

living rivers = Environmental Conservation. Biological diversity



Margal Ulla Life+ Project
Layman's report

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The Galician river network

Galicia is sometimes known as “the country of the thousand rivers”, as it proudly maintains a moderately healthy river network. However, we should not assume this dense network has been an exception to the general rule. During the last century Galician (and Spanish) rivers have been subject to a set of ever-increasing pressures which have continuously decreased their quality, in accordance with the ongoing process in many other European countries. As a result, nowadays they suffer a marked reduction of their ecological function.



This trend, though, has not come to an end and reversing its direction is still in our hands, given an informed and well-designed course of action is taken.

The **Margal Ulla Life+ project** was envisioned as a **conservation and restoration action plan with high demonstration capability**, based on the protection of two species of conservation interest, the Pyrenean desman (*Galemys pyrenaicus*) and the freshwater pearl mussel (*Margaritifera margaritifera*). The Ulla basin qualified for a pilot conservation plan, as it closely resembles what could be considered an average Galician watershed, as shown by the socio-economical network, the type and intensity of environmental impacts and its conservation status.

The ongoing degradation of Galician rivers has a double origin. On the one hand we find **intense and located impacts**, such as residual waters from large towns and industrial estates or large dams or reservoirs. On the other hand, we have **extensive impacts of low intensity**, originated from the diverse uses of the land (agriculture, forestry, cattle farming, recreational uses...), which results in a high accumulated impact (riverbed siltation, loss of water quality, eutrophication...). Such a widespread spatial origin of the impacts requires a watershed-wide planning, rather than focusing only on the riverine ecosystems.



The Pyrenean desman

As if carefully designed by a whimsical child, this small animal has traits of several diverse animal species: the trunk of an elephant, the hard moustache of sea lions, the palmate hands of ducks with bear claws and the long and scaled tail of a lizard. It is in fact, **the last survivor of an ancient lineage of moles that got adapted to living and hunting on river waters**, which gives them their particular appearance. Nowadays it only survives in Northern Pyrenees, in Northern Iberian Peninsula and in a short number of mountain ranges of the Iberian plateau.

The high metabolic rate of Pyrenean desmans forces them to feed frequently, which make them highly sensitive to the abundance of their favourite preys (medium to large bottom invertebrates). Hence, it has repeatedly been reported to depend on well preserved streams for its conservation. Recurrently named threats include river flow variability, eutrophication, oxygen depletion, organic and inorganic pollution, siltation and impoverishment of the riparian forest.

As suggested by its name, the freshwater pearl mussel readily resembles a common sea mussel, except that it lives semi-buried on sandy substrates. This similarity is not limited to its appearance, as both animals are also very active natural water filters: they both feed on the particles suspended on their surrounding waters. The filtering capacity of fresh pearl mussels is simply astonishing; each individual can filter up to 50 litres a day and hence, their role in maintaining clean waters in river ecosystems cannot be overestimated.

This is not the only particularity of this species, though. Mussels can only move short distances, but can be washed away towards the sea by flood waters. To balance this biased trend, freshwater pearl mussels rely on fishes for their dispersal. They release the newborn larvae (*glochidia*) into the waters and there, after being inhaled by salmon and trout, they stick onto their gills. Six to nine months later, the mussels –already metamorphosed into small juveniles– leave their temporal hosts and fall on the substrate, where they will live for up to seventy years (up to 150 at higher latitudes).

Freshwater pearl mussels live in the water, feed from the water and disperse by their interaction with salmonid fishes, which makes them really sensitive to any alteration of the habitat. **Many of the mussel populations have disappeared in the past decades, as a result of episodic or continuous human actions, ranging from infrastructure building** (either hydraulic, transportation or recreational) to pollution (both organic and inorganic).



The freshwater pearl mussel

Even so, the most severe threat the species is facing nowadays is its lack of recruitment. In Galicia, only five populations are home of young individuals; the rest of them are made exclusively of adult mussels. Whether this a consequence of pollution or the result of a decrease in trout and salmon abundance and movement, urgent action is needed if we want to cancel the extinction debt that is pending on this species.



Project goals

The Margal Ulla Life+ project was intended to improve the conservation status of freshwater pearl mussel (*M. Margaritifera*) and Pyrenean desman (*G. pyrenaicus*) in the Ulla river basin (Galicia), ensuring the conservation of the already existing populations in the basin, and establishing the appropriate conditions for the recovery of the original populations.

Specifically, Margal Ulla was focused on fulfilling the following goals:

- To improve those elements identified as factors of population decline of both species in the Ulla river basin.
- To implement measures to recover the hydromorphology of certain river sections affected by dams and the flow drawdown. These interventions aim to foster the natural dynamics of freshwater pearl mussel host fish populations, and to favor the habitat quality and connectivity of Pyrenean desman sub-populations.
- To recover populations of freshwater pearl mussel through the reinforcement and reintroduction of the species in suitable areas of the river basin.
- To improve the conservation status of the riparian forest in the Ulla river basin.
- To improve the conservation status of the river, supporting (as a result) the conservation of other endangered species and habitats.
- To improve the knowledge of the factors that threaten both species.
- To implement good practice in issues such as river quality (phytosanitary, bedload particles), river management and conservation of riparian forest.

A) Knowledge advancing actions

At the onset of the project, both target species had been scarcely studied in our country, making the design of conservation and restoration measures a difficult task. Although the freshwater pearl mussel has received considerable attention in Europe, in Galicia we scarcely had data on its distribution, which was not even enough to define an action plan for the Ulla basin. The situation was even worse for the Pyrenean desman, for which even the most basic data on its biology are still scarce. Previous efforts by the Galician Government to design conservation plans for both species revealed an alarming conservation status and the need for a deeper knowledge. The first actions of the project, hence, focused on improving the available knowledge on both species and their habitat in the Ulla basin.

- On the species

Distribution, abundance, and movement of the Pyrenean desman in the Ulla basina

After an initial failed attempt to assess the distribution of the species by live trapping, the survey of Pyrenean desman was completed by indirect methods. Both predator (otter and vison) and desman scats were collected across the whole watershed, and the presence of the species in a river reach was confirmed by genetic analyses or by the finding of typical desman hairs in these scats. All in all, **a total of 261 stream reaches were sampled searching for Pyrenean desmans, and more than 350 predator scats were analysed looking for its remains**, resulting in the identification of the species' presence in 54 new locations and 4 new sub-basins. Population density was generally above two individuals per kilometre of river.



Project Actions

Dams were traditionally assumed to pose an important physical barrier to the movement of this species, but more recent studies challenged these hypotheses. Hence, the **Margal Ulla Life+ project** aimed to **know the movement patterns of Pyrenean desmans in the Ulla basin**, both to understand the role of dams on their viability and to know their habitat selection patterns. A combination of radio-tracking and individual marking (with passive integrated transponders) was used to assess the spatial patterns of habitat use and home range size of the species.

Distribution, abundance and genetics of the freshwater pearl mussel in the Ulla basin.

Surveying and censusing freshwater pearl mussels is much more straightforward. Depending on the nature and depth of the given river, mussels were looked for and counted by means of an underwater visor, by snorkelling or by diving, accounting for a total of 154 kilometres of the Ulla basin. Such a huge effort accomplished a sharp increase in our actual knowledge of the species, providing 140 new presence locations and 2 new sub-basins for the freshwater pearl mussel, whose abundance was estimated at every single location. At each population found, mussel age and size were also estimated. Several adults were collected at selected sites, with the double aim of assessing the genetic relatedness among the five main sub-basins and analysing the genetic variability of the populations, which is often indicative of past impacts. The results confirmed the general lack of recruitment of the species in the basin and its generally low genetic variability and connectedness among sub-basins.

- On the habitat

Habitat characterization

An integral characterization of the habitat of both species accompanied their initial surveys, with stations set along the different sub-basins of the Ulla watershed. Habitat analyses were organized along two main axes: the physiochemical habitat and the biological habitat. Physiochemical analyses included measurements, at 64 sites, of river width and depth, water speed, temperature and oxygen content and the assessment of the concentration of multiple chemical compounds, ranging from basic nutrients to heavy metals (up to 51 variables).

The biological habitat was described by sampling, at 74 sites, the community of macro-invertebrates and surveying the plant community of the river and the riparian forest. In general, the basin was shown to be affected by organic pollution, with localized acidity and heavy metal pollution associated to a couple of mining facilities.



Impact survey

The knowledge on the problem was further improved by an extensive and intensive survey of impacts. Severe and intense impacts are generally well known and even monitored, under the Spill Control Plan, and so, the survey was focused on those impact sources of a more diffuse nature. After collecting a wide amount of data from farming, ranching and land use data bases, a detailed field inspection was carried out at randomly selected river reaches. During the field visits, which finally comprised 8,600 m and 44 river reaches, all kind of impacts were recorded, from direct physical damage (such as trampling, or river bed alteration) to pollution events or damage to riparian vegetation. As a consequence, a total of 465 samples associated to these impacts were analysed. The Ulla basin was shown to suffer mainly from a loss of water quality and an impoverishment of the riparian forest.

B) Conservation Actions

- On the species

Ex situ cultivation of the freshwater pearl mussel

Given the low number of individuals and the lack of successful reproduction of most of the freshwater pearl mussel populations in the Ulla basin, the **Life + project** adopted a line of action, based on *ex situ* cultivation aiming to reinforce the recruitment of the species in the watershed. After fitting out the O Veral Ichthyological Station, a selection of reproductive individuals from all the sub-basins was carefully collected in the river and brought to these facilities. Careful monitoring in captivity allowed scientists to detect the moment, just after fecundation, when these reproductive adults released a huge amount of tiny larvae (named *gloquidia*) into the surrounding waters.

These larvae were then used to infest one-year age juveniles of brown trout and Atlantic salmon, descendants of wild individuals.

The larvae lived attached to gills of infested fishes for up to nine months. Once grown, the already juvenile mussels (0,3 – 0,4 mm) left their hosts and were kept in rearing boxes, where they are monitored and hand-fed on a specific mixture of detritus and algae. The cycle of freshwater pearl mussel was closed in captivity for three consecutive years, providing infested fishes for their release in the reconditioned channels and rivers, and producing thousands of juveniles, from which 21,000 are still kept alive in the O Veral facilities, growing to attain a proper size for future reintroductions.



Reinforcing natural populations of the freshwater pearl mussel

A significant proportion of the juvenile mussels released from the gills of the captive fishes were used to reinforce the natural populations at several spots of the basin. Two approaches were used to that end: **seeding of pearl mussel juveniles on Buddensieck plates and direct release of infested fishes in confined waters.**

This spots were selected on the basis of the existence of old small mill channels, that could be fit out, making them good habitats for a population of young mussels.

Five such channels were finally reconditioned by recovering its depth, improving their bed substrate with gravel and sand, and installing retention nets to temporarily retain the previously infested, released fishes.

Buddensieck plates were installed in the river **bed and allowed to accommodate up to 60 juvenile pearl mussels**, protecting them from predators or incidental mortality derived from water overflow. The plates were installed within the fit out channels, in order to reduce their lost during high discharge periods, which makes monitoring survival and growth viable. At the same time, part of the infested fishes were released inside the fit out channels just before the time arrived for the pearl mussels to leave the gills. This way, the released juvenile pearl mussels arrived at a proper substrate, increasing their living chances.

Unfortunately, these individuals cannot be initially monitored, as they live buried in the substrate for 5-10 years, where monitoring would mean an intense habitat disturbance. Over the last years, 2,800 fishes (salmons and brown trout) which had been previously infested with mussel larvae (*glochidia*) were released in these channels and in the main Ulla river.



- On the habitats

Unsealing of weirs and small dams

Disruption of longitudinal connectivity is one of the most intensive impacts of human activities in the Ulla basin. The construction of three large dams in the last half century has severely altered the river dynamics, increasing short-term flow variability and water temperature, reducing water velocity and oxygen content, and drastically reducing the distribution of Atlantic salmon in the basin. But there are also many small to medium weirs and dams, mostly devoted to water harnessing for small scale farming. Although of a lesser impact, these barriers do significantly reduce the sediment transport along the river and the movement of trout and salmons, and produce the increase of water temperature and the destruction of running waters habitats. In order to minimize this source of impact, pre-selected barriers underwent a soft treatment of unsealing. After analysing the viability of modifying 26 pre-selected weirs and small dams, finally nine of them were partially pulled down or reconditioned to restore the hydrodynamics of the upstream and downstream river reaches and to allow the pass of fish and other aquatic species.

Except for one complete demolition, all the works involved partial demolitions and opening of channels, redistributing the resulting materials along the banks, which were then stabilized by coconut fabric and re-vegetation.

Recovery of the riparian forest and elimination of exotic invasive species

The degrading and disappearance of riparian forests have been identified as one of the most relevant impacts on the river functionality in the Ulla basin. The underlying factors –namely the use of land by farming, ranching and forestry– though, are still active, which means that correcting the disfunctionality must be a long run job, carefully dealing with land ownership and other rights. Technicians selected the sites to restore according to a series of criteria that included topographic variables, land uses, freshwater pearl mussel and Pyrenean desman abundance and the existing risks for both species. Re-vegetation of the river banks, consisted on manually planting saplings of several native tree species (alder, willow, ash, oak, birch and hazelnut tree) within the State-owned fringe along the selected river reaches. Finally, the works involved five kilometres of river banks that were lacking any tree cover, where more than a thousand tree saplings were planted.

During the site selection process we identified a large area dominated by extensive stands of exotic species along the Ulla river, namely giant cane, bamboo, mimosa and black locust. A new line of action was then prepared, in order to restore these areas to a native riparian forest along 12 km of the riverbank. The restoration first involved a manual logging of the stands, where the produced wood was left in situ for the local inhabitants to use it, and then followed by a re-vegetation with native species. Pooling all the species, a total of 3,040 trees were cut.



Establishment of good environmental practices

The conservation of our rivers must be compatible with the economic activities humans develop on the land, which involves changing our working methods in order to reduce the impact these activities have on our environment. The **Margal Ulla Life+ project** collected a set of **good-practice methods for the three economic sectors with a higher spread in the basin: agriculture, ranching and forestry**. These methods were presented in a comprehensive guide of good practice and three small booklets aimed at practitioners of the three sectorial activities, which will help to conserve healthy rivers. This material has been used to teach a specific subject within the **plan of the mandatory training for these agroforestral activities at 6 locations, totalling 280 attendants**, and was further disseminated by means of a poster campaign.

Complementarily, a **desiccation plant in the slurry treatment facilities of the Mouriscade farm** (owned by the local administration) was built with the aim of demonstrating its usefulness and environmental benefits. Several essays were carried out in the same farm to measure the efficiency of the different produces of the plant.



C) Dissemination actions

Dissemination activities were a fundamental part of the project, aided by **graphic material on both species and their relationship with river habitat, which were specifically tailored for the occasion.** To this aim, the Margal Ulla Life+ project implemented activities that surpass the **classical communication and dissemination** means.

On top of making an extensive use of our **website or social networks**, the **Margal Ulla Life+ project** was committed to **environmental education and awareness.** Awareness and environmental education are important tools to foster knowledge about the importance of ensuring a good environmental status of the Ulla river basin. Moreover, the activities carried out sought to encourage the younger generation's knowledge and raise the environmental consciousness among farmers of the natural heritage as a provider of important services (clean water, pollination...) as the foundation of environmental conservation and economic sustainable development.

Stakeholder meetings

A bottom-up approach inspired the meetings held by project's representatives with different stakeholders. The first stakeholder meeting was a perfect starting point to identify and characterize the project's main stakeholders. Following meetings involved groups of environmental activists, forest guards, fishermen associations, youth associations, or high school teachers. They aimed to allow these groups to become familiar with the objectives, activities, progress and results of the **Margal Ulla Life+ project**, as well as to gather new points of view or ideas that would enrich the action of the project.

Finally, meetings with **with different stakeholder groups amounted to 11 and involved around 173 people.** All in all, we have established **a channel of ongoing communication** among the public authorities involved in the project and the project's stakeholders.



Teaching materials for high school students

Environmental consciousness (both individual and collective) is a key characteristic of young population, and also a key variable to assure a sustainable development. In our case, nurturing and keeping this environmental consciousness is a guarantee for the preservation of these two threatened species and their habitat: the Ulla river basin.

With the sake of improving the knowledge of these relatively unknown species among young population, the **Margal Ulla Life+ project** developed teaching materials about the **key traits and life history of freshwater pearl mussels and Pyrenean desmans**. The materials focused on **giving key data on both species, their habitat, and the crucial conditions that are to be kept to preserve them along the Ulla river basin**. An effort was done to make entertaining, understandable and fun materials, including illustrations and quizzes. This teaching material was disseminated through **meetings with secondary school teachers** and trough the **website of the project**.

Production of a video documentary

With the aim of arriving at the widest possible audience, a video documentary was produced, **showing the problems of the Ulla basin and specially the development of the project**. For this end, the video material was recorded during the works associated to each action, and later complemented with interviews with the people in charge for the project at the member institutions of Margal Ulla. The final cut had a length of around **30 min**.



D) Management actions

As a final activity of the project, the Margal Ulla Life+ project developed a set of **guidelines for the Ulla basin management and technical handbooks** for ensuring the conservation of both species at the area. The work towards these guidelines was framed within an adaptive management strategy and involved the participation of several stakeholders, group modelling workshops and the integrated analyses of all the data gathered along the project. As a result, several documents were prepared, ranging from **good practice handbooks** for sectorial technicians of the different public institutions with competencies in the management of the basin, **to technical bases for the development of conservation and measure plans for both species**.

E) Internationalizing actions

The **Margal Ulla Life+ project** has made a special effort to spread its activity throughout Europe and at the same time, learn from the work of other previous and ongoing European projects. Much of the work carried out in the Ulla basin, was indeed based on this knowledge.

Hence, during these years, the freshwater pearl mussel team maintained an **intense activity of experience exchanging**, and visited several European projects, dealing with the conservation and restoration of the species. This action increased the knowledge of the team and facilitated networking activities among researchers and freshwater conservation experts. Visits involved several Life and Interreg projects in **Sweden** (LIFE04NAT/SE/000231), **Finland** (Interreg IV A North Programme), **Ireland** (Interreg IV A Programme), **Luxembourg** (LIFE05 NAT/L/000116) and **France** (LIFE09 NAT FR 000583).

Contact with the “**Restoration of pearl mussel populations in the Ardennes, Luxembourg**” (LIFE 05 NATL / 000116), which included similar activities to those of Margal Ulla, was of special relevance. During this project fish migration obstacles were eliminated, invasive plants were cut, riverbanks were restored, and mussels were bred ex situ. The support from and collaboration with this project has continued during the whole life of Margal Ulla, and significantly increased its baseline knowledge and success probability. **Visits to freshwater pearl mussel rearing stations (Bretagne, France, and Kefermarkt, Austria)** also improved the performance of the Margal Ulla *ex situ* rearing action.

As a consequence of this international activity, the freshwater pearl mussel research team of the Margal Ulla project is nowadays fully integrated in a **strong network**. Its first result has been the **development of a standard method for monitoring freshwater pearl mussel and its environmental requirements**. This is likely to become a European standard under the auspices of the European Committee for Standardization (CEN).





Expected socio-economic and environmental benefits

In addition to the expected impact of the activities on the conservation status of both species, the **Margal Ulla Life+ project** aimed to implement several measures using the Ulla river as an experimental basin. These measures are expected to demonstrate their effects in order to be extensively implemented in other basins across Galicia. In addition, we believe that the [strengthening of conservation measures on the water environment](#), and the [introduction of specific measures to be taken to achieve the objectives of the River Basin Management Plan of Galicia \(reviewed in 2015\)](#) may have a direct effect on the [medium-term conservation of these species](#), not only in the Ulla basin , but throughout the Autonomous Community.

A somehow unexpected benefit of the project relates to its management and implementation. According to all the members of Margal Ulla, a [new culture of collaboration and coordination](#) among different departments of the regional administration has been established. River management and more generally, the environment, will surely benefit from this continuous and planned information exchange among biodiversity, water and agroforestry professionals and heritage managers.

The implementation of the Natura 2000 network has meant that authorities and stakeholders have assumed the [concept of connectivity](#), and they have begun to take the appropriate steps to design and designate ecological corridors to guarantee the maintenance of biodiversity, habitats and species.

The findings on the state of conservation of the species in the project area have driven to [design conservation guidelines oriented towards the inclusion of recommendations in other areas of sectorial legislation](#) (water planning, water pollution, and agro-environment support, among others).

We expect that long-term results of the project will result into an [increase of environmental awareness](#) (individual and collective) of local residents and farmers about the conservation of these species. Moreover, the establishment of a [code of good agricultural practice and the collaboration](#) that is being established between local farmers and public administration, result in an improvement of the environmental quality of farms, their procedures and the places where they evolve their activity. As a result, they will increase the value of the received ecosystem services, which will certainly involve an improvement in their profits and way of life.





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