

## Report on the eel stock and fishery in Sweden 2008/2009

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**Reporting Period:** This Report was completed in September 2009, and contains data up to 2008 and some provisional data for 2009.

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### SE.2. Introduction

Most of the information presented in this Country Report is based on the Eel Management Plan (EMP) Sweden delivered to the EU (COM) in 2008. In the following sub-chapter the summary from the EMP are presented.

#### SE.2.1. Sub-chapters if required

The Regulation EC No 1100/2007 establishing measures for the recovery of the European eel requires the member states to prepare Eel Management Plans for all eel habitats (Eel Management Units). The objective of each Eel Management Plan shall be to reduce anthropogenic mortalities so as to permit with high probability the escapement to the sea of at least 40% of the biomass of silver eel relative to the best estimate of escapement that would have existed if no anthropogenic influences would have impacted the stock. The Eel Management Plan shall be prepared with the purpose of achieving this objective in the long term.

Each Member State shall report to the Commission, initially, every third year, with the first report to be presented by 30 June 2012. The frequency of reporting shall decrease to once every sixth year, after the first three tri-annual reports have been submitted. Reports shall outline the monitoring, effectiveness and outcome of the plan.

Based on this regulation Sweden has developed an eel management plan, which an initial emphasis on achieving a rapid increase of escapement of adult eels to the breeding place. In parallel long-term measures are initiated to improve the conditions for eels e.g. by habitat improvements.

The evaluation process according to article 9 of the regulation will show what additional measures are necessary to reach the escapement goal. The eel management plan will be coordinated with other processes e.g. the national environmental quality objectives, the water framework directive or the Baltic Sea Action Plan.

The historical level of pristine silver eel escapement from Swedish coast- and inland waters is difficult to assess. The main reason is that the eel population in coastal wa-

ters now dominate the Swedish stock and basic knowledge of potential productivity per unit area in coastal habitats is lacking. Furthermore it is unknown how the population density on the coast influences the migration to freshwater habitats, several ways are possible to make rough estimates of the pristine escapement level however.

With the assumptions that the catch is proportional to the population size and that the fishing mortality was the same at the historical maximum and at present then the pristine escapement can be calculated as the ratio between the historical maximum and the present catch, times the known present possible escapement without human mortality. The result is 10 500 000 silver eels/year. An alternative estimate can be made using the known area of freshwater and coastal eel habitats (3.7 and 1.6 million ha respectively) together with a qualified guess of the historical natural stocking density (approximately 10 eels/ha, producing 0.8 silver eels/ha). This ends up with the estimate 4 400 000 silver eels/year if a correction is made for land reclamation in lakes.

The historical reference level is according to this somewhere in the range 10 to 4.4 million silver eels. Forty per cent of this gives 4 to 1.8 million eels. The estimate of the present possible escapement without human mortality is 2.9 million eels. At present the escapement after fishing and turbine mortality is 1,1 million eels and this will increase to 2.6 million when the measures of the Swedish eel management plans take full effect.

Pending a better knowledge base to accurately estimate the historical reference condition the measures in the management plan are dimensioned to achieve a rapid change of trend of the eel recruitment from negative to positive. Calculations show that to stop the decline at least 80 % of the potential present escapement is reached where yellow eel fishery dominates and 90% if the fishery is for silver eels. This assumes that measures of this magnitude are made in the whole distribution area of the eel.

Using this approach the operational, short-term target of the Swedish plan is that 90% of the potential production of silver eels in Swedish waters shall survive and be allowed to migrate to the sea. In numbers this means 2.6 million silver eels. The plan thus uses data for the present situation. The implementation will be in an adaptive process, where the measures will be adjusted as data become available to calculate the 40% target of pristine escapement in the EU regulation. The plan will be evaluated in 2012 and subsequently each third year.

The time to reach the target is essentially fully dependent on the development of glass eel recruitment, which to a minor part depends on the measures made in Sweden. Model calculations show that a full recovery to historical levels will take approximately 80 years given a complete cessation of all anthropogenic mortality in the whole distribution range. Any remaining mortality will increase the recovery time. The whole of Sweden is considered one single eel management unit, which allows a maximum cost-effectiveness of the measures.

#### **SE.2.1.1. Measures**

The plan involves measures in four principal areas:

- Reduction of the fishery;
- Improved possibilities for downstream migration (reduced turbine mortality);
- Stocking of glass eel;
- Control.

#### **SE.2.1.2. Reduction of the fishery**

A first step to regulate the eel fishery was made in 2007 when fishing of eel was prohibited without a special permit. The effect of this was an approximately 30% reduction compared with the exploitation in 2006 (which is the reference year for the regulation). The national plan has as a target to reduce the 2007 level by a further 50% until 2013. The proposed regulation for 2009 is dimensioned to give a reduction of 20%. This will be followed up with successive reductions depending on continuous evaluation of the results of management measures.

For the silver eel fishery an effort regulation will be introduced, where a fisherman with an eel fishing permit is allowed to fish during a specific number of consecutive days, but with the freedom to choose when this period is started. The permit will specify the place and number of gear allowed.

The yellow eel fishery will be regulated by an increase of the period when fishing is forbidden. In the Sound the minimum landing size will be increased to 40 cm. Future increases of minimum landing size is an option for the future regulations.

#### **SE.2.1.3. Improved possibilities for downstream migration**

The management plan includes measures to reduce the mortality of silver eels in turbines as soon as possible. A voluntary agreement has been reached between the major hydropower companies and the Swedish Board of Fisheries that within the coming five years the total survival shall be increased to 40% of all silver eels leaving the freshwater where at least one hydropower station has to be passed. This will be achieved by concentrating work to river basins where the most cost-efficient measures can be made.

#### **SE.2.1.4. Stocking of glass eel**

The number of glass eels stocked as part of the management plan will be twice the present stocking. This should be possible using the European Fisheries Fund when the national management plan has been approved by the Commission. If the prices become lower due to the provision about restocking in the EU regulation the volume stocked can increase. All stocking will be made in river basins with free migration conditions to the sea. Areas with a high production potential and no or negligible fishery will be prioritized.

#### **SE.2.1.5. Increased control measures**

The follow up of compliance with effort limitations in the silver eel fishery will be made by control of documents in the regular monitoring of quotas and effort. To make control of gear use possible for vessels without mandatory logbook the present catch journals for coastal waters and inland waters will be changed so that the number of gear used each day shall be registered. The evaluation of the management plan requires a separation of silver eel and yellow eel catches. The present possibility to register catch of eel unspecified will cease. Sales notes concerning eel should have information on geographic origin of the catch and information of the minimum landing size for this area shall be registered. There is no community provision for those provisions and therefore a national regulation is planned in order to facilitate verification of catches of eel.

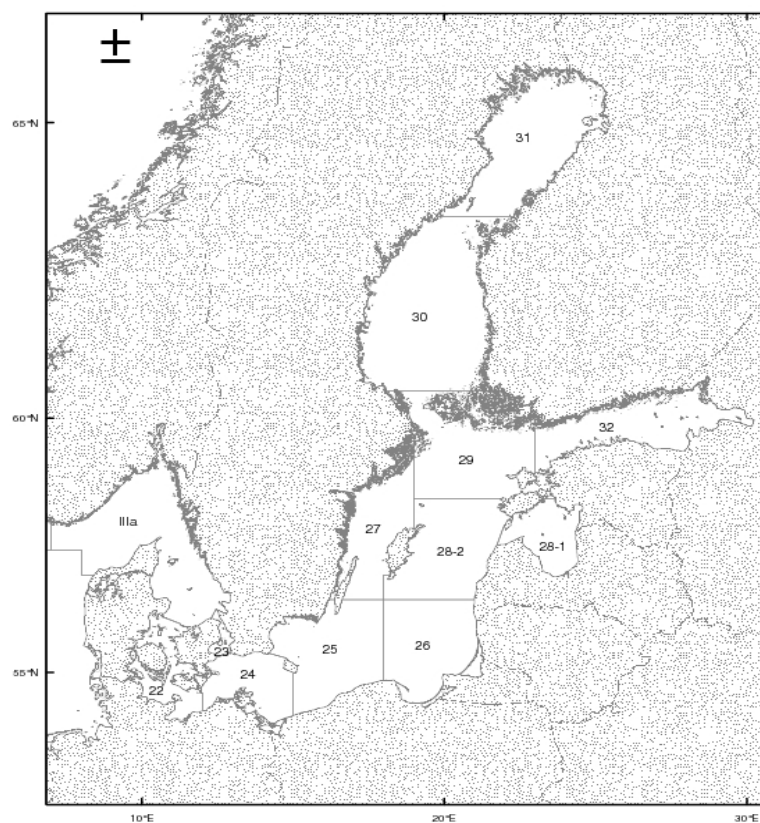
#### **SE.2.1.6. Quantification of the measures**

The overall target for the national management plan is that 90% of all silver eel that at present would have been produced in Swedish water without anthropogenic mortal-

ity shall survive and escape to contribute to reproduction. This shall be achieved by regulation of the fishery, reduction of turbine mortality and increased stocking of imported glass eel. The relative contribution of the different measures is shown in the following table (SE.a). The sign indicates extraction (-) or addition (+) to the production without anthropogenic impact.

**Table SE.a.**

	<b>SILVER EELS</b>	<b>PER CENT OF</b>
	(*1000)	production
Present natural production of silver eels in Sweden	2870	
Loss in the fishery before measures	-1470	-51%
Loss in hydro turbines before measures	-280	-10%
Addition from earlier stockings	+210	7%
Reduction of fishing due to regulation 2007	+390	14%
Continued regulation of fishery	+550	19%
Reduction of turbine mortality	+140	5%
Increased stocking	+185	6%
Net anthropogenic mortality after measures	-275	-10%



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

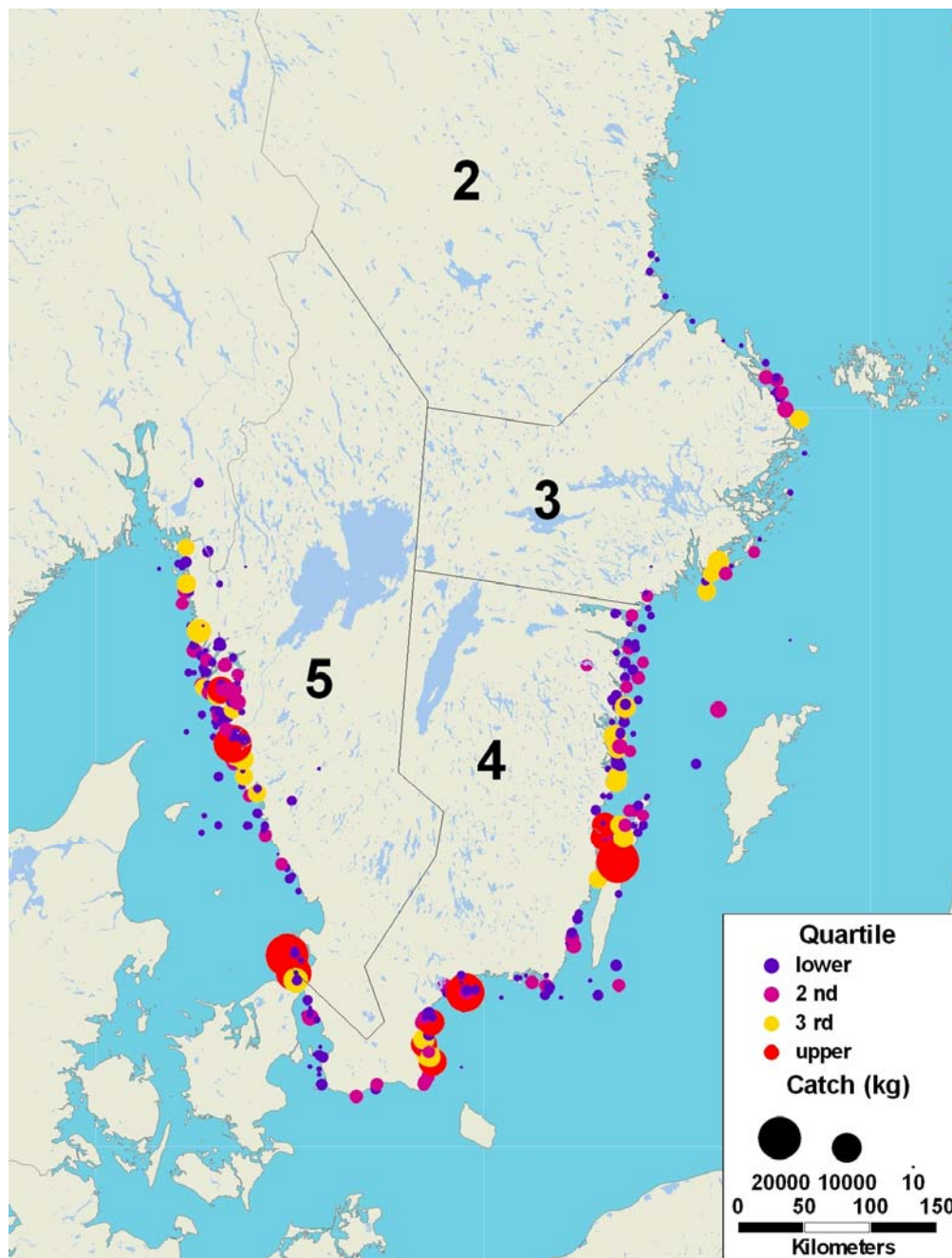


Figure SE.2.2. The commercial catch in year 2007 expressed per unit area (squares of 1 minute latitude \* 1 minute longitude). The sizes of the circles are proportional to the catch. Colour coding indicates where most eels are caught. The River Basin Districts are schematically indicated (as 25).

### SE.3. Time-series data

#### SE.3.1. Recruitment series and associated effort

Recruitment series is derived from eel passes in a number of rivers along the whole Swedish coast where young eels (elvers and bootlace eels) are caught and counted on their upstream migration. In the 1970s data from about 20 rivers were collected but due insignificant numbers of ascending eels in some rivers only eight series are still running. All of them are depending on the continued existence of industries as paper mills and hydro power stations as they are responsible for the operation and mainte-

nance of those eel passes with collecting boxes. This is regulated by the order of the Water Rights Court.

Additional recruitment data come from surveys and monitoring from RV Argos and in the intake canal for cooling water to the Ringhals Nuclear Power Station.

### SE.3.1.1. Glass eel

#### SE.3.1.1.1. Commercial

NO AVAILABLE DATA as there are no fishery for glass eels (not allowed).

#### SE.3.1.1.2. Recreational

NO AVAILABLE DATA as there are no fishery for glass eels (not allowed).

#### SE.3.1.1.3. Fishery independent

### SE.3.1.2. Recruitment to freshwater

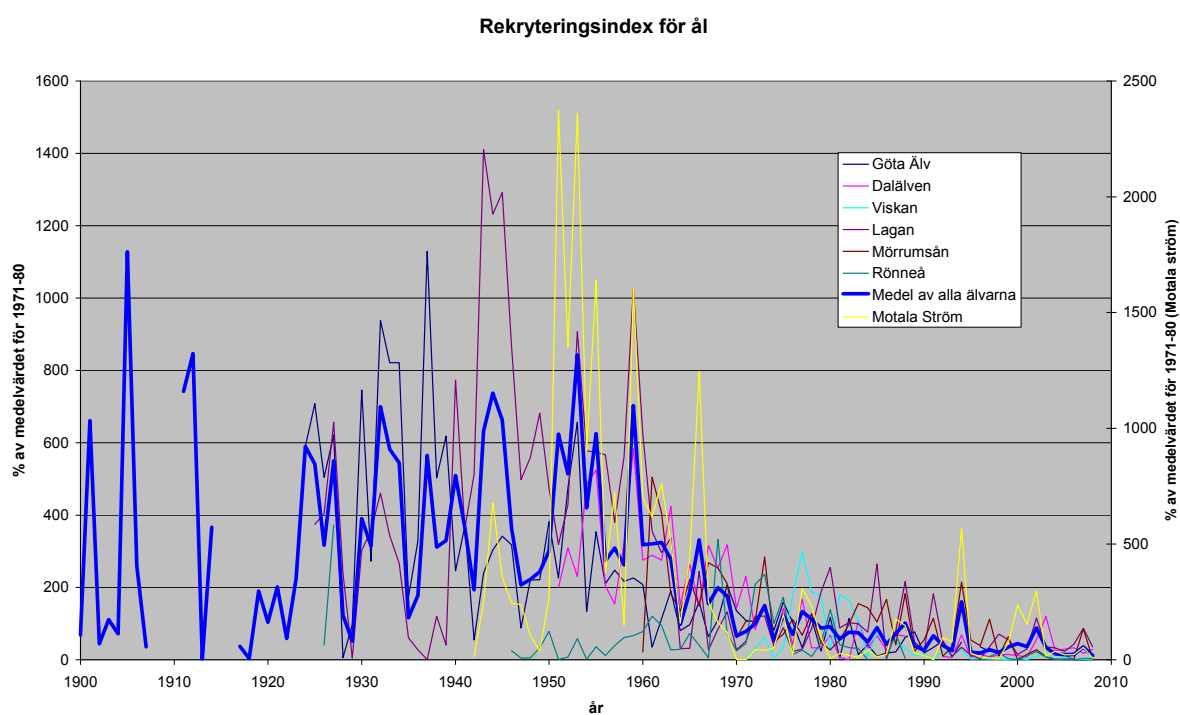


Figure SE.3.1. Recruitment indices from seven Swedish rivers. Data are presented as percentages of the averages for 1971 to 1980 in the same rivers, respectively.

Table SE.b. Amounts (kg) of ascending young eels caught in eight rivers along the Swedish coasts.

RIVER	DALÄLVEN	MOTALA STRÖM	MÖRRUMSÅN	KÄVLINGEÅN	RÖNNE Å	LAGAN	VISKAN	GÖTA ÄLV
YEAR/RBD	RBD 2	RBD 4	RBD 4	RBD 4	RBD 5	RBD 5	RBD 5	RBD 5
1900								530,0
1901								5100,0
1902								340,0
1903								858,0
1904								552,0
1905								8700,0
1906								2000,0
1907								275,0
1908								na
1909								na
1910								na
1911								5728,0
1912								6529,0
1913								20,0
1914								2828,0
1915								na
1916								na
1917					45,0			na
1918					4,5			na
1919					na			1465,0
1920					na			800,0
1921					na			1555,0
1922					na			455,0
1923					na			1732,0
1924					na			4551,0
1925					na	331,3		5463,0
1926					49,0	357,8		3893,0
1927					445,0	581,1		4796,0
1928					0,0	211,9		47,0
1929					0,0	4,5		756,0
1930					147,0	268,0		5753,0
1931					na	316,0		2103,0
1932					na	408,0		7238,0
1933					na	303,5		6333,0
1934					na	236,0		6338,0
1935					na	53,5		1336,0
1936					na	24,5		2537,0
1937					na	0,5		8711,0
1938					na	106,5		3879,0
1939					na	36,0		4775,0
1940					na	684,0		1894,0

RIVER	DALÄLVEN	MOTALA STRÖM	MÖRRUMSÅN	KÄVLINGEÅN	RÖNNE Å	LAGAN	VISKAN	GÖTA ÄLV
1941					na	321,0		2846,0
1942		14,0			na	454,0		427,0
1943		283,0			na	1248,0		1848,0
1944		773,0			na	1090,0		2342,0
1945		406,0			na	1143,0		2636,0
1946		280,0			29,7	766,5		2452,0
1947		272,5			5,8	440,8		675,0
1948		120,0			6,0	494,7		1702,0
1949		43,0			39,4	603,6		1711,0
1950		304,5			93,5	419,9		2947,0
1951	210,0	2713,0			1,0	281,8		1744,0
1952	324,0	1543,5			9,1	379,1		3662,0
1953	241,5	2698,0			70,0	802,4		5071,0
1954	508,5	1030,0			2,7	511,3		1031,0
1955	550,0	1871,0			42,6	506,9		2732,0
1956	215,0	429,0			14,1	501,6		1622,0
1957	161,5	826,0			46,8	336,1		1915,0
1958	336,7	172,0			73,2	497,2		1675,0
1959	612,6	1837,0			80,0	910,5		1745,0
1960	289,0	799,0	29,0		93,0	552,4		1605,0
1961	303,0	706,0	665,5		143,7	314,8		269,0
1962	289,0	870,0	534,8		113,0	261,9		873,0
1963	445,4	581,0	241,2		32,5	298,1		1469,0
1964	158,0	181,6	177,8		34,7	27,5		622,0
1965	276,4	500,0	292,3		87,1	28,0		746,0
1966	157,5	1423,0	196,3		48,5	216,5		1232,0
1967	331,8	283,0	353,6		6,6	24,4		493,0
1968	265,5	184,0	334,8		398,0	74,4		849,0
1969	333,7	135,0	276,8		85,7	117,1		1595,0
1970	149,8	2,0	80,4		29,8	24,7		1046,0
1971	242,0	1,0	141,1		53,3	45,3	12,0	842,0
1972	87,6	51,0	139,9		249,0	106,2	88,0	810,0
1973	159,7	46,0	375,0		282,3	107,1	177,0	1179,0
1974	49,5	58,5	65,4		120,7	33,6	13,0	631,0
1975	148,7	224,0	93,3		206,7	78,4	99,0	1230,0
1976	44,0	24,0	147,2		17,1	20,2	501,0	798,0
1977	176,4	353,0	89,6		32,1	26,4	850,0	256,0
1978	35,1	266,0	168,4		10,8	75,8	532,6	873,0
1979	34,3	112,0	61,4		56,1	165,9	505,2	190,0
1980	71,2	7,0	36,5		165,7	226,0	72,5	906,0
1981	6,8	31,0	72,8		49,2	78,0	513,1	40,0
1982	0,5	22,0	129,0		40,0	90,8	472,0	882,0
1983	112,1	12,0	204,6		37,6	87,8	308,4	113,0
1984	33,9	48,0	189,9		0,5	68,0	20,7	325,0
1985	69,7	15,2	138,1		0,0	234,1	211,5	77,0

RIVER	DALÄLVEN	MOTALA STRÖM	MÖRRUMSÅN	KÄVLINGEÅN	RÖNNE Å	LAGAN	VISKAN	GÖTA ÄLV
1986	28,4	26,0	220,3		8,6	2,5	150,9	143,0
1987	73,5	201,0	54,5		84,8	69,8	140,9	168,0
1988	69,0	169,5	241,0		4,9	191,7	91,9	475,0
1989	na	35,2	30,0		0,0	44,0	32,7	598,0
1990	na	21,0	72,5		32,0	21,6	42,1	149,0
1991	na	2,0	151,0	na	na	161,3	0,4	264,0
1992	9,6	108,0	14,0	12,5	na	42,2	70,3	404,0
1993	6,6	89,0	45,7	25,8	na	8,7	43,4	64,0
1994	71,9	650,0	283,0	4,0	na	30,7	76,1	377,0
1995	7,6	32,0	72,4	2,9	na	11,6	5,5	0,0
1996	17,5	14,0	51,9	13,5	na	2,8	10,0	277,0
1997	7,5	8,1	148,0	19,4	10,4	31,7	7,6	180,0
1998	14,7	5,5	12,9	15,3	24,0	62,6	5,0	0,0
1999	15,5	85,0	84,2	22,2	4,2	49,5	1,8	0,0
2000	12,4	270,1	1,0	5,0	na	13,0	14,1	0,0
2001	8,2	177,5	19,3	34,5	1,8	26,8	1,8	0,0
2002	58,6	338,8	37,4	19,3	27,0	102,0	26,2	693,0
2003	126,1	19,0	11,0	9,7	9,1	31,7	45,1	266,0
2004	26,4	42,0	1,5	248,3	2,0	29,0	5,0	125,0
2005	30,9	24,8	2,5	3,4	0,1	20,5	25,8	105,0
2006	35,1	25,9	2,5	94,4	0,1	38,1	2,7	0,04
2007	19	60,8	112,6	76	4,45	77	2,1	0
2008	31	9,7	3,8	4,3	4,05	31,7	3,4	4
2009	>79,5	~25	na	>0,8	na	na	>2	na

The ascent in River Viskan is totally dominated by elvers that arrived as glass eels the same year. Also in River Lagan there is a considerable proportion of "glass eels" but in the remaining rivers there is a mix of year classes, with eels up to more than 300 mm in TL. No data available = na. 0 for River Göta Älv in recent years (except in 2007) is due to the fact the eel pass was closed in those years. Data for 2009 are only indicated (in italics) as the season is not over yet.

### SE.3.1.3. Recruiting glass eels monitored in the sea

The abundance of glass eels in the open sea (Kattegat and Skagerrak) is surveyed by trawling with either an Isaacs–Kidd Midwater trawl (IKMT) or with a modified Methot-Isaacs–Kidd Midwater trawl (MIKT). The former trawl is used in a fixed position in the intake canal for cooling water to the condensers at the Ringhals Nuclear Power Station (e.g. Westerberg, 1998a; 1998b). The latter method is used from RV Argos during the ICES International Young Fish Survey (since 1993 called the International Bottom trawl Survey (IBTS Quarter 1) (Hagström and Wickström, 1990).

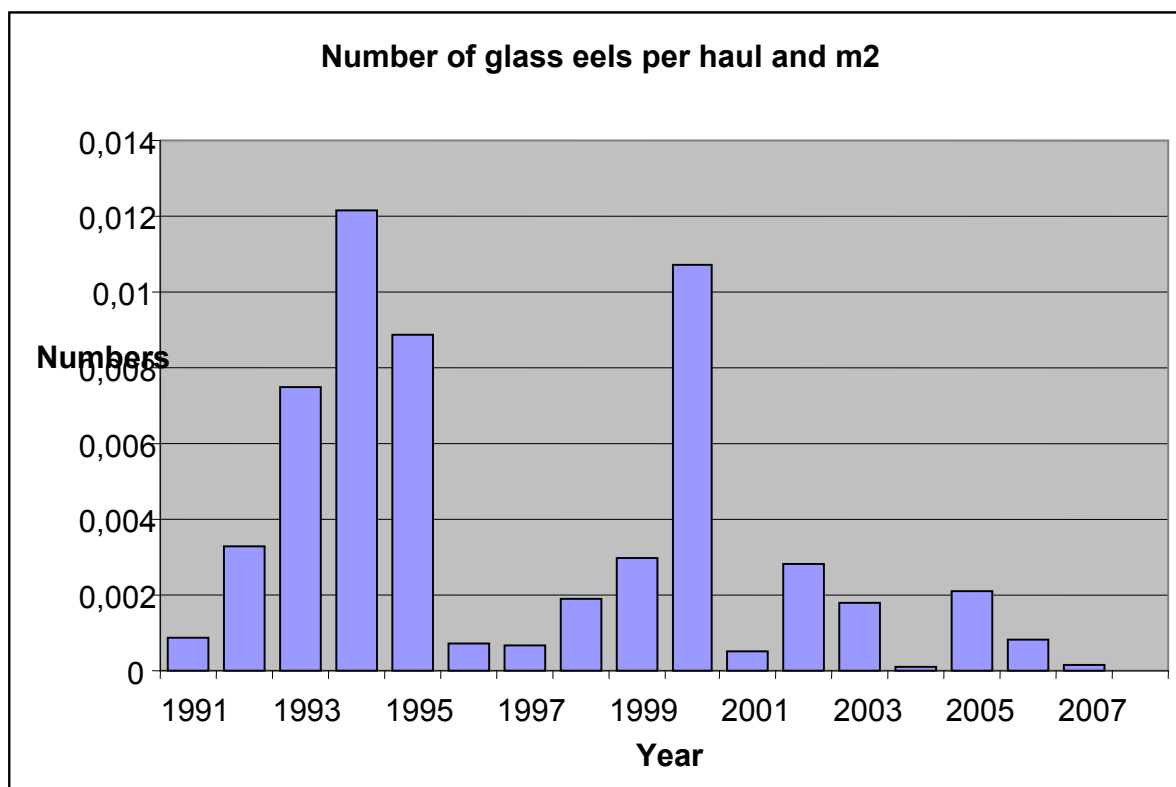
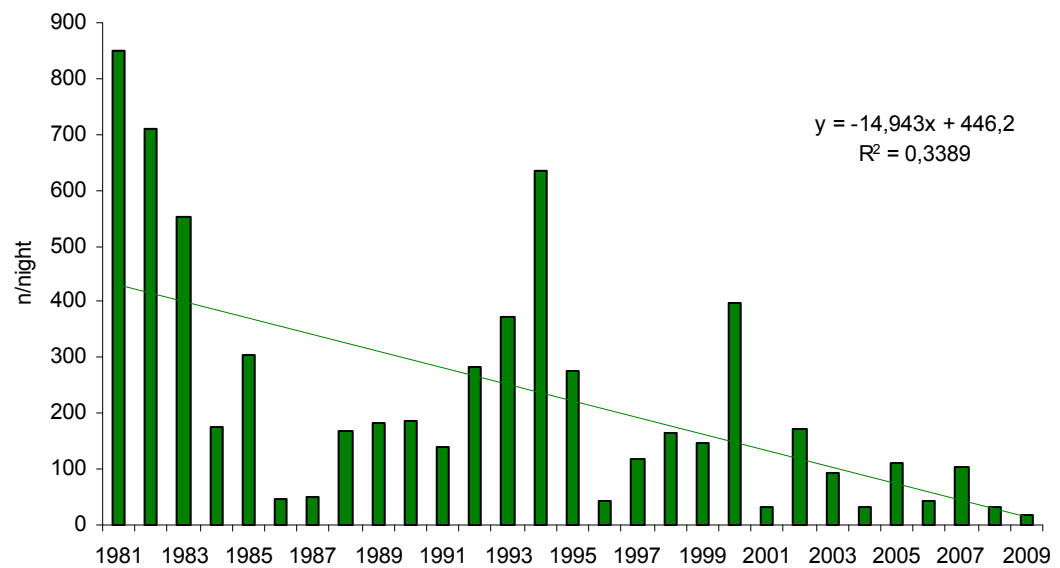


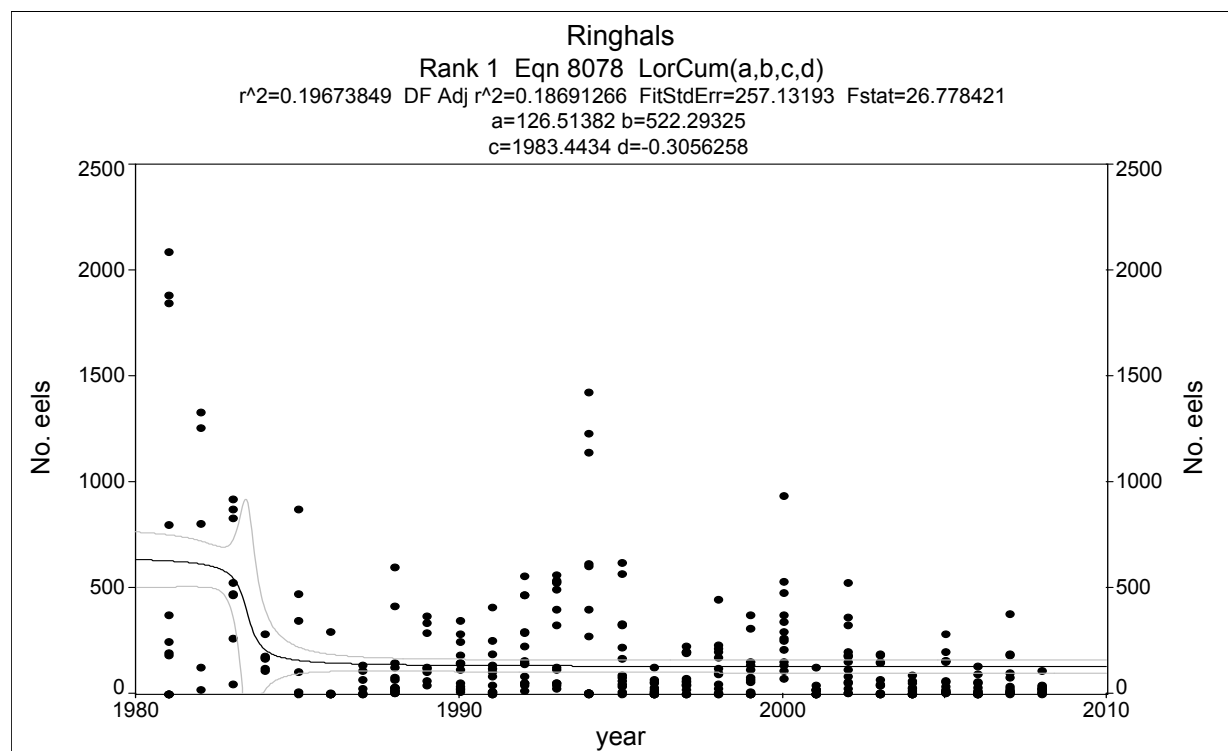
Figure SE.3.2. Catch of glass eels by a modified Methot-Isaacs-Kidd Midwater trawl (MIKT) in the Skagerrak-Kattegat 1991–2009. Numbers have been corrected for the flow through the net. There were no glass eels caught in 2008 and 2009.

When the glass eels have settled they and larger eels can be monitored on soft and shallow bottoms using a “Drop Trap” technique (Westerberg *et al.*, 1993). This was successfully done during a number of years but is now a resting series. The time-series from Ringhals is depending on the status of operation of the power plant and cannot be guaranteed on a longer time-scale. This approach made it possible to roughly estimate the total recruitment of young eels to the Swedish coast. From all three methods recruitment series could be compiled: Recruitment of glass eel to the Swedish west coast is monitored at the intake of cooling water to the nuclear power plant at Ringhals in the Kattegat (**Figure SE.3.3** and **Table SE.c.**). The time of arrival of the glass eels to the sampling site varies between years, probably as a consequence of hydrographical conditions, but the peak in abundance normally occurred in late March to early April. Abundance has decreased by 90% if recent years are compared with the peak in the early 1980s. The 2009 index is the lowest ever recorded. Reduced flow during the peak of the season may have biased the annual index of this year.



**Figure SE.3.3.** Time trend in glass eel recruitment at the Ringhals nuclear power plant on the Kattegat coast in Swedish RBD 5 (Västerhavet).

Applying a transition function to the data suggests a break in the trend in the early 1980s (Figure SE.3.4).



**Figure SE.3.4.** A transition function fitted to the glass eel data from Ringhals.

The time-series from Ringhals is depending on the status of operation of the power plant and cannot be guaranteed on a longer time-scale. A process has been started in Sweden to find a completely independent method to assess glass eel recruitment. The flow of water through the intake channel is normally stable over time at full produc-

tion of electricity. During longer stops of one of the reactors the flow may be reduced by half. This is compensated for by a linear transformation of observed cpue. As the relationship between flow and catchability is not known, bias may be introduced by this compensation.

**Table SE.c. Annual indices of glass eel recruitment at the intake canal for cooling water to reactors 1 and 2 at the Ringhals nuclear power plant. Mean of weekly means of numbers of glass eels collected with a modified Isaacs–Kidd midwater trawl during March and April (weeks 9–18). Data were corrected for variations in water flow.**

week	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	
3	3													1																
4	0							17			1			4					0											
5	4							8	15	14	18	30	5	4	0	0	1	1	0	74	2	27	6		20		10			
6								28	27	13	56	45	7	11	0	1	1	0	142	0	86	5	1	12	2	42	8	1		
7								6	22	9	85	331	7	41	0	22	9	8	267	3	154	2	2	62	3	4	27			
8	1							34	57	3	44	57	8	48	11	3	50	12	115	5	327	5	0	22	2	12	17	4		
9	187		51			3		36	342	185	3	160	55	3	172	0	68	125	62	344	5	117	5	1	15	6	11	10	3	
10	199	24				2		80	372	150	15	471	118	7	224	4	200	100	121	377	3	200	10	3	10	2	29	31	2	
11	250	130	528	176		4		19	129	150	88	290	130	610	333	13	198	8	72	533	22	366	44	3	39	1	81	114	3	
12	374	806	835	289	14	6	2	16	107	145	42	469	535	400	569	25	60	177	158	214	24	530	53	18	162	13	382	38	15	
13	1886	1258	265	122	109	1	0	72	291	251	110	562	495	1430	331	60	42	220	2	479	16	59	185	35	153	17	186	30	36	
14	2093	1335	469	181	0	3	31	149	121	351	138	151	403	1236	625	33	77	448	314	942	22	185	192	65	162	55	101	43	37	
15	1849		878	112	878			141	603	67	284	414	298	540	1145	91	128	201	237	377	154	45	184	151	55	202	97	191	26	25
16			925		476			69	416	42	120	254	142	527	619	64	73	49	96	79	299	25	53	74	90	286	132	20	13	23
17	804		477	171	350			6	127		37	193	231	564	278	80	56	44	202	141	257	128	8	158	32	66	62	18	2	11
18	0						297	114				124	55					230	31				9	46	8	10	36	7		
mean 9-18	849	711	553	175	305	45	52	169	184	186	138	283	374	636	277	44	117	164	147	400	32	171	92	31	110	42	102	34	17	

#### SE.3.1.4. Yellow eel recruitment

##### SE.3.1.4.1. Commercial

NO AVAILABLE DATA as fishing for eel below certain minimum sizes (40 cm) is prohibited.

##### SE.3.1.4.2. Recreational

NO AVAILABLE DATA as recreational fishing for eel is prohibited since 2007.

##### SE.3.1.4.3. Fishery independent

Data on ascending juvenile yellow eels are given together with glass eels above (Section 3.1.1.3).

#### SE.3.2. Commercial landings of silver and yellow eel in Sweden

##### SE.3.2.1. Coastal fishery

Total eel catches reported to the logbook system averaged 523 tons in 1999–2008. 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 four 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 reduced underestimation of catches. The Baltic Proper and the Kattegat-Skagerrak area strongly dominate the catches and there is a tendency for an increasing share for the Baltic landings in recent years.

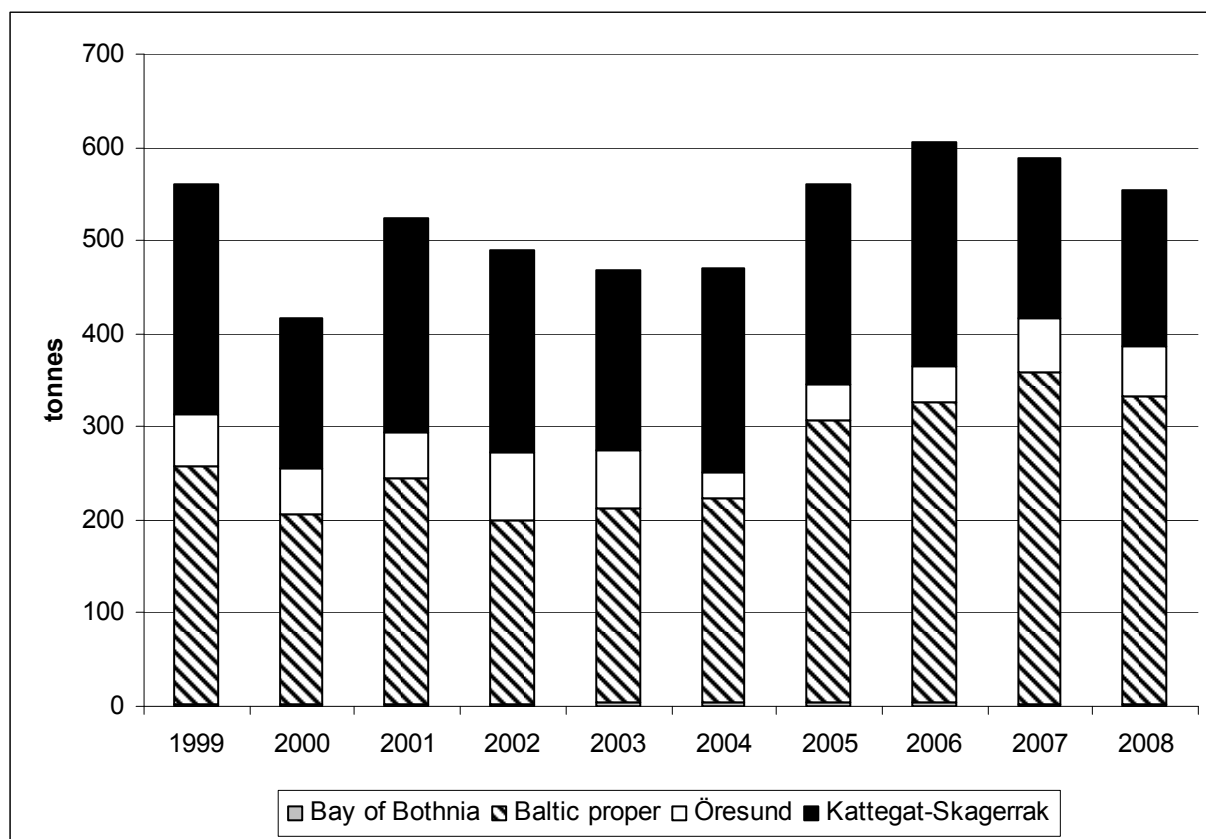


Figure SE.3.5. Total landings (tonnes) in the Swedish eel fishery as reported in logbooks in 1999–2008, separated on the main basins of the Baltic Sea, the Öresund and the Kattegat- Skagerrak area.

Before 2005 shares of silver- and yellow eel were equal and the undefined part was small. Silver eel proportion was larger in 2005–2007 and probably also in 2008, as an increase in landings was recorded in the Baltic proper after 2004. The Baltic eel fishery is strongly dominated by poundnet fishery for silver eel. As mentioned above changes in legislation may have biased the time-series after 2004 in relation to previous years.

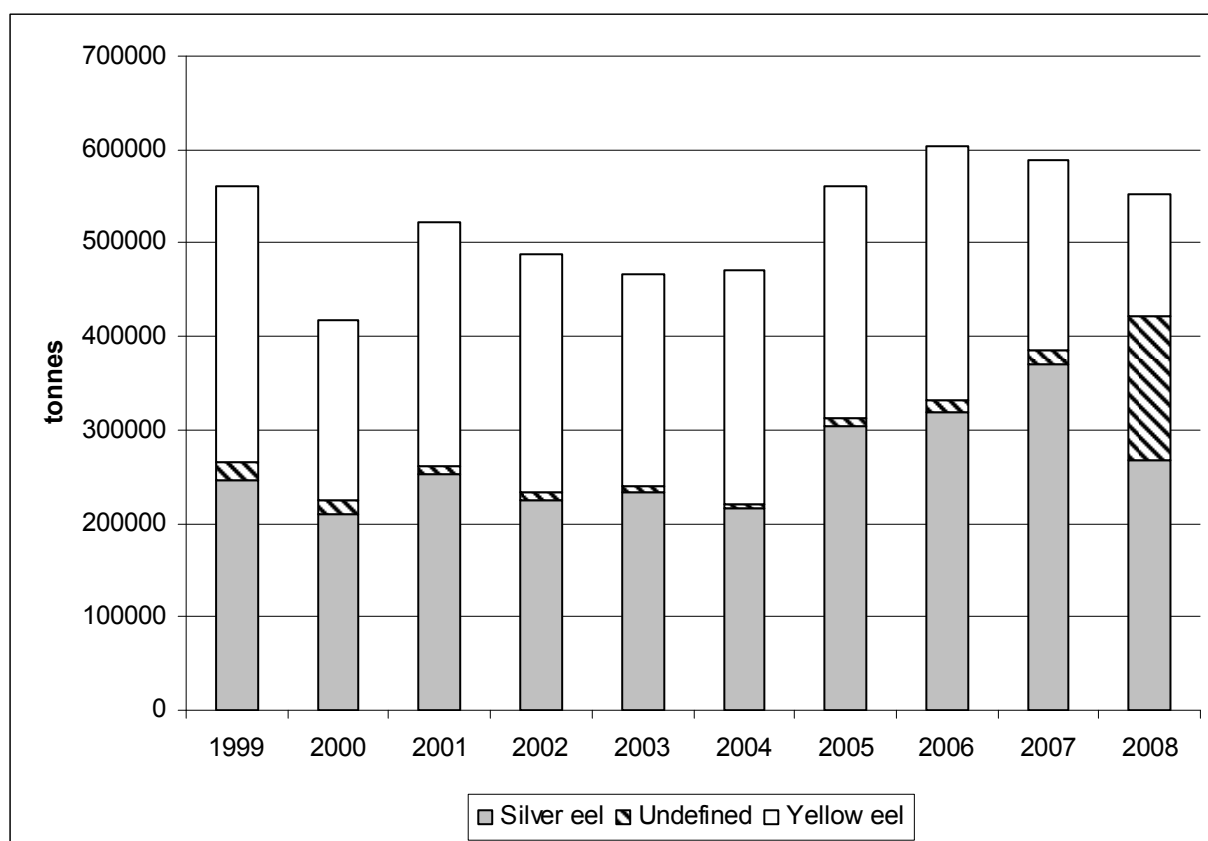


Figure SE.3.6. Total logbook landings in 1999–2008 separated on silver-, yellow- and undefined eels.

From the contract notes compiled by the Swedish Board of Fisheries another dataset was constructed, this time divided according to coastal area and also freshwater. Data from the log-book system and from the contract notes may differ. However, this series is the longest.

**Table SE.d. Commercial landings of eel in Sweden (Kattegat-Skagerrak corresponds to RBD 5 and the data come from the contract notes). (cf Figure SE.3.5).**

<b>YEAR</b>	<b>SOUTH C. (BALTIC SEA)</b>	<b>EAST C. (BALTIC SEA)</b>	<b>KATTEGAT-SKAGERRAK</b>	<b>FRESHWATER</b>	<b>TOTAL SWEDEN</b>
1925	624	936	155		1715
1926	520	1011	176		1707
1927	642	1216	152		2010
1928	373	509	157		1039
1929	582	644	167		1393
1930	716	596	216		1528
1931	782	497	252		1531
1932	769	701	253		1723
1933	645	704	196		1545
1934	798	830	215		1843
1935	829	880	240		1949
1936	608	818	226		1652
1937	548	931	244		1723
1938	666	969	235		1870
1939	535	988	248		1771
1940	553	974	98		1625
1941	633	926	69		1628
1942	426	592	110		1128
1943	820	648	77		1545
1944	879	1042	79		2000
1945	778	790	96		1664
1946	658	738	116		1512
1947	980	761	169		1910
1948	979	689	194		1862
1949	999	671	229		1899
1950	1109	911	168		2188
1951	962	755	212		1929
1952	791	627	180		1598
1953	1146	879	353		2378
1954	1186	780	140		2106
1955	1599	780	272		2651
1956	714	707	112		1533
1957	1158	856	211		2225
1958	938	642	171		1751
1959	1658	977	154		2789
1960	778	703	165		1646
1961	896	870	300		2066
1962	980	713	215		1908
1963	997	802	272		2071
1964	1303	749	236		2288
1965	749	768	285		1802
1966	748	893	328		1969

YEAR	SOUTH C. (BALTIC SEA)	EAST C. (BALTIC SEA)	KATTEGAT-SKAGERRAK	FRESHWATER	TOTAL SWEDEN
1967	646	703	268		1617
1968	713	794	301		1808
1969	622	733	320		1675
1970	476	515	318		1309
1971	545	587	259		1391
1972	425	582	197		1204
1973	419	553	240		1212
1974	322	470	242		1034
1975	494	629	276		1399
1976	283	363	289		935
1977	346	340	303		989
1978	376	385	315		1076
1979	267	404	285		956
1980	371	438	303		1112
1981	243	153	491		887
1982	342	250	569		1161
1983	267	171	735		1173
1984	559	136	378		1073
1985	647	213	280		1140
1986	479	138	234	92	943
1987	439	119	250	89	897
1988	532	190	304	136	1162
1989	447	132	264	109	952
1990	452	119	242	129	942
1991	486	181	285	132	1084
1992	534	162	352	132	1180
1993	550	93	438	129	1210
1994	654	98	630	171	1553
1995	444	79	555	127	1205
1996	564	67	406	97	1134
1997	546	181	513	142	1382
1998	318	50	165	112	645
1999	339	69	186	140	734
2000	286	39	123	113	561
2001	107	123	195	118	543
2002	126	183	222	102	633
2003	115	145	209	96	565
2004	84	134	227	106	551
2005	119	187	211	111	628
2006	125	195	227	123	670
2007	126	178	153	111	568
2008	110	116	156	113	495

### SE.3.2.2. Freshwater fishery

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 6 lakes showed 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 2000–2008 is shown below (Table SE.e.).

Table SE.e. Commercial catch in freshwater (tons).

YEAR	VÄNERN	MÅLAREN	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
2008	22	47	23	20	113

### SE.3.2.3. Recreational

NO AVAILABLE DATA as recreational fishing for eel is prohibited since 2007.

## SE.3.3. Silver eel landings

### SE.3.3.1. Commercial

Eels from the commercial fishery have been categorized as yellow, silver or simply eels, so fully reliable data are not available, but see Figure above.

### SE.3.3.2. Recreational

NO AVAILABLE DATA as recreational fishing for eel is prohibited since 2007.

## SE.3.4. Aquaculture production

### SE.3.4.1. Seed supply

Sweden imports glass eels/elvers only from River Severn in the UK (UK Glass Eels). For 2010 also France may become a supplier earlier in the year.

### SE.3.4.2. Production

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.

172 tonne were produced for consumption in 2008 compared with 175 tonne in 2007.

**Table SE.f. 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) \*SCB ( Statistics Sweden) is the official source of statistics in Sweden.**

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
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		
2008	172		

#### **Stocked numbers**

763 214 eels of about one gramme each, i.e. about 800 kg, were stocked in 2009 in Swedish waters, mostly in lakes. Another 117 550 were sent to Finland (to compare with 206 000 in 2008). Stocked amounts in Sweden were considerable less compared with 971 507 in 2007 and 1 390 134 eels in 2008, probably as an effect of high prices and lack of seed supply.

**Table SE.g. Restocked quantities as numbers of glass and yellow eels per River Basin District (freshwater) and year 2000–2009.**

<b>RBD</b>	<b>2</b>		<b>3</b>		<b>4</b>		<b>5</b>		<b>Σ</b>
Stage	G	Y	G	Y	G	Y	G	Y	
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
2008	na	na	na	na	na	na	na	na	1 027 207
2009	na	na	na	na	na	na	na	na	728 299
Σ	973 092	0	1 893 738	634 777	2 001 362	828 208	3 535 479	170 884	11 793 046

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

<b>RBD</b>	<b>2</b>		<b>3</b>		<b>4</b>		<b>5</b>		<b>Σ</b>
Stage	G	Y	G	Y	G	Y	G	Y	
Year									
2000	0	0	0	0	0	90 970	0	0	90 970
2001	0	0	0	0	0	60 643	0	0	60 643
2002	171 000	0	0	0	0	85 294	0	0	256 294
2003	111 460	0	52 400	0	61 000	0	0	0	224 860
2004	0	0	3 702	0	0	16 170	15 000	0	34 872
2005	0	0	0	0	89 604	0	0	0	89 604
2006	0	0	0	0	128 723	0	0	0	128 723
2007	0	0	69 060	0	80 426	0	7 500	0	156 986
2008	na	na	na	na	na	na	na	na	366 927
2009	na	na	na	na	na	na	na	na	37 915
Σ	282 460	0	125 162	0	359 753	253 077	22 500	0	1 447 794

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 2009.

### **SE.3.5. Stocking**

#### **SE.3.5.1. Amount stocked**

Glass eels are imported from River Severn in the UK and after an approved quarantine period of about eight weeks under aquaculture conditions in heated water they are allowed to be stocked in both fresh- and in brackish waters. From this year and onwards all eels stocked in Sweden have to be marked (in 2009 with strontium in their otoliths).

In addition elvers and young eels are caught and assisted in their migration around barriers in several rivers (cf 3.1.1.3).

As described above no “true unpigmented glass eels” are stocked. Normally the eels are pigmented and about one gramme each when stocked.

Bootlace eels were used in decreasing numbers until 2008, but since 2009 only quarantined eels are used for stocking.

#### **SE.3.5.2. Catch of Eel <12 cm and proportion retained for restocking**

NO DATA AVAILABLE (not applicable as catch of such small eels is prohibited).

### **SE.4. Fishing capacity**

#### **SE.4.1. Glass eel**

NO DATA AVAILABLE (not applicable as catch of such small eels is prohibited).

#### **SE.4.2. Yellow eel**

NO DATA AVAILABLE as the special eel permits do not differ between yellow and silver eels.

#### **SE.4.3. Silver Eel**

NO DATA AVAILABLE as the special eel permits do not differ between yellow and silver eels.

#### **SE.4.4. Marine fishery**

The number of special eel fishing permits was in 2007, 434 in total. In 2008 they were 400 and this year, 2009, there were only 377 permits issued.

#### **SE.4.5. Freshwater**

From the inland eel fishery, statistics exists from all fishermen 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 fishermen or in very few cases by two fishermen together. The number of fishermen in the lakes that reported catch of eels is shown below, per lake or group of lakes and per RBD. The total number of eel fishermen 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 due to the new legislation since May 2007.

**Table SE.i.**

<b>LAKE</b>	<b>VÄNERN</b>	<b>MÄLAREN</b>	<b>HJÄLMAREN</b>	<b>OTHER LAKES</b>	<b>TOTAL</b>
Number of fishermen in 2007	14	22	24	17	77
RBD	3	4	5	Total	
Number of fishermen in 2007	47	8	22	77	

## SE.5. Fishing effort

### SE.5.1. Coastal waters

The official catch statistics at the present do not give reliable information on the effort in the fishery for eel. Detailed information on effort is available locally from industrial monitoring in some sites in the Baltic. The Baltic eel fishery is dominated by poundnets targeting silver eel, to a great extent on private waters. In one area in the central Baltic, effort, as expressed by numbers of poundnets multiplied by time was reduced from 6000 in the late 1960s to less than 3000 around the turn of the millennium. This change is mainly explained by single enterprises closing down the fishery due to old age. The development is probably representative for the entire region.

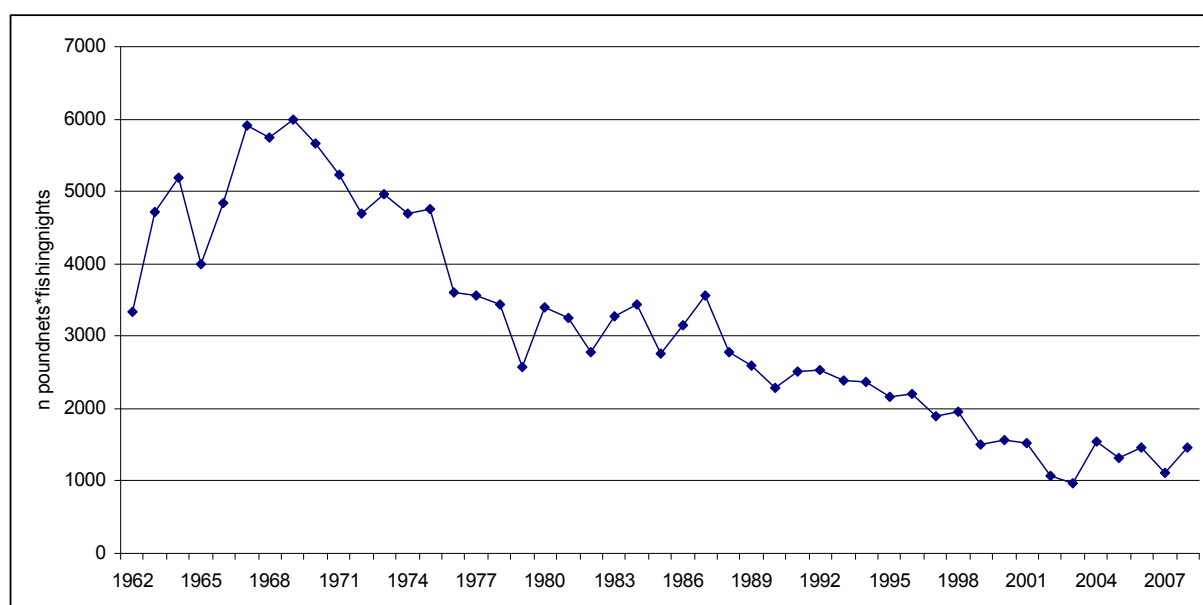


Figure SE.5.1. Effort in poundnet fishery for silver eel in one area on the Swedish coast in ICES Subdivision 27. The unit is number of gears\*number of fishing nights. (reported by EMU.)

### SE.5.2. Glass eel

NO DATA AVAILABLE (not applicable as catch of such small eels is prohibited).

### SE.5.3. Yellow eel

### SE.5.4. Silver eel

### SE.5.5. Marine fishery

### SE.5.6. 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 shown in the table below.

Table SE.j.

LAKE	VÄNERN	MÄLAREN	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.k.

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.

Since May 2007 eel fishing is in general prohibited in Sweden, unless you have got a license. The numbers of licenses issued in fresh and coastal waters are given in Table SE.l.

Table SE.l. Number of eel fishing licenses since 2007 (when eel fishing was prohibited in general).

YEAR	FRESHWATER	COASTAL AREAS	TOTAL	TRAMMEL NETS INCL.
2007	66	368	434	na
2008	70	339	400	na
2009	70	307	377	8

## SE.6. Catches and landings

### SE.6.1. Glass eel

NO DATA AVAILABLE (not applicable as catch of such small eels is prohibited).

### SE.6.2. Yellow eel

### SE.6.3. Silver eel

### SE.6.4. Marine fishery

Sweden includes the coastal area, i.e. also the marine eel fisheries, in our single country wide EMU. The 50% reduction is therefore not applicable in our case.

## SE.7. Catch per unit of effort

### SE.7.1. Glass eel

NO DATA AVAILABLE (not applicable as catch of such small eels is prohibited).

### SE.7.2. Yellow eel

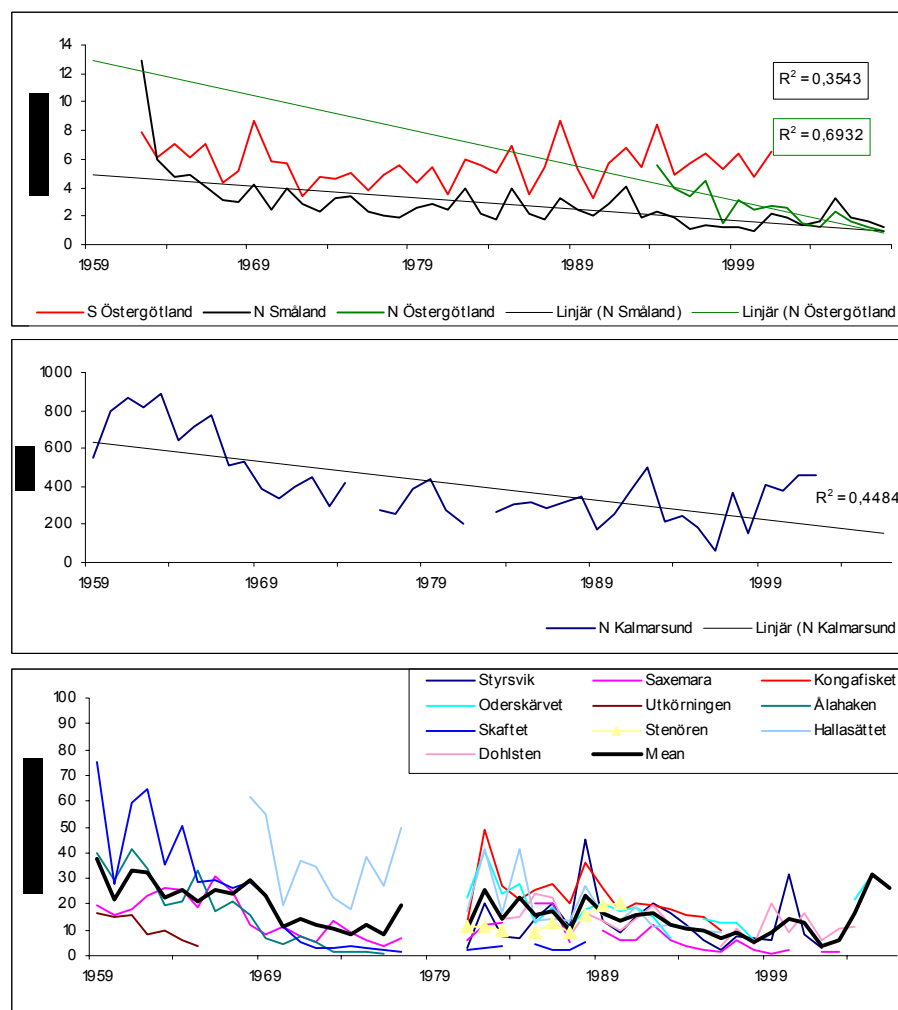
NO DATA AVAILABLE as the DCR has not yet been implemented in freshwater.

### **SE.7.3. Silver eel**

NO DATA AVAILABLE as the DCR has not yet been implemented in freshwater.

### **SE.7.4. Marine fishery**

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.7.1 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 at the single site remaining in 2004–2005 were on the same level as in the mid 1980s (Figure SE.7.1 lower panel). No trend exists in the southern Östergötland area (Figure SE.7.1 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.7.2).



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

Figure SE 7.2 has not been updated since last year's report.

**Figure SE. 7.2. 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 with 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.7.3). The cpue was stable in both areas over the years. In the southern Östergötland area ( ICES SD 27 north) 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 the northern parts of the county of Kalmar (ICES SD 27 south), 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.

These time-series depend on funding from a monitoring programme for the nuclear power plant at Simpevarp near Oskarshamn on the Swedish east coast. They may be broken if power plants are closed, if legal conditions for monitoring are changed or if the fishery is closed for any reason.

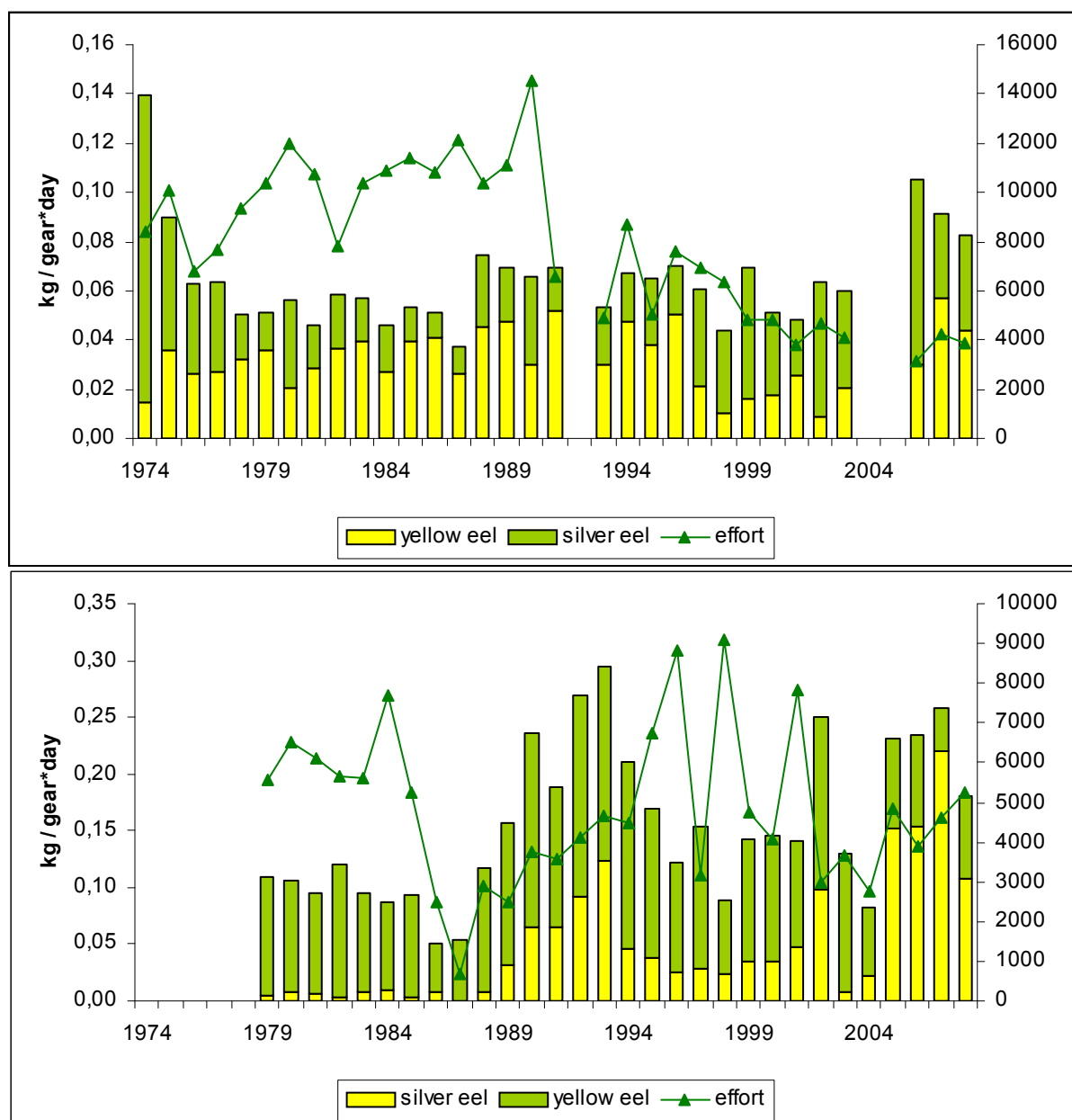


Figure SE.7.3 Time trends in cpue and effort in fykenet fishery for silver and yellow eel in two subareas located in ICES Subdivision 27 on the Swedish coast of the Baltic Proper. Southern part of the county of Östergötland (upper) and northern part of the county of Kalmar (lower).

## SE.8. Scientific surveys of the stock

### SE.8.1. Recruitment surveys, glass eel

### SE.8.2. Recruitment surveys/marine data

The abundance of glass eels in the open sea (Kattegat and Skagerrak) is surveyed by trawling with either an Isaacs–Kidd Midwater trawl (IKMT) or with a modified Methot-Isaacs–Kidd Midwater trawl (MIKT). The former trawl is used in a fixed position in the intake canal for cooling water to the condensers at the Ringhals Nuclear Power Station (e.g. Westerberg, 1998a; 1998b). The latter method is used from RV Argos during the ICES International Young Fish Survey (since 1993 called the International Bottom trawl Survey (IBTS Quarter 1) (Hagström and Wickström, 1990). When the glass eels have settled they and larger eels can be monitored on soft and shallow bottoms using a “Drop Trap” technique (Westerberg *et al.*, 1993). This was successfully done during a number of years but is now a resting series. This approach made it possible to roughly estimate the total recruitment of young eels to the Swedish coast. From all three methods recruitment series could be compiled:

Recruitment of glass eel to the Swedish west coast is monitored at the intake of cooling water to the nuclear power plant at Ringhals in the Kattegat (**Figure SE.3.3** and **Table SE.c**). The time of arrival of the glass eels to the sampling site varies between years, probably as a consequence of hydrographical conditions, but the peak in abundance normally occurred in late March to early April. Abundance has decreased by 90% if recent years are compared with the peak in the early 1980s. Applying a transition function to the data suggests a break in the trend in the early 1980s (Figure SE.3.4).

The time-series from Ringhals is depending on the status of operation of the power plant and cannot be guaranteed on a longer time-scale. A process has been started in Sweden to find a completely independent method to assess glass eel recruitment. The flow of water through the intake channel is normally stable over time at full production of electricity. During longer stops of one of the reactors the flow may be reduced by half. This is compensated for by a linear transformation of observed cpue. As the relationship between flow and catchability is not known, bias may be introduced by this compensation.

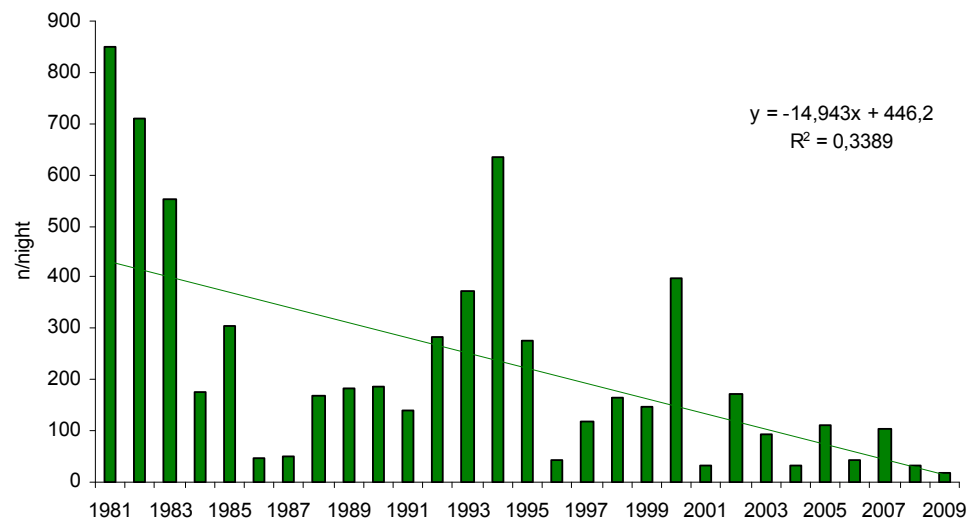


Figure SE.3.3. Time trend in glass eel recruitment at the Ringhals nuclear power plant on the Kattegat coast in Swedish RBD 5 (Västerhavet).

**Table SE.c. Annual indices of glass eel recruitment at the intake canal for cooling water to reactors 1 and 2 at the Ringhals nuclear power plant. Mean of weekly means of numbers of glass eels collected with a modified Isaacs–Kidd midwater trawl during March and April (weeks 9–18). Data were corrected for variations in water flow.**

week	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	
3	3													1																
4	0							17			1			4					0											
5	4							8		15	14	18	30	5	4	0	0	1	0	74	2	27	6		20		10			
6								28		27	13	56	45	7	11	0	1	1	0	142	0	86	5	1	12	2	42	8	1	
7								6		22	9	85	331	7	41	0	22	9	8	267	3	154	2	2	62	3	4	27		
8	1							34		57	3	44	57	8	48	11	3	50	12	115	5	327	5	0	22	2	12	17	4	
9	187		51			3		36	342	185	3	160	55	3	172	0	68	125	62	344	5	117	5	1	15	6	11	10	3	
10	199	24				2		80	372	150	15	471	118	7	224	4	200	100	121	377	3	200	10	3	10	2	29	31	2	
11	250	130	528	176		4		19	129	150	88	290	130	610	333	13	198	8	72	533	22	366	44	3	39	1	81	114	3	
12	374	806	835	289	14	6	2	16	107	145	42	469	535	400	569	25	60	177	158	214	24	530	53	18	162	13	382	38	15	
13	1886	1258	265	122	109	1	0	72	291	251	110	562	495	1430	331	60	42	220	2	479	16	59	185	35	153	17	186	30	36	
14	2093	1335	469	181	0	3	31	149	121	351	138	151	403	1236	625	33	77	448	314	942	22	185	192	65	162	55	101	43	37	
15	1849		878	112	878		141	603	67	284	414	298	540	1145	91	128	201	237	377	154	45	184	151	55	202	97	191	26	25	
16			925		476		69	416	42	120	254	142	527	619	64	73	49	96	79	299	25	53	74	90	286	132	20	13	23	
17	804		477	171	350		6	127		37	193	231	564	278	80	56	44	202	141	257	128	8	158	32	66	62	18	2	11	
18	0					297	114				124	55					230	31				9	46	8	10	36	7			
mean 9-18	849	711	553	175	305	45	52	169	184	186	138	283	374	636	277	44	117	164	147	400	32	171	92	31	110	42	102	34	17	

### SE.8.3. Yellow eel surveys in coastal waters

The coastal fish communities on the Swedish west coast are monitored by standardized fishing with fykenets in shallow water (2–5 m). Yellow eel is among the dominating fish species in August most years. The trend for the longest time-series from Vendelsö in N Kattegat is significantly positive. No trend exists in the Barsebäck series. In the other areas the period of sampling was too short to be examined for biologically significant trends. The magnitude of cpue though, was similar to that of the longer series. The interannual variations in cpue were influenced by water temperature at the time of sampling, but no time-trends in temperature were observed for the period with available data (1988–2008).

The time-series from Barsebäck and Vendelsö are financed by industrial monitoring and thus depend on the operation of two nuclear power plants. The power plant at Barsebäck in the Öresund was closed in 2005 and the Swedish Board of Fisheries has the ambition to secure this series for continuing monitoring in this transition area between the Baltic Sea and the Kattegat. Fjällbacka on the northern Skagerrak coast is a reference area in the national programme for environmental monitoring and future funding is considered to be secure. Other reference areas are all depending of annual funding and priority processes within the Swedish Board of Fisheries and other government agencies.

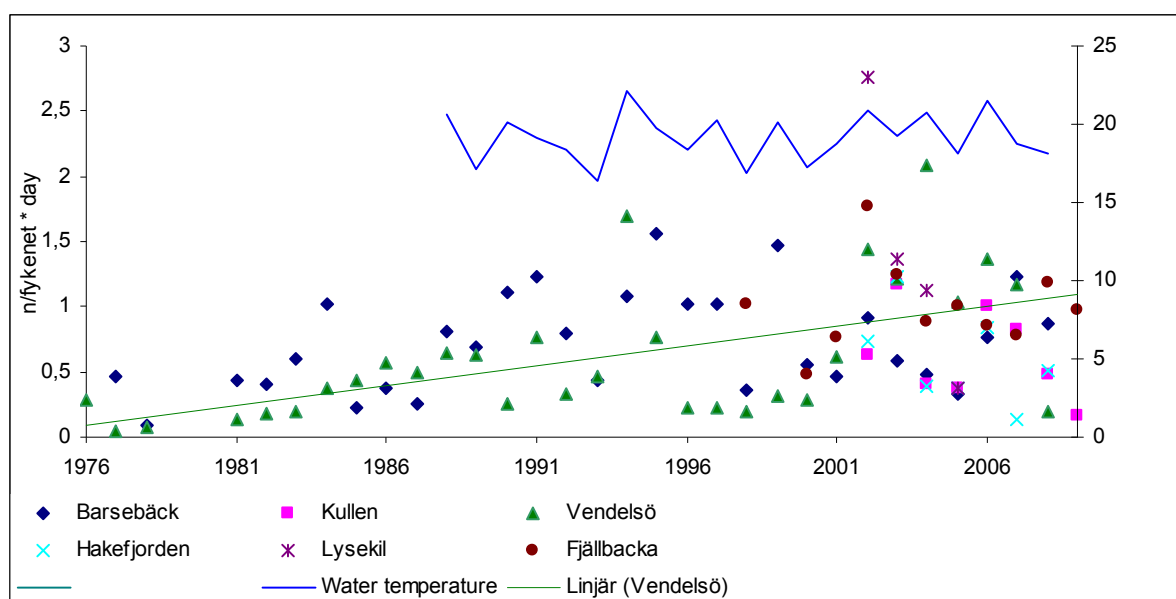


Figure SE.8.1. Time trend in the yellow eel catches in coastal fish monitoring with fykenets in August on the Swedish west coast. The trend is positive for Vendelsö in N Kattegat (linear regression,  $p < 0,005$ ). Annual mean water temperature at the fishing gears is presented for the Vendelsö area in central Kattegat.

### SE.8.4. Silver eel

## SE.9. Catch composition by age and length

### SE.9.1. Reported by sub-catchment, catchment or EMU

### SE.9.2. Catch composition by age and length in coastal areas

In 2002–2008 11 100 yellow eel were sampled for individual length, total and somatic weight, sex and prevalence of *Anguillicola crassus*. All but 130 individuals were female and the males were mainly recorded on the Skagerrak coast in SD 20. Age readings exist for 2700 individuals, but the major part of the otoliths were stored and not analysed after the year of catch 2005 (Table SE.m (b)). The sampling programme started as an initiative of the Swedish Board of Fisheries and is now part of the Swedish contribution to the DCR. Sampling of silver eel in poundnet catches started in 2005. So far length and weight recordings and otoliths were collected from 4100 silver eels and 1200 age readings were performed.

Table SE.m. Swedish sampling of yellow eel in commercial catches with fykenets.

a. total number sampled for size and age

ICES SD	Year of catch							Total
	2002	2003	2004	2005	2006	2007	2008	
20	202	201	200	729	670	723	870	3595
21	205	198	200	202	100	201	318	1424
23	202	201	200	200	197	200	200	1400
25	409	405	414					1228
27	392	426	469	465	478	597	625	3452
<b>Total</b>	<b>1410</b>	<b>1431</b>	<b>1483</b>	<b>1596</b>	<b>1446</b>	<b>1721</b>	<b>2013</b>	<b>11100</b>

b. total number of age records

ICES SD	Year of catch							Total
	2002	2003	2004	2005	2006	2007	2008	
20	97	96	98	433				724
21	98	99	98	201	100			596
23	96	96	198	199				589
25		97	99					196
27			390	188				578
<b>Total</b>	<b>291</b>	<b>388</b>	<b>883</b>	<b>1021</b>	<b>100</b>	<b>0</b>	<b>0</b>	<b>2683</b>

Sampling for length in commercial fykenet catches demonstrate a similar size composition of yellow eel in the Kattegat, the Öresund area and on the southern Baltic coast (SD 21, 23 and 25). Sizes in the interval 40–50 cm were most abundant. In Subdivision 20 on the Skagerrak coast, the negative slope of the size spectrum starts just above 40 cm. Sampling in Subdivision 27 in the central Baltic Proper demonstrates a population with considerably higher mean length and with single individuals reaching almost 90 cm in length (Figure SE.9.1).

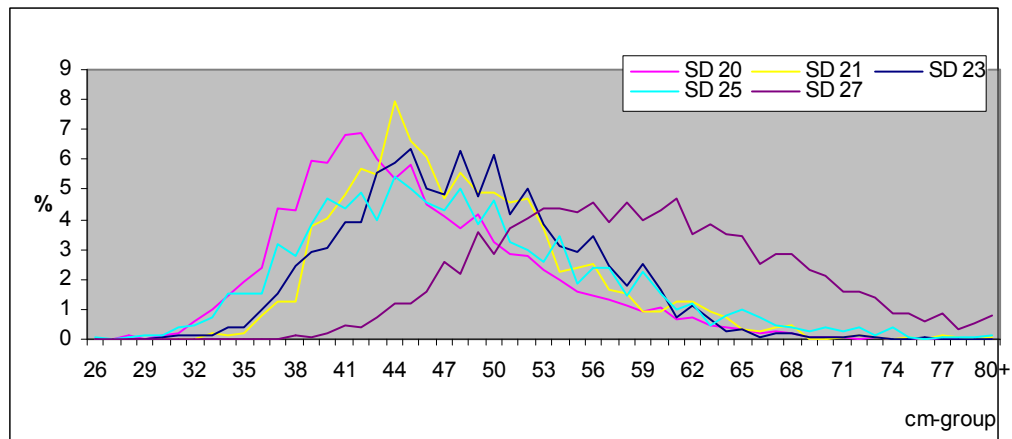


Figure SE.9.1. Length composition of yellow eel from commercial fykenet catches in samples collected in 2002–2008 in RBD SE Västerhavet (ICES SD 20–21) and RBD SE Baltic (ICES SD 23,25 and 27). Samples from Subdivisions 25 and 27 are based on an unsorted mixture of landings and discard.

There is a gradient in mean length of silver eel from 77 cm SD 27 in central Baltic to 65 cm in SD 23, Öresund. Since May 2007 the minimum legal landing size is 65 cm in the Baltic. The length distributions in SD 24–25 in the southern Baltic indicate a potential for a considerable reduction of the fishing mortality in the poundnet fishery in this area with the new size limit.

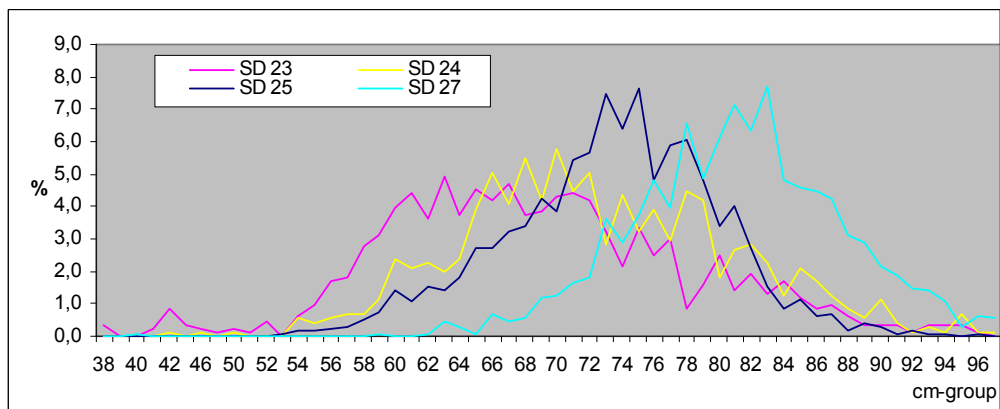


Figure SE.9.2. Length composition of silver eel from commercial poundnet catches for samples collected in 2005–2008 in RBD SE Baltic (ICES SD 23, 24, 25 and 27).

In the three western Subdivisions, Öresund, Kattegat and Skagerrak, the average age of the yellow eel in commercial landings varied between 8 and 10 years. The samples from SD 25 represent the first proper habitat for yellow eel recruits on their path of migration from the west coast into the Baltic Sea. The relatively low mean age in unsorted fykenet landings in SD 25 indicates that migrants on transit might make up a considerable proportion of the catches. Although the yellow eels from SD 27 in the Central Baltic were considerably larger, they were only 1–2 years older compared with the western sampling sites. Silver eel ages varied from 14 years on average in SD 27 to 10–12 years in SD 23–25.

Table SE.n. Mean age of yellow eel in the Swedish coastal fykenet fishery.

ICES SD	Year of catch					Total
	2002	2003	2004	2005	2006	
20	9,0	8,9	9,6	8,7		8,9
21	8,7	8,2	8,7	7,9	9,2	8,4
23	8,6	9,6	9,4	8,9		9,1
25		7,2	6,8			7,0
27			9,8	10,9		10,1

In SD 20, 21 and 23 (West Coast) eels were recruited to the fishery at the age of 4 to 5 years and the oldest individuals recorded had reached the age of 18 years. On the southern Baltic coast the age span in unsorted landings was 3–12 years. The age distribution in SD 27 was similar to those from the west coast, although shifted one year to the right in Figure SE.9.3.

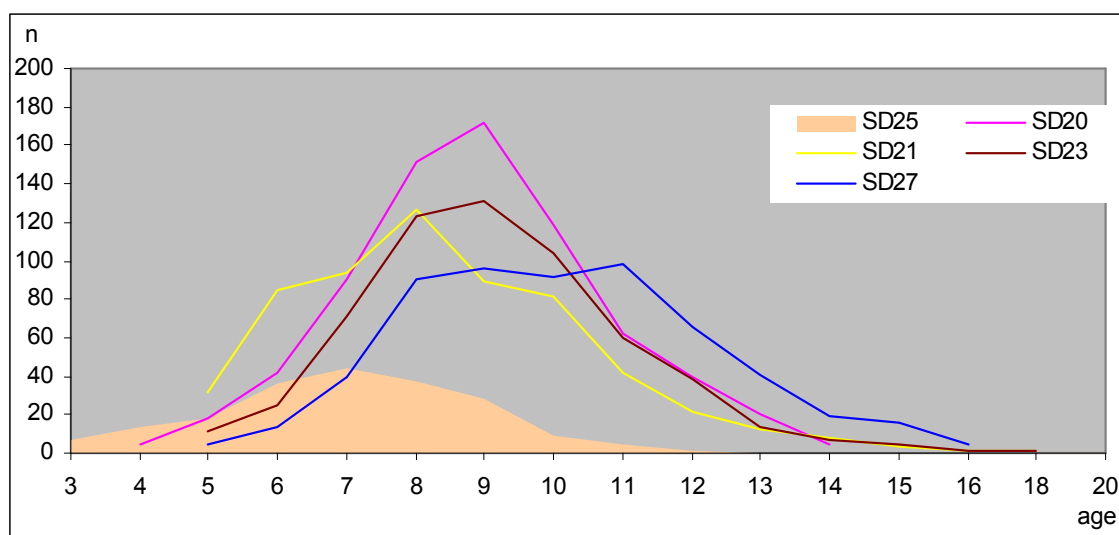


Figure SE.9.3. Age distribution of yellow eel from commercial fykenet catches for samples collected in 2005–2006 in RBD SE Västerhavet (ICES SD 20–21) and RBD SE Baltic (ICES SD 25 and 27).

## SE.10. Other biological sampling

### SE.10.1. Length and weight and growth (DCR)

The growth pattern is close to linear for both length and weight in all areas (Figure SE.10.1). Bias is probably introduced for younger ages due to gear selectivity and in higher ages due to silvering. Yellow eel from SD 27 in central Baltic were considerably longer and heavier than in other areas, a 10 year old female being 57 cm and 314 g in the former area compared with 49,5 cm and 192 g on the Skagerrak coast (SD 20). Comparing the most abundant ages, somatic condition is higher in the Baltic samples and increases with increasing age. The possibly transiting eels in SD 25 thus were in better condition than eels from the west coast, but had otherwise grown at approximately the same speed. Condition increasing with increasing age is seen in all areas but SD 20.

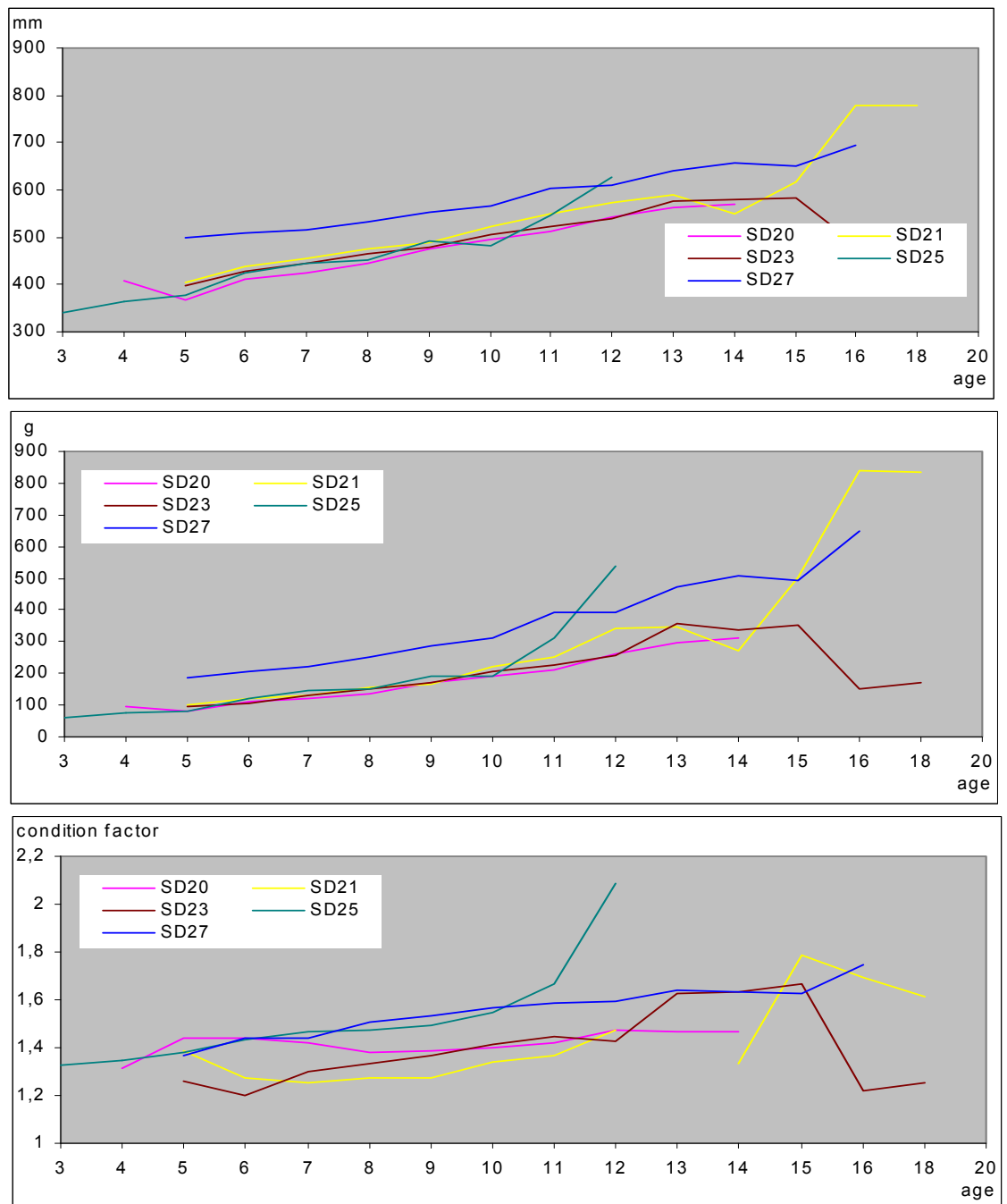


Figure SE.10.1. Length, weight and condition factor at age of yellow eel from commercial fykenet catches in samples collected in 2005–2006 in RBD SE Västerhavet (ICES SD 20–21) and RBD SE Baltic (ICES SD 25 and 27).

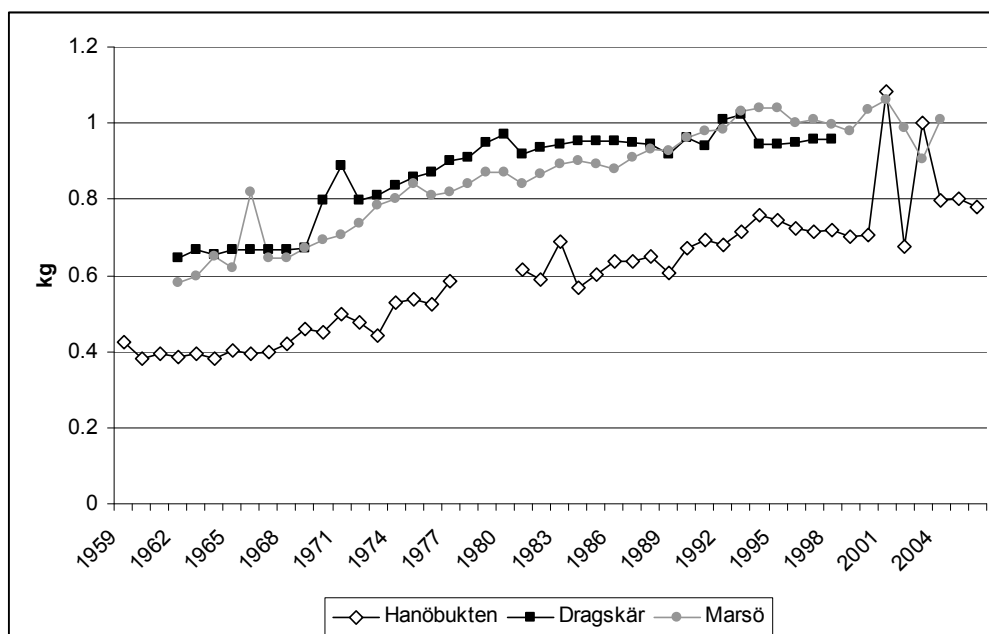


Figure SE.10.2. Changes over time in mean total weight of silver eels from SD 25 (Hanöbukten) and SD 27 (Dragskär+Marsö).

Mean weight of silver eels in commercial poundnet catches have increased over time (Figure SE.10.2) from 0.6 kg in the 1960s to 1 kg in recent years. The trend is the same in both SD 25 and SD 27 although the mean weight of silver eels is generally lower in SD 25. There are some uncertainties in the data before 1970 such that some yellow eel could be included in the statistics.

### SE.10.2. Parasites and pathogens

The swimbladder parasite (*Anguillicola*) does occur in eels from most sites. All eels dissected at the Swedish Board of Fisheries are analysed macroscopically for the prevalence (at both Institutes involved) and intensity (at the Institute of Freshwater Research only) of *Anguillicola* in their swimbladders. Prevalence of *Anguillicola crassus* is a mandatory variable in all coastal sampling of eel in Sweden, including the DCR sampling. The rate of infestation in the pooled data from 2002–2008 was 15% or less in the most marine areas, 46% in Öresund and 55–61% in the Baltic sites.

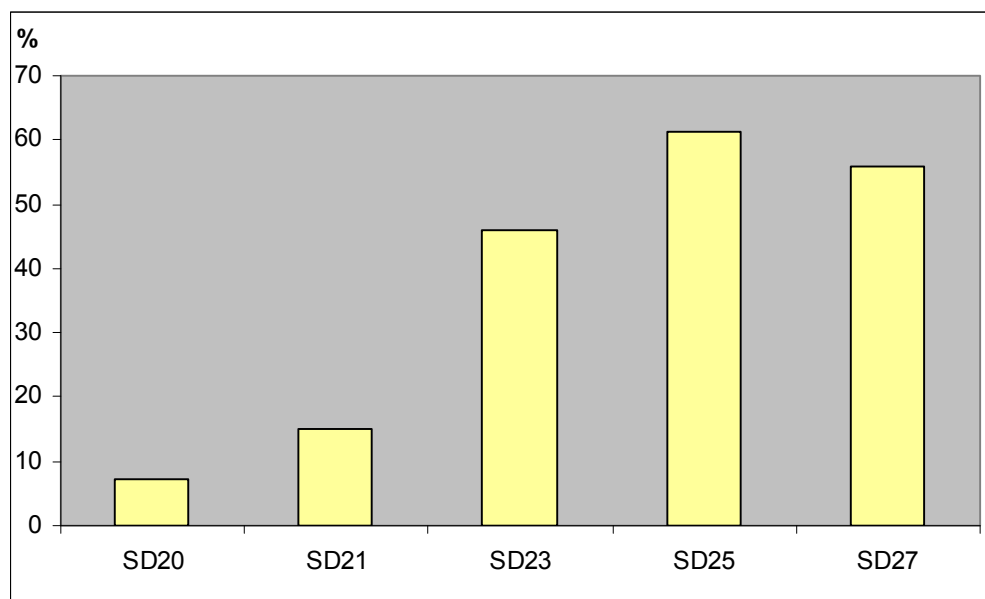


Figure SE.10.3. Prevalence of the swimbladder parasite (*Anguillicola crassus*) in yellow eel from commercial fykenet catches for samples collected in 2002–2008 in RBD SE Västerhavet (ICES SD 20–21) and RBD SE Baltic (ICES SD 25 and 27).

Table SE.o. Prevalence of *Anguillicola crassus* in yellow eel from Swedish coastal waters in 2002–2008. ICES Subdivisions 20–21 represent RBD 5, other subdivisions represent RBD 4.

	20	21	23	25	27
Not infested	3332	1210	758	476	1349
Infested	263	215	641	753	1712
Grand total	3595	1425	1399	1229	3061
Prevalence	7,3	15,1	45,8	61,3	55,9

All eels dissected at the Institute of Freshwater Research, i.e. mostly samples from freshwater, are analysed (macroscopically) for the presence and intensity of *Anguillicola*.

Since 2005 the average values for *Anguillicola* infestations in all eels dissected, irrespective of origin and sample sizes were as follows.

Table SE.p.

YEAR	2005	2006	2007	2008	2009
Prevalence	0,62	0,56	0,60	0,49	0,65
Intensity	7,05	5,57	3,71	5,81	5,02
Std (intensity)	7,81	5,92	4,32	6,05	7,21
N	na	Na	na	na	na

From Lake Mälaren (59°20 N, 17°53 E) more detailed data were obtainable when this report was compiled.

<b>LAKE MÄLAREN</b>					
Year	2005	2006	2007	2008	2009
Prevalence	0,63	0,52	0,52	0,65	0,61
Intensity	5,65	5,02	4,28	4,17	4,60
Std (intensity)	5,25	5,20	5,13	4,47	7,10
N	123	100	118	97	69

Table SE.q. *Anguillicola* in eel from three lakes in Sweden.

LAKE/COORDINATES	ANGUILLICOLA/YEAR	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Fardume	Prevalence	0,00	0,00	0,09	0,39	0,89	0,75	0,71	0,70	0,64	0,67	0,76	0,69						
57°47N, 18°55E	Intensity	0,00	0,00	1,67	2,75	17,08	6,56	8,00	6,69	7,88	6,52	5,76	8,53						
	sd	0,00	0,00	0,55	1,98	11,30	7,33	6,05	7,09	7,63	7,48	6,82	8,79						
	n	40	22	35	51	57	12	7	46	174	123	50	52						
Mälaren	Prevalence											0,76	0,75	0,83	0,63	0,52	0,52	0,65	0,61
59°20N, 17°53E	Intensity											5,09	6,90	6,83	5,65	5,02	4,28	4,17	4,60
	sd											4,18	5,55	9,59	5,25	5,20	5,13	4,47	7,10
	n											76	71	72	123	100	118	97	69
Ymsen	Prevalence												0,85	0,63	0,71	0,67	0,88	0,79	0,92
58°39N, 13°57E	Intensity												12,86	4,64	5,10	6,50	5,43	12,71	6,64
	sd												14,55	3,18	4,03	4,04	5,17	12,96	7,57
	n												62	35	14	3	16	43	12

**SE.10.3. Contaminants**

NO NEW DATA AVAILABLE

**SE.10.4. Predators**

NO NEW DATA AVAILABLE although there is a continuous debate regarding the impact on fish stocks, including eel, of the abundant cormorants.

**SE.11. Other sampling****SE.12. Stock assessment****SE.12.1. Local stock assessment****SE.12.2. International stock assessment****SE.12.2.1. Habitat**

Wetted Area : lacustrine: 32 763 km<sup>2</sup> (less than 20 m deep)

Riverine: na

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

coastal: 17 843 km<sup>2</sup>

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

**SE.12.2.2. Silver eel production****SE.12.2.2.1. Historical production**

x EMU 4 400 000–10 500 000 silver eels, corresponding to 4000–9500 tonne

**SE.12.2.2.2. Current production**

x EMU 2 870 000 silver eels or 2600 tonne

**SE.12.2.2.3. Current escapement**

x EMU 2 000 000 eels or 1800 tons

**SE.12.2.2.4. Production values e.g. kg/ha**

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

**SE.12.2.2.5. Impacts**

Fisheries, hydropower, etc.

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

Hydropower: 280 000 eels or 250 tonne

Quantify x EMU

**SE.12.2.2.6. Stocking requirement eels <20 cm**

x EMU 2 500 000

**SE.12.2.2.7. Data quality issues****SE.13. Sampling intensity and precision****SE.14. Standardisation and harmonization of methodology****SE.14.1. Survey techniques**

The most common sampling gear in lakes and in coastal areas are double fykes (summer fykes) fished as a train or chain of connected fykes.

**SE.14.2. Sampling commercial catches****SE.14.3. Sampling****SE.14.4. Age analysis**

Age is normally determined from ground, polished and stained otoliths in the sagittal plane. Also transverse sawed slices are occasionally used.

**SE.14.5. Life stages****SE.14.6. Sex determinations**

Sex is determined from the gross morphology of the gonads using naked eye or when uncertainty with a dissection microscope. Males are very rare in most sites.

**SE.15. Overview, conclusions and recommendations****SE.16. Literature references**

Clevestam, P. and Wickström, H. 2008. Rädda ålen och ålfisket! Ett nationellt bidrag till en Europeisk förvaltningsplan. Slutrapport från pilotprojekt till Fonden för fiskets utveckling Dnr: 231-1156-04, 42 (in Swedish).

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Sjöberg, N. B., Petersson, E., Wickström, H. and Hansson, S. 2009. N. B. Effects of the swim-bladder parasite *Anguillicola crassus* on the migration of European silver eels *Anguilla anguilla* in the Baltic Sea. *Journal of Fish Biology* (2009) 74, 2158-2170.