

**National Measures according
to the EU Eel Regulation
(EU Regulation no. 1100/2007)
in the Rhine catchment
2010-2012**

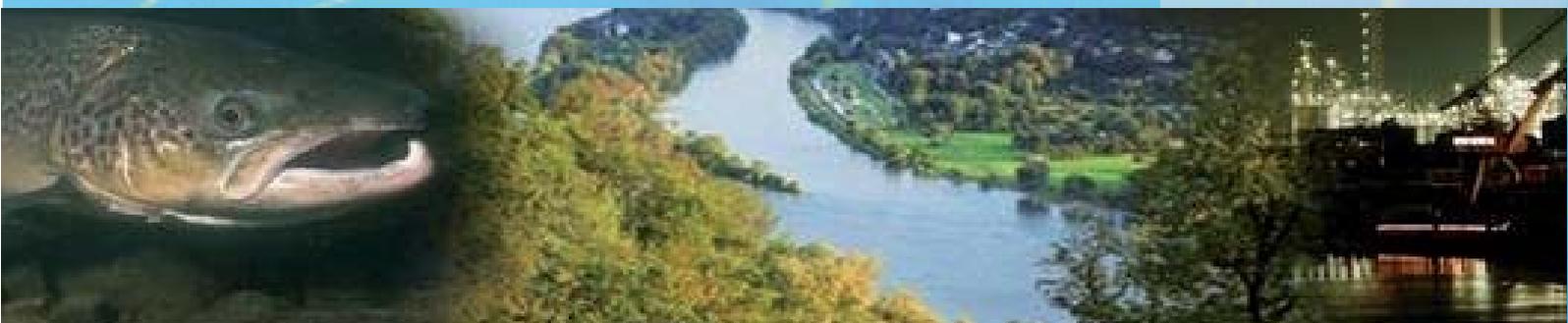


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Content

Summary	2
<i>National eel management plans for the Rhine catchment:</i>	3
1. Introduction	3
1.1 Transposition of the EU Eel Regulation into national law	4
2. Description of the present stock of eel	5
3. Measures aimed at stabilizing and monitoring the stocks of eel	7
3.1 Reduction of commercial fishing activities and of sports angling	7
3.2 Stocking measures	9
3.3 Hydro-morphological measures	10
3.3.1 Measures concerning obstacles	10
3.3.2 Habitat-related measures	13
3.3.3 Results of studies and monitoring	13
3.4 Catching and transportation measures	15
3.5 Predator management	15
3.6 Measures aimed at fish farming	16
3.7 Measures aimed at other pressures on the stocks of eel	16
4. References	17
National Eel Management Plans for the Rhine catchment	17
Further sources	17
Annex: Map „Eel in the Rhine catchment“	18



Figure 1: European eel - *Anguilla anguilla*. Source: Fiedler, LUBW

Summary

According to the **EU Regulation no. 1100/2007** the EU Member States with natural stocks of eel have drafted **national plans aimed at managing the endangered stocks of eel**. In the Netherlands, Germany and France, different models aimed at calculating the rate of downstream migration into the sea required by the regulation and representing at least 40 % of the biomass of silver eel compared to the natural stock have been developed. According to estimates made in Luxemburg, a downstream migration rate of 90 % from the Luxembourgian areas has already been achieved for 8 years. However, on their further migration downstream into the sea (passing by the Moselle and the Rhine), the further losses among these eels are unknown. In the Netherlands, long standing data on the occurrence of glass eel on the coast reveal a dramatic decline. Almost everywhere, commercial catches and sports angling have been limited by closed periods (between 3 months during the winter and all year), minimum fish size (50 cm) and/or a ban on professional fishing gear. In the Netherlands and in Germany (except for the High Rhine), different public organisms, professional fishermen and fishing associations carry through stocking measures. Within the WFD, eel protection measures are implemented at transverse structures (in all Rhine bordering countries) and pumping stations (Netherlands) until 2015, partly until 2027. Fish passes are built and grids are integrated in order to protect downstream migrating eel and, in the main eel migration period, the turbine management is adapted so as to reduce losses during downstream migration. Priorities were set for certain waters particularly important for eel. On the R. Moselle and Sûre, Main and Neckar eel protection measures including catching and transporting are implemented.

Eel research not only concentrates on experiments aimed at artificial eel reproduction, but, among others, also on eel mortality in technical installations during downstream migration. Eel mortality during downstream migration through these installations is considerable so that the targets of the EU Eel Regulation will not be met.

There are several practical examples for "fish-friendly" turbines at **small hydro power plants** with a nominal discharge up to **50 m³/s**. For these hydro power plants we also dispose of experience with functional downstream movement structures.

In the past years, many investigations were carried out at **medium sized hydro power plants** with a nominal discharge **up to 150 m³/s** without yet having developed a sufficient state of the art. In these cases a turbine management including periodic shutdown during fish migration periods may be a good option.

On the other hand, for **big hydro power plants** with a nominal discharge **above 150 m³/s** and in particular for the big hydro power plants along the Rhine there does not exist any satisfactory, implementable technique. At installations of this size, reliable protection mechanisms cannot be implemented using the known and effective components or their implementation would be excessively costly. There is urgent need for research and development with respect to these aspects. Furthermore, practical design tests are required in order to be able to grant for their functionality.

Investigations into the possibilities of silver eel to pass by hydro power plants, into eel behaviour during downstream migration, fish-friendly turbine management of hydro power plants in connection with alarm systems predicting downstream migration events and into the effects of infrasound barriers exist for the Rhine catchment.

Due to an excess of dioxin contents and contents of PCB similar to dioxins, eel catches have been completely prohibited in the Dutch catchments of big rivers and have almost completely stopped in Germany. In 2012, the recommendation of German authorities of 2003 to refrain from consuming wild eel from the main stream of the Rhine was extended to a major part of the tributaries to the Lower Rhine. In France, due to the PCB and mercury content of fish, a ban on selling and eating eel from the Rhine, the Grand Canal d'Alsace, the Ill and its tributaries has been issued.

Examinations of eels in the states of the Rhine catchment carried out between 2000 and

2011 partly resulted in a considerable contamination of the fish with dioxins, furans, dioxin-like PCBs, fluorosurfactants (PFT), in particular perfluorooctane sulfonate (PFOS), occasionally also with indicator-PCB, hexachlorobenzene (HCB) and mercury. Since the 1970s, a considerable reduction of the HCB contamination of yellow eel could be stated in the Delta Rhine. In the 1st river basin management plan according to the WFD for the international river basin district Rhine the Rhine bordering states committed themselves to restore heavily contaminated river sediments as far as possible (Overall sediment management strategy). At the time being, discussions on possible sources of contamination with PCB and other pollutants and on national remedial measures are going on.

National eel management plans for the Rhine catchment:

Netherlands:

- **Ministerie van Economische Zaken:** *The Netherlands eel management plan. 15 December 2008, revised in June 2011.*

Germany:

Responsible for the German federal states along the Rhine:

- **Ministerium für Umwelt und Naturschutz, Landwirtschaft und Verbraucherschutz des Landes Nordrhein-Westfalen:** *Aalbewirtschaftungsplan – Flussgebietseinheit Rhein. December 2008 - <http://www.portal-fischerei.de/fileadmin/redaktion/dokumente/fischerei/Bund/Bestandsmanagement/FlussgebietseinheitRhein.pdf>*

Luxemburg:

- **Ministère de l'Intérieur et de l'aménagement du territoire,** *Administration de la Gestion de l'Eau, Division de l'Hydrologie: Aalbewirtschaftungsplan Luxemburg (in German and French Luxemburg, 04 February 2009*

France:

- **Préfecture de la Région Lorraine:** *Plan de gestion anguille de la France – Volet local de l'unité de gestion Rhin. Application du règlement (CE) n°1100/2007 du 18 septembre 2007*

1. Introduction

For protection purposes and future management of the endangered eel populations in Europe, the European Union issued a regulation (EC No. 1100/2007) in June 2007 focussing on a restoration of the stocks of eel and on reducing eel mortality of anthropogenic origin. According to this regulation, all EU Member States with natural stocks of eel drafted national Eel Management Plans by end 2008 which they handed over to the EU Commission.

The regulation also stipulates that, in case of eel river basins extending to the territory of more than one Member State, the Member States involved shall jointly prepare an Eel Management Plan (Article 6). Due to the short deadlines for drafting the national Eel Management Plans in 2008, it was not possible for the Rhine bordering states to draft a joint Eel Management Plan by the deadline set to 31st December 2008. In 2009, the ICPR expert group FISH summarized the most important measures listed in the national plans in a short chapter of the "Master Plan Migratory Fish Rhine". So far, no further coordination work has been done.

Therefore, between 2010 and 2012, the EG FISH continued discussing national measures aimed at stabilising the stocks of eel in the Rhine basin and has drafted the following results.

1.1 Transposition of the EU Eel Regulation into national law

The obligations under the EU Eel Regulation have been transposed into the fishing regulations of all EU states in the Rhine catchment:

Netherlands: Fishery regulations. The Water Act states that turbine management must be adapted as long as there are no well-functioning fish passages.

http://wetten.overheid.nl/BWBR0024539/volledig/geldigheidsdatum_08-12-2011#Opschrift

Germany:

- Law on fisheries and Fisheries Regulations for North Rhine Westphalia - <http://www.umwelt.nrw.de/naturschutz/fischerei/index.php>
- Law on fisheries for Rhineland-Palatinate completed by a general regulation concerning a temporary ban on catching eel in the Rhine - http://www.wasser.rlp.de/servlet/is/LFischG_2009.pdf
- Law on fisheries for the federal state Hesse: <http://www.hessen.de/irj/RPDA> - Environment & Consumers – Agriculture/Viticulture – Fisheries
- Fishing regulations for Baden-Württemberg - http://www.rechtliches.de/BaWue/info_LFischVO.html
- Regulations on the execution of the Bavarian law on fisheries (AVBayFiG).

Luxemburg: Since the EU Eel Regulation is directly implemented as of right, the obligations have not been transposed into national law. With a view to eel protection, the following laws stipulate closed periods and minimum size (see Table 1):

- Law of 28 June 1976 regulating fishery in inland waters;
- Law of 21 November 1984 approving the Convention between the Grand Duchy of Luxemburg and the German federal states Rhineland-Palatinate and Saarland concerning a review of the fisheries regulation in transboundary waters (Condominium), signed in Trier on 24 November 1975.

France has drafted a two-levelled Eel Management Plan: The national level is represented by the Ministry of Agriculture and Fishery, the Ministry of Ecology, Energy, sustainable Development and spatial Planning. The regional level concentrates on the different catchments and is taken care of by the *Comités de Gestion des Poissons Migrateurs* (COGEPOMI) (Regional Committees in Charge of the Management of Migratory Fish). The COGEPOMI in charge of the Rhine-Meuse catchment is placed under the coordination of the Prefect for the Lorraine region.

Several regulations rule the different protection and rehabilitation measures for this species. The most important ones are:

- Concerning river continuity:
 - Article L.432-6 of the environmental legislation is applicable, as long as it has not been replaced by the following article (at latest 1st January 2014)
 - Article L.214-17 of the Water Act of 2006
- Concerning fisheries:
 - Decree of 29 September 2010 concerning the periods during which a ban on fishing European Eel applies (NOR: DEVO1022199A);
 - Joint decree of the prefect ARS/2001 no. 349 of 22 September 2011 concerning a ban on consuming and marketing fish (among others eel) from the Moselle-Sarre basin.
 - Prefectural order no. 2011-262-1 of 20 September 2011 concerning the ban on marketing and consuming certain fish species from rivers in the Département Haut-Rhin
 - Prefectural order of 16 December 2011 concerning the ban on marketing and consuming certain fish species from certain rivers in the Département Bas-Rhin
- Concerning the restoration of habitats and water quality:
 - Framework for water management (SDAGE) for the Rhine-Meuse basin of 2009 aimed at implementing the WFD (see www.eau2015-rhin-meuse.fr)

Switzerland is not obliged to implement the EU Eel Directive. However, within the Fishing Commission High Rhine, the equivalent regulations on the High Rhine are being harmonized with Baden-Württemberg.

2. Description of the present stock of eel

According to the EU Eel Regulation, the environmental target is to **secure the downstream migration of at least 40 %** of the silver eel biomass into the sea compared to the natural stock (reference value). The measures aimed at restoring the stocks of eel implemented within the Eel Management Plans approved by the EU are to secure that, on the long term, this target will be achieved.

In the Netherlands, a model for the yellow eel has been developed which may be used to estimate the number of downstream migrating silver eel. Input parameters are the quantities of eel caught, results of transponder studies, eel monitoring (population growth), glass eel monitoring, random silver eel sampling, etc.

In Germany, the stock of eel is determined as follows:

In the past, no extensive inventories of the stocks of eel were made across the Länder in the Rhine basin. The rate of eel migrating downstream the German Rhine basin is determined with the help of a population model using all available data from the German federal Rhine bordering states. Apart from calculating the target value and the target percentage of 40 % according to the Eel Regulation, this model can also be used for predicting the future development of the stocks of eel. The data resulting from on-going and starting monitoring projects are continually input. At the time being, the model prognosis reveals a downward trend. In 2010, the amount of downstream migrating silver eel was estimated to some 146 tons (target quota for the German Rhine catchment: 115 tons). Even though counterbalancing measures have been taken, it is expected that numbers will fall behind the target quota in about three years and will not reach this quota again before in approximately 25 years.

At present, an extensive monitoring programme over several years is starting in North Rhine-Westphalia. So far, quantitative statements on the stocks of eel can only be derived on a local scale from investigations carried through in 2005 and 2009.

In Rhineland-Palatinate, a long term eel monitoring programme has started in the Rhine and the Moselle. At the time being, quantitative statements can only be made based on the annual fishing campaigns upstream the hydro power plants in the Moselle and can be traced back to 1997.

For Hesse it is not possible to make any statement on the development of stocks, as there are only few professional fishermen with low but stable results.

Based on catch statistics (resulting from counts in the Iffezheim fish passage and control fishing campaigns in the Rhine), no decline of the stocks of eel was stated in Baden-Württemberg. It is however not possible to determine whether the eel have migrated upstream from the sea or whether they were stocked downstream.

In Luxemburg, the annual results for eel are estimated to amount to 1 to 1.5 tons, based on the results of fishing with skimming nets and eel pots upstream the hydro power plant Rosport/Sûre during the downstream migration period in autumn and winter.

In France, the present stocks of yellow and silver eel and their downstream migration rates have been estimated. However, there are no estimates which only relate to the French part of the Rhine. On a national level, these estimates are based on models into which the results of electro fishing campaigns in small, shallow rivers between 1977 and 2007 were entered. For 2006-2007 (considered to correspond to the present) the number of yellow eel is estimated to 260 million individuals. Considering that 5 % of the yellow eels develop to silver eel, the number of silver eel in the same period may be estimated to about 15 million individuals. The estimated downstream migration before 1980 (reference period for determining the 40 % target downstream migration rate) is based on the assumption that this rate develops proportionally to the population growth. Depending on the average age of silver eel, the downstream migration in 2006-2007

varies between 10 % (5 years difference) and 30 % (15 years difference) of the downstream migration in the past (before 1980). That means that, for France, the maximum potential downstream migration varies between 50 and 150 million silver eel per year.

The following map illustrates the area of eel distribution in the French part of the Upper Rhine.

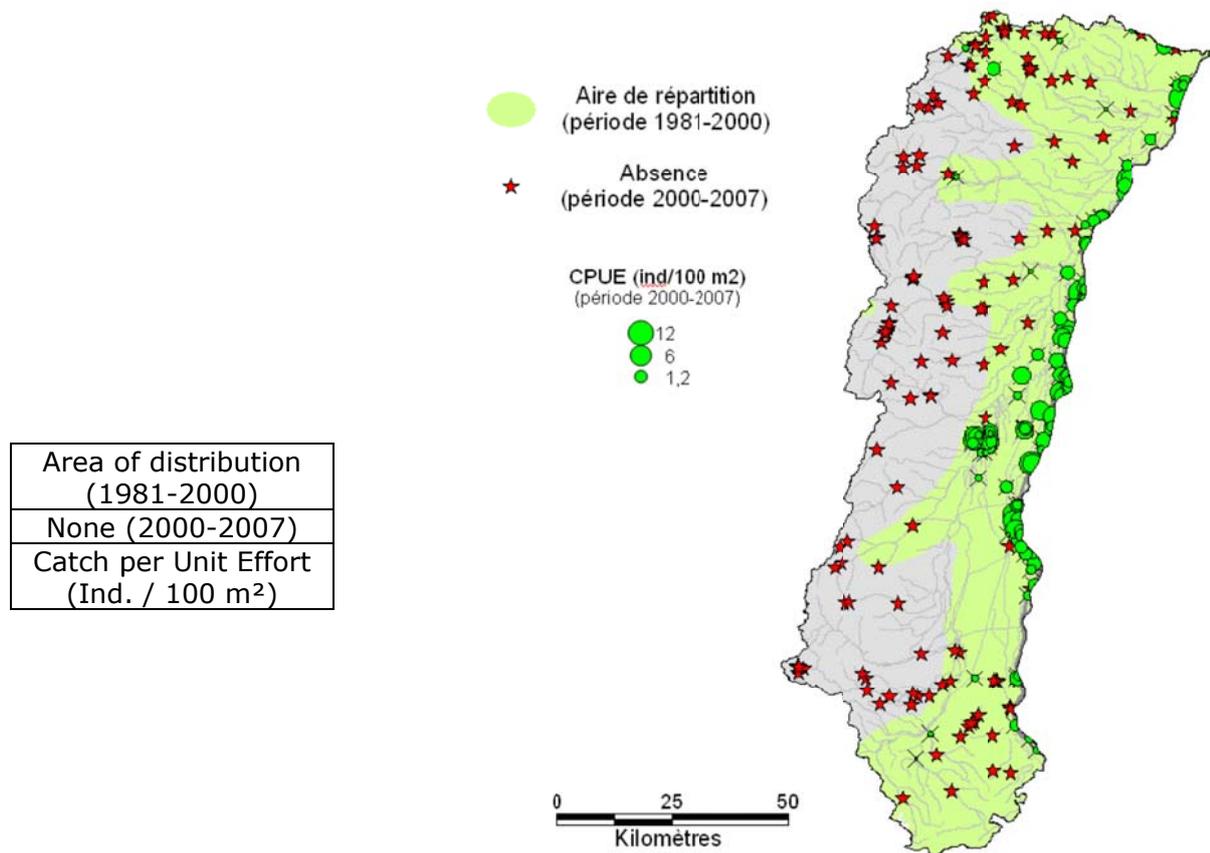


Figure 2: Area of eel distribution in the French part of the Upper Rhine (1981-2007).

Source: ONEMA

3. Measures aimed at stabilizing and monitoring the stocks of eel

3.1 Reduction of commercial fishing activities and of sports angling

In the Netherlands, there is a ban on fishing eel during the months of September, October and November. Since 1st April 2011 there is a complete ban on fishing eel in the basins of the big rivers (Meuse, Waal, Nederrijn/Lek and IJssel) as the contents of dioxins and dioxin-like PCB are too high. This is also true of the entire downstream area of the rivers, including Haringvliet, Volkerak and Biesbosch, Hollandse IJssel and North Sea Canal. In addition, sports anglers are obliged to return eel into the waters. At the time being, no closed areas will be created. As a result of the ban on fishing in contaminated areas, there is no eel fishing gear in the main migration routes of eel and other migratory fish. In the other parts of the Netherlands there is a ban on fishing silver eel during its migration period.

In the entire German part of the main stream of the Rhine, the closed season for downstream migrating silver eel covers the period 1st October to 1st March; in Hesse, this closed season also extends to all backwaters of the Rhine. In Baden-Württemberg the closed season for the main stream of the Rhine downstream the dam at the Eglisau hydro power plant in the High Rhine and for all backwaters, channels and torrents along this stretch, including old river branches and gravel pits has been extended to last all year. The closed season in the R. Neckar downstream the dam at the hydro power plant Neckargemünd until its outlet covers the entire year. For the other waters in Baden-Württemberg, the closed season covers the period 1st October to 1st March or a shortened period from 1st November to 1st March. No closed season applies to Lake Constance, instead, there is a minimum size of 50 cm.

After the publication of values in excess of the total highest value permissible under the foodstuffs legislation for dioxins, furans and dioxin-like PCBs, the marketing of eel from the Rhine (main stream) has practically stopped in all countries; that means, that there is practically no professional fishing for eel.

In Luxemburg there is no professional fishery. Leisure anglers rarely go for eel.

In France, there are still two professional fishermen in the Rhine basin, some leisure fishermen with special fishing gear and sports anglers. In order to reduce eel mortality due to fishing, the following measures were taken within the framework of the Eel Regulation:

- Ban on using particular fishing gear or techniques with a view to targeted fishing on "silver eel" for professional fishermen or sports anglers;
- since 2011, ban on catching eel (yellow eel) between 16 September and 14 April for all fishermen / sports anglers.

In addition, since 2006 and due to too high mercury concentrations, a prefectural order prohibits the selling and consumption of eel from the Ill. Following the PCB analysis campaign in 2009, an order of the French Departement Haut-Rhin prohibits selling and consuming eel from the R. Ill and its tributaries and from the Rhine as well as the Grand Canal d'Alsace (see 1.1).

In Switzerland, there is no professional eel fishing and no particular tradition concerning the consumption of smoked eel.

Table 1: Measures aimed at reducing fishing for eel in the Rhine bordering countries

Country/federal state	Closed season	Minimum size	Ban on fishing at night	Obligation to release catches	Ban on certain fishing gear	
Netherlands	1.9. to 1.12.; all year in big rivers	-	n. s.	yes	professional fishing gear	
DE-Lower Saxony (eel river district only in tributaries to the Rhine)	no	45 cm (implementation ongoing)	no	for eel below the minimum size or caught during the closed season	no, definition of minimum requirements	
DE-North Rhine-Westphalia (main stream of the Rhine)	1.10. to 31.3.	50 cm	no			
DE-Rhineland-Palatinate (main stream of the Rhine)	1.10. to 31.3.	50 cm	not completely			strongly regulated
DE-Hesse (main stream of the Rhine)	1.10. to 1.3.	50 cm	no			no
DE Bavaria	1.11. to 28.02. in the eel river basin	50 cm all over Bavaria	no			no
DE Baden-Württemberg	Rhine: all year. Details see text	50 cm	yes			n. s.
Lake Constance	no	50 cm	no			no
Luxemburg	1.1. to 28.2 (or 29.2); transboundary waters: 1.1. to 31.3.	40 cm; eventually raised to 50 cm	yes	no	all apart from handline	
France	for yellow eel: 16.9. to 14.4. (since 2011); for silver eel: all year	-	yes (for anglers)	yes (due to pref. order concerning PCB)	Special fishing gear for silver eel	
Switzerland ¹	no (discussion ongoing)	50 cm	yes	no	only sports angling	

¹ Even though the Eel Regulation is not binding for Switzerland, the minimum size for eel was raised to 50 cm.

3.2 Stocking measures

The Dutch government annually supports the stocking of glass eel and juvenile eel with 375,000 €. A particular protocol has been developed for stocking exercises, describing where and how glass eel are to be stocked (e.g. spread over the water body as rapidly as possible, release individuals into the shallow waters close to the banks, prefer turbid water and/or river banks with a high degree of habitat cover and shelters, etc.). The number of glass eel annually released is being monitored, the individuals used for stocking are however not marked.

Furthermore, professional fishermen and eel breeders stock glass eel and juvenile eel at their own costs.

In Germany, different state authorities and fisheries associations have been carrying out eel stocking measures in the entire Rhine catchment area apart from the High Rhine for several decades (in Lake Constance for more than 120 years).²

The federal state North Rhine-Westphalia stocks juvenile eel in more than 10,000 ha of obstacle-free waters. Health (see 3.7) and species (genetic determination) are checked. Financially, eel stocking measures are regularly supported. In this respect, all rivers in the eel river basin are classified according to whether downstream eel migration into the North Sea is not obstructed ("1a") or only obstructed by few transverse structures ("1b, 2a"). For so-called 1a-rivers, stocking measures for up to 40 eel fingerlings/ha are supported with means of the European Fisheries Fund, in 1b-rivers for up to 20 eel/ha. Funding of stocking measures with means of the federal states (fee on fishery) has been limited to 40 eel/ha for eligible waters. Waters outside the 1a/b and 2a classification are not eligible for federal state funding.

In Rhineland-Palatinate, eel are regularly stocked in the R. Moselle, in particular since its impounding. It is the Land Rhineland-Palatinate which has the corresponding fishing right. For some time, stocking measures in the Rhine had been stopped, but were resumed by the Land in 2004 after a distinct decline of the stock of eel had been stated. Stocking measures in R. Main in Hesse are carried out by fishing guilds.

In Baden-Württemberg, eel stocking has been going on since the 1970s, at first using glass eel, since the 1990s using farmed eel which proves to have a better survival rate. The means of optimized eel stocking are under discussion, e.g. by mixed stocking, improved material and choice of the most appropriate water bodies. The transboundary moratorium with Switzerland aimed at not stocking eel in the High Rhine - and in the rest of Switzerland - remains applicable.

There is no eel stocking in Luxemburg. However, the eel population is largely determined by eel stocking in the 10 impoundments of the German Moselle between Koblenz and Trier.

No eel stocking is planned for the Rhine-Meuse area in France. Since Alsace is too far away from the coast and the aim is to reduce eel mortality, eel is initially stocked in waters near the coast outside the Rhine catchment where the stocks of eel are not yet saturated.

² see map MP-K3 in the "Master Plan Migratory Fish Rhine", ICPR report no. 179.

Table 2: Stocking glass eel and eel fingerlings in the Rhine bordering states, example 2010

Country/federal state	Stocking 2010	Remarks
Netherlands	380,000 glass eel	Including catchments of Meuse, Scheldt and Ems
DE-Lower Saxony	11,000 eel fingerlings	Only Rhine tributaries
DE North Rhine-Westphalia	20,000 glass eel, 255,000 eel fingerlings (< 18.7 g)	Background for stocking (details see text)
DE Rhineland-Palatinate	221,000 eel fingerlings (< 18.7 g)	Including Moselle
DE Hesse	52,000 glass eel 112,000 eel fingerlings (< 18.7 g)	Including Main and Lahn river system
DE Baden-Württemberg	28,000 glass eel; 98,000 eel fingerlings (< 18.7 g)	Including Rhine tributaries (eel fingerlings) and Lake Constance (glass eel)
DE Bavaria	135,000 glass eel and 565,000 eel fingerlings (< 18.7 g)	On R. Main by fishing associations/fishing cooperatives
Luxemburg	No stocking	
France	No stocking in the Rhine catchment	
Switzerland	No stocking	

3.3 Hydro-morphological measures

"Structural measures aimed at securing river continuity and improving their habitats together with other environmental measures"

According to the implementation of the Water Framework Directive, the target of the states in the Rhine catchment is, to gradually restore river continuity of the main stream of the Rhine as far as Basel and in certain programme waters, and to gradually restore the quality of fish habitats. All measures required to achieve this target are listed in the "Master Plan Migratory Fish Rhine" (see www.iksr.org - report no. 179). Between 2000 and end 2012, river continuity has been improved at 479 transverse structures in the programme waters.

3.3.1 Measures concerning obstacles

In the Netherlands, some of the eel protection measures will be implemented at obstacles and pumps until 2015. Due to financial restrictions, part of the measures will be postponed until after 2015. Further measures will be implemented by 2027. According to the new Dutch Water Act, owners of hydro power plants must have a license. This license includes fish-friendly turbine management as a pre-requisite for operating the plant. In 2010, this issue was discussed with the operators of power plants. Since 17 November 2011 and before definitely attributing new licenses, the operators of the three big hydro power plants have adapted turbine management during the months of downstream migration of silver eel. The aim is to reduce eel mortality. At the same time it is looked into how the numerous pumping plants can be made "fish safe".

In Germany, among others in North Rhine-Westphalia, further transverse structures are being modified according to the "Manual on Transverse Structures" in order to achieve river continuity. The progress of these measures in the waters under the ICPR programme for migratory fish is listed in the brochure "Rhine 2020 - Programme on the Sustainable Development of the Rhine: Balance 2000 - 2012" which was published on the occasion of the Conference of Rhine Ministers in October 2013. At the hydro power plant Unkelmühle (DE-NRW) on the R. Sieg a pilot plant for downstream migrating fish, in

particular silver eel and salmon smolt is under construction which will be monitored once it has been put into service. The new fish passage on the first weir on the Moselle in Koblenz (DE-RLP) is an exemplary installation.

In the German federal state Hesse, grids with a distance of 15 mm between the bars have become obligatory by law in order to protect downstream migrating eel.

Before long, a technical fish passage will be put into operation at a barrage on the Neckar (DE-BW).

According to WFD, by 2015, 48 transverse structures in Luxemburg must be modified to grant river continuity. Within the applications for new licenses for some existing hydro power plants due by 22 December 2012, new conditions will among others be applied, aimed at protecting downstream migrating eel.

In Alsace (FR) a priority area for action has been designated aimed at achieving ecological river continuity for eel (see Fig. 2). Furthermore and in order to restore river continuity, France has modified its river classification in 2013 and has drafted a first list of water bodies in which the construction of new transverse structures is prohibited and a second list of priority water bodies in which obstacles are to be modified within 5 years. In order to fix a higher level of priority, a list of 84 transverse structures was drafted within the (French so-called) "Grenelle programme for environmental action", 57 of which are located in Alsace and which have to be modified by 2015 so that river continuity will again be given for fish. In this connection, discussions are going on with the operators of the hydro power plants concerned.

In Switzerland, by 2014 all obstacles at hydro power plants will be analysed with respect to passability for eel and measures will be determined to achieve fish passability. Their implementation must be achieved by 2030 at latest. At several hydro power plants in Switzerland solutions for improved eel migration are under elaboration.

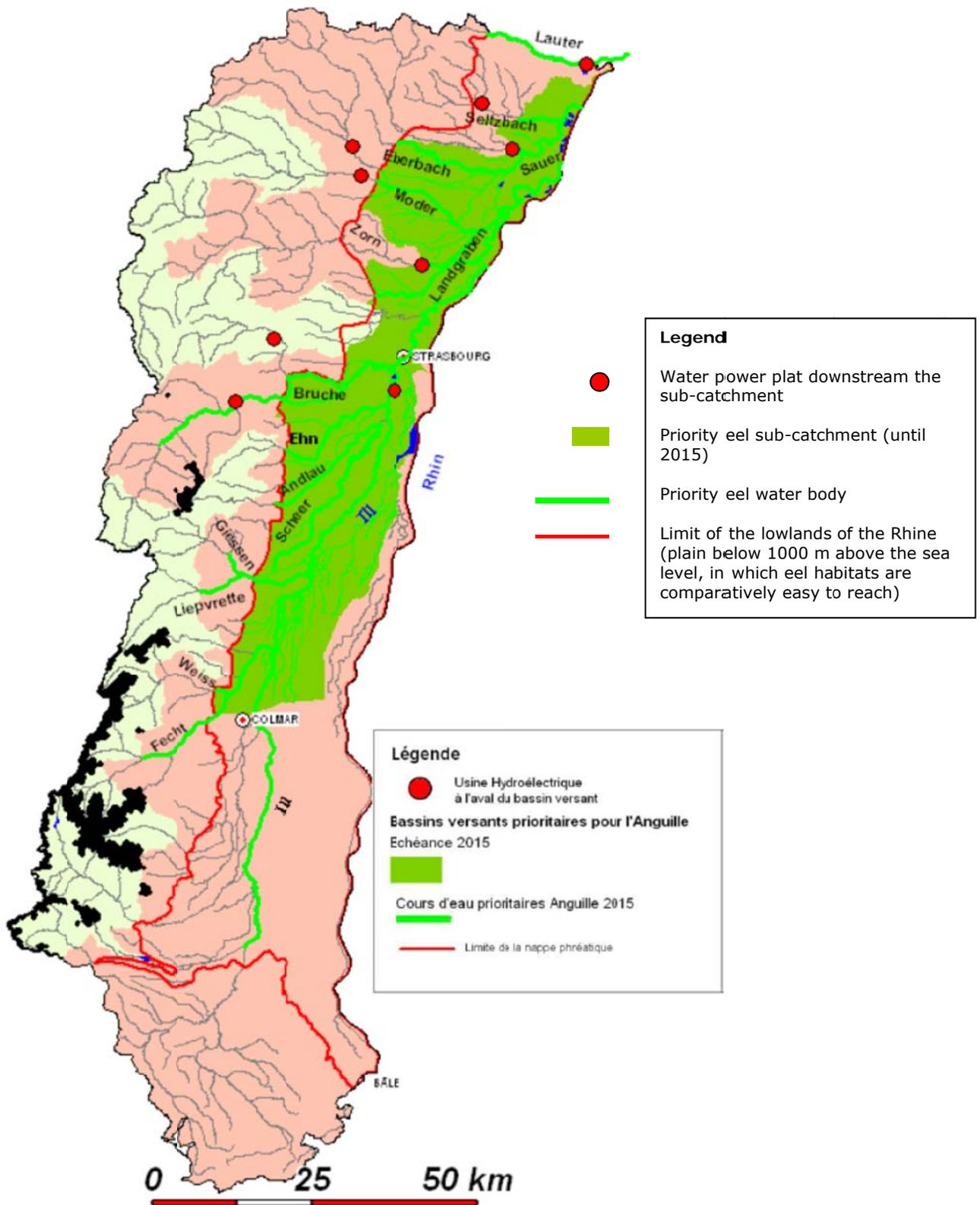


Figure 3: Priority rivers for eel migration during 2010-2015 in the sub-basin of the Upper Rhine (French part). Source: ONEMA

3.3.2 Habitat-related measures

The Dutch Eel Management Plan does not provide for any particular habitat-related measures. Within the implementation of the WFD, many hydro-morphological measures are carried out which also benefit to eel.

In Germany, when developing the shipping lane for navigation purposes, blocks with a side length ≥ 30 cm without interlocking will be used for river bank stabilization; the eel prefers the interstices as artificial habitats.

Furthermore, a targeted improvement of eel habitats is among others going on in North Rhine-Westphalia.

In Luxemburg, since the impounding of the Moselle, eel-friendly blocks are being used to stabilize the navigation channel. However, in the past, due to this measure shallow gravel banks in favour of other fish species have often vanished.

In France, the restoration of habitats is planned within the Framework of Water Management (SDAGE) for the Rhine and Meuse basin also covering the requirements of the WFD.

3.3.3 Results of studies and monitoring

Annually, the *ICES Working Group on Eel* (WGEEL) is determining a *Recruitment Index* for glass eel. This index is calculated on the basis of 30 data sets depending on fishery and not depending on fishery from all over Europe. These data sets cover a period of at least 35 years. The *Recruitment Index* issued by the WGEEL continues to indicate a **downswing** and indicated a historical low-point in 2012: Compared to the period 1960 to 1979, the **occurrence of glass eel** has sunk below 1 % in the North Sea and below 5 % in the rest of the distribution area.

Long standing data for glass eel in the Netherlands at Den Oever, IJmuiden and Lauwersmeer also show a comparable, dramatic decline.

For the Meuse (NL) it is being investigated whether the **main eel migration period** coincides with the closed period established (1 September to 1 December).

Furthermore, a research project aims at making **artificial eel reproduction** possible. So far, one has succeeded in keeping larvae alive in fish farms until they reach the stage of food intake. They then perish, as no suitable food has yet been found. This aspect is being worked on.

Additionally, in Germany, research programmes are going on with respect to **infrasound barriers** and **reporting systems** for the main migration (e.g. sounder, reports by professional fishermen).

A **monitoring of the stocks of eel** has begun in North Rhine-Westphalia, taking into consideration all eel stages (upstream migrating glass eel, yellow eel, silver eel). In R. Sieg, a tributary to the Rhine, a pilot project on the protection of downstream migrating fish at hydro power plants is going on (location Unkelmühle). The target of the project is to achieve functioning protection of downstream migrating silver eel and salmon smolt and to optimize the hydro power plant operation at the same time.

DE-NRW and the Netherlands are cooperating with respect to regular investigations into the downstream migration of silver eel by means of transponders in order to monitor migration routes in the Rhine delta and possible losses during downstream migration. In order to develop a **turbine management** adapted to fish, research is going on in Rhineland-Palatinate (Moselle) in cooperation with hydro power plant operators concerning e.g. automatic reporting systems; in Luxemburg (Rosport on R. Sûre) research on fish-friendly turbine management is going on. Attempts on the Moselle to determine general main migration periods have not yet led to any effective fish protection appropriate for the situation at existing hydro power plants and will presumably not do so in future; additional detection "in situ" is supposed to indicate feasible means of protecting downstream eel migration.

Monitoring aimed at success control at the new **fish passage** in Kostheim on the Main in Hesse has delivered information both on eel **mortality** and **migration behaviour**. About

30 % of the eel, 15 % of the trout and 55 % of cyprinids/perch were dead or no longer viable (= with critical or average damage).

In France, the mortality of downstream migrating eel in the turbines of two hydro power plants in the French-German section of the Rhine was examined within an EDF study. After 48 hours, eel mortality caused by the 4 blade Kaplan turbine of the Fessenheim power plant amounts to about 7 %. In the Ottmarsheim power plant equipped with a 5 blade Kaplan turbine, mortality amounted to about 21 %. Further studies carried out by the Normandeau society and in laboratories with other turbine types have revealed that the form of the blades, in particular the strength of the leading edge is decisive for fish survival. Further investigations into this issue are planned.

A second study using the NEDAP monitoring system has determined the rate of distribution of downstream migrating eel on the different migration routes in the Franco-German section of the Rhine. So far, monitoring only succeeded for 27 fish. One fourth of the 20 eels which began downstream migration at Kembs used the Old Bed of the Rhine, while three fourth migrated through the Grand Canal d'Alsace. Not one eel used the navigation sluices. The migration time through the Grand Canal d'Alsace varied between 13 hours and a little more than 3 months. Analysis of the preferred migration routes and on the relationship between downstream migration and environmental parameters is going on.

About ten of the silver eel equipped with NEDAP transponders which had been released into the Upper Rhine were traced by the network of Dutch stations. It took these fish released near Kembs during the winters 2010 to 2012 between 13 days and more than one year to migrate downstream these 850 km. Depending on their speed of migration, the first individuals can be divided into 3 groups: one group which on average migrated less than 10 km/day and whose downstream migration lasted 8 months; one which migrated 10 to 50 km/day and whose downstream migration lasted 1 month on average and the fastest group which made more than 50 km/day and reached the estuary within 2 weeks.



Figure 4: Injured fish. Function control of the Kostheim fish passage, December 2011
Source: BFS

3.4 Catching and transportation measures

Transportation of silver eel from inland waters to water bodies from which unhindered downstream migration into the Sargasso Sea is possible

As part of the eel protection initiative of the German federal state Rhineland-Palatinate and the energy supplier RWE, annually 6 to 7 tons of silver eel are caught upstream the impoundments in the **Moselle** and transported to the Rhine per lorry. Thus, the total damage caused to eel is estimated to have been reduced from 80 to 65 %.

In Luxembourg, from June to December eel are caught in the R. **Sûre** upstream the Rosport hydro power plant and transported to the Rhine. During higher discharges, special nets, the so called skimming nets also used in the tidal are used for catching, during low flow, fyke-nets are used.

The measure is being continued and, in 2011 it was for the first time extended to the **Upper Moselle** (3 impoundments up to the German-French border).

Since 2009, annually some 5 to 6 tons of silver eel are caught in the Bavarian part of the **Main** and brought to the Rhine, from where they can migrate downstream without further obstacles.

During the next five years, professional fishermen will catch eel in the R. **Neckar** upstream the Bietigheim-Bissingen impoundment and release them into the Rhine near Mannheim. A monitoring programme is going on in parallel to this project in order to gather information on the readiness of eel to migrate downstream.

In 2012, within two pilot studies in the Netherlands, silver eel were caught at transverse structures and released again immediately downstream of these structures in order to freely migrate into the **sea**. An assessment of these pilot studies will show, what its continuation in 2013 could look like.

Table 3: Eel caught in the Rhine basin within transportation measures

Country/federal state	Caught in water body, location	Transported towards (water body, location)	Year	Number of silver eel resp. catches in kg/t
Luxemburg	Sûre / Rosport	Middle Rhine	2004-2011	300 to 960 silver eel per year (up to about 1 t per year)
DE Rhineland-Palatinate	Moselle (each impoundment; in particular upstream hydro power plants)	Middle Rhine near Rolandseck, resp. Bad Breisig	1997-2008	1,474 to 7,357 kg
			2009 / 2010	4,030 kg / 3,850 kg
DE Bavaria	Main	Rhine / Wiesbaden	2009/2010	4,730 / 5,703 kg
DE Baden-Württemberg	Neckar upstream of Bietigheim-Bissingen	Rhine / Mannheim	2009/2010	319.5 / 261 kg

3.5 Predator management

"Measures aimed at fighting predators"

In Germany, cormorant regulations have been issued in certain federal states, permitting a limited shooting of **cormorant** in order to protect eel and other fish species (e.g. salmon, sea trout, grayling).

In Luxemburg, cormorant only appear during the winter. Their population is being recorded since 1999; during the winter 2009/2010, a maximum of 412 specimen and 10 locations where they spent the night were counted in the downstream area of the R. Alzette and Sûre and along the Moselle. Along some of these waters, cormorant will undoubtedly impact the stock of endangered fish species such as eel, however, a

quantification is problematic. Measures aimed at scaring off cormorant are neither envisaged along the Moselle, nor the Lower Sûre as a deterioration of the situation of certain endangered fish species is expected to be the result in the upper reaches of the Sûre.

3.6 Measures aimed at fish farming

Along the Rhine, measures aimed at fish farming are not relevant.

3.7 Measures aimed at other pressures on the stocks of eel

The considerable decline of the stocks of eel is, among others, also caused by **parasites** such as *Anguillicoloides crassus* impacting the swim bladder of the eel, as well as by **illness** (e.g. herpesvirus of eel). In North Rhine-Westphalia, the healthiness of eel used for stocking purposes is examined, as, in the past, it has occurred that material planned for stocking was affected by *Anguillicoloides crassus* and the herpesvirus of eel.

The pollution of eel with certain toxic agents accumulating in the lipid of eel may contribute to a physiological stress of eel during their spawning migration. Analysis of eels in the Rhine catchment states carried out between 2000 and 2011³ along the Rhine and in many tributaries gave evidence of extensive pollution of the fish with dioxins, furans, dI-PCB and mercury, in some cases also indicator PCB or hexachlorobenzene (HCB). In the Delta Rhine, a major decrease in HCB contamination of yellow eel was apparent since the 1970s, from more than 0.1 mg/kg FW to values of about 0.01 mg/kg FW. Fluorosurfactants (PFT) as well as perfluorooctane sulfonate (PFOS) also accumulate in eel. So far, little is known of the effect of the different pollutants on the health of the fish; however, a physiological contamination which in particular concerns the long spawning migration is assumed. In the 1st river basin management plan according to the WFD for the international river basin district Rhine the states in the Rhine catchment committed themselves to restore heavily contaminated river sediments as far as possible⁴. At the time being, discussions on possible sources of contamination with PCB and other pollutants and on national remedial measures are going on.

³ see ICPR report no. 195: Contamination of Fish with Pollutants in the Catchment Area of the Rhine www.iksr.org

⁴ Comprehensive Strategy Sediment Management; ICPR report no. 175, www.iksr.org.

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Annex: Map „Eel in the Rhine catchment“

