Report to the European Commission required in line with Article 9 of Regulation 1100/2007/EC

Implementation of Eel Management Plan (EMP) in the Netherlands

June 2015

Contents

Nederlandse samenvatting (Dutch summary)

Inleiding
De onderliggende rapportage betreft een evaluatie van de effecten van het Nederlandse aalbeheerplan tot op heden. Om een totaalbeeld van het effect van de maatregelen van 2009 tot 2015 te laten zien, is er voor gekozen de bestaande rapportage uit 2012 te actualiseren.

Sinds de 60-70-er jaren is de aalpopulatie en aalvangst sterk teruggelopen. De huidige intrek van glasaal is slechts 5% van de intrek destijds. Om herstel van de aalpopulatie mogelijk te maken, heeft De Raad van de Europese Unie in 2007 de "EU Regulation for the Recovery of the Eel Stock (EC 1100/2007)" vastgesteld. Deze verordening verplicht de lidstaten om met een eigen nationaal aalbeheerplan te komen en te implementeren. Het doel van deze aalbeheerplannen is daarbij als volgt omschreven: "Doel van de beheerplannen voor aal is het verminderen van de antropogene sterfte, zodat er een grote kans bestaat dat ten minste 40% van de biomassa van schieraal kan ontsnappen naar zee, gerelateerd aan de beste raming betreffende de ontsnapping die plaats zou hebben gevonden indien de mens geen invloed had uitgeoefend op het bestand. De beheerplannen voor aal worden opgesteld met het oog op het bereiken van die doelstelling op lange termijn."

Lidstaten zijn verplicht om voor 1 juli 2015 voor de tweede maal over de voortgang van de nationale aalbeheerplannen te rapporteren aan de Europese Commissie. De Europese Commissie zal een verslag opstellen over deze aalbeheerplannen. Dit verslag zal door de Europese Commissie worden ingediend bij het Europees Parlement en de Raad.

In het eerste deel (hoofdstuk 1 en 2) van dit rapport wordt uitgelegd hoe gemonitoord is en worden schattingen gegeven over de uittrekkende schieraal, de visserij-inspanning en de vangsten in vergelijking met de situatie voordat het aalbeheerplan van kracht was. Ook worden de mortaliteitsfactoren buiten de visserij beschreven. Daarna (hoofdstuk 3 en 4) volgt een overzicht van alle maatregelen die in het Nederlandse aalbeheerplan zijn opgenomen. Hierbij wordt gekeken naar de voortgang van de maatregelen. Of deze op tijd geïmplementeerd zijn, op schema lopen, wat de reden hiervoor is als dat niet het geval is en tegen welke problemen is aangelopen.

Al met al moet worden geconcludeerd dat de aalsterfte door menselijk handelen in Nederland aanzienlijk is afgenomen. Ondanks deze afname in aalsterfte blijft de status van aal in de Nederland "ongewenst" (hoge sterfte, lage biomassa). De huidige biomassa van uittrekkende schieraal ligt onder de doelstelling van minimaal 40% van de pristine biomassa (B_o) (exclusief zee- en kustwateren) en de huidige sterfte door menselijk handelen ligt boven de geadviseerde sterfte bij een dergelijke lage biomassa aan uittrekkende schieraal.

Maatregelen hebben geleid tot een substantiële verbetering van de overleving Het aalbeheerplan is geëvalueerd in het licht van de voornoemde "beheersdoelen" uit de Aalverordening. De methodiek die bij deze evaluatie gehanteerd is komt voort uit de ICES - "werkgroep aal". De evaluatie is uitgevoerd door middel van modellen, vangstgegevens, veldwaarnemingen en statistische analyses, uitvoerig beschreven in de wetenschappelijke rapportage. Het geheel van deze inspanning resulteerde in schattingen voor (2005-2007) en na (2008-2010, 2011-2013) de implementatie van het Aalbeheerplan van met name:

- De biomassa uittrekkende schieraal: 897 t in 2005-2007, 1035 t in 2008-2010 en 1057 t in 2011-2013
- De pristine biomassa aan uittrekkende schieraal: 10.400 t (exclusief kust- en zeewateren)
- De doelstelling Aalverordening voor Nederland: 4160 ton (40%van de pristine biomassa exclusief kust -en zeewateren)
- De uittrek van schieraal ten opzichte van deze doelstelling: 22% in 2005-2007, 25% in 2008-2010 en 25% in 2011-2013.
- De reductie in antropogene sterfte door de genomen maatregelen: de antropogene sterfte van glasaal naar schieraal is afgenomen van 72% in 2005-2007 en 46% in 2008-2010 naar 38% in

2011-2013. Dit betekent dat de overleving van glasaal tot uittrekkende schieraal is verdubbeld van 28% tot 62%.

Deze schattingen zijn ruw en de daarmee gepaard gaande onzekerheid is in de begeleidende wetenschappelijke rapportage (van de Wolfshaar et al., 2015) omschreven.

Effecten van het Nederlandse aalbeheerplan op de Nederlandse aalpopulatie zullen pas na vele jaren zichtbaar worden. De aalpopulatie in Nederland en de uittrek van schieraal zullen pas veel later substantieel verbeteren. De reden dat dit zo lang duurt, is dat aal een langlevende soort is. Het duurt meer dan een jaar voordat glasaal na geboorte aankomt bij de Nederlandse kust en de binnenwateren op zwemt. Vervolgens duurt het 5-15 jaar voordat deze aal "schier" wordt en als schieraal terugtrekt naar zee. Tot die tijd blijft het huidige aalbeheerplan inclusief de daarin opgenomen maatregelen van kracht.

De evaluatie laat zien dat de maatregelen uit het Nederlandse aalbeheerplan hebben geleid tot een teruggang in sterfte door menselijk handelen. Deze reductie is voornamelijk het gevolg van beperkingen van de visserij (recreatief en beroep).

Het blijft onzeker of de genomen maatregelen op termijn werkelijk zullen leiden tot een duurzaam verbeterde aalstand. De reden is dat niet zeker is wat de oorzaak of oorzaken zijn van de achteruitgang in de aalstand.

Implementatie van maatregelen
Onderstaande tabel geeft een overzicht van de implementatie van de maatregelen uit het aalbeheerplan. Hieruit blijkt dat hoewel een deel van de maatregelen tijdig is ingegaan, er ook een aantal later is gestart. De redenen daarvoor worden hierna kort toegelicht. De laatste maatregel was onvoorzien: het sluiten van de belangrijkste grote rivieren en enkele kanalen voor de aalvisserij in verband met verontreiniging van aal met PCB's en dioxinen.

Tabel *Overzicht van de implementatie van de beheersmaatregelen in het Nederlandse aalbeheerplan.*

Nr	Maatregelen op tijd geïmplementeerd	Geplande implementatie	Gerealiseerde implementatie
1	Terugzetten van aal (a) op zee en (b) op binnenwater door sportvissers	2009	1 oktober 2009
2	Verbod op recreatieve visserij, gebruikmakend van professionele vistuigen.	2011	1 januari 2011[a]
3	Gesloten aalvisseizoen 1 september tot 1 december	2009	1 oktober 2009[b]
4	Stoppen met uitgave van peurvergunningen op Staatswateren.	2009	1 mei 2009
5	Onderzoek naar het kweken van aal in gevangenschap.	doorlopend	EU-project
6	Oplossen van migratieknelpunten bij sluizen, gemalen en andere kunstwerken; van de 1800 belangrijkste knelpunten worden 900 opgelost voor 2015 en de overige 900 voor 2027.	2009-2027	2009-2027[c]
7	Aangepast turbinebeheer bij de 3 grote waterkrachtcentrales.	2009	17 november 2011[d]
8	Visserijvrije zones in gebieden die belangrijk zijn voor aalmigratie.	2010	1 april 2011[e]
9	Uitzet van glas- en pootaal.	2009	Start 2010, daarna elk jaar.
10	Sluiten van de visserij in de belangrijkste grote rivieren, met als aanleiding dioxineverontreiniging.		1 april 2011[f]

[a] *Het gebruik van fuiken en staand want in de recreatieve visserij in de kustgebieden is verboden sinds 1 januari 2011. Op 1 januari 2012 is staand want in de Waddenzee en Westerschelde weer toegestaan. En in mei 2012 ook weer in de Noordzee. Reden hiervoor is dat met staand want geen aal gevangen wordt.*

[b] *In 2009 twee maanden gesloten, oktober en november, vanaf 2010 drie maanden gesloten (oktober-december).*

[c] *Door de taakstelling uit het regeerakkoord zijn een aantal maatregelen in het hoofdwatersysteem*

getemporiseerd tot na 2015.

[d] Om technische redenen blijkt een effect van 24% maximaal mogelijk.

[e] Vanwege het sluiten van de belangrijkste grote rivieren (maatregel 10), die dienst doen als "migratie snelwegen" is besloten deze maatregel niet meer in te voeren. Het besluit is genomen op grond van een wetenschappelijke analyse.

[f] Per 1 april 2011 zijn grote gebieden gesloten (vooral de grote rivieren) voor de aalvisserij omdat de aldaar gevangen aal niet voldeed aan eisen rond voedselveiligheid door te hoge gehalten aan PCB's en dioxines. Deze maatregel was geen onderdeel van het oorspronkelijke aalbeheerplan, maar is later toegevoegd. Op 1 januari 2015 is het gesloten gebied uitgebreid.

De conclusie is dat de visserijmaatregelen op tijd zijn geïmplementeerd. Het onderzoek naar het kweken van aal in gevangenschap liep al enige jaren en is sinds het in werking treden van het aalbeheerplan voortgezet. In 2009 heeft het ministerie van EZ mee gefinancierd aan het project "Glasaal Volendam" en in 2015 zal bijgedragen worden aan het project "Hollandse aal".

Van het oplossen van belangrijke aalmigratieknelpunten is in eerste instantie gekeken naar de top 30 voor aal (Tom Buijse et al., 2009), en vervolgens naar een verdere uitwerking en uitbreiding tot een top 58 migratieknelpunten voor de schieraal uittrek gebaseerd op geschatte potentiële schieraalverliezen (Winter et al 2013a, Winter et al. 2013b). In de periode 2012-2015 zijn een aantal verbeteringen bij deze knelpunten doorgevoerd. Door de taakstelling uit het regeerakkoord zijn een aantal maatregelen in het hoofdwater- systeem getemporiseerd tot na 2015. Daarbij zitten ook vispassages. Bij de keuze is echter rekening gehouden met de effectiviteit van de vispassages. Zo zijn de vispassages tussen zoet en zout overgangen , stromend en stagnant (=stilstaand water) water zoveel mogelijk in de eerdere planning gelaten. In de periode 2009-2015 zijn 743 vispassages uitgevoerd.

De maatregelen die tot vermindering van mortaliteit van aal moeten leiden bij de drie grootste waterkrachtcentrales zijn begin november 2011 geïmplementeerd. Vanaf dit moment passen de waterkrachtcentrales van NUON en ESSENT aangepast turbinebeheer toe. Daarbij wordt de volgende turbine pas aangezet als de voorgaande turbine op vollast draait. Turbines die op hoge snelheid draaien, veroorzaken namelijk minder sterfte/schade aan vissen dan turbines die op lagere snelheid draaien. Dit komt doordat de ruimte tussen de schoepen bij lagere snelheid veel kleiner is en de kans dat de vissen geraakt worden daardoor groter.
In December 2014 is de nieuwe Waterwet in werking getreden met een extra waarborg voor visbescherming. Zo kan een watervergunning voor een waterkrachtcentrale slechts verleend worden indien de waterkrachtcentrale voldoet aan de maximale beschikbare mogelijkheden van visbescherming voor stroomafwaartse migratie en indien eventuele negatieve effecten op de stroomafwaartse vismigratie gecompenseerd worden. Voor reeds bestaande waterkrachtcentrales kan een uitzondering worden verleend als de vergunningaanvraag betrekking heeft op initiatieven met een experimenteel karakter, waarbij bestaande turbines worden vervangen door nieuwe, innovatieve turbines of anderszins vernieuwende en innovatieve technieken worden toegepast.

De maatregel visserijvrije zone bleek tijdens de evaluatie in 2012 overbodig. Deze maatregel was in het aalbeheerplan opgenomen met als doel gedurende de aalmigratie de aal ruim baan te geven om naar zee te trekken. In het grootste deel van de tijd waarin de migratie van schieraal plaatsvindt geldt echter al een gesloten tijd voor de aalvisserij. Toen later (1 april 2011) ook nog de belangrijkste grote rivieren, die tevens de belangrijkste migratieroutes voor schieraal zijn, gesloten werden, is de maatregel na wetenschappelijk advies als overbodig bestempeld.

Glas- en pootaal worden in het voorjaar uitgezet. Toen het aalbeheerplan in oktober 2009 in werking trad, was het voor 2009 te laat om dat jaar nog glas- en pootaal uit te zetten. In 2010 is de uitzet wel volgens plan verlopen. In 2011 is het niet gelukt het totale bedrag voor 2011 te besteden. Dit kwam door aanbestedingsproblemen en het warme voorjaar van 2011 en de daarmee geringe glasaalvangsten in april en mei. Het niet besteedde bedrag is toegevoegd aan het in 2012 uit te geven bedrag. In de jaren 2013 en 2014 zijn volgens het plan glas- en pootaal uitgezet. Daarbij kan worden opgemerkt dat in 2014 twee keer zoveel glasaal is uitgezet door de lage glasaalprijzen.

Chapter 1: Outline the monitoring, effectiveness and outcome of the eel management plan Martin

Requested by format European Commission: Outline the monitoring, effectiveness and outcome of the eel management plans implemented on your territory in co-operation with neighbouring countries. Do you have any indication/evidence/data to suggest that an amendment of the Regulation [and consequently the eel plans] is necessary to achieve the objective set out in Article 2(4) of the Regulation and to ensure the recovery of the species?

1.1 Monitoring progress EMP

A wide range of new and existing programmes are in place to record the abundance of glass eel, yellow eel and silver eel, to monitor commercial and recreational catches and to register changes in barrier mortality (hydropower plants, pumping stations). These data are used to calculate the biomass of escaping silver eel using the Yellow Eel Model. For further details see the attached scientific report of IMARES (van de Wolfshaar et al., 2015).

Glass eel: Glass eel abundance is recorded at 12 locations along the Dutch coast with the longest series at Den Oever dating back to the 1930s.

Yellow eel and silver eel: In regionally managed water bodies, eel abundance is recorded as part of the Water Framework Directive Fish Monitoring Programme. All water bodies are surveyed at least once every six years. Ditches are an important type of inland waters but are poorly represented in the WFD fish surveys. An additional eel survey was initiated in 2012 to collect data on eel densities in ditches to supplement this knowledge gap in the WFD fish surveys. In nationally managed waters (major rivers, IJsselmeer/Markermeer) eel abundance is determined on an annual basis. A specific silver eel index to monitor the relative abundance of migrating silver eel on the most important migration routes along the coast started in the fall of 2012.

Commercial fishery: Until recently, only landings from IJsselmeer/Markermeer were recorded, however, on 1 January 2010 an obligatory online catch registration system was introduced (weekly landings per individual). On 1 January 2012 the registration system was updated and currently both catches and fishing efforts are recorded on a weekly basis. The Market Sampling Programme (size, frequency; biological samples) which has been in place since the 1960s on IJsselmeer/Markermeer was extended to cover the whole of the Netherlands in 2009/2010.

Recreational fishery: In 2009 the Recreation Fishery Programme was launched. Every other year the number of recreational fishermen is determined on the basis of a screening survey (2009, 2011, 2013) and 2000-2500 individuals are selected for a 12-month logbook programme (2010; 2012; 2014) for an estimation of the catches.

Hydropower plants: Telemetry studies were conducted in the two major rivers Meuse and Rhine in 2002/2004 (before EMP), 2010,2011 and 2013 (both after EMP). Telemetry (and mark-recapture) studies will continue in the future to monitor change in silver eel mortality caused by passage through hydropower plants.

Barriers: The progress of the planned infrastructural improvements for fish migrations of the ~1800 barriers identified as important for eel are being monitored every three years and started in 2012.

1.2 Effectiveness implemented measures of the EMP

Commercial and recreational fishery: The most effective measures of the EMP were the measures developed to reduce the impact of commercial and recreational fisheries. The introduction of a closed season (Sep-Nov) and closed area (polluted rivers) has roughly halved the landings of commercial and recreational fishery between 2005-2007 and 2008-2010. Between 2008-2010 and 2011-2013 the commercial catch declined a further 15%. The introduction of a catch & release fishery for eel in most waters for the recreational fishery has achieved a similar reduction of retained catches. The achieved reduction in anthropogenic mortality (*see* fig 1.1) between 2005-2007 and 2008-2010 and between

2008-2010 en 2011-2013 is almost exclusively the result of the reduction in both commercial and recreational landings.

Barriers: The commitments under the government's coalition agreement made it necessary to suspend a number of measures until after 2015. These measures also concern fish passages. The effectiveness of the passages was a determining factor. Passages in the fresh and salt, or running and stagnant water transition zones remained in the planning. In the period up to 2015 at least 47% of the eel migration barriers have now been fitted with fish passage facilities. Despite the suspension of a number of measures, the original objective of solving 50% of the eel migration barriers appears to have been achieved.

Hydropower plants: In the period 2009-2011 the measures to achieve a 35% reduction in mortality by hydropower plants had little effect. In the first place, fish-friendly turbine management was not implemented till late November 2011. Secondly, due to technical difficulties (wear and tear turbines at maximum water flow), the intended mortality reduction of 35% as described in the EMP will not be achieved, the maximum reduction in mortality using adjusted turbine management will be 24%. In 2012 and 2013 fish friendly turbine management was enabled during the whole year but is obligatory during August - January (pers. comm. H. Bakker RWS-ZN). However, the telemetry studies that started in 2010 and 2013 suggest no indication for an improvement of mortality at HPS was detected since the implementation of adjusted turbine management. It has to be noted that year to year variation in mortality rates related to differences in discharge patterns can be large and that more specific research is needed to establish whether a reduction in mortality due to this new operating management has occurred.

Glass eel stocking: A protocol was drawn up for the introduction of glass eel with criteria for the selection of waters (Klein Breteler, 2008). Another protocol was drawn up to optimise chances for glass eel survival (Kuijs & de Graaf, 2011). The effectiveness of the current glass eel stocking programme is unclear. Impact of the stocking program in the period 2009-2013 will not be visible until the glass eel has grown past 30 cm in length and has recruited into the fishery and eel monitoring programmes. Even if the stocked glass eel recruit into the fishery and the monitoring programmes it is unlikely to evaluate the effectiveness as the stocked glass eels are not marked and cannot be distinguished from naturally occurring (glass)eel. Introducing translocated glass eel from France, Spain and/or England into Dutch waters will undoubtedly increase the biomass of silver eel in Dutch waters, however, it is unclear whether the current stocking programme has a net benefit for the whole European eel stock.

1.3 Outcome of the EMP

Over the past years the ICES Working Group on Eels (WGEEL), have progressively been working on a pragmatic framework for a (inter)national post-evaluation of the status of the eel stock and the effect of management measures (ICES 2014 and references therein).

In the Eel Management Plan (2009), the Netherlands has provided estimates of pristine biomass and of anthropogenic mortalities before the implementation of the EMP, and thus has set reference points to which the status of the local stock and efficacy of implemented management actions can be compared.

During the past ICES working groups (ICES 2014 and references therein) have adapted the classical ICES precautionary diagram to the eel case (Fig. 1.1). In the modified ICES precautionary diagram the horizontal axis reflects the status of the stock (biomass escaping silver eel, ratio $B_{current}/B_o$) in relation to the estimated pristine situation. On the vertical axis total anthropogenic mortality is plotted, a summation of all (quantified) sources of anthropogenic mortality during the continental phase of eel. The vertical axis indicates to what extent the current population is protected in comparison with a situation where no anthropogenic mortality occurs and the production of silver eel per glass eel is at its maximum (anthropogenic mortality, ratio $B_{current}/B_{best}$).

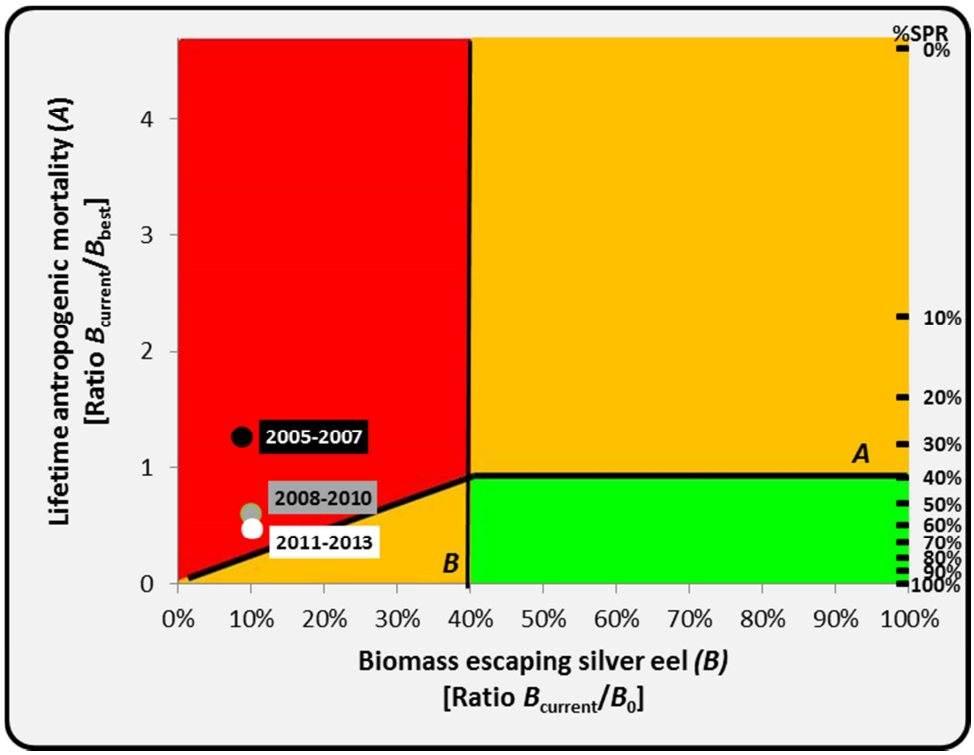
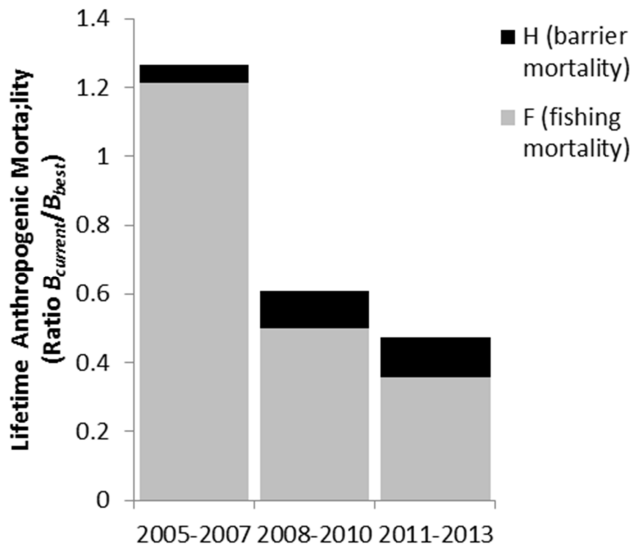


Fig. 1.1 *ICES modified precautionary diagram representing the status of eel in the Netherlands in 2005-2007, 2008-2010 and 2011-2013. The horizontal axis represents the status of the stock in relation to pristine conditions, while the vertical axis represents the impact made by anthropogenic mortality. %SPR = spawner potential ratio, a measure for the survival to silver eel relative to pristine conditions.*

The status of the eel population in 2005-2007, 2008-2010 and 2011-2013 and hence, the evaluation of the Dutch Eel Management Plan is graphically presented in Figure 1.1, using the ICES Modified Precautionary Diagram with respect to the management targets from the EC Eel Regulation. The evaluation demonstrated that in the periods before (2005-2007) and after (2008-2010 and 2011-2013) the implementation of the EMP the status of eel in Dutch waters remained in a situation regarded as "undesirable" (high mortality, low biomass). Current biomass of escaping silver eel is below the target of 40% of the pristine situation and current anthropogenic mortality is above the recommended mortality at such low biomass of escaping silver eel (following the modified precautionary diagram developed by ICES (2014 and references therein).

Measures to reduce anthropogenic mortality are relatively quick and easy to implement and will directly result in measurable improvements (vertical axis Fig. 1.1). A reduction in anthropogenic mortality is therefore a good indicator of the drive and prowess of a member state. In the Netherlands the implementation of the EMP has resulted in a sharp reduction in anthropogenic mortality between 2005-2007 and 2008-2010. The observed reduction was almost solely the result of a decrease in fishery mortality (F), landings of both commercial and recreational roughly halved between these two periods.



The remaining measures (hydropower plants, pumping stations etc) have had limited measurable impact on the reduction in mortality. More importantly 2005-2007 and 2008-2010 the contribution of barrier mortality (H) to total lifetime anthropogenic mortality (A) nearly doubled (Fig. 1.2) most likely due to increase in number of silver eel surviving the fishery and having to pass barriers during their migration to the sea.

Fig. 1.2 *Changes in the contribution of F (fisheries mortality) and H (barrier mortality) to the life time anthropogenenic mortality of eel in the Netherlands.*

Between 2008-2010 and 2011-2013 a further modest decrease was observed in lifetime anthropogenic mortality (A) (Figs. 1.1, 1.2). This modest reduction was again mainly due to a further reduction in commercial and recreational fishery mortality (F). The small increase in barrier mortality (H) between 2008-2010 and 2011-2013 is more complex to interpret (Fig. 1.2). In the first place it appeared that the implemented changes in turbine management of hydropower stations have had little effect on the survival of eel passing through the turbines of a HPS (*see 2.3.2*). The (relative) mortality of eels passing a barrier did, however, decrease from 16% to 15% in the assessment model (van de Wolfshaar et al., 2015). The slight reduction in (relative) mortality in the assessment model was achieved by infrastructural changes to improve migration (*see Wolfshaar et al., 2015*)at some of the priority migration barriers (Winter et al., 2013). Due to a further modest reduction in fishing mortality between 2008-2010 and 2011-2013, more eel survived to the start of the silver eel migration. While the (relative) mortality of eels passing a barrier *decreased* from 16% to 15% this positive effect was most likely masked by an *increase* in the number of eels passing through migration barriers and hence a further increase in the contribution of (absolute) barrier mortality to the lifetime anthropogenic mortality (Fig. 1.2). The main source of quantified anthropogenic mortality in 2011-2013 remained commercial and recreational fishing mortality (Fig. 1.2).

Chapter 2: Estimates of biomass escaping silvereel and reductions in antropogenic mortalities

Requested by format European Commission:
Provide the best available estimates of:
2.1 The proportion of the silver eel biomass that is currently escaping towards the sea to spawn, relative to the target level of escapement set out in Article 2(4), i.e. 40% of the pristine biomass.
2.2 The level of fishing effort that catches eel each year and the level of catches, and the reduction in effort and catches effected since the entry into force of the Regulation.
2.3 The level of mortality factors outside the fishery, and the reduction effected in accordance with Article 2(10);
2.4 The amount of eel less than 12 cm in length caught and the proportions of this utilised for all purposes such as restocking, direct consumption, aquaculture within the EU and outside the EU, export outside the EU.

2.1 Silver eel biomass currently escaping

The proportion of the silver eel biomass that is currently escaping towards the sea to spawn, relative to the target level of escapement set out in Article 2(4), i.e. 40% of the pristine biomass =

$$\frac{B_{current} = 1057\ t}{40\%\ of\ B_0 = 4.160\ t^*} \times 100 = 25\%$$

* *inland waters only*

Details on the estimation of $B_{current}$ can be found in van de Wolfshaar et al. (2015) and details on the estimation of B_0 can be found in the Eel Management Plan (2009 and references therein).

2.2 Reduction fishing effort and catches

2.2.1 Commercial fishery

2.2.1.1 Effort

Fishing effort was until recently (1/1/2012) not recorded in the Netherlands. Only the potential fishing capacity for Lake IJsselmeer/Markermeer was known (Fig. 2.1) but no record was kept of the actual usage of the gears. Furthermore, in IJsselmeer/Markermeer the effort of the long line fishery is restricted by licences, but the number of long lines per licence is not regulated. The amount and/or recent changes of long line numbers and/or were unknown.

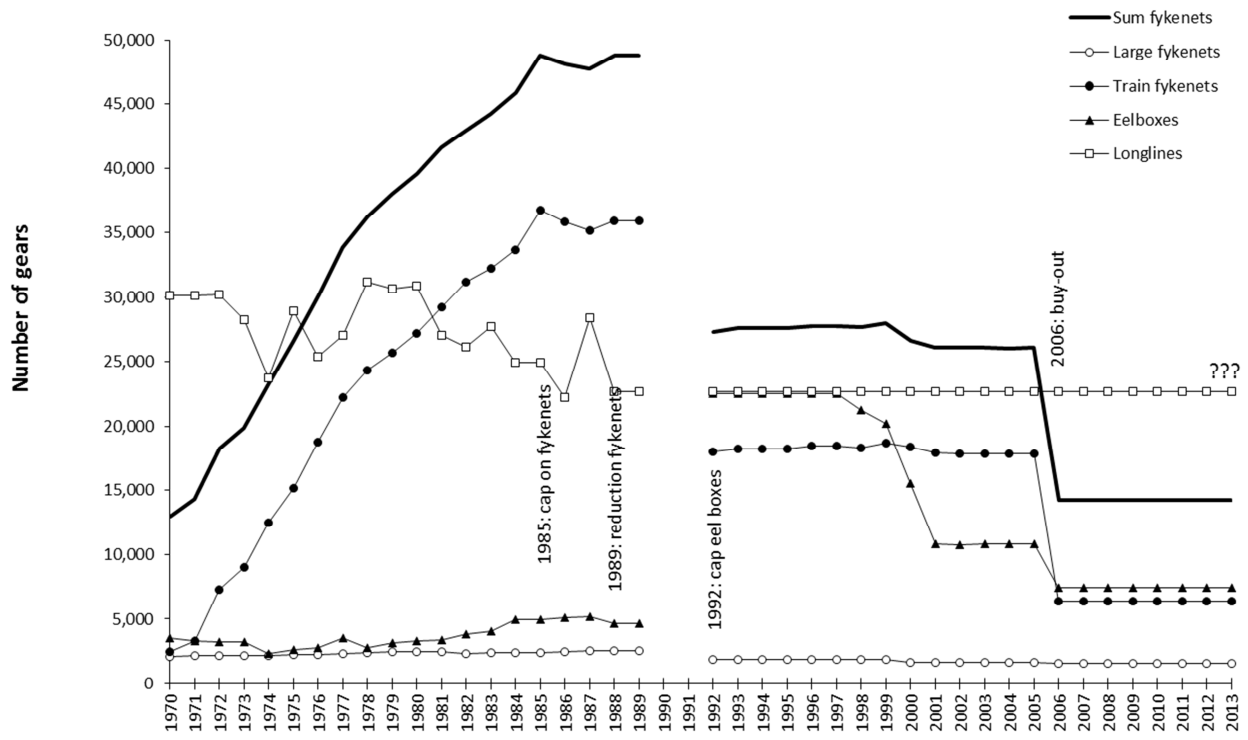


Fig. 2.1 *Trend in the nominal quantity of fishing gear in eel fishery on Lake IJsselmeer/Markermeer. Information before 1989 is based on a voluntary questionnaire in 1989 (Dekker 1991); after 1992, the licensed quantity of gear is shown. Note that long line fishery is only restricted by the number of licences, the number of long lines per licence is not regulated.*

In 2008 fishing gear quantities in a large part of the eel fishery (40% of the registered eel fishing companies) remained unresolved. In 2010 and 2011 EZ contacted all eel fishing companies operating outside IJsselmeer/Markermeer and the closed areas to gain insight in the numbers and type of fishing gear used. Table 2.1 provides a rough overview of eel fishing gear used in the Dutch eel fishery before and after the implementation of the EMP. In Lake IJsselmeer/Markermeer, no changes have occurred in quantities of potential fishing gear (fyke nets and eel boxes) in the period 2008-2011, although (changes in) number of bottom long lines is unclear. Although no changes in the (maximum) capacity have occurred it is not known if any changes have occurred in the actual usage of the fishing gears. The closure of the eel fishery in the polluted areas of the rivers Rhine and Meuse has reduced the quantity of eel fishing gear to zero in 2011. In these areas fishermen are only allowed to use seine nets to catch cyprinid and percid fish.

Table 2.1 *Fishing gear types used in the Netherlands (Source: 2008 EMP and Dekker et al. 2008; 2011 EZ).*

Gear	IJsselmeer/Markermeer		Rivers ("closed areas")		Other waters	
	2008	2011	2008	2011	2008	2011
large fykes	1579	1579	318	0	?	3900
train fykes	6386	6386	2433	0	?	4040
other fykes			51	0	?	2800
Eel boxes	7415	7415	551	0	?	190
longlines (bottom; #blocks, 200 hooks per block)	100 (?)	100 (?)			?	150
longline (surface; #hooks)					?	5800
Electro fishing gear			+	0	?	23
Stow net					?	5
Eel seine					?	5

The introduction of a closed season as part of the EMP in 2009 has significantly reduced "effort" when defined as the number of fishing days. Table 2.2 provides an overview of the changes in length of the eel fishing season throughout the Netherlands.

Table 2.2 *Changes in the length of the eel fishing season in Dutch waters.*

	2008	2011	Reduced fishing season (days/%)
IJsselmeer/Markermeer			
large fykes	1 May-31 December	1 May–31 August & 1-31 December	91 (38%)
train fykes	1 May–30 September	1 May–31 August	31 (20%)
Eel boxes and long lines	12 April–30 September	12 April–31 August	31 (20%)
Rivers ("closed areas")	1 Jan–31 December	closed	365 (100%)
Other waters	1 Jan–31 December	1 Jan–31 August & 1-31 December	91 (25%)

It is difficult to properly evaluate the change in effort (number of gear and usage of gear) before and after the implementation of the EMP due to:

- the lack of information on quantities of fishing gear and usage in the waters outside IJsselmeer/Markermeer, and
- the lack of information on quantities of fishing gear (long line) and usage on IJsselmeer/Markermeer.

To avoid similar issues in the future, all eel fishermen have been obliged to report effort (type of gear and quantities of gear used) on a weekly basis as of 1 January 2012 as part of the obligatory catch recording system which was implemented by EZ on 1 January 2010.

An overview of the number and type of gear deployed weekly throughout 2013 is presented for IJsselmeer/Markermeer and for other locations in the Netherlands in Fig. 2.2. In general, effort was fairly constant throughout the season, with at most a slight increase during the season. In Lake IJsselmeer/Markermeer, only eelboxes were deployed mainly in the first half of the season.

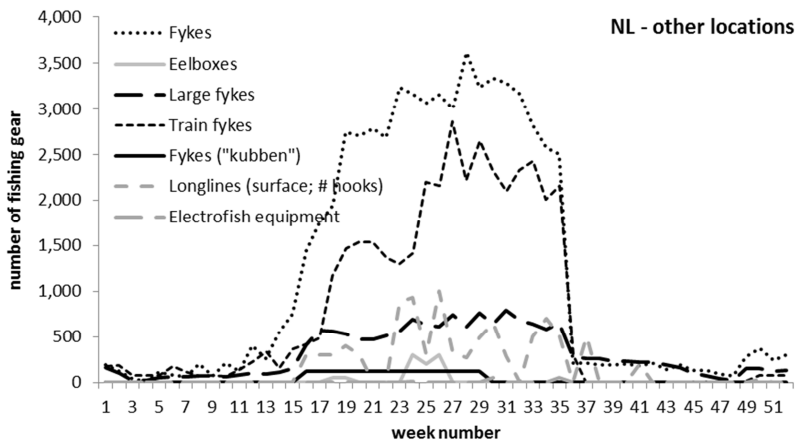


Fig. 2.2 *Number of fishing gear employed weekly in the Dutch eel fishery in Lake IJsselmeer & Markermeer (top) and other locations throughout the Netherlands in 2013 (source EZ).*

2.2.1.2 Catches

On 1 January 2010 an obligatory eel catch registration system was introduced. In 2010, 452 tonnes of eel were caught by commercial vessels in the Netherlands (Fig. 2.2). Roughly a third of this catch (172 t) came from the areas that were closed to the fishery of eel and mitten crab on 1 April 2011, due to presence of eels with dioxine-levels higher than considered safe for human consumption (ER 1881/2006; Kotterman & van der Lee 2011).

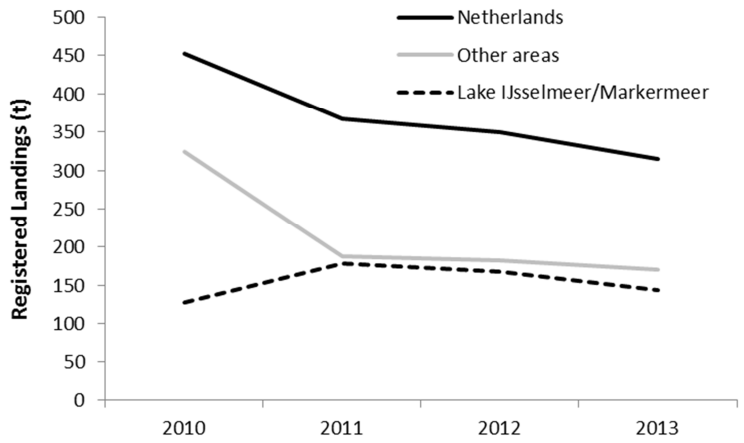


Fig. 2.2 *Trends in annual eel catches by the commercial fishery in the Netherlands (source: Min EZ).*

Overall, the introduction of the closed season in 2009 and the closure of the polluted areas in 2011 have resulted in a 63% reduction in eel catches by commercial vessels from 920 tonnes in 2008 down to an average of 344 tonnes in 2011-2013. (Table 2.3).

Table 2.3 *Eel landing estimates of the commercial fishery before and after the implementation of the EMP. (Source 2008 data EMP and Dekker et al. (2008); average catches 2011-2013 based on landings registration Min EZ).*

	Estimated catches 2008 (t)	Estimated avg. catches 2011-2013 (t)	Estimated reduction 2011-2013 (t)
yellow eel	640	193	70%
silver eel	280	151	46%
total	920	344	63%

2.2.2 Recreational fishery

In 2012 an estimated ~2 million eels were captured in the recreational fishery (angling only) in the Netherlands (Table 2.4). Roughly 80% of the eels were released upon capture.

Vriese et al. (2008) estimated eel catches (retained) by recreational fishermen of 280-400 tonnes before the implementation of the EMP. In the EMP itself recreational eel catches (retained) were estimated to be around 90-300 t (EMP Table 2.3.3) before 2009.

The number of recreational fishermen retaining eel has always been modest and has further declined in 2012; 6% in 2002 (males ≥15 inland waters), 9% in 2004 (males ≥15 inland waters), 4% or ~65,000 fishermen in 2010 (males ≥15/females ≥15/children in inland and marine waters), 4% or ~56,000 fishermen in 2012 (males/females ≥ 6 years old in inland). The average number of eel taken home appears to be declining over the past 10 years from 18 in 2002, 9 in 2004, 6 in 2010 to 5 in 2012.

In addition to the ~400,000 retained eel in 2012, an estimated ~1,500,000 eels were released upon capture. It is, however, highly likely that a percentage of these will not survive the ordeal of being caught due to injuries sustained in the hooking and handling process. For the time being the catch-&-release (C&R) mortality is set at 12% (see van der Hammen and de Graaf (2015) for further details). Unfortunately, to date no C&R mortality studies exist for European eel. Insight in post-release survival and best practise guideline for eel are urgently needed in the Netherlands and the rest of Europe. In 2015 a C&R mortality study for eel is being planned in co-operation with German scientists. How to deal with C&R mortality will need careful consideration. Advice on default values in the absence of specific eel C&R mortality studies may be agreed upon internationally by the ICES Working Group on Recreational Fisheries Surveys.

Table 2.4 *Eel catches (number) and percentage of retained eel in fresh and marine waters in the Netherlands in 2010 and 2012 (van der Hammen & de Graaf, 2012; van der Hammen & de Graaf, 2015).*

	2010			**2012**		
	marine	**fresh**	**sum**	**marine**	**fresh**	**sum**
retained	174 000	341 000	515 000	91 000	313 000	404 000
released	109 000	873 000	981 000	67 000	1 517 000	1 584 000
sum	283 000	1 212 000	1 496 000	158 000	1 830 000	1 988 000
% retained	62%	28%	34%	58%	17%	20%

2.3 Reduction of mortality outside the fishery

2.3.1 Pumping stations and other barriers

The Netherlands is a densely populated country, with an intensive use of the natural resources. Situated in the delta of four different river basins, the country is extremely rich in waterways providing potential habitats for eel. The intensive use of the country has generated enormous numbers (>15,000) of migration barriers (pumping stations, dams, locks, hydropower stations) for eel. Buijse et al. (2009) concluded that of the 2745 identified migration barriers, ~1800 were of particular importance for the migration of eel (glass, yellow and/or silver eel) (Fig. 2.4 *left*). Winter et al. (2013a,b) made a list of prioritized migration barriers for silver eel escapement (Fig 2.4 *right*). The quality of the underlying data that was used in the 2013 silver eel migration barrier assessments was, however, highly variable and often still incomplete (Winter et al. 2013a). Some sites were very well studied, e.g. the sites with hydropower stations in the River Meuse (Winter et al. 2006, 2007, Jansen et al. 2007, Griffioen et al. 2013), the discharge sluices complexes in Haringvliet (Winter & Bierman 2010) and at the sluices-pumping station complex at IJmuiden (Winter 2010), but for other sites, e.g. ship locks and some pumping station sites, data on relative route passage and mortalities per route at a specific site are still largely lacking.

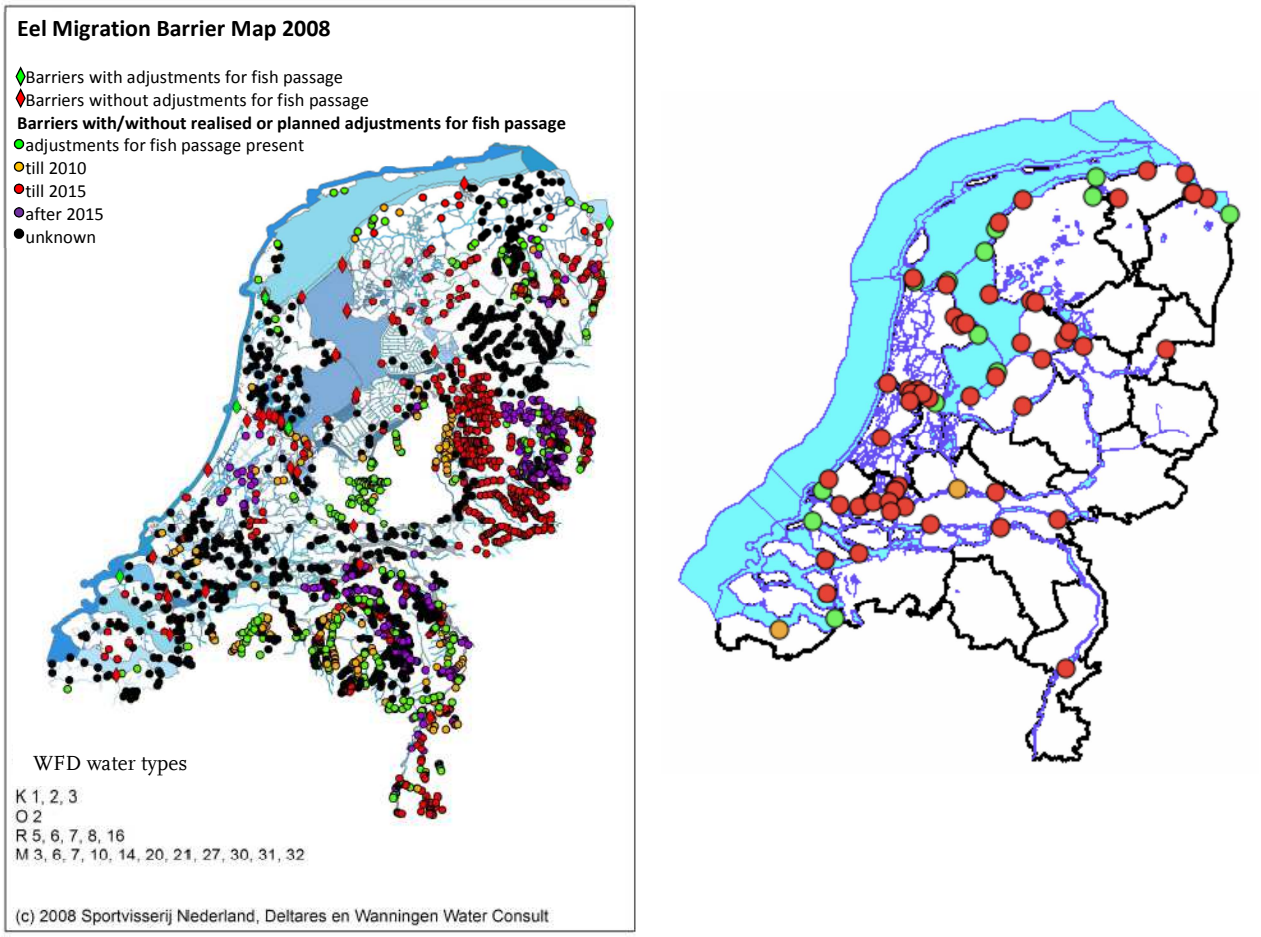


Fig. 2.4 *Left: Migration barriers for eel (glass, yellow and/or silver eel) in the Netherlands, and time line of planned solutions as formulated in 2008 (Buijse et al. 2009). Right: Overview of the most important migration crossings for silver eel in the Netherlands. Migration crossings indentified as barriers are marked in red while green dots indicate migration crossings that are not seen as barriers. Two crossings are marked in orange: the weir and HPS at Hagenstein which has not been operational for 10 years and the sluices at Terneuzen for which no information was available (see Winter et al., (2013) for further details).*

The national (Ministry of Environment and Infrastructure (Min I&M)) and regional (water boards) water managers work are responsible for the implementation of fish passage facility at the ~1800 eel migration barriers. An overview of the different categories of eel migration barriers is provided in Table 2.6. Weirs are by far the main type of migration barriers followed at a distance by pumping stations and

ship locks. In 2014 all water managers were approached and asked to provide an update on the progress on the implementation on fish passage facilities. The fast majority of the water managers provided information (26 of the 30 [19 water boards and 7 sections of Min I&M]). Only four water boards did not respond to the data call.

Table 2.6 *Overview of eel migration barriers in national (Min I&M) and regional (water boards) waters in the Netherlands (after Kroes et al. 2015 using the selection of eel migration barriers as described in Buijse et al., 2009).*

		Culvert	Pumping station	Intake	Ship lock	Discharge sluice	Weir	Fish passage*	Trash rack	Water mill	Hydropowerplant	Other	Unknown	Total
National waters	No	1	1	0	43	1	10	0	0	0	4	3	0	*63*
Regional waters	No	28	185	19	74	7	1135	55	4	6	1	2	12	*1528*
Total	No	29	186	19	117	8	1145	55	4	6	5	5	12	1591
	%	2%	12%	1%	7%	1%	72%	4%	<1%	<1%	<1%	<1%	1	100

**some water boards recorded fish passages as migration barrier although they were nor considered as a barrier for fish migration; this will need to be adjusted in the database.*

In the period 2012-2015 297 (19% of 1591) measures were implemented to facilitate eel migration. In total, 743 (47%) of the eel migration barriers have now been fitted with fish passage facilities (Table 2.7) in 2015. The original objective of solving 50% of the eel migration barriers appears to have been achieved. Of the remaining eel migration barriers ~25% are planned to be solved before 2027. However, of almost 30% of the original ~1800 eel migration barriers it is unknown whether measures are planned and/or when measures will be implemented before 2027.

Table 2.7 *Overview of the progress of solving migration barriers per period in national (Min I&M) and regional (water boards) waters in the Netherlands (after Kroes et al. 2015 using the selection of eel migration barriers as described in Buijse et al., 2009).*

		before 2008	2008-2011	2012-2015	2016-2027	No planned migartion facility	Unknown	Total
National waters	No	24	3	13	17	2	4	63
	%	38%	5%	21%	27%	3%	6%	
Regional waters	No	327	92	284	362	23*	440*	1528
	%	21%	6%	19%	24%	2%	29%	
Total	No	351	95	297	379	25	444	1591
	%	22%	6%	19%	24%	2%	28%	

*four water boards did not provide an update of their activities regarding solving eel migration barriers, possibly underestimating the number of solved eel migration barriers

Most of the adjustments have been made on weirs and different types of fish passages have been most commonly implemented at migration barriers (Table 2.8). Kroes et al. (2015) mentioned that the effectiveness of most fish passage facilities at fish migration barriers were not evaluated.

Table 2.8 *Overview of the type of the fish passage facility up to 2014 (after Kroes et al. 2015 using the selection of eel migration barriers as described in Buijse et al., 2009).*

Adjustment	Percentage	Number
V-stepped pool passage	21%	151
Cascade passage	13%	91
'De Wit" passage	12%	84
Bypass	9%	67
Adjusted sluice management	8%	55
Vertical slot passage	4%	31

Fish lock	3%	19
Removal of weir	2%	18
Unknown	16%	116
Other	13%	95
Total	*100%*	*729*

Due to recent improvements of fish passage at some of the priority silver eel migration barriers (e.g. sluices, ship locks, pumping stations) the relative mortality of silver eel for passage from boezem waters to the national waters in assessment model decreased from 17% in 2005-2007 and 2008-2010 to 14% in 2011-2012 (see Wolfshaar et al., 2015 for further details).

2.3.2 Hydropower stations

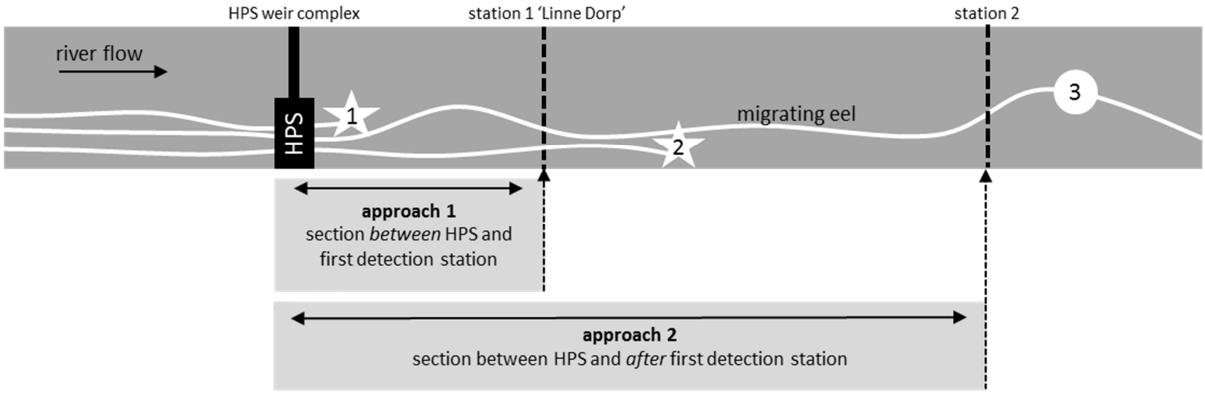
There are six hydropower stations in the Dutch part of the river basins of Rhine and Meuse, three of which are a factor ten larger than the others (Table 2.9). All of these stations have fish passes to allow upstream migration of eel.

Table 2.9 Main hydropower stations (HPS) in the Netherlands.

River	Location	Company registered	Power	Annual production	Year of first use
Meuse	Alphen/Lith	Nuon	14.0 MW	44 Gwh	1990
Meuse	Linne	Essent	11.5 MW	35 Gwh	1989
Lower Rhine	Amerongen	Nuon	10.0 MW	24 Gwh	1988
Lower Rhine	Hagestein	Nuon	1.8 MW	3 Gwh	1958*
Overijsselse Vecht	De Haandrik	Essent	0.2 MW	0.3 Gwh	
Roer	Roermond	Nuon	0.1 MW	0.1 Gwh	1988

* Out of operation for the last 10 years

The mortality and injury of silver eel due to hydropower stations has been monitored in the river Meuse. Telemetry studies of migrating silver eel in 2002 and 2004 indicated a mortality range of 16-34% in two hydropower stations in the Meuse that are set in series, almost half of the total mortality (Winter & Jansen, 2006). Preliminary results of telemetry studies in 2010, 2011 and 2013 showed little change in mortality due to hydropower stations in the Meuse in the period 2010-2013 (Table 2.10). Fyke fisheries was prohibited in the month September, October and November in 2010 and completely prohibited after April 1st 2011. Comparing the telemetry studies before and after 2010, no increase was found in successful passage of eel to the North Sea after the closure of the fisheries. Since mid-November 2011 an adapted turbine management regime was implemented to reduce eel mortality from 24% (Bruijs et al. 2003) to 18% (reduction of 24-25%). This was implemented on 17 November 2011 at HPS Alphen/Lith and 21 November 2011 HPS Linne in the Meuse and 17 November 2011 at HPS Amerongen in the Lower Rhine. The telemetry data of the river Meuse in 2010 (no adapted regime) at HPS Linne and 2013 (adapted regime) were compared to see whether there is an indication for mortality reduction. The length of the used eel of both years were comparable (2010: 53.2 – 100cm average 82.98 cm; 2013 57.5-98cm average 81.83cm). This analysis was done in two approaches (Figure 2.5):



	detection at station			disappeared in assigned section after passing HPS for mortality analysis	
	HPS	**station 1**	**station 2**	**approach 1**	**approach 2**
eel 1	Yes	No	No	**Yes**	**Yes**
eel 2	Yes	Yes	No	**No**	**Yes**
eel 3	Yes	Yes	Yes	**No**	**No**

Fig. 2.5 *Example of eel that disappeared in a river section after the HPS-weir complex. Method 1) Eel that passed the HPS at Linne and were not detected at the following detection covering the full river bed (station 1 'Linne Dorp') were classified as disappeared (most likely suffering mortality). Method 2) Eel that passed the HPS at Linne and were not detected at detection stations downstream from Linne Dorp were classified as disappeared (most likely suffering mortality).*

approach 1 2010: 84 HPS passage, 73 detected at Linne Dorp = 13% disappearance
2013: 94 HPS passage, 83 detected at Linne Dorp = 12% disappearance
approach 2 2010: 84 HPS passage, 69 eel detected after Linne Dorp = 18% disappearance
2013: 94 HPS passage, 73 eel detected after Linne Dorp = 22% disappearance

The telemetry data show no indication for an improvement of mortality at HPS Linne when comparing 2010 and 2013 data. Although the data suggests that there is no decrease in mortality between both years, environmental conditions during passage such as discharge may affect mortality rates and cause variation in mortality rates between periods and years. Secondly, some turbines might have been out of order due to renovation during eel migration (pers. comm. H. Bakker RWS). This is not taken into account in the analysis. Thirdly predation by large European Catfish might affect silver eel survival rate in the river sections downstream the HPS complex. This could have been different between the years and is not taken into account.

The mortality rate at the hydropower plants was not directly measured and therefore these telemetry data only give a first indication whether reduced mortality did occur. Direct mortality measurements as Bruijs et al. (2003) should be done to evaluate the adapted management for mortality reduction of migrating silver eel.

Table 2.10 *Observed and estimated mortality rates of silver eel in the river Meuse (2002, 2004 from Winter & Jansen (2006); 2010 from Griffioen et al. (2013); 2011 and 2013 unpublished data Griffioen & Winter).*

**not included possible mortality between the last detection station and the sea in Nieuwe Waterweg (~20km).*

	2002 (n=121)		2004 (n=105)		2010 (n = 121)		2011 (n=88)		2013 (n = 110)	
	Obs (%)	Est (%)	Obs (%)	Est (%)	Obs (%)	Est (%)	Obs (%)	Est (%)	Obs (%)	Est (%)
successful passage to sea cf. Winter et al. (2006) *	37	>37	31	>31	30	>30	18	>18	20	>20
commercial fisheries	15	15-21	13	19-22	0	0	0	0	0	0
recreational fisheries	1	1	2	3	0	unknown	0	unknown	0	unknown
hydropower Plant mortality cf Winter et al. (2006)		16-26		25-34		15-26		13-23		19-27
hydropower Plant mortality cf Griffioen et al. (2013)	NA	NA	NA	NA		22-25		25-27		30-31
"unknown" mortality/disappearance	38	15-31	35	10-22		44-55		59-69		53-61

2.4 Quantities of eel <12 cm in length

The legal minimum market size for eel fishery in the Netherlands is 28 cm, therefore no eels <12 cm in length are harvested in the Netherlands. The quantity of eels <12 cm caught in the Netherlands is zero.

Chapter 3: Status of measures foreseen and implemented

Requested by format European Commission: 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.

Table 3.1 gives an overview of the foreseen measures and their implementation.

***Table 3.1** EMP measures aimed at achieving the 40% escapement objective.*

No	EMP measure (implemented as planned)	Planned implementation	Realised implementation
1	Release of eel caught (a) at sea and (b) in inland waters by anglers	2009	1 October 2009
2	Ban on recreational fishery in coastal areas using professional gear	2011	1 January 2011[a]
3	Closed season from 1 September to 1 December	2009	1 October 2009[b]
4	Stop the issue of licences to snigglers in state-owned waters	2009	1 May 2009
5	Research into the artificial propagation of eel.	ongoing	EU-project and project "Glass eel Volendam."
6	Reducing barriers at pumping stations and other water works; of the 1800 most important migration barriers 900 will be removed by 2015 and the remaining 900 by 2027	2009-2027	2009-2027[c]
7	Reducing barriers at hydro-electric stations by at least 35%	2009	2011 17-11[d]
8	Introducing fishery-free zones in areas that are important for eel migration	2010	1 April 2011[e]
9	Restocking of glass eel and pre-grown eel from aquaculture	2009	Early 2010
10	Closure eel fishery in contaminated areas (PCBs, dioxins)		1 April 2011[f]

[a] *The use of fykes and long-lines in recreational fishery was banned on 1/1/2011. The use of gillnets, however, is still allowed in some marine waters.*

[b] *In 2009 there was a closed season from 1 October to 1 December.*

[c] *In agreement with the European Commission changes have been made to the original schedule of solving migration barriers.*

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

[e] *Most of the areas closed for commercial fisheries on 1/4/2011 on account of contamination were in the major rivers, which are the main "high ways" for diadromous species like salmon and eel.*

[f] *On 1 April 2011 large areas (mainly large rivers like Rhine and Meuse) were closed for the eel fishery due to contaminants (PCBs, dioxins). This closure was not a part of the original eel management plan but has been added at a later strage. On 1 January 2015 the area closed for eel fishery due to contaminants (PCBs, dioxins) was enlarged.*

Chapter 4: Implementation of EMP measures

Requested by format European Commission: Have all the foreseen measures been fully implemented as described within the adopted plan(s) pertaining to your national territory?
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.

4.1 Release of eel caught at sea and in inland waters in recreational fishery

4.1.1 Inland waters
In the summer of 2008, the national organisation of anglers (*Sportvisserij Nederland*) announced a ban on eel landings from 2009 onwards for holders of licences issued by the organisation. According to this decision, no eel may be retained, but a catch-and-release fishery remains allowed. The area for which the organisation issues fishing licences covers about 90% of the inland waters. Even though the restriction is voluntary, its enforcement takes place in accordance with the 1963 Fishery law. This because under section 21 of this law, fishing is not allowed without a licence, or permission of the owner of the fishing rights. This also includes fishing in breach of a fishing licence. The closed season for eel fisheries also applies to recreational fisheries in inland waters.

4.1.2 Marine waters
As of 1 January 2011 it has become obligatory for all recreational fishermen in all marine and coastal zones to return the eel alive to the water immediately upon capture (Official Gazette No 13978; Section 23a *Regelement voor de Binnenvisserij 1985*). The closed season for eel fisheries also applies to recreational fisheries in marine and coastal waters.

4.2 Ban on the use of professional gear in recreational fishery in coastal areas

The use of professional gear like fykes, gillnets, long-line and eel boxes in coastal waters in recreational fishery has been banned as of 1 January 2011 (Official Gazette No 19689; Section 5a *Regeling instandhoudingsmaatregelen zeevisserij*). The ban on professional gear in recreational fishery in inland waters had already been in force before the implementation of the EMP.

Once this regulation was introduced, the Dutch Parliament asked for the use of "historical" or "traditionally existing" small recreational gill nets to be allowed in the Wadden Sea and Westerscheldt. This request was honoured as no eels are caught in this type of fishing gear and as of 1 January 2012 the use of small recreational gill nets has been allowed in the Wadden Sea and Westerscheldt. By the end of May 2012 this has also been allowed (under strict conditions) in the North Sea.

4.3 Closed season from 1 September to 1 December

4.3.1 Closed season
On 1 October 2009 an annual closed season (1 September – 1 December) was introduced for the use of a range of eel fishing gears in marine, coastal and inland commercial fisheries (Official Gazette No 13978, and Section 32a, *Reglement voor de Binnenvisserij 1985*). The closed season applies to commercial and recreational fisheries in marine, coastal and inland waters.

4.3.2 Regional Eel Management (pilot Friesland)
The EMP describes the closed season as 'a temporary measure'. In future this measure could be replaced by a regional measure. In 2010 the European Commission gave the Netherlands permission to start a pilot in Friesland with regional eel management. In this pilot, which started in 2011, fishermen in Friesland were given a quota and were allowed to fish the whole year. Quotas were based on the quantities caught over 9 months in the previous year so that this approach incorporates the closed season. The first results of the pilot show that regional eel management is feasible. A decentralised approach raises fishermen's awareness of the need for more sustainable management and highlights the advantages of a decentralised approach. Increased awareness of the need for sustainable

management will increase support and contribute to the efforts towards improving the status of eel stocks. In 2015 a study of the cost–effectiveness of local eel management will be made.

4.4 No more government issued licenses for sniggling

In 2009, with the issue of 98 licences, sniggling was still allowed in state-owned inland waters. The annual renewal of the licences for this type of eel fishery was discontinued on 1 May 2009. The estimated effect of this measure in terms of extra silver eel escapement has been limited. Based on a local survey conducted among snigglers in Groningen and Drenthe by Huigen (2006), Quak (2006) made a rough estimate of the numbers of eel landed by snigglers in the Netherlands.
Quak estimated the total catch of (yellow) eel at roughly 9 tonnes. The estimate was based on ~4200 snigglers (government licences ~125, licences issued by *Sportvisserij Nederland* ~4000 and commercial fishermen ~100), fishing on average 2.35 nights with an average catch of 0.9 kg per night. Using the figures provided by Huigen (2006) and Quack (2006) the estimated annual catch by the 98 snigglers with government licences was around 207 kg or 0.21 tonnes.

4.5 Research into the artificial propagation of eel

For several years the government has subsidised research at the University of Leiden aimed at the artificial propagation of eel. If a reliable technique could be developed for the mass production of glass eels, at least the aquaculture sector would no longer be dependent on glass eel caught in the wild. This will reduce the pressure on the wild stock. To date mass production of eel by means of artificial reproduction has not been yet been achieved. Since 2009 the research into the artificial propagation of eel has continued with the European research project "Pro-eel", in which the Netherlands is a partner. After two years of research, scientists made progress in some aspects such as food and the selection of reproducers, protocols for hormonal induction of males and females, hormonal control of reproduction, fertilisation and production of viable eggs and larvae. So far, the experts at Pro-Eel have managed to increase the production of viable eggs and larval survival: after completing their embryonic development, larvae were able to live up to 25 days after hatching.
The next step lies in getting the development of experiments on larval rearing and food for reproducers. Between 2009 and 2012 the research project "Glass eel Volendam" was implemented with the objective to master the artificial reproduction of eel. The project was unsuccessful as the reproductive biology of eel was too complex to control in the laboratory. As a result no eel larvae were available for the planned research on the diet and feeding of early (post yolk sac) larvae (few mm) during the transition to the glass eel stage (7cm).

4.6 Reducing eel mortality at pumping stations and other water works

The commitments under the government's coalition agreement made it necessary to suspend a number of measures until after 2015. These measures also concern fish passages. The effectiveness of the passages was a determining factor. Passages in the fresh and salt, or running and stagnant water transition zones remained in the planning. In the period 2009-2015 743 of the eel migration barriers have now been fitted with fish passage facilities. The original objective of solving 50% of the eel migration barriers appears to have been achieved.
As a temporary measure silver eel could be caught before the migration barriers and released behind them (trap-and-transport). In 2011 pilots started to gain the necessary experience for such an (interim) measure, beginning with the most important migration barriers close to the sea. In 2011 0,54 t of silver eel was caught and released again past the barriers at four sites (assisted migration). In 2012 this amount increased almost tenfold to 4,90 t (15 sites) and in 2013 to 9,32 t.

4.7 Reduction of eel mortality at hydro-electric stations

Measures will have to be put in place near the three large hydropower stations (Lith, Linne and Amerongen), to reduce (downstream) eel mortality, initially by at least 35%.

In early November 2011 NUON and Essent hydropower stations have applied adjusted turbine management to reduce eel mortality. In adapted turbine management the second turbine is not

switched on until the first is operating at full load. Mortality is less in turbines turning at high speed because at low speed the space between the blades is smaller, which increases the risk of eel strike. A document on turbine management, written by T. Buijse in 2009, which was based on a study carried out at Linne, indicated that adaptation of turbine management could reduce fish mortality by 35%. This percentage was used for the EMP. In practice, full load operation is not possible, as it causes too much wear. In practice turbines will operate at lower speeds, which will mean mortality reduction will be 24%.

Adapted turbine management

In adapted turbine management a second turbine is not switched on until the first is operating at full load. This is already the case at flows of 70m³/s passing through it, and when the next turbine is switched on 2 x 35 m³/s is passed through. The same is true for the third turbine, which is switched on at a flow of 114 m³/s, then there is a flow of 3 x 38 m³/s. The fourth turbine is switched on at a flow of 158 m³/s, when a flow of 4 x 40 m³/s passes through. Low flows cause relatively high mortality as there is less space between the blades. Fish mortality resulting from turbine passage is considerably lower if the second turbine is not switched on until the first is operating at full load. (100 to 120 m³/s).

In December 2014, the new Water Act came into force with an additional guarantee for fish protection. This new Water Act states that a water permit for a hydropower station can only be granted if the hydropower station incorporates the most effective measures available for protection of downstream migration of fish and compensates negative impacts on downstream migration of fish if they occur. For existing hydropower station, an exception can be granted if it concerns a pilot project, where existing turbines are replaced by new, innovative turbines or other innovative techniques are used.

4.8 The establishment of fishery-free zones in areas that are important for eel migration

The establishment of fishery-free zones is no longer needed in the Netherlands because since 1 April 2011 eel fishery is no longer allowed in the major rivers in the Netherlands on account of dioxin contamination. These rivers are the most important "high ways" for diadromous species like eel and salmon. In other parts of the Netherlands there is a closed season for eel fishery from September to December.

4.9 Restocking of glass eel and pre-grown eel from aquaculture

Each year the Dutch government bugets 375,000 euro (10% of which to be subsidised by the European Fishery Fund) to restock waters with glass eel and pre–grown eel from aquaculture.
In 2009 and 2010 waters were restocked as planned. But in 2011 on account of public procurement problems and the warm spring resulting in small glass eel catches in April and May the full earmarked amount for 2011 could not be spent. This was made good in 2012. A framework contract was drawn up with three glass eel/pre-grown eel suppliers, which made it easier to buy glass eel in time. In 2013 and 2014 waters were restocked as planned. In 2014 large amounts of glass eel and pre-grown eel were restocked due to high supply of glass eel and low glass eel prices.

Table 4.1 *Activities period 2010-2014; Restocked glass eel and pre-grown eel in kg.*

Restocking	Quantities 2010	Quantities 2011	Quantities 2012	Quantities 2013	Quantities 2014
glass eel	763	164	766	630	2341
pre-grown eel	0	1395	1674	1520	3542

4.10 Closure eel fishery in contaminated (PCBs, dioxins) areas

This was an unforeseen measure at the start of the EMP's implementation. Since 1 April 2011 areas in the major rivers and some shipping channels in the Netherlands have been closed to eel fisheries as some of the eel caught in these areas were found to contain high levels of dioxin. The closed areas are part of important eel migration routes and are likely to benefit eel migration.

Fig. 4.1 *Waters closed to eel and mitten crab fishery as of 1 April 2011.*

References

Bruijs, M. C. M., H. J. G. Polman, G. H. F. M. van Aerssen, R. H. Hadderingh, H. V. Winter, C. Deerenberg, and H. M. Jansen. 2003. Management of silver eel: Human impact on downstream migrating eel in the river Meuse. EU Report Contract Q5RS-.

Buijse T, T van den Beld, N Breve , H Wanningen. (2009) Migaratiemogelijkheden voor aal door Nederland.

Griffioen, A.B. O.A. van Keeken and H.V. Winter 2013 Silver eel mortality during downstream migration in the Meuse: comparing telemetry study 2010-2012 to 2002-2006 IMARES Report number C028/13

Van der Hammen T, de Graaf M. 2012. Recreational fishery in the Netherlands: catch estimates of cod (*Gadus morhua*) and eel (*Anguilla Anguilla*). IMARES C014/12, pp. 62.

Van der Hammen T, de Graaf M. 2015. Recreational fisheries in the Netherlands: analyses of the 2012-2013 online logbook survey, 2013 online screening survey and 2013 random digit dialing survey. IMARES C042/15, pp. 55

Huigen, P.P.P., 2006. Peur enquête 2005. Faculteit der Ruimtelijke Wetenschappen, Rijksuniversiteit Groningen. In opdracht van Hengelsportfederatie Groningen Drenthe, Tynaarlo.

ICES. 2011. The report of the 2011 Session of the Joint EIFAC/ICES Working Group on Eels, September 2011; ICES CM 2011/ACOM:18.241pp and country reports.

Jansen, H.M., H.V. Winter, M.C.M. Bruijs & H. Polman. 2007. Just go with the flow? Route selection and mortality during downstream migration of silver eels in relation to discharge. ICES Journal of marine Science 64: 1437-1443.

Klein Breteler J.G.P., 2008. Herstel van de Aalstand II. Bouwen aan een beheerplan. Het streefbeeld, de huidige uittrek, een nadere verkenning van de mogelijke maatregelen en een protocol voor het uitzetten van aal. VIVION BV, Utrecht. Projectnummer VIVION 08.002a, 118

Kuijs E, de Graaf M (2011) Protocol voor het uitzetten van glas- en pootaal in Nederland. IMARES Rapport C001/11, pp. 11.

Kroes, M.J.,H. Wanningen, P.van Puijenbroek,, Breve N., 2015. Nederland leeft met Vismigratie. Actualisatie Landelijke database vismigratie. In opdracht van Sportvisserij Nederland, IMARES, Planbureau voor de leefomgeving.

Ministry of Agriculture, Nature and Food Quality. 2009. The Netherlands Eel Management Plan. pp. 62.

Pollock KH, Jones CM, Brown TL (1994) Angler survey methods and their application in fisheries management. American Fisheries Society, Special Publication 25, Bethesda, Maryland.

Quak, J., 2006. Notitie Project Inventarisatie Peur. Sportvisserij Nederland, Bilthoven, 3 p.

Vriese, F., J. G.P. Klein-Breiteler, M.J. Kroes, and I.L.Y. Spierts, 2008. Duurzaam beheer van de aal in Nederland. Bouwstenen voor een beheerplan. Visadvies BV Utrecht. Report VA2007-01. 178 pp.

Winter, H.V., H.M. Jansen and A.W. Breukelaar. 2007. Silver eel mortality during downstream migration in the River Meuse, a population perspective. ICES Journal of marine Science 64: 1444-1449

Winter, H.V. and H.M. Jansen, 2006. De effecten van waterkracht en visserij tijdens de stroomafwaartse trek van schieraal in de Maas: zender-onderzoek gedurende 2002-2006. IMARES report CO72/06, 67pp.

Winter, H.V., H. M. Jansen, and M. C. M. Bruijs. 2006. Assessing the impact of hydropower and fisheries on downstream migrating silver eel, *Anguilla anguilla*, by telemetry in the River Meuse. Ecology of Freshwater Fish 15:221-228.

Winter, H.V., Griffioen, A.B., van de Wolfshaar , K.E,. 2013a. Inventarisatie van de belangrijkste knelpunten voor de uittrek van schieraal in Nederland. IMARES-report C107/13.

Winter, H.V. ; Griffioen, A.B. ; Wolfshaar, K.E. van de. 2013b Knelpunten inventarisatie voor de uittrek van schieraal t.b.v. 'Paling Over De Dijk' IJmuiden : IMARES, 2013 (Rapport / IMARES C134/13) - p. 20.

van de Wolfshaar, KE, Tien, N Griffioen, AB, Winter HV, de Graaf M. 2015. Evaluation of the Dutch Eel Management Plan 2015: status of the eel population in the periods 2005-2007, 2008-2010 and 2011-2013. IMARES C078/15, pp. 104.

Annex A: Biomass and mortality estimates 2011-2013

	Estimate*	Source
B_o	10.400 t	EMP (2009)
$B_{current}$	1057 t	Wolfshaar et al., (2015)
B_{best}	1697 t	Wolfshaar et al., (2015)
∑F	0.35	Wolfshaar et al., (2015)
∑H	0.12	Wolfshaar et al., (2015)
∑A	0.47	Wolfshaar et al., (2015)
R	0	

*excluding coastal waters.

Annex B: Price monitoring & reporting
Attach as an annex the annual report required in line with Article 7(5).
[Point 9 will apply once every three years in order to combine the two reporting obligations for the sake of simplification]