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Report of the Workshop on Baltic Eel (WKBALTEEL)

2–4 November 2010

Stockholm, Sweden

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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Executive summary

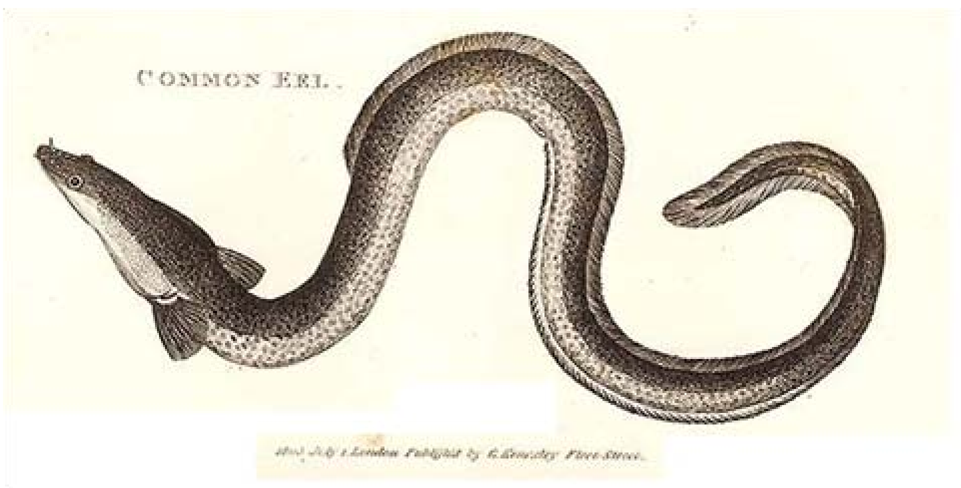
This report presents the results of a Workshop on Baltic Eel, held in Stockholm on 2–4 November 2010. This workshop was jointly organized by ICES and HELCOM. In this section, the main outcomes from the report are summarized, a forward focus is proposed and the main recommendations are presented.

The stock of the European eel is in decline and management was not considered to be within safe biological limits. In order to protect and recover the stock, the European Union decided in 2007 to establish a recovery plan, aiming at protection and restoration of the stock (Council Regulation (EC) No 1100/2007 of 18 September 2007 establishing measures for the recovery of the stock of European eel. Official Journal of the European Union L 248/17).

According to this Regulation, Member States are obliged to compile Eel Management Plans for the stocks on their territory. Where river basins span national boundaries, Member States shall devote special attention to coordination. In this context, the preamble makes special reference to the Baltic Sea area.

In spring 2010, ICES and the HELCOM Baltic Fisheries and Environmental Forum decided to organize the Workshop reported here, with the aim of collating available information, and stimulating regional cooperation on the eel, especially where management measures taken in one country might interact with measures taken in other countries. The Workshop implemented this, taking the lines set out by the Working Group Eel WGEEL and the Study Group on International Post-Evaluation on Eels SGIPEE (ICES 2010 a&b) as a starting point. Thus, this report should be read in conjunction with the earlier reports by WGEEL and SGIPEE.

The objective of this Workshop has been to document and present the information on the eel stock in the Baltic currently available, to standardize stock status assessments (cf. SGIPEE), to initiate a common assessment for the whole Baltic stock, to identify and quantify interactions between management measures taken in different countries, and to suggest future improvements by means of further standardization, cooperation and integration of monitoring and assessment efforts; and identify future data requirements and current knowledge gaps.



Summary of this report

The status of the eel stock in the Baltic corresponds in general to that in the remaining distribution area: a long-lasting gradual decline in landings since the 1960s, and a slow decline in recruitment. Glass eels entering the Straits leading into the Baltic, pigment, grow and age on their way in before migrating into rivers. The riverine migration of (young) yellow eels in the Baltic has been in decline since the 1960s. This contrasts to the situation outside the Baltic, where glass eel dominate the recruitment, and glass eel series have only gone down since 1980.

The density of the eel stock in the Baltic decreases from west to east, and from south to north; this pattern is primarily based on reported commercial catches. Fishing targets the yellow and silver eel stage, with silver eel fisheries dominating around the outlet of the Baltic. Restocking of glass eel (derived from southern countries) has been practised for decades, mainly in inland waters; this has considerably influenced the commercial yield and the biological composition of the stock, and it still does.

The report gives a detailed account of the information available, including fishing capacity, landings, restocking quantities, biological characteristics, Catch-per-unit-of-effort series, other (anthropogenic and non-anthropogenic) impacts, and management measures implemented.

The implementation of the European Eel Regulation (1100/2007) requires that all countries develop management targets specific for the eel stock on their territory; in 2012, the effectiveness of this recovery plan will be post-evaluated. ICES (2010 a,b) is developing an assessment framework, that will allow post-evaluation by country, region and for the whole stock. For this, a triplet of stock indicators is required (pristine, current and today's best achievable biomass of silver eel escapement). Some of the countries did report these indicators before; for the remaining countries, this report derives a preliminary estimate from the data in the Eel Management Plans (before protective measures were implemented). The overall status of the Baltic eel stock appears to be severely suffering from reduced reproductive capacity, and exploitation is unsustainable.

Interactions between countries occur where coastal lagoons span the border between countries. Data available for the Curonian, the Vistula and the Szczecin lagoons, turned out to be insufficient to produce estimates of these interactions, and improved data collection is recommended.

The biggest interaction is found in the silver eel fisheries around the outlet of the Baltic, targeting the silver eel derived from yellow eel stocks in other (eastern and southern) countries around the Baltic. Historical tagging data indicate a substantial impact of these fisheries. However, most tagging data come from the western countries. Continuation and extension of tagging studies is therefore recommended.

Overall, this workshop marks a beginning of coordination and integration of eel monitoring and research in the Baltic area. The Workshop recommends strengthening further coordination and cooperation, to increase the effectiveness and cost-effectiveness, which will also enable a quantitative assessment of the interactions.

Forward focus

This report presents results from a one-time Workshop that contributes to the development of sustainable management for the eel all over Europe. The forward focus, presented in this section, is centred on the Baltic area, but it should not be read separate from the ongoing process of designing and implementing Eel Management Plans by individual countries, and from the ongoing process of documenting and analysing the stock status at the international level by WGEEL and SGIPEE.

In the past decade, the status of the eel stock has been documented by WGEEL, in Country Reports and international analyses and SGIPEE has proposed a framework for international post-evaluation. The current workshop on the Baltic eel stock found that a major body of information was already available (summarized in chapter 2), and additional information will become available, as the Eel Management Plans are being implemented and the monitoring under the Data Collection Framework applied. Standardisation, integration and coordination of the ongoing data collection will improve the coverage of the data; sharing expertise, standardizing methods and dividing up some of the work load might increase the cost-effectiveness of the implementation.

The impact of coastal fisheries in the countries around the outlet of the Baltic has been quantified using information from tag-recapture studies; these studies have addressed the national fisheries only. Though impacts on the escaping silver eels from other countries have been documented in long-running tagging programmes, these impacts so far have remained unquantified. To quantify the impact of the outlet-countries on the total Baltic stock, international tagging experiments are required, in which eels are tagged on the east-side and recaptured in the west. Such an experiment cannot be organized by individual countries, neither east nor west. A joint initiative for a pan-Baltic tagging programme is required (high information tracking studies; mass-marking methods for quantification).

The eel stock in Europe is assumed to constitute a single, panmictic stock, jointly exploited and impacted by all countries. Restoration of the stock thus requires that protective measures are taken in all countries (or at least, no single country can be excluded at forehand without jeopardizing the required recovery). Because protective measures are most effectively organized and implemented by country, the Eel Regulation has obliged EU Member States to develop an Eel Management Plan for the eel stock, for their whole territory or for individual rivers (resp. River Basin Districts, Eel Management Units). In the Baltic, however, major interactions between countries have been identified, questioning the nation-by-nation (river-by-river) approach of the Eel Regulation for this region. Silver eels, emigrating from one country, are being fished on their route towards the outlet; and possibly, young eels on their way into the Baltic might be affected by coastal management in the countries around the inlet. Effective management of the eel stock in the Baltic requires that protective efforts are coordinated between countries, or potentially integrated into a single Baltic Eel Management Plan.

The scientific documentation of the stock status and advice on potential management actions will benefit from further integration and coordination in monitoring and research. To this end, field programmes can be (further) integrated, expertise be shared, a central database designed (or a standardized data exchange procedure developed), and a joint assessment of stock status developed. Because the interactions between countries in the Baltic are essentially regional in character, a regional monitoring and assessment procedure will relieve the truly international assessment addressed by SGIPEE and WGEEL.

The first post-evaluation of the Eel Regulation is foreseen in 2012. Individual countries will report on the status of their stock and fisheries, other anthropogenic impacts and protective measures. Standardisation (of the data and/or the reporting) will greatly facilitate the international post-evaluation process. As a pragmatic interim goal for further integration of eel stock management in the Baltic, a full integration of the data collection and analysis by 2012 is recommended. An integrated assessment will set the scene for joint management advice, as a basis for strengthening cooperation between HELCOM States with regard to protection of eel in the Baltic Sea.

Main recommendations

The Workshop on the Baltic Eel recommends:

1) To coordinate, standardize, integrate and jointly organize eel stock monitoring in the Baltic;

2) To set up data exchange/storage procedures for data on the Baltic eel stock (recent and historical data);

3) To initiate (new) field programmes to quantify the interactions between management areas in the Baltic (marking restocked eels, international silver eel tagging experiments);

4) To organize a series of practical workshops on eel data collection and working procedures, to support local programmes, to coordinate and standardize, and to explore post-evaluation methods for local eel stocks;

5) To evaluate the status of the stock, the anthropogenic impacts and the effect of protective measures by 2012 on a pan-Baltic level;

6) To develop pan-Baltic management advice by 2012.

1 Introduction

1.1 Terms of Reference

At the 98th Statutory Meeting of ICES (2010) it was decided that:

A **Workshop on BALTic EEL** [WKBALTEEL] (Chair: Willem Dekker, Sweden) will meet in Stockholm, Sweden 2–4 November 2010 to:

a) assess the status of the eel stock in the Baltic, to identify available data, to summarize the documentation available in national management plans;

b) prepare the work of SGIPEE as regards the Baltic by assessing the status of the eel stock in the Baltic region as a whole, following the assessment framework developed by WGEEL/SGIPEE, and to make the required data available to WGEEL/SGIPEE;

c) assess the anthropogenic impacts on the stock in the Baltic, focusing on international interactions between countries/rivers, and to relate that to the targets/limits of the (national) Eel Management Plans and the (international) EU recovery plan;

d) consider data requirements for the assessment of the international interactions, and to identify data and knowledge gaps.

WKBALTEEL will report for the attention of WGEEL and PGCCDBS and ACOM.

20 people attended the meeting, from nine countries (see Annex 1). Unfortunately, Russia was not represented, but otherwise all countries around the Baltic participated in this Workshop. In the preparatory process for this Workshop, contacts were made and information exchanged with the Kaliningrad State Technical University, Russia.

1.2 Setting and framework for this Workshop

At the start of the meeting, Mr Anders Alm, Swedish Ministry of the Environment, gave a short introduction to the setting of this Workshop. The Baltic Sea Action Plan urges rapid implementation of the existing long-term management plans for cod and eel, not later than by 2012 to improve their distribution size/age-range. EU member countries and the contracting parties of HELCOM have agreed to develop national programmes for the conservation of eel stocks. Within the BSAP the plans are to be seen as a contribution to a Baltic coordinated effort that ensures successful eel migrations from the Baltic Sea drainage basin to natural spawning grounds. The issue of ensuring successful eel migrations from the Baltic Sea drainage basin was discussed at the fourth HELCOM Baltic Fisheries and Environmental Forum on March 30, 2010. Subsequently, ICES and the HELCOM Baltic Fisheries and Environmental Forum decided to organize this workshop, with the aim of collating available information, and stimulating regional cooperation on the eel, especially where management measures taken in one country might interact with measures taken in other countries. The joint organization of this workshop by ICES and HELCOM ensures the linkage to the scientific advisory process and access to the network of ICES specialists, while framing the workshop in the relevant regional policies.

The Workshop is focused on the eel stock and fisheries in the Baltic Sea area. There are several definitions of the exact limits of this area, especially with regard to the limit in the Straits between Denmark and Sweden. The Workshop decided to take a liberal interpretation: data from all over Sweden and from all Danish waters east of

Skagen (north tip of Jutland) were included, and where relevant, spatial detail was presented explicitly; data from Norway were included where readily available. That is: the Workshop presents the data in a way that allows for *post hoc* selection.

1.3 Overview of the report

In this report, results of the workshop are presented. This report should be read in conjunction with the reports from SGIPEE in May 2010 and from WGEEL in September 2010 (ICES 2010a & b), which describe the international framework and have set the stage for the assessment of the stock status. In particular, the workshop has made fruitful use of the Country Reports 2010, appended to the report of WGEEL. Though frequent use has been made of the information contained in these, they will not been repeated here.

The structure of this report follows the order of the Terms of Reference. In **Chapter 2**, the available information is summarized, and an overview of the Baltic eel stock and fisheries is presented. **Chapter 3** compiles an assessment (status vs. targets) of the stock in the Baltic using the methodology of SGIPEE, and preliminary estimates of the status by country. **Chapter 4** then identifies where overlap and interactions between management actions occur, and finally **Chapter 5** discusses what (additional) information will be required for the 2012 post-evaluation, and suggests further steps towards cooperation and joint assessment of the stock status by 2012.

1.4 Glossary and terminology

Eels are quite unlike other fish. Consequently, eel fisheries and eel biology come with a specialised jargon. This section provides a quick introduction for outside readers. It is by no means intended to be exhaustive.

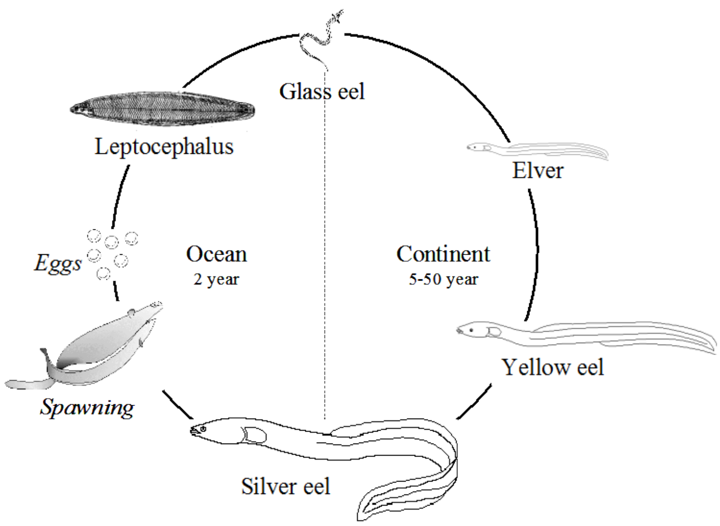


Figure 1.1. The life cycle of the European eel. The names of the major life stages are indicated. Spawning and eggs have never been observed in the wild.

Glossary of Terms

Glass eel	Young, unpigmented eel, recruiting from the sea into continental waters
Elver	Young eel, in its first year following recruitment from the ocean. The elver stage is sometimes considered to exclude the glass eel stage, but not by everyone. Thus, it is a confusing term.
Bootlace, fingerling	Intermediate sized eels, approx. 10–25 cm in length. These terms are most often used in relation to stocking. The exact size of the eels may vary considerably. Thus, it is a confusing term.
Yellow eel (Brown eel)	Life stage resident in continental waters. Often defined as a sedentary phase, but migration within and between rivers, and to and from coastal waters occurs. This phase encompasses the elver and bootlace stages.
Silver eel	Migratory phase following the yellow eel phase. Eel characterized by darkened back, silvery belly with a clearly contrasting black lateral line, enlarged eyes. Downstream migration towards the sea, and subsequently westwards. This phase mainly occurs in the second half of calendar years, though some are observed throughout winter and following spring.
Eel River Basin or Eel Management Unit EMU	“Member States shall identify and define the individual river basins lying within their national territory that constitute natural habitats for the European eel (eel river basins) which may include maritime waters. If appropriate justification is provided, a Member State may designate the whole of its national territory or an existing regional administrative unit as one eel river basin. In defining eel river basins, Member States shall have the maximum possible regard for the administrative arrangements referred to in Article 3 of Directive 2000/60/EC [i.e. River Basin Districts of the Water Framework Directive].” EC No. 1100/2007
River Basin District RBD	The area of land and sea, made up of one or more neighbouring river basins together with their associated surface and groundwaters, transitional and coastal waters, which is identified under Article 3(1) of the Water Framework Directive as the main unit for management of river basins. Term used in relation to the EU Water Framework Directive.
Stocking, restocking	Restocking is the practice of adding fish [eels] to a waterbody from another source, to supplement existing populations or to create a population where none exists.
Trap & transport	Traditionally, the term trap and transport referred to trapping recruits at impassible obstacles and transporting them upstream and releasing them. Under the EMPs, trap and transport (or catch and carry) now also refers to fishing for downstream migrating silver eel for transportation around hydropower turbines.

ICES (2010a,b) provides a list of reference points for stock management, as applied to eel. In the current report, this specialised jargon is only used in Chapter 3, where the required jargon will be introduced.

Throughout this report, a number of codes have been used for countries, management units, etc., which are summarized below.

Table 1.a. Data codes for countries, eel management units, habitat types and life stages.

Country codes	
NO	Norway
SE	Sweden
FI	Finland
EE	Estonia
LV	Latvia
LT	Lithuania
RU	Russia
PL	Poland
DE	Germany
DK	Denmark

EMU codes.	
In general, EMU codes	
For the specific EMUs,	
Co	Coastal wa
Cu	Curonian la
Da	Daugava
Ga	Gauja
In	Inland wate
Li	Lielupe
Ma	Marine wat
Od	Oder
Sc	Schleie/Tra
Ve	Venta
Vi	Vistula
Wa	Warnow/Pe

Habitat types	
Lac	Lacustrine
R	Riverine
T	Transitional
Lag	Lagoon
C	Coastal

Life stages	
Y	Yellow eel
S	Silver eel
M	Mix of yello

2 The eel stock in the Baltic Sea area

2.1 Introduction on the eel stock in the Baltic Sea area

In 2002 (ICES 2003), WGEEL advised to set up a system of annual reports of dataseries on eel stocks by individual countries, in so-called Country Reports. From 2003 onwards, all countries participating in WGEEL meetings have compiled an up-to-date Country Report on an annual basis. The most recent were reported to the September 2010 meeting of WGEEL; Estonia and Lithuania were not represented at that meeting, and these two countries have now compiled an update specifically for this workshop. In this chapter, the available information is summarized, and supplemented with some additional information collated during the meeting.

2.2 Habitat and migration barriers

Data on the different habitats are inconsistent and sometimes lacking. Therefore compiled data in tables and graphs are far from complete, but gives a rough overview only. From some countries with several EMUs only a few are presented and the riverine areas are usually not known, probably due to methodological difficulties as lack of appropriate GIS-layers, etc. The eel productive areas in coastal waters are difficult to define and estimate. Some countries are including all coastal areas down to 20 m depth while others down to 10 m only. However, the coastal habitats were significant and varied, when data were available, between 24 and 83% of the total area per country, (Table 2.a and Figure 2.1).

In a similar way as described above it was difficult to find useful data on barriers and inaccessible areas upstream. Some countries with most significant areas of freshwater have not yet been able to divide and present the required data. One reason is the numerous dams and waterfalls making it hard to know if a barrier is passable for eels or not and to what extent it disturbs the recruitment of young eels and the downstream migration of silver eels. The lack of useful GIS-data is another cause. The data available are presented in Figure 2.2.

Table 2.a. Area of eel habitats per EMU, presented as riverine, lacustrine, transitional and coastal when available.

Country	EMU	Habitat	Area (ha)	Total area (ha) per country	Proportion of coastal areas (%)
NO		na			
SE	Whole	Lac	3,926,246		
SE	Whole	C	1,390,581		
SE	Whole	R	198,200	5,515,027	25
FI	Whole	Lac	38,200		
FI	Whole	L not	2,050,900		
FI	Whole	C reserve	178,300		
FI	Whole	C	467,700	2,735,100	24
EE	Narwa RDB	Lac	430,000	430,000	
LV	Whole	C+T	89,776		
LV	Whole	Lac	15,768		
LV	Whole	R	7,426	112,970	79
LT	Dauguva RBD	Lac	17,202		
LT	Dauguva RBD	R	108		
LT	Lielupe RBD	Lac	5,896		
LT	Lielupe RBD	R	2,326		
LT	Nemunas RBD	C	41,500		
LT	Nemunas RBD	Lag	41,300		
LT	Nemunas RBD	Lac	86,396		
LT	Nemunas RBD	R	29,109		
LT	Venta RBD	Lac	6,137		
LT	Venta RBD	R	1,658	231,632	36
RU		na			
PL	PL-OD	Lac	179,000		
PL	PL-OD	R	1		
PL	PL-OD	T+Lag	45,700		
PL	PL-OD	C	646,450		
PL	PL-VI	Lac	150,000		
PL	PL-VI	R	1		
PL	PL-VI	T+Lag	32,800		
PL	PL-VI	C	344,100	1,398,052	76
DE	DE-OD	C	0		
DE	DE-OD	Lac	49,205		
DE	DE-OD	R	2,654		
DE	DE-OD	T	28,507		
DE	DE-SC	C	310,761		
DE	DE-SC	Lac	20,546		
DE	DE-SC	R	2,483		
DE	DE-WA	C	166,400		
DE	DE-WA	Lac	30,175		
DE	DE-WA	R	4,620		
DE	DE-WA	T	143,680	759,031	63
DK	Whole	Lac	45,000		
DK	Whole	Lag	300,000		
DK	Whole	R	15,000		
DK	Whole	T		360,000	83
			Total	11,541,812	

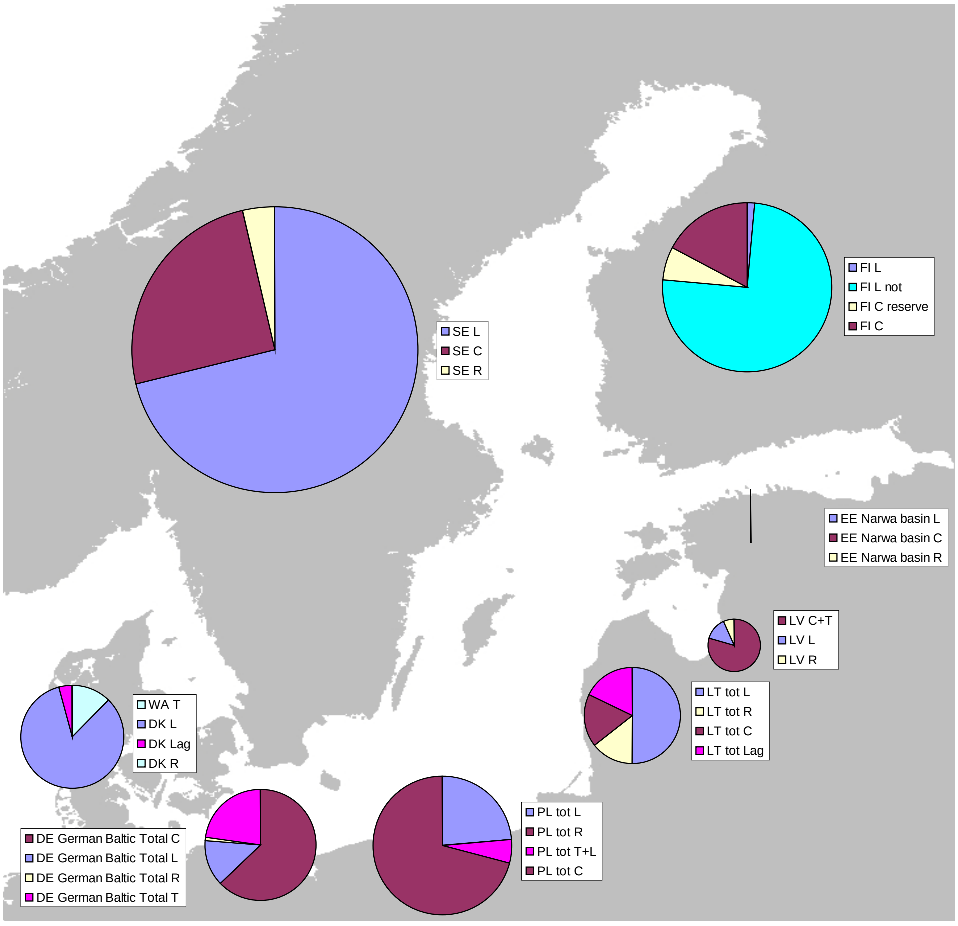


Figure 2.1. Different types of habitats presented when available as riverine, lacustrine, transitional and coastal.

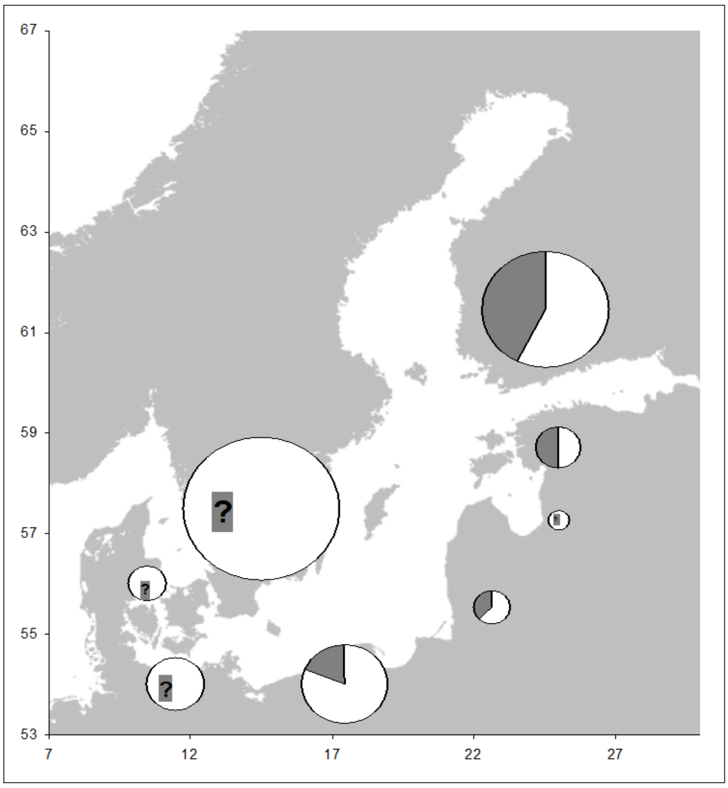


Figure 2.2. Total area of eel habitats (ha, white), and area of habitats currently inaccessible (partly or totally blocked, grey), where data were available.

2.3 Recruitment series

No dataseries for (truly unpigmented) glass eel are available, because no glass eels occur in the Baltic area. Time-series used for recruitment analysis in the Baltic are only available from six rivers in two countries (DK: rivers Tange and Harte; SE: rivers Mörrumsån, Motala Ström, Dalälven and Kävlingeån). This concerns young eels migrating into rivers, being in the yellow eel stage, they might be from one to several years old at the time of immigration In the last years, monitoring on immigration and upstream migration of young yellow eel has also been set up in Germany (Ubl and Dorow, 2010). The monitoring stations were established in waters of the RBD's Warnow/Peene and Oder.

In Figures 2.3 and 2.4 the trends in recruitment within the Baltic Sea (Baltic Proper) and in neighbouring areas outside the Baltic Sea are illustrated by a few examples from eel passes where ascending young eels are monitored. Within the Baltic Sea recruitment has already dropped since the 1960s while outside the decline commenced later. Note that in general, the further up the Baltic, the older and larger the recruiting yellow eels are.

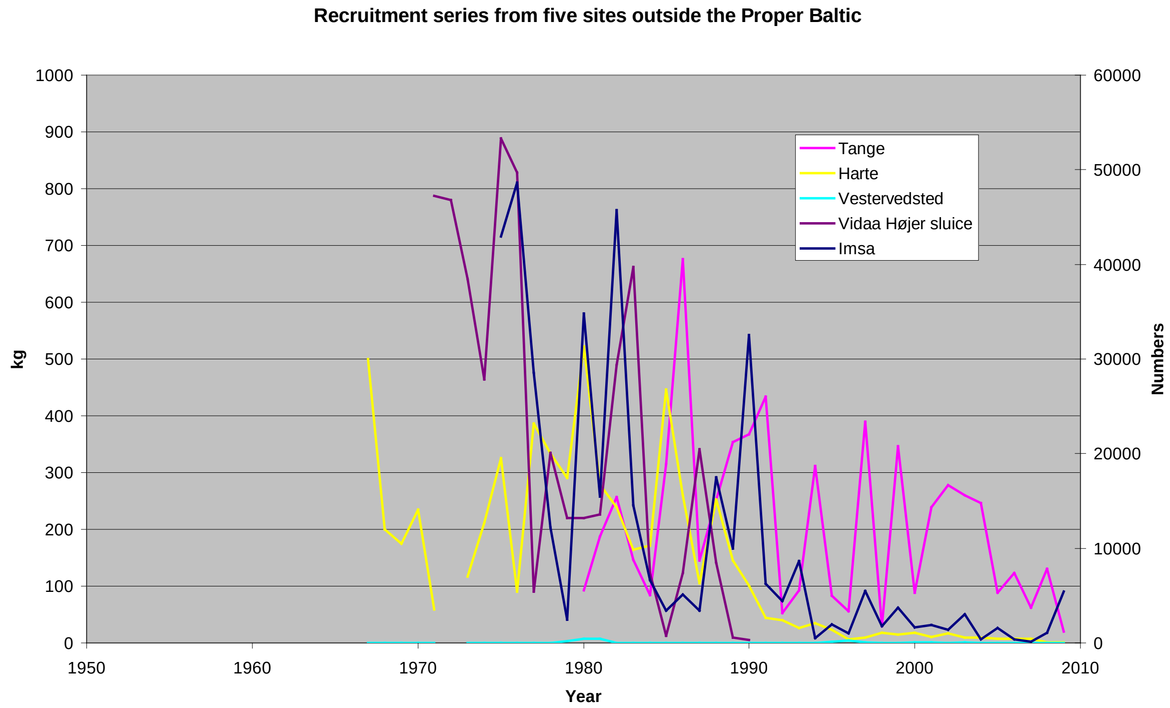


Figure 2.3. Trends in recruitment of young yellow eels into rivers in rivers in the western Baltic area, outside the Baltic proper.

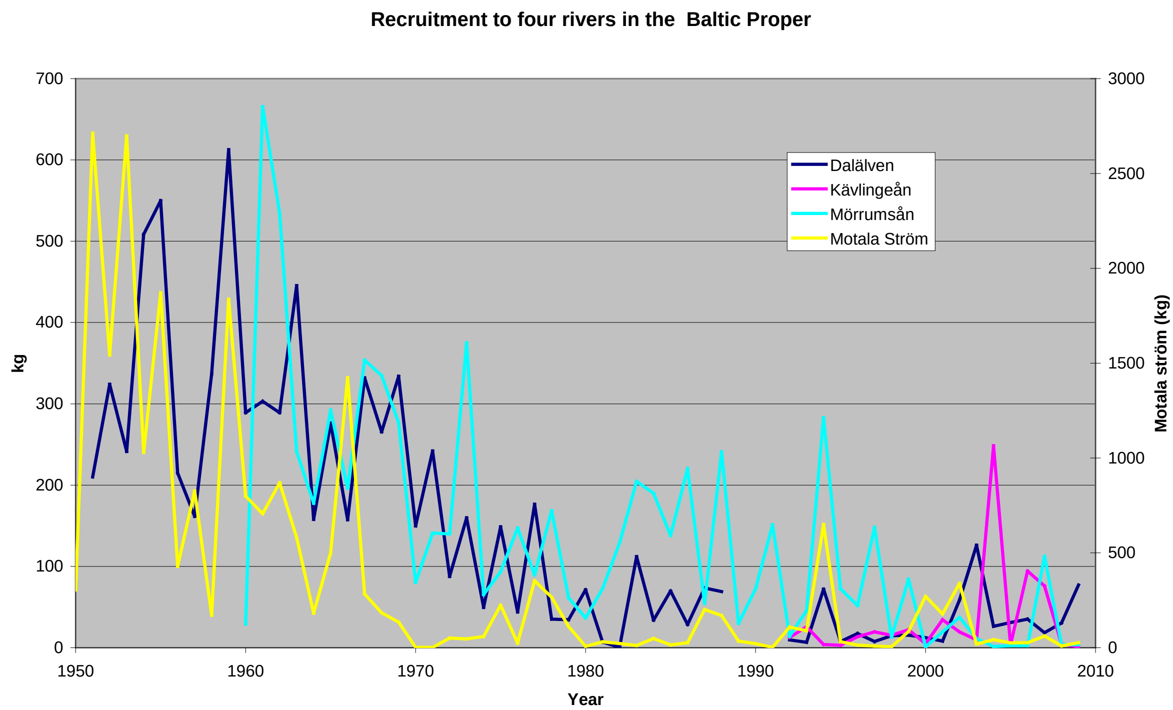


Figure 2.4. Trends in recruitment of young yellow eels into rivers in the Baltic proper.

The spatial distribution of recruiting young yellow eels in Baltic rivers is shown in Figure 2.5. These maps show the absolute number of eels being trapped, at places where there is effectively no other route into the river. It should be noted, that the absolute numbers might be indicative of local circumstances; however, these spatial characteristics have not changed considerably over time.

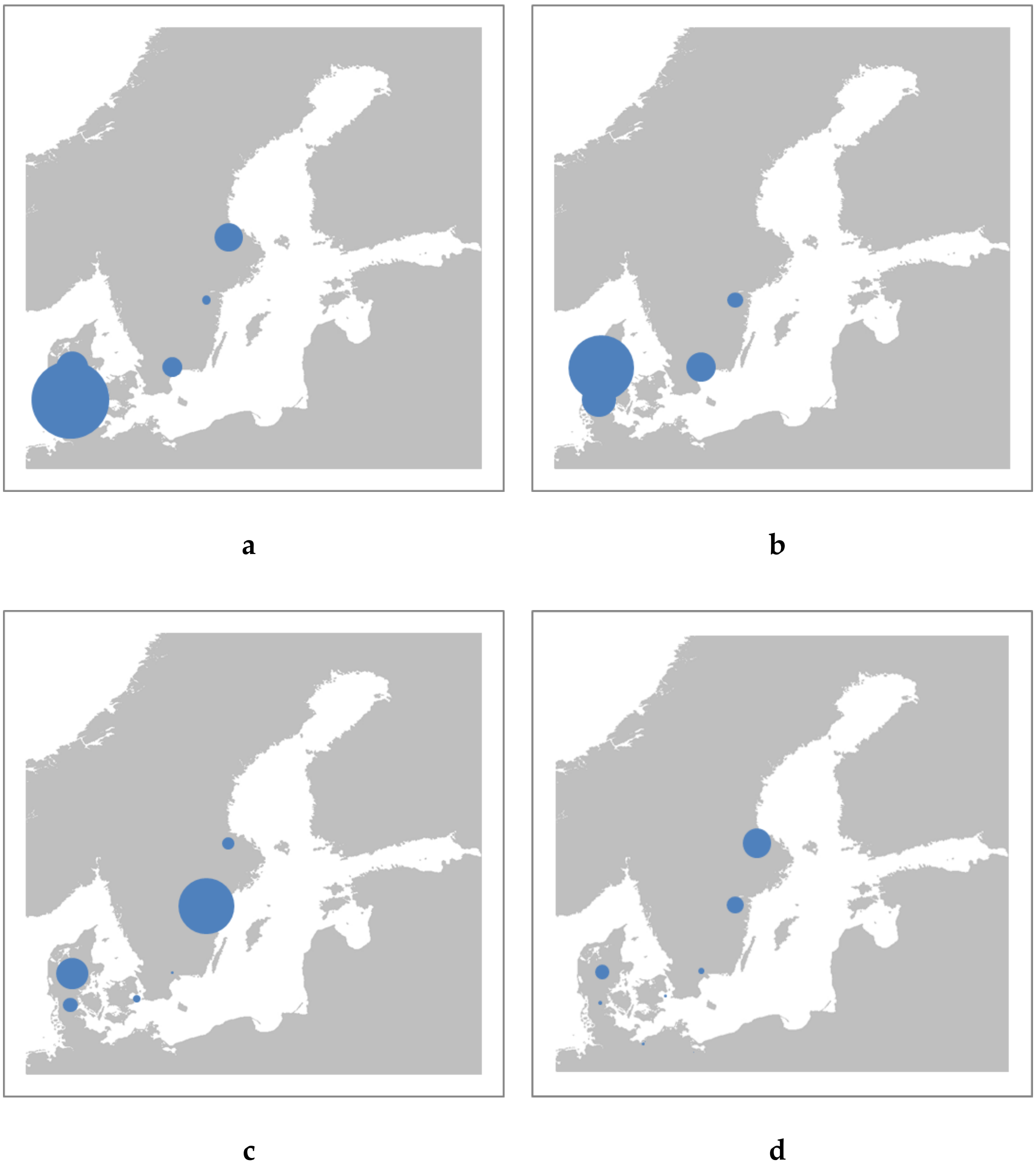


Figure 2.5. Locations of the recruitment monitoring in the Baltic region for a) 1980, b) 1990, c) 2000 and d) 2009. The size of the circles is relative to the quantity of eels being trapped.

2.4 Restocking

Restocking might involve glass eels, freshly caught on their migration from the ocean into freshwater, bootlace eels of larger size which have been caught in the wild, or cultured eels which are derived from indoor culture facilities (which themselves take wild-caught glass eels as seed material). In some countries, a quarantine period in indoor culture is obliged, to minimize the risk of spreading diseases.

It has been advocated to express all restockings in so-called “glass eel equivalents”, that is: the number of glass eels required to get the same number of survivors. In Germany, for instance, 1 cultured bootlace (average 25 gr) is considered equivalent to

4.5 glass eels; 1 bootlace (7 gr) to 3 glass eels; and evidently 1 wild glass eel to 1 glass eel. However, these conversion factors have not been generally accepted. The Workshop therefore considered it impossible to transform all restocking data in glass eel equivalents. For this reason, data were split into glass and yellow eel restocking separately. The data stem from the annex tables from the WGEEL Report 2010. For Germany, only those data were used in the analysis, which reflect drains to the Baltic. The Danish data are for both, North Sea and Baltic Sea RBD's.

In Denmark no restocking with glass eels is undertaken. In other countries like Germany and Poland, stocking glass eel has decreased strongly since the early 1990s and appears now to be at low level (Figure 2.4.1). Causes for this decrease were the increased prices due to the reduced availability of stocking material. In Poland this has partly been compensated for by an increasing number of young yellow eels stocked since the middle 1990s (Figure 2.4.2). At present only Sweden has a considerable glass eel stocking. In the southern Baltic countries, the stocking with yellow eels is dominant.

However, for the future it would be helpful, if there is a conversion factor for glass eel equivalents for different yellow eel sizes which would simplify the comparison between different countries or EMU's.

In recent years, glass eel used for restocking in Sweden and Finland have been marked before release, using a $SrCl_2$ bath, which deposits a ring in the otoliths that is detectable in a microprobe. To assess the effect of restocking on the stock and to document the contribution restocking make to the implemented management measures, it is recommended that all restockings are marked in future. For this, a smart coding system will be required, coding for the year and place. In 2010, Swedish restocking got a single ring, while Finnish got two rings. Other marking agents might be considered and/or other coding methods.

One further aspect to be considered is the origin of the stocking material used. According to Frankowski *et al*. (2009) restocking activities are the reason of the occurrence of *A. rostrata* in German inland waters draining into the Baltic Sea. For the identification of *A. anguilla* and *A. rostrata* a specific DNA test was developed (Frankowski *et al*., 2010). Based on a three year monitoring period it was demonstrated that *A. rostrata* represented a significant proportion of the commercial eel catches in the natural water bodies where *A. rostrata* was introduced.

Based on this, a regular genetic screening of the stocking material was implemented in the German EMU´s affected, to prevent further stocking activities with *A. rostrata*. To avoid further introduction of *A. rostrata*, it is recommended to monitor the origin of all stocking material, in the Baltic region as well as elsewhere in Europe.

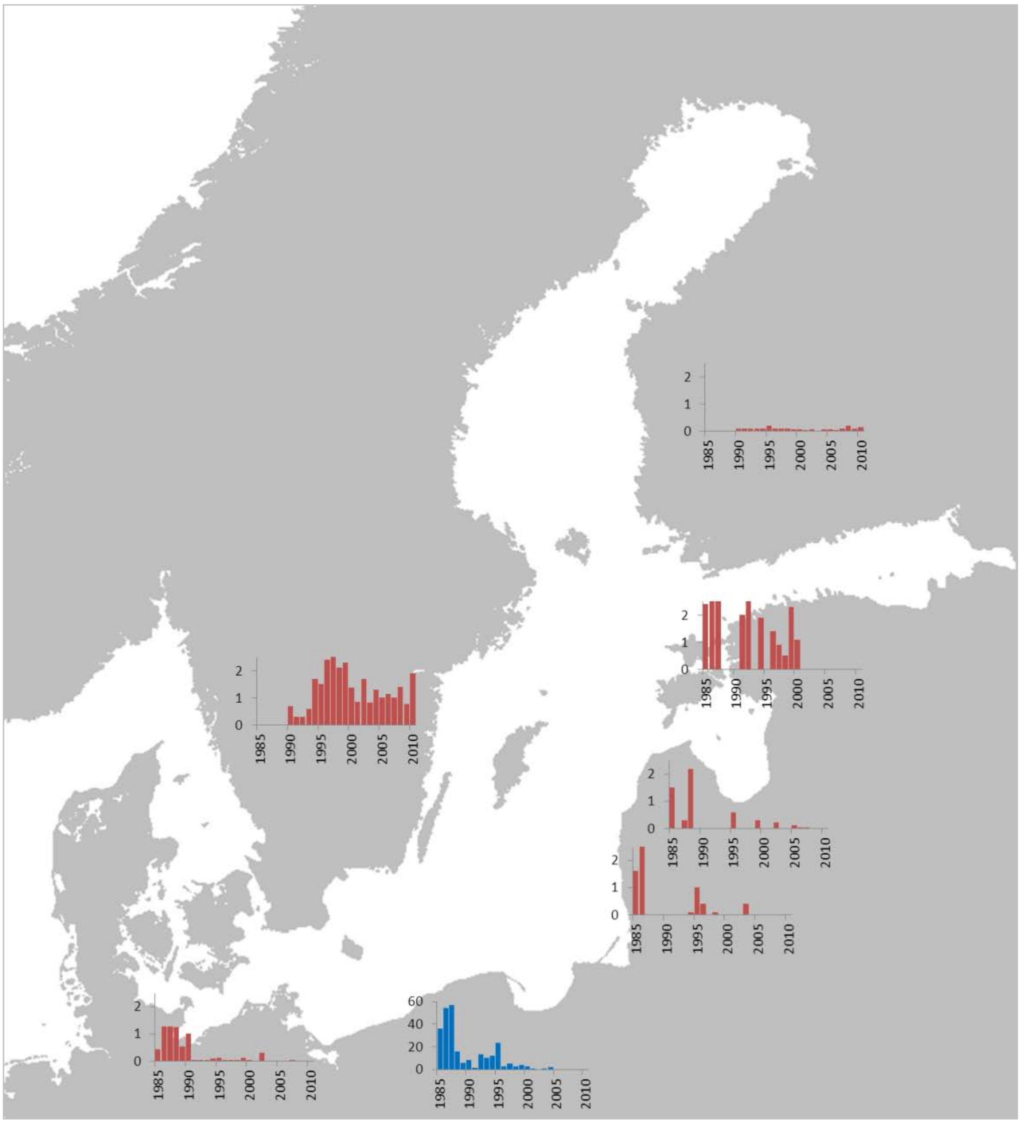


Figure 2.6. Glass eel restocking in million numbers in the last 25 years. Note that Poland has different scale for the y-axis.

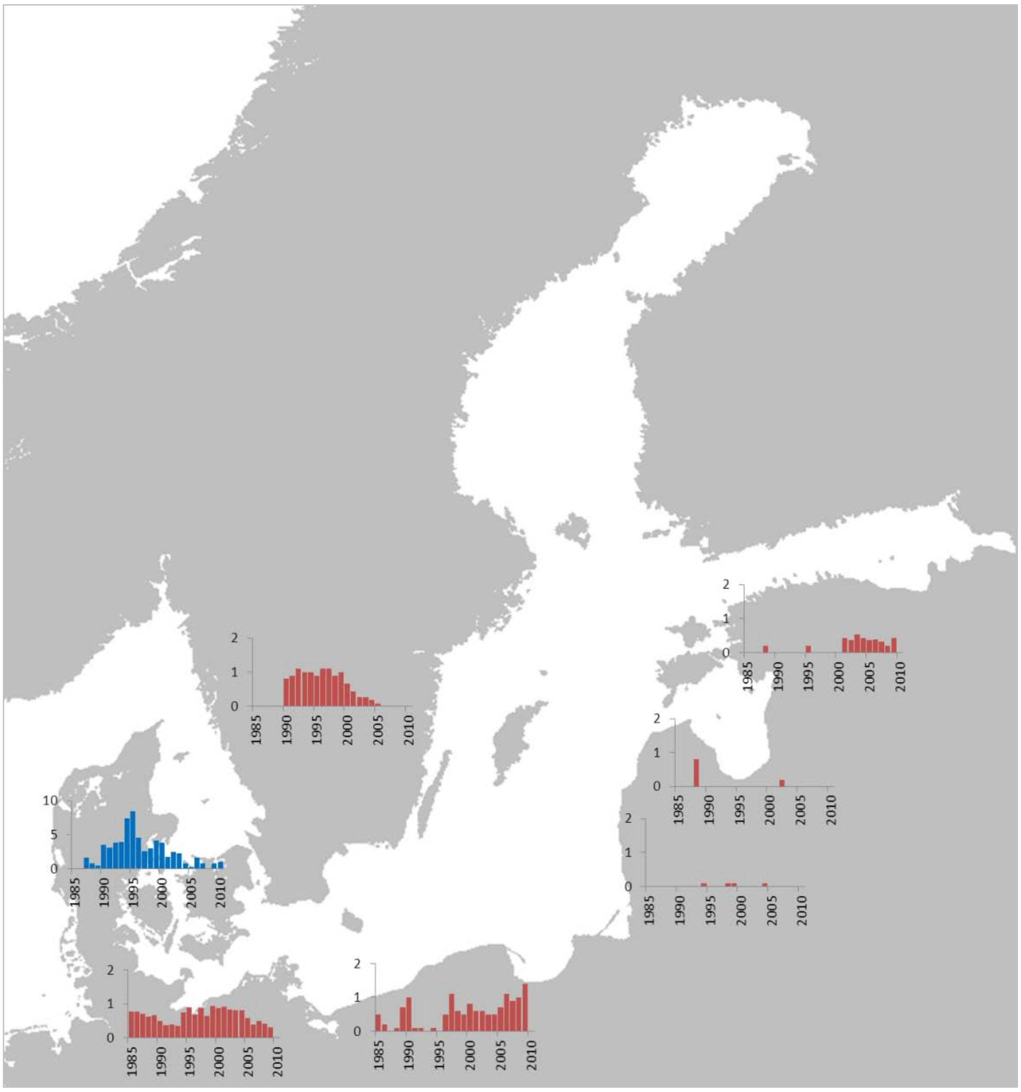


Figure 2.7. Yellow eel restocking in million numbers in the last 25 years. Note that Denmark has different scale for the y-axis.

2.5 Fishing capacity

The data on fishing capacity available to the Workshop are incomplete and require standardization. Fishing capacity can be described as number of vessel targeting eel. Taking into account, that there is no dedicated eel fishery (or very limited) in countries like Poland, Lithuania, Latvia and Estonia (that is: eel is only caught as a by-catch), estimation of capacity based only on number of licences will be incomparable. Each country has a different system of licensing, and in some case all fishers are allowed to catch eels and they will report only small portions. If we use métiers with eel as a target assemblage, and calculate capacity on that level, result will be more adequate.

2.6 Landings

2.6.1 Inland fisheries

In the 1970s, Poland and Denmark dominated the eel landings from inland waters, with an average of 293 and 185 tons annually (Figure 2.8; Table 2.b). Lithuania landed 97 tons annually in the same period. No other countries reported landings above 60 tons. In 2004–2006, Sweden reported the highest landings (113 t), now followed by Poland, landing 60 tons annually from freshwater fisheries. Landings from Denmark, Lithuania and Poland were 8–25% of the levels in the 1970s. Sweden increased its landings by 500%.

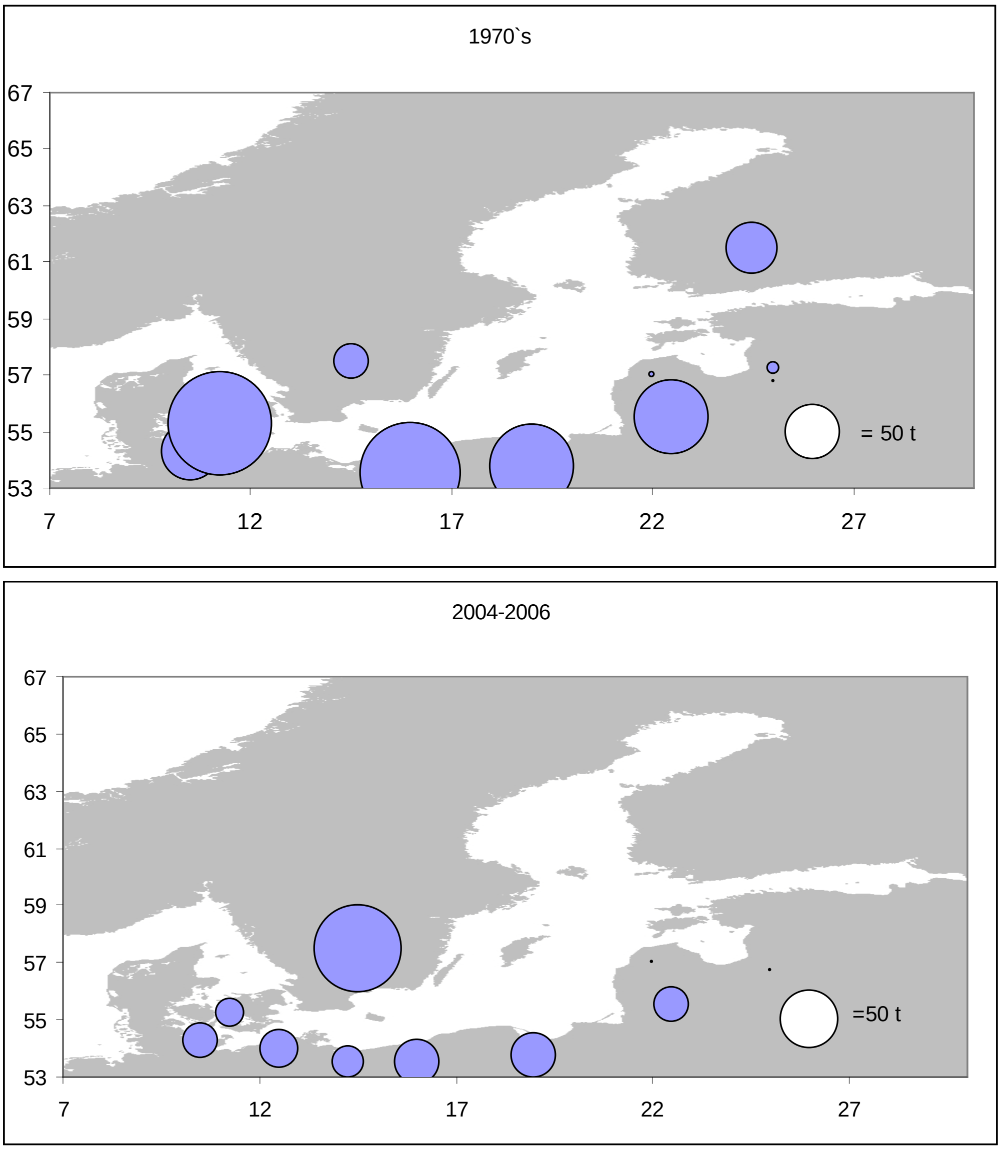


Figure 2.8. Geographical distribution of landings from inland waters, in the 1970s (top) and in recent years (bottom).

Table 2.b. Inland landings.

Country code:	SE	FI	LV	LV	LV	LV	LT	PL	PL	PL	DE	DE	DE	DE	DK
EMU/RBD code:			Da	Li	Ve	All	LT	OD	VI	All	SC	WA	OD	All	All
Yellow/Silver/Mix:	Silver	Mix	Mix	Mix	Mix	Mix	Mix	Mix	Mix	Mix	Mix	Mix	Mix	Mix	Mix
1950			0	1	2,1	3,1	29							0	147
1951			0	1	1,8	2,8	32							0	145
1952			0,1	1	1,4	2,5	39							0	152
1953			0	1	1,3	2,3	80							0	212
1954			0,2	0,4	2	2,6	147	64	216	280				0	213
1955			0,5	0,7	4,9	6,1	163	72	252	324				0	255
1956			0,1	0,5	3,9	4,5	131	58	259	317				0	163
1957			0,2	0,2	4	4,4	168	71	220	291				0	178
1958			0	0,3	4,6	4,9	149	111	204	315				0	191
1959			0,2	0,7	3,4	4,3	155	64	186	250				0	197
1960			0,2	0,2	5,8	6,2	165	99	230	329				0	214
1961			0,1	0,1	6,4	6,6	139	92	221	313	87			87	235
1962	8		0	0	4,2	4,2	155	85	231	316				0	215
1963	9		0	0,5	7,4	7,9	260	84	295	379				0	238
1964	12		0,1	0,6	5,2	5,9	225	74	393	467				0	223
1965	11		0,1	0,4	4,8	5,3	125	105	230	335				0	205
1966	13		0	0,1	5,3	5,4	238	103	365	468				0	211
1967	15		0,2	0,2	3,3	3,7	153	115	447	562				0	243
1968	18		0,1	0,2	3,9	4,2	165	102	416	518				0	258
1969	18		0,2	0,3	4,3	4,8	134	151	384	535				0	254
1970	18		0,5	0	2,4	2,9	118	159	244	403				0	249
1971	19		0,2	0,1	2,7	3	124	144	222	366	60			60	183
1972	20		0,4		1,3	1,7	126	162	148	310				0	200
1973	20		0,5		0,7	1,2	120	174	127	301				0	201
1974	20		0,1		0,7	0,8	86	176	107	283				0	163
1975	29		0	0	1	1	114	145	99	244				0	260
1976	22	9	0		0,7	0,7	88	187	77	264				0	178
1977	28	47	0		0,3	0,3	68	206	82	288				0	179
1978	22	62	0,1		0,4	0,5	70	165	59	224				0	157
1979	22	61	0,1		0,3	0,4	57	188	59	247				0	78
1980	32	63	0		0,6	0,6	45	216	85	301				0	147
1981	33	31	0		0,7	0,7	27	142	58	200	74			74	140
1982	38	29	0		1	1	28	168	63	231				0	163
1983	39	29	0		0,6	0,6	23	196	61	257				0	116
1984	42	23	0		0,6	0,6	27	215	71	286				0	126
1985	50	23	0		0,7	0,7	29	192	99	291		77	64	142	111
1986	92	51	0	0	0,9	0,9	32	223	113	336		75	67	142	120
1987	88		0	0	0,6	0,6	20	229	105	334		72	48	120	90
1988	136		0	0	1,2	1,2	23	242	121	363		60	45	105	119
1989	109		0	0	0,7	0,7	21	176	140	316		54	42	96	114
1990	128		0		0,4	0,4	19	177	111	288		34	45	80	107
1991	132		0		0,4	0,4	16	132	90	222		39	37	76	99
1992	132		0	0	0,1	0,1	12	140	75	215		42	35	77	109
1993	129		0	0	0,3	0,3	10	111	90	201	33	47	35	116	57
1994	171		0,1	0	0,7	0,8	12	125	104	229	34	48	35	116	60
1995	127		0,3	0	0,2	0,5	9	114	100	214	29	44	29	101	52
1996	108	21	0,1	0	0,3	0,4	9	88	125	213	22	37	28	87	34
1997	143		0,1	0	0,3	0,4	11	71	130	201	19	33	31	83	39
1998	112		0,1	0	0,1	0,2	17	63	133	196	22	32	24	78	40
1999	140		0,2	0	0,2	0,4	18	66	93	159	24	29	28	81	30
2000	114		0,3	0	0,2	0,5	11	58	66	124	23	29	25	76	28
2001	118		0,4	0	0,4	0,8	12	46	67	113	16	29	25	70	36
2002	103		0,4	0	0,4	0,8	13	42	59	101		27	24	50	27
2003	96		0,4	0	0,2	0,6	12	30	39	69	21	23	15	59	24
2004	107		0,4		0,3	0,7	16	10	35	45		18	16	34	15
2005	110		0,3		0,3	0,6	22	41	29	70	22	22	17	61	14
2006	123						16	38	28	66	20	25	17	63	14
2007	111						15	36	27	63	22	22	18	62	11
2008	112	4					13	36	25	61				0	9
2009	96						9	31	28,7	31				0	13

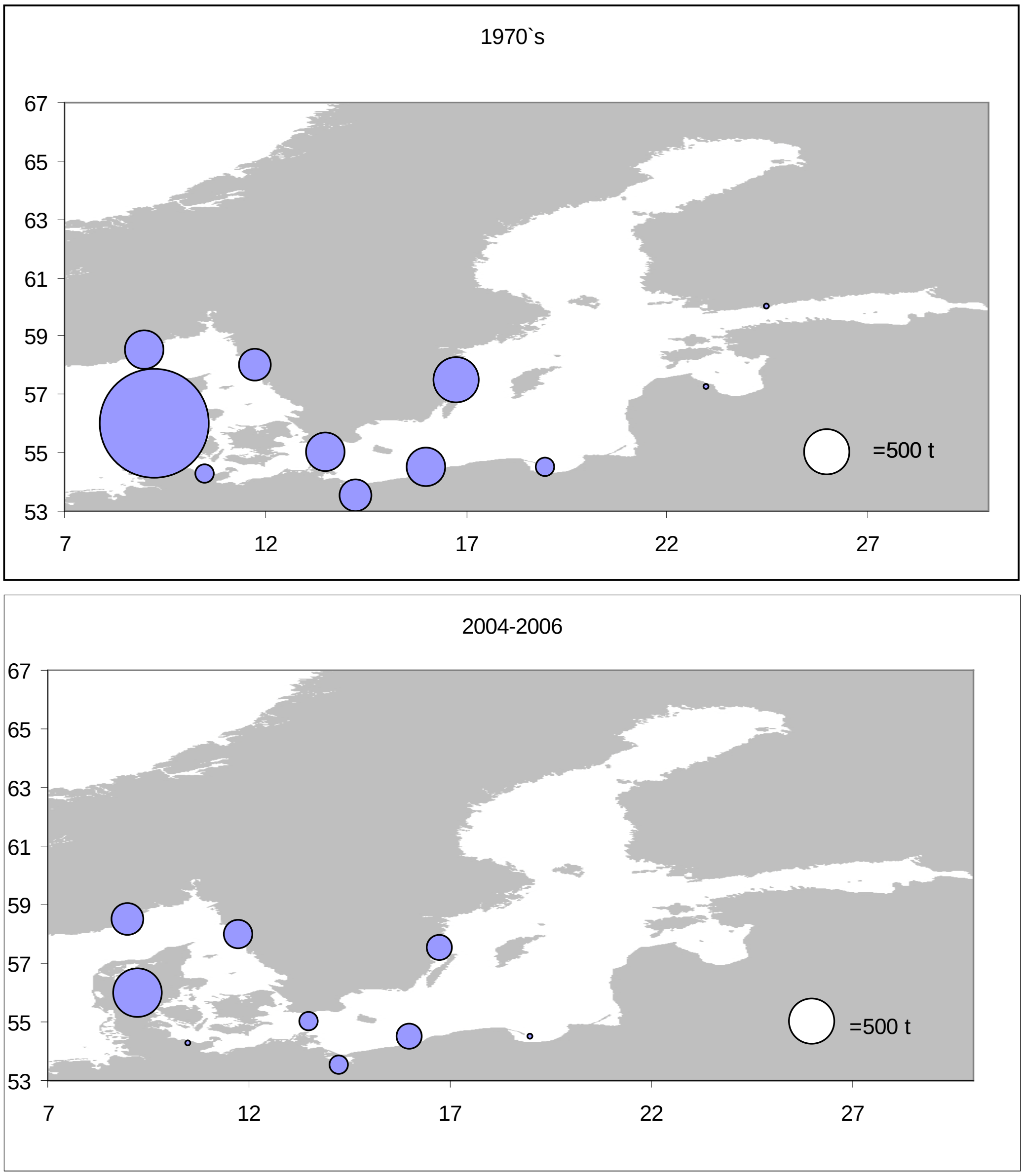


Figure 2.9. Geographical distribution of landings from coastal waters, in the 1970s (top) and in recent years (bottom).

2.6.2 Coastal landings

In the 1970s, Denmark landed close to 2700 tons annually from coastal fisheries, followed by Sweden landing 1150 tons (total landings from the Baltic and west coast. combined). Nearly 50% of the Danish catch was silver eel and the Swedish landings from the Baltic Sea were dominated by silver eel, whereas the west coast landings are almost exclusively yellow eel. Poland landed close to 500 tons from coastal estuaries and Norway had a coastal yellow eel fishery of similar magnitude. In total, the coastal fisheries in the 1970s landed 5600 tons annually.

Denmark still holds the leading position in the Baltic coastal eel fishery in the period 2004–2006 (Figure 2.9; Table 2.c). Compared with the 1970s, the level of the Danish landings has declined to 20% of its former level, now 543 tons. A similar, but somewhat less severe decline (32–33%) is seen the Swedish and Polish fisheries in the Baltic. The change in landings of coastal fisheries on the Swedish west coast and in Norway differ from the development in the Baltic see as the levels in 2004–2006 were

81% and 67% respectively of the landings in the 1970s. As in the 1970s, silver eel dominated the Danish and Swedish landings from the Baltic Sea, but the share of silver eel in Danish landing had increased to 70%.

Table 2.c. Coastal landings.

Country code:	NO	SE	SE	SE	FI	LV	PL	PL	PL	DE	DE	DK
EMU/RBD code:		South Coast	East Coast	West Coast		Co	OD	VI	All	SC	WA/OD	
Yellow/Silver/Mix:	Yellow	Silver	Silver	Yellow	Mix	Mix	Mix	Mix				mix
1950	282	1109	911	168		10						4353
1951	312	962	755	212		10						4255
1952	178	791	627	180		10						3748
1953	371	1146	879	353		20						4088
1954	327	1186	780	140		20	156	174	330		840	3587
1955	451	1599	780	272		40	161	246	407		998	4545
1956	293	714	707	112		20	154	184	338			3537
1957	430	1158	856	211		20	173	153	326		907	3422
1958	437	938	642	171		20	142	177	319		851	3109
1959	409	1658	977	154		24	121	196	317		849	3803
1960	430	778	703	165		37	190	214	404		859	4509
1961	449	896	870	300		43	167	160	327		902	3640
1962	356	980	713	215		41	178	169	347		935	3692
1963	503	997	802	272		56	243	140	383		1161	3690
1964	440	1303	749	236		37	248	169	417		974	3059
1965	523	749	768	285		35	206	142	348		626	2992
1966	510	748	893	328		33	232	104	336		769	3479
1967	491	646	703	268		39	259	85	344		706	3193
1968	569	713	794	301		28	272	154	426		550	3960
1969	522	622	733	320		36	283	116	399	205	402	3370
1970	422	476	515	318		21	354	90	444	144	373	3060
1971	415	545	587	259		17	289	67	356	125	281	3012
1972	422	425	582	197		15	337	50	387	147	263	3029
1973	409	419	553	240		19	307	28	335	151	272	3254
1974	368	322	470	242		12	416	96	512	110	312	2651
1975	407	494	629	276		10	436	113	549	124	364	2965
1976	386	283	363	289	19	12	388	152	540	103	302	2698
1977	352	346	340	303	16	10	470	144	614	78	251	2144
1978	347	376	385	315	15	6	520	201	721	63	208	2178
1979	374	267	404	285	16	6	423	242	665	82	208	1748
1980	387	371	438	303	16	1	523	396	919	66	125	1994
1981	369	243	153	491	9	2	550	269	819	75	113	1947
1982	385	342	250	569	9	2	595	207	802	98	95	2215
1983	324	267	171	735	9	1	464	101	565	83	106	1887
1984	310	559	136	378	5	1	426	119	545	51	91	1619
1985	352	647	213	280	5	2	515	205	720	50	67	1408
1986	272	479	138	234	5	1	478	169	647	66	73	1432
1987	282	439	119	250		2	393	146	539	57	56	1099
1988	513	532	190	304		1	395	164	559	70	51	1640
1989	313	447	132	264		1	257	180	437	87	34	1468
1990	336	452	119	242		0	252	158	410	82	41	1461
1991	323	486	181	285		1	232	126	358	84	112	1267
1992	372	534	162	352		0	241	127	368	79	138	1233
1993	340	550	93	438		1	199	95	294	67	131	966
1994	472	654	98	630		0	199	103	302	64	160	1080
1995	454	444	79	555		1	190	104	294	60	118	788
1996	353	564	67	406	1	2	178	108	286	28	107	684
1997	467	546	181	204		1	108	76	184	45	121	719
1998	331	318	50	165		2	127	74	201	19	135	517
1999	447	339	69	186		2	146	100	246	27	142	657
2000	281	286	39	123		2	110	70	180	30	107	600
2001	304	107	123	195		2	122	61	183	29	108	671
2002	311	126	183	222		2	101	34	135	28	98	582
2003	240	115	145	209		2	83	52	135	27	93	625
2004	237	84	134	227		2	82	21	103	17	94	531
2005	249	119	187	211		2,6	190	23	213	17	86	520
2006	293	125	195	227		2	177	14	191	21	91	581
2007	194	126	178	153		1,1	170	11	181	11	76	526
2008	211	110	116	156	13	1	100	12	112	13	71,1	457
2009	69	63	127	101		0,8	74	9,1	83,1	9	64	466

2.6.3 Catches in recreational fisheries

Data on recreational fishing are scarce. There are large differences in characteristics of recreational fishing between countries. Differences concern the type of fishing gear allowed: generally only rods or longlines are allowed. Fykenets are allowed in Germany (limitation on numbers per fisher), Finland, Denmark, Sweden, and Norway. The two latter countries were the only ones that permitted recreational fishers to sell their catch. These countries also demonstrated the highest catch (Table 2.d). However recreational fishing has now been banned in both these countries.

Table 2.d. Estimates and characteristics of recreational fishing for each country.

Country	Country code	Estimate (tons) (NA: not available)	Characteristics of the fishery
Germany	DE	NA	The fish caught is meant for personal consumption only, i.e. selling is not allowed. There are 2 types of licences: 1) angling, 2) 6 fykenets and a gillnet of max. 100 m. Recreational fishing with commercial fishery gears is restricted to coastal waters.
Denmark	DK	100 (interview from 2009)	Mostly yellow eels. Only fykenets are allowed (poundnets are forbidden)
Estonia	EE	<1	Longlines and spears
Finland	FI	NA	Fykenets, longlines, angling, spears
Lithuania	LT	NA	Angling. Traps or nets are not allowed. Not allowed to sell the catch.
Latvia	LV	<1	Needs a fishing permit. Obligation to report catch. Not allowed to sell the catch.
Poland	PL	50 (2009)	Need a fishing permit. Only angling. Not allowed to sell the catch
Sweden	SE	200 (interview)	Prohibited since 2007. Before that: no limitation on fishing gear. Allowed to sell catch.
Norway	NO	100 (average over 2000–2008)	Prohibited since 2009. But before: no limitation on fishing gear. Allowed to sell catch until 6250 Euros/year.

2.7 Other impacts

2.7.1 Anthropogenic factors

The most important mortality factor outside the fishery is probably the mortality caused by hydropower stations blocking the downstream migration routes of silver eel. Few Baltic Sea countries included quantified estimates of this mortality in their EMPs (number or tons of silver eel damaged by turbines). Data on silver eel mortality in hydropower turbines are available from Sweden, Denmark, Poland and Germany.

Table 2.e. Silver eel mortality in hydropower facilities 2004–2006.

Country	Silver eel mortality (tonne per annum)
Germany	24
Poland	64
Sweden	269
Total	357

The mortality passing trough turbines depends on the type and construction of the turbines and size of the eel passing. Recent evidence from Estonia (Narva river hydropower station) indicates that eel might pass turbines successfully (Järvalt, pers. comm.).

There is no quantitative information on mortality of eel due to other factors, such as contaminants and parasites.

2.7.2 Natural factors

Predation by birds (cormorant, heron) and mammals (grey seal, otter and American mink) may affect natural mortality rates of eel.

Two species are frequently mentioned as important factors concerning fishery and fish resources: cormorants and grey seals.

The impact of these species can have two forms:

- direct loss of eel;
- damage to fishing gear and catch.

The cormorant population in the Baltic Sea is estimated at some 175 000 breeding pairs. The growth of the cormorant population has ceased in the southern Baltic Sea, at the coasts of Denmark, Germany and Sweden. However, the nesting population is still growing in the central and northern parts of the region, e.g. at the coasts of Estonia and Finland.

Research data demonstrate daily rations of cormorants can be up to 0.5 kg of fish. The composition of the diet generally reflects the available fish resources on the feeding grounds.

The bulk of prey consists of roach, silver bream and ruff. Usually, the proportion of eel does not exceed 1% of the total diet in weight. However, the impact of cormorants on the eel can still be significant. The total consumption (2004–2006) in Poland, Denmark, Germany and Sweden is estimated at approx. 650 t of eel per year.

The impact of grey seals on Baltic Sea fish resources is estimated at 45 000 t of fish per year. The number of seals increased the last decade to over 20 000 specimens counted by monitoring (Bäcklin *et al.*, 2010). The impact of grey seal on eel is unclear; for Sweden, an estimate of 17 t of eel (probably silver eel) damaged inside coastal fishing gear by seals is given.

Table 2.f. Eel mortality (t) due to predation, Baltic Sea area, 2004–2006.

Country	Mortality of eel (tonne per annum)	
	Cormorants	Grey seal
Denmark	80	
Germany	142	
Poland	30	
Sweden	400	17
Total	652	17

Overall, the information on other (anthropogenic and non-anthropogenic) impacts other than fisheries covers the Baltic stock insufficiently, or remains unquantified.

2.8 Cpue series and stock surveys

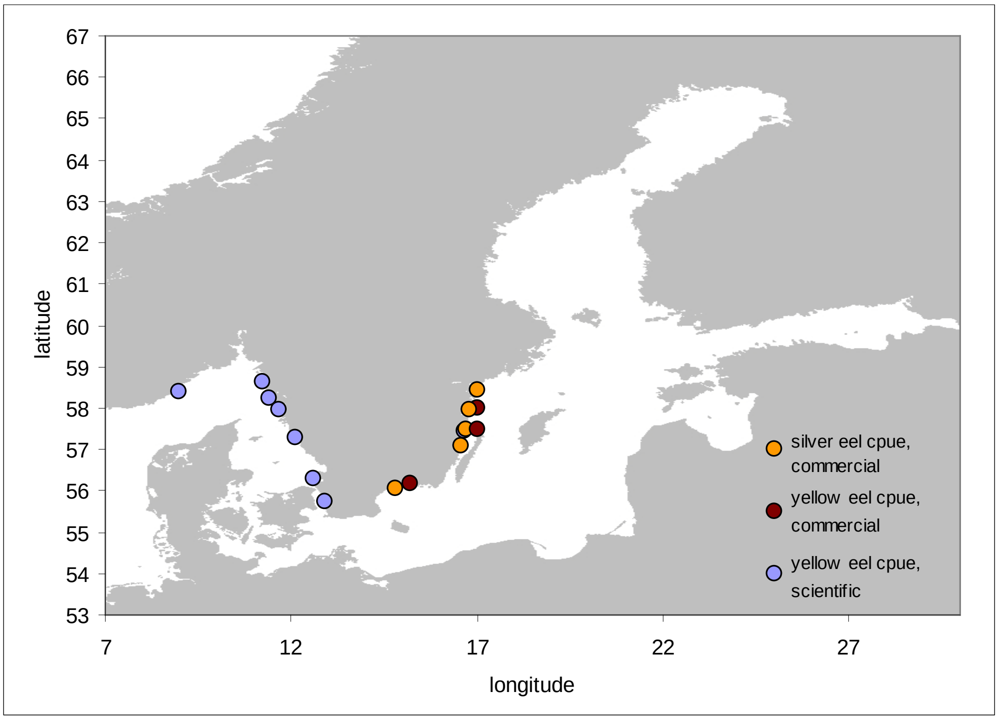


Figure 2.10. Sites with available data on yellow- and silver eel cpue.

2.8.1 Yellow eel

Data on cpue in scientific surveys are available from a long time-series of sampling with beach-seine in several sites on the Skagerrak coast in Norway (Figure 2.10). On the Swedish west coast, test fishing with fykenets started in the late 1970s. New areas were added in 2002 and until 2010 fishing has been performed in six areas (Figure 2.10).

Reliable time-series data on cpue in commercial fisheries are available from fisheries on the Swedish Baltic coast.

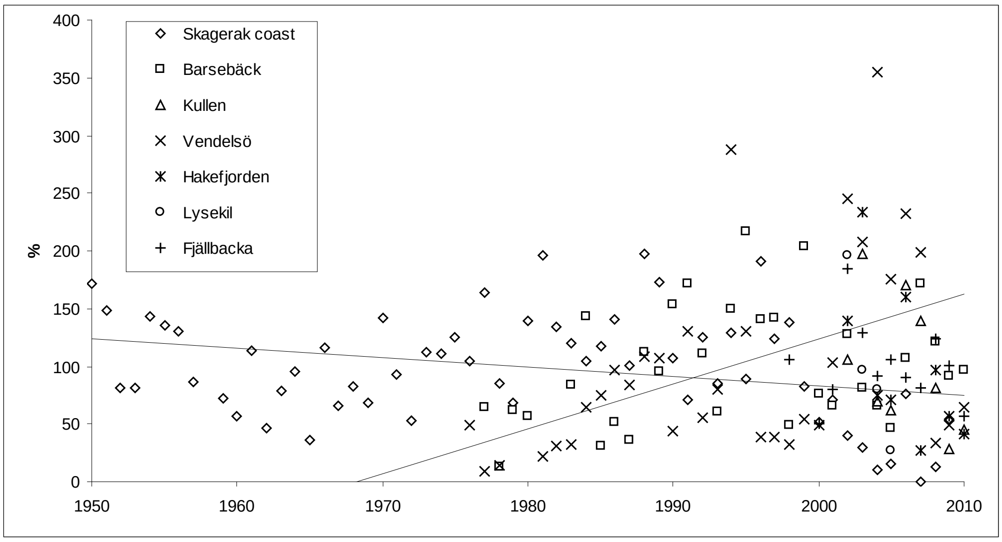


Figure 2.11. Trends in normalized yellow eel cpue in scientific surveys in Skagerrak, Kattegat and Öresund.

Yellow eel cpue on the Skagerrak coast of Norway decreased significantly over the period 1950–2009 (Durif *et al.*, 2010) (Figure 2.11). Until the mid-1990s, catches were on a stable level. From 1996 on, a strong negative trend is evident (linear regression, $p<0.01$). No negative trends were observed in the fykenet surveys on the Swedish west coast. On the contrary, in one area, Vendelsö in the central Kattegat, cpue increased significantly in 1976–2010 (linear regression, $p<0.05$). In the same period, yellow eel cpue at Barsebäck in the Öresund tended to increase, though this was not statistically significant.

Commercial cpue in the yellow eel fishery in the southern Östergötland area in the Baltic Sea using fykenets changed significantly in 1974–2009, when expressed in numbers (Figure 2.12, linear regression, $p<0.05$), but no long-term trend was detected for weight, and no trend was found in either number or weight in northern Kalmar county. Since 1993 though, there is a strongly negative trend in both numbers and weight-per-unit-of-effort in the Kalmar data (linear regression, $p<0.001$). The decline in yellow eel in this period was to a great extent compensated for by an increasing share of silver eel in the fykenet catches in both areas (WGEEL Country Report). A stepwise increase in the legal size limit from 53 cm to 65 cm in the Baltic eel fishery in Sweden has probably contributed to this development.

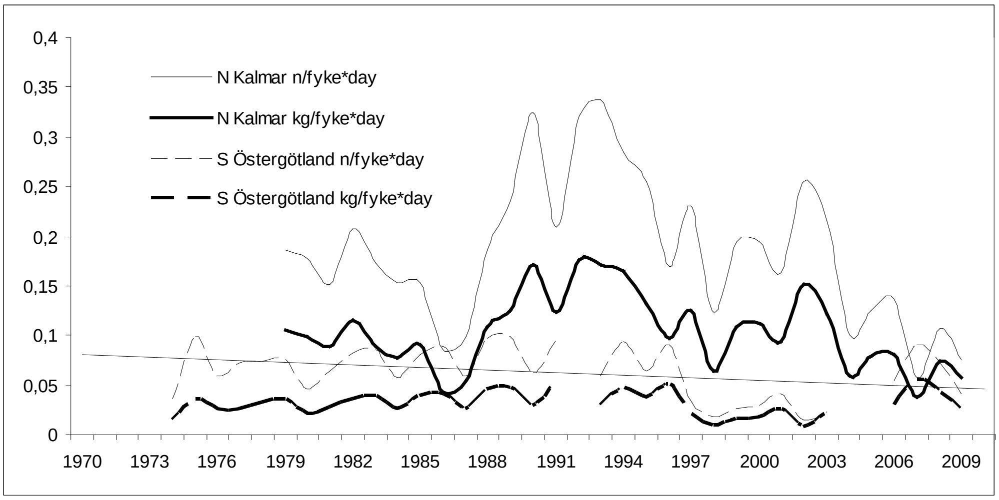


Figure 2.12. Cpue of yellow eel in numbers and weight (kg) in commercial fishing with small fykenets in two areas on the Swedish coast of the central Baltic Proper.

Regional differences in relative abundance with comparable fishing methods reveal considerably higher densities on the Swedish west coast than in the few sites with existing data inside the Baltic Sea (Figure 2.13). Fykenet surveys are rare in this area and commercial cpue of a good quality has so far been hard to find. The single survey in the Baltic Proper was part of an assessment of the fish biomass in a sheltered bay. Eel biomass in the bay was estimated at 1.8 kg/ha (Adill and Andersson, 2004). Commercial data from two areas was obtained by directed actions, asking the fishers to provide information on the total catch, including eel, which is otherwise discarded.

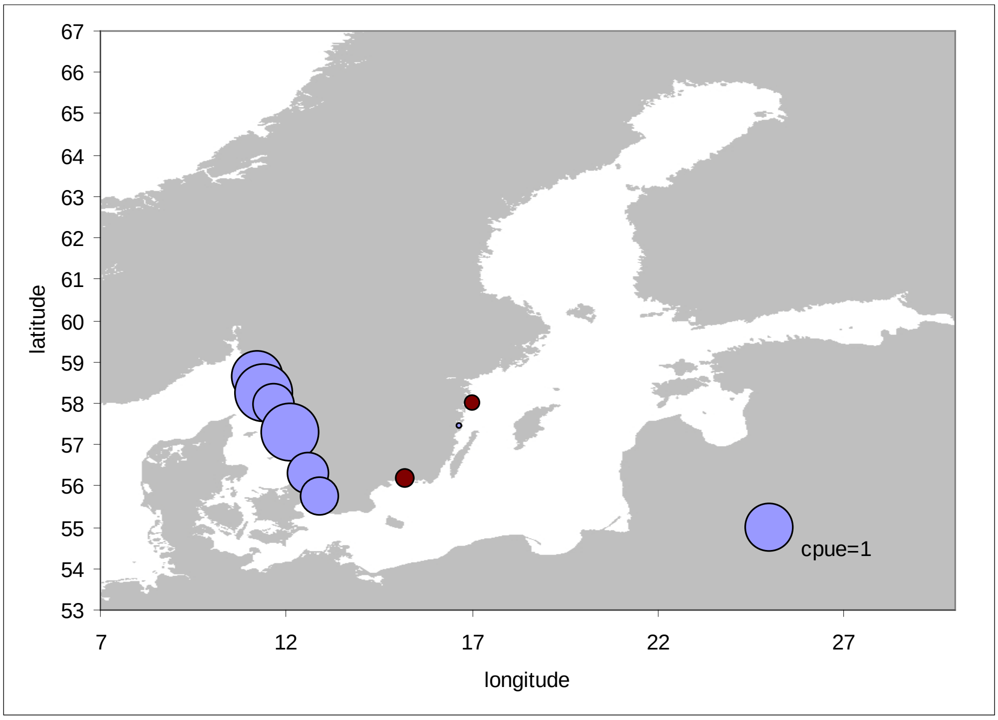


Figure 2.13. Yellow eel cpue in unsorted fykenet catches from surveys (blue) and from commercial fisheries (red) in 2002–2006, expressed as numbers per fykenet and day.

2.8.2 Silver eel

Catch-per-unit-of-effort in the Swedish poundnet fishery for silver eel was obtained since the late 1950s from a selected number of fishers contracted in industrial monitoring programmes. Trends are significantly negative in three out of five time-series, N Kalmarsund, N Kalmar county and N Östergötland (linear regression, $p<0.001$, Figure 2.14). N Kalmarsund and Listerlandet represent individual poundnets fished on the same sites. The other time-series are based on average cpue from a number of fixed sites in the same area. A considerable decrease is observed in two of the longest time-series during the 1960s. A similar decrease was also observed in other parts of Sweden in the same period. Since the 1970s cpue was relatively stable in most areas and in the Listerlandet area cpue was on a historically high level in recent years.

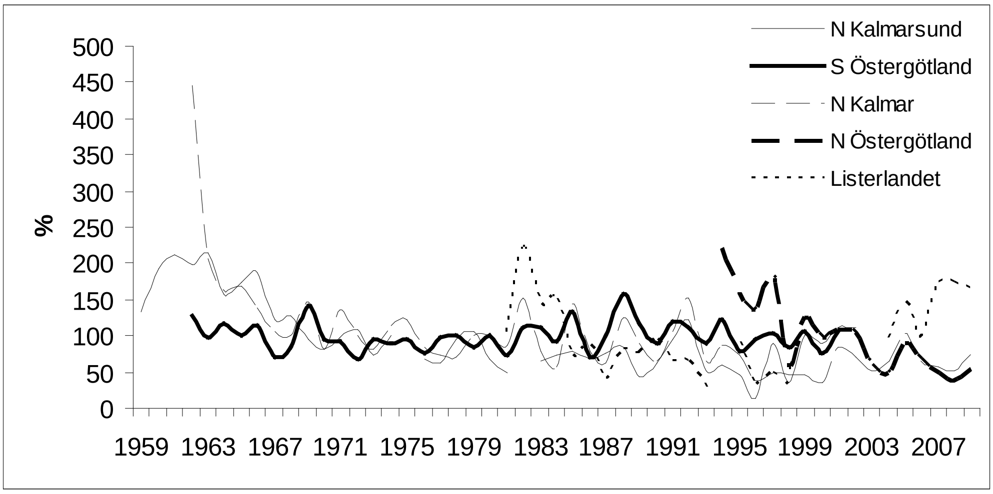


Figure 2.14. Trends in cpue in the commercial silver eel fishery with poundnets in five areas on the Swedish coast of the Baltic Sea. Data have been normalized to mean=100.

2.9 Biological data

2.9.1 Growth

Growth was calculated assuming linear growth and using length and age of silver eels from 34 locations, from five different countries. Age and length values were averaged over the years for countries having data over several years. Maximum growth (80 mm per year) was found in Germany in the Schlei river which is a small eutrophic lowland river. High growths, over 60 mm per year, are found mostly in coastal regions and highly productive areas (Lake Roxen in Sweden). Older eels are found inland in the most upstream locations.

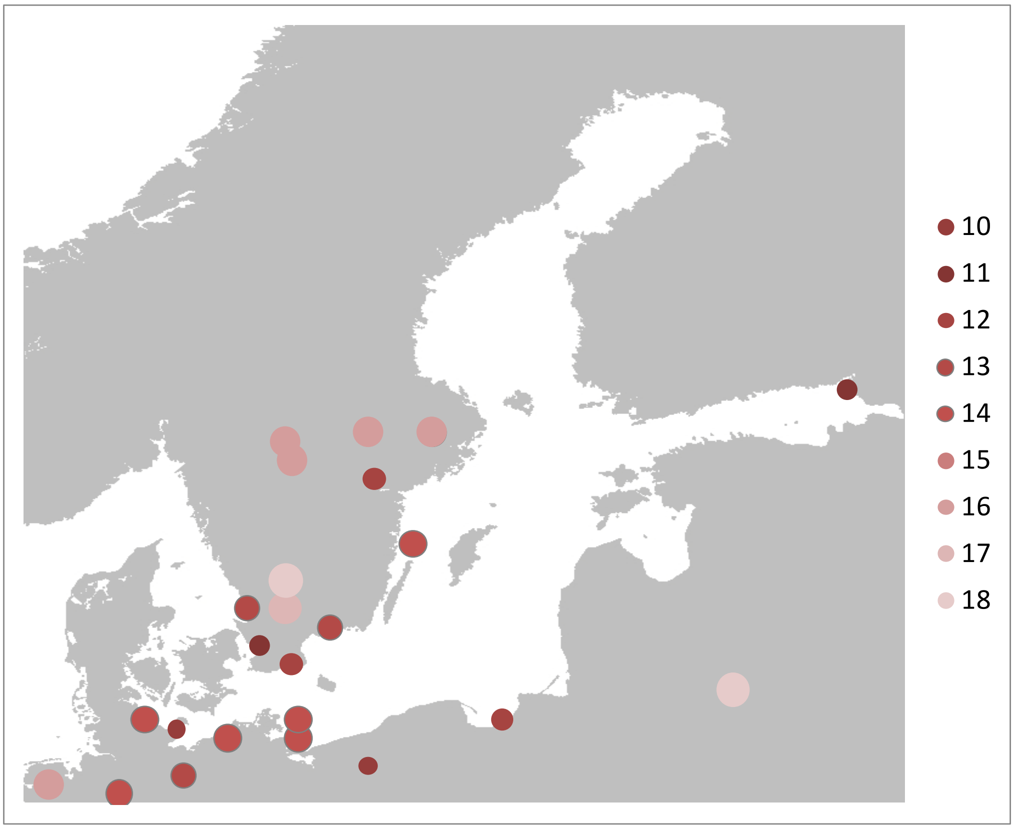


Figure 2.15. Age (y) of female silver eels in Baltic countries.

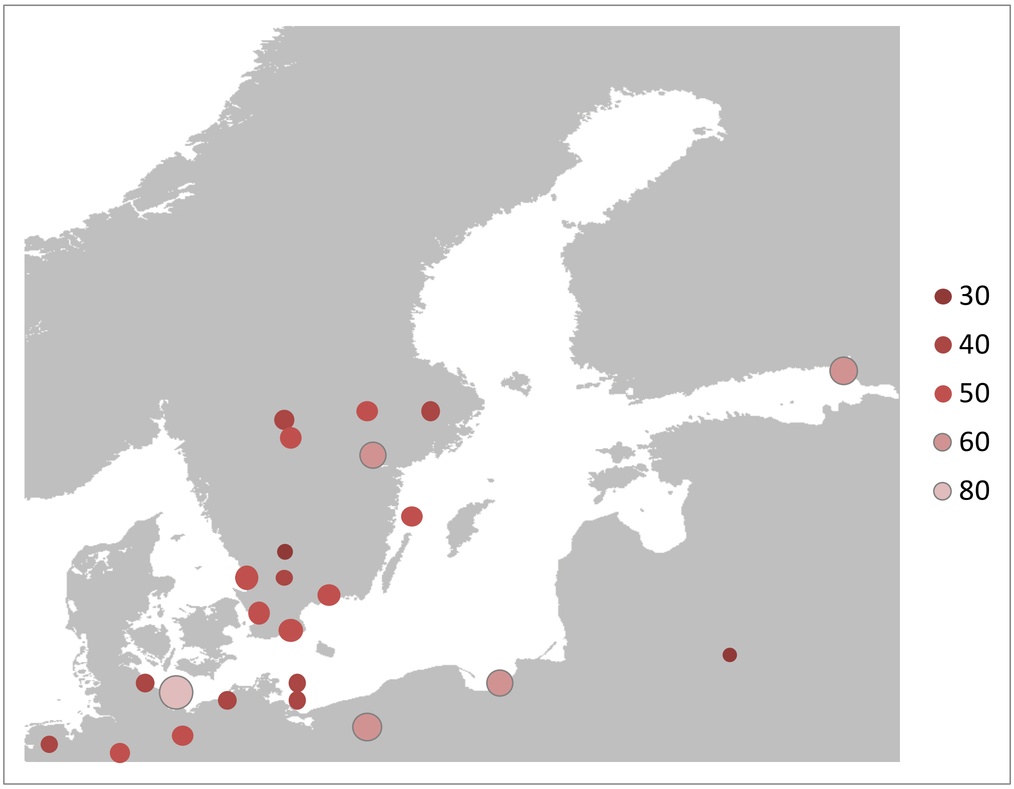


Figure 2.16. Average growth (mm per annum) of female silver eels in Baltic countries (calculated from the final age and length of silver eels).

It was possible to plot age and growth over the years for four locations (three in Sweden and one in Germany). All the locations demonstrated a decrease in growth, while age increases.

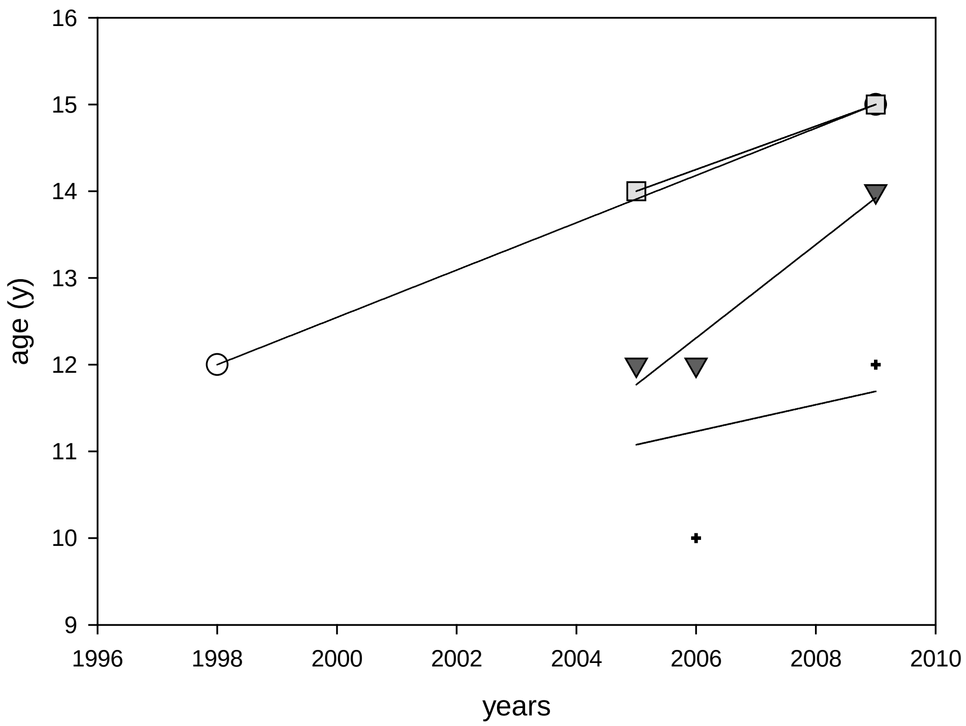


Figure 2.17. Age of eels from Sweden (squares, triangles and +) and Germany (black circles), averaged over the years for which data were available.

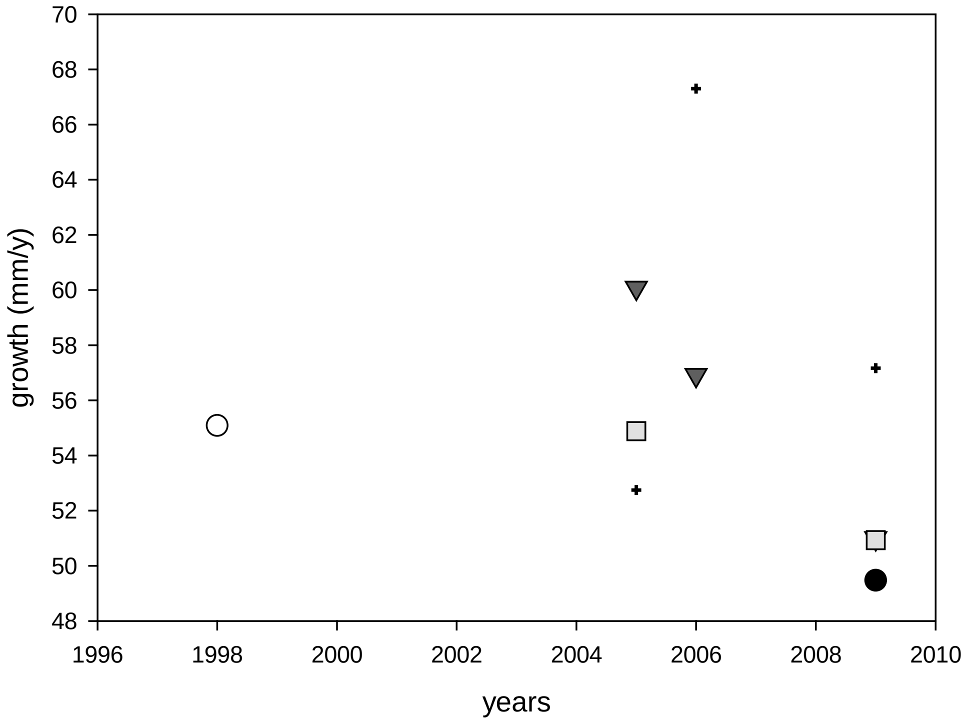


Figure 2.18. Growth of eels from Sweden (squares, triangles and +) and Germany (black circles), averaged over the years for which data were available.

2.9.2 Silver size

Mean body length of silver eels was compiled for 49 locations (in nine countries). There are significantly more females eels in the Baltic than males. Male eels are usually not retained in the catch of fishers because of their small size (Latvia). Nevertheless they are rare in Finland, never been recorded in Estonia, and only present in restocked lake in Lithuania. They are more common in Norway, Germany, Denmark, Poland and Sweden. Lengths of silver eels plotted over the years demonstrate an increase in females, but also in males although to a lesser degree.

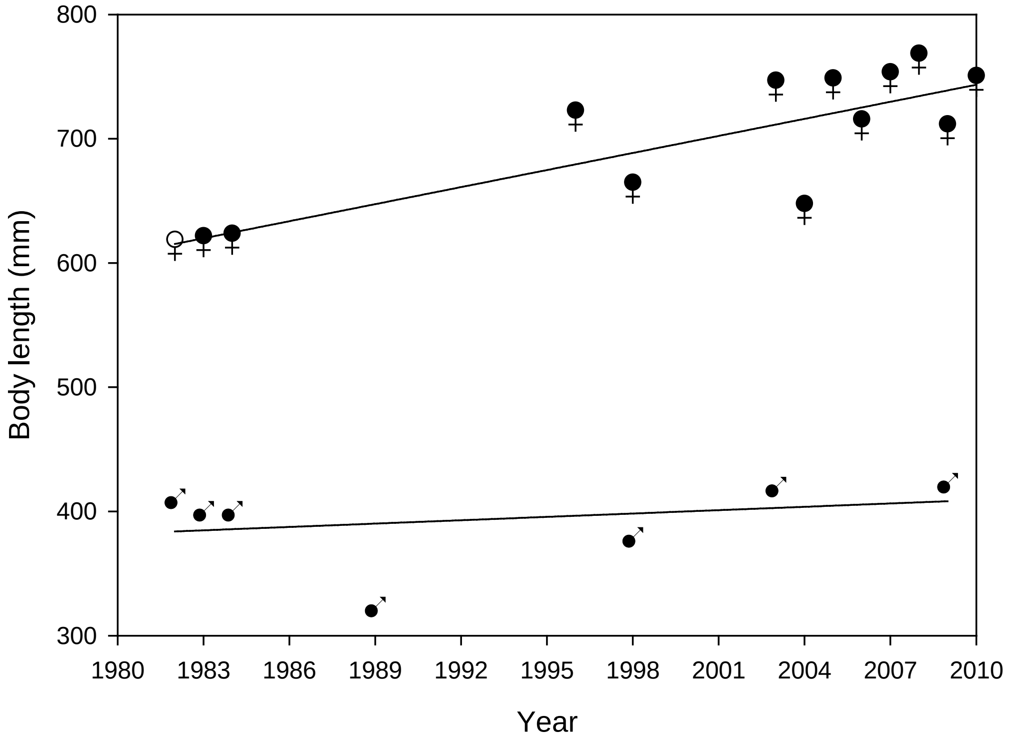


Figure 2.19. Average body length per year of female and male silver eels from 49 locations (in nine countries).

2.9.3 Prevalence of *Anguillicolides*

Prevalence of the swimbladder parasite *Anguillicolides* is higher in the western part of the Baltic and below 70% in the Eastern part. Every country has reported the presence of the nematode *A. crassus*. It is present both in freshwater and brackish water areas. The parasite has also been recorded in restocked lakes.

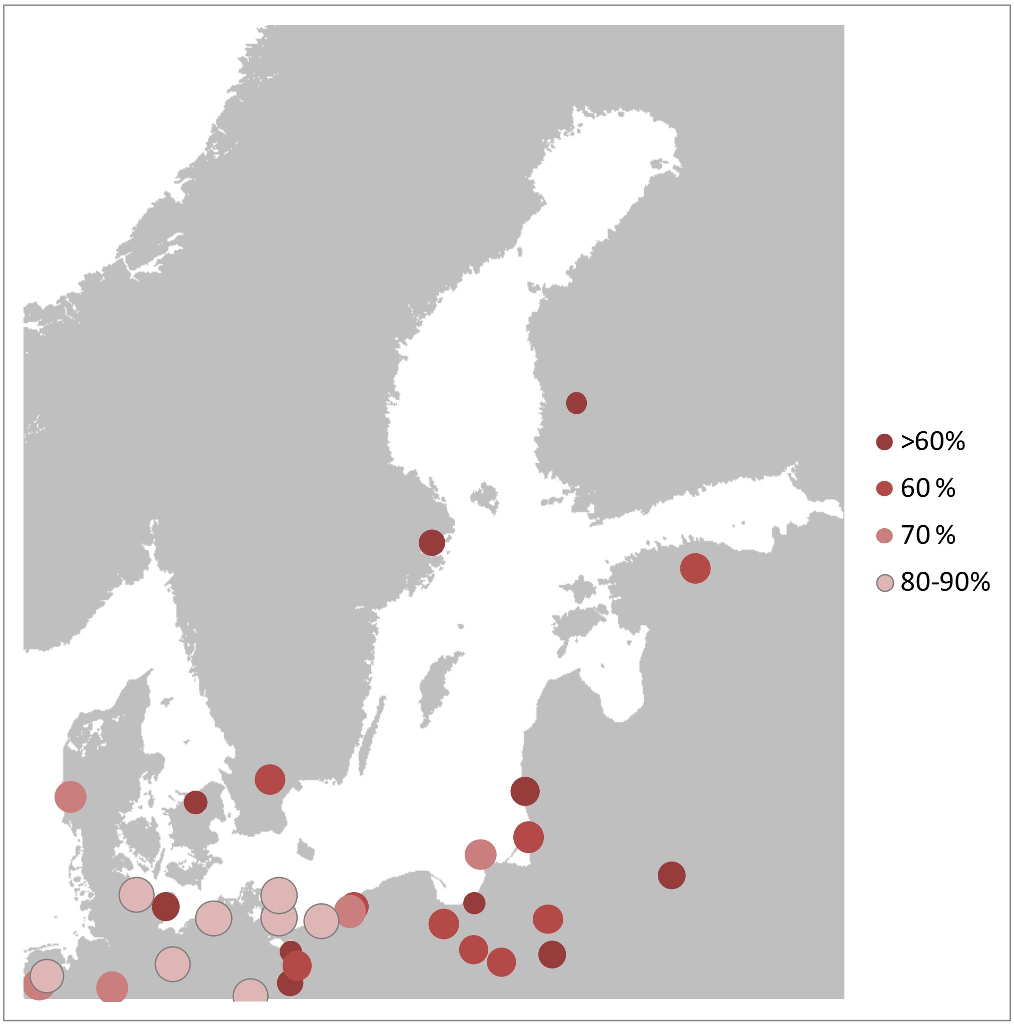


Figure 2.20. Prevalence of *Anguillicolides crassus* in Baltic countries.

2.10 Management measures

An overview of management measures in place or planned in the EMPs of the various countries is shown in Table 2.g below.

Figure 2.21 shows the minimum legal size per country, and where relevant, per region.

Table 2.g. Overview of management measures taken by country.

COUNTRY	STOCKING	ANTHROPOGENIC MORTALITY			MIN. LENGTH (CM)
	Number of glass eel/year, or weight per year	Commercial fishery	Recreational fishery	Hydropower/ pumping stations	
Norway	0	50 tonnes allowed	-100%	No new actions	40
Sweden	2 500 000	73% compared with 2006		-50% by 2015	40/65
Finland	500 000	No action	No action	No action	None
Estonia	740 000	YES	No action (1.2 tonnes per year)	IN PART	35/50/55
Latvia	900 000	No action	No action	No action	40
Lithuania	17 000	YES	YES	No new actions	35
Poland	14 000 000	-25%		- ~30%	50
Germany	increased stocking	YES	YES	YES	50
Denmark	1.25 million (inland) 0.30 million (marine)	-50% by 2013	-50% by 2013	YES	36

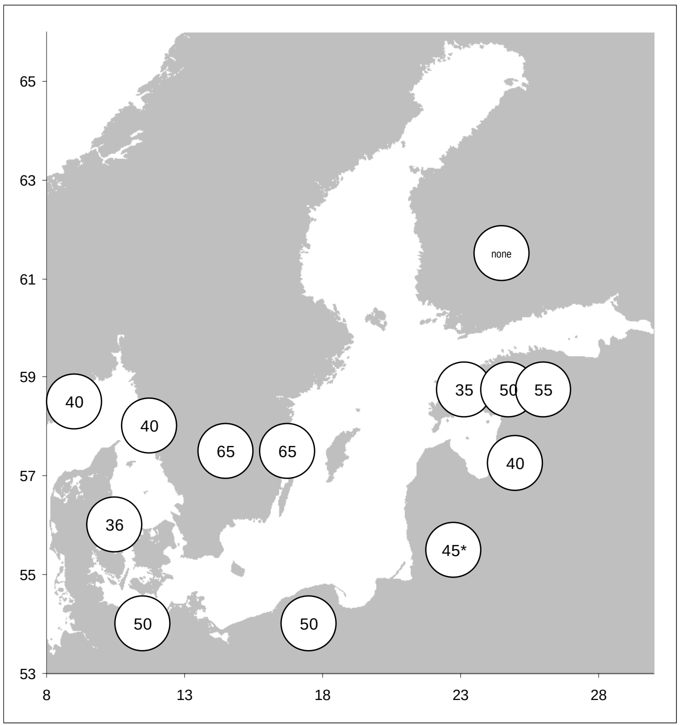


Figure 2.21. Minimum legal size (in cm) applied in the various countries in the Baltic. Where more than a single value is given, a separate value for inland and coastal waters applies. In Estonia, a singular value of 55 cm applies to L. Võrtsjärv only; in Lithuania, 10% of the catch is allowed between 35–45 cm, and longlining and silver eel fisheries have no minimal legal size.

3 Preliminary assessment of the stock status

3.1 Introduction on the preliminary assessment of the stock status

The results of the approaches to assess the size of the stock and spawner escapement from the Baltic waters are presented below. For this purpose the assessment framework developed by the WGEEL/SGIPEE was applied.

The status of the eel stock is described by three indicators:

> $B_{current}$ is reflecting the biomass of silver eel escaping under the conditions of low recruitment and existing anthropogenic impacts.
>
> B_{best} is the biomass of silver eel escaping if no anthropogenic impacts would exist under current conditions, taking the current low recruitment into account. All anthropogenic impacts (barriers, habitat loss, hydropower, fishing impacts, etc) are assumed to have been absent over the whole life period.
>
> B_0 is the pristine biomass of silver eel that would escape if no anthropogenic impacts would exist and recruitment was still at natural high level.

All three B´s are expressed in tons per year (t/a). The SGIPEE framework requires that the 3Bs are estimated for each EMU separately; subsequently, estimates can be integrated at higher geographical integration levels, such as the Baltic region and ultimately the whole European stock.

The basis of this summary was the country reports of the WGEEL Report (2010). Where data were not documented in the country reports, countries were asked to provide estimates in advance of the meeting in Stockholm. However, for five countries no estimates of the three B´s were given. To provide a complete overview for the Baltic Sea the first task was to provide an estimation of the missing values. Using available data in the country reports and the input of participants, an estimation of the 3B´s on country level was conducted. The data in the national EMPs refer to the years prior to the implementation, mostly 2004–2006. Consequently, stock indicators demonstrated in this chapter all refer to this period too. The improvement in the stock status due to the implementation of the EMPs will be assessed in the 2012 post-evaluation. Pending the data collection programmes currently being implemented and the assessment methodology being developed, an update of the stock status indicators is not a realistic option. However, implementation of the recommendations of this workshop, in particular the recommendation to coordinate, standardize and integrate the ongoing data collection and stock assessments, will greatly facilitate the 2012 post-evaluation.

Table 3.a. Available data for estimation of stock indicators, by country.

Country	Silver catch	Yellow catch	Total catch	Anthrop. impacts	Length Freq.	Age Freq.	Restocking
DE			x	x			x
DK	x	x	x				x
EE			x				x
FI			x		x	x	x
LT			x		x	x	x
LV			x		x		x
NO		x	x				
PL			x		x	x	x
RU							
SE	x	x	x	x	x	x	x

3.2 Stock status indicators in the 2009 Eel Management Plans

The estimates of the eel stock in each country are mainly based on the catches in the national commercial fisheries, linked to mark-recapture studies to determine fishery mortality in silver eel fisheries and catch curve analysis for yellow eel stocks. The distinction between yellow and silver eel in the data used for calculation of biomass or numbers of silver eel equivalents is not fully complete and adds to the uncertainty of the given levels.

The fact that countries closer to the Sound and Belt in the exit area of the Baltic also have a greater proportion of eel produced in other areas of the region has implications when basing the estimate of the national production on catch levels in the fisheries, especially the part based on the catch of silver eel.

Denmark and Sweden have surveys of the natural recruitment. These surveys however, reveal trends and cannot be used to describe the absolute numbers recruitment.

Age composition for both yellow and silver eel is available for Poland and Sweden, while Lithuania has for yellow eel and Finland for silver eel. Length composition is available from all countries with age composition as well as from Latvia.

Looking at the estimates of the current catch of silver eel in the Baltic region, Denmark has the highest contribution. According to the calculations, as much as 41% of the silver eel catch in the Baltic region is derived from Denmark followed by Germany with 25%, Norway 12%, Sweden 11%, Poland 8% and the contribution with 1% each from Finland, Estonia, Latvia and below 1% from Lithuania. It should be noted, however, that a large part of the Danish and Swedish escapement is probably derived from yellow eel stocks in other countries; these eels might have been counted twice: once in the country where they grew as yellow eel, and once on their route as silver eel passing the Straits out of the Baltic.

Under the best conditions without anthropogenic disturbances with the low recruitment of today there is a small change in the order of escapement contributions by countries, but still as much as 38% of the silver eel escapement in the region is found in Denmark.

The estimates of the pristine production demonstrates that Denmark produces 48% of the eel in a pristine state Baltic region, 20% in Poland, 12% in Sweden, 7% in Germany, 5% in Estonia and Norway respectively, 2% in Latvia and 1% in Finland and

Lithuania respectively. However, the problem of double-counting noted above, might have an even bigger effect on the estimates of pristine production.

The conclusions to draw from the estimates of the biomasses of silver eel escapement in the region, current as well as pristine, is that the current estimates, not taking into consideration the problem of double-counting, may give a skewed picture of the real production by country. The recommendation is to find better ways to estimate the biomass of silver eel that do take into account the serial impacts on yellow and silver eel.

Until more reliable sources for the pristine silver eel production have been identified for the Baltic region it is unclear how the 40% level of silver eel escapement of pristine conditions can be identified. Updated estimates will be required and until a better estimate of the pristine production of the region is known, the escapement estimates must be interpreted as conservative that is, over-optimistic estimates.

Table 3.b (below) summarizes the 3Bs indicators per country, used in the analyses in this report.

3.3 Stock status indicators for the remaining countries

Eel stock assessment for all Baltic countries is based on the estimation of B_{curent}, B_{best}, B_0 (3Bs).

Estimates for the 3Bs were presented for SE, DK, DE, PL, but NO, FI, EE, LV and LT did not provide ready calculations, RU did not attend the meeting and did not provide the information on the stock and fisheries. In this section, an attempt is made to fill in the missing estimates. The main problem is lack of length and age frequencies data from the countries which haven't estimations of the 3Bs. The best available historical and current data on the stock and fisheries were used for the calculations.

Table 3.a summarizes the available data. All countries, except RU, provided long time-series for total commercial landings, but only SE and DK have data on yellow and silver landings separately. Data on anthropogenic impact (cormorants, hydropower station and other impacts) were available for DE and SE only.

SE has comprehensive length–age frequencies data, some countries provided length frequencies data (FI, PL, LT, LV), while age frequencies data are available for PL, some data for LT and very few for FI.

Restocking data are available for DE, DK, EE, FI, LT, LV, PL and SE. Norway is not restocking eels.

Some data are available only for recent years, e.g. Denmark provided data on yellow and silver eel landings only from 2000, while Norway provide data on yellow eel and total landings from 1950. Most countries lack historical data on age and length frequencies. Evidently, there is a need to start collecting comprehensive and standardized data on anthropogenic impacts in all Baltic countries.

Due to missing data from RU, errors might occur for estimations of PL and LT 3Bs because these countries share and exploit coastal lagoons with RU. In addition, it is not clear, what is the RU contribution to the whole Baltic eel spawning stock from countries territory.

3.4 Stock status indicators for the whole Baltic stock

Table 3.b (below) summarizes calculations of 3Bs indicators of the eel stock for all Baltic countries except Russia which did not provide data on eel stock or eel fisheries. SE, PL, DE and DK provided 3Bs calculations, while values for FI, EE, LV, LT and NO were calculated during the meeting using the following assumptions and aiming to generalize the calculations in cases of missing length frequencies and age frequencies data:

- Data on current (2004–2006) and historical (the best data available prior 1980 when the stock was in good condition) eel fisheries landings were used.

Calculations of $B_{best\ and}$ B_0 followed the approach presented for Denmark, where fishery landings are used to estimate the pristine silver eel biomass. In our case, we needed to find a simplifying estimation approach that fits to the available database provided by the countries. For calculating B_{best} the period of 2004–2006 was used as the reference. In the case of B_0 the most appropriate historical time-series was used. If the catch composition by stage (yellow/silver eels) is unknown, it was presumed that 25% of caught eels are at silver eel stage and 75% at yellow eel stage (historical data for (historical and current data for EE, historical data for LV and LT).

Following formulas entered the calculation approach:

B_{best} = ((Yellow landings * F^{-1}) * cF) + (Silver landings * F^{-1})

Yellow and Silver landings are the averages of 2004-2006 registered eel landings for commercial fisheries

F (fishery mortality) = 0.5

cF (converting factor of yellow eel weight to silver) = 1.5

The estimation of $B_{current}$ for Baltic countries with missing length and age frequencies data was based on the ratio of $B_{best}/B_{current}$ as averaged over the other countries that did provide estimates of 3Bs (DK, SE, DE, PL) and was calculated as follows:

$\sum$A= $B_{current}/B_{best}$= 0.78.

Using $\sum$A=0.78 and estimates of B_{best} for FI, EE, LV, LT and NO, $B_{current}$ was calculated for each country as follows:

$B_{current} = B_{best}/0.78$

B_0 = ((Yellow landings * F^{-1}) * cF) + (Silver landings * F^{-1})

Yellow and Silver landings are the averages of the most appropriate reference period registered eel landings for commercial fisheries

F (fishery mortality) = 0.5

cF (converting factor of yellow eel weight to silver) = 1,5

The current escapement as a percentage of the pristine escapement was calculated as follows:

%SSB = 100 * $B_{current}$ / B_0.

The current escapement as a percentage of the now best possible biomass was estimated as follows:

%SPR = 100 * $B_{current}$ / B_{best}.

The lifetime anthropogenic mortality, as an instantaneous rate was estimated:

$$\Sigma A = -\ln(\ \%SPR/100\ ) = -\ \ln(\ B_{current}\ /\ B_{best}).$$

Lifetime mortality ΣA for the whole Baltic Sea and each Baltic country is plotted in a Modified Precautionary Diagram (Dekker 2010; ICES 2010a,b). Because of the quality of the data and the associated uncertainties for certain countries only the precautionary diagram for the complete Baltic Sea is given. The presented precautionary diagram (Figure 3.4.1) indicates that current harvest level is not sustainable and the full reproductive potential is not achieved under current recruitment level and the anthropogenic impact factors.

Table 3.b. 3Bs for all Baltic Sea countries (except Russia).

	SE	PL	DE	DK	FI	EE	LV	LT	NO	RU	TOTAL
Bcurrent	546	424	1280	2066	27	77	4	40	607		5072
Bbest	848	679	1608	2745	35	99	6	51	779		6849
B0	1992	4624	1738	11 110	159	1375	153	127	1218		22 490

Estimates of the $B_{current}$ and B_{best} indicate that the habitats situated in southern and western parts of the Baltic contributes most to the spawning stock (SE, NO, DK, DE and PO, Figure 3.4.2–3.4.4), while northeast area much less (LT, LV, EE, FI). Estimations of the B_0 indicate similar distribution of stock abundances, except EE might have large stock in the marine waters under pristine conditions.

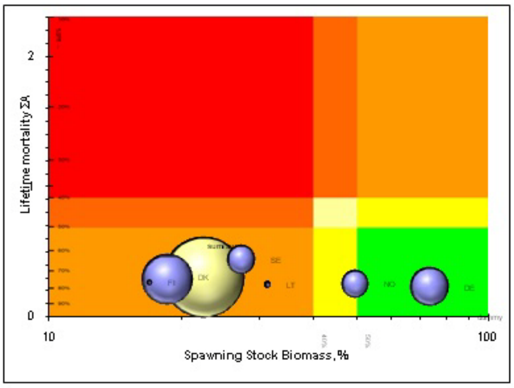


Figure 3.1. Precautionary diagram for the complete Baltic based on the stock status indicators estimated in national EMPs, supplemented by preliminary estimates for those countries where no information was available. The estimates are mostly based on data referring to 2004–2006, i.e. before the EMPs were implemented. Note that data might be incomplete, inconsistent, or false; though problems are known, no corrections have been made.

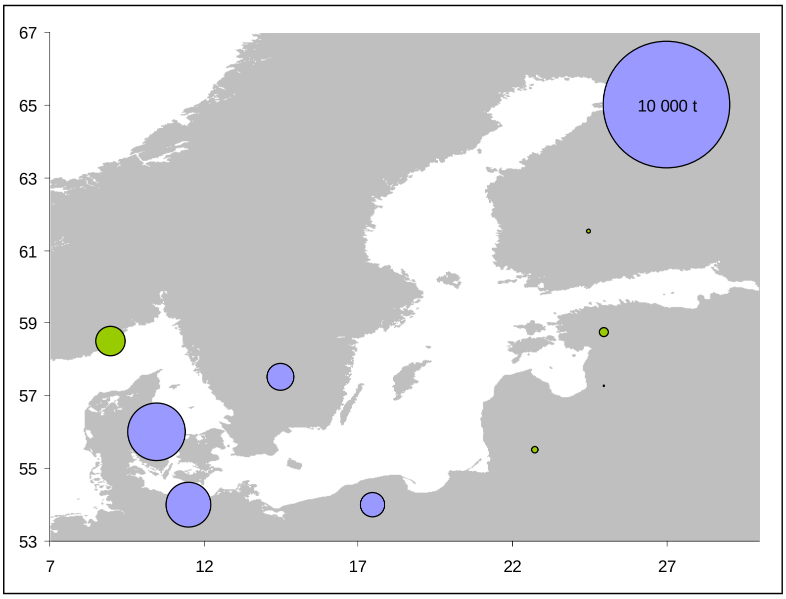


Figure 3.2. B$_{current}$ for the whole Baltic stock.
Blue: estimates from national EMPs or Country Reports (ICES, 2010b); Green: working group estimates.

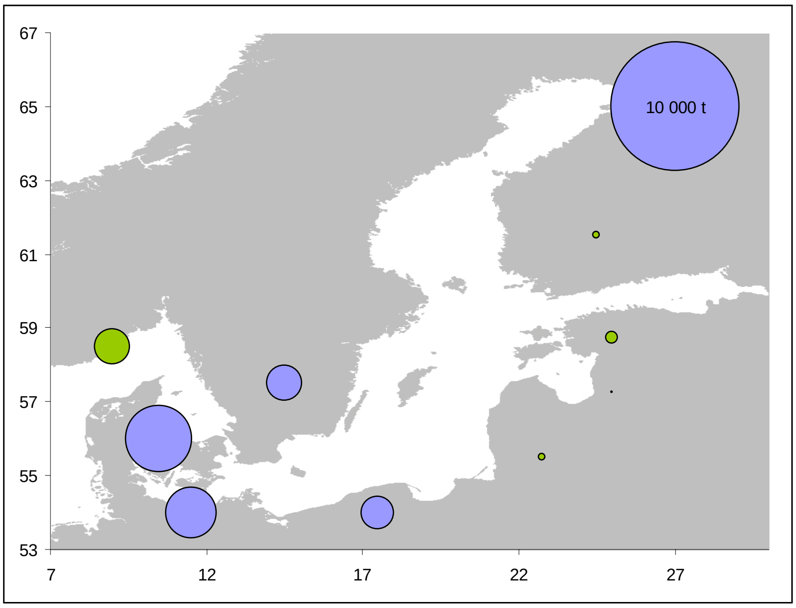


Figure 3.3. B$_{best}$ for the whole Baltic stock
Blue: estimates from national EMPs or Country Reports (ICES, 2010b); Green: working group estimates.

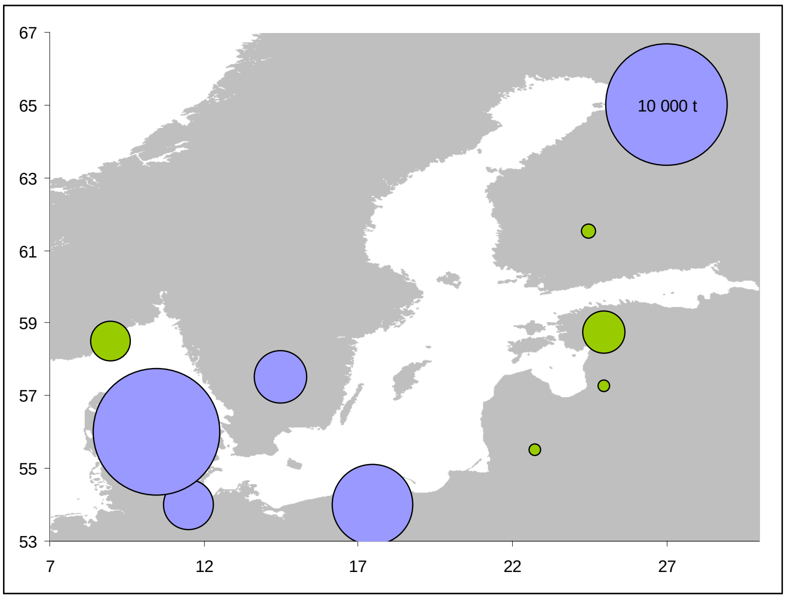


Figure 3.4. $B_{pristine}$ for the whole Baltic stock
Blue: estimates from national EMPs or Country Reports (ICES, 2010b); Green: working group estimates.

3.5 Stock status indicators and restocking

The critical status of the stock has been indicated by both the declining recruitment and the decline in the commercial catch. The decline in recruitment to the stock in the Baltic is demonstrated, but is not as easily interpreted as the eels do not have an equally sharp arrival time as in other parts of the distribution. The trend in the commercial catch over time in the Baltic might be more difficult to interpret, because large restocking programmes have been executed over the decades, which might have kept stock and catch at unnatural high levels. In some cases, as in Germany, these restocking programmes have been undertaken since about the year 1900. Since the 1950s it is estimated that some 2 billion individual eels of various sizes have been restocked into the Baltic Sea drainage, which has resulted in considerable augmentation of the natural stock (e.g. the current stock in some areas can be larger than the small natural stock, resulting in negative estimates of total anthropogenic impacts; see ICES, 2010a,b).

The stocking practices have varied between countries where some countries have stocked their coastal waters, though most have stocked inland waters. The catch figures show, however, that even where mainly the inland waters have been restocked, the coastal water catch figures may remain high over a long period. It appears that for the states along the eastern Baltic, the inland catches have become more dominant in recent times, while the Swedish catches in the Baltic Sea proper mainly come from migrant silver eels.

Otolith microchemistry has revealed that 20% of the eels inside the Curonian lagoon are restocked eels, but outside the lagoon only 2% are restocked. The proportion of restocked eels approaches near 100% in many areas, and upstream of impassable obstacles, the whole stock must have been derived from restocking. The large-scale eel fishery along the Swedish southeast coast on migrating silver eels probably is a mix of naturally recruited and restocked eels.

Due the longevity of the eel, these Baltic Sea restocking efforts have created long lasting effects on the catch data. As stockings have not been coordinated between neighbouring states, one can expect overlapping effects from a multitude of restocking on catch series downstream. We note in particular that the catch data on silver eels in Denmark and Sweden have been inflated by the abundant restocking efforts elsewhere, but to an unknown extent.

Historical catch data from the Baltic must be used with special care in management decisions due to poor or suspect quality. The catch dataseries from many parts are affected by restocking since the early 1900s. If used at face value, it will be hard to set realistic management targets.

The restocking efforts have helped the eel fishery to survive. Due to the very sharp decline of natural recruitment in recent decades, it is unlikely that there would have been a much smaller viable fishery left. The masking of the decline by restocking has lead to a reduced awareness of the critical situation in some cases.

We recommend that monitoring efforts focus on natural recruitment of eel specimens smaller than a given size, as the restocked eels will continue to influence catch statistics for a long time; and that special consideration is given to the effect of restocking on management targets and stock indicators.

3.6 Conclusions on preliminary assessment of the stock status

Regarding the available eel fishery time-series we have identified several weaknesses of the data both in quantity and quality. First, only a few countries include data from before World War II. Second, the separation of the landings in a silver and yellow fraction was only available from few countries. Both these points indicate that the definition of a standardized reference time period for calculating the pristine silver escapement is nearly impossible.

Based on the quality of the available time-series, providing the basis of the calculation of the 3Bs (B_0, B_C, B_B) it was suggested that a fishery-independent calculation approach should be preferred. According to the estimated values of the B_0 for the different states around the Baltic Sea it could be concluded that different regions of the Baltic Sea contribute in a different degree to the overall silver eel production. For example, it is known that Danish coastal waters have a higher potential silver eel production compared with the coastal waters of Finland and northern Sweden. This is primarily caused by the primary production, length of the growing season, and other factors. At the same time, it is unclear to which proportion the silver eel catches along Danish Baltic coast originate in Danish waters.

One aspect that needs to be considered in the calculation of the potential silver eel production is the distribution of the incoming glass eels (or bootlace eels). Are these equally distributed in the Baltic or do they settle down in a downward trend (eel density) from the southwest to the northeast?

By defining the potential silver escapement for certain habitat types, the total silver eel production can be calculated from the total surface area of the specific habitat type. For the estimation of the current silver eel production different monitor or calculation approaches exist around the Baltic.

It is crucial to take into account the effect of stocking in the calculation of the current silver eel escapement. Some of these approaches are already available as fishery-independent silver eel escapement monitoring or coastal eel monitoring.

However, the calculated biomass indicators (the "3 Bs") for each country as well as the whole Baltic do indicate that the eel stock has dramatically declined in the Baltic too.

4 Interactions between countries

4.1 Introduction on Interactions between countries

Interactions between countries exist in various forms. In this chapter, two variants will be discussed. First, there are a number of lagoons, located on the border between two countries. All management actions in these areas will affect the stock and fisheries of both the countries involved. Secondly, eels do cross from one management unit into another; in particular, silver eel migrate from their feeding grounds through the Straits towards the Ocean, and fisheries in the Straits thus affect the net escapement from the feeding grounds elsewhere.

4.2 Shared lagoons

4.2.1 Szczecin Lagoon

Poland and Germany sharing Oder RBD initially had a discussion on a ministry level about establishing transboundary Oder Eel Management Plan in 2012, which would include the Szczecin Lagoon. Common main activities should cover areas of scientific cooperation about monitoring of ascending eel, as well as silver eel escapement.

4.2.2 Vistula Lagoon

During the last session of the Polish–Russian Joint Fishery Commission, the subject of eel stock management was shortly discussed, and agreed that cooperation between scientists should start during one of the common working groups. That topic is extremely important in case of Vistula Lagoon, where intensive Polish restocking is planned, and without the same management measures 40% escapement target might not be achieved.

4.2.3 Curonian Lagoon

During the last sessions of the Lithuanian–Russian Joint Fishery Commission, the subject of eel stock management was discussed. The Russian side proposed joint restocking measures in the Curonian Lagoon, but they did not provide plans for management measures meeting the criteria of the EC regulation, to protect and achieve 40% silver eel escapement. Lithuanian argued that plans to restock and intensively exploit eel stocks are not in agreement with the current alarming European eel status in the whole range of distribution; therefore management measures for appropriate silver eel escapement must be planned prior or in accordance with the restocking planning. However, the Lithuanian EMP prioritizes restocking of inland lakes in Lithuania first, while the restocking of the Curonian Lagoon is not planned in the near future due to precautionary approaches and reasons listed in the EMP.

4.3 Silver eel fisheries

The impact of silver eel fisheries around the outlet of the Baltic Sea on the total stock is foremost quantified by means of tag-recapture studies: silver eels are being tagged in or close to their feeding grounds and released; tags being recaptured near the outlet, then provide quantitative information on the impact of the silver eel fisheries.

4.3.1 Tags released and recaptured

The compilations of historical tagging experiments and observed recaptures are presented by country in the following maps (Figure 4.1–4.5). The release points are shown as circles with a diameter proportional to the number of tagged eels. Individual recaptures are shown as red dots.

Figure 4.1. Release and recapture of silver eels from Estonia.

Figure 4.2. Release and recapture of silver eels from Finland.

Figure 4.3. Release and recapture of silver eels from <u>Germany</u>.

Figure 4.4. Release and recapture of silver eels from <u>Poland</u>.

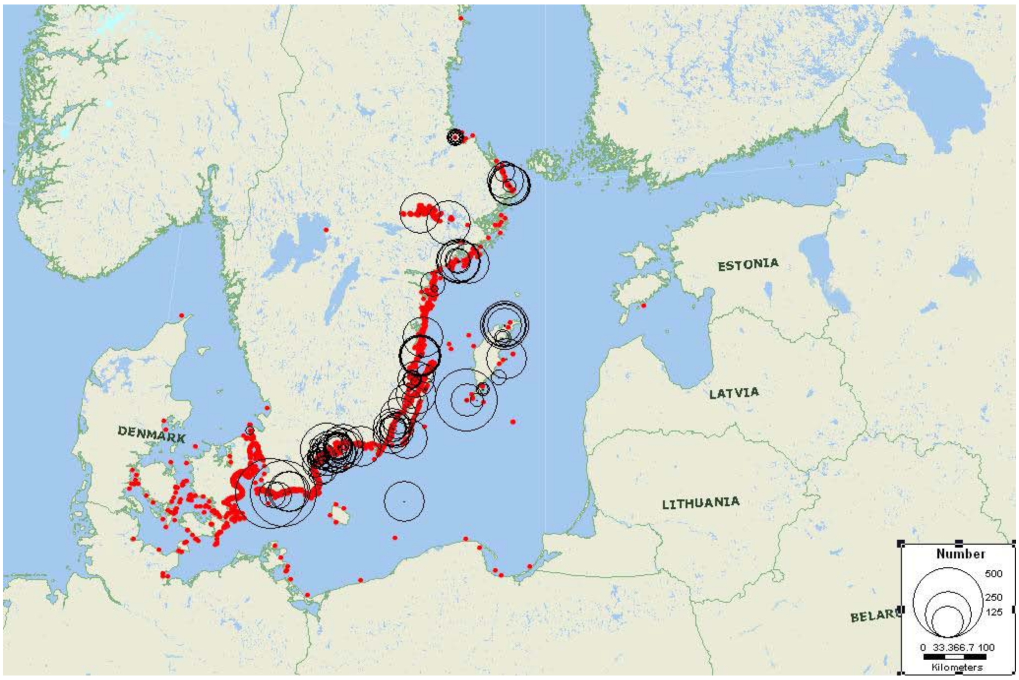


Figure 4.5. Release and recapture of silver eels from Sweden.

4.3.2 The impact of fishing

The tagging studies compiled in Table 4.a demonstrate that tagged and released silver eels are mainly caught in the country in which they were released, but as well in other countries on the migration route toward the North Sea. Catch rate averaged 35% during the period 1904–2010 and most recaptures are in Sweden and Denmark. The Danish fishery is the last major silver eel fishery on the migration route out of the Baltic and the Danish fisheries tend to capture about 15% of the eels released in Sweden which fits well with the 19% catch rate in the local Danish tag recapture study in 1996 (Pedersen and Dieperink, 2000). The catch rate of silver eel released in FI, PL, EE recaptured in other countries is 9% (Denmark 2%, Sweden 5%, Germany 1% and Estonia 1%).

4.3.3 Effect of sequential impacts on estimated stock indicators

All catch rate values based on tagging are biased downwards because of tagging mortality and because the recapture reporting is rarely 100%.

The information available from historical tagging studies is summarized in Table 4.a.

Table 4.a. Basic tagging data available for calculation of catch rates of silver eel. The grey rows are not considered as these do not represent pure silver eel tagging.

	Release					Recapture								
Row number	Country	stage	Tagging method	Year	Release	total	In release country	DK	DE	SE	RU	ES	PO	NA
1					n	n	n	n	n	n	n	n	n	n
2	FI	S	Silver plate	1939	115	24	2	1		6		15		
3	FI	S	Carlin	1975	5	0								
4	PI	S	Carlin	1986	552	49	6	21	7	15				
5	DK	S	Carlin	1996	1198	227	227							
6	FI	S	Silk thread	1903-04	327	10	2	1	0	7				
7	ES	S	Silver plate	1937-39	724	126	54	12	5	52			3	
8	SE	S	in and silver plate	1903-2008	23485	9831	8214	1539						78
9	DE	S	External tag	1959	2835	79	19	27		33				
10	ES	Y	Carlin	2008	237	21	20	1						
11	PI	Y&S	Floy tag	1994	5050	1166	1145	7	1	3	10			
12	ES	Y&S	Carlin	2006-2010	766	122	119	2	1					
13	Sum for all releases (only silver eel tagging included)				29241	10346	8524	1601	12	113	0	15	3	
14	% for all releases					0.35	0.29	0.05	0.00	0.00	0.00	0.00	0.00	
15	Sum for Fi, PL, ES, releases				1723	209	64	35	12	80	0	15	3	
16	% for Fi, PL, ES, releases					0.12	0.04	0.02	0.01	0.05	0.00	0.01	0.00	

The historical data lead to the following conclusions:

Based on Row 5:	Danish silver eel are not caught by other countries.
Based on Row 5:	the Danish fishing rate on silver eel is 227/1198=19% on Danish silver eel.
Based on Row 8:	Swedish silver eel are also caught by Denmark.
Based on Row 8:	The fishing rate in Denmark on Swedish silver eel is 1539/23485=7%.
Based on Row 14:	The catch rate is 35% of Swedish silver eel at sea of which 34% is by Denmark and Sweden.
Based on Row 16:	The catch rate of FI, PL, EE silver eel by other countries is 9% (Denmark 2%, Sweden 5%, Germany 1% and Estonia 1%).

The above data are rather variable, span considerable periods, and may be difficult to apply to the post-EMP period. The silver eel fishing effort in both Denmark and Sweden has decreased substantially in recent years (ICES, 2010b) although it is uncertain whether fishing mortality have decreased to a similar extent. Some time-series of cpue seem not to display any decline.

The Swedish data are by far the most comprehensive and these data should be explored more in terms of time-trends and geographical position to recapture fishing.

However, it is certain that new tagging studies are needed especially in east Baltic areas where historically very few tagging have been done, to get estimates of catch rates in Denmark and Sweden of the escapement from this area.

4.3.4 Differential impacts on natural and restocked eels

The orientation mechanism used on the spawning migration is unknown. Tagging experiment with eel stocked as cultured "bootlace" eel in a lake on the island Gotland in the Baltic (Westin, 2003) demonstrated aberrant behaviour of the silver eel compared with eel from the mainland fishery. The spread of recaptures was larger and a relatively large part of recaptures were made a year after the release.

Westin interpreted that the stocked eels lacked an imprinted route to follow on the return migration. If this was the case, then stocking would not contribute to reproduction of the eel, and would have no value as a management instrument for recovery of the stock.

This type of experiment has not been replicated. Analysis of conventional tagging data as well as otolith analysis of eels leaving the Baltic did not verify the conclusion by Westin (Sjöberg and Peterson, 2005); because almost all of the tagged eels migrated in an expected direction towards the outlet in the same year they were released (Sjöberg and Peterson, 2005). But the origin of those tagged eels was unknown.

Unless new knowledge arises the precautionary conclusion is that stocking cannot be used to compensate for anthropogenic mortality. As stocking is a prominent part of many eel management plans, well designed tagging experiments should be a priority to resolve this question.

4.3.5 Requirements for future tagging programmes

The following issues can be addressed in tagging studies.

1) Distribution of each countries eels in the outlet straits;
2) Distribution of each countries eels between SE, DE and DK catches;
3) Estimate of total escapement from the Baltic, if possible by country;
4) Yellow eel population size by country;
5) Accumulated mortality until escapement by country.

Due to the restrictions imposed by the management plans there is a high risk of underreporting of conventional tags. The attitude among fishers varies, some are still willing to cooperate by reporting recaptures of tagged eels whereas other clearly state that they are against all cooperation. The magnitude and geographic distribution of mis- or underreporting is unknown and can't be corrected for in the analysis of conventional tagging with external tags. This means that other techniques should be considered too.

The relative proportion of escapees by country taking different routes through the Baltic exits (question 1) can be found using acoustic ID tags and arrays of listening buoys in the Sound and Danish Belts. Implantable ID tags are now available with an active life of more than a year at a cost of approximately 300 € per tag. Recording buoy arrays have been tested in the Sound successfully and an installation is already in place in Femern Belt. A permanent array system covering the Baltic outlets is feasible and can have general use for migration studies of other species too.

Data from such a system may reveal the total mortality during the Baltic phase of migration by country and answer question 3 if estimates of the total stock of silver eels in each country are available.

The acoustic tag data can also be used to estimate the distribution of eel catches in the outlets with origin from different countries (question 2), given historical and present data on fishing pressure in DE, DK and SE.

A programme of PIT (Passive Integrated Transponder, miniature glass-encapsulated tags that can be implanted permanently in even small yellow eels) tagging of yellow eels in all Baltic countries combined with a screening of all eels passing through the large eel merchants will if implemented on a large scale and run for a sufficient time give data that can be used to answer question 4 and 5. In addition this will also be useful for elucidating possible differences between stocked and naturally immigrated eels. Before such a programme is started and implemented, a feasibility-study and power-analysis will be required, to determine what number of tags is required and what quantities of catches need to be scanned.

PIT-tags can also be a complement or alternative to conventional external tagging of silver eels. Detection of a tag in the delivery to an eel buyer will not give precise data on recapture site or date, but the general area of recapture will be known and in some cases the tag may be traced back to a specific landing. Double tagging with PIT and external tags can give data on intentional or unintentional external tag loss.

4.4 Conclusions on Interactions between countries

The Danish and Swedish silver eel fisheries have a substantial impact on the silver eel stocks escaping from the other Baltic countries. Further analyses of historical data and new international coordinated tagging studies are needed to obtain catch rates with adequate precision.

5 Data requirements and knowledge gaps

In this chapter, data requirements and knowledge gaps will be reviewed. For the data requirements, the existing obligations under the DCF will be reviewed, which will then be contrasted to the data needs.

5.1 Commercial fisheries

Council regulation (EC) no. 199/2008 requires sampling of eel from commercial and recreational fishery, in both marine and inland waters. Analysis of National Proposal and Technical Reports demonstrates that not all of the Baltic States plan and conduct specific eel sampling. The table below provides details of marine sampling for 2009–2010 within the DCF framework.

Table 5.a. Overview of sampling of marine commercial fishery, biological variables.

Country	Métiers identified/ target assemblage	No of sampling trips	Biological sampling	Variables collected	No of samples
Germany	No	n/a	Y	Weight,age	600
Poland	FPO_FWS>0_0_0	12	Y	Length,weight,sex,age	400
Lithuania*	No	n/a	N	n/a	n/a
Latvia	FPO_FWS>0_0_0	12	Y	Length,weight,sex,age	200
Estonia	FYK_DEF>0_0_0	24	Y		
Finland	No	n/a	N	n/a	n/a
Sweden	FPN_CAT>0_0_0 FYK_CAT>0_0_0	14	Y	Length,weight,sex,age	1800
Denmark	FPN_CAT>0 _0_0	3	Y	Length,weight,sex,age	1400

*** Lithuania included eel sampling in NP proposal for 2011–2013.**

In addition, MS are obliged to sample inland eel fishery, but only Poland and Sweden planned to conduct monitoring. In case of other MS, the NP proposals do not indicate for what reason sampling inland waters has been omitted, and no derogation is called for. So in that case, a clear guideline and exact requirements are strongly desirable.

Table 5.b. Overview of sampling of inland commercial fishery, biological variables.

Country	Gear code	No of sites/lakes	Biological sampling	Variables collected	No of samples
Germany	No	n/a	N		
Poland*	FYK	1/1	Y	Length,weight,sex,age	600
Lithuania	No	n/a	N	n/a	n/a
Latvia	No	n/a	N	n/a	n/a
Estonia	No	n/a	N	n/a	n/a
Finland	No	n/a	N	n/a	n/a
Sweden	FPN	6/4	Y	Length,weight,sex,age	750
Denmark	No	n/a	n/a	n/a	n/a

*** Poland conducted a pilot study in 2010.**

5.2 Recreational fisheries

The following is noted:

Germany: Because of the poor knowledge available on the recreational eel fishery investigation had the character of a pilot study.

Poland: There is no marine recreational fishery of eels in Poland. Data about anglers catch in inland waters is collected using questionnaires.

Lithuania: no information.

Latvia: insignificant catches, but no calls for derogation.

Estonia: collection of marine catches from EFIS databases. No information is given for inland fishery.

Finland: no information

Sweden: recreational fishery is prohibited.

Denmark: Denmark has planned a sampling scheme for the collection from anglers in 2009 and 2010 that continues the survey on the recreational fishing that started in 2006.

5.3 Future data needs and knowledge gaps

The EU Eel Regulation obliges Member States to protect the eel stock, to monitor and register the anthropogenic impacts, and to report on the status of the stock by 2012 along with the reduction in impacts achieved. The national reports in 2012 will report on the overall status of the stock, which must at least supply the minimal information (B_0 , B_{best} , B_{post}; see SGIPEE, ICES, 2010a); however, for quality assurance reasons, the basic data used for the national assessment (and the method used) will need to be made available to the international level too. Timely coordination of the data collection, storage, analysis and reporting will facilitate the evaluation process in 2012. Additionally, for the Baltic area, it will be necessary to quantify the cross-border interactions too. These interactions will go beyond the capacity of individual countries, and therefore will require international cooperation in the whole Baltic area. As noted in the preceding chapters, the information currently available is scarce, and not really fit for international stock assessment; especially, there is a need for more extensive cross-Baltic tagging studies on silver eel, and for a dedicated assessment of the interactions using these data.

To estimate the <u>fishing impact exerted on the yellow eel stocks</u>, a standard approach based on catch-curve analysis and/or VPA-type is foreseen, but the limited set of data available and time restrictions did not allow the Workshop to proceed along this line now. This type of analysis will primarily use the data on landings, the length- and age-composition data; secondarily, recruitment trends and cpue-data can be used to verify the results, while effort-series will be required to monitor the direct effect of management measures (compliance).

To estimate the <u>fishing impact exerted on the silver eel</u> migrating towards and along the coasts, the total quantity of silver eels being caught is known from the landings statistics; the mortality (relative impact) can be estimated from mark-recovery programmes in combination with landings statistics. It is noted that mark-recovery data are not routinely included in the DCF. Methodology to derive estimates of fishing mortality using mark-recovery data is now being developed in Sweden; this methodology will probably be applicable in other countries too. In the Baltic, special attention has to be paid on the international interactions, as neither the data nor the methodology is currently available.

To estimate the impact of hydropower-related mortality, an assessment of the impact of individual power-stations will be required, using tagging and tracking studies. Subsequently, these local estimates will need to be scaled up to country totals/averages, using GIS approaches to quantify the total eel stock and the impact of hydropower.

Ultimate recovery of the stock will have to be measured in terms of recovery of the recruit immigration from the ocean, which is now in almost consistent decline. National monitoring of recruit immigration may be useful for local stock assessment, but its primary information relates to the global status of the stock. Analyses of the historical time-trends in recruitment have demonstrated, that trends can be extracted, and spatial coherence patterns detected, though some statistical uncertainty remains. It is essential that these dataseries will be continued, and possibly extended to areas where currently no monitoring exists (Dekker, 2002); in the Baltic area, recruitment is currently only monitored around the entrance, in Sweden.

The Workshop endorses the recommendation by WGEEL to organize a (series of) international workshop(s) on eel data collection, to support local programmes, to coordinate and standardize, and to explore post-evaluation methods for local eel stocks. Noting the linkages between national management actions, this should also comprise a follow-up to the current Baltic Workshop. Though data collection frameworks exist at this moment in time (DCF, WFD, Eel Regulation), the data actually available are restricted and often insufficient for analysis. A stricter coordination and timely adjustment of sampling programmes will be required to ensure an adequate database for the 2012 post-evaluation. Organisation under the umbrella of the RAC would fit.

6 Country Reports

In September 2010, most countries represented in this Workshop submitted a Country Report to the meeting of WGEEL in Hamburg, giving an update of all dataseries up to 2009/2010. The current Workshop has used these reports extensively, but has not attempted to give a further update after only two extra months. However, for Lithuania, the most recent Country Report dates from 2008 and for Estonia from 2009. For these countries, an updated Country Report is presented in Annex 2, at the end of this report. For all other countries, the reader is referred to the most recent report of WGEEL (ICES 2010b).

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Annex 2: Updated country reports for Estonia and Lithuania

In September 2010, most countries represented in this Workshop have submitted a Country Report to the meeting of WGEEL in Hamburg, giving an update of all data-series up to 2010. The current Workshop has used these reports extensively, but has not attempted to give a further update after only two extra months. However, for Lithuania, the most recent Country Report dates from 2008 and for Estonia from 2009. For these countries, an updated Country Report is presented here. For all other countries, the reader is referred to the most recent report of WGEEL (ICES 2010b).

Report on the eel stock and fishery in Lithuania 2009/'10

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Reporting period: This report was completed in October 2010, and contains data up to 2009 and some provisional data for 2010.

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LT.2 Introduction

LT.2.1 Eel habitats

Eel habitats in Lithuania include lakes, reservoirs, the Curonian Lagoon and the Baltic Sea coastal zone. According to Barak and Mason (1992), natural populations of eel in rivers are concentrated in estuaries or lower reaches. Eel are found more than 1000 km upstream. However, normally the migration rate of their populations is less than 20 km a year (Dekker, 2004). It is evident that this migration, when occurring during the stage of the yellow eel, depends on the population density. With regard to the fact that in Lithuania eels from the sea enter a highly productive Curonian Lagoon where the population density is meagre, it can be assumed that eel migration from the Curonian Lagoon upstream the Nemunas River is possible but highly unlikely in the present state of the population. Yellow eel are extremely rare in Lithuanian rivers; according to Virbickas (pers. comm.) in Lithuania and Birzaks in Latvia (pers. comm.), decades-long studies of electrofishing have shown just a few eels caught in rivers. Those few eel in rivers have been found in the streams in short distance from the lakes stocked with eel (Lithuania) or by river dams near the sea (Latvia). Commercial fishing statistics recorded eel catches in water bodies of the Nemunas delta area (delta branches, old riverbeds and polders) during the period 1950 to 1969 which averaged between 0.1 t and 0.3 t per year. Thus, in the present state of stocks, rivers in Lithuania are not considered typical eel habitats, but they are ways of silver eel migration.

LT.2.2 River basins in Lithuania and EMU according to national EMP

Lithuania has 2782 lakes with areas exceeding 0.5 ha (88 548 ha) and 1159 reservoirs with areas over 0.5 ha (28 306 ha), also 4418 rivers longer than 3 km, their total length measuring 37 636 km and their surface area totalling 33 200 ha. Lakes and reservoirs over 50 ha number 285 (68 754 ha) and 70 (21 291 ha) respectively. Lithuanian territory covers 41 300 ha (26%) of the Curonian Lagoon (total area 158 400 ha). The Baltic Sea coastal zone is the area between the coastline and the 20 m depth isobath. This zone makes up an area of 41 500 ha. According to Directive 2000/60/EC, there are four RBDs in the territory of Lithuania (Figure 2.2.1):

1) Nemunas RBD (73.9% of the LT territory);

2) Daugava RBD (2.8% of the LT territory);

3) Lielupe RBD (13.7% of the LT territory);

4) Venta RBD (9.6% of the LT territory).

All four RBDs are transboundary basins. The largest one is the Nemunas RBD where 41.9% of the river basin area is in the territory of Lithuania, 39.6% in Belarus, 9.7% in Poland, 8.7% in Russia (the Kaliningrad region) and 0.1% in Latvia.

The Daugava, Lielupe and Venta RBDs are situated in the territories of Lithuania and Latvia. The Daugava RBD is also located in the territories of Russia and Belarus. Only 2.8% of the territory of this RBD is in Lithuania, where eel habitats (lakes) are not numerous. In addition, the habitats are not viable for the recovery of eel stocks as there are as many as three large HPs on the Daugava River in the territory of Latvia. With regard to this, Lithuania does not find it reasonable to recover stocks in this part of the Daugava RBD as long as the HPs should cause mortality for migrating the silver eel. Lithuania will apply common EMP measures by way of fishery restrictions in this part of the Daugava RBD, just as it does in the remaining territory of the country.

The Lielupe and Venta RBDs are situated in the territories of Lithuania and Latvia only. In Lithuania, these two basins cover 23.3% of the country's area, but habitats appropriate for eel (lakes and reservoirs) make up only 4.2% and 4.4%, respectively. It should be noted that over the past ten years the annual eel catch in inland water bodies has only been 5.1 tonnes on average and has depended on stocking. The Lielupe and Venta RBDs practically have no eel as no stocking in the waterbodies of the Lielupe basin has occurred since 1983, while stocking in the Venta basin has amounted to 0.1% of the total quantity of stocked eel in the same period. In addition, the Venta basin has a number of hydropower plants built in series on rivers that have their source in the basin's largest lakes. Under these circumstances Lithuania does not see need to prepare the individual plans for the RBDs where eel are practically nonexistent at present. However, common EMP measures will be applied to the territories of these RBDs by imposing fishery restrictions. With a view to recovering the eel population in these RBDs, Lithuania will apply measures similar to those in the whole territory of the country. However, it would implement those actions only upon coordinating them with Latvia to ensure migration of silver eel.

Lithuania has designated one Management Unit for the EMP based on Council Regulation (EC) 1100/2007 where Article 2(1) stipulates such a possibility and is developing one EMP for the whole territory of the country. The EMP Management Unit has been designated according to Lithuania's division into RBDs under Directive 2000/60/EC. The EMP also includes the Baltic Sea coastal zone. Assumptions for the designation of one EMU:

- The commercial catch and stocks of eel are not high in the territory of Lithuania and have averaged around 15 t annually over the past 10 years;
- The Nemunas RBD comprises 74% of the territory of Lithuania and 81% of eel habitats;
- About 99% of eels stocked since 1983 are found in the Nemunas RBD;
- About 99% of the eel catch and stocks are attributed to the Nemunas RBD;
- The Nemunas RBD includes 96% of lakes of reservoirs from which eel can escape unaffected by turbines or through passes installed on HP dams;
- Although the Daugava RBD comprises a fairly large part of lakes and reservoirs (11.6%), escapement of eel to the sea is restricted by three large HPs in Latvia;
- Conditions in the other RBDs are similar (except for the different impacts of HPs), thus no specific measures for implementation of the plan in the other basins are needed.

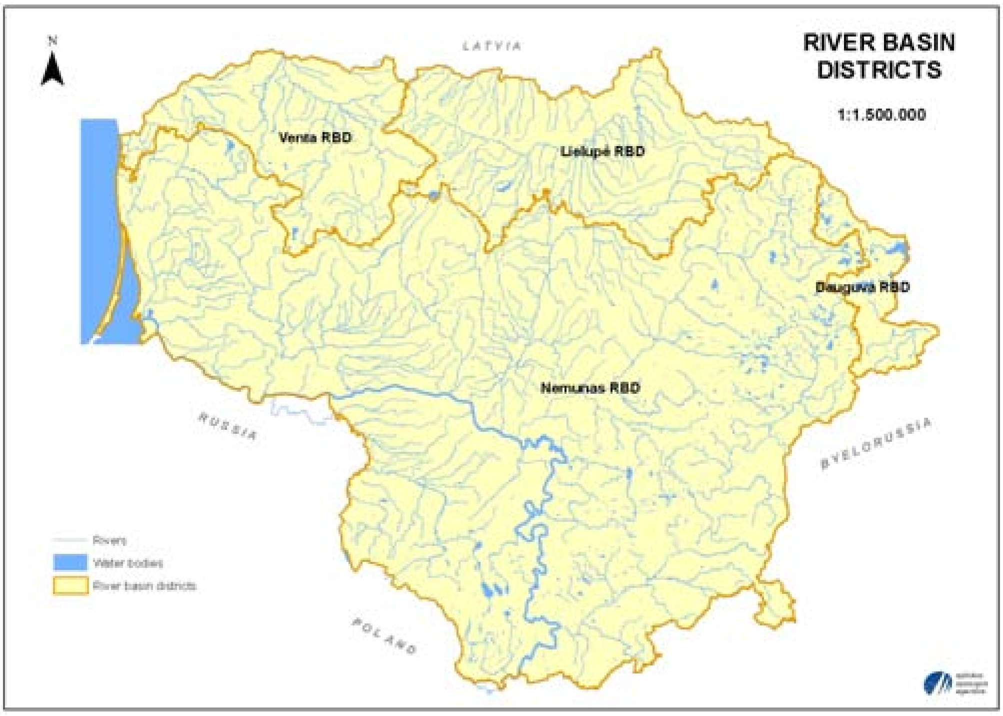

Figure 2.2.1. Lithuanian River Basin Districts.

LT.2.3 Eel fishery

According to importance, fishery features, catches and the origin of eels, fisheries in Lithuania should be divided into fishery in inland waters and the Curonian Lagoon, and very small-scale fishery in the Baltic Sea. Commercial fishery statistics have been available since 1926. That year saw a 55.1 tonne catch of eel. Similar catches were recorded until 1938. Active fishing began again from the early 1950s (at least statistics became available), and the average catches of eel were 141 tonnes during 1953–1978. The largest catches amounting to 260 tonnes were recorded in 1963. Catches went into decline from the mid-1970s, and over the last ten years they have made up 15 tonnes on average. Slightly higher catches (average 17.1 tonnes) in 2004–2007 are to be linked with improved fishery controls and reporting. During 1926–2007, the major part of catches (88.5%), came from the Curonian Lagoon During the period from 1926 to 1938, eels on average accounted for 18.8% of the value of fishery in inland water bodies and the Curonian Lagoon (excluding the Vilnius region). The value of catches from these water bodies in 2007 amounted to about LTL 6.3 million. Eels accounted for 13.4% of the value of catches at the price of 56.5 LTL/kg (the average price of other fish was 3.3 LTL/kg). Therefore, despite relatively low catches, income from the eel fishery in the structure of fishermen's income is very significant.

LT.2.4 Fishery management and authorities responsible for EMP implementation

Pursuant to the Law on Fisheries of the Republic of Lithuania (27 June 2000, No VIII-1756), the regulatory authorities in the fisheries sector are:

The Ministry of Agriculture which participates in the making and implementation of the Lithuanian fisheries policy, conducts management of the fisheries sector, implements the Common Fisheries Policy of the European Union, organises and implements conservation and control of fish stocks in maritime waters; establishes the procedure for commercial fishery and issues permits for fishing in maritime waters;

owns, manages and uses a data system of fisheries in maritime waters (exploitation of fish stocks, users, economic and biological data, etc.).

The Ministry of Environment which participates in the making and implementation of the fish stock conservation and control policy, conducts public management of the fisheries sector in inland waterbodies; establishes the regulation for commercial and recreational fisheries in inland water bodies and issues permits (except for private fish waterbodies); owns, manages and uses a data system of fisheries in inland waterbodies (use of fish stocks, users, economic and biological data, etc.).

The Ministry of Agriculture and the Ministry of Environment which, within their respective competence, organise the recovery of fish stocks and fisheries research in fisheries waterbodies.

The Ministry of Environment is responsible for the exploitation of fish stocks in inland waterbodies, including the Curonian Lagoon. The Ministry of Agriculture is responsible for the implementation of the Common Fisheries Policy of the European Union. Since the Council Regulation contains the obligation to prepare and implement the EMP, therefore both ministries assume the responsibility for preparing and implementing the plan. In addition, conservation measures for protected fish species, including the eel, and their habitats and migratory routes are established and their implementation is controlled by the Ministry of Environment, while the work of improving the conditions for farming, spawning and migration of protected fish species is organised by the Ministry of Agriculture or a body authorised by it. The procedure for fisheries in public fisheries waterbodies and also of eel stocking, carried out according to the programmes approved by the Ministry of Agriculture and agreed with the Ministry of Environment, is also established by both ministries.

LT.2.5 Summary of Lithuanian EMP

- *Council Regulation, responsible authorities and initial actions***.** Council Regulation (EC) 1100/2007 adopted on 18 September 2007 obligates Member States to define the Eel Management Unit, describe the current state of the stocks, identify measures necessary for the recovery of the stocks, implement those measures and assess their effectiveness. In Lithuania, the eel stock is not abundant and the national fisheries make up only 0.1% to 0.2% of Europe's eel catch. Abiding by the principle of solidarity, the country took the first preventive measures to minimise the impact of fisheries on the stock prior to the entry into force of the Regulation. Lithuania has two authorities responsible for the implementation of the Eel Management Plan, in particular the Ministry of Environment and the Ministry of Agriculture. Despite the lack of detailed information on the past state of the eel stock in the country, Lithuania has sought, in developing the Eel Management Plan, to collect the most accurate information possible about the past and current state of the eel stock in the country and, taking into account the information available, to take adequate measures for preventing the decline of the stock, seek the recovery of the stock in the future and establish a system of monitoring the state of the stock.
- *RBD designation and neighbouring countries***.** In identifying the Eel Management Unit, Lithuania, pursuant to Article 2(1) of Council Regulation (EC) No 1100/2007 which grants such a pragmatic possibility, has designated its national territory, including the Baltic Sea coastal zone, as a European Eel Management Unit, since the Nemunas RBD covers most of the territory

and comprises the country's most significant eel habitats. Lithuania sees the possibility in future to coordinate actions with the neighbouring Member States, in particular Latvia, Estonia and Poland, as well as with Russia and Belarus as third countries if the latter provided management plans of the protection and recovery of the stocks.

- *Eel habitats in Lithuania and their quality.* Habitats of eel in Lithuania include lakes, reservoirs, the Curonian Lagoon and the Baltic Sea coastal zone. Eel were known to inhabit lakes situated in the territory of the country more than 100 years ago. Due to their poor stocks, however, eel practically had no commercial significance, while the stock in the Curonian Lagoon was considerably higher. Lithuanian lakes and reservoirs indicate a low eutrophic level and low pollution, 39% of them are not situated in the basins affected by HP turbines and are appropriate for ensuring safe migration of silver eel. Fisheries are extensive in the Curonian Lagoon where only large eel are fished. The Lagoon is an open waterbody, i.e. a wide channel of Klaipėda Port connects it with the sea which allows free escapement of silver eel to the sea. Some 22% of waterbodies offer free access to yellow eel that migrate from the sea, if such migration existed. Therefore, Lithuanian waterbodies can be a good ground for the production of quality spawners. Lithuania has one large cormorant colony on the seacoast and a few small colonies in the central and eastern parts of the country. Impacts from other predators are little known. Infection with *Aguilicolla crasus* has been recorded in the sea, the Curonian Lagoon and lakes, but there have been almost no studies of diseases.
- *Stocking and fisheries***.** In Lithuania, stocking was launched and carried out in 1928–1939 in the country's eastern part. Later on, active stocking began in 1956, and within approximately 50 years 50 million eels were stocked, which artificially generated eel populations in inland waterbodies. Recent commercial harvests in inland waterbodies and the Curonian Lagoon have amounted to about 15 tonnes of eels per year. Impacts of recreational fishing are unknown but may constitute three to five tonnes.
- *Eel origin.* Microchemical analysis of otoliths of recent years has established that all eels explored in inland waterbodies are stocked. In the Curonian Lagoon and the Baltic Sea coastal zone 80% and 98% of eel respectively come from natural migration and 20% and 2% are stocked. It has been established that eel enter Lithuanian freshwaterbodies in the stage of the yellow eel, at the age of 5.2 years on average.
- *Lithuanian EMP target.* The 40% target level of escapement of silver eel under pristine conditions in the Lithuanian EMP has been calculated by using a simplified model of the eel population dynamics (Dekker *et al*., 2008) and based on historical data on eel catches and information available about the structure of catches. For the Lithuanian section of the Curonian Lagoon, silver eel production of 87 tonnes in the good state of the stock (1954–1978) under pristine conditions has been estimated. The calculation only relates to the Curonian Lagoon, as in the past catches and stocks in other inland waterbodies were very low, while at present fisheries mostly involve stocked eel. In the Baltic Sea coastal zone, impacts on the eel stock were and are extremely insignificant. According to these calculations, in the Lithuanian EMP the 40% target level of escapement of silver eel from Lithuanian waterbodies makes up 35 tonnes of silver eel annually. Mean-

while, the current escapement from the Curonian Lagoon where the major part of the population is natural and from lakes should be about five tonnes according to theoretical estimations. Thus, to achieve the objective set out in the Council Regulation, Lithuania would have to stock at least such a quantity of glass eel that would allow additional production of at least 30 tonnes of silver eel in Lithuanian waterbodies, assuming that the natural eel population and its recruitment do not decline in the future.

- *Actions for the recovery of the stock. Restrictions on fisheries.* The first practical steps intended to prevent further decline of the stocks and various measures and actions reducing anthropogenic mortalities and the recovery of the stocks have been included in the country's action plan: to restrict fisheries in the Curonian Lagoon by paying compensations to fishermen for retirement from business; in inland waterbodies, the number of licensed fishing sites has already been reduced by 43%; in addition, other measures include shortening of the fishing season by only leaving the spring fishing of silver eel, cutting of the fishing time for yellow eel to three months, imposition of restrictions on baits for longlining with a view of avoiding bycatch of eels of non-marketable size, and, in recreational fishery, reduction of the day's catch limit from five to three individuals. The country has put in place a fisheries control and accounting system which will facilitate the implementation of the fisheries restriction measures contained in the EMP. HP impacts will be assessed in major locations and ways for reducing turbine-related mortalities will be sought. From 13 March 2009, Lithuania will be ready, pursuant to the provisions of CITES, to introduce a control system and implement restrictions on international and domestic trade in eels. Presently, the country has a comprehensive trade control and accounting system in operation which will ensure control of trade in eel and of their origin.
- *Stocking and the timescale of implementing the EMP objective.* Lithuania will use stocking as one of the measures of the recovery of the eel stock. Lithuanian inland waterbodies already have eel populations that originated from previous stocking activities and now exceed those that existed prior to the launch of stocking programmes in the mid-1950s, i.e. for inland waterbodies, the country already complies with the objectives set out in the Council Regulation. Lithuania agrees with the ICES recommendation to avoid stocking where natural populations exist and, observing a precautionary approach, will carry out stocking in the Curonian Lagoon only after stocking the country's lakes. By stocking inland waterbodies, Lithuania will seek to compensate the decline in the population in the Curonian Lagoon. Stocking will primarily be carried out in lakes which are not situated in basins affected by HP turbines. Such waterbodies make up an area of about 40 000 ha where up to 4 million glass eel can be stocked. Lithuania intends to stock up to 30 000 ha (up to 3 million glass eel) on an annual basis. This quantity would allow the anticipated production of about 54 tonnes of silver eels (without closing fisheries) within approximately 10 to 20 years after stocking (within the life of one generation), reaching or even exceeding the target set out in the Council Regulation.
- *Studies necessary for optimising the EMP.* Lithuania lacks information about the past and current state of stocks; this requires a number of studies for collecting information and developing a system for monitoring the state of stocks: to initiate commercial fishery sampling with a view to assessing

mortalities and monitoring the stock and its natural recruitment, to install a fish pass on coastal river dams and to launch monitoring of trawling in the Curonian Lagoon, to carry out tagging and telemetry studies by also using traditional fishing methods that would enable mortalities induced by HP turbines and fishing to be assessed in the silver eel stage, to carry out microchemical analysis of otoliths in the stage of the silver eel with a view to assessing the effectiveness of stocking programmes, to carry out an analysis of contaminants and energy resources in samples of silver eel for the purpose of evaluating the quality of eel leaving Lithuanian habitats for spawning, upon carrying out stocking to conduct an assessment of the effectiveness of stocking by monitoring the survival, infection with parasites, growth rates and sex ratio of stocked eel, and, by employing surveys, to assess the impact of recreational fishing activities. In carrying out these studies, Lithuania will seek cooperation with other Member States, as conducting all this research on its own would be complicated. Information collected about the stocks will enable the review and optimisation of the national Eel Management Plan in 2012.

LT.3 Time-series data

LT.3.1 Recruitment-series and associated effort

LT.3.1.1 Glass eel

Glass eel do not occur in Lithuanian waters. The likelihood that eel used to come to the Lithuanian coast in the glass eel stage at the beginning of the 20th century cannot be ruled out. However, the last two reports on glass eel found in coastal streams come from the mid-1940s.

LT.3.1.1.1 Commercial

Glass eel do not occur in Lithuanian waters.

LT.3.1.1.2 Recreational

Glass eel do not occur in Lithuanian waters.

LT.3.1.1.3 Fishery independent

Glass eel do not occur in Lithuanian waters.

LT.3.1.2 Yellow eel recruitment

LT.3.1.2.1 Commercial

No commercial dataseries on recruitment exist.

LT.3.1.2.2 Recreational

No commercial dataseries on recruitment exist.

LT.3.1.2.3 Fishery independent

A study of eel otoliths' microchemistry intending to restore the migratory past and origin of eels have established that all eel examined in inland waterbodies are stocked, while in the Curonian Lagoon and the Baltic Sea coastal zone 80% and 98% of eel respectively come from natural migration and 20% and 2% are stocked. These studies indicate that eel arrive in Lithuania's freshwaterbodies in the stage of the yellow eel at the age ranging between one and 10 years (average 5.2 (±2.1)) (Schiao *et al*., 2006, Lin *et al*., 2007).

LT.3.2 Yellow eel landings

LT.3.2.1 Commercial

No dataseries exist; total landings of yellow and silver eels combined.

LT.3.2.2 Recreational

No dataseries exist.

LT.3.3 Silver eel landings

LT.3.3.1 Commercial

No dataseries exist; total landings of yellow and silver eels combined.

LT.3.3.2 Recreational

No catches.

LT.3.4 Aquaculture production

LT.3.4.1 Seed supply

Seed supply comes from Great Britain.

LT.3.4.2 Production

In Lithuania, eel have been reared by one company since 1998, which in recent years has produced about ten tonnes of eel annually (Table 3.4.2.1). The aquaculture company, Auksinis ungurys UAB, is about to complete building a new aquaculture facility and expects to produce 100 tonnes of eel per year. After it is completed the company will need 280 kg of glass eels annually. According to the company, they exported eels for stocking to Belarus in 2004–2008 (Table 3.4.2.2).

Table 3.4.2.1. Marketable eel production in aquaculture during 1998–2007.

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Production, t	2	2	1	5	17	20	9	8	12	13

Table 3.4.2.2. Auksinis ungurys UAB information on exports to Belarus.

YEAR	QUANTITY, UNITS	SIZE
2004	375 000	1–4 g
2005	1 050 000	glass eels
2006	150 000	1–5 g
2007	350 000	1 g
2008	260 000	1–5 g
Total	2 185 000	

LT.3.5 Stocking

LT.3.5.1 Amount stocked

Stocking of lakes with glass eel in the territory of Lithuania was carried out in 1928-1939 in the Vilnius area (a part of the area and the stocked lakes now belong to Belarus). Back then, about 3.2 million glass eel were stocked. In the post-war period, stocking of Lithuanian inland waterbodies with glass eel originating from France or Great Britain began in 1956 (or 1952, according to other data). During 1956–2007, a total of 148 lakes and reservoirs covering an area of 95 618 ha was stocked. About 50 million glass and juvenile eels were stocked in total, or 1.25 million per year on average (Figure 3.5.1.1). Some 89% of them were stocked in the Nemunas RBD, mostly in the basins of the rivers Žeimena and Šventoji. Stocking during the most intensive period of 1960–1986 amounted to 33.2 million eel. The area of waterbodies where stocking was carried out comprised 40 204 ha, and the average stocking density made up almost 826 individuals/ha throughout the whole period. Later on, the quantities declined and stocking was sporadic, but small quantities were stocked on an annual basis. The last more sizeable stocking took place in 2004 with 70 100 juvenile eel stocked. From 1983 (a period when at least some eel could have remained in the country's waterbodies) about ten million eel were stocked, their major part (96.5%) being in the Nemunas basin (99% of the Nemunas RBD). Lakes of the Žeimena (60%) and the Šventoji (19%) sub-basins saw the most intensive stocking. Stocking in the Curonian Lagoon (143 000) in that period was low (Figure 3.5.1.2).

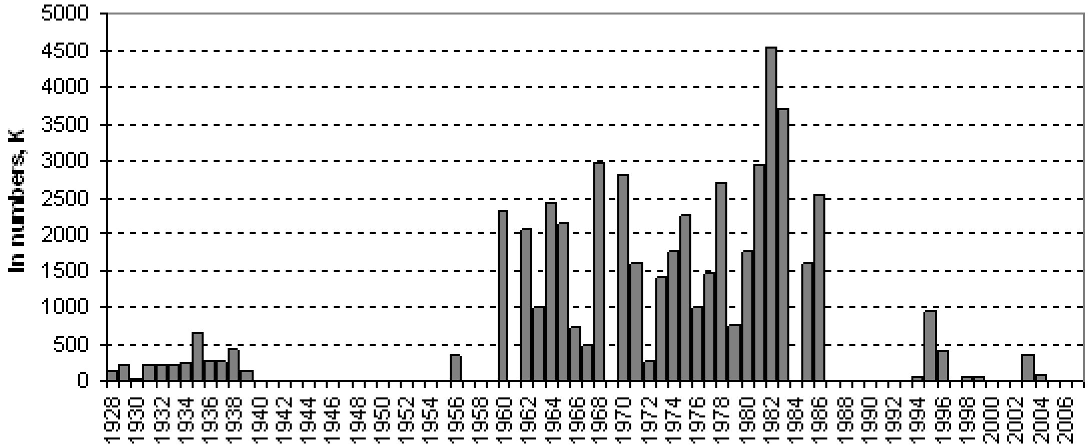

Figure 3.5.1.1. Stocking of inland water bodies with glass eels in the period 1928 to 2007 (thousand units).

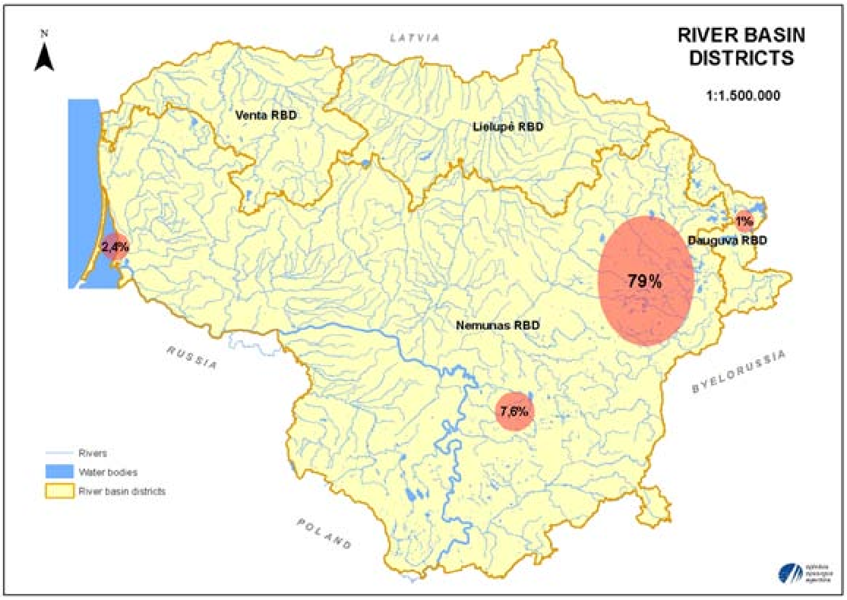

Figure 3.5.1.2. Major eel stocking regions since 1983.

LT.3.5.2 Catch of eel <12 cm and proportion retained for restocking

There is no fishery of eel <12 cm.

LT.4 Fishing capacity

LT.4.1 Glass eel

There is no glass eel fishery.

LT.4.2 Yellow eel

In inland waterbodies, 45% of eel are caught in lakes using traps, while a small portion is caught using longlining, mostly in the stage of the yellow eel. According to studies of escapement seasonality, 60% of eel escape in spring. In 2004–2007, almost all fishing activities in lakes were performed by four companies in four lakes covering a total area of 66 km^2, with annual average catches amounting to 3.2 tonnes.

Fishery in the Curonian Lagoon lands yellow eel mostly, however some small proportion of silver eel are caught as well. The established quota for fykenets has been 413 units since 2003. Longlining is insignificant (three to four companies have some longlining activities). In 2008, there were 71 fisheries companies in the Curonian Lagoon, most of which were small enterprises only with two or three employees. Most companies own between one and four small vessels (up to 10 m long). There are only a few vessels with the length exceeding 10 m. A total of 227 vessels are registered in the Curonian Lagoon. Some of them fish only for a part of the year, mostly from September to December. The eel fishery generates income for around 40 companies. In 2008, 52 companies had quotas for fykenets. Pursuant to the rules of implementation of the activity 'Modification for reassignment of inland fishing vessels' of priority axis 2 'Aquaculture, inland fishing, processing and marketing of fishery and aquaculture products' under the Operational Programme for the Lithuanian Fisheries Sector for the period 2007–2013, approved by Order No 3D-549 of the Minister for Agriculture of 9 October 2008, LTL 10 million are to be allocated to modification for reassignment of inland fishing vessels to other activities. In 2010, the quota for fykenets is reduced down to 225 units.

LT.4.3 Silver eel

According to rough estimations, 55% of eel caught at the inland waterbodies are in seaward migration (silver eel); they are caught by setting traps across the river. The number of companies fishing (silver eels) in rivers in 2008 was 25. Fishing sites are established and fishing permits are issued by the Ministry of Environment, while the Ministry of Agriculture distributes fishing quotas among fisheries companies by way of competition. In 2005–2008, the number of fishing sites in rivers was reduced from 77 to 44 (Figure 4.4.2.4). Fishing with one trap is allowed in each fishing site at a time. On average, one company fished in 4.3 sites in 2004 and in 1.8 sites in 2007.

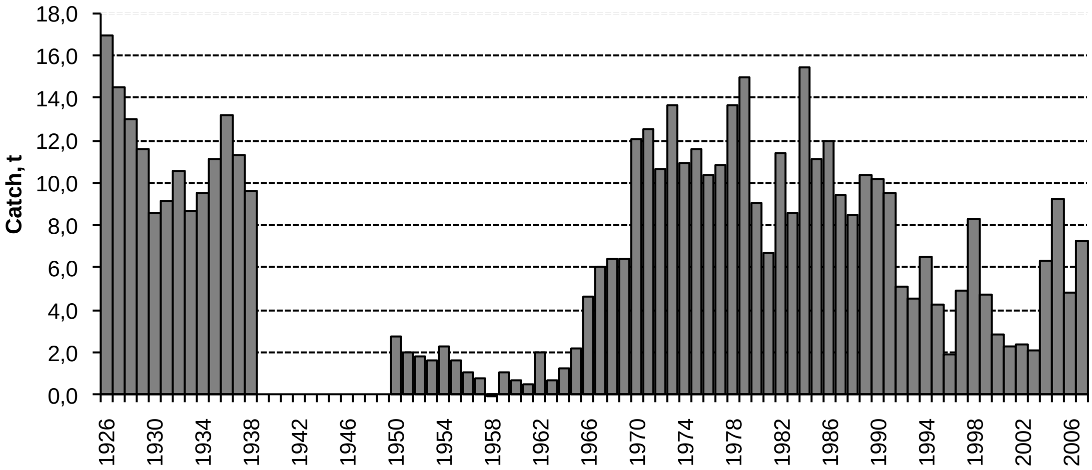

Figure 4.4.2.3. Eel catches (tonnes) in inland waterbodies in 1926–2007. (Note: 1926–1938 excludes the Vilnius area; no data on catches in 1939–1949; catches prior to 1939 are mostly from inland waterbodies of the coastal region).

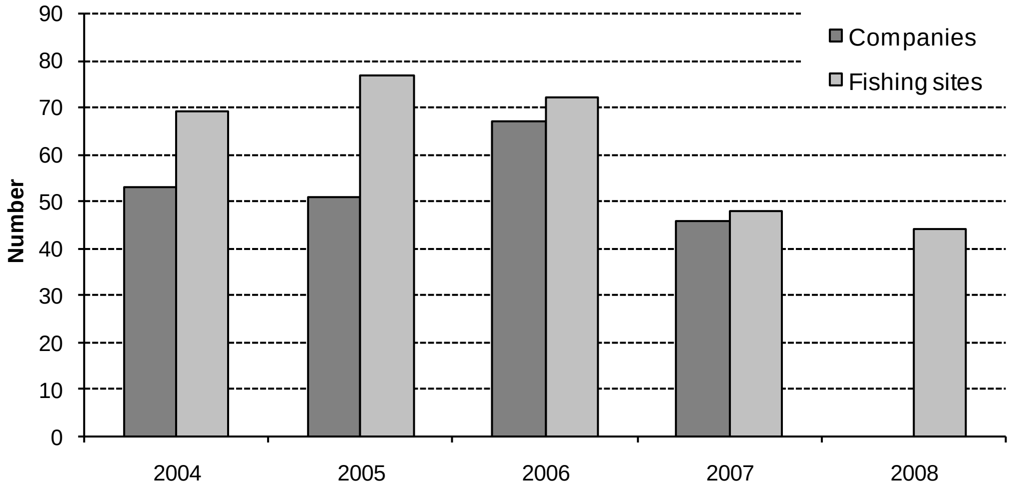

Figure 4.4.2.4. Number of companies engaged in the eel fishery with river traps and trap quotas in 2004–2008.

LT.4.4 Marine fishery

The eel fishery in the Baltic Sea coastal zone has never been significant. Pre-war commercial fishery statistics mentioned eels in 1931 (0.6 tonnes), with catches in 1937 and 1938 making up 0.5 tonnes and 0.2 tonnes respectively. In the subsequent years, there must have been no eel catches at all, as commercial fishery statistics were sufficiently accurate and well managed in Lithuania at that time.

During the Soviet occupation, commercial fishery in the coastal zone was banned until 1991. Since 1991, about 100 mainly small companies with two to three employees and one or two small vessels (up to 10 m) have fished in the coastal zone. Most employees are only engaged in fishing part-time. Recently, the number of fisheries companies has dropped and stood at 72 in 2007. Eel are fished with longlines in the stage of the yellow eel. Eel recorded in commercial fishery in the period 1995 to 2007 inclusive made up only about 0.18 tonnes on average. Only a few companies have been engaged in the specialised eel fishery in recent years, their number (five in 2005 and one in 2007) and catches have been declining: according to 2007 commercial fishery statistics, eel catches were only 8 kg. Low catch rates are probably a result of low stocks and low fishing efforts. Almost all eels studied in the coastal zone were of natural origin.

LT.5 Fishing effort

Fisheries companies provide information according to their logbooks (each fishing case, including gears used and catch must be obligatory recorded) about fishing effort on a monthly basis to the authority issuing permits: a regional environmental protection department under the Ministry of Environment of the Republic of Lithuania if a company is engaged in inland fisheries (including the Curonian Lagoon), or the Fisheries Department of the Ministry of Agriculture of the Republic of Lithuania if an company is engaged in maritime fisheries.

LT.5.1 Glass eel

There is no glass eel fishery.

LT.5.2 Yellow eel

There is no information summarized by lifestage. Specific analysis of the reports is needed.

LT.5.3 Silver eel

There is no information summarized by lifestage. Specific analysis of the reports is needed.

LT.5.4 Marine fishery

Eel fishery in marine waters is banned since 2010.

LT.6 Catches and landings

Fisheries companies provide information according to their logbooks (each fishing case, including gears used and catch must be obligatory recorded) about catch on a monthly basis to the authority issuing permits: a regional environmental protection department under the Ministry of Environment of the Republic of Lithuania if a company is engaged in inland fisheries (including the Curonian Lagoon), or the Fisheries Department of the Ministry of Agriculture of the Republic of Lithuania if a company is engaged in maritime fisheries.

	Lakes and rivers (small fykenets and trapnets)	Curonian Lagoon (fykenets)	Baltic Sea (longlines)
	Inland	Inland	Coastal
	Yellow/silver	Yellow/silver	Yellow
1995	4.3	5.1	0.1
1996	2.0	6.6	0.1
1997	5.0	5.7	0.0
1998	8.4	8.7	0.1
1999	4.7	13.2	0.3
2000	2.9	8.1	0.2
2001	2.3	9.2	0.3
2002	2.4	10.4	0.2
2003	2.1	9.7	0.6
2004	6.3	9.7	0.3
2005	9.9	12.4	0.1
2006	4.9	10.9	0.1
2007	7.3	7.6	0.0
2008	6.7	6.8	0.0
2009	3.7	4.9	0.0
2010*	4.6	4.5	0.0

***for the period January–September.**

LT.6.1 Glass eel

There is no glass eel fishery.

LT.6.2 Yellow eel

Yellow eel fishery is mixed with silver eel in most cases except coastal waters of the Baltic Sea, where small numbers of yellow eel are caught using longlines.

LT.6.3 Silver eel

Statistical data do not provide information on the eel stage; specific analysis of the reports or logbooks is needed.

LT.6.4 Marine fishery

Banned since 2010.

LT.7 Catch per unit of effort

LT.7.1 Glass eel

There is no fishery for glass eel.

LT.7.2 Yellow eel

No data.

LT.7.3 Silver eel

No data.

LT.7.4 Marine fishery

No data.

LT.8 Other anthropogenic impacts

According to a rough GIS analysis, 32% of eel stocked to inland lakes during the last 20 years are in the basins blocked by hydropower stations. Detailed analyses as well as surveys of mortality in turbines are needed.

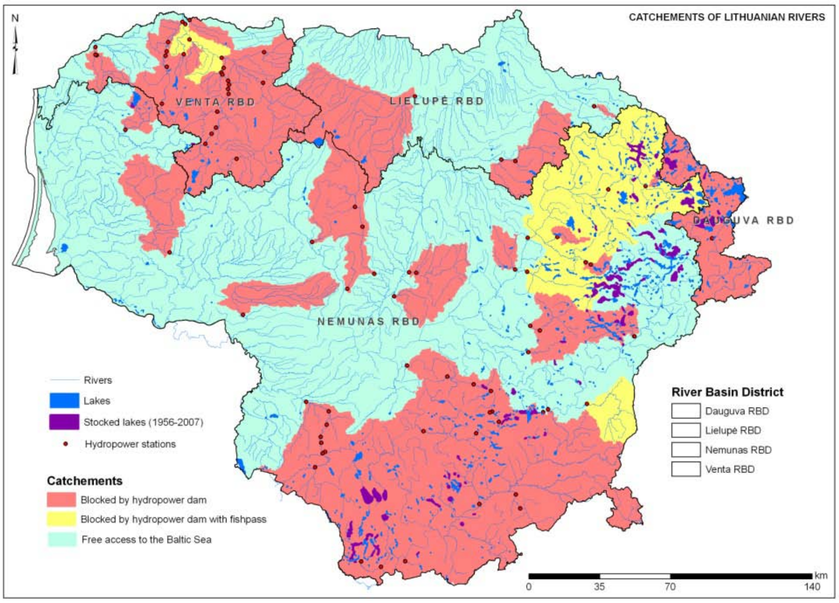

Figure 8.1. Catchments of Lithuanian rivers and hydropower stations.

LT.9 Scientific surveys of the stock

There are no research surveys of eel stock done in Lithuania until 2010.

LT.10 Catch composition by age and length

Fisheries landings are not sampled until 2010. Sampling should start in 2011.

LT.11 Other biological sampling

LT.11.1 Length and weight and growth (DCF)

Data regarding biological variables such as length, weight, and growth should be collected from 2011 as part of DCF.

LT.11.2 Parasites and pathogens

No new data.

LT.11.3 Contaminants

No new data.

LT.11.4 Predators

No new data.

LT.12 Other sampling

Sampling for cormorant diet analysis is done on regular basis as part of PhD project on Cormorant effect on fish stocks in the Curonian Lagoon since 2005. About 1000 samples were analysed and no eel are found in the diet.

LT.13 Stock assessment

LT.13.1 Local stock assessment

There are no stock assessment surveys in Lithuania. However, first stock assessment was conducted in 2008 using Simplified model of the eel population dynamics (Dekker *et al.*, 2008). Using the model natural escapement levels of silver eel under pristine conditions were calculated as well as current escapement.

LT.13.2 International stock assessment

LT.13.2.1 Habitat

Wetted Area: lacustrine. Lakes & Reservoirs: 117.000 Ha

Riverine. Rivers: 33.200 Ha (38.000 km)

transitional & lagoon. Curonian Lagoon: 41.300 Ha

coastal. Baltic Sea: 41.500 Ha

Lithuania has 2782 lakes with areas exceeding 0.5 ha (88 548 ha) and 1159 reservoirs with areas over 0.5 ha (28 306 ha), also 4418 rivers longer than 3 km, their total length measuring 37 636 km and their surface area totalling 33 200 ha (Table 13.2.1.1). Lakes and reservoirs over 50 ha number 285 (68 754 ha) and 70 (21 291 ha) respectively. Lithuania has 41 300 ha (26%) of the Curonian Lagoon (total area 158 400 ha). The Baltic Sea coastal zone is the area between the coastline and the 20 m depth isobath. This zone makes up an area of 41 500 ha. According to Directive 2000/60/EC, there are four RBDs in the territory of Lithuania (Figures 13.2.1.1 and 13.2.1.2).

Table 13.2.1.1. Eel habitats in Lithuania.

Habitat	Number	Length, area
Rivers	4418	37 636 km
Lakes	2782 (>0.5 ha)	88 548 ha
Reservoirs	1159 (>0.5 ha)	28 306 ha
Curonian Lagoon	1	41 300 ha
Baltic Sea coastal zone	1	41 500 ha

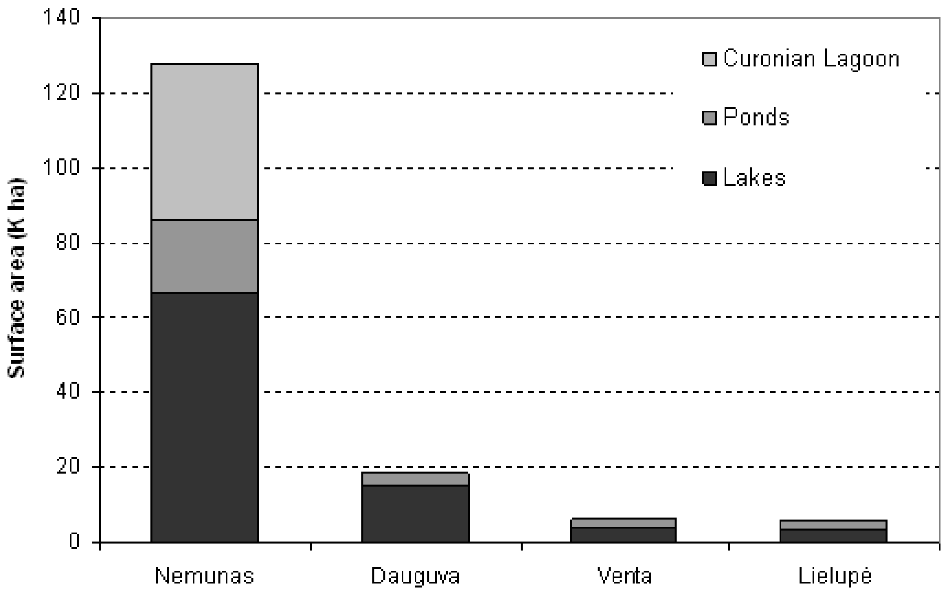

Figure 13.2.1.1. Areas of RBD waterbodies in Lithuania (thousand ha).

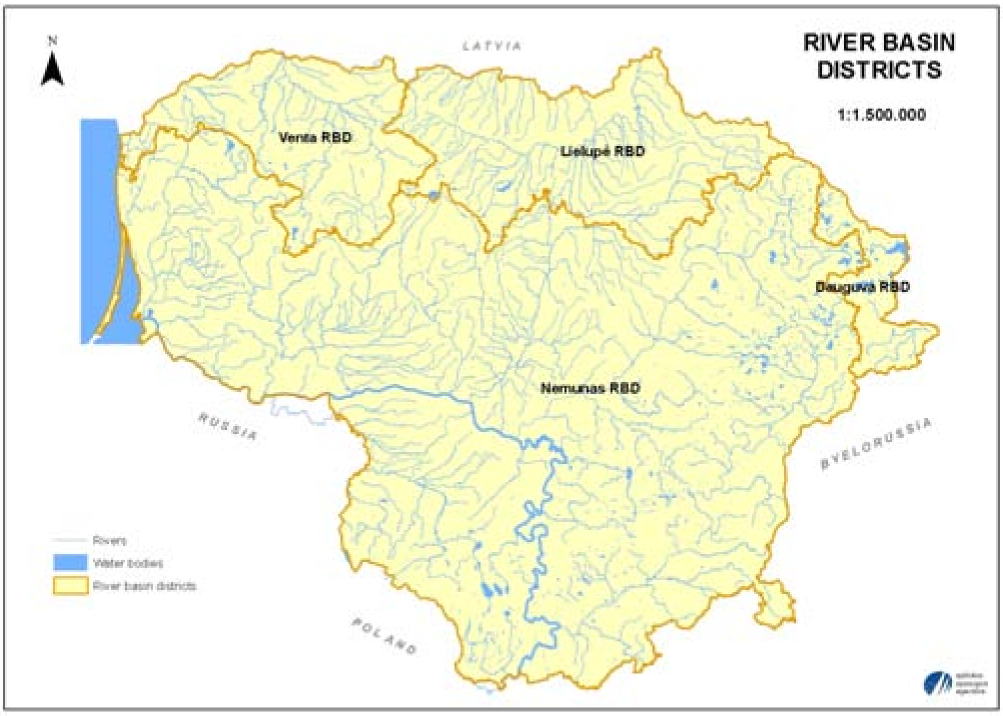

Figure 13.2.1.2 Lithuanian River Basin Districts.

LT.13.2.2 Silver eel production

Based on historical data on eel catches and information about the structure of catches, the average production of silver eel was calculated simplified model of the eel population dynamics (Dekker *et al*., 2008).

According to the calculations presented in Tables 13.2.2.1 and 13.2.2.1.1, in the Lithuanian EMP the 40% target level of escapement of the spawning stock biomass from Lithuanian waterbodies (SSB is calculated under pristine conditions) makes up 35 tonnes of silver eel per year. Meanwhile, according to theoretical calculations, the current escapement from the Curonian Lagoon, where the major part of the eel population is natural, and from stocked lakes should be around five tonnes. Thus, to achieve the objective set by the Council Regulation, Lithuania would have to stock at least such a quantity of glass eel that would allow additional production of at least 30 tonnes of silver eel in Lithuanian waterbodies, provided that the natural eel population and its recruitment with new individuals in the Curonian Lagoon do not decline in future.

Table 13.2.2.1. Eel production in the absence of anthropogenic impacts.

Eel habitat	Period	Stocking	Catch, t	Catchnat. indiv., t	SSBnat, t
Curonian Lagoon (total area)	1954–1978	0	250	250	333

LT.13.2.2.1 Historic production

Calculations of the historical production are done using simplified model of the eel population dynamics (Table 13.2.2.1.1). It was assumed that the effectiveness of the silver eel fishery in the past was similar to that of other Baltic countries (the level established by experiments with tagged eel in Scandinavia, i.e. 25%). In addition, the calculations were based on the assumption that an insignificant overfishing of yellow eel had occurred, with the rate of yellow eel exceeding that of silver eel in catches. The calculation was only done for the Curonian Lagoon, as catches in other inland waterbodies had been extremely poor in the past, while current catches mostly include stocked eel. In the Baltic Sea coastal zone, eel catches have always been insignificant, usually amounting to a few hundred kilograms per year or no eel fishery has occurred at all. Plans are made to support the eel fishery of very low intensity (<100 kg/year) and to prohibit any specialised fishery in the Baltic Sea. Thus, it can be assumed that there were no and there will be no anthropogenic impacts on eel in Lithuania's coastal zone of the Baltic Sea. For that reason, the spawning eel stock biomass under pristine conditions and the target level of escapement in these waterbodies were not included in the calculations.

Table 13.2.2.1.1. Calculation of EMP target SSB (SSB_{prist} is SSB under pristine conditions and $SSB_{curr.}$ is the current level of escapement).

Escapement	Spawning Stock Biomass, t
SSBprist, t (Curonian Lagoon, total area)	333
SSBprist, t (Curonian Lagoon, LT section (26%))	87
SSB, 40% under pristine conditions)	35
SSBcurr. (lakes and Curonian Lagoon (LT section))	5

LT.13.2.2.2 Current production

There are no calculations.

LT.13.2.2.3 Current escapement

See above and Table 13.2.2.1.1.

LT.13.2.2.4 Production values e.g. kg/ha

There are no calculations.

LT.13.2.2.5 Impacts

There are no calculations.

LT.13.2.2.6 Stocking requirement eels <20 cm

The quantity of glass eel needed for stocking was calculated by taking into account the optimal stocking density for the area's latitude where Lithuania is located (100 glass eel ha^{-1}, see Section 5.4.5) and the area of waterbodies appropriate for stocking. The Lithuanian EMP contains a specific stocking strategy: in stocking, priority will be given to habitats that are unaffected or partially affected by HP turbines (HPs have fish passes), have low levels of pollution and are remote from cormorant colonies. Stocking of priority lakes unaffected by HP turbines (excluding rivers and the Curonian Lagoon) requires one tonne of glass eel per year approximately (≈ € 0.5 million per year). If the country has sufficient financial resources and the possibility to acquire glass eel (if recruitment of glass eel does not decline, their fishery is not banned and all Member States have sufficient glass eel resources for implementing their national EMPs), Lithuania plans to stock up to 30 000 ha of waterbodies in implementing the EMP. This would allow expecting a larger escapement level of silver eel than that set out in the Council Regulation (40% of natural production). The maximum total surface area of priority lakes was calculated, as not all lakes will be stocked due to various risk factors, and stocking in some lakes and reservoirs will be below 100 units ha^{-1} where a waterbody has lower productivity. In addition, some waterbodies still contain eels and these basins will not be stocked or stocking will be low-scale.

Until the end of 2010 large scale stocking programme is not started. Stocking activities should start in 2011.

Table 5.2.1. Quantity of glass eel needed for stocking and expected annual costs (if the price is about 500 €/kg).

Water bodies by order of priority	Surface area, ha	Quantity of glass eels, kg (units, million)	SSB production, t*
Lakes and reservoirs unaffected by HPs	23 995	800 (2.4)	44
Lakes and reservoirs partially affected by HPs	15 159	500 (1.5)	28
Curonian Lagoon	41 300	1400 (4.2)	78

Note: *SSB production without prohibiting the fishery (catches of 5% of yellow eel and 25% of silver eel per year).

LT.13.2.2.7 Data quality issues

LT.14 Sampling intensity and precision

There is no sampling done until the end of 2010.

LT.15 Standardisation and harmonisation of methodology

There is no sampling done until the end of 2010.

LT.15.1 Survey techniques

LT.15.2 Sampling commercial catches

LT.15.3 Sampling

LT.15.4 Age analysis

LT.15.5 Life stages

LT.15.6 Sex determinations

LT.16 Overview, conclusions and recommendations

Eel studies in Lithuania in the past were undertaken only in occasional cases aiming to collect samples for different research purposes (e.g. otolith microchemistry). Implementation of the national EMP until the end of 2010 is limited to legal regulations which are aimed to reduce fishery impact on the stock. Lithuania submitted national DCF program and should start collect data in 2011 if the programme is approved. In 2011 Lithuania should start programme for implementation of the EMP using financial mechanism of the European Fisheries Fund. The programme is aimed to restock lakes and to fulfill gaps in the research on the eel stock.

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Report on the eel stock and fishery in Estonia 2009/'10

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This report was completed in October 2010, and the data for 2010 are incomplete

Reporting Period: This report was completed in October 2010, and contains data up to 2009 and some provisional data for 2010.

EE.2 Introduction

EE.2.1 General overview

Eel fisheries in Estonia occur in Lake Võrtsjärv (20–100 t) and in coastal waters (5–30 t). Annual catch from small lakes and rivers mostly in L. Peipsi basin and L. Peipsi itself is 2–5 t. Eel catches by amateur fishermen constitute about 1 t from brackish water and about 2 t from inland waterbodies. According to the fishery statistics during the last decade the total annual catch of eel from Estonian waters was nearly 50 tons, but diminished remarkably during the last years (in 2008 32 tons and 2009 21 tons). During the first half of previous century eel was very abundant and one of the most important commercial fish in western coastal 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 Ivangorod 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 silver 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 Ministry of Agriculture give out fishing licences. There are gear and size restrictions. From 2011 Lake Võrtsjärv Fisheries Development Agency (FDA) will be responsible for stocking.

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 fishes in the lake. Professional fishing gears are fykenets and longlines are used by recreational fishermen. Every fisherman has own individual licences. The eel production of L. Võrtsjärv is entirely based on stocking with wild caught elvers or farmed eels (2–20 g).

During the half hundred years (1956–2010) 47 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 fishermen comes from eel, despite their annual investments to the state Foundation of Environmental Investments (>100 000 € annually) in stocking material. Due to the changes in fishing law, the number of fishermen increased five years ago. During 1970–1998, the number of professional fishermen varied between 20–25, followed by an increase to 32 in 2003 and over 40 in 2004–2010. The total number of people involved in the fishery of L. Võrtsjärv is estimated to be two times higher.

2) In coastal waters, the Gulf of Riga, the Väinameri, the Gulf of Finland, the catches of eel have increased (from 3–10 t in 1991–1995 to 20–28 t in 1999–2003), but from 2004 decreased again up to 4,3 ton in 2009. Along the shore of the Baltics eel are caught with bottengarns (poundnets) and fykenets; longlines are also used. As there are hundreds of fishermen 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 the last eight years: in Vooremaa district, L. Saadjärv (707 ha), L. Kuremaa (497 ha) and L. Kaiavere (250 ha) and L. Vagula (519 ha) in South Estonia. Fishing gear is dominated by fykenets.

EE.2.2 WDF and Eel Management Units

According to ordinance of government (RT I 2004, 48, 339) and WFD the territory of Estonia is divided into three basins and nine sub-basins. Basins and sub-basins are not connected directly with one river, as in European scale Estonian rivers are very small, except Narva River and its watershed area (1/3 of territory of Estonia and shared with Russia). Other more important rivers are River Pärnu, River Kasari and River Gauja, shared with Latvia (not incl. into EMP).

In connection with Eel Management Plan (EMP) Estonian waterbodies were divided into two eel management units on the basis of the formation of eel stock.

1) Narva River Basin District (East-Estonian basin)-population of eel based entirely on stocking;

2) West-Estonian Basin District (coastal waters and West-Estonian inland water bodies)-natural population of eel.

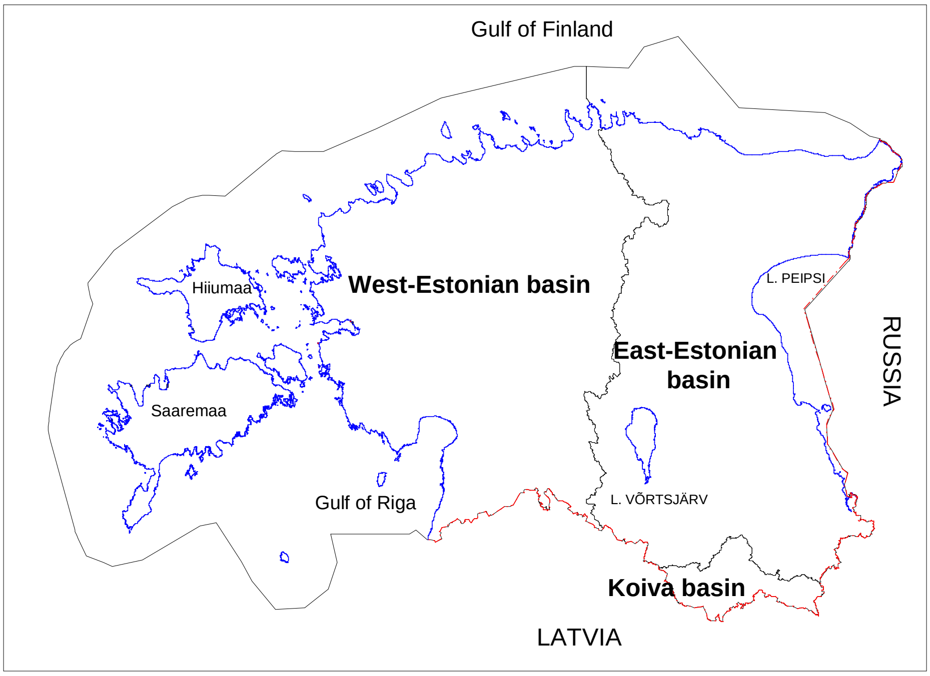

Figure 1. Map of basins

EE.3 Time-series data

EE.3.1 Recruitment-series and associated effort

EE.3.1.1 Glass eel

EE.3.1.1.1 Commercial

Glass eel do not occur in Estonian waters.

EE.3.1.1.2 Recreational

Glass eel do not occur in Estonian waters.

EE.3.1.1.3 Fishery independent

Glass eel do not occur in Estonian waters.

EE.3.1.2 Yellow eel recruitment

Natural recruitment of eel in Estonian waters takes place in stage of young yellow eel. No data.

EE.3.1.2.1 Commercial

No time-series are available.

EE.3.1.2.2. Recreational

No time-series are available.

EE.3.1.2.3 Fishery independent

No time-series are available.

EE.3.2 Yellow eel landings

EE.3.2.1 Commercial

No time-series are available as landings of yellow and silver eel are reported together.

EE.3.2.2 Recreational

No time-series are available as landings of yellow and silver eel are reported together.

EE.3.3 Silver eel landings

EE.3.3.1 Commercial

No time-series are available as landings of yellow and silver eel are reported together.

EE.3.3.2 Recreational

No time-series are available as landings of yellow and silver eel are reported together.

EE.3.4 Aquaculture production

At present there is only one fish farm in Estonia, which started with farming of eel at 2001. In 2002–2010 the stocking material of eel (young yellow eel 2–20 g) for Estonian lakes was brought from this eel farm.

Aquaculture production of eel in Estonia.

2002	2003	2004	2005	2006	2007	2008	2009
10	20	25	40	50	50	45	30

In 2009 was imported to Estonia 276 kg of glass eels. During the first week in eel farm the total loss was 12 kg and during next three months 2 kg (recalculated in weight of glass eels). Total mortality was 14 kg or 5%. In 2004–2008 the mortality varied between was 2–3% from glass eel to 5 g young yellow eel. In 2010 was imported 180 kg of glass eels, among them 60 kg for stocking into natural waterbodies after farming (5 g).

EE.3.5 Stocking

EE.3.5.1 Amount stocked

Estonia has state stocking programme of fish, including eel, for years 2002–2010.

In Soviet times government using state money organized stocking. Since the beginning of the 1990s 75–100% was financed by fishermen. During the last years stocking of eel has been financed fully by local fishermen (>100 000 € per annum). Finances for stocking were collected as licence tax of eel fishing gears (fykenets, longlines) of waterbodies where eel was stocked. Stocking quantities are listed in Tables 7 and 8. Estonia imported glass eel up to 1987 from France, thereafter from England. Young yellow eel (5–20 g) were imported from Germany in 1988 and 1995, from local fish farm in 2002–2010. Young eel were reared previously in a fish farm before stocking into lakes. During the period 2011–2014 the stocking of eel into L. Peipsi basin will supported by EFF up to 255 000 EUR (co-financing up to 1/3 of total annual financing).

In 1956 stocking of glass eel into L. Võrtsjärv was started. However, stocking has been irregular (Table 1). The stocking rate with glass eel in L. Võrtsjärv has been relatively low: annual average in 1956–2000 was about 37 ind.ha^{-1}yr^{-1} with a maximum of 80 ind.ha^{-1}yr^{-1} in 1976–1984. The peak of stocking with glass eels occurred in the early 1980s. As a result, during the following eight to twelve years the catches of eel were the highest, constituting 2.5 kg ha^{-1} yr^{-1}. The maximum catch of this fish in L. Võrtsjärv was recorded in 1988 (104 t or 3.7 kg ha^{-1}). From the end of 1980s the declared annual catch was decreased. Since 2005 in Estonia there was stocked only into lakes named in Table 2.

Table 1. Stocking of glass eel and young yellow eel in the Estonia (in millions).

	1950		1960		1970		1980		1990		2000		2010
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	young yellow eel
0			0,6		1		1,3				1,1		0,21
1							2,7		2			0,44	
2			0,9		0,1		3		2,5			0,36	
3							2,5					0,54	
4			0,2		1,8		1,8		1,9			0,44	
5			0,7				2,4			0,15		0,37	
6	0,2				2,6				1,4			0,38	
7					2,1		2,5		0,9			0,33	
8			1,4		2,7			0,18	0,5			0,19	
9									2,3			0,42	

Table 2. Stocking number of young yellow eel (10^3) into the lakes of Narva River Basin and stocking density in 2002–2010.

	Area											Stocking density	
Lake	(ha)	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total	sp/ha	sp/ha/year
Võrtsjärv	27 000	285	408	483	330	330	290	175	370	178	2849	106	12
Saadjärv	707	50	36	29,4	15	15	10	8,3	20,5	12,5	197	278	31
Kaiavere	250	20	25	22	10	10	10	4,5	12,1	7,5	121	484	54
Kuremaa	397	0	30	11,2	10	10	10	3	7,5	5,3	87	219	24
Vagula	519	6	20	19,6	10	10	8,1	2,6	8,4	5,7	90	174	19

Table 3. Stocking of glass eels in 1956–2000, yield 1964–2008 and recapture percentage in L. Võrtsjärv.

	Stocking rate		Yield		Recapture	
Stocking			average 8-12 years later		Reported	Estimated
period	sp/ha	sp/ha/year	kg/ha	kg/ha/year	%	%
1956–1960	29	5,7	0,8	0,2	4,9	6,1
1961–1970	156	15,6	11	2,2	12,9	16,1
1971–1980	392	39,2	19,1	1,9	7,0	11,1
1981–1990	585	58,5	14	1,4	4,5	7,4
1991–2000	489	48,9	8,5	0,9	4,2	6,0
Total	1611		53			
Mean		33		1,3	6	8,6

Percentage of re-capture was highest in 1970s (16,7) and lowest in 2000s (6,2) in Lake Võrtsjärv.

EE.3.5.2 Catch of eel <12 cm and proportion retained for restocking

There is no catch of eel <12 cm in Estonia.

EE.4 Fishing capacity

Potential eel fishing gear are dominated by fykenets in coastal waters and in some lakes of the basin. According to fishery law fykenets in coastal waters are divided into four groups: large fykes in deeper open waters; the height of mouth of fykenet is over 3 m; fykenets 1–3 m; fykenets with the height of mouth up to 1 m and small fykes in line. Only small fykes in line are focused on eel specially.

Table 4. Number of gear licences (professional) allocated for coastal waters in West-Estonian Basin in 2008.

AREA (COUNTY)	IDA-	LÄÄNE-	HARJU-	HIIU-	LÄÄNE-	PÄRNU-	SAARE-		TYPE	CATCH
Type of gear	Virumaa	Virumaa	maa	maa	maa	maa	maa	Total	%	%
Large fyke nets	30	30	80	250	30	487	130	1037	11	37
Fyke nets (1-3 m)*	20	75	61	65	85	131	265	702	7	38,7**
Fyke nets up to 1 m*	12	29	101	1000	70	315	197	1724	18	
Small fyke nets in line	5	5	80	1026	1890	550	1300	4856	50	21
Longlines (100 hooks)	2	25	76	200	130	835	208	1476	15	4
Total	69	164	398	2541	2205	2318	2100	9795		

*** Height of the mouth of fykenet**

****Total catch of fykes up to 1m and 1–3 m mouth height**

Table 5. Number of gear licences (professional) allocated for waterbodies in Narva River Basin in 2008.

TYPE OF GEAR	L. PEIPSI	L. VÕRTSJÄRV	NARVA R. AND RES.	SMALL LAKES AND RIVERS	TOTAL
Fykenet	901	324	40	144	1409
Longline (100 hooks)	10			26	36

Fykenets are potential eel fishing gear. In L. Peipsi and Narva reservoir eel type of fishing gear are not used specially for the catch of eel (Table 5).

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 the total number of fykenets was reduced to 324 (1.2 fykenets per km^{-2}) (Table 5).

In recreational fishing only longlines and harpoon are allowed to be used in Estonia.

Longlines are used only for sport fishing in L. Võrtsjärv. In 2003–2007 fishing effort was 500 fishing nights of 100 hooks per year and mean annual catch was 400 kg. In Vooremaa lakes licensed fishermen have 36 fykenets (2.6 fykenets per km^{-2}) and 3 eel boxes on the outflow. 20 licensed longlines (professional fishery) are not continuously in use. In 2007 there was used totally 40 licences of longlines (100 hooks) in two Vooremaa lakes, L. Saadjärv and L. Kuremaa. Both lakes are clear water lakes and therefore rather popular among underwater hunters. During 2007 there was given out 150 licences of harpoon and the total catch was 110 kg.

The proportion of amateur fishery from total eel catch in inland waters in 2005–2007 was 3,9 %.

Eel has a legal (minimum) size: 55 cm in L. Võrtsjärv and L. Peipsi, 50 cm in other Estonian inland waterbodies and 35 cm in coastal waters.

EE.4.1 Glass eel

There is no glass eel fishery in Estonia.

EE.4.2 Yellow eel

EE.4.3 Silver eel

EE.4.4 Marine fishery

EE.5 Fishing effort

EE.5.1 Glass eel

There is no glass eel fishery in Estonia.

EE.5.2 Yellow eel

EE.5.3 Silver eel

EE.5.4 Marine fishery

EE.6 Catches and landings

EE.6.1 Glass eel

There is no glass eel fishery in Estonia.

EE.6.2 Yellow eel

No distinction in catch statistics has been made between yellow and silver eels. Since 2008 in some eel lakes were estimated proportion of silver eel in commercial fykenet catches.

Table 6. Mean length (TL cm), weight (TW g) and proportion (%) of silver eel in fykenet catches in "eel lakes" of Narva River Basin in Autumn 2008.

			Proportion (%)	Number of
Lake	TL cm	TW g	of silver eel	measured eels
L. Võrtsjärv	58	412	41	199
L. Kuremaa	64	480	50	27
L. Saadjärv	70	608	94	69
L. Kaiavere	72	672	97	40

EE.6.4 Silver eel

50–80% of total eel catch in Estonia based on stocking (Table 7). 80% from registered catch of eel from small lakes and rivers originated from the three lakes (Kaiavere, Kuremaa and Saaadjärv) situated in the Vooremaa district.

Table 7. Catch of eel (in tons per year) in different water bodies of Estonia in 1993–2010 and proportion (%) of stocked eels.

Year	Baltic Sea	L. Võrtsjärv	L. Peipsi	Others	Total	Proportion (%) of stocked eels fromNarva RBD
1993	10	49	0,2		59,2	83
1994	10	36,9			46,9	79
1995	6	38,8		0,6	45,4	87
1996	20	34,1	0,1	1,2	55,4	64
1997	18,3	40,3	0,5		58,8	69
1998	22,2	21,8	0,2		44,2	50
1999	28,3	36,3	0,2		64,8	56
2000	26,7	38,9	0,2		67	60
2001	27,1	37,6	0.3	1,2	65,2	58
2002	27,3	20,4	0,2	2	50,3	46
2003	18,8	26,4	0,2	3,2	48,6	61
2004	15,6	20,1	0,3	3,2	38,9	60
2005	15,7	17,6		3	36,3	57
2006	9,6	19,9	0,1	3,1	32,7	71
2007	6,5	21,5	0,1	2,8	30,9	79
2008	4,8	19,9	0,1	4,5	30,4	81
2009	4,3	12,9	0,1	3,5	20,8	79

Table 8. Annual landings (in tons) from Lake Võrtsjärv.

Year	1933–39	1960	1970	1980	1990	2000	2010
0	1,8	0	6,5	17,8	56,1	38,8	
1	Mean	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	19,9	
9		5	45	47,6	35,2	12,9	

EE.6.4 Marine fishery

Eel catches by amateur fishermen, using mostly longlines, constitute totally about 1 t from brackish water and about 2 t from inland waterbodies.

Statistics of non-commercial catches is incomplete.

Table 9. Non-commercial catches (kg) of eel in ICES subdivisions in Estonian coastal waters in 2005–2007.

Year	28-2	28-5	29-2	29-4	32-1	32-2	Total
2005	46	231	88	57	49	9	480
2006	35	120	17	33	24	0	229
2007	37	84	32	18	30	1	202
Total	118	435	137	108	103	10	911
%	13,0	47,7	15,0	11,9	11,3	1,1	

EE.7 Catch per unit of effort

EE.7.1 Glass eel

There is no glass eel fishery in Estonia.

EE.7.2 Yellow eel

Data on cpue have only been available for combined commercial and recreational landings of yellow and silver eels.

EE.7.3 Silver eel

Data on cpue have only been available for combined commercial and recreational landings of yellow and silver eels. In logbook every professional fisherman 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. In 2000–2004 the mean annual catch of eel per fykenet in L. Võrtsjärv was 80 kg, in 2005–2008 60 kg.

Table 10. Cpue (catch in grams per 100 hooks per night during June–August) of longlines in inland waterbodies of different river basins (data from 2001–2008).

River basin	CPUE g	Number of Longlines	Catch kg	Sub-basin	Origin
Amme R.	1758	541,5	952	Peipsi	Stocked
Emajõgi R.	1071	135	145	Peipsi	Stocked
Võhandu R.	368	223	82	Peipsi	Stocked
Väike Emajõgi R.	1218	352	429	Võrtsjärve	Stocked
L. Võrtsjärv	1096	1330	1457	Võrtsjärve	Stocked
Õhne R.	836	44	36,8	Võrtsjärve	Stocked
L. Ermistu	800	4	3,2	Pärnu	Natural
Pärnu R.	421	67,5	29	Pärnu	Natural
Koiva (Gauja) R.	544	9	5	Mustajõe	Natural
Daugava R.	390	122	48	Mustajõe	Stocked
Salaca R.	0	6	0	Mustajõe	Natural

EE.7.4 Marine fishery

Data on cpue have only been available for combined commercial and recreational landings of yellow and silver eels.

Table 11. Cpue (catch in grams per 100 hooks per night during June–August) of longlines in coastal waters of Estonia (data from 2001–2008).

Area	CPUE g	Number of longlines	Catch kg
Väinameri	635	262	167
Saaremaa	612	489	299
Riga Bay	629	397	250
Mean/Total	623	1148	715

EE.8 Scientific surveys of the stock

The fish stock assessment programme of Fishery Department of 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 some other inland waters of Estonia.

EE.9 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. Due to the legal size of eel 55 cm and minimum legal mesh size in the codend of fykenet (18 mm knot to knot) 50–60% of eels in commercial catch in L. Võrtsjärv is silver eel. In Vooremaa lakes this proportion reaches up to 90%.

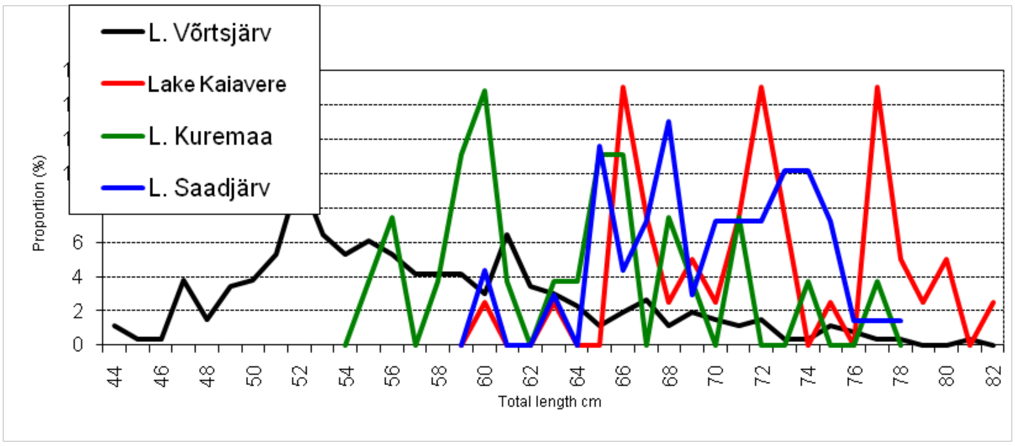

Figure 2. Length distribution of eel in fykenet catches in L. Võrtsjärv and in the lakes of Vooremaa district in September 2008.

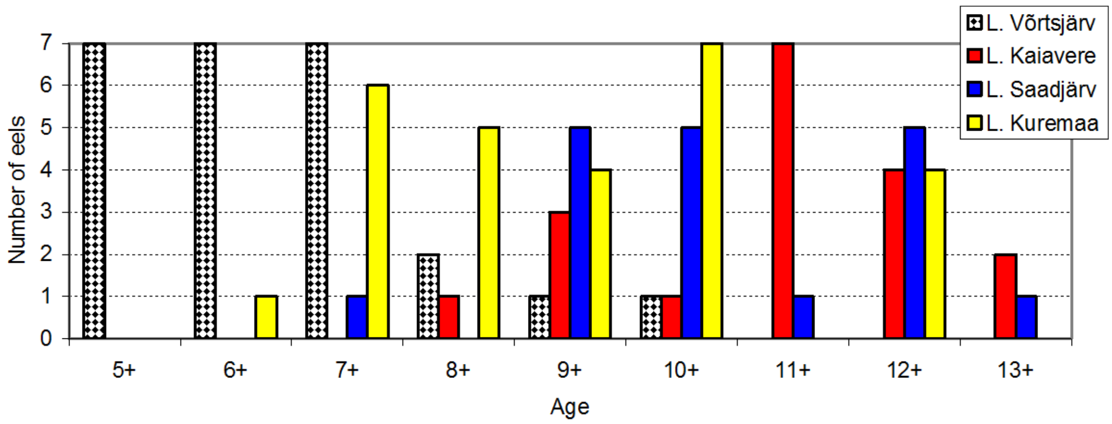

Figure 3. Age composition of eel in fyke net catches in L. Võrtsjärv and in the lakes of Vooremaa district in 2008.

EE.10 Other biological sampling

Until the end of the 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 catches 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 coastal waters was not done in Estonia.

EE.10.1 Length and weight and growth (DCR)

There is a sampling programme including measuring of length, weight and age determination of eel in L. Võrtsjärv and in small lakes.

EE.10.2 Parasites and pathogens

There are no routine programmes monitoring parasites and pathogens of eel in Estonia, except special investigations in the end of 1990s, 2002 and 2008–2009. Two articles were published during this period (see literature).

EE.10.3 Contaminants

There is no sampling related to contaminants and effects on eel in Estonia.

EE.10.4 Predators

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

In 2002–2008 was investigated feeding of pike in winter and the proportion of eel in it.

EE.11 Other sampling

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

1) Re-stocking results in small lakes;
2) Food resources of eel in waterbodies suitable for stocking;
3) The distribution of eel and long-term re-stocking results in L. Peipsi and L. Võrtsjärv basin;
4) Downstream migration of silver eel;
5) Mark-recapture estimation of yellow and silver eel.

Registration of fishing efforts, investigation of catch composition, etc. is well organised in inland waters, but in coastal waters it should be monitored better.

Positive effect of restocking is clear and it is therefore recommended to continue the existing restocking according restocking programme. There is urgent need for monitoring of restocking results more detail, especially survival using marking of the whole amount of stocking material. Silver eel migration is necessary to continue and start with a pilot study for quantifying angling catch and effort.

EE.12 Stock assessment

EE.12.1 Local stock assessment

EE.12.1.1 Habitat

EE.12.1.2 Silver eel production

EE.12.1.2.1 Historic production

Historically eel was one of the most important fish species in coastal waters of Estonia. Before the Second World War (1938) the total annual catch of eel in Estonia exceeded 500 tons (Kint, 1940). In 1950s total catch decreased to one hundred ton and continues to decline up to 20 t in the end of 1970s. In 1980s the eel catch increased again up to 30 tons (Figure 13). Shallow coastal waters close to western inlands and Väinameri (Figure 12) were most productive areas at that time and there are biggest catches of eel at the present also.

According to A. Kangur (1998) the annual fishing return in L. Võrtsjärv has considerably changed. The specially high values (8,4–8,7%) were noticed at the end of 1970s and in 1980s (5–6,6%). Since the beginning of 1990s until the end of glass eel stocking fishing return decreased (4%). During long-term glass eel stocking period (1965–2001) the effectiveness of stocking (the number of glass eels required to produce 1 kg of eel catch) was 32 (Kangur, 2002). As in this period the legal size of eel was 60 cm and mean weight in fykenet catches was 0,5 kg, there was recaptured one silver eel per 16 stocked glass eels or mean recapture percentage was 6,3.

EE.12.1.2.2 Current production

In Spring 2007 81 Carlin-tagged eels over legal size (>55 cm) were stocked into L. Võrtsjärv (Table 11). During the same year 12 eels (14,8%) were recaptured and annual catch of eel was 21,5 tons. In 2007 mean weight of eel in the fykenet was 430 g and total catch in numbers was 50 thousand. According to the recapture percentage there was over 330 000 eels over mean length at first capture 50 cm in the lake. Similar results from years 2008–2009 (Table 12). On the basis of mark-recapture results approximately 85% of silver eel emigrating L. Võrtsjärv via Emajõgi R. to L. Peipsi and therefore via Narva R. to Gulf of Finnland. As it is not allowed to have fishing gear closer than 200 m from both side of outflow, entrance into river for migrating fish is free. There are 60 fykenet licences in Emajõgi R. (100 km), but 2/3 of riverbed should be left open. According to official statistics the total catch of eel in Emajõgi R. was 50–150 kg yr^{-1} in 1996–2007, in L. Peipsi 100–500 kg yr^{-1} (Table 7).

Table 12. The number of tagged and recaptured eels, annual catch in kilos and numbers, total number of eel over mean length at first capture (50 cm) in fykenet catches in L. Võrtsjärv in 2007–2009.

Year	Tagged eels in the lake	Number of recapture	Percentage of recapture	Annual catch kg	Mean weight of eel g	Yield in number	Total number of eels (>50 cm)
2007	81	12	14,8	21 500	430	50 000	337 838
2008	96	12	13,2	19 900	425	46 824	354 727
2009	150	10	6,7	12 580	500	25 160	377 400

EE.12.1.2.3 Current escapement

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. As a result, eel almost disappeared from the fish fauna of Estonian large lakes.

To investigate the downstream migration of silver eel from L. Võrtsjärv and L. Peipsi and their possibility to go through the turbines there was tagged 146 eels. All specimens were tagged with Carlin-type of tags, among them seven specimens with radio telemetric tags. Release of label-tagged eels into Narva water reservoir took place in November 2006 and in June 2007. In spite of low intensity of catch with eel-type fishing gear in Narva River, there were recaptured four label-tagged eels downstream of the station in 2007–2009. One eel was recaptured in Finnish Gulf near the river mouth Purtse. During 2007–2009 three large eels with Carlin tag and one small eel (82 g) have been caught in Danish Straits. The smallest recaptured specimen was brought directly from fish farm and was released into L. Võrtsjärv in 2008. During a year of migration the lost in weight was 44 g (initial weight 126 g). As most of tagged eels were yellow eels, the recapture outside of the lake of release is still low, except Narva reservoir (Table 13, Figure 4).

In November 2007 there was observed also survival and behaviour of seven eel equipped with transmitters after coming through the turbines using manual registration of migration. As minimum four of the radio-tagged eel came through the turbines alive and without any damage. Three of them were caught back in Narva R. after two months in winter and one next summer close to island Saaremaa.

During the last years the total catch and the part of natural population of eel in Estonian coastal waters is decreasing, but the proportion of stocked eel caught in Finnish Gulf mostly emigrating Narva RBD, is increasing.

Table 13. Release of tagged eel in Estonian inland waterbodies, recapture and repeated recapture in the same lake or outside of the waterbody of release in 2006–2010.

Water body of release	Number of tagged eels	First recapture	Second recapture	Third recapture	Total recapture	Percentage of recapture	Recapture outside of waterbody of release
Narva Reservoir	139	8	0	0	8	5,8	7
Ivangorod HPS	7	4	0	0	4	57,1	1
Lake Võrtsjärv	526	77	7	0	84	16,0	2
Lake Saadjärv	98	10	0	0	10	10,2	0
Lake Kuremaa	113	26	5	1	32	28,3	1
Lake Kaiavere	53	4	0	0	4	7,5	0
Lake Vagula	38	1	0	0	1	2,6	0
River Emajõgi	25	0	0	0	0	0,0	0
Total	999	130	12	1	143	14,3	11

Figure 4. Waterbodies of release (blue – L. Võrtsjärv; red – L. Kuremaa; yellow – Narva reservoir) and recapture of eel outside of Narva RBD.

EE.12.1.2.4 Production values e.g. kg/ha

No information available.

EE.12.1.2.5 Impacts

No information available.

EE.12.1.2.6 Stocking requirement eels <20 cm

Since 2001 only farmed eel were stocked, mean weight 5g. According to the plan, there is requirement to stock at least 0,5 million farmed or 2,5 million glass eels into Estonian lakes.

EE.12.1.2.7 Data quality issues

No information available.

EE.13 Sampling intensity and precision

No information available.

EE.14 Standardisation and harmonisation of methodology

On the bases cpue of longlines catches in lakes and coastal waters were estimated relative abundance in different areas (Tables 10 and 11).

EE.14.1 Survey techniques

No surveys or samples are done.

EE.14.2 Sampling commercial catches

Section 9.

EE.14.3 Sampling

No surveys or samples are done.

EE.14.4 Age analysis

Section 9.

EE.14.5 Life stages

No surveys or samples are done.

EE.14.6 Sex determinations

No surveys or samples are done.

EE.15 Overview, conclusions and recommendations

The natural status of eel stock in Narva River Basin before the construction of hydropower station was not very abundant (annual catch 1,8 tons L. Võrtsjärv and 3–6 tons L. Peipsi), therefore the contribution into recruitment was tenth of times lower than at present. Due to permanent stocking and rather fetterless downstream migration, the 40% escapement objective of silver eel in Narva River Basin is achieved. On the basis of financing of local fishermen the present escapement capacity exceed the historically natural escapement several times and there is no need of reduction in fishing effort. The main proposal is to increase annual stocking amount of eel in the waterbodies of Narva River Basin and to enhance the stocking with additional financing. The hydroelectric power station lying on Russian side totally hindered the natural pass of eel into Narva River Basin. Therefore without stocking huge area (ca 4000 km^2 of suitable habitat for eel will be cut off for recruitment.

According to tagging and recapture results more than 2% of silver eel escaped from Narva River Basin were caught in Danish Straits.

As in most of fykenets used in coastal waters eel is a bycatch and it consists of less than 1% of the total, thus there is no need to diminish the number of licences of those gear, except small fykes in line what are focused on catch of eel. In 2009 the number of licences of small fykes in line where diminished approximately 15% already. For 2013 this number will diminish up to 45% of present number. Catch of eel in West-Estonia, mostly in coastal waters, should to be less than 6 tons per year, set in relation to the catches in 2004–2006 (12 tons). Actually, the requirement of 50% reduction in eel catch in maritime areas is followed up to now already as the yield of eel in coastal waters was 4.8 tons, in 2008. In spite of this there will be diminished licences of small fykes 55%. In case of the increase of eel catches in coastal waters of Estonia the number of licences of small fykes will be diminished up to zero or additionally will diminished other types of fykenets, mostly fykes with mouth height up to 1 m.

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