MigratoEbre

for a river full of life

Guide to the exhibition

MIGRATOEBRE
LIFE13 NAT/ES/000237

Life

NATURA 2000

Guide to the exhibition

1 INTRO

The aim of the Life MigratoEbre project is to recover healthy and viable populations of the four species of migratory fish found in the final stretch of the Ebre River: l'anguila (eel), la saboga (shad), la llampresa (lamprey) and l'esturió (sturgeon). At the same time, it also endeavours to improve the connectivity of the Catalan stretch of the Ebre river by adapting and making the existing river barriers permeable to fish, including the Xerta-Tivenys weir, and Ascó and Flix dams. To meet the project objectives, a series of actions have been planned including the reintroduction of disappeared species, monitoring of fish stocks as a whole, improving habitats, building fish ladders and carrying out dissemination campaigns to raise awareness among the local population and obtain their involvement in the project through the creation of a volunteer network.

The survival in the Ebre of such emblematic species and valuable worldwide like the sturgeon or lamprey, two living fossils; the eel, a creature that reproduces across the Atlantic after a transoceanic journey, or the shad, undoubtedly the most popular fish in the Terres de l'Ebre for centuries, become projects for the future. In the framework of the recovery of the Ebre as a symbol of identity and environmental diversity in our territory, it depends on the current generation to maintain these four species in a new context geared towards a sustainable development model that has to preserve, as a strategic axis, a river full of life (natural, cultural, leisure...).

This travelling exhibition, with the dissemination and participation activities that accompany it, endeavours to contribute to publicizing and making possible this collective project that has the support of the European Union and the Government of the Generalitat of Catalonia.

2 PRESENTATION

The Ebre – The Great Iberian River

Satellite image of the Ebre basin. Source: NASA

Since five million years ago, the Ebre has been draining its basin, channelling water transport and dragging sediments from the headwaters and intermediate zones of the central depression to the sea, to the discharge and deposition area. Over the last 8,000 years, this area has been located, more or less, in the place where the current Delta is.

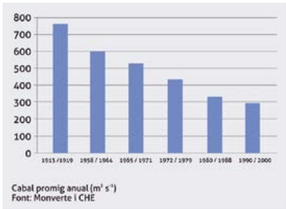
The Ebre has always been a river of a markedly Mediterranean nature with a quite irregular flow regime as regards both year-on-year variations and monthly oscillations. The seasonal water regime is characterized by low levels all summer, which are followed by autumn and spring floods due to torrential rains and thaws. The construction of reservoirs in the last century, 184 dams of which 55 are on the main river course, has produced not only the modification of the flow regime and a reduction of 25% in the frequency of the floods, but also changes in the morphology, the environment and the river communities.

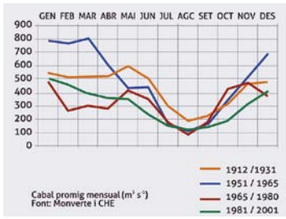
Nevertheless, the river brings together significant natural values, with well-preserved river bank forests, waters with relatively little contamination and the presence of plant and animals species of interest.

Sediment plume in the mouth of the Ebre. Source: J. Martin

Flow rate evolution

The annual average flow rate of the river has decreased by almost 50% in the last 100 years due to an increase in water use throughout the basin. The average annual volume has declined from 595 m^3/s (1913-1934 period) to 291 m^3/s (1980-2013). In addition, the situation could worsen further if the new Ebre Basin Plan was applied, which envisages an average volume of up to 107 m^3/s from Tortosa on, well below the ecological flow that scientistific organisms propose.





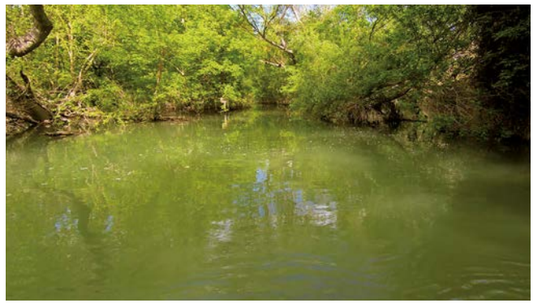
Sediment transport reduction

The progressive construction of reservoir dams in the basin throughout the 20th century caused a decrease of approximately 90% of the total solids load that reached the mouth, compared to the beginning of the last century. Thus, if in the 40s it was calculated that the Delta received 40 million tonnes, in 2004 the sediment delivery was only 3 million. This deficit negatively affects the stability of the delta plain, compromised by the phenomenon of subsidence by sediment compaction and the rise of sea levels.

The Fluvial Ecosystems

The fluvial habitat comprises two highly differentiated ecosystems. On the banks of the river, there are optimum conditions (water, soil fertility, and so on) to establish riverside forests. These forests are densly vegetated, comprising trees, shrubs and lianas, where deciduous species dominate, unusual in areas of Mediterranean climate outside a river setting.

The aquatic ecosystem of the river is formed by a set of quite rich and diverse environments, in which the communities that constitute it and the different species live each in ntheir own space, well adapted to the different habitats depending to parameters such as: depth, current velocity, type of substrate, and so on. Algae are the base of the primary food production chain, consumed by the zooplankton and by small grazing and filtering invertebrates. Some invertebrates adopt shredder strategies and take advantage of the organic matter entering the river (leaves, humus...), which falls into the water or is dragged there from nearby terrestrial ecosystems. They serve as food for the macroinvertebrates that are hidden amoungst vegetation, mud or stones and which, at the same time, are the basis of the diet of many vertebrates (amphibians, birds and fish).



Galatxo at Illa d'Audí. Source: P. Bertomeu

School of fish. Source: P. Bertomeu

The role of fish in the ecosystem

The vegetation, the macroinvertebrates and the bottom organic matter constitute the food source of the fish in the river. In this sense, the species exhibit a greater or lesser trophic specialization. From exclusively carnivorous predators such as sea bass, eel, catfish, american perch or pike; or other omnivorous species such as sturgeon, bearded carps, Iberian carps..., to planktophthalics (plankton filterers) such as shad; phytophthalics (vegetation) filterers such as chub; to detrivores (detritius waste feeders) like the mullet. All of them, through their mobility, reproductive capacity, and other characteristics, contribute to regulating the flows of matter and energy and the appearance of river ecosystems.

Ribera communities

The vegetation formations on the shore can help to cushion the impact of the river floods by absorbing floodwater, as they increase the roughness of the ground and limit the erosive power of the water. In addition, river bank forests improve the quality of water, fix sediments and take up nutrients and, at the same time, become a quite effective natural filter, favouring the ability of the river to self-purify itself. These environments also have a high landscape value and a high potential as areas of leisure or contact with the natural environment.

On the other hand, the valley and the river course, with flooded areas, reedbeds and trees that grow in the miriad of islands and river banks, make up a series of bio-bridge that facilitate the movement of a multitude of species, such as currently, as many wetlands birds use them to travel from the coastal wetlands to the basin interior.

Riparian woodland. Source: M. Cebolla

The Eel

Eels. Source: M. Cebolla

Sweetwater prawns and dragonfly larva. Source: P. Luque

Head of an eel. Source: M. Cebolla

The eel has an elongated and laterally compressed body, a characteristic feature that is accentuated towards the tail by the disposition of the dorsal, flow and anal fins, that are fused into a single one. The head, eyes and mouth are relatively small and the lower jaw is prominent. The scales are so tiny that they cannot be seen because they are embedded deep within the skin and covered by a mucus that gives it its slippery touch. The coloration varies depending on the biological state, so larvae and elvers are translucent and, when they mature, their pigmentation intensifies more, and at this point they are called eels. Immature adults exhibit a yellow belly and a dark green back, while the breading stock have an silver belly and an even darker back.

The eel carries out a catadrome migration, that is, it lives in continental waters and reproduces at sea. In continental waters, where they spend most of their lives, they exhibit benthic (bottom) and nocturnal (night) habits. Elvers enter the rivers from October to Spring, peaking in December and January. When they mature sexually, they migrate to the Sargasso Sea, in a long 6,000 km migration. Once they spawn, the adults die and the larvae are transported by the Gulf Stream, thus initiating a trip that can last from three to seven years, until returning to the very rivers from where their parents came from.

Food

Their food varies depending on their stage of development and the places where they live. Larvae feed on microplankton, but elvers lose their teeth in the larval phase and do not feed. Elvers and adult eels are omnivores and detrivores. In the fresh waters, they eat insects, crustaceans, molluscs and fish; whereas in brackish waters and the sea they prefer crustaceans and fish.

Big-scale sand smelt. Source: Wikimedia Commons

Distribution of eels in Europe. Source: Monverte

Current distribution of eels on the Iberian Peninsula. Source: Atlas y libro rojo de los peces continentales de España

Distribution

The European eel is distributed along the estuaries and rivers flowing along the North Atlantic, from Scandinavia to Morocco and the Canary Islands, and its extension area also includes the rivers of the North, Baltic, Cantabrian and Mediterranean seas, reaching the Black Sea.

Eel. Source: T. Llobet

Family: *Anguillidae*

Scientific name: *Anguilla anguilla*

Common name: eel

Local name: anguila borda, anguila vera, anguila, anguleta

Size: adult eels measure between 20 and 100 cm, but can reach 150 cm in length and 6 kg in weight.

The Sturgeon

Sturgeon. Source: Pixabay

The origin of the sturgeon dates from about 390 million years ago. Since then, they have hardly changed morphologically and are considered as authentic "living fossils". Sturgeons belong to a primitive group of fish called condrostis, characterized by having the internal skeleton essentially made of cartilage, only modestly ossified. They have an elongated body of pentagonal section and have five longitudinal rows of plates or bony shields. The mouth is deep, protractile and without teeth. The nose is elongated, conical and with four sensory whiskers that help them to find food.

They are an anhydrous migratory fish that spend most of their life in the sea, but enters the rivers to reproduce, from January to March when the rivers are in flood. In the sea, it is a demersal (living close to the floor of the sea or a lake) species and lives habitually near the coast at between 5 and 60 m depth. It has a high longevity with a highest recorded age of 100 years.

Distribution

Its distribution includes the Northeast of the Atlantic, the Mediterranean and the Black Sea. In the Iberian peninsula, it has penetrated the great rivers such as the Miño, the Douro, the Tajo, the Guadiana, the Guadalquivir and the Ebre. Currently, the only confirmed population left in the wild is in the French estuary of Gironde (from which specimens have been released in the Elba and Rhine rivers in Holland and Germany).

Previous and current (blue) distribution of sturgeon in Europe. Source: Monverte

Recent distribution of sturgeon on the Iberian Peninsula. Source: Atlas y libro rojo de los peces continentales de España

Sturgeon. Source: T. Llobet

Food

At sea, adult sturgeons feed on benthic (bottom) organisms such as molluscs, annelids (worms) and crustaceans, although occasionally they can include small fish in their diet. Adults stop feeding during reproductive migration. Juvenile individuals also eat insect larvae throughout their stay in rivers.

Head of a sturgeon. Source: CEMAGREF

Polychaete. Source: Animal Biodiversity Resource Centre

Family: *Accipenseridae*

Scientific name: *Acipenser sturio*

Common name: common sturgeon

Local name: esturió

Sizes: Can reach 6m in length and weigh 300 kg, although in the Iberian Peninsula the maximum known size captured is 250 kg.

The Sea Lamprey

The sea lamprey belongs to an ancient group of fish, the petromizontides, as old as the sturgeon (360 million years), characterized by having lost their jaws during their evolution. The elongated body is cylindrical in the front half and flattened in the rear part. They have two dorsal fins and a small caudal (tail) fin, a single nasal orifice and seven pairs of breathing holes, but the most prominent characteristic is the funnel shaped-mouth with numerous pointed teeth. The body does not have scales, but rather many skin glands.

It is an anadromous migrator fish (one that leaves the sea and ascends rivers), after being born in rivers, adults live at sea often at depths of 200 to 300m, although they have been captured at more than 4,000 m. The timing of the migratory ascent of rivers varies depending on latitude, flow and temperature, but usually begins in February, or before, and lasts until May and June. Spawning takes place between April and July, when the temperature of the water is greater than 15ºC. The larvae remain in the river environment for 4 to 5 years, before moving towards the sea. Its longevity varies from 9 to 11 years.

6 Lamprey parasitizing a Salmonidae. Source: Wikimedia Commons

Mouth of the lamprey. Source: Wikimedia Commons

Food

Larvae feed on microplankton and debris, while adults are hematophagous (feed on blood) and parasitic. While they parasite on other fish such as salmon, shad, mullet, cod, or even large species such as tuna or the pilgrim shark, they usually do not kill their host.

Lamprey. Source: Estación Hidrobioloxía Encoro do Con

Current distribution of lamprey in Europe. Source: Monverte

Current distribution of lamprey on the Iberian Peninsula. Source: Atlas y libro Rojo de los Peces Continentales de España

Distribution

It is to be found in the Atlantic along the European coast and the coasts of North America and penetrates into the Mediterranean as far as the Aegean Sea. Recently, molecular analyzes suggest that European and North American specimens are different species. Mediterranean populations, including in the Ebre, have diminished considerably in the last century and are at risk of disappearing.

Lamprey. Source: T. Llobet

Family: *Petromyzontidae*

Scientific name: *Petromyzon marinus*

Common name: Sea lamprey

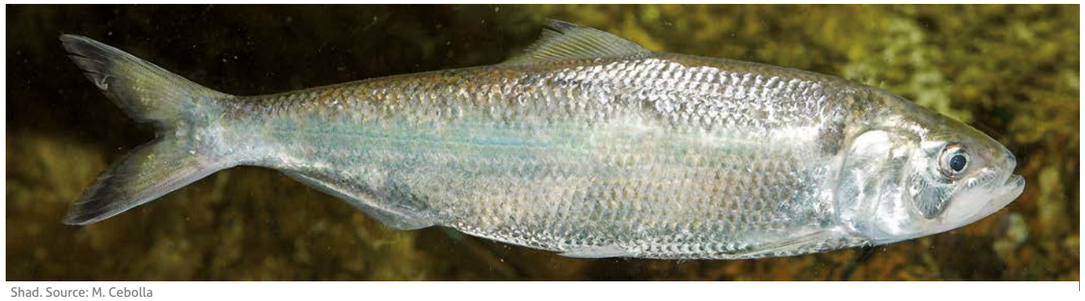
Nombre local: llampresa

Sizes: : medium-sized, usually between 60 and 75 cm in total length, although it can be as long as 150 cm and weigh more than 2 kg.

The Shad

The shad belong to the same family as other well-known fish such as sardines and are closely related to anchovies. The shad has a fusiform (tapered at both ends) shape and laterally compressed body, a head with large eyes and an operculum (gil cover) with radial stretch marks. The back is dark blue with silver sides and two elongated scales at the base of the caudal fin. It has a large dark blotch behind the operculum followed by 4 to 7 smaller blotches.

It is a gregarious species, which forms shoals. It is anadromous migrator fish, and spends most of the biological cycle in the open sea, in coastal areas close to the shore. During the spring it enters the low stretches and the mouths of the rivers to reproduce. It enters fluvial (river) speed of flow in April, where it spawns in May and June on gravel bottoms. It shows a relatively high fecundity (reproductive productivity) and after spawning, many adults die. The larvae grow up and feed in the river, and after a year, the juveniles return to the sea.



Shad. Source: M. Cebolla

Food

Juveniles feed on zooplankton while they live on the rivers; however adults broaden their diet by incorporating fish and crustaceans.

Head of a shad. Source: M. Cebolla

Plankton. Source: Wikimedia Commons

Distribution

The Atlantic distribution area goes from the northern coasts to Morocco, and also extends into the Mediterranean and the Black Sea. In the Iberian Peninsula, the populations of the Miño, Guadalquivir and Ebre rivers have historically been the most significant and, in Catalonia, it was also to be found in other rivers such as Llobregat or Fluvià. On the Atlantic and the Mediterranean coasts, there are two closely-related species belonging to the genus Alosa, the guerrilla or aixavó *(Alosa alosa - anchovy)* and the shad *(Alosa fallax)*. At present, however, only the shad maintains an established presence in the Ebre.

Distribution of shad in Europe. Source: Monverte

Current distribution of shad on the Iberian Peninsula. Source: Atlas y libro de los peces continentales de España

Family: *Clupeidae*

Scientific name: *Alosa fallax*

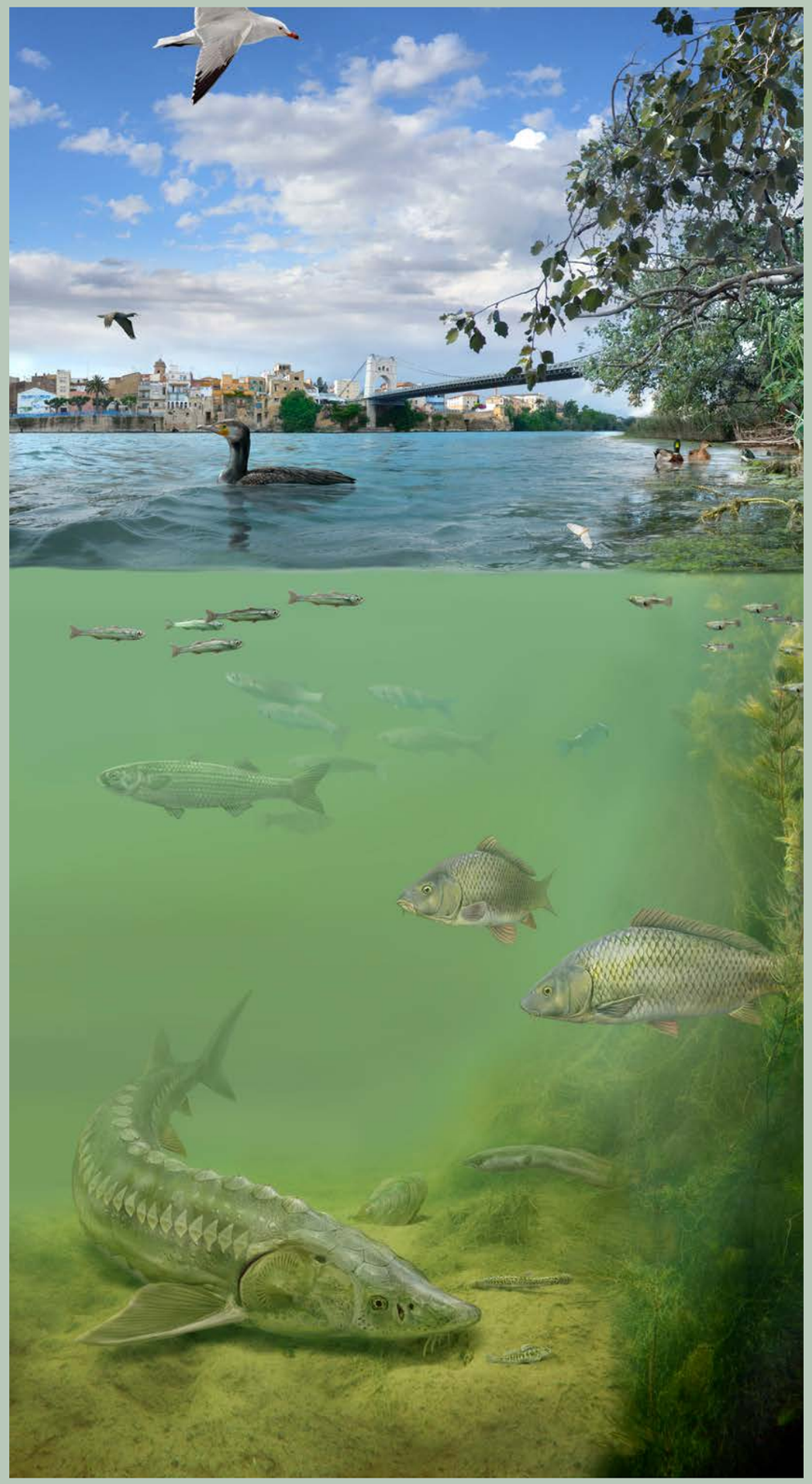
Common name: shad

Local name: saboga, peix de maig

Sizes: on average, it usually grows to between 25 and 40 cm and weighs 500g, although it can reach 60 cm in length and 3 kg in weight.

Shad. Source: T. Llobet

3 MOUTH-AMPOSTA STRETCH



26 Km Through The River Ebre Delta

Illa de Sapinya [Sapinya Island]. Source: P. Bertomeu

In the final section, on the 26 km stretch that runs from the Mediterranean and the river mouth up to the town of Amposta, the Ebre river runs through the middle of the delta plain. Here the channel has little gradient -at its exit from Amposta, it is only 2.5m above sea level- and due to the low water discharge volume, a lamina of fresh water forms that is counteracted by salty water that can even come up the estuary as far Amposta and beyond. This is how the sea due to its proximity has a clear influence on the river, altering the morphology, physicochemical composition and, even the fauna that lives there.

The Ebre, with its old mouths and bow lakes abandoned these days, does not have large meanders, and has a width ranging from 150 to 200m and an average depth of 6 m. The dominant substrate of the channel is formed by fine sediment, sand, sludge and lutite (extremely fine sediments) that are transported by the river and deposition is favoured by the slowing speed of flow, around 0.25 m/s.

Illa de Rius [Rius Island]. Source: Comunitat de Regants de la Dreta de l'Ebre

Migjorn and Illa de Buda [Buda Island]. Source: Comunitat de Regants de la Dreta de l'Ebre

Interconnected aquatic media

Beginning in the mid-nineteenth century, rice cultivation became extended and now occupies 60% of the delta plain. All the environments that are part of the Delta, the river itself, rice fields, coastal bow lakes, marshes, bays and the open sea are interconnected by the hydraulic system associated with rice cultivation. Thus, the network of channels and drains facilitates the movement of fish between all these environments.

Illa de Gràcia [Gràcia Island]. Source: P. Bertomeu

Islands and river banks

On the three islands in this part of the river, the ones called Gràcia, Sapinya and above all, the Buddha, is where the natural values of greatest interest are to be found. In the rest of the river's course, agricultural activity has significantly reduced the range of original riparian (land-river interface) vegetation, and reed and canes have invaded the river banks. Recently, the entire right river bank was subject to a reforestation plan that led to the planting of about 50,000 river shore trees.

The Estuary Habitat

Mouth of the Ebre. Source: P. Bertomeu

In the Delta, the current landscape is the product of agricultural colonization started in the mid-nineteenth century and not completed until a hundred years later. This change was produced by the construction of channels, by the filling and drying out of ponds, and by the building of irrigation systems to drain salt marshes previously occupied by salty ponds and sand bars. Despite being a process that allowed the preservation of valuable open spaces, the transformation was progressive and led to the disappearance of river ox-bow lakes and ponds, a change in the seasonal relationship between fresh and salt water, chemical pollution of rice fields, the concreting of the channels... in short, alterations that have caused a crisis for all aquatic fauna, except for birds.

In the final 30 km stretch, the Ebre behaves like an estuary, which is subjected to the intrusion of a sea water mass that we call a salt wedge. The extent of the wedge, which is weakly mixed with fresh water and tends to level out at flow rates below 400 m3/s, depends primarily on the river flow rate. Other factors include the sand bars at the mouth, as well as the morphology and the relief of the bottom, which also plays an significant role. We should note that the penetration limit of certain fish species of marine origin are conditioned, among other factors, by the extension of the salt water wedge.

Aerial view of the Ebre Delta. Source: P. Bertomeu

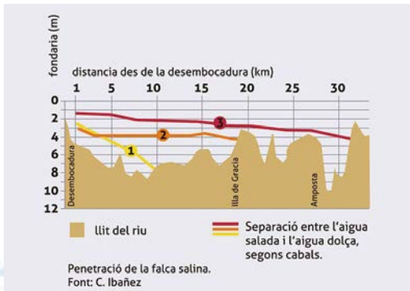
Salt wedge, eutrophication and anoxia

If the water flow rate does not exceed 100 m^3/s, the salt wedge goes up the Galera ravine mouth. The persistence of low flow rates during prolonged periods aggravates the problems of eutrophication proliferation. The increase of nutrients in the water also causes phytoplankton proliferation, which at the same time causes the increase of organic matter in the bottom sediment. This, together with the stratification and lack of water renewal, leads to situations of lack of oxygen that are harmful to the benthic communities. When anoxia persists, the river bottom life disappears.

The aquatic habitats mosaic

In the delta water medium, the mixture of water is not only the origin of the great diversity of habitats, but also the basis of high primary productivity. For fish, after the bays (a medium that the limnetic [well-lit, open surface waters away from the shore] species does not colonize, that is, those that properly belong to fresh water, due to their low osmoregulation capacity [the maintenance of constant osmotic pressure in the fluids of an organism by the control of water and salt concentrations]). Oxbow lakes are the most significant environment, followed by channels and marshes. In the physical diversity league, the river comes top, above the rice fields. This fact reinforces the importance of conserving the river, the estuary and the Delta, as different species use all aquatic environments at one point or another of their life cycle.

Inlet of Sant Pere and Encanyissada lake. Source: Comunitat de Regants de la Dreta de l'Ebre



Penetració de la falca salina.
Font: C. Ibañez

Biodiversity And Prominent Species

Acipenser sturio

The sturgeon

Currently, the sturgeon is considered to be extinct in the Ebre, but its presence has been documented since the Arab era. The data from the medieval period bear witness that it occupied a large area and extended at least to Tudela (Navarra), 490 km upstream of the estuary. Adults reproduced in spring, following the river up to their different spawning zones, dispersed throughout its course, in bendy, pebbly areas with a fast current.

The population of the Ebre began to suffer a significant decline after the construction of the Xerta-Tivenys Weir in the 15th century, which limited and considerably reduced the species' habitat. The causes of the disappearance of sturgeon in the 20th century are diverse, but they should be regarded in a global context: apart from the river barriers, we should take into consideration the reduction in the river water quality and possibly also the overfishing of reproductive females to provide caviar. The last capture of an adult specimen in the Ebre River happened in 1960 in Tivenys, and the last juvenile was fished in 1970 on the island of Sant Antoni (Deltebre).

Superior plants

Miriophyllum spicatum / Spiked water-milfoil

Populus alba / White poplar

Lonicera biflora / Honeysuckle

Tamarix boveana / Taray

Arundo donax / Giant cane

The river bank vegetation

In the final stretch of the Ebre, the river bank vegetation does not differ from one end to the other, and similarly, the species are more or less the same everywhere. The predominant formation is the silver poplar, willows, and so on. These days, each river bank in the Delta has quite a different aspect. On the right bank after the 2009 replanting, the forest is completely consolidated, however on the left bank the forest is almost nonexistent and its place is occupied by reeds.

Molluscs and insects

Anodonta cygnea / Swan mussel

Pomacea insularum / Island applesnail

Crocothemis erythraea / Scarlet dragonfly

Ephoron virgo / Mayfly

Invertebrates

In the lower stretches of the river, fine organic matter in suspension and phytoplankton (microscopic photosynthesizing organisms that inhabit the upper sunlit layer) are abundant. These elements favour the proliferation of invertebrates, scavengers and filterers such as larvae from Trichoptera *Hydropsyche* (caddisflies), *Simuliidae* (black fly) *Chironomidae* (non-biting midges), and the Ephemeroptera (mayflies) *Caenis luctuosa* and *Ephoron virgo*. In particular, the insect called locally "palometa" (mayfly) lives for years in the form of a larva inside the river and as an adult has a quite short life. It emerges from the water, reproduces and then dies. Its mass hatching and emergence from the water can be spectacular with thousands of them filling the river and the river banks on summer nights, something that we should consider to be a sign of the good environmental quality of the Ebre.

Fish


Atherina boyeri / Big-scale sand smelt


Pomatochistus microps / Common goby


Mugil cephalus / Flathead grey mullet


Anguilla anguilla / European eel


Gambusia hoolbroki / Eastern mosquitofish


Misgurnus anguillicaudatus / Pond loach


Cyprinus carpio / Common carp

Amphibians and birds


Pelophylax perezi / Perez's frog


Anas platyrhinchos / Mallard


Egretta garzetta / Little egret


Phalacrocorax carbo / Great cormorant


Larus aoudouinii / Audouin's gull

Introduced species

Fish

In the river, the intrusion of salt water from the sea favours the entry of marine fish species. Thus, near the mouth, the presence of mullets, black-striped pipefish and bluefish is common, and further upriver, we can find other species such as guilded seabream and pompanos. The mixture of freshwater and saltwater fish makes this stretch one with great biodiversity, with 30 species identified, 67% of which are autochthonous. They prominent ones are: eel, sea bass, flathead grey mullet, big-scaled sand smelt, common goby, and so on.

Bird dormitories

The remaining fragments of the river bank forest are used by many birds as resting places to spend the night. These environments, sometimes consisting of just a few trees, become resting places. Species such as the doral, little egret, cattle egret and the large cormorant occupy it, gathering sometimes in large numbers. They are one of the most impressive natural spectacles on the river. We can sometimes see dozens of large birds perching together on the same tree.

The River Relationship Is Still Alive In The Delta


Fish Feast in Amposta in 1913. Source: Terres de l'Ebre Museum

The Amposta fish festival

On August 17th, 1913, as part of the events of the annual festivities, the "fish festival" was celebrated for the first time with new features with which Amposta showed "a highly practical, civilized and educational spirit". This fishery repopulation initiative was a mass celebration, with the participation of almost everyone, driven by the pioneer of the days of the Tree, and of the in the Tarragona Denomination of Origin, Mr. Manel Peñarrubia.

We know that only three years before this, the city council of Banyoles, with the support of the Board of Natural Sciences of Barcelona, in October 1910 held a similar celebration for the first time. Later, it was followed by other Catalonian municipalities such as Terrassa, Sant Pere de Torrelló and Sant Sadurní d'Anoia, and also Amposta.

The Ebre Delta Natural Park

The Ebre Delta Natural Park was founded in 1983 and right from the beginning in 1996, it equipped with an Ichthyology Centre (the branch of zoology that deals with the study of fish and other marine life) located at the Tancada (Amposta). From there, it promotes different programmes for the monitoring and conservation of ichthyofauna and its habitats. Among the programmes carried out, there are salvage campaigns that rescue fish from the Delta irrigation network. This has been carried out annually since 1987. It also promotes projects for the recovery of species such as el fartet (Spanish toothcarp), el samaruc (Valencian toothcarp), la raboseta de riu, el llopet (loach), l'espinós (three-spined stickleback) and the tritó palmat (salamander). Apart from this, as regards public use areas, awareness-raising activities are carried out, such as the river environment discovery trails, the events related to the travelling fish day, and so on.


Fish rescue at Delta de l'Ebre. Source: Migratoebre


Activity at MónNatura Delta de l'Ebre. Source: Fundació Catalunya la Pedrera

Without a doubt, the productivity of the river and the sea due to the water mixing in the Ebre delta has led to an close relationship between the people and the aquatic environment. For centuries, until the advent of rice cultivation, fishing in the continental waters and the working of the salt mines were the two itinerant businesses that the delta depended on. The importance of fishing led to the development of the San Pedro Fishermen's Association in the 14th and 15th centuries, and they continue to fish in the various lakes: La Encanyissada, La Tancada, Canall Vell, Goleta....

On the river, the decline and loss of indigenous species has led to the disappearance of an ancestral activity that was maintained until a few years ago by the river's fishermen cooperatives such as Sapiña in Amposta and Deltebre or The Papaseit in Amposta.


Exhibition "The Ebre, waterway". Source: G. Barberà

The Terres de l'Ebre Museum

The Museum facilities includes a permanent exhibition, called "The Ebre, the way to the water" that showcases the natural and cultural heritage of the river. Among its exhibits is the ichthyology collection, comprising more than 3,000 records and 86,000 examples, from the follow-ups carried out by the University of Barcelona on the river and the Delta in the 80s. The museum has also carried out many research projects since 1984, such as those dedicated to the sturgeon and the shad, and others in the area of the cultural heritage of the river.

MónNatura Delta de l'Ebre

The Catalonia-La Pedrera Foundation restored 41ha of the ancient La Tancada saltworks under the auspices of the LIFE Delta Lagoon project, where it also set up the MónNatura Delta de l'Ebre space in 2012, a facility to add value to the natural environment and the diversity of these saline environments. The facilities -the visitors' centre, the observatory, the look-out post, and so on-, within the natural spaces and programmes of environmental education and dissemination, allow implementing actions and specific projects related to fish (el fartet...[toothcarp]), the world of salt, traditional fishing in oxbow lakes and the birds. The centre organises awareness initiatives such as different open days, including the Migrant Fish World Day in the month of May each year.

The Institute of Research and Agri-Food Technologies

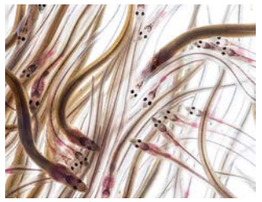
IRTA in Sant Carles de la Ràpita is positioned strategicly to undertake research and development in aquaculture, and for monitoring aquatic ecosystems. The facilities with their different laboratories, and their team composed of 29 researchers, 37 technicians and other personnel, allow them to carry out numerous programmes and projects related to fish farming, monitoring the marine environment, climate change, biodiversity, conservation of wetlands, and so on.

The Problem Of Fishing

Trawler. Source: J. Colomé

There has always been significant fishing activity in the river and the Delta ponds linked to migrating species among others. This was a traditional commercial activity that did not pose a danger to maintaining physical populations. However, in the last century, the increase in the size of catches due to increasingly intensive fishing on particular fish communities that were already in regression, and for other reasons, such as pollution of agricultural origin, contributed to the drastic decline in many species.

If, during the 20th century, the commercial pressure on continental waters was intense, it was now even more so these days, especially in the marine waters near the Delta. Here, the fleet went from being artisan to being heavily mechanized, which increased engine power and therefore fishing capacity. We should remember that with the exception of the eel, the adults of the other three migratory species live in the continental shelf waters. In particular, trawling could have threatened the survival of a benthonic and demersal species such as the sturgeon.



Eels. Source: Ò. Rodbag

Box for eel fishing. Source: M. Cebolla

Eel fishing

Of the four great migratory species, the eel is the only one that maintains populations that are abundant enough to allow the commercial exploitation of both adults and juveniles. Elver fishing occurs from October to March at 346 points along the river and in the Delta ditches. In addition to the river obstacles and pollution, the overexploitation to which it has been subjected is one of the causes of the serious decline in the eel worldwide.

River sailing. Source: M. Cebolla

Fluvial navigation

When correctly done, navigating the Ebre, either for sport fishing or tourist cruises, has a minimal or zero impact on river ecosystems. However, the loss of river bank vegetation along with the excessive speed of some motor boats can produce landslides on the banks. This is an environmental problem that would be reduced by a replanting vegetation on the banks, together with a stricter control of the motor boats that sail on the river.

The Migratoebre Objective: The Fish

The improvement and recovery of the most threatened populations of diurnal fish (migrants between the sea and the river) (eel, sturgeon, sea lamprey and shad) is one of the basic objectives around which actions revolve in this project. First of all, to achieve this, we need to quantify the current state and composition of the ictic (subject to stress) population in the river and the deltaic estuary. To this end, a series of periodical sampling is done in different river sections from a boat by means of electric fishing (the specimen is stunned, but not harmed and returned to the river after measurement). The captures taken allow us to determine the ichthyofauna (the fish that live in a particular region) of the river and particularly, the state of the species that the project is studying. At the same time, a proportion of the captured specimens are tagged with PIT markers (i/d and tracking marks, like bird rings). In parallel, there are more than 40 stations distributed in other aquatic media such as canals, oxbow lakes and bays. In all cases, the captured specimens are measured and biometric data are taken. This study allows the use of the river and the deltaic estuary to be determined by means of the species that live for shorter or longer periods of time in the river, and in the transition environments between fresh and salt water.

In parallel, and to define the potential reproductive habitat of these species in the river, the potential spawning areas and fry that are in between Xerta-Tivenys and the Flix dam will be studied. This study comprised: the characterization of the bottom (the type of substrate, the degree of coverage of macrophytes (aquatic plants large enough to be seen by the naked eye) and so on, the water flow speed, the average depth and the geographic location of the sites. With this data, the potential spawning and fry growing sites for shad, sturgeon and lamprey have been identified and represented cartographically.

Project management

The Life MigratoEbre project endeavours to be an example of good practice to apply to other final stretches of European rivers. Coordinated and led by the Institute for the Development of the Counties of the Ebre (IDECE), it has a budget of 1,568,574 Euros and will last until 2018. The project's members come from the Department of Territory and Sustainability, the Catalonia-Pedrera Foundation, the Private Foundation of the Museu del Ter (CERM) and the Institute of Research and Agri-Food Technologies (IRTA). In addition, it has the collaboration of the Natural Park of the Ebre Delta, the Natural Reserve of Sebes and the Museum of the Terres de l'Ebre. The project, apart from the usual monitoring and inspection activity carried out by the European Commission, has its own advisory scientific committee, an advisory body made up of experts of acknowledged prestige, and set up with the aim of developing specialized analysis and advisory functions to ensure the correct execution of the project.

Releasing a marked fish. Source: Migratoebre

Work meeting. Source: Migratoebre

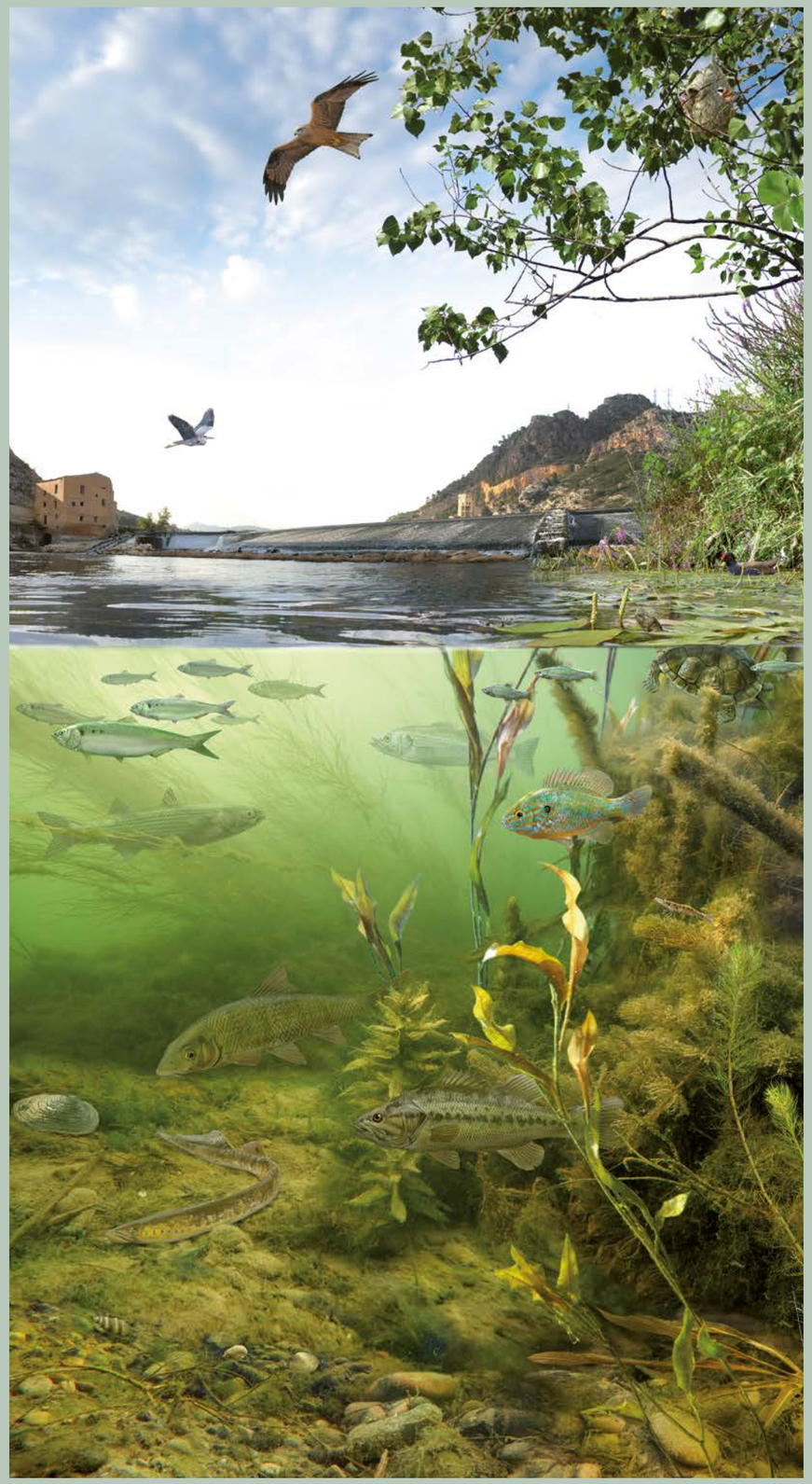
Visit of the Scientific Advisory Committee to the IRTA facilities. Source: Migratoebre

The return of the sturgeon

The sturgeon, the most emblematic fish in the river, became extinct during last century. This is why the Life MigratoEbre project is actively working to accomplish its return to the Ebre. The approval of the French Government has already been obtained at the IRSTEA (National Institute for Research in Sciences et Technologies pour l'Environnement et l'Agriculture) and the MIGADO, to obtain a supply of young sturgeon specimens from France that can be reintroduced to the river Ebre. When they arrive, the sturgeon first undergo a settling-in period in the IRTA facilities in Sant Carles de la Ràpita, where they become acclimated to the conditions of the Ebre and have their state of health assessed prior to release. All the specimens are tagged so that they can be tracked by means of ultrasonic telemetry systems. Before this, a preliminary test was carried out with a minimum of 60 transmitters marking thinlip and flathead grey mullets (Liza ramada and Mugil cepahlus) and eels. Receivers are installed on the river to track their movements between Flix and the sea. We expect that in the spring of 2017, with the system already set up, 50 young sturgeon can be tagged and released.

Sturgeons at the IRSTEA. Source: Migratoebre

4 AMPOSTA-WEIR STRETCH



30 Km Along The Lower Ebre River Banks

Road network crossing the Ebre. Source: Comunitat de Regants de la Dreta de l'Ebre

Tortosa. Source: Comunitat de Regants de la Dreta de l'Ebre

The Ebre waters under the Pont del Mil·lenari [Millennium Bridge]. Source: J. Colomé

la de Vinallop [Vinallop Island]. Source: J. Colomé

The section of the river between Amposta and the Xerta-Tivenys weir has a total length of 30 km and an elevation above sea level that varies between the 8 m at Amposta Castle and 13m at Tivenys. In this zone, the river is still not conditioned by any type of orographic (following the shape of mountains) fitting but is quite straight, broken up only by the presence of some meanders that have been created in areas where the land is harder and has forced the Ebre to adopt a more winding path.

This stretch is characterized by having average widths and depths of about 100 m and 3 m respectively, although both parameters vary greatly depending on the location. The river bed substrate is made up of pebbles (more than 50%), stones (20%), gravel (10%) and lesser percentages of sand, clays and organic matter. The current flow speed is around 1 m/s, resulting in a rapidly-moving medium transporting suspended materials.

An urban river bridged by many infrastructures

Already in the Middle Ages, this part of the valley was the most populated of the Catalan section of the Ebre. At the that time time, it is here where urban growth (cities, industrial zones and dispersed buildings) has been more concentrated and where more Infrastructures (trunk roads, different pipelines, and so on) have been built, which impacted the landscape and have occasionally caused the river environment to be modified.

Islands protected by the PEIN

The PEIN is an official list of areas of natural interest drawn up by the government of Catalonia in 1992. High-quality habitats have been preserved in this area, such as river beaches (Xiquina, Aldover, Weir...) and river bank forests, mainly around the Vinallop and Bous, d'Audí islands, from the Els Estrets ravine or from the d'Andust farms. These islands are protected by the PEIN and identified as "the Ebre islands and river banks" and are also a Wildlife Natural Reserve (previously, in the 20th century, the Carrova and Blanquet islands had been swallowed up by agriculture).

Habitats In Recovery

The river banks are environments of great productivity thanks to the contribution of nutrients that the rivers bring when in flood. It is precisely the existence of fertile soils which has generated by this phenomenon that, over the centuries, has led to the river terraces being used intensely and continuously for agricultural. Even so, the existence of smaller estuaries that lead into it and fluvial islands has facilitated the conservation of some sections where the banks of the river still retain a large proportion of their natural values and biodiversity.

With regard to the aquatic environment, the abundance of areas where the waters circulate slowly with little flow favours the growth of macrophytes and submerged vegetation that host a varied community of invertebrate species. Fluvial beaches with areas of sand, gravel and pebbles are also mediums of great ecological importance for many species. It is precisely in and around these environments where fish such as shad, the river loach and, perhaps also, the lamprey continue to find the ideal habitat to spawn.

Xerta. Source: Comunitat de Regants de la Dreta de l'Ebre

Illes de la Xiquina [Xiquina Islands]. Source: P. Bertomeu

Water quality Improvement

The quality of river water has improved significantly in recent years, mainly due to the reduction of phosphates, the positive effect of sewage treatment plants, and that the reservoirs partially retain nitrates. This, together with the increase of filtering animals since the appearance of zebra mussels, seems to have favoured the transparency of water, the appearance of a certain oligotrophy (having a deficiency of plant nutrients that is usually accompanied by an abundance of dissolved oxygen leading to very clear water) and the proliferation of macrophytes. However, more transparent water does not necessarily mean an improvement in the habitat quality.

Zebra mussel. Source: Wikimedia Commons

Macròfits. Source: Migratoebre

Regenerated forest coverage

Although forest coverage in water-based terraces is sparse, we have no doubt that the forest status has improved in recent decades due to a series of factors. First of all, the sequence of the floods has favoured the growth and retention of vegetation. The pressure of traditional activities has also been less: on one hand, the towing paths, which kept the shores free of trees, have no longer been used since the 60's. On top of this, agriculture has been less harmful due to the increase in river monitoring, together with the abandonment of vegetable plots. At the same time, the re-vegetation programmes (ACUAMED) and the protection of the river islands have had a positive effect.

Biodiversity And Prominent Species

Alosa fallax / Twaite shad

The shad

The shad used to be so abundant in the Ebre that they were the object of intensive fishing, constituting considerable economic and commercial interest. However, in the second half of the 20th century, they practically disappeared. In the last years since 2005, their reproductive populations have begun the process of returning to the river and in recent times, the shad has had a regular presence, albeit in low densities.

The reappearance of the shad may be linked to a relative improvement in water quality, which would favour the re-entry and survival of the migrant population. Guaranteeing their populations means maintaining a minimum river flow rate during the migration period and, the preservation of the river's environmental quality, and the elimination of river barriers.

Petromyzon marinus / Sea lamprey

The lamprey

The lamprey has never been one of the most abundant fish in the Ebre, and its presence has become increasingly rare, to the point that soon perhaps it could be considered extinct. Since 1985, only 32 specimens have been spotted and more than 90% of these have been produced for some time ago now, in the 90s. The most recent news of the lamprey in this geographical area corresponds to one of them parasitizing a mullet in the Les Olles (L'Ampolla) pond in 2001, and an dead individual found on the El Fangar beach (Deltebre), in 2010.

Superior plants

Ceratophyllum demersum / Hornwort

Ulmus minor / Field elm

Populus nigra / Black poplar

Scirpus maritimus / Sea clubrush

Lythrum salicaria / Purple lythrum

Macrophytes

In the body of water, we also find floating plants that grow rooted in the glade; they are macrophytes (with the appearance of algae, even though it is a higher plant). The most abundant are fennel pondweed *(Potamogeton pectinatus)*, the Eurasian watermilfoil *(Miriophyllum spicatum)* and the hornwort *(Ceratophyllum demersum);* Also, epiphytic (an organism that grows on the surface of a plant and derives its moisture and nutrients from the air, rain, water in marine environments or from debris accumulating around it) seaweed such as diatoms and small green algae grow. Macrophytes provide food and cover for the fish and even a place to lay their eggs.

Molluscs, crustaceans and insects


Margaritifera auricularia / Spengler's freshwater mussel


Melanopsis tricarinata


Corbicula fluminea / Asian clam


Atyaephira desmaresti / Sweetwater prawn


Simulium erytrhrocephalum / Black fly


Oxygastra curtisii / Orange-spotted emerald

Fish


Dicentrarchus labrax / European bass


Liza ramada /Thinlip mullet


Luciobarbus graellsii / Bearded carp


Lepomus gibbosus / Pumpkinseed


Pseudorasbora parva / Topmouth gudgeon


Micropterus salmoides / Largemouth black perch

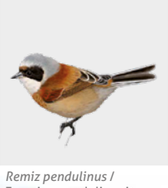
Reptiles and birds


Mauremys leprosa / Spanish pond turtle


Milvus migrans / Black kite


Gallinula chloropus / Common moorhen


Ardea cinerea / Grey heron


Remiz pendulinus / Eurasian penduline tit

Molluscs

The aquatic vegetation of the river constitutes the ideal habitat for many species of invertebrates. In addition to plants, water snails such as Teodoxus, Melanopsis or Ancylus wander about while feeding on the layer of algae that is deposited on the surface. On the riverbed, in the background with bass, the freshwater bivalve molluscs of the genera *Anodonta* (mussels), *Psilunio* (freshwater clam) and *Margaritifera* live. The *Margaritifera auricularia*, locally called "freshwater mussel" is prominent. These are large animals, up to 18 cm long, and quite long-living, and they can live more than 100 years.

Practically everywhere in this segment of the river, we find the small larvae of Simuliida (black flies), including *Simulium erytrocephalum*, a small diptera that, when after undergoing metamorphosis and becoming an adult, is known locally as the black fly.

The fish

In this segment of the river, there are almost all the species of fish that we find in the segment between the mouth and Amposta, except those of marine origin, since the salt wedge does not reach here. Because of this, the physical diversity, that is to say, the number of species of fish that populate it, is reduced to 20, and the proportion represented by exotic species exceeds (65%) the autochthonous ones.

Breeding birds

Birds are always present throughout the river. In addition to those who visit it sporadically, or that only spend the winter, many breed here. Ducks and common moorhen make their nests amongst the low vegetation, whereas the black kites do so only in the highest parts of the trees. If we are lucky, we can spot the extraordinary nest of the weaver bird, a small, beautiful little bird; it is just one of several insectivorous birds that populate the river bank forest.

Introduced species

Stories From The River, Not All Of Them Bad


Rowers on the river Ebre. Source: G. Barberà

"Stories of the river, all bad", is an expression often uttered by the last of the rowing boat sailors on the Ebre, and reminds us how hard their life was. The floods had a tragic effect on the river bank communities, the livelihood of rowing boat sailors and ferrymen. Working always outdoors and exposed to the force and character of the water, meant that once the river was regulated and channelled, they abandoned navigation. When bridges replace ferries, the rowing boatsmen burned their boats and people turned their backs on the river for decades.

Nonetheless, these days the trend has changed: social movements in favour of the river and against inter-basin transfers of water, doing water sports (rowing, canoeing...), the recovery of festivals and traditions, the conditioning of green trails and pathways near the Ebre... all have had a hand in inverting this trend and have contributed to encouraging a more socially friendly environment. This project about the recovery of fish species and the improvement of the river environment also seeks to help establish a new mentality and instil a more positive relationship with the river.

The end of shad fishing

From the Middle Ages to the middle of the 20th century, shad fishing was the most important activity on all the river. Initially, fishing was done from the riverside in villages and in different zones or specific places where fishermen went out on boats along the river Ebre. In the 15th century, the weir became the most significant fishing ground and for this reason, a licence fee was established by the Tortosa town hall. The most used shad fishing method was shade nets, and from the twentieth century it became shad traps, although in the decade of the 20s and 30s a few devices known as fishing machines were tried out. The last squads devoted exclusively to shad fishing were clustered around the Porres and Benet associations, both in Tivenys, until they collapsed around 1960. With the end of shad fishing, diminished by small catches and by increasing competition from sea fishing, ended the river commercialization that had characterised the region of the Ebre and Tortosa for centuries. Before the arrival of cod, river species were the main source of fish on the table, and species such as the shad, lamprey and above all, the sturgeon, were highly valued and used as gifts made to ecclesiastical, civil and royal dignities.


Shad fishing at Tivenys. Source: F. Piñol

Idece and navigability of the Ebre

In 1983, the Generalitat de Catalonia started a study of recovering sailing on the Ebre, from Tortosa to the sea. The idea was to develop a strictly river tourist navigation, to provide an alternative to in coastal tourism. The project was presented in 1992, with the collaboration of the four County Councils and the Diputació de Tarragona (The Central Government Delegation for the province).

Since 1996, the Institute for the Development of the Ebre regions (IDECE) has been the body responsible for managing the recovery and maintenance of navigability of the Ascó-Amposta section. This body, assigned to the Department of Territory and Sustainability, is entrusted with ensuring river navigation during the campaign period from May to November along a 168 km stretch. To do this, it has a network of 24 ferries, an assistance, surveillance and control service with several devices such as the weir lock service and with boats that extract macrophytes and algae, a zebra mussel disinfection service, which also checks the stretch daily. IDECE also publishes written materials, organizes actions such as Vogant per l'Ebre (sailing down the Ebre) and gives publicity to the idea of river navigation as a tourist attraction.

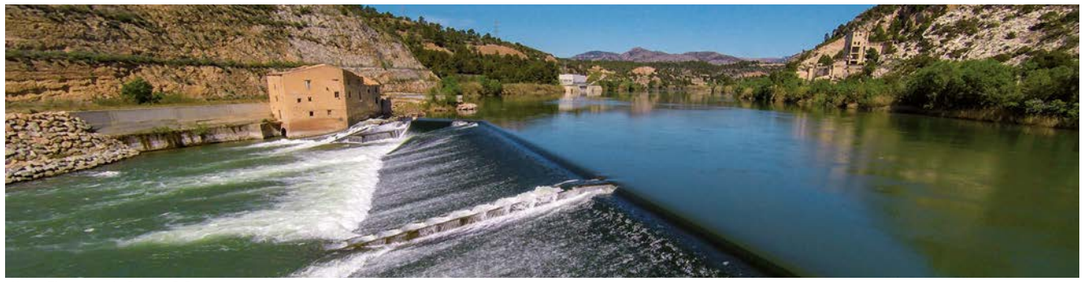
6th Canoe Race on the Ebre to Ascó. Source: Migratoebre

The Rius (Rivers) Project

The Rius Project was created and fostered by the Habitats Association, to be pursued throughout the Catalonia in collaboration with local entities. In the Ebre, from its beginning in 2000, it was the Ebre Learning Camp that organized this activity annually until 2007.

The project intends to monitor and disseminate the state of river ecosystems by means of periodical follow-up by volunteers. However, if we want to ascertain the ecological status of the Ebre in detail, we have to go to the series published by the Hydrographic Confederation of the Ebre and the Catalan Water Agency, along with the publications made based on thesis and other studies at the University of Barcelona and IRTA.

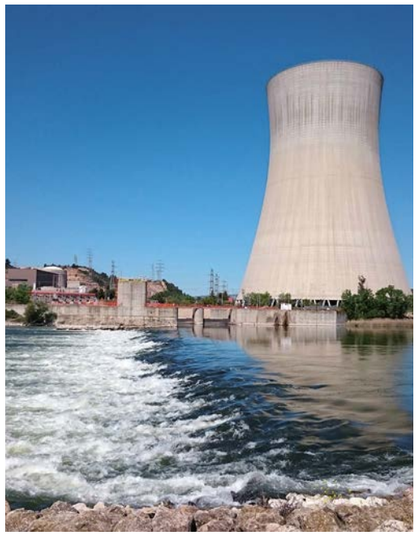
The Problem Of River Obstacles



Xerta-Tivenys weir. Source: P. Bertomeu

In general, the regulation of the rivers usually goes hand-in-hand of a reduction in natural diversity. The construction of weirs and dams considerably modifies the structure and functionality of river systems, retains sediment and reduce the water turbidity, particularly in the lower stretches of rivers, to which many species of fish have adapted themselves. In addition, the slowing down of the flow, the elimination of vegetation and the transformation of the habitat all benefit invading species, the majority of them belonging to still waters.

River obstacles prevent the movement of fish up and down the river and make migration quite difficult. Migratory fish need to cross them to complete their biological cycles and by preventing them doing so, these constructions become a key cause of population reduction. On top of this, hydroelectric generation modifies the water flow regime of the rivers. The lack of seasonality in the floods, along with the random and almost day-to-day nature of dam discharges, causes disruptions in the life cycles of many species.



Weir of the Ascó Nuclear Power Station. Source: P. Luque

The Xerta-Tivenys weir

The construction of the weir in the first half of the 15th century is one of the earliest examples of environmental impact in Europe, due to the severity of its effect on migratory fish. More recently in the 1950s, fish ladders were installed to allow them to jump over the 5.5m difference in altitude of the weir, and with the construction of the hydroelectric plant, others were built. However, both structures are inefficient in a practical sense, since although they are used by mullets, carps, eel, shads and loaches, it has been proven that other species do not pass.

Right channel and the river. Source: J. Colomé

Shallow waters at Garxal. Source: J. Colomé

An ecological flow to guarantee the future

The excessive reduction of the Ebre flow rates, and the result commercialization that is occurring throughout the basin, makes it necessary to establish what water quantity and regime should be maintained to guarantee the various functions: ecology, existence of the Delta and the productivity of the nearby marine ecosystem. This value is what we call the river's ecological flow. We need to guarantee this through legal frameworks of water regulation, so that the river brings sufficient water. This is essential not only for the survival of animals and plants that depend on it, but also for the future of the inhabitants, in an area of great natural value that is also quite densely populated.

Migratoebre Objective: Obstacle Suppression

Fish elevator at the Golfech reservoir (Toulouse, France). Source: Migratoebre

Monitoring of improvements in ecological connectivity

The results achieved with the improvement in the management of the locks, and as a result of the installation of the new fish ladder devices planned, will be monitored. We will use camcorders in navigation channels and lock exits upriver from the fish ladder at Xerta-Tivenys. During periods of the greatest migratory activity, regular sampling of PIT-tagged fish will be carried out at the fish ladder. This will add hundreds of individuals to the stock of those already tagged in the electric fishing capture campaigns in 2016 and 2017. In parallel, both at the navigation lock, the fish ladder, and the Ascó Weir ramp, there will be PIT detectors, which will allow monitoring the tagged fish travelling both upstream and downstream.

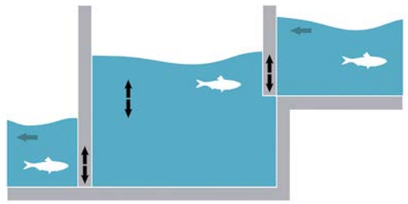
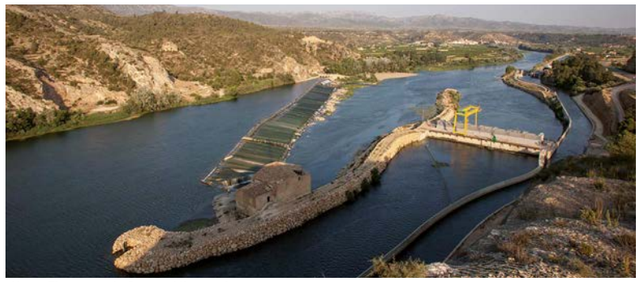


Diagram of a fish elevator

The restitution of the ecological connectivity of the Ebre River, currently interrupted by river obstacles such as the Xerta-Tivenys weir, and the Ascó and Flix dams, is essential to maintain and improve the migratory fish populations in the Ebre.

For this reason, the Life MigratoEbre project promotes the establishment of new fish ladder devices, appropriately designed, particularly for the European sturgeon but also for shad, lampreys and eels. Specifically, the construction a fish ladder is planned in the Xerta Weir (Baix Ebre) and a fish ramp in the Ascó Weir (Ribera d'Ebre), which will probably be completed and operational in 2017. Other plans include adjusting the operation of existing navigation sluices (at the Flix Weir and reservoir) to facilitate the passage of both fish and boats.

On completion of these actions, 64 km of river will have been recovered for fish to use in the stretch they require in their life cycle. We estimate that with this, the presence of eels in the stretches above these obstacles might be increased by a factor of ten, and that the potential areas of reproduction of sturgeon, shad and lamprey could also multiply by a factor of four.



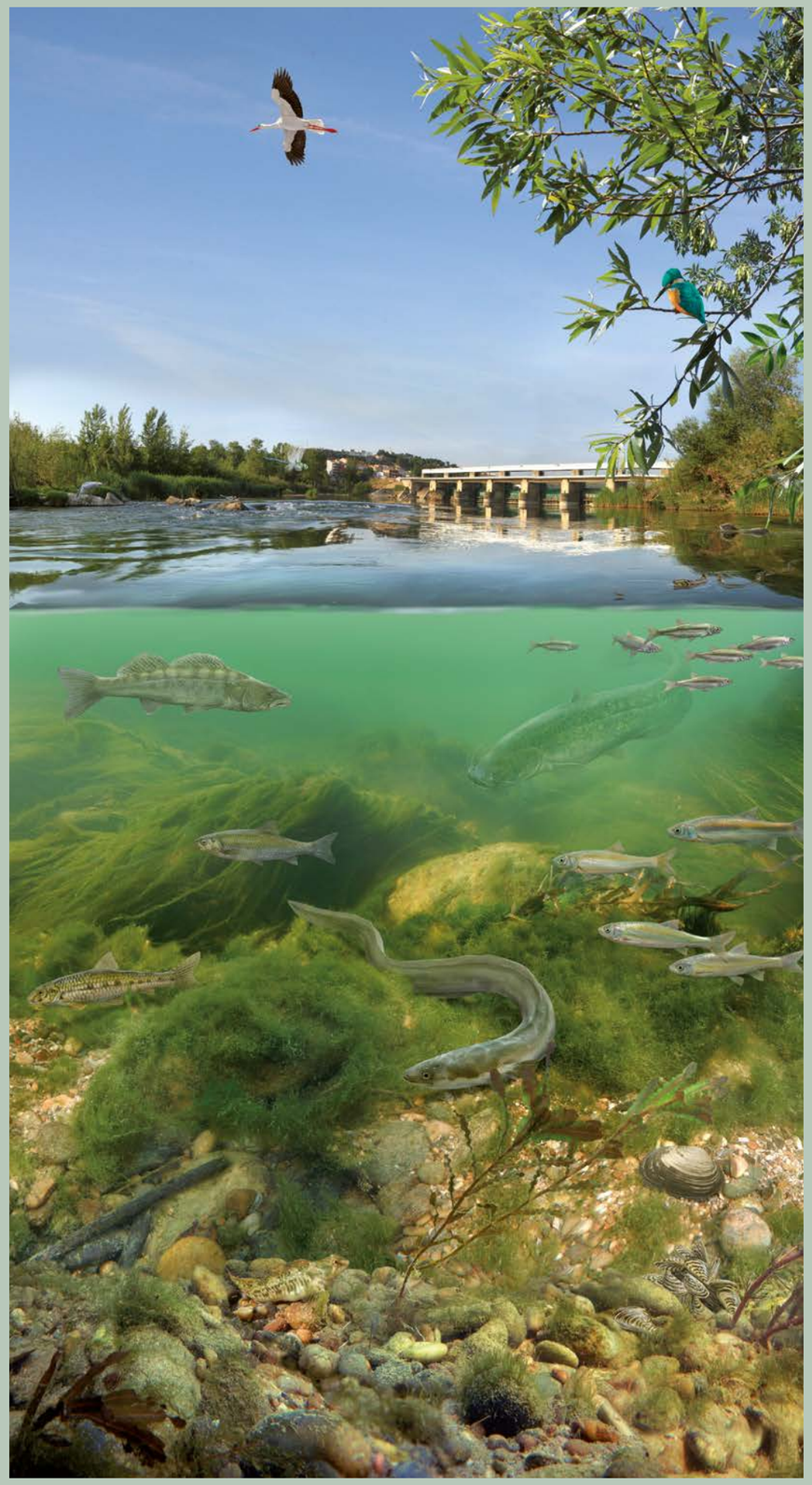
Xerta-Tivenys weir. Source: Migratoebre

The environmental quality of the Ebre river

Being aware of the state of river ecosystems is an essential goal in river management. It is a reflection of the quality of water and the integrated environment obtained from the observation and sampling of biological, hydro-morphological and physicochemical elements, which is established by proposal of European legislation, specifically the Water Directive Framework. Obtaining this data is essential to assess the ecological status of the final stretch of the Ebre River and its interrelation with the fish population. With this objective in mind, the information on the physicochemical and biological quality of the water and aquatic habitats of the river is being collected, either through our own sampling, or from other sources and studies. In this way, the environmental evolution of the river can be tracked throughout the duration the four-year project.

Environmental quality monitoring of the river at Miravet. Source: Migratoebre

5 WEIR-RIBA-ROJA STRETCH



72 Km Through The Ribera d'Ebre

Pas de Barrufemes [Barrufemes Pass]. Source: P. Bertomeu

The course of the Ebre, in the 72 km stretch that starts from above the weir and Coll de Som upstream to Ribarroja, is characterized by the river flowing between the buttresses of the two sides of the pre-coastal mountain ranges. The Barrufemes Pass is located downstream of the Móra basin, where the river widens. The valley closes up again at the the Ase Gorge, after which a series of laterally-expanding sedimentary reliefs serve as a prelude to the central Ebre channel. The three reservoirs, Flix, Riba-roja and Mequinensa, were constructed between 1948 and 1967, creating a hydroelectric complex that flooded 161 km of the valley in the central axis of the river. Consequently, this area presents two differentiated physiognomies. Upstream from the weir to Ascó, some of the best-preserved and undisturbed natural areas of the river are to be found, of great landscape and ecological interest. The upper section, where the three large reservoirs, the Ascó nuclear power station and the Flix electro-chemical factory are located, is much more altered.

In this area of the Ebre, the river course stops being straight and becomes more curved and meandering. The average width of the channel is narrower here compared to the areas further downstream: it reaches maximum widths that vary between 165 and 200m, coinciding with river islands. Depths are quite variable and there are quite deep points in the Móra mini-basin, up to 15 m. The flow speed tends to be quite high, exceeding 1,5 m/s in many places.

Marshland and river islands

This area is where we can see the most representative and numerous examples of the river bank forest in the lower Ebre. On the marshland and river islands that exist, there are well-preserved forest formations, a varied fauna, particularly invertebrates, amphibians, reptiles and birds that take refuge in these spaces that emerge in the middle of the stream. There are also quiet and upland spots, such as at Benifallet, Cataula and Nap, the Miravet salt cedar grove, the islands of Xano and Benissanet, the Móra la Nova marshlands, or Subarrec at Móra d'Ebre, the confluence of the Siurana at the village of Garcia or the new island at Ascó.

Islands and irrigated land at Benissanet. Source: P. Bertomeu

The former riverbed

The upper stretch of the river in the Terres de l'Ebre (Ebre Lands) was transformed after the installation of the three large reservoirs, the Weir, the Ascó nuclear power plant and the Flix electro-chemical factory. The former valley lies beneath their waters (which these days occupy about 10,000 ha), as do the islands adjacent to the Flix Weir, the lands of Dellà de Faió, the islands of the mouth of Matarranya, and so on, which became submerged. These days, here in this section of the river is we need to look for the areas of greatest natural interest, in the Sebes Nature Reserve, at the confluence of Matarranya and, further on, in the Segre-Cinca lagoon.

Sebes Nature Reserve. Source: P.J. Jiménez

Habitat Characterization

Meandre de Flix. Source: Migratoebre

Despite the obvious natural values it possesses, like many others this stretch of the river has undergone major changes as a result of weir and dam construction. The simple fact of building a reservoir already supposes the disappearance of the natural habitat, by transforming the former physical and biotic environment taken over by the reservoir. In addition, alterations in the hydraulic regime that occur modify the morpho-nutrient regime of the habitats located below the dam. By way of example, it was found that, prior to the construction of the three reservoirs, there were plenty of itinerant sand bars, the formation of deposits and river beaches, the changes in the layout and extensive un-transformed areas in this stretch of the river. In contrast, after the 60s, the stability of the river's course was greater and became more settled, leading to increasing river bank vegetation and, in general, reduced channel width. In spite of this, this stretch maintains extensive well-preserved river stretches both within the main channel and on the river bank groves, which is, fundamentally, the spots at which the project's actions are aimed in the recovery of migratory fish that live in the Ebre.

Replenishment of the low river bed at the Flix dam. Source: J. Colomé

Dams as ecosystems

As in other ecosystems, in reservoirs temporary changes determine the fluctuations and evolution of the natural population. However, in this case it is the water renewal rate (in the hands of hydroelectric management) that is one of the most significant parameters. First, the exposed banks at the reservoir water edges become bare areas, almost without vegetation. Secondly, if the water mass has a high residence time, eutrophication (excessive richness of nutrients) is accentuated, and an example of this occurs due to its slow passage through the Ribarroja reservoir. This contrasts with Flix reservoir, where due to the reduced volume, hydroelectric management allows it to empty up to three times per day. The high nitrogen and phosphorus content cause high primary production, which, along with water stratification, makes the bottom anoxic. At the same time, the lack of penetration of the light limits the presence of life to a background presence of some worms (oligochaeta) and insects (chironomids). In contrast, the reservoir fish, largely introduced ones, although in quite an artificial environment, find adequate means to prosper.

Mequinensa dam. Source: Wikimedia Commons

The effects of emptying reservoirs

The extreme regulation imposed on the lower Ebre section causes the flow, both on a daily and monthly basis, to be highly variable, depending on the electric companies' needs. Many studies indicate that this is a factor in a tendency towards a smaller diversity of species in regulated basins. The intermittent flows caused by reservoir emptying can affect the reproduction of autochthonous species and, in particular, the migratory species are the most affected, as well as the development of young fishes in general, which also find themselves in difficulty due to these fluctuations.

Mequinensa reservoir. Source: Wikimedia Commons

Biodiversity And Prominent Species

Anguilla anguilla / European eel

The eel

The eel is a common species in the Ebre from the mouth up to the Xerta-Tivenys Weir. However, further upstream its presence decreases and is only due to the repopulations carried out by the Administration since 1996. This decrease with distance from the river mouth is not exclusive to the Ebre, but without doubt, here it has been exacerbated by the river barriers that exist along the valley, and that improving the fish ladder devices would benefit the species' extension.

However, the eel is, amongst all the fish in the delta zone, the most widespread species and occupies many different delta environments. As it is a quite ambivalent animal, it is capable of tolerating quite extreme temperature and salinity ranges. Nevertheless, it seems to have a preference for habitats with saline water such as oxbow lakes, which is where it is most abundant.

Superior plants

Potamogeton pectinatus

Potamogeton crispus / Curled pondweed

Salix alba / White willow

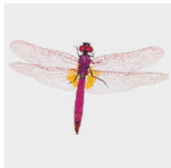
Fraxinus angustifolia / Narrow-leafed ash

Phragmites australis / Common reed

The river bank vegetation

Here, thanks to the spontaneous regeneration of the river bank forest, we find well-established groves on the majority of the rivers banks and river islands. They basically correspond to silver poplars and willow groves, but there are also well-established French Tamarisks such as in the Miravet meander, as well as extensive reed beds such as those at Sebes.

Molluscs and insects



Trithemis annulata / Violet dropwing

Anax imperator / Blue emperor

Aquarius najas / River skater

Potomida littoralis / River clam

Dreissena polymorpha / Zebra mussel

Predatory invertebrates

At the river edges, in the places where the waters are shallower and slower, the habitat is ideal for groups of insects that are small predators. Skimming on the surface against the water flow, we find pond skaters, hunters and scavengers. Flying just above the river or in the edge vegetation, dragonflies hunt and reproduce, laying their eggs in the edge waters. In this sector we can find the orange-spotted emerald dragonfly *(Oxygastra curtisii)*, one of the most threatened odonates of our fauna.

Fish

Parachondrostoma miegii / Roach

Salaria fluviatilis / Freshwater blenny

Squalius laietanus / Striped chub

Gobio lozanoi / Iberian gudgeon

Alburnus alburnus / Common bleak

Silurus glanis / Wels catfish

Sander lucioperca / Pike-Perch

Reptiles, birds and mammals

Natrix maura / Viperine water snake

Lutra lutra / Eurasian otter

Alcedo athis / Common kingfisher

Ciconia ciconia / White stork

Nycticorax nycticorax / Black-crowned night heron

Motacilla alba / White wagtail

Introduced species

The fish

Regarding the biodiversity of fish, in this sector we can cite up to 18 species; however, the exotic ones by themselves represent 77% of the total. The specific values obtained in the majority of surveys carried out in this section of the river does not exceed a dozen species and the abundance is considerably lower compared to the other two sectors of the river that we present in the exhibition. Among the native fish, the bearded and Iberian carps are the most prominent, with the eel and loach less abundant. Included on the list of exotic fish are: the common bleak, pumpkinseed sunfish, pike, scissortail rasbora, carp and catfish, among others.

Birds and mammals

The abundance of aquatic fauna, particularly fish, leads to the presence bigger predators on the banks of the river. Egrets, herons and storks fish from the river beaches between the reed beds, where water is not too deep. The kingfisher keeps a lookout from a branch, waiting for a passing small fish, caught by diving head-first into the water. And at night, otters, disappeared years ago, have returned now to the river in response to the improvement of the environmental quality and the abundance of food.

Changing Relationships: From Fishing From Rowboats To Fishing Tourism

"And I am pleased to remind your excellencies of the damage that the factory of weir represents for our city, because before, it could be observed in this place that the sturgeons and many shads were fished and collected in the river in this place [Benifallet] and for their fishermen it represented an income of more than 200 pounds [currency at that time] from this fish... And what they have lost has been won by our city and the city of Xerta". (ACBE, Benifallet no. 8, 15th century, originally written in the Catalonian dialect of the day).

This document is how we found out that, since the 15th century, those fishing the river above the Weir, Benifallet, Miravet, Flix, and Riba-roja d'Ebre had to go gradually abandoning this activity. So, except for Mequinensa where a small nucleus still survived until the middle of the 20th century, in the rest of the towns, river fishing became a part-time activity for boatmen and farmers. Many species of fish, such as eels and shads, became increasingly scarce, to the point that in Mequinensa "go looking for shads" became a saying as in further downstream, "go looking for shrimps" (embark on a quest for an imaginary creature). Here, in the villages on the banks of the upper reaches, due to the difficulty of land communications and the importance of coal and cement mines, life as rowing boatsmen in many places remained tied to the river until 1962. At this point ENHER (electricity generation and distribution company) bought up the remaining licenses to navigate the river. It was an abuse of power at that time, to avoid having to build new locks, and also allowed the hydroelectric company to take control of the river traffic. This in turn implied that some of the means of earning a living, that were in any case in gradual decline, suddenly disappeared forever.

Small sailboats Faió. Source: Arxiu Mas

The Sebes Nature Reserve

The natural spaces of Sebes and the meander at Flix have been part of the PEIN since 1992. Subsequently, they extended their boundaries to the current area of 250 ha of Wildlife Reserve and were incorporated into the Natura 2000 Network. Since its inception, the management of this area has been the responsibility of a local NGO, the Freixe Nature Group, in agreement with the City Council of Flix and the Generalitat of Catalonia. The space includes facilities such as the Mas del Director and the Sirga Track Interpretation Centre, as well as infrastructures such as footpaths and bird observatories that enable us to go into the reef and the river bank forest. This entity also carries out habitat species management projects, research, education and river care initiatives in the final stretch of the Ebre, and also participates in the Migratoebre Life project in charge of the tasks of dissemination and social involvement.

The repopulation of eels and mullets

The Department of Agriculture, through the General Directorate of Fisheries, has been releasing fish destined for repopulation at least since the 80s.

The release of fish mainly comprises eel, given the existence of the European guidelines, which set out European eel management plans, which in Catalonia means the release in the Ebre and Ter (and in recent years, also in the Llobregat) of 5-10% of the eel catches. Accordingly, in 2015, 106,000 eels weighing 1-3 gr each were released in the Ebre; here the repopulation, depending on which year, also include stocks of mugalid juveniles (mullets).

Repopulation of fish. Source: Migratoebre

Wels catfish fishermen at the Riba-roja reservoir. Source: M. Cebolla

Sport fishing in reservoirs

Decreased populations of autochthonous species, together with traditional fishing, especially after the construction of reservoirs and the new development and environmental management models of the second half of the 20th century, favoured repopulation with exotic species and the practice of sport fishing. A business that would gradually become uncontrolled and environmentally unfriendly. Soon, in 1974, the introduction of catfish by those wanting them for sports fishing in the reservoirs of Riba-roja and Mequinensa (also called the Sea of Aragon), would cause irreversible damage to the Ebre river ecosystem.

These days, this activity continues and contributes to inland tourism. Only at the Mequinensa reservoirs, about 2000 fishing licenses per month are issued. However, there remain controversial aspects such as poaching, the use of prohibited nets or live bait, which sometimes facilitate the inadvertent introduction of new exotic species; not to mention the controversial slogan "Capture and release! Respect the environment!" that in fact could not be more erroneous when applied to exotic species.

Ebre, A River In Good Condition

River Ebre. Source: P. Bertomeu

The Ebre cannot be considered to be a contaminated river. Several studies report that the quality of river water in its final section is rated as good or quite good. However, this positive data does not mean that pollutants are not present or that the risk of major pollution is zero. In fact, every day pollutants are emitted into the river in three ways: the first would be the diffuse contamination derived from the intense existing agricultural activity; the second, the occasional uncontrolled dumps or the contribution of wastewater from the coastal villages throughout the basin, and finally, there are chemical contaminants discharged by neighbouring industries.

At present, the main problems of contamination in the Ebre are those caused by pesticides and heavy metals. These components are persistent and bio-accumulative substances in the environment that, although over time may eventually disappear from water, accumulate in sediments or in aquatic fauna. In fish such as catfish and carps, elevated concentrations of organic chlorine and mercury compounds have been detected, and even in other organisms such as the American crayfish, and detectible concentrations have even been found in certain birds. Once decontamination of the reservoir has been carried out, we foresee that these residual values will decrease.

Flix reservoir. Source: P. Bertomeu

The extraction of sediments from the Flix reservoir

The Flix reservoir held 300,000 Tonnes of contaminated sludge, the result of the industrial activity of Flix Electro-chemical factory that generated discharges since the end of the 19th century. Some of the dangerous substances that have been identified in high concentrations are: hexachlorobenzene, copper, chromium, nickel, zinc, butyl, tin and nonylphenol compounds. The Flix dam is where the highest contamination in the sediment matrix occurs. Because of this, since 2008, sludge has been extracted to remove the contaminated deposits, and thereby eliminate the risk of its accidental mobilisation.

Tortosa water treatment plant. Source: I.C.C

Urban water treatment

Since the 90's, the implementation of treatment and purification systems for the wastewater that the coastal towns and villages dump into the river and their tributaries has meant an improvement in water quality in the hydrological network. In the Ebre, the implementation of urban treatment plants has resulted in a drastic reduction in dissolved phosphates, since most of the contained phosphorus came from urban waste water. On the other hand, the concentration of nitrates has not diminished significantly, given that their main origin is in agriculture. The most obvious effect of the reduction of phosphates has been the significant increase in water transparency, a reduction in phytoplankton and the increase of macrophytes in the river.

The Problem Of Introduced Species

Currently, most of the river basins of the Iberian Peninsula have as many foreign species as native ones. The Ebre is no exception and, of the 48 known species of fish, almost 50% are exotic and three-quarters of them have managed to settle here. In addition, most are invaders and have a negative impact on autochthonous populations. During the period prior to 1995, it had been established that the main means of introduction was through sport fishing, particularly in the case of large predators or others used as bait. In recent years, aquaculture and aquariums have become the most usual means of dispersal. In spite of the awareness and information campaigns launched to address this problem, the trend is on the rise and in the last 20 years, more than 15 new fish species have been detected in the Ebre.

The presence and appearance of invasive species represent a serious problem that affects the conservation of natural values, a widespread danger on a global scale which has become the second-largest cause of extinction of freshwater fish and one of the greatest problems for environmental management. The ecological effects that a new foreign species can cause in a medium are quite varied: from competition for habitat or depredation of local species, loss of genetic diversity through hybridization or the transmission of new diseases, which at the same time entail changes in the composition and functioning of ecosystems and the loss of biodiversity. In addition, the economic costs caused by invasive species can be enormous, either by direct losses in different economic sectors or by the indirect costs derived from the containment of the impact they cause.

Wels catfish. Source: M. Cebolla

Roach. Source: M. Cebolla

Common bleak. Source: M. Cebolla

The competition between autochthonous and exotic species

Exotic fish interact negatively, with detrimental impacts on local fauna, such as the predation of eggs, and on adults of other species; this is the case of predators such as pike *(Sander lucioperca),* American black perch *(Micropterus salmoides)* and catfish *(Silurus glanis).*

The competition for trophic resources (food) and habitat can lead to the displacement and disappearance of autochthonous species. A clear example is what has happened to the roach *(Parachondrostomus miegii),* whose populations from 1992 have been reduced almost until extinction, when the common bleak *(Alburnus alburnus)* was introduced to the estuary stretch.

Table of species introduced in the Ebre

SPECIES	COMMON NAME	ORIGEN	FIRST CAPTURE	MEANS OF INTROD.	PLACE OF CAPTURE
Carassius auratus / Carassius carassius	Red carp	Eurasia	17th century	Aquaculture	
Cyprinus carpio	Carp	Asia	16th-17th century	Aquaculture	
Gambusia holbrooki	Eastern mosquitofish	North America	1921	Administration	<1974 extended
Micropetrus salmoides	Largemouth bass	North America	1967	Sport fishing	Ullals de l'Arispe i Baltasar (Amposta)
Silurus glanis	Wels catfish	Central Europe	1974	Sport fishing	Mequinenza
Scardinus erythrophtalmus	Common rudd	Southern Europe	1988–1989	Sport fishing	Assut (Xerta-Tivenys)
Sander lucioperca	Pike-perch	Central Europe	1990	Sport fishing	Canals de Buda (Sant Jaume d'Enveja)
Alburnus alburnus	Common bleak	Central Europe	1992	Sport fishing	From Tivenys to Deltebre (5 locations)
Perca fluviatilis	Perch	Eurasia	1998	Sport fishing	Riba-Roja d'Ebre Reservoir
Pseudorasvora parva	Scissortail rasbora	Asia	1999	Fishkeeping	Sèquia mare ()
Misgurnus anguillicaudatus	Loach	Eurasia	2001	Fishkeeping	Sèquia mare ()
Leponis gibbosus	Pumpkinseed	North America	2003–2004	Fishkeeping	Riba-Roja d'Ebre Reservoir
Leuciscus idus	Ide	Central Europe	2003/2004	Fishkeeping	Sèquia nº 2 / CP de l'estació (L'Aldea)
Fundulus heteroclitus	Mummichog	North America	2006	Not known	Sifó Agulla 2 (Amposta)
Rutilus rutilus	Common roach	Central Europe	1999	Sport fishing	Extended throughout both hemideltas in 1990
Ictalurus punctatus	Channel catfish	North America	1995	Aquaculture	Casilla guardacanal E3_2 ()
Ameirus melas	Black bullhead	North America	1987	Aquaculture	1 km from Migjorn (Sant Jaume d'Enveja)
Acipenser baerii	Siberian sturgeon	Central Europe	1995	Not known	Tortosa
Acipenser naccari	Adriatic sturgeon	Southern Europe	1996	Not known	Campredó

Objective Of The Migratoebre: Social Participation

Carrying out the Life MigratoEbre project would not make any sense without the involvement and complicity of the whole country, and in particular, of the people of the Terres de l'Ebre. They are who live in the riverside villages and who perform their daily activities on the river. Once the different actions have been carried out, they are the ones who need to be involved in the improvements in the migratory fish populations, and in this sense, it is essential that they know and appreciate the work done and the results achieved.

For this reason, local awareness campaigns are being carried out make everyone everywhere aware of the project to reintroduce sturgeon into the Ebre and improve the ecological connectivity of the river. In this aspect, during the four years of the project, we have participated using information stands at fairs, local festivals and sports activities in the area, and festival days such as World Migrating Fish Day, which have been organized so that everyone gets to know and internalises the Life MigratoEbre project. Information panels have also been placed at the points where works have been carried out to allow visitors, whether local or foreign, to understand and appreciate these infrastructures, their role and their importance for fish and for the river.

Campaign to raise awareness of the project at the Móra la Nova Fair. Source: Migratoebre

The underwater view

One of the main actions planned to publicize and stimulate the public's interest in the fish of the river is based on a strategy of making their visual impact more visible. Given that, as they live underwater and cannot be easily seen, it is more difficult for these animals to capture people's imagination. With this criterion, a virtual underwater lookout point has been planned. This will not be built as a physical infrastructure within the river, but rather with the use of new technologies, with underwater cameras installed at the fish transit points. They will remotely transmit live images to different visitors' viewing points such as MónNatura Delta, Delta Ecomuseum, Sebes Nature Reserve and the Terres de l'Ebre Museum.

Virtual view of the subaquatic river. Source: Migratoebre

Volunteer work

Simultaneously, we are encouraging the creation of a volunteer network incorporating willing entities that want the project to be a success. The function of this network is to inform about the observations or captures of different species of fish such as sturgeon, lamprey or shad, data that is of great importance in the evaluation and follow-up of the results of the project. To reinforce this communication network and to explain more about the project, we have visited all associations of the river and the Ebre coast related to sports, recreational or professional fishing, other water sports, and so on. The volunteer network is also open to whichever entity that want to be part of it, such as schools, environmental and cultural groups, amongst others.

Volunteers releasing fish back into the water. Source: Migratoebre

MigratoEbre 2.0

Social networks and new communication technologies are fundamental work tools that help transmit the day-to-day life of the project in an easier and faster manner to the public at large. A web page has been created in which all the information related to Life MigratoEbre appears, and that links to the different profiles that have been created in the main social networks. At this moment, instruments such as Facebook, Twitter or Instagram allow us to instantaneously broadcast the information of what is being done every day in the Life MigratoEbre project, thus making it much more present for everyone in general, rather than only for the experts or those with a particular interest in it.

Life Migratoebre website **www.migratoebre.com.** Source: Migratoebre

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Departament de Territori i Sostenibilitat

IDECE
Institut per al Desenvolupament de les Comarques de l'Ebre

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