Solar salt works implementation in Ribeira de Aljezur, Portugal – Part 2 Biodiversity and Ecosystem Services Value

Mauro Rafael da Cunha Hilário[1] and Ricardo Jorge Dolores Coelho[2]

[1] Independent Researcher. mauro_lwt@hotmail.com

[2] Independent Researcher. ricardojdcoelho@gmail.com

"Nowadays people know the price of everything and the value of nothing"

Oscar Wilde

ABSTRACT Ribeira de Aljezur is a rich ecological area located in Parque Natural do Sudoeste Alentejano e Costa Vicentina and belongs to Natura 2000. It is classified as an ecological target area that requires specific conservation actions. Part of the area is not natural due to the existence of ponds belonging to an old semi-intensive aquaculture, whose activity stopped in 2010. Before the area was used to rice and marine salt production although with an uncertainty of when were active for the last time. The fact is that the disappearance of these activities had an impact on the landscape, biodiversity, water regime and local economy. Actually there is a transformed landscape without natural biological settlement and human use. However the rehabilitation of the area is possible through a solar salt works implementation that can lead to a positive impact on the landscape, increasing the biodiversity, water management and can additionally stimulate local economy. As analysis, a biological survey for flora, birds and other animals was made, questionnaires were elaborated to study the natural status and the perception of local people in a rehabilitation of the area through an implementation of solar salt works in Ribeira de Aljezur and ecosystem services were discussed with socio-economic groundwork. In conclusion, theoretically, this implementation will bring positive impacts to the local population and will increase natural and economic values of Ribeira de Aljezur.

Key words: Solar salt works, Land rehabilitation, Ecosystem services, Biological survey, Wetlands, Ribeira de Aljezur, Portugal

1. BRIEF BACKGROUND OF RIBEIRA DE ALJEZUR

Ribeira de Aljezur is located in Parque Natural do Sudoeste Alentejano e Costa Vicentina (PNSACV) in the Algarve southwest coast. It is a 33.7 km water channel [1] and drains an area of 182.9 km^2 [2]. During the dry season, the stream has almost no freshwater flow, but is influenced by tides [3]. The coastal inlet is adjacent to Amoreira beach and shows an unexpected morphologic resilience that results from a dynamic equilibrium between tide and wave action. This state is only altered when high magnitude external conditions occur, associated to tide increase forced by extreme fluvial discharges [4]. It is not a real estuary, but a transition system that from an ecological point of view can be classified as a lagoon-estuarine environment [5]. History tell us that Ribeira de Aljezur had several uses, however today almost all of them disappeared taking with them value and leaving abandoned land.

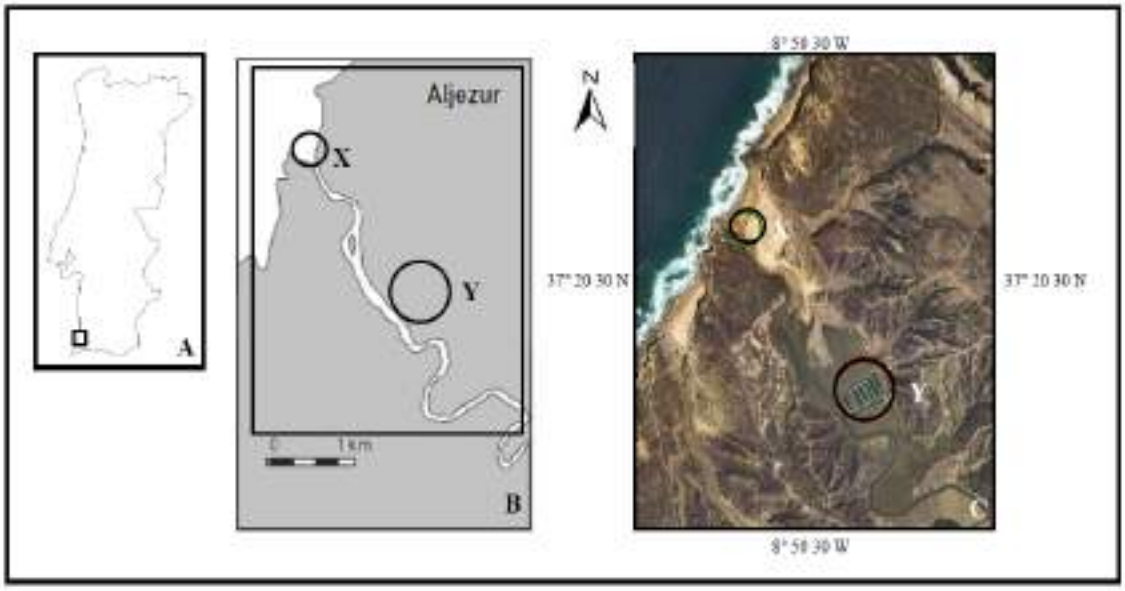

Figure 1: (A) Location of Ribeira de Aljezur in Portugal; (B) Location of the area to rehabilitate (Y) and the inlet (X); (C) Aerial photograph of Ribeira de Aljezur with the area to rehabilitate (Y) and the inlet (X).

The area to be concerned and the focus of this study is the area behind the dunes of Amoreira beach. The area is not natural due to the existence of ponds belonging to an old semi-intensive aquaculture, whose activity stopped in 2010. The area surrounding was used to rice and salt production back to the year 1318 [6] and it is possible to observe activity marks in the ground although with an uncertainty of when were active for the last time. The fact is that the disappearance of those three activities had an impact on the landscape, biodiversity, water regime and local economy.

2. ECOLOGICAL CLASSIFICATION OF THE AREA

The area is a specific intervention river area, type I and type II with partial protection and belongs to Natura 2000. The location results, that any rehabilitation activity must follow rules from Plano Especial do Parque Natural do Sudoeste Alentejano e Costa Vicentina Natural (PEPNSACV). This plan aims the insurance of ecosystems equilibrium, the promotion of economic, social and cultural development [7]. The area also belongs to the Public Water Domain [8], National Ecological Reserve (REN) [9] and National Agriculture Reserve (RAN), each with specific management guidelines [10].

3. SOLAR SALT WORKS PRESENCE AND CONSERVATION VALUES

The solar salt works activities are normally present in wetlands, more specifically in salt marshes rich in biodiversity and represent unique biological systems [11], which makes them environmentally relevant activities [12]. Many species live, feed and reproduce in a salt marsh and in a solar salt works area [13]. They provide the environment for biological diversity, including plants, birds, reptiles, fish and invertebrates, prevent flooding and improve water quality [14]. This is why a presence of solar salt works in Ribeira de Aljezur could be an ecological solution for land rehabilitation. Without negative impact and stimulate sustainable development.

Usually, even salt producers do not give great importance to its ecological value and is difficult to estimate an economic value, but it is possible to list the arguments in favor of solar salt works as an environmental friendly areas and activities. The presence of solar salt works can control the hydrological regime, promote the area preservation, controlling natural and anthropogenic factors and can control water quality [15-18].

So, the question is: How do we give a value to something that is already priceless? Identifying and quantifying is the normal answer. And that it is only possible with biological surveys and ecosystems services descriptions through natural, social and economic evaluation.

4. METHODS

A biological Survey with three specific groups of organisms was made: plants, birds and other animals. Was also described the possible role of them in the ecosystem with the identification of the location and behaviors.

4.1. Plants

Plants were identified by direct observation at the study area through a plant guide [19] and by samples collected and analyzed in laboratory. It was sampled both leaves and flowers with shears.

4.2. Birds

Bird species were identified by direct observation with binoculars, with a bird guide [20] and by sound.

4.3. Other Animals

Other animals were identified by direct observation.

4.4. Ecosystems Services

Was made an identification of biodiversity values based in the biological survey. Was predicted what could happen with a solar salt works implementation in terms of biodiversity and ecosystem. Was made an identification of socio-cultural values based on Aljezur economic information and cultural perceptions through a questionnaire. The information was bonded to promote a global view [21, 22] about Ribeira de Aljezur ecosystem values.

5. RESULTS AND DISCUSSION

5.1. Biological Survey

Given the example of this list of species (Annex 2) regarding the type of ecosystem and the type of activity that should be introduced, one can conclude that, theoretically it seems a good strategy to rehabilitate the former aquacultures in Ribeira de Aljezur into traditional solar salt works.

First of all, if the area is going to be used sustainably by man, it is going to be studied and cleaned, not only improving the landscape but also increasing the knowledge of the Ribeira de Aljezur biodiversity. Second, if well taken care of, and therefore ensuring good water quality, it is also a certainty that the solar ponds will attract birds. Why the certainty? One should consider the main reason why all animals including our own species move, in two words, food and water. But what makes us migrate from place to place, the search for a steady food supply. And mainly birds will find small aquatic invertebrates in the ponds, including *Artemia* spp. For some species this is a crucial food source, attracting many individuals not only to feed, but also to rest and mate. For example, *Falco peregrinus* that preys upon birds will also be appealed by the number of increasing birds in the area. Third, if the ecosystem is healthy, flowers and vegetation will grow, attracting insects that will attract small mammals, reptiles and amphibians. The food web will evolve in a vigorous way. Ultimately the positive evolution of the biodiversity of Ribeira de Aljezur will raise awareness and attract tourists and environmental researchers.

5.2. Ecosystem Values

Ecosystem goods and services together are known as ecosystem services that represent functions directly related to the habitat, biological or system properties or processes of ecosystems and the benefits for human populations, directly or indirectly, from ecosystem functions. [23]. There are diverse methods of ecosystem services evaluation [24]. However it is hard to quantify the variables of real ecosystems goods

or function and consequently ecosystems services. Recent ecosystem services research has highlighted the importance of spatial connectivity between ecosystems and their beneficiaries. Despite this need, a systematic approach to ecosystem service flow quantification has not yet emerged [25, 26]. So the best way to do an approach in Ribeira de Aljezur is to proceed with the identification of intrinsic values and an identification of connections between man and the ecosystem, always in a perspective that man is part of the ecosystem with the clarity that a multi- and interdisciplinary research in this area is relatively rare so far [27]. That can lead to a clash between science and metaphysics in the moment to make valuation and decisions [28, 29].

This first identification of particular services, opens the door to new approaches in managing Ribeira de Aljezur. Rather than planning just to protect ecosystems which appear to provide services, ecosystem service science begins to support more holistic conservation and development planning [26].

It is possible to identify the following services promoted by the ecosystem in Ribeira de Aljezur: landscape beauty, recreation, biodiversity, riverline flood regulation, subsistence for fish and for birds, research, carbon sequestration, environmental education and water quality.

It is clear that there are also direct connections between human activities and the ecosystem as agriculture and animal production. It is easy to show a single piece of demonstrative information but behind that there is a complex system to quantify. This happens due to the lack of numerical data in order to make a capital value of the ecosystem, just being possible by enumerating and evaluating through argumentation how these relationships are important and how they will improve the quality of the area not only for Man but also for Biodiversity. And that would be a consequence of the implementation of a solar salt works and would result in an improvement of all these connections and consequently a greater appreciation of the area.

Considering that this implementation connects the ecosystem and the population, it is necessary to have a view in the socio-economic data (Figure 2). And the data shows that the population of Aljezur is small and that only half are active workers. Of these workers, which belong to a small number of firms or are liberals, there is a high percentage represented by doing part-time jobs in Aljezur and with it the need for individual billing.

Population	5288
Economically Active Population	2289
Companies	85
Liberal Workers	1516

Figure 2: Table with Aljezur´s Population [30], Economically Active Population [31], Companies and Liberal Workers.

With a small population, the opinion and perception of values within that population are important, because the population has its own perspectives and passes it on into the practice and management of their lives. This is why we need to build a questionnaire and try to understand people according to their realities.

5.3. Questionnaire Results

The questionnaire (Annex1) covered 10 inhabitats from Aljezur aged between 40 and 66 years old and exposes opinions on (1) water quality of Ribeira de Aljezur, (2) biodiversty in Ribeira de Aljezur, (3) the former aquaculture and about the landscape, (4) the rehabilitation of the area through a solar salt works implementation, (5) and other comments.

1) All of them are unaware of the chemical quality of the water, but they all say that is relatively good because of the fact that Sewage Treatment Plant (STP) is fully functional and cover the population living near the Ribeira de Aljezur. However some do not use the Ribeira de Aljezur for recreational activities for thinking that it has dubious quality due to fertilizers that are used on agricultural land. Others respond that the quality of the water from the headspring to the village is good but after it the quality is uncontrolled. Other sewage is treated completely and the increased control on fertilizers and pesticides used in agriculture or animal production decreased organic and chemical compounds in Ribeira Aljezur, still the same people who claim that there is more control, would like that there was even more control and that will promote a more integrated and comprehensive management in Ribeira de Aljezur and consequently increase the water quality.

2) Almost all people mentioned that there is a lot of biodiversity (birds, fish, jackknife clam and clams), that the Ribeira de Aljezur works as a maternity for fish and a place for nesting for birds. The most reported group of organisms was Birds, followed by Fish. Generally people were unaware of the salt marsh concept and its ecological features, but some mentioned that it used to be a place to catch crayfish. Many people refer to the fact that there is a proliferation of algae without knowing that eventually

has a negative effect promoting the eutrophication in the waters of the Ribeira de Aljezur. Some despise the existence of fish but almost all consider important to coastal fisheries that fish use the Ribeira de Aljezur as maternity. Many people refer to the fact that there exist many amphibians and insects and remembered the plagues of insects at the time when Ribeira de Aljezur had rice paddies.

3) People had mixed reactions when talking about the old aquaculture. Some people highlighted that it was good because it provided employment, because it was an innovative activity and consequently brought dynamism, fostering the economy of Aljezur. However even those said that the activity was dirty and they never had contact with the locals. Regarding the landscape, everyone thinks that is very beautiful, but with degrading aspect and that the cleaning of all land from the inlet till the center of Aljezur is urgent.

4) Almost all people think that the implementation of a solar salt works would be a good solution for job creation (perhaps because Portugal is facing a big financial and social crisis) and the possible retention of young because Aljezur has an aged population. Some highlighted the fact that rehabilitation would use land that is abandoned with stagnant waters that clashes with the landscape. Some also mentioned the beauty that solar salt works can lead to in an environment in which it operates and the use of marine resources. Also it would be an interesting activity that can keep a balance between the environment and economic development.

5) Previously people used more land for crops and took care of their land and adjacent areas, cleaning them. But currently the land is abandoned, whether it is private or public. Often the PNSACV is blamed for the abandonment and the lack of activities due to the amount of regulation and the difficulty in obtaining projects approval. There is even aggressiveness from people talking about the regulators that prevent them from carrying out activities that they used to perform in the past with less bureaucracy.

With the information on current values from observation, literature or from the questionnaire, it is possible do to a comparison with the actual values and the potential values coming with the solar salt works implementation as shows Figure 4.

Ecosystem Services	Actual Perception Value	After SSW Implementation Perception Value
Landscape beauty	No good	↗
Recreation	No good	↗
Biodiversity	Medium	↗
Riverline flood regulation	Medium	↗
Subsistence for fish	Medium	↗

Subsistence for birds	No good	↗
Research	No good	↗
Carbon sequestration	Good	→
Environmental education	No good	↗
Water quality	Medium	↗

Figure 3: Table with the Ecosystem Services, Actual Perception Value and After the Solar Salt Works (SSW) Implementation Perception Value in Ribeira de Aljezur.

We predict that there will be an increase in all the ecosystem services. Regarding the landscape, the area will be improved and beauty will increase, as a result from going from an abandoned land with stagnant waters and garbage to a maintained solar salt works. Recreation will increase as a consequence from almost all of the other services. Biodiversity will increase particularly for birds that will find a place to feed on and better adjacent places to nest, as other organisms will adapt into their own habitats, also a consequence from the increase of water quality. River line flood regulation, subsistence for fish and for birds will increase with the transformation, because at the moment the area almost does not have a biological settlement and it contains garbage. So this implementation will clean the area and manage/protect the adjacent areas. The research will increase because solar salt works at the moment is a hot activity not only because of new products but because in the last years we saw an increase of published papers about the topic. Carbon sequestration will be stable, and will probably decrease at a first stage because of the implementation, but after it will also increase. Environmental education will grow but it will be an option for activity promoters. Finally the water quality that is supposed to be one of the first services to be mentioned will experiment an increase. It is observed that there is eutrophication in the aquaculture ponds area and in some adjacent areas, where the water has no dynamics, and with an activity as solar salt works there will be a water flow every week, in fact every day. Also the water management and the chemical analysis will be one of the focus in the management of the solar salt works, so it obvious that a supervision and more control will be done regarding the water quality.

This results, in a significant increase of possibilities after the solar salt works implementation, resulting from all the effects on adjacent areas and even across the Ribeira de Aljezur.

6. CONCLUSIONS

Ribeira de Aljezur has a big potential to receive an implementation of solar salt works, however there are doubts if it is functionally feasible with the surrounding ecosystem and if the impacts will be positive or negative. Theoretically through the biological survey, the identification of the ecosystem services and the questionnaire, the project has what it takes to apply a growing of biodiversity and promote more ecosystem services because the former aquaculture has no purpose now. Neither the local human, animals or plants population takes any advantages from it. So far, there are only benefits from the transformation into solar salt works; either to the local community or to the environment and all the improvements are connected. All of them regarding jobs, the landscape, recreation, river line flood regulation, research, environmental education, improvement of the water quality, carbon sequestration and subsistence of fish and birds. However there were no natural value or ecosystem services translated into capital value. The surrounding area has an incredible biodiversity, but could be improved specifically the area of the ponds can be integrated into the rest of the environment. However the area is inserted in the PNSACV and although it makes it harder for the project's implementation, it is definitely an asset to the Park and an improvement considering the current conditions. Since the Park was created for Nature's protection, maintenance and development an improvement of the area through solar salt works is largely a good contribution. The recognition of the importance of this project through enhanced status can provide an incredible improvement of the area and the development of a eco-friendly human activity, and Portugal, being a country with such historical tradition in producing and trading salt for centuries deserves more from the available and abandoned land.

The Author's Message

Do we want to teach our children about the world and nature without having that pristine nature to show them? That is precisely why the maintenance of sites like solar salt works need to be preserved and developed, to serve as examples of man-made activities that still respect and keep nature intact. Where birds nest while just beside them, men work and plants still grow strong with the input of that work.

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Annex1 - Questionnaire

Person
Age and Profession?
Water quality of the Ribeira de Aljezur?
Biodiversity of the Ribeira de Aljezur?
What do you know about the former aquaculture?
What do you think about the current landscape?
What do you think about rehabilitating the area with Solar Salt Works?
What do you think the community would gain with the Solar Salt Works?
What do you remember from 20/30 years ago??

Annex 2

Birds

[1] Ardea cinerea

Portugal's biggest egret, with 90-100 cm in length. It has a big body, grayish and darker on the upper body. The head is black and white, the neck is long and the bill is straight and yellowish. The feet and legs are yellowish. The breeding season occurs between February and July, usually in colonies. It inhabits fresh or brackish waters. It feeds on fish, amphibians and small mammals.

[2] *Ardea purpurea*

Can reach up to 75-90 cm in length. Its plumage varies between grayish and pinkish tones. The underwing has purple spots, visible in flight. The head and neck are brown. It is present a spring and summer visitor in Portugal. It can be seen in estuaries and shallow lagoons. It preys upon fish and insects.

[3] *Egretta garzetta*

Medium sized egret, up to 55-65 cm in length, it has white plumage, black bill and legs and yellow feet. In Portugal it has a long breeding season. It is gregarious while nesting. I tis easily seen in wetlands and feeds on fish, crustaceans, amphibians and small mammals.

[4] *Ciconia ciconia*

It has white plumage, with black primary feathers. The bill and legs are red, mostly in adults and reaches up to 100-110 cm in length. It is a migratory species that may nest solitarily or in colonies, sometimes in urban settlements near agricultural fields and wetlands. It feeds on many preys, including aquatic organisms, small mammals, amphibians and insects.

[5] *Charadrius hiaticula*

A wader with 18 cm in length. It has a complete black collar and during summer adults have orange legs and bill. It has a broad black band on top of the head and the back is brown. It can be found in open areas, beaches, saltmarshes and intertidal areas. Worms and crustaceans are the main part of its diet.

[6] *Calidris minuta*

A small wader, reaching 14 cm in length. It has a short straight bill and black legs. The back is gray in winter and brown in summer. It passes through Portugal mostly in autumn. It occurs in estuaries, rice paddies and coastal lagoons. It feeds on small aquatic invertebrates.

[7] *Limosa lapponica*

Around 38 cm in length. During winter it is mainly brownish and in summer, males get more reddish and females cream. The bill is quite long and narrow. It occurs in estuaries, solar saltworks and intertidal areas. It's a winter migrant and it feeds on small invertebrates.

[8] *Tringa totanus*

It has 27 cm in length, the legs and base of the bill are bright red. In winter the back is brown, and in summer is darker. The belly is white streaked with brown. It is seen in several wetlands and brackish saltmarshes. It eats small invertebrates and polychaetes.

[9] *Tringa nebularia*

A wader with about 32 cm in length. It has greenish legs and a long bill, slightly curved upwards. During summer its back is gray with a bit of black, and the lower body is whitish. It inhabits coastal wetlands, saltmarshes an flooded fields. Its diet consists in small aquatic invertebrates and small fish.

[10] *Pandion haliateus*

It reaches 50-55 cm in length and 160 cm in wingspan. The dorsal area is dark brown and the lower part of the body is white with dark bands. The head is white with a black ocular stripe. It does not nest in Portugal anymore. It prefers cliffs, estuaries and lagoons to be able to hunt for medium sized fish, in both salt and freshwater.

[11] *Hieraatus fasciatus*

This is a large eagle, with 70 cm in length and 145-165 cm of wingspan. It has a light body and dark wings. It has a white spot in the back and while soaring the edge of the wings look white. The nuptial parade starts in November. It prefers valleys with big rivers in which to live, building the nest in cliffs, hunting mammals and reptiles in agricultural areas and woods. Can also nest on big trees in the south of Portugal.

[12] *Falco peregrinus*

The biggest falcon in Portugal, 45 cm in length and 115 cm of wingspan. It has broad pointy wings and short tail. The back and head are grayish and the belly is whitish and with black stripes. It can be seen near rocky areas, where it also nests. It preys upon other bird species.

[13] *Falco tinnunculus*

A falcon with 67-80 cm length and 67-80 cm of wingspan. The male has a gray head and tail and the back is brownish. The chest has many small spots. Females are all brown. It's a common species seen in many habitats like fields, parks, coastal areas and city centers. It breeds from March until June. It feeds mainly on small mammals.

[14] *Alcedo atthis*

It has 17 cm in length, with the head and back blue-green and the belly Orange. It has a long and strong bill and short legs. It is present in a great variety of freshwater habitats, from rice paddies to dams and lakes. It feeds mainly on small fish and aquatic insects and crustaceans. The breeding season goes from April to June. It nests near freshwater.

[15] *Merops apiaster*

A quite colorful species with 28 cm in length. The body is yellow, reddish and greenish –blue. The tail is long and the bill slightly curved down. Found in forested areas, plains and open areas. Builds the nest in holes in sandy walls or in the ground. It's a spring migrant and breeds in May. It preys mostly bees and beetles.

Small bird with 10 cm in length. It has short round wings and tail. The back is striped, the throat is white and pale around the eyes. It occurs in riparian biotopes, fields and saltmarshes. The breeding season is from March to September. It feeds on insects.

[16] *Cisticola juncidis*

It has about 13 cm in length. The male has a black head and a red orbital ring. The belly is white and the back is gray. The female is similar but brownish and duller. It is common to see this species in riparian areas, woods and fields. The breeding season is between March and July. During summer it east mostly insects and in winter add to the diet berries and fruits.

[17] *Sylvia melanocephala*

Small bird with 13 cm in length. Its back is reddish-brown with a supercillar gray stripe. The lower body is white. It occurs in wetlands, seen in riparian vegetation. It feeds mainly on insects.

[18] *Cettia cetti*

Small with 17 cm in length. It bears a crest and is mostly brown with a white belly. It can be seen in rocky fields, arid terrain and agricultural areas. It feeds on insects and seeds.

[19] *Galerida theklae*

A swallow with 17 cm in length. With bluish color, a rufous band on the back of the head, a cream rump, and long tail. They prefer valleys with streams or springs, nesting on bridges. It comes to Portugal in Spring and Summer. It feeds on invertebrates.

[20] *Cecropis daurica*

Bird with around 12 cm in length. The males in summer have a black head with a white collar. The wings are dark brown and the chest is orange. Females are duller than males, being light brown. It can be seen near wetlands, agricultural areas and dunes. The breeding season goes from February until July. It feeds on insects, barriers and seeds.

[21] *Saxicola torquata*

Salt marsh Plants

Quite branched, up to 1 m. Leaves of 4-10x1 mm, fleshy, normally green and sometimes red. Flowering occurs between March and October; the flowers are have vertical seeds. Habitat: Saltmarshes, salty soils and coastal cliffs.

[22] *Suaeda vera*

It can be found in saltmarshes, solar salt works, ocean cliffs, salty and sandy soils near the coast somewhat disturbed. It has edible leaves. May be used as ornamental.

[23] *Atriplex halimus*

Flowers between April and September. Present in halophyte woods, saltmarshes and estuaries.

[24] *Arthrocnemum macrostachyum*

Inhabits estuaries, salt marshes and solar salt works. When present on salty soils it can be flooded periodically.

[25] *Halimione portulacoides*

Shrubby perennial halophyte. Flowers with equal height in the cymes. Adapted mostly to upper part of saltmarshes.

[26] *Sarcocornia perennis*

Yellow, present in salt marshes and estuaries. A parasite in roots of other salt marsh plants.

[27] *Cistanche phelypaea*

Perennial, it has pink flowers. Present in halophyte woods, alkaline soils, saltmarshes, cliffs and coastal rocks.

[28] *Limonium ferulaceum*

Perennial. Grows on salty soils, rocky shores and salt marshes. Flowering occurs between April and September. Endemic to Portugal.

[29] *Limonium lanceolatum*

Other animals

Common length 50 cm. With a small mouth, rough skin and with a straight lateral line. Green-olive colored. Adults occur on mud and sand bottom in shallow water, at sea and brackish. Juveniles live in coastal waters. Juveniles feed on plankton and larvae of insects, adults feed on small fishes and invertebrates.

[30] *Platichthys flesus*

Common length 35 cm, with an oval body and rounded head. Eye side grayish-brown, with diffuse dark spots. It burrows into sandy and muddy bottoms, retreating to deeper water in winter. Juveniles inhabit the first years in coastal nurseries before migrating to deeper waters. Adults feed on worms, mollusks and small crustaceans.

[31] *Solea Vulgaris*

Elongated, anguilliform body. Lower jaw slightly longer and projecting with elongated dorsal and anal fins and green-brown colored. Inhabits all types of benthic habitats from streams to shores of large rivers and lakes. They enter the estuaries and colonize rivers and lakes; some individuals remain in estuaries and coastal waters to grow into adults.

[32] *Anguilla anguilla*

Small Fish, endemic to Portugal, up to 13 cm with a rounded snout. Inhabits small to medium sized streams with Mediterranean water regime. May be restricted to very small pools during summer. Breeds in shallow riffle habitats in fast-flowing water.

[33] *Squalius aradensis*

[34] *Discoglossus galganoi*

Adults vary between 5 and 7,5 cm in length. Wide head and pointy snout, Shiny and smooth skin. The hind legs are long with dark stripes. With a brownish back with different coloration patterns, being the belly white. Quite dependent on water. Nocturnal, feeding on slugs, worms and other invertebrates. The breeding season is in autumn.

[35] *Hyla meridionalis*

Maximum length of 5,5 cm. The eyes are big and brown and the legs are long with adhesive disks on the fingers. The belly is white and the skin bright green with a dark stripe from the nostril to the shoulder. The skin color may vary. It preys upon insects and reaches sexual maturity at 3 years.

[36] *Alytes cisternasii*

Maximum length 3,5-4,5 cm. It feeds on small invertebrates. The male protects the eggs from humidity and dryness, by carrying them on its back. A small toad, with a short and wide head, the back is brown with reddish warts and a white belly.

[37] *Mauremys leprosa*

Brown, gray or greenish oval shell. Orange lines along the neck. Yellowish plastron and strong nails. Females larger than males, reaching 21cm. Diurnal, inhabiting fresh water ponds or streams with high vegetation cover. The breeding season is during spring. Feeds on invertebrates, plants and fish.

[38] *Lacerta schreiberi*

A lizard that reaches 12,5 cm (head and torso) and the tail can be as long as its body. Yellow and greenish body with many small black spots. Males have blue heads during breeding season. It is diurnal, hibernating in winter. Eats mainly small invertebrates. Prefers damp places with high vegetation cover. Its sensitive to the water quality.

[39] *Lutra lutra*

Reaches 60-90 cm in length. Long and slender body, with a brown back and white belly. It has a thick and silky fur. Paws with interdigital membranes. Rounded snout, small ears and eyes. Mainly nocturnal having one litter per year. Feeds mainly on fish. Lives in family groups along streams and rivers.

[40] *Erinaceus europaeus*

Reaches 24 to 31 cm in length. Its body is covered with spines. Brownish in color with short legs. Pointy snout and small ears. Essentially nocturnal, breeding in spring. Feeds upon invertebrates that roam the ground. Inhabits forests, meadows and also suburban areas. Can disperse in search of food.

[41] *Oryctolagus cuniculus*

Reaches 35-50 cm in length. Ears with an inferior length than the head. Brownish fur. Mainly nocturnal breeding from October to June having several litters per year from 3-6 juveniles. Lives in family groups. Feeds mainly on leaves, grass and bulbs. Inhabits open fields, woods and farm lands.

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