

CONSERVATION OF AQUATIC HABITATS AND SPECIES IN HIGH MOUNTAINS OF THE PYRENEES



photo: Marc Ventura

EDITORIAL



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In this new edition of the newsletter, we focus on the amphibians found in the high mountains of the Pyrenees, the threats they must face and the impact of the conservation actions that are being carried out within the framework of the project.

During the last six months we have continued the actions of conservation, monitoring and dissemination already programmed. This newsletter explains in detail the restoration activities of the Font Grossa in the Aigüestortes i Estany de Sant Maurici National Park. We also talk about participation in different activities of dissemination, within the calendar of activities of the same National Park

going through the annual course of Interpretive Guides or the annual collaboration that we have established with the Bac de Cerdanya School.

Finally we make a mention of the dissemination in the scientific-technical field with the participation in the Congress on Exotic Invasive Species that we have co-organized together with the LIFE POTAMOFAUNA project, Consorci del Ter and Grupo de Especialistas en Invasiones Biológicas and the meeting of more than 60 LIFE projects focused on exotic species that took place in Milan and in which we also participated. We hope you find it very interesting.

THE AMPHIBIANS OF PYRENEAN LAKES

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Delicate key-species of the ecosystem

Amphibians are the most primitive terrestrial vertebrate group of those currently in existence. Their ancestors evolved from groups of fish 380 million years ago, and acquired the necessary adaptations to survive in the terrestrial environment, such as limbs for movement efficient on land and lungs for breathing. These ancestors would be common for all groups of current terrestrial vertebrates: amphibians, reptiles, birds and mammals. However, amphibians, being the most primitive branch, are those that remain more linked to the aquatic environment. Both amphibian skins and the cover of their eggs have fewer layers than those of other terrestrial vertebrates, making them vulnerable to water loss. Also, amphibian larvae mostly retain typically aquatic gills. This is why amphibians place their eggs in water or in very humid areas, where embryos and larvae can develop in suitably wet conditions. Adults can show more mixed habits and frequent the terrestrial environment, but almost all species avoid times of severe sun and wind, when they could lose all the water in the body,

leading to death from desiccation in a matter of minutes. The high permeability of amphibian skin is also manifested in the opposite direction, allowing the entry of contaminants or toxic substances that can be in water, soil or air. That's why amphibians are considered an excellent bioindicator of the environmental quality of habitats, especially aquatic habitats.

Globally decreasing species

At present, amphibians are in decline worldwide and are one of the most threatened animal groups, mainly due to causes related to global change caused by the human species. Different studies have shown that amphibians are threatened by anthropogenic factors such as changing landscape uses, degradation, pollution and fragmentation of the habitat (both aquatic and terrestrial), different emerging infectious diseases, invasive species, climate change, and the increase in ultraviolet radiation, pesticides, and mortality on the roads. The survival of many amphibian populations will continue to be compromised in the short and

medium term, as it is not expected that all these negative factors will be reduced in the near future. On the contrary, it is likely that these pressures will increase even more. Knowledge of these factors highlights the need to work actively for the conservation of amphibians.

Trophic role

Amphibians living in high mountain lakes and ponds are part of different food webs and are involved in complex trophic relationships making them key species within the ecosystem. Their trophic role is crucial. On the one hand, the tadpoles of common frog, common toad and midwife toad are basically herbivores, feeding by grazing algae and other microorganisms that grow on lake rocks or sediment. In this way, they control algal growth and maintain the structure and natural functionality of the whole lake. In the ponds where tadpoles and other herbivores are lacking, this community of algae and microorganisms increases greatly in volume and changes in structure including which species are most common. This leads to a very different community from the natural one. Tadpoles, while controlling the growth of algae and other organisms, also represent a frequent food resource for the many natural predators that are quite abundant in the ponds when fish had not been introduced. Here we are talking mainly about dragonfly larvae, and larvae and adults of aquatic beetles, skaters and back swimmers. We can see then, that tadpoles are located in the middle of the food chain, grazing and controlling vegetal organisms of the lower levels, but also serving as food at the top level of predators. In high mountain lakes and ponds, adult newts, and adults of common frog, common toad and midwife toad, are



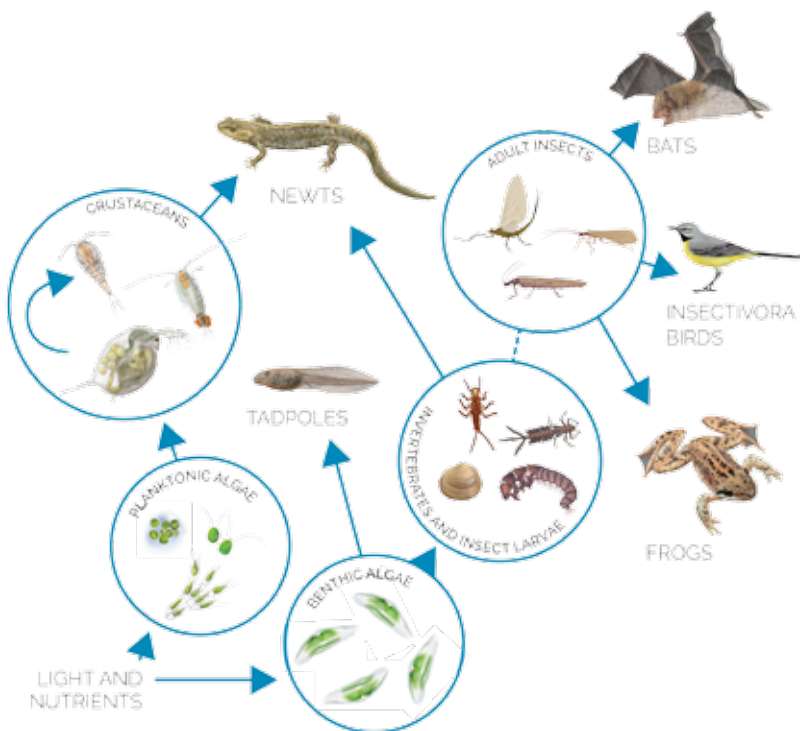
Figure 1. Palmate newt (*Lissotriton helveticus*). Photo: Marc Ventura.

in the top of the natural trophic web. They feed on different invertebrates, among which the predatory insects of tadpoles. Adult amphibians play the role of controlling the abundance of invertebrates in general and insects in particular. Thus, we can easily understand that the disappearance of amphibians in high mountain ponds causes a series of imbalances in the ecosystem linked to the food relationships that they maintain with the rest of the organisms in the ecosystem.

Threats in high mountain lakes and ponds

Emerging diseases, such as those caused by ranaviruses and chytrid fungus, are causing amphibian mortality, especially notable in high mountain areas, which are endangering the survival of entire populations. European species are prone to the negative effects of the chytrid fungus *Batrachochytrium dendrobatidis*, which is naturally present in skin microbial communities of Asian amphibians without harming them. Once they reached Europe, probably carried by imported amphibians, they have proved extremely harmful to native species that are not naturally immune, as is the case of midwife toad. The risk of arrival of a second species of Asian chytrid fungus, *Batrachochytrium salamandrivorans* is especially worrying for newt and salamander conservation. This fungus species has already been detected in north west Europe during the last decade and has been the cause of mortality of up to 95% in different affected populations. All those who frequent aquatic habitats have to think that if we carry out aquatic activities in remote areas without disinfecting the tools used, we can act as vectors, facilitating and accelerating the expansion of emerging diseases. In this sense, even activities that may seem innocent and innocuous such as, swimming accompanied by the pet in several lakes, can contribute to spread emerging diseases.

Who is eaten by who



A second threat is the alteration of the habitat by the artificial variation of the water level due to hydroelectric exploitation. This activity affects 15% of the lakes over 0.5 hectare in the Pyrenees mountain range. The artificial oscillation of the water level leads to an arid strip around the lake which prevents the survival of the marginal communities of aquatic plants, invertebrates and amphibians, as these cannot persist in absolutely dry environments for prolonged periods of time.

However, the main threat to the amphibians that we have detected in the lakes of the Pyrenees so far is the presence of exotic fish. Currently, between 35% and 85% of the Pyrenean lakes, depending on the basin, have introduced fish. Fish directly depredate larvae, juveniles, and adults of amphibians and eliminate them in most cases. They also indirectly harm them as they feed on invertebrates and larvae of insects that are common food. This means that amphibians, with the sole exception of the common toad, and fish cannot coexist in lakes.



Figure 2. On top common frog eggs. Below tadpoles of common toad. Photo: Alex Miró.



Effects of the conservation actions that are being carried out

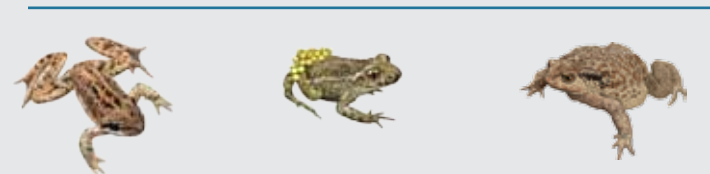
One of the objectives of the LIFE LIMNOPIRINEUS project (2014–2019) is the recovery of amphibian populations in eight high mountain lakes by controlling or eradicating fish that had been previously released. Five of the eight ponds are located in the National Park of Aigüestortes i Estany de Sant Maurici, and the other three in the Natural Park of the High Pyrenees (Alt Pirineu). During the summer months of 2014 to 2017, we extracted more than 99% of the fish present in six of the eight ponds and most of those present in the other two.

At the same time, we have documented changes in amphibian populations by collecting data on their presence and abundance. This allowed us to verify that the different species of native amphibians present in each valley have colonized the ponds. Amphibian populations have recovered by their own means in all eight lakes as fish eradication works were progressing. The key to this rapid recovery is the nearby presence of refuges where species have been able to maintain viable populations. The first natural colonization of amphibians was observed, in all cases, after the second year of eradication works, although there was still a certain proportion of fish in the lakes. This fact shows the high capacity of recovery (resilience) of the amphibian fauna of the Pyrenean lakes, after reducing or eliminating a disturbance.

The conservation actions carried out within the framework of the project have led to recovering amphibian populations of high mountain lakes. However, a good prevention dynamic would be even more beneficial. Amphibian populations of high mountain lakes would improve their conservation status, if there are no new fish introductions, if lakes maintained maximum and stable levels of water when there is hydraulic exploitation, and if activities that can spread emerging diseases are limited.

Amphibians are amongst the most conspicuous native animals of high mountain aquatic ecosystems. We can find up to six amphibian species in the lakes of the Pyrenees. Three of them, the common frog, the midwife toad and the common toad, are anurans or tailless amphibians. The other three, the Pyrenean newt, the palmate newt and fire salamander, are salamandrids or tailed amphibians.

Anurans



Rana temporaria

The common frog is the most widely distributed and abundant species. At the time of the spring thaw, it produces masses of up to 1000 eggs each. Tadpoles are herbivorous. Adults can live on the edges of the ponds or move away some kilometers during the summer to hunt terrestrial invertebrates.

Alytes obstetricans

The midwife toad is a small toad. Its distribution in the lakes is limited by the presence of fish and dissolved mineral salts in the water. Although the adult is small, their tadpoles are the biggest and fastest. The tadpoles can survive under the winter ice and grow during different consecutive summers. For this reason, we only find midwife toad in permanent lakes or ponds that do not dry out.

Bufo spinosus

The common toad is the most thermophilic amphibian present in the Pyrenees. The adults are large and nocturnal and the tadpoles are small and black. They are not affected by fish predation due to the bufotoxin, a toxic and unpleasant substance on the skin. The feeding is similar to that of the common frog, with tadpoles mainly herbivorous and adults being hunters of insects and other arthropods.

Salamandrids



Calotriton asper

The Pyrenean newt is well distributed throughout the Pyrenean range, including the neighbouring limestone foothills such as the Montsec. It always appears bound to rocky habitats. When we find it coexisting with fish in the same lake, it is only present in rocky shelters that prevent depredation.

Lissotriton helveticus

The palmate newt that we find in the Pyrenees is a species very common also in much of western Europe and Great Britain. Males have interdigital membranes on the back feet. The females place the eggs in submerged leaves of plants that can be found inside the lake or its margin and fold the leaves to protect the eggs from light and predators.

Salamandra salamandra

In the case of fire salamander, adults are not aquatic, rather they live in areas of vegetation, either in forests or meadows, especially in the middle-reaches of the mountains. However, as with the two newts we have seen before, larvae are aquatic, breathing through external gills. One can find salamander larvae in some low-altitude Pyrenean lakes, close to the middle-reaches of the mountains.

RESTORATION OF FONT GROSSA PEAT BOGS

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During the first summer of the project, some preliminary tasks were carried out to establish the scientific basis for the restoration of the Font Grossa peat bogs, in the Aigüestortes i Estany de Sant Maurici National Park. These tasks included the collection of seeds and cuttings of species capable of effective colonization and building the basis for the target communities. With these 'engineering' species, different experiments were conducted to determine the germination rates in controlled conditions of temperature and light, to analyse the growth from seedlings onward, and to know the degree of competition between species.

A topographic survey and a detailed vegetation map were also carried out, and sampling points were established where to measure water levels (phreatic and piezometric) and ionic water contents, and to draw complete vegetation inventory (vascular plants and bryophytes). Finally, the seed bank of the soil was analyzed through greenhouse cultivation of samples, in order to evaluate the potential for spontaneous recovery of the peat bog. All this information led to prepare a restoration protocol that began to be applied last summer of 2017.



The *Carex rostrata* rhizomes with one or two shoots that had been collected from the artificial reservoir of Lladres were translocated to Font Grossa in the plots indicated following the flood gradient.

The first works were the protection closure of the total perimeter of the area to be restored, and the stabilization of the substrate and protection of the shore against flood flows. Some ancient stumps of dead trees were placed in appropriate places as the basis where new hummocks could be installed in a second phase of restoration.

After this morphological conditioning, *Carex rostrata* cuttings were collected and translocated from the artificial reservoir of Lladres, located next to Font Grossa. On August 25, the first phase of introduction of this species was completed, which constitutes the recovery nucleus of HIC 7140.

Subsequently the protection perimeter was enlarged to include part of the existing peat bog, to ensure its protection from visitors and a propitious place where set further restoration actions.

During late summer and autumn, the good establishment of *Carex rostrata* in the form of a loose lawn has been confirmed.

On October 27, an experimental introduction of sphagnum moss characteristic of HIC 7140 was carried out, which will be completed once the 2018 thaw has been completed.



General aspect of the action with the extension of the perimeter of protection to the sector where a part of the former peat bog is preserved.

THE SHORT NEWS



16/08/2017

We participate in an activity of the PNAESM

Members of the LIMNOPIRINEUS technical office have participated in a field trip organized within the summer activities calendar of the Aigüestortes i Estany de Sant Maurici National Park. We have crossed the valley of Aigüestortes to the refuge of Estany Llong and then we have gone to the cirque of Dellui. During the itinerary we have made several short talks on the biodiversity and ecology of high mountain lakes and on the problems of the invasive fish that affect them. In the cirque of Dellui they could see the work done by Sorelló technicians as part of the restoration activities within the framework of the LIMNOPIRINEUS project.



17/08/2014

LIMNOPIRINEUS summer fieldwork

Over the last few weeks, we have been collecting samples on the target lakes that will allow us to quantify the progress in the restoration measures that are taking place within the framework of the project.

This year we have devoted more effort to amphibian nocturnal monitoring since last year we realised it gives more reliable results.



19/09/2017

Curs de Guies Interpretadors

Within the framework of the 25th edition of the course of the Interpretive Guides of the PNAESM, we organised an excursion to the cirque of Dellui. In this zone we have known the restoration actions being carried out by the project for the recovery of the autochthonous species of high mountain lakes.



24/09/2017

Ending seasonal fieldwork with ice and snow

The ice and snow have accompanied us on the last day of fieldwork. We have been working in Dellui cirque and what has started as a summer day has completely changed with the entrance of a front that has left a winter landscape. Snow season starts!



26/9/2017

A visit to Malniu with Bac de Cerdanya School

Once again, LIMNOPIRINEUS has collaborated with the School of Alp, Bac de Cerdanya, on their first excursion.

This year, second-grade students have explored high mountain aquatic ecosystems with a visit to Lake Malniu. Although the threat of rain has been present all day, we have done the activity without difficulties, leaving the ski resort of Guils de Cerdanya, and following the GR-11 we have arrived at the refuge of La Feixa where we have visited the wetlands that are next to the refuge. Then, we have continued to walk until we reached Lake Malniu where, through a game, we have learned which are the native species and which are the non-native.

The students with the help of the teachers have explored the littoral zone of the lake in search of different organisms.



This activity helped them to see the state of the lake in terms of conservation based on the composition of the community.

18/10/2017

V National Meeting on Exotic Invasive Species, EEI 2017

The congress, in which LIMNOPIRINEUS has participated as a co-organizer together with the Grupo Especialista en Invasiones Biológicas, the LIFE POTAMOFAUNA project and the Ter Consortium, has offered an open space for the exchange of experiences and knowledge and an opportunity for training of positive synergies among all those institutions and entities involved in the management of invasive alien species.

The congress has been well received in its 5th edition and a proof of this is the high level of participation with 32 oral communications and 43 posters.



Participants, researchers, representatives of scientific organizations and conservationists, professionals, technicians and managers of the administration of the environmental area have elaborated in consensus a series of conclusions that can be read from the blog of our web (www.lifelimnopyrineus.eu/es).

11/12/2017

Milano joins 62 LIFE projects dedicated to control invasive alien species

LIFE platform meeting on invasive alien species was organized by the LIFE Integrated Project GESTIRE 2020 last November in Milan. A meeting of more than 60 LIFE projects dedicated to invasive alien species in 17 European countries to discuss their study objectives.

Experiences and studies were shared on IAS (Invasive Alien Species) and their impact on the environment. The opportunity was also used to evaluate the challenges that this phenomenon causes, to look for solutions of the future, to optimize the LIFE projects that deal with this problem and to improve the implementation of the European regulation on invasive alien species.

The meeting was attended by representatives of a large part of LIFE projects that are dedicated to mitigate the negative effects of invasive alien species, each contributing a small description of their projects, as well as information on target species, relevant activities, costs, sustainability of the results, lessons learned, recommendations, etc.

In this sense, LIFE projects are a very important instrument for the development and subsequent implementation of European policies and legislation on the subject.



The results of this meeting were published in a guide that you can download from <http://www.naturachevale.it/wp-content/uploads/2017/06/A-catalogue-of-LIFE-projects-contributing-to-the-management-of-alien-species-in-the-European-Union-1.pdf>

Marc Ventura (CEAB-CSIC) participated as coordinator of the LIFE + LIMNOPIRINEUS project presenting the actions aimed at achieving one of the objectives of the project, returning eight lakes of high mountain to its natural fishless state.



The project is co-financed by the European Program LIFE+ that promotes conservation actions and restoration of habitats and species of flora and fauna at protected sites of the European Union within the Natura 2000 network.

LIFE LimnoPirineus
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