LAKE BANYOLES

Section 1

Regenera Water Sports Pilot Site Vulnerability Assessment

Pilot Site	ESTANY DE BANYOLES
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Full name	REGENERAWATER SPORT 'Sustainable and Regenerative management of physical activity and practice of sport in water-areas and surrounds'
Work Package	2

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Deliverable	2.2. Vulnerability Assessment and SWOT Analysis
Submission Month	M10

This Vulnerability Assessment is a tool for informing adaptation, planning and enabling resource managers to evaluate the impacts of water sports on a water body. This assessment is designed to support sound decision-making by identifying which ecosystems or species are significantly affected by current and proposed activities. This assessment will help understand why an ecosystem or species may be vulnerable. Vulnerability has three principal components: sensitivity, exposure, and adaptive capacity.

Consider the following while conducting your assessment:

- Screening – do you feel that an ecological study may be necessary?
- Scoping - which impacts in the blue space need to be assessed?
- Baseline study – has a baseline study of the geographic, biological, socio-economic and cultural context already been conducted?
- Impact prediction - what are possible impacts, positive and negative of conducting this analysis, if any?
- Mitigation - how can these negative impacts be mitigated?

Objectives of Vulnerability Assessment:

1. To evaluate the potential vulnerabilities and impacts of water sports and other human activities on blue spaces within the Regenera Water Sport framework.
2. Evaluate exposure to known vulnerabilities and assign severity levels to those vulnerabilities. Recommend remediation or mitigation if and whenever needed.

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Scope of Vulnerability Assessment:

To include activities such as boating (sailing, rowing etc), swimming, fishing, jet skis, hiking and walking trails within blue spaces and surrounds.

Goal of vulnerability assessment:

Is to provide the necessary knowledge to partners and stakeholders within the Regenera project to take appropriate actions against threats to the case study blue space environments.

Biosecurity

Invasive, non-native flora and fauna can have damaging effects on ecosystems of blue spaces. Anyone using waterways can inadvertently spread species from one water body to another.

Please note following while conducting your assessment

Check -all clothing and equipment thoroughly for any visible material (mud, leaves, animal matter). Closely inspect seams/seals on waders and boots.

Clean - hose down or pressure wash all equipment on site. If there are no facilities, carefully bag all equipment until such facilities are available. Washings must be left on site or disposed of carefully. Do not allow washings to enter other watercourses.

Dry - Hang boots, nets etc in an airy space as air drying is the best method of disinfection. Some non-natives can survive up to 2 weeks on damp surfaces and 2 days on dry surfaces. Ensure items have been drying for 48 hours before using them on the next water way.

1.0 Site Description

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1.1 Lake name

Lake of Banyoles

1.2 Location

ETRS89 - UTM 31N:	479753.40, 4663589.47
Geographical (lat, long):	42.124149, 2.755051
Altitude:	172 m
Bordering municipalities:	Banyoles, Porqueres
Distance to the main cities:	Girona, 22,2 km Barcelona, 117 km
Origin:	Natural
Watershed:	El Ter

Figure 1: Orthoimage of the Lake of Banyoles. Self-produced. Source: Cartographic Institute of Catalonia

Figure 2: Image of Lake of Banyoles. Source: Self-produced.

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1.3 Size and Depth

Lake surface area (ACA)	113.7 ha
Surface area of protected natural space (Nature 2000 Network)	1,064.01 ha
Length	2,150 m
Width	775 m (North lobe) 725 m (South lobe)
Average depth	14.8 m
Maximum depth	31 m (Basin I) 46.4 m (Basin II) 130 m (Basin III)
Volume	15.45 hm^3

Source: Catalan Water Agency (ACA)and Banyoles Museum

1.4 Surroundingenvironment - flora, fauna, and geographical features

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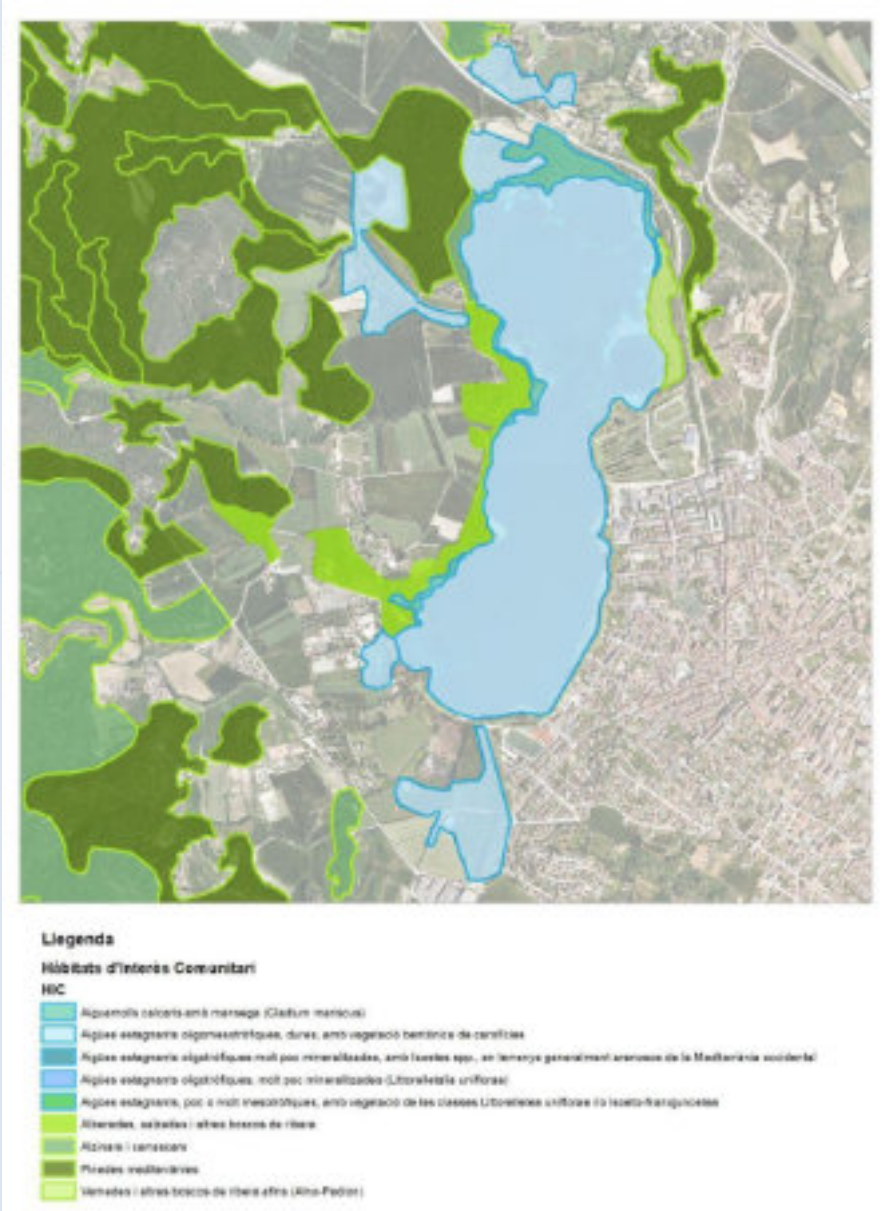
Around the Lake of Banyoles there are up to 11 habitats of community interest (included in the Annex I of directive 92/43/EC). Hydrophilic vegetation of reeds and peaty reeds dominated by mansega (a herbaceous perennial plant of the Cyperaceae family) predominates forming a belt around its entire perimeter, with typical submerged plant communities of waters rich in lime and rooted or floating hydrophytic vegetation of lakes and eutrophic waters.

Figure 3: Map of Habitats of Community interest. Self-produced.



1.4.1 *Flora*

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In the floodplains around the lagoons and lakes, herbaceous communities of large Cyperaceaeare formed, and in the emerged, yet moist, soils the Mediterranean meadows of tall grasses. The non-urbanised part of the lake has a reclaimed area of alluvial forests with evergreens and ash trees, with riparian forest with poplars and willows. In the streams that carry water or drain into the lake, whether they are of permanent or intermittent flow, these have communities of aquatic meadows. 240 taxa of flora are identified around the lake. Attached is the map of the inventoried taxa (Source: Catalan Flora). Verification field work is carried out in September 2024.

Figure 4: Table of indigenous flora found in the Lake of Banyoles

Scientific name	Habitat
Populus alba	Riverside forest
Fraxinus angustifolia	Riverside forest
Salix alba	Riverside forest
Alnus glutinosa	Riverside forest
Chara spp	The whole lake, creeks and streams
Typha latifolia	Shallow areas and on the shore
Phragmites australis	All over the lake
Carex riparia	Wetlands, lagoons, shallow areas and on the shore
Equisetum telmateia	Riverside forest
Potamogeton nodosus	Creeks and creeks
Potamogeton pectinatus	Creeks and creeks
Thelypteris palustris	Creeks and creeks
Scirpus litoralis	All over the lake
Scirpus holoschoenus	Shallow areas and on the shore
Juncus inflexus	Pond front
Lysimachia vulgaris	Riverside forest
Lemna minor	Creeks and creeks
Iris pseudacorus	Creeks and creeks
Cladium mariscus	All over the lake
Ranunculus repens	Reed beds and rushes
Lythrum salicaria	Creeks and creeks

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Myriophyllum verticillatum	Shallow areas and on the shore

Figure 5: Which environment best describes the land next to the water level?

	Present	Moderate	Abundant
Wasteland	•		
Forest			•
Prairie	•		
Crops/others	•		
Urban			•
Urban green areas, parks			•
Roads			•
Other (describe)			

1.4.2 Fauna

Regarding fauna species, there are populations of 15 species included in annexes II, IV or V of the Habitats Directive. Of these, the lake turtle and the brook turtle stand out (*Emys orbicularis and Mauremys leprosa*), the Mediterranean barbel (*Barbus meridionalis*) and the 4 native species of naiads (*Unio elongatulus*).

The Lake of Banyoles is included in the RAMSAR list as a wetland of international interest for waterfowl (2003).

Figure 6: List of protected and endemic species. See the complete list in Annex 13.2

Species	Autochthonous	Protected (p)

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Mammals		
Lutra lutra	•	p
Myotis daubentonii	•	p
Pipistrellus pipistrellus	•	p
Rhinolophus hipposideros	•	p
Myotis capaccinii	•	p
Myotis emarginatus	•	p
Myotis blythii	(probable presence)	p
Barbastella barbastellus	(probable presence)	p
Miniopterus schreibersii	(probable presence)	p
Arvicola sapidus	•	Vulnerable (UICN)
Sciurus vulgaris	•	p

Birds (n: nesting / h: wintering)		
Alcedo atthis	•	p
Aythya ferina	•	p
Bubulcus ibis	•	p
Ardea cinerea	•	p
Actitis hypoleucos	•	p
Tachybaptus ruficollis	•	p
Spinus spinus	•	p
Cyanistes caeruleus	•	p
Erithacus rubecula	•	p
Upupa epops	•	p
Certhia brachydactyla	•	p
Cettia cetti	•	p
Sitta europaea	•	p
Ciconia ciconia	•	p

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Fish		
Barbus meridionalis	•	•
Gasterosteus aculeatus	•	•
Rutilus rutilus	•	
Reptiles and amphibians (i:invasive)		
Emys orbicularis	•	NT UICN
Mauremys leprosa	•	p
Tarentola mauritanica	•	p
Anguis fragilis	•	p
Natrix natrix	•	p
Zamenis scalaris	•	p
Zamenis longissimus	•	p
Bufo bufo	•	p
Bufo calamita	•	p
Alytes obstetricans	•	p
Hyla meridionalis	•	p
Triturus marmoratus	•	
Lissotriton helveticus	•	p
Salamandra salamandra	•	p
Invertebrates		
Unio elongatulus subsp. penchinatianus	•	p
Potomida subreniformis	•	p
Potomida littoralis	•	p
Unio ravoisieri	•	p
Unio mancus	•	•

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Vertigo moulinsiana	•	•
Lucanus cervus	•	•
Cerambyx cerdo	•	•
Vertigo angustior	(probable presence)	•
Oxygastra curtisii	(probable presence)	•
Euphydryas aurinia	(probable presence)	•

1.4.3 Vegetation

The Riparian Forest

The riparian forest vegetation close to the body of water is abundant, but not uniform. Most riparian areas receive direct anthropic pressure. The areas that do not have so much pressure (north and west sector) have had a process of renaturalisation, therefore, the appearance is of an incipient young riparian forest with certain discontinuities.

. Aquatic plants

The aquatic plants found in the lake are common and typical of these environments. There are five species included in the catalogue of threatened species of Catalonia, of which two are from wet and flood-meadows such as the marsh fern *Thelypteris palustris* and a heather (*Carex elata*) and three aquatic plants such as greater spearwort (*Ranunculus lingua*), the perfoliate pondweed (*Potamogeton perfoliatus*) and the spiny water nymph (*Najas marina*).

In fact, the Lake of Banyoles, including wetlands, reserves, lagoons and ponds, is a place of high richness of aquatic plants, which largely contribute to improving the quality of the water and are indicators of good condition of an ecosystem. However, it hasn't always been that way.
With the introduction of the gardí, a Central European species of herbivorous fish, and the carp, which stirs the bottom, the complete disappearance of aquatic plants was favoured between the 1920s and 1980s. Interestingly, it was the proliferation of other exotic predatory fish species such as pike or black bass, which, in turn, allowed the algae population to recover as of the mid-90s. Recently, the arrival of new invasive plants from aquaculture (aquariums and garden ponds) has been detected, which can lead to severe environmental and social impacts.

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Most of the bottom of the Lake is currently covered with caracasias, plants with a rough feel that build up calcium on their walls, and which give off an unpleasant smell, but there are many other species. That is why the Lake has been declared an area of floristic interest by the Autonomous Government of Catalonia.
There are five species included in the catalogue of threatened fauna of Catalonia, of which two are from wet and flood-meadows such as the marsh fern *Thelypteris palustris* and a tufted sedge (*Carex elata*) and three aquatic plants such as greater spearwort (*Ranunculus lingua*), the perfoliate pondweed (*Potamogeton perfoliatus*) and the spiny water nymph (*Najas marina*). We have the duty to preserve them as unique heritage, therefore, any action on the water that could alter its state: piers, works, sculptures, activities, etc. its preservation should be taken into account [Source: Limnos, 2019]

3. Remarkable geographical characteristics about 20 km from the body of water

The topography of the area is characterised by being a transition space between the Emporda Plain and the last foothills of the Pre-Pyrenees. To the north rise the hills of Mare de Déu del Mont and the Massís de les Salines, to the west the mountains of the Garrotxa volcanic area, witness to the tectonic activity of the past, and to the southwest the massif of Rocacorba, with the Pujarnol, Sant Patllari and Ginestar mountain ranges.

However, the area stands out for its hydromorphology which is explained precisely by the tectonic and karst activity of the area. The *tfalla d'Albanyà*, located on the east side of the lake basin, delimits a change in geological materials, so that the limestone layer through which the aquifer circulates has no continuity beyond Banyoles, and a layer of marls, impermeable materials, which cause an increase in pressure in the system forcing the water to exit vertically through cracks and fissures to feed the lakes, ponds, sources and jets.

In this way, a whole system of sinkholes is formed, produced by the dissolution of the underground layers of gypsum and the subsequent sinking of the surface, which favours the formation of ponds and lakes such as the one in Banyoles.

The waters of the lake therefore arrive underground from the area of Alta Garrotxa, located about 20 km in a northerly direction, thanks to the permeability of the calcareous materials, and emerges on the surface due to the pressure of the system in the form of surges. At the bottom of the lake, up to 13 upwelling points have been counted.

In a radius of 600 m around the lake, there are more than a dozen small lagoons, all of them with circular contours and with underground water. In the plain of Usall and in the lake of Espolla, 1.5 kilometres to the north, at an elevation 40 m higher than that of the lake and on

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a formation of travertines, there is the intermittent rise of the Clot de l'Espolla, which is a natural overflow of the same lake, and which manifests itself after heavy rains.

Other important hydrological manifestations in the area are the Sant Miquel de Campmajor ponds, located 5.5 km to the west of the lake, on materials made up of clays and blue marls. In this area, we have come to count nearly 90 ponds, some of recent and sudden formation.

1.4.4 Water Quality

In summer, the Catalan Water Agency (ACA) carries out the annual Monitoring and Information Programme for the quality of bathing water in Catalonia in accordance with the European Directive 2006/7/CE concerning the management of bathing water quality, and the Royal Decree 1341/2007 that transposes it.

The Catalan Water Agency, in the report Results of the classification of the quality of bathing water in Catalonia, in which the period 2020-2023 was assessed, published the results of the classification of the quality of the water in continental bathing areas:

- Lake of Banyoles 1, Sufficient
- Lake of Banyoles 2, Excellent

The results of this report improve the classification compared to 2022 (Insufficient in 2022) and it was possible to identify and solve the causes that led to the lack of quality in Banyoles (the impact caused by the ducks that spend the night on the platforms). The ACA will continue to implement the surveillance actions that are necessary to maintain quality in these areas.

For 2024, water quality presents the following results:

2024	E.coli		Entero.inters.		Qualification
	Percentil 90	Percentil 95	Percentil 90	Percentil 95	2024
CASETA de Fusta					
1 Sampling point	100	140	76	114	Excellent (95)
15 %	69	91	65	96	Excellent (95)
CLUB NATACIÓ					
1 Sampling point	127	203	162	277	Good (95)
15 %	113	181	117	194	Excellent (95)
BANYS VELLS					

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1 Sampling pointoint	44	66	75	129	Excellent (95)
15 %	36	52	26	35	Excellent (95)

Table 2024. Values of the 90th and 95th percentiles of the bacteriological indicators and water qualification in the three swimming areas of the Lake during the 2024 season. The two options allowed by RD 1341/2007: excluding or 1 point or 15% of the scheduled samples.

Categories ACA (any 2021)	Excellent	Good	Temporary alteration
E. coli	≤ 500	500 - 1000	> 1000
Enterococs	≤ 200	200 - 400	> 400

1.4.5 Local Human population

The population is mainly located in the towns of Banyoles and Porqueres, which occupy the southeast area of the lake. The homes are very close to the edge of the lake, separated by a promenade and a road.

The population around the lake is younger than other municipalities in the area.

Figure 7: Table of demographic data for the municipalities around the lake.

	Banyoles	**Porqueres**
Total population(2023)	20.492	4.717
Annual variation	1,51%	0,11%
Variation 2019-2023	3,36%	2,08%
Inhabitants per km2	1.854	141
Men	10.169	2.339
Women	10.323	2.378
Percentage of young people	17,85%	16,05%
Percentage of adults	63,97%	65,27%
Large population percentage	18,18%	18,68%

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Ageing index	101,86	116,38%
Middle age	41,70	43,19%
Global dependency index	56,33	53,20
Seasonal population	19.518	4.276
Population residing abroad	605	48
Distance from inhabited centres in Banyoles Lake	Between100 m i 2,5 Km	Between 30 m i 1,8 Km

1.4.8. List Designated Sites

The Natura 2000 Network forms a mosaic of protected natural areas. The Lake of Banyoles is surrounded by other spacesthat are also part of the Natura 2000 Network, however, it does not have direct contact with the rest of the spaces, which can affect some aspects such as its ecological connectivity.

Code	Name	Distance from lake
ES5120008	Estany de Banyoles	0 km
ES5120018	Muntanyes de Rocacorba - Puig de la Banya del Boc	3,8 km
ES5120021	Riu Fluvià	5 km
ES5120023	Rieres de Xuclà i Riudelleques	6,5 km
ES5120020	Riu Llémena	9,26 km
ES5120004	Zona volcànica de la Garrotxa	12 km
ES5120001	Alta Garrotxa - Massís de les Salines	12,6 km
ES5120010	Les Gavarres	12,8 km
ES5120011	Riberes del Baix Ter	13,3 km
ES5120029	Riu Brugent	16,8 km
ES5120025	Garriga d'Empordà	18,68 km

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ES5120012	Les Guilleries	19 km
ES5110005	Sistema transversal Català	19, 2 km

Figure 8: Map of areas of the Natura 2000 Network around Lake of Banyoles. Self-produced.

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2.0 Identify Vulnerabilities

2.1 Identify Vulnerabilities Table

Figure 9: Vulnerability identification table (5 is the highest risk and 1 is the lowest).

Ecological impact	Species	Danger	What will be harmed?	Control measure	Risk score
Sensitivity of Flora species	Myriophiyllum, Nymphaea. Ranunculus lingua. Potamogeton perfoliatus. Najas marina.	Spills of fuel or other pollutants. Overcrowding, trespassing on the edges of the pond. Rubbish Discharges gardening waste, invasive species	The homogeneous distribution of these species Species populations The associated fauna (insects, fish, etc.) The maintenance of biodiversity in general and the good state of the ecosystem	Zoning of the space (zones with different levels of protection and use management, mandatory cleaning zones for boats, Awareness actions. Maintenance actions (garbage collection) Monitoring of populations. Control and surveillance in space.	4
Sensitivity of Fauna species	Mammals Birds Reptiles and amphibians Fish	Fuel spills. Over-attendance, disturbances in life cycles. leave them noise Strokes due to fishing or sports activities. Destruction of eggs, nests or burrows. Run overs Water pollution.	The maintenance of biodiversity in general and the good state of the ecosystem. Nesting sites. Breeding and reproduction areas. Predator feeding areas. Feeding areas of herbivores. Biological connectors between environments or	Zoning Maintain safe distances from nesting sites Monitoring of populations Awareness of users of the space Control and surveillance in space.	4

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		Competition from invasive species. illegal hunting	spaces.		
Alteration of the habitat	Calcareous marshes with mansega (Cladium mariscus) Mediterranean temporary lagoons. Mediterranean meadows rich in annuals, basophilic (Thero-Brachypodietalia). Vernedes and other similar riparian forests (Alno-Padion)	Presence of cane or other invasive species. Affecting nesting sites. Rubbish New uses that may cause light pollution or noise	Ecosystems Ecological and landscape connectivity. Food chains	Education of users. Preserve natural vegetation, create protected areas. Good practice in urban planning of the space, following local guidelines for construction.	4
Physical damage to the habitat	Calcareous marshes with mansega (Cladium mariscus) Mediterranean temporary lagoons. Mediterranean meadows rich in annuals, basophilic (Thero-Brachypodietalia). Vernedes and other similar riparian forests (Alno-Padion)	Removal of vegetation for development or recreation.	coastline, reedbeds, banks	Good practice in urban planning of the space, following local guidelines for construction.	2
Noise pollution	Mammals, birds, Reptiles and amphibians, fish.	Motor boats The thump and rumble of the oars. Use of megaphones in some sporting activities Noise from cars and motorcycles	Refuges, hunting and breeding areas	Education and awareness Regulation of uses according to seasonality.	4

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		Screams of people walking Noises and screams from participants in some recreational activities (Dragon Boat, for example) Music from restaurants Very loud music from concerts and festivals			
Light pollution	Nocturnal fauna (bats, nocturnal insects, fish and mammals)	Road lighting, lighting installation Concert and festival lights	Food chains Biodiversity in general and the good state of the ecosystem. Breeding and reproduction areas. Predator feeding areas.	Good lighting practices by councils Monitoring of populations	4
Risk of collision	Submerged vegetation, fish and mammals (otter), amphibians, egg-laying.	Users or vehicles that encounter fauna and flora , etc.	Flora and fauna, protected areas	Education Reduce speed in sensitive areas, Buffer zones	4
Invasive species	Fauna: Mussel zebra, Florida turtle, coypu, American crayfish, American mink. Flora: specified in section 3 of this report.	Propagation of seeds, plant material and animals Displacement and disappearance of native species.	Native species and ecosystems	Clean boats and all equipment thoroughly. Follow the guidelines (LNT). Installation of traps. Campaigns to eliminate invasive plant species.	4
Chemical pollution	The most vulnerable species.	Fuel spills, sun cream, chemical runoff from the building, etc	flora Fauna Biodiversity	Correct fuel handling, organic products, LNT guidelines	2
sedimentation	Herpetofauna,	Increase in	Riparian and	Implement erosion	2

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	plants and aquatic algae.	Sediments due to erosion, construction and changes in land use, overcrowding,	submerged ecosystems	control measures, limit construction near the coast. Regulate attendance , establish buffer zones and regulate uses in each space.	
Water pollution	Especially Herpetofauna and fish which are usually more sensitive. Protected plant species. Otters	Runoff from agriculture, urban areas and nautical activities	Ecosystems	Implement buffer zones, use ecological navigation practices, regulate agricultural runoff	3
Fishing pressures	Fish under protection regime.	overfishing Introduction of non-native or invasive species	Alteration of aquatic food systems, disturbance of breeding sites	Implement no-fish zones, catch-and-release practices, catch limits	3
Aesthetic and recreational pressure	Affecting all vulnerable species.	pollution, habitat destruction by trampling. Noises and screams	Natural beauty of the lake, vulnerable flora and fauna	Calculate the carrying capacity of the natural space, and ensure compliance	4
Effects of climate change	Affecting all vulnerable species.	Contribution to the emissions of motorboats drought Canals without water, death of flora and fauna. Lowering of the water table, changes in water oxygenation... Water temperature changes	Changes in temperature and rainfall can affect biodiversity	Follow all guidelines established by regulatory bodies.	4

2.2 Environmental vulnerability

As detailed in Annex I of the Lake of Banyoles Special Management Plan (2016), there is a clear desire to preserve the plant communities of singular interest in the lake and its immediate surroundings. Therefore, the cutting, uprooting or crushing thereof is strictly prohibited, except if it is strictly necessary for its better management and conservation, which will have

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to be regulated through a specific Technical Management Plan, which will require a report from the competent department in the natural environment and biodiversity before the approval thereof.

This prohibition also applies throughout the entire hillock, except for the allowed bathing and jetty areas (Banys Vells, Sector Esportiu and Caseta de Fusta), the restoration of those spaces being essential where, due to artificial causes (stones, panels of concrete, gravel, etc.), vegetation cannot grow.

It will also be necessary to take into account the list of Habitats of Community Interest, which must be conserved and managed under criteria of sustainability and conservation of natural heritage and biodiversity. The habitats listed in the Annex of the Habitats Directive 92/43/CEE are included as elements to be protected.

Some of the invasive species of flora found in the space are reed, Black locust, yuca, medlar. Some of them are not widely established in the area, which is why they could propose actions to eliminate it.

Figure 10: Main invasive species in Banyoles lake.

Taxon	Origin and distribution
Acanthus mollis L.	Eastern Mediterranean (gardening, established)
Acer negundo L.	America (gardening, widely distributed)
Arundo donax L.	Asia (agriculture and gardening)
Cyperus eragrostis Lam.	America (gardening, widely distributed)
Eriobotrya japonica (Thunb.) Lindl.	Agriculture (edible fruit), gardening, not established
Oenothera rosea L'Hér. ex Ait.	america (accidental)
Oxalis articulata Savigny in Lam.	America (gardening)
Robinia pseudoacacia L.	America (gardening, widely distributed)
Solanum chenopodioides Lam.	America (accidental, established)
Yucca gloriosa L.	America (gardening, widely distributed)

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To avoid the accidental introduction of species, from 2017 the yacht club has created a disinfection point for boats to deal with the threat of the zebra mussel and other invasive species. This equipment, with an approximate value of €38,000, is part of the European program *Life Potamo Fauna*. Since 2014, this programme has been implemented in other protected areas of the counties of Girona, with the aim, among other things, of protecting endangered native species.

Figure 11: Mobile disinfection station of the Consorci de l'Estany located at the Yacht Club.

For invasive fish, their sport fishing is promoted exhaustively, where they would be eliminated by continued hunting pressure. These are: *Micropterus salmoides, Cyprinus carpio, Salaria fluviatilis, Lepomis gibbosus, Anguilla anguilla, Perca fluviatilis, Squalius laietanus, Sander lucioperca and Barbus meridionalis.*

From the Life Potamofauna project, the Consorci del Ter also took actions to reduce the presence of exotic turtles. The five most common exotic taxa cited within the action area are *Trachemys scripta ssp. scripta*, *T. s. sp. elegans, Chrysemys picta, Pseudemys concinna* i *Graptemys pseudogeographica.* Of these, at least the two subspecies of the pond slider (*T. scripta*) are established in the area, maintaining breeding and expanding populations. These invasive exotic turtles have a clear negative effect on some ecosystems and also on native species, including amphibians and native turtles. Native turtles are displaced, mainly through competition for the best basking or nesting areas. As part of the project, invasive turtles were

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extracted through 21 trapping points where specimens were captured and removed from the habitat. The American crab had a periodic trap in 60 points.

In the case of mammals, one of the invasive species found in the natural space is the coypu. If the coypu population were to increase, it could cause erosion and landslides on the banks of the lake, given that this is where it makes its dens.
In Catalonia there are specific regulations for the extraction of invasive species:

- RESOLUTIONACC/929/2023, of 17 March, by which the species subject to hunting exploitation, the suitable hunting periods and the special bans for the 2023-2024 season are fixed throughout Catalonia.
- RESOLUTIONACC/483/2023, of 15 February, which orders fishing in the continental waters of Catalonia during the 2023 season.
- ORDERACC/214/2022, of September 13, regulating the procedure for the exceptional authorization of live capture for the control of predatory hunting species and invasive exotic species predators and Annex I is amended of Decree 56/2014, of April 22, relating to the approval of methods of live capture of predatory hunting species and invasive exotic species and the accreditation of the people who use them.

The Life Rescue Alpyr project is currently being carried out in Catalonia, which strives to completely clear 11 lakes in the Pyrenees of fish by 2026. It is a European initiative that has the support of the Autonomous Government of Catalonia.

Erosion

The karst formations, present at different points on the shore of the lake, are particularly sensitive to erosion. This type of landscape is mainly formed from limestone rocks, which are soluble in acidic water. Because of this solubility, karst formations can be more vulnerable to erosion and other geological processes compared to other rock types. It makes them very interesting from a geological and tourist point of view, but they require careful management to preserve them.

Water quality

The ascending sediments come mainly from the underground springs that feed the lake. They can carry nutrients and other materials that can alter the ecological balance of the lake. For example, they can encourage excessive growth of algae, which can reduce water quality and affect aquatic life.

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The water comes from an aquifer or underground reserve that is nourished by the rains that take place in the basins of the Llierca and Borró rivers, in Alta Garrotxa. In this area, it infiltrates through layers of calcareous, permeable rocks and circulates inside to the different outlets that the karst lake system offers.

At the bottom of Lake of Banyoles, up to 13 main water sources have been identified, which provide between 400 and 600 litres per second (approximately 40,000 cubic metres of water per day). These inflows of water, both surface and underground, constantly renew the volume of the Lake. The time required for a complete renewal of the lake exceeds 200 days. The last bathymetric study, conducted by Moreno-Amich and García-Berthou in 1989 using echo sounding, delimits the structure of the Lake and defines its geometry.

The entry of possible invasive species is closely linked to the uses of the Lake. It is estimated that every year there is an entry of around 800 boats into the Lake from another source. This implies a constant risk of the arrival of exotic species. With a view to reducing the risk posed by this activity, a disinfection point has been installed at the Yacht Club.

The main species that alters the water quality of the lake is the zebra mussel. The non-native fish species that also alter it are the Black bass or Largemouth bass (*Micropterus salmoides*), carp (*Cyprinus carpio*), red carp (*Carassius auratus*), eastern mosquitofish (*Gambusia holbrooki*), rutilus roach (*Rutilus rutilus*), river trout (*Salmo trutta*), pumpkin seeds (*Lepomis gibbosus*), European perch (*Fluviatilis perch*), sander or pikeperch (*Sander lucioperca*).

Chemical state of the water

In November 2023, the Aigües de Banyoles laboratory presented some conclusions on the daily state of the water in the 3 swimming areas of the Lake, following the legally marked guidelines to determine the quality of the water of the lake. The conclusion they reached is that the general quality of the lake's water is excellent.

Given that the ACA presented the results of 2022 as insufficient in the swimming club (CNB), a fact that transcended to the public, it has been calculated with our data from the Aigües de Banyoles study for 2023, the qualification of the CNB water as sufficient (excluding 1 single point per year) or as good (excluding 3 points). Likewise, it has been calculated for the year 2023 and the results are the same.

The current results show similarity of results with respect to the year 2023 between the results presented by the ACA and for the Aigües de Banyoles laboratories.

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Use of water

Local meteorologists Enric and Gabriel Estragués did a 2017 study on the water that comes out of Lake of Banyoles every day. This study reveals that drinking water extractions from Banyoles are the second cause of water leaving the lake (the first cause is natural evaporation, with an average of 2,250 m³/day). Drinking water withdrawals for consumption in Banyoles and Porqueres represent around 6,300m³/day in summer and around 5,800m³/day in winter, with an annual average of 6,050 m³/day.

The third cause of water outflow is the five streams that leave the lake: Rec Major, Rec de la Figuera d'en Xo, Rec de can Teixidor, Rec de Guèmol and Rec de ca n'Hort. The flow rate of these streams is very variable and depends on the contribution of the aquifers at the bottom of the lake, the inlet streams and the rain that falls directly on the lake and its receiving basin. In times of drought, these streams empty approximately 10,000 m³/day, while in periods of rain or when the lake is above zero, the flow can reach about 39,000 m³/day, with an average of 24,500 m³ /day. This water is used for irrigation and orchards.

Thus, an average of 32,800m³/day leave the lake every day, equivalent to the number of cubic meters of water that enter the lake basin every day. According to this study, every day about 18,400 m³ arrive from the aquifers at the bottom of the lake, about 12,000 m³ of water comes from the streams and an average of 2,400 m³/day corresponds to the water that falls from the rain directly on the lake. (Source: Study of the water of the Lake of Banyoles, Enric and Gabriel Estragués, 2020)

The water from Lake of Banyoles is used for various activities, including cleaning. This water is used to clean streets, squares and other public spaces in the city. It is also used to irrigate gardens and green areas, thus contributing to sustainability and the efficient use of available water resources.

The water from the Lake of Banyoles is used as a source of drinking water supply for the city of Banyoles and its surroundings. Aigües de Banyoles has been in charge of collecting, treating and distributing water since 1930. The water is collected from the lake, treated at the company's facilities and then distributed through a network of pipes until it reaches homes.

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2.3 Human Impact

Overcrowding

In the Lake of Banyoles, although specific studies are not known or consulted (such as through people counters), it can be considered that there is, at specific times, an over-frequenting of visitors, especially concentrated on the days of weekend and the summer months.

On certain dates, problems associated with overcrowding are observed, such as the lack of parking spaces, the encroachment of naturalised areas, noise that can harm wildlife, greater dumping of waste, water pollution, etc.

Vehicular traffic and overcrowding, when there is any, are mainly concentrated on the southern and especially eastern side of the Lake where we find the urbanised sectors closer.

Waste management

Figure 12: Garbage table

	None	Present	Moderate	Abundant
Trash in the water		•		
Garbage in the vicinity			•	

This table can suffer seasonal variations, predictably more aggravated in the summer periods and weekends, when there is more anthropogenic and tourist pressure.

Infrastructures

The most significant infrastructure on the edge of the lake is the Club Natació Banyoles (CNB) building. The club's facilities include docks, a bar, swimming pools, gymnasiums and areas for recreational activities, boat storage space, and is a very popular meeting point.

Also, Banys Vells, located a few meters from the CNB, where there are two docks and offer catering and bathing services.

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The fishing ponds of Lake of Banyoles are small constructions that stand on pillars in the water and were built between 1818 and 1931. Originally, they were used to store fishing equipment, but over time they became recreational areas for the local bourgeoisie and holiday makers. Currently, there are 20 fishing piers that, as well as being part of the lake landscape, are a unique part of the architectural heritage of Banyoles and, together with the Passeig de l'Estany, have been declared Cultural Heritage of National Interest (BCIN) in the Historic Garden category by the Autonomous Government of Catalonia.

The best-known fisheries are:

- The Gimferrer fishery, near the Draga Park.
- Carpa d'Or, one of the most photographed and emblematic.
- The fishery that houses the Tourist Office.

By the lake there is also the Caseta de Fusta, a swimming area delimited and supervised in summer, which has a portable bathroom, an awning and stairs to access the water.

A little further north is the pier and the Torre del Rem, a wooden construction that acts as a shelter for the referees during rowing competitions, while also offering a vantage point from which to look out over the landscape.

And along the perimeter of the lake, in particular in the municipal area of Porqueres, there are also small wooden lookouts for wildlife observation.

It is not permitted under any circumstances to discharge wastewater, either directly or indirectly, into the lake, ponds, watercourses or run-off streams from the surface water basin that drains into the lake.

To avoid water pollution, it is strictly forbidden to:

- Carry out direct or indirect discharges that contaminate the waters.
- Accumulate solid waste, debris or substances, regardless of their nature and the place where they are deposited, that constitute or may constitute a danger of water pollution or visual degradation of their surroundings.
- Carry out actions on the physical or biological environment linked to water, which constitute or may constitute its degradation.
- Use slurry or any other type of fertilizers or herbicides on crops

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existing within the delimitation.

Forecast of new infrastructures

The Banyoles Council has scheduled actions lined up to improve the Lake, within the framework of the EU Next-Generation grants, which are as follows:

- Currently, the installation of four automated floodgates is being executed to regulate the flow of water more efficiently, with remote control, with a €200,000 budget project (*Banyoles Next Destination*). The project aims to be able to regulate the lake's water level better and more quickly and efficiently to reduce the risk of flooding, facilitate the passage of fish and reduce carbon dioxide emissions.

- Still in the project, they want to earmark €200,000 to improving the viewpoints of Joan de Palau and of the Lake and their accessibility. The aim is to have two iconic viewpoints, equipped with informative panels and other improvement elements, and to improve their accessibility. This action must also contribute to the fact that visitors are getting to know the Lake from new perspectives, distributing the flow of people towards less transited points.

- There is a project to improve the regatta field, hillock and other support spaces for the practice of the different sports that take place on the Lake, such as rowing, canoeing and triathlon with a budget of €150,000

They also want to carry out a project to rehabilitate the Pesquera Mata and create a tourist route linked to the fisheries that includes signage and night lighting of the fisheries.

Another project that is being carried out is the adaptation of a Via Brava, an open water swimming lane, on the southeast side of the lake.

The carbon footprint of visitors

According to Idescat data, in 2022, there were 6 hotels in Banyoles with 171 places to stay. In Porqueres there were 2 hotels with 35 places, 1 campsite with 771 places and 9 rural tourism houses with 65 places. Furthermore, in 2022, there will be 85 flats for tourist use in Banyoles, with 468 places, and 12 homes with 67 more places in Porqueres. In total, there are approximately 1,577 places for tourist accommodation near the lake.

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The origin of visitors to Catalonia, according to Idescat, in 2023, is as follows:

- Local tourists (from Catalonia): 50%
- Rest of Spain: 20%
- International: 30% (Within international tourists, a significant part comes from European countries such as France, Germany and the United Kingdom)

According to the European project Green tour (https://greentour-project.eu/), transport is the category with the greatest environmental impact, representing between 60% and 96%, depending on the means used by tourists to reach the destinations

Most travellers to the Lake of Banyoles arrive by private vehicle or bus. A journey by car from Barcelona, round trip, represents around 46 kg of CO_2 eq., by bus represents 6.72 Kg of CO_2 eq. From Madrid, the movement of a vehicle emits 261.36 kg of CO_2 eq., or 40.43 kg of CO_2 eq. per passenger if arriving by bus. With regard to air travel, the emissions, for a two-hour journey, for example, represent, round trip, about 400 kg of CO_2 eq. per passenger, to which must be added the journey from Barcelona to Banyoles or Porqueres, by private vehicle or by bus. A journey of 2000 km, from Paris, represents around 362 kg of CO_2 eq.

Considering the accommodation places in Banyoles and Porqueres, and with an assumed average occupancy of 60% per year, we can calculate a rough approximation of the emissions represented by the transport of travellers to the Lake of Banyoles over the course of a year. Thus, the annual carbon footprint derived from the transport of visitors is more than 72,000 Tn of CO_2 eq.

To these figures should be added the carbon footprint of each traveller in restaurants, accommodation, and finally in leisure activities. According to the Greentour project, it can represent about 25.2 kg of CO_2 eq. per tourist. In our case, for an average annual occupation of 60%, it would represent 5,220 Tn of CO_2 eq. more, apart from transport, resulting in an approximate figure of the annual carbon footprint of visitors to the lake of 77,220 Tn of CO_2 eq.

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2.4 Socio-economic considerations

2.4.1 What role do water sports play in attracting tourists to the area?

More than 56 sporting events take place in the lake every year, 17 of which are of international significance.

On the one hand, Banyoles hosts the training stays of a large number of sports teams and federations. It was the venue for the 1992 Olympic Games and has been and is the venue for various international rowing, triathlon and mountain biking competitions. Since 2005, the city has also housed the first Department of Sport and Physical Education of the University of Girona and the Centre for Olympic Studies of the University of Girona; as well as training cycles of medium and higher level of physical-sporting activities for the training and dissemination of physical activity and sport.

The sports tourist destination has more than 80 sports facilities, where 22 different sports are practised, of which rowing and canoeing, cycling and mountain biking, swimming, team sports (basketball, football and handball), triathlon and running. And more than 40 agents are involved in the sports field of the region, of which 5 are active and sports tourism companies, 4 are public administrations that allocate resources to sport and tourism and 33 are organisations, clubs and tourism associations sporty and active.

Banyoles is also the first destination certified in Sports Tourism by the Catalan Tourism Agency, in 2003. This seal of quality recognises the tourist destination for offering high-quality resources and services aimed at elite athletes, professionals, amateurs and tourists looking to do sports activities.

On the other side of the lake, from the municipality of Porqueres, sustainable tourism is also fostered with activities such as guided cycling routes and bike hire, forest bathing, visits to local producers and artists. Porqueres has a municipal swimming pool with a children's area.

The most prominent entities are:

- Banyoles Swimming Club: It offers facilities for rowing, canoeing, swimming, and other water sports. It also has beach volleyball courts, basketball, and a weight room.

- Lake of Banyoles Sports Consortium: It organises sporting events and provides information on sporting activities in the area.

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- Active and sports tourism companies: There are several companies that offer activities such as cycling, mountain biking, hiking, and triathlon.

- Public administrations: Banyoles Council and Pla de l'Estany County Council, and the Sports Council allocate resources to foster sport and sports tourism.

- Sports organisations and associations:
    - Banyoles Rowing Club: Specialised in the practice of rowing, it organises competitions and regular training.
    - Banyoles Canoeing Club: Dedicated to canoeing, with activities for all ages and levels.
    - Banyoles Sports Association: It organises sporting events and fosters different sports in the area.
    - Banyoles Triathlon: An entity that organises triathlon competitions and fosters this discipline.
    - Banyoles Sports: An association that offers various sporting activities, including cycling and athletics.
    - Les Alforges equestrian centre. There are routes with horses through the natural areas of Porqueres as well as routes with ponies for the little ones
    - Equestrian Club Pla de l'Estany Region. They offer routes with horses throughout the county

2.4.2. Cultural aspects of the lake

The Lake of Banyoles is a cultural and identity symbol for the local population. It is considered to symbolise Banyoles. It represents a meeting point and a space for coexistence for the community. Numerous cultural aspects stand out:

1. The lake is surrounded by legends, such as that of the Banyoles dragon or the legend of Morgat, which are part of popular culture.
2. Architectural Heritage: around the Lake there are historic buildings such as the Romanesque church of Santa Maria de Porqueres and the monastery of Sant Esteve.
3. Cultural Events: the Lake is the scene of numerous cultural events, such as concerts, festivals and fairs that attract both locals and visitors.

2.4.3. Historical aspects

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The Draga Neolithic Park is one of the first lakeside Neolithic settlements in Europe. Discovered in 1990 while preparing for the Olympic Games, it is one of the oldest settlements of farmers and herders in the north-east of the Iberian Peninsula, dated between 5400 and 4900 BC.

The location of the site in a wetland has allowed exceptional preservation of organic materials, such as wooden pillars, tools, basketwork and ropes. The park has reproductions of Neolithic huts, which allow visitors to experience what daily life was like at that time. Educational activities are also offered for schoolchildren and tourist groups, focusing on the daily life of the Neolithic, including cereal and leguminous fields.

The site is the subject of continuous excavations and studies by the Archaeological Museum of Banyoles, in collaboration with other institutions such as the CSIC and the Autonomous University of Barcelona.

3.0 Exposure Assessment

3.1 Biodiversity exhibitions

The seasonal variations in Lake of Banyoles have a significant impact on the flora and fauna, especially during periods of greater human activity (spring-summer) and quieter periods (autumn-winter).

During the summer, the increase in visitors directly causes soil compaction and degradation of vegetation in the most frequented areas. This can affect the ability of plants to absorb nutrients and water, reducing their growth and flowering. If there are fewer viable seeds, their survival is compromised, especially the most vulnerable.

Fish and other aquatic animals can be stressed by increased pollution and noise. Bats, which have their breeding season in the spring and early summer, can be affected by the decrease in food resources and the stress caused by human presence.

Autumn is a quieter time, and this allows the vegetation to recover. Plants can take advantage of this period to accumulate nutrient reserves for the winter.

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Many species of migratory birds pass through Banyoles during the autumn, taking advantage of the fruits available to feed themselves before continuing their journey. Fish can also benefit from reduced human pressure, improving their rearing and feeding conditions.

In summer, competition for food resources increases, especially affecting animals that depend on insects and other small organisms. In autumn, the availability of fruit and other food increases, benefiting migratory birds and other species.

Summer habitat stress and degradation can reduce the reproductive success of many species. In contrast, autumn offers more favourable conditions for breeding, with less human interference. Although in the autumn numerous sporting and cultural events take place there on a timely basis which can also disturb nature.

Migratory birds benefit from the quiet of autumn to build their strength back up before continuing their journey. Overcrowding in summer can displace some species, altering their migration routes.

3.2 Consider human activities

The human activities that are carried out within the water table are:

- **Rowing and Canoeing.** These activities can cause erosion of the banks and alteration of the aquatic vegetation. The constant movement of boats can affect the habitats of fish, herpetofauna and other aquatic organisms. Furthermore, sports teams sometimes use motorboats to move technical teams, which can cause water pollution due to the risk of losses or discharges of polluting substances. Megaphones are also used to give orders to athletes, which causes noise pollution.

- **Sport swimming:** Swimming is limited to certain areas and circuits, and the CNB is responsible for it. This activity takes precedence over the others. It is one of the most popular activities, especially during the Travessiade l'Estany, which attracts thousands of participants every year (more than 2,600 participants in 2024). It can cause alteration of aquatic vegetation and disturbances to aquatic fauna. The use of sun creams, soaps and other chemical products by bathers can contaminate the water.

- **Swimming:** It is only allowed in Banys Vells, the CNB and the Caseta de Fusta area. The swimming area is delimited with buoys, up to 30 meters. The swimming season, at least July and August, is regulated by mayor's decree. Swimming can cause rumbling in the water and erosion of the bottom, harming the species of aquatic vegetation and

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the organisms that live there. The use of sun creams and soaps on the skin, without the obligation to take a shower before bathing, can also contaminate the waters of the lake.

- **Underwater activities.** They are only allowed for scientific, study, maintenance, rescue or similar purposes. You must always signal and notify the managing bodies. The resulting impacts can be noise from the bottom and harm the flora and fauna.

- **Recreational Fishing.** Recreational and sport fishing is allowed on the shore of the lake and in the Vilar pond. The use of live bait is not allowed. Nor fishing from boats, or at night. Native fish must be caught without killing and must be returned to the water. The number of fishermen in the competitions is limited to 100. In specific cases, fishing for exotic species is allowed. Fishing can damage native fish populations, weakening their individuals, and facilitate the introduction of invasive species, if controls are not carried out. Fishing waste, such as hooks and lines, can be dangerous to wildlife. And paths can be opened that can damage the plant cover.

- **Sports competitions.** Sports competitions, such as triathlons and regattas, can cause a significant increase in noise and human presence, affecting local wildlife. They can also generate a large amount of waste and water pollution.

- **Strolling rowing boats.** A maximum of 20 rowing boats are allowed which can be rented for outings. The activity is regulated according to the concession of the Banyoles Council.

- **Commercial motorboats for sightseeing.** A commercial motorised boat, with a capacity for between 60 and 80 passengers, is authorised, through a concession from Banyoles Council. It must have an electric motor or one that does not pose a risk of pollution. It is strictly forbidden to clean the boat or the engine in the lake, and you cannot pour debris or pollutants into the water.

- **Motorboats.** They are not allowed in general. Even so, they are authorised in the case of sports competitions or rowing and/or canoeing training, or for rescue, scientific, maintenance purposes, etc. These types of boats cause noise, risk of collision and water pollution.

- **Tourist activities.** Recreational activities such as the Dragon Boat are carried out, aimed at young people and companies to encourage teamwork. These activities have an impact mainly due to the noise caused by the participants and organisers. There are also rowing boats for rent and the Tirona, the electric boat, for tourist trips. The impact of these boats is due to the roar of the waters, which cause changes in the

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physio-chemical conditions of the water, and a certain tension on the aquatic plants, and the noise of the participants, which can cause discomfort to the fauna.

- **Kayak polo:** recently training and competitions are also allowed for this sport that combines kayaking and basketball, in the same way as rowing, they can cause discomfort to the fauna and flora, mainly due to the movement of the water and the noise, in this case of the whistles and shouts of the participants.

Activities that are carried out in the immediate surroundings of the lake:

- **Hiking.** Walkers can cause soil compaction and erosion of vegetation and soils, especially if they walk off established routes. They can also affect the riparian vegetation if visitors do not respect the protected areas. In the case of walking with sticks (*Nordic walking*) the impact on the ground is greater due to the use of sticks.

- **Cycling and mountain biking**. There is a bike path that goes around a large part of the perimeter of the lake. For the organisation of races, permission must be requested from the town councils. Bicycles, in particular when ridden on unpaved paths and paths, cause erosion of soils and vegetation. Participants in sports competitions can throw waste into the natural environment, or polluting liquids (from brakes, puncture repair, grease, etc.)

- **Excursions on horseback.** Horse riding is not allowed on the paths around the lake. Sporadically, in the event of sporting events, horses can trample around the lake, causing soil compaction and erosion of the soil and plant cover.

- **Hunting.** It is not allowed, only exceptionally, by the administration, for the purpose of controlling populations or problematic individuals.

- **Festive or cultural events.** Festivals and large competitions can cause severe habitat degradation, water pollution from waste and chemicals, and increased noise that affects wildlife. The massive presence of people can destroy riparian vegetation and cause significant erosion.

- **Animal feeding.** It is very common for the elderly in the area and families to feed the ducks and waterfowl (coots, moorhens, etc.), offering them bread that they usually bring from home. Although there are signs in different parts of the lake that it is not recommended. Feeding wildlife has serious consequences for individuals, causing them to approach people and put themselves at risk, artificially increasing the

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populations of some species, causing imbalances in ecosystems, or infecting them with diseases, or contributing to malnutrition, since by sticking to one type of food, they don't look for foods that are more beneficial for them.

- **Restaurants and bars**. Around the lake there are some catering activities such as the Nautical Club, the Old Baths, and some fisheries that offer food and drink in the summer. Their activity can disturb the tranquillity of the space with noises such as ambient music, or accidental dumping of waste (bags flying in the wind, bottles falling into the water, etc.). Also, occasionally, some bars in the area organize live concerts or parties.

3.3 Intensity of water sports

Figure 13: Table of frequency and volume of activities

Activity	frequency	volume
Rowing and canoeing	very high	medium
Sports swimming	low	very high
Bathroom	high	medium
Underwater activities	very low	very low
Recreational fishing	low	down
Sports competitions	high	very high
Strolling rowing boats	medium	medium
Commercial boats	medium	medium
Motorboats (rowing equipment and/or canoeing)	medium	medium
Tourist activities	medium	medium
kayak polo	low	down

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Hiking	very high	very high
Cycling and mountain biking	very high	very high
Excursions on horseback	low	down
Hunting	very low	very low
Mass events	medium	very high
Fauna feeding	high	high
Restaurants and bars	high	high

3.4 Table for Vulnerability Assessment

Figure 14: Lake Vulnerability Assessment Table for specific activity at specific times of the year. (Risk 1-low risk; 5-high risk)

Activity	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Des.
Paddle	2	2	3	4	4	5	5	5	4	3	2	2
Canoeing	2	2	3	4	4	5	5	5	4	3	2	2
Sports swimming	1	1	2	3	4	5	5	5	5	2	2	1
Bathroom	1	1	1	1	2	3	5	5	4	3	1	1
Active recreational fishing	2	2	3	3	4	4	5	5	4	3	2	2
Sports competitions	1	1	2	3	4	5	5	5	5	2	2	1
Recreational boats	2	2	2	4	4	4	4	4	4	2	2	2

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Commercial boats	1	1	1	1	2	3	5	5	4	3	1	1
Motorboats	2	2	3	4	4	5	5	5	4	3	2	2
Tourist activities (dragon boat)	2	3	4	5	5	5	4	2	3	3	3	2
kayak polo	2	2	3	4	4	5	5	5	4	3	2	2
Hiking	2	2	3	4	4	5	5	5	4	3	2	2
Cycling and mountain biking	2	2	3	4	4	5	5	5	4	3	2	2
Excursions on horseback	1	1	1	1	1	1	1	1	1	1	1	1
Hunting	1	3	5	5	5	5	3	3	2	2	1	1
Mass events	2	2	3	4	4	5	5	5	4	3	2	2
Fauna feeding	1	3	5	5	5	5	3	3	2	2	1	1
Restaurants and bars	2	2	3	4	4	5	5	5	4	3	2	2

4.0 Sensitivity Assessment

Broadly speaking, there are two different situations of pressure on the ecosystem. One is throughout the year, where there is a polarity of anthropic pressure between the east zone, closer to the urban environment of the town of Banyoles and the infrastructures, such as the C-150a and C-66 roads, and the west zone, more preserved and, therefore, a more natural space that acts as a refuge for the different species. Usually, therefore, we will find a

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greater presence of species in the north-west area, as well as finding the most naturalised space of the entire perimeter.

The second aspect would be the seasonal polarity, since during the summer season there is an increase in the use of the lake for leisure purposes and a significant increase in the number of visitors, thus creating more pressure on the ecosystem until the beginning of September, when there is again a decrease in the number of visitors and leisure and sports activities in the lake, and the conditions of basal levels of alterations on the environment are thus recovered. It is precisely at this time when there is the visit of certain species of wintering birds that seek tranquillity to spend the most unfavourable season in our territory, such as the osprey, the woodcock, the white martin and the cormorant, to name but a few.

In the case of the flora, it can be affected mainly by climbing or by maintenance actions (cutting of reeds or grass to facilitate sports practices). It would be necessary to preserve species vulnerable to human action, by not destroying their habitat by building infrastructure or compacting the soil and take actions such as raising awareness among visitors to the lake so that they use it responsibly and not uproot them. Care must also be taken to prevent the arrival of invasive plant species by means of an early detection of the first specimens or seeds.

In the case of fauna, areas must be preserved where animals can find refuge, as well as try to prevent the entry of invasive species, either by sensitising visitors not to release specimens there (as in the case of the Florida turtle), how to be very careful cleaning the boats in the specially authorised areas to avoid the spread of species such as the zebra mussel. During the autumn and winter months, it is necessary to respect the presence of wintering species, as well as maintain a safe distance in all those dens and nests to guarantee the breeding of the different species that visit or live in the Lake.

It is important to foster and offer conditions of respect during the visit of the users and their approach to the observation of the fauna, doing so in the designated places on the route (such as the viewpoint of the Lake of Banyoles in the north-east area of the perimeter) as well as avoid causing discomfort with too much noise from recreational activities, cultural activities or the use of music from mobile devices.

In the case of aquatic habitats, the sensitivity of the species that live there, mainly hydrophytic plants, are affected by causes of a diverse nature; on the one hand, navigation, since it causes water pollution, and they can be carriers of invasive species on their surface. On the other hand, the boats must be anchored in the qualified buoys in order not to damage the bottom of the lake and the species that may live there rooted.

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In the case of animal species in this same habitat, it is necessary to ensure the ecosystemic balance between herbivores and predators, as well as the non-introduction of invasive speciesthat could destroy the structure of the habitat either with their presence or with which it derives from its activities (feeding, breeding, etc.).

In the caseof riparian habitats, water sports and activities based on walks and excursions can damage the area around the edge of the lake and the riparian forest community in the exercise of their practice. With excessive trespassing and frequent visits to non-enabled spaces. Therefore, it will be necessary to only do sports in authorised areas, and to delimit the paths correctly.

The arrival of invasive species such as the coypu can also accelerate bank erosion and create a risk of landslides.

In the Lake of Banyoles, various sports activities have a significant impact on the protected speciesof fauna and flora. This impact varies according to the activity and its intensity. Below is a detailed analysisof the most harmful activities for the fauna and flora of the lake, ordered from most to least impact.

Species Sensitivity Table

	species	High impact	Medium impact	Low impact
Canoeing and rowing	Otter and water bat, Common Pipistrel, Lesser Horseshoe Bat, Big-footed Bat, Mountain Barbel, Spiny, Red-headed Blackbird, Red-headed Blackbird, Red-headed Plover, Red-breasted Plover, White-tailed Godwit, Lure, Blue Tern. Aquatic plants and algae in general.		•	
Swimming	Mountain barb, thorny.			•
Taking a bath	Mountain barb, thorny.			
Recreational fishing	Mountain barb, thorny.		•	
Recreational rowing boats	Otter and water bat, Common Pipistrel, Lesser Horseshoe Bat, Big-footed Bat, Mountain Barbel, Spiny, Red-headed Blackbird, Red-headed Blackbird, Red-headed Plover, Red-breasted Plover, White-tailed Godwit, Lure, Blue Tern. Aquatic plants and algae in general.		•	

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Boating with motor	Otter and water bat, Common Pipistrel, Lesser Horseshoe Bat, Big-footed Bat, Mountain Barbel, Spiny, Red-headed Blackbird, Red-headed Blackbird, Red-headed Plover, Red-breasted Plover, White-tailed Godwit, Lure, Blue Tern. Aquatic plants and algae in general.	•		
Dragon Boat (recreational boats)	Otter and water bat, Common Pipistrel, Lesser Horseshoe Bat, Big-footed Bat, Mountain Barbel, Spiny, Red-headed Blackbird, Red-headed Blackbird, Red-headed Plover, Red-breasted Plover, White-tailed Godwit, Lure, Blue Tern. Aquatic plants and algae in general.			
Cycling	Anacamptis pyramidalis, Cephalanthera damasonium, Cladium mariscus, Dactylorhiza elata, Euphorbia nicaeensis, Himantoglossum robertianum, Nymphaea alba, Ophrys apifera, Ophrys catalaunica, Phragmites australis, Salix alba, Serapias lingua, Viburnum tinus. Terrestrial fauna in general.			•
Trail Running	Anacamptis pyramidalis, Cephalanthera damasonium, Cladium mariscus, Dactylorhiza elata, Euphorbia nicaeensis, Himantoglossum robertianum, Nymphaea alba, Ophrys apifera, Ophrys catalaunica, Phragmites australis, Salix alba, Serapias lingua, Viburnum tinus. Terrestrial fauna in general.		•	
Hiking, Nordic walking	Anacamptis pyramidalis, Cephalanthera damasonium, Cladium mariscus, Dactylorhiza elata, Euphorbia nicaeensis, Himantoglossum robertianum, Nymphaea alba, Ophrys apifera, Ophrys catalaunica, Phragmites australis, Salix alba, Serapias lingua, Viburnum tinus. Terrestrial fauna in general.			•
horse riding	Anacamptis pyramidalis, Cephalanthera damasonium, Cladium mariscus, Dactylorhiza elata, Euphorbia nicaeensis, Himantoglossum robertianum, Nymphaea alba, Ophrys apifera, Ophrys catalaunica, Phragmites australis, Salix alba, Serapias lingua, Viburnum tinus. Terrestrial fauna in general.		•	

Impact on protected wildlife species

Motorised water activities, such as motor boating, are the most harmful to the fauna of the lake. These activities generate noise and water pollution, and cause significant disturbance to

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natural habitats. Motor boating particularly affects species such as water bats and otters, which are very sensitive to changes in their environment.

Swimming and fishing have a moderate impact. Although less intrusive than motorised activities, they can cause disturbance to aquatic vegetation and reduce native fish populations. Fishing, in particular, can introduce invasive species that compete with local species.

Canoeing and rowing have a moderate impact as they can cause bank erosion and disturbance to aquatic habitats. These activities are less harmful than motorised activities, but can still affect local wildlife.

Activities such as trail running, cycling and hiking are low impact. These activities are less intrusive and generally do not directly affect aquatic habitats or breeding grounds. However, they can cause soil compaction and disturbances to terrestrial fauna.

Impact on protected flora species

Motorised activities, such as motorboats, are the most harmful to the lake's flora. These activities can cause water pollution and bank erosion, affecting the riparian vegetation that is crucial for protection against erosion and for providing habitats for various species.

Swimming and fishing have a moderate impact. Swimming can alter aquatic vegetation and introduce pollutants such as sunscreens. Fishing can affect aquatic vegetation and introduce invasive species that compete with local species.

Canoeing and rowing boats have a moderate impact as they can cause bank erosion and disturbance to aquatic vegetation. These activities are less harmful than motorised activities, but can still affect the local flora.

Activities such as trail running, cycling and hiking are low impact. These activities are less intrusive and generally do not directly affect aquatic vegetation or riparian areas. However, they can cause soil compaction and disturbance to terrestrial vegetation.

Habitat sensitivity table

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	Habitat	High impact	Medium impact	Low impact
fishing	Submerged plant communities of oligomesotrophic waters (code 3140)		•	
swimming	hydrophilic reed vegetation (code 7210) and submerged plant communities (code 3150)			•
Motorboats	Underwater macrophyte meadows (code 3150) Benthic vegetation with charophyces (code 3140)	•		
Rowing boats	hydrophilic reed vegetation (code 7210) and submerged plant communities (code 3150)		•	
canoeing	Hydrophilic reed vegetation (code 7210) Submerged plant communities (code 3150)		•	
cycling	Alnus glutinosa and Fraxinus excelsior alluvial forests (code 91E0) Gallery forests of Salix alba and Populus alba (code 92A0)			•
Trail Running	Alnus glutinosa and Fraxinus excelsior alluvial forests (code 91E0) Gallery forests of Salix alba and Populus alba (code 92A0)			•
walking	Alnus glutinosa and Fraxinus excelsior alluvial forests (code 91E0) Gallery forests of Salix alba and Populus alba (code 92A0)			•

Motorised activities, such as motor boating, are the most damaging to lake habitats. These activities generate noise and water pollution, and cause significant disturbance to natural habitats. Motor boating particularly affects underwater macrophyte grass beds (code 3150) and benthic vegetation with charophyceae (code 3140), which are habitats of community interest.

Swimming and fishing have a moderate impact. Although less intrusive than motorised activities, they can cause disturbance to aquatic vegetation and reduce native fish populations. Fishing, in particular, can introduce invasive species that compete with local species and affect the habitats of submerged plant communities in oligomesotrophic waters (code 3140).

Canoeing and rowing have a moderate impact as they can cause shoreline erosion and disturbance to aquatic habitats. These activities are less damaging than motorised activities, but can still affect hydrophilic reedbed vegetation (code 7210) and submerged plant communities (code 3150).

Activities such as trail running, cycling and hiking are low impact. These activities are less intrusive and generally do not directly affect aquatic habitats or riparian areas. However, they

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can cause soil compaction and disturbance to terrestrial vegetation, such as the alluvial forests of *Alnus glutinosa* and *Fraxinus excelsior* (code 91E0)and the gallery forests of White willow (Salix alba) and *Populus alba* (code 92A0).

In summary, motorised activities are the most damaging to the habitats of Lake of Banyoles, followed by non-motorized water activities and, finally, terrestrial activities that have a smaller impact. Duly managing these activities is of utmost importance to protect the lake's ecosystem and ensure its long-term sustainability.

4.6 Proposed Future Developments

From 2022, the Tourism Sustainability plan is being developed: Banyoles, City of Water, through the EU Next Generation Fund. In this plan, it is planned to carry out different projects that may affect habitats or species to varying degrees. Here we list them based on whether they have a positive, low, moderate and high impact.

Figure 17: Table of future projects in the lake.

Project	***budget***	***state***	***strategic axis***	***impact***
Regulating behaviour of the Pond and the waters	€200,000	in execution	Green and sustainable transition	Positive: It should mean an environmental improvement
Viewpoints around the Estany (Joan de Palau and de l'Estany)	€200,000	Pending start	Green and sustainable transition	Moderate in its implementation and harmless afterwards.
Wi-Fi trackers and sensors in the fragile spaces of the Lake	€120,000	in execution	Green and sustainable transition	Positive: It should mean an environmental improvement
Deterrent parking for vehicles and motorhomes	€100,000	in execution	Green and sustainable transition	Positive: It should mean an environmental improvement
E-Bike Centre	€150,000	Pending start	Green and sustainable transition	Low: facilitates and increases the use of the space.
Network of cycling itineraries, specialized by modality and segment	€50,000	in execution	Energy efficiency	Moderate: incidence within the space in its execution. Subsequently, it facilitates and increases the use of the space.
Bike lanes connecting the Estany, the city centre and the Via Verda	€350,000	Pending start	Energy efficiency	Low: incidence within the space in its execution. Subsequently, it facilitates and increases the use of the space.

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The great return to Banyoles	€50,000	Pending start	Energy efficiency	Low: incidence within the space in its execution. Subsequently, it facilitates and increases the use of the space.
Rehabilitation of the Old Bathrooms	€200,000	in execution	Energy efficiency	Moderate: incidence within the space in its execution. Subsequently, it facilitates and increases the use of the space.
Experiential path of water	€125,000	Pending start	Digital transition	Positive: it proposes new tourist spaces outside the most frequented areas.
Video-Mapping "Banyoles, city of water"	€80,000	Pending start	Digital transition	Positive: it proposes new tourist spaces outside the most frequented areas.
Smart tourist signage plan	€120,000	in execution	Digital transition	Positive: it proposes new tourist spaces outside the most frequented areas.
Marketing plan	€40,000	Pending start	Digital transition	Positive: allows you to have more information about the state of the spaces and tourist flows
Improvement of the Estany sports area	€150,000	Pending start	Competitiveness	High: works to improve the regatta field, moat and other support spaces for rowing, canoeing and triathlon.
Fishing route. Project of night lighting, signage and rehabilitation Pesquera Mata	€100,000	in execution	Competitiveness	High: the rehabilitation of the Pesquera Mata and the creation of a tourist route linked to the fisheries that includes signage and night lighting of the fisheries.
Water Park	€80,000	Pending start	Competitiveness	Positive: creation of a new family play area in the historic centre.
The sweet route - gastronomic itinerary	€30,000	in execution	Competitiveness	Positive: it proposes new tourist spaces outside the most frequented areas.
Certificate or badges of quality of the destination	€30,000	Pending start	Competitiveness	Positive: it involves city agents in a certification process that improves sustainable management.

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5.0 Summarisation & Utilisation of Findings:

5.1 Adaptive Capacity of the Blue Space

5.1.1. Biodiversity

The Eurasian otter (*Lutra lutra*) is an indicator species of water quality and helps control fish populations and other aquatic organisms. Their presence is of utmost importance to maintain the balance of the aquatic ecosystem. Bats, such as the water bat and common pipistrelle, contribute to the control of insect populations, pollination and seed dispersal, thereby reducing the need for pesticides and helping to maintain plant diversity.

Native fish, such as barbel and stickleback, help maintain the balance of the aquatic ecosystem by controlling populations of invertebrates and other fish, and contributing to nutrient cycling. Waterfowl, such as the tern and the blue tern, contribute to seed dispersal and the control of fish and invertebrate populations, helping to maintain plant diversity and the health of aquatic habitats.

Underwater macrophyte grass beds (code 3150) provide shelter and food for many aquatic species and improve water quality. Benthic vegetation with charophyceae (code 3140) contributes to water quality and provides habitats for aquatic invertebrates. The reed workers (*Phragmition australis*, code 7210) are important for water filtration and provide shelter for many species. Wetland meadows and sedges (code 6410) help maintain water quality and provide habitats for many species.

These species and their interactions are essential to maintain the resilience of Lake of Banyoles. Bats and birds control insect populations, reducing the need for pesticides. Aquatic plants and reeds help filter the water, improving its quality. Fish and invertebrate species contribute to the nutrient cycle, maintaining the balance of the ecosystem. Underwater grass beds and reed beds provide shelter and food for many species, increasing biodiversity.

5.1.2. Water Quality

Yes, there are studies and data available on the water quality of Lake of Banyoles. For example, the company Aigües de Banyoles manages water quality and has participated in several studies on the temperature, turbidity and other physical aspects of the lake. These studies have shown how climate change is affecting thermal stratification and water turbidity.

However, it is always beneficial to conduct specific studies to gain a better insight into the long-term effects of human activities and the effects of climate change on the lake ecosystem. Additional studies could help identify new threats and develop more effective conservation strategies.

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5.1.3. Connectivity

Is the lake connected to other water bodies, wetlands, where exchange of species and genetic material can take place? Will this enhance biodiversity and resilience?

The lake is connected to adjacent wetlands. These wetlands around the lake, such as Clot d'Espolla, act as ecological corridors that facilitate the movement of species between different habitats. These wetlands are crucial for the dispersal of seeds, the migration of birds and other species, and the connection of populations of flora and fauna.

The rivers and streams that feed the lake also contribute to ecological connectivity. These watercourses allow the exchange of genetic material and species between the lake and other aquatic ecosystems in the area.

Encouraging connectivity between different populations of fauna and flora always increases their resilience, prevents genetic impoverishment and favours conservation.

5.1.4. Climate Resilience

What is the ability of the lake to buffer against climate change, such as changes in temperature, precipitation, (and ice cover)?

Lake of Banyoles has certain capacities to cushion the effects of climate change, but it also presents vulnerabilities.

- Temperature regulation: Lake water can help moderate local temperatures, as water has a high heat capacity and can absorb and release heat slowly. This can help reduce extreme temperature variations in the surrounding area.
- Precipitation and water level: Changes in precipitation can affect the lake's water level. During periods of drought, the level may drop, while in periods of heavy rain, it may rise. Vegetation and aquatic ecosystems can help buffer these changes, but increased frequency and intensity of rainfall may overwhelm this capacity. Considering that the water supply to the lake is of karst origin, it does not have a direct dependence on the rain. This increases its resilience.
- Ice cover: the Lake of Banyoles does not usually freeze over in winter, the temperatures are not low enough. No changes are expected in this regard.

5.1.5. Management Practices

Are sustainable management and conservation practices in place? What are the local, national and European rules and regs? Are they being followed?

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Various sustainable management and conservation practices are carried out in the Lake of Banyoles. These practices are directed by the Consorci de l'Estany, which strives to preserve and revalue the natural and cultural heritage of the lake and its surroundings.
The most outstanding initiative is the conservation actions and the various LIFE Natura projects that the Consorci de l'Estany has promoted, to improve water quality and restore habitats. The Consortium also carries out specific actions to control and eradicate invasive species that can negatively affect local ecosystems. Furthermore, educational and awareness-raising activities are organized for the local population and visitors, with a view to fostering conservation of the lake.
In terms of rules and regulations, at local level there is the Lake Activities Regulation, which regulates the activities that can be carried out in the lake to ensure that the ecosystem is not damaged, and the municipal ordinances, which include regulations on water use, fishing and other recreational activities. At national level, the Law on the Protection of Natural Areas sets forth the rules and regulations for protecting and managing protected natural areas. At the European level, the Water Framework Directive aims to achieve a good ecological status of all bodies of water, and the Habitats Directive protects natural habitats and species of wild flora and fauna of community interest.
The Consorci de l'Estany and the local authorities work together to ensure compliance with these rules and regulations. Furthermore, participation in European projects such as LIFE Natura helps to ensure that best conservation and sustainable management practices are followed.

5.1.6. Community Engagement

Are there local community groups involved in lake management? Have the groups got the knowledge to support monitoring efforts, and implement adaptive practices tailored to local conditions?

Yes, in the Lake of Banyoles there is an active participation of local community groups in the management and conservation of the lake. The Consorci de l'Estany collaborates with a number of local entities to foster the preservation of the natural and cultural heritage of the lake. These community groups participate in environmental monitoring, education and awareness activities, as well as volunteering and ecological restoration projects.
Local community groups have access to training and resources that enable them to acquire the necessary knowledge to support monitoring efforts and implement adaptive practices. For example, the Banyoles Nature School offers educational activities and training on the lake's biodiversity and ecosystems. Furthermore, the Pla de l'Estany Adult Training Centre provides continuous training in various areas, including environmental management.

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There is also the Limnos entity, a non-profit environmental organisation that was born at the end of 1987, dedicated to activism, with the aim of defending the natural heritage of the Pla de l'Estany, in which they consider a unique heritage and of high ecological interest. The organisation offers information and recommendations on issuesthat affect the environment and reports possible irregularities that could affect the region's environment to prevent the degradation thereof.

These collective efforts help ensure that management practices are adapted to local conditions and that the community is well informed and involved in the conservation of the lake.

5.2 Impacts

5.2.1 Short term impacts

What are the immediate issuesidentified on water quality, disturbance, litter, pollution etc, that may be caused by water sports?

One of the main problems is water pollution. Motorised boats, although limited, can release oils and fuels into the water, affecting its quality and endangering aquatic life. Furthermore, heavy use of the lake for activities such as rowing, swimming, and canoeing can cause movement of bottom sediments, increasing water turbidity and affecting sunlight reaching aquatic plants.

Disturbance from the noise and constant movement of boats and recreational activities can stress local wildlife, particularly waterfowl that use the lake as a nesting and feeding site. Thesedisturbances can alter their habits and reduce their populations in the long term.

Another important problem is the generation of garbage. Sporting events and the influx of visitors often leave waste on the shores and in the water, such as plastics, bottles and other litter. This waste not only pollutes water, but can also be ingested by wildlife, causing serious harm.

Furthermore, people walking across unauthorised areas can damage the vegetation and cause soil compaction.

Finally, pollution from chemicals, such as sunscreens used by swimmers, can affect water quality and the health of aquatic organisms. These products may contain toxic substances that dissolve in water and affect local flora and fauna.

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5.2.2 Long term impacts

What are the cumulative identified issues on water quality, erosion, habitat damage, invasives etc?

One of the most significant problems is the degradation of water quality. Continued use of the lake for recreational and sports activities can increase the load of nutrients and pollutants, such as oils and fuels from boats, as well as chemicals from sunscreens used by swimmers. These pollutants can cause eutrophication, a process that favours the excessive growth of algae and aquatic plants, reducing the oxygen available to other organisms and negatively affecting biodiversity.

Bank erosion is another major problem. The constant traffic of people and boats can destabilize the banks, causing the loss of soil and the degradation of natural habitats. This can affect the plants and animals that depend on these habitats for their survival. Furthermore, erosion can increase water turbidity, affecting sunlight reaching aquatic plants and disrupting underwater ecosystems.

Habitat damage is also a concern. Recreational activities can destroy nesting areas for waterfowl and other species, as well as fish breeding grounds. This can reduce local populations and alter the ecological balance of the lake[2].

The introduction and proliferation of invasive species is a growing problem. Boats and sports teams, despite taking measures, can carry non-native species that, once established, can compete with native species for resources and habitats. This can lead to a decrease in biodiversity and alter local ecosystems.

5.3 Mitigation

1. **Biodiversity protection** - Are protected zones, noise regulation, light pollution, water quality (bunded areas) in place?

The Lake of Banyoles is divided into several zones with different degrees of protection to ensure the conservation of its natural and cultural values. These areas include:

- **Integral Protection Zone.** This area includes the most sensitive and vulnerable habitats, such as underwater macrophyte grasslands and benthic vegetation with charophyceae. These areas have strict protection to avoid any type of alteration that could affect the ecosystems.

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- **Special Protection Zone.** It includes areas of reed beds and herbaceous communities of large cypress trees, which are habitats of priority community interest. These areas have specific regulations to limit human activities and preserve biodiversity.

- **Public Use Area:** This area is intended for recreational and sports activities, such as rowing, canoeing and swimming. Although these activities are permitted, they are regulated to minimise environmental impact and ensure that the ecosystem is not damaged.

- **Transition Zone:** This zone serves as a transition area between the strict protection zones and the public use zones. Some human activities are allowed here, but with restrictions to ensure the protection of natural habitats.

These areas are regulated by various local, autonomous and European regulations, which ensure that human activities are carried out in a sustainable manner and that the natural values of the lake are preserved:

- Regulation of activities of the lake of Banyoles, 2010
- Special Plan for the protection, management and restoration of the immediate surroundings of the Lake of Banyoles. Banyoles Council, 2016
- Banyoles Council Municipal Planning Plan, 2014
- Porqueres Council Municipal Planning Plan, 2023
- Areas of Natural Interest Plan (PEIN) and the Special Delimitation Plan for the Lake of Banyoles area, 1992
- Habitats Directive 92/43/EEC, Natura 2000 Network, 1992
- The Ramsar List of Wetlands of International Importance, 1982

2. **Erosion control** - stabilising shoreline (sometimes this can cause more issues), Are vulnerable shorelines being protected? Is there restricted access to vulnerable areas?

Various measures are taken to control erosion and stabilize the coastline. These measures include planting native vegetation on the banks to strengthen the soil and prevent erosion. The vegetation helps maintain the integrity of the banks and provides habitats for local wildlife.

With regard to the protection of vulnerable shores, through current regulations (Activity Regulations, Special Protection Plan, urban planning regulations, etc...) there are specific areas of the lake that are protected to limit access and minimise the human impact. These areas include sensitive habitats such as reedbeds and waterfowl nesting areas. Access to

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these areas is restricted to prevent habitat degradation and ensure their long-term conservation.

3. **Pollution control** – are fuelling best practices guidelines to be followed, adequate facilities for waste disposal, nature-friendly sunscreens (LNT principles), Signage?

The Lake of Banyoles Activities Regulations, approved in 2010, determine that the Lake of Banyoles is a zone of high acoustic sensitivity (A), which implies that the activities must conform to noise values determined (60 dB, from 7 a.m. to 11 p.m. and 50 dB from 11 p.m. to 7 a.m.).

The regulation also establishes the zone that coincides with the Natura 2000 Network as of maximum protection against light pollution (E1), and specifies that public and private lighting must be designed in such a way as to prevent light pollution and favour the saving and use of energy. The lamps to be used will be those with the highest energy efficiency and minimum luminous flux emission, in accordance with current sector regulations.

The CNB has created an APP (Digirow) aimed at rowing users, which, among other things, includes a training course on the natural environment of the lake and fosters best practices towards the natural environment and environmental awareness.
In 2023, the CNB carried out an action to reduce waste, it distributed drums to carry water to all the participants of the crossing of Sant Martirià (October). It was also distributed among the athletes of the sections. In addition to stopping the use of single-use packaging, this measure also strives to prevent these from ending up in the natural environment, impoverishing the landscape.

On the shores of the lake there are different signs that inform about the regulations of the space. There are different signs and notices that indicate the special protection zones, the rules of behaviour and the conservation measures that must be followed.

The use of sunscreens is encouraged to prevent the impact of the sun on the skin; however, there are no campaigns that foster the use of certain products that generate less environmental impact.

4. Is there an **Invasive Species Management Plan**? Is there adequate policing to ensure that its actions are supported appropriately? E.g. washing of clothing.

In the Lake of Banyoles there is a specific management plan to control invasive species. This plan is part of Project Lake, which strives to recover native species and improve the

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biodiversity of the lake. The project comprises a number of actions to combat invasive species, such as the capture and removal of exotic fish and turtle species, as well as the restoration of affected habitats.

Furthermore, the Banyoles Nature School organizes workshops and educational activities to raise awareness among the community about the fragility of ecosystems and the consequences of the introduction of exotic species. These activities include games, simulations and real-life case studies to help better understand the impacts of invasive species.

Efforts to control invasive species also include collaboration with scientists and technicians who work to slow the growth of these species and restore natural habitats. These actions are of utmost importance to maintain the ecological balance of the lake and protect native species.

Recently, the Generalitat de Catalunya has recruited a brigade of environmental informants who, in the busiest months, and under the coordination of the Consorci de l'Estany, will carry out tasks of welcoming visitors, providing information on best practices and collection of data and incidents, over the next 4 years.

5.4 Non-Technical Summary

The Lake of Banyoles is a very attractive place from an environmental, cultural, sporting, touristic and economic point of view. The proximity to the urban core and its high attractiveness generates a strong human pressure that makes the compatibility of public use of the lake and its conservation very complex.

Numerous public and private entities, together with the population, do an active task in the conservation and promotion of the biodiversity of the Lake and its surroundings, maintaining and improving the habitats of community interest and through actions to preserve threatened species.

The state of the ecological corridors is one of the important points of vulnerability, beyond the streams and rivers that have special attention.

The quality of surface and underground water is excellent. Periodic and constant monitoring of its quality is carried out. Its waters are used to supply cities and for agricultural irrigation.

The geological and flood risks are taken into account in the regulation of uses of the Lake, integrating measures to minimize these risks in the planning of the territory. And more so

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now that the remote control of the sluice gates of streams and streams that communicate with the lake is being implemented.

Noise and light pollution are one of the most vulnerable points, very difficult to reduce its impact. It is contemplated in the management plan to limit vehicletraffic and exterior lighting to avoid negative impacts on living organisms. However, it is planned to carry out an action to improve the lighting in the Banyoles fisheries, which may worsen light pollution and harm biodiversity.

Broadly speaking, landscape integration is promoted in the design of the area, reducing obstaclesthat hinder the visibility of the Lakefrom points of interest in order to also open up the possibility of decongestingareas of higher influx and thus reducing the impact.

The space presents a zoning where part of the lake is allocated to human activity and other parts that have more restricted accessand very clear limits regarding the activities that can be carried out there. The aim is to foster conservation and sustainability. However, some activities that cause impacts are currently allowed, such as the use of motorboats or noisy activities such as Dragon Boating.

The growing tourist and sports activity in nearby cities poses a serious threat to the natural space. If it is intended to act in a sustainable manner, it will be necessaryto review the tourist model of the city and the recreational uses of the lake, and to act with anticipation of the possible impacts.

It is necessaryto work to make the coexistenceof the different uses of the spacecompatible with the preservation of the habitats and the most vulnerable species. It is also necessaryto promote the improvement of existing facilitiesand to sensitisethe inhabitants and visitors to the need to preservethe flora and fauna from environmental alterations throughout the year.

Key actions

The following key actions are proposed:

- Establishthe ecological load capacityvalues for each of the activities carried out in the lake. Load capacity is the number of people that a natural space can accommodate in a single day without damaging its natural values. To obtain the final value, two calculations are developed: the physical load capacity, which takes into account parameters such as the surface area and visiting hours, and the actual load capacity, which must also take into account accessibility, parking, space protection, ecological

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values, etc. Know and respect the load capacity of the space will facilitate the management of overcrowding and avoid its impacts.

- Permanent monitoring of indigenous species that are indicators of the effects of human activity in space. These studies must provide management tools for improving their habitat and also indications for carrying out human activity with respect for the environment. It must be possible to safely guarantee the survival of the most vulnerable species and their habitats.
- Continue with water quality analyses to ensure both the safety of users and the well-being of the species of fauna and flora that depend on it.
- Conduct impact studies of sporting activities or major cultural events, and look for methodologies to reduce or mitigate impacts and ecological compensation. Seek strategies and social consensus to space out human activity, especially sports, so that it is not so aggressive in the summer months when there is more activity.
- Draw up a protocol of the best environmental practices for sporting, cultural, recreational events, etc. to be carried out in the lake.
- Continue monitoring and reducing populations of invasive species that pose a risk to the permanence of native species.
- Install over-attendance data collection systems, such as people counters, and impact monitoring indicators.
- Look for strategies that reduce overcrowding or that serve to decongest the lake area. It is necessary to be able to promote the lake as a tourist and sports destination, while at the same time alternative spaces and centres of interest need to be created that allow visitors to move to other areas of the city (historic centre, areas of the lake with a lower degree of protection which are less visited, etc).
- Study the possibility of incorporating a space control and surveillance team, with sanctioning powers, at least in the months of greatest frequency, and/or at weekends, which will allow strengthening the tasks of information and environmental education which are already planned, or which are already carried out in the lake.

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https://greentour-project.eu/

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Section 2

Regenera Water Sports Pilot Site SWOT Analysis

Pilot Site	ESTANY DE BANYOLES
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Grant Acronym	REGENERA WATER SPORT
Full name	REGENERA WATER SPORT 'Sustainable and Regenerative management of physical activity and practice of sport in water-areas and surrounds'
Work Package	2
Deliverable	2.2. Vulnerability Assessment and SWOT Analysis
Submission Month	M10

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Abstract

A SWOT analysis is a tool used to evaluate the Strengths, Weaknesses, Opportunities, and Threats related to the natural environment and biodiversity.

Strengths (Internal Positive Factors):

- Resilient biodiversity
- Protected areas
- Community engagement
- Research and knowledge
- Supportive policies and legislation

Weaknesses (Internal Negative Factors):

- Habitat fragmentation
- Pollution
- Invasive species
- Limited funding
- Lack of public awareness

Opportunities (External Positive Factors):

- Ecotourism
- Technological advances
- Global conservation initiatives
- Environmental education
- Restoration projects

Threats (External Negative Factors):

- Climate change
- Urbanisation
- Overexploitation of resources
- Increasing pollution
- Potential policy changes weakening environmental protections

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Pilot site analysis

Strengths	*Weaknesses*
There is public awareness: the lake is an identity space, loved by the local population, and there is a certain desire for conservation.	It requires significant resources to develop mitigation plans and maintenance responses.
A unique and emblematic space in Europe.	Technical ignorance of the specific impact of each of the sporting and cultural activities carried out there.
There are different entities that operate in the space: Banyoles and Porqueres Councils, Consorci de l'Estany, supra-municipal administrations such as the County Council, and the Deputation of Girona, service companies and environmental organizations (Limnos, Escola de Natura de l'Estany, etc.). These entities have specialized human and technical resources that can form part of a multidisciplinary team (biologists, environmentalists, teachers, etc.)	Lack of coordination between departments of the same body (for example: sports and environment) or between the different entities in the space, which makes their management difficult and detrimental.
	Operational complexity with multidisciplinary teams and strategies that can be different (tourism, economic activity, conservation, etc.)
The space is Xarxa Natura 2000 and is regulated to ensure the conservation of natural spaces.	Potential for water pollution resulting from its use both for water sports (fuel, rubbish) and by visitors (sunscreens/rubbish)
The zoning of the lake makes it possible to make human activity more flexible by reducing the impact on biodiversity.	Human traffic leading to habitat degradation by walkers
Other cities have similar problems; you can learn from the actions they have taken and possible success stories	Throughout the year, many activities are carried out in the lake and its surroundings, which can damage and put at risk the conservation of biodiversity.

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Maintenance actions are carried out in the area with a conservationist vision, which favours biodiversity.	Erosion of the coastline is inevitable in some areas, due to trampling and use for sports activities, as well as the arrival of certain invasive species that can accelerate the erosion process.
Some of the species present in the lake are monitored and projects of European scope are carried out to promote conservation (Life Estany, Life Potamofauna, etc...)	No specific studies have been carried out on the frequency of people. The carrying capacity of the natural space has not been established, both for visitors and for each of the sporting activities and sporting events that take place there.
A highly aesthetic area and tourist attraction.	Lack of local participation in environmental issues
There is some community commitment to conservation projects, and the population's environmental awareness is improving.	There is not enough control and there are no penalties for bad practices or inappropriate use.
A space of singular biodiversity of habitats, which means that there is a high richness of species of flora and fauna, both aquatic and terrestrial.	Presence of invasive species of flora or fauna, which put biodiversity at risk. Numerous invasive species present in the space (common cat, coypu, American mink, exotic turtles, fish introduced into the lake, flora from gardening, etc.
Its karst origin makes it a unique place to visit in the geological area of the Peninsula	Bad practices and incivility that lead to the increasing presence of litter.
Existence of specific regulations and/or strategic documents that facilitate the management of the space: regulation activities, the special plan, the POUMs of Banyoles and Porqueres, the Areas of Natural Interest Plan, the Nature strategy, the Habitats Directive, etc.	Some activities and uses of dubious compatibility with current regulations and/or the use plan, or at least with biodiversity conservation strategies, are being allowed.
A space with the ability to promote educational values of awareness and responsibility, through volunteering,	Very compromised ecological connectivity between the different spaces (urban areas and roads that fragment the space)

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outreach campaigns, etc	

Opportunities	***Threats***
New water sports practices are being developed that are increasingly sustainable and respectful of the environment.	Some sporting practices may continue to directly affect natural ecosystems, habitats and water quality, mainly those linked to motor use.
European multidisciplinary scientific, social and teaching teams are willing to work together.	There are difficulties in integrating and consolidating the staff of multidisciplinary teams and assuming the cost of hiring appropriate disciplines in certain projects.
New innovative projects such as the Banyoles Next Destination improve infrastructure, enhance the Lake's appeal and increase the sustainability of its use by visitors.	Long-term ecological damage if conservation management plans are not implemented. It will increase the stress on wildlife if the space is not managed properly.
More and more versatile sustainable infrastructures are projected.	Lack of local business/community support. Sectoral resistance to getting involved in environmental problems.
The diversity of habitats, their exceptional quality and the historical heritage of the area make it possible to work on new learning situations for all levels in educational centres in different geographical areas.	Climate change can cause variations in the current environmental conditions, which put conservation at risk due to the lack of rain, the increase in temperature and evaporation of the water mass.
Good location to connect very diverse areas in a small area and to be able to access them from different points.	The overcrowding of the area, mainly in the summer season, can cause various damages and inconveniences to the ecosystem and to the different species,

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	such as soil compaction and alterations in the behaviour of nesting species.
The space has the capacity to generate its own resources that can be dedicated to projects with conservation objectives.	Decrease in water quality that would affect humans, flora and fauna.
The ODS can be worked on in different areas such as 3 (Health and Welfare), 4 (Quality Education), 6 (Clean Water and Sanitation), 9 (Industry, Innovation and Infrastructure), 10 (Reduction of inequalities), 11 (Sustainable Cities and Communities), 12 (Responsible Production and Consumption), 13 (Climate Action), 14 (Undersea Life), 15 (Terrestrial Ecosystems).	Unexpected changes can happen on a global scale that can affect space (wars, pandemics, etc.) and put the conservation of the lake ecosystem at risk.
There are different citizen science projects that allow the collection of information linked to nature (flora, fauna, invasive species, attacks on the environment, etc.) and that, in the long run, will make it possible to expand the knowledge of protected natural spaces.	Nearby cities suffer from mass tourism and gentrification, for example, Girona, receives every year an increasing number of tourists linked to the cycle tourism and cycling sports sector, a model that can easily spread towards the Banyoles lake.
It participates in different European projects that make it possible to learn about similar realities and possible measures to improve the sustainability of space.	Potential conflicts between conservation activities and recreational or sporting activities.
Invader control projects are carried out in other bodies of water in Catalonia and Europe, which can be examples of good practice for the Banyoles lake.	The future of protected species, due to environmental changes, pollution and anthropogenic pressure, is no longer assured. Possible loss of plants and animals vulnerable to environmental changes.
Society is minimally organized and aware. There are environmental activism and	Political changes towards radical options can lead to a risk of wildlife conservation

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climate emergency organizations.	(policies in favour of fishing, hunting or excessive forest exploitation)
The CNB has recently published an APP aimed at rowing users, which, among other things, promotes good practices towards the natural environment and environmental awareness.	Lack of awareness and knowledge of the population about the impact of their actions, such as, for example, feeding the ducks, a very common activity in the lake.
Innovative projects are proposed in the lake that can serve as references for other communities.	Many sporting events do not have a part of raising awareness towards volunteers, participants, companions... about the natural environment where this activity takes place, its fragility and the importance of taking care of it.

https://turisme.banyoles.cat/ca-es/agenda/month/06/year/2024

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