

Help for a giant: The LIFE + project for the Giant Pearl Mussel (*Margaritifera auricularia*)

Une géante en voie d'extinction : Le projet LIFE+ au secours de la Grande Mulette (*Margaritifera auricularia*)

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RÉSUMÉ

La Grande Mulette (*Margaritifera auricularia*) est l'une des espèces d'invertébrés les plus grandes et les plus rares d'Europe continentale. Historiquement présente dans les grands fleuves de l'Europe de l'Ouest, il ne subsiste aujourd'hui que quelques populations en France et en Espagne. L'espèce subit de multiples facteurs de stress tels que la disparition du poisson hôte (porteur des larves (glochidies)), la perturbation de l'habitat et de la qualité de l'eau. L'équipe internationale du projet LIFE13 BIOFR001162 « Conservation de la Grande Mulette en Europe » tente de limiter le déclin des populations existantes avec des études sur la biologie de l'espèce, la reproduction et l'élevage artificiels, la recherche de poissons hôtes alternatifs et par la protection de la plus grande population Européenne. La carte biogéographique de l'espèce a été actualisée et la situation actuelle des populations a été révisée à partir d'inventaires de terrain. Des laboratoires mobiles ont été créés pour réaliser la reproduction *in vitro* et l'élevage de juvéniles. Actuellement, plus de 25 000 juvéniles ont été produits, mais les taux de mortalité restent très élevés. L'identification de poissons hôtes autres que l'esturgeon est en cours.

ABSTRACT

The Giant River Pearl Mussel (*Margaritifera auricularia*) is one of the largest and one of the rarest invertebrate species in continental Europe. Originally occurring in large rivers of Western Europe, today, only few populations are found in France and Spain. The species undergoes multiple stressors such as the extinction of the host fish (carrying the larvae (glochidia)), habitat destruction and water pollution. In a LIFE + Project (LIFE13 BIO/FR/001162) dedicated to save this species, an international team take efforts to halt the decline of the extant populations by studies on the biology of the species, artificial rearing, search for non-sturgeon host fish, and protection of the largest population in France. The biogeographical data have been thoroughly revised and field data sampling has evidenced the actual distribution of the species and the size of several populations. Mobile laboratories have been established for in-vitro infection of sturgeon and rearing of juveniles in artificial flumes. So far, > 25.000 juveniles could be produced, but mortalities are still very high. Current work focuses on the identification of non-sturgeon host fish species able to carry glochidia in absence of the main host fish.

KEYWORDS

Conservation, host fish, large rivers, LIFE Program, mollusks

1 INTRODUCTION: MULTIPLE STRESSORS REQUIRE INTEGRATED CONSERVATION PROGRAMS

The Giant Pearl Mussel *Margaritifera auricularia* is a large unionoid mussel displaying an obligatory parasitic stage of the larvae (glochidia) in the gills of a host fish (fig. 1). Previously occurring in many larger rivers of Europe, today, only disjunctive and strongly reduced populations currently occur, in France and Spain. Being rated by the IUCN Red List as “critically endangered”, it ranks among the rarest bivalves worldwide. The survival of the species is at stake. Local extinction of its supposed favourite host fish (the European sturgeon species), mass sampling for nacre extraction, water pollution, habitat destruction and possibly other, yet unstudied factors (endocrine disruptors, competition and transfection by invasive bivalves, viruses?) cause that residual populations are over-aged; the youngest specimen found being at least 10 years old. Reproductive biology is partly known (Araujo et al. 2002), however the development of the post-glochidial juveniles is almost unknown (but see Nakamura et al. 2017). The LIFE + Project (LIFE13 BIO/FR/001162) takes efforts to halt the decline of the extant populations by studies on the biology of the species, artificial reproduction and rearing, search for non-sturgeon host fish, and protection of the largest population in the Charente River. A large habitat restoration is planned with mud dredging in the Charente River. Some first results are presented in the Poster and in the following text.

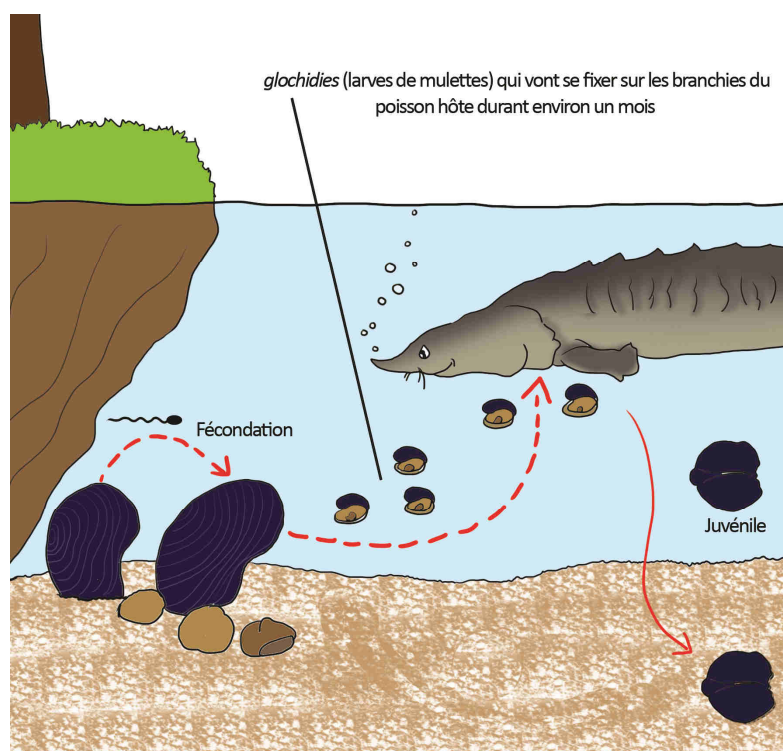


Figure 1 : Life cycle of *M. auricularia* (redrawn after Prié et al, 2012, Plan National d'Actions en faveur de la Grande Mulette, see <http://life.univ-tours.fr>)

1.1 Historical occurrence data and field backsearch

Based on the French National Plan to preserve the species, occurrence data were refined by re-analysing museum specimens and backsearches in the field based on quoted biogeographical data and potential yet unknown sites using aquascopes and scuba-diving (Fig.2, Prié *et al.* in press, Soler *et al.* unpublished). These studies have shown that there are few smaller specimens of 10-20 years of age, indicating that natural reproduction must have taken place after the extinction of the sturgeon in the studied rivers, which is somewhat reassuring news considering a contraction of the original expansion of the mussel by 90%.

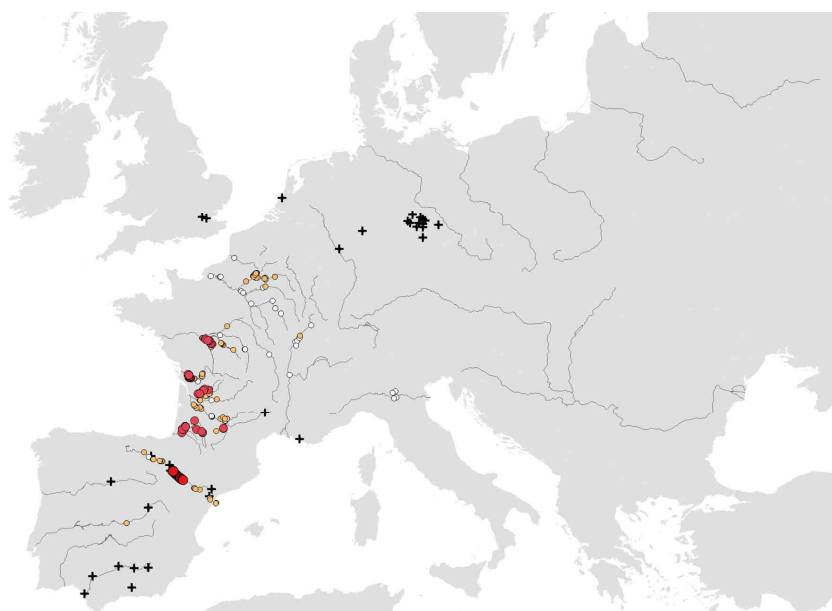


Figure 2: Fossil and extant occurrence of *M. auricularia* in Europe. Crosses = fossil data, White dots = historical data (literature and museum collections), Orange dots = recent data – shells only, Red dots = recent data – live specimens

Figure 2: Répartition historique et actuelle de *M. auricularia* en Europe. Croix = fossiles, points blancs= données historiques (littérature et collections en muséum), points orange = coquilles récentes, points rouges = animaux vivants

1.2 Habitat characteristics

A quick field survey protocol was established for the fast habitat characterization of multiple sites, and detailed habitat studies were performed using SCUBA equipment for deeper rivers and using precision bathymetry, granulometry and current measurements in wadeable sites. Considering the longevity of the species (> 80 years), their occurrence in the potamal zone of rivers, and the fact that larger, adult specimen only perform short lateral movements, potential habitats are limited to sites that remain relatively stable during flood events, and are composed by gravel and sand substrates (Soler et al. unpublished).

1.3 Artificial reproduction and rearing

Mobile laboratories were installed to perform artificial infection of reared host fish (Siberian sturgeon, *Acipenser baerii*) with glochidia from French populations of *M. auricularia*. More than 25.000 juveniles could be obtained in the past 2 years, however, juvenile mortalities are still very high (fig. 3). Different rearing techniques, sediment compositions and food sources have been tested. (Soler et al. unpubl.).

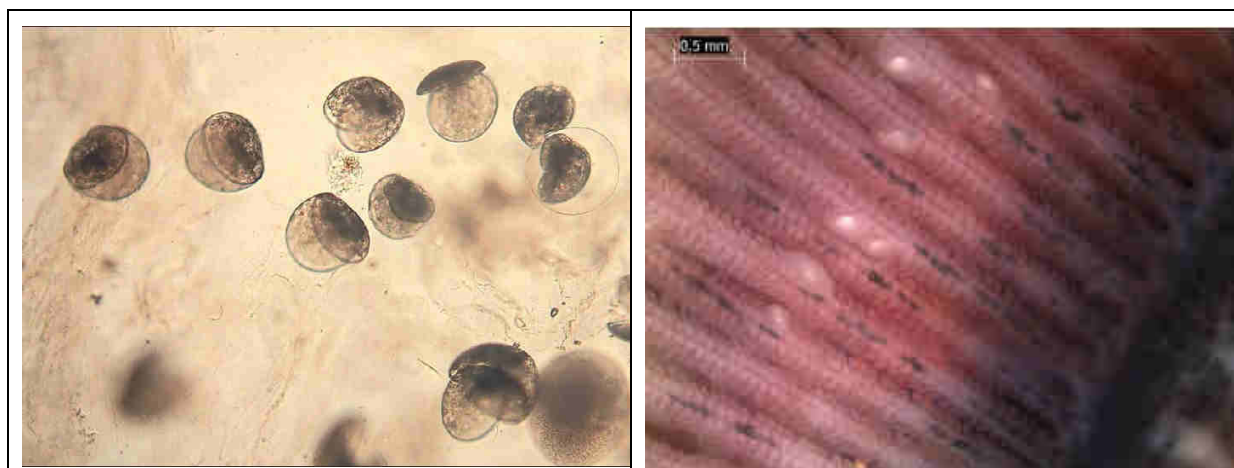


Figure 1: Left: Glochidia of *M. auricularia* (© P. Juge). Right: Encysted glochidia in sturgeon gills (© J. Soler)

1.4 Alternative host fish

Due to the local extinction of the European sturgeon species in the rivers with extant *M. auricularia* populations, it is necessary to identify other fish species that could serve as hosts, i.e. in the gills of which the glochidia of *M. auricularia* could fully develop until the stage of free-living juveniles. In Spanish studies, river blennies (*Salaria fluviatilis*) could successfully be used as alternative host fish. Based on field observations following electrofishing, and subsequent rearing experiments, we could identify at least one more alternative host co-occurring with the French populations of *M. auricularia* and which may be infected *in situ* in future (results will be presented in June, Soler et al. unpublished).

1.5 Preliminary conclusions

Contrarily to its smaller sister species, *Margaritifera margaritifera*, the Giant River Pearl Mussel has a much worse starting position for recovery: There are much less populations left, and those are displaying very limited recent natural reproduction. The glochidia of *M. auricularia* remain about 4 weeks in the gills of the host fish and are much smaller (ca. 150µm, thus weaker and encountering higher juvenile mortality) than in *M. margaritifera*, which can grow there for 7-9 months. The habitats of *M. auricularia*, situated in the lower river sections, are more polluted and – due to their size – more difficult to restore than headwaters. For the population of the Charente River, a large restoration activity, including the removal of accumulated sediments above a dam, and the establishment of a more natural dam management scheme, allowing sediment dynamics, is envisaged. This news and the first results shown here allow a moderate optimism that the extinction of this species may be halted.

LIST OF REFERENCES

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