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PROJECT.ESTANY
LIFE + NATURA

Layman report

2010 - 2013

CONSORCI DE
l'estany

IMPROVING THE HABITATS AND SPECIES OF BANYOLES NATURA 2000: A DEMONSTRATIVE PROJECT
(LIFE08 NAT/E/000078)

Beneficiaries
Consorci de l'Estany (coordinator) / Banyoles Town Council / Porqueres Town Council

Co-financiers
Catalan Ministry of Agriculture, Livestock, Fisheries, Food and the Natural Environment (Generalitat de Catalunya)/ Girona Provincial Council / Agència Catalana de l'Aigua / Aigües de Banyoles

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Total cost and EU contribution
TOTAL - 1,020,352 € **EU - 510,176 € (50%)**

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Project Estany

Lake Banyoles Natural Area

Lake Banyoles Protected Natural Area consists of a lake (*estany*), the largest karstic lake in the Iberian Peninsula, and a series of much smaller satellite lakes and temporary lagoons that together make up the most important karstic lake system in the country. It covers 1,031 ha, is part of the Natura 2000 network and is included on the RAMSAR list and the Catalan list of Areas of Natural Interest.

In all, the area contains 11 habitats of Community interest and holds 15 protected species included in the EC Habitat Directive, 28 in the Bird Directive and a number of other species protected nationally.

The main threats

- The presence and proliferation of invasive exotic aquatic species of flora and fauna.
- The risk of extinction of animal species of interest at European level.
- Abusive angling practices on the lake.
- The loss of the riparian woodland and marshland and the proliferation of invasive plant species.

In 2009 the European Commission awarded the area a LIFE + programme aimed at carrying out the tasks included in *Projecte Estany: Improvement in the habitats and species in the Natura 2000 network: a demonstrative project* during the period 2010–2013.

What were the aims of *Project Estany*?

General aim

- Carry out a global intervention to combat, slow down and reverse the decline in species of Community interest caused by invasive species.

Specific aims

- Control of the invasive aquatic flora and fauna: fish, reptiles (terrapins) and plants.
- Direct recovery of the populations of four locally critically endangered species of local interest.
- Control of exotic flora and restoration of the quality and/or extension of the alluvial and lacustrine habitats.
- Indirect recovery of populations of macro-invertebrates, amphibians and birds of Community interest, above all via the control of invasive species.
- Drafting and passing of a species and habitats management plan.
- Carrying out of a pilot demonstrative project of great interest that will be useful in the management of other habitats and species in the Natura 2000 network and other similar sites.
- Awareness-raising amongst the local population and visitors regarding the conservation of our natural heritage and the fight against invasive species.

Actions and methods

Intensive campaign to eliminate exotic fish species.

- Design of intensive and continuous techniques combining different strategies to eliminate exotic fish (electric fishing, netting and trapping).

Reinforcement of the lake's autochthonous fish populations.

- Regular release of autochthonous species captured elsewhere in the same river basin.

Results

- Improvement in techniques and methods for controlling exotic fish species in a large lake.
- Removal of over 100,000 fish of exotic species.
- Drop in the population density of exotic fish species, above all of largemouth black bass (75%) and carp (90%).
- Release of over 20,000 autochthonous fish (75% Mediterranean barbel).
- Establishment of new breeding sites for Mediterranean barbel around the lake.
- Increase in the density of the host fish of the freshwater mussels (e.g. 95% increase in freshwater blenny).

Fish

Intensive controls of invasive exotic fish

The problem

Currently, the environmental conditions of lake Estany de Banyoles are excellent, as much in terms of the lake's water quality and associated plant communities, as in how public use (above all, sporting events) and access are regulated. However, the main environmental problem in the site is the continued presence of invasive exotic plant and animal species.

The proliferation of exotic fish species has been particularly severe and has led to the fall in numbers – or even disappearance – of most of the lake's autochthonous fish species. Thus, the three-spined stickleback (*Gasterosteus aculeatus*) died out in the area at the beginning of the past century, whilst the Mediterranean barbel (*Barbus meridionalis*) and a chub *Squalius laietanus* were confined to just a few small streams. Only the freshwater blenny (*Salaria fluviatilis*) and eel (*Anguilla anguilla*) survived in the lake, albeit in very small numbers.

Most of the exotic species were introduced to encourage angling and currently the dominant fish in the lake are large predators. They have also provoked changes in the ecology of the lake, namely, a fall in the water quality of the main and satellite lakes, alterations in underwater plant communities, and a gradual disappearance of autochthonous species of fauna (above all, amphibians and freshwater mussels). It is also important to highlight the fact that the lake acts as a source for the dispersal of exotic fish species throughout the rest of the basin of the river Ter.

Mediterranean barbel

The Mediterranean barbel (*Barbus meridionalis*) is an autochthonous species of Community interest whose populations have been severely affected by the increase in number of exotic fish species. Before the project began, in the whole of the Banyoles area there were just two small populations of this species confined to two streams.

Thus, it was necessary to improve the stocks of this species in the lake by translocating fish from other parts of the basin of the river Ter where it is still abundant. Using electric fishing, six capture campaigns were carried out during the project in the river Ter and in some of its main tributaries. The captured fish were carefully selected (all ill or injured fish, or those of other species, were discarded at this point) and then transported to the lake in a specially designed tank.

In all, over 15,000 Mediterranean barbels were released in the lake and the neighbouring Estanyol de Vilar. At the same time, over 5,000 chub *Squalius laietanus* were also translocated and released into the lake.

Although the situation of this species still needs to improve, it has been re-established in parts of the lake and surroundings (e.g. the canals that drain from the lake) from where it had disappeared.

Control campaigns

Given the hydrographic, morphological and socio-economic nature of Lake Banyoles, the fight against invasive exotic fish species can only be carried out via intensive controls of their populations. Thus, Projecte Estany evolved a pioneering methodology based on the optimization of various different intensive-capture techniques. Very few similar projects have ever been carried out in Europe in water bodies of the size of Estany de Banyoles.

The principal targets of the control campaigns were the lake's main exotic fish species: largemouth black bass (*Micropterus salmoides*), pumpkinseed (or sunfish) (*Lepomis gibbosus*), carp (*Cyprinus carpio*), European perch (*Perca fluviatilis*) and zander (or pike-perch) (*Sander lucioperca*). The fishing campaigns were designed to be both long and intense enough to have a lasting impact on the populations of introduced fish – above all on the large predators (black bass and zander) – in order to provide the lake's autochthonous species with a chance to recover. The overall aim was to restore a balance in the lake's fish communities in which, despite the presence of some exotic fish, all the autochthonous species are once again present.

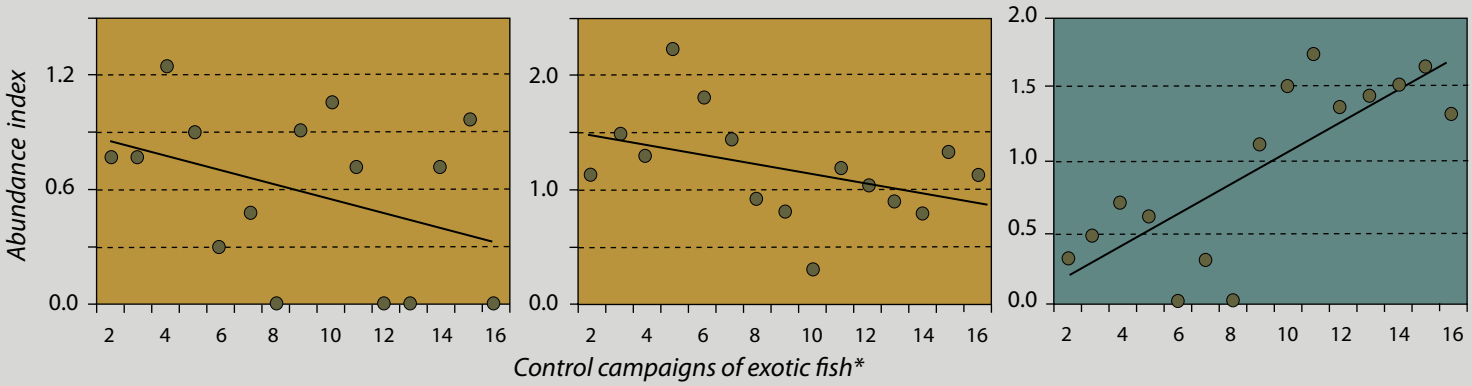
Continuous fishing campaigns throughout the year were conducted combining different methods of capture, i.e. electric fishing, netting and trapping. The most efficient technique in terms of the amount of biomass extracted was electric fishing, above all in regard to the two most abundant fish in the lake, the pumpkinseed and black bass. Even so, the other techniques were also necessary to be able to capture species such as European perch and zander that are less common in the shallower waters near the lake's banks.

Main changes resulting from the control of exotic fish

Black bass (*Micropterus salmoides*)
(Adults over 40 cm)

Carp (*Cyprinus carpio*)
(Main population)

Freshwater blenny (*Salaria fluviatilis*)
(Main population)



* Consecutive and accumulative electric fishing campaigns throughout the project; each campaign consisted of a number of weeks of fishing along the edges of the whole of the lake.

The terrapins

The recovery of the European pond terrapin (*Emys orbicularis*)

The problem

One of the problems facing autochthonous species of terrapin is competition with invasive exotic species. Over the past years the continuous release of the red-eared slider in the area has pushed the local populations of autochthonous terrapins to the brink of extinction. The restoration of habitat and the creation of new lagoons near the lake during a previous project (LIFE03 NAT/E/00067) were not sufficient to restore the populations of the European pond terrapin.

A number of different actions have been carried out in *Project Estany* aimed at reducing the number of exotic terrapins in the lake and strengthening its populations of the European pond terrapin.

Actions and methods

Elimination of invasive species

- Drafting of a protocol for capture.
- Campaigns to capture invasive species using different types of traps.

Breeding and release

- Captive breeding in the L'Albera Chelonian Recovery Centre.
- Release in the lagoons and pools in the vicinity of the lake.

Habitat improvement

- Placing of platforms where terrapins can bask.

Results

- 580 exotic terrapins removed.
- 7 different species of exotic terrapin removed.
- 130 terrapins bred and released
- 40% of released terrapins recaptured and a known minimum mortality rate of 4%
- Good adaption to the site and excellent growth rates.
- Maximum movements of 1–2.5 km.
- Confirmation of a small population of European pond terrapin.

Reinforcing the populations of *Emys orbicularis*

All the terrapins released in 2011–2013 came from a breeding centre, L'Albera Chelonian Recovery Centre, that has been rearing European pond terrapins since the 1990s from an original stock of a dozen terrapins from the basin of the river Ter (which includes Lake Banyoles).

The released terrapins measured 7–11 cm and were equipped with a subcutaneous micro-chip that identified each animal and/or a radio-transmitter attached to their carapace. In this way the movement of individual terrapins could be studied, along with their adaption to the habitat.

Success of the release

The adaption by the released *Emys orbicularis* to date has been excellent. The terrapins that have been monitored show good rates of growth (size and weight) and bright colours. They have adapted well to the sites where they were released, which most have not left, thereby showing that they were released in places that were suitable for the species.

Flora

Restoration of riparian and wetland habitats

The problem

The proximity of streets, gardens and agricultural areas has enabled exotic invasive plant species to proliferate in the riparian habitats of Community interest in and around Lake Banyoles.

The local riparian woodland is in its initial phase of succession and, given the loss of habitat caused by changes in land use, is thus vulnerable to colonization by invasive plant species.

The main threats come from the following species:

- Pyracantha or scarlet firethorn (*Pyracantha crenato-serrata, P. angustifolia*) (1)
- Chinese or glossy privet (*Ligustrum lucidum*) (2)
- Japanese honeysuckle (*Lonicera japonica*) (3)
- Cherry plum (*Prunus cerasifera*) (4)

In addition, giant cane (*Arundo donax*) is also present in the area.

These problems were especially serious in two parts of the wetland: around the Estanyol d'Ordis to the north of the main lake, and around Estanyols de la Puda, to the south.

Work has been carried out on private land with the permission of the owners and on public land.

Improving the connectivity between the lake and the lagoons at Can Morgat

One of the most important actions was the purchase of agricultural land on the right-bank of a stream, Riera de Can Morgat. Here, the giant canes were eliminated, the stream was widened and autochthonous species of riparian plants were planted.

Actions and methods

Control of exotic species

- Removal of biomass and application of herbicide (Glyphosate 36%) to the roots and stumps of *Arundo donax* and *Lonicera japonica*.
- Three phases of work during the project (autumn/winter).

- Land purchase and agreements signed with landowners.

Restoration of riparian habitats of Community interest

- Restoration work to broaden the profile of the right bank of Riera de Can Morgat.
- Planting of 400 riparian species of trees and bushes.

Results

- 12 ha of riparian woodland and marshland subject to species control.
- Purchase of 2,750 m^2 of agricultural land.
- Restoration of a 175 x 15-m stand of riparian woodland.

Freshwater mussels

A pioneering breeding laboratory

Actions

- Breeding in captivity and semi-captivity of the freshwater mussel *Unio elongatulus* (= *U. mancus* + *U. ravoisieri*).
- Strengthening of natural populations of autochthonous fish.
  1. Campaigns to control exotic fish species.
  2. Strengthening of populations of Mediterranean barbel and the chub *Squalius laietanus* in the lake and lagoons.

Methods

- Setting up of a laboratory to breed freshwater mussels
- Drawing up of protocols for obtaining and rearing juvenile mussels
- Release of juvenile mussels and host autochthonous fish into the lake and associated watercourses.

The problem

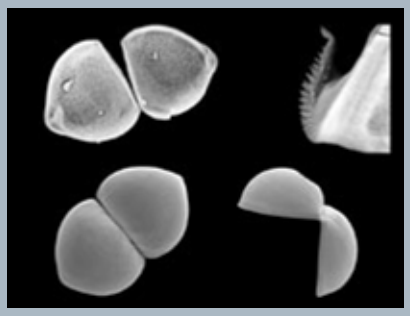
Freshwater pearl mussels are filter-feeder bivalves that live in the sediments of clean waters. They are considered to be good bioindicators of the ecological health of an ecosystem and all are legally protected due to their precarious conservation status and their natural interest. Four different species of freshwater mussel live in Estany de Banyoles.

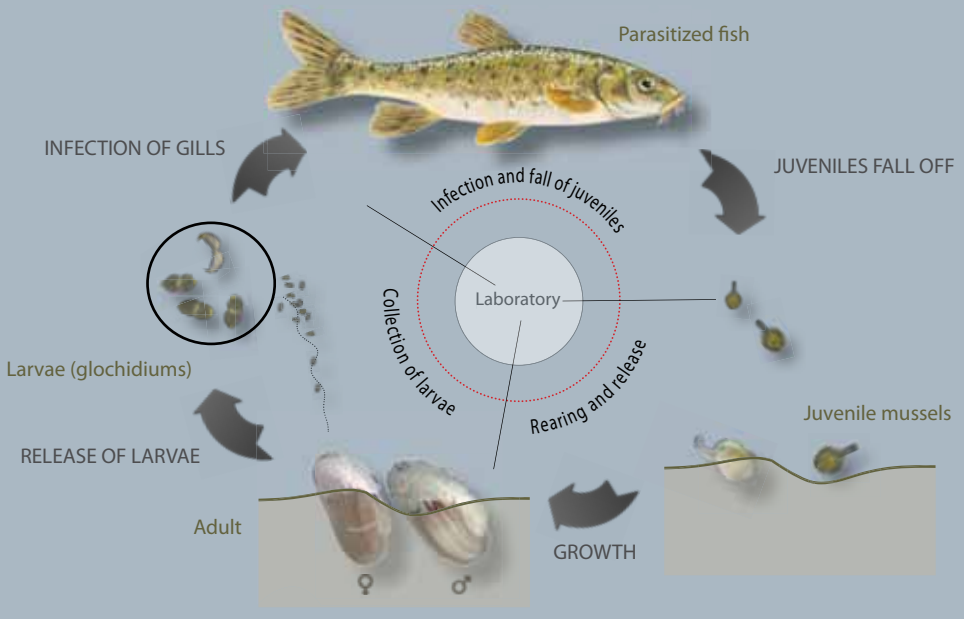
These bivalves need robust populations of autochthonous fish if they are to survive. With the fall in numbers of these fish in face of competition from invasive exotic species, the mussel populations in the lake have been affected negatively: numbers have fallen and populations have become destructured, with only a few very old mussels surviving.

The two key mussel-related actions in *Project Estany* were the strengthening of host populations of autochthonous fish species and the increasing of the number of mussels by releasing juveniles bred in captivity. The setting up of a specialized laboratory to breed and rear mussels according to established protocols was an essential part of the second part of the project.

Life cycle

Female freshwater mussels release larvae (glochidiums) that attach themselves for 10–20 days to the gills or fins of the fish they parasite. Once they have grown into juvenile mussels they drop off their hosts into the sediment, where they grow into reproductive adults. Each species of mussel only parasitizes certain species of fish that, in the case of Banyoles, are the Mediterranean barbel, a chub *Squalius laietanus* and freshwater blenny.



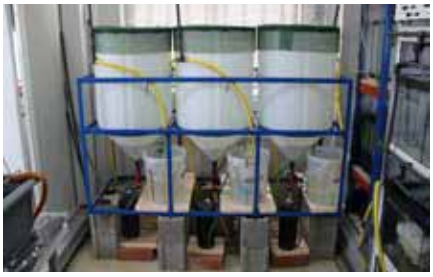


The breeding laboratory

These installations were a key part of the freshwater mussel captive breeding programme. Work centred on maintaining populations of host fish and of fertile adult mussels (*Unio elongatulus* = *U. mancus and U. ravoisieri*). Techniques and methods for obtaining young mussels were tested and the successfully reared young were released into the lake and its associated watercourses.

Work began in February 2010 in the installations, which include indoor aquariums and outdoor tanks for fish and mussels. By spring 2011, 10,000 mussel larvae had been bred thanks to breeding and rearing techniques that improved with time. The installations were initially designed to last just for the length of the project but could continue work for a further four years.

The project was run by the technical staff of the Consorci de l'Estany, in collaboratin with Dr. Rafa Araujo, expert in freshwater mussels from the National Natural History Museum (CSIC) in Madrid, and with the participation of interns.



Growth

Release

Results

- Successful captive breeding and rearing of large numbers of juvenile mussels, the first time this has been achieved in Europe.
- Birth of 132,918 juveniles (2011–2013), giving 150 juveniles per fish (107,152 *U. mancus* and 25,766 *U. ravoisieri*). High mortality rates during first days of life.
- Release into the lake and Riera de Can Morgat of 3,517 parasitized fish.
- The population of *U. mancus* increased by at least 40 % (release of 278 ind.).
- The population of *U. ravoisieri* increased by over 200 % (release of 224 ind.).
- The maximum size of mussels born in 2011 was 32 mm.
- By the end of the project there was a captive stock of 318 juvenile mussels born in 2011, 1,700 in 2012 and around 6,000 in 2013.

Public awareness

Public activities

The problem

In general, the problem of invasive exotic species (IES) and the negative effects that they have on habitats and autochthonous species is poorly understood by the wider public. Furthermore, amongst those who use Estany de Banyoles there is little knowledge of the specific problem of IES in Banyoles or even of the natural values of the lake itself.

This lack of awareness regarding the threats posed by IES – and, in particular, the lack of preventative control measures – has aggravated the negative effects these species have had on the native flora and fauna.

One of the main aims of *Project Estany* was to increase awareness within the local and visiting population of the natural ecological importance of the lake's autochthonous species and the threats posed by IES. Another key objective was to describe and justify the actions to be carried out within the framework of this LIFE project.

What have we achieved?

The raising of awareness was achieved via a number of different actions directed at both local and regional residents, as well as at the scientific community and, above all, at schoolchildren.

Different strategies were used including appearances on television and radio and in the printed press, the giving of talks and conferences, the publication of didactic material, and the organization of leisure activities in and around the lake.

The website of the Consorci de l'Estany www.estanyespainatural.net was actively employed to allow people to find out more about certain areas of the project and the actions carried out there.

The impact of the project within the scientific and technical community is centred on the on-line publication of all the project's reports and protocols, and on the participation in numerous national and international congresses and workshops.

Project Estany and the media

One of the most effective ways of raising awareness of the project was the emission of a series of reports on local TV and a block of 57 programmes on Radio Banyoles.

A documentary *Espècies exòtiques invasores: Projecte Estany* was filmed, with 12, eight-minute chapters in which the problems of invasive species and how to deal with them are discussed. These chapters form the basis for a documentary that can be seen on-line on the project's website.

Espai Estany is a seven-minute radio programme with information about *Project Estany*, the Natura 2000 network and the protected area of Estany de Banyoles whose main aim was to provide more information about the project and help answer some of the most frequently asked questions.

As well, 11 press conferences were held and 17 press releases were published in the local and national press. Of most interest were the five appearances of the project on Catalan TV (TV3) on programmes such as *El Medi Ambient*, *Espai Terra* and *El Divendres* with an average audience of 400,000 spectators.

Printed didactic material

The following items of promotional and didactic material were prepared and printed: a poster of the lake's autochthonous species with an explication of the threats they are facing (2,500 copies), a leaflet about *Project Estany* (9,000 copies in three languages), three information boards describing the main autochthonous and invasive species, and an album of children's stories titled *Kingfisher and the stories of his friends* (1,500 copies) that continues on from a pre-existing collection about *The Kingfisher* that help explain the problem of introduced species.

Festival of Fish

In 2010 the hundred years of the *Festival of the Fish* was celebrated with a parade and the presentation of a *capgròs* (lit. 'bighead'; a large-scale replica of a person's head or a element of local interest that is commonly paraded during town festivities) in the form of a freshwater mussel and a kingfisher to stimulate interest in the lake's natural values. During the annual festivities of Porqueres in 2011 a new *capgròs* of a Mediterranean barbel was paraded.

Itinerant exhibition

An exhibition, Aliens! The invasion of the exotic species, was set up to increase awareness of the increasingly serious problem of invasive exotic species. Its displays and specific examples were seen by over 2,400 people in the Darder Museum in Banyoles and by 84,145 in the Museum Blau in Barcelona.

Talks and workshops

Organization of over 30 talks aimed at different sectors of the population (OAPs, students, general public and law-enforcement agencies), as well as various seminars and workshops held in Girona and Barcelona universities. The Consortium presented 32 scientific communications and posters related to aspects of the project at over 20 local, national and international congresses and workshops. In all, 10 groups of experts and technical staff visited the Consortium's installations, above all the freshwater mussel laboratory.

Popular activities

Project Estany participated in the 20-plus leisure activities organized in and around the lake that attracted hundreds of people to events such as the tree-planting at Can Morgat, a family-day centred around the release of terrapins, the celebration of World Wetlands Day and the Day of the Lake, and the organization of a stall at the Firestany and St George's Day fairs.

Scientific congress

On 10 April 2013 a hundred experts met in Banyoles to discuss and debate experiences in controlling and managing invasive species in rivers and wetlands.

The *II Congress on Invasive Species in Rivers and Wetlands. Control and Management Methods* aimed to provide participants with more knowledge of how to prevent the penetration of new invasive species into wetland areas, and of techniques in the fight against already established invasive species.

At the end of the workshop, participants visited the protected area and a demonstration of techniques for controlling exotic fish species was given.

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CONSORCI DE l'estany

Life

NATURA 2000

Ajuntament de Banyoles

Ajuntament de Porqueres

Generalitat de Catalunya
Departament d'Agricultura, Ramaderia, Pesca, Alimentació i Medi Natural

Diputació de Girona

Agència Catalana de l'Aigua

AIGÜES DE BANYOLES, S.A.