Ministry of Food, Agriculture and Fisheries of Denmark

Fourth Danish progress report (2021) on implementation of the Eel Regulation and Eel Management Plan (EMP) in Denmark

To be submitted in line with Article 9 of Council Regulation (EC) No 1100/2007 of 18 September 2007 establishing measures for the recovery of the stock of European eel.
Further to be submitted as appendix to ICES Eel Data Call 2021

Ministry of Food, Agriculture and Fisheries • Slotsholmsgade 12 • 1216 Copenhagen K Denmark
Phone +45 38 14 21 42 • Fax +45 33 14 50 42 • CVR 12854358 • EAN 5798000862005 • mfvm@mfvm.dk •
www.mfvm.dk

Content

Introduction and summary

This report is an update of the third progress report (2018) which follows the 8 questions in the Commission Guidance Document for the production of reports to be submitted to the Commission in line with Article 9 in the Eel Regulation (1100/2007). The report is a collaboration of the National Institute of Aquatic Resources (DTU Aqua), at the Technical University of Denmark, the Danish Fisheries Agency and the Ministry of Food, Agriculture and Fisheries.

This Danish status report shows that the foreseen gradual reduction in eel fishing effort and eel landings is in line with the Eel Regulation and the Danish Eel Management Plan.

1. Outline of the monitoring, effectiveness and outcome of the Danish Eel Management Plan

The Danish fisheries authorities have implemented a control and catch monitoring system to monitor Danish fisheries, including the regulation implemented according to the Danish Eel Management Plan (EMP). Thus, the developments in fishing effort, effort reduction, and the developments in eel landings and reduction in eel landings have been closely monitored.

Since 2007 the Danish fisheries authorities have applied a risk based strategic control and monitoring of both commercial and recreational fishing activities, in order to target and optimize the utilization of the authority resources based on a dynamic assessment of the risks in each type of fishery. The risk based control and monitoring strategy has mainly focused on "hot spot" (high priority) areas, periods and species and supported by a biological assessment from the National Institute of Aquatic Resources. The Danish fisheries authorities have furthermore established an electronic reporting system that helps to collect and distribute information about observed irregularities.

Since implementation of the Danish EMP in 2009, this risk based control and monitoring strategy has targeted control and monitoring of the restrictions implemented in Danish legislation for all types of eel fishing. In both marine and freshwater in line with the Danish EMP – i.e. closed seasons, number and type of gears allowed, eel passes, and increased minimum legal size for yellow eel.

Glass eel monitoring takes place at a few selected sites in the Danish waters. Yellow eel monitoring takes place in one small river system. As stated in the Danish EMP, silver eel escapement is monitored in 3 out of 887 river systems.

Concerning the stocking measure and expected outcome, Denmark initiated a program to monitor the effect by stocking tagged eels in selected areas. Furthermore, short time experiments in ponds have been initiated to evaluate fitness of stocked farmed eel compared to wild eels.

<u>Outcome: Commercial eel fishing</u>

The reductions in the Danish commercial eel fishing implemented as of 1 July 2009 have by 31 December 2020 resulted in:

- A gradual reduction in commercial eel fishing licenses from 406 to 227 (205 marine and 22 freshwater).
- A substantial reduction in fishing effort for eel relative to the average effort deployed from 2004 to 2006. The reduction in eel fishing licenses has resulted in the following reduction in fishing effort relative to the average effort deployed from 2004-2006 (section 2.B):
  -fykenets: 54.6 % reduction
  - small pound nets: 46.4 % reduction
  - large pound nets: 68.3 % reduction
  - hook lines: 91 % reduction.
- A reduction in commercial marine landings by 67 % relative to the average catch in the period 2004-2006.
- A substantial regional reduction in commercial landings targeting eel from the Baltic Sea relative to the landings in the period 2004-2006 (section 2. B and map in Annex 3)
  77 % reduction in the Eastern Baltic (ICES area 24-IIId)
  68 % reduction in the Belt Sea and Western Baltic Sea (ICES area 22-IIIc)
  73 % reduction in the Sound (ICES area 23-IIIb)
  47 % in the Kattegat (ICES area IIIas).

Outcome: Recreational eel fishing

- Recreational eel fishing effort in marine waters was estimated to be reduced by 50 % in 2009 by implementing closed seasons for fyke nets and hook lines. In accordance with Article 11 (2) of the Regulation, the landings from recreational fishermen have been estimated at approximately 100 ton in 2009. The landings are estimated to have been reduced to approximately 55 ton in 2014, but estimated to have been increased to approximately 91 ton in 2020 (Table 2.B3).

- Recreational fishery in freshwater is estimated to have been reduced from approximately 16 ton to 8 ton in 2020 by implementing a closed season i.e. a very limited period for eel fishing from 1 August until 15 October.

The estimates of recreational landings given in this report are the results of a telephone and internet survey made by the National Institute of Aquatic Resources and Statistics Denmark. A project RECREA has been completed to gain more knowledge of the size of the recreational harvest on eel and other species (trout, salmon, cod).

In the RECREA project eel harvest data and eel fishing effort data were collected on site by personal contact to the fishermen in selected areas. These data were combined with airplane and boat surveys that count eel fyke nets. The expected outcome was a better resolution in the data of recreational eel harvest to show how precise the standard telephone and internet survey describe the recreational eel harvest in Denmark. However, the data obtained in the project was too weak and no firm conclusion was achieved (Olesen et al. 2020).

2. Best available estimates of escapement, level of fishing effort and landings, reduction in effort and landings, level of mortality factors outside the fishery and the amount of eel utilized for restocking

2. A. Silver eel biomass currently escaping

The current best estimate of silver eel production in freshwater is 144.7 ton. Mortalities in freshwater is 22.4 ton and the current escapement is 122.3 ton. The 40 % pristine target level is 444 ton (Danish EMP) and the difference between current escapement and target level is 122.3 – 444 = - 321.7 ton (Table 1).

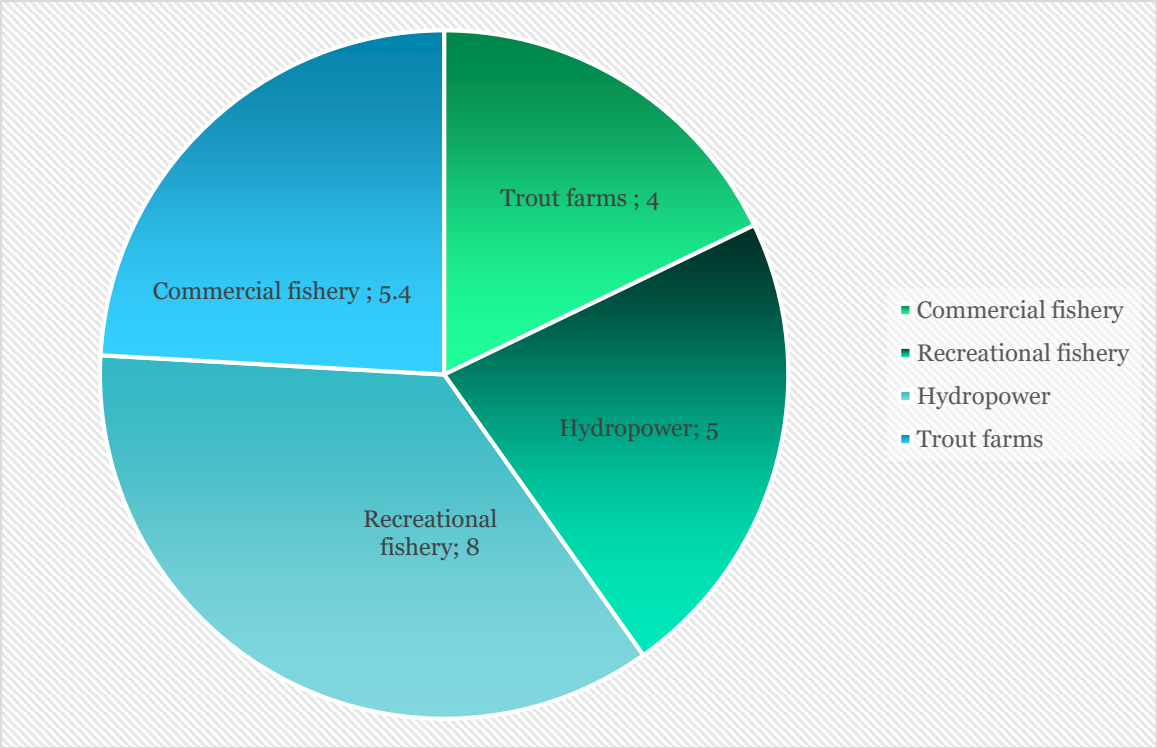

Figure 1: Best estimates of mortality (22.4 ton) in freshwater. The number refers to ton in each category.

The landings of commercial registered fisheries are 5.4 ton and unregistered fishery from recreational fisheries is 8.0 ton. Total fisheries mortality adds up to 13.4 ton. Some mortality has been documented due to hydropower turbines especially from Tange Hydropower plant but not from Vestbirk Hydropower plant (see chapter 2. C1). An estimate from all hydropower plants is approximately 5 ton. At flow-through, trout farms located at the bank of rivers the mortality is estimated to approximately 4 ton (see chapter 2. C2). Mortality outside the fishery adds up to 9 ton.

Predation from cormorants and mammals in freshwater is difficult to estimate. Cormorants do eat eel from rivers and lakes, but they mainly forage in coastal waters, where results from Ringkøbing Fjord show a predation of 40 % of stocked eel during the first year.

Table 1: Current escapement (2020) from inland waters, mortality factors and target level.

Inland water	Area (ha)	Silver eel production (kg/ha)	Total production (ton)
Running water	15,000	7.8	117.7
Lakes	45,000	0.6	27.0
Total	60,000		**144.7**
Mortality (fisheries, hydropower)			**22.4**
Current escapement			**122.3**
Target level – 40 % pristine			**444**

The stock indicators suggest a current escapement of 122.3 ton in 2020. The silver eel production in River Ribe Å is used as indicator of silver eel production for Danish running water. The Gudenå is problematic as indicator because natural recruitment is probably non existing due to the large distance to the sea of more than 100 km and the eels we find there have mostly been stocked. A decrease in production (Figure 2) is observed in river Gudenå that reflect the long term decrease in recruitment to the inland stocks, starting in the late 1980's or earlier. In river Ribe Å the production has increased from 6.8 kg/h in 2017 to 7.8 kg/h in 2020.

Despite no major difference was observed in the overall production of silver eels since the last progress report (2017), the models of the National Institute of Aquatic Resources (Pedersen and Rasmussen 2013) suggest that escapement of silver eels will decrease until years ~2030, from where it will start increasing again.

2. A1. Current production of silver eels

Due to the large number of Danish river systems (887) it was suggested in the Danish EMP to select 3 index river systems and count the number of silver eels escaping these systems. Data from these index systems are used to calculate the total silver eel escapement from the Danish freshwater territory. The count should be repeated every three years. The National Institute of Aquatic Resources has succeeded in estimating and counting escaping silver eels from the River Ribe Å, upper part of River Gudenå and Lake Vester Vandet Sø. At all three sites this is now estimated at an annual basis.

River Ribe Å

River Ribe Å is a medium size lowland river with a catchment area of 1723 km^2 with a commercial fishery situated in the lower part of the river. To estimate the escapement of silver eels in River Ribe Å, the fisheries efficiency has annually been measured by tag recapture experiments. The fisheries efficiency was estimated at 17.7 % in 2010; 28 % in 2014 and 21 % in 2017 and 19 % in 2020. The effort in terms of number of gear used has been fairly constant since the EMP was introduced in 2009. The variation in fisheries effort may be explained e.g. by differences in river discharge and floating debris, which can alter the effectiveness of the fishing gear.

Combined with data for the total commercial catch in 2020, production can be calculated at 7.8 kg of silver eel per hectare of the river system (Figure 2).This figure was used in the calculation of eel production for rivers for 2020 (Table 1).

River Gudenå

At Vestbirk Hydropower station, the biomass of silver eels produced upstream is monitored every year in an eel trap. Monitoring has taken place from August to December every year since 2001. When the eel trap is in operation 65 % of the spring and autumn migrants are counted. The upstream productive river area (66.6 ha) and lake area (121.3) total 188 ha. The present silver eel production in the area is calculated at 0.2 kg/ha.

The trap, however, does not reflect the escapement from the whole river system because the trap is located in the upper part of the River Gudenå, about one hundred km from the marine Kattegat. So natural recruitment is expected to be reduced to this area and to counteract this, heavy stocking was performed in the late 1980s and beginning of the 1990s but these fish has probably left the area. The last stocking took place in 2001 and 2002 with tagged individuals. The lakes downstream have been stocked annually for many decades and some of these lake stockings may immigrate to the upper part of river Gudenå.

Lake Vester Vandet

In Lake Vester Vandet in northern Jutland (479 ha) silver eels leaving the lake are caught in an eel trap during the months September to December. About 75 % of the river water passes through the eel trap whereas about 25 % of the river water passes through a bypass stream. There is no commercial fishery in the lake but there are a number of recreational fishermen exploiting the yellow eel stock. The fishery in the lake and also escapement of spring migrants are not included in the figure for production. Silver eel production in 2020 was 0.15 kg/ha. The figure is considered too low to represent eel production in Danish freshwater lakes.

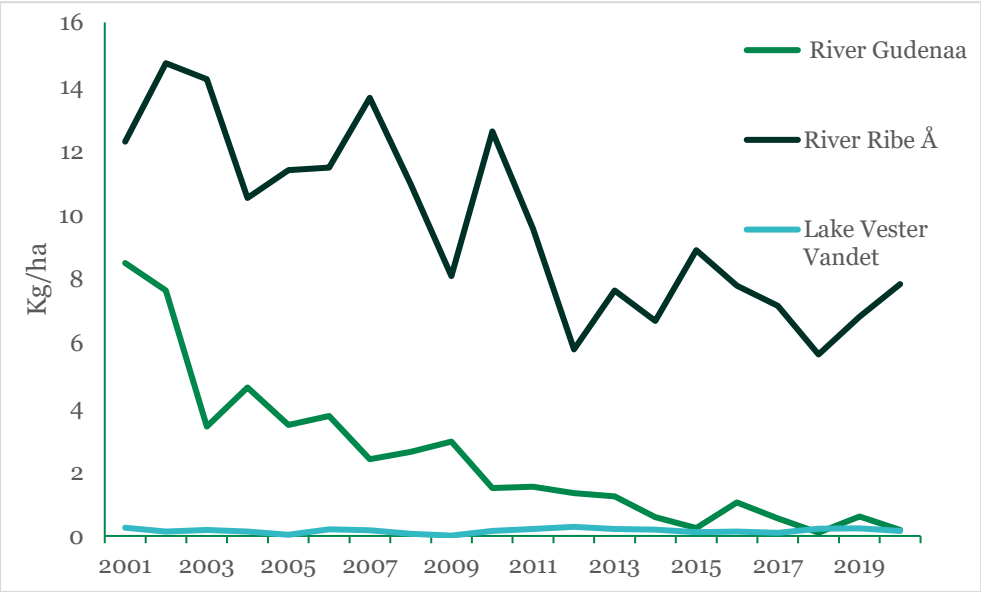

Figure 2: The production of silver eel (kg/ha) from three index systems from 2001-2020.

Fisheries yield from Danish Lakes
In a number of lakes, where commercial fishery takes place, the yellow and silver eel catch average 2018 – 2020 was 1.4-0.6 kg/ha. This suggests a potential silver eel production in these lakes to be about 1 kg/ha (2.A.1, Annex 1) this differs from 0.15 kg/ha as suggested from the index system Lake Vester Vandet. In 2020 the catch average from freshwater lakes was 0,6 kg/ha. This figure was used in the calculation of eel production in lakes for 2020 (Table 1).

2. B. The level of fishing effort that catches eel each year, the level of landing, and the reduction in effort and landings effected since the entry into force of the Regulation

In accordance with Article 8 of the Council Regulation, Denmark has implemented a series of measures aimed at gradually reducing fishing effort and thereby landings in Community waters by at least 50 % relative to the average effort deployed from 2004 to 2006. According to Article 8(1) this reduction is to be achieved gradually, initially by steps of 15 % per year in the first two years over a 5-year period, from 1 July 2009.

In conjunction with the plan, Danish fisheries authorities implemented a license system as of 1 July 2009, which limits each commercial fisherman and entity to a limited number of gears, and thus a limited fishing effort. The system includes a variety of elements, routine compulsory registration and reporting and tangible measures for strengthened control efficiency, providing managers and researchers with comprehensive and reliable data for monitoring, analysis and adequate management. The developments in fishing effort reduction and the corresponding developments in eel landings have been closely monitored and analyzed by the Danish fisheries authorities. The registered reductions in effort have resulted in subsequent and substantial reductions in registered eel landings.

Of the 783 commercial fishermen and entities with registered landings and registered pound nets in the reference period 2004-2006, a total of 525 applied for licences in 2009. A total of 406 commercial licenses were allocated in 2009. Since then, a total of 179 licenses have been cancelled, reducing the number of active commercial fishing licenses to 227. According to Danish national regulation stipulating the conditions for commercial eel fishery, cancellation of inactive licenses will be effected by the Danish fisheries authorities (Danish Fisheries Agency).

Commercial eel fishing effort and the reduction in fishing effort

Table 2.B1*. The level of commercial fishing effort by type of gear from 2004-2006 to 2020. From 2009, the number and types of gear represent the total allocated number and types of gear in all the individual fishing licenses (Danish Fisheries Agency)*

	Fyke nets		**Small pound nets**		**Large pound nets**		**Hook lines**	
	Number	**Reduction**	**Number**	**Reduction**	**Number**	**Reduction**	**Number**	**Reduction**
Average 2004-2006	43,500 *		1,588		1,572		6,366	
2007	41,114	5.50%	1,578	0.60%	1,582	-0.60%	5,875	7.70%
2009	38,336	11.90%	1,292	18.60%	1,466	6.70%	1.932	69.70%
2010	33,661	22.60%	1,082	31.90%	1,322	15.90%	1.200	81.10%
2011	32,591	25.10%	1,000	37.00%	1,273	19.00%	1,200	81.10%
2012	32,191	26.00%	963	39.40%	1,273	19.00%	1,200	81.10%
2013	29,004	33.30%	917	42.30%	1,198	23.80%	1,176	81.50%
2014	27,281	37.30%	915	42.40%	1,157	26.40%	1,136	82.20%
2015	26,922	38.10%	921	42.00%	1,131	28.10%	1,136	82.20%
2016	23,071	47.00%	886	44.20%	642	59.20%	952	85.00%
2017	21,269	51.10%	900	43.30%	604	61.60%	832	86.90%
2018	21,417	50.77%	874	44.96%	572	64.12%	687	89.21%
2019	19,633	54.87%	880	44.58%	544	65.90%	687	89.21%
2020	**19,736**	**54.63%**	**871**	**46.35%**	**507**	**68.26%**	**576**	**90.95%**

*The total number of 40,077 fyke nets registered by the fishermen, who applied for commercial eel licenses in 2009 and an estimate of 3,423 fyke nets used by the 258 fishermen, who reported landings of eel in the reference period 2004-2006, but who did not apply for eel licenses in 2009.

In October 2015, the Danish Fisheries Agency met with representatives from the Danish Fishermen's Association in order to give an up to date status of eel fishing and to inform of this report. As the reduction in the number of fyke nets and large pound nets indicated a lower reduction rate, it was suggested that some commercial eel fishermen held licenses to use more gear than is actually used for eel fishing. It was therefore decided by the Danish Fisheries Agency and the Danish Fishermen´s Association in 2015 that action had to be taken to adjust the individual fisherman's license to the actual number of gear used and thus obtain an expected further reduction in commercial eel fishing effort. This further reduction in gears is reflected in table 2.B1. The large pound nets were reduced significantly. Several fishermen converted large pound nets for smaller ones or for fyke nets, this was accepted by the Danish Fisheries Agency, due to the fact that the catch effect of these other types of gear are less effective than that of large pound nets.

Commercial eel landings and the reduction in eel landings

Table 2.B2. *The level of registered commercial landings in ton since the reference period 2004-2006 and the level of reduction in landings (Danish Fisheries Agency)*

Marine				Fresh waters			
Year	Silver	Yellow	Total	Year	Silver	Yellow	Total
2004	342	178	520	2004	4	11	15
2005	384	133	517	2005	4	10	14
2006	424	146	570	2006	8	8	16
2007	413	109	523	2007	5	5	10
2008	363	89	452	2008	5	4	9
2009	367	87	454	2009	8	5	13
2010	306	105	411	2010	11	3	14
2011	271	84	355	2011	11	5	16
2012	226	78	304	2012	9	4	13
2013	223	95	318	2013	10	3	13
2014	240	77	317	2014	12	3	15
2015	188	59	247	2015	9	6	15
2016	179	74	253	2016	10	3	13
2017	170	70	240	2017	12	5	16
2018	88	82	170	2018	6.5	5	11.5
2019	95	79	173	2019	5.9	4.0	9.9
2020	101	76	177	2020	3.6	1.6	5.4

The total reduction in commercial marine landings by 31 December 2020 is 67 % relative to the average landings from 2004-2006. The total reduction in commercial freshwater landings by 31 December 2020 is 64 % relative to the average landings from 2004-2006.

Recreational eel landings and the reduction in eel landings

From 2009 the recreational fisheries were reduced by a closed fishing season in marine waters. From 10 May to 31 July. In freshwater eel fishing was only allowed during the autumn from 1 August until 15 October. There are no data available before 2009.

Table 2.B3. The level of estimated recreational landings in ton from interview surveys.

	Fresh	**Marine**	**Total**
2009	8.0	100.0	108.0
2010	8.0	117.5	125.5
2011	4.3	75.2	79.5
2012	0.4	51.9	52.3
2013	0.4	49.5	49.9
2014	2.0	55.0	57.0
2015	23.3	95.0	118.3
2016	10.2	154.0	164.2
2017	8.3	109.0	117.3
2018	3.5	101.5	105.0
2019	8.5	101.5	110.0
2020	8.0	90.9	98.9

Regional Focus: Regional landings and reduction in regional landings with special regard to fisheries targeting eel from the Baltic Sea

The Danish EMP states that due to the geographical location of Denmark, the nature of Danish marine waters and the structure of the Danish eel fishing fleet, the Danish eel management plays an important role in securing silver eel escapement from the Baltic Sea. The Danish fishing authorities have therefore devoted special attention to fishermen and entities registering eel landings in the Baltic area.

***Table 2.B4**. The level of regional commercial registered landings in ton and the level of reduction in landings (see map for specific areas in Annex 3). (Danish Fisheries Agency)*

Area	Skagerrack (IIIaN)	Kattegat (IIIaS)	The Sound (23-IIIb)	Belt Sea and Western Baltic (22-IIIc)	Eastern Baltic (24-IIId)	North Sea (IV)	Fresh-water	Total
2004	0.3	20.0	121.7	366.4	1.1	10.5	15.2	535.2
2005	0.1	26.1	130.2	352.9	0.1	7.4	13.7	530.5
2006	0.1	36.1	138.9	386.7	0.1	8.2	16.0	586.0
2007	0.3	26.3	162.3	327.8	0.4	5.9	10.4	533.4
2008	0.0	22.1	153.0	269.7	1.2	6.2	8.5	460.7
2009	0.2	19.4	156.7	266.0	2.1	9.0	13.3	466.7
2010	0.1	21.6	102.2	271.8	0.6	14.8	14.4	425.4
2011	0.0	22.9	111.1	205.7	0.6	15.6	14.8	370.3
2012	0.0	23.3	108.3	158.3	0.8	14.2	13.8	318.7
2013	0.1	31.2	96.6	175.0	0.6	14.3	13.3	331.0
2014	0.1	22.5	98.5	184.3	0.4	11.6	14.8	334.3
2015	0.0	18.2	73.5	148.3	0	9.1	14.4	263.5
2016	1.0	22.3	82.4	136.0	0	13.4	12.9	268.0
2017	0.4	21.0	65.9	140.3	0	12.5	16.4	256.5
2018	0	25.8	41.1	89.3	0	16.0	11.5	183.7
2019	0.1	21.9	38.3	100.7	0	15.4	9.9	186.3
2020	0	14.4	35.6	118.8	0.1	8.8	5.4	182.9
Reduction (%)	100	47	73	68	77	-1	64	67

*) Reduction indicates the geographical reduction since the reference period (2004-2006).

The reduction by 31 December 2020 in registered commercial regional landings, relative to the average landings from 2004-2006 is:
77 % reduction in the Eastern Baltic (ICES area 24-IIId)
68 % reduction in the Belt Sea and Western Baltic Sea (ICES area 22-IIIc)
73 % reduction in the Sound (ICES area 23-IIIb)
47 % in the Kattegat (ICES area IIIas).

2. C. The level of mortality factors outside the fishery

2. C1. Hydropower

In 2006 there were at least 43 hydroelectric power units in operation in Denmark. Since then several hydropower units have been closed down (e.g. Vilholdt, Karlsgårdeværket, Harte, Holstebro). The Danish legislation stipulates that physical screens with a maximum bar distance of 10 mm must be installed in front of hydropower turbines. Bypasses guiding the eel around the power plant are established at some power plants, although at most power plants only fish ladders to guide salmonid are present. The knowledge of the efficiency of the different bypasses for the downstream migrating silver eel is limited and may differ from place to place. It is known that fish impinge on the turbine screens and die there.

Recent research at the biggest hydropower unit in Denmark, Tange Hydropower plant, suggests that up to 77 % of the eels are lost bypassing the hydropower plant. There is no exact knowledge of the proportion of eels that impinge on the screens or are lost for other reason e.g. predation and fisheries, but approximately 10 % of the migrants overwinter upstream the power plant and resume migration in the next year. At Tange Hydropower plant there is a significant bypass problem for eels (Pedersen *et al.* 2011). At Vestbirk Hydropower station 25 % of the water discharge is passed around the turbines in two bypass facilities. One bypass stream is the old riverbed and the other is at the turbine screens guiding the fish around the turbines. The bypass facility seems appropriate and fish including eels do not impinge on the screens except at very low temperatures < 5°C in combination with very high water discharge. These situations usually occur during winter outside the normal eel migration period. Similar problems likely appear at other hydropower facilities. This has not yet been investigated.

2. C2. Aquaculture

Danish trout farms are often located on the banks of rivers depending on water intake from the rivers. To guide the river water into the trout farm, a weir is built in the river. Less than 150 trout farms use "flow through" river water and approximately 40 have systems for recirculation of water. To prevent fish from entering the trout farms, a screen with a max. 6 mm bar distance is obligatory at the point of the water inflow and a max. 10 mm bar distance at the point of outflow. Small eel can easily enter trout farms, and are possibly predated by the trout. However, for the past years there has been an on-going process in collaboration with municipal environmental authorities to improve measures for the unhindered migration of several different fish species. Research in relation to weirs of trout farms have been conducted in connection with three trout farms in River Mattrup Å and River Kongeåen.

River Mattrup Å

At Brejnholt trout farm in River Mattrup Å the National Institute of Aquatic Resources studied the behaviour of silver eels while bypassing the weir at the trout farm. The river water is guided into the farm by a weir and screens prevent the eels to enter the farm. Fish passage is through an overflow spillway at the weir and the water discharge in the spillway may be significantly reduced depending on the hydrological conditions. The study was conducted during two years. The first year the water discharge was low and only 56 % of the eels bypassed the weir. The second year the river discharge was normal and several more eels succeeded to pass the weir (82%) during the same year as they were released. It was concluded that the weir had a significant effect in delaying migrating silver eels. The delay varied with water discharge in the migration period. It is therefore recommended that a constant amount of water in the fish pass should be available e.g. 25 % of the river discharge to neutralize the effect of the weir (and screens are placed appropriate to guide the fish. (Pedersen and Jepsen 2012).

River Kongeå

In River Kongeå two trout farms are situated on the bank of the river at Vejen and Jedsted. In the autumn 2011 forty fish were radio tagged and their downstream migration was monitored while passing the two trout farms. Both trout farms have 6 mm bar distance at the water intake. At Vejen fish farm several fish entered the fish farm despite the 6mm bar screen which seems not correctly installed or damaged. At Jedsted no fish entered the fish farm and the screen was working well. If the screen at Vejen fish farm is fixed properly, eels would not be able to enter the fish farm. However, it is quite difficult to see by eye if there is any such problem at other comparable fish farms unless the place where the screen is mounted is dried out.

2. C3. Predation

Predation on eel may occur from various species of birds e.g. heron and cormorants and from mammals, e.g. otter and mink. Cormorants are possibly the only important predators due to the large number of nesting birds; predation is expected to be largest in the vicinity of the colonies, but migrating birds may have significant impact during the fall. The number of cormorants nesting in Denmark during the last 10-15 years can be regarded as stable, but with downward trend. In the year 2000, 42.481 nests were counted in colonies throughout Denmark. In 2020 there were 31.964 nests (Figure 2. C.3).

In the Danish EMP it was suggested that in the period 2004-06 app. 80 ton of yellow eel was eaten by cormorants. However, recent work from Hirsholmene (57.29'N; 10.37'E) a cormorant colony in Kattegat, analyzing 350 regurgitated pellets showed that eel otoliths occurred with a frequency of 0.3 % (Poul Hald 2007). The frequency of occurrence of eel otoliths found in cormorant pellets in 2005 was only 0.12 % (Sonnesen 2007) suggesting that wild eels are not important as food in Ringkøbing Fjord (55,55'N;08,20'E). However, despite this low occurrence, the estimated number of eels eaten in Ringkøbing Fjord by cormorants in 2004 was 38,000 – more individuals than was caught in the fishery – and recovery of cw-tags from 20,000 tagged stocked eels showed a 40 % predation from cormorants during the first season (Jepsen et al. 2010). Thus, cormorant predation can be a very significant factor in areas with a high cormorant density. The number of cormorants in Ringkøbing Fjord is not higher than most coastal areas in Denmark.

Recent analyses of data from ongoing studies of silver eel migration, using PIT tagging, showed that even relative large silver eels can be eaten by cormorants as PIT tags were recovered from nearby colonies and roosting sites. The recoveries may provide a basis for quantification of the predation in future studies.

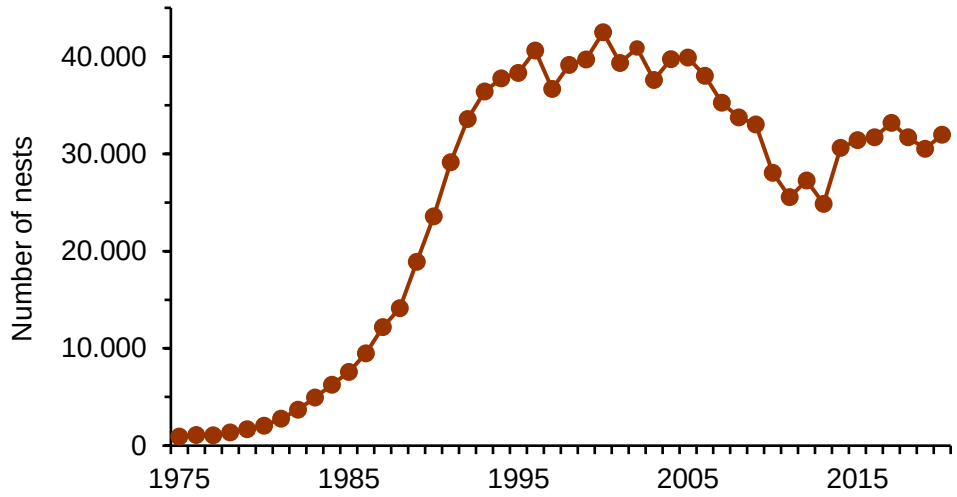

Figure 2. C3: Number of cormorant nests in Denmark 1973 -2020. Data from NERI. University of Århus.

2. D. The amount of eel utilized for restocking

See section 3.8.

3. Have all the foreseen measures been fully implemented as described within the adopted plan pertaining to your national territory?

3.1 Fisheries

All the foreseen measures have been fully implemented as described within the adopted Danish EMP.

3.2 Obstruction to migration

As part of general measures to restore rivers, a high number of obstacles have been and are currently being removed. This includes major hydropower stations (Holstebro and Karlsgårde) and close to 100 smaller dams and weirs, many of which were fish farm dams. These measures have certainly improved both up- and downstream eel passage and reduced silver eel mortality substantially in the restored rivers. Routine control of eel passes and their functionality at remaining obstructions in rivers has continued.

3.3 Hydropower

Some investigations have been conducted (see section 2.C1). The mortality and delay (silver eels) caused by hydropower facilities are significant and can best be mitigated by complete removal of the facility or by letting a significant proportion of the water run through a bypass channel (like is the case at Vestbirk Hydropower station). The Danish stations are old and produce insignificant amount of power. Currently, only a few hydropower facilities remain.

3.4 Aquaculture

Some investigations have been conducted (see section 2.C2.) The mortality and delay (silver eels) caused by traditional fish farms are significant and can best be mitigated by complete removal of the facility or by letting a significant proportion of the water run through a bypass channel. Recently, many Danish fish farms are being converted into fully recycled facilities, which do not require weirs to divert water through. Thus, numerous weirs have been removed and the river connectivity restored. This process is encouraged by the authorities and is expected to continue. A removal of fish farm barriers will clearly benefit migrating eels.

3.5 Predators

According to the National Management Plan for Cormorants, regulations in the form of protective shooting (at fish nets and fish farms) as well as egg oiling (culling) in colonies have continued, resulting in a reduction in the numbers of breeding pairs (see section 2C3). No new research has been conducted to evaluate the effect on cormorants on local eel population.

3.6 Parasites and contaminants

Procedures for testing restocked eel for viruses and parasites (*anguillicola*) have continued as a standard protocol and monitoring of the spread of *Anguillicola crassus* is continued. There is no new knowledge available to further limit contamination of *Anguillicola*.

3.7 Eel habitats

A high number of obstacles are currently being removed (see section 3.2). In line with the EU Water Frame work Directive Denmark aims, during the years 2012-2023, to have reestablished 1700 km of river in good ecological state. The Ministry of Environment continues to reduce nutrient flows from soil to river basins. This is being done by re-establishing formerly drained lakes and meadows. Aside from

official wetland restoration projects, a private fund (Aage V. Jensens Fund) has reestablish the 915 ha Lake Filsø.

Considerable improvements and measures for restoration of Danish rivers takes currently place through grants of approximately 66 million DKK per year (equal to approximately 8.8 million Euro per year). These measures will also benefit migrating eels.

3.8 Restocking

Restocking has been fully implemented as described within the Danish EMP. The amount of restocked eel in freshwater has increased from year 2010, where funds from the European Fisheries Fund were granted. In the Danish EMP the amount of eel to be restocked was proposed to be 0.8 million eels. The actual amount of restocked eels has increased to 1.2-1.6 million eels during the years 2010 – 2020 (Table 3.8).

Table 3.8. *Number of restocked eel size 2-5 gram.*

	Number of restocked eel size 2-5 gram		
Year	**Lakes**	**Rivers**	**Total**
2009	203,900	50,000	253,900
2010	574,350	672,000	1,246,350
2011	771,000	590,000	1,361,000
2012	644,000	640,000	1,284,000
2013	665,400	610,000	1,275,400
2014	712,000	630,000	1,342,000
2015	790,000	609,000	1,399,000
2016	690,000	700,000	1,390,000
2017	690,000	700,000	1,390,000
2018	666,000	310,000	976,000
2019	880,000	745,000	1,625,000
2020	638,200	555,000	1,193,200

Net benefit of eel stocking

The National Institute of Aquatic Resources has recently conducted experiments comparing growth and mortality of wild and farmed eel of weight, 2-5 g, in semi natural drainable ponds. The experimental eels were not fed. The expected outcome was that the wild eels would perform better, concerning growth and mortality, since they were used to natural food items and not fed on artificial pellets as farmed eel. However, the results showed that the farmed eel both survived and grew better than the wild eels and the National Institute of Aquatic Resources concludes that farmed eel is a satisfactory stocking material (Pedersen et al. 2017). The National Institute of Aquatic Resources also analyzed the yield per recruit (YPR) from stocking two different sizes of eel, 2-5 gram eel and larger 8-10 gram eel, in a Marine Fjord where a commercial fishery was operating. The expected outcome was that the larger eel would have a better yield per recruit due to a better survival of the bigger eel. The professional fishery recaptured 12.7 % of the 2-5 g and 9.4% of the 8-10 g eels, originally stocked. Growth rate and mortality rate were different for the two stocked sizes, favoring the small eels. Brut yield per recruit (YPR) was 13 and 9.2

g and net YPR was 9.8 and 0.31 g for 2-5 and 8-10 g eel, respectively. It was concluded that there seems to be no advantage in using a larger eel compared with small 2-5 g eels for stocking. Disregard size at stocking about half of the recaptures were caught as silver eels (Pedersen and Rasmussen 2015).

4. Provide a list of the measures foreseen and implemented and a list of the measures foreseen but not implemented. Provide the date as of which each measure was implemented

The measures foreseen in the Danish Eel Management Plan have all been implemented. The regulation and restrictions for commercial eel fishing activities were implemented as of 1 July 2009.
The regulation and restrictions for recreational eel fishing activities were implemented as of 1 February 2009.

5. Provide an explanation for each measure included in the adopted plan(s), which has not been implemented, or implemented after the foreseen date. If an alternative measure was implemented, please describe it and compare its effectiveness in relation to the measure it has replaced or will replace.

Denmark has nothing to report.

6. Please list the difficulties encountered in the implementation of the plan

Denmark has not encountered major difficulties in the implementation of the Danish EMP. Since the implementation of the Danish EMP, Danish fisheries authorities and the National Institute of Aquatic Resources have had a close cooperation with all segments of eel fishing.

7. Do you have any indication/evidence/data to suggest that an amendment of the Regulation is necessary to achieve the objective set out in Article 2(4) of the Regulation and to ensure the recovery of the species?

Denmark does not have any indication/evidence/data to suggest that an amendment of the Regulation is necessary to achieve the objective set out in Article 2(4) of the Regulation and to ensure the recovery of the species. However, Denmark will continue to follow the situation closely. Denmark will inform the Commission if any new inputs to amendment of the Regulation are found.

8. Attach as an annex the annual report required in line with Article 7(5)

Reporting on prices for eels for restocking. See Annex 2.

9. References

Danish EMP (2008). Danish Eel Management Plan December 2008. In accordance with COUNCIL REGULATION (EC) No 1100/2007 of 18 September 2007.

Claus R. Sparrevohn og Marie Storr-Paulsen (2010). DTU Aqua-rapport nr. 217-2010. Åle- og torskefangst ved rekreativt fiskeri i Danmark.

Hald, P. (2007). Skarvernes Fødevalg ved Hirsholmene i årene 2001-2003. http://www.sns.dk/publikat/2001/hirsholmen_skarv_2001_2003.pdf

Jepsen, N.• R. Klenke, P • Sonnesen, T. Bregnballe (2010). The use of coded wire tags to estimate cormorant predation on fish stocks in an estuary. Marine end freshwater Research. Volume 61, Issue 3, pp. 320-329.

Olesen Hans Jakob (red.), Mads Christoffersen, Margit Eero, Casper Gundelund, Anders Schou Jensen, Niels Jepsen, Troels Kjeldbjerg, Anders Koed, Jesper Kuhn, Michael Ingemann Pedersen, Stig Pedersen, Anna Rindorf, Marie Storr-Paulsen, Karin Stubgaard, Josianne Støttrup og Christian Skov (2020). Forbedring af forvaltningsgrundlaget for bestande i det rekreative fiskeri (REKREA). DTU Aqua. DTU Aqua-rapport No. 364-2020 https://www.aqua.dtu.dk/-/media/Institutter/Aqua/Publikationer/Rapporter-352-400/364-2020-REKREA-Forbedring-af-forvaltningsgrundlaget-i-rekreativt-fiskeri.ashx.

Pedersen, M.I. og J.S. Mikkelsen (2011). Udvandring af blankål fra Ribe Å i 2010. DTU Aqua-rapport nr. 241-2011, pp 10.

Pedersen M. I., N. Jepsen, K. Aarestrup, A. Koed, S. Pedersen and F. Økland (2011). Loss of European silver eel passing a hydropower station. J. Appl. Ichthyol. 28, 189-193.

Pedersen M. I., N. Jepsen (2012). Passage for ål ved dambrug og kraftværk i Gudenåen og Kongeåen. DTU Aqua-rapport nr. 259-2012, pp 24.

Pedersen M.I and G. Rasmussen (2016). Yield per recruit from stocking two different sizes of eel (Anguilla, anguilla) in the brackish Roskilde Fjord. ICES Journal of Marine Science. . Vol. 73, No. 1, 158-164.

Pedersen M.I., N. Jepsen, G. Rasmussen (2017). Survival and growth compared between wild and farmed eel stocked in freshwater ponds. Fisheries Research 194 (2017) 112–116.

Sonnesen, P. (2007). Skarvens prædation omkring Ringkøbing Fjord – en undersøgelse af sammenhænge mellem fødevalg og fiskebestandenes sammensætning. DTU Aqua Specialerapport pp. 76 + bilag.

Annex 1

Produced in accordance with the Commission Guidance document 2014.

Table A1.1. Landings from Danish freshwater lakes and rivers. NA= Not available

Lake	2018	2019	2020	Water surface	2018	2019	2020
	Catch (kg)	Catch (kg)	Catch (kg)	(ha)	Catch (kg/ha)	Catch (kg/ha)	Catch (kg/ha)
Arresø	5,430	4,506	2,146	4,047	1.3	1.1	0.5
Flade Sø	2,801	1,714	404	482	5.8	3.6	0.8
Flyndersø	438	309	291	418	1.0	0.7	0.7
Gudenå	1,522	1,628	576	374	NA	NA	NA
Jylland syd for Limfjorden	790	406	380	NA	NA	NA	NA
Mossø	461	139	248	1,689	0.3	0.1	0.1
Ribe Å			552	287	NA	NA	1.9
Sorø Sø	14	25	37	200	0.1	0.1	0.2
Stilling-Solbjerg Sø	7	50	23	371	0.0	0.1	0.1
Tissø		833	500	1,290	NA	0.6	0.4
Vidå		271	188	187	NA	1.4	1.0
Total	11,463	9,881	5,345	Avg	1.4	1.0	0.6

Bo = 1110 ton
Bcurrent = 122.3 ton
Bbest = 144.7 ton
A = the sum of anthropogenic mortality equal 22.4 ton.

Table A1.2. Fishing mortality and the reduction affected. Catch (ton) in the reference period 2004-2006 and in 2017.

Fishery	2004-2006	2020
Commercial fishery (*)	15	5.4
Recreational, eel traps, landowners (**)	16	8.0
Total	**31**	**13.4**

(*)Reported catch data (**) Interview survey

Table A1.3. Estimates of mortality (ton) outside the fishery – no new measures are available. However, some hydropower plants have been closed down.

	2004-2006	**2020**
Hydropower (ca. 43 small units)	unknown	5
Fish farms (ca 200 farms)	unknown	4
Predation (Cormorants)	unknown	10
Total		19

Table A1.4. Approximate number of glass eels used for stocking in fresh waters (calculated by multiplying number of stocked eel by 1.15 equal to 15 % mortality between glass eel and 2-5 gram eel).

Year	**Stocked eel, #** (2-5 g)	**Glass eel used, #**
2009	253,900	291,985
2010	1,246,350	1,433,303
2011	1,361,000	1,565,150
2012	1,284,000	1,476,600
2013	1,275,400	1,466,710
2014	1,342,000	1,543,300
2015	1,399,000	1,609,100
2016	1,390,000	1,598,500
2017	1,390,000	1,598,500
2018	1,106,000	1,271,900
2019	1,810,000	2,081,500
2020	1,343,200	1,544,680

Annex 2

Article 7 (5) in Council Regulation (EC) No 1100/2007 of 18 September 2007 establishing measures for the recovery of the stock of European eel – Reporting on prices for eels for restocking

Please find Danish data for the quantity and prices paid for eel 2-5 g for restocking in accordance with Council Regulation (EC) 1100/2007 and the Danish Eel Management Plan. In order to fulfil the reporting obligations set out in Article 7 (5) of the Regulation, the Commission requests that the Member States provide the following information in writing: Prices paid for glass eel purchased for the purpose of restocking, starting from the date of implementation of the relevant. Member State's eel management plan until present.

As described in the Danish Eel Management Plan, Denmark does not stock glass eel. Danish eel farmers purchase glass eel, typically from France. After 2-3 months in aquaculture, eels of 2-5 g are

purchased by the Ministry of Food, Agriculture and Fisheries for restocking.

Table A2.1 The average prices of each eel for restocking in the period of 2010-2020.

Year	Danish currency (DKr)	Euro (€)
2010	2.35	0.31
2011	2.05	0.27
2012	2.07	0.28
2013	2.14	0.29
2014	2.05	0.27
2015	1.93	0.26
2016	1.93	0.26
2017	1.92	0.26
2018	2.05	0.27
2019	1.63	0.22
2020	1.63	0.22

Table A2.2 The quantity of glass eel bought for restocking during 2010-2020.

Year	Restocked eels (2-5 g), individuals	Approximately number of additional eels of 2-5 g purchased to restock in marine waters
2010	1.25 millions	300,000
2011	1.36 millions	200,000
2012	1.28 millions	250,000
2013	1.28 millions	250,000
2014	1.34 millions	226,000
2015	1.40 millions	130,000
2016	1.39 millions	130,000
2017	1.39 millions	130,000
2018	1.11 millions	130,000
2019	1.81 millions	185,000
2020	1.34 millions	150,000

Annex 3

Shows the regional areas described in table A3.1.