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

Sweden

2023-2024

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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Contents

1 Summary of national and international stock status indicators

1.1 Escapement biomass and mortality rates

The most recent assessment was made in 2024 (van Gemert et al., 2024). All impacts throughout the eel's life were accounted for in the assessment (van Gemert et al. 2024). For the Baltic coast (SE-East), these impacts often take place in other countries in the Baltic region – and noting that those impacts remain unquantified for the Baltic Sea as a whole, indicators were reported as "not available" (the impact of the Swedish fishery was reported separately, as F_{SE}). For the west coast (SE-West), the current absence of a commercial eel fishery means that no biomass indicators can be derived due to lack of data. The stock indicators of the 2024 assessment are shown in Table SE. 1.

Table SE. 1: Stock indicators of silver eel escapement, biomass and mortality rates, and assessed habitat area. The Inland EMU indicators are shown both with (+) and without (-) the effect of restocking.

Year	EMU_code	Assessed Area (ha)	B_0 (kg)	B_{curr} (kg)	B_{best} (kg)	Bcurr/B_0 (%)	∑F	∑H	∑A
2023	SE-West	NP	NA	NA	NA	NA	0	0	0
2023	SE-Inland+	1 800 000	556 000	84 000	281 000	15.1	0.34	0.86	1.21
2023	SE-Inland-	1 800 000	300 000	7 260	25 000	2.4	0.34	0.86	1.21
2023	SE-East	NP	NA	3 677 000	NA	NA	NA	NA	NA

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.

1.2 Recruitment time series

The WGEEL uses these time series data to calculate the Recruitment Indices, relative to the reference period of 1960-1979, and the results form the basis of the annual Single Stock Advice reported to the EU Commission. These recruitment indices are also used by the EU CITES Scientific Review Group in their annual review of the Non-Detriment Finding position.

The Swedish input to international (WGEEL) recruitment series is based on data on the catch of glass eels in the open sea of the Skagerrak-Kattegat (former ICES YFS, now IBTS, 1st quarter, Figure SE. 1), the catch of glass eels at the Ringhals nuclear power plant (Figure SE. 2), and the amounts of ascending young eels from eel passes in several rivers along the Swedish coast (Figure SE. 3, Figure SE. 4).

Recruitment of glass eel (truly unpigmented) to the Swedish west coast, is monitored at the intake of cooling water to the Ringhals nuclear power plant at the Kattegat shore (Figure SE. 2). The sampling at Ringhals is performed once or twice weekly in February–April, using a modified Isaacs–Kidd Midwater trawl (IKMT). The trawl is fixed in the current of incoming cooling water, fishing passively during entire nights.

The time of arrival of the glass eels to the Ringhals sampling site varies between years, probably as a consequence of hydrographical conditions, but the peak in abundance normally occurs in late March to early April. The sampling depends on the operation of the power plant, i.e. the amount of seawater needed for cooling. In 2017, sampling was moved to an alternative intake channel (cooling the reactors 3 and 4) a few hundred meters SW along the same shoreline due to discontinued operations of reactors 1 (closed in 2020) and 2 (closed in 2019), whose cooling water intake was sampled before the move. This new sampling site was used also in 2022 and has become the permanent sampling site. The annual glass eel index used to be adjusted for different levels of water discharge, but in 2024 it was decided to report the raw CPUE observations instead (and update the existing data in the WGEEL database to the raw CPUE observations), since the raw CPUE observations turned out to be strongly correlated with the observations corrected for flow The 2023 catch of glass eel was around the same level as the 2022 catch (Figure SE. 2).

Recruitment of young eel to Swedish waters is monitored at eel passes in several Swedish rivers (Figure SE. 3, Figure SE. 4). As the catch of ascending young eels has declined substantially in most Swedish rivers, the interest and maintenance of these river eel passes might have deteriorated in some cases. The removal of dams and the construction of by-passes at some hydropower dams have changed the conditions in other rivers. At present, only the most reliable sites are used to construct the recruitment indices. Different eel passes catch different ages and thus sizes of young eel, depending on their location along the Swedish coast. The eel passes on the western coast of Sweden catch younger and smaller eel, with progressively older and larger eel being caught the further away the eel pass is located along the Baltic Sea coast. The Viskan and Lagan eel passes, along the Swedish west coast where eels are younger than on the Swedish east coast, indicate increasing numbers of recruits during a couple of years (Figure SE. 4); however, the number of recruits are still low in comparison to historical levels. On the east coast (Baltic Sea), the number of recruits are low, though in 2021 and 2022 a large increase in number of recruits was observed in Motala ström, which dropped down again in 2023. Unfortunately, the longest recruitment series in Europe, the river Göta Älv, was interrupted in 2018, and has been left unsampled since 2017, due to lack of staff, unclear responsibility roles and maintenance of the eel pass.

Glass eel catches in the IBTS trawl survey in Skagerrak-Kattegat have been low during recent years and in 2024 six glass eels were caught (Figure SE. 1).

To increase and improve the recruitment monitoring programmes, young-of-the-year elvers could be monitored along the west coast at stations that operate independently from dam owners or similar. Since 2011, such monitoring programme has been under development and since 2017, 15 selected sites from north to south along the Swedish west coast targeting eel has been sampled for eel using electrofishing and the design of the monitoring program is currently being evaluated. In addition, there is an ongoing extensive electro-fishing program in Sweden. This programme is being run in streams and small rivers across the whole country with various purposes and is financed from several different sources. All data are stored in the open national database SERS, and we are currently developing suitable analysis methods on recruitment and abundance of mainly yellow eel in freshwater systems, which we aim to include in future country reports.

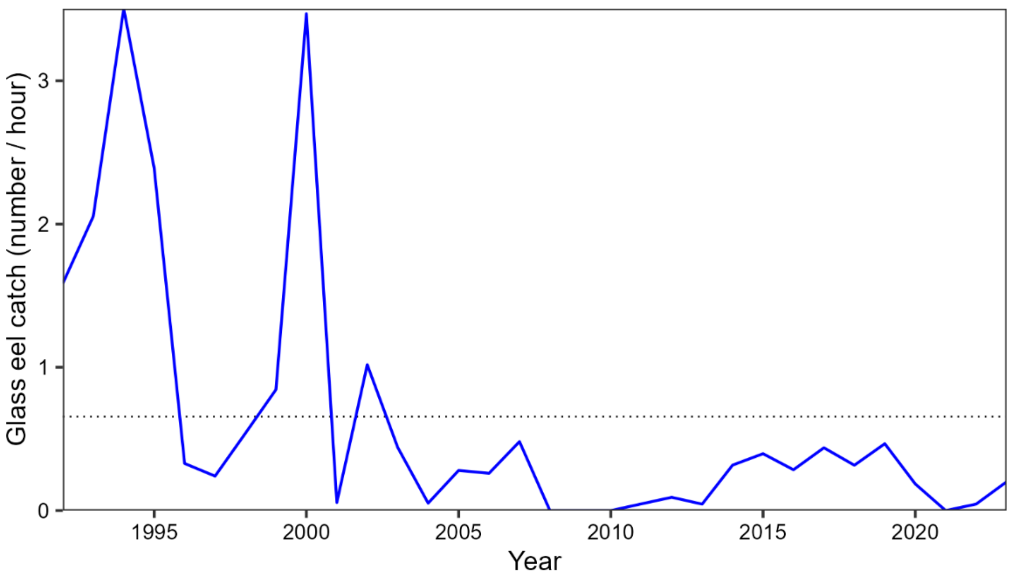

Figure SE. 1: Catch-per-unit-effort in late winter of glass eels in a MIK-trawl in open sea (Kattegat-Skagerrak) 1992-2023. Note that in 2011, no MIK trawling occurred.

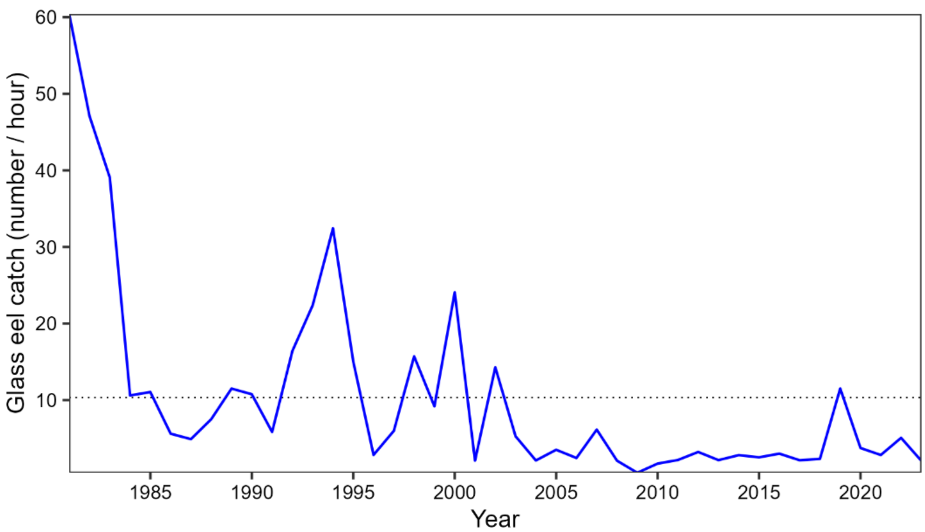

Figure SE. 2: Catch-per-unit-effort of glass eel at the cooling water intake at the Ringhals nuclear power plant 1981–2023. Sampling takes place 1-2 times per week in the period February-April,

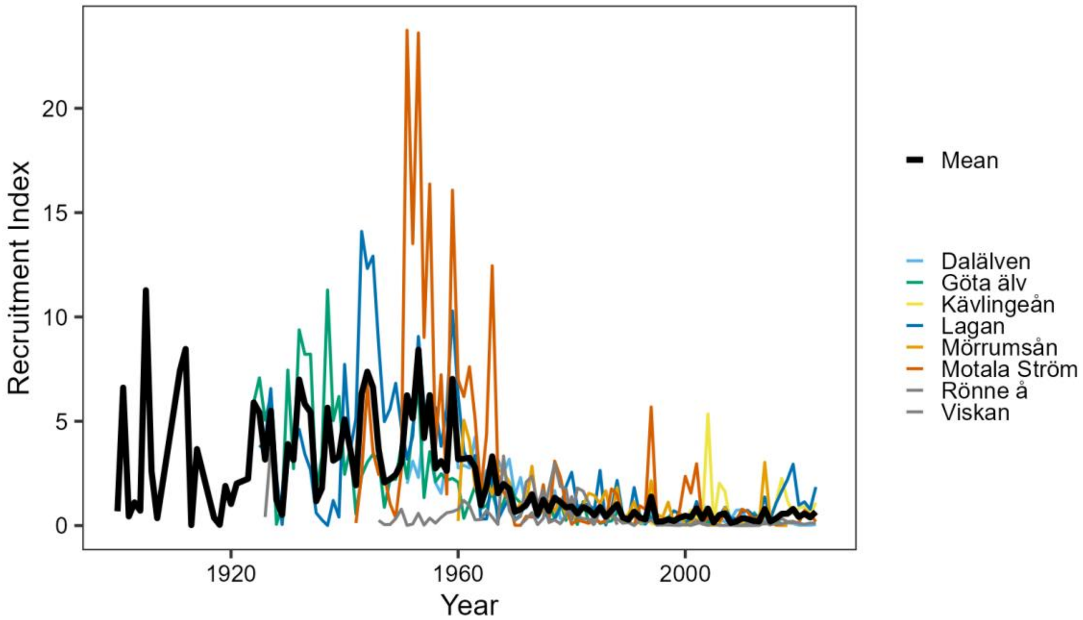

Figure SE. 3: Recruitment index of young eels in eight rivers, calculated as trapped weight relative to each river's average for 1971–1980 (except for River Kävlingeån that relates to 2002–2011), including their arithmetic mean (thick black line).

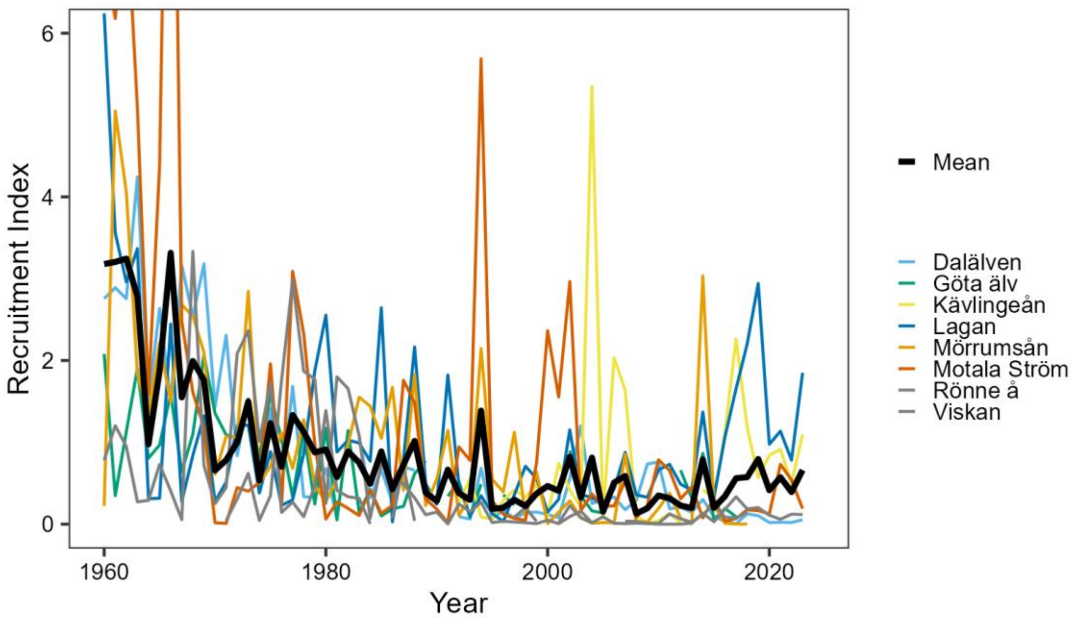

Figure SE. 4: Recruitment index of young eels in eight rivers, calculated as trapped weight relative to each river's average for 1971–1980 (except for River Kävlingeån that relates to 2002–2011), including their arithmetic mean (thick black line). Same data as above in Figure SE. 3, but reduced to 1960–2023 to show recent years more clearly.

2 Overview of the national stock and its management

2.1 Describe the eel stock and its management

2.1.1 EMUs, EMPs

Sweden has one Eel Management Plan (EMP), covering the entire country as one official Eel Management Unit (EMU), including the mountain region in the north and northwest where eels actually do not occur anymore. However, for various reasons, assessments are made for three separate regions, so in practice there are three EMUs, namely the west coast (SE-West), Baltic (SE-East) and the Inland (SE-Inland). Data, habitats and management measures differ fundamentally between the regions.

Two ecoregions are concerned, namely the North Sea (Swedish west coast) and the Baltic Sea. However, the fishery for eels along the Swedish west coast north of Torekov, in the North Sea area, was closed in spring 2012. Öresund is the strait between Sweden and Denmark where many silver eels from the Baltic Sea have to pass when leaving for the North Sea and the Atlantic Ocean. Öresund is defined as part of the Baltic Sea in this report and by all relevant eel advice and management authorities.

In the Baltic Sea, there are two main types of eel fisheries. One is the traditional fishery with fixed traps (pound nets) along the coast of the southernmost county Skåne, where silver eels are the target species. The other type of fishery also uses large pound nets, but targets several species including cod, perch, pike, flounder, etc. depending on the site and abundance of different species. Fyke nets of different sizes are also used at several sites.

Finally, there are eel fisheries in around twenty inland lakes. The major part of eel landings today are from lake Mälaren, Vänern, and Hjälmaren. The lake fisheries are also mainly maintained using pound nets and to some extent also fyke nets and target additional species to eels.

2.1.2 Management authorities

The fish stocks and the fisheries are managed by the governmental agency, Swedish Agency for Marine and Water Management, SwAM. Data and advice for management use are mainly given by the Department of Aquatic Resources at the Swedish University of Agricultural Sciences (SLU Aqua).

2.1.3 Regulations

The fishery for eels has been regulated in several different ways since 2007, e.g. through a mandatory eel fishing licence (actually an exempt from the general eel fishing ban), an increased minimum legal size, effort restrictions in time and number of fishing gears, and for some licence types, an upper limit in total catch per licence. No new licences are issued, and the number of licensed fishers is therefore steadily decreasing. As previously mentioned, since spring 2012, eel fishing on the west coast has been completely closed (north of Torekov, 56°25′, in the Kattegat). South of Torekov and in the Baltic Sea the fishing is either limited to the period May 1– September 14, or an individually determined period of 90 consecutive days. In the part of Kattegat just north of Öresund this determined period is restricted to 60 days. In freshwater, eel fishing is allowed for licensed fishers during 120 individually determined days.

On top of the above, since 2017, the EU Ministerial Council has taken annual decisions on a three-month fishing closure in EU marine and brackish waters. In 2023, the Council extended this fishing closure from three to six months. For 2023, SwAM decided on a consecutive six-month closure period from 1 October 2023 until 31 March 2024. For 2024, SwAM decided on a consecutive six-month closure period from 15 September 2024 to 15 March 2025.

2.1.4 Management actions

The Swedish EMP is an adaptive plan where a restricted fishery is one management action among others; the aim of the EMP is to reduce anthropogenic impacts to a level that will allow the stock to recover. Stocking is another action, where the target was to double the previous amounts of pre-grown elvers to about 2.5 million individuals stocked annually. An improved escapement of silver eels at hydropower plants is also a management measure in the EMP as well as an improved control of the fishery.

The stocking target was reached within a few years and has been reached for the majority of years thereafter, until 2021, when SwAM decided to pause the government-funded restocking programme until further notice (see 3.2 Restocking). Trap and Transport (T&T) of silver eels from upstream to downstream sites in rivers has been implemented, but a few hydropower plants have also been reconstructed to allow downstream migration of silver eels. Within the T&T-program, approximately 232 000 kg silver eels were transported downstream by road between 2010 and 2023. T&T will continue as one measure to decrease eel mortalities due to hydropower exploitation, and government-funded T&T releases were started in 2024. In addition, operating permits for all hydropower stations in Sweden are since 2020 being re-assessed based on modern environmental law, a process that is estimated to be ongoing for ca 20 years. This process will likely increase connectivity and decrease turbine mortality for eel and other species in many river systems.

2.1.5 Local stock assessment

Previous assessments of the local stock can be found in Dekker (2012; 2015), Dekker et al. (2018; 2021), and van Gemert et al (2024). Anthropogenic impacts include barriers for immigrating recruits, restocking, yellow and silver eel fisheries, hydropower related mortality, Trap & Transport of young recruits and of maturing silver eels, etc.

As previously mentioned, according to the Swedish Eel Management Plan, the whole Swedish national territory constitutes a single EMU. Several management actions, however, and most of the anthropogenic impacts, differ between geographical areas: inland waters and coastal areas are contrasted and west coast vs. Baltic coast (east and south). Thus, the assessment is divided over three EMUs: the west coast (SE-West), Baltic (SE-East) and the Inland (SE-Inland).

2.2 Significant changes since last report

Since the last report, a new stock assessment of the eel in Sweden has been published (van Gemert et al, 2024). Most notably, this assessment differed from the previous one (Dekker et al, 2021) in using an updated recruitment model for the inland waters, and no longer including T&T catches in the fishery statistics. These different methods have led to different estimates of biomass and mortality indicators for inland waters, but overall the trends remain the same. In inland waters, the current lifetime anthropogenic mortality exceeds the limit of 0.92, and current escapement biomass is below 40% of Bbest. As such, there have not been any major changes in the status of eel in Sweden since the previous country report.

3 Impacts on the national stock

3.1 Fisheries

3.1.1 Glass eel fisheries

There is no fishery for glass eels in Sweden.

3.1.2 Yellow eel fisheries

There is, in essence, no fishery for yellow eel in Sweden since the minimum legal size is 700 mm, meaning that the fishery almost exclusively targets silver eel. Data from mixed samples of yellow (half-silver) and silver eel, representative for the catch, are presented below in Section 3.1.3.

3.1.3 Silver eel fisheries

Commercial landings of silver eel in Sweden have declined in recent times, particularly in the coastal fishery (Table SE. 2, Figure SE. 5). The coastal fishery is limited to the east and south coast (the Baltic Sea), and the west coast south of 56°25′ (Öresund and the southernmost part of the Kattegat). In 2023, the Swedish coastal fisheries reported a total catch of 93 tonnes. The freshwater catch for 2023 was reported at 82 tonnes, i.e. together with the brackish/marine fisheries the total Swedish catch for 2023 was 175 tonnes. The catch per unit of effort (CPUE) in two monitored coastal fisheries of the Baltic Sea has been quite stable in recent years, in particular in southern Östergötland (Figure SE. 6), but this data has not been updated since 2020.

Fishers have also reported on their effort through logbooks. However, previous investigations into this effort data found that it was not of adequate quality to determine CPUE with: i.e. many fishers reported their effort inconsistently or not at all. However, in recent years, SwAM has worked on improving the reporting of effort data, and a new analysis of the quality of the effort data is planned to be undertaken in the near future.

The capacity, i.e., the number of fishers licensed in 2023 to fish eels were 138, out of which 89 held coastal fishing licences and 49 held freshwater licences (Figure SE. 7). The data came from SwAM, who are the responsible licensing agency.

Recreational fishing on eel is generally banned in Sweden. However, there is an exception from this ban in inland waters located above three hydropower installations, since almost no silver eel would be able to pass safely to the sea from such areas. At present, the extent of that fishery, and whether those eels are illegally sold or not (only licensed, commercial fishers can sell eels legally), is largely unknown, but some data on reported eel catches in recent years have been collected in 2024.

There have been numerous reports on illegal fisheries. SwAM and other authorities have been working actively to detect and combat illegal eel fishing since 2016, mainly in the counties of Skåne and Blekinge (southern Sweden). The number of seized gears has been rising since 2016, and in 2023 SwAM seized 94 illegal eel-catching gears from 27 different locations. In total, 200 eels (113 kg) were released from these illegal gears.

Specific details on the gears together with the spatial distribution has made SwAM convinced that many people currently fish eel illegally in Blekinge. Several of these people fish more than what can be estimated to be for household needs. In 2022, additional efforts were planned in

Kalmar County to be able to assess the characteristics of the illegal eel fishing along the east coast (Tobias Jeppson, SwAM, personal communication).

Table SE. 2: Reported commercial landings of eel in the different Swedish EMUs, shown in tonnes. The west coast fishery was closed in 2012.

Year	West coast	East coast	Inland
2005	215	345	115
2006	240	364	128
2007	172	417	114
2008	168	387	118
2009	108	314	97
2010	108	307	110
2011	84	271	96
2012	0	236	101
2013	4	264	103
2014	0	209	111
2015	0	158	89
2016	0	181	98
2017	0	143	102
2018	0	143	103
2019	0	84	87
2020	0	86	94
2021	0	80	90
2022	0	66	48
2023	0	93	82

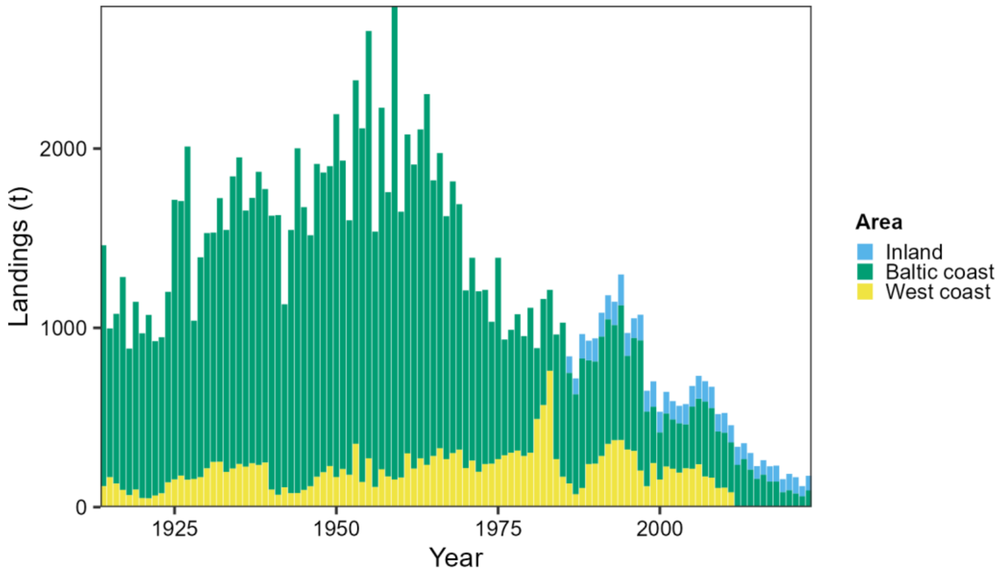

Figure SE. 5: Total reported commercial landings of eel, for the Baltic coast, West coast, and Inland EMUs. For the Inland EMU, no data prior to 1986 are available. The West coast fishing was closed in 2012.

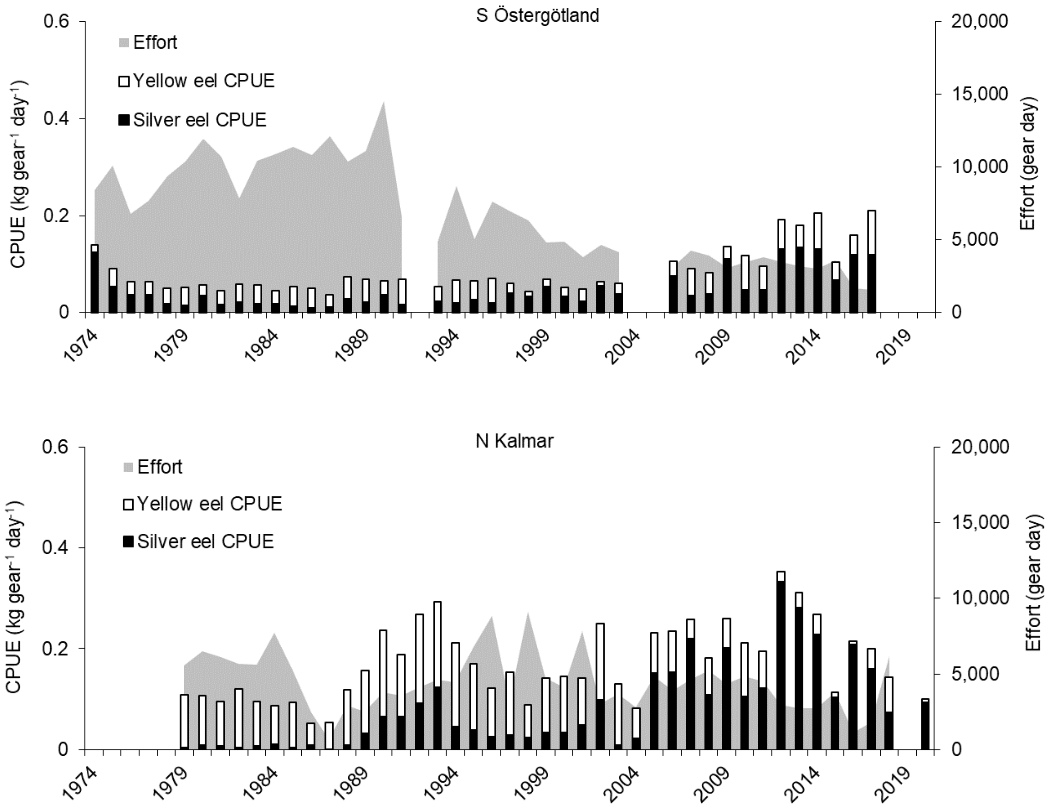

Figure SE. 6: Effort (grey area) and catch-per-unit-effort (yellow eel in white bars, silver eel in black bars) in two fykenet fisheries in the Baltic Sea. S Östergötland (upper panel) contains data until 2017 whereafter that fishery stopped (the fisher retired). Note that both panels start on 1974 to facilitate comparison, but no data prior to 1979 are available for N Kalmar.

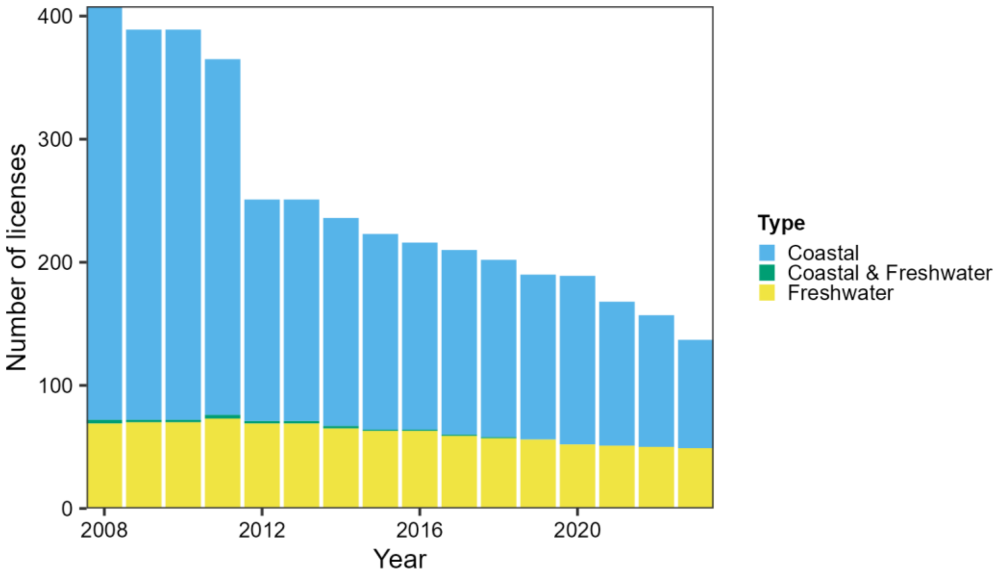

Figure SE. 7: Number of fishers with eel fishing licences (based on data from SwAM, who are the responsible licensing agency).

3.2 Restocking

In 2023, 778 674 glass eels were restocked in Sweden. Since 2021, due to Brexit, these eels are being imported from France, rather than the UK, which had been the origin of restocked glass eels in Swedish waters for many years. The majority of the imported eels were stocked in inland waters, with a lower number stocked on the coast (Figure SE. 8). In Sweden, eels must go through a quarantine period of about ten weeks before being stocked. This is to check for, and to minimise the risk of introducing different diseases and viruses. During the quarantine period, eels are kept and handled under eel aquaculture conditions. Their mean weight is ca. 1 g each or slightly less when stocked, and they are not sorted based on size before stocking.

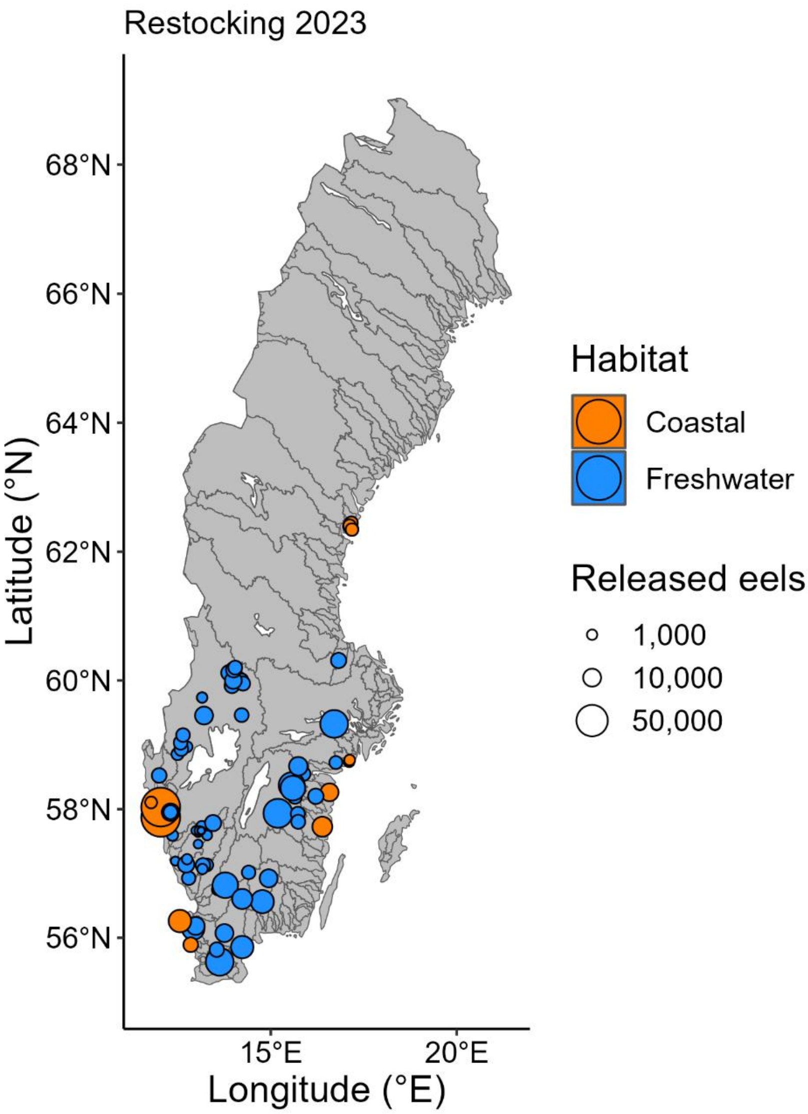

Figure SE. 8: Distribution of restocked eels in 2023. Note that coordinates are not always exact and might denote the outlet of a lake or river system in instances where only a lake/river name was provided.

3.3 Aquaculture

Aquaculture production for consumption purposes was 44 200 kg in 2023 and that originates from a single aquaculture facility. In 2023, 500 kg of glass eels were imported from France, of which around 176 kg were designated for aquaculture production.

3.4 Entrainment

Eel entrainment with deadly consequences primarily occurs at two types of power plants in Sweden: hydropower plants (a major impact in inland waters) and nuclear power plants (probably a marginal impact).

The impact on silver eels descending to the sea from lakes and rivers is high, as they most often have to pass several hydropower installations with their intake gratings and turbines before arriving at the sea. This mortality has been estimated at 115 tonnes in 2023 (van Gemert et al., 2024). The assumptions behind this assessment was a mortality derived from the best available estimate per individual turbine passage of silver eels that were modelled to have been produced upstream based on natural recruitment and stocking. Since there are several turbines to pass in most rivers, the accumulated mortality is quite high and is of the same magnitude as the commercial fishery for eels in freshwater, or higher (Dekker, 2015; Dekker et al., 2018; Dekker et al., 2021; van Gemert et al, 2024). There is uncertainty in the average impact per hydropower station but that hardly affects the numbers, due to the high number of hydropower stations to pass (van Gemert et al, 2024).

Sweden has three nuclear power plants by the sea (Ringhals, Forsmark and Oskarshamn) which use seawater for cooling. During this process, eels and other fishes are entrained into or impinged in the cooling water intake or circuit. At the Ringhals nuclear power plant on the Swedish west coast, many glass eels (albeit an unknown number per time unit) pass through the whole cooling system and their mortality has been estimated at 13.4%; which is low compared to other juvenile fish (Bryhn et al., 2014). Larger eels (mainly yellow eels) are also entrained at this nuclear power plant, which has a fish diversion system, and the mortality for larger eels has been estimated at about 14% (Bryhn et al., 2013). However, the absolute number of eel entrainment at Ringhals has not been systematically investigated. The remaining two nuclear power stations (Forsmark and Oskarshamn) are located on the east coast and they do not entrain or impinge glass eel since they do not occur there. However, yellow and silver eels have about 100% mortality at entrainment if they get caught in the sieving stations (Bryhn et al., 2013). At Forsmark, the power company currently monitors eel occurrence and collects eels in the sieving station during abundance peaks (before they otherwise would be trapped and killed). Virtually all of these eels are silvers. The eels that are alive are transported by SLU Aqua and released into the sea 30 km south of Forsmark. Forsmark is currently investigating possibilities for camera surveillance to be able to handle incoming eel better and increase survival. The eel mortality at the Oskarshamn nuclear power plant has not been systematically investigated due to insufficient monitoring, but based on older estimates from Forsmark (Bryhn et al., 2013) and on eel abundance in the area, a certain loss should be expected.

3.5 Habitat Quantity and Quality

There are numerous large and small lakes and rivers with suitable eel habitats. The low numbers of recruits, in combination with migration obstacles like dams and hydropower turbines, are the limiting factors of today, not lack of wetted areas as such. Historical habitat decreases in inland waters have most likely been substantial, but have not been quantified.

Many eels in Sweden spend most of their lives in coastal waters and their habitats are generally of high quality (Andersson et al., 2019), although the shoreline in many places has been drastically altered by anthropogenic disturbance, for example leading to habitat loss (Baden et al., 2003). The shoreline is also altered by anthropogenic constructions (e.g. harbours, jetties, bridges, etc.). However, such habitat change is believed to constrain the eel habitat area to a much lesser extent than historical habitat changes in inland areas, e.g. due to construction of hydropower dams and historical lowering of lakes and drainage of wetlands to create agricultural land.

3.6 Other impacts

3.6.1 Predation

Predation by cormorants (*Phalacrocorax carbo sinensis*) as well as by grey seals and harbour seals (*Halichoerus grypus* and *Phoca vitulina*) have been suggested as possible causes of eel mortality in Sweden, however results are not congruent (Engström, 2001; Lundström et al., 2010; Östman et al., 2012; 2013; Ovegård et al., 2017; Hansson et al., 2018). Ongoing studies further suggest that eel is one of the species that risks being underestimated in predator diet analyses, since its otoliths erode fast. More research on the cormorant impact on eel in Sweden continues to be performed, and there are plans to account for cormorant predation in the Swedish assessment model in a more substantial way in the future, given the continued increase in cormorant abundance in Sweden (Lundström 2024).

4 National stock assessment

4.1 Description of Method

There are several eel projects running, both in freshwater and in the brackish/marine environment. In freshwater and coastal waters, the collection of silver eels from the commercial fishery is a major part of Sweden's EU MAP programme. In addition, recruitment is monitored through electrofishing in small rivers and streams as well as counting ascending young eels caught in eel passes. As part of the recruitment studies a number of eels are chemically analysed for their origin, being naturally recruited or stocked (Wickström and Sjöberg, 2013). The basis for this latter project is that all stocked eels since 2009 are marked with strontium, which makes clear marks in their otoliths. The analysis rationale is that if the stocked eels have high survival and stay where they have been released, they will be rather abundant and would hence most likely bias some of our (natural) recruitment series used for indices, both at a national and international level. Very few of the ascending recruits were of stocked origin (Myrenås, 2022).

All sampled yellow and silver eels are analysed with respect to length, weight, stage, prevalence of *Anguillicola crassus*, and sex (sex is only determined in eels larger than 250 mm). A subset of eels are also aged.

Fat has been measured occasionally (only on eel sampled alive and usually done when tagging) with a Fish Fatmeter (model FFM-992). Fecundity is usually not estimated, but some results and comparisons between different stocks were given by MacNamara et al. (2016).

To assess the fishing mortality of silver eels leaving the Baltic Sea, a mark–recapture programme running since the early 1900s was restarted in 2012, mostly using eels caught by fishers fishing on the coast. More information about this programme is presented under 5.2.1.

Sweden has one designated index river in each EMU. In 2018, River (Kävlingeån in Skåne, southern Sweden) where descending silver eels are monitored using a fish camera counter and a Wolf trap. The river is also electrofished at two sites.

4.1.1 Data collection

In ICES subdivisions (SD) 23 (Öresund), 25 and 27 (Baltic Proper), 200 silver eel samples have previously been bought from the commercial poundnet fishery. SD 24 no longer has any commercial fishery and SD 23 has not been sampled since 2019 due to financial constraints, and difficulties in finding fishers. Length, weight, somatic weight, eye diameter, and pectoral fin length are measured, and at least five eels from each available cm class are aged (or, if less than 5 eel are available in a cm class, all eel in that cm class are aged). Total weight of landings and discards is also registered. The difficulty in finding suitable coastal fishers to collaborate with is due to the declining number of licences. This has prompted us to request further funding to enable fisheries-independent monitoring at ten sites in the Baltic Sea and five sites (i.e. one additional) on the west coast.

Fishery-independent sampling of yellow eel and silver eel is also performed on the west coast, using fykenets, in SD 20 (Fjällbacka and Stenungsund/Hakefjorden in the Skagerrak), SD 21 (Vendelsö in the Kattegat), and SD23 (Öresund/Barsebäck). Yellow eels and silver eels are measured by length, eye diameter, and pectoral fin length, but only yellow eels are weighed and aged (at least 200 individuals per site; a maximum of five from every cm class). Sampling at each site is terminated if/when more than 500 yellow eels have been caught.

In freshwater, commercially fished eels are sampled annually from one lake. Which lake to sample is alternated every few years in order to cover most of the inland eel fisheries. 100 eels are randomly sampled over the main fishing season, and then analysed for size, maturity (stage), age, prevalence and intensity of *Anguillicola crassus*, etc.

4.1.2 Analysis

In order to make stock assessments we use extensive data on recruitment, elver transport, restocking, landings, age and growth, hydropower installations, river geography, and more, covering an extended geographical area, over a period of many decades (van Gemert et al., 2024). The assessment is divided over three EMUs: the west coast (SE-West), Baltic (SE-East) and the Inland (SE-Inland).

<u>West coast</u>

The Swedish EMP presented an assessment for the west coast, based on catch curve analysis. By 2012, fishing restrictions had been implemented, including a reduction in effort and a rise in minimum size. After the west coast fishery was closed in spring 2012, Dekker (2012) made a rather simple re-assessment: assuming that the stock remained almost stable, fishing mortality and landings were assumed to have developed proportionally. In 2015, however, three years had passed since the closure of the fishery (recovery), and the last available data were from 2006 (nine years before). In the absence of sufficient new data, no new assessment was made, and no new indicators were given. This situation has not changed, and no new assessments are currently being produced for the west coast. Existing monitoring efforts (sampling six sites along a 320 km coastline) are insufficient to assess the stock in absolute terms (Bcurrent, Bbest and B0), but allow yellow eel abundance trend-monitoring (relative changes in abundance over time). Additionally, recent analysis of historical information (Magnusson and Dekker, 2021) indicates that the west coast fishery was a demand-driven fishery, gradually increasing its efforts over the decades. This finding confirms one of the alternative options, presented in Dekker (2012), in which it was assumed that the stock declined proportionally to recruitment, while fishing impact kept increasing. Based on that assumption, B0 has been estimated at 1154 ton.

Baltic coast

The Baltic coast (SE-East) stock is a mix of local production and (mostly) immigrants from elsewhere in the Baltic, and is a mix of restocked and naturally-recruited eels. The impact of the Swedish silver eel fishery has been assessed on the basis of historical mark–recapture experiments (method described in Dekker and Sjöberg, 2013), which have been re-continued since 2012. No lifetime mortality indicators can be estimated, due to insufficient information on silver eel origin. This will require a pan-Baltic assessment, as proposed in Dekker (2013).

Inland

The Inland assessment starts by estimating absolute recruitment to inland waters, by extrapolating recruitment from sample rivers to all Swedish rivers, using a statistical model. Spatial data on restocking and assisted migration is then used to give an overview of spatial yellow eel abundance in inland waters. Empirical observations on growth and silvering age, and an estimate of natural mortality, lead to an extrapolation of the spatial production of silver eel. Silver eel are removed by commercial fishing (spatial landings information available), or by a Trap & Transport programme which moves silver eel to below the most downstream hydropower station (spatial data available). Then, for each river/lake, starting at the most upstream part, impact of hydropower is assessed by taking estimated abundance of silver eel upstream of a hydropower station (a complete overview of hydropower stations in Swedish rivers is available), and estimating hydropower mortality from (in order of priority) local experiments, a simulated value reported in Calles and Christianson (2012), or a default impact of 70% per station. Survivors move downstream, and the process is repeated for each hydropower station located downstream. The silver eel that remain after commercial fishing and hydropower mortality (plus those moved through the Trap & Transport programme) constitute the estimated escapement of the inland EMU.

Only limited ground-truth information exists to verify the Inland result (electrofishing in rivers, while most restocking was done in lakes). However, an attempt to ground-truth the inland assessment using electrofishing data is currently in progress. Surprisingly, actually observed landings derived from past restocking indicate that natural mortality M must have been extremely low (5–10%), much below conventional estimates (15–20%). In the absence of independent verification, the current estimate for natural mortality M is 0.10 yr^{-1}.

4.1.3 Reporting

Selected results from Swedish eel studies are reported to the EU as requested in 2012, 2015, 2018, 2021, and 2024. This is done by the responsible agency SwAM, and more recently also by SLU through the tri-annual joint ICES-EU Data Call, and the underlying data are also published in our department report series Aqua reports (e.g. van Gemert et al., 2024). Relevant data are also used for scientific papers (see the reference list below). In addition, selected data and results are reported to ICES and WGEEL when appropriate.

4.1.4 Data quality issues and how they are being addressed

The assessments reported in van Gemert et al. (2024) make use of extensive data on recruitment, elver transport, restocking, landings, age and growth, hydropower installations, river geography, and more; covering an extended geographical area, over a period of many decades. The 2018 and 2021 assessments were essentially a repetition of the 2015 assessment with a few more years of data and updated parameters (Dekker et al., 2018; Dekker et al., 2021). The 2024 assessment (van Gemert et al., 2024) introduced an updated recruitment model and changed the handling of T&T data, but otherwise also made little changes to the methodology.

For the west coast, no new assessments have been produced after 2009, as after the closure of the fishery no data has been available to this end. Instead, historical data have been compiled, (re)-checked and analysed (Magnusson and Dekker, 2021), and fisheries-independent fyke net surveys have provided an index for the continued development of the west coast stock.

For the Baltic coastal fishery, Swedish mortality rates are reported on the basis of Survival Analysis of a century of mark–recapture data (Dekker and Sjöberg, 2013). Stock size (biomass) estimates were derived from the Survival Analysis results (fishing mortality), in combination with available landings data (van Gemert et al., 2024). The targeted silver eel is derived from yellow eel stocks along the Swedish coast, in Swedish inland waters, but probably mostly from coastal and inland waters in other countries all over the Baltic area. Thus, in order to cross-check the Swedish escapement biomass estimates for the Baltic Sea, and to be able to estimate lifetime anthropogenic mortalities, a joint assessment of the whole Baltic stock is required (which in itself will be required to develop joint management of this shared stock), as was for instance proposed by Dekker (2013).

For the inland waters, yellow and silver eel abundance are predicted from the available information on recruits (natural, translocated, restocked) forward in time, towards the yellow and silver eel stage (van Gemert et al, 2024). No independent verification on yellow or silver eel data is made. However, information on yellow eel abundance derived from electro-fishing surveys could potentially be used to ground-truth the inland assessment. Specifically, as most eels caught in electro-fishing are small, the recruitment model of the inland assessment can be tested using electro-fishing data. Such development is currently in progress.

Freshwater landings data are reported according to two different systems (one per year for the smaller lakes, and more detailed reporting for the larger lakes), which increases the risk for errors. Eels used for Trap and Transport might also be miscounted as here too there are different reporting systems.

Recreational fishing for eel, as previously mentioned, is forbidden with some exemptions; however, recreational fishing might have a significant impact. Hidden, unmarked fyke nets, pound nets and trammel nets have been discovered along the coast during the last few years (see Section 3.1.3). Additionally, in some freshwater bodies there can be an eel fishery that authorities have no knowledge about, since it is legal as long as the catch is not sold.

As previously mentioned, the very long river recruitment series from Trollhättan in Göta Älv (ongoing since 1900) was interrupted in 2018. This (hopefully) temporary break was due to lack of personnel and unfortunately, this trap is still not operating during 2024, and will require extensive repair before it can be operational again.

4.2 Trends in Assessment results

All estimated stock indicators for the three EMUs (West coast, Baltic coast, Inland) over the years 2000-2023 are given in Table SE. 3.

For the west coast, no biomass indicators are estimated due to a lack of data, but survey-trends (CPUE) are presented (Figure SE. 9). For eels smaller than 37 cm, the CPUE time-series shows an initial decreasing trend to an overall minimum around the year 2009, after which CPUE appears to show a slightly increasing trend again. This appears to be in line with overall glass eel recruitment trends. For eels sized 37-49 cm, the CPUE trend over time is less clear. For eels sized 50-59 cm and over 60 cm, CPUE was stable until 2010, after which a clear increasing trend in CPUE can be observed, implying an increasing trend in abundance. This appears to be in line with the definitive closure of the west coast eel fishery in 2012. Given that the west coast fishery was closed in 2012 and that it is assumed that there are no other anthropogenic mortalities, it can be assumed that biomass is approaching Bbest.

For the Baltic coast, the assessment showed that the impact of the Swedish eel fishery has been declining since the 1980s, and continues to decline in recent years (Figure SE. 10). Currently, the impact of the Swedish silver eel fishery along the Baltic coast is relatively small, with an estimated fishing mortality of 0.003 yr^{-1} for the 2020s decade. However, decreases in landings and tag recapture rates, as well as a 6-month closed season, make these fishing mortality estimates increasingly uncertain. For recent years, the tag recapture rates were so low that it resulted in unrealistically-high Bcurrent estimates. Therefore, assuming that Bcurrent has remained relatively stable over recent years, Bcurrent is estimated by taking the biomass production estimate from 2012, and subtracting annual landings (Table SE. 3).

For the inland stock, silver eel increasingly originate from restocking, with naturally-recruited and assisted migration eel currently making up only a small percentage of the inland production of silver eel (Figure SE. 11). Estimated stock biomass Bcurrent is showing a consistent decline over time (Table SE. 3). Both lifetime fishing mortality sumFas well as lifetime hydropower mortality sumH have shown a decreasing trend since the last assessment, with sumH exceeding sumF with more than a factor of two in 2023 (Table SE. 3). Figure SE. 12 shows a time trend of the fate of inland silver eel, visualizing the impact of both inland fisheries and hydropower on inland eel survival. Lifetime anthropogenic mortality sumA has shown a decreasing trend since the last assessment (Table SE. 3), but continues to exceed the minimum limit that would allow recovery.

Table SE. 3: Stock indicators by area and year. For inland waters, biomass indicators are given with (+) and without (-) the contribution from restocked eels. All mortality estimates refer to true mortality (both on natural and restocked eels), not interpreting restocking as a compensation for other mortalities. For all coastal waters, ΣH=0, hence ΣF=ΣA. For Trap & Transport, the biomass released is specified, for the West coast and the Baltic separately. All biomass indicators expressed in tonnes, mortality indicators as rate per lifetime.

	West coast				Inland waters									Baltic coast				
					With restocking +			Without restocking -			Mortality rates							
year	$B_{current}$	B_{best}	B_0	∑A	$B_{current}^+$	B_{best}^+	B_0^+	$B_{current}^-$	B_{best}^-	B_0^-	∑F	∑H	∑A	$B_{current}$	B_{best}	B_0	∑A	year
2000				1.79	106	443	583	38	160	300	0.30	1.13	1.43	3507				2000
2001				2.53	121	434	594	39	140	300	0.32	0.95	1.28	3473				2001
2002				2.41	148	425	600	43	125	300	0.28	0.78	1.05	3497				2002
2003				2.15	167	414	605	44	109	300	0.27	0.64	0.91	3495				2003
2004				2.43	165	396	602	39	94	300	0.34	0.54	0.87	3516				2004
2005				2.39	169	390	608	35	82	300	0.35	0.48	0.83	3424				2005
2006				2.66	165	390	619	30	71	300	0.40	0.46	0.86	3404				2006
2007				1.91	174	406	643	27	64	300	0.33	0.52	0.85	3352				2007
2008				1.86	163	422	665	22	57	300	0.33	0.62	0.95	3381				2008
2009				1.19	159	439	688	18	51	300	0.25	0.76	1.02	3460				2009
2010				1.20	150	455	709	15	46	300	0.28	0.84	1.11	3463				2010
2011	12	1154	1154	0.93	148	452	711	13	41	300	0.24	0.88	1.12	3499				2011
2012				0	129	442	705	11	37	300	0.26	0.98	1.23	3531				2012
2013				0	128	425	692	10	34	300	0.23	0.97	1.20	3500				2013
2014				0	121	402	670	10	32	300	0.26	0.94	1.20	3558				2014
2015				0	117	370	640	10	31	300	0.21	0.94	1.15	3613				2015
2016				0	94	329	599	9	30	300	0.28	0.97	1.25	3590				2016
2017				0	80	292	562	8	30	300	0.34	0.95	1.29	3628				2017
2018				0	66	262	532	7	29	300	0.41	0.97	1.38	3624				2018
2019				0	64	246	517	7	28	300	0.35	1.00	1.35	3671				2019
2020				0	57	245	518	6	27	300	0.47	0.99	1.46	3670				2020
2021				0	62	249	524	6	26	300	0.45	0.94	1.39	3693				2021
2022				0	95	261	536	9	25	300	0.24	0.77	1.01	3710				2022
2023				0	84	281	556	7	24	300	0.34	0.86	1.21	3677				2023

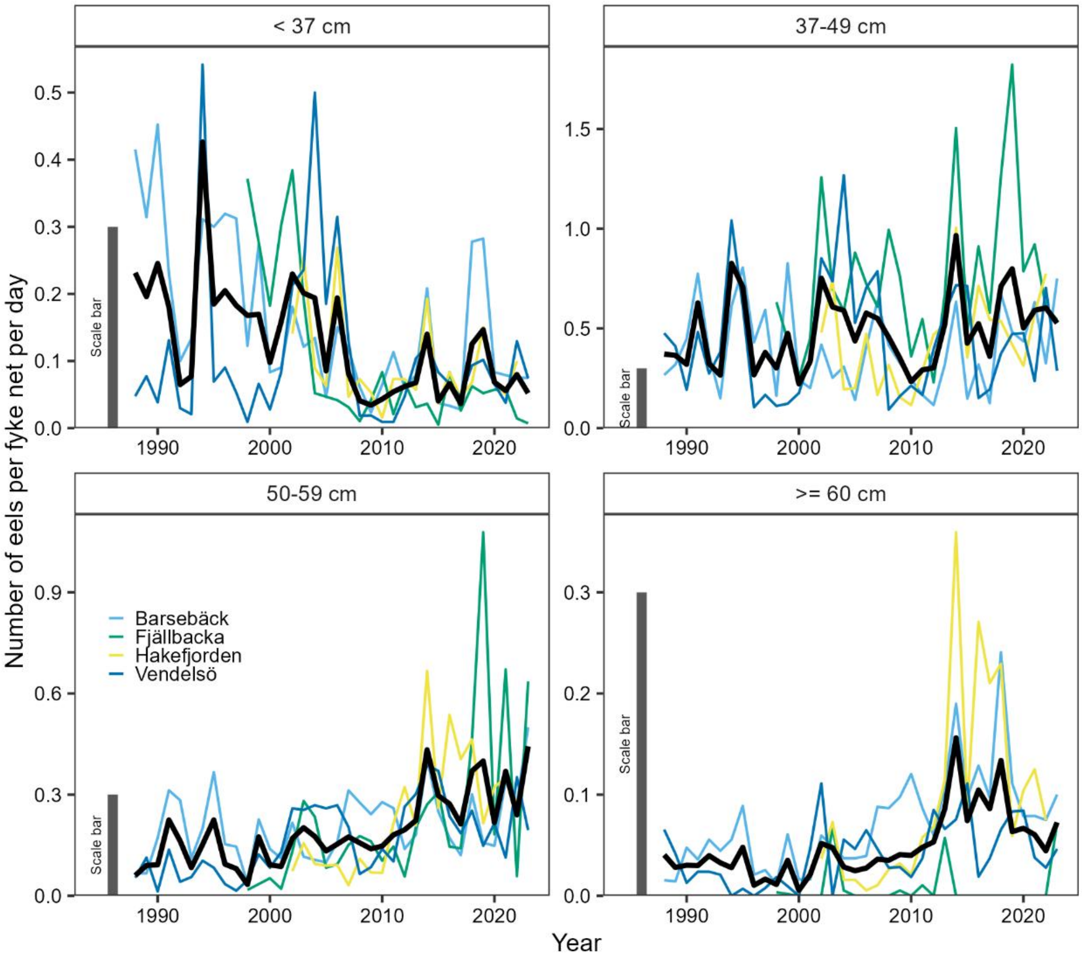

Figure SE. 9: Catch-per-unit-effort of yellow eel by size-class (total length) from fisheries-independent fyke net surveys at various areas along the Swedish west coast, including their average (black line). Note that the range of the y-axis differs between subfigures, as is also indicated by the scale bar.

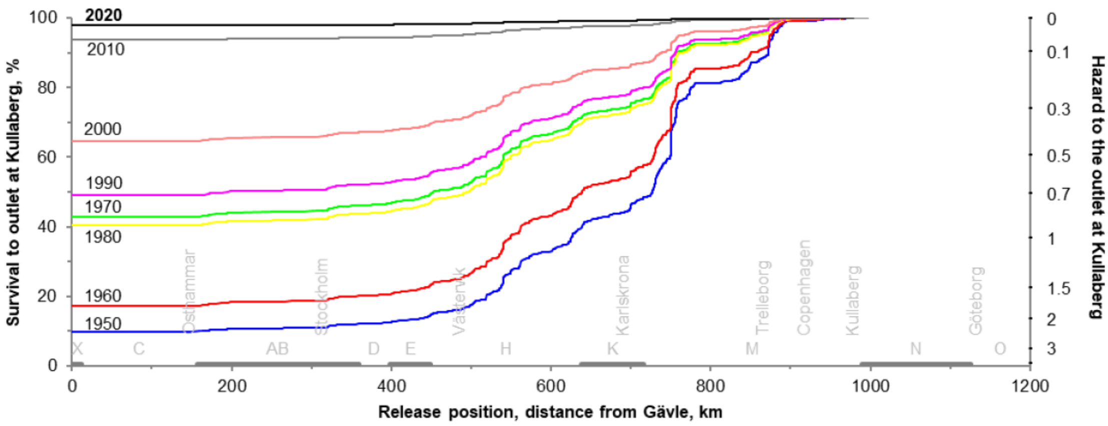

Figure SE. 10: Estimated survival and hazard over distance along the Swedish coast, per decade. The left y-axis shows the estimated net survival from a given position along the Swedish coast up to the outlet of the Baltic Sea at Kullaberg, the right y-axis shows the associated accumulated hazard over that interval.

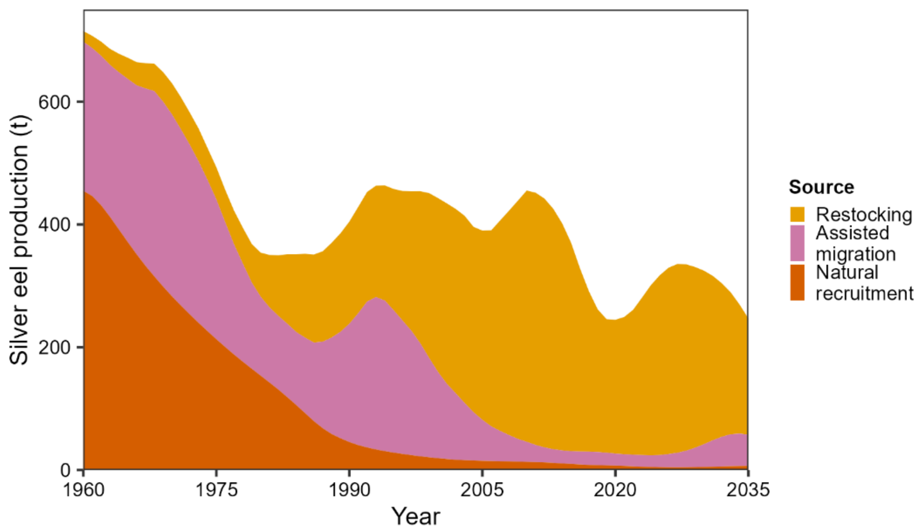

Figure SE. 11: Production of silver eel by year and by origin of the eel, that is: the estimated total production before the impact of fishery and hydropower. For these results, a natural mortality rate of M=0.10 was assumed. Results are extrapolated forward in time for 2024-2035, assuming a status quo equal to the most recent assessment year (i.e., recruitment, assisted migration, and restocking remain equal to their 2023 value).

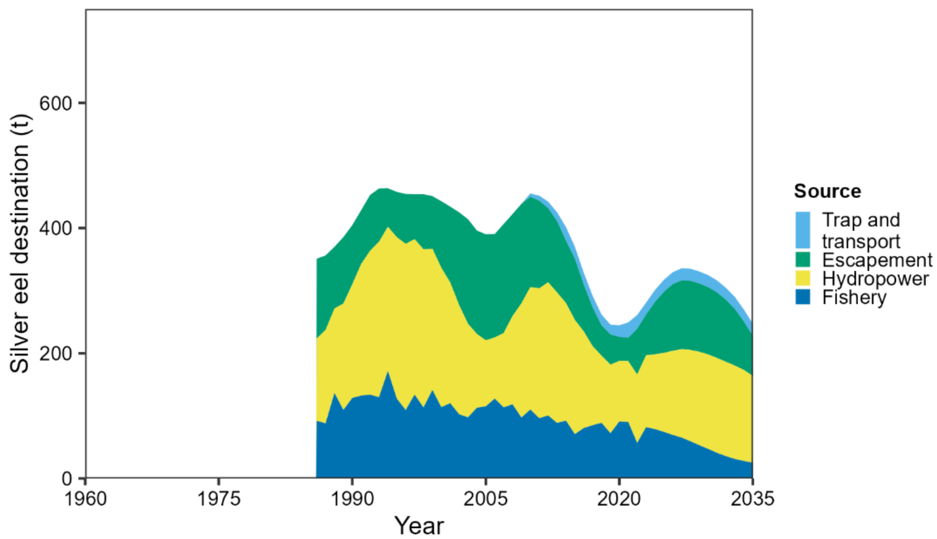

Figure SE. 12: Time-trends in the destination of the silver eel produced in inland waters. Data before 1986 are incomplete and therefore not shown. Results are extrapolated forward in time for 2024-2035, assuming a status quo equal to the most recent assessment year (i.e., recruitment, assisted migration, restocking, fisheries mortality, and hydropower mortality remain equal to their 2023 value).

5 Other data collection for eel

5.1 Yellow eel abundance surveys

In addition to the yellow eel abundance surveys along the west coast presented in Section 4, some smaller projects follow the development of stocked eel populations using fykenets or outlet traps. In 1997, a cove in Lake Mälaren was stocked with 5000 marked (Alizarin) elvers. This introduced stock has been monitored in a fykenet fishery since. After a few years the local stock was dominated by the stocked eels, and their proportion in nets has been about 60% from 2005 to 2017 (Figure SE. 13). As more and more eels now become silvers and leave this open system, the CPUE and the proportion of marked eels is declining since 2017. Since the year 2023, 15.1% of the stocked eels have been recaptured. In 2011, this cove was stocked with another 1862 elvers, this time marked with both strontium and barium. Some of them are now among the smallest eels caught.

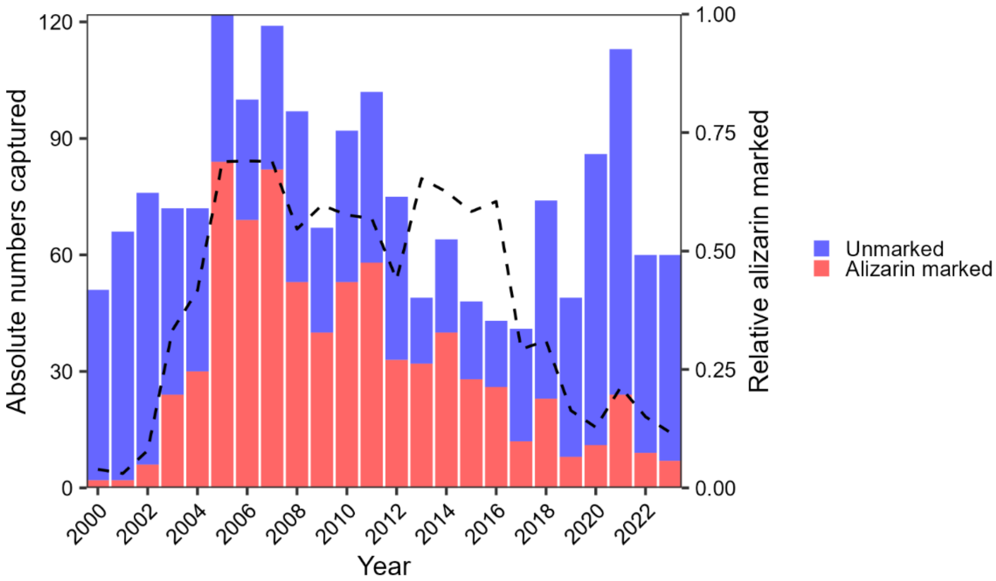

Figure SE. 13: Number of unmarked and alizarin marked eels (bars) as well as the percent marked eels (dotted line) in a survey of a stocked population in Lake Mälaren from 1999 to 2021.

5.2 Silver eel escapement surveys

Please also see Section 4.1.

5.2.1 Eel tagging programme in the Baltic Sea

In the Baltic region, tagging experiments were made already in 1903, with the objective to gain general information on migration direction and migration routes (Sjöberg, 2015). Since then, thousands of eels have been tagged, most of them with silver plates and Carlin tags. Recaptures of tagged eel were relatively scarce in the early 1900s, probably because fish tagging was a new phenomenon and the fishers were unaware of the ongoing experiments (hence, recaptures might have occurred, but they were not reported). As the Swedish eel landings from the Baltic Sea started to increase, so did the recapture rates (Figure SE. 14). However, when the catches started to decrease in the 1960s, the recapture rates did not change much initially. Only when the intensity of the fishery started to decrease in the early 1970s, as shown in Andersson et al. (2012) did recapture rates decrease somewhat (Figure SE. 14). Regular tagging programmes were run until 1995, and were then re-started in 2012, continuing with the same method as before, but the recapture rates after 2012 have been much smaller than before (Figure SE. 14, Figure SE. 15,

Table SE. 4).

Since 2012, approximately 70% of the recaptures were made in the Swedish fishery at the east and south coast, while around 30% were recaptured in Denmark. A few individuals were recaptured in Germany and Poland. The tagging programme has become an important part within the EU´s data collection programme (EC No 665/2008) and it is the basis for estimating the fisheries impact on eels leaving the Baltic Sea region to spawn (Dekker and Sjöberg, 2013; Dekker et al., 2021). The 6-month fishing closure in Denmark and Sweden will presumably affect recapture numbers from the outlet straits in Öresund and the Danish Belts, and may introduce additional bias to the mark-recapture programme.

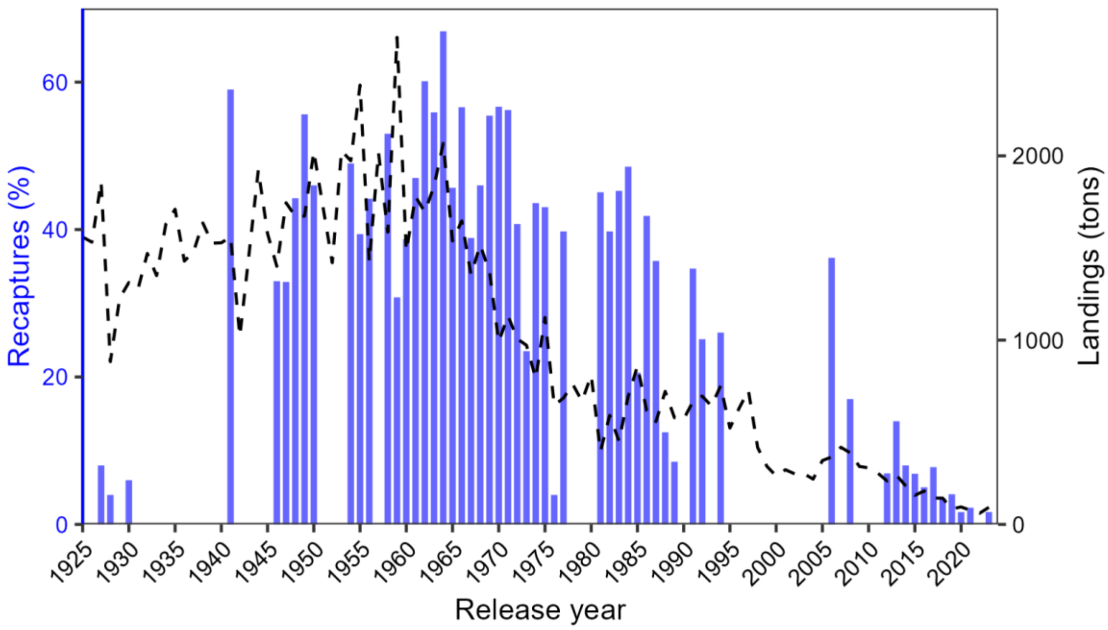

Figure SE. 14: Recaptures (percentage) over time of tagged eels made in Sweden, Denmark, Germany, and Poland (blue bars), shown against landings over time from the Swedish fishery on the east and south coast (dashed line). Shown for coastal tagging experiments using Carlin tags without experimental manipulation.

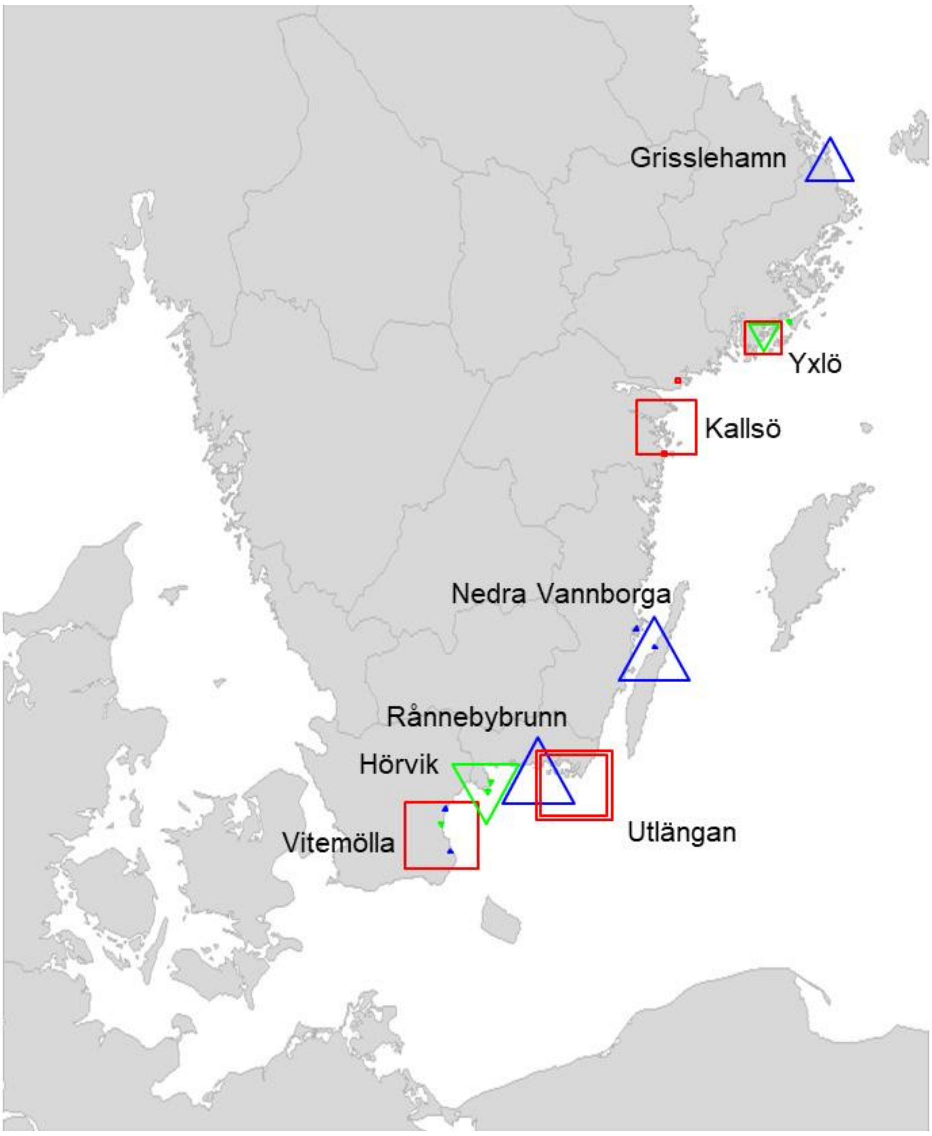

Figure SE. 15: Releases and recaptures of tagged eels within the EU MAP program along the Swedish east coast for the years 2021–2023. Location of eel tagging experiments are indicated by the larger symbols, whose size is proportional to the number of eels released. The small dots represent recaptures of single eels. Colour indicates month of release of the tagged eel. For exact recapture numbers see Table SE. 4. Shown for coastal tagging experiments using Carlin tags without experimental manipulation.

Table SE. 4: Coastal tagging experiments within the EU MAP program between 2012 and 2020, using Carlin tags without experimental manipulation. Total number of tagged and released eels, proportion and number of recaptures, and the distribution of recaptured eels in Sweden (SE) and abroad.

Year of release	Release location	Tagged (N)	Recaptures (%)	Total recaptures (N)	SE	Abroad
2012	Bylehamn	150	2.7	4	2	2
2012	Vinö	119	9.2	11	9	2
2012	Sandhamn	150	9.3	14	7	7
2013	Rompeboden	150	14.0	21	18	3
2014	Yxlö	150	6.0	9	9	0
2014	Birkö	150	11.3	17	14	3
2014	Svartö	150	6.7	10	6	4
2015	Torö	151	4.6	7	6	1
2015	Borrbystrand	140	9.3	13	5	8
2016	Byxelkrok	147	3.4	5	3	2
2016	Böda	151	6.6	10	3	7
2017	Yxlö	200	5.0	10	9	1
2017	Hörvik	199	10.6	21	13	8
2018	Grisslehamn	199	3.0	6	6	0
2018	Ekö	140	4.3	6	6	0
2019	Yxlö	199	0.5	1	1	0
2019	Utlängan	123	8.9	11	1	10
2019	Svartö	240	4.6	11	5	6
2020	Torö	284	0.7	2	2	0
2020	Kallsö	199	2.0	4	4	0
2020	Svartö	295	2.4	7	5	2
2021	Vitemölla	301	2.7	8	0	8
2021	Kallsö	201	1.5	3	2	1
2021	Hörvik	243	2.5	6	5	1
2021	Yxlö	50	2.0	1	1	0
2022	Utlängan	252	0.0	0	0	0
2022	Grisslehamn	129	0.0	0	0	0
2022	Yxlö	71	0.0	0	0	0
2023	Rånnebybrunn	298	1.7	5	5	0
2023	Nedra Vannborga	277	3.6	10	10	0
2023	Utlängan	319	0.0	0	0	0
Total		**5827**		**233**	**157**	**67**

5.3 Life-history parameters

As part of our EU MAP data collection programme, eels from a number of commercially fished lakes have been sampled since 2010 (Table SE. 5). They are dissected and data is collected on weight, length, and age (Table SE. 5).

Table SE. 5: Length, weight, age and growth in all commercially fished eels sampled from freshwater within the EU MAP programme. Mean growth rate was calculated based on individual length, with glass eel length (73 mm) subtracted, divided by age.

Lake	Year	Total N	Mean length (mm)	Mean weight (g)	Mean age (yr)	Growth rate (mm yr^{-1})	Aged (N)	Aged (%)
Bolmen	2017	126	698.7	651.8	21.7	29.9	126	100.0
	2018	128	701.1	689.3	20.8	30.7	125	97.7
	2019	123	706.4	671.3	19.9	32.3	122	99.2
	2020	130	720.5	724.6	20.8	31.5	128	98.5
	2021	131	724.9	743.2	20.9	31.7	129	98.5
Hjälmaren	2010	125	866.3	1524.5	16.1	50.5	119	95.2
	2011	111	872.4	1511.5	15.7	52.4	108	97.3
	2012	127	883.4	1589.9	15.4	53.6	125	98.4
	2013	127	897.4	1652.7	14.3	59.6	125	98.4
	2022	101	925.4	1693.2	17.0	51.2	100	99.0
	2023	100	943.8	1768.3	16.4	53.4	98	98.0
Mälaren	2010	346	734.4	895.9	16.8	40.3	312	90.2
	2011	354	732.1	863.8	16.7	39.8	314	88.7
	2012	326	769.3	997.1	17.4	40.6	294	90.2
	2013	437	741.9	863.1	16.5	42.9	281	64.3
	2014	402	739.7	821.6	18.4	38.5	290	72.1
	2015	322	769.1	927.8	19.1	37.3	303	94.1
	2016	319	768.1	934.2	19.6	36.3	300	94.0
	2017	52	639.6	497.6	15.6	38.1	41	78.8
	2018	80	611.5	469.7	16.0	36.6	57	71.3
	2019	67	707.3	772.2	17.9	37.5	42	62.7
	2020	160	732.0	942.3	16.0	37.1	38	23.8
	2021	143	689.1	795.8	16.9	35.4	28	19.6
	2022	78	599.7	706.0	17.8	32.4	8	10.3
	2023	60	641.5	518.0	15.8	35.1	52	86.7
Ringsjön	2011	124	678.5	619.8	16.1	38.7	113	91
	2013	127	699.5	666.7	15.7	40.2	117	92
	2019	105	754.8	892.0	18.4	37.7	105	100
	2020	150	755.8	851.4	20.6	33.7	148	99
Roxen	2014	88	877.3	1427.3	15.8	51.7	84	95.5
	2015	100	869.9	1417.8	16.5	49.0	100	100.0
	2016	140	893.8	1496.9	16.8	49.4	137	97.9
	2017	105	902.9	1486.3	19.3	43.5	105	100.0
	2018	66	935.3	1748.0	20.3	42.9	66	100.0
Vombsjön	2014	124	756.2	932.0	15.3	45.4	123	99.2
	2015	127	756.4	909.6	18.0	38.7	127	100.0
	2016	125	731.0	865.3	14.5	46.0	123	98.4
	2017	141	735.5	900.4	21.3	35.1	125	88.7
	2018	130	744.2	805.8	19.4	35.5	129	99.2
Vänern	2010	255	775.2	990.7	14.1	52.0	247	96.9
	2011	257	793.3	1028.0	16.3	46.0	235	91.4
	2012	247	813.2	1144.0	16.9	44.9	236	95.5
	2013	249	834.6	1286.9	16.2	47.9	235	94.4
	2014	230	826.5	1217.9	16.1	47.6	226	98.3
	2015	251	812.4	1130.5	18.0	41.7	251	100.0
	2016	248	841.0	1283.7	18.2	42.9	245	98.8
Ymsen	2019	129	889.6	1434.9	17.2	48.3	122	94.6
	2020	132	908.2	1529.7	17.4	48.9	132	100.0
	2021	136	886.4	1390.0	16.4	51.0	134	98.5

5.4 Diseases, Parasites & Pathogens or Contaminants

5.4.1 Parasites & Pathogens

All eels that are dissected at the Department of Aquatic Resources are screened for *Anguillicola crassus* by counting the number of visible parasites in the swim bladder, or by noting presence/absence. A considerable proportion of eels from most sites are infested but the prevalence has levelled out. The prevalence in Swedish western coastal waters generally appears to be lower than in the Baltic proper and in Swedish lakes (Figure SE. 16-Figure SE. 19). In 2023, 201 eels caught in freshwater were analysed and 34% were infested. From test fishing in coastal waters in 2022, 893 yellow eels were analysed and 38% were infested. Moreover, in coastal waters 212 silver eels were analysed in 2020, and 48% of those were infested.

Imported eels used for stocking and for aquaculture purposes are monitored by the Swedish National Veterinary Institute (SVA) mainly for Infectious pancreatic necrosis virus (IPNV) during the quarantine phase, investigating both glass eel initially and finally sentinel species (Axén C. and Hällbom H., SVA, pers. comm.). SVA is also assigned to monitor diseases in wild eels by the Swedish Agency for Marine and Water Management. In 2024, the imported glass eel tested positive for EVEX during quarantine. As a result, these eels were not allowed to be released into Swedish waters. They were also not allowed to be moved into aquaculture, following the EU Eel Regulation stipulation that at least 60% of glass eel catches must be reserved for restocking. Currently, they remain in quarantine until a suitable destination is found for them.

Parasites and other pathogens are diagnosed by SVA in case of suspected disease/acute mortality, or due to temporary investigations. At necropsy, standard routine fish necropsy protocol is followed, with examination of skin, gills, fins, eyes, muscle tissue, organs, etc. In case of a suspected bacterial disease, samples are taken from the kidney as well as organs with pathological changes (e.g. wounds).

Samples are cultured on agar, and bacteria are typed by MALDI-TOF or biochemical methods. If findings indicate viral disease, samples are taken for cell cultures (general cells sensitive for IPN, EVEX and VHS) and molecular analysis. In case of virus growth on cell culture, the virus is further typed by immunological and molecular methods. Wild eels are also routinely controlled for Anguillid herpesvirus by molecular methods.

It was reported (during the summer of 2020) that some eels in River Ätran had the parasite that caused “white spot disease”.

Eel herpes (Anguillid herpesvirus 1, AngHV-1) was commonly found in yellow eels along the west coast in 2020, as well as in some lakes a few years earlier (2018 in lake Bolmen and lake Hjälmaren).

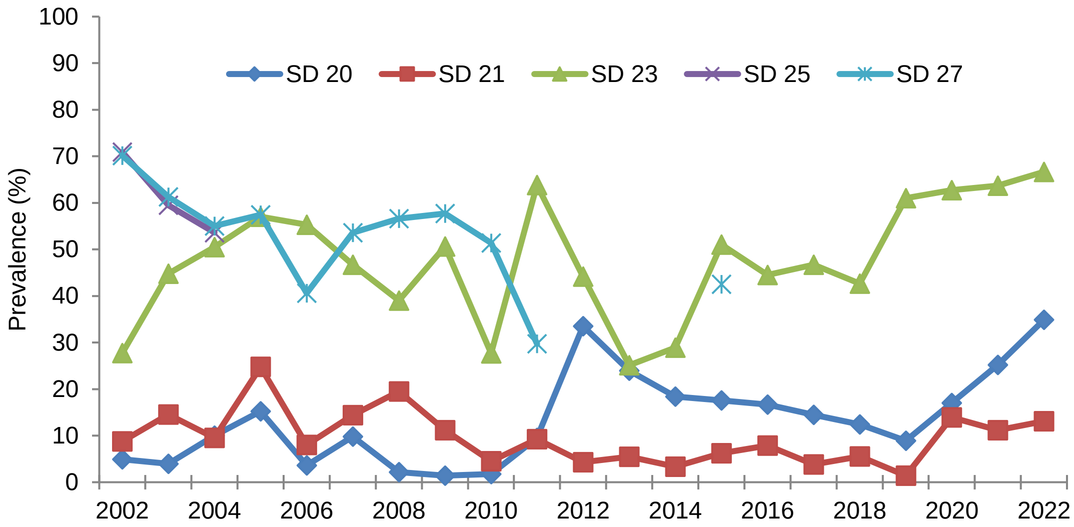

Figure SE. 16: Prevalence (%) of the parasite *Anguillicola crassus* in yellow eel along the Swedish coast. SD refers to ICES subdivisions.

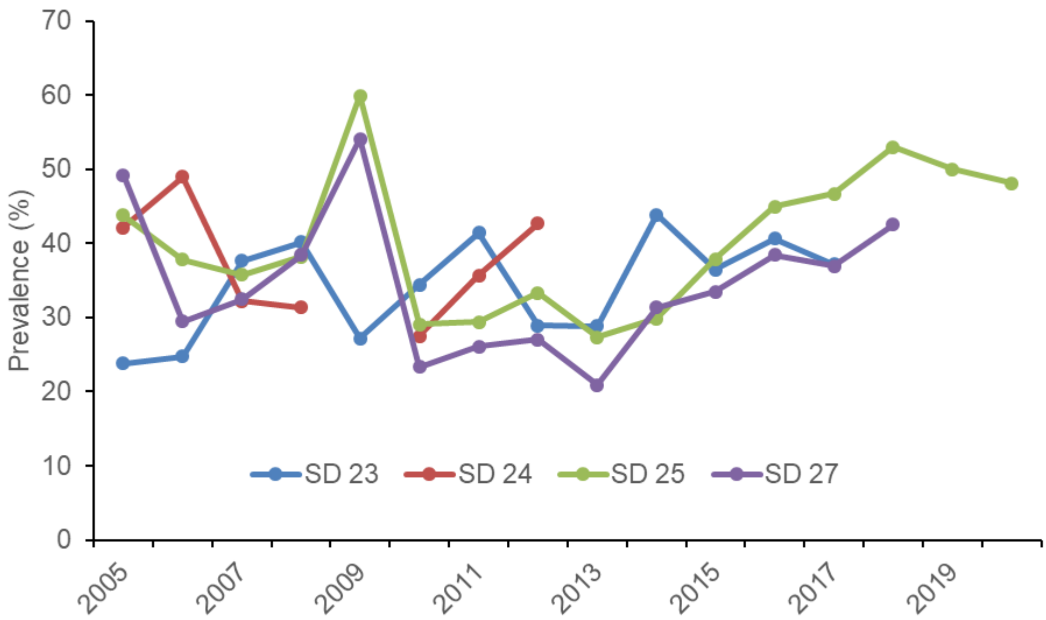

Figure SE. 17: Prevalence (%) of the parasite *Anguillicola crassus* in silver eel along the Swedish coast. SD refers to ICES subdivisions.

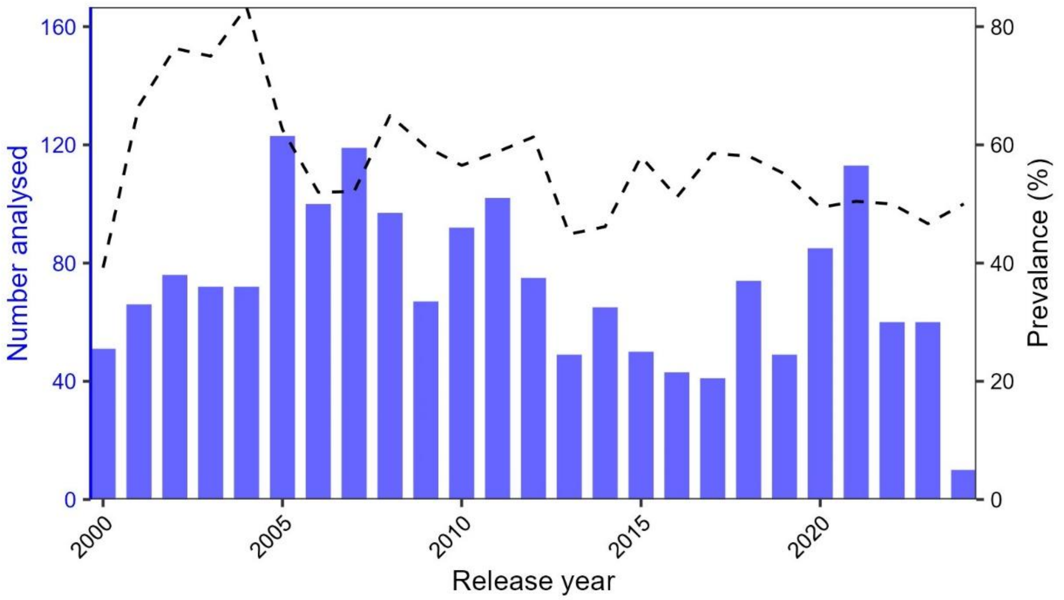

Figure SE. 18: Percentage prevalence (black dashed line) and number of eels dissected and inspected for parasite prevalence (blue bars), by counting the number of visible parasites in the swim bladder, for *Anguillicola crassus* at one site in Lake Mälaren 1998–2024.

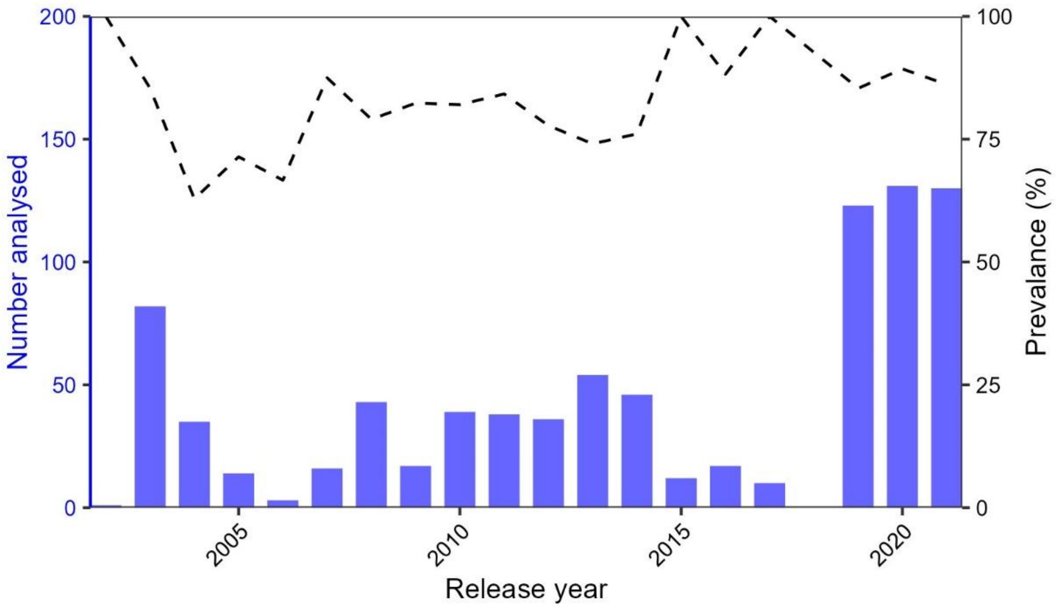

Figure SE. 19: Percentage prevalence (black dashed line) and number of eels dissected and inspected (blue bars) for *Anguillicola crassus* in Lake Ymsen 2002–2021.

5.4.2 Contaminants

Pharmaceuticals

Preliminary data from analyses of eel tissue (muscle, brain, liver) samples from three lakes in Sweden (Bolmen, Ringsjön, Ymsen) from 2020-2021 show presence of 36 different pharmaceutical compounds (Sundin et al. In preparation). The pharmaceuticals detected include, but are not limited to, painkillers, antihistamines, antidepressants, antibiotics, and muscle relaxants. The highest bioaccumulation levels were detected for antibiotics and painkillers, with levels up to 50 ng g^{-1} (Sundin et al. In preparation).

No other data to report on contaminants since the 2018 Country Report.

6 New Information

Relevant reports

- van Gemert, R., Holliland, P., Karlsson, K., Sjöberg, N., Säterberg, T. (2024). Assessment of the eel stock in Sweden, spring 2024; Fifth post-evaluation of the Swedish eel management. Aqua reports 2024:5. Uppsala: Swedish University of Agricultural Sciences (SLU), https://doi.org/10.54612/a.4iseib7eup

This report presents the updated assessment of eel in Swedish waters. In summary, the report finds that human impacts on the Swedish West Coast and Baltic Coast are within the limits necessary for recovery, but for Inland waters anthropogenic mortality exceeds the limit and escapement biomass is below the target.

New projects

Evaluation of trap and transport: This project commenced in 2022 and is funded by the Swedish Agency for Marine and Water Management. The project goals are:

- Evaluate mortality during trap and transport using existing data form trap and transport protocols. Completed in 2022 in a report in Swedish (summarised above, the report is currently being rewritten into a scientific manuscript, Sundin et al. in preparation, and was presented at the ICES ASC in 2023, and at the World Fisheries Congress in 2024).
- Evaluate stress during trap and transport using biologgers. Fieldwork was executed in 2023 and 2024. Results from 2023 are presented in a report in Swedish (Sundin et al. 2023). Results from 2024 are currently being evaluated. Results from 2023 and 2024 will be combined and a scientific manuscript is under preparation.
- Evaluate migration pattern of Trap and Transport eel via satellite and acoustic tagging. Fieldwork and data processing are currently ongoing. Results will be presented in a report in Swedish and in a scientific manuscript. The timeline for the report and manuscript has not been decided upon.

Evaluating the effects of restocking in Sweden. This project commenced in 2022 and was continued in 2024, funded by the Swedish Agency for Marine and Water Management.

- So far, three reports have been generated in the project since the start in 2022 (Myrenås 2022, 2024; Myrenås & Jacobson 2024),
- Evaluating habitat utilization (freshwater, brackish or marine) of restocked (Sr-marked) vs natural recruited yellow eel based on otolith micro chemistry caught at the Swedish

west coast. Results will be summarized in a Swedish report planned to be published by the end of 2024.
- The combined findings will be synthesized in a scientific manuscript in 2024-2025.

Investigate downstream migration survival and behaviour prior to and after the implementation of fish passage solutions in a natural system with three hydropower plants. The project commenced in 2022 and is funded by the Oscar and Lili Lamm Memorial Foundation. Fieldwork started in 2022 and has continued during 2023 and 2024 (for data prior to fish passage solutions), and during 2025-2026 (after fish passage solutions). The study is being conducted in river Kävlingeån, the Swedish eel index river.

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