Report on the eel stock, fishery and other impacts, in:

Estonia

2024

Note to the reader – this document accompanies a series of spreadsheet tables that provide the bulk of the data in a format most suitable for the working practices of WGEEL. Summaries of these data are provided in this document

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Reporting Period: This report was completed in September 2024, and contains data up to 2023.

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1 Updates to the previous report

All tables and figures have been updated with the most recent data that is available.

2 Stock status summary

The age determinations show that in the case of Lake Võrtsjärv, the migration of silver eels from the lake begins at the age of 9 years, whereas age groups 6-8 are making up the majority (72.4%) of catches. A slight increase in the catches of 9-year age group (13.3% of catches) was once again present in 2023 compared to 2022 due to large restocking numbers during 2014-2015. It is known from previous studies that mortality on the migration route is caused by the turbines of the Narva Hydroelectric Power Station, which all migrating silver eels must pass through. In addition, the biomass of the migrating eel is also affected by fishing mortality on the migration route from Emajõgi through Lake Peipsi to Narva Bay, which has been assessed by the study "Success of the catadromous migration of the European eel (*Anguilla anguilla*) in the Peipsi basin" conducted by the Estonian University of Life Sciences and Wildlife Estonia in 2019-2021. This study estimated the combined fishing mortality on the migration route during the period 2019-2021 as F=0.08, which in turn must be added to the mortality caused by the commercial fishing in the restocking water bodies. The size of the biomass of migrating eel in the Narva RBD depends primarily on the number of eels restocked annually, which have increased significantly since the beginning of the 2010s compared to the first decade of the 2000s. At the same time, knowledge about the possible mortality of eels during migration has improved, which is why the corresponding estimates of both fishing and other anthropogenic impacts have also changed.

Table 1. Stock indicators of silver eel escapement, biomass and mortality rates, and assessed habitat area.

Year	EMU_code	Assessed Area (ha)	B_0 (kg)	B_{curr} (kg)	B_{best} (kg)	Bcurr/B_0 (%)	∑F	∑H	∑A
2018	EE_Narv	1887800	90000	52341	64547	58	0.09	0.12	0.21
2019	EE_Narv	1887800	90000	65779	82658	73	0.08	0.12	0.20
2020	EE_Narv	1887800	90000	66952	93616	74	0.16	0.12	0.28
2021	EE_Narv	1887800	90000	73986	103672	82	0.17	0.12	0.29
2022	EE_Narv	1887800	90000	72014	101907	80	0.17	0.12	0.29
2023	EE Narv	1887800	**90000**	**81382**	**111751**	**90**	**0.15**	**0.12**	**0.27**
2018	EE_West	3650000	x	x	x	x	x	x	x
2019	EE_West	3650000	x	x	x	x	x	x	x
2020	EE_West	3650000	x	x	x	x	x	x	x
2021	EE_West	3650000	x	x	x	x	x	x	x
2022	EE_West	3650000	x	x	x	x	x	x	x
2023	EE_West	3650000	x	x	x	x	x	x	x

Key:
EMU_code = Eel Management Unit code (see Table 2 for list of codes); B_0 = the amount of silver eel biomass that would have existed if no anthropogenic influences had impacted the stock (kg); B_{curr} = the amount of silver eel biomass that currently escapes to the sea to spawn (in the

assessment year) (kg); B_{best} = the amount of silver eel biomass that would have existed if no anthropogenic influences had impacted the current stock (kg); ∑F = mortality due to fishing, summed over the age groups in the stock (rate); ∑H = anthropogenic mortality excluding the fishery, summed over the age groups in the stock (rate); ∑A = all anthropogenic mortality summed over the age groups in the stock (rate); Assessed area (ha) = combined area total (ha) of transitional and inland waters.

3 Overview of the stock and its management

3.1 Describe the eel stock and its management

Management of the eel stock in Estonia is under the control of Estonian government. There are fishery departments in the Ministry of Regional affairs and Agriculture which handle matters such as restocking, fishing licenses, gear, and fish legal size limit restrictions. Gear and size restrictions apply in eel fisheries. The lowest legal size of the eels caught in the coastal sea is total length (TL) = 35 cm and for inland waterbodies (excluding Lake Võrtsjärv, L. Peipus, and L. Pskov where the limit is 55 cm) the size limit is TL = 50 cm. Since 2008, the number of licences issued for small fyke nets in the coastal areas has been reduced by 50%. Since 2011 Lake Võrtsjärv Fisheries Development Agency (FDA) is responsible for restocking of glass/young yellow eel. Since 2008, the number of licences issued for small fyke nets in the coastal fisheries has been reduced by 50%.

Commerical eel fisheries in Estonia are roughly divided in two:

1. Freshwater eel fishery (10-55 t/year, 2006-2023) – occurs in Narva RBD. All of the eel caught is of restocked background. Occasionally eel is caught from Lake Ermistu which has a possible connection with the sea in the West-Estonian basin.

2. Coastal sea eel fishery (0.5-10 t/year, 2006-2022) – occurs in the coastal waters of Estonia. Eel is not targeted by the fishery and mostly registered as bycatch in fyke nets. Eels both of natural and restocked origin are being fished.

Long lines with 100 hooks per line and harpoons are used in recreational eel fisheries. Eel fisheries in Estonia are described in more detail in paragraph 3.1.

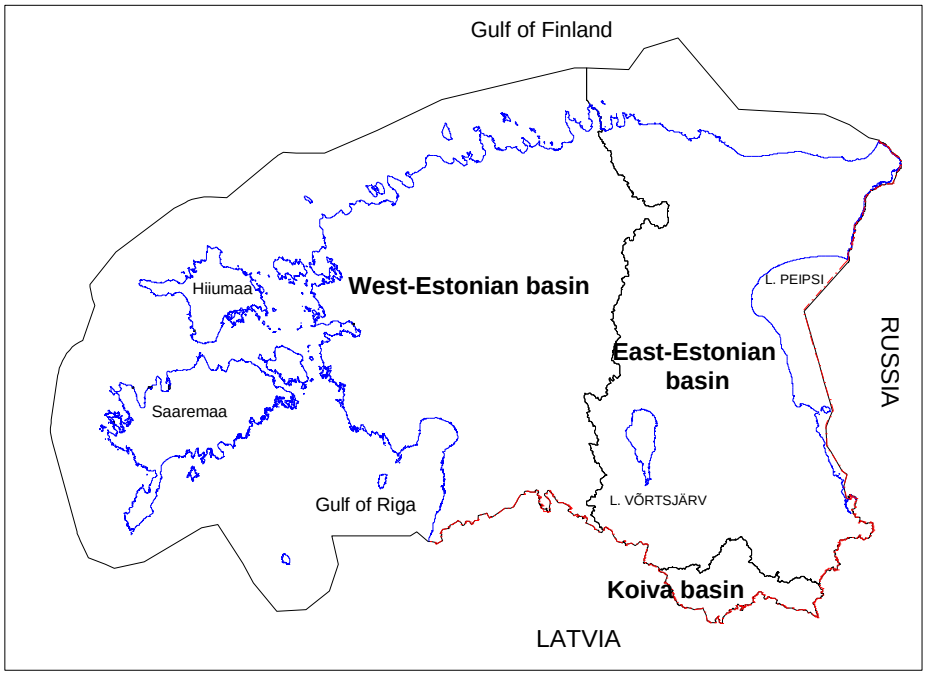

Figure 1. Map of basins. Note that East-Estonian basin and West-Estonian basin correspond to Narva RBD and West-Estonian RBD according to Estonian Eel Management Plan.

According to ordinance of government (RT I 2010, 64, 477) and Water Framework Directive the territory of Estonia is divided into 3 basins (Figure 1) and 8 sub-basins. Basins and sub-basins are not directly connected to one river, as in European scale Estonian rivers are very small, except River Narva and its watershed area (1/3rd of territory of Estonia and shared with Russia and Latvia). Other more important rivers are River Pärnu, River Kasari and River Gauja, last of which is shared with Latvia (not incl. to the EMP).

Estonia submitted its national Eel Management Plan (EMP) in accordance to the Regulation EC No 1100/2007 establishing measures for the recovery of the stock of European eel on 31st of December 2008 and this plan was approved by the European Commission on 30th of November 2009 (Report of…, 2015).

3.2 Significant changes since last report

4 Impacts on the stock

4.1 Fisheries

The total capacity of the coastal fishery in 2023 was 1061 commercial fishermen/companies. 167 commercial fishermen/companies of the coastal fishery reported eel with an average catch per fisherman/company of 14.5 kg/year in 2022. The total capacity of the freshwater fishery in 2022 was 373 commercial fishermen/companies. 96 commercial fishermen/companies of the freshwater fishery reported eel in their catch. In the freshwater fishery 97% (55.2t) of the eel was caught from Lake Võrtsjärv, the rest (1.9 t) from Lake Peipsi and other smaller lakes. This information is collected by Estonian Agriculture and Food Board. Register is updated every

year and available online at https://pta.agri.ee/ettevotjale-tootjale-ja-turustajale/kutseline-kalapuuk/puugiload-ja-voimalused and https://pta.agri.ee/ettevotjale-tootjale-ja-turustajale/kutseline-kalapuuk/puugistatistika (both in Estonian). Records are kept over the number and type of gears used. Data from fishermen is collected electronically via PERK system and the collected information is uploaded twice a year. Eel landings in Estonian waters are brought out in Figure 2 and Table 2.

Figure 2. Eel landings (tons) in different water bodies of Estonia in the period 1993-2023.

Table 2. Eel landings (tons) in different water bodies of Estonia in the period 1993-2023 and proportion (%) of restocked eels in the reported landings (landings in fresh- vs coastal waters).

Year	Baltic Sea	L. Võrtsjärv	L. Peipsi	Other freshwaters	Total	Proportion (%) of restocked eels in reported landings
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	19.7	34.1	0.1	1.2	55.1	64
1997	18.3	40.3	0.5		59.1	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	1.2	67	60
2001	27.1	37.6	0.3	2	67	58
2002	27.3	20.4	0.2	2	49.9	46
2003	18.8	26.4	0.2	3.2	48.6	61
2004	15.6	20.1	0.3	3.2	39.2	60
2005	9.4	18.2	0.1	3	30.7	69
2006	9.2	20.3	0.1	3.8	33.4	73
2007	6.3	21.7	0.1	3	31.1	80
2008	5.3	20.5	0.1	4.7	30.6	83
2009	4.4	13.6	0.1	4	22.1	80
2010	3.6	10.3	0.1	4.9	18.9	81
2011	2.2	11.3	0.1	2.6	16.2	86
2012	1.9	12.6		3.2	17.7	89
2013	1.7	12.7		3	17.4	90

2014	1.1	13.3		2.3	16.7	93
2015	0.8	12.06	0	1.29	14.15	94
2016	0.8	13	0	1.4	15.2	95
2017	0.7	13.8	0	1.2	15.7	96
2018	0.5	16.7	0.1	1.1	18.4	97
2019	0.9	19.6	0.1	1.0	21.6	96
2020	1.5	35.8	0.04	1.45	38.79	96
2021	1.9	44.8	0.08	1.1	47.9	96
2022	1.5	50.9	0.14	1.2	52.3	97
2023	2.4	55.2	0.19	1.65	59.45	96

In Estonia, both silver- and yellow eels are reported together in commercial fishery so no separate data for silver- or yellow eel in commercial landings is available.

Long lines with 100 hooks per line and harpoons are used in recreational eel fisheries. Both mentioned types of gear require applying for a fishing card, which is issued for a fee by the Estonian Environmental Board. Fishing cards require reporting of catch. However eel can also be caught by fishing rods with hook and sinker rig, which require paid recreational fishing rights but reporting of catch is voluntary. Time series for reported recreational eel catch in the period 2005-2022 is brought out in Figure 3. It can be seen that recreational eel catches in coastal waters are almost non-existent compared to their freshwater counterparts. This is possibly due to low number of eels inhabiting the coastal areas combined with less recreational fishermen actually fishing for eels.

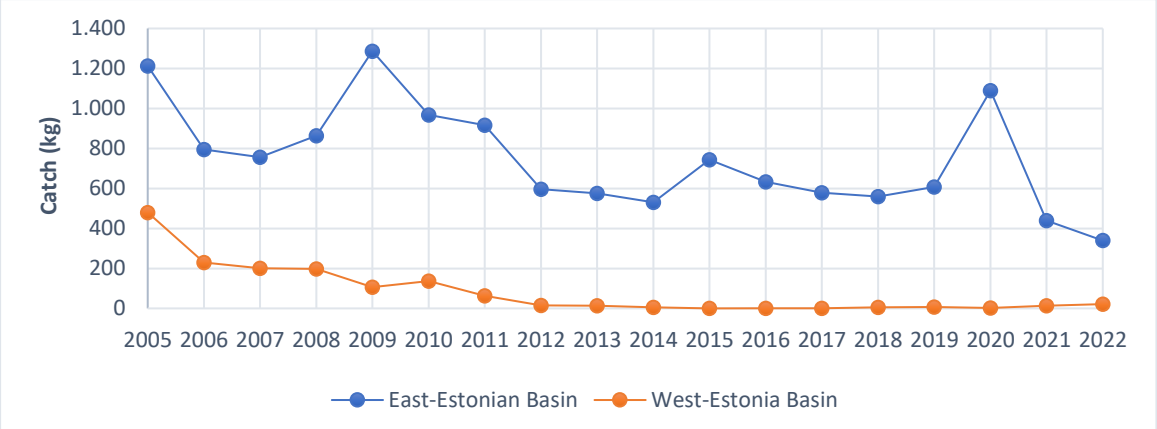

Figure 3. Recreational catch during period 2005-2022 in the Estonian Eel Management Units.

4.1.1 Glass eel fisheries

NO DATA AVAILABLE

4.1.2 Yellow eel fisheries

NO DATA AVAILABLE

4.1.3 Silver eel fisheries

NO DATA AVAILABLE

4.2 Restocking

In Estonia, eels are restocked into the waterbodies of Narva RBD. Waterbodies in the Narva RBD include L. Võrtsjärv, L. Saadjärv, L. Kaiavere, L. Kuremaa and L. Vagula. Restocking of eels into the RBD has been a tradition since 1956 and from 1970s restocking has taken place annually (Table 3). Depending on availability of finances and restocking material either glass eels or ongrown eels have been restocked. In 2023 approximately 1070880 glass eels (357 kg) were restocked into water bodies of Narva RBD. Restocking activities took place mostly in the end of February and to a lesser extent in April. Glass eels were provided by Earl Aguirrebarrena (France).

Table 3. Restocking of glass eel and ongrown eel in the Narva RBD in Estonia (in 10^6).

	1950		**1960**		**1970**		**1980**	
	glass		**glass**		**glass**		**glass**	
year	**eels**	**elver**	**eels**	**elver**	**eels**	**elver**	**eels**	**elver**
0			0.6		1		1.3	
1							2.7	
2			0.9		0.1		3	
3							2.5	
4			0.2		1.8		1.8	
5			0.7				2.4	
6	0.2				2.6			
7					2.1		2.5	
8			1.4		2.7			0.18
9								
	1990		**2000**		**2010**		**2020**	
	glass		**glass**		**glass**		**glass**	
year	**eels**	**elver**	**eels**	**elver**	**eels**	**elver**	**eels**	**elver**
0			1.1			0.21	2.03	
1	2			0.44	0.68	0.2		0.08
2	2.5			0.36	0.91	0.12	1.07	
3				0.54	0.89	0.13	1.07	
4	1.9			0.44	3	0.19		
5		0.15		0.37	1.87			

6	1.4			0.38	0.9	0.22		
7	0.9			0.33		0.31		
8	0.5			0.19	1.4			
9	2.3			0.42	1.58			

4.3 Aquaculture

NO DATA AVAILABLE

4.4 Entrainment

See 2020 Country Report

4.5 Habitat Quantity and Quality

See 2020 Country Report

4.6 Others

NO DATA AVAILABLE

5 National stock assessment

5.1 Description of Method

5.1.1 Data collection

Data is collected by regular fyke nets annually during the fishing season (may-september). 100-200 specimens are collected from commercial fishermen to measure length and weight. Up to 3 regular fyke nets (mouth opening 1-3 m, mesh size in the cod end > 16mm) set in different locations in L. Võrtsjärv are used for collecting scientific samples. Eel samples from the scientific fyke net in L. Võrtsjärv are analysed for length and weight along with the CPUE. Sex, silvering stage and infection intensity of *A. crassus* parasites is determined. Otoliths are collected for age reading and micro-chemical analyses.

Enclosure fyke net system was used on the small lakes of Narva RBD in 2018. The methodology was modified after Ubl & Dorow (2015). A random fishing area was selected taking the depth (as the leader nets of the system are 1.8 m high, the sampling spot should not be very deep) into account. The system was set for one week per sampling spot. Samples were collected twice a week. All eels caught were measured and weighted. Sex and silvering stage was determined. Also the occurrence of parasites and the type of food ingested was recorded. From a select sample, otoliths were extracted for age reading and possible micro-chemical analyses. Samples were taken from May until the middle of October 2018. Collected otoliths were etched and stained with 1% HCl acid and neutral red solution according to the Swedish method (ICES, 2009).

West – Estonian RBD: University of Tartu was responsible for the scientific monitoring of eel. Small fyke nets were used for annual monitoring. 6 monitoring areas in the coastal waters have been surveyed since 1998. The gear is 55 cm high with a semi-circular opening and a leader or wing that is 5 m long. Fykes are made of 17-mm mesh in the arm and 10-mm in the cod-end. Mostly yellow eel were caught using this gear. Catch per unit effort (CPUE) data were presented

as an average number of eels caught per fyke/day by study years and monitoring areas (Bernotas *et al*, 2016).

5.1.2 Analysis

Enclosure fyke net system (Ubl & Dorow, 2015) was used to determine approximate number of eels per hectare in L. Võrtsjärv in 2016-2017. Escaping silver eel biomass was calculated using these variables:

N – number of eels in lake according to enclosure fyke net catches

Ni – number of i-age group eels in the lake

F – commercial fishing mortality for given year

Fi – commercial fishing mortality of i-age group eels for given year

Pi – proportion of i-age group eels in commercial landings (%)

NRi – corrected number on i-age group eels in commercial landings according to enclosure fyke net data

Ji – number of i-age group eels in the lake after subtracting commercial fishing mortality for given year

Vi – escapement of i-age group eels for given year

k – correlation coefficent

M – natural mortality

$$F_i = \frac{F \times P_i}{100}$$

$$N_i = \frac{N \times P_i}{100}, if\ i = 9 - 14\ years$$

$$N_i = N_{i+1}\frac{Fi}{0{,}9}, if\ i = 6 - 8\ years$$

$$NR_i = N_i \times k, where\ k = \frac{N}{\sum_{i=6}^{14} N_i}$$

$$Ji = NR_i - F_i - M \times NR_i$$

$$V_i = J_{i-1} - J_i, if\ i = 10 - 14\ years$$

Analysis of mortality caused by hydropower facilities is described in paragraph 3.4.

5.1.3 Reporting

Results are reported annually to the Agriculture and Food Board and ICES.

5.1.4 Data quality issues and how they are being addressed

As of now, yellow and silver eel are reported together in commercial landings, which makes silver eel escapement calculations based on the commercial landings data difficult. Also under-

reporting exists in commercial landings. Data on recreational fisheries exists only for fishers who use gear that requires a fishing card (long lines and harpoons), other recreational catches go unreported.

5.2 Assessment results

The number of restocked specimens increased during the period 2011-2015 compared to the first decade of 2000s and this also reflects in the increased biomass estimators. Subsequently the biomass estimators (B_{curr} and B_{best}) in Narva RBD increased to new heights in 2023 (Figure 4). In Lake Võrtsjärv, most of the eels restocked are glass eels, which have a faster growth in comparison with elvers (Silm et al, 2017). This has also an effect on the distribution of age groups in the commercial catches where prevailing age class is 7. We have determined that eels in either FIV or FV silvering stage have an average age of 9 years (with a mean weight of 704 g) which can be counted as the mean age for the start of migration from the lake. As the assessment depends on the data of commercial landings which are under-reported an overestimation of B_{curr} appears affecting also the value of ∑A. However it is difficult to assess the proportion of over-estimation as the dimension of under-reporting in unknown.

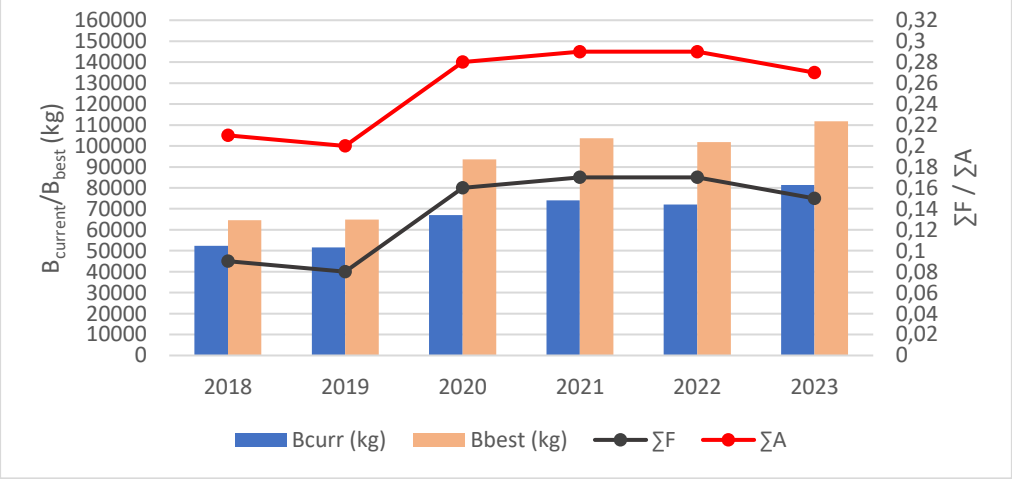

Figure 4. Changes in the amount of silver eel biomass that currently escapes to the sea to spawn (in the assessment year; $B_{current}$), the amount of silver eel biomass that would have existed if no anthropogenic influences had impacted the current stock (B_{best}), ∑F = mortality due to fishing, summed over the age groups in the stock (rate), ∑A = all anthropogenic mortality summed over the age groups in the stock (Hydroelectric dam + fishing mortality).

6 Other data collection

6.1 Recruitment time series

NO DATA AVAILABLE

6.2 Yellow eel abundance surveys

See ICES, 2018.

6.3 Silver eel escapement surveys

See chapter 4.1.2

6.4 Biological parameters

In 2023 survey fyke net catches on L. Võrtsjärv were carried out from April to October. During that time period 579 eels were caught out of which 96% were above legal size limit (TL≥55 cm; Figure 5). The mean length of the caught eels was 62.3 cm and weight 492.5 g, which is a decrease (-53.7 g) compared to 2022. Average Fulton condition index of the measured specimens was K=0.2.

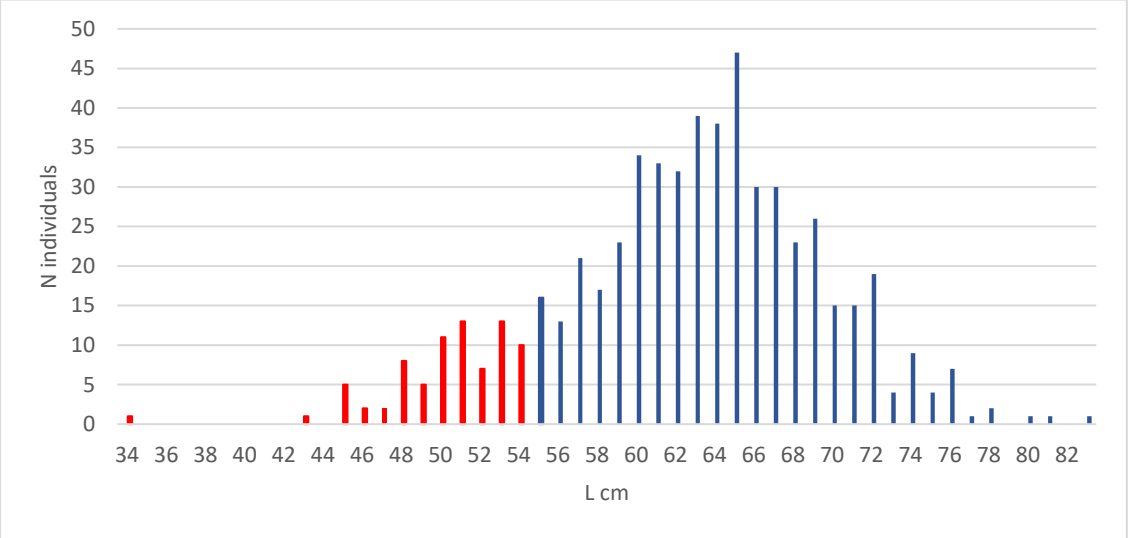

Figure 5. Overview of eel length distribution in Lake Võrtsjärv in 2023. Red bars indicate specimens under legal size limit (under TL=55cm).

Among the age groups, 5–12-year-old fish were present in the survey catches, with 7+ age group being the most abundant (Figure 6). The 8+ age group was made up of eels restocked in 2016 (when 900,000 glass eels and 220,000 pre-grown eels were restocked).

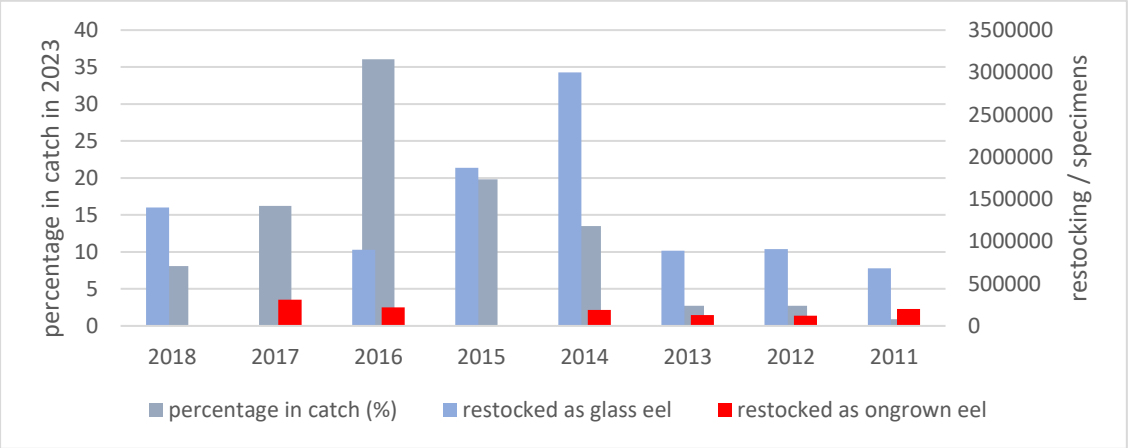

Figure 6. Proportion of different eel generations in the 2023 survey fyke net catch in Lake Võrtsjärv. Blue bars denote the proportion of age class in the catch and correspond to the scale on left. Light blue and red bars correspond to the scale on left and denote which stage of eel was restocked.

Eels of FII stage (54.8%) made up most catches in the survey fyke net. FIII stage (26.47% of catches) eels were less present than in 2021. The number of FIV and FV stage silver eels had increased compared to 2022 probably due to the strong stock of 2014 getting ready for migration.

In the commercial fishermen fykes however samples collected from different parts of the lake showed that the catch was made up of stage FII (85%) and FIII (11%) fish. The parameters corresponding to the development stage in the samples analysed in 2023 are presented in Table 4, and the length distribution according to the age group in Figure 7.

Table 4. Mean ages and lengths of caught eels according to silvering stage in Lake Võrtsjärv in 2023 (N=374).

Silvering stage	Mean age	Min age	Max age	Average length cm
FII	7	5	10	59.5
FIII	8.5	6	11	68.2
FIV				77.7
FV	8.4	6	12	65
MD	5	5	6	49.7

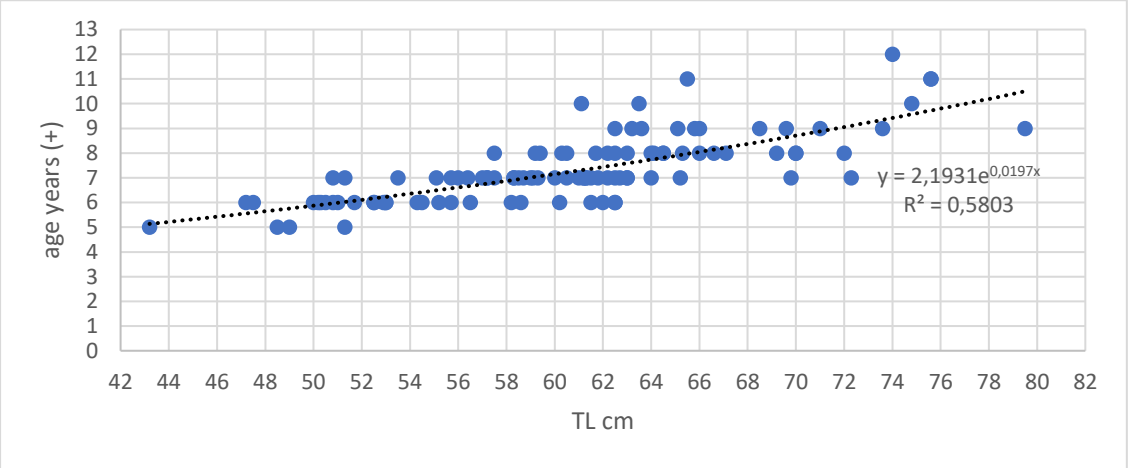

Figure 7. Total length of eels (N=111) according to age groups in Lake Võrtsjärv in 2023

In the West-Estonian RBD the CPUE of survey fyke nets stayed at a very low level in 2023, similar to 2022 (R. Eschbaum, *unpublished data*, Figure 8). In the last 3 years the most productive sampling area in terms of fyke net CPUE is near the island of Vilsandi on the western edge of Estonia. Vilsandi, along with Kõiguste were the only sampling points where eel was caught in 2023.

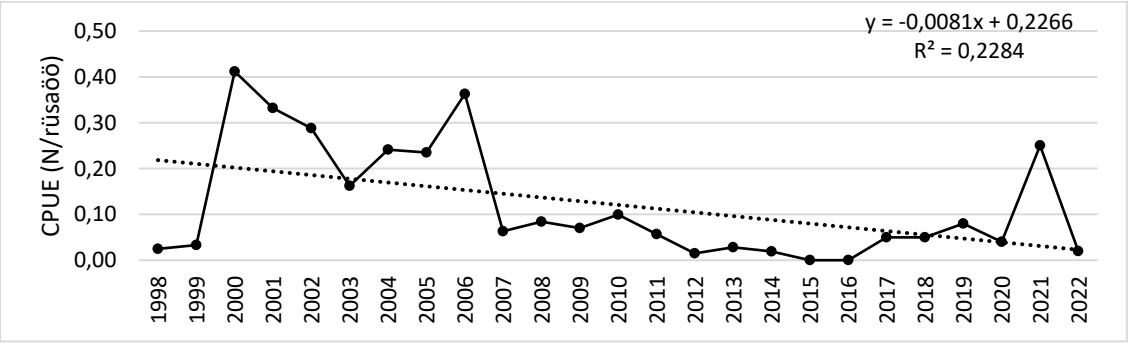

Figure 8. Eel CPUE of small fyke nets set in coastal monitoring areas from period 1998-2023 (R. Eschbaum, *unpublished data*).

6.5 Parasites & Pathogens

In order to study the prevalence of swim bladder parasite *Anguillicoloides crassus* in Lake Võrtsjärv, survey fyke net samples (N=235) were analysed. A total of 64% (N=151) of the analysed eels were infected with the parasite, which is a slight decrease compared to 2022 infection rates (-5%). The infection intensity stayed at a similar rate as last year, at 6.6 parasites per fish (Figure 9).

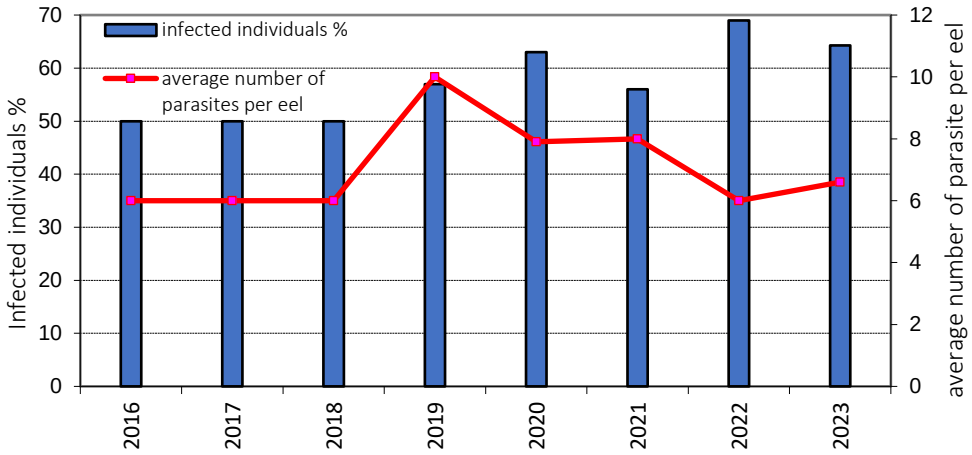

Figure 9. Percentage of eels infected with *A. crassus* in L. Võrtsjärv during 2016-2023 indicated by blue columns according to the scale on the left. Red line indicates the infection intensity, illustrated by the red line according to the scale on the right.

6.6 Contaminants

NO DATA AVAILABLE

6.7 Predators

NO DATA AVAILABLE

7 New Information

The Estonian Eel Management Plan, which has been used for eel management since 2008 is currently being updated.

8 References:

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