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

Netherlands

2023

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 the WGEEL. Summaries of these data are provided in this document.

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Acknowledgments: DUPAN (glass eel stocking data, assisted migration silver eel and eel aquaculture production), NVWA (data on illegal fishing), RVO (licences fishermen), Ben Griffioen (Wageningen Marine Research; glass eel indexes), Twan Leijzer (Wageningen Marine Research; parasite infections, fisheries data); Anieke van Leeuwen (yellow eel data NIOZ fyke), Michiel Kotterman (Wageningen Marine Research; data on contaminants), Martijn Schiphouwer (RAVON, glass eel index).

Contents

1 Updates to the previous report

Compared to the previous report, the eel stock assessment (**Error! Reference source not found.**) has been updated using the estimates derived from van der Hammen et al. (2024). Data updates have occurred for the fisheries section (4), the fishery independent data collection for glass eel (5.1) and yellow and silver eel (5.2), restocking (6), aquaculture (7), assisted migration (8), diseases, parasites and pathogens (9), contaminants (10) and predators (11).

2 Stock status summary

The Netherlands is one EMU with one Eel Management Plan (EMP)[1] that was implemented in July 2009 and revised in 2011 and 2018. The Dutch Ministry of Agriculture, Nature and Food Quality (LNV) is responsible for the conservation of stocks and for the management of all anthropogenic impacts, as well as for the delivery of the EMP.

Table 1 shows calculated estimates of silver eel escapement and mortality indicators. Methods are described in Van der Hammen et al. (2024).

Table 1 Stock indicators of silver eel escapement, biomass and mortality rates, and assessed habitat area for the period 2006-2023 derived from Van der Hammen et al. (2024).

Year	EMU	B_0 (t)	B_{curr} (t)	B_{best} (t)	B_{curr}/B_0 (%)	∑F	∑H	∑A
2006-2008	NL_Neth	10,400*	555	3,363	5.3	1.61	0.20	1.80
2009-2011	NL_Neth	10,400*	724	1,656	7.0	0.63	0.20	0.83
2012-2014	NL_Neth	10,400*	830	1,628	8.0	0.48	0.19	0.67
2015-2017	NL_Neth	10,400*	1,022	1,777	9.8	0.38	0.17	0.55
2018-2020	NL_Neth	10,400*	952	1,957	9.1	0.57	0.15	0.72
2021-2023	NL_Neth	10,400*	1,269	2,322	12.2	0.50	0.11	0.60

* Excluding coastal waters (2,600 t).

Key: EMU = Eel Management Unit; B_0 = prisine silver eel biomass; B_{curr} = silver eel biomass that currently escapes; B_{best} = silver eel biomass without anthropogenic influences on the current stock; ∑F = mortality due to fishing (rate); ∑H = anthropogenic mortality excluding the fishery (rate); ∑A = all anthropogenic mortality (rate).

3 Overview of the stock and its management

Current biomass of escaping silver eel ($B_{current}$)

Between 2006-2008 and 2015-2017, the biomass of escaping silver eel increased every period ($B_{current}$, Table 1). Large differences between years in biomass were not expected as current silver eel escapement has largely been determined by processes (recruitment, anthropogenic mortality) that occurred in the previous 5-15 years. Furthermore, an increase in glass eel recruitment will, at the earliest, result in an increase of silver eel after 5-15 years, and glass eel recruitment has not significantly increased after the implementation of the EMP in 2009. Moreover, the total silver eel biomass depends not only on the status of the Dutch part of the eel stock, but also on the stock status in the other Member States. After a slight decrease in 2018-2020, the biomass of escaping silver eels in 2021-2023 is the highest since the beginning of this time series.

1 https://rijksoverheid.archiefweb.eu/#archive
Search for "aalbeheerplan"

Current best possible biomass (B_{best})

The current best possible biomass (B_{best}) has a steep decrease between 2006-2008 and 2009-2011, after which there was a steady increase up to 2021-2023 (Table 1).

Anthropogenic Mortality (sumA)

A reduction in Anthropogenic Mortality (sumA) can be achieved by reducing fishing mortality and barrier mortality. A reduction in anthropogenic mortality is therefore the direct result of the measures taken by a Member State. In the Netherlands, the implementation of the EMP has resulted in a reduction in sumA between 2006 and 2017 from 1.8 to 0.6. This reduction was mainly the result of a decrease in fishery mortality, both commercial and recreational: retained catches (landings) of both commercial and recreational fishery strongly decreased between 2006-2008 and 2009-2011. In the latest period, there is again a decrease in fishery mortality, again because of a higher estimate of the standing stock (504 tonnes in 2021-2023).

3.1 Management actions

An overview of all the measures described in the Dutch Eel Management Plan implemented to reach the 40% escapement objective are listed in Table 2.

Table 2 Overview of the measures described in the Dutch Eel Management Plan implemented (source: Dutch Eel Management Plan2).

Measure	Planned implementation	Realized implementation
• Implementation of a program for the improvement of fish migration including eel, which is expected to resolve the issues at 1800 of the most important migration barriers.	2015-2027	2015-2027[a]
• Reduction of eel mortality at hydroelectric stations by at least 35%.	2009	November 2011[b]
• The establishment of zones where fishing is not allowed in areas that are important for eel migration.	2010	1 April 2011[c]
• Closed area to eel fisheries due to high levels of dioxins and	-	1 April 2011[c]
• Release of eel caught (a) at sea and (b) at inland waters by anglers.	2009	1 October 2009
• Ban on recreational fishing using professional gear in coastal areas.	2011	1 January 2011
• Annual closed season from 1 September to 1 December.	2009	1 October 2009[d]
• Decentralized eel management in the province of Friesland (a quota system).	-	2018[d]
• Stop the issue of licenses for eel snigglers (*Dutch: 'peur'*) by the minister of LNV in state-owned waters.	2009	1 May 2009
• Restocking of glass eel and pre-grown eel from aquaculture	2009	Early 2010
• Research into the artificial propagation of eel:		
PRO-EEL (EU-project)	2010	2010-2015
EEL- HATCH	2014	2014-2017
EELRIC (Dutch innovation centrum)	2015	2015
Glasaal Volendam (duurzame palingkweek/innovatief	2017	2017

[a] *In agreement with the EC, changes have been made to the original schedule of solving migration barriers.*

[b] *Due to technical difficulties, the maximum achievable reduction in mortality through adjusted turbine management is 24%.*

[c] *There was an (unforeseen) closure of eel fishery in contaminated (PCBs, dioxins) areas (all large rivers). The majority of the contaminated areas that were closed for commercial fisheries on 1/4/2011 include the main rivers. These rivers are the most important migration routes for diadromous species.*

[d] *In 2011 the province of Friesland started a pilot on a quota system. This system was adopted in the eel management plan in 2018. This allows those fishermen fishing in the province of Friesland to fish during the closed season based on a TAC (quota of 36.6 tonnes for all fishermen).*

2 https://rijksoverheid.archiefweb.eu/#archive
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4 Fisheries

4.1 General information

Management implications

Eel fisheries in the Netherlands occur in coastal waters, estuaries, larger and smaller lakes, rivers, polders, etc. Management of eel stock and fisheries has been an integral part of the long tradition in manipulating water courses (polder construction, river straightening, ditches and canals, etc.). Governmental control of the fishery is restricted to on the one hand a set of general rules (gear restrictions, size restrictions (MLS = 28cm, hence no glass eel fishing), closed season, quota (Friesland), and on the other hand site-specific licensing[3]. Since 2010 there is a general registration of landings in fresh water.

Until April 2011, the total Dutch fresh water fishery on eel involved approx. 200 companies, with a total catch of nearly 442 tonnes of eel in 2010. However, on 1 April 2011 a large part of the fishery was closed due to high PCB-levels (Figure 1). This closure affected about 50 fishing companies catching 170 tonnes of eel in 2010.

In addition, the European Council Regulation of 30 January 2023 stated that it requires Member States to prohibit eel fishing in marine waters for a minimum of six consecutive or non-consecutive months[4]. The Dutch Ministry of Agriculture, Nature and Food Quality (LVVN) decided to prolong the closed season (1 September-1 December) with another three months (1 September-1 March) for 2023-2024 and 2024-2025 thereby complying with the EU regulation[5].

Silver eel landings

There is no reliable historical data on silver eel landings available. Silver eel and yellow eel landings have therefore been combined. Since the closed season for fisheries in marine and fresh waters from 1 September to 1 December (October 2009 onwards), which is during the main migration period of silver eel, it is expected that the amount of silver eel landings has declined.

3 https://wetten.overheid.nl/BWBR0024539/2019-08-14#Hoofdstuk3_Paragraaf3.2_Artikel28b

4 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32023R0194

5 https://www.rijksoverheid.nl/documenten/kamerstukken/2023/03/08/gesloten-periode-aalvisserij

Since 2011, Frisian inland fishers, associated through the Frisian association of inland fishers ('Friese Bond van Binnenvissers'), have been experimenting with fishing quotas for eel. This approach is also known as 'decentralised eel management' (Dutch: decentraal aalbeheer). This quota (36.6 tonnes for all fishermen) is in lieu of the statutory eel fisheries system, which includes a three-month period in which no eel may be fished, which means that Frisian inland fishers continue fishing during the closed period and will be catching more silver eels. In April 2018 a change in the eel management plan was accepted by the European Commission and the decentralised eel management in Friesland was added to the management plan. Together, the Frisian fishers are allowed to catch 36.6 ton annually regardless of the season.

Figure 1 Overview of the areas closed for eel fishery as of 1 April 2011 (Source: Ministry of Agriculture, Nature and Food Quality).

4.2 Spatial subdivision

The fishing areas in the Netherlands can be categorised into five groups:

1. **Lake IJsselmeer and Markermeer**; 52º40'N 5º25'E; now 1820 km². Lake IJsselmeer and Markermeer are shallow, eutrophic freshwater lakes, which were reclaimed from the Wadden Sea in 1932 by a dike (Dutch: Afsluitdijk), substituting the estuarine area known before as the Zuiderzee. The surface of the lakes was reduced stepwise by land reclamation, from an original 3,470 km² in 1932, to 1,820 km² since 1967. In preparation for further land reclamation, a dam was built in 1976, dividing the lake into two compartments of 1,200 km² (IJsselmeer) and 620 km² (Markermeer), respectively, but no further reclamation has actually taken place. In managing the fisheries, the two lake compartments have been treated as a single management unit. The discharge of the river IJssel into the larger compartment (at 52º35'N 5º50'E, average 7 km³ per annum, coming from the River Rhine) is sluiced through the Afsluitdijk into the Wadden Sea at low tide, by passive fall. Fishing gears include standard and summer fyke nets, eel boxes and long lines; trawling was banned in 1970. Licensed fishermen are not spatially restricted within the lake, but the number of gears is controlled by a gear-tagging system. Landings are reported by the fisheries organisation (PO IJsselmeer), the Fish Board (PVIS) and catch registration system of the Ministry of Agriculture, Nature and Food quality (LNV)Estimated landings show differences between the three different sources, the official catch registration system of the Ministry is assumed to be the most reliable.

2. **The Wadden Sea**; 53ºN 5ºE; 2,591 km². The Wadden Sea is an estuarine-like area, shielded from the North Sea by a series of islands. The inflow of sea water at the western side mainly consists of the outflow of the river Rhine, which explains the estuarine character of the Wadden Sea. The fishery in the Wadden Sea is permitted to license holders

and assigns specific fishing sites to individual licensees. Fishing gears include fyke nets and pound nets; the traditional use of eel pots is in rapid decline. The fishery in the Wadden Sea is obliged to apply standard EU fishing logbooks.

3. **Zeeland**; 965 km^2. In the Southwest, the Rivers Rhine, Meuse and Scheldt (Belgium) discharge into the North Sea in a complicated network of river branches, lagoon-like waters and estuaries. Following a major storm catastrophe in 1953, most of these waters have been (partially) closed off from the North Sea, sometimes turning them into fresh water bodies. Fishing is licensed to individual fishermen, mostly spatially restricted. Fishing gears are dominated by fyke nets. Management is partially based on marine, partly on fresh water legislation. This area has also been affected by the ban on eel fishery due to high pollution levels (April 2011).

4. **Main rivers**; 180 km^2 of water surface. The Rivers Rhine and Meuse flow from Germany and Belgium respectively, and in the Netherlands constitute a network of dividing and joining river branches. Traditional eel fisheries in the rivers have declined tremendously during the 20th century, but following water rehabilitation measures in the last decades, was slowly increasing before the closure from April 1, 2011. The traditional fishery used stow nets for silver eel, but fyke net fisheries for yellow and silver eel dominated in the latest years before the closure. Individual fishermen were licensed for specific river stretches, where they execute the sole fishing right. Since 1 April 2011 the eel fishery on the main rivers has been closed due to high levels of pollutants in eel.

5. **Remaining waters**; inland 1,340 km^2. This comprises 636 km^2 of lakes (average surface: 12.5 km^2); 386 km^2 of canals (> 6 m wide, 27,590 km total length); 289 km^2 of ditches (< 6 m wide, 144,605 km total length); and 28 km^2 of smaller rivers (all estimates based on areas less than 1 m above sea level, 55% of the total surface; see Tien and Dekker 2004 for details). Traditional fisheries are based on fyke netting and hook and line. Individual licenses permit fisheries in spatially restricted areas, usually comprising a few lakes or canal sections, and the joining ditches. Only the spatial limitation is registered.

4.3 Fishing capacity/effort

Capacity is defined as the potential fishery usage (i.e. number of licences issued). For marine waters and Lake IJsselmeer a register of vessels is kept, but for the other waters there is no central registration of the vessels being used.

For Lake IJsselmeer/Markermeer, an estimate of the number of gears actually used is available for the years 1970-1988 (Dekker 1991). In the mid-1980s, the total capacity of fyke nets was capped, and reduced by 40% in 1989. In 1992 the number of eel boxes was counted, and capped. Subsequently, the caps have been lowered in several steps, the latest being a buy-out in 2006. Since the number of companies has reduced at the same time, the fishing effort per company has not reduced at the same rate, and underutilisation of the maximum capacity probably still exists. The effort in the longline fishery was not restricted, other than by the number of licenses.

Since 2012, fishermen of Lake IJsselmeer are obliged to report their fishing effort (expressed as number of gears x number of weeks). Most effort comes from summer fykes and standard fykes followed by longlines and eel boxes (Figure 2). The effort of most gears fluctuates but seem to remain relatively stable over time, for summer fykes however, there seems to be an increase in effort since 2017. There was also a substantial increase in the effort of eel boxes in 2022.

The ministry (LNV-RVO) provides permits that give the right to fish with certain gears. The numbers of gears and rights differ per permit holder. Insight in the use of the permits is provided by the weekly catch reports that fishermen are obliged to hand in. When fishermen fish with a certain gear, they have to mark it with a label. Permits can also be reserved temporarily, e.g. when there is no vessel available. In that case, there are no rights to fish (source: pers. com. RVO, Ministry of Agriculture, Nature and Food quality, 2017). In 2024, the total number of gears allowed was 1,579 fixed fykes, 3,193 train fykes (1 fyke = 2 eel units), 7,415 eel boxes. These numbers have hardly changed in the past few years.

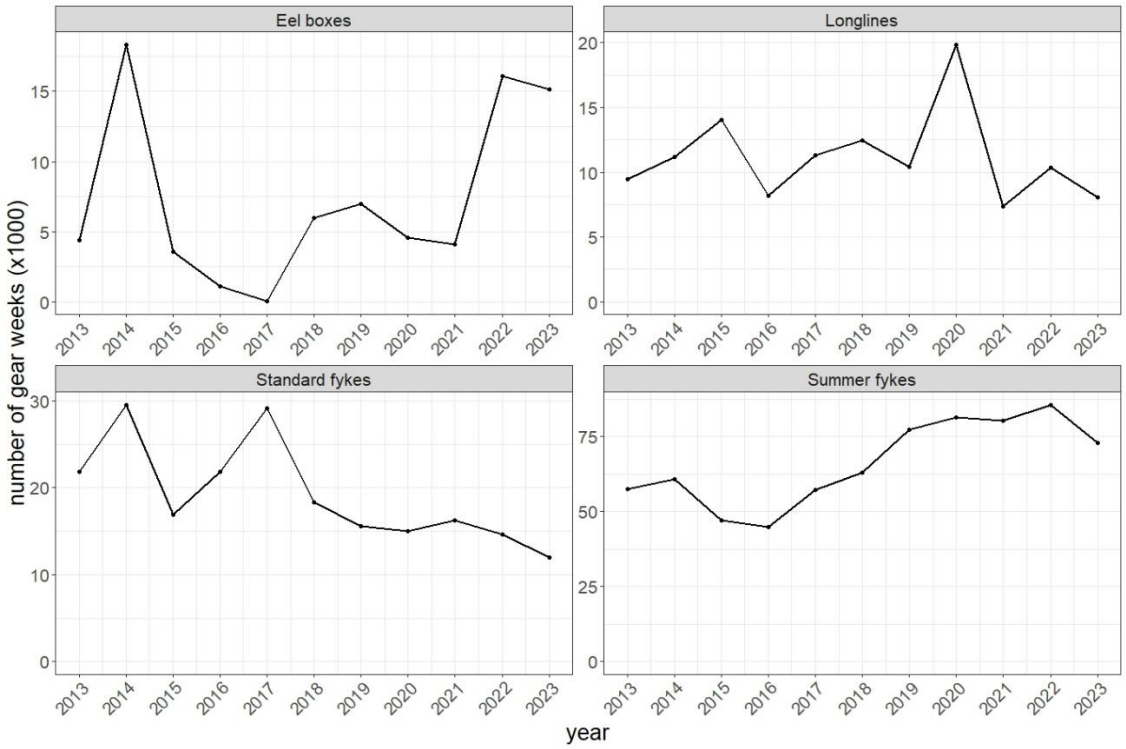


Figure 2 Effort per gear type in lakes IJsselmeer and Markermeer per year (source: RVO). Effort is self reported by the fishermen.

4.4 Fresh water eel fisheries

Landings data from before 2010 is only available for the lakes IJsselmeer and Markermeer. Total landings of yellow and silver eel combined were reported. Collection of the IJsselmeer and Markermeer landings data has been done by LNV/PVIS and the PO IJsselmeer. Since 2010 all freshwater landings are registered by the ministry (LNV). Below the different sources are described.

LNV (1938-1993) / PVIS (1994-2012): Statistics from the auctions around lakes IJsselmeer and Markermeer were kept by the Ministry of LNV until 1994; and between 1994 and 2012 statistics were kept by the Fish Board (PVIS). The quality of this information from PVIS deteriorated considerably, due to misclassification of gears, and the trading of eel from areas other than Lake IJsselmeer and Lake Markermeer at the auctions around the lakes.

PO IJsselmeer (2001-): From 2001 onwards the fishers organisation (PO IJsselmeer) has kept records of the catches of their associated fishers (>90% of the fishers active in the IJsselmeer area). These records cover the IJsselmeer only and only those fishers that are member of the PO. In recent years the members of the PO have decreased.

LNV registration system (2010 -): In January 2010 an obligatory catch registration system was introduced in the Netherlands by the Ministry of LNV. Weekly catches of eel are reported, but yellow eel and silver eel catches are combined in this program. Since 2012, also information on effort are reported, however the completeness of the effort data is unclear up till now. We regard the landings data from 2010 onwards as the best representative of the amount of eels actually caught and landed in The Netherlands (Table 3, Figure 3). However, the data is self-reported and not checked by the authorities on being correct.

Market sampling: Representative samples are taken from retained catches from commercial fisheries each year and the lengths of the individual eels are measured. Furthermore, several eels per length class were selected from each sample for dissection and measurements of maturity, weight and sex (see Volwater, 2024 for methods). These measurements are used to calculate maturity-at-length, weight-at-length, and sex-ratio-at-length (van der Hammen et al. 2024). Since 2010, otoliths have been obtained annually. From 2014 onwards, ~50-100 otoliths are sent to the Swedish University of Agricultural Sciences (SLU) in Sweden annually. The number of annuli were counted to determine the age of individuals ("crack and burn" method). Furthermore, distances between consecutive annuli were measured using image analysis software to determine growth increments.

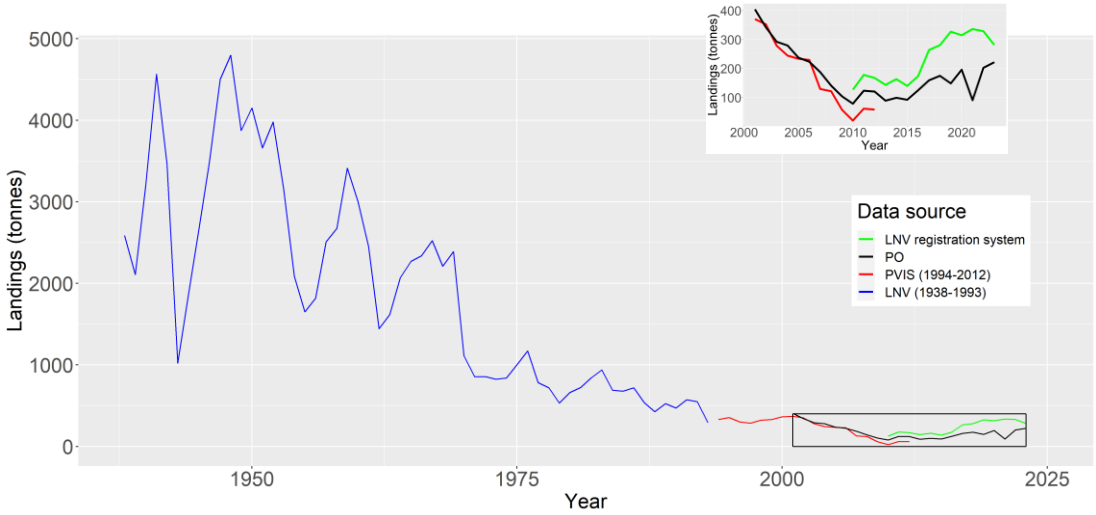


Figure 3. Time series of landings of yellow plus silver eel combined from Lake IJsselmeer/Markermeer from 1938-2020 (before 1938 these two lakes were not separated and directly connected to the sea and was called, "Zuiderzee"). Source data: LNV, Productschap Vis (PVIS) and PO IJsselmeer.

In addition to landings of Lake IJsselmeer, the Ministry of LNV collects also eel landing data from all other Dutch inland waters through the catch registration system since 2010 (Figure 4). The steep drop in landings in 2011 in 'other inland waters' (Figure 4) is due to the closure of eel fishery in contaminated (PCBs, dioxins) areas. Since this closure, the landings of Lake IJsselmeer exceed those of all other inland waters. In 2023, landings in Lake IJsselmeer and Lake Markermeer, have decreased compared to 2021 and 2022 as is true for the other inland waters (Table 3, Figure 4).

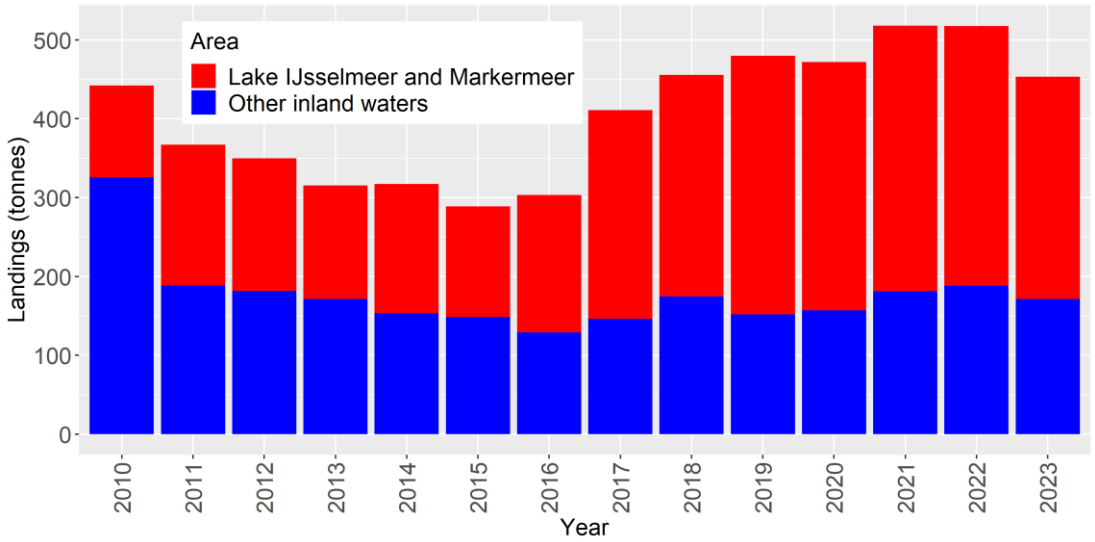


Figure 4 Time series of landings of yellow and silver eel combined from all inland waters based on the catch registration system. Source data: LNV.

Table 3 Time series of landings of yellow and silver eel combined from all inland waters based on the catch registration system. Source data: LNV.

Year	Lake IJsselmeer & Markermeer (kg)	Other inland waters (kg)	Total (kg)
2010	116,613	325,505	442,118
2011	178,535	188,566	367,101
2012	168,280	181,514	349,794
2013	144,124	171,465	315,589
2014	163,832	153,308	317,140
2015	140,544	148,425	288,969
2016	174,284	129,119	303,403
2017	264,489	146,268	410,757
2018	281,138	174,581	455,719
2019	327,674	151,987	479,661
2020	315,295	156,832	472,127
2021	336,770	181,299	518,069
2022	329,184	188,393	517,577
2023	281,783	171,664	453,447

4.5 Marine water fisheries

Landings in marine water are mainly in the Wadden Sea. There is a sudden increase from ~4 tonnes in 2015 to 19 tonnes in 2018 (Table 4). In 2018-2023 there is a decline again to similar quantities as before 2016 (3-6 tonnes) with the catches of 2022 being the lowest of the whole timeseries. The reliability of the (registration) of the marine landings data is doubted and the data should be used only carefully.

Table 4 Dutch marine fisheries landings.

Year	Landings (tonnes)	Year	Landings (tonnes)
1999	25	2012	3
2000	22	2013	3
2001	34	2014	3
2002	27	2015	4
2003	17	2016	9
2004	30	2017	10
2005	17	2018	19
2006	17	2019	4
2007	9	2020	3
2008	6	2021	6
2009	3	2022	2
2010	6	2023	3
2011	3		

4.6 Recreational Fishery

In 2009 an extensive biennial Recreational Fisheries Program was started in the Netherlands. In December in every odd year ~50,000 households were approached during a screening survey to determine the total number of recreational fishermen in the Netherlands. In the following (even) year , 2000-2500 recreational fishermen were selected for a 12-month logbook programme. By combining the results from the screening survey, the logbook survey and the Dutch population size the total number and weight of eel caught by recreational anglers in The Netherlands was estimated (van der Hammen, 2019). The Dutch eel management plan states that since October 2009 all eel caught by recreational anglers should be returned (***Table 2***).

4.7 Illegal, unreported and unregulated (IUU) fishing

The task of adherence to rules and regulations pertaining to eel fishery is carried out by the Netherlands Food and Consumer Product Safety Authority (NVWA). In 2015 in total 202 fishing gears associated with illegal eel fishing were seized (61 incidents). In 2022, this number decreased to 45 and the number incidents also decreased over time to 31 (Figure 5). The most common cause of illegal fishing in 2023 was fishing using illegal gears (Table 5, Figure 5).

Table 5 Overview of suspected causes of illegal fishing activities in the Netherlands (2023). Number of cases (incidents) per area (Source: NVWA).

	IJsselmeer	Noord-Holland	Randmeren	Zuid-Holland	Gelderland	Zeeland	Friesland	Groningen	TOTAL
Fishing out of the season	1					1	1		
Fishing without licence	4	1				2			
Fishing using illegal gears	5		2			2	4	1	
Retention of eel below size limit									
Illegal selling of catches									
Fishing in closed areas	2		3	1	1				
TOTAL	**12**	**1**	**5**	**1**	**1**	**5**	**5**	**1**	**31**

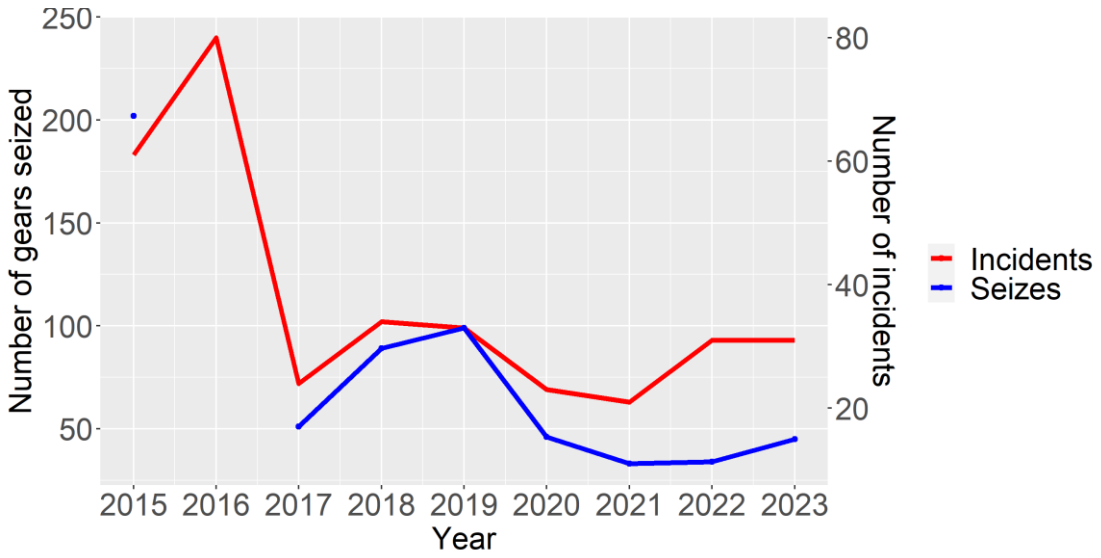


Figure 5 Number of gears seized (blue) and number of incidents (red) per year as reported by the NVWA.

5 Fishery independent data collection

5.1 Glass eel

The WGEEL uses recruitment time series from several countries to calculate recruitment indices, relative to the reference period of 1960-1979. The results form the basis of the annual Advice reported to the EU Commission.

5.1.1 Liftnet WMR

Recruitment of glass eel in Dutch waters is monitored at 11 sites along the coast (*Figure 6*). Eleven locations, however, rely on volunteers. In recent years, volunteers were not always available and not all locations are sampled every year. In 2021 sampling was done on only 6 locations due to COVID-19. In 2022 only these 6 locations were sampled again, due to lack of volunteers and in 2023 and 2024 only 5 locations were sampled (location IJmuiden was not sampled). Glass eel data are presented as the average number of glass eels per haul in the months April and May, between 18:00-8:00 and only years with > 5 hauls are included (details in Griffioen et al. 2017).

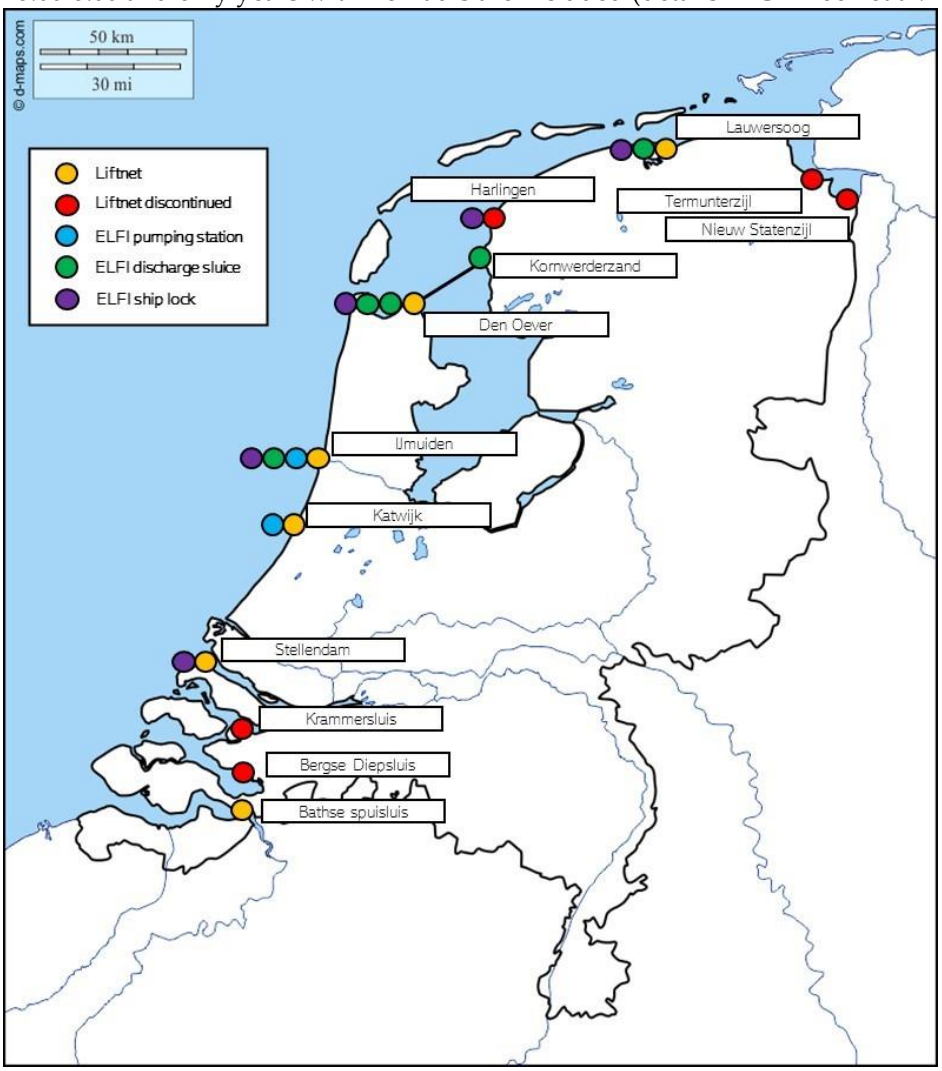


Figure 6 Map of sampling locations of the liftnet and ELFI timeseries.

5.1.1.1 Den Oever series (1938 -)

The time series in Den Oever (Figure 7, Table 6) does not depend on volunteers, is the most extensively sampled and is the longest time-series (from 1938). In Den Oever recruitment levels are very low compared to the reference period (1960-1979). Recruitment was slightly better in 2013 and 2014 but in 2015 recruitment level reached a historic low. After a slight increase in 2017, in the past four years, the recruitment at Den Oever is at a similar low level as that of the 2000s. Since 2019, construction of the discharge sluices is conducted at the sampling location in Den Oever. This causes that in 2020-2024 sampling was done on the same location, but from a boat.

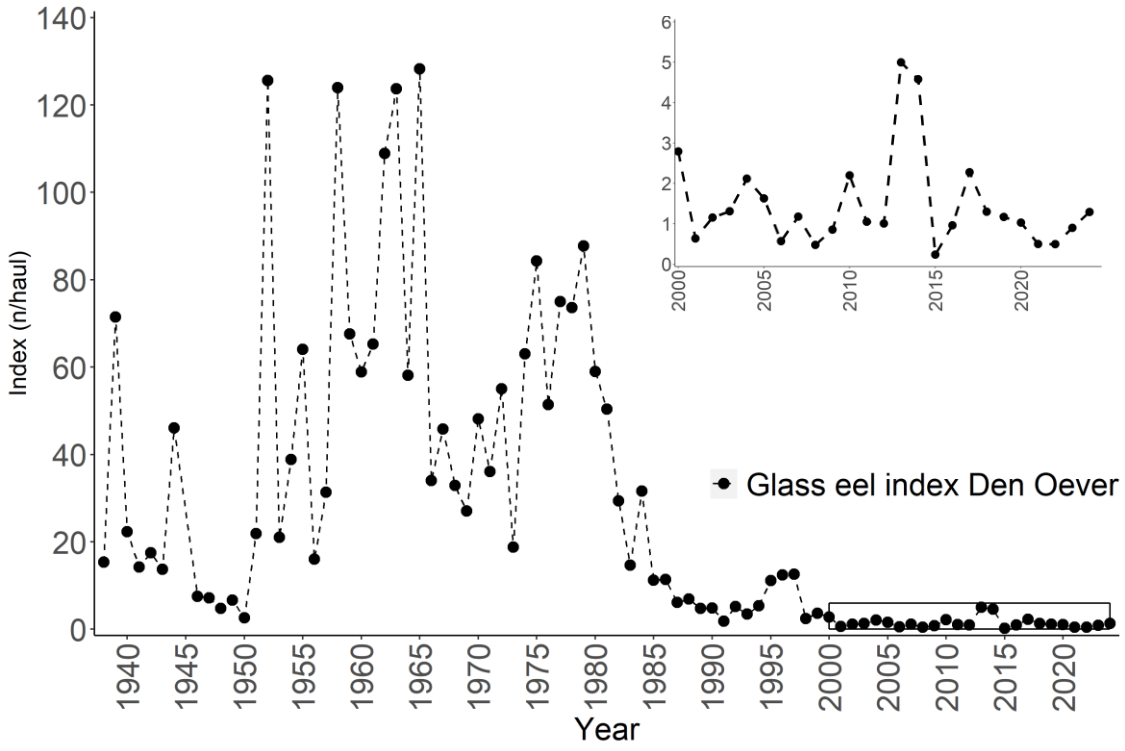


Figure 7 Glass eel trend index at the discharge sluices in Den Oever trend index (average number per lift net haul in April and May).

Table 6 Glass eel trend index at the discharge sluices in Den Oever trend index (average number per lift net haul in April and May).

DECADE / YEAR	1930	1940	1950	1960	1970	1980	1990	2000	2010	2020
0		22.4	2.7	58.9	48.1	59.0	4.9	2.8	2.2	1.0
1		14.3	21.9	65.2	36.1	50.4	1.8	0.6	1.1	0.5
2		17.5	125.6	108.9	55.0	29.4	5.2	1.2	1.0	0.5
3		13.7	21.1	123.7	18.8	14.7	3.5	1.3	4.9	0.9
4		46.1	38.8	58.1	63.0	31.6	5.4	2.1	4.6	1.3
5			64.1	128.3	84.3	11.2	11.1	1.6	0.2	
6		7.5	16.1	34.0	51.4	11.4	12.5	0.6	1.0	
7		7.2	31.3	45.8	75.0	6.2	12.6	1.2	2.3	
8	15.3	4.8	124.0	32.9	73.6	7.0	2.4	0.5	1.4	
9	71.5	6.6	67.6	27.1	87.7	4.8	3.7	0.9	1.2	

5.1.1.2 Other liftnet series

The other ten liftnet sites do rely on volunteers and are therefore less extensively sampled than the Den Oever location (Figure 8, Table 7).

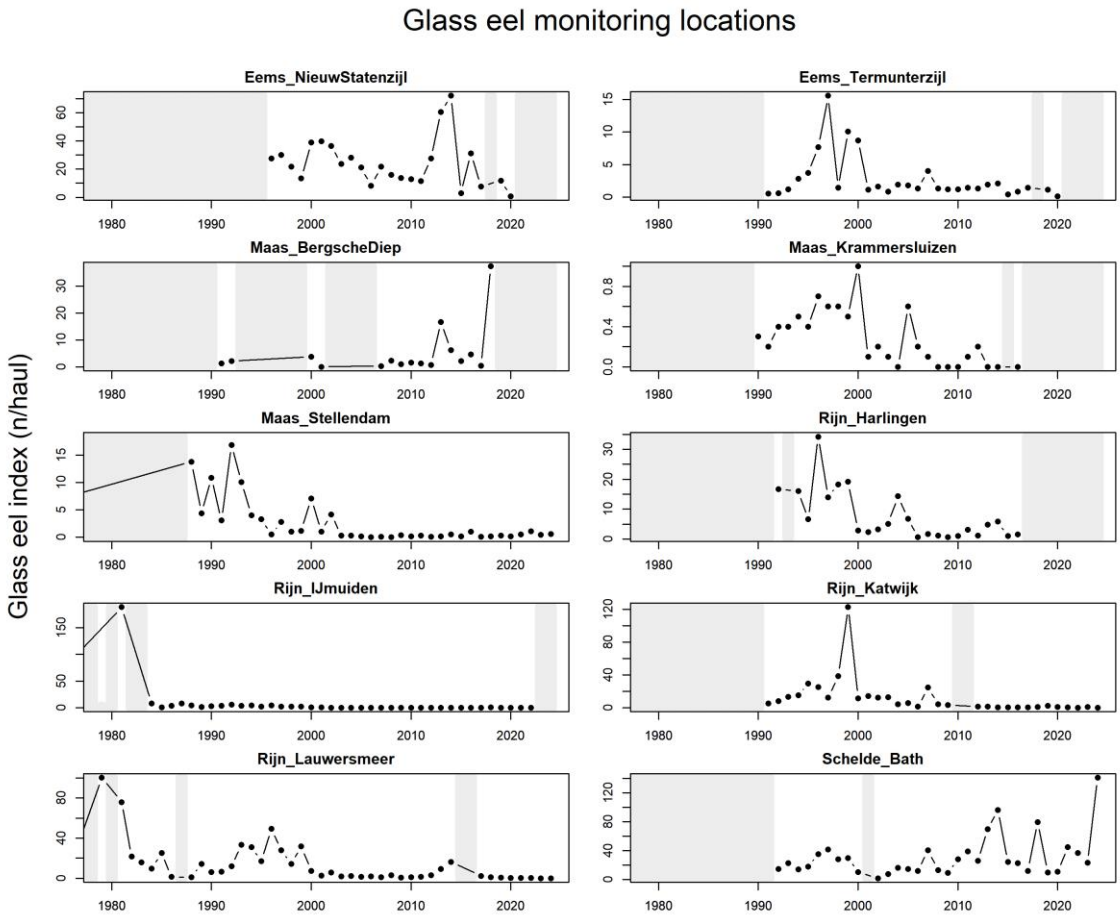


Figure 8 Time series of the glass eel indices from 1979 (data of other liftnet series, Table 7). Grey = not sampled/insufficient data (data WMR).

Table 7 Average number of glass eel caught by liftnet hauls after sunset, before sunrise in the period April-May at 11 sites in the Netherlands (1979-2023). If less than 6 hauls were carried out on a location in a year, data are not presented. Data are visualised in Figure 8. The locations in light grey are used in the ICES assessment.

Year	Schelde_Bath	Maas_BergscheDiep	Maas_Krammersluizen	Maas_Stellendam	Rijn_DenOever	Rijn_Harlingen	Rijn_IJmuiden	Rijn_Katwijk	Rijn_Lauwersmeer	Eems_NieuwStatenzijl	Eems_Termunterzijl
1979					87.7		222.3		100.4		
1980					59.0						
1981					50.4		188.7		75.9		
1982					29.4				21.6		
1983					14.7				15.8		
1984					31.6		8.1		9.5		
1985					11.2		0.6		25.2		
1986					11.4		3.3		1.3		
1987					6.2		7.7				
1988				13.8	7.0		4.0		1.0		
1989				4.4	4.8		1.5		14.3		
1990			0.3	10.9	4.9		3.2		6.0		
1991		1.3	0.2	3.1	1.8		3.6	5.1	6.6		0.5
1992	14.5	2.2	0.4	16.9	5.2	16.7	5.8	8.1	12.1		0.6
1993	22.7		0.4	10.1	3.5		3.3	13.5	33.2		1.2
1994	14.2		0.5	4.0	5.4	16.0	4.0	15.1	31.0		2.8
1995	17.8		0.4	3.3	11.1	6.6	2.0	29.7	16.9		3.7
1996	35.3		0.7	0.5	12.5	34.2	4.5	25.3	49.4	27.5	7.7
1997	41.6		0.6	2.8	12.6	14.0	1.8	12.3	27.8	30.0	15.6
1998	28.2		0.6	1.0	2.5	18.3	2.0	38.8	14.4	21.8	1.4
1999	29.7		0.5	1.2	3.7	19.1	1.9	122.7	31.7	13.5	10.1
2000	10.2	3.8	1.0	7.1	2.8	2.9	0.7	11.6	7.2	38.8	8.7
2001		0.1	0.1	1.0	0.6	2.3	0.5	14.1	2.4	39.7	1.1
2002	1.9		0.2	4.2	1.2	3.2	0.1	12.3	5.5	36.4	1.6
2003	7.5		0.1	0.3	1.3	5.1	0.0	12.7	1.7	23.6	0.8
2004	16.4		0.0	0.3	2.1	14.3	0.1	4.5	2.3	28.1	1.9
2005	14.6		0.6	0.2	1.6	6.8	0.0	5.6	1.4	21.1	1.8
2006	12.0		0.2	0.0	0.6	0.6	0.0	1.4	1.7	8.3	1.3
2007	40.5	0.4	0.1	0.1	1.2	1.7	0.1	24.8	0.9	21.7	4.0
2008	13.2	2.3	0.0	0.0	0.5	1.1	0.1	4.1	2.8	15.9	1.3
2009	9.1	1.1	0.0	0.4	0.9	0.7	0.1	3.5	0.6	13.6	1.2
2010	28.4	1.7	0.0	0.2	2.2	1.0	0.0		1.1	13.0	1.2
2011	39.2	1.3	0.1	0.3	1.1	3.1	0.0		1.4	11.6	1.4
2012	25.8	0.8	0.2	0.1	1.0	1.1	0.1	1.6	2.9	27.6	1.3
2013	69.5	16.7	0.0	0.2	5.0	4.8	0.0	1.4	9.1	60.5	1.9
2014	96.3	6.3	0.0	0.5	4.6	5.8	0.0	0.4	16.2	72.0	2.1
2015	24.2	2.2		0.2	0.2	1.0	0.1	0.6		3.0	0.4
2016	22.8	4.7	0.0	1.0	1.0	1.5	0.0	0.7		31.1	0.8
2017	12.2	0.5		0.1	2.3		0.0	0.4	2.3	7.6	1.4
2018	79.4	37.4		0.2	1.3		0.7	0.8	1.2		
2019	9.8*			0.3	1.2		0.0	2.3	0.8	11.9	1.1
2020	10.9			0.2	1.0		0.0	0.8	0.1	0.7	0.1
2021	44.8**			0.5	0.5		0.0	0.5	0.4		
2022	36.7			1.1	0.5		0.0	0.03	0.1		
2023	23.2			0.4	0.9			0.9	0		
2024	141.0			0.6	1.2			0.2	0		

*April only

**Two nights of sampling only

5.1.2 Glass eel detectors (Elfi's.)

Many glass eel monitoring programs, including the program coordinated by WMR, are executed with liftnets. The liftnets have low catchability and therefore a lot of effort is needed to get sufficient precision. However, often very low precision is obtained because the monitoring is executed by volunteers and thus rely on their effort. Therefore, Wageningen Marine Research experimented with a new approach using a "elver finder" (https://www.elverfinder.com/) which has much higher catchability, is independent of volunteers and ensures equal effort along the Dutch coast besides the long-term liftnet monitoring program. Moreover, this approach also allows for continues monitoring during the migration season including mark recapture studies which is preferred over using a lift net to measure glass eel recruitment.

Since 2019 (2017 for the location IJmuiden) the Dutch glass eel monitoring along the coast is extended with the use of so called 'elver finders' (ELFI's, *Figure 6*). An ELFI uses an continues attraction fresh water flow pumped from the hinterland to efficiently attract and catch glass eel. An ELFI is 24-hours a day in operation. Contrary to a conventional glass eel ladder, an ELFI is a floating device and uses coconut fiber on the 'ladder'. Also, it is equipped with a container where glass eels are trapped for monitoring purposes. In the national glass eel WOT monitoring, ELFI's are emptied twice a week from March until the end of June.
Preliminary results are shown in Figure 9 where the number of caught eels per day is averaged over the different sublocations (shiplocks, sluices, pumping stations) within a monitoring location. In the future, there will be a comparison between the methods on locations where both methods (lift nets and glass eel detectors) have been used.

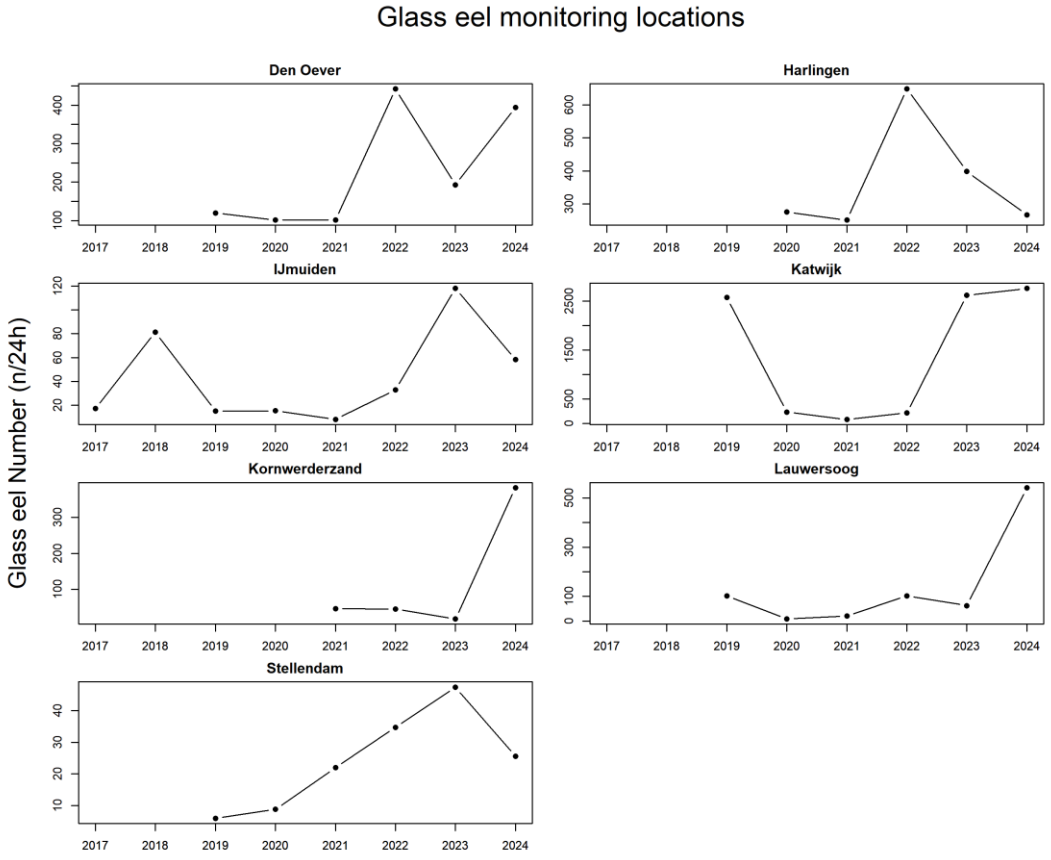


Figure 9 Number of glass eels caught per 24 hours with glass eel detectors at seven different locations from March 15 to June 15. Data from 2017-2024.

5.1.3 **Liftnet RAVON**

Since 2014, recruitment of glass eel in Dutch waters is also monitored at many other locations along the coast by volunteers (Figure 10). This is coordinated by a Dutch research institute called RAVON that specialises in fish, reptiles and amphibians. They calculated a glass eel index based on sampling with a lift net (1x1 meter). The index is an average number of glass eels per haul corrected for catch effort during the period when glass eels migrate towards freshwater (March-May), for the locations at the North Sea Channel the period April-June was selected. The data have been collected once or twice a week at night, half an hour after sunset, and each sampling night consisted of >5 hauls. Locations with less than five years of data, or less than three years of data for the Wadden Sea area, are being excluded. These indexes entail preliminary data, more detailed and corrected indexes will be calculated next year. A few indexes have a trend break due to improvements for fish migration at the fish migration barrier. This is the case for the Gemaal Schoute (from 2019) and for Gemaal de Noord (from 2020).

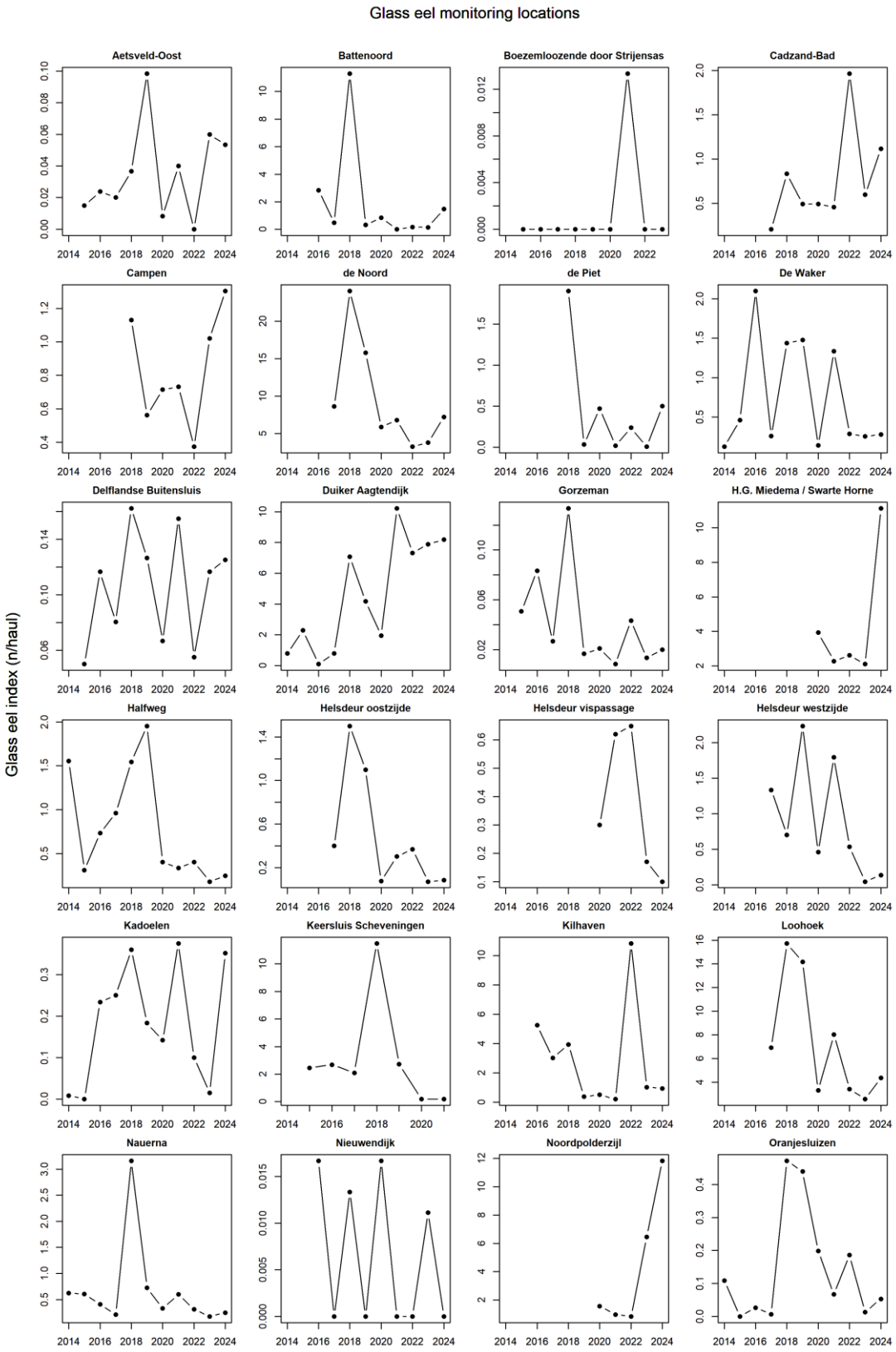


Figure 10 Time series of the glass eel indices of 40 locations sampled by volunteers (data RAVON).

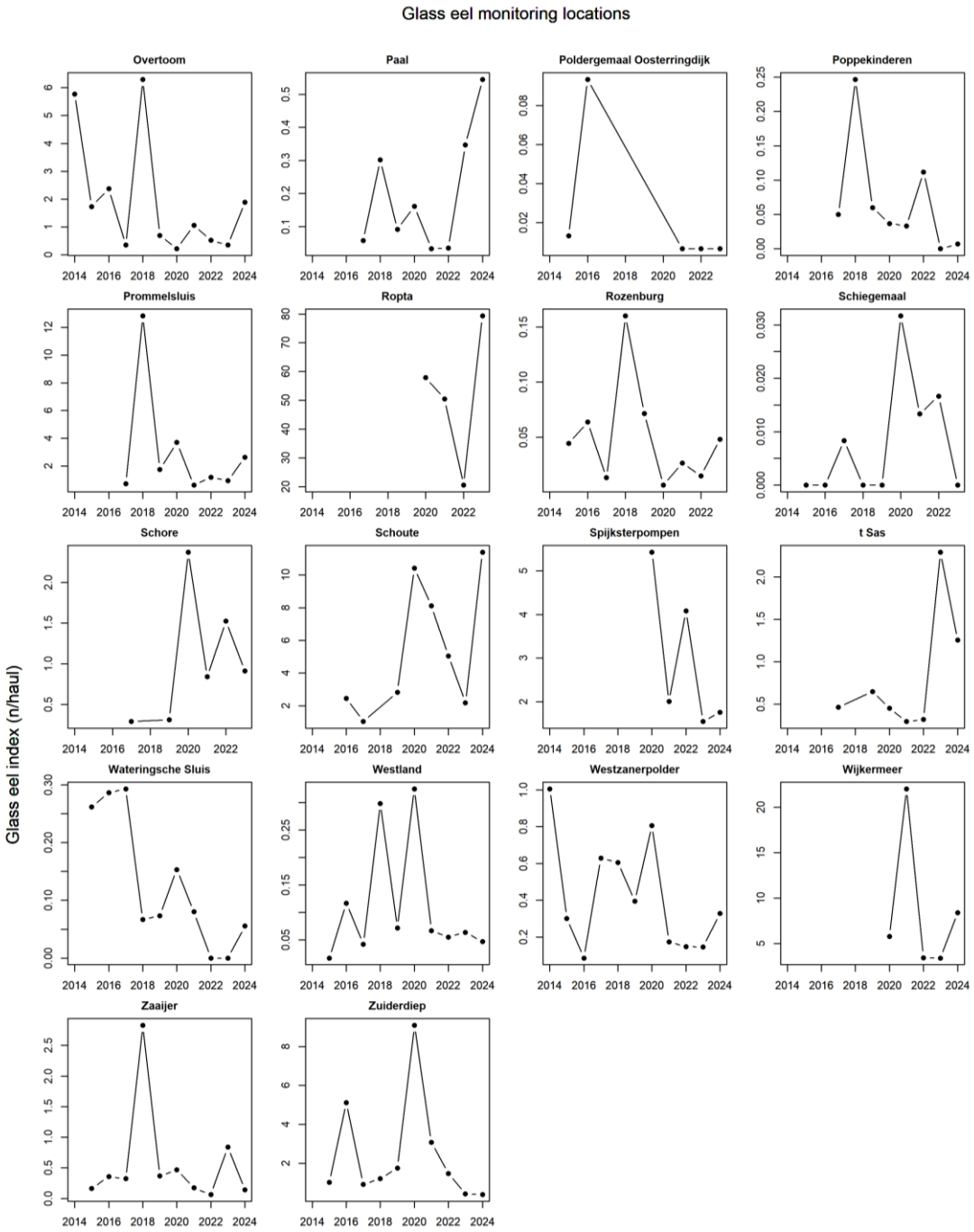


Figure 9 (continues) Time series of the glass eel indices of 39 locations sampled by volunteers (data RAVON).

5.2 Yellow and silver eel

5.2.1 Water Framework Directive waters (Regionally managed water bodies)

Eel sampling within the Water Framework Directive (WFD, 2000/60/EC) waters was executed following an EU certified protocol. Sampled water bodies are representative for water types defined within the Netherlands based on WFD regulation. Data collection is managed and stored by regional water boards. Electric dipping net data for recent years were obtained from ATKB (consultancy for water, soil, and ecology) and several water boards. A total of ~8800 samples by electric dipping nets were available between 2006 and 2019, covering most of the combination of water boards and water body types.

5.2.2 Main rivers: surveys in nationally managed water bodies.

Within the survey program "Fish Monitoring National Waters," fish species in the main Dutch rivers are monitored yearly (Volwater, 2024). In the program, the main rivers and water bodies connected to the main rivers are sampled in autumn or in some cases early spring. Depending on the region, sampling started in 1997 or later.

5.2.2.1 Active gear

A selection of data collected from 1999-2022 was made over five so-called "VBC-areas" (Figure 11). VBC areas were selected when annual monitoring data was collected for 12 years or more. Figure 12 shows the trends in CPUE for the annual (yellow) eel surveys in these five VBC areas per sampling area collected by electrofishing along the shores of the main stream. CPUEs tend to fluctuate strongly over the past two decades. Almost all sampling areas show an increase either in 2015, 2016 or in 2017 after which CPUE decreases again and higher CPUEs were again found for most sampling areas in 2021 and 2022 In fact, in four areas, the year 2022 showed the highest CPUE since the beginning of the monitoring.

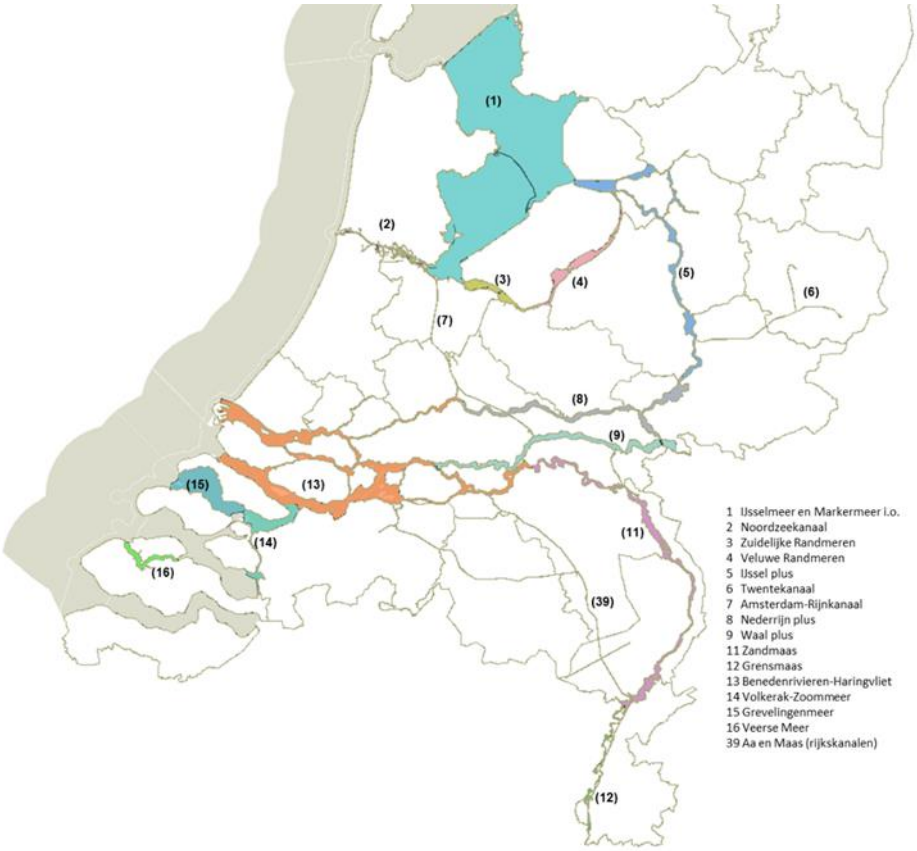


Figure 11 Map of VBC areas in the Netherlands. VBC IJssel Plus (5) entails sampling areas Bovenloop and Benedenloop Gelderse IJssel, VBC Nederrijn Plus (8) entails sampling areas Bovenloop and Benedenloop Nederrijn, VBC Waal plus (9) entails sampling area Bovenloop Waal and Rijn, VBC Grensmaas (12) entails sampling area Grensmaas and VBC Benedenrivieren-Haringvliet (13) entails sampling areas Getijden Lek, Getijden Maas, Nieuwe Merwede and Oude Maas.

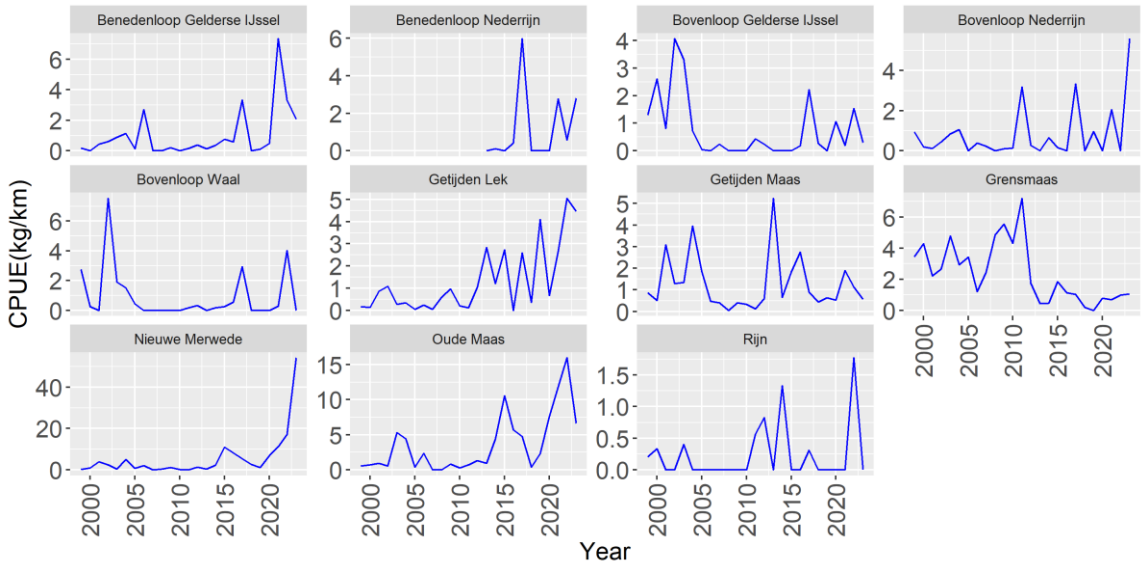


Figure 12 CPUE trends in five VBC areas per sampling area (kg/km), sampled by electrofishing (data: Wageningen Marine Research).

5.2.2.2 Passive gear: Silver eel index

A survey programme started in 2012 to monitor the abundance of migrating silver eel on five exit points (Kornwerderzand sluices, Den Oever sluices, North Sea Canal, New Waterway channel, Haringvliet-West inlet) and two entry points for migratory fish (River Rhine and River Meuse) during spring and autumn. The programme is a collaboration between WMR, Rijkswaterstaat and commercial fishermen. The months September, October and November were selected for illustrating trends in silver eel abundance at each location (Figure 13). Due to changes in locations and fishermen some of the early monitoring years were removed for the trend analysis for the locations Rhine, North Sea Chanel, IJsselmeer (Kornwerderzand) and IJsselmeer (Den Oever).

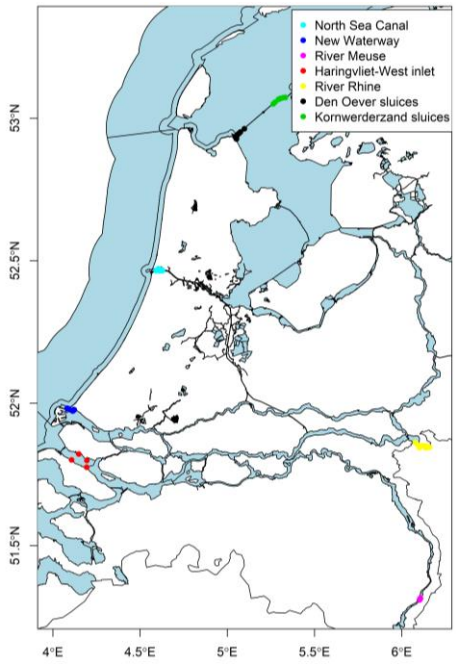


Figure 13 Locations of the diadromous fish monitoring programme.

The months September, October and November were selected for illustrating trends in silver eels at each location. Eel numbers fluctuate strongly on a yearly basis (Figure 14). The highs CPUE is observed at Kornwerderzand and Den Oever (both lake IJsselmeer) and Haringvliet-west.

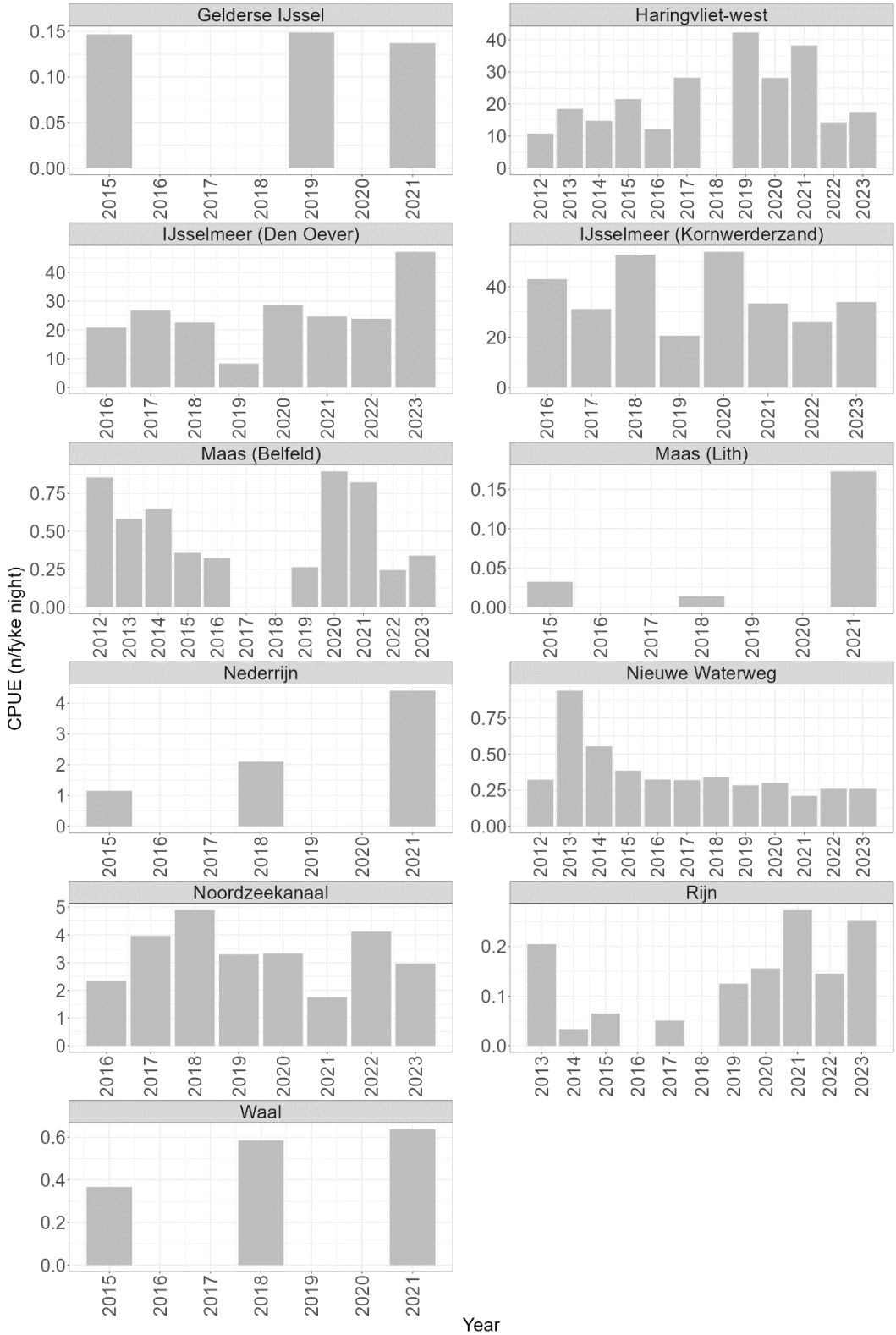


Figure 14 CPUE of silver eel (number per fyke day) caught during the diadromous fish monitoring per catch location. Data is missing or not used because of inconsistency of sampling locations/period for the Haringvliet-West inlet in 2018, for the Den Oever and Kornwerderzand sluices in 2012-2015, the River Meuse in 2017 and 2018, the North Sea Channel in 2015 and for the River Rhine in 2012, 2016 and 2018.

5.2.2.1 Passive gear: Wadden Sea (Kornwerderzand)

A survey program started in 2001 to monitor the abundance of migrating eels at the exit point of the IJsselmeer; at the Kornwerderzand sluice complex located at the Afsluitdijk on the Wadden Sea side during spring and autumn. The program is a collaboration between WMR, Ministry of Agriculture, Nature and Food Quality and commercial fishermen. There are 7 stations at this location which all have been selected for the trend below. The months September, October and November were selected for illustrating trends in (silver) eel abundance at each location (Figure 15). Eels are *not* subdivided in yellow and silver eels in this monitoring and lengths are also not measured.

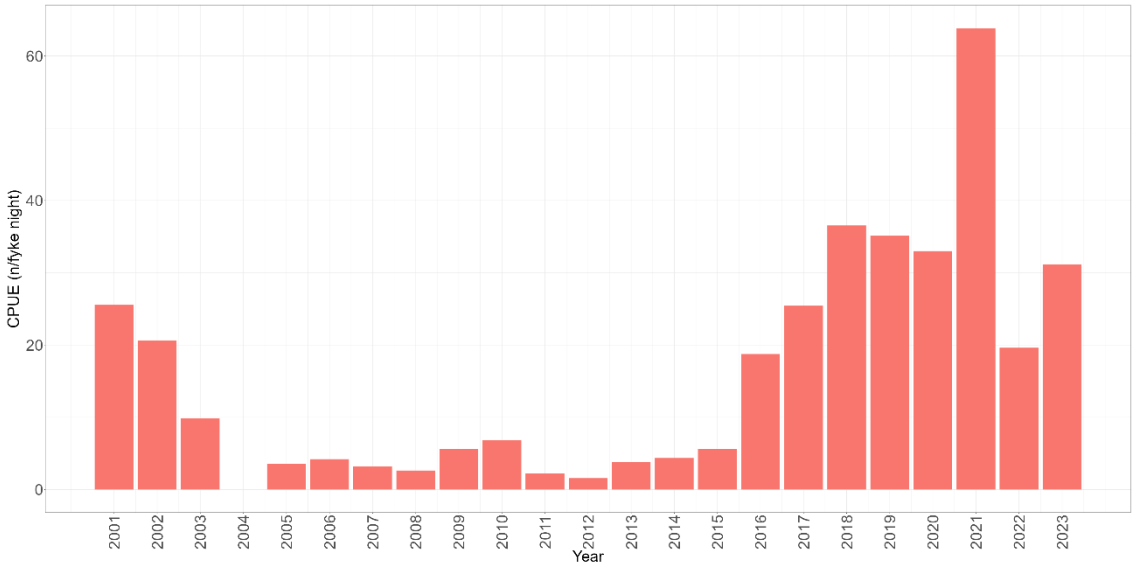


Figure 15 CPUE of eel (number per fyke day) caught during the diadromous fish monitoring at the Wadden Sea side of Kornwerderzand (Afsluitdijk). Location 6 and 7 have not been monitored from 2021 onwards, in 2022 location 8 and 9 were added instead, in 2022 location 2 has been permanently moved and location 3 was not monitored in 2022; all due to the construction of the fish migration river at this site. Using only location 1-5 does not change the trend but only increases the cpue throughout all years.

5.2.3 FYMA electric trawl survey in lakes IJsselmeer and Markermeer.

Since 1989, WMR has been conducting an annual (yellow) eel survey in lake IJsselmeer (25 sites) and lake Markermeer (15 sites) with an electrified trawl. The survey takes place in the autumn (October-November).

Figure 16 presents the trends in CPUE for the annual (yellow) eel surveys in Lake IJsselmeer (25 sites) and Figure 17 shows these trends for Lake Markermeer (15 sites), using the electrified trawl. Weight of the eel catches in 2017-2023 were relatively high compared to the previous decade. The number of eels remains low, indicating an increase of heavier (larger) eel in the lakes. For the year 2021, catches were very low due to a malfunction of the electrified trawl and the data were not used. For the year 2023, there is a strong increase in biomass and a slight increase in numbers.

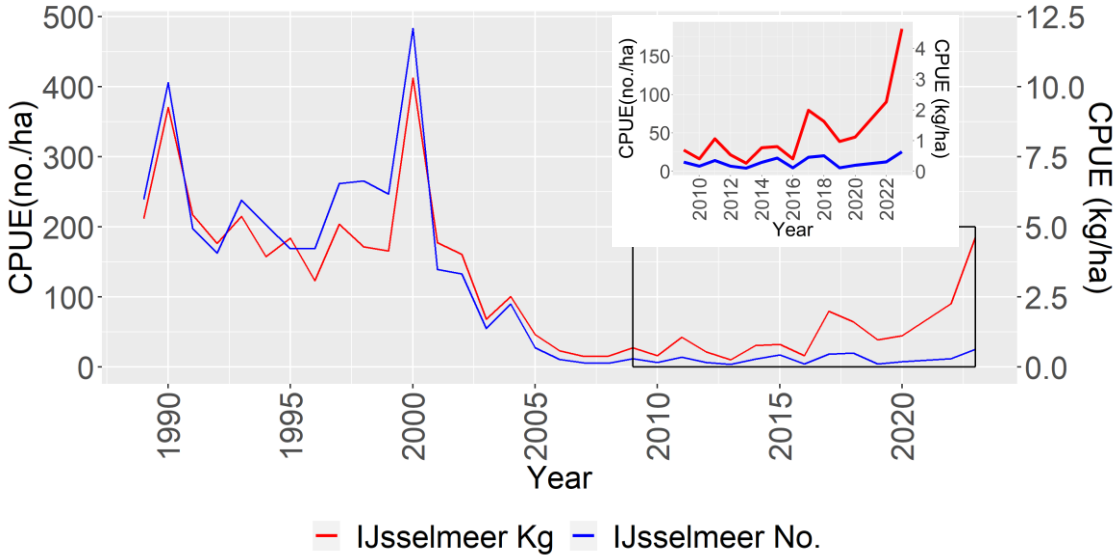


Figure 16 CPUE trends in Lake IJsselmeer stock surveys (no/ha and kg/ha), using the electrified trawl. Note: The northern and southern compartments (IJsselmeer and Markermeer resp.) have been separated by a dyke since 1976 (data: Wageningen Marine Research).

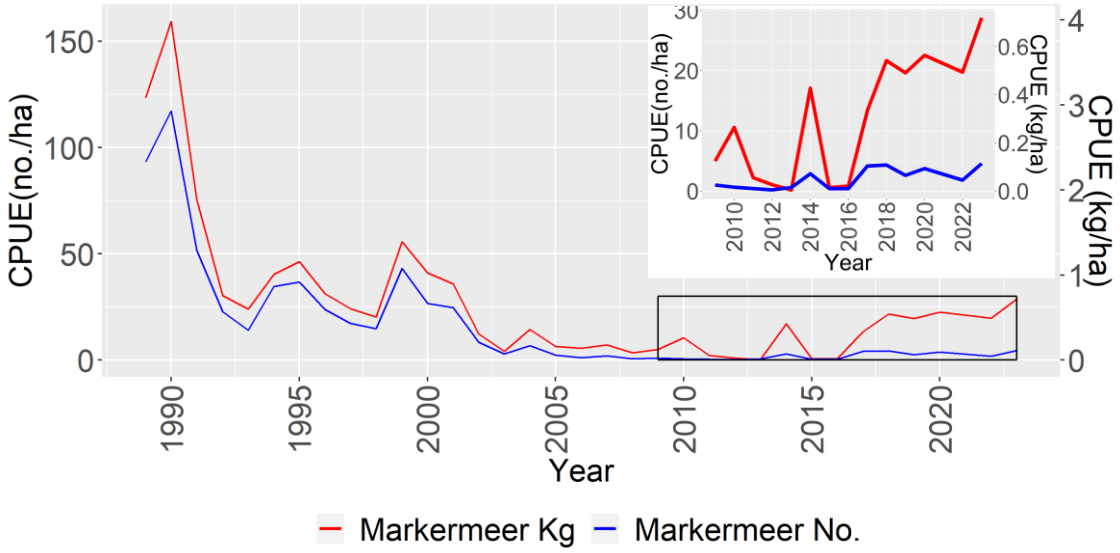


Figure 17 CPUE trends in Lake Markermeer stock surveys (no/ha and kg/ha), using the electrified trawl. Note: The northern and southern compartments (IJsselmeer and Markermeer resp.) have been separated by a dyke since 1976 (data: Wageningen Marine Research).

5.2.4 FYOE electric dipping net survey in lakes IJsselmeer and Markermeer.

Figure 18 presents the trends in CPUE for the annual eel surveys along the shore of Lake IJsselmeer and Lake Markermeer, using an electric dipping net. Sites that were sampled with a beach seine or sites that included a so-called "preshore" (Dutch: vooroever) were excluded as only a few eels were caught at those sites. For Lake IJsselmeer both numbers and biomass of eel caught between stones fluctuate, but the biomass at rocky shores in 2022 and 2023 is the highest since the beginning of the monitoring. For Lake Markermeer, there is a steep decline in 2013, followed by a clear upward trend since 2015 of eel caught between stones, especially in biomass with the highest biomass since the start of the monitoring in 2021-2023, indicating catches of larger eel and thus more females. Eels are consistently more caught between stones then along shores with

reed. Both the biomass and number of eels along shores with reed seem to be fairly stable through time for both lakes.

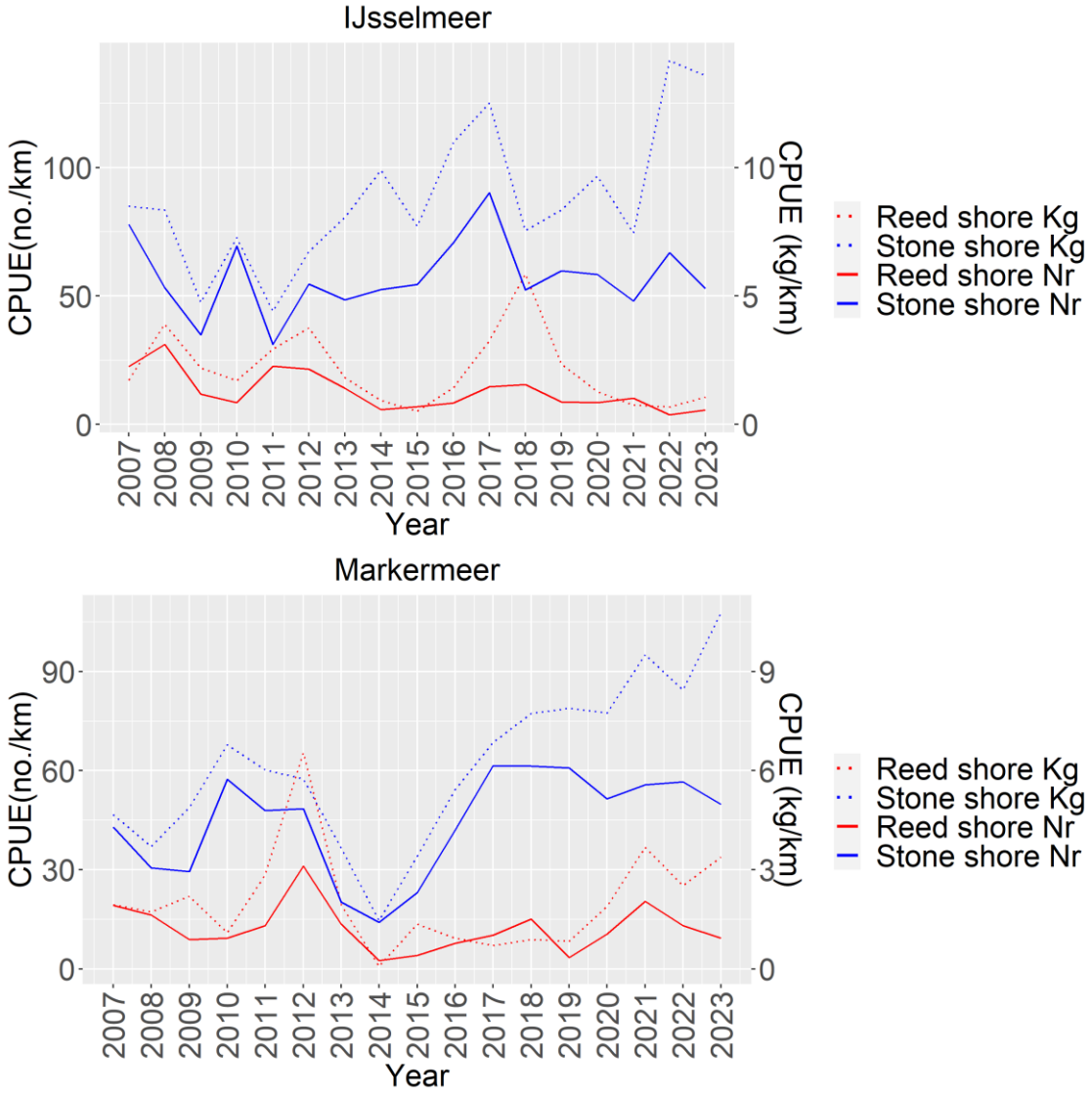


Figure 18 CPUE trends along the shores of Lake IJsselmeer (top) and Lake Markermeer (bottom) shore surveys (no/km and kg/km), using an electric dipping net, separated by shores that are covered by reed (red) and shores that mainly consist of rock (blue), data: WMR.

5.2.5 NIOZ Fyke

One of the few long time series for eel is the fyke monitoring at NIOZ (Den Burg, Texel; van der Meer *et al.* 2011, Figure 19). This data set shows a pattern of a decline in abundance since the 1980s.

In the past almost all catches were yellow eel, based on their length. More recently, the catches also comprise silver eel (source: NIOZ). For all the previous years, only eels that were caught in spring and autumn were used for this figure. For 2020 however, the data were not used. The fyke was only set during 55 days in autumn because of Covid-19 measures during spring 2020. In 2022, we see a remarkable increase in the number of eels which is caused by higher numbers in the fyke during the month October, especially October 20th & 21th when 154 (probably silver)

eels were caught on these two days combined. In 2023 again, a relatively high number of eels were caught in October and November and none in the spring.

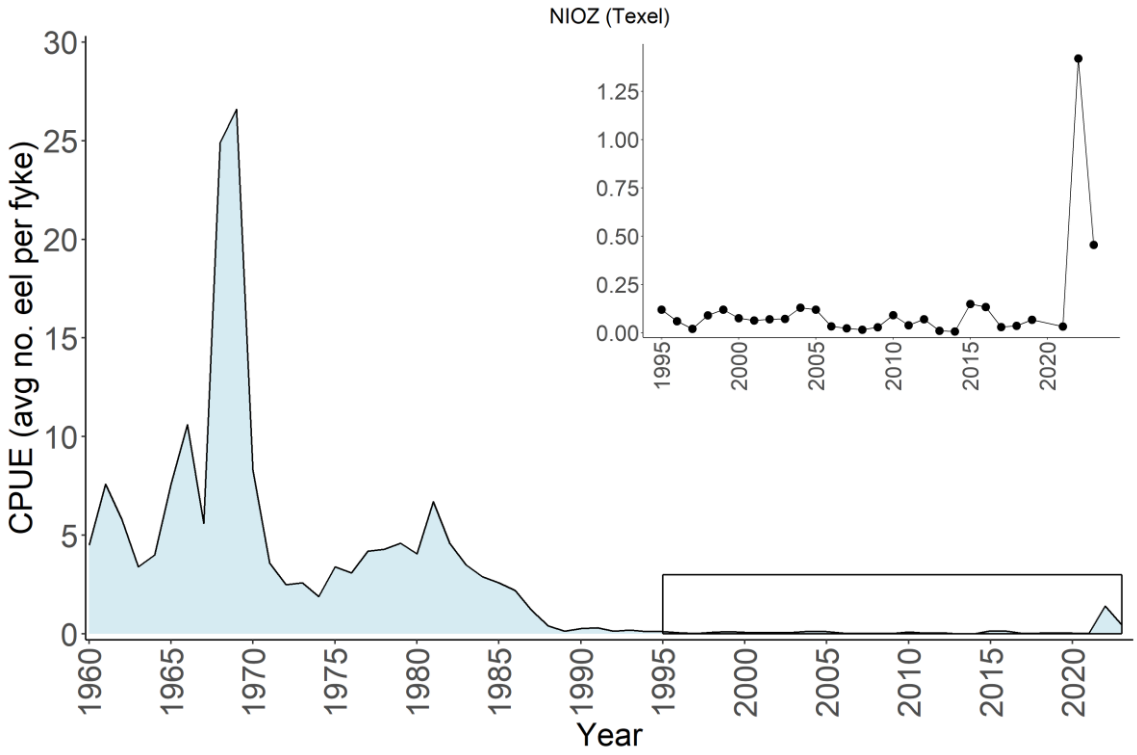


Figure 19 Time series of the mean catch per fyke (numbers) of eel caught in spring and autumn at NIOZ 1960-2023 (data: NIOZ).

5.2.6 Ditches monitoring

Ditches are underrepresented in the set of Water Framework Directive (WFD) water bodies. Therefore, a survey with an electric dipping net is carried out by WMR every year. From 2013-2023, 461 tracks divided over 15 water management areas were sampled with an electric dipping net (Figure 20). In total, 303 eels were caught divided over 92 tracks, averaging over less than one eel per track. Higher eel densities were found for some ditches which were connected to larger water bodies such as the Wadden Sea or Lake IJsselmeer.

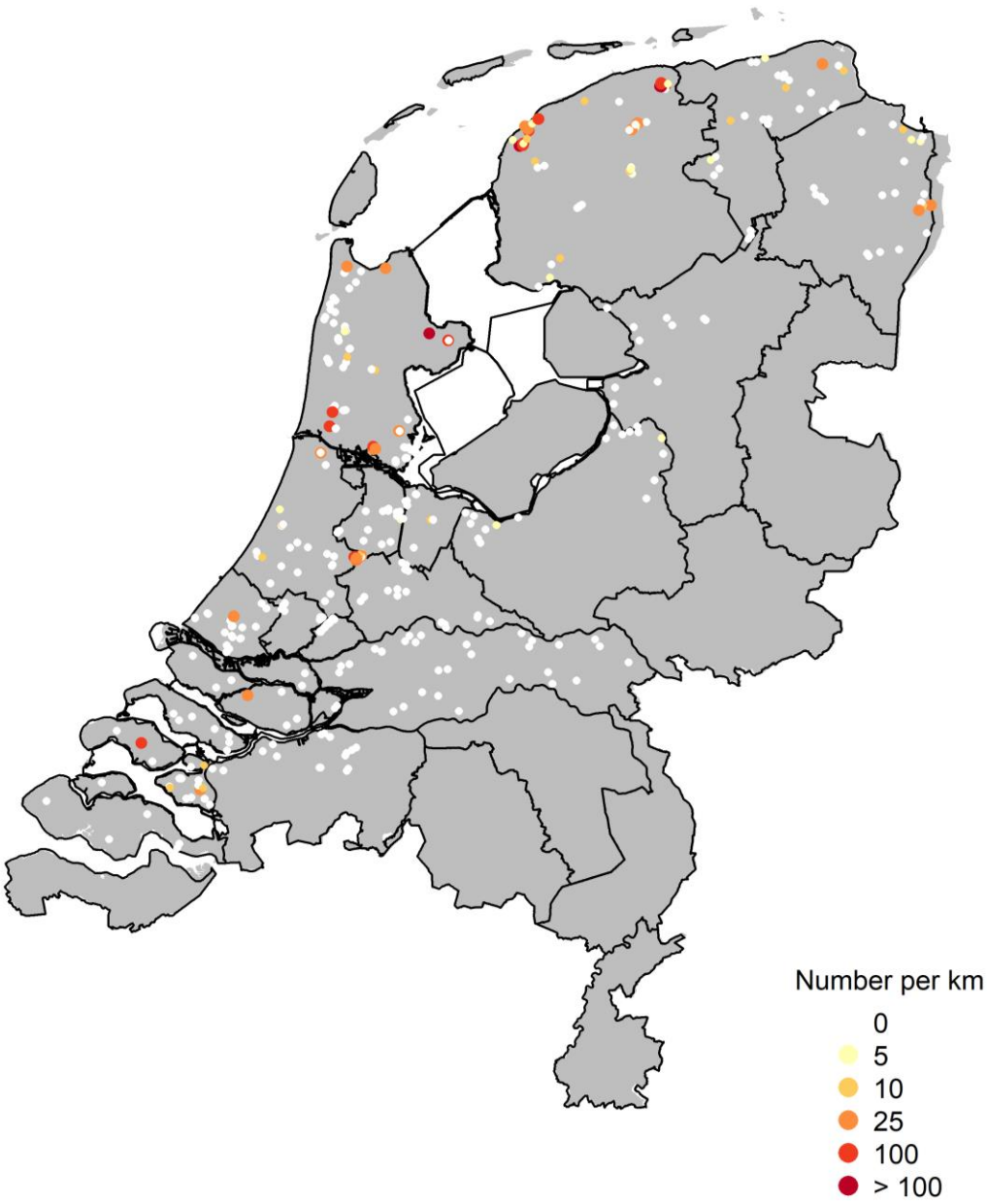


Figure 20 Map of all sampling locations of the ditch monitoring. White dots = zero eel caught, yellow-red dots = increasing number of eels caught per km shore.

5.2.7 Demersal Young Fish Survey: Coastal waters

The number of eels caught in a coastal survey DFS (Demersal Young Fish Survey) is presented below. The DFS has been designed to target young flatfish with a beam trawl in inshore areas like the Dutch, German and Danish coastal zone, the Dutch Wadden Sea, and the southwestern Dutch Delta. The survey has been carried out each year in September-October, since 1970.

Until the mid-1980s, considerable catches of eel were observed, after which a gradual decrease was observed (Figure 21). Only a few eels are caught in the Wadden Sea and the Eastern Scheldt in the past few years.

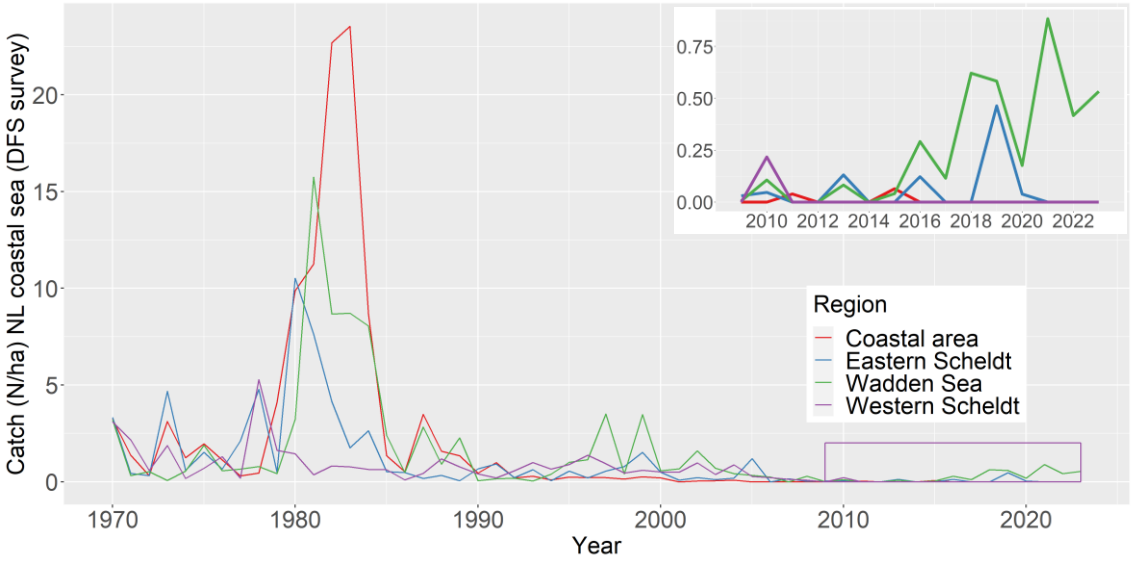


Figure 21 Trends in coastal survey catch 1970-2023 (n/ha). Most of the Wadden Sea belongs to RBD Rhine; Eastern Scheldt is mixed RBD Scheldt and Meuse; Western Scheldt belongs to RBD Scheldt (with an extra inflow from Meuse), the coastal area belongs to RBD Rhine (data: Wageningen Marine Research).

6 Restocking

In the Netherlands restocking of glass eel and ongrown eel (eels that are grown in culture facilities for some time before being restocked, also called "pre-grown") exists for decades. After the decline of glass eel availability, this commercial restocking lessened, mostly because the glass eel prices increased. Since 2010, €375.000 of public money is spend on a yearly basis on the purchase and restocking of young eel to increase the number of escaping silver eel. The restocking is commissioned by the ministry of Agriculture, Nature and Food quality (LNV) and is executed by the DUPAN foundation (www.DUPAN.nl), a foundation representing Eel processers, fish farmers and eel fishermen. The purchase of glass eel and ongrown eel is done by putting out a request for tenders and selection of the best offer. The total number of eels purchased for restocking varies between years depending on the offer. Around 2/3 of the available amount is spent on glass eel and around 1/3 on ongrown eel. In recent years, the glass eel is almost always caught in France, but in earlier years, the origin was also the UK. Ongrown eel is usually bought from a aquaculture company in the Netherlands. Glass eels are also restocked by fishermen for commercial purposes. The numbers of these commercially stocked eel are unknown and vary a lot between years but are assumed to be much lower than the numbers restocked by publicly funded program (pers. comm. M. v.d. Meer).

The restocking locations are selected by DUPAN in consultation with the government. DUPAN made a list with suitable restocking locations based on three criteria: 1) Silver eel should be able to migrate to the sea; 2) the water quality is sufficient for young eel to grow and mature in healthy silver eel; and 3) the fish right holders agree with the restocking under the condition that the fish right holder will not profit or have a disadvantage because of the restocking. This resulted in that large rivers are excluded because of pollution and some areas are excluded because the fish right holders do not want to cooperate. In addition, relatively large water bodies were chosen, so large quantities could be restocked at one time (restocking density should not exceed 250 glass eel/ha or 150 ongrown eel/ha). This resulted in a list with suitable restocking locations. From this list, in practice every other year the "Veerse meer" and the "Friese Boezem" were selected and the alternated year the "Veluwe Randmeren" and the "Zuidelijke Randmeren" were selected. Only, if sufficient glass eel/ongrown eel were restocked in these locations and budget was available, other locations were selected. The same locations were not chosen two years in a row to investigate if the restocked yearclasses could be detected. Another reason is that the spread of location will reduce the risk that the carrying capacity is reached, which might reduce eel growth (van der Hammen 2018).

6.1 Reconstructed Time Series on Stocking

The amount of restocked (glass) eels over time is shown in Figure 22. No (historical) data is available with regards to origin and whether or not stocked eels were quarantined. In 2024, the amount of restocked eels was similar to that of 2023.

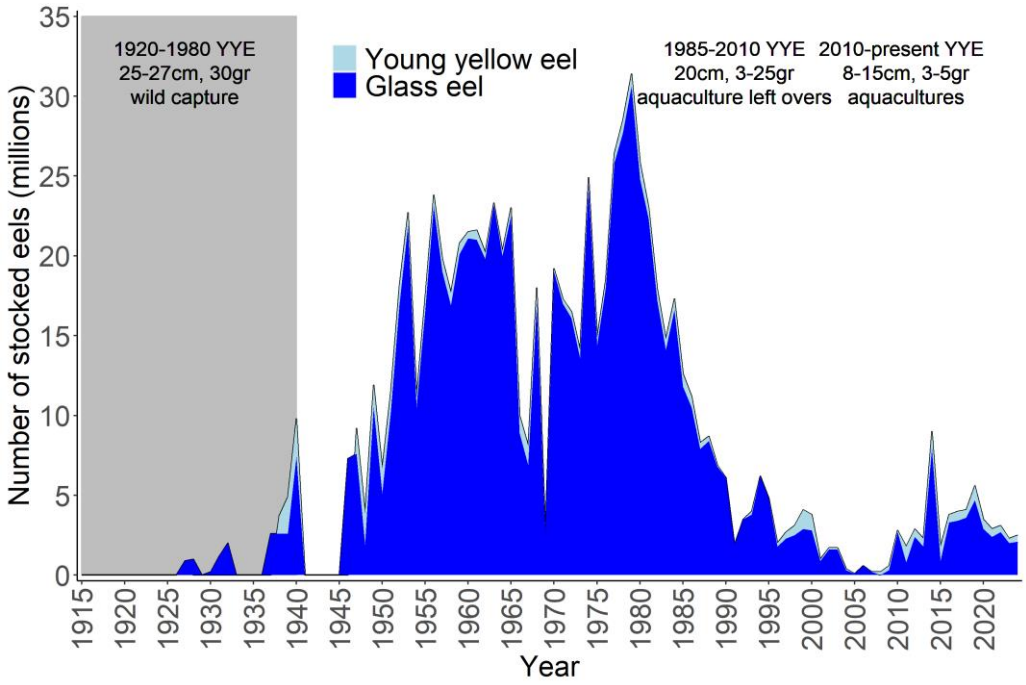


Figure 22 Overview of stocking of glass eel and young yellow (ongrown) eel in the Netherlands. Note that the average weight of stocked young yellow eel decreased from ~30g to ~3 g between 1920 and 2010. YYE = Young Yellow Eel

6.2 Amount stocked

The locations and numbers of eels stocked in 2024 in the Netherlands can be found in Table 8.

Table 8 Overview of glass eel and young yellow eel stocked in the Netherlands in 2024 (Source DUPAN).

	DATE	LOCATION	FUNDING	ORIGIN	KG	NUMBER	NO./KG
Glass Eel	5-3-2024	Friese Boezem	Government	France	490	1,193,996	2,437
	5-3-2024	Veerse meer	Government	France	223	542,139	2,431
	5-3-2024	Steenbergse Vliet	Government	France	8	19,362	2,420
	5-3-2024	Zeeuws-Vlaanderen	Government	France	42	103,265	2,459
	14-3-2024	Westeinderplassen	NetVISwerk	France	15.5	40,789	2,632**
	14-3-2024	Vinkeveenseplassen	NetVISwerk	France	12	31,579	2,632**
	14-3-2024	Markiezaatsmeer	NetVISwerk	France	11	28,947	2,632**
	26-3-2024	Vechtboezem	NetVISwerk	France	12	31,579	2,632**
	26-3-2024	Kromme Mijdrecht	NetVISwerk	France	3	7,895	2,632**
	26-3-2024	Amstelmeer	NetVISwerk	France	18	47,368	2,632**
	26-3-2024	Wieringermeer	NetVISwerk	France	18	47,368	2,632**
	26-3-2024	Westeinderplassen	NetVISwerk	France	3	7,895	2,632**
	26-3-2024	Vinkeveenseplassen	NetVISwerk	France	3	7,895	2,632**
	26-3-2024	Markiezaatsmeer	NetVISwerk	France	3	7,895	2,632**
	Total				862	2,117,972	
Young Yellow Eel	20-04-2024	Ganzendiep, IJssel and surrounding waters	Government	Glass eel from France (aquaculture in NL)	257*	42,857	168*
	24-05-2024	Friese Boezem	Government	Glass eel from France (aquaculture in NL)	1077	349,700	325
	24-05-2024	polder Wetering Oost at Lekkerkerk (Krimpenerwaard)	Government	Glass eel from France (aquaculture in NL)	4	~1332*	333*
	24-05-2024	Bokkewiel (Friesland)	Government	Glass eel from France (aquaculture in NL)	5.25	1,500	286
	Total				1,343	395,389	
Glass eel + Yellow eel	Total				2,205	2,513,361	

* Guesstimates

** assumed to be similar to glass eels stocked funded by the government, same period caught and same location.

Recent historical data from the point that DUPAN started restocking eel in the Netherlands can be found in Table 9.

Table 9 Overview of total restocked KG/Number glass eel and young yellow eel stocked in the Netherlands from 2010-2024 by DUPAN (Source DUPAN).

	Glass eel			Young yellow eel			Total	
Year	KG	Number	KG/Number	KG	Number	KG/Number	KG	Number
2010	868*	2710000	0.00032039*	190	60000	0.00316124*	1058	2770000
2011	256*	800000	0.00032039*	3161	1000000	0.00316124*	3418	1800000
2012	766	2374600	0.00032258	1674	499500	0.00335135	2440	2874100
2013	630	1830780	0.00034412	1520	498534	0.00304894	2150	2329314
2014	2460	7947250	0.00030954	3541	1085500	0.00326209	6001	9032750
2015	278	863226	0.00032205	3811	854787	0.00445842	4089	1718013
2016	950	3305158	0.00028743	1528	517000	0.00295551	2478	3822158
2017	1029	3422162	0.00030069	1894*	599000	0.00316124*	2950	4021162
2018	1028	3577000	0.00028739	1442	517000	0.00278917	2470	4094000
2019	1481	4676735	0.00031667	2510	850792	0.00295019	3991	5527527
2020	1013	2930487	0.00034568	1600	618831	0.00258552	2613	3549318
2021	879	2389933	0.00036779	1441	472464	0.00304997	2320	2862397
2022	956	2735514	0.00035000	1288	363483	0.00466400	2244	3098997
2023	905	2004279	0.00046398	741	257341	0.00287945	1542	1983720
2024	862	2117972	0.00040676	1343	395389	0.00339729	2205	2513361

*Kg unknown, calculated from averages kg per number of other years

7 Aquaculture

Aquaculture of eels exists already since the early 1980s in The Netherlands. It is estimated that about 2,000 tonnes of consumption eel are cultured on a yearly basis since 2010 (Figure 23). To culture eels, glass eels are necessary which are bought by several aquaculture companies, mainly from France (Table 10). There is a quota on the number of glass eels that are allowed to be caught in France which is implemented by the French Eel Management Plan. Of this number, it is stated that only 40% of all caught glass eel can be used for aquaculture the other 60% should be used for restocking purposes. The increase of glass eel weight used for aquaculture is due to increased production capacity and due larger glass eels being caught in France.

Table 10 Origin and amount (kg) of glass eel used for aquaculture in the Netherlands since 2010. Amounts are rough estimates (Source DUPAN).

YEAR	FRANCE	SPAIN	ENGLAND	TOTAL (KG)
2010	4,725	1,890	135	6,750
2011	5,325	1,350	100	6,775
2012	5,500	650	550	6,700
2013	3,400	250	1,250	4,900
2014	4,400	500	300	5,200
2015	5,200	0	300*	5,500
2016	5,300	800	150	6,250
2017	4,690	900	300	5,890
2018	5,730	0	550	6,280
2019	4,340	0	1,000	5,340
2020	3,780	0	1,450	5,230
2021	5,970	200	0	6,170
2022	5,900	300	0	6,200
2023	6,000	0	0	6,000
2024	7,000	0	0	7,000

*it is actually 'a few hundred kg'. We assume this to be 300 kg

The estimated production of yellow eels through aquaculture remains relatively stable over the past decade (Figure 23).

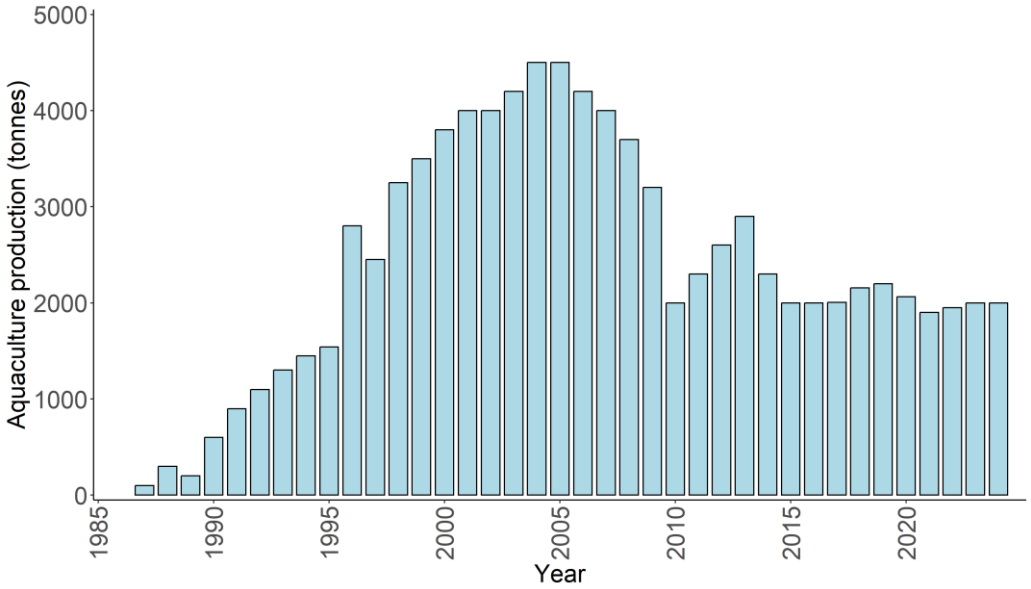


Figure 23 Trend in aquaculture production of yellow eel for consumption in the Netherlands. In 2024, a (rough) estimate of the production was 2000 tonnes (Source DUPAN).

8 Assisted migration (trap and transport)

Since 2011 several (pilot) projects have started at migration barriers (pumping stations) to assist the migration of silver eel (programme 'Paling Over De Dijk', PODD). In 2011 540 kg silver eel was caught and released again past barriers at four sites ('assisted migration'). In 2023, about 12,400 kg was caught and released, the highest amount since the start of the project, mainly due to the addition of the project in IJmuiden in 2023 (Figure 24).

Figure 24 Overview of the amount of silver eel (kg) assisted over migration barriers in the Netherlands.

9 Diseases, Parasites & Pathogens

The swim bladder nematode *Anguillicoloides crassus* was introduced from South-East Asia in wild stocks of European eel in The Netherlands in the early 1980s. In the market sampling before 2009 for Lake IJsselmeer information was collected on eels showing *A. crassus* infection based on inspection of the swim bladder by sight. We scored an infection as 'present' when either we observed one or more *A. crassus* or a thickened swim bladder. As part of the extended market sampling program starting in 2010, data on *A. crassus* infection rates have also been collected in two other areas (Friesland and Rivers), and since 2011 the market sampling was conducted in most of the Netherlands (Table 11, Figure 25).

Table 11 Infection rates of eels with A. crassus.

	FRIESLAND			IJSSELMEER			MARKERMEER			REST NL		
	N eels	N infected	%	N eels	N infected	%	N eels	N infected	%	N eels	N infected	%
2010	534	243	46	390	192	49	225	108	48	511	258	50
2011	107	40	37	293	127	43	104	35	34	583	231	40
2012	133	44	33	320	170	53	253	95	38	529	186	35
2013	35	12	34	159	88	55	93	41	44	265	102	38
2014	49	31	63	202	100	50	46	12	26	321	127	40
2015	61	24	39	267	111	42	-	-	-	297	112	38
2016	65	14	22	261	89	34	27	77	35	258	79	31
2017	74	34	46	172	33	19	25	151	17	291	73	25
2018	85	22	26	245	78	32	17	49	35	302	91	30
2019	78	15	19	217	77	35	38	97	39	297	122	41
2020	111	34	31	97	21	22	28	144	19	255	38	15
2021	103	17	17	172	45	26	37	190	19	288	66	23
2022	125	33	26	191	48	25	26	168	15	303	66	22
2023	116	11	9	290	69	24	15	97	15	279	75	27

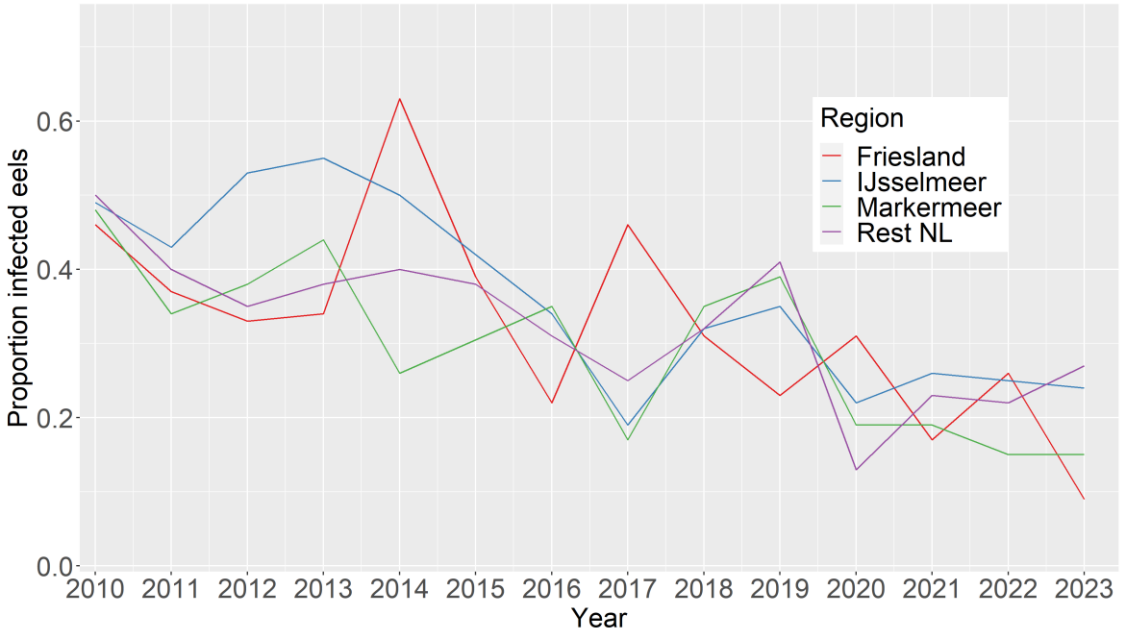


Figure 25 Proportion eels infected with A. crassus per region.

10 Contaminants

In 2023, 22 locations were sampled to assess contaminant levels (sum TEQ and sum non-dioxin-like PCBs) in eel (Table 12, TEQ=Toxic Equivalent: sum of dioxines, furanes and dioxine-like PCBs). There were not enough eels of length class 30-40 cm caught which is why this length class is excluded from this year's analysis. The predefined length class 53-76 cm consisted of approximately 15 individuals per sampling location. For these larger eels, the mass of filet per eel used is determined by the size of the eel. In this way, the pooled sample is a proper representation of the eel composition in the Dutch waters (determined by monitoring the eel catch of fisherman).

Contaminant concentrations are always higher in larger eel than in smaller eel from the same locations. As in previous years, several samples had contaminant levels above the revised regulatory limits of 2012 set by the European Commission (10 pg/g sum TEQ and 300 ng/g sum Non-dioxin-like PCBs[6], plus 10% uncertainty, Table 12). All locations that did have eels with a concentration of Sum TEQ or Sum Non-dioxin-like PCBs above the regulatory levels were fed (directly or indirectly) by the rivers Rhine (IJssel, Lek) and Meuse, except for the locations close to Amsterdam which are connected to the North Sea Channel and the Braasemermeer.

Since 1978/1979 several locations have been monitored annually for PCBs. The levels for PCB 153 are shown in Figure 26. Since 2016, large eels (53-76 cm) are monitored on a yearly basis at nine different locations (Figure 27). The Sum TEQ seems to increase for all locations over time, although lower values have been measured in 2022 and 2023 (except for Volkerak, this location shows a steady increase over time). Non-dioxin-like PCBs and PCB-153 fluctuate strongly throughout the years but seem to remain relatively stable over time.

[6] Sum of 6 PCBs including PCB153. These are non-toxic indicator PCBs that can be measured easily.

*Table 12 Sum-TEQ, sum Non-dioxin-like PCBs, and PBC-153 in eel (2023) (data: Wageningen Marine Research and Wageningen Food Safety Research). PCB-153 is plotted in Figure 26. Values of Sum-TEQ above the regulatory limit of 11pg/g (10+10%*10) and of Sum-ndl-PCB above the regulatory limit of 330 ng/g (300+10%*300) are indicated in bold and grey.*

Location	Size (cm)	Lipid level (%)	Sum-TEQ	Sum-ndl-PCB	PCB 153
IJsselmeer, Medemblik	53-76	18.5	4.26	56.2	26.5
Waal, Tiel	53-76	26.9	**22.1**	**596**	245
Lek, Culemborg	53-76	18.2	**21.7**	**785**	321
Hollands Diep	53-76	16.2	**19.2**	**740**	329
Volkerak, Volkeraksluizen	53-76	21.0	**16.2**	**507**	218
IJssel, Deventer	53-76	21.5	**19.3**	**463**	198
Rijn, Lobith	53-76	18.0	**17.8**	**509**	210
Maas, Heijen	53-76	16.9	9.96	**609**	258
IJsselmeer, direction Lelystad	53-76	24.9	9.95	199	84.8
Overijsselse Vecht, mouth Zwarte Meer	53-76	14.4	5.17	120	56.6
Schokkerhaven	53-76	20.7	**16.2**	**393**	169.0
Ramsdiep, Ramspolbridge	53-76	19.7	8.40	207	94
Spaarne, Haarlem-Waarderbridge	53-76	12.0	9.73	297	124
Buiten Liede, bridge A208	53-76	14.3	8.92	273	108
Zaan, A8-Wormerveer	53-76	18.4	8.11	205	84.4
Braasemermeer	53-76	16.3	**12.2**	251	120
Westeinderplassen	53-76	10.4	2.88	53.1	24
Volkerak, Dintelsas side	53-76	15.7	8.14	171	81
Volkerak, across Dintelsas side	53-76	12.6	6.18	173	82
Reeuwijkse plassen	53-76	18.3	3.16	45.5	19
Reevediep / Drontermeer	53-76	15.6	2.56	54.8	26
Noordzeekanaal, outer side	53-76	21.6	6.11	102	48

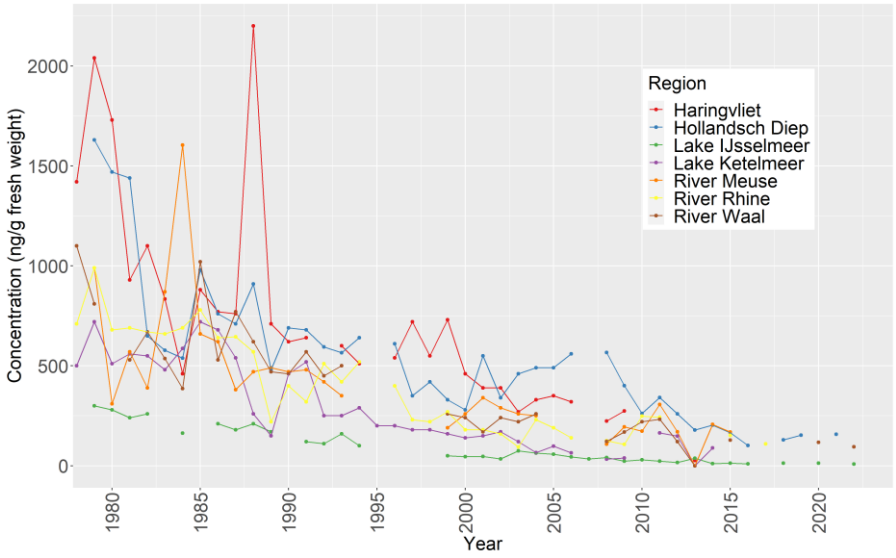
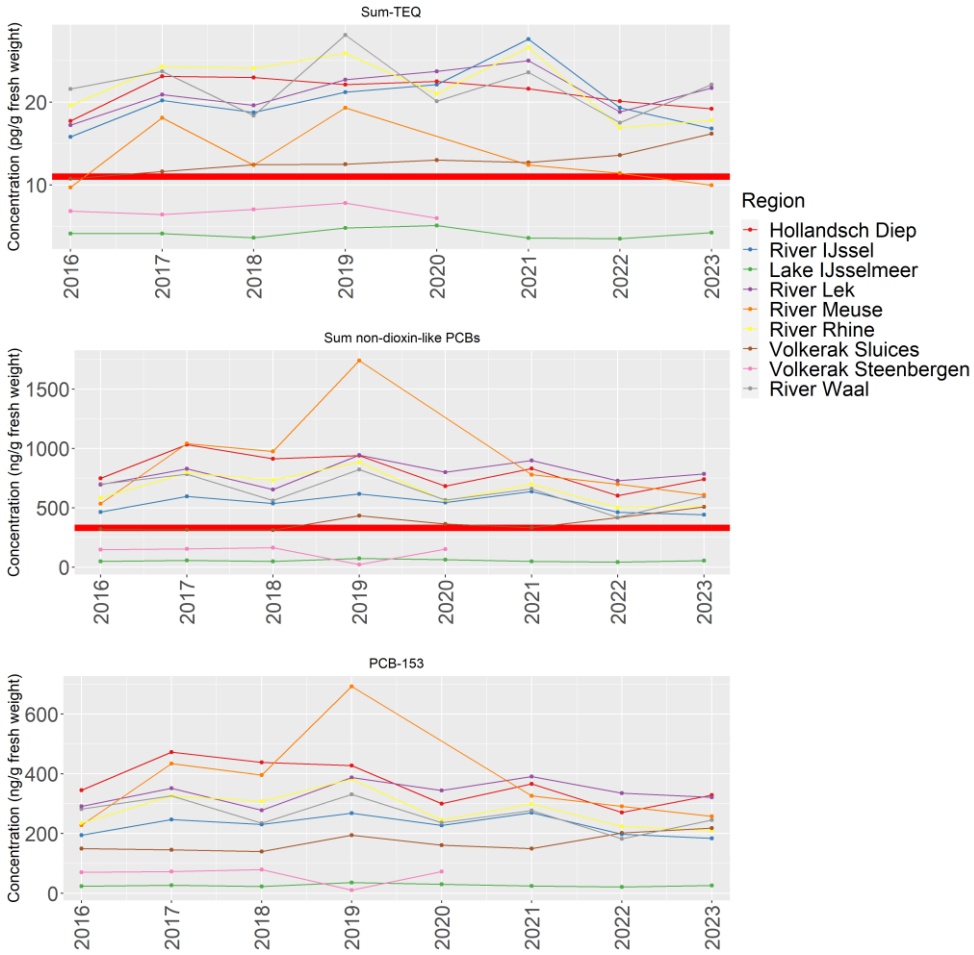


Figure 26 Trend in PBC-153 in 30-40 cm eel. No data for this size class was available for 2023. Only consecutive years are connected with a line (data: Wageningen Marine Research and Wageningen Food Safety Research).



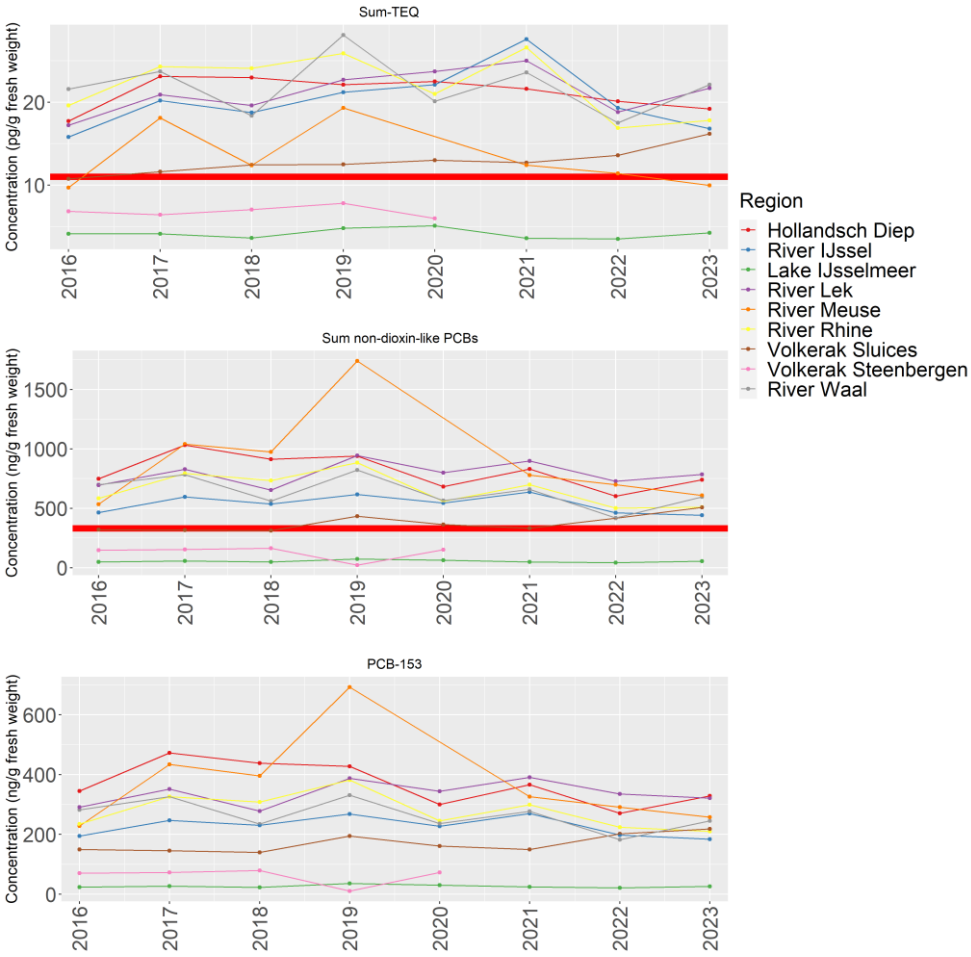


Figure 27 The sum TEQ, sum non-dioxin-like PCBs and PCB153 of eels >53 cm from 2016 onwards. Data for the river Meuse of 2020-2023 was retrieved from a different location (Heijen) than previous years (Eijsden). Data: Wageningen Marine Research and Wageningen Food Safety Research.

11 Predators

Cormorants (*Phalacrocorax carbo*) are known to predate on eel. The number of cormorant breeding pairs increased rapidly until the early 1990s, then stabilised and even decreased strongly in recent years, although there the number breeding pairs in 2023 is quite a bit higher than in 2020-2022 (Figure 28, Figure 29). For Lake IJsselmeer, food consumption by cormorants has been quantified (van Rijn & van Eerden 2001; van Rijn 2004); eel constitutes a minor fraction of the diet of cormorants. In other areas, neither the abundance, nor the food consumption by cormorants is known.

Figure 28 Natura 2000 areas with cormorant breeding colonies adjacent to the IJsselmeer and Markermeer: (72) IJsselmeer (73) Markermeer & IJmeer (78) Oostvaarderplassen (79) Lepelaarsplassen (94) Naardermeer.

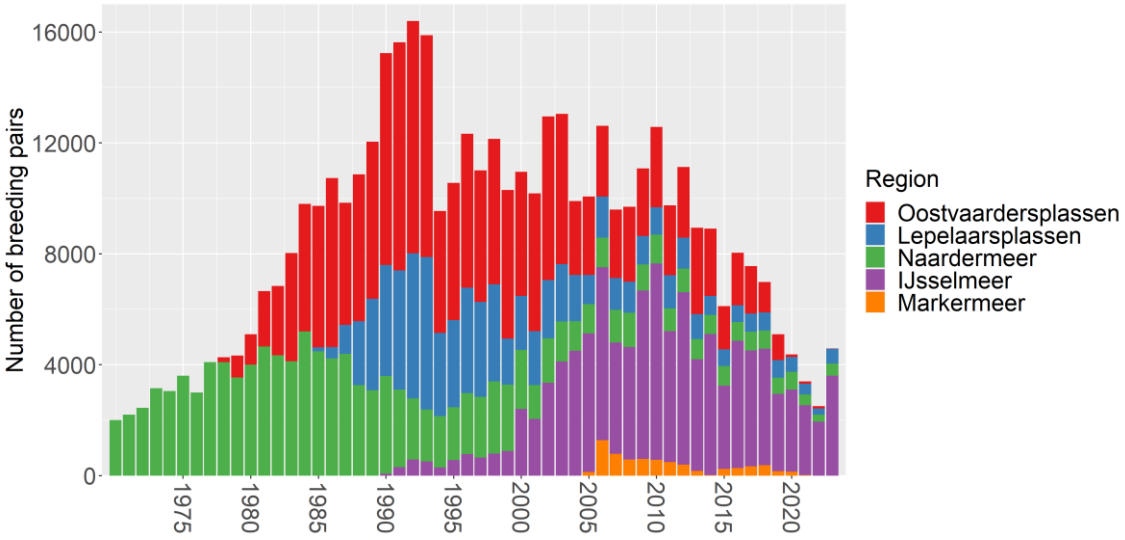


Figure 29 Trends in the number of breeding pairs of cormorants in and around Lake IJsselmeer/Markermeer (Source: Netwerk Ecologische Monitoring, Sovon & CBS).

12 New Information

Eel migration

Two major improvements in terms of eel migration possibilities have been/will be implemented. The Haringvliet sluices separate the North Sea and the freshwater inlet "Haringvliet" since 1970. The Haringvliet is an important estuary of the Rhine-Meuse delta. In order to improve the ecological situation in the rivers Meuse and Rhine, several sluices are officially opened on 15th November 2018. This allows the return of brackish water and will partly restore the main route for migrating fish. Because of the drought in the summer of 2018, only one sluice was actually opened which occurred on 16th January 2019. On 12th February 2019 the sluices were opened for a second time; five sluices were opened during the first tide and three sluices were opened during the second tide. After that, the sluices were open on a regular base (558-1039 hours per year in the period 2019-2022, K. Workel, pers. comm.).

The Afsluitdijk is a hard barrier (dike) between the salty Wadden Sea and the fresh IJsselmeer. There are two openings: the Stevin locks at Den Oever and the Lorentz locks at Kornwerderzand. However, these locks only allow large amounts of fresh water from the IJsselmeer into the Wadden Sea and not the other way around. In addition, the current is much too strong for most species of migratory fish to swim against. As a solution, a "Fish Migration River" (an opening in the Afsluitdijk) is being constructed in and is planned to open in 2025 so that migratory fish can swim from fresh to salt water and vice versa. Especially glass eels might benefit from the tide current created by the Fish Migration River.

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