LIFE08 NAT/E/000078

"***Improvement of the Natura 2000 habitats and species found in Banyoles: a demonstration project***"

E.6. – CONSERVATION AND CONTINUITY PLAN

Conservation and Continuity *After-LIFE* Plan

December 2013


NATURA 2000
Ramsar

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PRESENTATION

This plan has been drawn up as part of Project *Estany – Improvement of the Natura 2000 habitats and species found in Banyoles: a demonstration project* (LIFE08 NAT/E/000078) and corresponds to Action E6.

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1. PRESENTATION

As part of its programme LIFE+, the European Commission awarded funds in 2009 for the execution of the project *Improvement of the Natura 2000 habitats and species found in Banyoles: a demonstration project* [LIFE08 NAT/E/000078], also known as LIFE Project *Estany*, in the period 2010–2013.

It main objective was to carry out comprehensive work aimed at combating, reducing and reverting the decline in habitats and species of community interest in and around Lake Banyoles being caused by exotic invasive species of flora and fauna. The project was designed as a pilot demonstrative scheme that would provide useful experience for the management of habitats and species in similar Natura 2000 sites.

Specifically, the Project aimed to:

- Control invasive aquatic species of flora and fauna: fish, reptiles (terrapins) and plants.
- Restore the populations in this SCI of four critically endangered species of community interest: the freshwater mussel *Unio elongatulus* [*U. mancus* + *U. ravoisieri*], Mediterranean barbel (*Barbus meridionalis*), European pond terrapin (*Emys orbicularis*) and Mediterranean terrapin (*Mauremys leprosa*).
- Control the exotic flora and restore the quality and/or extension of alluvial and lacustrine habitats.
- Restore indirectly populations of macro-invertebrate, amphibian and bird species of community interest, above all by controlling invasive species.
- Draw up and approve a management plan for the lake's habitats and species.
- Improve local and visitor awareness of the lake's natural values and the need to conserve its natural heritage.

As stated in the Directives of the LIFE Project *Estany*, a Conservation and Continuity Plan must be drawn up to be implemented in the years following the termination of the project.

The development of a conservation and continuity plan depends to a large extent on the possibilities of finding sources of funding for the actions that are of greatest importance. Given the current economic situation, care must be taken when establishing priorities and drawing up long-term conservation and continuity programmes. Thus, in this plan an emphasis has been put on actions that are potentially economically viable.

2. INTRODUCTION

2.1 Lake Banyoles

The Lake Banyoles Natural Protected Area consists of the lake itself, the largest karstic lake in the Iberian Peninsula, and a series of smaller lakes and lagoons that, together, make up the largest karstic system in the country. Covering 1,031 ha, it is currently part of the Natura 2000 network [code ES5120008] and is included on both the RAMSAR list and in the Catalan Inventory of Areas of Natural Interest.

The waters of this wetland originate in L'Alta Garrotxa, a mountainous area 50 km to the north where water filters through the calcareous rocks into the groundwater system. Lake Banyoles and its associated lagoons and springs are located in the lowest part of this hydrogeological system. The underground waters drain in a north-south direction and are forced up to the surface when they come into contact with a fault. As they ascend, they dissolve layers of gypsum and other calcareous strata, which eventually causes large-scale subsidence (*dolines*) and the formation of numerous lakes and springs.

Lake Banyoles itself consists of six basins and 13 springs; close by the lake, there are also a number of small permanent lakes or *estanyols* – for example, La Ceniza, Montalt, Ca n'Ordis and Can Cisó and el Nou – and temporary lagoons such as Platja d'Espolla (3 ha) and the springs on the plain of Usall.

The Lake Banyoles catchment area covers 12.1 km^2 and provides around 20% of the lake's total water intake, the other 80% corresponding to subterranean upwellings. Of the streams that flow into the lake, only four are permanent, the others running only in the event of heavy rain. Five channels drain the southeastern sector of the lake and run into the river Terri, which in turn flows into the river Ter.

The main threats to this natural area are as follows:

- The destruction of the wetland areas around the lake
- The growing pressure exerted by human activities
- The presence and proliferation of exotic invasive species of aquatic flora and fauna
- The risk of extinction of species of fauna of Community Interest
- Malpractice by anglers
- The regression of the riparian woodland and wetlands and the proliferation of invasive species of plants.

The lake is home to 11 habitats of Community Interest, as well as to 15 protected species that appear in the EU Habitats Directive and 28 in the Birds Directive. There are likewise a number of other species of flora and fauna that are protected by national legislation.

The lake's hydrophyte communities are dominated by (i) reed beds (*Typho-Schoenoplectetum glauci*) and calcareous fens with great fen-sedge *Cladium mariscus* (habitat code 7210), which fringe the whole of the lake, and (ii) benthic plant communities found in hard oligo-mesotrophic waters, with *Chara* spp. (habitat code 3140), and floating hydrophyte vegetation communities found in natural eutrophic lakes (*Potamion*) (habitat code 3150). In areas liable to flooding around the lake and lagoons, tall herbaceous communities of sedges *Magnocaricion elatea* form, along with Mediterranean grasslands of *Molinio-Holoschoenion* (cod. hab. 6420). The natural shores of the lake host restored alluvial forests with *Alnus*

glutinosa and *Fraxinus exelsior* from the *Alno-Podion*, *Alnion incanae* and *Salicion albae* plant communities (habitat code 91E0) and gallery woodland of *Salix alba* and *Populus alba* (habitat code 92A0). Also of special importance are the temporary Mediterranean ponds such as Playa de Espolla (habitat code 3170).

2.2 Previous management

Lake Banyoles is a natural site possessing a series of exceptional hydrogeological, scenic and ecological characteristics that is subject to serious pressure from a number of human leisure activities. The current aspect of the lake and its surrounding areas show the extent to which much of the surrounding marshland has been drained and converted into built-up areas. The celebration of the rowing events in the 1992 Olympic games was an important moment for Lake Banyoles and led to the implementation of the first environmental corrective measures including the banning of motor boats and water-skiing and the first attempts to regulate the human activities carried out in the area surrounding the lake. It was during this period that land was acquired for the first time for public use.

In 2003 a new phase in the management of the lake, orientated towards the conservation of the area's natural values, got underway. The LIFE Nature project *Recuperation of the aquatic environments of Porqueres and Lake Banyoles* [LIFE03 NAT/E/000067] carried out in 2003–2007, enabled the local beneficiaries, along with the Girona Provincial Council and the Catalan Government, to set up the Lake Banyoles Consortium, an inter-municipal entity empowered with the management of the site. This body has managed the lake and surroundings since April 2004 and is assigned an annual budget that enables it to run a technical office and manage both publically owned land and privately owned land via land stewardship agreements.

This first LIFE project acted as a catalyst for various other projects and led to significant changes in the way the lake and its surrounding area was managed. It began the task of combating the principal threats to the site such as land drainage and excessive human presence, and was able to improve the overall management of the lake, expand the habitats of natural interest and increase the breeding numbers of species such as little grebe, coot, great reed warbler, kingfisher, little bittern, amphibians, roe deer and otter.

Thus, over the past 10 years, wetlands have been restored, accesses and public facilities have been improved, trails have been established and the legal instruments that regulate human activities have been refined. As well, a lot of work has been carried out to increase awareness of the lake's natural values amongst local people and visitors.

The Consortium has carried out numerous restoration projects in the site's wetlands and alluvial woodland, of which one of the most important was the concerted attempt to combat the spread of exotic invasive species of flora and fauna (e.g. LIFE Project *Estany*).

2.3 The LIFE Project *Estany*

The LIFE Project *Estany* came to a conclusion on 31 December 2013 and during its four years of activity was successful in many of the tasks it undertook. Some of successes are described in the following section.

- A laboratory for breeding and rearing the freshwater mussel (*Unio elongatulus [U. mancus + U. ravoisieri]*) in captivity was set up. During the

four years of the project, a total of 132,918 juvenile mussels were bred. By the end of the project, 502 mussels (two-and-a-half years of age, 3 cm in length) had been released into the lake. A further 218 two-and-a-half-year-old mussels, 2,240 one-and-a-half-year-old mussels and 43,700 juveniles born in 2013 remain in the tanks and channels of the captive breeding facility. In the case of *Unio mancus*, a minimum natural increase in its population of 40% has been estimated. Furthermore, 3,500 fish parasitized by mussel larvae have been released into the lake, which will have led to hundreds of juvenile mussels being naturally seeded in the lake — a process that controls have been able to corroborate *in situ*. The population of *U. ravoisieri* has increased by 200%, a level of production (births plus growth to three years of age) that has never previously been achieved in Europe.

- One hundred and thirty European pond terrapins (*Emys orbicularis*) bred in L'Albera Tortoise Reproduction Centre were released; their growth rates show that they have adapted well to their new environment. Traps enabled 580 exotic terrapins belonging to seven different taxa to be captured and removed. As well, the presence of a small population of Mediterranean terrapin (*Mauremys leprosa*) was confirmed.
- One of the project's main aims was to try and reduced the quantity of exotic fish in the lake. Over 100,000 such fish were captured, and the population of large examples of black bass (*Micropterus salmoides*) was reduced by 75% and of common carp (*Cyprinus carpio*) by 90%. The release of 20,000 Mediterranean barbel (*Barbus meridionalis*) and another autochthonous fish, *Squalius laietanus*, into the lake and the streams and canals in the surrounding area has helped restore the populations of these fish species. An increase by 95% in the population of another autochthonous fish, the freshwater blenny (*Salaria fluviatilis*), has also been registered: this species – like the abovementioned species – is host to the parasitic larvae of the freshwater mussel. Different fishing methods have been tried and tested and capture techniques have been improved.
- Another important aspect is the restoration of 175 lineal metres (or 2,750 m^2) of riparian woodland, made possible by the purchase of land and the planting of 400 examples of riparian species of trees and bushes. Three intensive attempts to eliminate exotic plants were conducted in 12 ha of land populated by part of the lake's fringing riparian woodland. The main invasive species eliminated were pyracantha (*Pyracantha* sp.), Chinese privet (*Ligustrum lucidum*), giant reed (*Arundo donax*) and Japanese honeysuckle (*Lonicera japonica*) in both publically owned land and land subject to stewardship agreements.
- Finally, efforts such as the Technical Plan for Angling Management have been made to regulate some of the human activities carried out around the lake. The only objective that was not fulfilled was the definitive drafting and approval of a Management Plan for the habitats and species in the area surrounding Lake Banyoles.

3. ANALYSIS OF THE CURRENT SITUATION

3.1 Current situation and management needs

After four years of actions within the framework of LIFE project *Estany*, the current situations of some of the target species and habitats such as the freshwater mussel, the European pond terrapin, the Mediterranean barbel and the riparian

woodland in general have improved in the main area in which actions were carried out. Nevertheless, it is important to remark that these improvements do not guarantee the future conservation of these species and so reinforcement actions will be needed; likewise, the fight against the invasive exotic species must continue.

In light of the final results of the project, the following conclusions can be drawn for each area of action:

- **Freshwater mussels.** The repopulations in the lake have substantially increased the number of freshwater mussels, which will start to breed when 4–5-years old. This fact, along with the boost provided by the release of some laboratory-bred examples, will ensure that the lake's population of these invertebrates is stabilized. Even so, action is still required to improve the populations of the lake's native fish populations and to control species such as carp that prey on juvenile stages of the mussels.
- **European pond terrapin.** The released examples have adapted very well to their new surroundings. It is hoped that they will start to breed naturally within 1–2 years and so further monitoring of their population is required. Their current populations must be reinforced whenever possible with fresh releases to guarantee minimum viable numbers of terrapins, and the control of exotic terrapins must be continued. We believe that the population of exotic terrapins in the lake has been reduced significantly and so henceforth less intensive monitoring will be needed to ensure that their populations do not begin to expand again.
- **Control of exotic fish species.** The significant reduction in the number of adult individuals of the lake's exotic fish species has favoured the population of the native species such as the freshwater blenny. The repopulations have also strengthened the lake's small population of Mediterranean barbel and *Squalius laietanus.* These three fish species are all hosts that intervene in the breeding cycle of the freshwater mussel.

  This situation at the end of the project could vary over the coming years given that it was not possible to reduce the number of small individuals of the exotic fish species, and so in a few years time the populations of these species could recover to their levels at the beginning of the project. This means that periodical control actions are needed to prevent any increase in the number of large individuals of these predator species, which could once again have a negative impact on native species. Thus, the experience acquired and the available infrastructure offer good opportunities to keep the exotic fish species under check with a modicum of effort. This control is vital to conserve the breeding populations of the freshwater mussels, which breed in the streams and canals around the lake that act as important refuges where autochthonous species can breed.
- **Riparian woodland.** The 175 lineal metres of riparian woodland that were restored were in good health by the end of the project, as shown by the fact that all the planted trees survived. Small-scale actions will be necessary to eliminate the shoots of the giant reeds and other exotic species; these tasks can be easily included as one of the periodic management tasks to be carried out around the lake.

  The actions designed to eliminate the exotic flora in a 12-ha plot were also satisfactory, although the protocol requires action every five years to eliminate any fresh shoots and to completely exhaust the seed bank. Nevertheless, given that there are private properties in the area around the lake in which exotic species are still common, the risk of recolonization remains high, even in areas in which management tasks have already been

carried out. The control of exotic species must also be undertaken in these properties, as stated in the initial management plan of this protected area. This work has been one of the main management actions in the area surrounding the lake over the last 10 years.

The Lake Banyoles Consortium is the public entity that is currently managing the natural protected area of Lake Banyoles (ES5120008). It represents the various different administrative bodies that have responsibility for the area: the Generalitat de Catalunya (the Catalan government), the town councils of Banyoles and Porqueres, and the Diputació de Girona (Girona Provincial Council). Nevertheless, in the ultimate instance it is the Generalitat de Catalunya that is responsible for the conservation and management of the lake's flora, fauna and habitats.

Despite being initially relatively stable from 2004 onwards, the Consortium's annual budget has suffered severe financial cutbacks in recent years. It has a management and administrative team that is actively working to find new sources of funding, investment and material for the natural area in order to ensure its protection, restoration and improvement, and to stimulate collaboration between administrations and local non-government entities. The type of funding that it seeks include grants from the Girona Provincial Council and the Catalan government that are specifically designed for protected natural areas.

Thus, the Consortium will guarantee the continuity of some of the necessary actions that are discussed in this plan, which will necessarily be dependent on the type and amount of specific annual financial support received. The Consortium could incorporate some of the required actions directly into its annual activity programme (a document that is linked to its standard annual budget that is approved every year). This would guarantee the conservation and restoration of the fauna and habitats of Lake Banyoles in the mid-term.

3.2 DAFO analysis

Strengths	**Weaknesses**
• Experience acquired from 2 LIFE projects. • Creation of team with expertise in the fight against exotic invasive species (EIS) of fauna and aquatic fauna. • Knowledge, experience and success in the captive breeding of European pond terrapins and freshwater mussels. Establishment of centres for breeding threatened autochthonous species in captivity. • Good public perception of the Lake Banyoles Consortium. • Good water quality and fast recovery of the restored ecosystems around Lake Banyoles. • Increase in local people's environmental awareness. • The routine control of the vegetation around the lake carried out by the Consortium's staff includes the maintenance of infrastructures such as trails and hides, and also work aimed at preventing the spread of invasive plants. • Approval of a fishing management plan for the lake.	• Inexistence of an overall management plan for the ecosystems and species found in Lake Banyoles. Difficulties in agreeing on management plans. • Difficulties in obtaining funding for conservation projects. • High cost of actions aimed at controlling certain EIS such as exotic fish. • Technical difficulty in controlling effectively exotic invasive species such as the black bass, sun fish or Japanese honeysuckle. Quick recovery of the EIS if control actions are stopped. • Complex management of coarse fishing: contrasting opinions between Consortium and other groups and resistance shown by some anglers to the sacrifice of exotic species. • Lack of visibility of some of the Consortium's actions, which thus have had little direct impact on the local population. • Lack of ability to regulate or stop the spread of EIS at regional, national and international scales.

Opportunities	**Threats**
• Approval of *Potamo Fauna* (LIFE12 NAT/ES/001091), a new LIFE+ Natura project for Lake Banyoles. • Existence of a breeding centre for protected species (European pond terrapin and freshwater mussels) where tried and tested protocols have been conducted. • Greater awareness of the threats posed by EIS and the need to act urgently. • Interest from other natural areas in applying the conservation measures for threatened species used at Lake Banyoles. • New legal framework for controlling exotic species*:* Royal Decree 630/2013 of 2 August setting up a *Spanish Catalogue of Exotic Invasive Species*.	• Important number of leisure activities carried out at Lake Banyoles implying the presence of large numbers of people and boats, with the consequent risk of the accidental introduction of new EIS such as the zebra mussel (*Dreissena polymorpha*). • Possible arrival of new EIS such as the zebra mussel and other fish species that will threaten wetland habitats. • Proliferation of exotic plants originating in nearby gardens and peri-urban areas around the lake. The sale of ornamental species that may act as EIS continues. • Pressure from anglers – above all, those who fish for black bass – to establish an intensive fishing area to promote fishing for large exotic carnivorous fish.

4. OBJECTIVES AND THE IMPLEMENTATION OF THE PLAN

As stated by the directives of the LIFE Project *Estany*, a Conservation and Continuity Plan must be drawn up containing actions that can be realistically implemented in the five years following the ending of the LIFE project.

The beneficiary of the Project *Estany*, the Lake Banyoles Consortium, is committed to continuing with those actions that require a degree of maintenance and/or monitoring. This continuity can take place over different time-scales, from every year to every five years, and actions may form part of the standard annual action programme of the Consortium or may be funded by grants or other external sources of finance obtained for specific purposes.

4.1 Objectives

The following objectives have been established as part of the post-LIFE Conservation Plan:

- **O.1. –** Consolidate the conservation of the fish species, the terrapins and freshwater mussels of Community Interest within the radius of action of the LIFE project (*Barbus meridionalis, Emys orbicularis, Unio elongatulus* [*U. mancus* + *U. ravoisieri*].
- **O.2. –** Contribute to the conservation of the habitats of Community Interest in the radius of action affected by the spread of exotic invasive plant species.
- **O.3. –** Foment participation by the general population and interest groups and increase awareness of the problems deriving from attempts to manage biological invasions.

To achieve these objectives it is essential to work side-by-side with groups and entities at all levels that are involved in territorial planning and in the conservation of the region's natural heritage. Some these entities are listed below:

- Ministry of Agriculture, Livestock, Fisheries, Food and the Environment of the Catalan government.
- Girona Provincial Council
- Catalan Water Agency
- Lake Banyoles Consortium
- River Ter Consortium
- L'Albera Wildlife Recovery Centre
- Banyoles Town Council
- Porqueres Town Council
- National Natural History Museum
- Pla de L'Estany Anglers' Association
- Darder Museum. Banyoles Wetland Interpretation Centre
- Banyoles Nature School
- Limnos Naturalists' Association

4.2 Action plan

The following are brief descriptions of the actions contemplated by the *After-LIFE* continuity plan of LIFE Project *Estany*:

Fishing management		
Actions	**Execution**	**Funding**
1. Implementation of the lake's fishing plan	Lake Banyoles Consortium and the Catalan government, the competent administrative body.	Self-funded, work to be carried out by Consortium staff.
Objectives: O.1. and O.3.	**Priority:** High	

Management of lake surroundings		
Actions	**Execution**	**Funding**
2. Approval of management plan for species and habitats	Lake Banyoles Consortium and the Catalan government, the competent administrative body.	Self-funded, work to be carried out by Consortium staff.
Objectives: O.1. and O.2.	**Priority:** High	

Control of EIS		
Actions	**Execution**	**Funding**
3. Exotic fish species	Lake Banyoles Consortium	Self-funded, work to be carried out by Consortium staff; new projects.
Objective: O.1.	**Priority:** High	
4. Exotic terrapins	Lake Banyoles Consortium and environmental volunteer groups.	Self-funded, work to be carried out by Consortium staff. Work camps and environmental volunteers
Objective: O.1.	**Priority:** Medium	
5. Exotic plants	Lake Banyoles Consortium	Grants from the Catalan government for Natura 2000 sites and from the Girona Provincial Council Maintenance teams and vegetation management to be carried out by Consortium staff.
Objective: O.2.	**Priority:** High	

Recovery of autochthonous species		
Actions	**Execution**	**Funding**
6. Breeding of freshwater mussels	Lake Banyoles Consortium	Self-funded, work to be carried out by Consortium staff. External funding for conservation projects.
Objective: O.1.	**Priority:** Medium	

Raising environmental awareness		
Actions	**Execution**	**Funding**
7. Media and public awareness campaign	Lake Banyoles Consortium and environmental volunteers Joint activities run by Darder Museum, Limnos and Nature School	Darder Museum Staff of CES Catalan government via grants for educational projects and for associations and work camps
Objective: O.3.	**Priority:** Medium	

Ecosystem monitoring		
Actions	**Execution**	**Funding**
8. Monitoring of flora and fauna	Lake Banyoles Consortium Environmental volunteer programme Catalan government's rural ranger service	Self-funded, work to be carried out by Consortium staff and environmental volunteers.
Objective: O.1. and O.2.	**Priority:** Medium	
9. Monitoring protocols	Lake Banyoles Consortium and local administrations (Banyoles Town Council, Catalan government, …)	Self-funded, work to be carried out by Consortium staff and other administrative bodies
Objective: O.1. and O.2.	**Priority:** Medium	

4.3 Actions

Some of the actions listed in the previous section are described briefly below.

4.3.1. ACTION 1: LAKE FISHING PLAN

A fishing plan (Action A8) was drawn up as part of LIFE Project *Estany* whose aim was to control and manage angling activities around Lake Banyoles and its main tributaries. This plan will remain in force in the coming years and should be revised every five years (2018). The ban on returning captured exotic species to the lake should help control these species and make anglers more aware of the problems caused by the EIS. The review of this plan will have no additional cost as it is an internal document drawn up by the Consortium's staff in collaboration with the Catalan government.

One of the points established by the fishing plan was the commitment to publish information leaflets on fishing within four years (2015). Other pledges that the Consortium must fulfil are the maintenance of the signage, the vegetation around the lake, the pedestrian trails and the accesses to the water's edge, as well as the monitoring of fish populations, the reinforcement of native fish populations and the improvement of the connection between the lake and the river Terri, a tributary of the river Ter.

4.3.2 ACTION 2: HABITATS AND SPECIES MANAGEMENT PLAN

The habitats and species management plan contained in LIFE Project *Estany* (Action A9) could not be finished and so has not yet been approved definitively by the

competent local administrative bodies. The plan should include the proposals made in this continuity plan, with full information regarding how each of the recommendations and necessary actions are to be carried out.

During 2014 the plan will be drawn up and approved. It is a document of great interest for the Consortium, the two local town councils and the Catalan government. There will be no additional cost as it is an internal document drawn up by the Consortium's staff; nevertheless, time must be found to be able to complete this difficult task.

4.3.3. ACTION 3: CAMPAIGNS TO CONTROL EXOTIC FISH POPULATIONS

Continuous selective fishing was carried out in 2014–2017 aimed at reducing the populations of the main exotic fish species present in the lake (SCI Lake Banyoles [ES5120008]): *Micropterus salmoides*, *Lepomis gibbosus*, *Cyprinus carpio*, *Perca fluviatilis* and *Sander lucioperca*. This process was based on the use of a combination of three techniques: (i) electric fishing from a boat moored on the edge of the lake; (ii) large, strategically placed floating fish traps and nets; and (iii) lines. We believe that this action merits being included in the new proposed LIFE *Potamo Fauna*, and is the only action dating from LIFE Project *Estany* for which such an important level of further effort – albeit somewhat less intensely than before – has been proposed.

The justification for continuing this action is based on its great demonstrative value at both national and international scales, as well as on the lack of similar experiences in Europe and the need to complete the tasks undertaken in previous years. Its continuity will aid the recovery of the local populations of *B. meridionalis* and *U. elongatulus*, and other species of Community Interest that are the object of the current proposal. This continuity will also help reduce the size of the dispersion nuclei of the exotic fish species, which are able to spread from Lake Banyoles into the rest of the basin of the river Ter.

The future campaigns to control the lake's exotic fish populations will be based on the knowledge gained from this LIFE project, which will optimize the capture periods (April-May) and increase the efficiency of the techniques and efforts (electric fishing from a boat, fixed traps and nets, and lines) employed in the capture of target species. The use of theses techniques will enable other control techniques and protocols to be tried out in the longer term. A key aspect in this and any other project's long-term sustainability is the ability to establish which control techniques and procedures are the best — and this will require more years of controlled fishing and detailed analyses of the results as they are obtained.

This action will be possible given that the LIFE *Potamo Fauna* includes a provision for material (fuel, nets, buoys, etc.) for repairing and maintaining the electric fishing equipment and for incorporating its own specialist staff who will be able to carry out the controlled fishing tasks.

Below, we describe briefly the main criteria to be taken into account when planning these fishing campaigns:

- PRINCIPAL TARGET SPECIES: Black bass.
- SECONDARY TARGET SPECIES: sun fish, carp, perch and zander.
- CHOSEN FISHING TECHNIQUES: electric fishing from a moored boat.
- COMPLEMENTARY FISHING TECHNIQUES: large traps and nets, and lines.
- FISHING EFFORT: 2–4 complete electric-fishing campaigns from a boat covering the whole of the lake's shores; 15–25 days of fishing with nets (minimum 100 hooks per day); 6 months of passive fishing with nets and

traps (minimum 10–25 traps); 1–2 campaigns of three days each of electric fishing in Llacuna del Vilar.

- OPTIMUM FISHING PERIOD: electric fishing: April–July; lines and traps: May–September.

The application of these criteria must take into account other protocols describing in greater detail the actual techniques employed, hours and dates, etc.

4.3.4. ACTION 4: CAMPAIGNS TO CONTROL EXOTIC TERRAPIN SPECIES

The capture of terrapins will be carried out continuously in 2014–2017 in Lake Banyoles using the traps already tried and tested in LIFE Project *Estany*. The placing of the traps will be carried out according to the following strategy:

1. Placement of a minimum of 10 traps in Lake Banyoles. The trapping period will be shortened in order to take greater advantage of the best trapping period (May-October).
2. Placement of traps around the lake in July and September, when most captures are made. Weekly checks.
3. Placement of traps by summer work camps during two weeks in the summer.

The traps will be checked regularly by the Consortium's staff and, on occasions, by environmental volunteers organized by local ecologist groups.

This campaign to remove the exotic terrapin species from the lake will also permit us to monitor the lake's populations of autochthonous terrapin species (*Emys orbicularis* and *Mauremys leprosa*) and to search for any signs that these target species are in fact breeding.

It is hoped that good contact will be kept with the breeding and recuperation centre in L'Albera (CRT) in order to undertake more releases in Lake Banyoles of 'surplus' *Emys orbicularis* bred by this centre. The work-group monitoring this species that was formed by the LIFE project will continue its conservation work at Lake Banyoles and in the basin of the river Ter.

4.3.5 ACTION 5: BREEDING OF FRESHWATER MUSSELS (*UNIO ELONGATULUS*)

Given the excellent results of the captive breeding programme, the freshwater mussel breeding laboratory will be kept open, expanded and upgraded. However, in the short term the maintenance of the breeding programme and the production of new seeds from the mussels from Lake Banyoles is a priority since the excellent results of the current project have built up a stock of seeds both in the laboratory's tanks and the cages in the lake itself ready to be fed. On the other hand, it will be necessary in the mid-term to carry out specific actions to reinforce the current population using a number of different techniques: repopulation with autochthonous fish infested by the mussel larvae, production of fresh mussel seed and the release of juvenile mussels of over 3 cm in length.

When financially possible, the fresh production of mussel seeds will be incorporated into future repopulations or used to infect autochthonous fish before their release in the lake and its associated canals and streams. This latter technique is by far the easiest to apply in the mid-term and has been proven to be successful in Banyoles.

Finally, the monitoring of the mussel populations will require external funding from other conservation projects. The monitoring programme need not be exhaustive nor cover the whole protected area; however, in 2017 it is hoped that a more thorough

prospection of the whole area will provide an evaluation of the results of eight years of mussel breeding in Banyoles.

Other lines of work to be continued are the maintenance of the mussel working group and contacts with experts from other parts of the Iberian Peninsula and Europe, the publication of articles and the participation in mussel-related congresses and events.

4.3.6. Action 6: Control of exotic species of flora

During the habitual management tasks designed to control the vegetation around the lake, a protocol for eliminating exotic plant species is used. The maintenance teams periodically mow the meadows to keep the invasive hairy aster *Aster pilosus* and shoots of pyracantha, cherry plum and Chinese privet at bay, and cut the giant reed along the stream banks where it still sprouts. Special attention will be paid to the areas where management took place during the LIFE Project *Estany* to control any possible new shoots appearing in places in which herbicide was applied.

The control of the exotic species of plant in the areas to be managed will be carried out by the vegetation and infrastructures maintenance team that the Consortium contracts every year. The Consortium technical service will work to obtain funding for new projects designed to manage and control the lake's exotic flora in properties around the lake that border on areas that were managed during the current LIFE project.

In 2018 a review of the state of the EIS plants – i.e. a catalogue and an appraisal of their distribution around the lake – will be carried out.

4.3.7. Action 7: Media and awareness-raising campaign

Concerted efforts will be made to publicize and disseminate the results of the project via press releases, talks in schools, presentations in workshops and congresses, and both general and scientific articles. The project's website will continue to be updated and, most importantly, will continue to provide all the necessary information regarding LIFE Project *Estany*.

Thus, once the projects ends it will be necessary to consider what type of strategies should be employed to communicate the results and economic benefits of the project. The following ideas have been mooted:

- Dissemination of the project's technical material

All the project's management reports will be available on the website, along with the partial technical reports, the protocols and the reports of the monitoring projects. Also made available will be the datasheets of the invasive species, the layman's report and the awareness-raising material (videos, radio programmes, news, articles, etc.). If possible, some of the reports will be translated into other European languages.

- Press releases relating to the dissemination of the results obtained in the years following the ending of the LIFE project

The actions aimed at recovering the autochthonous species may continue to bear fruit in the years following the termination of the project. News relating to the scientific monitoring programmes carried out periodically by the Consortium's staff may generate interesting data such as the first case of breeding by released

European pond terrapins (*Emys orbicularis*), or data concerning the repopulations of, for example, the freshwater mussel.

- Publishing of general articles with information about the project

Whenever possible, general articles will be written and published about the work carried out and the results of LIFE Project *Estany*. A good example of this type of publication is the article that was published in *Quercus* in February 2014 that described the breeding of the freshwater mussels during the LIFE project.

- Writing of scientific articles for specialized journals and the presentation of posters and oral communications in scientific congresses and meetings

A scientific article discussing the recuperation of the lake's freshwater mussels is currently being written for a prestigious scientific journal.

During the coming years, the Consortium will participate in a minimum of four congresses or workshops at different levels (local, national and international) in which the partial results of the project will be made public. Some of the events that the Consortium aims to attend include the Catalan Herpetological Workshop, the Girona Environmental Workshops, the congress of the Iberian Ichthyological Society and the Iberian Herpetological Congress.

- Participation in and organization of various public-orientated activities

1. The freshwater mussel and barbel *capgrossos*. Given that they now form a part of local folklore, the lake's *capgrossos* – giant moulded model heads worn during local festivities – representing the freshwater mussel and barbel will continue to parade during the Banyoles and Porqueres local festivities in coming years.
2. Talks and seminars. Talks in the three local schools in the Pla de l'Estany region will continue to be offered. Technical workshops will be organized whenever required and an effort will be made to continue to present the partial results of the project in forums such as World Wetland Day.
3. Fairs. Every year the Consortium will participate in the Day of the Lake and the Fair of Sant Martirià, attended by hundred of visitors.

4.3.8. ACTION 8: MONITORING OF ECOSYSTEMS, FLORA AND FAUNA

Given current economic circumstances, the task of justifying to local administrations the need to continue scientific monitoring of the flora and fauna is not an easy one. Some of the monitoring programmes will have to be given priority over others. Some are already planned to be conducted only periodically (in the mid-term) but others need to be carried out on an annual basis. The lack of funding means that alternatives such as the use of environmental volunteers will have to be considered. New ways of funding must be taken advantage of whenever they arise.

The scientific monitoring to be carried out over the coming years is described in the documentation and programming of the protocols of ecological indices drawn up as part of this project (Action E4). The following is a summary of the monitoring tasks and their proposed frequencies to be carried out in the future:

- **Autochthonous fish populations**. Every two years an attempt will be made to carry out a spring and autumn campaign to monitor the autochthonous Cyprinidae in the streams and canals around Lake Banyoles.

The effort involved is not great and will be carried out with the support of Project *Potamo Fauna*. The monitoring of the freshwater blenny will also be carried out every two years using the Consortium's own funds.

- **Populations of exotic fish.** The continuation of the control of exotic fish species as part of LIFE Project *Potamo Fauna* will enable us to monitor the populations of both exotic and autochthonous fish at least every two years.

- **Freshwater shrimp and other macro-invertebrates.** The populations of these species will be carried out every two years by students from the University of Girona.

- **Freshwater mussels.** The continuation of the work on freshwater mussels by the Banyoles breeding laboratory will enable us to monitor the populations of this invertebrate, essentially using the Consortium's own staff. A complete revision of this group has been proposed for 2017 or 2018, that is, five years after the previous review. Specific funding will be sought to continue with the breeding programme in the laboratory and for the associated monitoring tasks.

- **Odonata**. No annual monitoring of the dragonflies and damselflies of the lake is currently contemplated. Nevertheless, monitoring tasks should be repeated in five years time. At the beginning of 2014, the Wildlife Service of the Catalan Government made it known that their rural rangers will carry out small-scale annual monitoring of the species *Libellula fulva*, *Aeshna isoceles* and *Oxygastra curtisii* in the area of Can Morgat and Lake Banyoles in April–July.

- **American crayfish.** The monitoring of this species needs to be carried out annually and will be conducted by environmental volunteers. A series of activities have been programmed for 2014 for a work camp that will include sampling for this invasive crayfish species.

- **Amphibians and birds**. Although no annual control of these groups is planned, every five years monitoring must be carried out. The aim is to promote the monitoring of these groups via annual campaigns carried out by environmental volunteers.

- **Autochthonous and exotic species of terrapin**. Annual controls of these species will be conducted using the data derived from traps placed for these species in the lake.

- **Aquatic macrophytes**. The annual monitoring of this group will not continue.

4.3.9. ACTION 9: INDICATOR PROTOCOLS

Over the next five years, the protocols for ecological indicators will be applied according to previously established time-scales and methodologies. This action is closely linked to Action E3 (scientific monitoring) and so will depend on whether or not the monitoring tasks can be carried out in the protected area. These tasks will be carried out by the Consortium's staff and will have no additional cost.

5. FINANCIAL PREVISIONS

The following table contains the maximum estimated annual costs of each part of the plan for the years 2014–2018. The estimates are only approximate as some of the tasks will be carried out by the Consortium's staff and will only require a minimum of additional material. However, others tasks will need much greater investment and will depend on the obtaining of external funding and the development of complementary projects in collaboration with other administrative bodies or associations.

ACTION	2014	2015	2016	2017	2018	SUB-TOTAL (€)
1 – Lake fishing plan		500			2,500	**3,000**
2 – Habitat management plan	4,500	500				**5,000**
3 - Control EIS: fish	15,000		15,000		15,000	**45,000**
4 – Control EIS: terrapins	3,000	3,000		3,000		**9,000**
5 – Breeding freshwater mussels	2,500	25,000	2,500	25,000	2,500	**57,500**
6 – Control EIS: flora	5,000		5,000		5,000	**15,000**
7 – Media and public-awareness campaign	500	1,500	1,500	2,000	1,500	**7,000**
8 – Monitoring of fauna and flora	2,000	5,000	2,500	6,000	6,000	**21,500**
9 – Indicator protocols	1,500	0	1,500	0	1,500	**4,500**
SUB-TOTAL (€)	**34,000**	**35,500**	**28,000**	**36,000**	**34,000**	**166,500**

The development of a conservation and continuation plan is dependent on the capacity to fund the actions that are deemed to be necessary. Given the current economic climate, it is vital that care be taken when establishing which actions and conservation programmes are be given priority in the mid-term.

The Consortium's annual funding is provided by the Banyoles and Porqueres town councils, the Catalan government and the Girona Provincial Council. In addition, the Consortium also benefits from grants received for specific conservation projects awarded by public and private institutions. Nevertheless, the Consortium's funding has suffered financial cutbacks in recent years due to the general financial situation of Spanish public bodies, which has obliged it to adjust its expenditure accordingly. This situation has limited greatly the development of new conservation actions that go beyond the simple day-to-day running of the Consortium, which is now essentially reduced to the general maintenance of the protected area.

The continuity actions proposed in this *After-LIFE* plan will be incorporated whenever possible into the routine tasks carried out by the Consortium's staff –

both the maintenance section and the technical staff – that are funded by its ordinary annual budget. The monitoring programmes and the control of the exotic species of flora and fauna will be carried out by these staff. Some grants are available for actions in natural areas; for example, the Girona Provincial Council awarded the Consortium in 2014 a grant (known as an *Aliens* grant) whose aim is to manage the invasive vegetation in the area around the lake. Other possibilities include the grants for environmental education set up by the Catalan government, awarded to Limnos and to Nature School, which, in collaboration with the Darder Natural history Museum, foment activities aimed at increasing environmental awareness.


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