OSPAR COMMISSION

Background Document for Sea lamprey *Petromyzon marinus*

Biodiversity Series

2009

OSPAR Convention

The Convention for the Protection of the Marine Environment of the North-East Atlantic (the “OSPAR Convention”) was opened for signature at the Ministerial Meeting of the former Oslo and Paris Commissions in Paris on 22 September 1992. The Convention entered into force on 25 March 1998. It has been ratified by Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Luxembourg, Netherlands, Norway, Portugal, Sweden, Switzerland and the United Kingdom and approved by the European Community and Spain.

Convention OSPAR

La Convention pour la protection du milieu marin de l'Atlantique du Nord-Est, dite Convention OSPAR, a été ouverte à la signature à la réunion ministérielle des anciennes Commissions d'Oslo et de Paris, à Paris le 22 septembre 1992. La Convention est entrée en vigueur le 25 mars 1998. La Convention a été ratifiée par l'Allemagne, la Belgique, le Danemark, la Finlande, la France, l’Irlande, l’Islande, le Luxembourg, la Norvège, les Pays-Bas, le Portugal, le Royaume-Uni de Grande Bretagne et d’Irlande du Nord, la Suède et la Suisse et approuvée par la Communauté européenne et l’Espagne.

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Background Document for Sea lamprey *Petromyzon marinus*

Executive Summary

This background document on the Sea lamprey (*Petromyzon marinus*) has been developed by OSPAR following the inclusion of this species on the OSPAR List of threatened and/or declining species and habitats (OSPAR agreement 2008-6). The document provides a compilation of the reviews and assessments that have been prepared concerning this species since the agreement to include it in the OSPAR List in 2003. The original evaluation used to justify the inclusion of *P.marinus* in the OSPAR List is followed by an assessment of the most recent information on its status (distribution, population, condition) and key threats prepared during 2008-2009. Chapter 7 provides proposals for the actions and measures that could be taken to improve the conservation status of the species. In agreeing to the publication of this document, Contracting Parties have indicated the need to further review these proposals. Publication of this background document does not, therefore, imply any formal endorsement of these proposals by the OSPAR Commission. On the basis of the further review of these proposals, OSPAR will continue its work to ensure the protection of *P.marinus*, where necessary in cooperation with other competent organisations. This background document may be updated to reflect further developments or further information on the status of the species which becomes available.

Récapitulatif

Le présent document de fond sur la lamproie marine a été élaboré par OSPAR à la suite de l'inclusion de cette espèce dans la liste OSPAR des espèces et habitats menacés et/ou en déclin (OSPAR accord 2008-6). Ce document comporte une compilation des revues et des évaluations concernant cette espèce qui ont été préparées depuis qu'il a été convenu de l'inclure dans la Liste OSPAR en 2003. L'évaluation d'origine permettant de justifier l'inclusion de la lamproie marine dans la Liste OSPAR est suivie d'une évaluation des informations les plus récentes sur son statut (distribution, population, condition) et des menaces clés, préparée en 2008-2009. Le chapitre 7 fournit des propositions d'actions et de mesures qui pourraient être prises afin d'améliorer l'état de conservation de l'espèce. En se mettant d'accord sur la publication de ce document, les Parties contractantes ont indiqué la nécessité de réviser de nouveau ces propositions. La publication de ce document ne signifie pas, par conséquent que la Commission OSPAR entérine ces propositions de manière formelle. A partir de la nouvelle révision de ces propositions, OSPAR poursuivra ses travaux afin de s'assurer de la protection de la lamproie marine, le cas échéant avec la coopération d'autres organisations compétentes. Ce document de fond pourra être actualisé pour tenir compte de nouvelles avancées ou de nouvelles informations qui deviendront disponibles sur l'état de l'espèce.

1. Background Information

Name of species

Petromyzon marinus (Linnaeus, 1758) Sea lamprey

Species ecology and breeding biology

The sea lamprey is one of the largest marine diadromous amphihaline and ectoparasite species. At the end of the winter, it leaves coastal waters to migrate upstream, at night, into rivers over 500km from the sea. Reproduction takes place between the end of April and the end of May in zones over 50 cm water depth and with currents greater than 40 cm/s. Here they construct vast semi-circular nests (the diameter of which can reach 2 m) called redds, with the males creating a depression in the river bed by wriggling and moving stones with their mouths with the help of the currents to form a large band of pebbles and gravel held together by sand at the base. The females release a large number of eggs which become lodged between the redd pebbles. The genitors die shortly after spawning. Ammocoete larvae of 5mm length hatch after 10-15 days and immediately go in search of ammocoete "beds", sheltered marginal sandy-silt zones where they stay burrowed in a vermiform state for 5 to 7 years. Their food consists of diatoms, blue-green algae and organic particles filtered facing the current. Metamorphosis takes place at the end of the summer when the juveniles swim downstream at night during the autumn and reach the sea by the winter. Their marine growth phase is short and lasts around 2 years, by parasiting various fish species (shad, herring, pollock, salmon, mullets, cod, haddock, basking sharks). Homing behaviour is not apparent in this species. The sea lamprey is considered as vulnerable at a european and several national levels within the OSPAR area, but as yet no conservation measures are in place (Sabatié, 1998).

2. Original Evaluation against the Texel-Faial selection criteria

List of OSPAR Regions and Dinter biogeographic zones where the species occurs

OSPAR Regions:	I, II, III, IV
Dinter biogeographic zones:	Lusitanean (Cold/Warm), Lusitanean-boreal, Boreal-lusitanean, Boreal, Norwegian Coast (Westnorwegian), Norwegian Coast (Skagerrak), South Iceland - Faroe Shelf

List of OSPAR Regions and Dinter biogeographic zones where the species is under threat and/or in decline

All where it occurs. Threats are most pronounced in freshwater.

Original evaluation against the Texel-Faial criteria for which the species was included on the OSPAR List

P.marinus was nominated for inclusion on the OSPAR list on the basis of an evaluation of their status according to the Criteria for the Identification of Species and Habitats in need of Protection and their Method of Application (the Texel-Faial Criteria) (OSPAR 2003), with particular reference to its decline, rarity, and sensitivity, with information also provided on threat.

Table 1: Summary assessment of *P.marinus* against the Texel-Faial criteria

Criterion	Comments	Evaluation
Global importance	Both sides of North Atlantic, north to Iceland and along Norwegian coasts to Barents Sea (River Ura, Kola Peninsula). North Sea, Baltic and western and central Mediterranean basins, very rare in Baltic basin, only known to enter Odra, Vistula (Poland, Germany), Western Dvina (Latvia), Narova and Luga (Russia) drainages. Several landlocked populations in North America where the construction of the St Lawrence seaway allowed lamprey to enter the great lakes where they have become a serious pest; none in Europe (Freyhof *et al*., 2008). Occasional specimens are taken in midwater in the Atlantic Ocean (Lelek 1973) This does not makes the OSPAR Maritime Area of global importance for this species.	Does not qualify
Regional importance	Sea lampreys are recorded more frequently in estuaries along the Atlantic Arc of the OSPAR Maritime Area; regions III & IV are therefore likely to contain a high proportion of the total sea lamprey population within the OSPAR area. However, virtually nothing is known about their distribution during their adult phase at sea.	Does not qualify
Rarity	The sea lamprey is much scarcer in western Europe than it was formerly, and is rare in much of its range today (Wheeler 1978).	Qualifies
Sensitivity	The sea lamprey is probably most sensitive to human activity during its freshwater stage where poor water quality and degraded spawning habitat can have an impact on the species. The ammocoete larvae may however be fairly resilient during the period when they burrow into the silt of rivers and streams, sometimes for several years (OSPAR 2006)	Sensitive
Keystone species	Not a species which has a controlling influence on any community within the OSPAR region.	Not applicable
Decline	There is no total estimate of the population size of sea lamprey in the OSPAR Maritime Area but it is known to have declined in many parts of Europe and particularly so in the last 30 years. It was found in the Scheldt estuary and along the Belgian coast, for example, but is only rarely caught in this area today (Poll, 1945). It was also present in the Dutch Rhine and Meuse but, because of declines, is now on the Red Data list of freshwater fishes in the Netherlands as an endangered species. There are also reports of a decline in Ireland in recent years (Kurz & Costello, 1999) but no substantive baseline information to quantify this (Kelly & King, 2001).	Significant

Threats have not changed since the species was listed, but are further elaborated upon under section 4.

3. Current status of the species

Distribution in OSPAR maritime area

Figure 1 is a map derived from the GIS data available on EIONET (European Topic Centre on Biological Diversity) where, in accordance with the provisions of Article 17 of the Habitats Directive, the EU25 Member States reported on the conservation status of all the species and habitats listed in the annexes of the Directive. With the exception of Germany, no data on this species distribution at sea was made available and several countries did not submit shapefiles therefore the absence/presence depicted is inaccurate. Information and distribution maps of this species in Spain, Portugal and Sweden are included in annex 1.

The rarity of capture in coastal and estuarine waters suggests that marine lampreys are solitary hunters and widely dispersed at sea (Henderson 2003). It is quite possible that they often feed in deeper offshore waters as they have been caught at considerable depths (as deep as 4099 m (Haedrich1977)).

Due to their parasitic adult phase which means their distribution is largely dictated by their host, sea lampreys do not display any homing behaviour (Bergstedt & Seelye, 1995). However they are selective in their choice of spawning streams and are thought to favour sites where ammocoete larvae are present due to olfactory cues (Vrieze & Sorensen, 2001). Studies of great lake tributaries in North America showed that it is not uncommon for adult lamprey to cease returning to small streams once the larvae have been extirpated (Torblaa & Westman 1980). Therefore the higher the concentration of larval pheromones in a stream, the more likely it is this river will be colonised by genitors: this is noteworthy in terms of stock management and reinforces the need to restore the marginal sandy-silt zones which are the sea lamprey's larval habitat.

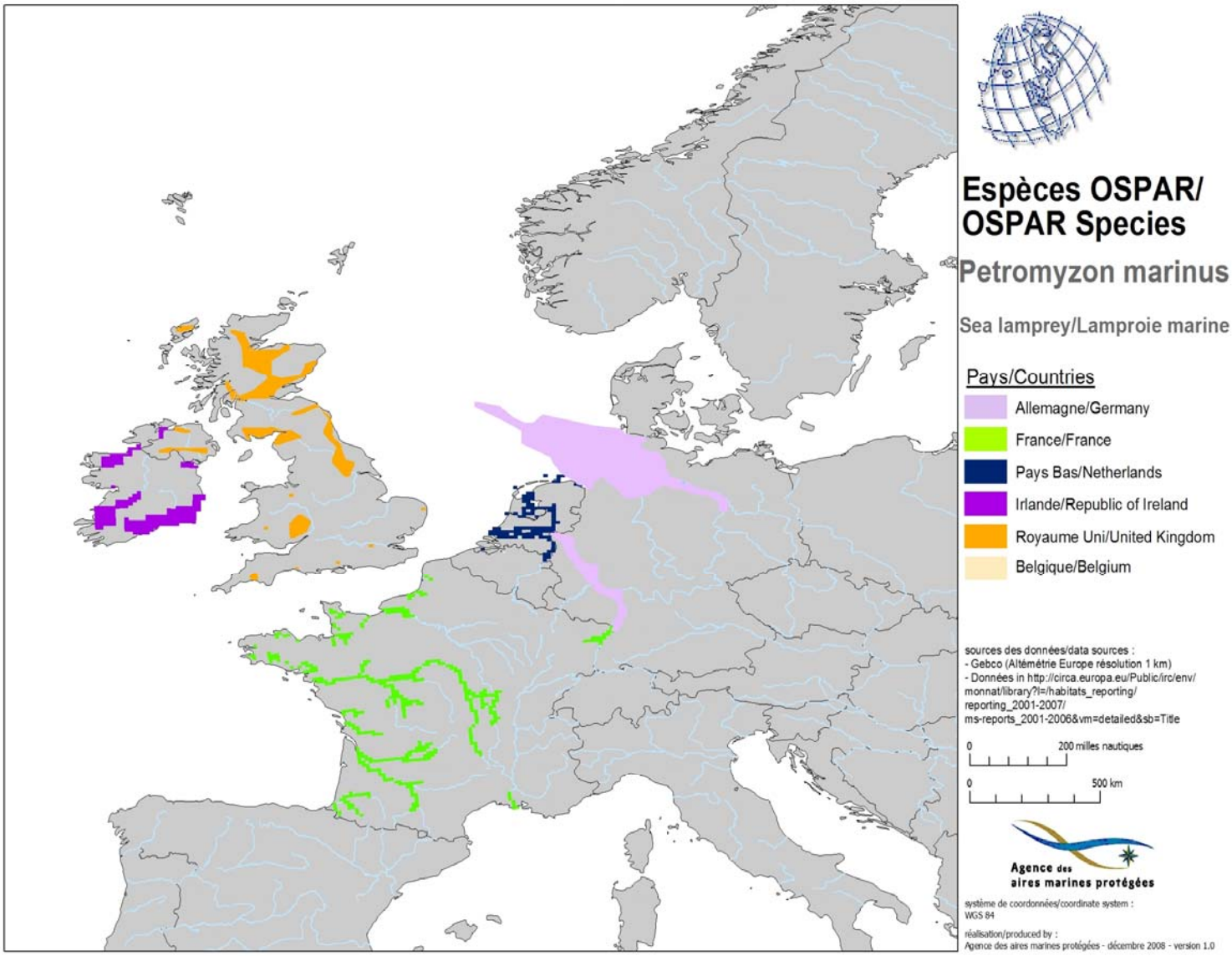

Figure 1: Map issued from Member States data submission to EIONET in accordance with article 17 of the EU Habitats Directive.

Population (current/trends/future prospects)

Although present levels are still far from historic abundances, certain European rivers (reviewed in Beaulaton *et al*., 2008) have shown a recent increase in lamprey population size since the 1990s. Future trends however remain very unclear.

There have been projections for a decrease in the presence of the sea lamprey in the basins bordering the east coast of the Adriatic Sea, in most of the Italian basins and in the Iberian Peninsula by 2010. This was in a study where the observed distribution of *P.marinus* was related to a set of environmental variables describing the prevailing climate in the basins, the physical nature of the basins and reflecting historical events known to have affected freshwater fish (Lassalle *et al.*, 2008) in order to construct predictive models. However, in the same study, conditions remained suitable in the northern part of its present distribution area and the Icelandic basins became favourable to this species (Fig. 2).

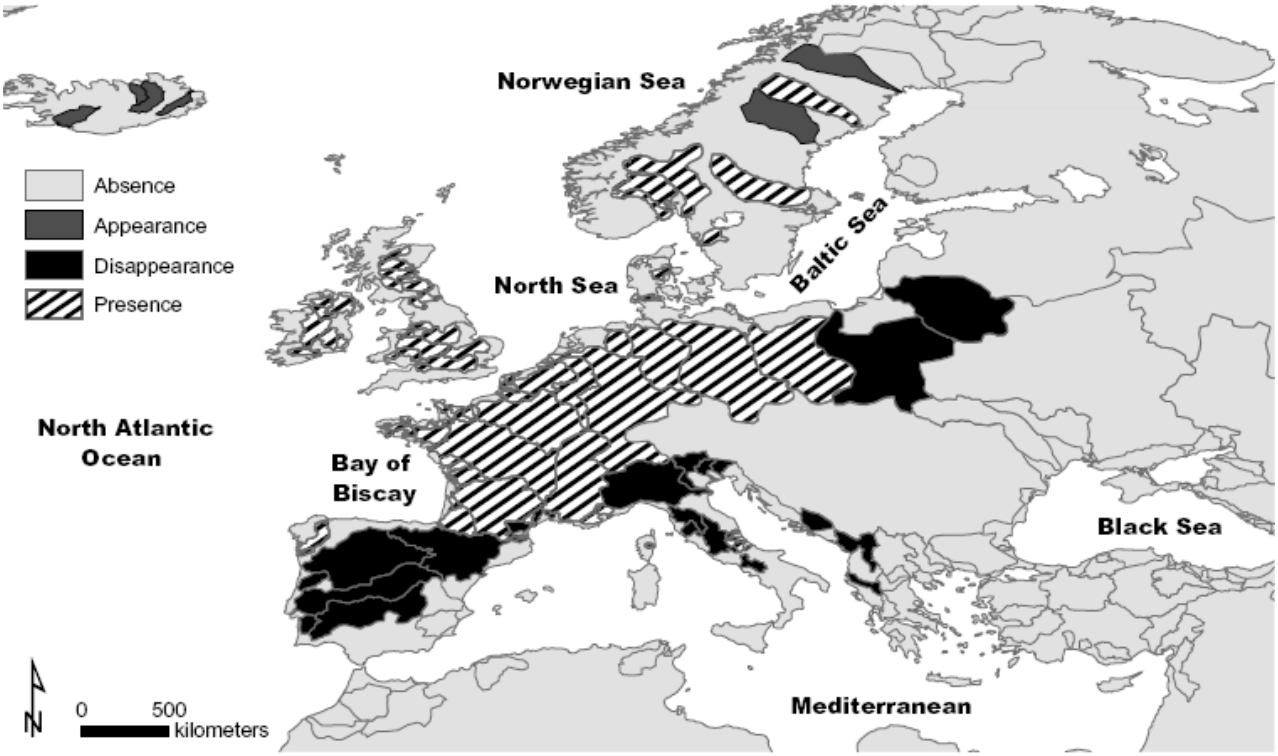

Figure 2: (Lassalle *et al.*, 2008) Potential distribution range of *P.marinus* under projected climate conditions at the end of the 21st century. This map is a hypothetic generation of a predictive model.

Few genetic studies have been carried out on the *P.marinus* but the little that has been done shows that the sea lamprey has a single pan-european population, which implies that it has good genetic resistance. Due to their lengthy larval life cycle they are subject to typically high interannual population fluctuations before returning to the ocean therefore certain years a very strong delayed emergence occurs (Lepage, pers.comm).

The impact of human activities has led to a drastic restriction and fragmentation of the distribution area of sea lamprey and has contributed to its placement on the red list of threatened species in Europe (Table 1, adapted from Beaulaton *et al.*, 2008).

Table 1: Conservation status of sea lamprey by country in the eastern Atlantic Ocean and western Mediterranean Sea according to IUCN (1994) criteria; adapted from Beaulaton *et al*. (2008).

Conservation status	Criteria	Countries
Extinct	There is no reasonable doubt that the last individual has died.	Flanders (Belgium)
Critically Endangered	Species is facing an extremely high risk of extinction in the wild in the immediate future.	United Kingdom, Germany, Spain (populations from South of Spain)
Endangered	Species is not critically endangered but is facing an extreme risk of extinction in the near future.	Sweden
Vulnerable	Species is not critically endangered or endangered but is facing a high risk of extinction in the wild in the medium-term future.	Portugal, France, Spain
Not evaluated	Species has not been assessed against the criteria	
Data Deficient		

Condition (current/trends/future prospects)

No known change since the time it was listed. Future trends are currently very unclear.

Little is known about the natural variability in the population of sea lamprey and therefore whether the decline is greater than might be expected through natural change (OSPAR 2006). The fact that activities on river systems are known to have affected the ability of adults to migrate up river does however suggest that the decline is at least in part due to human activity rather than natural variability. It is considered that future threats are generally the same as the present pressures, although awareness of lamprey conservation issues is already reducing the impact of river drainage and channel maintenance works on these species and these activities should be less of a threat in the future. Nonetheless, if sea lamprey population levels remain at the apparent present low levels then there is even greater likelihood that some populations may fail to achieve favourable conservation status without extensive intervention management (Igoe *et al.*, 2004).

Sea lamprey feed on large fish including sharks, adult shad and salmon. It seems likely that the abundance of sea lamprey in OSPAR waters may be linked to the abundance of suitable prey, in particular shad and salmon. The re-establishment of large migratory populations of these species in the rivers of a region will almost certainly aid the re-establishment of large sea lamprey populations (Henderson, 2003).

Limitations in knowledge

No change since the time it was listed.

Only the continental part of their biological cycle is partially known. As is often the case with diadromous fish species, our present knowledge of the biology and distribution during the marine part of their life cycle is practically non-existent. The decline in records in its freshwater habitat has provided the data on which this species has been given international protection through the EC Habitats and Species Directive and the Bern Convention (OSPAR 2006). It is recommended that a reporting scheme be initiated so that accidental captures by commercial fishermen and anglers can be recorded. Further research is also needed on the dispersal during the marine phase in the life cycle, and fidelity to their natal rivers, of sea lampreys, as the issue of homing has important consequences on the management of European stocks (Beaulaton *et al*., 2008).

Due to the absence of bony structures, such as otoliths, scales or spines, investigations on the larval growth of lampreys have usually relied on the analysis of length-frequency data (Hardisty & Potter, 1971) and yielded poor results, although recent studies on the use of statolith microchemistry as a technique for the natal origins of sea lamprey populations are promising (Hand *et al*., 2008).

Very little is known about the precise habitats occupied by adult sea lampreys. Although adults are sometimes caught at sea, the precise conditions in which they occur have not been described, nor is it certain which fish are the main prey species (Maitland 2003).

4. Evaluation of threats and impacts

A summary of the key activities which can cause impacts to *P.marinus* carried out in inland waters is given in Table 2. Sea lampreys are vulnerable to habitat modifications and the obstruction by weirs and barrages across their migratory routes. They are also affected by poor water quality in the larval habitat. Because they are widely distributed during the marine part of the life cycle there are no specific threats linked to habitat loss or modification within coastal and estuarine waters (Henderson 2003).

Table 2: Summary of key threats and impacts to *P.marinus*

Type of impact	**Cause of threat**	**Comment**
Obstacles blocking access to spawning grounds	Development: Building of dams and navigation weirs/lochs	Features such as weirs and dams, may impede migration to spawning grounds. In comparison to other migratory species, sea lampreys seem to be relatively poor at ascending obstacles to migration, and are frequently restricted to the lower reaches of rivers.
Poor water quality	Water pollution: sewage, pesticides/ herbicides, heavy metal contamination	Lampreys need well-oxygenated freshwater. As the ammocoetes remain buried in sandy/silty deposits for several years, they are particularly sensitive to the accumulation of toxins or heavy metals in interstitial water.
Loss of substrate for spawning	Riverbed sand and gravel extraction Removal of sediment	Since a large proportion of the life cycle of lampreys is spent in burrows in silt beds, special attention must be paid to these (not normally considered as important fish habitat), and to spawning gravels, in considering the impact of a proposed development on a river.

Type of impact	Cause of threat	Comment
Overfishing	Fishing	Probably the most important fishing related mortalities are caused by fish traps in estuarine waters in localities where lamprey concentrate during their upstream spawning migrations. Although historically the sea lamprey has been commercially fished throughout its European range, nowadays it is much reduced and limited to fisheries in Spain, Portugal and France. Accidental capture during trawling in marine waters seems to be rare.
Habitat modification resulting in uniform channel structure	Development: land claim Uses: shipping	Inappropriate timing of channel maintenance could lead to disruption of redd structures in gravelled areas with egg washout and dispersal. O'Connor (2004) has identified arterial drainage as a major factor in altering the hydraulic regime in impacted channels and, in turn, eliminating juvenile lamprey habitat. The processes of straightening, of removal of bed high points and subsequent formation of extensive uniform glide areas are considered to have reduced the areas available for natural sediment deposition – the natural homes for juvenile lamprey.
Juvenile mortality	Climate change	Water temperature and river discharge, both of which can be altered by climate change, are the two most important parameters determining marine lamprey migratory movement and choice of resting sites.
Juvenile mortality	Power stations water intake	Long, thin fish are particularly vulnerable to passage through pumps and other moving machinery. Where cooling water intakes are present, small numbers of migratory lamprey are killed each year. Because of their large size the cooling water intakes of direct-cooled coastal power stations are almost certainly the most damaging (Henderson 2003).
Eutrophication	Nutrient increase	Eutrophication acts in a similar way to other forms of pollution. Lush growths of algae and bacteria associated with increased nutrients smother both the spawning gravels (preventing spawning or killing eggs) and nursery silts, creating anoxic conditions there.
Bait digging	Fishing	There has always been an interest in lampreys (both ammocoetes and adults) from anglers as bait, and this seems to have increased in recent years and to favour adult river lampreys in particular. Indiscriminate trapping of adults could damage populations, and the search for larvae (by digging out substrate) not only affects the population directly but also causes significant damage to their habitat.

Type of impact	Cause of threat	Comment
Modification of hydrographic functioning, general	Uses: coastal forestry/farming	In addition to direct impact on ammocoete beds (drying out, modifications in sediment size) freshwater use for agricultural, industrial and domestic purposes is also responsible for a considerable reduction in the river flow. As a consequence, migratory clues have been eliminated, resulting in a decrease in the number of adult sea lampreys that enter the rivers to spawn (Almeida *et al.*, 2000).
Management of aquatic and bank vegetation for drainage purposes	Development and navigational maintenance	The diversity of habitats required by lampreys means that any "cleaning" actions concerning aquatic and bank vegtation need to be carried out with extreme caution. Unregulated management can lead to monotonous riverine macro-habitats (Sabatié 1998). The presence of lentic waters with silty substrates rich in organic matter are an essential component of the productivity of the lower trophic levels in a river (organic matter, primary production and invertebrates), the value of which have been underligned for other anadromous species such as sea trout.

5. Existing Management measures

The sea lamprey is listed on Annexes IIa & Va of the EC Habitats Directive and Annex III of the Bern Convention. It was classified as Least Concern by IUCN in 2008.

There are no known dedicated monitoring, artificial breeding or re-stocking programmes for sea lampreys. A number of research programmes carrying out migratory fish inventories in river basins are underway in several Contracting Parties to record sea lamprey presence and biological parameters, but as these research efforts are varied, separate and mostly still ongoing results cannot be presented in this assessment.

A considerable amount of research on sea lamprey biology has been carried out in North America where sea lamprey populations invaded the Great Lakes in the 1800s. Since the 1980s a number of costly control programmes have been developed to prevent the decimation of local landlocked fish populations.

In France where on some river basins the sea lamprey supports a thriving fishery (see Annex 1), a minimum landing size of 40 cm is set and the fishing season is limited to between 1 December and 15 May. In Portugal the professional fishing season is set between December and April. No annual quotas per river basin are currently in place in France, Portugal or Spain.

6. Conclusion on overall status

There is no known change in the status of this species since it was first proposed to be listed by OSPAR in 2001. Future trends are currently very unclear. In Beaulaton *et al*. (2008), historical datasets for four European rivers (Adour, Garonne, Vilaine and Rhine) show an increase in the number of lamprey captured since the 1990s. However, because of the absence of historical or recent data sets for comparison over a wider area it is not possible to make any definitive comment on trends at an OSPAR scale, therefore even an apparent positive trend in population should not be interpreted to mean that no further actions are required. Current management measures concern riverine habitat

management and restoration, and while helpful do not appear to be sufficient to allow for the recovery of this species.

Since a large proportion of the life cycle of lampreys is spent in burrows in silt beds, special attention must be paid to these (not normally considered as important fish habitat), and to spawning gravels, in considering the impact of a proposed development on a river. Fishery management for one group may adversely affect other wildlife and its habitat. For example, action to improve conditions for salmonids (for example, dredging or the provision of fish passes only surmountable by salmonids) may be detrimental to lamprey (Maitland, 2003). However, the implementation of Water Framework Directive (WFD) requirements should lead to improvements in water quality attributes in estuaries and rivers. This may, in turn, facilitate habitat use by all diadromous species. In addition, physical barriers to upstream migration may also come under scrutiny under the WFD, which requires that 'connectivity' exist in watercourses. Such geomorphological connectivity would benefit biological connectivity and would benefit all life history stages of all diadromous fish species.

Most of the environmental problems affecting sea lamprey are in freshwater and estuarine environments, and there is no evidence that anthropogenic activities in fully marine environments are threatening sea lamprey populations. Therefore, in summary, there seem to be reasonable prospects for restoration of the species' supporting inland habitat. But the extent to which the species' habitat is restored in areas outside the site network designated through the implementation of the Water Framework Directive is unclear at present. Restoring access for the species to areas from which it is excluded by barriers is another potential future restoration action. Action to restore the morphology of rivers to achieve the objectives of the Water Framework Directive may help deliver this, but a lack of understanding of the water quantity needs of *P.marinus* and some of their exact habitat requirements is a potential hindrance. The difficulty in confidently recording *P.marinus* ammocoetes, and hence assessing their population status and range, is a further hindrance. Based on this information, it is difficult to confidently justify a judgment on the sea lamprey's overall status (JNCC 2007).

7. Action to be taken by OSPAR

Action/measures that OSPAR could take, subject to OSPAR agreement

As set out in Article 4 of Annex V of the Convention, OSPAR has agreed that no programme or measure concerning a question relating to the management of fisheries shall be adopted under this Annex. However where the Commission considers that action is desirable in relation to such a question, it shall draw that question to the attention of the authority or international body competent for that question. Where action within the competence of the Commission is desirable to complement or support action by those authorities or bodies, the Commission shall endeavour to cooperate with them.

OSPAR should contact the European Commission and the standing committee of the Bern Convention to:

a. notify them of the listing under OSPAR, threats facing the species, and the willingness of OSPAR to co-operate in developing conservation measures;

b. request information on the effectiveness of any measures taken for the protection of this species;

OSPAR should work with relevant Contracting Parties (see Table 3 below) to:

a. raise awareness of status and threats to the species among management authorities, fishermen, retailers and the general public;

b. improve communication and information exchanges between *P.marinus* researchers and authorities;

c. improve communication between North American and OSPAR Region research and management initiatives and results.

Actions/measures for relevant Contracting Parties

OSPAR should recommend that relevant Contracting Parties (see Table 3 below):

a. organise a reporting scheme so that the capture of sea lamprey by commercial fishermen in Portugal, Spain and France is recorded and centralised and envisage closing spawning grounds to fishing from March until May;

b. organise a reporting scheme to gather all abundance data gathering within contracting parties on ammocoete and/or adults;

c. organise a reporting scheme so that the accidental by-catch of sea lamprey at sea is logged systematically in order to further knowledge on the distribution and feeding of sea lamprey during the marine part of their life-cycle.

OSPAR should establish a mechanism by which Contracting Parties report back on the implementation of the above recommendations so that the development of the necessary measures can be evaluated. As a first step Contracting Parties who have *P.marinus* present in their coastal waters should make an assessment of the effectiveness of the regulations they already have in place for its protection, consider how those regulations might be made more effective through improved monitoring, control and surveillance and report the results to the OSPAR Commission.

Suggestions for further research

OSPAR should emphasise to relevant scientific funding bodies and existing national monitoring programmes the following research needs with respect to *P.marinus:*

a. further development of decision-support tools such as microsatellite markers and biogeographical models;

b. further international collaboration to investigate the genetic diversity and relationships among the various populations of sea lamprey in Europe;

c. further data collection, harmonisation and collation to increase the baseline data collection where resources allow;

d. research relevant to the reintroduction of the sea lamprey to sites from which it has been excluded by pollution, dams and weirs;

e. further studies regarding the sea lamprey's preferential resting sites and migratory movement.

Table 3: Summary of key threats and existing protection for *Petromyzon marinus*

Key threats	Encountered in inland waters: habitat alteration, pollution, activities that result in altered river flow rate.
Relevant Contracting Parties	Iceland, UK, Ireland, Belgium, the Netherlands, Germany, Denmark, Norway, Sweden, France, Spain, Portugal
Other responsible authorities	EC, FAO, RFMOs

Already protected? **Measures adequate?**	Habitat & Species Directive Annex IIa and Va (excepting the Swedish populations) Bern Convention Annex III Barcelona Convention Annex III IUCN Red List LC (Least Concern)	One of the first steps Contracting Parties are recommended to take is an assessment of the effectiveness of the regulations they already have in place, and how those regulations might be made more effective through improved monitoring, control and surveillance.

Brief Summary of proposed monitoring system (see annex 2)

As for the allis shad, a set protocol for monitoring the river, brook and sea lamprey (*Lampetra fluviatilis*, *Lampetra planieri* and *Petromyzon marinus*) has been produced in the UK as part of Life in UK Rivers (Harvey & Cowx, 2003) – a project to develop methods for conserving the wildlife and habitats of rivers within the Natura 2000 network of protected European sites.

Sea lampreys are caught so infrequently at sea and so little is known about their maritime distribution that a targeted marine monitoring system is not feasible.

Annex 1. Overview of data and information provided by Contracting Parties

Contracting Party	**Feature occurs in CP's Maritime Area**	**Contribution made to the assessment (e.g. data/ information provided)**	**National reports** **References or weblinks**
Belgium	Y	Y	
Denmark	Y	Y	
France	Y	Y	Beaulaton L., Taverny C. and Castelnaud G., 2008. Fishing, abundance and life history traits of the anadromous sea lamprey (*Petromyzon marinus*) in Europe. *Fisheries Research* **92**: 90-101. Girardin M., Castelnaud G., Beaulaton L., 2006. Surveillance halieutique de l'estuaire de la Gironde – Suivi des captures 2004 – Etude de la faune circulante 2005. Rapport pour EDF CNPE du Blayais/ Etude Cemagref, groupement de Bordeaux, Cestas. N°105, 211p. Keith P. and Allardi J.(coord), 2001. Atlas des poissons d'eau douce de France. *Patrimoines Naturels* **47**: 387p.
Germany	Y	Y	Fricke R. 1987. Deutsche Meeresfische. Bestimmungsbuch. Hamburg (DJN), 219 pp. Meyer, Lutz (2009): On the situation of sea lamprey stocks in the catchments of the Rivers Elbe, Weser and Ems (Lower Saxony). – Lower Saxony Federal State Office for Consumer Protection and Food Safety, Department for Inland Fisheries; written communication from 29.01.2009. Spratte, S (2009): Short overview on the situation of the sea lamprey stocks in the catchments of the Rivers Elbe and Eider (Schleswig-Holstein). – Landesamt für Landwirtschaft, Umwelt und ländliche Räume des Landes Schleswig-Holstein (LLUR), Außenstelle Kiel (Fischerei), Abt. 3 Fischerei, Dezernat Binnenfischerei und Aquakultur; personal communication from 29.01.2009.
Iceland	Y	Y	

Contracting Party	**Feature occurs in CP's Maritime Area**	**Contribution made to the assessment** **(e.g. data/ information provided)**	**National reports** **References or weblinks**
Ireland	Y	Y	http://www.npws.ie/en/PublicationsLiterature/HabitatsDirectivereport07/Species/ Igoe F., Quigley D.T.G., Marnell F., Meskell E., O'Connor W. & Byrne C., 2004. The sea lamprey Petromyzon marinus (L.), river lamprey Lampetra fluviatilis (L.) and brook lamprey Lampetra planeri (Bloch) in Ireland: general biology, ecology, distribution and status with recommendations for conservation. Biology and Environment: Proceedings of the Royal Irish Academy 104B: 43–56. Kurz, I. and Costello, M. J. 1999 An outline of the biology, distribution and conservation of lampreys in Ireland. Irish Wildlife Manuals No. 5. Dublin, Duchas – the Heritage Service.
Netherlands	Y	Y	http://library.wur.nl/way/bestanden/clc/1883069.pdf (Dutch report with distribution maps)
Norway	Y	Y	
Portugal	Y	Y	http://www-heb.pac.dfo-mpo.gc.ca/congress/2002/Lamprey/Almeida.pdf
Spain	Y	Y	Alfonso A.& Vaz-Pires, P. (1992): A pesca da lampreia (Petromyzon marinus) no estuario do rio Lima. Instituto Nacional de Investigaçao das Pescas Publicaçoes Avulsas, 17: 179-197. Americo Sousa, J. (1992): Fase larvar e metamorfose da populaçao de lampreia (Petromyzon marinus) no estuario do rio Lima. Instituto Nacional de Investigaçao das Pescas Publicaçoes Avulsas, 17: 199-227. Beamish, F.W.H., Potter, I.C.& Thomas, E. (1979): Proximate composition of the anadromous sea lamprey, Petromyzon marinus. Environmental Biology of Fishes 4 (1): 1-9. Doadrio, I. (Ed) (2001): Atlas y Libro Rojo de los Peces Continentales de España. 2ª Edición. CSIC/MIMAM: 374 pp. Granado, C. (2001): Lamprea marina, p.15, in: Libro Rojo de los Vertebrados Amenazados de Andalucía. Consejería de Medio Ambiente. Junta de Andalucía. 336 pp.

Contracting Party	**Feature occurs in CP's Maritime Area**	**Contribution made to the assessment (e.g. data/ information provided)**	**National reports** **References or weblinks**
Sweden	Y	Y	Ljunggren, N. & M. Söderman 2008. Inventering av havs- och flodnejonöga i Halland 2008. Länsstyrelsen Halland, Enheten för naturvård och miljöövervakning. Meddelande 2008:XX (unpublished) Nathanson, J.E. & T. Soler 2009: Åtgärdsprogram för bevarande av Havsnejonöga. Fiskeriverket och Naturvårdsverket.(unpublished) Nathanson, J.-E. & T. Soler 2007. Havsnejonöga, Petromyzon marinus. s. 31-33. Ur: Tjernberg, M. & M. Svensson (red.) Artfakta. Rödlistade ryggradsdjur i Sverige. ArtDatabanken, SLU, Uppsala.
UK	Y	Y	http://www.jncc.gov.uk/pdf/Article17/FCS2007-S1095-audit-Final.pdf http://www.english-nature.org.uk/LIFEinUKRivers/publications/lamprey.pdf http://www.jncc.gov.uk/ProtectedSites/SACselection/species.asp?FeatureIntCode=S1095 Barnes, M.K.S., 2008. Petromyzon marinus. Sea lamprey. Marine Life Information Network: Biology and Sensitivity Key Information Sub-programme [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 21/11/2008]. Available from: http://www.marlin.ac.uk/species/Petromyzonmarinus.htm Davies CE, Shelley J, Harding PT, Mclean, IFG, Gardiner R and Peirson, G (eds.). 2004. Freshwater fishes in Britain. The species and their distribution. Harley Books, Colchester.

The Sea Lamprey was nominated for inclusion in the OSPAR List in 2001 by Belgium. Contact Persons: Jan Haelters & Francis Kerckhof, Management Unit of the North Sea Mathematical Models, 3e en 23e Linieregimentsplein, 8400 Oostende, Belgium.

Summaries of country-specific information provided

Britain: *Petromyzon marinus* is reasonably widespread in UK rivers. Records are concentrated in East Anglia, the south-west and south and east Scotland. The rivers Wye and Severn are particular strongholds, together with several rivers in Wales (Davies *et al.,* 2004). There are no records from the Northern Isles and the Inner Hebrides, and it appears to be absent from much of north-west England and the Midlands, with only sparse records from the southern counties of England (Davies *et al.,* 2004).

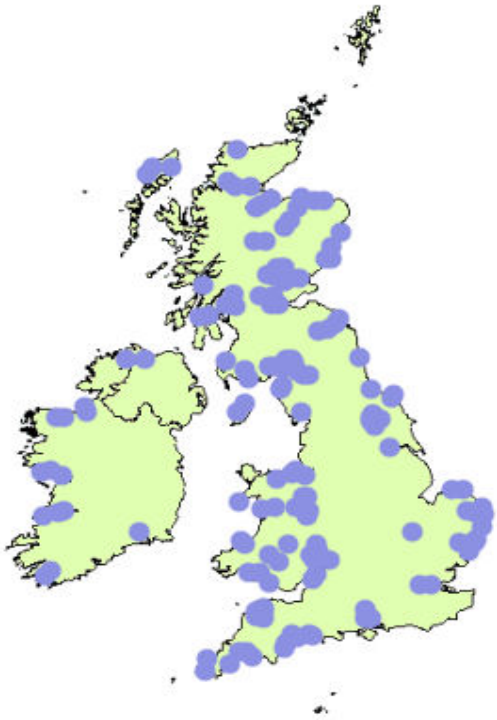

Figure 3: Distribution map of *P.marinus* in the UK and Ireland- courtesy of MarLIN

Ireland: Kurz and Costello (1999) compiled the first review of available information on records of all three taxa in Ireland. Between this baseline and subsequent survey work, considerable awareness has been created and many additional records added. Spawning has been observed in the R. Moy in Ballina, the R. Corrib in Galway city, the Fergus in Ennis, the Shannon at Castleconnell and Plassey, the neighbouring R. Mulkear at Annacotty, at the Cork Waterworks on the R. Lee, the Munster Blackwater in Fermoy and in the R. Suir at Clonmel. Redd count surveys have been undertaken by Central Fisheries Board on the Munster Blackwater and Slaney (King & Linnane 2004) and on the Suir and Nore (CFB unpublished data). These have permitted an appraisal of location and extent of spawning effort. Staff of Eastern Regional Fisheries Board recorded a sea lamprey on the R. Glyde in May 2007 and on the R. Vartry in June 2007, in what may be the first records for these systems. Evidence of redd construction, but without sightings of adult fish, have come from ERFB staff on the Boyne and Liffey. When an ERFB record from the Avoca catchment is added, this points to a penetration of all the major east-coast catchments by *Petromyzon marinus*.

There is no recorded coverage for sea lamprey from the R. Lee around the west Cork and Kerry coasts to Castlemaine. This may be largely a consequence of their not being observed in many of these remote and thinly-populated areas. Sea lamprey adults are reported from the Killarney National Park (Kurz & Costello 1999) and from the R. Feale (O'Connor 2006 (a); P. Halpin, ShRFB pers. comm.). The species is widely recorded in waters of the Shannon estuary and major tributaries – in the Deel (P. Halpin, ShRFB pers comm.), Fergus, Shannon and Mulkear. There are also some records pointing to the presence of a land-locked population of sea lamprey in L. Derg (O' Connor pers comm.; ESB 1998; responses to CFB website). Apart from records in Galway city and occasional records from Oughterard, there are no reports on the Galway and west Mayo coastline or influent channels. Sea lamprey are commonly reported on the Moy and from the Deel, a tributary catchment of L. Conn. In 2007, adult fish were also reported well up the catchment in the Castlebar River and in the R. Eignagh by Fisheries Board staff (P. Traynor, NWRFB pers. comm.; G. Wightman CFB). There are records of sea lamprey from the Garavogue system, with one email report of a sea lamprey in Sligo as early as January (Diarmuid Neilan, pers. comm.).

France: Sea lampreys are present in a number of small rivers in Brittany, in the Loire, the Gironde estuary, the Adour, and in the Rhône and a few other Mediterranean streams (Fig. 4). The Loire, Gironde-Garonne-Dordogne river system and the Adour support a professional and non-professional sea lamprey fishery which targets adult individuals on their upstream migration, and takes place between 1 December and 15 May. In 2003 total lamprey production was estimated as being 150.5 tonnes, with an average price of 12 euros per kilo (Girardin *et al*., 2006). Although no quota is set, the minimum landing size for lamprey is 40 cm. The mean catch of the Garonne basin, over the period 1985–2003, was 72 t, confirming the top rank of the Garonne Basin sea lamprey population and of its fisheries. Sea lamprey abundance appears to have peaked strongly between 1952 and 1970. From 1973 onwards, the trend is stable and abundance was only 35–40% of the maximum level. Since the end of the 1990s, the CPUE has shown a strong increase — a sign of an upward trend in lamprey abundance (Beaulaton *et al.,* 2008).

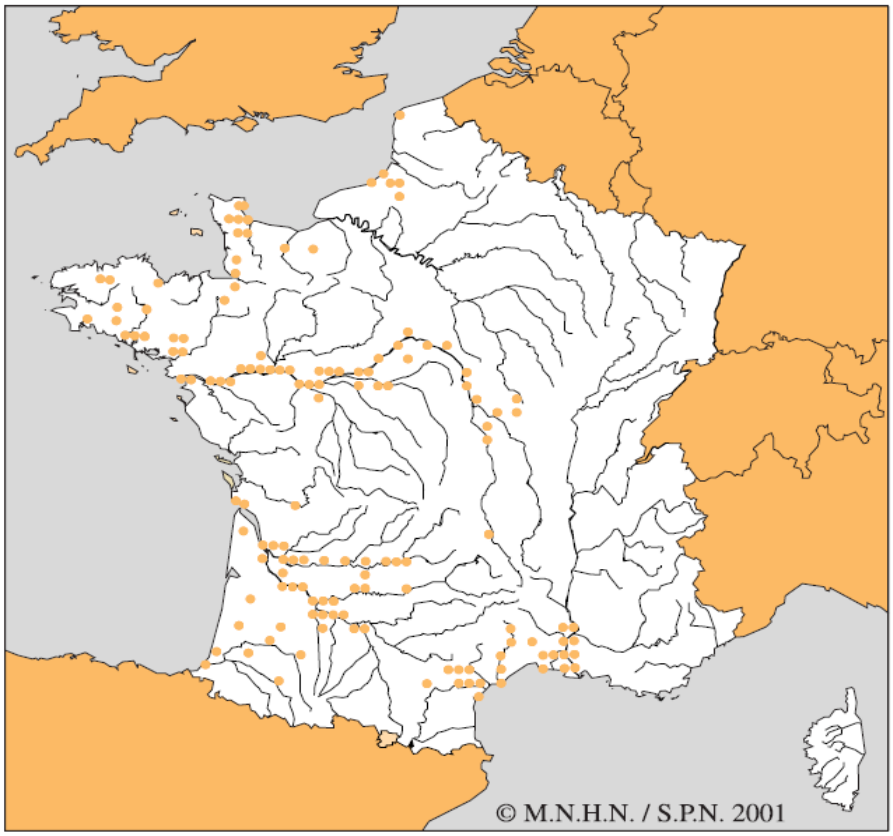

Figure 4: Distribution of *P.marinus* spawning sites in French river systems (Keith & Allardi 2001).

Migratory Fish Management Committees (COGEPOMI – *Comités de Gestion des Poisson Migrateurs*) have been set up for 8 major river basins in France established under the 1984 Fisheries Act and Decree No. 94-157 of 16 February 1994. They draw up 5-year management plans for individual river-basins, watercourses or groups of watercourses, setting out fishery management regulations tailored to the type of commercial or recreational fishing practised there, as well as conservation measures where necessary. These management committees represent the authorities and the industry. In addition to the sea lamprey, 6 other species are managed by these committees: the river lamprey

(*Lampetra fluviatilis*), the Atlantic salmon (*Salmo salar*), the allis shad (*Alosa alosa*), the twaite shad (*Alosa fallax*), the european eel *(Anguilla anguilla*) and the brown trout (*Salmo trutta*).

Germany: There are only sparse data on the distribution (spatial, seasonal) of sea lamprey in the German part of the North Sea because this species is caught only accidentally by commercial fisheries or scientific fishing surveys.

Information is provided on distribution and abundance of the sea lamprey in the German Federal State of Lower-Saxony hosting the main tributaries to the German North Sea area.

According to historical references from around 1900, sea lamprey seemed to be not abundant in the catchments of the Rivers Ems, Weser, Elbe and Eider and, as a result, was characterized as “rare”. Therefore, sea lampreys have never been an object of commercial fishery, in contrast to the anadromous river lamprey (*Lampetra fluviatilis*). The occurrence (or spawning) of this species was also documented for several major tributaries in the tidal reaches of the above-mentioned Rivers.

Meanwhile until the 1980s the sea lamprey became almost extinct in the northern German tributaries to the North Sea, due to heavy water pollution (especially in the estuaries), the building of migration barriers and the alteration of water courses in the adjacent river systems. However, since 1995 the stocks of sea lampreys are remarkably increasing again (especially in the catchment of the tidal River Elbe), probably due to the improved water quality following the political changes in Central Europe since 1990 (Rivers Elbe and Weser) and the restoration of water courses (e. g. the improvement of fish passage facilities) since the programme for management of water courses of Lower Saxony started in 1992.

Although annual spawning migrations of sea lamprey are documented in all the estuaries, the current situation of sea lamprey stocks in the catchments of the Rivers Elbe, Weser and Ems differ remarkably.

River Elbe: The estimated by-catch of sea lampreys by commercial fyke netting on eel in the tidal reach upstream Hamburg amounts to approximately 500/a on average (lampreys are generally released). Spawning ascent and/or spawning is regularly documented in all major tributaries of the tidal Elbe in the federal states Lower Saxony (Oste, Schwinge, Aue-Lühe, Este, Seeve, Luhe, Ilmenau) and Schleswig-Holstein (Stör, Pinnau, Krückau and some smaller tributaries of the Nord-Ostsee-Kanal, S. Spratte, personal communication, 29.01.2009), sometimes on artificial riffle structures (*e.g.* in the tailrace of hydroelectric power stations s of or under road bridges). Altogether, the estimated number of sea lampreys ascending into the Lower Saxonian tributaries also amounted to approximately 500/a on average, based on systematic surveys on spawning sites in 2001-2003 (with a considerable number of unreported cases). Sea lampreys are also annually documented in the Middle Elbe by stow netting about 100 or 200 km respectively upstream the tidal weir at Geesthacht. Due to the fact, that most of them obviously are spent lampreys, spawning on large gravel banks in the Middle Elbe (Saxony-Anhalt) seems to be likely. In Schleswig-Holstein a spawning ascent is also observed in the River Treene (**River Eider** catchment), (S. Spratte, personal communication, 29.01.2009).

River Weser: Based on the number of sea lampreys documented by non commercial fyke netting in the tailwater of the weir at Bremen-Hemelingen the annual spawning run in the tidal River Weser amounts to an estimated number of several hundred lampreys at least. Additionally, a number of approximately < 100 sea lampreys are annually documented from detected spawning sites in the tributaries of the tidal river Weser (Hunte, Wümme, Ochtum, Delme). In contrast, the situation of the sea lamprey stock in the catchment of the Middle Weser is unknown up to now (only one proof of a male sea lamprey in the River Leine after a flood period in spring 2002).

River Ems: The estimated number of sea lampreys annually ascending through the River Ems estuary documented by stow net fishery is small (< 100 on average) compared to the estuaries of River Elbe and Weser, due to problems connected with temporary deficits in oxygen saturation and extreme high turbidity. In the past spawning migration in the Middle Ems was obstructed by the almost impassable weir at Bollingerfähr (upstream the tidal weir at Herbrum). Spawning in the River Ems or the tributaries (catchment of Leda-Jümme) was not detected up to now, particularly suitable spawning sites are lacking.

In the updated *Red List of Freshwater Fishes of Lower Saxony* the sea lamprey has been downgraded from “near to extinction” to “seriously endangered”. Furthermore, the sea lamprey in Lower Saxony will also profit by the continued implementation of the “Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora” and the “Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy”.

Portugal: The sea lamprey supports commercial fisheries in most of the major Portuguese river systems (Fig. 5), particularly in the central and northern regions of the country.

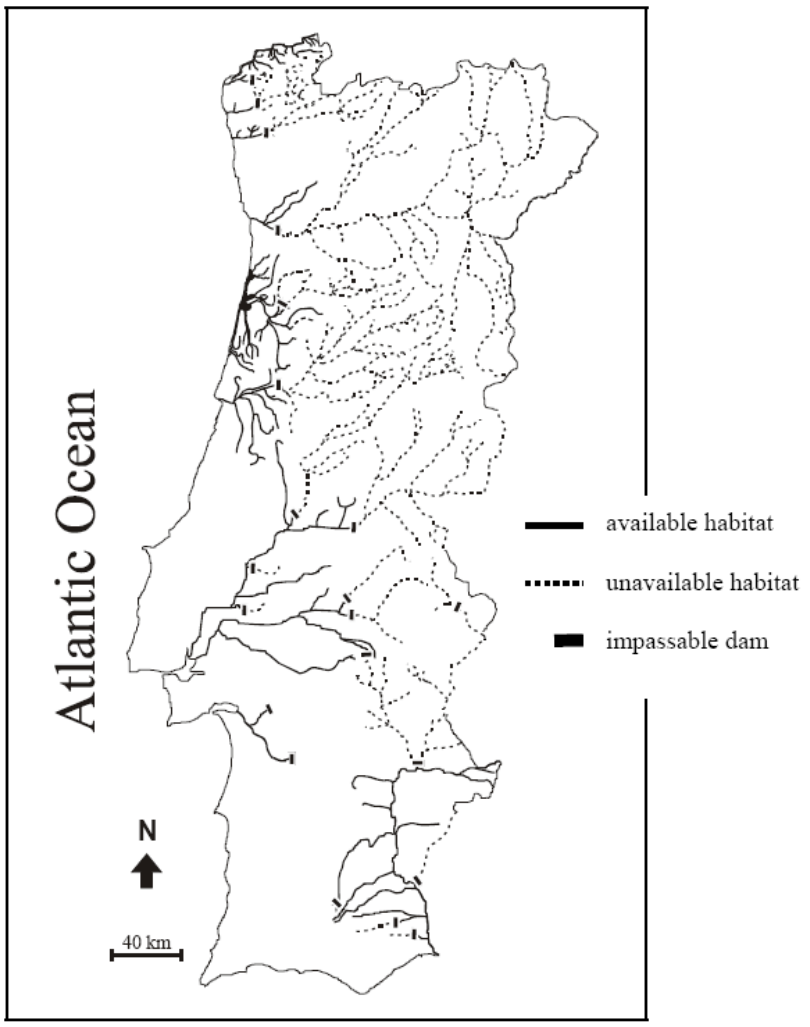

Figure 5: Habitat available to sea lamprey populations in Portuguese river basins where the species is known to occur.

Sea lampreys are considered a delicacy in Portugal and, due to the high economic value of this fishery (one animal can cost as much as € 45), the main Portuguese estuaries and rivers are crowded with

fishermen and poachers during the annual sea lamprey spawning migration. These intense fisheries along with the reduction of suitable habitat, due to the construction of impassable dams, are the major threats to the survival of this species in Portuguese river basins.

There are intense sea lamprey fisheries: the exploitation in the Minho and Tagus river are assessed to 40 000 – 60 000 and 2500 – 5000 lampreys respectively (Almeida, P.R., personal communication).

The Netherlands: The Sea lamprey used to migrate from the North Sea upstream in the river Rhine up to Basel and in the Meuse up to deep in Belgium. Also in the Scheldt and the Ems the sea lamprey was common. Since 1960 numbers have declined steeply with minimum numbers reached in the '70s and '80s. However, Sea lamprey never completely disappeared from the Meuse and the Rhine. Since 1990 there is a slight, but continuous, increase in numbers in the rivers and the IJsselmeer.

The larvae of the sea lamprey grow up in the Netherlands, but adult individuals also pass through the Netherlands when migrating to spawning areas in Germany and Belgium. It is possible that there are even spawning sites in the Netherlands. Probable causes for the decline in numbers were the water quality and the blockage of passages through dams and sluices.

Spain: In the Spanish OSPAR Area, *Petromyzon marinus,* is present on the Cantabrian and Galician coasts, and in the Guadalquivir and Guadiaro estuaries, Guadalete river, Barbate river and Guadiana River (fig.6). Its present distribution extension covers less than 2000 km^2. (2007 data); southern populations are critically endangered while the northern populations are suffering a strong decline (with the exception of Galician Atlantic river populations).

Evaluation of threats and impacts

The decline in the Spanish populations is mainly based on deteriorating living conditions in watercourse habitats, such as pollution, reclamation projects, dredging projects, migration obstacles etc. Also, the overfishing activities are a threat for the species.

The following conservation measures are proposed:

Fishing regulations for all the populations.
Establishment of fish passes.
Control of dredging materials
Control of river pollution.

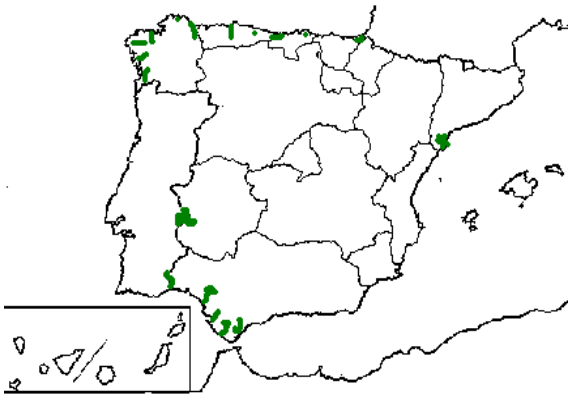

Figure 6: Habitat available to sea lamprey populations in Spanish river basins where the species is known to occur.

Sweden: Only a small part of the world population of Sea lamprey occur in Sweden. . From the 19th century onwards, it is described as being of infrequent or rare occurrence. It is primarily found in

watercourses discharging to the Kattegat or Öresund. Occurrence in watercourses discharging to the Skagerrak or the Baltic Sea is rarer. From the province of Blekinge and northward, reports of occurrence are few. The northern-most catch was made in 1965 in the Rickle stream (the province of Västerbotten).

The watercourse where most reproductive individuals go up to spawn is likely the river Ätran in the province of Halland. Attached is a figure of the distribution in the main watershed areas in Sweden.

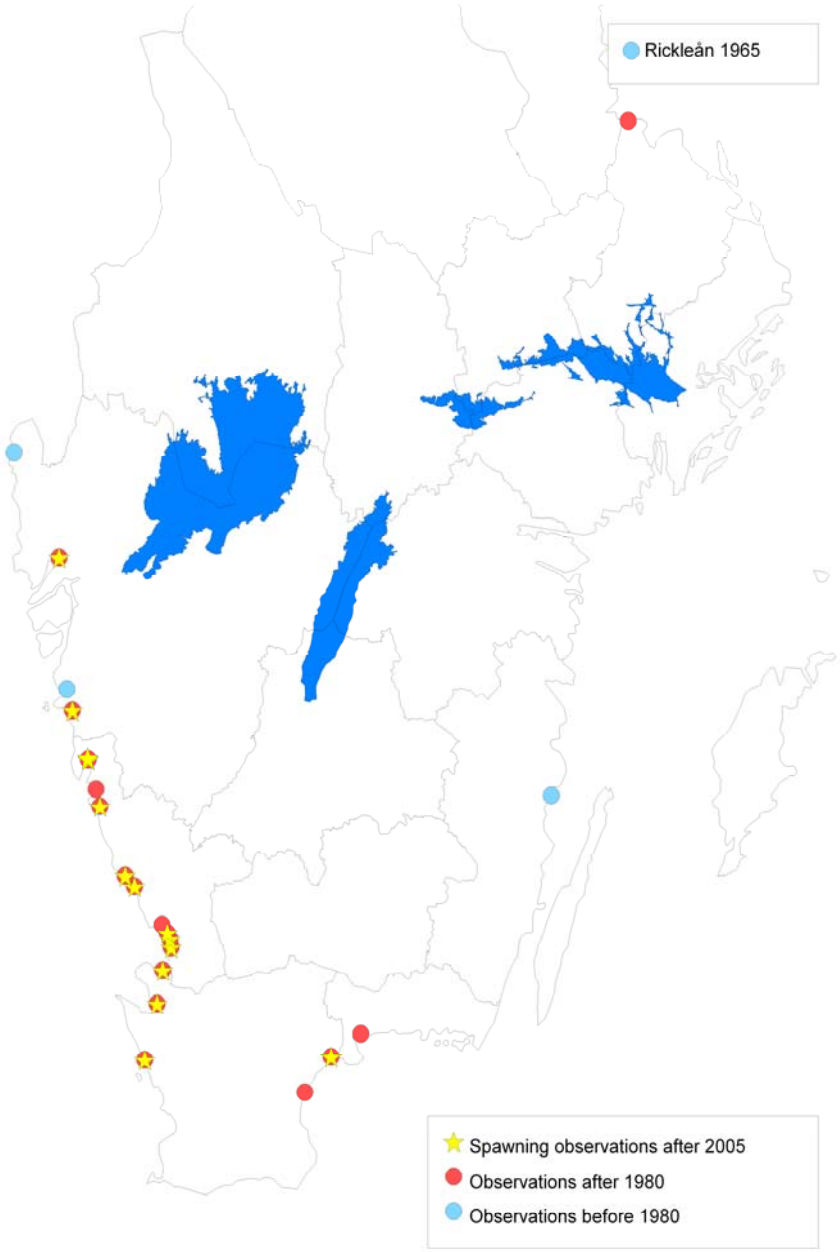

Figure 7: Distribution of the sea lamprey (*Petromyzon marinus*) in Swedish main drainage areas before and after 1980, and spawning observation after 2005.

Population

On the Swedish Red List for the year 2005, sea lamprey is listed as "*Endangered*" (EN). The listing is due to the fact that the population is estimated to comprise fewer than 2500 mature individuals, and that the stock has declined by at least 10% over the last 24-30 years (three generations). No subpopulation (watercourse) has more than 250 reproductive individuals. In the past two generations, the decline has been 20%.

It is difficult to estimate the population trend for the next ten years. Improvement in watercourse biotopes such as fish passes, clearing of migration obstacles, etc., may in time favour the species. Possibly the most current threat to the species is the deteriorating living conditions in the marine and coastal areas, as well as an increasingly limited access to food. The distribution and population status of sea lamprey should be favoured by a warmer climate in the northern hemisphere.

Condition

Detailed knowledge of population growth and yield is lacking in this country.

Limitations in knowledge

In the summer of 2008, the first directed inventory of the species was conducted. All watercourses containing sea lamprey in Halland were surveyed. In nine rivers, spawning was observed. Reproductional success in earlier years was inventoried using electric fishing of larvae. In two watercourses, the spawning fish were counted. Similar studies to those made in Halland should be conducted in other parts of the area of distribution, in all events in those watercourses that debouch to the Skagerrak, Öresund and the southern Baltic Sea. When the occurrence has been mapped, a (standardized) methodology for monitoring should be established in order to facilitate comparisons with other populations occurring in Europe.

In order to optimize directed measures, those activities detrimental to the species in those water systems where spawning and larva growth are taking place should be identified.

The greatest knowledge gap is with regard to the marine environment, such as choice of food, the condition of prey at the moment of attack, and the growth environments in use in the marine and coastal areas. In addition, knowledge of the genetic exchange between the Swedish population(s) and those at more southern latitudes would be of value.

Evaluation of threats and impacts

The decline in the population specified in the Swedish Red List is based on deteriorating living conditions in watercourses, such as pollution, reclamation projects, migration obstacles etc. Also, the increasingly lower occurrence of cod species along the Swedish coast is an worrying factor. What might favour the species in time is the improving water quality in Swedish watercourses, and that fish management of salmon species may also favour other species such as sea lamprey.

Existing Management measures

In Sweden, the catching of sea lamprey is prohibited (FIFS 2004:36 concerning fishing in the Skagerrak, the Kattegat and the Baltic Sea, and FIFS 2004:37 concerning freshwater fish). The prohibition is with regard to the intentional catching and killing of sea lamprey.

In order to improve the situation, a national action plan for sea lamprey is to be instituted. Prioritized measures will be biotope improvement (fish passes and restoration of important environments), re-introduction and area protection. The inventories made are to be the basis of population surveillance. To increase knowledge concerning the species, a certain amount of informational material will be assembled. In general, it is of importance that the protection and consolidation of the species will be addressed and highlighted when reviewing current court judgements and regulations. Sea lamprey should also be taken into consideration in court trials of water activities which may have consequences for the long-term survival of the species.

Annex 2. Description of the proposed monitoring and assessment strategy

A protocol for monitoring the river, brook and sea lamprey (*Lampetra fluviatilis*, *Lampetra planieri* and *Petromyzon marinus*) has been produced as part of Life in UK Rivers (Harvey & Cowx, 2003) – a project to develop methods for conserving the wildlife and habitats of rivers within the Natura 2000 network of protected European sites. The project's focus has been the conservation of rivers identified as Special Areas of Conservation (SACs) and of relevant habitats and species listed in annexes I and II of the European Union Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora (92/43/EEC) (the Habitats Directive). Given resource constraints, this protocol seeks to develop a programme that can monitor compliance with conservation objectives in a realistic and cost-effective way. For a more detailed protocol on the monitoring of river, brook and sea lamprey please see http://www.english-nature.org.uk/lifeinukrivers/species/lamprey_monitoring.pdf

Rationale for the proposed monitoring

Regular monitoring of the migrating sea lamprey population will be necessary to guarantee the effectiveness of measures taken to restore the species to a favourable conservation status in the OSPAR Maritime Area.

Synergies with monitoring of other species or habitats.

Attempts should be made to combine monitoring of lamprey ammocoetes with routine juvenile salmonid monitoring. The use of existing salmonid monitoring sites has a number of advantages (Harvey & Cowx 2003):

- Existing sites are generally situated near bridges, and older structures are often in areas where silt accumulates, providing optimal habitat conditions.
- Existing sites are likely to have areas of sub-optimal habitat (e.g. organic material, shallow sediment) where ammocoetes may be present.
- Existing sites are usually well distributed through a particular catchment, which will provide information on ammocoete distribution.
- Ammocoete sampling may be undertaken following salmonid surveys, thus avoiding the need for a repeat visit to the catchment. This would considerably decrease survey costs.
- The presence/absence of lampreys is usually recorded in juvenile salmonid monitoring. Hence, re-interrogating existing historical databases will reveal information on presence/absence of lamprey.
- Riparian-owner and fishery-owner access permissions are already agreed, thus avoiding the need for lengthy discussions concerning access.

Assessment criteria

Prior to identifying criteria to interpret the data, long-term data series for sea lamprey need to first of all be collected and centralised.

Techniques/approaches:

Baseline Monitoring

- Relevant current and historical data should be collected into a national data base and be made available to OSPAR;

- Standardized by-catch reporting (by informed and trained fishermen);
- Specialized surveys in suitable river basins (for example, Garonne-Gironde-Dordogne, Loire, Minho) and eventually in other areas if restocking is conducted.

Enhanced Monitoring

- Non-lethal fin ray samples of live by-caught specimens;
- Biopsies of dead by-caught specimens.

Selection of monitoring locations

The monitoring and reporting of by-caught specimen in marine fisheries has to take place in the entire OSPAR Maritime Area, though with an emphasis on coastal shelf areas and river basins.

Specialised freshwater surveys as described in the rest of this annex should take place in river basins where a spawning lamprey population is known to be present. In addition, improved monitoring of commercial and recreational lamprey fishermen could be envisaged in the following estuaries: Loire, Gironde, Adour (France), Minho, Tagus (Portugal) and Ulla (Galicia- Spain).

Timing and Frequency of monitoring.

The timing of surveys for ammocoetes is important to ensure capture of a range of size-classes that includes both young ammocoetes and transformers (juveniles transforming into adult lamprey). Metamorphosis usually takes place between July and September. It is therefore recommended that surveys are carried out in July at the earliest, but preferably between August and October, to detect the presence of transformed ammocoetes. This is the same time recommended for bullhead sampling and for monitoring salmonids, so costs should be reduced if the lamprey survey can be done at the same time.

Data collection and reporting

Baseline Monitoring

Relevant data on by-catch:

- Date;
- Location and depth;
- Type of fishing gear and species targeted;
- Size;
- Weight (kg);
- Visual condition;
- Fate (returned to sea, dead, sold, etc.).

Enhanced Monitoring

- Biopsies (needs detailed protocol with regards to the objectives (e.g. genetic identification, pathology search, etc.)
- Statolith microchemistry

Quality assurance

Refer to Harvey & Cowx (2003).

Annex 3: References

Almeida P.R., Quintella B.R., Dias N.M., Andrade N., 2002. The anadromous sea lamprey in Portugal: Biological and conservation perspectives. Lamprey Biology: Fish Biology Congress 2002. 10pp.

Almeida P.R, H.T. Silva and B. Quintella. 2000. The migratory behaviour of the sea lamprey *Petromyzon marinus* L., observed by acoustic telemetry in River Mondego (Portugal). In: A. Moore and I. Russel (eds.) Advances in fish telemetry. CEFAS, Suffolk: 99-108.

Andrade, N.O., Quintella, B.R., Ferreira, J., Pinela, S., Povoa, I., Almeida, P.R., 2007. Sea lamprey (*Petromyzon marinus* L.) spawning migration in the Vouga river basin (Portugal): poaching impact, preferential resting sites and spawning grounds. *Hydrobiologia* **582:** 121–132.

Beaulaton L., Taverny C. and Castelnaud G., 2008. Fishing, abundance and life history traits of the anadromous sea lamprey (*Petromyzon marinus*) in Europe. *Fisheries Research* **92**: 90-101.

Bergstedt R.A. and Seelye J.G., 1995.Evidence for lack of homing by sea lampreys.*Transactions of the American Fisheries Society* **124(2)**: 235-239.

Derosier A.M., Jones M.L., Scribner K.T., 2007.Dispersal of sea lamprey larvae during early life: relevance for recruitment dynamics. *Environmental Biology of Fishes* **78**:271-284.

Freyhof J. and Kottelat M. 2008. *Petromyzon marinus*. In: IUCN 2008. 2008 IUCN Red List of Threatened Species. <www.iucnredlist.org>

Haedrich R.C., 1977 A sea lamprey from the deep. Copeia 4: 7678.

Hand C.P., Ludsin S.A., Fryer B.J., and Marsden J.E., 2008. Statolith microchemistry as a technique for discriminating among Great Lakes sea lamprey (Petromyzon marinus) spawning tributaries. Canadian Journal of Fisheries and Aquatic Sciences 65: 1153-1164.

Hardisty M.W. and I.C. Potter. 1971. The behaviour, ecology and growth of larval lampreys. In: M.W. Hardisty and I.C. Potter. (eds.). The biology of lampreys Vol. I, London: Academic Press: 85-125

Harvey J. and Cowx I., 2003. Monitoring the River, Brook and Sea Lamprey, *Lampetra fluviatilis, L. planeri and Petromyzon marinus*. Conserving Natura 2000 Rivers Monitoring Series No. 5, English Nature, Peterborough.

Henderson P.A., 2003. Background information on species of shad and lamprey. Bangor, *CCW Marine Monitoring Report* **7** ; 30pp.

ICES, 2008. Report of the Working Group on Fish Ecology (WGFE), 3-7 March 2008, ICES, Copenhagen, Denmark. ICES CM 2008/LRC:04. 119 pp.

ICES, 2003. Report of the working group on fish ecology, Copenhagen, Denmark, ICES CM 2003/G:04.107pp.

Igoe F., Quigley D.T.G., Marnell F., Meskell E., O'Connor W. & Byrne C., 2004. The sea lamprey *Petromyzon marinus* (L.), river lamprey *Lampetra fluviatilis* (L.) and brook lamprey *Lampetra planeri* (Bloch) in Ireland: general biology, ecology, distribution and status with recommendations for conservation. *Biology and Environment: Proceedings of the Royal Irish Academy* **104B**: 43–56.

Kelly F.L. and King, J.J., 2001. A review of the ecology and distribution of three lamprey species, Lampetra fluviatilis (L), Lampetra planeri (L.), and Petromyzon marinus (L.): a context for conservation and biodiversity considerations in Ireland. *Biology and Environment: Proceedings of the Royal Irish Academy*. **101B**(3):165-185

Lassalle G., Béguer M., Beaulaton L. and Rochard E., 2008. Diadromous fish conservation plans need to consider global warming issues: An approach using biogeographical models. *Biological conservation* **141:**1105-1118.

Lelek A (1973). Occurrence of the sea lamprey in midwater off Europe. *Copeia* 1, 136–137.

Maitland P.S., 2003. *Ecology of the River, Brook and Sea Lamprey*. Conserving Natura 2000 Rivers Ecology Series No. 5. English Nature, Peterborough.

O'Connor W. & Byrne C., 2004. The sea lamprey *Petromyzon marinu*s (L.), river lamprey *Lampetra fluviatilis* (L.) and brook lamprey *Lampetra planeri* (Bloch) in Ireland: general biology, ecology, distribution and status with recommendations for conservation. *Biology and Environment: Proceedings of the Royal Irish Academy* **104B**: 43–56.

OSPAR 2006. Case Reports for the Initial List of Threatened and/or Declining Species and Habitats in the OSPAR Maritime Area. Biodiversity Series, 150pp.

OSPAR 2003. Criteria for the identification of species and habitats in need of protection and their method of application (the Texel-Faial Criteria). OSPAR Commission, London (Reference Number: 2003-13).

Poll M., 1945. Poissons marins. Faune de Belgique. Musée Royal d'Histoire Naturelle de Belgique, Brussels, 452pp.

Sabatié, M.R., 1998. Eléments d'écologie de la lamproie marine (*Petromyzon marinus* L.) dans une rivière bretonne: le Scorff. INRA, Rennes, Rapport final de la convention Région Bretagne du 23.10.1995 n.◦12172/95.

Taverny C., Urdaci M., Elie A.-M., Beaulaton L., Ortusi I., Daverat F. and Elie P., 2005. Biologie, écologie et pêche des lamproies migratrices (Agnathes amphihalins) - Troisième tranche fonctionnelle. Rapport final, n° 99, Cemagref Bordeaux, 71 p.

Torblaa R.L., and Westman R.W. 1980. Ecological impacts of lampricide treatments on sea lamprey (*Petromyzon marinus*) ammocoetes and metamorphosed individuals. *Canadian Journal of Fisheries and Aquatic Sciences* **37**: 1835–1850.

Vrieze L.A., and Sorensen P.W., 2001. Laboratory assessment of the role of a larval pheromone and natural stream odor in spawning stream localization by migratory sea lamprey (*Petromyzon marinus*). *Canadian Journal of Fisheries and Aquatic Sciences* **58:** 2374-2385.

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OSPAR's vision is of a healthy and diverse North-East Atlantic ecosystem

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