Report on the eel stock and fishery in Norway 2008

NO.A Authors

Jan Atle Knutsen, Institute of Marine Research, Flødevigen 4817 His, Norway

Tel: +47 37 05 90 18. FAX: +47 37 05 90 01

Jan.atle.knutsen@imr.no

Caroline Durif, Institute of Marine Research, 5392 Storebø, Norway

Tel: +47 56 18 22 50. FAX: +47 56 18 22 22

caroline.durif@imr.no

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Contributors to the report:

L. A. Vøllestad, University of Oslo

J. Gjøsæter, Institute of Marine Research-Flødevigen

NO.B Introduction

Eel fishing is performed with fykenets from May–November in coastal areas of the sea. Eel fishing takes place in estuarine, brackish as well as saltwater areas. The data reported here consists of the only known eel dataset from brackish or salt water.

The European eel has been added to the Norwegian Red List of Species since May 2006.

NO.C Fishing capacity

Fishing for glasseel is prohibited in Norway.

There is a minimum legal size of between 37 (silver eels)–40 cm (yellow eels). The official catch data consists of annual totals by district.

The eel fisheries are located mainly along the south coast of Norway. No distinction is made between yellow and silver eels and they are both caught with eel pots. Fishermen operate in the estuarine area around coastal islands. Fykenets are set on soft and muddy bottom, with preference of areas with seagrass beds (eelgrass *Zostera marina*). Like seagrasses throughout the world the eelgrass in Nordic waters are under great pressure (Baden, 2003), and human-induced disturbances are among the main factors threatening these habitats. Alarming, Baden *et al.*, 2003 demonstrated great loss of seagrass on the Swedish Skagerrak Coast (58% in 10–15 years), especially within areas with the highest nutrient loads.

NO.C.1 Reported by year

The table lists the number of eel fishing licenses delivered each year. These figures correspond approximately to the number of fishers although one boat (fisher) can change licences within a year.

Table 1. Number of eel fishing licenses in Norway between 1977–2007.

Year	Number of licenses
1977	326
1978	313
1979	374
1980	541
1981	501
1982	505
1983	478
1984	434
1985	399
1986	412
1987	425
1988	525
1989	479
1990	468
1991	449
1992	434
1993	404
1994	452
1995	423
1996	417
1997	445
1998	389
1999	429
2000	347
2001	336
2002	327
2003	284
2004	258
2005	241
2006	247
2007	

NO.C.2 Reported by district

The total number of licenses delivered in Norway since 1977 is 12 062. Trends are similar in all the districts (Figure 1). Highest numbers were in 1980 and 1988. The number of registrations is significantly decreasing since the year 2000.

Table 2. Number of eel fishing licenses in Norway between 1977–2006.

District	Number of licenses
A	89
BD	38
F	3
H	2930
M	463
N	20
NT	47
O	27
R	1733
SF	384
ST	42
T	10
TK	677
V	736
VA	1680
Ø	1980
AA	1203

NO.D Fishing effort

There is no registration of fishing effort (about number of eel pots or boat per license).

NO.E Catches and landings

Eel landings were highest in the 1930s and 1960s amounting to an annual total of 500 tons. Two important decreases in the landings were observed during both World Wars (1914–18 and 1939–45). Since 1969, landings have decreased with a few years of exception (for example in 1988). It is difficult say whether this trend reflects the number of eels because this number is correlated with the number of licenses (available between 1977 and 2006, R=0.60).

Institute of Marine Research has two resource monitoring programmes of importance for the Norwegian eel populations. a) a fykenet monitoring programme, and b) a beach-seine programme.

a) Since 1977 20–30 fishers have reported yearly information from their fykenet fishing.

Data on: 1) how many fykenets are used during eel fishing, 2) the exact period (days) eel fishing is performed and 3) the landings of eel are reported. These data demonstrate little variations in catch rates and landings over the latest 10–20 years.

Table 3. Official landings of yellow and silver eels reported by fishers in Norway. The number of registration is available since 1977 and cpue were calculated based on these numbers.

Year	Norway (tons)	Year	Norway (tons)	cpue
1908	268	1958	437	
1909	327	1959	409	
1910	303	1960	430	
1911	384	1961	449	
1912	187	1962	356	
1913	213	1963	503	
1914	282	1964	440	
1915	143	1965	523	
1916	117	1966	510	
1917	44	1967	491	
1918	35	1968	569	
1919	64	1969	522	
1920	80	1970	422	
1921	79	1971	415	
1922	94	1972	422	
1923	140	1973	409	
1924	290	1974	368	
1925	325	1975	407	
1926	341	1976	386	
1927	354	1977	352	1.0797546
1928	325	1978	347	1.1086262
1929	425	1979	374	1
1930	450	1980	387	0.71534196
1931	329	1981	369	0.73652695
1932	518	1982	385	0.76237624
1933	694	1983	324	0.67782427
1934	674	1984	310	0.71428571
1935	564	1985	352	0.88220551
1936	631	1986	272	0.66019417
1937	603	1987	282	0.66352941
1938	526	1988	513	0.97714286
1939	434	1989	313	0.65344468
1940	143	1990	336	0.71794872
1941	174	1991	323	0.71937639
1942	131	1992	372	0.85714286
1943	136	1993	340	0.84158416
1944	150	1994	472	1.04424779
1945	102	1995	454	1.07328605
1946	167	1996	353	0.84652278

Year	Norway (tons)	Year	Norway (tons)	cpue
1947	268	1997	467	1.0494382
1948	293	1998	331	0.85089974
1949	214	1999	447	1.04195804
1950	282	2000	281	0.80979827
1951	312	2001	304	0.9047619
1952	178	2002	311	0.95107034
1953	371	2003	240	0.84507042
1954	327	2004	237	0.91860465
1955	451	2005	249	1.03319502
1956	293	2006	293	1.18623482
1957	430	2007	194	0.8362069

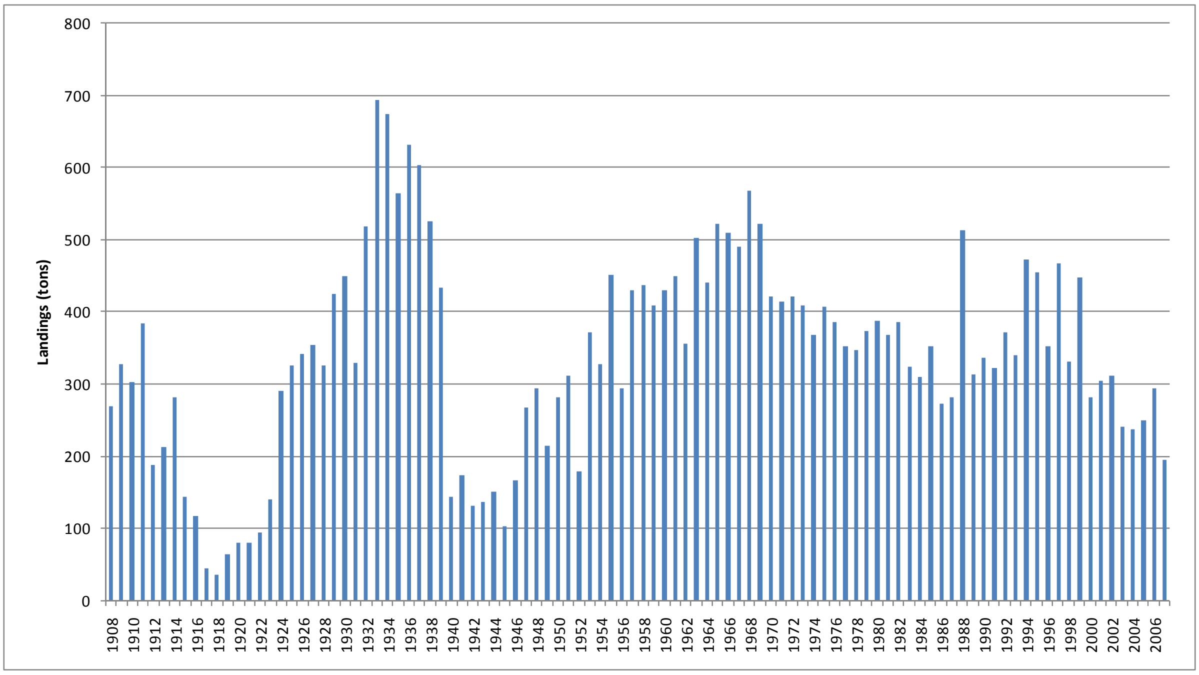

Figure 1 Landings (tons) of yellow and silver eels reported for Norway between 1908 and 2007.

NO.F Catch per unit of effort

Cpues were calculated as: cpue=landings/number of registration.

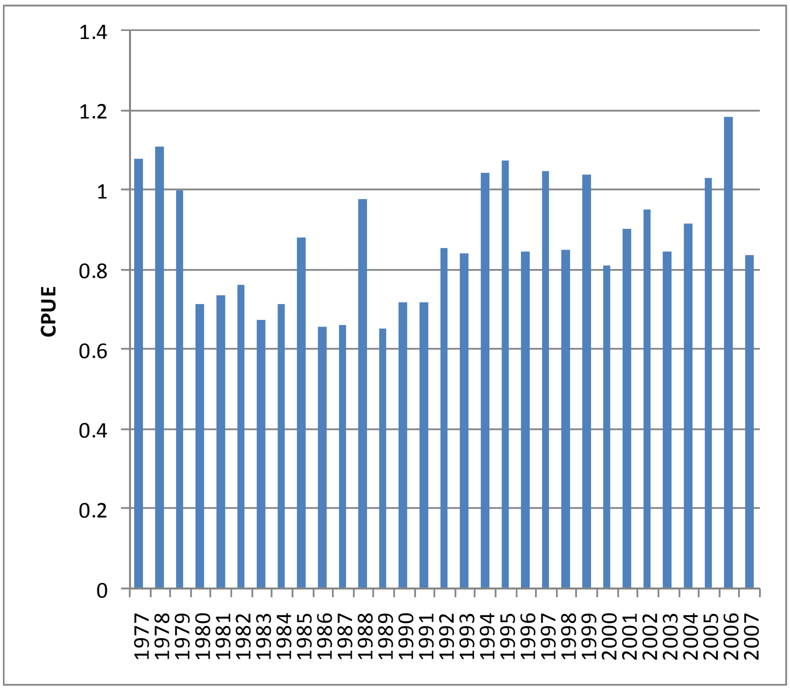

Figure 2 Cpues of eels calculated between 1977 and 2007.

IR.G. Scientific surveys of the stock

NO.G.1 Freshwater data

The only available time-series for eel abundance in fresh water in Norway is the one maintained by the Norwegian Institute for Nature Research at Ims (southwest Norway; since 1975). Silver eels are caught in a Wolf Trap at the river's mouth. Elvers and small yellow eels are also counted as they ascend the river. Data is missing between 1994 and 1999. This time-series was formally analysed by Hvidsten, 1985a and by Vøllestad and Jonsson, 1988. The later part of the time-series has not been analysed in detail. Further, during the 1980s detailed data on the population dynamic were collected and analysed (Vøllestad, 1990; Vøllestad and Jonsson, 1986, 1988). However, Vøllestad did sample more population dynamic data that has not been analysed in detail-these data include information about age, sex and size of subsamples of downstream migrating silver eels for a number of years. The downstream migration of the silver eels in Imsa has also been studied in detail (Haraldstad *et al*., 1985; Hvidsten, 1985b; Vøllestad *et al*., 1986, 1994).

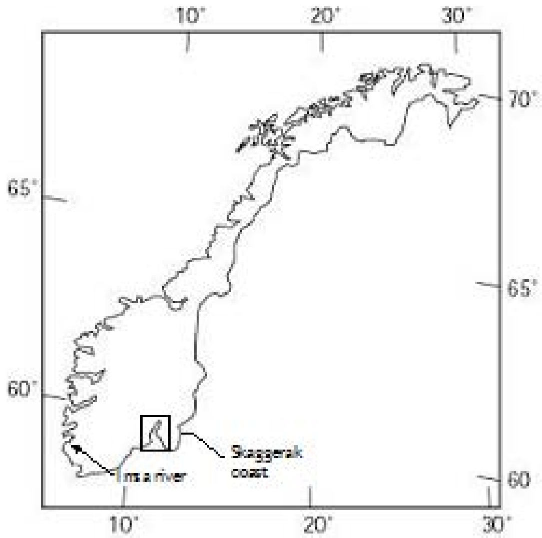

Figure 3. Locations of the sampling areas along the Skagerrak coast and of the Imsa River.

Table 3. Trap data from the river Imsa.

YEAR	NUMBER OF ELVERS	NUMBER OF SILVER EELS
1975	42 945	5201
1976	48 615	3824
1977	28 518	5435
1978	121 818	4986
1979	2457	2914
1980	34 776	3382
1981	15 477	2354
1982	45 750	3818
1983	14 500	3712
1984	6640	3377
1985	3412	4427
1986	5145	3733
1987	3434	1833
1988	17 500	4274
1989	10 000	2107
1990	32 500	2196
1991	6250	1347
1992	4450	1394
1993	8625	681
1994	525	
1995	1950	
1996	1000	
1997	5500	

YEAR	NUMBER OF ELVERS	NUMBER OF SILVER EELS
1998	1750	
1999	3750	
2000	1625	1749
2001	1875	4580
2002	1375	1850
2003	3575	2824
2004	375	2076
2005	1550	1894
2006	350	2827
2007	100	3067

The ascent of elvers has decreased strongly the last years (Figure 7), and on a log scale the trend is clearly linear. Before 1995 the number of elvers entering the elver trap in Imsa has varied between 5000 and 50 000, with large annual variation. In the last 10 years the number of ascending elvers has been extremely low, and decreasing. Earlier analyses of the data-the first 10–15 years of the time-series-did indicate a relationship between temperature and number of ascending elvers (Hvidsten, 1985a; Vøllestad and Jonsson, 1988). The suggestion was that more elvers ascended fresh water when water temperature during summer was high. To test if the temperature hypothesis could also help explain the long-term trends we collected data on mean June–July air temperatures from the Meteorological Institute. There was no relationship between the number of ascending elvers (ln-transformed) and temperature ($r = 0.007$, $P > 0.9$). The complete collapse in eel recruitment in the Imsa thus is very similar to what is happening all over Europe (ICES 2007).

The silver eels are intercepted at downstream migration during autumn. The numbers were high during the early part of the time-series before a reduction starting in the mid-1980s (Figure 6). What is striking, however, is that the silver eel numbers have remained relatively stable (but low) despite the recent strong reduction in recruitment. A simple model with log-transformed numbers of silver eels as response and time as predictor can explain 34.9% of the variation ($P < 0.001$). However, there is large year-to-year variability, a lot of which can be explained by variation in year-class strength (Vøllestad and Jonsson, 1988). The recruitment of some year classes was very weak originally (i.e. the 1979 year class and all year classes since 1994), whereas other year classes are very strong (i.e. 1976 and 1983). To add complexity, the 1985 year class was used in a growth experiment at the research station, and very few elvers were allowed to migrate upstream. In total this should lead to large variability in silver eel production.

NO.G.2 Skagerrak beach-seine survey

The Skagerrak beach-seine surveys data from Norway constitute the longest non-fishery dependent set of data. It is also the only potential time-series on the subpopulation of marine eels. This unique monitoring programme was initiated at the Norwegian Skagerrak coast as a result of a controversy between the founder of the Flødevigen Marine Research Station Gunder Mathiesen Dannevig (1841–1911) and the great pioneer in marine research Johan Hjort (1869–1948; Solemdal, 1997). Every year a series of beach-seine hauls are carried out in some selected fjords of the Norwegian Skagerrak coast. Here we analyse for the first time the time-series concerning eels.

More details on the methods used to analyse the data can be found in Durif *et al*., 2008.

The first hauls of the Skagerrak monitoring programme were conducted in 1904, and during the following years, new sampling stations were added, and a standard routine for the hauls was developed. Approximately 80 stations are sampled in 20 different areas (Figure 4). All hauls are taken at the same season (autumn) and always during daytime. Based on the initial results from these hauls, the monitoring programme was established and reached its present form in 1919 (Dahl and Dannevig, 1906; Fromentin *et al*., 1998; Johannessen and Sollie, 1994; Solemdal *et al*., 1984).

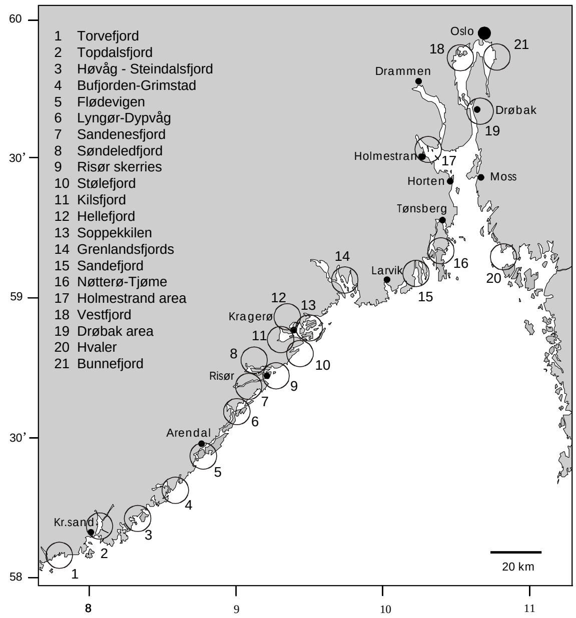

Figure 4 Sampling areas of the Skagerrak beach-seine survey.

Eel catch during the Skagerrak survey has fluctuated substantially since 1925, but with a substantial decline in catch the last 10 years. Eel catch was initially low (from 1925 to 1936) after which it increased to reach its highest level in 1996. The period between 1959 and 1979 was relatively stable. The collapse in eel catch began in 1997 (Figure 5), and last year's catch (in 2007) was null.

The time-series from Imsa (fresh-water recruitment and escapement) correlated with the Skagerrak data. Significant correlations between the elver and the Skagerrak series were found when lags of, either, 0, 1 or 3–6 years were applied (respectively $r = 0.41$; 0.36; 0.47; 0.40; 0.43 and 0.48; $P < 0.01$). Significant correlations were also found with the silver eel series at lags 5–6 and 8–11 years (respectively $r = 0.41$; 0.46; 0.57; 0.45; 0.51 and 0.59, $P < 0.01$). Decline in elvers and silver eels on the Imsa began respectively in 1982 and 1988 (Figure 6, Figure 7). This is consistent with the age structure of silver eels from this river which are approximately 6–8 years old (Figure 11). The decline in the Skagerrak is first observed in 1997, thus 9–15 years later. The fact that the series correlate at several lags is because of the fact that eels from the Skagerrak represent several cohorts (possibly from early yellow stage to silver stage). This is also seen through the body length distribution measured since 1993 (Figure 10). Because the Imsa series are much shorter (only since 1975) than the Skagerrak series, it is improbable that correlations with greater lags would be significant because of too few overlapping data points.

In order to compare with another longer time-series from Europe, a trend was calculated on the recruitment time-series (glass eels) at Den Oever, in the Netherlands (Figure 8). A very similar trend was obtained revealing a complete collapse starting in 1981. A significant correlation between the two original series was obtained when lags of either 17 or 18 years were applied (respectively r = 0.28; r = 0.34; P<0.01).

No significant correlations were found between the Skagerrak series and NAO. However, correlations with sea surface temperatures measured in the Sargasso Sea were significant (Figure 9). Standardized eel catch was negatively correlated with temperatures when lags of 7 or 11 years were applied (respectively r = -0.30 and -0.32; P<0.01). This indicates that eels caught during the Skagerrak survey are probably between 7 and 11 years old. This fits well with the age distribution of yellow eels caught with fykenets in the Drøbak area of the Oslo fjord (Vøllestad, 1985, 1986).

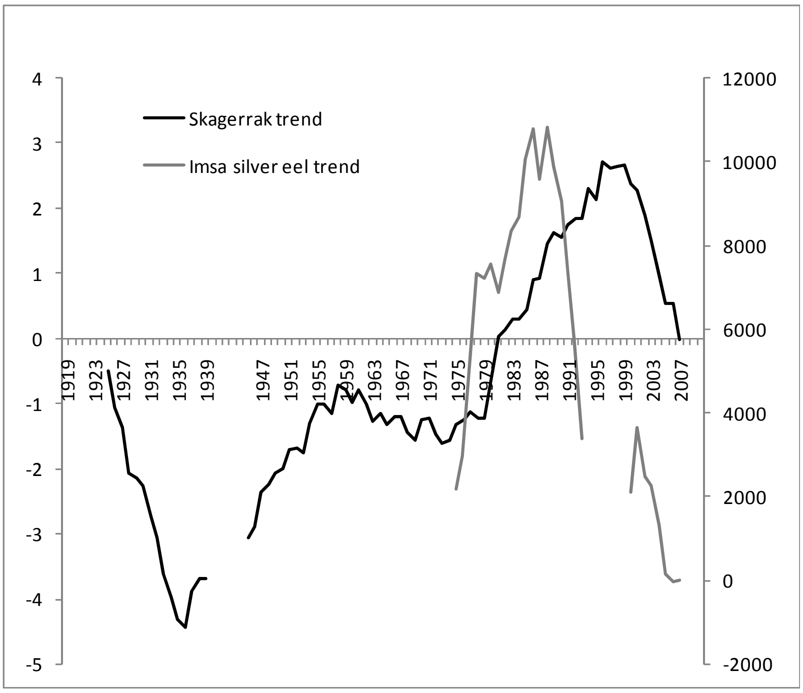

Figure 5. Time series from the Skagerrak coast. CUSUM were calculated on the standardized catch.

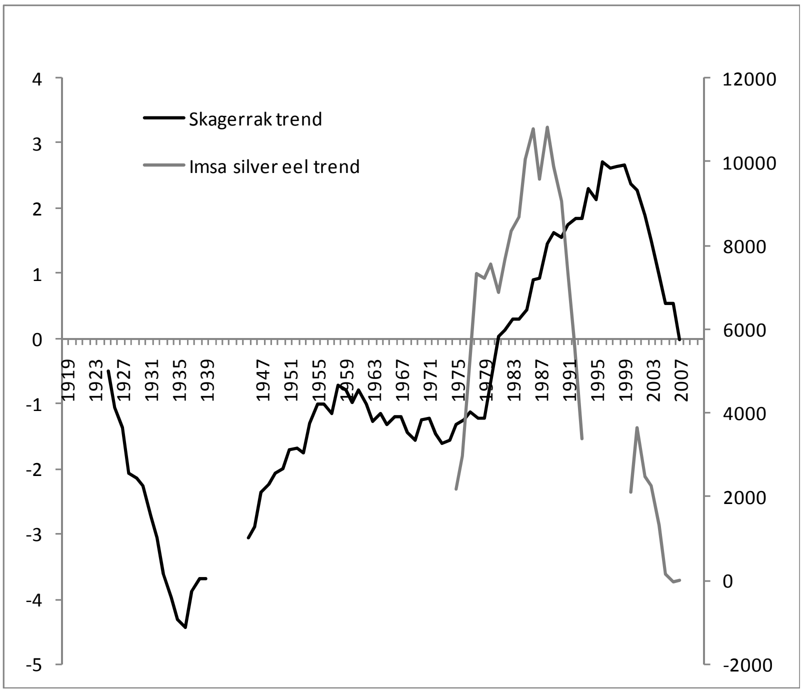

Figure 6. CUSUM trends of the Skagerrak time-series and silver eel monitoring on Imsa.

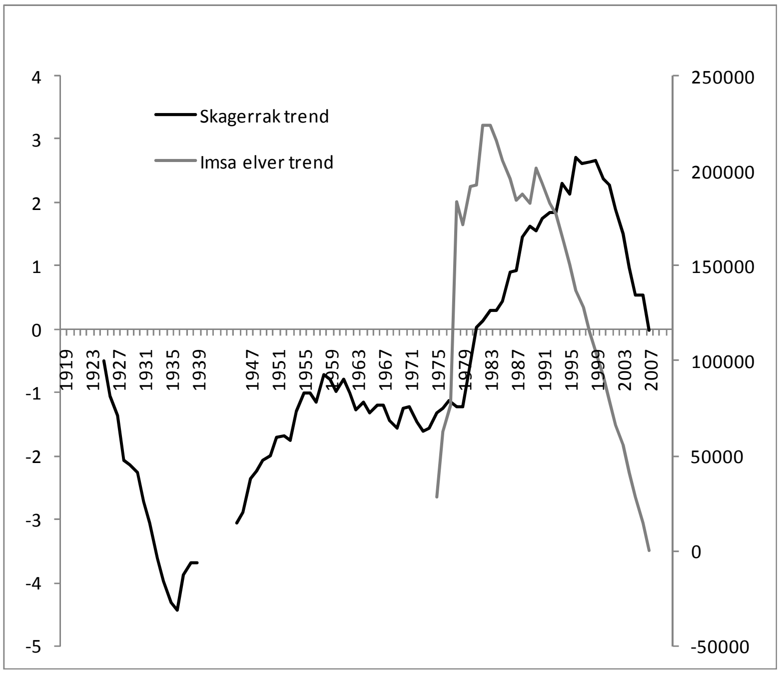

Figure 7. CUSUM trends of the Skagerrak time-series and elver monitoring on Imsa.

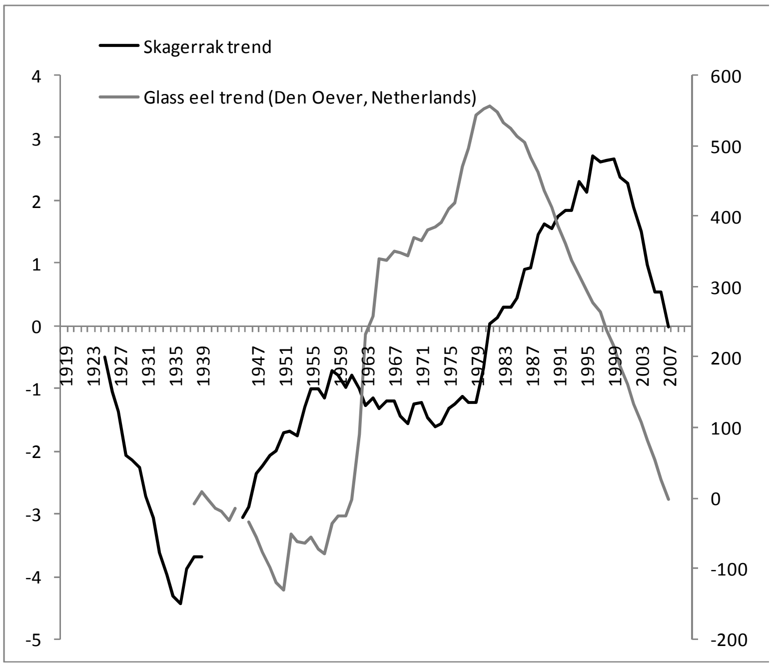

Figure 8. CUSUM trends of the Skagerrak time-series and of the Den Oever Index indicator for glass eel recruitment in the Netherlands.

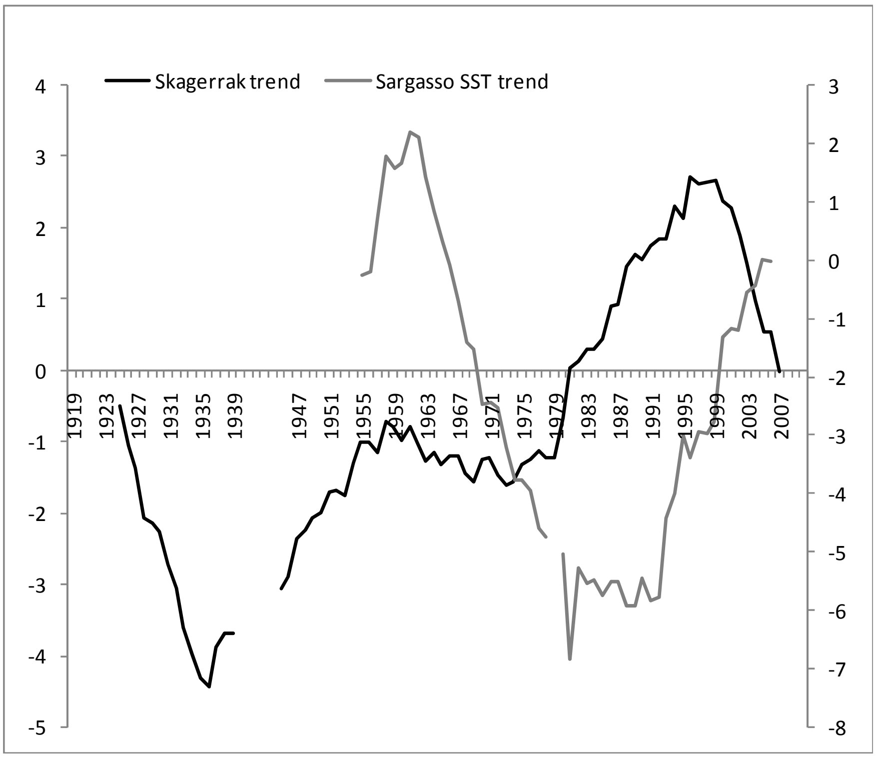

Figure 9. CUSUM trends of the Skagerrak time-series and Sargasso Sea surface temperature.

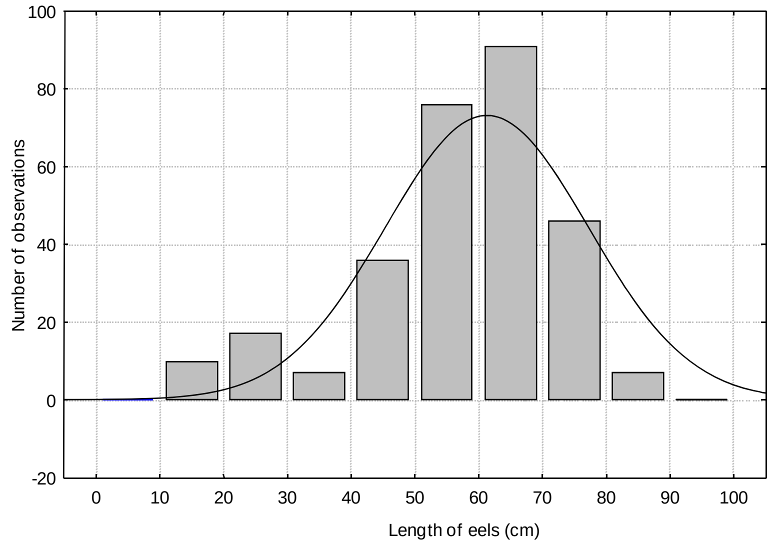

Figure 10. Size distribution of eels measured since 1993 during the Skagerrak beach-seine survey.

NO.H Catch composition by age and length

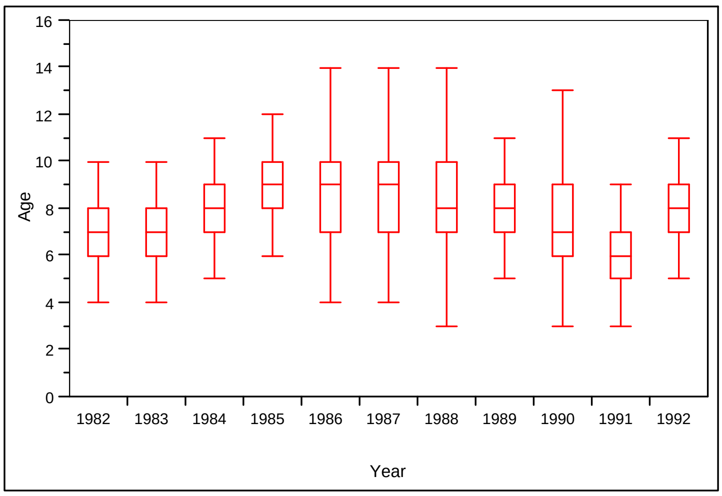

Figure 11. Age structure of eels in the river Imsa. The box plot demonstrates median, 25th and 75th quantile, and the 5th and 95th quantile.

NO.I. Other biological sampling

NO.I.1 Length and weight and growth (DCR)

NO.I.2 Parasites

Infection of eels from the river Imsa by *Anguillicola crassus* was first reported in July 2008. In total 7 out of 22 silver eels contained the parasitic nematode *Anguillicola crassus* in their swimbladder, therefore a prevalence of 32%.

All eels were female and at the silver migrating stage. Infected eels tended to be bigger in length and weight, but their condition factor was not significantly different (Mann-Whitney test, P=0.934). Two eels contained mature worms filled with eggs, in their swimbladder. Small and medium sized worms were also found.

NO.I.3 Contaminants

See excel file.

NO.J Other sampling

None

NO.K Stock assessment

None

NO.L Sampling intensity and precision

None

NO.M Standardisation and harmonization of methodology

None

NO.M.1 Survey techniques

NO.M.2 Sampling commercial catches

NO.M.3 Sampling

NO.M.4 Age analysis

NO.M.5 Life Stages

NO.M.6 Sex determinations

NO.N Overview, conclusions and recommendations

NO.O Literature references

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Report on the eel stock and fishery in Estonia

EE.A. Author

Ain Järvalt, Centre for Limnology, Institute of Agricultural and Environmental Sciences, Estonian University of Life sciences, 61101 Rannu, Tartumaa, Estonia.

Tel. +372 454 544, fax +372 454 546

ain.jarvalt@emu.ee

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EE.B. Introduction

Eel fisheries in Estonia occur in Lake Võrtsjärv (20–100 t) and in costal waters (10–30 t). Annual catch from small lakes and rivers mostly in L. Peipsi basin and L. Peipsi itself is 2–4 t. Eel catches by amateur fishers constitute about 1 t from brackish water and about 2 t from inland water bodies. According to the fishery statistics during the last decade the total annual catch of eel from Estonian waters was nearly 50 tons (in 2007 35 tons). During the first half of previous century eel was very abundant and one of the most important commercial fish in western costal waters of Estonia. At that time annual catch of eel exceeded hundreds of tons.

Natural eel stocks have never been very dense in Estonian large lakes. The annual catch of eel in 1939 was only 3.8 tons from L. Võrtsjärv and 9.2 tons from L. Peipsi. The construction of the Narva hydropower station in the early 1950s blocked almost totally the natural upstream migration of young eel from the Baltic Sea to the basins of lakes Peipsi and Võrtsjärv. As a result, eel almost disappeared from the fish fauna of Estonian large lakes. Today, thanks to the introduction of glass eels or farmed eels into L. Võrtsjärv, it has become one of the most important commercial fish in this lake. According to latest investigation the downstream migration of eel through the hydropower station is possible.

Management of eel stock (re-stocking and fishery) is under the governmental control. The Fishery Department of Ministry of Environment takes care of stocking and local services of the Ministry of Agriculture give out fishing licenses. There are gear and size restrictions.

Estonia has the state programme of reproduction and re-stocking of fish (2002–2010) including European eel. In connection with this programme we have ongoing special investigations and monitoring projects concerning eel in Estonia financed by the Ministry of Environment and ERDF:

Re-stocking results in small lakes.

Food resources of eel in water bodies suitable for stocking.

The distribution of eel and long-term re-stocking results in L. Peipsi and L. Võrtsjärv basin.

Downstream migration.

There are three main eel fishing areas in Estonia:

1) L. Võrtsjärv is a large but very shallow and turbid lake with a surface area of about 270 km^2 and mean and maximum depths of 2.8 m and 6.0 m, respectively. Its drainage basin (Figure EE 2; 3104 km^2, incl. 103 km^2 in Latvia) is situated in the Central Estonia. Eel *Anguilla anguilla* (L.), pikeperch *Sander lucioperca* (L.), northern pike *Esox lucius* L. and bream *Abramis brama* (L.) are the main commercial fish in the lake. Professional fishing gears are fykenets and longlines are used by recreational fishers. Every fisher has own individual licenses. The eel production of L. Võrtsjärv is entirely based on stocking with wild-caught elvers or farmed eels (4–20 g). During the half hundred years (1956–2008), 46 million eels were stocked. According to the official statistics in 1988, the maximum annual catch of eel exceeded 100 t. In the 1990s, the reported annual catch of eel (22–49 t) was much smaller than real catch (estimated catch was 80% higher). Nearly half of the income of fishers comes from eel, despite their annual investments to the state Foundation of Environmental Investments (>100000 € annually) in stocking material. Due to the changes in fishing law, the number of fishers has increased during the last 5 years. During 1970–1998, the number of professional fishers varied between 20–25, followed by an increase to 32 in 2003 and over 40 in 2004–2008. The total number of people involved in the fishery of L. Võrtsjärv is estimated to be two times higher.

2) In costal waters, the Gulf of Riga, the Väinameri, the Gulf of Finland, the catches of eel have increased (from 3–10 t in 1991–95 to 20–8 t in 1999–2003), but from 2004 decreased again up to 6 tonne in 2007. Along the shore of the Baltic eels are caught with bottengarns (poundnets) and fykenets; longlines are also used. As there are hundreds of fishers in that region, eel is not first-rate fishing object.

3) Small lakes in Peipsi basin, where eel has migrated from L. Võrtsjärv and was additionally stocked consistently during last 5 years: in Vooremaa district (Figure EE 1) L. Saadjärv (700 ha), L. Kuremaa (400 ha) and L. Kaiavere (250 ha) and L. Vagula (500 ha) in South Estonia. Fishing gears are dominated by fykenets.

The WFD subdivides the Estonia into 3 districts and 8 subdistricts, what are not connected only with one river. The Narva River District is the biggest (1/3 of territory of Estonia and shared with Russia (Figure EE 2). Other more important rivers are River Pärnu, River Kasari and River Gauja, shared with Latvia.

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

No data available of fishing capacity.

The exact number of fykenets being used in costal waters is unknown. The number of fykenets in L. Võrtsjärv in 1970s and 1980s was 200–250, in 1990s 300 and from 1998 up to 2004 350. In 2005-2008 the total number of fykenets was reduced to 324 (1.2 fykenets per km^{-2}). Longlines (622 fishing nights of 100 hooks, catch 0,6–1,0 tons in 2004–2007) are used only for sport fishing. In Vooremaa lakes licensed fishers have 36 fykenets (2.6 fykenets per square kilometer) and 3 eel boxes. 20 licensed longlines (100 hooks) are not continuously in use.

The eel catches have two peaks in inland waters: May and August–September. Eel has a legal (minimum) size: 55 cm in lakes Võrtsjärv and Peipsi, 50 cm in other Estonian inland water bodies and 45 cm min. coastal waters.

Figure EE.1 Location of Estonia, Lake Võrtsjärv and the Vooremaa Lake District.

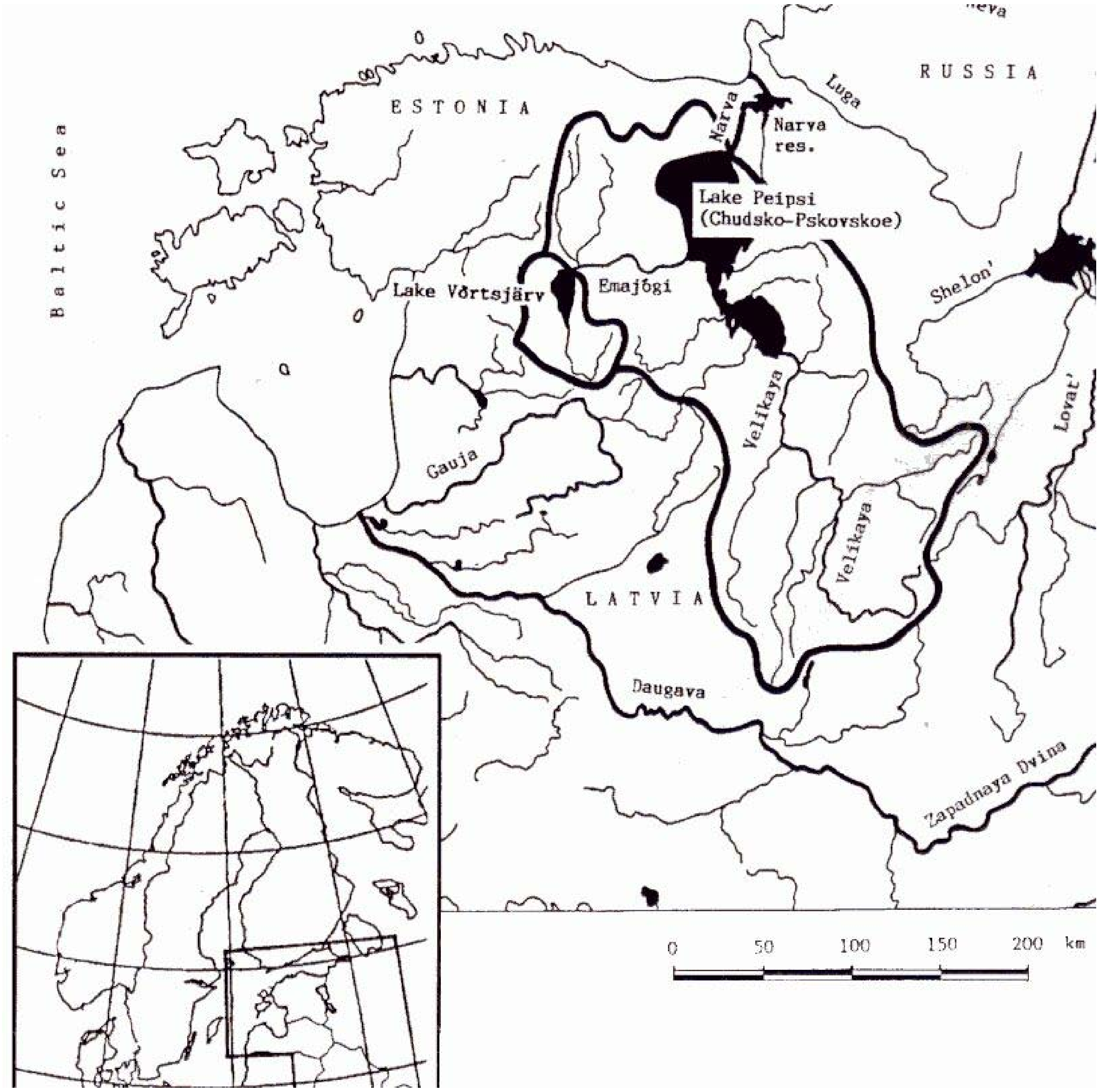

Figure EE.2 Location of watershed areas of L. Peipsi and L. Võrtsjärv.

More than half of the catch of eel in Estonia comes from L. Võrtsjärv (Table EE A). According to the information provided by fishers, the actual catches of eel in L. Peipsi are significantly higher. 80% from registered catch of eel from small lakes and rivers originated from the three lakes situated in Vooremaa district. The real total catch in Estonia should be 1.5 up to 2 times higher.

Table EE A Catches of eel in tons per year in different water bodies in 1993–2007.

Year	Baltic Sea	L. Võrtsjärv	L. Peipsi	Others	Total	Percentage of L.Võrtsjärv
1993	10,0	49,0	0,2	-	59,2	83
1994	10,0	36,9	-	-	46,9	79
1995	6,0	38,8	-	0,6	45,4	85
1996	20,0	34,1	0,1	1,2	55,4	62
1997	18,3	40,3	0,5	-	58,8	69
1998	22,2	21,8	0,2	-	44,2	49
1999	28,3	36,3	0,2	-	64,8	56
2000	26,7	38,9	0,2		67,0	58
2001	27,1	37,6	0.3	1,2	65,2	58
2002	27,3	20,4	0,2	2	50,3	41
2003	18,8	26,4	0,2	3,2	48,6	54
2004	15,6	20,1	0,3	3,2	38,9	52
2005	15,7	17,6	?	3	36,3	49
2006	9,6	19,9	0,1	3,1	32,7	61
2007	6,5	21,5	0,1	2,8	30,9	70

Table EE.B Landings per tons year from Lake Võrtsjärv.

Year	1933–39	1960	1970	1980	1990	2000
0	1,8	0	6,5	17,8	56,1	38,8
1		0	6,5	16,5	48,5	37,6
2		0	16,4	10,8	31	20,4
3		0	21,3	24,5	49	26,3
4		3	18,7	66,7	36,9	20,1
5		0,3	36,9	71,9	38,8	17,6
6		1,9	49,6	55,6	34,1	19,9
7		2,7	50	61,2	40,3	20,5
8		2,9	44,5	103,8	21,8	
9		5	45	47,6	35,2	

EE.E.2. Re-stocking

Estonia has re-stocking programme for years 2002–2010. 75–100% of re-stocking has been financed by local fishers, except Soviet time. Restocking quantities are listed in Table C. Estonia imported glass eel up to 1987 from France, thereafter from England. Young yellow eel (average weight approx. 5 g) was imported from Germany in 1988 and 1995, from Netherland in 2003 and 2005, from local fishfarm in 2002 and 2004.

Table EE.C Re-stocking of glass eel and young yellow eel in the Estonia, in millions re-stocked.

	1950		1960		1970		1980		1990		2000	
Year	Glass eel	Young yellow eel	Glass eel	Young yellow eel	Glass eel	Young yellow eel	Glass eel	Young yellow eel	Glass eel	Young yellow eel	glass eel	Young yellow eel
0	0,0	0,0	0,6	0,0	1,0	0,0	1,3	0,0	0,0	0,0	1,1	0,0
1	0,0	0,0	0,0	0,0	0,0	0,0	2,7	0,0	2,0	0,0	0,0	0,44
2	0,0	0,0	0,9	0,0	0,1	0,0	3,0	0,0	2,5	0,0	0,0	0,36
3	0,0	0,0	0,0	0,0	0,0	0,0	2,5	0,0	0,0	0,0	0,0	0,54
4	0,0	0,0	0,2	0,0	1,8	0,0	1,8	0,0	1,9	0,0	0,0	0,44
5	0,0	0,0	0,7	0,0	0,0	0,0	2,4	0,0	0,0	0,15	0,0	0,37
6	0,2	0,0	0,0	0,0	2,6	0,0	0,0	0,0	1,4	0,0	0,0	0,38
7	0,0	0,0	0,0	0,0	2,1	0,0	2,5	0,0	0,9	0,0	0,0	0,33
8	0,0	0,0	1,4	0,0	2,7	0,0	0,0	0,18	0,5	0,0	0,0	0,19
9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	2,3	0,0		

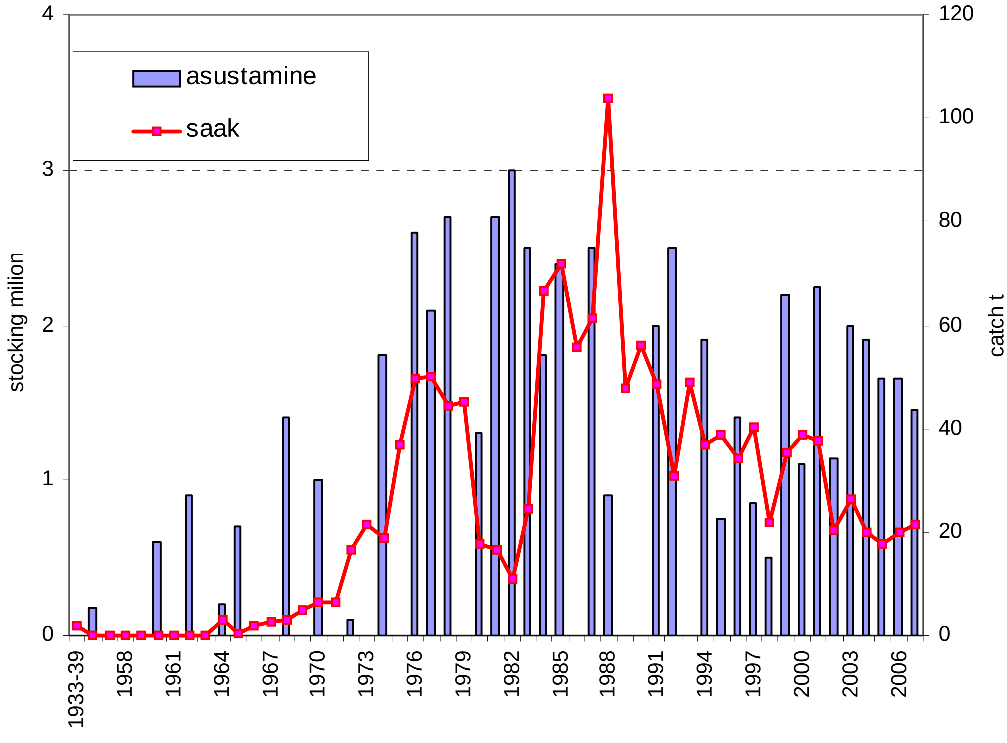

Figure EE.3 Re-stocking (blue columns) and catch (red line) of eel in L. Võrtsjärv. (1 young yellow eel = 5 glass eels).

In 1956 re-socking of glass eels into L. Võrtsjärv was restarted. However, re-stocking has been irregular (Figure EE.3**)**. In the years 1988, 1995 and 2001–2005 young eels reared previously min a fish farm, were stocked. The re-stocking rate with glass eels has been relatively low: annual average in 1956–2001 was about 35 ind. ha^{-1} with a maximum of 84 ind. ha^{-1} in 1980–1984. The peak of re-stoking with glass eels occurred in the early 1980s. As a result, during the following five-eight years the catches of eel were the highest, constituting 2.5 kg ha^{-1} y^{-1}. The maximum catch of this fish was recorded in 1988 (104 t or 3.7 kg ha^{-1}). From the end of 1980s the declared annual catch was decreased.

EE.E.4. Aquaculture

There is only one eel farm in Estonia. Aquaculture production was:

Year	2003	2004	2005–2007
Production (tons)	10	15	40–50

EE.E.5. Recreational fishery

Eel catches by amateur fishers, using mostly longlines, constitute about 2 t from brackish water and about 2 t from inland water bodies.

EE.F. Catch per unit effort

In logbook every professional fisher makes records daily, according to specific fishing gear (fykenets, longlines). According to the longline data the natural density of eel population in Estonian lakes outside of Peipsi watershed area was 2–3 times lower (Table EE B; Figure EE.2). In 2000–2004 the mean annual catch of eel per fykenet in L. Võrtsjärv was 80 kg, in 2005–2007 60 kg.

Real catch in 1,5 times higher.

Table EE B Cpue (catch in grammes per 100 hooks per night) of longlines in water bodies of different river basins (Figure EE.2) and in L. Võrtsjärv in 2000–2004.

River basin, lake	CPUE	
R. Emajõgi	2847	re-stocked
R. V.-Emajõgi	1393	re-stocked
L. Võrtsjärv	1316	re-stocked
R. Õhne	976	re-stocked
R. Gauja	700	natural
R. Pärnu	421	natural
R. Võhandu	397	re-stocked
R. Daugava	338	?
R. Salaca	0	natural

EE.G. Scientific surveys of the stock

EE.G.1 No data available

EE.G.2.

Until the end of 1990s Estonian investigations, based on commercial catches, were focused on stocking and fishing return of eel in L. Võrtsjärv. Since 2001 the catches of yellow and silver eel were investigated in many lakes and rivers all over Estonia. Main source of the information for the eel were official catch and special longline fykenet catches and electrofishing in rivers (multispecies survey in more than 300 stations every year, relative abundance). Special survey of eel in costal waters was not done in Estonia. During last five years investigations of eel were financed by the Ministry of Environment.

Investigations of downstream migration and influence of turbines and dam of Narva hydroelectric power station

Due to the re-stocking, eel is the most important commercial fish in Lake Võrtsjärv and in many small lakes in Estonia. The construction of the hydropower station on the Narva River in the early 1950s blocked the natural path of eel to the waterbodies of L. Peipsi basin. About 45 million glass and farmed eels have been stocked into the L. Võrtsjärv during 1956–2007. According to the European Council Regulation of establishing measures for recovery of the stock of eel, the principal element of the Regulation is the establishment of national eel management plan, by means of which each Member State will achieve the objective of a 40% escapement of adult silver eel from each river basin. One of the most crucial conservation measures in L. Peipsi basin to ensure eel survival and reproduction are modifications to dam and turbines to allow improved eel migration. The hydroelectric power station lies on the side of Russian Federation of Narva River. To investigate the downstream migration of silver eel from Lake Võrtsjärv and Peipsi and their possibility to go over or through the dam and turbines during the project period 557 eels was tagged in all. All specimens were tagged with Carlin-tags among them 7 specimens with radiotelemetric tags. Eels for tagging was brought from professional fishers Lake Võrtsjärv and caught from Lake Ülemiste. To evaluate migration behaviour of eels held before the stocking in non-native conditions, 200 of them were brought from special eel farm. First label-tagging and stocking of eel into Narva water reservoir and Lake Võrtsjärv took place from October 2006–August 2008. Recapture results in 2007 were rather successful. In spite of low intensity of catch with eel-type fishing gears in Narva River, there was recaptured 4 label-tagged eels downstream of the dam. One eel in Finnish Gulf near the River Purtse and one after 4 month in Koge Bay, close to Denmark. We observed also survival and behaviour of eels equipped with transmitters after coming through the turbines using manual and automatic registration of migration. Minimum 50% of radio-tagged eels came through the turbines alive. Two of them were caught back in Narva River after two month and one next year close to island Saremaa. The fixed evidence of possible downstream migration of eel is very important result for sustainable and reproductive management of European eel in Lake Peipsi basin during the last 50 years. According to the project results both partners made a proposal to construct new fish-ladder using old riverbed.

places of re-capture

place of stocking (Narva reservoir)

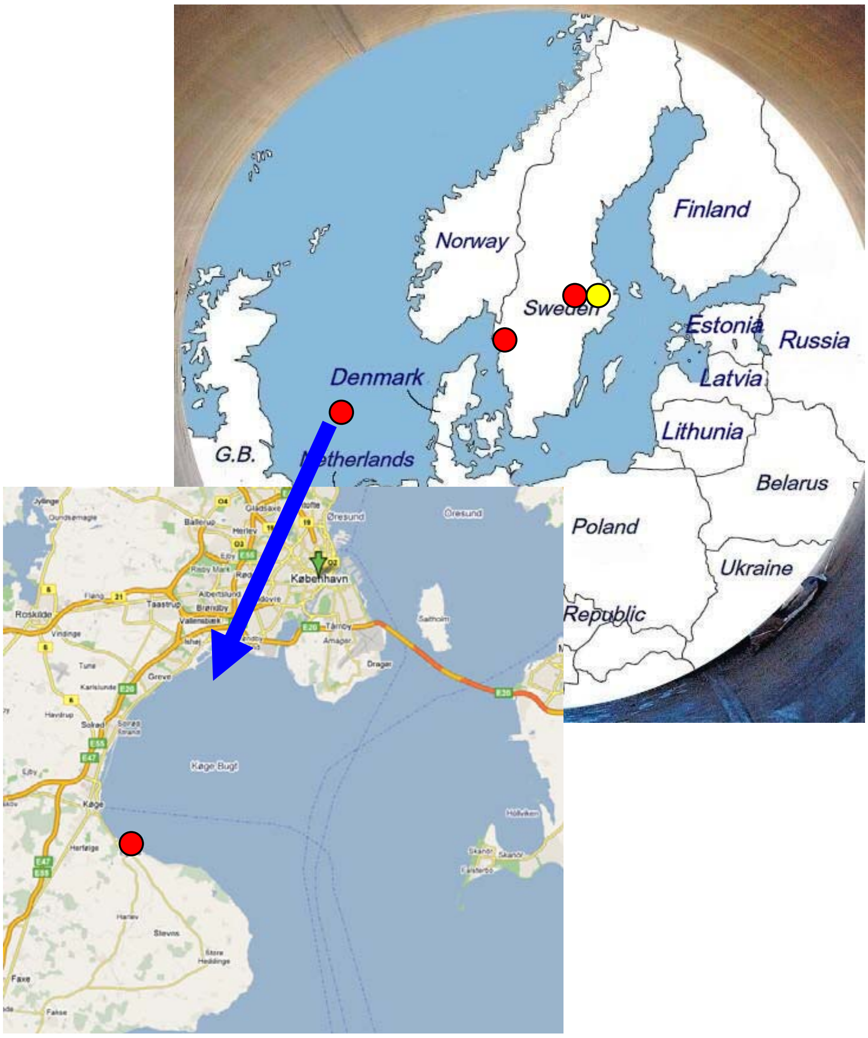

Figure EE.3 A. Places of re-capture.

Figure EE.3 B.Eel with radio-tag.

EE.H. Catch composition by age and length

There is a sampling programme including measuring of length, weight and age determination of eel in L. Võrtsjärv and small lakes (Figure EE4; Table EE C).

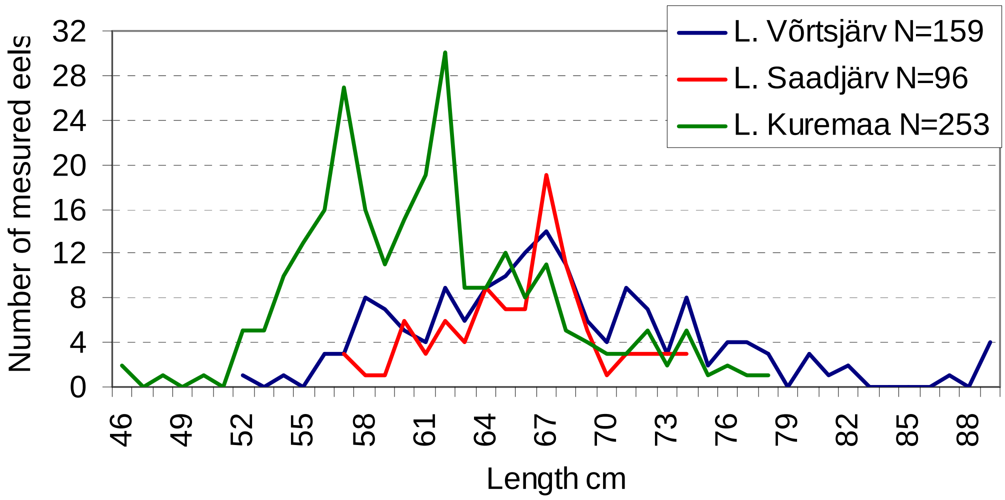

Figure EE.4 Number of measured eels and length distribution in fykenet catches in L. Võrtsjärv, L. Saadjärv and L. Kuremaa in May 2004.

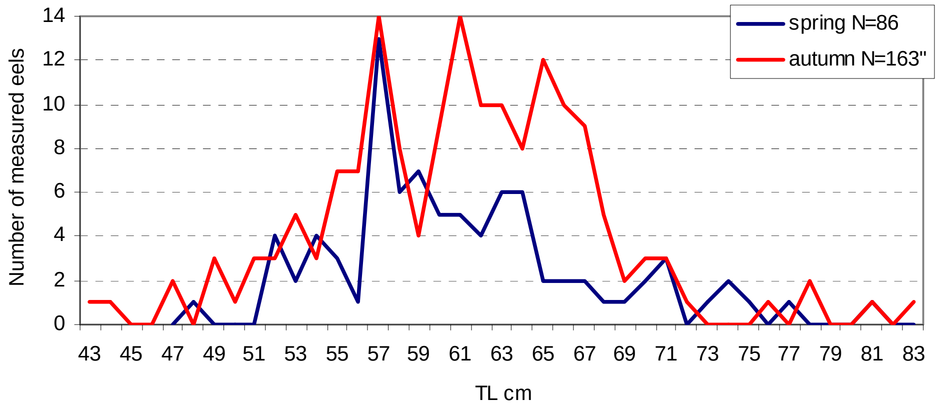

Figure EE.4 Number of measured eels and length distribution in fykenet catches in L. Võrtsjärv in Spring and Autumn 2007.

EE.I. Other biological sampling

Since 1992 the intensity of *Anguillicola* infection in the eel population of L. Võrtsjärv has studied. During last 20 years the feeding and the condition factor of eel in L. Võrtsjärv have studied.

EE.J. Other sampling

During 1999–2003 there was estimated food composition of cormorants in the costal waters including the proportion of eel.

In 2002–2006 feeding of pike in winter and the proposition of eel in it.

EE.K. Stock assessment

The fish stock assessment programme of the Fishery Department of the Ministry of Environment financed Environmental Investments Centre, includes special project of eel stock investigations (length, and age structure, recapture calculations, prognoses, limits) in L. Võrtsjärv and in other inland waters of Estonia. The results are reported to the Fishery Department.

EE.L. Sampling intensity and precision

Since 1973 measurements of eel in L. Võrtsjärv have been carried out. In all 11 000 specimens have been analysed. In 1990s and 2000s were measured 500–1000 eels annually mostly during two high seasons, in May and in August–September.

EE.M. Standardisation and harmonization of methodology

EE.N. Overview, conclusions and recommendations

- registration of fishing efforts is well organized in inland waters, but not so good in coastal waters.
- biological sampling almost absent.

- stock surveys are good in L. Võrtsjärv, in decent level in some small lakes but it is random on costal waters.

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Report on the American eel (*Anguilla rostrata*) stock and fisheries in Canada 2008

CA.A. Authors

Guy Verreault, Ministère des Ressources naturelles et de la Faune, 186, rue Fraser, Rivière-du-Loup, Québec G5R 1C8 Canada.

Tel: +418 862 8213 ext. 306. FAX: +418 862 1188

guy.verreault@mrnf.gouv.qc.ca

Reporting Period: This report was completed in August 2008, and contains data up to 2007 and some provisional data for 2008.

Contributors to the report:

D. K. Cairns, Fisheries and Oceans Canada.

P. Dumont and Y. Mailhot, Ministère des Ressources naturelles et de la Faune du Québec.

A. Mathers, Ontario Ministry of Natural Resources.

R. Verdon, Hydro-Québec.

CA.B. Introduction

The American eel (*Anguilla rostrata*) is widely distributed in the eastern part of Canada, from the Atlantic Ocean as far inland as Niagara Falls in the Great Lakes (Figure 1). Historically, the American eel had one of the largest distributions of any fish species in Canada but abundance has declined precipitously since the mid-1980s, in the upper reaches of the St. Lawrence River and Lake Ontario. This sharp decline prompted government agencies involved in stock and fisheries management (Québec, Ontario and Canada) to collate information in order to determine the status of the species throughout the distribution range. Information was summarized in a Status Report prepared for the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and can be found at http://dsp-psd.pwgsc.gc.ca/Collection/CW69-14-458-2006E.pdf.

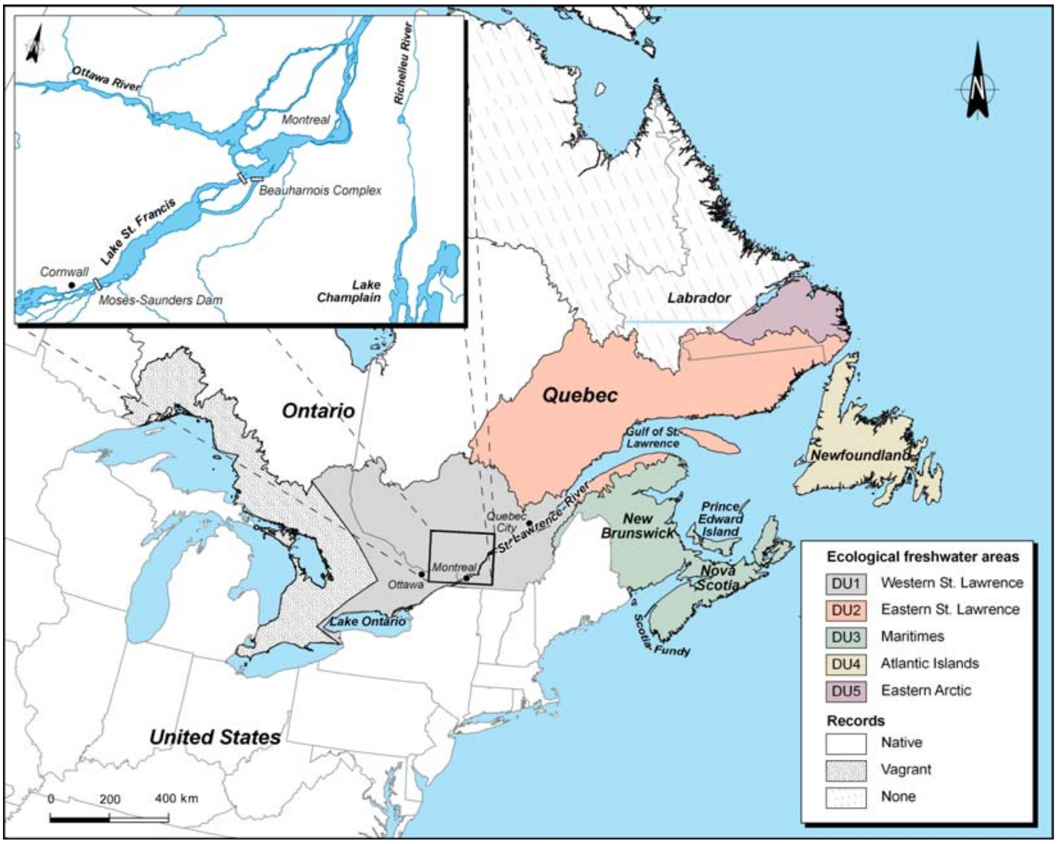

Figure 1. Distribution range of the American eel in Canada, by Ecological Freshwater Areas.

CA.B.1. Species status and management plan

In May 2006, COSEWIC assessed the American eel in Canada as Special Concern (a species that may become a threatened or an endangered species because a combination of biological characteristics and identified threats). A decision by the Government of Canada on whether or not to officially list the species is pending. A draft Management Plan has been developed to coordinate actions among Canadian jurisdictions. Public hearings on the Management Plan started in early 2007 and a final version will be completed based on input from the public and stakeholders by 2008. The next step will be the implementation of a more detailed plan to strengthen management, reverse abundance declines and foster conditions for rebuilding the population. In the Province of Ontario, American eel was listed as endangered under the new Ontario Endangered Species Act on July 1st. In this province and in Québec, action Plans were set up by Government agencies and public hydro companies (Ontario Power Generation and Hydro-Québec) to mitigate the impact of dams on the St. Lawrence River.

CA.C. Fishing capacity

Eels are subject to ongoing fisheries in parts of eastern Canada (Figure 2), although substantial areas have never been commercially fished (Figure 2). Fisheries in many areas have changed since the mid-1980s. Traditional fisheries were for yellow and silver eels but a recent (1989) fishery for elvers and glass eels began in Nova-Scotia and southern New Brunswick (DU 3). Restrictions in the number of licenses and on seasons for large eels, and on harvest for elvers, have been in place in all areas since the mid-nineties (Anon., 2007).

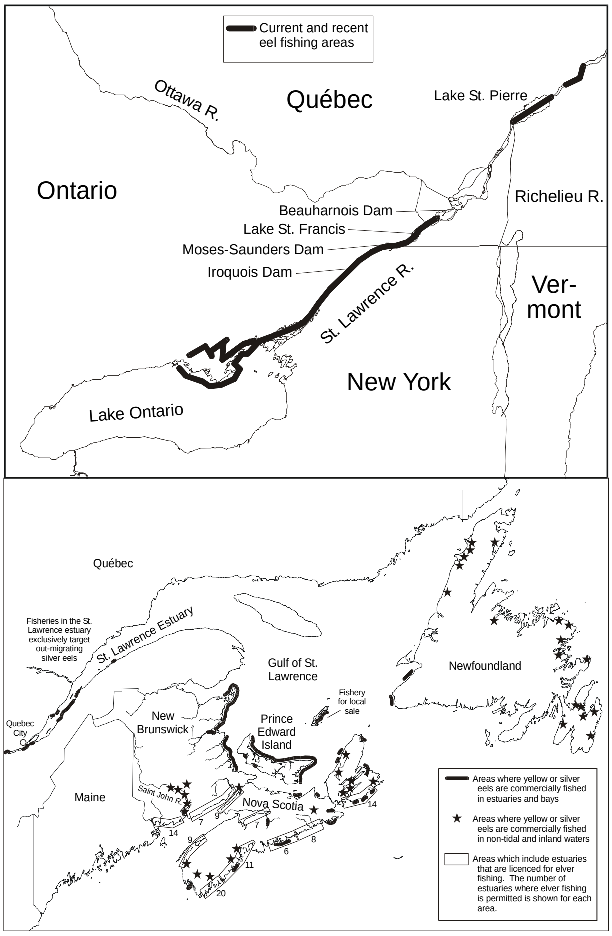

Figure 2. Approximate areas of current and recent commercial eel fisheries in Canada (Cairns *et al.*, 2008).

In response to the sharp decline in abundance, the Richelieu River eel fishery was shut down in 1998. Ontario closed all eel fisheries by setting the quotas on 95 commercial fishing licenses to zero in 2004 and closing the sport fishing season for eel in 2005. In Lake St. Pierre, fishing effort was reduced by 86% since 2002, compared to the historical number of fishing licenses and hoop-nets, as a consequence of a buy-out programme completed in 2008. In the St. Lawrence tidal estuary, a 60% decrease in fishing effort was observed during the last ten years and related to the decrease in silver eel abundance during autumn migration. In the Maritime Provinces, fishing licenses have been frozen for the elver fisheries and commercial elver quotas reduced by 10%. However this 10% can still be harvested provided that the elvers could be sold only for conservation (stocking) purposes.

CA.D. Fishing effort

Eel fishing effort is unevenly distributed within the Canadian range of the American eel. In some areas, there are intensive fisheries although in others, eels are unexploited. The stage targeted by fisheries (glass eel, elver, yellow eel, and silver eel) also varies geographically.

In Québec, there are major fisheries in the upper St. Lawrence River and estuary (DU1) which target mainly silver eels. Except for the Magdalen Islands, eels originating in DU2 are not exploited. In the southern Gulf of St. Lawrence (DU3), commercial fisheries target primarily yellow eels in tidal waters. Yellow eels are fished extensively in coastal waters and estuaries of New Brunswick and Prince Edward Island. There is relatively little eel fishing effort in Gulf Nova Scotia, and none in most fresh waters of the southern Gulf of St. Lawrence. Winter recreational spear fisheries also contribute to anthropogenic mortality of yellow eels in the Southern Gulf of St. Lawrence. In the Scotia-Fundy area, eel fishing occurs in both fresh and marine waters, but many rivers and coastal areas are not fished. The only elver fishery in Canada occurs in Scotia-Fundy. In Newfoundland (DU4) and Labrador (DU5), yellow and silver eels are fished principally in rivers, but many rivers are not exploited. Landings for Labrador were reported only in 1985 (4.3 tonnes) and in 1993 (0.1 tonne), and it is unknown whether this irregular pattern is related to abundance; however, landings are not large (COSEWIC 2006).

CA.E. Catches and landing

Total harvest for Canada between 1961 and 2007 fluctuated between 500 and 1200 tons per year and catches declined from approximately 1100 tons in late eighties to less than 500 tons today (Figure 3). Unreported catches are not thought to be significant.

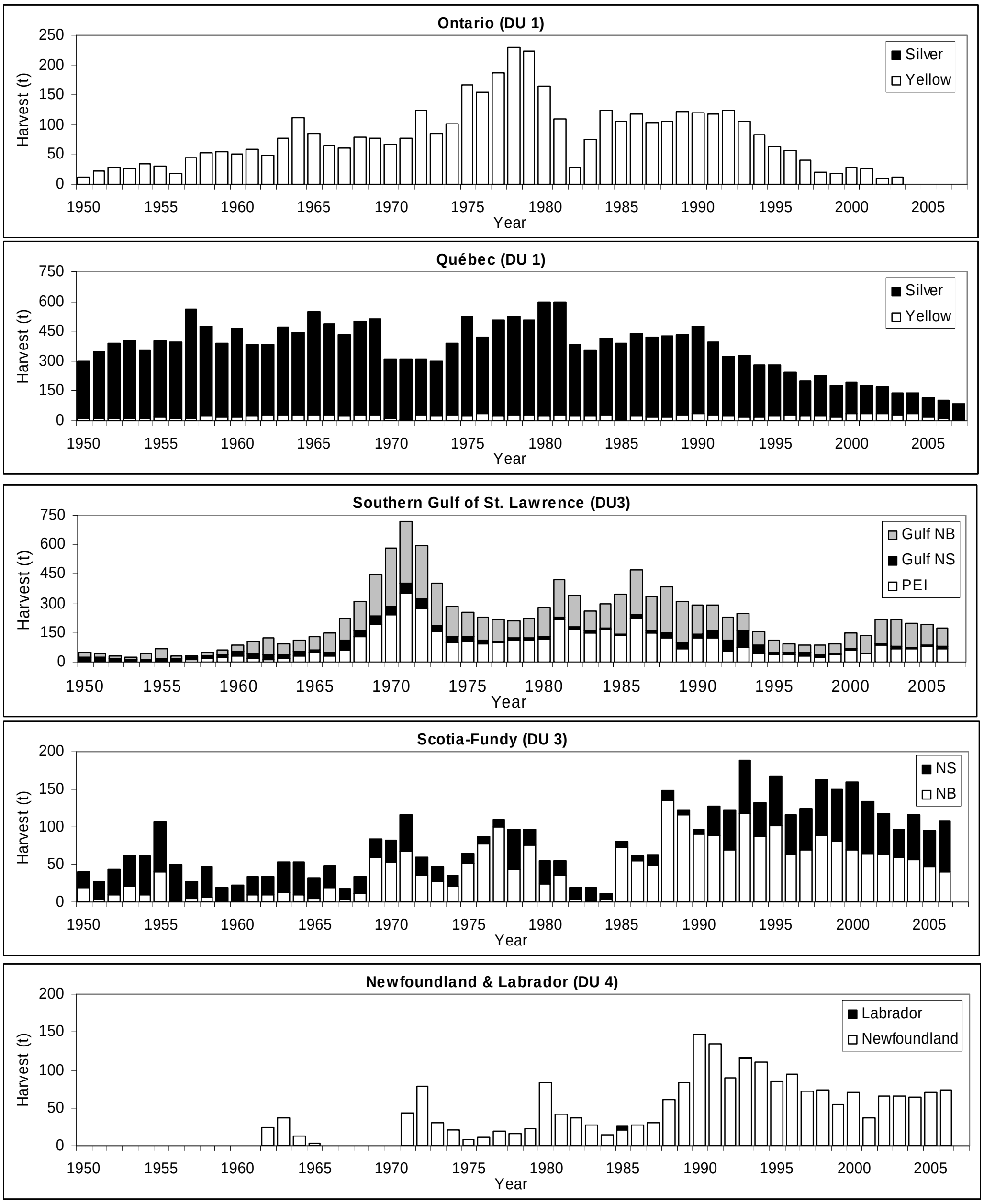

Figure 3. Reported landings (t) of American eel in Canada 1950–2007.

CA.G. Scientific surveys of the stock

CA.G.1 Recruitment surveys/ascending young eels

Long-term datasets on recruitment of young eels in Ontario and Québec include the Chambly ladder (since 1997), the Beauharnois trap and ladder (starting in 1994), the Saunders eel ladder (initiated in 1974), and the Sud-Ouest River ladder (since 1994). Two other series targeting yellow eel exist: the Bay of Quinte trawling survey, starting in 1972, and, a standardized electrofishing series in Lake Ontario which was first collected data in 1984.

In the most downstream location (DU 2), on the Sud-Ouest River, a continuing juvenile year-class strength index (YCSI) was developed and has been maintained since 1994. This index allows the evaluation of the relative contribution of each cohort ascending this river. The YCSI reveals a general and drastic decline in cohort relative abundance (Figure 4) which might possibly be related to a general decline of the overall recruitment of the species.

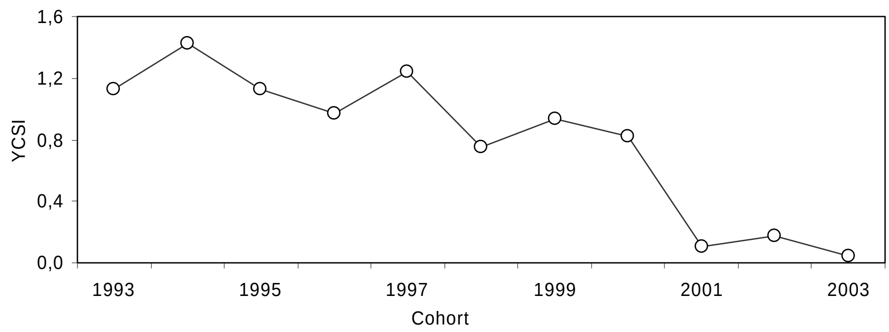

Figure 4. Year-Class Strength Index for American eel, Sud-Ouest River, Québec, Canada.

On the Richelieu River (DU 1), the Chambly ladder is operated at a dam during the upstream migration. Total annual count was 9875 during the first year and decreased rapidly the following years (Table 1), most probably representing a pluri-annual accumulation of young eels in front of the dam before the opening of the eel ladder. The actual annual counts of the recent years (range: 239–3336) are certainly insufficient to support annual historical landings of silver eel (ca. 35 t). No age estimation is available on this location.

Table 1. Young eels ascending the Chambly ladder from 1998 to 2007 (data from Bernard and Desrochers 2007).

Year	Total count (n)	Mean length (mm)	Standard error (mm)
2007	1340	327.4	69.6
2006	434	283.3	93.4
2005	2177	324.8	73.4
2004	727		
2003	3336		

2002	240		
2001	357		
2000	239		
1999	3685	331.3	52.7
1998	9875	386.3	79.3

At the Beauharnois Power Dam, the first anthropogenic obstacle for eels migrating upstream in the St. Lawrence, two ladders are operated and total count, along with mean length, are routinely monitored by Hydro-Québec. Last year migrant numbers revealed a slight decrease along with an increasing mean length (Table 2). However, compared to what was needed to support historical fisheries in the watershed, these counts are still very low. No age estimation has been available for this site since 2004 but decreasing mean size suggests that age structure has changed since the implantation of the eel ladders.

Table 2. Total count and mean length of ascending juvenile eels in the Beauharnois ladder from 1994 to 2007 (data from Bernard and Desrochers, 2007).

	West side ladder		East side ladder		
Year	Total count (n)	Mean length (mm)	Total count (n)	Mean length (mm)	Total
2007	52 969	360.6	1	-	52 970
2006	50 389	349.0	28 127	339.5	78 516
2005	51 694	344.3	2 932	347.1	54 626
2004	42 635	350.8	15 951		58 586
2003	32 684	365.9	26 885	382.8	59 569
2002	10 503	426.2	32 608	388.5	43 211
2001	13 099	420.6			13 099
2000	6881	448.3			6881
1999	10 692	468.7			10 692
1998	5441	471.7			5441
1995	17 072	449.6			17 072
1994	24 721	430.0		448.9	24 721

The next man-artificial obstacle for upstream migrants on the St. Lawrence River is the Moses-Saunders Power Dam, located 85 km upstream from Beauharnois. An eel ladder first built in 1974 and operated by Ontario Power Generation is located on the Canadian side of the Moses-Saunders Power Dam and represents the longest-term dataset on yellow eel recruitment in the St. Lawrence River system. In 2006, a second ladder was put in operation, on the US side of the power dam: respectively 8184 and 13 144 eels transited this new passage facility in 2006 and 2007. At this dam, numbers of eels moving up the ladders have declined by three orders of magnitude over the past 22 years, from over 1-million in 1982 and 1983 to 14 204 in 2007 (Table 3). The size of eels observed at the Saunders ladder has decreased in recent years.

Table 3. Total count and mean length of juvenile eels ascending ladders at the Moses-Saunders from 1974 to 2007.

YEAR	SAUNDERS LADDER		MOSES LADDER		MOSES-SAUNDERS
	Total Count (n)	Mean length (mm)	Total Count (n)	Mean length (mm)	Total Count (n)
2007	2860	386.6	11 344	400.9	14 204
2006	8960	383.7	8184	382.8	17 144
2005	14 891	413.6			14 891
2004	11 325	456.0			11 325
2003	2876	479.3			2876
2002	2663	469.2			2663
2001	944	454.7			944
2000	2895	457.1			2895
1999	1860	457.9			1860
1998	3432	471.6			3432
1997	6117	470.9			6117
1996					
1995	35 076				35 076
1994	163 518	492.8			163 518
1993	8289	414.3			8289
1992	11 534				11 534
1991	40 241	433.6			40 241
1990	121 907	429.8			121 907
1989	258 622	458.2			258 622
1988	213 187	404.0			213 187
1987	465 364	409.8			465 364
1986	230, 70	406.1			230, 70
1985	935 320	404.3			935 320
1984	647 480	382.4			647 480
1983	1 313 570	367.0			1 313 570
1982	1 013 848	374.6			1 013 848
1981	748 724	362.7			748 724
1980	253 758	373.5			253 758
1979	869 135				869 135
1978	794 600	318.9			794 600
1977	966 800	367.8			966 800
1976	659 478	347.9			659 478
1975	936 128	347.0			936 128
1974	130 000				130 000

Two other indices for yellow eels are in place in Lake Ontario and their results can be related to the decline of the eel passage at Moses-Saunders. Both the Bay of Quinte trawling index and an electrofishing index in the eastern part of Lake Ontario have declined by 1 and 2 orders of magnitude because the 1980s and are currently not significantly different from zero (Table 4). Although available information and indices cannot be combined into a quantitative assessment to the overall abundance population, they clearly reveal a general decline as a consequence of reduced recruitment and reduction of distribution area.

Table 4. Numbers of eel captured in Bay of Quinte trawls and electrofishing (Casselman and Marcogliese, 2007) conducted in eastern Lake Ontario.

Year	Bay of Quinte, eels per trawl	Eastern Lak.e Ontario, eels electrofished per hour
2007	0.000	0.21
2006	0.000	0.49
2005	0.000	1.23
2004	0.000	0.52
2003	0.000	0.65
2002	0.013	3.36
2001	0.006	6.82
2000	0.053	9.37
1999	0.074	21.60
1998	0.123	12.90
1997	0.085	7.30
1996	0.356	14.90
1995	0.091	10.50
1994	1.157	30.00
1993	0.434	22.70
1992	0.585	44.40
1991	0.454	38.50
1990	0.356	64.10
1989	0.952	93.00
1988	0.299	68.80
1987	1.552	89.00
1986	0.865	82.90
1985	0.778	63.10
1984	0.330	85.60
1983	0.557	
1982	1.884	
1981	1.530	
1980	0.252	
1979	0.767	
1978	0.417	
1977	1.064	
1976	1.286	
1975	1.543	
1974	0.997	
1973	1.620	
1972	1.873	

The longest fisheries-independent time-series of American eel abundance come from the electrofishing surveys in the southern Gulf of St. Lawrence (DU 3). These include series of yellow eel capture from Restigouche River (from 1970), the Miramichi River (from 1952), and the Margaree River (from 1957; Figure 5). The series with the greatest sampling intensity is that of the Miramichi, which reveals stable trends in the 1950s and 1960s, a peak in the 1970s, a trough in the late 1980s and early 1990s, and subsequent recovering numbers.

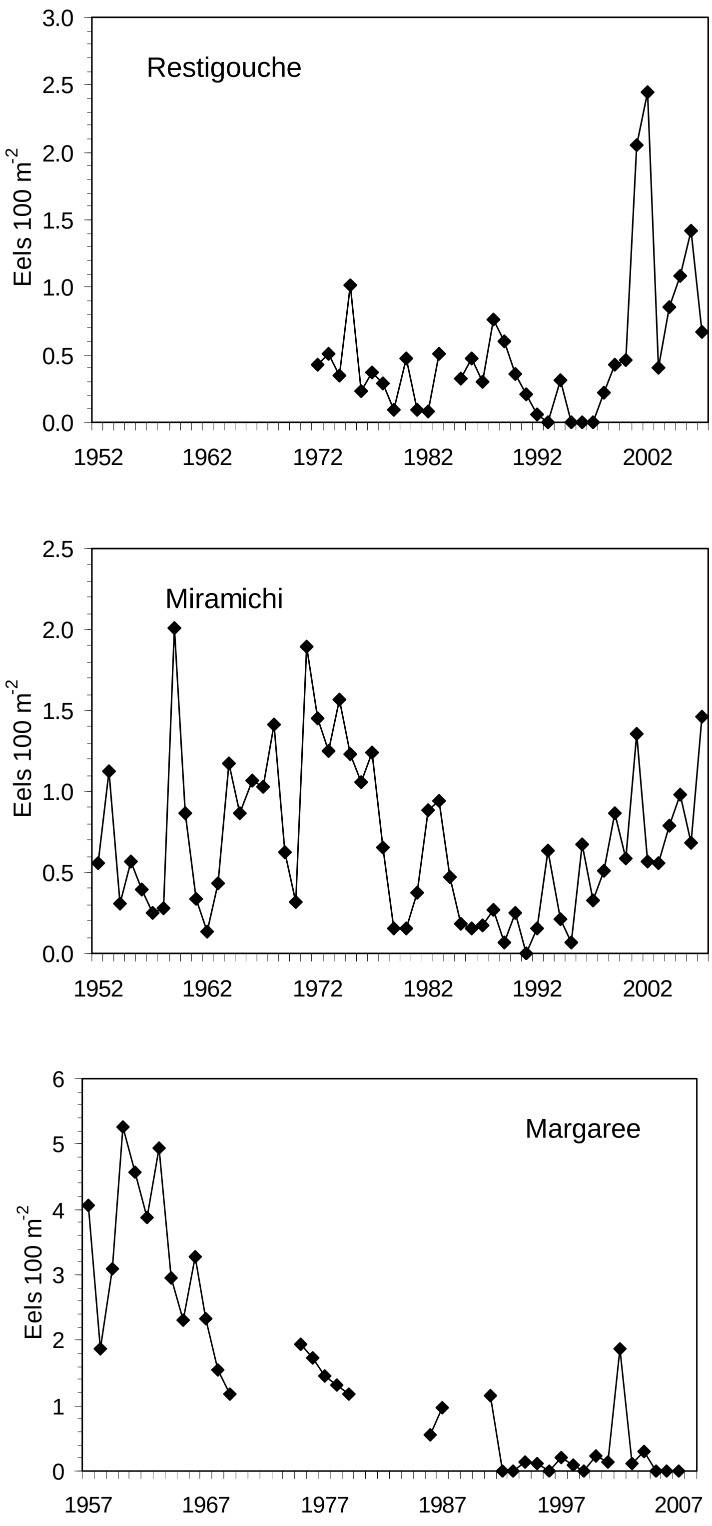

Figure 5. Densities of American eels in Southern Gulf of St. Lawrence River, based on electrofishing surveys. Data from Cairns *et al.*, 2008.

CA.H. Catch composition by age and length

Catch composition by length is not routinely done for fisheries. The silver eel fishery in the St. Lawrence estuary has a very long history. Harvest composed of large migrating female decreased drastically and average weight gradually rose from 1,16 to 1,64 kg between 1996 and 2007 (Figure 6).This observation suggests an ageing population in the Upper St. Lawrence River and Lake Ontario that is not sufficiently supplemented by recruits. The same pattern was also observed in the Richelieu River from the mid 1980s to the 1990s.

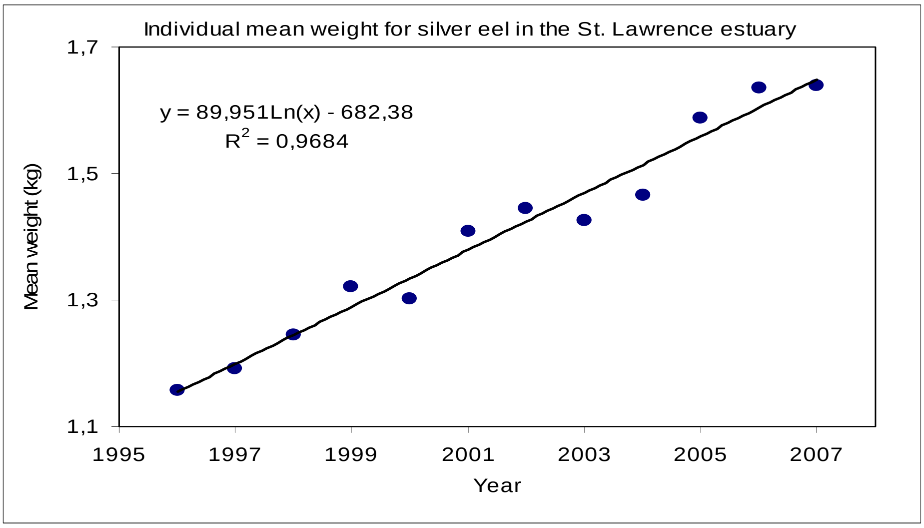

Figure 6. Silver eel mean weight harvested in the St. Lawrence estuary fishery from 1996 to 2007. (Verreault, G., Ministère des Ressources naturelles et de la Faune du Québec, unpublished data).

Age composition is restricted to specific research projects in Ontario, Québec (DU 1 and DU2) and the Maritimes (DU 3). In the latter, short-term series (2–4 years) are available for unexploited and exploited sites (see Cairns *et al.*, 2007a for details). Long term series (>10 years) is restricted to only two sites, the Saunders dam eel ladder (Ontario) and the Sud-Ouest River (Québec).

CA.H.1 Saunders dam eel ladder

Age composition of eels ascending the ladder at the R. H. Saunders Hydro Generation Station was evaluated by Casselman, 2008. Juvenile eels ranged in age from 3 to 19 (Figure 7). The broadest age distributions were in the 2003 and 2004 samples, along with the highest modal ages (10 and 9 years, respectively). There were appreciably younger fish in 2005, in the 4–7 age range, slightly more than twice as many as in 2004. In 2006 and 2007, young fish were similarly abundant. It is quite obvious that there was increased recruitment of appreciably younger eels to the ladder in 2005, and this persisted to 2007. Several relatively strong cohorts of eels ascended the Saunders ladder during this 5-year period. These cohorts indicated increased recruitment in 1992-93 and 1995–96, as well as a stronger multiple-year cohort from 1998 to 2002.

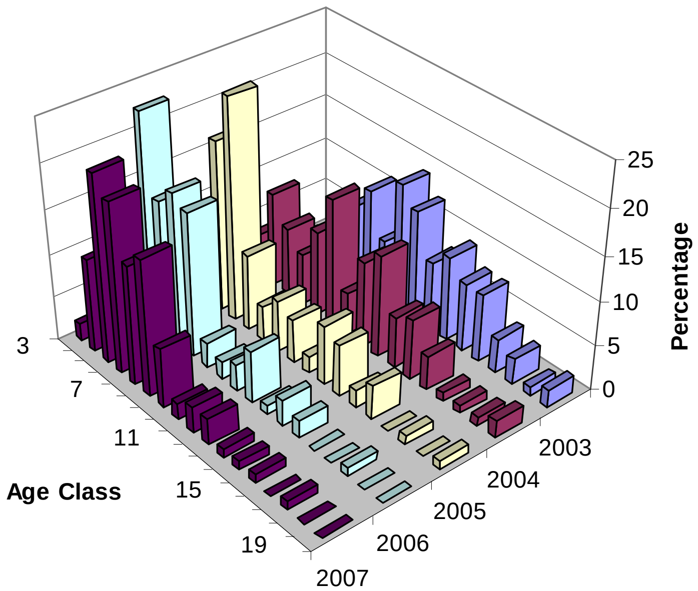

Figure 7. Age class distribution observed in eels ascending the Saunders eel ladder (Casselman, 2008).

CA.H.2 Sud-Ouest River

The Sud-Ouest River is located on the south shore of the St. Lawrence estuary in DU 2 and upstream migrants have been sampled for length and age structure since 1994. On this site, total abundance and age structure are monitored routinely. Abundance of upstream migrants varied from 16 617 in 1994 to 2171 in 2006. Over this period, mean length increased significantly (Figure 8).

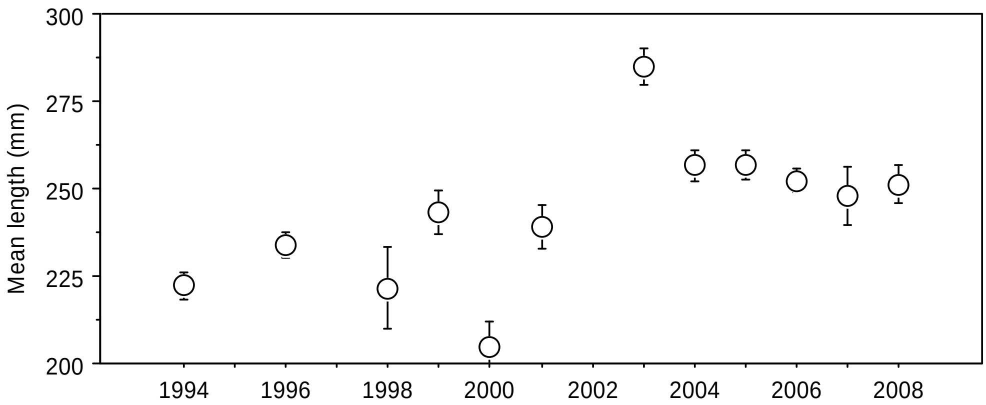

Figure 8. Mean length (C.I. 95 %) for upstream migrant eels in the Sud-Ouest River from 1994 to 2008.

This length increase reflects a shift in age structure over time. In fact, mean age was estimated at 4.2 years in 1994 but it increased gradually to 6.0 over a half generation time.

Young cohorts (<3 years) are now virtually absent in the migration (Figure 9), probably a result of poor recruitment in the system.

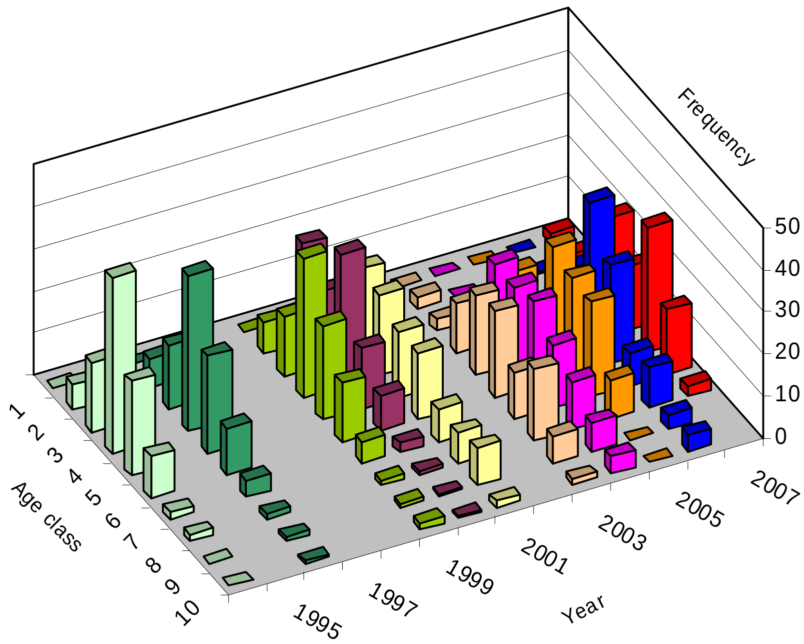

Figure 9. Age structure for upstream migrant eels, Sud-Ouest River, 1994–2007.

CA.H.3 Stocking

Eel stocking with elvers and advanced elvers from Atlantic Canada (DU 3) was done in the Richelieu River/Lake Champlain (DU 1) and Lake Ontario (DU 1; Table 5). For the Richelieu River/Lake Champlain, the Eel Fishermen's Union of Québec is in charge of this activity and financial and scientific support is provided by Hydro-Québec and provincial agencies. For Lake Ontario, the Ontario Power Generation company was in charge of the stocking. A monitoring programme was initiated by provincial agencies in recent years.

Table 5. American eel stocking in Canadian waters.

Year	Richelieu River/ Lake Champlain		Lake Ontario	
2005	600 000	105 kg	-	-
2006	1 000 000	200 kg	144 300	100 kg
2007	421 500	74.2 kg	450 000	90 kg
2008	746 000	145 kg	2 001 561	375 kg

The repeat in 2007 of yellow eel population estimates previously performed in three large bays in Lake Champlain in 1979 and 1985 confirmed the very low abundance of yellow eel in the Richelieu River-Lake Champlain watershed and will contribute to the monitoring of these stockings.

CA.I Other biological sampling

CA.I.1 Parasites

To avoid parasite transfers, screenings are routinely done for elvers caught in DU 3 before their stocking in fresh-waters locations in DU 1. Screenings for viruses (IHNV, ISAV, IPNV and EVH) and *Anguillicola crassus* in individuals prior to stocking were negative during these years. During summer 2006 and 2007, 914 yellow eels were collected from 17 sites in the Maritime provinces, Québec and Ontario and *Anguillicola crassus* was found for the first time in the country. This swimbladder parasite is now present in New Brunswick and Nova Scotia (Antigonish and Cape Breton; Ken Oliveira, University of Massachusetts, pers. comm.).

CA.I.2 Contaminants

Concentrations of many contaminants in the North American environment were high in the 1960s and 1970s, then decreased as bans and restrictions took effect. The St. Lawrence River-Great Lakes system receives a wide variety of pollutants, some of which have lethal (Dutil *et al.*, 1987, Castonguay *et al.*, 1994a) or sublethal (Couillard *et al.*, 1997) effects on eels. Concentrations of most contaminants, including PCBs and mirex, in eels migrating through the St. Lawrence Estuary fell in the 1980s (Hodson *et al.*, 1994). This trend presumably reflects decreased contaminant exposure, but does not takes into account the presence of new contaminant (for example the brominated compounds) and the increasing number of non native species in the Great Lakes watershed that alter fish community composition and foodweb energy flow, leading to subsequent change to pathways and fate of contaminants.

Recently, a 3-year research project on the role of chemicals in the decline of the American eels was initiated to evaluate if eels accumulate sufficient chemical contaminants during their growth and maturation to cause embryo toxicity, and to estimate when contaminants might have affected eel. Under the leadership of Dr Peter V. Hodson (Queen's University), a team of university and government scientists, including colleagues in the US and Europe are collecting fresh and archived samples of eels from reference and contaminated ecosystems. The eels are analysed for concentrations of chemicals known to be embryo-toxic, such as chlorinated and brominated organic compounds, selenium, and alkyl tin. The toxicity of extracted chemicals will be assessed with a battery of tests using fish embryos and fish cells in culture.

CA.I.3 Predators

No study available for natural populations. In the Richelieu River, in summer 2007, comparison of predation rates of elvers in the first 18 hours after day and night stocking revealed that short-term post stocking predation was very low and that stocking during night-time does not offer better survival conditions.

CA.J. Other sampling

CA.K. Stock assessment

Stock assessment was done for all DU's during the COSEWIC process. A bi-national recovery framework focusing on American eel in the St. Lawrence River and Lake Ontario below Niagara Falls extending to the St. Lawrence estuary (DU 1 and a portion of DU 2) is under completion by the Great Lakes Fisheries Commission.

CA.L. Overview, conclusions and recommendations

The Canadian Eel Working Group has developed a preliminary Management Plan for American eel. This plan, still under public consultation, includes a number of goals and objectives in order to rebuild overall abundance of American eel in Canada to its mid-1980s level. It is mainly based on the need:

- to reduce eel mortality from all sources by 50% relative to the 1997–2002 average,
- to achieve a net gain in abundance and escapement by ensuring access to and passage from quality habitats, specifically, provide upstream passage to an additional 10% of lost eel habitat in each jurisdiction every 5 years; to help reaching this objective, a GIS decision tool is under development to identify the watersheds where to intervene in priority,
- to maintain and, where required, develop fishery-independent abundance indices,
- to ensure presence of eels in areas where abundance has collapsed by stocking young eels,
- and develop a Canada/USA management plan.

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Report on eel stock and fisheries- Latvia 2008

LV.A. Author

Janis Birzaks, Latvian Fish Resources Agency, Daugavgrivas 8, Riga, LV- 1048, Latvia.

Tel. +371 7612536. Fax: +371 7616946

Janis.Birzaks@lzra.gov.lv

Reporting period: This report was completed in September 2008 and contains data including 2007.

LV.B. Introduction

Historically the eel fishery in Latvia is carried out in coastal waters, river estuaries and lagoon- type lakes close by the sea. After the initiation of artificial restocking of eel in 1930s, fisheries were organized in the inland lakes and lake outlets, too. At present eel commercial fisheries are carried out in 17 lakes and along 500 km of the coastline in ICES Subdivision 28.

Only stationary gears are used in eel fisheries by Latvian fishers. Since 1930 to 1950s anchored bottom long- lines have been the main gear in eel fisheries in the coastal waters. Fyke- and trapnets as well as eel weirs are mainly used gear in the inland waters fisheries. Currently different construction fykenets and trapnets are more common gear in the eel fisheries.

Only in some lakes fisheries targeting eel still exist. In the coastal waters eel mostly is bycatch in mixed fisheries used small mesh size gear and targeting other fish species, especially herring and eelpout.

Current management measures of eel stock exploitation limits:

- the number of gear in coastal and inland waters;
- local closures regarding season and placement of gear;
- the construction of gear (size, mesh size);
- size limit (40 cm) for commercial fisheries and angling and bag limit (for angling only).

In accordance with WFD territory of Latvia is separated in four River Basin Districts.

LV.C Fishing capacity

In the coastal waters of Latvia there are no fisheries companies targeting only eel. In 2007 70 fishing rights owners reported eel bycatch.

In the inland waters eel catches are reported in 14 lakes belonging to three river basin districts. In 2007 45 fishing rights owners where engaged in eel fishery in lakes.

Only two of these lakes are accessible for diadromous fish, other watercourses are blocked by HPS dams, fisheries in these waterbodies based on restocked eel.

Eel fisheries in the RBD's 2007, Latvia.

RBD	Number of lakes with eel fisheries	Surface of RBD (km2)	Number of fisher's leaseowners	Catch of eels (t)	Data source
Daugava	11	27 041.5	23	5.5	Logbooks
Venta	2	15 632.7	21	3.0	Logbooks
Lielupe	1	8841.7	1	<0.1	Logbooks
Gauja	No eel fisheries				

LV.D Fisheries effort

Effort in eel fisheries.

Number of gear used									
1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Waterbodies accessible for eel									
Fyke nets less <30 m									
65	65	65	65	65	65	70	68	68	68
Lakes not accessible for eel, restocked									
Trapnets in river outlets from the lakes, less <30 m									
-	26	26	26	26	26	23	9	9	9
Trapnets in river outlets from the lakes, wider >30 m									
27	27	28	27	27	25	24	23	23	23
Eel weirs									
10	10	6	6	10	11	11	11	11	11

Fisheries effort is fixed by the limited number of gear used in the both inland and coastal fisheries.

LV.E Catches and landings

In 2007 in total 1.2 t of eel was landed in coastal waters and 8.6 in inland waters.

LV.E.1 Catches of glass eel

There is no catch of glass eel in Latvia.

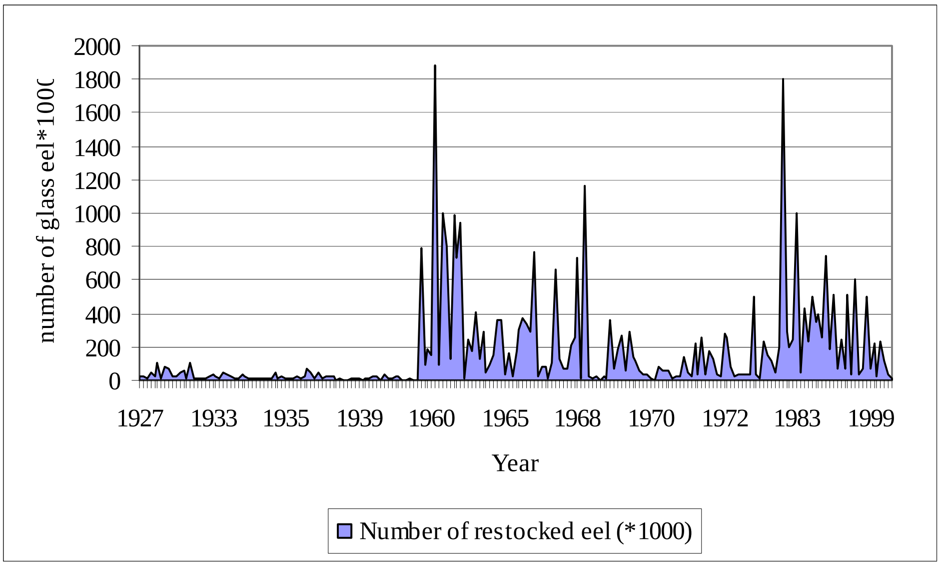
LV.E.2 Restocking

The first official glass eel and young yellow ell stocking are carried out in 1927. Interruptedly eel re-stocking has been performed till nowadays, the maximum was fixed in 1960–1970s. From the dawn of eel restocking till 1990s this measure was organized by the state (for example to increase an income and welfare of fishers in 1930s).

In the last decade eel restocking are carried out by the fishing rights owners or lakes leaseholders. There are no eel restocking financed by state programmes.

All the data of restocking from 1927 is available from database including information on waterbodies.

The eel re-stocking in Latvia inland waters

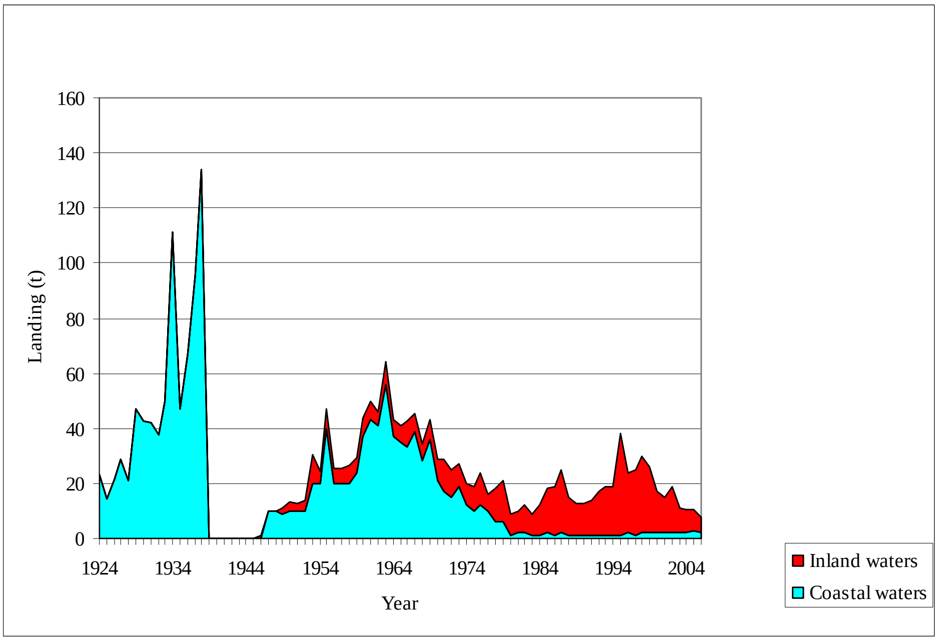


Restocking of eel in Latvia late years (2005–2007)

YEAR	NUMBER OF RESTOCKED EEL (*1000)
2005	120 (glass eel)
2006	6 (elvers)
2007	18 (elvers)

LV.E.3 Catches of yellow and silver eel

Latvian fisheries legislation does not contribute the separation of eel catch in two different strains. Only small-scale data based on biological sampling still exist. This data were collected in summer of 2005–2006 from three reference areas/fishers who voluntarily checked the own catch and marked the yellow or silver eel presence.



Eel landings in coastal and inland waters of Latvia

In the course of time the fisheries statistics principles, organization and collection changed significantly. At present eel fisheries statistics in the inland waters by RBD's would be accessible from 1946, but in the coastal waters from the period of 1927–1938 and 1946 till now.

From 1992 fisheries statistics in coastal and inland waters of Latvia are based on monthly logbooks with declared daily catch if fishing carried out. Each logbook embodies data regarding fishers, fishing area, gear used and caught. Monthly logbooks collected by the Marine and Inland waters Administration regional officers. The logbook data are processed and stored in LFRA.

LV.E.4 Aquaculture

There is no eel aquaculture in Latvia.

LV.E.5 Recreational fisheries

In 2007 the new angler's inquiry is organized. To obtain the data for National fisheries data collection programme, questions regarding eel angling included in questionnaire. In total 3000 individual anglers will survey in this study.

Results of anglers' inquiry 2007

METHOD-INTERVIEW	
Number of anglers in LV	100 000
Number of anglers in survey	3223
Average angling days/catch per year	49 days/58kg
Number of anglers reporting the eel catch (N?/%)	77/4.1
Proportion of eel in catch	<1%
Estimated eel catch	~4 t
Method- direct registration of catch	
Number of anglers interviewed in situ	1386
Proportion of eel in catch	1 jeb 0.2%
Zušu daudzums lomos pēc tiešās uzskaites	~1.9t

LV.F Catch per unit effort

Catch per unit effort data are available form 1999 for inland waters and 1990 for coastal fisheries.

LV.G Scientific surveys of the stock

No eel stock surveys in Latvia

LV.H Catch composition by age and length

Eel has been included in National Fisheries Data Collection programme since 2006. Eel sampling is organized in 2 areas-near the river Daugava outlet in the Gulf of Riga and the lake Kisezers connected with the river Daugava without migration barriers for migratory species. (Figure 5). Sampling is carried out by commercial fishers' operated with standard gear. Sampling includes following parameters: body length, weight, sex, length of pelvic fin, eye diameter, otholits.

The number of sampled eel in Fisheries data collection programme

YEAR	LOCATION OF SAMPLING	NUMBER OF SAMPLED EEL
2008	Lake Kisezers	94
2008	Gulf of Riga	26

LV.I Other biological sampling

No other biological sampling of eel in Latvia.

LV.J Other sampling

The river fish monitoring covers all country territory by ~100 electrofishing sites. Only few specimens of eel were caught in monitoring 2006–2008.

River fish monitoring effort in the rivers of Latvia

Year	Fished area (m2)	Number of rivers	Number of sites	Number of eels caught
2005	7700	23	71	0
2006	13 115	44	117	3
2007	23 510	48	118	0
2008	30 280	52	128	3

LV.K Stock assessment

Eel landing statistics and effort data were collected every year by LFRA and reported to Ministry of Agriculture.

LV.L Sampling intensity and precision

Sampling intensity exceeds DCR requirements.

LV.M Standardization and harmonization of methodology

Biological samples of eel were collected from landings by two fishers' family enterprises through all fishing season from April to October.

LV.N Overview, conclusions and recommendations

Several conclusions:

The eel landings in LV coastal and inland waters continue decreasing; in fact it reaches historically lowest level.

The share of unreported catches of eel seems to be high, therefore catch and landing statistics should be verified.

General results of river fish monitoring demonstrated the very low abundance of eel in the rivers.

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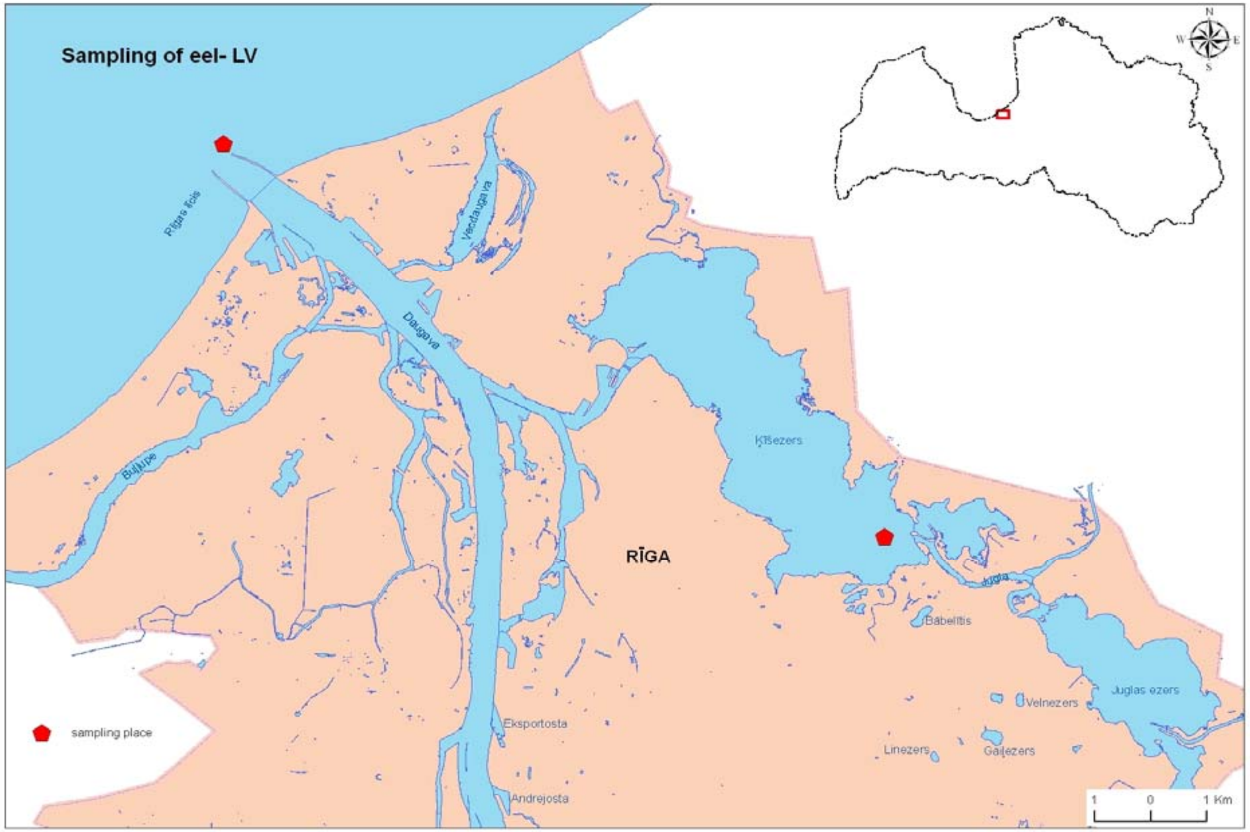
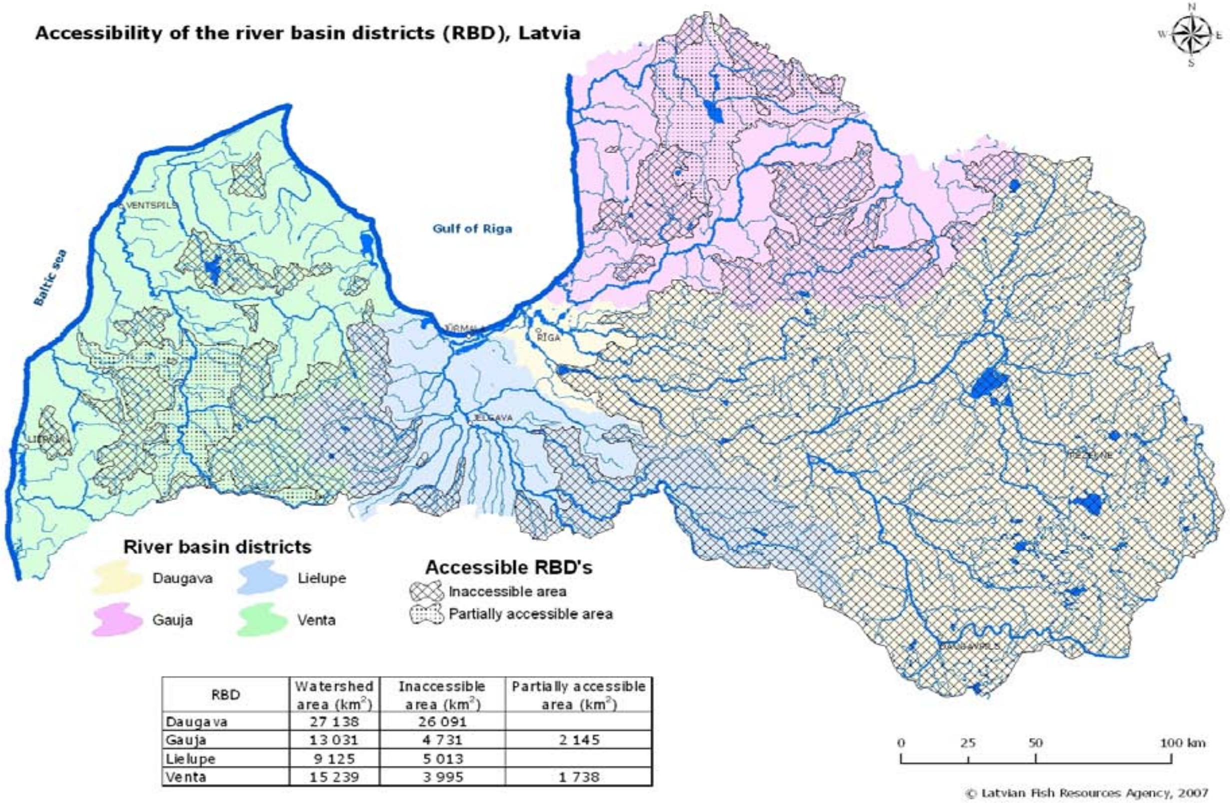


Figure LV.5 Location of eel sampling 2006–2007.



RBD	Watershed area (km^2)	Inaccessible area (km^2)	Partially accessible area (km^2)
Daugava	27 138	26 091	
Gauja	13 031	4 731	2 145
Lielupe	9 125	5 013	
Venta	15 239	3 995	1 738

Figure LV.6 Latvia RBD's and their accessibility.