**Swedish report of 2015 submitted in line with Article 9 of the Council Regulation (EC) No 1100/2007 of 18 September 2007 establishing measures for the recovery of the stock of European eel.**

## The Swedish eel management plan

The Swedish EMP subscribes to the objectives in article 2.4 of the Regulation No 1100/2007 and emphasises a rapid increase of silver eel escapement, to a level at which the stock decline is expected to stop and turn into an increase. Up to the present, four different measures are operating according to the Swedish EMP: i) reduce impact from fishing, ii) reduce impact from hydropower stations on downstream migrating silver eel, iii) increase stocking of quarantined glass eels and iv) control of eel fishery and sales. All planned types of management measures have been taken. Some actions have been more extensive than planned, some actions will have a delayed effect while others haven't been fully implemented and will be further developed in the coming years.

In accordance with article 9 an updated post-evaluation of stock indicators have been compiled during 2015, aiming to describe current status of the stock as well as anthropogenic impacts (Dekker 2015). Focus has been to quantify present actual ($B_{current}$), present potential ($B_{best}$) and pristine ($B_0$) biomass of silver eel escaping as well as the anthropogenic mortality endured by those eels during their lifetime ($\sum A$). Due to different impacts dominating in different areas, results are presented separately for the West coast, Inland waters and the Baltic coast. Since no new directives have been given this report has been compiled using the same report template as in 2012. Further, this report should be considered as an updated version of the national report submitted to the Commission in June 2012.

Unless otherwise stated, all numbers, estimates and stock indicators presented in this report refer to the recent post-evaluation. A technical and detailed review of calculations, stock indicators, uncertainties and general issues regarding this assessment is given in Dekker 2015.

### Summery per area

West coast – Fishing for eel was completely closed during spring 2012. Since this was a yellow eel fishery it will not change the silver eel escapement until those saved yellow eels mature. Monitoring of the stock using fyke-nets is on-going but collected data are so far not enough to fully assess the recovery of the stock. Since the maximum protection level is achieved by closing the fishery, absence of stock indicators will not make a big difference for the management of the stock at the west coast. However, absence of stock indicators from the west coast constitutes a loss of information that prevents quantification of national totals. In 2011 West coast $B_{current}$ was estimated to 12 tons and $B_{best}$ was estimated to 1154 tons (Dekker 2012). Despite uncertainties in these estimates and absence of stock indicators in 2014, measures taken are expected to have a large impact to future silver eel escapement. As fishery dependent data no longer is available, new assessments have to be developed and reconstructed which haven't been possible within the given timeframe. This work, using old as well as new data, will be initiated in the autumn 2015.

Inland waters - Current report presents a major update and completion of the assessment in 2012, now including the contributions from past re-stocking as well as natural recruitment and assisted migration. Additionally, the impact of hydropower is assessed in a spatially explicit reconstruction. Subtracting the catch made by the fishery and down-sizing for the mortality

incurred when passing hydropower stations, an estimate of the biomass of silver eel escaping from each river towards the sea is derived. Inland $B_{current}$ in 2014 (91 tons) is estimated to approximately 15% of inland $B_0$ (595 tons) and 28% of inland $B_{best}$ (330 tons). Please note that restocking is included in the estimates of $B_{current}$, $B_{best}$ and $B_0$. Hence, the estimate of ΣA (1.29) reflects the true life time anthropogenic mortality rate and not the beneficial effect of restocking as compensation. Natural recruitment has been replaced gradually by restocking and now contributes to about 90 % of inland $B_{current}$. Temporal variation in production, mortality and escapement is largely the consequence of a differential spatial distribution of the restocked eel over the years. Without considering restocking, potential biomass affected by inland fishery and/or hydropower would be only 10% (35 tons) compared to present impacted potential biomass with restocking (330 tons). Further, inland $B_{current}$ would reduce from 15% to 3% (10 tons) of inland $B_0$ (300 tons) without considering restocking. The relation to inland $B_{best}$ without restocking would not change, since restocked eels would not be recorded in either biomass value, and thus be 28 %.

Baltic coast – The assessment has been updated, using information from mark-recapture experiments. Results indicate that impact related to the fishery is declining rapidly. Current impact from the Swedish silver eel fishery in the Baltic Sea is estimated to 2% (ΣA = 0.02) and $B_{current}$ in the Baltic Sea in 2014 (3557 tons) is estimated to approximately 98% of potential $B_{best}$ (3770 tons) and 28.5% of pristine $B_0$ (12500 tons). Please note that estimates of ΣA only take the Swedish fishery into account. Estimated escapement may partly include restocked as well as natural recruited eels escaping from the Baltic Sea and its drainages, that are exposed to anthropogenic impact from other Baltic countries.

**1. Outline the monitoring, effectiveness and outcome of the eel management plans implemented on your territory or in co-operation with neighbouring countries.**

The monitoring of the EMP mainly relies on mandatory reports of catches which applies to all licensed fishermen in the sea and inland water. Additionally, stock surveys, biological sampling and tag-recapture information has been used. For catches in the sea, this includes fishery in the coastal area (e.g. in the Swedish eel management unit). Sea fishery is reported in a daily logbook for vessels larger or equal to 10 m, in the Baltic 8 m (for area 29-32 only if cod is taken aboard). Otherwise catches are reported in a monthly coastal fishery journal, sent to the Swedish Agency for Marine and Water Management. Catches from the inland fishery in the great lakes (Vänern, Vättern, Mälaren and Hjälmaren) are reported in a monthly inland fisheries journal while catches from other private lakes are reported in a yearly inland fisheries journal.

Data on catches and landings are crosschecked with sales notes where this is possible. Normally such crosschecking cannot be done on the level of individual landings for eel, as usually several eel catches are stored and sold together at the same time. The practical and administrative burden would be excessive if each landing would be recorded on a separate sales note. Controls are thus made on an aggregated level over a longer time period and results indicate that even crosschecking this aggregate level is useful.

Certain verification can be made by crosschecking first-hand sales. A buyer of fish caught in the sea is required to make sale notes unless he is the final consumer. Fishermen who sell more than 10 kg to a final consumer must make a sale note of the transaction. On the sale notes the geographic origin and applicable minimum landing size shall be declared. As there

is no detailed EU regulation regarding those provisions, a national regulation has been introduced in order to facilitate verification of eel catches.

The monitoring of the EMP demands a separation of yellow and silver eel (national code GGG and BBB respectively) and information have been distributed to all fishermen how to report in difficult cases, e.g. for exceptionally large yellow eels. A system for catches of trap and transported silver eel has been introduced through dispensation with special requirements to report these catches in order to separate this component from commercial landings. The development of the total catch is monitored in the official catch data (through logbooks and sales notes).

According to the short term target in the Swedish EMP, anthropogenic impacts should be reduced to a level where 90% of the present potential silver eel escapement ($B_{current}$ = 90 % of $B_{best}$) is achieved. To achieve this target it was estimated that the existing impact of hydropower and fishing had to be reduced by approximately 50 % compared to the level in 2007 as well as double the amount of quarantined glass eels, from local surplus areas in UK or FR, to be restocked annually into Swedish waters.

All decisions regarding reductions of fishing undertaken by the former Board of Fisheries (section 4 below) in line with the EMP during years 2009-2011, was estimated to result in a decrease in catches of approximately 65 % (silver eel equivalents) by the end of 2012. This is due to a reassessment of the contribution of increased restocking of glass-eels in relation to the formulated overall target. Increased restocking will not contribute to increased levels of silver eel escapement until 14 years (according to the EMP) after stocking. Suggested actions in the Regulation 1100/2007 operate on different time scales resulting in delayed effects of listed measures. Full effects of the EMP may acquire the same magnitude of time-span. Therefore, this management action (increased restocking) has been out ruled in the estimates of the instant contribution to increased escapement as it was outlined in the EMP. Moreover, the overshoot (65% instead of 50% reduction) in reduction of fisheries constitutes a precautionary approach regarding both the uncertainties concerning fisheries statistics and methods and actions to facilitate downstream migration of silver eel. This reassessment forms an explicit use of adaptive management when implementing the EMP.

**2. Provide the best available estimates of:**

**(a) 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.**

The assessment of the status of the eel stock in Sweden has recently been updated (Dekker 2015). According to article 9 focus has been to quantify actual ($B_{current}$), potential ($B_{best}$) and pristine ($B_0$) biomass of silver eel escaping as well as mortality endured by those eels during their lifetime ($\sum A$). Updated stock indicators for each area are summarised in Annex 1. Please note that estimates of stock indicators regarding the Baltic coast are in part based on escapement of eels (natural and restocked) from all of the Baltic Sea and its drainages.

**(b) 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.**

***Level of fishing effort and reduction in fishing effort***

In 2007 special permits became mandatory for all commercial eel fishery. In same year recreational fishery for eel was banned except in some selected inland waters above three or more definite migration obstacles. Permits where only approved to licenced fisherman who landed a quantity exceeding 400 kg per year or received an income from the eel fishery exceeding 20 000 SEK per year. Special permits are now only renewed if they were approved and used during the previously year. As a consequence, Sweden does not approve any new fishermen permits for eel fishery. This regulation combined with a closure of the West coast fishery in 2012 has caused a general decline in number of licenced fisherman catching eel, from 434 in 2007 to 238 in 2014, corresponding to a decrease of approximately 46% (Table 1). Since 2009 each permit also specify the place and number of fishing gear allowed for each holder.

*Table 1. Number of special permits approved for each year and area*

| Year | Area | | | Total |
|---|---|---|---|---|
| | West coast | Inland water | Baltic coast | |
| 2007 | 108 | 66 | 260 | 434 |
| 2008 | 93 | 70 | 246 | 409 |
| 2009 | 91 | 72 | 227 | 390 |
| 2010 | 91 | 72 | 227 | 390 |
| 2011 | 80 | 76 | 211 | 367 |
| 2012 | 0 | 71 | 182 | 253 |
| 2013 | 0 | 71 | 182 | 253 |
| 2014 | 0 | 67 | 171 | 238 |

***Level of catches and catches effected***

Implemented fishing regulations outlined in the Swedish EMP in 2008 has resulted in an overall reduction of registered commercial catches from approximately 702 tons in 2007 to approximately 324 tons in 2014, corresponding to a decrease in biomass of about 54% (Table 2). Since the West coast fishery was completely closed in spring 2012, all catches since then derives from inland waters and the Baltic coast. Percentage of yellow eel in these catches is very small, and the yellow eels caught are generally close to the silver eel stage. Hence, the catch in silver eel equivalents is almost identical to the reported catch in 2012-2014. As the West coast fishery mainly did catch yellow eel, no significant increase in silver eel escapement is expected before the saved yellow eel mature. Even though fishery in-dependent monitoring have continued after the closure, available information is currently not enough to assess the recovery of the stock. However, as the fishing mortality rate is zero, and maximum protection level is achieved, this measure expects to have large impact to future silver eel escapement.

Recent assessment of inlands waters has been reconstructed and the impact from the fishery in inland waters is now fully updated (Table 2). The assessment in the EMP was based on the assumption that lake productivity can be estimated from habitat characteristics but present restocking in lakes highly effect catches, contradicting this assumption. Dekker (2012) took the restocking data as the starting point for a reconstruction of lake productivity, but did not

include natural and assisted immigration. The present assessment estimates the number of natural recruits, taking into account the contributions from natural, assisted and restocked recruits, as well as the impact from the fishery and hydropower, in a spatially and temporally explicit reconstruction. Impact from the fishery in inland waters in 2014 (landings = 111 tons) is estimated to a mortality of just above 30% ($\sum F = 0.38$) of present potential silver eel escapement ($B_{best}$ = 330 tons) (Table 2).

For the Baltic coast recent assessment indicates that impact from the fishery is declining rapidly. Current impact from the Swedish silver eel fishery in 2014 (landings = 213 tons) is estimated to a mortality of about 2% ($\sum F = 0{,}02$) of present potential silver eel escapement ($B_{best}$ = 3770 tons) (Table 2). Please note that the Swedish fishery is just one of the anthropogenic impacts affecting the Baltic eel stock, this stock is most likely also impacted by anthropogenic impacts in other countries around the Baltic Sea.

*Table 2. Total landings (tons) and estimated eel lifetime mortality rate, for each year and area.*

| Year | Landings (tons) | | | Lifetime fishing mortality rate (∑F) | | |
|---|---|---|---|---|---|---|
| | West coast | Inland waters | Baltic coast | West coast | Inland waters | Baltic coast |
| 2007 | 170 | 114 | 418 | 1.91 | 0.49 | |
| 2008 | 164 | 118 | 389 | 1.86 | 0.50 | 0.1 |
| 2009 | 107 | 97 | 310 | 1.19 | 0.36 | |
| 2010 | 108 | 110 | 307 | 1.20 | 0.39 | |
| 2011 | 83 | 96 | 271 | 0.93 | 0.32 | |
| 2012 | 0 | 101 | 239 | 0 | 0.33 | 0.02 |
| 2013 | 0 | 103 | 271 | 0 | 0.34 | |
| 2014 | 0 | 111 | 213 | 0 | 0.38 | |

**(c) The level of mortality factors outside the fishery, and the reduction effected in accordance with Article 2(10)**

Efforts have been conducted to precise and re-evaluate the estimated general hydro power related mortality. In two of the 11 most productive eel drainage basins in Sweden, Göta älv and Kävlingeån, the overall observed survival was estimated to 32 % and 55 % respectively. Moreover, technical solutions, mainly fine-grid inclined installations, has been tried and tested in a number of hydro power stations with encouraging results. These studies indicate that a standard assumption of 30% survival per hydropower station used in the EMP is an over-simplification of reality.

Recent assessment of the inland stock includes a spatially and temporally explicit reconstruction of the impact from individual hydropower stations by use of the best available data. All estimates refer to the actual situation also taking into account measures achieved within the Trap & Transport programme. Without Trap & Transport of silver eel operating, estimated impact from hydropower stations would have been higher. From this detailed reconstruction of the assessment it becomes clear that temporal variation effectively is a consequence of a temporal change in spatial distribution of the stock, caused by altered restocking practices in the past. Restocking practices in lakes located above hydropower stations results in a rising estimate of the overall impact from hydropower on the inland silver eel escapement. In 2014, impact from hydropower was estimated to 147 tons corresponding to about 40 % ($\sum H = 0.96$) of present potential silver eel escapement from inland waters (also including escapement from inland waters with no hydropower station downstream) (Table 3).

Natural recruits, freely immigrating or assisted upstream, have gradually been decreasing and natural recruits now make up 5-10% of the total silver eel production in inland waters. Without restocking practices, impact from hydropower would have been much lower. At the same time, absence of restocking would have implicated a reduction of present potential escapement in inland waters from 330 tons to 35 tons as well as a current escapement from 91 tons to 10 tons (Anex 1).

*Table 3. Estimated impact of hydropower stations on the silver eel run given in biomass (tons) and lifetime mortality rate*

| Year | Biomass of silver eel (tons) | | | Lifetime hydropower mortality rate (∑H) | | |
|---|---|---|---|---|---|---|
| | West coast | Inland waters | Baltic coast | West coast | Inland waters | Baltic coast |
| 2007 | | 65 | | | 0.45 | |
| 2008 | | 80 | | | 0.57 | |
| 2009 | | 115 | | | 0.73 | |
| 2010 | | 126 | | | 0.81 | |
| 2011 | | 146 | | | 0.87 | |
| 2012 | | 160 | | | 0.99 | |
| 2013 | | 156 | | | 0.97 | |
| 2014 | | 147 | | | 0.96 | |

***Action plan on improved downstream migration***

In the EMP, an action plan to improve downstream migration was formulated. A Memorandum of Understanding was signed in 2010 by six large waterpower companies (E.ON, Fortum, Statkraft, Vattenfall, Holmen Energi, Tekniska Verken) and the former Board of Fisheries. Main target in this memorandum was to achieve a reduced overall hydro power mortality of migrating silver eels to the general target of 60 % until 2015, in line with the Regulation. To achieve this target, a number of optional measures were stated in the Memorandum:

- Construction of free passages for migrating silver eels
- Lowered and designed running of power stations during migration periods (e.g. nights with moon cover)
- Trap and transport
- Compensatory measures (e.g. restocking)

In 2011, the Memorandum was further specified since a joint programme was designed. Objectives in this program were: 1) until 2015 reduce current average hydropower mortality by 50 % for silver eel in rivers where contracting companies own hydropower stations and 2) by 2013, measures taken should correspond to a total increase of 100 thousand silver eels escaping freely towards the sea. At this stage, six different river basins were prioritized. Moreover, the small scale hydropower association (about 800 members) has informally adopted the targets of the Memorandum. There are on-going voluntary measures in several hydropower stations across southern Sweden. However, these efforts have not been quantified within the given time frame.

Within the framework of this agreement, research has been initiated and protective measures have been taken. Among suggested actions Trap & Transport and compensatory restocking along the West coast has been prioritized. A program for Trap & Transport, given its direct

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*Table 4. Quantities of silver eel applied in the Trap & Transport programmes, in numbers and biomass (kg) (mainly actions within the Memorandum)*

| Year | 2010 | | 2011 | | 2012 | | 2013 | | 2014 | |
|---|---|---|---|---|---|---|---|---|---|---|
| River | Number | Biomass | Number | Biomass | Number | Biomass | Number | Biomass | Number | Biomass |
| Motala Ström | | | 545 | 676 | 928 | 1 283 | 2 526 | 3 167 | 3 788 | 4 708 |
| Mörrumsån | | | 1 613 | 1 883 | 135 | 154 | 212 | 269 | | |
| Rönne Å | | | | | | | | | 733 | 415 |
| Lagan | 422 | 365 | 652 | 367 | 72 | 110 | 931 | 921 | 1 445 | 1 484 |
| Ätran | | | | | 369 | 253 | 120 | 82 | | |
| Göta Älv | 4 582 | 4 841 | 4 243 | 4 499 | 7 790 | 8 237 | 9 024 | 9 393 | 12 335 | 12 417 |
| Total | 5 005 | 5 206 | 7 053 | 7 425 | 9 293 | 10 037 | 12 812 | 13 832 | 18 300 | 19 024 |

ffect of silver eel escapement, was initiated in 2010 and has gradually increased in effort until 2014. The fishery for eels used for Trap & Transport is primarily regulated in accordance with the rules for the commercial fishery. Fishing is only allowed to due to applied dispensation. Catches have to be reported in the common fishery statistics as well as separate journals to enable crosschecking between this component and commercial catches. Since the report in 2012, uncertainties in catch statistics due to Trap & Transport practices have been corrected, now including Trap & Transport into the assessment. In 2014, a quantity of 19 tons and 18 300 silver eels were trapped, transported and released, corresponding to about 17% of the total catch in inland waters 2014. Silver eels have been caught, transported and released into the river mouth in seven different drainage basins (Rivers Göta älv, Ätran, Motala ström, Mörrumsån, Lagan, Kävlingeån and Rönne å). According to present current silver eel escapement in inland waters, Trap & Transport has been estimated to a total contribution of 1-6% between 2010 and 2014. Quantities caught and released per year and drainage basin are given in Table 4.

Effects of actions taken in prioritized river basins within the memorandum during 2011-2013 were evaluated in 2015. This evaluation implicates that, the first target to reduce impact from hydro power stations by 50 % until 2015 not has been achieved and only is partly implemented. Including actions taken by Trap and Transport, impact (mortality) of potential escapement have been reduced by 11 %. Consequently, the impact has to be reduced by another 40 % to achieve this target. According to the second target, that measures taken until 2013 should correspond to an increase of 100 thousand silver eels annually escaping freely towards the sea, target has been achieved. Summarised over the years 2011-2013, actions taken have been estimated to a contributed of increased escapement by 270 000 silver eels (silver eel equivalents). Since this contribution to a large extent arises from compensatory restocking along the west coast, actions taken (except trap and transport) will have a delayed effect and in reality not contribute to silver eel escapement before 2020.

**(d) 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.**

This action is not valid for Sweden since there are no glass eel fisheries in the country (either viable or legally approved). Eels for restocking practices are taken from France and/or England. Eels for restocking practices are always quarantined to guarantee that no disease is introduced to Swedish waters.

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

All prescribed measures in the EMP regarding reductions of the fishery through regulations have been implemented. Short-term targets concerning landings and effort have been achieved due to decisions undertaken by the authorities (see below). The targets in the EMP concerning increasing number of restocking have also been fulfilled.

Protection and restoration of migration routes are essential for all migratory species such as eel and salmon. This can in practical be achieved by control of compliance and demands for prescriptions to be stated in the permits for dams and hydropower stations. Moreover, it is also possible to renegotiate these conditions. However, the legal process is known to be time-consuming. Traditionally, the emphasis in environmental conditions according to environmental court decisions has been on upstream migration. Arrangements to facilitate downstream migration are generally lacking.

The control measures for monitoring the efficiency of the EMP actions have been implemented.

**4. Measures foreseen and implemented, with dates, and measures foreseen but not implemented.**

***Fishing regulations***
There are two basic statutes that regulate the eel fishery in Sweden: "*Fiskeriverkets föreskrifter om fiske i Skagerrak, Kattegatt och Östersjön (FIFS 2004:36)*" and "*Fiskeriverkets föreskrifter om fiske i sötvattensområdena (FIFS 2004:37)*".

The prime measures to regulate eel fishing are minimum legal size, closed areas, restrictions in fishing season, limitations to the number of gears used and maximum total annual catch. Since fishing operations differ between inland and coastal areas, measures have been differentiated between these areas. A number of regulations have been decided since 2006 and especially after 2008 when the EMP was decided. The regulations are summarised below, by the end of 2014 the following rules apply (dates of decision in brackets):

- Fishing for eel is forbidden in general (2007-05-01)
- Licensed fishermen may apply for a special permit, if they comply with specified requirements. From 2008 and onwards, no new licenses are allowed, though existing licenses could be continued. The permit may set additional restrictions (2009-03-21).
- Some selected areas upstream three or more definitive migration barriers are exempted. It is considered unlikely that eels from these areas can migrate safely towards the sea. These areas have explicitly been listed (2007-06-01, 2008-01-01). A minimum size of 70 cm applies (2011-01-01), and selling the catch is prohibited (EC-regulation in 2011).
- Licensed fishermen with special permits are allowed to catch 8,000 kg per year at maximum (2011-01-01).
- In inland waters, the fishery should not last for more than 120 days (2009-02-01).
- In the Baltic (including *Öresund*), the fishery should either take place between 1st of May and 14th of September, or during a continuous period of 90 days maximally "effortdays" (2009-02-01).

- South of 56°25'N in the Kattegatt, non-moveable gear can be allowed. Fisheries with fixed or moveable gears are restricted to a continuous period of 60 days at maximum "effortdays"(2009-02-01).
- A fixed gear, which has not been registered with the authorities as fishing for eel, should stand open or have two circular escape openings of minimal 60 mm (inland waters and the Baltic) or 75 mm (West Coast) diameter, placed on opposite sides of each cod-end (2009-02-01).
- The minimum legal size for eel in inland waters and the Baltic (excluding the Öresund) is 70 cm; in the Öresund it is 45 cm (2011-01-01).
- Eel fisheries is completely forbidden on the West Coast (Skagerrak and Kattegatt), (2012-03-05).

***Restocking***

In 2008, the amount of restocked glass eels in Sweden were 1-1,2 million individuals annually. The short-term target in the EMP was set to double this figure (2-2,5 million individuals) to 2010. This target was achieved the first year of implementing the EMP by reprioritizing within the measures in the area of "Aquatic resources" (2009-03-08) formulated in the European Fisheries Fund (EFF) and a reduced price of glass eels (probably as a result of the Regulation Art. 7 (2)) (Table 5).

The historical objectives for restocking in Sweden have been to support the fishery. Current restocking is intended to support recovery of the stock (governmental restocking in unobstructed, unexploited water) to avoid future anthropogenic impacts on the stocking programme (i.e. fishing and hydropower mortality). Hence, restocking practices to compensate for other anthropogenic mortalities (restocking on the west coast, compensating for the impact of hydropower generation) have been performed in the hydro power program within the memorandum.

A data base of eel restocking is held at the Swedish university of agricultural science, specifying year, quantity (number), life stage (glass eel, elvers, bootlace), origin (national sources in detail, or international source country), destination location (latitude/longitude and name of the lake/river). The data series start in the early 1900s - that is the start of the restocking in Sweden - and run continuously until present.

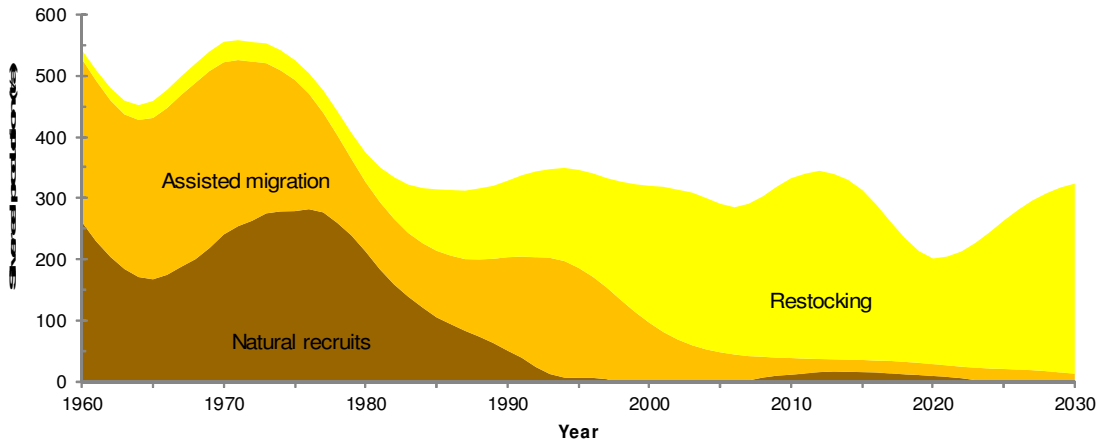


*Figure 1. Estimated potential escapement of silver eel ($B_{best}$) in inland waters by year and by origin of the eel. Corresponds to estimated total production before the impact of fishery and hydropower.*

*Table 5. Number of eels restocked, by area. To the left, the actual numbers released, by the year in which they were released. To the right, the same but expressed in glass eel equivalents, by their year class, i.e. the estimated number and year that they would have been a glass eel.*

| Year released | Actual numbers | | | Year class | Glass eel equivalents | | |
|---|---|---|---|---|---|---|---|
| | West coast | Inland waters | Baltic coast | | West coast | Inland waters | Baltic coast |
| 2007 | 7 500 | 821 498 | 169 576 | 2007 | 7 820 | 830 750 | 174 406 |
| 2008 | | 1 130 187 | 366 927 | 2008 | | 1 056 273 | 382 589 |
| 2009 | | 599 690 | 180 002 | 2009 | | 611 540 | 184 245 |
| 2010 | 180 000 | 1 726 510 | 30 000 | 2010 | 187 683 | 1 800 172 | 31 281 |
| 2011 | 543 000 | 2 011 984 | 71 000 | 2011 | 566 178 | 2 097 855 | 74 031 |
| 2012 | 553 000 | 1 956 022 | 57 000 | 2012 | 576 605 | 2 039 480 | 59 433 |
| 2013 | 581 600 | 1 985 984 | 90 000 | 2013 | 606 426 | 2 070 679 | 93 842 |
| 2014 | 778 611 | 2 049 432 | 120 000 | 2014 | 811 846 | 2 136 812 | 125 122 |

To enable comparison between different categories of material, all historical data series have been transformed to a common unit of "glass eel equivalents", that is: the estimated number of true glass eels that would be required under natural circumstances to produce the same number of eels actually restocked (Table 5).

The contribution from restocking to the coastal stocks is small in comparison to the natural stock. For the west coast, the potential production of silver eel escapement was estimated at 1154 t (Dekker 2012), and current restocking (0.8 million in 2014) will potentially produce less than 100 t. For the Baltic coast, the potential production of silver eel escapement for the Baltic coast was estimated at 3770 t (Dekker 2012), and current restocking (0.1 million in 2014) will potentially produce less than 10 t. For the inland waters, recent assessment of the silver eel production identifies explicitly which eels that derives from restocking, which ones from other sources. The restocking-based production is in an order of 300 tons, while the natural silver eel production is estimated at 35 tons (Annex 1). Consequently, about 90 % of potential escapement from inland waters in 2014 derives from present restocking practices (Figure 1)

***Improved migration routes - reduced turbine mortality***
See section 2 (c)

**5. Explanations 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.**

Stock indicators for the inland stock point out that the anthropogenic mortality exceeds the short-term limit in the EMP to establish recovery of the stock (90% of the present potential silver eel escapement) as well as the long term limit in the Eel Regulation (40 % of the pristine silver eel escapement) (Annex 1). Management actions as assisted migration, restocking, fishing restrictions and Trap & Transport have strong interactions. When adjusting one measure, any positive effect is likely to be largely annihilated by the other impacts. Management actions resulting in a reduction of the inland stock (e.g.: diminished restocking) will decrease the amount of eel that is impacted, but at the cost of increasing the distance to the biomass limits.

***Improved migration routes - reduced turbine mortality***
The action plan on increased survival of migrating silver eel has not yet been fully implemented as described in sections 2 c. The EU Regulation acknowledges that many anthropogenic factors have an impact on the stock, but focuses on mortality induced by fisheries and hydropower generation. For other factors than fishing impacts, the actions relies heavily upon Swedish Environmental Law (*Miljöbalken 1998:808*) where EC-regulation: Water Framework Directive (2000/60/EG) and Habitat Directive (92/43/EG) are implemented. Existing hydropower was primarily built during a time when the environmental standards were not the same as today, and environmental permits from that time may not take appropriate conditions for support of migratory aquatic species into regard. There is a possibility for the licensing authority to revise the environmental permit, but it is a time-consuming and costly process for the authorities involved. According to the Environmental law the license holders are granted economic compensation if the revision of their permit result in a loss of more than five percent of the production value of the hydroelectric power which can be generated at the station.

**6. Difficulties encountered in the implementation of the plan.**

***Improved migration routes - reduced turbine mortality***
The action plan on increased survival of migrating silver eel has not yet been fully implemented as previously mentioned. A survey of obstacles for migrating silver eels, information on protective measures within stations, number of stations from particular lakes to the open sea, wetted areas in between was conducted prior to the formulating of the EMP. Data was formed into a database and GIS-model to present for waterpower companies. However, the structure of the hydropower owners in southern Sweden (southern water districts, with the highest eel production) is scattered and diverged. Therefore, approaching the largest companies does not necessarily cover the largest hydro power impacts on the inland stock. This fact was realised when implementing the action plan on reduced turbine mortality 2009-2010. As mentioned above revision of permits is a challenge. Furthermore, there are a large number of small-scale hydropower plants that lack permits, and where there are no conditions for upstream- or downstream passage. The supervisory authority has the right to submit that the operator must apply for a permit in these cases, and the operator has no right to any compensation in that case.

**7. Indications suggesting 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?**

- Based on ICES advice it should be discussed whether the target of 40% escapement to the sea is enough to ensure the long-term recovery of the stock with reasonable probability and whether time frames should be introduced.

- Target of escapement to the sea should be supplemented by a target that is related to glass eel migration. Escapement to the sea gives a measure of conservation efforts made by each MS while recruitment shows whether the combined efforts actually lead to recovery.

- Given that restocking turned out to be such an important and complex part of the EMP:s and given the current low abundance of glass eel it has to be ensured that any

restocking generates net benefits to the breeding population. Three basic conditions have to be fulfilled:

  - A local surplus of glass eel where caught
  - No or low anthropogenic mortality where released
  - High probability that restocked eel can migrate to the Sargasso Sea when mature.

- Prescriptions for improvements of possibilities of ascending into watersheds and monitoring of recruitment should be considered in the Regulation for long-term sustainability of the eel stock.
- Stock indicators seem to fit the international assessment framework, but inconsistencies and interpretation differences at the international level deplete their usage. Guidelines and standardisation of the tri-annual reporting are therefore necessary.
- International standardisation and calibration of monitoring and assessment methodologies to achieve consistent and more cost-effective assessment across Europe is necessary. Especially when the fisheries are restricted and then not included for data collection within the data collection framework (EU DCF).
- Actions to ensure recovery of the eel population need to be coordinated on regional levels (for example the Baltic Sea) rather than on national levels.
- Articles 9(2) and 9 (3) are no longer applicable and should be amended.

**8. Attach as an annex the annual report required in line with Article 7(5).**
Not applicable.

**Annex 1**

**Symbols & notation used in this stock assessment**

The assessments in this report derive the following stock indictors:

$B_{current}$ The biomass of silver eel escaping to the ocean to spawn, under the current anthropogenic impacts and current low recruitment.

$B_{best}$ The biomass of silver eel that might escape, if all anthropogenic impacts would be absent at current low recruitment.

$B_0$ The biomass of silver eel at natural recruitment and no anthropogenic impacts (pristine state).

A Anthropogenic mortality per year. This includes fishing mortality F, hydropower mortality H, and other possible factors. A=F+H.

$\sum A$ Total anthropogenic mortality rate, summed over the whole life span.

%SPR Percent spawner per recruit, that is: current silver eel escapement $B_{current}$ as a percentage of current potential escapement $B_{best}$. %SPR can be derived either from $B_{current}$ and $B_{best}$, or preferably from $\Sigma A$ (%SPR = 100*exp($\Sigma A$)).

%SSB Current silver eel escapement $B_{current}$ as a percentage of the pristine state $B_0$.

All of the above symbols may occur in three different versions. If a contribution based on restocking is explicitly included, the symbol will be expanded with a + sign ($B_{current}^+$, $B_{best}^+$, $B_0^+$, $\sum A^+$, etc.); if it is explicitly excluded, the symbol will be expanded by a – sign ($B_{current}^-$, $B_{best}^-$, $B_0^-$, $\sum A^-$, etc.); when the difference between natural and restocked immigrants is not relevant, the addition may be omitted.

*Table 1. Stock indicators by area and year. For inland waters, biomass indicators are given with (+) and without (-) the contribution from restocked eels. All mortality estimates refer to true mortality (both on natural and restocked eels), not interpreting restocking as a compensation for other mortalities. For all coastal waters, ΣH=0, hence ΣF=ΣA. For Trap & Transport, the biomass released is specified, for the West coast and the Baltic separately. All biomass indicators expressed in tons, mortality indicators as rate per lifetime, %SPR (relative survival) and %SSB (relative state of the stock) in percent*

| year | West coast | | | | | | Inland waters | | | | | | | | | | | | Baltic coast | | | | | | T&T | | year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | with restocking + | | | | without restocking - | | | | Mortality rates | | | | | | | | | | W | B | |
| | $B_{current}$ | $B_{best}$ | $B_0$ | %SSB | ∑A | %SPR | $B_{current}^+$ | $B_{best}^+$ | $B_0^+$ | $\%SSB^+$ | $B_{current}^-$ | $B_{best}^-$ | $B_0^-$ | $\%SSB^-$ | ∑F | ∑H | ∑A | %SPR | $B_{current}$ | $B_{best}$ | $B_0$ | %SSB | ∑A | %SPR | $B_{current}$ | | |
| 2007 | | | | | 1.91 | 15 | 113 | 291 | 549 | 20.5 | 16 | 41 | 300 | 5.4 | 0.49 | 0.45 | 0.95 | 38.8 | 3352 | 3770 | 12500 | 26.8 | | | | | 2007 |
| 2008 | | | | | 1.86 | 16 | 104 | 303 | 563 | 18.5 | 14 | 40 | 300 | 4.6 | 0.50 | 0.57 | 1.07 | 34.4 | 3381 | 3770 | 12500 | 27.0 | 0.10 | 90.5 | | | 2008 |
| 2009 | | | | | 1.19 | 30 | 107 | 319 | 580 | 18.5 | 13 | 39 | 300 | 4.4 | 0.36 | 0.73 | 1.09 | 33.6 | 3460 | 3770 | 12500 | 27.7 | | | | | 2009 |
| 2010 | | | | | 1.20 | 30 | 101 | 333 | 595 | 17.1 | 12 | 38 | 300 | 3.9 | 0.39 | 0.81 | 1.19 | 30.5 | 3463 | 3770 | 12500 | 27.7 | | | 5 | | 2010 |
| 2011 | 12 | 1154 | 1154 | 1.0 | 0.93 | 39 | 105 | 340 | 603 | 17.5 | 12 | 37 | 300 | 3.8 | 0.32 | 0.87 | 1.17 | 31.0 | 3499 | 3770 | 12500 | 28.0 | | | 5 | 3 | 2011 |
| 2012 | | | | | 0.00 | | 94 | 345 | 608 | 15.5 | 10 | 37 | 300 | 3.3 | 0.33 | 0.99 | 1.30 | 27.3 | 3531 | 3770 | 12500 | 28.2 | 0.02 | 98.0 | 9 | 1 | 2012 |
| 2013 | | | | | 0.00 | | 94 | 339 | 604 | 15.6 | 10 | 36 | 300 | 3.3 | 0.34 | 0.97 | 1.28 | 27.8 | 3499 | 3770 | 12500 | 28.0 | | | 10 | 3 | 2013 |
| 2014 | | | | | 0.00 | | 91 | 330 | 595 | 15.3 | 10 | 35 | 300 | 3.3 | 0.38 | 0.96 | 1.29 | 27.5 | 3557 | 3770 | 12500 | 28.5 | | | 14 | 5 | 2014 |

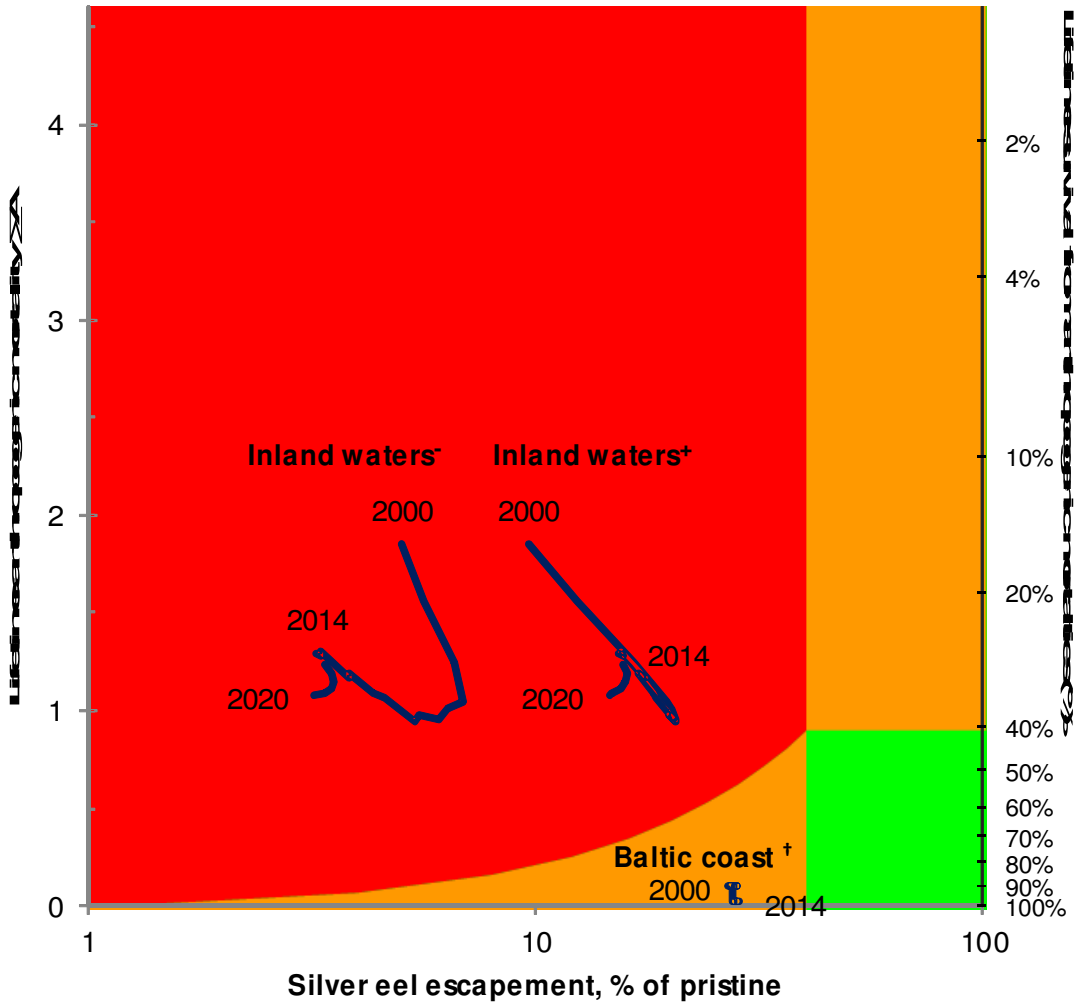


*Figure 1. Precautionary Diagram for the Swedish eel stock in inland waters and along the Baltic coast. For the west coast, no stock indicators are currently available. For inland waters, the true mortality is shown (not interpreting restocking as compensating for other mortalities), giving separate curves for the current biomass with or without the contribution from restocking, %SSB$^{+}$ resp. %SSB$^{-}$.*
*† For the Baltic coast, only the impact of the Swedish silver eel fishery is included; impacts in other life stages, in other areas/countries, are not.*

## References

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