAL	WEST	ALL
1999	0	27	37	169	172	405
2000	3	28	35	141	134	341
2001	0	27	27	140	138	332
2002	1	26	28	126	145	326
2003	1	29	28	144	132	334
2004	1	32	29	134	127	323
2005	0	30	33	158	132	353
2006	2	28	29	188	124	371
2007	2	4	35	181	100	322
Mean	1	26	31	153	134	345

Reliable information on fishing capacity can only be presented as the number of individual fishers reporting catches in the official statistics. The numbers in Table SE.a do not consider the size of the reported catch of the individual fisher or which life stage is the primary target. The Southern Baltic and the West Coast RBD's were the dominating districts with equal shares in 1999–2007.

SE.C.2 Freshwater

From the inland eel fishery, statistics exists from all fishers that have fishing licenses or a permit to use deeper fykenets and poundnets in Lakes Vänern, Mälaren and Hjälmaren. There are no companies operating in the lakes but the fishing is carried out by single fishers or in very few cases by two fishers together. The number of fishers in the lakes that reported catch of eels is demonstrated below, per lake or group of lakes and per RBD. The total number of eel fishers has decreased from 104 to 77 in a few years with a sudden step from 93 in 2006 to 77 in 2007. This decrease is probably as a consequence of the new legislation since May 2007.

Table SE.b

LAKE	VÄNERN	MÄLAREN	HJÄLMAREN	OTHER LAKES	TOTAL
Number of fishers in 2007	14	22	24	17	77
RBD	3	4	5	TOTAL	
Number of fishers in 2007	47	8	22	77	

SE.D Fishing effort

SE.D.1 Coastal waters

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

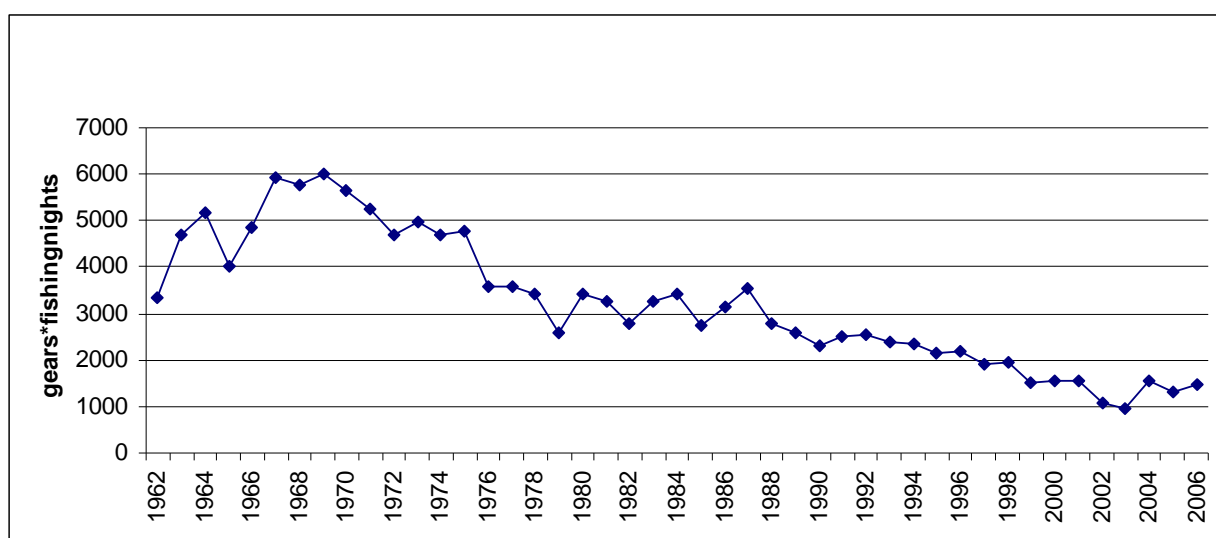


Figure SE.3 Effort in poundnet fishery for silver eel in one area on the Swedish coast in ICES Subdivision 27. The unit is number of gears*number of fishing nights.

SE.D.2 Freshwater

In the eel fisheries in the three lakes mentioned above, the type of net used varies both between and within lakes. There is no other information than that the nets are deeper than 1, 5 m. The nets have a leader which may be 50–300 m long and the depth of the nets varies between 3 and 20 m.

The temporal resolution of the statistics is on a daily basis in the larger lakes and on a yearly basis in the smaller lakes. The maximum number of all kinds of fykenets used in 2006 is demonstrated in the Table below.

Table SE.c

LAKE	VÄNERN	MÅLAREN	HJÄLMAREN	OTHER LAKES	TOTAL
Number of net permits	101	165	167	133	566

During 2007 the following numbers of poundnets (“bottengarn”) were used on a daily average in four of our lakes.

Table SE.d

LAKE	NUMBER OF POUNDNETS USED (DAILY AVERAGE OVER THE YEAR)
Vänern	45
Vättern	5
Mälaren	75
Hjälmaren	87
Total	212

The abundance of fykenets is largest in the shallow Lake Hjälmaren, which area is about 20% of the area of Lake Vänern and 40% of the area of Lake Mälaren.

SE.E Catches and landings

SE.E.1 Catch of glass eel/elver

Not valid as there are no glass eel fisheries in Sweden (neither viable nor legally allowed).

SE.E.2 Restocking

Restocking inland and coastal waters with glass eels, elvers, bootlace or medium-sized yellow eels, is practised since many years in Sweden, in order to improve the local eel fishery. Already at the beginning of the 20th century elvers were imported from England (via Hamburg, Germany). Since the beginning of the 1970s a more regular restocking programme has been in operation. From the beginning mostly medium-sized yellow eels from the Swedish West Coast were used but the proportion of imported and quarantined elvers has slowly increased. Most of the costs are covered by the Government using different funds destined for fish stock management (e.g. funds imposed by the water-rights courts), but also the commercial fishers' association and local societies make a substantial contribution. In 1998 ca. 1.1 million € was spent on restocking while only about 0,5 million € was spent in 2005. A database over the amounts of stocked eels in separate water bodies is almost finalized. During 2000–2007 the following quantities of eels were restocked:

Table SE.e Restocked quantities as numbers of glass and yellow eels per River Basin District (fresh water) and year 2000–2007.

RBD	2		3		4		5		Σ
	G	Y	G	Y	G	Y	G	Y	
Stage									
Year									
2000	43 750	0	249 955	266 013	233 180	275 308	846 295	35 618	1 950 119
2001	60 405	0	183 420	149 050	210 265	170 698	389 632	59 784	1 223 254
2002	282 100	0	374 390	59 268	298 618	79 365	561 264	32 241	1 687 246
2003	163 860	0	324 810	73 964	118 360	177 298	1 736	21 560	881 588
2004	214 190	0	114 292	46 200	245 468	103 675	696 179	18 469	1 438 473
2005	32 000	0	185 496	40 282	308 667	21 864	399 072	3 212	990 593
2006	32 000	0	287 140	0	340 021	0	352 949	0	1 012 110
2007	144 787	0	174 235	0	246 783	0	288 352	0	854 157
Σ	973 092	0	1 893 738	634 777	2 001 362	828 208	3 535 479	170 884	10 037 540

Table SE.e Restocked quantities as numbers of glass and yellow eels per River Basin District (coastal areas) and year 2000–2007.

RBD	2		3		4		5		Σ	
Stage	G	Y	G	Y	G	Y	G	Y		
Year										
2000	0	0	0	0	0	0	90 970	0	0	90 970
2001	0	0	0	0	0	0	60 643	0	0	60 643
2002	171 000	0	0	0	0	0	85 294	0	0	256 294
2003	111 460	0	52 400	0	61 000	0	0	0	0	224 860
2004	0	0	3 702	0	0	0	16 170	15 000	0	34 872
2005	0	0	0	0	89 604	0	0	0	0	89 604
2006	0	0	0	0	128 723	0	0	0	0	128 723
2007	0	0	69 060	0	80 426	0	0	7 500	0	156 986
Σ	282 460	0	125 162	0	359 753	0	253 077	22 500	0	1 042 952

Today “glass eels” (G) implies quarantined and pre-grown elvers of about one gramme each and the medium-sized yellow eels (Y) are about 90 grammes each. For the first time in many years no medium-sized yellow eels were stocked in 2006 and 2007.

SE.E.3 Catch of yellow and silver eel

SE.E.3.1 Landings (data from contract notes)

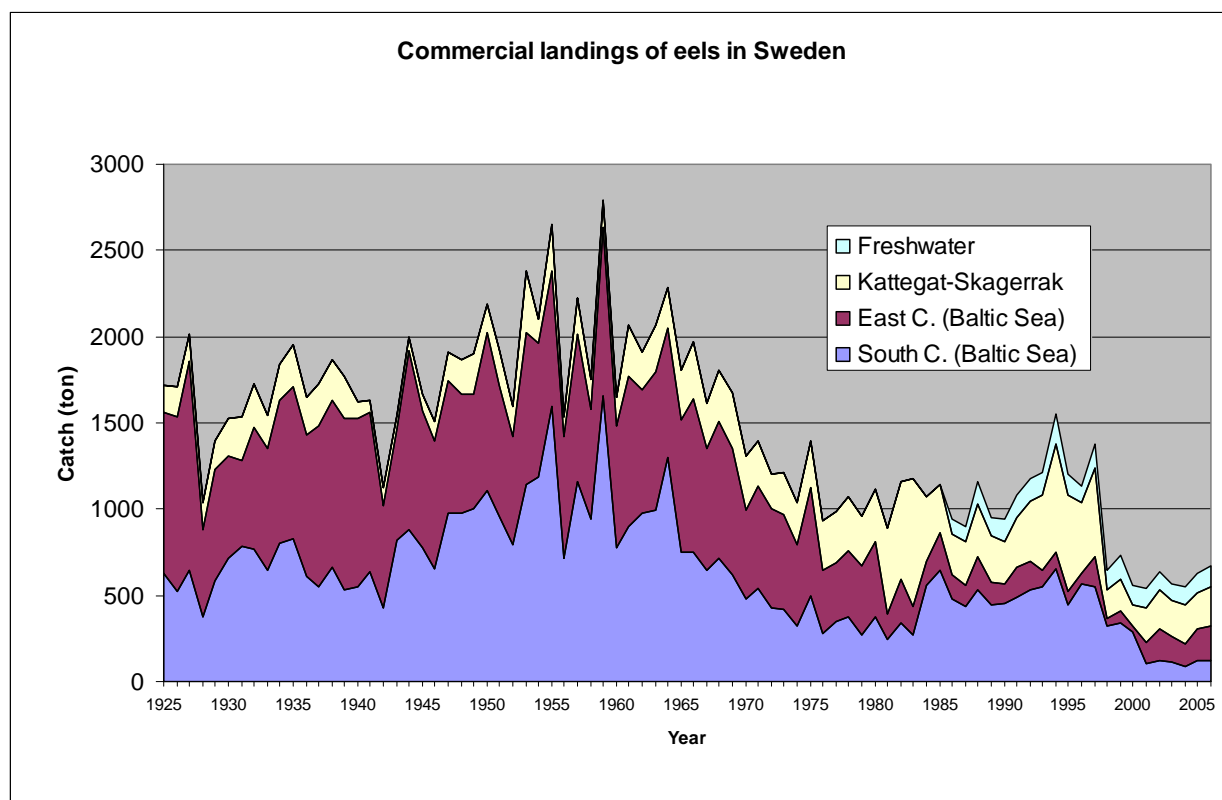


Figure SE.4 Commercial landings of eel in Sweden (data come from the contract notes, Kattegat-Skagerrak corresponds to RBD 5). The data behind this figure is given in the Appendix (Table SE.n).

SE.E.3.2 Freshwater

In inland waters the catch statistics is reported and stored at the Swedish Board of Fisheries. No distinction is made of different life stages of the eels caught. A recent sample from the commercial catch in six lakes demonstrated that about 80% were silver eels and 20% yellow or half-silver. The average size was 0,96 kg with a range from 0,25 to 2,5 kg. Eels do silver at different sizes in different lakes. Yearly catches for the period 2000–2007 is shown below.

Table SE.f Commercial catch in fresh water (tons).

YEAR	VÄNERN	MÄLAREN	HJÄLMAREN	OTHER LAKES	TOTAL
2000	22	38	20	34	114
2001	25	38	23	32	118
2002	22	34	18	29	103
2003	23	31	16	26	96
2004	23	38	18	28	107
2005	21	42	18	29	111
2006	21	45	21	36	124
2007	19	41	20	31	111

The catches have varied fairly little during the period.

SE.E.3.3 Freshwater per RBD:

RBD 1. There are no data or catches reported from fresh water in this district. This is in accordance with the low natural recruitment to this remote part of Sweden and to the fact there are no regular restocking activities in operation. There are more than 15 157 lakes with a total area of 9919 km² in this RBD.

RBD 2. Eels do occur in this area, but there is only a small fishery for them. There are no data from fresh water available. There are more than 12 132 lakes with a total area of 10 212 km² in this RBD.

RBD 3. From this district there are catch data from four lakes, Mälaren, Hjälmaren, Sottern. The total reported catch was 61,4 tons in 2007. There are more than 2474 lakes with a total area of 3375 km² in this RBD.

RBD 4. In this district there are catch data from 9 lakes. In total 9,6 tons were caught in 2007. There are more than 3970 lakes with a total area of 4899 km² in this RBD.

RBD 5. There are commercial eel fisheries in six lakes in this district. The main part comes from the huge Lake Vänern (5650 km²) with 19,0 tons and the total reported catch was 39,7 tons in 2007. There are more than 4900 lakes with a total area of 9734 km² in this RBD.

SE.E.3.4 Coastal waters

Total eel catches reported to the logbook system averaged 520 tons in 1999–2007. As the system allows reports of undefined eel catches, the relation between life stages is not exactly known. It is estimated that the shares are equal for yellow- and silver eel. The duty to present logbooks was not mandatory for fishing on private waters until 2005. This implies that catches in the Baltic Sea silver eel fishery were underestimated. The degree of underestimation is not known. However, during the last three years reported catches were considerably higher than the preceding years. That might be an effect by this new legislation. In addition, the new legislation requiring license for eel fishing in 2007 has probably further reduced underestimation of catches.

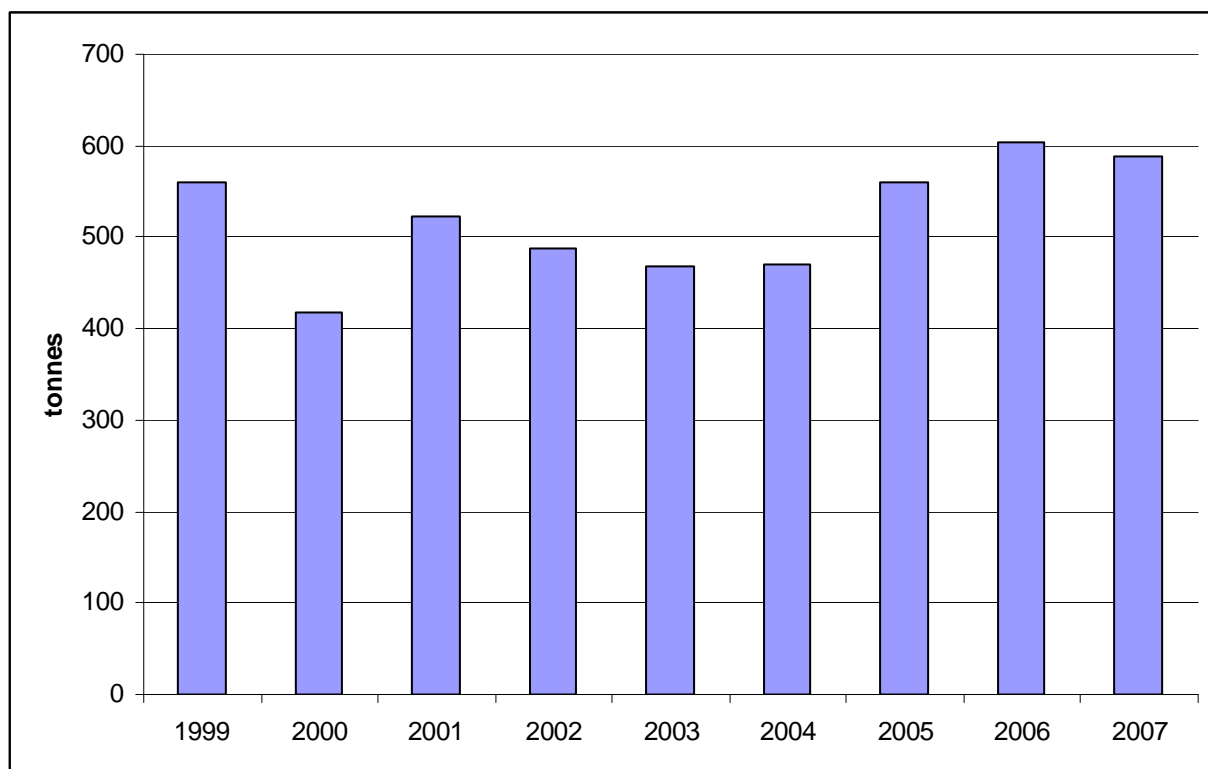


Figure SE.5 Total landings (tonnes) in the Swedish eel fishery as reported in logbooks in 1999–2007.

When catches are separated on RBD's, the dominance for the Southern Baltic and the West Coast districts is evident (see Figure SE.6). The catches in Southern Baltic RBD are dominated by silver eel from poundnets, while the catches from the West coast RBD concerns mainly fykenet catches of yellow eel.

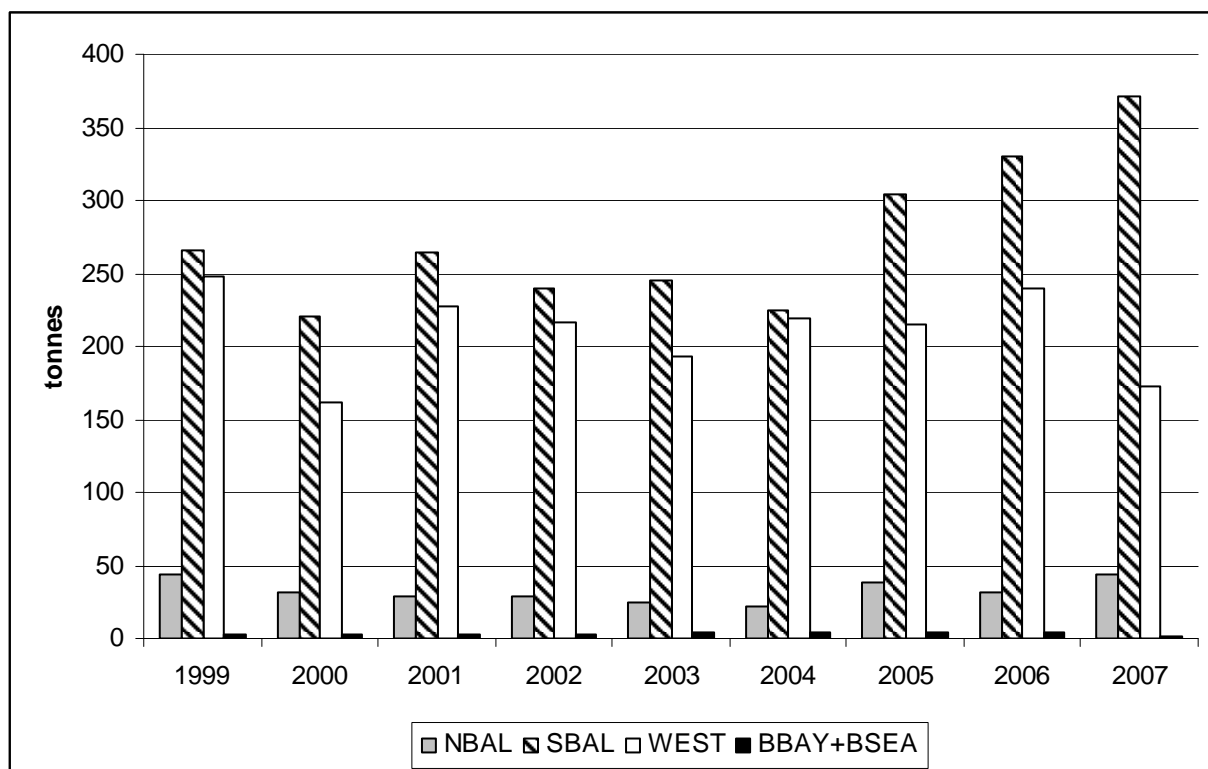


Figure SE.6 Total logbook landings in 1999–2007 approximately separated on RBD's.

SE.E.4 Aquaculture

Today there are two eel cultures running, one based on imported elvers from the UK and the second one on medium-sized yellow eels from the Swedish West Coast. Different sources reported slightly diverging results for the Swedish eel aquaculture industry:

Table SE.g Production of eels in aquaculture from 1983 in Sweden. (SCB 1 and SCB 2 denote one official (SCB 1) and one "unofficial" (SCB 2) version (SCB 2007).

AQUACULTURE PRODUCTION (TONS/YEAR)	DATA SOURCE		
	*SCB 1	*SCB 2	FAO FISHSTAT
1983	2	2	2
1984	12	15	12
1985	41	47	41
1986	51	59	51
1987	90	104	90
1988	203	233	203
1989	166	190	166
1990	157	179	157
1991	141	160	141
1992	171	195	171
1993	169	192	169
1994	160	182	160
1995	139	158	139

AQUACULTURE PRODUCTION (TONS/YEAR)	DATA SOURCE		
	*SCB 1	*SCB 2	FAO FISHSTAT
1996	161	184	161
1997	189	215	189
1998	204	232	204
1999	222	253	222
2000	273	311	273
2001	200	228	200
2002	167	190	167
2003	170	194	170
2004	158	158	158
2005	222		222
2006	191		191
2007	175		

*SCB (Statistics Sweden) is the official source of statistics in Sweden.

SE.E.5 Recreational fisheries

In addition to commercial fisheries, the sports/recreational/household fisheries did contribute significantly to the total landings of eel. The recreational fisheries have been studied in four surveys, most recently in 2005, by means of questionnaires (Fiske 2005-Report by the Swedish Board of Fisheries and Statistics Sweden). Although biased when it comes to the representativeness in the collected data (those who do fish tend to answer questionnaires whereas those who do not fish do not bother) the amount of eel caught by sport/recreational/household fishery in the whole country is estimated to 491±218 tonnes per year-about the same amount as the commercial fisheries.

The results and conclusions from this study have recently been subject for a provisional recalculation. It seems that as a consequence of the problems mentioned above the recreational catch of eels was overestimated with 97%. The new and corrected results are displayed below.

Table SE.h

FISHING DISTRICT	SKAGERRAK & KATTEGAT	THE SOUND	S. BALTIC SEA	MIDDLE BALTIC SEA	THE GULF OF BOTHNIA	OTHERS	TOTAL
Corresponding RBD	5	4	4	~3	~1-2	na	
Corrected estimated catch (kg)	18 283	19 765	60 549	81 597	3364	65 840	249 398

Adding up these 249 tons of eel from recreational fisheries (Table SE.h) to the commercial catch ends in a total Swedish catch of about 800 tons.

A fifth survey has just been carried out and the preliminary results concerning eel and 2006 give ca. 281 tons of which 22 tons were taken by anglers. 38 tonnes of the total recreational catch were reported as coming from fresh water.

Using the most recent but preliminary data above for the recreational fishery in 2006, the corresponding total Swedish catch was about 950 tons. The legislation from May

2007 made most recreational fishing for eel illegal.

It has been estimated that the total catch of eels have decreased by about 35% since the new legislation came into force in May 2007. As the development in landings were different along the East Coast compared to the West Coast, normalized data from a subsampled population of individual eel fishers were used to correct the estimates (Westerberg, pers. comm.). The main reason to this decline is probably that the number of active eel fishers decreased by 10%.

SE.F Catch per unit of effort

SE.F.1 Freshwater

In inland eel fisheries cpue data can be calculated on a yearly basis in respective lake, but the dataset is not available. As the type of nets may shift over time it may, however not seem to be very meaningful to do that. In Lake Mälaren and Hjälmaren for example the fishers tend to replace fine mesh fykenets, which catch pike, pikeperch and perch in addition to eel, with nets with a coarser mesh size to be able to fish for pikeperch more effectively. The data has never been used for stock assessment as the fishery is based mainly on stocked individuals.

SE.F.2 Marine areas

Selected companies have provided detailed catch statistics from the poundnet fishery for silver eel in the Baltic Sea since the late 1950s. The trend in cpue is negative in the longest time-series from ICES Subdivision 27 (Figure SE.7 upper and middle panel, N. Småland and N. Kalmarssund), corresponding to a 50% decrease from the 1960s to recent years. The trend is negative also in the Hanöbukten area, but catches increased more evidently in that area in recent years (Figure SE.7 lower panel). No trend exists in the southern Östergötland area (Figure SE 7. upper panel). The time-series are based on an arithmetic average of a set of fixed fishing stations in all areas but N Kalmarssund. This may induce a bias as a consequence of optimizing the effort over time, such that stations giving lower catches are abandoned. When the three most significant stations were tested in the S. Östergötland area, considering contribution to total catch and representation over time, a negative trend was observed in two cases, corresponding to the decrease in areas further south along the coast. In the third case no trend was found (Figure SE.8).

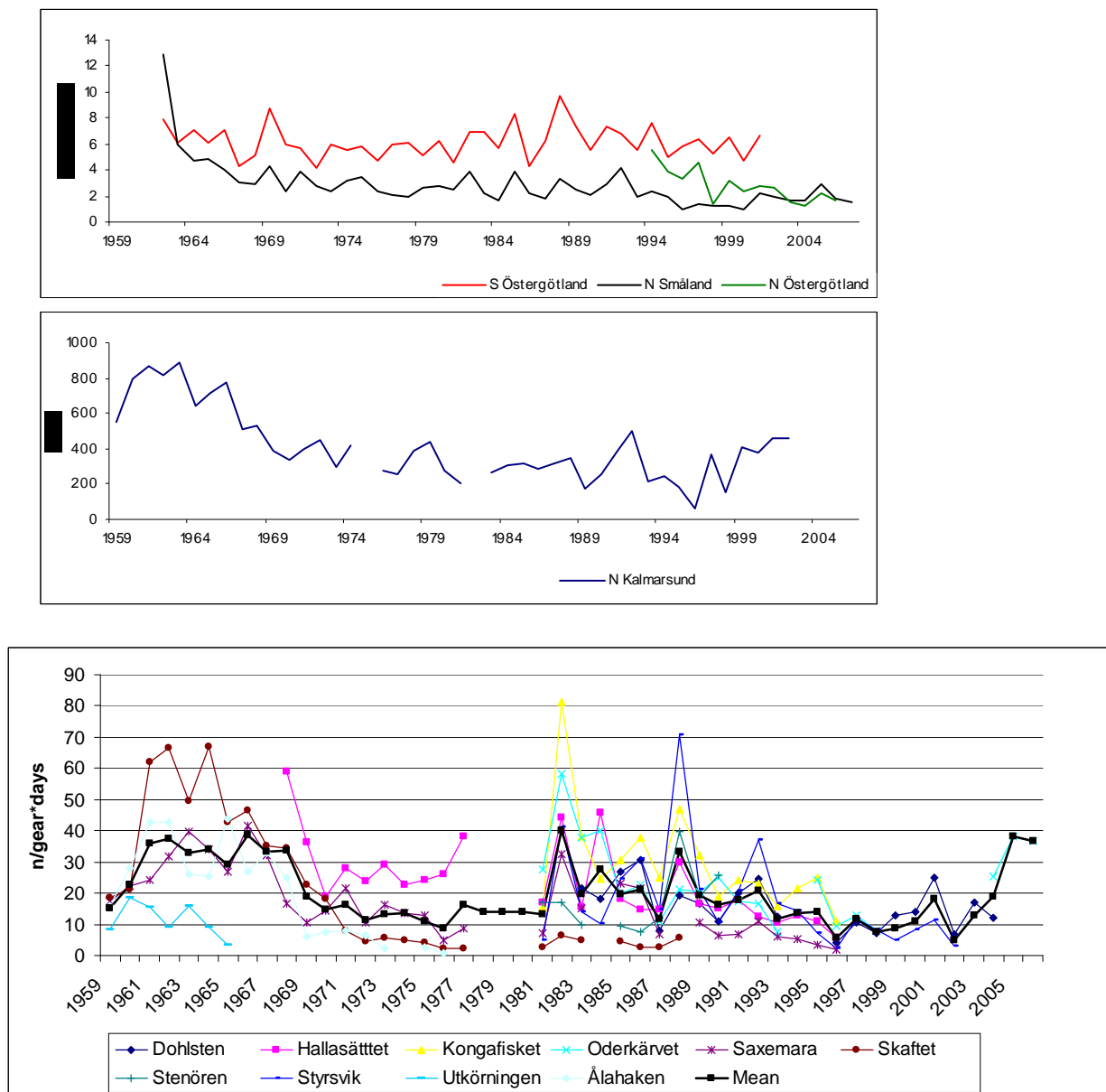


Figure SE.7 Time trends in poundnet catches of silver eel in five subareas in Swedish RBD 4 (Southern Baltic). Four subareas (upper and middle panel) are all located in ICES Subdivision 27 on the Swedish coast of the Baltic Proper. The Hanöbukten area (lowest panel) is located in ICES SD 25 on the SE coast of Sweden.

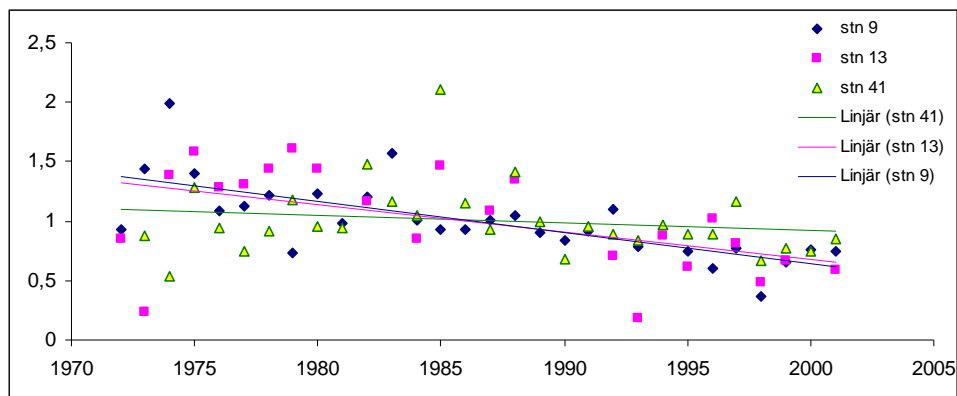


Figure SE. 8 Trend in silver eel cpue in three specific poundnet stations in the S Östergötland area. Individual observations were divided by the long-term mean.

Fishing for eel with fykenets is of minor importance compared to poundnets on the Swedish coast of the Baltic Proper. Nevertheless it operates in a rather conservative way since several decades and long time-series exist from a few companies. Since determination of life stages by the fishers may be influenced by market demands rather than being based on biology, catch per unit of effort is presented for yellow- and silver eel together (Figure SE.9). The cpue was stable in both areas over the years. In SD 27 north (the southern Östergötland area) yellow eel became less abundant in the mid 1990s, but this decrease was compensated by a larger proportion of silver eels. The cpue in 2006–2007 of both life stages together was the highest since 1974. In SD 27 south (the northern county of Kalmar), silver eel became more abundant in fykenet catches in the early 1990s. In this area the silver eel catches in 2005–2007 were the biggest ever recorded in fykenets, and fishers all over the area reported good catches. The good catches of silver eels in recent years may have induced a change in practice in the fykenet fishery, more towards targeting silver eel.

From 1990 the minimum legal size for landing of yellow eel was raised in two steps from 53 to 60 cm. This probably had an influence on the cpue in fykenets. From 1 May, 2007 the minimum legal size was raised to 65 cm for both yellow and silver eels. The mean weight of yellow eel landings was close to 600 g in recent years.

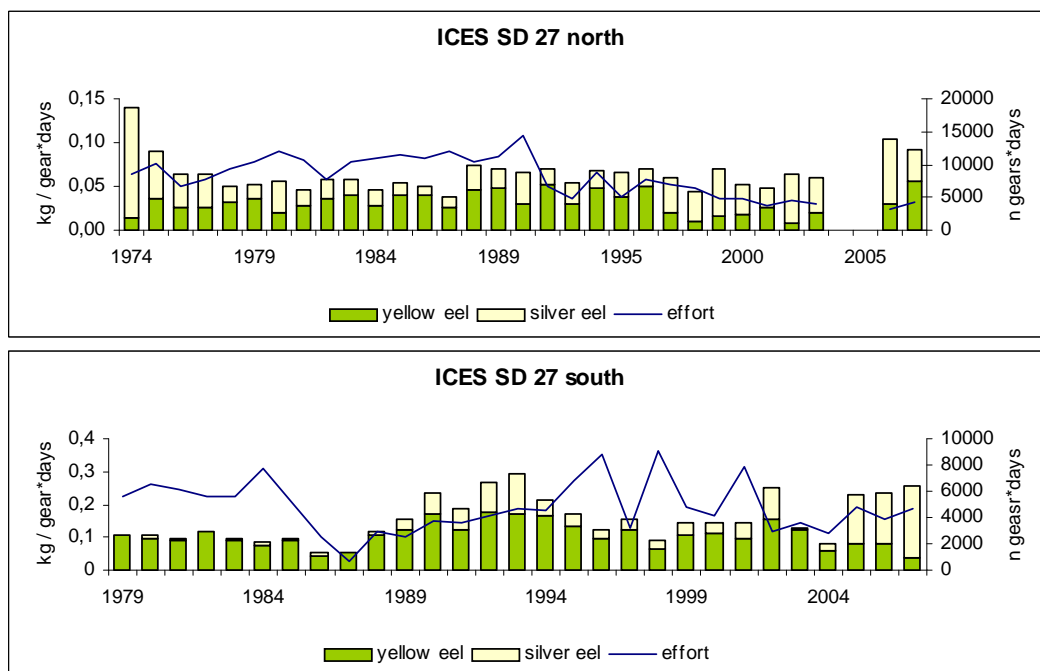


Figure SE.9 Time trends in cpue and effort for fykenet catches of silver and yellow eel in two subareas in Swedish RBD 4 (Southern Baltic). The subareas are all located in ICES Subdivision 27 on the Swedish coast of the Baltic Proper. Southern part of the county of Östergötland (upper) and northern part of the county of Kalmar (lower).

SE.G Scientific surveys of the stock

SE.G.1.1 Recruitment surveys/ascending young eels

Recruitment of young eels (from glass eels and elvers to quite large bootlace eels) in Swedish waters is monitored in eel passes (equipped with collecting boxes) at the most downstream hydropower dam in a number of rivers along the Swedish coasts. Eels caught are weighed (or counted) before being released in upstream areas. Data from the most reliable eel passes, four in the Baltic Sea and four in Skagerrak-Kattegat, are given in the table below (see Wickström, 2002 for a more complete description).

During the last years the recruitment has generally been low or very low compared to historical levels until the 1960s. So far unexplained, there are sudden peaks in the amount of ascending eels during certain years and in different rivers. In e.g. River Kävlingeån there was an unusually high catch in 2004 when all the remaining rivers were still very low. Since 2006 the catch in the River Göta Älv eel pass is negligible and the reason behind is still unclear. Technical inefficiencies at the eel pass can be one reason. Reconstruction work at the most downstream dam might as well have affected the upstream run of eels in the river.

Additional recruitment series on glass eels come from an experimental trawl fishery (with an IKMWT) in the intake channel for cooling water at the Ringhals Nuclear Power Plant (in Kattegat) and from the ICES-IBTS (formerly YFS) using an MIK-trawl in Skagerrak-Kattegat (cf. Section SE.G.1.2).