



**Puerto de Huelva**

Autoridad Portuaria de Huelva

## **PROJECT REPORT**

### **"ECOLOGICAL RECOVERY IN THE PORT OF HUELVA"**



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## 1. INTRODUCTION

The Port of Huelva is located in the Southwest of the Peninsula, a strategic position with respect to the main international maritime routes. Specifically, its land and inland water service area is located in the estuary of the Odiel and Tinto rivers, making it a longitudinal port and most of the Port's facilities and service piers are located along the left bank of the Odiel and Ría de Huelva estuaries.

The origins of the Port of Huelva are closely linked to the province's wealth of minerals. That is why the first civilizations (Tartessians, Phoenicians, Romans...) exploited mineral deposits in Huelva, and settled in the area since there was a natural port with a strategic location on the shores of the Atlantic that allowed the maritime transport of minerals.

Later, great events throughout history such as the mining operations of English companies in Huelva with advanced techniques, and the settlement of the Industrial Promotion and Development Pole in the mid-20th century, shaped and laid the foundations of the current Port.

From then until today, the Port of Huelva has continued growing in facilities and traffic, consolidating itself as one of the first Ports of General Interest in Spain.

The Port of Huelva has the largest land area in the Spanish port system, 1.700 hectares, where port activity coexists with that of one of the main industrial centres in Spain, with more than 245.000 hectares of land and water in protected areas.

Consequently, in the Port of Huelva exists sites of international importance for migratory waders, natural habitats and wild protected fauna and flora, mainly: Estuaries (1130), Mudflats and sandflats not covered by seawater at low tide (1140), Coastal lagoons (\*1150), Salicornia and other annuals colonizing mud and sand (1310), Spartina swards (*Spartinion maritimae*) (1320), Mediterranean and thermo-Atlantic halophilous scrubs (*Sarcocornetea fruticosi*) (1420), Embryonic shifting dunes (2110), and Shifting dunes along the shoreline with *Ammophila arenaria* ('white dunes') (2120). These areas are home to a wealth and variety of habitats and landscapes, which are ideal for the breeding of a variety of species of birds protected places. Highlights include: *roseate spoonbill*, *ardea cinerea*, *ardea purpurea*, *circus aeruginosus*, *pandion haliaetus*, *ciconia nigra*, *plegadis falcinellus*, *grus grus*, *lutra lutra*, among others. The ecological uniqueness of these spaces in the Port of Huelva has coexisted and have been sustained with industrial, logistics, commercial and port activity settled in the Service Area for over 140 years.

Moreover, the urban development of the city of Huelva is concentrated along the left bank of the river Odiel, where the infrastructure of the Inner Harbor is located, as well as facilities of an important basic chemical industrial complex settled since the 1960s.

Sustainability is therefore for the Port Authority of Huelva, one of the pillars of its activity and its environmental, economic, social and institutional strategy. In this context, the Port of Huelva, aware of the needs of environmental conservation, has executed projects such as the one we present regarding the environmental and social restoring of natural areas in the Port.

## 2. DESCRIPTION OF THE SUBMITTED PROJECT

### 2.1 BACKGROUND

As it has been introduced, the Port of Huelva has existed since very ancient times due to its strategic position for the maritime traffic of minerals, and one of its great transformations came from the settlement of the Industrial Promotion and Development Pole in the middle of the 20th century.

This was an important revulsion for the city and the Port and it still is today, but in its beginnings, the 60's, with an environmental legislation practically inexistent, a landscape and environmental degradation in the marshes closest to the industrial pole that are the ones located in the left bank of the Odiel river, and are inside the Service Zone of the Port.

In the 1980s and 1990s, were executed different plans to correct spills and we improve industrial installations with environmental criteria. However, there were damaged areas that required intervention for environmental recovery, areas without vegetation or dominated by the invasive species *spartina densiflora*, with high rates of erosion.

So, in the first decade of the 21th century, the city began to demand the use and approach of its Estuary again, with greater environmental awareness. So, the Port of Huelva promoted the integration and restoration of environmental and socio-cultural values of the estuary, undertaking an ambitious ecological recovery project.



Figure 1: Location

## 2.2 PURPOSE OF THE PROJECT

The project proposed basically one object: the improvement of the environmental quality in the area, and the quality of life of citizens. The outcomes were magnificent:

- Recovery of ecological functions in marshes and the native species, *spartina maritima*, first experience in Europe.

### BEFORE



### AFTER



**Figure 2:** Restored area, before and after.

- Creation of a carbon sink that captures more than 300 tons of carbon annually.
- Stabilization of marshes eroded by sea level changes.

### BEFORE

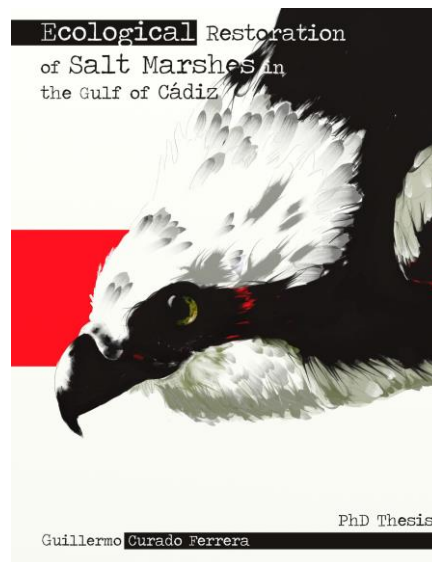
### AFTER





**Figure 3:** Consolidation and stabilization of sediments, before and after.

- Conservation of protected species such as: *pandion haliaetus*, *platalea leucorodia*, *lutra lutra*, etc.
- Eradication of invasive species such as *spartina densiflora*.
- The construction of a Riverwalk, a pedestrian walkway and a bicycle lane, in order to facilitate the connection of the city of Huelva with the Punta del Sebo, thus diversifying the current modes of transport.
- Environmental dissemination: scientific articles, cycle of conferences for citizens in collaboration with Seo BirdLife, edition of the Huelva Port bird guide, etc.





Estuaries and Coasts (2014) 37:589–601  
DOI 10.1007/s12237-013-9713-1

### Do *Spartina maritima* Plantations Enhance the Macroinvertebrate Community in European Salt Marshes?

Guillermo Curado · Juan E. Sánchez-Moyano · Enrique Figueroa · Jesús M. Castillo

Journal of Coastal Research	30	3	629–634	Coconut Creek, Florida	May 2014
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### Plant Zonation in Restored, Nonrestored, and Preserved *Spartina maritima* Salt Marshes

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### POTENTIAL OF *SPARTINA MARITIMA* IN RESTORED SALT MARSHES FOR PHYTOREMEDIATION OF METALS IN A HIGHLY POLLUTED ESTUARY

G. Curado, A. E. Rubio-Casal, E. Figueroa, and J. M. Castillo  
Departamento de Biología Vegetal y Ecología, Universidad de Sevilla, Sevilla, Spain

Water Air Soil Pollut (2014) 225:2108  
DOI 10.1007/s11270-014-2108-5

### Effectiveness of the Aquatic Halophyte *Sarcocornia perennis* spp. *perennis* as a Biotool for Ecological Restoration of Salt Marshes

Guillermo Curado · Brenda J. Grewell · Enrique Figueroa · Jesús M. Castillo

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## Public Perceptions and Uses of Natural and Restored Salt Marshes

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*Bird Study* (2013), 1–10  
<http://dx.doi.org/10.1080/00063657.2013.790875>



## Avian communities in *Spartina maritima* restored and non-restored salt marshes

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*Environ Monit Assess* (2013) 185:8439–8449  
DOI 10.1007/s10661-013-3185-4

## Native plant restoration combats environmental change: development of carbon and nitrogen sequestration capacity using small cordgrass in European salt marshes

Guillermo Curado • Alfredo E. Rubio-Casal •  
Enrique Figueroa • Brenda J. Grewell •  
Jesús M. Castillo

Figure 4: Phd Thesis and some of the scientific articles published.

### 2.3 PROJECT ACTIONS AND INNOVATIVE CHARACTER

The project we are dealing with consisted of two actions:

#### Action 1: Recovery of ecological values.

The Port of Huelva started an innovative project of ecological restoration of a four-kilometre stretch of the left bank of the Odiel River, covering more than 220,000 m<sup>2</sup>, an innovative action at European level because it used bio-tools such as *spartina maritima*.



At that time, the invasive species were eliminated and more than 100.000 seedlings of *spartina marítima* were introduced, in addition to other species such as the *atriplex halimus*, *limonia strummonopetalum* and *tamarix* sp., in the high marsh areas, and *pinus pinea* and *juniperus oxycedrus* in the small estuary dunes.

Thus, the seedlings began to grow and expand, creating grasslands and colonizing areas without vegetation, thus helping to consolidate sediments, fix atmospheric carbon, proliferate macroinvertebrates, fish and birds, and ultimately increase biodiversity.

During 2012, work was carried out to monitor plant, fish and bird communities, evaluate the ecological functions of the restored area and assess the impact on citizens.

The results showed the absolute success of the actions undertaken, and logically, the need to continue undertaking new and more ambitious tasks for the conservation of the restored area.

In these sense, in 2015, the Port of Huelva carried out the development of new actions as part of an integral project for the conservation of natural spaces in the port. In this last stage of the project, the plant diversity has been increased by introducing (seeds or seedlings) new native halophytes (*inula chritmoides*, *tripolium aster*, *limonium* sp., etc.), and the bird community in the Port has been studied, in relation to the vegetation and the characteristics of the abiotic environment along the tidal gradient in the restored marshes after their maturation.

Specifically, we have developed the following actions with the project:

1. Increase of the vegetation diversity in Port marshes by introducing (in seeds and plants) new endangered native species of halophytes with high interest (*chritmoides inula* L., *aster tripolium* L., *limonium* sp., *frankenia* sp., etc.). In this plantation participated volunteers from the University of Huelva, citizens, the responsible for environmental administration and the Port Authority of Huelva representatives. All of them recognized the environmental initiative, what was reported in various media.





**Figure 5:** Volunteer day for planting new species.

2. Monitoring of plant communities in low, medium and high marshes, paying special attention to the presence of threatened species (*zostera noltii* and *spartina maritima*) and alien invasive (*spartina densiflora*). In comparison with previous results in 2011-2012, the last project achieves excellent and better results of the habitat evolution in terms of coverage; ecological connectivity; ecological diversity; and total biodiversity of species established in the marshes studied.



**Figure 6:** Monitoring works.

3. Study of zonation of the bird community in relation to vegetation, and characteristics of the abiotic environment along the tidal gradient in port marshes along their maturation.



**Figure 7:** Monitoring works.

4. Finally, in 2015 started the last phase of construction of the river walk along a stretch of one kilometer from the left river Odiel began. This part of the project has just ended, having scheduled to open on July 5, 2016. For this inauguration were planned acts aimed enjoyment of citizenship.

### **Action 2: Recovery of social and historical values.**

Likewise, a pedestrian path and an elevated footbridge were created that runs through the 4 km of restored marshes, in height, so as to facilitate the connection of the population and visitors, between the city of Huelva and the Punta del Sebo.

Along this path and footbridge, different points have been arranged with environmental interpretation panels, providing passers-by with information about the ecological importance of the restoration undertaken and the important benefits for the estuary.

At the same time, began the construction of a riverwalk along a one-kilometre stretch of the left bank of the River Odiel,. It is therefore annexed to the Riotinto Quay, an Asset of Cultural Interest that is today one of the signs of identity of the city of Huelva.

This phase began in parallel with the previous one and has taken 8 years to complete. Once the river walk was put into service, the access of the citizens to the restored space in the Odiel estuary was greatly enhanced, favouring the dissemination of the environmental values of the space and the estuary, and the leisure and enjoyment of the space.



**Figure 8:** Riverwalk.

**Therefore, the combination of both actions has resulted in the recovery of the environment and social uses, successfully facing the important challenge presented by the project: to improve the environmental quality and the quality of life of the citizens of Huelva, and we contribute to the global goals of decarbonization.**



Currently, it is possible to say that the project has integrated perfectly port-industrial uses with the conservation of environmental values and with the development of the City, making possible Port-City integration strengthening the environmental strategy of the Port of Huelva.

In fact, the project has become an international reference as an example of an innovative environmental project that has made possible the integration of the Port-City. That has led it to be considered by the World Network of Port Cities in its Guide to Good Practice "Making the City with the Port".

The project's budget has exceeded 27 million euros. This shows the important commitment of the Port Authority of Huelva to sustainability in its space.

## 2.4 OUTCOMES

Currently, the results of the project executed and the follow-up studies are enormously satisfactory. Highlighting:

- The conservation of *spartina maritima*, an endangered species included in some European red lists, has been promoted.
- A total of 57 bird species (17 of them waders) have been censused in the restored port marshes. The most important protected species that used the restored harbour marshes were protected ones.
- Of the latest introduced species, *limonium angustifolium* showed 80% survival, *limonium ferulaceum* 30%, *aster tripolium* 67% and *frankenja laevis* 16%.
- The carbon sequestration capacity of the restored marshes was evaluated in 300 tons of carbon per year, which corresponds to the carbon dioxide emitted over two and a half million kilometers by an average utility vehicle (emitting 110 g of carbon dioxide per kilometer traveled), that is, over 7 trips between the Earth and the Moon.
- Based on population surveys, coastal marshes are beneficial ecosystems for 75 per cent of respondents. More than 60% of citizens visit the marshes at least once a year. The reasons for these visits are usually: walking, cycling, fishing, photography and bird watching.



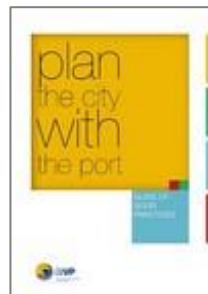
### 2.3 PROJECT OPPORTUNITIES FOR ENVIRONMENTAL EDUCATION AND AWARENESS OF THE POPULATION

Based on all these results, it has been possible to develop a specific program for the dissemination, education and environmental awareness of the population and visitors. Highlighting aspects such as the following:

- An environmental itinerary has been created, with environmental interpretation points showing information about the project and the need for conservation of the space.
- Environmental information material has been published, such as the Guide to the Birds of the Huelva Estuary. These materials have been disseminated in different languages and at different points and through different means. This Guide was made with the collaboration of Seo BirdLife.
- An educational program associated with the restored port marshes in the Huelva estuary has been developed. It includes the implementation of 6 different modalities of environmental education. This program was carried out with the collaboration of Seo BirdLife. The objective was to disseminate the environmental values associated with the restored area using the avifaunal diversity as a teaching resource. The main groups were: school children, university students and other interest groups.
- A communication and dissemination plan has been developed at a local, regional, national and international level, through the Web, RRSS, specialized magazines, the media, etc.

### 2.3 IMPACT OF THE PROJECT AT THE INTERNATIONAL LEVEL

The project promoted by the Port Authority of Huelva is consequence of its commitment to sustainable, linked to global goals and policies, and Port-City integration. It has become an international reference, having been taken as a reference by the World Network of Port Cities (AIVP) in its good practice guide "Making the City with the Port". Likewise, this project has been presented in different international meetings and congresses.



These and other acknowledgments, recognise the innovative nature and ecological and environmental benefit of the project not only at local level, but also on a large scale as long as the project was planned consistently with energy and nature conservation policies.