



Main conclusions and recommendations: 6

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► To cite this version:

Pedro R. Almeida, Eric Rochard. Main conclusions and recommendations: 6. Report of the ICES Workshop on Lampreys and Shads (WKLS), 2015, pp.169-195. hal-02602583

HAL Id: hal-02602583

<https://hal.inrae.fr/hal-02602583>

Submitted on 16 May 2020

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6 MAIN CONCLUSIONS AND RECOMMENDATIONS

Almeida P.R. and Rochard E.

6.1 SEA LAMPREY

The largest European populations of sea lamprey appear to be in the NW of the Iberian Peninsula (NW Spain and N Portugal) and W-SW France, regions that also contain the main sea lamprey commercial fisheries.

Recent research shows evidence of population structuring in western Iberian Peninsula that indicates the existence of three different stocks. This structuring may exist in other regions across the geographical range of the species, like in France, and further studies are needed to clarify this, in order to adequately manage the different stocks.

There is a considerable lack of information regarding the marine phase of the sea lamprey life cycle. Studies are needed to improve scientific knowledge during this period, since the balance between predator-prey may easily be disrupted if, for instance, the sea lamprey's preferential prey becomes a prime target for commercial fisheries. Which areas (horizontal and vertical distribution) of the Atlantic Ocean are used as feeding grounds by the sea lamprey is another question lacking an answer.

Some river basins in Portugal, Spain and France show signs of recovery based on the number of migrating adults, and abundance of larvae. These results should be analysed carefully, as this species presents a large inter-annual variation in their population numbers. Also, in some countries the official statistics are obtained from commercial fisheries catches, and fishing effort is not taken into account.

There is an urgent need for reliable information regarding commercial fisheries catches. Independent estimates of the annual number of migrating adults are fundamental to the monitoring of the population status. Larval abundance is a good way of measuring the population trends in a particular river basin or in a broader geographic range. A good solution is the monitoring of fishways, together with independent observations of fishery landings, and electric fishing larvae surveys. A good example of this integrated approach to accompany sea lamprey abundance trend in a particular watershed is the work that has been done in River Mondego, Portugal.

Obstacles to migration are consistently pointed out as the main threat to the survival of sea lamprey in Europe. In some European rivers, like in the Iberian Peninsula, an 80% habitat loss was estimated to occur during the last century. Thus, conservation and management efforts need to be directed towards ensuring the longitudinal connectivity within rivers, as well as the continued existence of the specific habitats used along lamprey life-cycles, like spawning and nursery areas.

Fisheries regulations should also be revised, since in some countries (e.g. Portugal), the fishing season covers the entire migration period. The definition of a close fishing period (5-10 days) during the migration peak could be one of the solutions to reduce fishing effort. This was put in practice in River Mondego (Portugal), since 2013, and the results are very promising.

In the countries with the bulk of the exploitation of sea lamprey, i.e. Portugal, Spain and France, there is no evidence of relevant bycatch of this species, and there are no recreational fisheries directed to it.

6.2 RIVER LAMPREY AND BROOK LAMPREYS

The conservation status of these species varies greatly across their distributional range. The Iberian Peninsula was one of the most important Pleistocene glacial refugia in Europe, and a number of studies have been supporting the existence of several minor refugia within Iberia, showing high genetic diversity, probably the result of refugial persistence and subsequent accumulation of variation over several ice ages. This is in contrast to the low levels of genetic diversity observed in central and northern Europe, which probably reflect a rapid postglacial colonization. Recent studies combining data from morphology and mitochondrial DNA led to the description of three new cryptic lamprey species, endemic to Portugal: Costa de Prata lamprey (*Lampetra alavariensis*), Nabão lamprey (*Lampetra auremensis*) and Sado lamprey (*Lampetra lusitanica*). These species have extremely restricted distributions, being inherently at risk of extinction.

Appropriate measures, such as, the designation of a network of Special Areas of Conservation (SACs) for each imperilled species, and their inclusion in the IUCN categories and other European legislations (as well as at the national levels) would help to ensure the survival of these species. This recommendation is especially important in the case of the newly-described species endemic to Portugal, which are currently not protected by any legal tool.

Like in the case of sea lamprey, conservation and management efforts should promote the longitudinal connectivity within rivers, as well as the recovery and maintenance of the specific habitats used along lamprey life-cycles, like spawning grounds and larval habitats.

Even though of particular conservation concern in the southern limit of its distribution, the river lamprey is abundant in its northern distribution. Substantial populations of river lamprey occur in the eastern Baltic Sea and commercial fisheries operate in some countries for this species. In Estonia, river lampreys are widespread and commercially exploited. The river lamprey is an important source of income for many fishermen in Sweden and Finland. The total yearly catch of lampreys in Finland during the 1980's was 2-2.5 million lampreys. Commercial river lamprey fisheries were present on British rivers but commercial fishing is now confined to the Yorkshire Ouse.

Further deliberations on river lamprey conservation – exploitation, in the context of ICES, should strive to ensure that representation is available from countries of northern Europe, where major harvesting takes place. Relevant countries would include Poland, Lithuania, Latvia, Estonia, Sweden and Finland.

The main life cycle requirements for the anadromous lamprey include access to freshwater habitat, adequate water quality along the migratory route and in spawning and nursery areas, availability of suitable spawning habitat and availability of suitable and appropriate larval habitat. Factors that may impact adversely on these requirements include: (i) Habitat loss through barriers that impede or delay migration; (ii) Fishing mortality; (iii) Water quality – water pollution issues; (iv) Flow regulation regimes - abstractions (Southern Europe in particular); (v) River management works that alter the channel

morphology, thereby impacting the sediment dynamics with potential loss of larval habitat and associate larval populations.

6.3 ALLIS SHAD

Presently, allis shad has only a very localised distribution outside France and north-western Iberian Peninsula. In the past it has been severely affected by pollution, impoundment of large rivers and overfishing throughout Europe. However, most populations declined during the first decades of the 20th century and the species now seems to have stabilised at a low or medium level in recent times.

Shads are essentially harvested by commercial fisheries over their current distribution area. They can be fished in estuaries or in the mid sections of rivers for anadromous form, or in lakes/reservoirs for resident form. The fish are generally caught when they migrate from their feeding areas towards their spawning grounds. A few catches are recorded at sea or along the coast, with the exception of Portugal, where coastal landings are also important.

In France, during the 1989-1997 period, shad landings, of which 98% were of *Alosa alosa*, were the highest production of anadromous fish and lampreys (33.1 % of the total production) with a turn-over of 1.3 million euros. In 1997, 280 commercial fishermen were recorded fishing for allis shad; equivalent to 19.8 % of the total number of licensed professionals.

In Portugal, historically the catch was at the level of 300t but declined dramatically (about 90%) after the construction of the first dams in the 1950s. In the last 20 years mean annual catches reached about four tonnes in the River Minho, the river where the total catch mainly comes from. Recently, catches from coastal areas have also became important, specially from the central region of the country, increasing this number to an average of 30 tonnes per year in the last 20 years (10-70 tonnes).

From 1978 to 1999, approximate total landings ranged from 357 to 1,198 tonnes in their current distribution area. On average 72.5-98.7 % of the total landings come from France and the Gironde-Garonne-Dordogne system, respectively. In this watershed catches range from 338 to 1007 tonnes and are much higher when compared to other rivers. The collapse of the allis shad population in the Gironde-Garonne-Dordogne (France) in the beginning of the century, resulted in the fishery closure in 2008.

After the collapse of the Gironde-Garonne-Dordogne system allis shad population, the Minho river (Portugal) population seems to be one of the largest populations of the species' distribution.

6.4 TWAITE SHAD

At present, twaite shad is very locally distributed (large estuaries), being severely affected by pollution and impoundment of large rivers throughout Europe. As with allis shad, most populations declined during the first decades of the 20th century. However, current status of the species is good and is increasing in the North Sea and Baltic.

Recreational fishing for shad, using a rod, used to be practised in Great Britain, mainly in the rivers Severn and Wye, but since 1998 this activity became illegal. In Ireland there is a small recreational fishery on the River Barrow for *A. fallax*.

In France, particularly in the rivers Charente, Garonne and Rhône, as well as in a number of small rivers, recreational fisheries have become increasing popular. In the River Ulla (NW of Spain) sport fishing is very popular with undulated fishing spoons for *A. fallax*. In the River Minho (boundary between Spain and Portugal, NW of Iberian Peninsula) undulated fishing spoons and fly fishing flies are used to capture both shad species.

For both species of shad, other than maintaining access to their spawning grounds and safe passage for the juveniles on their out-migration, the other main habitat features that need to be maintained are deep pools where the adults can congregate prior to spawning. Particular sites (sanctuary areas) important for the persistence of the population must be given special protection.

The occurrence of hybrids may be indicative of a pressure, either in the form of low population levels or of restrictions, natural or man-made. It has been suggested that the prevalence of hybridization is related to the presence of obstructions to the free passage of migrants upstream, resulting in the use of communal spawning areas.

6.5 HABITAT RECOVERY AND RELATED CONSERVATION EFFORTS

In Portugal, according to the recent (2013 and 2014) recommendations and comments of the Commission about the implementation of the Habitat Directive to shad and lamprey, it is classified as Insufficient moderate (IN MOD): one or several additional Sites of Community Importance (SCI) or extensions of SCI, must be proposed to achieve a sufficient coverage of the Natura 2000 network for these species.

In Great Britain, the favourable reference area of shad accessible habitat is 2313ha, of which 949ha is in Wales and 1364ha in England. A significant proportion of potentially suitable habitat in 2012 is still inaccessible or poorly accessible and does not represent favourable conservation status.

In Ireland, improvement in fish passage facilities in river basins where SAC were designated for lamprey and shad, could permit a spatial, and hence genetic, separation of allis and twaite shad in the same catchment. It is envisaged that an additional 25 km of channel would be available for spawning in each river. It would be imperative that the upstream channel provide suitable spawning habitat including extensive areas of fast-flowing shallows over cobble and gravel as well as pool areas and backwaters.

Data regarding lamprey and shad in the European database on Natura 2000 sites needs to be reviewed.

Several projects (*e.g.* Ireland, Portugal) have contributed to the increase in available habitat for lamprey and shad, mostly through the construction of fishways designed for these species.

The Water Framework Directive also contributed to the improvement in water quality throughout most of the geographical range of these species. This Directive is also vital in highlighting the importance of river connectivity, within the hydromorphology quality element, and the role of connectivity for

sediment transport and for passage up- and downstream of all life stages of all fish species and invertebrates. This is key for the migratory lamprey and shad.

Some restrictions imposed on fisheries regulations (e.g. intermediate closed fishing season, Portugal) have decreased the fishing effort in estuaries and rivers.

The imminent collapse of the allis shad population in Portugal, following what happened in France, requires urgent actions to recover this population, by drastically reducing the fishery catches in coastal areas. Since shads are very sensitive to manipulation, discard fish are unlikely to survive, so a possible solution is to identify areas where fish aggregate prior to entering estuaries, and prohibit fishermen from using nets in those areas during certain months. A bycatch of less than 15% should also be implemented.

Two LIFE projects have been held to recover the populations of allis shad in the Rhine (2008-2010) and in the Rhine and Gironde (2011-2015), in the first project, some 4.8 million larvae were released, and in the on-going project ca. 1.5-2 million larvae per year are being released.

Increasing public awareness initiatives are being implemented in different countries, alerting people to the problems related with management and conservation of diadromous fish.

Even though there has been great effort to restore habitat connectivity in European rivers and preserve lamprey and shad species, there are still a number of difficulties encountered by researchers, namely:

- i. Lack of political and public awareness;
- ii. Lack of coordination between administrative organs, between different parts of the river basins, and between river, estuarine and marine jurisdictions;
- iii. Lack of fishermen declarations in rivers, or false declarations (maritime and rivers);
- iv. Lack of knowledge on habitat use and requirements particularly during the marine stage of the life cycle of these anadromous species;
- v. Low or lack of efficiency of fishways (attractiveness, improve and adjust monitoring, improve hydraulic conditions).

6.6 FISHERIES MONITORING AND ASSESSMENT

In Europe, there are some monitoring programs targeting lamprey and shad species.

After this first attempt to review the monitoring programs and conservation actions directed to shads and lampreys in Portugal, Spain, France, United Kingdom and Ireland, the group feels that there is a necessity to: (i) Extend the review to the north-western European countries, to correct possible inconsistencies in the information presently gathered; (ii) Harmonize the protocols in countries in order to permit comparisons or, failing this, to inter-calibrate methods between countries in the near future; (iii) Try to merge fisheries management and conservation management in a more comprehensive program of monitoring.

The globally observed trend of decreasing populations (in size and range) leads to the conclusion that the majority of the populations of lampreys and shads are in critical conservation status. A first attempt

to define biological reference points is being performed for allis shad in the Gironde system and this may prove more meaningful, ecologically and in management terms, than current monitoring criteria.

Finally, the group recommends to:

- i. Develop methodologies and collect data to calculate management targets and limits with coordination between conservation and fisheries objectives. The cost of such programs should be in accordance with the commercial and heritage value of the species;
- ii. Assess the possibility of using these species in metrics of habitat continuity or quality.

ANNEX A

A1: FEATURES OF A. ALOSA MONITORING PROGRAMS IN IRELAND, UNITED KINGDOM, FRANCE, SPAIN AND PORTUGAL (FROM EXPERT GROUP KNOWLEDGE)

Presence: R = detected reproduction; P = presence but no reproduction detected; Pr? = presence but interrogation for reproduction; A = Absence; ? = unknown

Fishery : com = commercial fishery, rec = recreational fishery, no = no fishery, ? = Unkwnon

Monitoring: y = yes; n : no; ?: Unknown

Monitoring objective: c = conservation, f = fishery, candf = both, n = no monitoring

Country	Rivers	presence	Fishery	monitoring	monitoring objective	Fishery dependant methods	Fishery independant method	targeted stage	time series	monitoring framework	reference
IE	Barrow	R	no	y	c		juvenile survey	juvenile in estuary	2010-2014	national funding	King and Roche 2008
IE	Nore	P	no	y	c		juvenile survey	juvenile in estuary	2010-2014	national funding	http://www.fisheriesireland.ie/fisheries-research-1/445-habitatsfull-summary-report-2013
IE	Suir	R	no	y	c		juvenile survey	juvenile in estuary	2010-2014	national funding	
IE	Munster Blackwater	R	no	y	c		juvenile survey	juvenile in estuary	2010-2014	national funding	
IE	Slaney	P	no	y	c		juvenile survey	juvenile in estuary	2010-2014	national funding	

IE	Boyne	P	no	y	f		by-catch of managed salmon escapement fishing study				
FR	Rhine	?	no		c		fish pass survey	adult	yes	?	
FR	Aa	A									
FR	Wimereux	A									
FR	Liane	A									
FR	Canche	A									
FR	Authie	A									
FR	Bresle	A									
FR	Arques	A									
FR	Seine	?	no		c		fish pass survey	adult	yes	local funding	
FR	Touques	A									
FR	Dives	A									
FR	Orne	R	?		c		fish pass survey	adult	yes	local funding	
FR	Vire	R	?		c		fish pass survey	adult	yes	local funding	
FR	Douve	?	no	?							
FR	Sinope	A									
FR	Sienne	?	no	?							
FR	Thiar	A									
FR	Sée	?	no	?							
FR	Sélune	R	?	?							
FR	Couesnon	?	?	?							
FR	Guyoult	A									
FR	Rance	?	?	?							
FR	Arguenon	?	?	?							
FR	Urne	A									

FR	Gouessant	?	?	?							
FR	Gouët	?	?	?							
FR	Trieux	?	?	?							
FR	Jaudy	A									
FR	Léguer	A									
FR	Douron	A									
FR	Jarlot	A									
FR	Elorn	?	?	?							
FR	Penzé	A									
FR	Aulne	R	?	y	c		fish pass survey	adult	y	?	
FR	Goyen	?									
FR	Pont l'Abbé	?									
FR	Odet	?									
FR	Ellé	?									
FR	Blavet	R	?	y	c		trapping	adult	y	?	
FR	Goah Guillerm	A									
FR	Auray	?									
FR	Bilair	A									
FR	Penerf	A									
FR	St Eloi	A									
FR	Vilaine	R	com	y	candf	official fishery declaration		adult	y	national funding	
FR	Vilaine	R	com	y	candf		fish pass survey	adult	y	local funding	Briand <i>et al.</i> 2014
FR	Vilaine	R	com	y	candf		spawning events survey	reproduction	y	local funding	
FR	Vilaine	R	com	y	candf						

FR	Loire	R	com	y	candf	official fishery declaration		adult	y	national funding	SIH and SNPE
FR	Loire	R	com	y	candf		fish pass survey	adult	y	local funding	
FR	Loire	R	com	y	candf		spawning events survey	reproduction	y	local funding	
FR	Loire	R	com	y	candf		beach seine survey	juvenile in river	y	?	Boisneau <i>et al.</i> 2010
FR	Lay	?									
FR	Sèvre Niortaise	?	no	y	c		fish pass survey	adult	y		
FR	Charente	R	com	y	candf	official fishery declaration		juvenile at sea	y	national funding	
FR	Charente	R	com	y	candf	official fishery declaration		adult	y	national funding	
FR	Charente	R	com	y	candf		fish pass survey	adult	y	local funding	
FR	Charente	R	com	y	candf		spawning events survey	reproduction	y	local funding	
FR	Garonne	R	com	y	candf	official fishery declaration		adult	y	national funding	SIH and SNPE
FR	Garonne	R	com	y	candf	unofficial fishery declaration sampling		adult	1987-	local funding	Girardin and Castelnau 2013

FR	Garonne	R	com	y	candf		juvenile survey	juvenile in river	1991-	local funding	Girardin and Castelnau 2013
FR	Garonne	R	com	y	candf		spawning events survey	reproduction	1995-	local funding	Migado 2013
FR	Garonne	R	com	y	candf		fish pass survey	adult	1995-	local funding	Migado 2013
FR	Leyre	A									
FR	Adour	R	com	y	candf	official fishery declaration		adult	y	national funding	SIH and SNPE
FR	Adour	R	com	y	candf		fish pass survey	adult	y	local funding	
FR	Nivelle	R	?	y	c		fish pass survey	adult	y	?	
FR	Nivelle	R	?	y	c		spawning events survey	reproduction	y	?	
FR	Têt	A									
FR	Agly	A									
FR	Berre	A									
FR	Aude	A									
FR	Orb	A									
FR	Hérault	A									
FR	Salaison	A									
FR	Vidourle	A									
FR	Rhône	A									
FR	Gapeau	A									
FR	Argens	A									
FR	Golo	A									
FR	Tavignano	A									

FR	u Fium'Orbu	A									
ES	Bidasoa	R	recreational	y						European funding (SUDOE project)	
ES	Asón	R	recreational	?							
ES	Deva	Pr?	recreational	?							
ES	Sella	Pr?	recreational	?							
ES	Nalón	Pr?	recreational	?							
ES	Navia	Pr?	recreational	?							
ES	Eo	P	recreational	?							
ES	Masma	A									
ES	Mera	A									
ES	Mandeo	A									
ES	Anllóns	A									
ES	Tambre	A									
ES	Ulla	A									
ES	Umia	A									
ES	Lérez	A									
ES/P T	Miño/Minh o	R	commerci al	y	candf	official fishery declaration		adult	1914	local funding (river administration)	Mota 2014
ES/P T	Miño/Minh o	R		y	candf		beach seine net	juvenile in river	2009- 2012	European funding (MIGRANET project, INTERREG)	Mota 2014
PT	Lima	R	commerci al	y	f	official fishery declaration		adult	1995	national funding (administration)	
PT	Neiva	A									

PT	Cavado	R	commercial	y	f	official fishery declaration		adult	1995	national funding (administration)	
PT	Ave	A									
PT	Leça	A									
PT	Douro	Pr?	commercial	y	f	official fishery declaration		adult	1995	national funding (administration)	
PT	Vouga	R	commercial	y	f	official fishery declaration		adult	1995	national funding (administration)	
PT	Mondego	R	commercial	y	candf	official fishery declaration		adult	1995	national funding (administration)	
PT	Mondego	R	commercial	y	candf	unofficial fishery declaration sampling		adult	2013		
PT	Lis	A					fish pass survey	adult	2012		
PT	Tejo	R	commercial	y	f	official fishery declaration		adult	1995	national funding (administration)	
PT	Sado	A									
PT	Mira	A									
PT	Arade	A									
PT/E S	Guadiana	R	no	n							
ES	Guadalquivir	R	no	n							
ES	Guadalete	A									

A2: FEATURES OF *A. FALLAX* MONITORING PROGRAMS IN IRELAND, UNITED KINGDOM, FRANCE, SPAIN AND PORTUGAL (FROM EXPERT GROUP KNOWLEDGE)

Presence: R = detected reproduction; P = presence but no reproduction detected; Pr? = presence but interrogation for reproduction; A = Absence; ? = unknown

Fishery : com = commercial fishery, rec = recreational fishery, no = no fishery, ? = Unknown

Monitoring: y = yes; n : no; ? : Unknown

Monitoring objective: c = conservation, f = fishery, candf = both, n = no monitoring

Country	Rivers	presence	Fishery	monitoring	monitoring objective	Fishery dependant methods	Fishery independant method	Targeted stage	Time series	Monitoring framework	Reference
IE	Barrow	R	no	y	c		juvenile survey	juvenile in estuary	2010-2014	national funding	King and Roche 2008
IE	Nore	P	no	y	c		juvenile survey	juvenile in estuary	2010-2014	national funding	http://www.fisheriesireland.ie/fisheries-research-1/445-habitatsfull-summary-report-2013
IE	Suir	R	no	y	c		juvenile survey	juvenile in estuary	2010-2014	national funding	
IE	Munster Blackwater	R	no	y	c		juvenile survey	juvenile in estuary	2010-2014	national funding	
IE	Slaney	P	no	y	c		juvenile survey	juvenile in estuary	2010-2014	national funding	
IE	Boyne	P	rec	y	f	official fishery					

						declaration					
GB	Wye	R	no	y	c		egg survey	reproducti on		national funding	Caswell and Aprahamian 2001
GB	Tywi	R	no	y	c		egg survey	reproducti on		national funding	
GB	Usk	R	no	y	c		egg survey	reproducti on		national funding	
FR	Rhine	A									
FR	Aa	A									
FR	Wimereux	A									
FR	Liane	A									
FR	Canche	A									
FR	Authie	A									
FR	Bresle	A									
FR	Arques	A									
FR	Seine	A									
FR	Touques	A									
FR	Dives	A									
FR	Orne	A									
FR	Vire	A									
FR	Douve	A									
FR	Sinope	A									
FR	Sienne	A									
FR	Thiar	A									
FR	Sée	A									
FR	Sélune	A									
FR	Couesnon	A									
FR	Guyoult	A									
FR	Rance	A									
FR	Arguenon	A									
FR	Urne	A									

FR	Gouessant	A									
FR	Gouët	A									
FR	Trieux	A									
FR	Jaudy	A									
FR	Léguer	A									
FR	Douron	A									
FR	Jarlot	A									
FR	Elorn	A									
FR	Penzé	A									
FR	Aulne	A									
FR	Goyen	A									
FR	Pont l'Abbé	A									
FR	Odet	A									
FR	Ellé	A									
FR	Blavet	A									
FR	Goah Guillerm	A									
FR	Auray	A									
FR	Bilair	A									
FR	Penerf	A									
FR	St Eloi	A									
FR	Vilaine	A									
FR	Loire	R	com	y	candf	official fishery declaration		adult	y	national funding	SIH and SNPE
FR	Loire	R	com	y	candf		fish pass survey	adult	y	local funding	
FR	Loire	R	com	y	candf		spawning events survey	reproducti on	y	local funding	
FR	Loire	R	com	y	candf		beach seine survey	juvenile in river	y	?	Boisneau <i>et al.</i> 2010

FR	Lay	A										
FR	Sèvre Niortaise	A										
FR	Charente	A										
FR	Garonne	R	com	y	candf	official fishery declaration		adult	y	national funding		
FR	Garonne	R	com	y	candf		juvenile survey	juvenile in river	1991-	local funding	Girardin and Castelnau 2013	
FR	Garonne	R	com	y	candf		spawning events survey	reproduction	2007-	local funding	Migado 2013	
FR	Adour	R	com	y	candf	official fishery declaration		adult	y	national funding	SIH and SNPE	
FR	Adour	R	com	y	candf		fish pass survey					
FR	Nivelle	A										
FR	Têt	?		?								
FR	Agly	?		?								
FR	Berre	A										
FR	Aude	R	com	y	candf	unofficial fishery declaration sampling		adult	y	local funding	?	
FR	Orb	?		?								
FR	Hérault	?		?								
FR	Salaison	A										
FR	Vidourle	R	?	y	c		spawning events survey	reproduction	y	local funding	?	
FR	Rhône	R	com	y	candf	unofficial fishery declaration		adult	y	local funding	?	

						sampling					
FR	Rhône	R	com	y	c		spawning events survey	reproducti on	y	local funding	?
FR	Rhône	R	com	y	c		egg trap	reproducti on	n	local funding	?
FR	Gapeau	?									
FR	Argens	?									
FR	Golo	R	?	?							
FR	Tavignano	R	?	?							
FR	u Fium'Orbu	?	?	?							
ES	Bidasoa	A									
ES	Asón	P r ?	rec	?							
ES	Deva	P r ?	rec	?							
ES	Sella	P r ?	rec	?							
ES	Nalón	P r ?	rec	?							
ES	Navia	P r ?	rec	?							
ES	Eo	P	rec	?							
ES	Masma	A									
ES	Mera	A									
ES	Mandeo	A									
ES	Anllóns	A									
ES	Tambre	A									

ES	Ulla	R	rec	y	candf		experimental fishing	adult in river	2010-2012	regional funding; European funding (INTERREG, project MIGRANET)	Nachón (PhD ongoing)
ES	Ulla	R		y	candf		experimental fishing	juveniles in river/estuary	2012	regional funding; European funding (INTERREG, project MIGRANET)	Nachón (PhD ongoing)
ES	Ulla	R	rec	y	candf		fish pass survey	adult in river	2008-2012	regional funding; European funding (INTERREG, project MIGRANET)	Nachón (PhD ongoing)
ES	Umia	A									
ES	Lérez	A									
ES/P T	Miño/Minho	R	com	y	candf	official fishery declaration		adult	?	local funding (river administration)	Mota 2014
ES/P T	Miño/Minho	R	Com and rec	y	candf		experimental fishing	adult in river	2009-2012	European funding (INTERREG, project MIGRANET)	Nachón (PHD ongoing)
ES/P T	Miño/Minho	R		y	candf		beach seine net	juveniles in river/estuary	2009-2012	European funding (INTERREG, project MIGRANET)	Nachón (PHD ongoing)
PT	Lima	R	no	n							
PT	Neiva	A									
PT	Cavado	R	no	n							
PT	Ave	A									

PT	Leça	A									
PT	Douro	P	no	n							
PT	Vouga	R	no	n							
PT	Mondego	R	no	y			fish pass survey	adult	2012		
PT	Lis	A									
PT	Tejo	R	com	n							
PT	Sado	R	no	n							
PT	Mira	R	no	n							
PT	Arade	R	no	n							
PT/E S	Guadiana	R	com	y	f	official fishery declaration		adult	1995	national funding (administration)	
ES	Guadalquivir	R	?	n							
ES	Guadalete	A									

A3: FEATURES OF *P. MARINUS* MONITORING PROGRAMS IN IRELAND, UNITED KINGDOM, FRANCE, SPAIN AND PORTUGAL (FROM EXPERT GROUP KNOWLEDGE)

Presence: R = detected reproduction; P = presence but no reproduction detected; Pr? = presence but interrogation for reproduction; A = Absence; ? = unknown

Fishery : com = commercial fishery, rec = recreational fishery, no = no fishery, ? = Unknwon

Monitoring: y = yes; n : no; ?: Unknown

Monitoring objective: c = conservation, f = fishery, candf = both, n = no monitoring

Country	Rivers	presence	Fishery	monitoring	monitoring objective	Fishery dependant methods	Fishery Independent method	targetted stage	time series	monitoring framework	reference
IE	Vartry	P	no	n							
IE	Avoca	P	no	n							
IE	Slaney	R	no	y	c	redd survey	reproduction			national funding	
IE	Barrow	R	no	y	c	redd survey	reproduction			national funding	
IE	Nore	R	no	y	c	redd survey	reproduction			national funding	
IE	Suir	R	no	y	c	redd survey	reproduction			national funding	
IE	Munster Balckwater	R	no	y	c	redd survey	reproduction			national funding	
IE	Laune	R	no	y	c	redd survey	reproduction			national funding	
IE	Feale	R	no	y	c	redd survey	reproduction			national funding	
IE	Fergus	R	no	y	c	redd survey	reproduction			national funding	
IE	Mulkear	R	no	y	c	redd survey	reproduction			national funding	
IE	Shannon	R	no	n							
IE	Corrib	R	no	n							
IE	Moy	R	no	n							

IE	Garavogue	P	no	n								
IE	Erne	P	no	n								
GB	Lochy	A										
GB	Endrick	A										
GB	Eden	R	?	y	c		electro fishing	juvenile in river	?	national funding (SAC)	Harvey and Cowx 2003	
GB	Dee	R	?	y	c		electro fishing	juvenile in river	?	national funding (SAC)	Harvey and Cowx 2003	
GB	Wye	R	?	y	c		electro fishing	juvenile in river	?	national funding (SAC)	Harvey and Cowx 2003	
GB	Teifi	A										
GB	Western Cleddau	A										
GB	Eastern Cledeau	A										
GB	Dore	R	?	y	c		electro fishing	juvenile in river	?	national funding (SAC)	Harvey and Cowx 2003	
GB	Tywi	R	?	y	c		electro fishing	juvenile in river	?	national funding (SAC)	Harvey and Cowx 2003	
GB	Usk	R	?	y	c		electro fishing	juvenile in river	?	national funding (SAC)	Harvey and Cowx 2003	
GB	Axe	R	?	y	c		electro fishing	juvenile in river	?	national funding (SAC)	Harvey and Cowx 2003	
GB	Kennett	A										
GB	Pang	A										
GB	Thames	R	?	y	c		electro fishing	juvenile in river	?	national funding (SAC)	Harvey and Cowx 2003	
GB	Derwent and Ouse	A										
GB	Teith	A										
GB	Tay	R	?	y	c		electro fishing	juvenile in river	?	national funding (SAC)	Harvey and Cowx 2003	

GB	Spey	R	?	y	c		electro fishing	juvenile in river	?	national funding (SAC)	Harvey and Cowx 2003
FR	Rhine	?	no	y	c		fish pass survey	adult	y	?	
FR	Aa	A									
FR	Wimereux	A									
FR	Liane	A									
FR	Canche	?									
FR	Authie	?									
FR	Bresle	?									
FR	Arques	?									
FR	Seine	?									
FR	Touques	?									
FR	Dives	A									
FR	Orne	R	no	y	c		fish pass survey	adult	y	local funding	?
FR	Vire	?	no	y	c		fish pass survey	adult	y	local funding	?
FR	Douve	?									
FR	Sinope	A									
FR	Sienne	?									
FR	Thiar	?									
FR	Sée	?									
FR	Sélune	R	no	y	c		fish pass survey	adult	y	local funding	?
FR	Sélune	R	no	y	c		bottom sampler	juvenile in river	y	?	Marchand <i>et al.</i> 2014
FR	Sélune	R	no	y	c		smolt trapping	juvenile in river	n		Marchand <i>et al.</i> 2014
FR	Sélune	R	no	y	c		redd survey	reproduction	y		?
FR	Couesnon	?									
FR	Guyoult	?									
FR	Rance	A									
FR	Arguenon	?									
FR	Urne	A									

FR	Gouessant	A										
FR	Gouët	?										
FR	Trieux	?										
FR	Jaudy	?										
FR	Léguer	?										
FR	Douron	?										
FR	Jarlot	?										
FR	Elorn	A										
FR	Penzé	A										
FR	Aulne	R		y	c		fish pass survey	adult	y	local funding	?	
FR	Goyen	A		?								
FR	Pont l'Abbé	A		?								
FR	Odet	R										
FR	Ellé	R										
FR	Blavet	R		y	c		trapping	adult	y	RandD	Jeanot <i>et al.</i> 2014	
FR	Goah Guillerm	?										
FR	Auray	?										
FR	Bilair	?										
FR	Penerf	?										
FR	St Eloi	?										
FR	Vilaine	R	com	y	f	official fishery declaration		adult	y	national funding (SIH)		
FR	Vilaine	R	com	y	c		fish pass survey	adult	y	local funding	Biriand <i>et al.</i> 2014	
FR	Vilaine	R	com	y	c		redd survey	reproduction	y	national funding (Onema)	Boussion	
FR	Loire	R	com	y	candf	official fishery declaration		adult	y	national funding	SIH and SNPE	
FR	Loire	R	com	y			fish pass survey	adult	y	local funding		

FR	Loire	R	com	y			redd survey	reproduction	y	local funding	
FR	Loire	R	com	y							
FR	Lay	A									
FR	Sèvre Niortaise	R	?				fish pass survey	adult	y	local funding	
FR	Charente	R	com	y	f	official fishery declaration		adult	y	national funding	SIH SNPE
FR	Charente	R	com	y	f		fish pass survey	adult	y	local funding	
FR	Charente	R	com	y	f		redd survey	reproduction	y	local funding	
FR	Garonne	R	com	y	candf	official fishery declaration		adult	y	national funding	
FR	Garonne	R	com	y	candf	unofficial fishery declaration sampling		adult	y	local funding	Girardin and Castelnau 2013
FR	Garonne	R	com	y	candf		redd survey	reproduction	y	local funding	Migado 2014
FR	Garonne	R	com	y	candf		fish pass survey	adult	1993-	local funding	Migado 2014
FR	Adour	R	com	y	candf	official fishery declaration		adult	y	national funding	SIH SNPE
FR	Adour	R	com	y	candf		fish pass survey	adult	y	local funding	
FR	Adour	R	com	y	candf		redd survey	reproduction	y	local funding	
FR	Nivelle	R	no	y	c		redd survey	reproduction	y	local funding	
FR	Têt	?	?	n							
FR	Agly	A									
FR	Berre	A									
FR	Aude	?									
FR	Orb	?									
FR	Hérault	?									
FR	Salaison	?									
FR	Vidourle	?									
FR	Rhône	?									

FR	Gapeau	A										
FR	Argens	?										
FR	Golo	A										
FR	Tavignano	A										
FR	u Fium'Orbu	A										
ES	Bidasoa	R	no	y						european funding (SUDOE)		
ES	Asón	A										
ES	Deva	R	no									
ES	Sella	R	no									
ES	Nalón	R	no									
ES	Navia	R	no									
ES	Eo	R	no	y	c		ammocoete density/biomass	postmetamorphic stage	2007-2011	regional funding	Cobo <i>et al.</i> 2010; Silva <i>et al.</i> 2013; Silva 2014	
ES	Masma	R	no	y	c		ammocoete density/biomass	postmetamorphic stage	2007-2011	regional funding	Cobo <i>et al.</i> 2010; Silva <i>et al.</i> 2013; Silva 2014	
ES	Mera	R	no	y	c		ammocoete density/biomass	postmetamorphic stage	2007-2011	regional funding	Cobo <i>et al.</i> 2010; Silva <i>et al.</i> 2013; Silva 2014	
ES	Mandeo	R	no	y	c		ammocoete density/biomass	postmetamorphic stage	2007-2011	regional funding	Cobo <i>et al.</i> 2010; Silva <i>et al.</i> 2013; Silva 2014	
ES	Anllóns	R	no	y	c		ammocoete density/biomass	postmetamorphic stage	2007-2011	regional funding	Cobo <i>et al.</i> 2010; Silva <i>et al.</i> 2013; Silva 2014	

ES	Tambre	R	no	y	c		ammocoete density/biomass	postmetamorphic stage	2007-2011	regional funding	Cobo <i>et al.</i> 2010; Silva <i>et al.</i> 2013; Silva 2014
ES	Ulla	R	com	y	candf		ammocoete density/biomass	postmetamorphic stage	2007-2011	regional funding	Cobo <i>et al.</i> 2010; Silva <i>et al.</i> 2013; Silva 2014
ES	Ulla	R	com	y	candf		fish pass survey	postmetamorphic stage	1997-2010	regional funding	Cobo <i>et al.</i> 2010; Silva <i>et al.</i> 2013; Silva 2014
ES	Ulla	R	com	y	candf		fish pass survey	adult	1997-2010	regional funding	Cobo <i>et al.</i> 2010; Silva <i>et al.</i> 2013; Silva 2014
ES	Ulla	R	com	y	candf	official fishery declaration		adult	2000-2010	regional funding	Cobo <i>et al.</i> 2010; Silva <i>et al.</i> 2013; Silva 2014
ES	Umia	R	no	y	c		ammocoete density/biomass	postmetamorphic stage	2007-2011	regional funding	Cobo <i>et al.</i> 2010; Silva <i>et al.</i> 2013; Silva 2014
ES	Lérez	R	no	y	c		ammocoete density/biomass	postmetamorphic stage	2007-2011	regional funding	Cobo <i>et al.</i> 2010; Silva <i>et al.</i> 2013; Silva 2014
ES/PT	Miño/Minho	R	com	y	candf		ammocoete density/biomass	larval stage in river	n		
ES/PT	Miño/Minho	R	com	y	candf	official fishery declaration		adult	1914	local funding (administration)	Araújo <i>et al.</i> (<i>in press</i>)

ES/PT	Miño/Minho	R	com	y	candf	unofficial fishery declaration sampling		adult	n		
PT	Lima	R	com	y	f	official fishery declaration		adult	1995	national funding (administration)	
PT	Neiva	A									
PT	Cávado	R	com	y	f	unofficial fishery declaration sampling		adult	ad-hoc (2004, 2011)	RandD (thesis project)	Gonçalves 2011
PT	Cávado	R	com	y	f	official fishery declaration		adult	1995	national funding (administration)	
PT	Ave	A									
PT	Leça	A									
PT	Douro	Pr?	com	y	f	official fishery declaration		adult	1995	national funding (administration)	
PT	Vouga	R	com	y	candf		ammocoete density	juvenile in river	n		
PT	Vouga	R	com	y	candf	mark-recapture		adult	n		Andrade <i>et al.</i> 2007
PT	Vouga	R	com	y	candf	official fishery declaration		adult	1995	national funding (administration)	
PT	Mondego	R	com	y	candf			adult	2002, 2003	national funding	Quintella <i>et al.</i> 2004
PT	Mondego	R	com	y	candf		fish pass survey	adult	2012-2014	national funding	Almeida <i>et al.</i> 2015
PT	Mondego	R	com	y	candf	official fishery declaration		adult	1995	national funding (administration)	
PT	Mondego	R	com	y	candf	unofficial fishery declaration		adult	ad-hoc (2002, 2014)	national funding	Duarte <i>et al.</i> 2003

						sampling					
PT	Mondego	R	com	y	candf		Electro fishing	larval stage	2012-2014	national funding	Almeida <i>et al.</i> 2015
PT	Lis	Pr?	no	n							
PT	Tejo	R	com	y	f	official fishery declaration		adult	1995	national funding (administration)	
PT	Sado	A									
PT	Mira	Pr?	no	n							
PT	Arade	A									
PT/ES	Guadiana	R	no	n							
ES	Guadalquivir	R	no	n							
ES	Guadalete	R	no	no							

A4: FEATURES OF *L. FLUVIATILIS* MONITORING PROGRAMS IN IRELAND, UNITED KINGDOM, FRANCE, SPAIN AND PORTUGAL (FROM EXPERT GROUP KNOWLEDGE)

Presence: R = detected reproduction; P = presence but no reproduction detected; Pr? = presence but interrogation for reproduction; A = Absence; ? = unknown

Fishery : com = commercial fishery, rec = recreational fishery, no = no fishery, ? = Unknnon

Monitoring: y = yes; n : no; ?: Unknown

Monitoring objective: c = conservation, f = fishery, candf = both, n = no monitoring

Country	Rivers	presence	Fishery	monitoring	monitoring objective	Fishery dependant methods	Fishery Independant method	targeted stage	time series	monitoring framework	reference
IE	Boyne	P	no	n							
IE	Liffey	P	no	n							
IE	Avoca	P	no	n							
IE	Owenavaragh	P	no	n							
IE	Slaney	P	no	n							
IE	Barrow	P	no	n							
IE	Nore	P	no	n							
IE	Suir	P	no	n							
IE	Munster Blackwater	P	no	n							
IE	Fergus	P	no	n							
IE	Maigue	P	no	n							
IE	Mulkear	P	no	n							
GB	Lochy	R	?	y	c	electro fishing	juvenile in river	?	national funding (SAC)	Harvey and Cowx 2003	

GB	Endrick	R	?	y	c		electro fishing	juvenile in river	?	national funding (SAC)	Harvay and Cowx 2003
GB	Eden	R	?	y	c		electro fishing	juvenile in river	?	national funding (SAC)	Harvay and Cowx 2003
GB	Dee	R	?	y	c		electro fishing	juvenile in river	?	national funding (SAC)	Harvay and Cowx 2003
GB	Wye	R	?	y	c		electro fishing	juvenile in river	?	national funding (SAC)	Harvay and Cowx 2003
GB	Teifi	R	?	y	c		electro fishing	juvenile in river	?	national funding (SAC)	Harvay and Cowx 2003
GB	Western Cleddau	R	?	y	c		electro fishing	juvenile in river	?	national funding (SAC)	Harvay and Cowx 2003
GB	Eastern Cledeau	R	?	y	c		electro fishing	juvenile in river	?	national funding (SAC)	Harvay and Cowx 2003
GB	Dore	R	?	y	c		electro fishing	juvenile in river	?	national funding (SAC)	Harvay and Cowx 2003
GB	Tywi	R	?	y	c		electro fishing	juvenile in river	?	national funding (SAC)	Harvay and Cowx 2003
GB	Usk	R	?	y	c		electro fishing	juvenile in river	?	national funding (SAC)	Harvay and Cowx 2003
GB	Axe	R	?	y	c		electro fishing	juvenile in river	?	national funding (SAC)	Harvay and Cowx 2003
GB	Kennett	R	?	y	c		electro fishing	juvenile in river	?	national funding (SAC)	Harvay and Cowx 2003
GB	Pang	R	?	y	c		electro fishing	juvenile in river	?	national funding (SAC)	Harvay and Cowx 2003
GB	Thames	R	?	y	c		electro fishing	juvenile in river	?	national funding (SAC)	Harvay and Cowx 2003
GB	Derwent and Ouse	R	?	y	c		electro fishing	juvenile in river	?	national funding (SAC)	Harvay and Cowx 2003
GB	Teith	R	?	y	c		electro fishing	juvenile in river	?	national funding (SAC)	Harvay and Cowx 2003

GB	Tay	R	?	y	c		electro fishing	juvenile in river	?	national funding (SAC)	Harvay and Cowx 2003
GB	Spey	R	?	y	c		electro fishing	juvenile in river	?	national funding (SAC)	Harvay and Cowx 2003
FR	Rhine	A									
FR	Aa	?									
FR	Wimereux	?									
FR	Liane	?									
FR	Canche	A									
FR	Authie	A									
FR	Bresle	R	no	y	c		trapping	adult	y	national funding	Fournel <i>et al.</i> 2014
FR	Bresle	R	no	y	c		bottom sampler	juvenile in river	n	national funding	Lasne <i>et al.</i> 2008
FR	Arques	?									
FR	Seine	?									
FR	Touques	?									
FR	Dives	?									
FR	Orne	?									
FR	Vire	?									
FR	Douve	?									
FR	Sinope	?									
FR	Sienne	?									
FR	Thiar	A									
FR	Sée	?									
FR	Sélune	R	no	y	c		fish pass survey	adult	y	local funding	?
FR	Sélune	R	no	y	c		bottom sampler	juvenile in river	y	?	Marchand <i>et al.</i> 2014
FR	Sélune	R	no	y	c		smolt trapping	juvenile in river	n		Marchand <i>et al.</i> 2014

FR	Sélune	R	no	y	c		redd survey	reproduction	y		?
FR	Couesnon	?									
FR	Gouyault	A									
FR	Rance	A									
FR	Arguenon	A									
FR	Urne	A									
FR	Gouessant	A									
FR	Gouët	A									
FR	Trieux	A									
FR	Jaudy	A									
FR	Léguer	A									
FR	Douron	A									
FR	Jarlot	A									
FR	Elorn	A									
FR	Penzé	A									
FR	Aulne	A									
FR	Goyen	A									
FR	Pont l'Abbé	A									
FR	Odet	A									
FR	Ellé	A									
FR	Blavet	A									
FR	Goah Guillerm	A									
FR	Auray	A									
FR	Bilair	A									
FR	Penerf	A									
FR	St Eloi	A									
FR	Vilaine	A									
FR	Loire	R	com	y	f	official fishery declaration					
FR	Lay										
FR	Sèvre Niortaise	?									

FR	Charente	?	?	y	c		fish pass survey	adult	y	local funding	
FR	Garonne	R	?	y	c		redd survey	reproduction	?	local funding	Migado 2014
FR	Adour	R	?	?							
FR	Nivelle	A									
FR	Têt	A									
FR	Agly	A									
FR	Berre	A									
FR	Aude	A									
FR	Orb	A									
FR	Hérault	A									
FR	Salaison	A									
FR	Vidourle	A									
FR	Rhône	A									
FR	Gapeau	A									
FR	Argens	A									
FR	Golo	A									
FR	Tavignano	A									
FR	u Fium'Orbu	A									
ES	Bidasoa	Pr?	no	n	n						
ES	Asón	A									
ES	Deva	R	no	n	n						
ES	Sella	A									
ES	Nalón	A									
ES	Navia	A									
ES	Eo	A									
ES	Masma	A									
ES	Mera	A									
ES	Mandeo	A									
ES	Anllóns	A									
ES	Tambre	A									

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