



Layman's report

Integrated management of three constructed wetlands in compliance with Water Framework, Birds and Habitats Directives

LIFE12 ENV/ES/000685

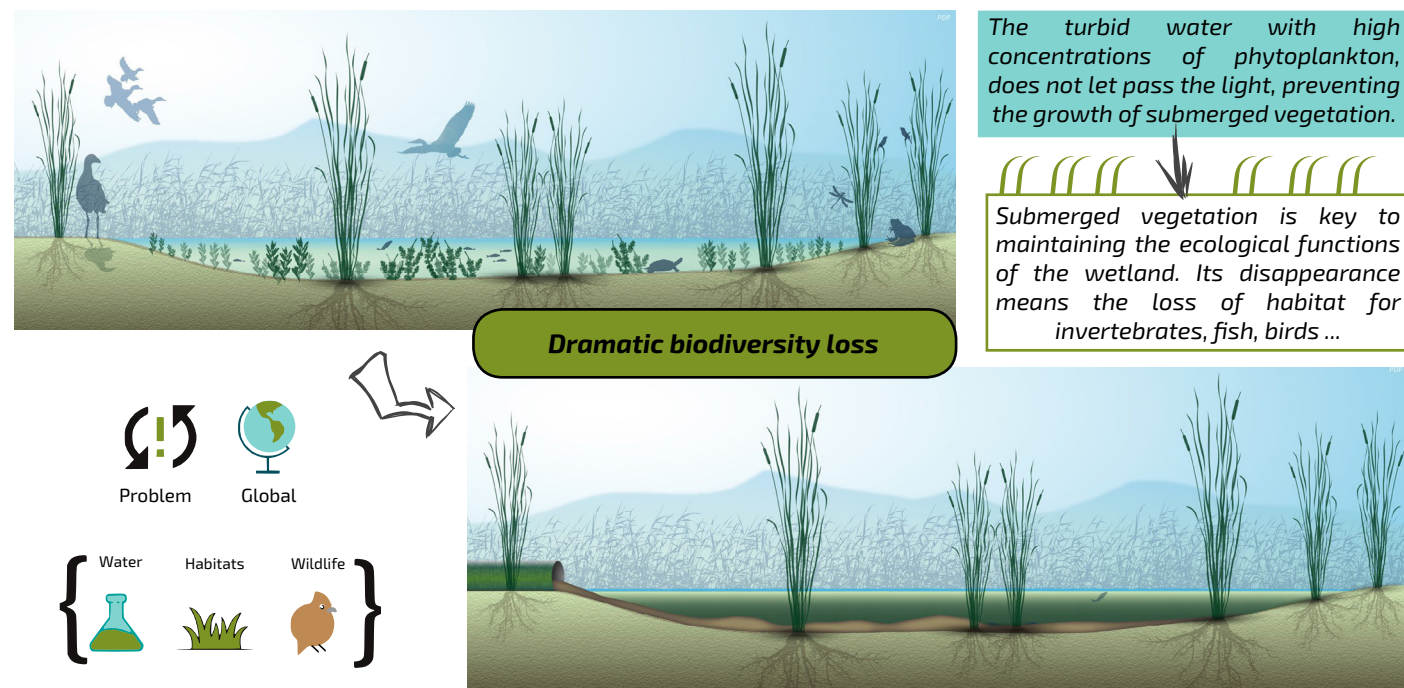


THE PROBLEM

Water quality is important, if the quality is low habitats and biodiversity are degraded.

«**Eutrophication**»: the enrichment of water by nutrients, especially compounds of nitrogen and/or phosphorus, causing an accelerated growth of algae and higher forms of plant life to produce an undesirable disturbance to the balance of organisms present in the water and to the quality of the water concerned.

Directive 91/271/CEE



L'ALBUFERA DE VALENCIA

L'Albufera is one of the most important protected natural spaces in Spain.

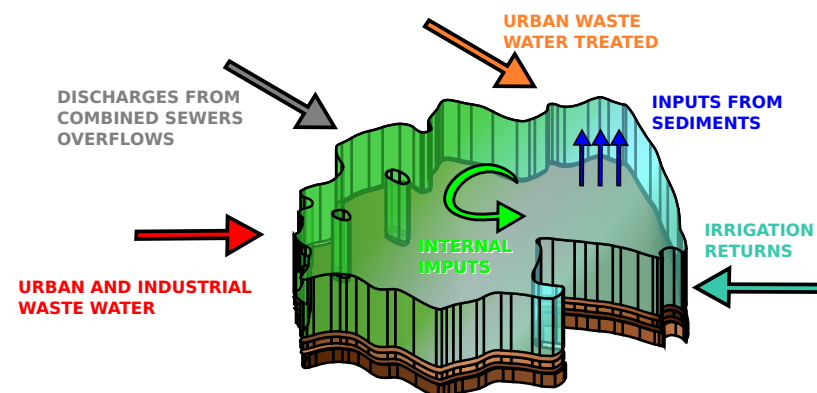


Today L'Albufera is considered hipereutrophic, for its high nutrient concentrations and phytoplankton, being far of achieving the good ecological potential. Nevertheless, L'Albufera of Valencia is one of the most important wetlands in the Mediterranean, and the third of the Iberian Peninsula. In fact, it is declared **Natural Park** (1986); it is a **Special Protection Area for Birds (SPA)** and **Site of Community Interest (SCI)**, being part of the **Natura 2000** -the network of natural areas most important in the European Union-, thanks to the great diversity of birds and habitats present.

What is the cause of this change in water quality?

Programme of measures:

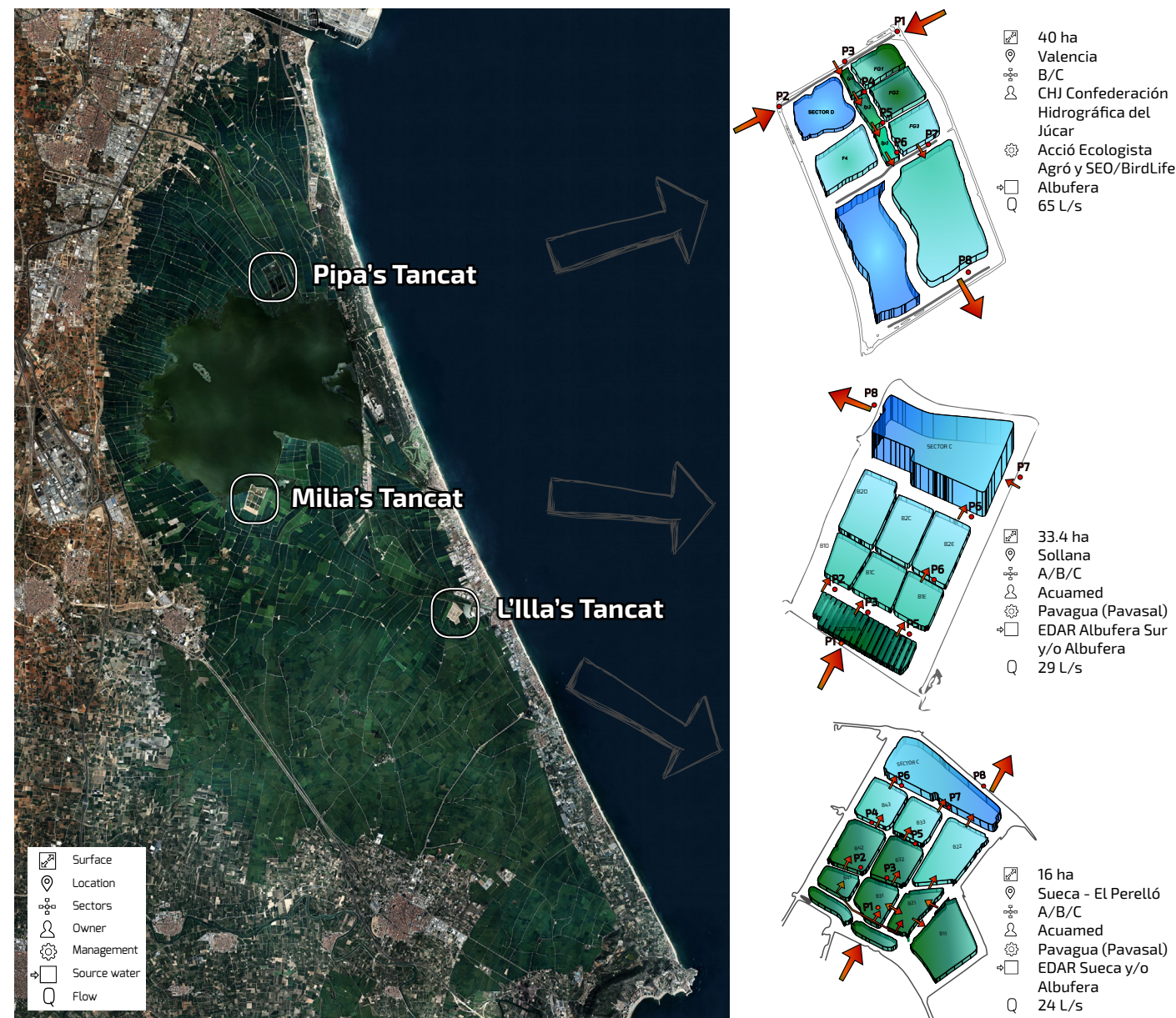
- Control of external loads (construction of waste water treatment plants, enlargement of sanitation systems, etc.).
- Control of internal loads: water treatment by constructed wetlands. These constructed wetlands serve several functions: improving water quality, restoring lost habitats in the Natural Park and enhancing biodiversity; as well as providing space for public use.



TANCATS

Tancat word comes from the Valencian language and means a closed or isolated from the rest area.

«**Tancat**»: is an area of cultivation, in this case rice, enclosed by a perimeter speck and has a motor for extraction and / or water input.



OBJECTIVES OF THE PROJECT

Its main objective is to contribute to sustainable development in the environment and climate.

- Establishing the most adequate management rules in artificial wetlands in order to jointly optimize water quality and habitat and biodiversity improvement, according to the implementation of the Water, Habitats and Bird Directives.
- Proving that the joint management of the three artificial wetlands contributes to improve water quality and biodiversity in the Albufera.
- Establishing a methodology to determine good status indicators for bird conservation to apply in other Natura 2000 wetlands.
- Providing recommendations addressed to the competent administrations to set a basis in the development of management plans for Natura 2000 areas and hydrological management plans.



LIFE ALBUFERA PROJECT

LIFE + cofinances projects for environmental protection in the European Union.

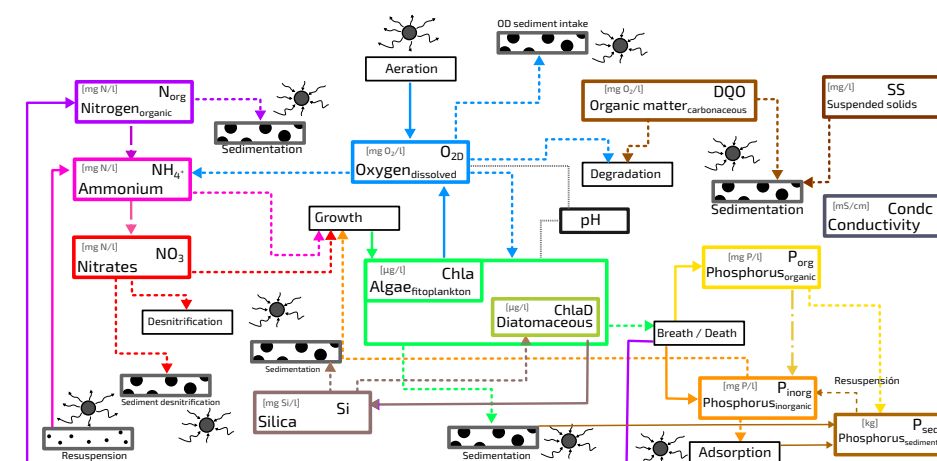
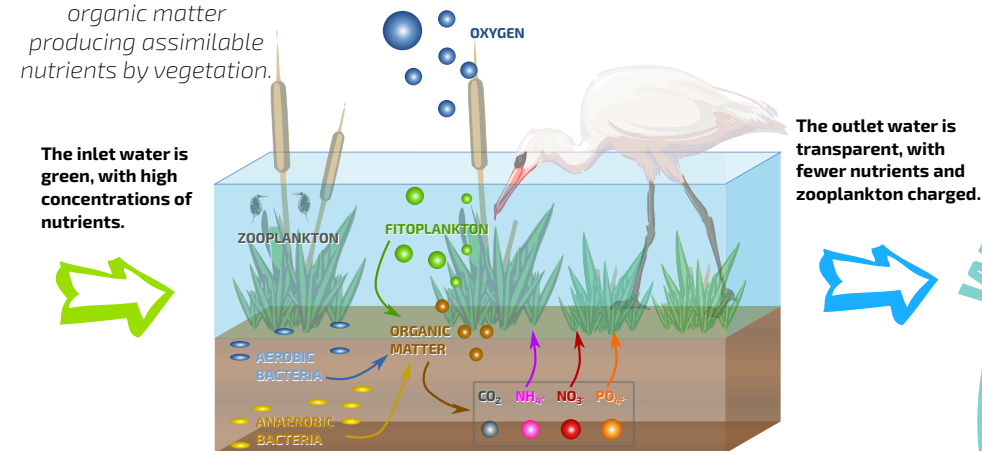
The **LIFE program** is the only financial instrument of the European Union dedicated to the environment. Its overall objective for the period 2004-2020 is to contribute to sustainable development and the achievement of the objectives and goals of the Europe 2020 and relevant strategies and plans of the Union's **environment and climate**.

WATER

Water quality improves as it flows through artificial wetlands. A good coverage of helophyte vegetation is key to further reduce the content of phytoplankton. The right conditions for the development of zooplankton are created. These organisms, formed in part by filter feeders, help to reduce phytoplankton.

The bacteria degrade organic matter producing assimilable nutrients by vegetation.

TOWARDS THE GOOD STATUS OF WATER



Material balances allow us to mathematically model the water quality variables and their interrelationships.

HABITATS

Recovery of lacustrine habitats, improving coverage of marshy vegetation and submerged macrophytes. Submerged aquatic vegetation fulfills important functions:

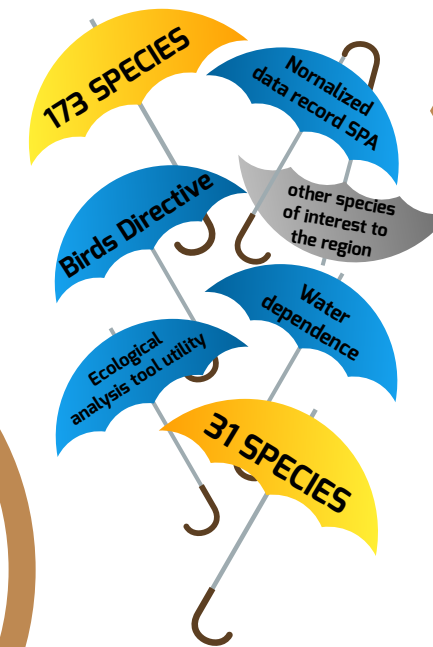
- To grow, it uses the nutrients from the water and release oxygen, so they are natural water treatment plants. It dampens the waves, reducing resuspension of sediment and bank erosion.
- It is the refuge for zooplankton and the place where aquatic invertebrates lay their eggs.
- It provides shelter for small native fish like fartet, samaruc, goby and loach (while they feed on small invertebrates and microscopic algae) and serve as a refuge from predators.
- It is the place where herbivorous waterbirds feed, as red-crested pochards or common coots, and other species that feed on fish, such as grebes and terns, also serving for these species as a place to build the nest.
- Represent the environment in which many waterbirds broods feed, whose diet consists mainly of aquatic insects.

BIRDS

Birds Directive represents the framework for the conservation and protection of birds in Europe, and allows you to set conservation objectives: an SPA is considered in a favorable conservation status as long as the conservation status of its typical species is favorable. In addition, the ecological requirements of some species allow working with them and identifying their role as an indicator of parameters that define the good status of one habitat. This aspect enables the definition of a framework to improve the conservation status of birds and serves as an example of complementarity between Birds Directive and Water Framework Directive (WFD):

Objective: improvement of the conservation status of **Albufera SPA**.

IN WHAT SPECIES WE FOCUS?

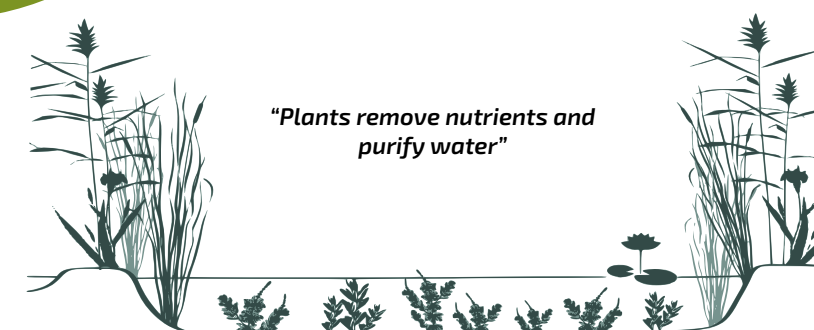


The species selected are the most representative of all birds indicator parameters related to the condition of the lake. Therefore, improving their conservation status involves improving the conservation status of other species sharing requirements

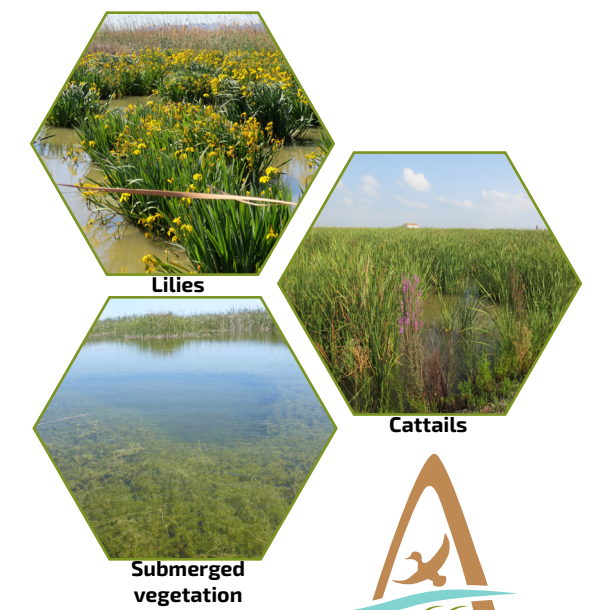
TOWARDS THE FAVOURABLE CONSERVATION STATUS

The helophyte vegetation:

- Reduces solar radiation, limiting the growth of phytoplankton.
- Promotes sedimentation and reduces resuspension.
- Absorb nutrients and produce oxygen.
- It is habitat for food, shelter and nesting areas.



- Determine the species of waterbirds indicator of good quality and among these, the most representative of the group to estimate the favorable conservation status in the SPA.
- Determine their relationships with water quality indicators for the classification of ecological potential according to the WFD.
- Determine favorable reference values (FRV) of the favorable conservation status for each species, based on the sizes of the populations of the species selected as representative.



HOW WE DO IT?

The following shows the steps we have taken.

1. Definition of a management strategy of water and vegetation in three constructed wetlands.
2. Monitoring the impact of this management on water, biodiversity and habitats.
3. Development of an indicators system based on avifauna and mathematical modeling of water quality, as tools for the management of these spaces.
4. Development of planning tools involving the basis of management plans for l'Albufera SPA and can be extrapolated to other areas of the Natura 2000 network.

WATER

METHODOLOGY



In the management strategy, hydraulic operation parameters for the different sectors of the constructed wetlands are defined.

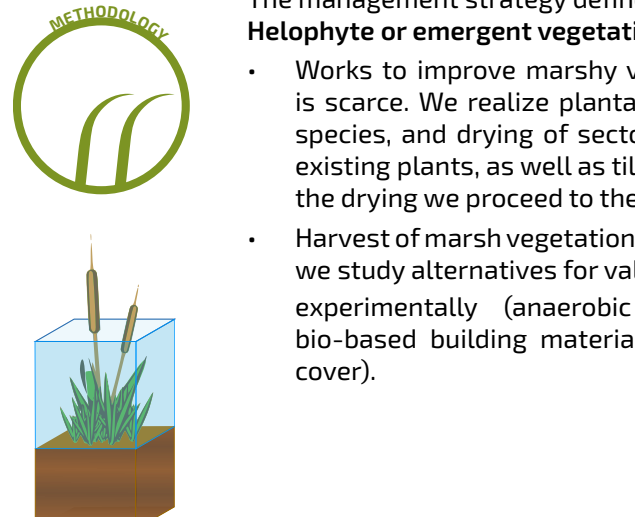
- Superficial hydraulic loading rate: volume of water treated per unit area and time.
- Depth: depth of the water column in the cells of artificial wetland.
- HRT: hydraulic retention time, is conditioned by the previous two and the surface of the cell.

Then we proceed to monitor water quality and sediment:

- Hydromorphological elements: morphology, hydrological regime.
- Chemical and physico-chemical elements: organic matter, nutrients (nitrogen, phosphorus), turbidity, etc.
- Biological elements: phytoplankton, zooplankton, benthic macroinvertebrate fauna, fish fauna.

VEGETATION

METHODOLOGY



The management strategy defines different activities, making a distinction between:

Helophyte or emergent vegetation:

- Works to improve marshy vegetation coverage in those sectors of surface flow where it is scarce. We realize plantations, testing different frames of planting and different plant species, and drying of sectors to promote the growth of plantations and colonization by existing plants, as well as tillage of soils to encourage germination of the seed bank. During the drying we proceed to the removal of exotic fish.
- Harvest of marsh vegetation in those areas where the vegetation is very dense. Once mowed, we study alternatives for valorizing the harvested biomass. Some of them are implemented experimentally (anaerobic digestion, bio-based building materials, and soil cover).

BIRDS

METHODOLOGY



Tracking avifauna:

- Censuses plots to determine the habitat use.
- Tracking the productivity of breeding pairs.
- Monitoring the survival of juveniles.
- Listening stations points.
- Network of sampling stations through scientific ringing.
- Study passerine territories of interest by radio transmitters.

Additional key factors:

- Submerged vegetation coverage.
- Coverage and emergent vegetation composition.
- Community structure of fish fauna.

Demographic parameters of interest.
Use of habitat.
Trophic and spatial relationships between species.

Information parameters according interest of DMA:

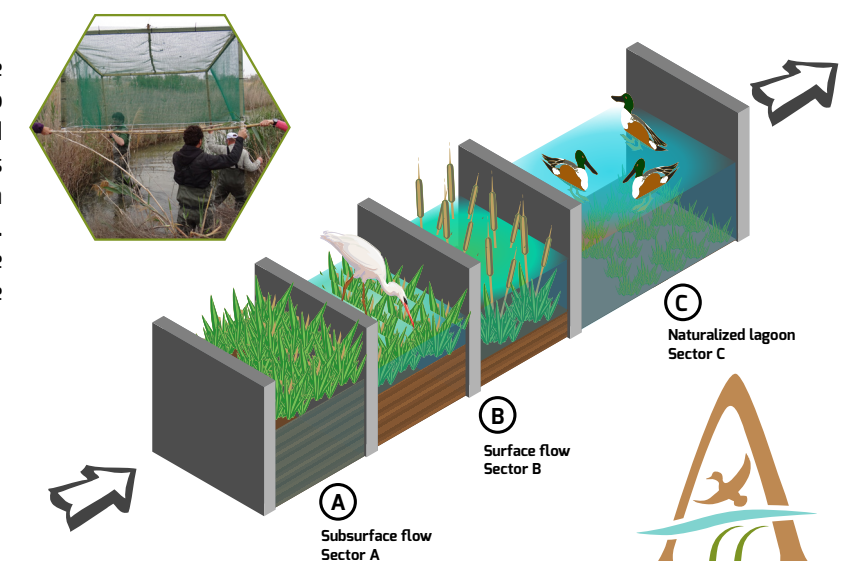
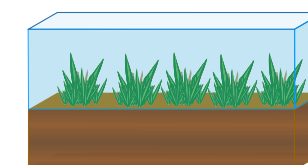
- Hydromorphological.
- Physiochemical.
- Biological: community of phytoplankton, zooplankton and aquatic macroinvertebrates.

Assessment of the conservation status of species and their habitats, and the SPA status.

Ecological requirements for management guidelines to incorporate in the management plan of SPA / SCA and Basin Plan.

Submerged vegetation:

Activities to recover its coverage. We installed protective enclosures (2x2 m), to protect macrophytes from predation, and placed inside cuttings of various species donated by the Center for conservation of freshwater species (Valencian Region). When enclosures are fully colonized, we proceed to its enlargement to drive the spread of this vegetation.



RESULTS - WATER

What have we learned?



It has been shown that in the range of the hydraulic loading rates (HLR) tested (0005-0150 m³/m²/d), the improvement of quality of water in their physicochemical and planktonic aspects is evident.



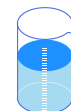
Input (green glass, left of photo):

- Chlorophyll *a* (Chl *a*) = 80 µg/L
- Suspended solids (TSS) = 46 mg/L
- Total phosphorus (TP) = 0.27 mg/L
- Total nitrogen (TN) = 3.8 mg/L



Output (transparent glass, right of photo):

- Chlorophyll *a* (Chl *a*) = 27 µg/L
- Suspended solids (TSS) = 32 mg/L
- Total phosphorus (TP) = 0.15 mg/L
- Total nitrogen (TN) = 1.7 mg/L

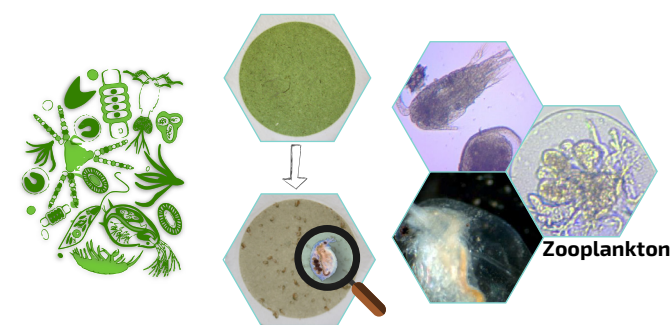
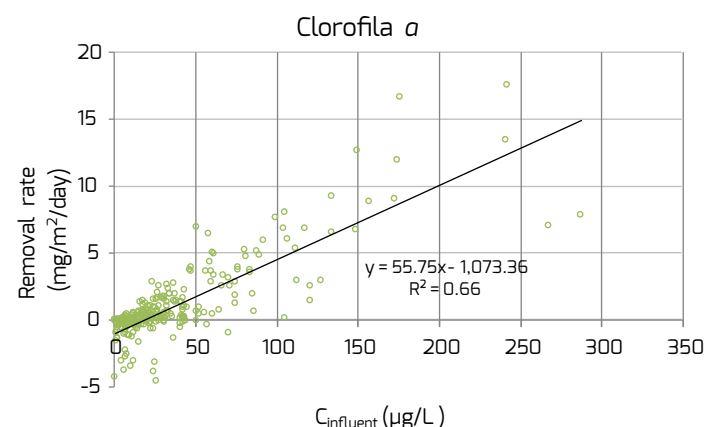


Focusing on specific variables:

- To reduce phytoplankton and water turbidity is convenient to work at HLR between 0.050 and 0.150 m³/m²/d, with yields around 75% in the cells of constructed wetlands that are either subsurface flow, or surface flow but with high vegetation coverage.
- If the objective is to reduce nitrogen, the yield is greater at lower HLR (<0,025 m³/m²/d). However, if one wants to remove large amount of nitrogen mass it is desirable to increase the HLR, because although the yield is lower, when treating more water more nitrogen is removed.

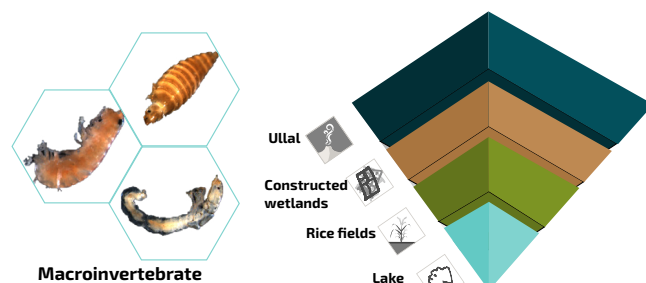
Subsurface flow sectors have very good results in all the variables studied, including the Chemical Oxygen Demand (COD). Surface flow sectors work efficiently removing suspended matter and nutrients, if they have high vegetation cover, but exported organic matter.

Among the parameters that influence the performance of artificial wetlands, the input concentration is the variable most influential. In all the variables analyzed, the higher concentration higher yields and pollutant removal rates are achieved.



Zooplankton

Zooplankton concentration increases as it passes through the constructed wetlands, especially in those more vegetated. In addition, the zooplankton organisms that more increase are big filter feeders, as the water flea (*Daphnia magna*). This result is highly positive since we are returning to the lake clear water and full of filter feeders that play an important role within the lake.



Macroinvertebrate

Quality indices of macroinvertebrates indicate that constructed wetlands have an environmental quality that could be below that of Ullal Baldoví but better than the lake or the rice fields.

All these results show the important role of vegetation, so we consider transcendental the work of vegetation management to maintain good vegetation cover. In this respect, the learning from the project has been fundamental.

RESULTS - BIRDS

What have we learned?



For those species linked directly or indirectly to the good water quality in this space, such as red-crested pochards, common coot or common pochard, with high FRV of the conservation status of population size, the constructed wetlands help to **increase productivity, initial survival, rate of recruitment of young birds to adult fraction of the population and act as refuge over the loss of habitat** in the vicinity of the lake, and especially draw lessons to apply to the rest of the SPA. These results contribute to the fulfillment of the objectives of the Water Framework Directive (WFD) and the Birds Directive.

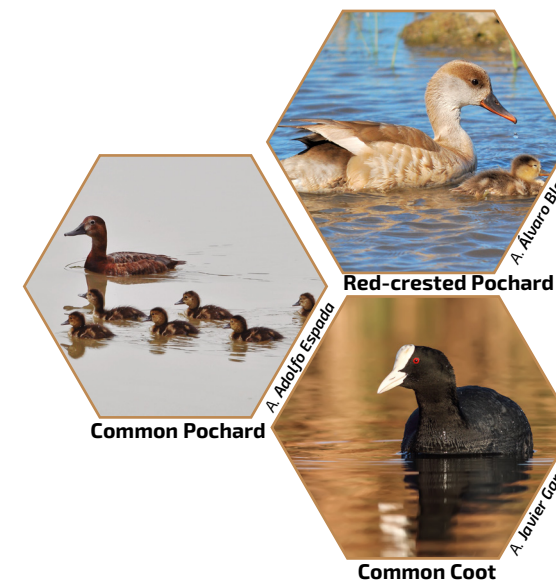
Given the reduced surface that the constructed wetlands occupy in the Albufera SPA, **by themselves do not allow to increase the population size** of these species enough to improve their conservation status.



Marbled Teal

Purple Heron

Eurasian Bittern



Red-crested Pochard

Common Pochard

Common Coot

In the case of rare species, along with other species that have colonized the SPA thanks to artificial wetlands, these spaces allow **increasing its range**, improving their conservation status simply by generating a new space to occupy.

The **WFD indicators alone** account for the state or habitat conditions but do **not necessarily provide information about the "suitability or true condition" for waterbirds**. The definition of indicators based on waterbirds and methodology of conservation status, along with the WFD indicators, allows an overall assessment of the **actual state of conservation of the spaces** in compliance with the Birds Directive, Habitats Directive and WFD in the Basin Plan and the Albufera SPA plan management.



Towards good ecological potential and favorable conservation status.



Common Kingfisher

Bearded Parrotbill

Black-winged Stilts

Grey Heron

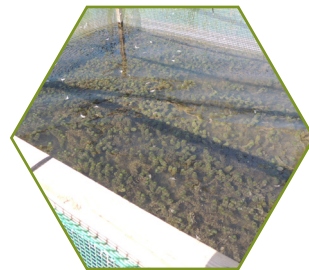


RESULTS - VEGETATION

What have we learned?



Green building



Fence



Planting

HELOPHYTE VEGETATION

- **Plantations.** Monoculture had higher survival, especially yellow lily, which has shown a high resistance to predation. Although other plant species have had a lower survival and / or slower growth, it is considered important to bet on creating systems with plant diversity. In this sense, the reeds and rushes, the swamp sawgrass and plants of the genus *Scirpus*, albeit more slowly, have developed successfully on some of the sectors in which they were planted.
- **Substrate treatment.** From the tests performed drying, puddling and tilling, it can be concluded that the most advantageous treatment is drying, with the following benefits:
 - Promote growth and colonization of some plant species.
 - Activate the existing seed bank in the sediment.
 - Aerate, mineralize and settle the sediment, which then exerts a lower oxygen demand and is less likely to be re-suspended.
 - Reduce herbivory by waterbirds.
- **Harvest.** Project experience indicates that the best time to run the mowing is the end of winter. The advantages have been demonstrated:
 - The role of vegetation as refuge for wildlife is preserved.
 - The mower machine performance is higher, because the tissues are dry and offer less resistance to cut than when they are green. Moreover, the weight of biomass removal is less, having a much lower humidity, which means less effort in the collection and transfer tasks.
 - If the depth of the cell is large (> 35 cm), it is desirable to mow cutting the stems at water surface or very few centimeters below it, to ensure prompt regrowth of vegetation.
- **Biomass management.** Once the plant biomass is harvested in constructed wetlands, it is necessary to apply a correct valorization of this product. In the project we have tested the following: biogas production (in collaboration with LIFE Sostrice); use as green building material (with Econstrucció) and as soil cover on the access roads to the cells of the constructed wetlands to stop the colonization of unwanted vegetation; with very positive results in all three cases.



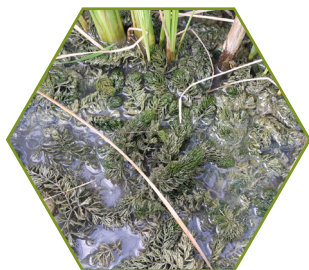
Fences



Anaerobic digester



Fishing



Vegetation submerged

Thanks to municipal nurseries Devesa-Albufera (Valencia City Council) service and Center for the conservation of freshwater species of Valencia (GVA) for the donation of more than 30,000 seedlings, as well as technical advice received.



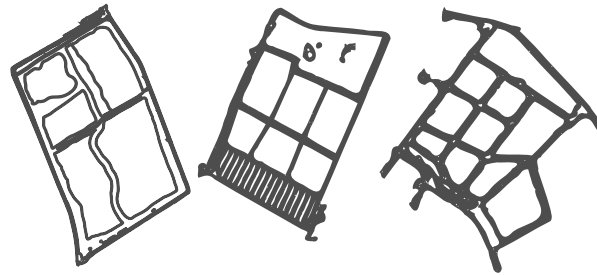
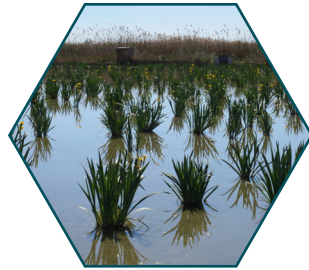
SUBMERGED VEGETATION

The work carried out for the recovery of submerged vegetation coverage has been very enriching. Planting in protective enclosures -4 m²- medium sized and subsequent scaling up to 30 m²- has been a very effective technique, but also laborious. Among the factors that determine the viability of the plantations are the water transparency -greater success with more transparent water- and a very careful maintenance of protective fences to minimize the entry of predators (fish and birds). The more successful species have been *Myriophyllum spicatum*, *Ceratophyllum demersum*, *Potamogeton pectinatus* and *Zannichelia peltata*, reaching 100% colonization of the protected surface. It has been proven a direct link between the treatment of substrate (dried) and the withdrawal of fish with vegetation growth, both within the enclosures as spontaneous.

Towards good ecological potential and favorable conservation status.

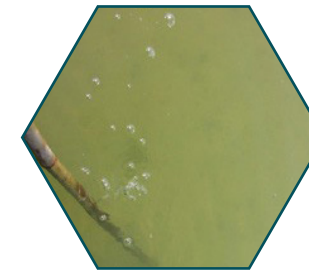
GLOBAL RECOMMENDATIONS

Towards good ecological potential and the favorable conservation status of habitats and birds.

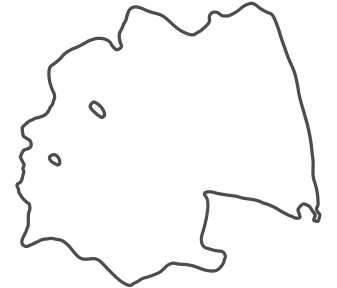


Management recommendations in the constructed wetlands:

- Operating at hydraulic loading rates between 0.05 and 0.15 m³/m²/d, from the lake and/or irrigation ditches. Working in the high range maximizes nutrient removal and favors the presence of species of interest, such as red-crested pochard and coots.
- Increase the number of gates in the cells with a single gate, to improve flow distribution and dampen oscillations of level associated with sudden changes in flow.
- Promote the diversity of depths to favor species with different requirements, always keeping some cells with 20-30 cm, and others with 30-50 cm in which the herbivorous pressure by purple swamphen is reduced.
- Establishing zones with different degrees of helphyte vegetation cover improves water quality and favors species of interest; increasing the border of vegetation in the lagoons favors red-crested pochard and common coots.
- Increase the coverage of submerged macrophytes, because of its importance for species linked to water quality.
- Install systems for excluding ichthyofauna of large sizes.
- To keep water monitoring programs, habitats and birds, to assess the achievement of the objectives of improving the conservation status and generate early warnings of threats.
- Continue with the model of participatory management, with the participation of universities, NGOs, governments and local actors.
- Carry on the opening of constructed wetlands to the public through communication activities and public use.



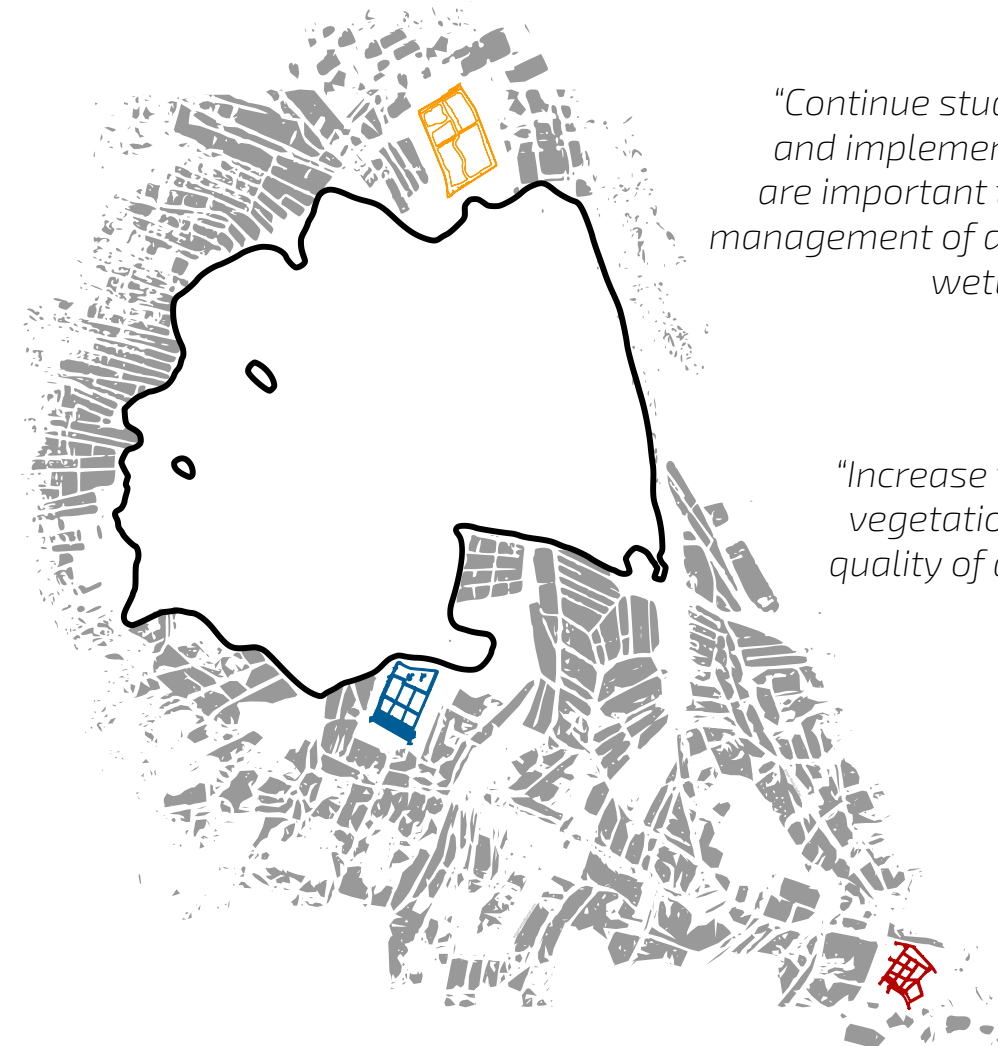
Western swamphen



Recommendations for improving the conservation status of L'Albufera:

- Increase the area of marshy vegetation on the border of the lake, for example by creating new artificial wetlands, providing surfaces both with emergent vegetation (surface flow constructed wetlands with a variety of depths) and with dry substrate associated formations (e.g. by creating islands, *alterons* or subsurface flow constructed wetlands). It is estimated that an area of about 200 hectares could provide significant improvements in the status of the lake.

This undoubtedly would improve the quality of a greater volume of water, the initial productivity of the birds, their survival rate and recruitment of youth to adult fraction, while reducing intraspecific competition and predation rate among species .
- Create specific feeding areas for herons and purple swamphen in the channels of the constructed wetlands, thus improving their conservation status and reducing the pressure on other elements of the constructed wetlands.
- Establish indicators of management objectives and maintain monitoring systems to assess the achievement of management objectives.
- Generate a coordination committee among the reserve areas of L'Albufera, favoring the integration of management objectives defined in the constructed wetlands for compliance with the environmental objectives of the Natura 2000 network and the Water Framework Directive in L'Albufera.



"Continue studying, analyzing and implementing the results are important tasks for optimal management of artificial constructed wetlands."

"Increase the area of marshy vegetation will improve the quality of a greater volume of water."

COMMUNICATION

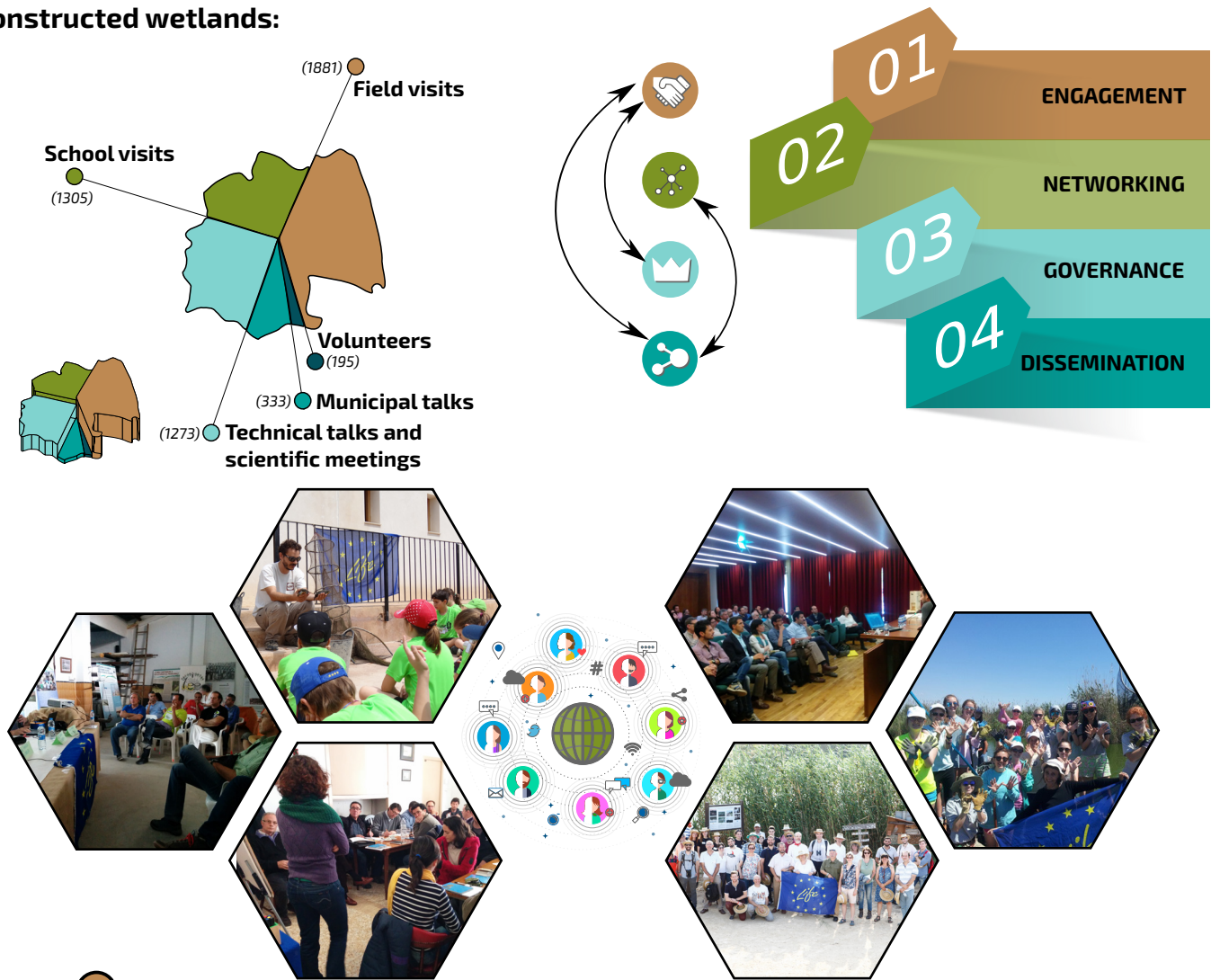
The media where the project has been present.

In the **Participation Plan** we have made field visits, personal interviews and sectoral meetings with representatives of the various competent authorities, the agricultural sector, tourism, fishing, hunting, green building, cultural associations and universities.

The aim has been to improve communication channels, collect their perceptions and proposals and effectively communicate the work done in artificial wetlands. Throughout the process we have detected negative perceptions about the impacts of birds in rice production, on regulations of public use and accesses, lack of communication, but we have also received positive assessments related to boosting tourism in these places, their educational role and its role in promoting biodiversity. We have carried out several activities together with the participation of municipalities.

The proposals received will be integrated into management protocols applied to the constructed wetlands, and also in the proposals of the LIFE + Albufera to the competent authorities for the design of water management and Natura 2000 plans. The territorial integration of the constructed wetlands has been improved, and a consolidation of the participatory management model has been achieved, thus improving governance in the management of l'Albufera.

Data of visits to the constructed wetlands:



Followers

@LIFEALBUFERA > 500

/lifealbufera > 1600

¡Join us!

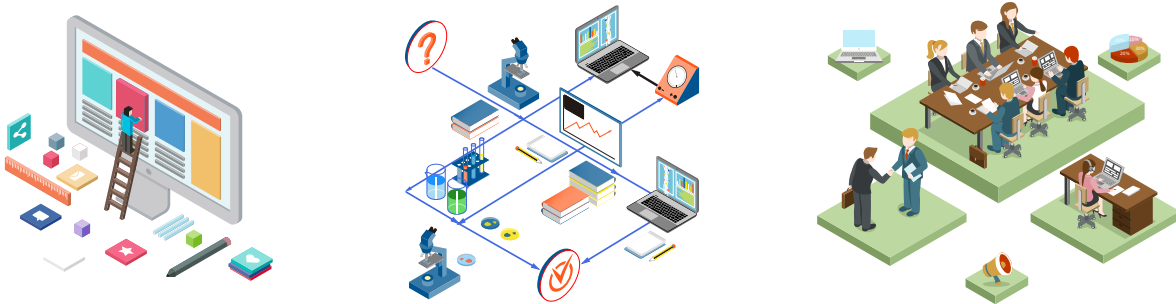
Talks of national and international experts available in:

Online seminar: <http://www.lifealbufera.org/index.php/es/seminario-online>

Closing Conference: <http://www.lifealbufera.org/index.php/es/clausura/videos/category/1>

UPCOMING ACTIVITIES...

The learnings of the project will be disseminated through activities that partners will continue to making, as the project presentation at an event organized by the LIFE Zaragoza Natural Project (Oct 2016) project at a conference in Nantes (Meeting of European Lowland Lakes' network, February 2017). A post-LIFE very important action is the dissemination and distribution of manuals published in the project, requesting support for authorities to organize these presentation events.



Team



Credits

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