



# **Management and restoration of Mediterranean wetlands to provide ecosystem services and other benefits.**

**Nature-based Solutions in the former saltworks of the Camargue**

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# Content



- **The Camargue**
- **Flood risks**
- **Our site: the former saltworks**
- **New management: A Nature-based Solution restoration strategy**
- **Ecosystem services & economic benefits**
- **Conclusions**

# The Camargue : a human shaped delta



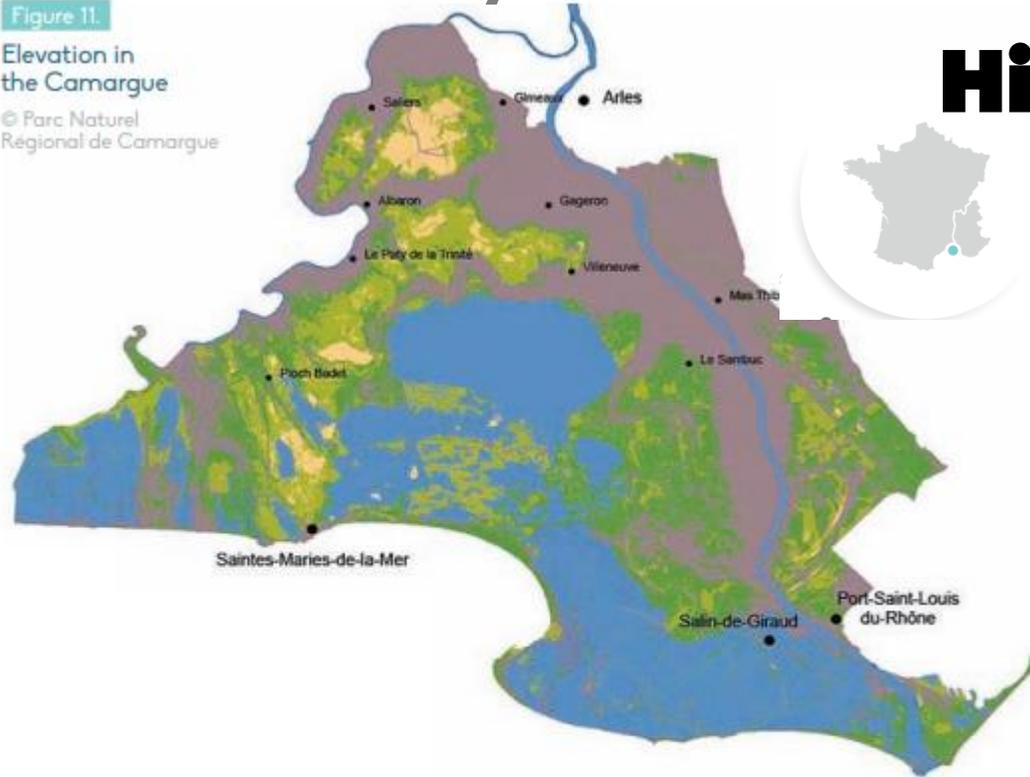
- **Lagoon system disconnected from the Rhône river**
- **Water pumped out of the Rhône river**
- **Agriculture and bull farming**
- **Very important area for migratory birds**



# Like many other Mediterranean coastal ecosystems:

## High vulnerability to sea level rise

Figure 11.  
Elevation in the Camargue  
© Parc Naturel Régional de Camargue



- 70% of the Camargue < 1m
- European Space Agency: Elevation of 2m in 2100

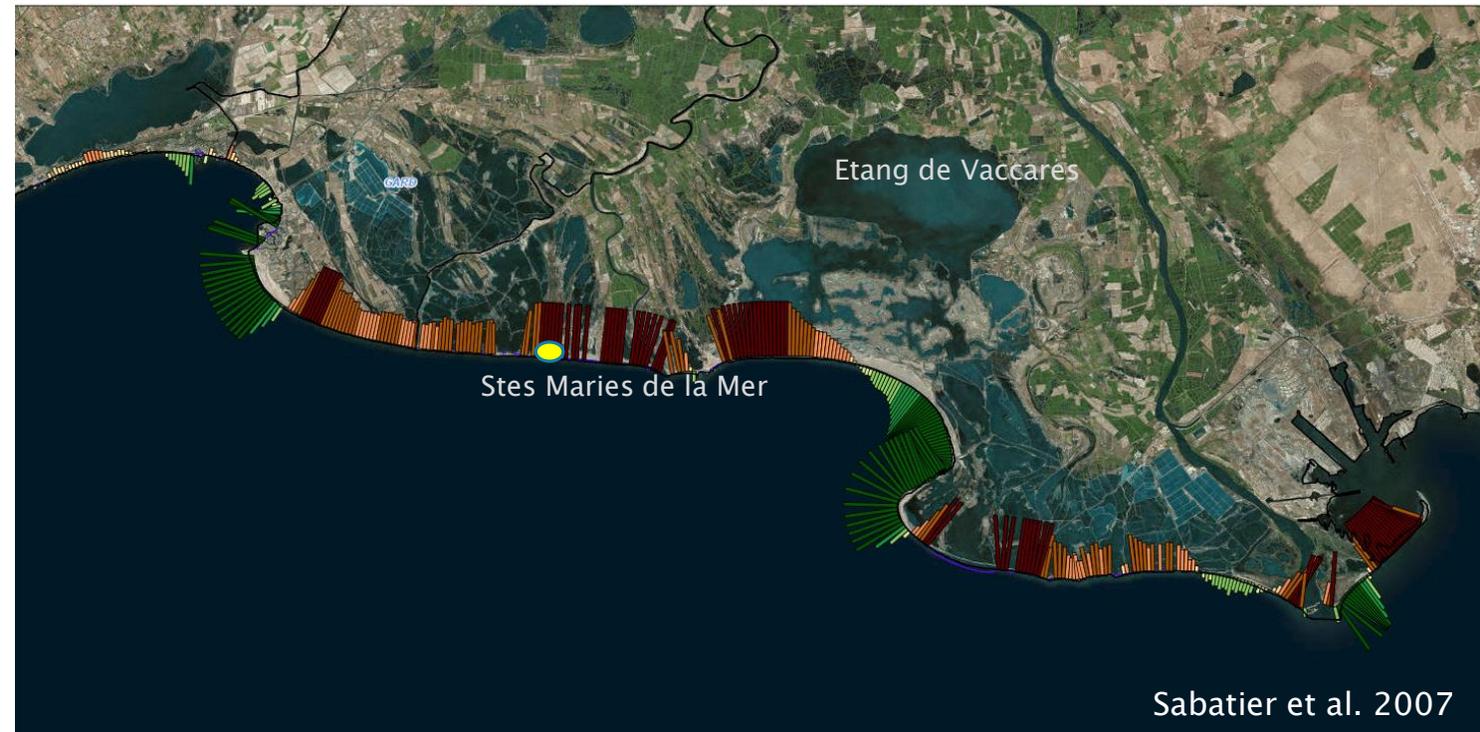
Elevation	Surface	% of territory
Below 0m	2600 ha	2,6
≥ 0 m and ≤ 0,5m	13800 ha	13,8
≥ 0,5 m and ≤ 1m	22200 ha	22,2
≥ 1m	30500 ha	30,5
Water surface	30900 ha	30,9

# With a Dynamic shoreline

- A naturally dynamic shoreline
- Highly artificialized to protect against coastal



geographic data at sea and on the coast: coastline and risks



# The former saltworks Sold to the Conservatoire du Littoral





**What to do?**

# Identification of CHALLENGES

## Environmental

1. Sea level rise: habitat transformation
2. Oversalinization of the lagoons .  
Disruption of the life cycle of aquatic species
3. Loss of Salicornia scrubs and other salt marshes

## Social

- 1. Sea level rise:** Protection of people and properties in surrounding areas
2. Engage the local population and stakeholders that are used to the saltworks
3. Accessibility to the site
4. Exploitation of natural resources (hunting and fishing)

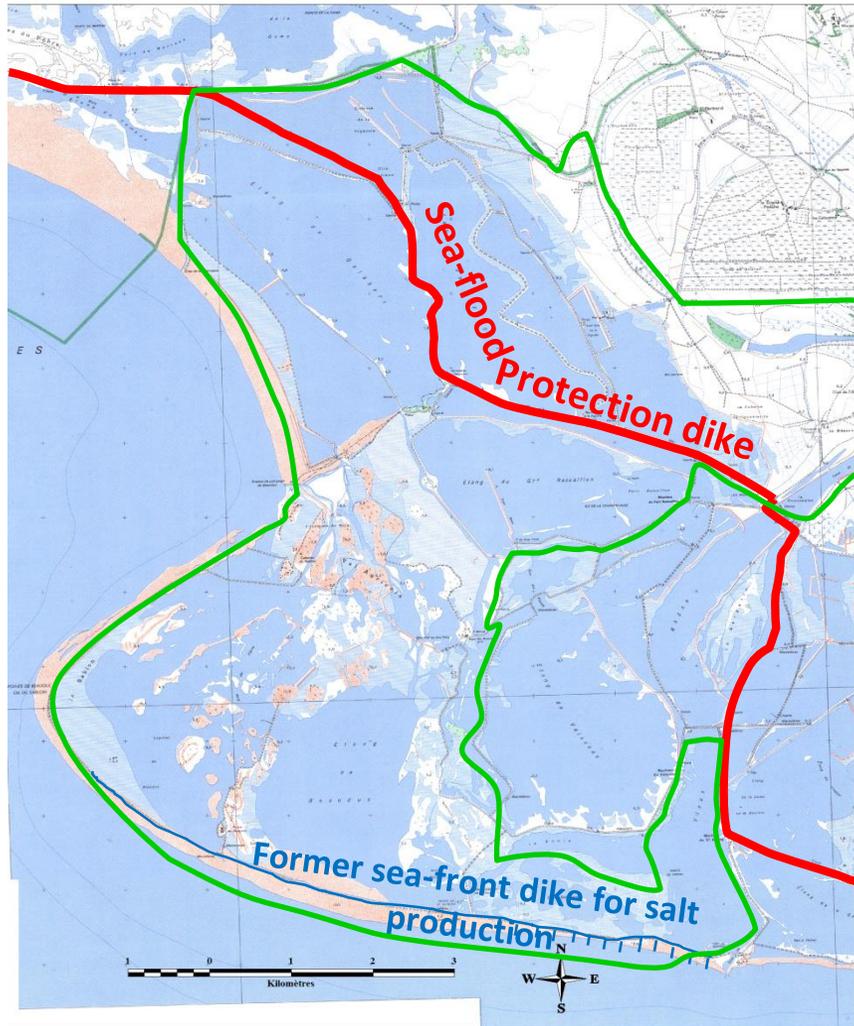
## Economic

1. Coastal erosion (dikes)
2. Management of sea flooding risk
3. Hydraulic management of the former saltworks

**Main challenge:  
Sea level rise**

# Option 1) Grey infrastructure

**repair the sea front dike to limit the phenomena of erosion and marine submersion**



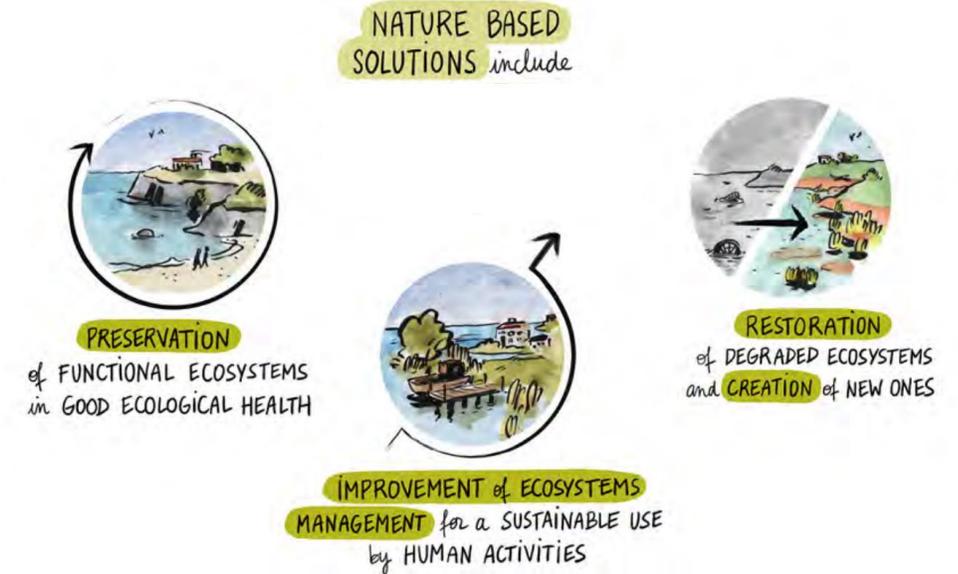
 Property of Conservatoire du littoral

# Option 2) a hybrid solution = Grey + NbS

**Renaturalize the former saltworks** so that the site can act as a **buffer zone** during submersion events and provide natural means of adapting to variations of the coastline.



**Keep the protection of the existing internal dike** and abandon the front sea dike



# TOUR IN THE CAMARGUE'S FORMER SALTWORKS



A CONCRETE NATURE  
BASED SOLUTION



<https://vimeo.com/255004511>



# Management decision:

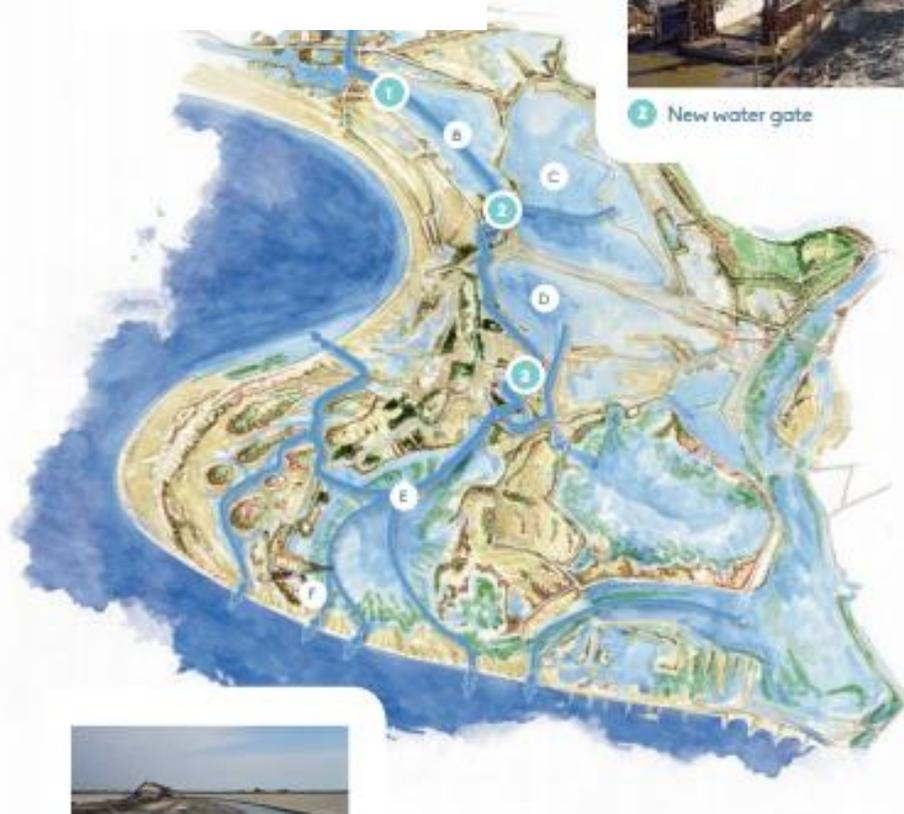
## Option 2) Ecological and hydrological restoration

intervention

Monitoring & research

- |     |  |     |
|-----|--|-----|
| +++ | <b>1</b> Restore a more natural hydrological functioning   | +++ |
| +   | <b>2</b> Restore the natural ecosystems characteristic of coastal lagoons and sandy coastlines, including dunes, salt steppes and saltmarshes. | +++ |
| ++  | <b>3</b> Maintain or increase the carrying capacity for breeding colonial water birds.   | +++ |
| +++ | <b>4</b> Implement adaptive management to sea-level rise, including controlled coastal retreat in areas affected by erosion.                   | +++ |
| +++ | <b>5</b> Contribute to sustainable development, including green tourism and recreational activities.   | +++ |

# Restore a hydrological function in



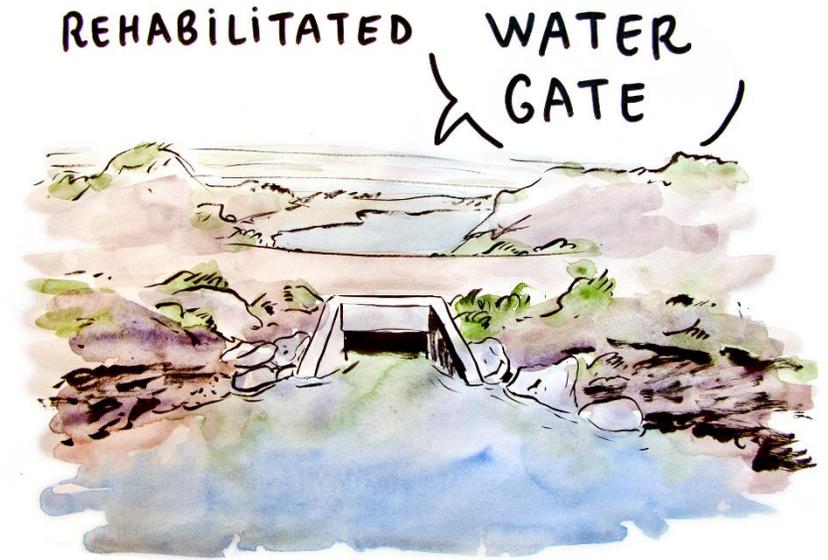
1 Rehabilitated water gate



2 New water gate



3 Channel dredging



© Flore Vigneron

- LIFE+ MC-SALT (2012–2016)
- Partnership with WWF–France (2014–2020)
- « Reconnections » projects supported by Agence de l’Eau and Region Sud(2017–2019)

# **How to support a Nature -based Solution?**

## NbS Actions

1) Identify the Societal challenges

2) Recognize the solution through Ecosystem -based approaches

3) Holistic analysis to engage the stakeholders: Evaluation of biodiversity and human well being effects, so called ecosystem services



## 2 Ecosystem-based approach



*“In a changing climate, wetlands can play a significant role as buffer zones. They are real “sponges”, stocking water during heavy rain, which is then available during periods of drought. They can thereby regulate the high variability in precipitation, which our dams and dikes cannot address anymore”,*  
Jean Jalbert, General Director, Tour du Valat, Camargue, France.



M. Gauthier Clerc / Tour du Valat



M. Thibault



M. Thibault

# Biodiversity habitat recovery

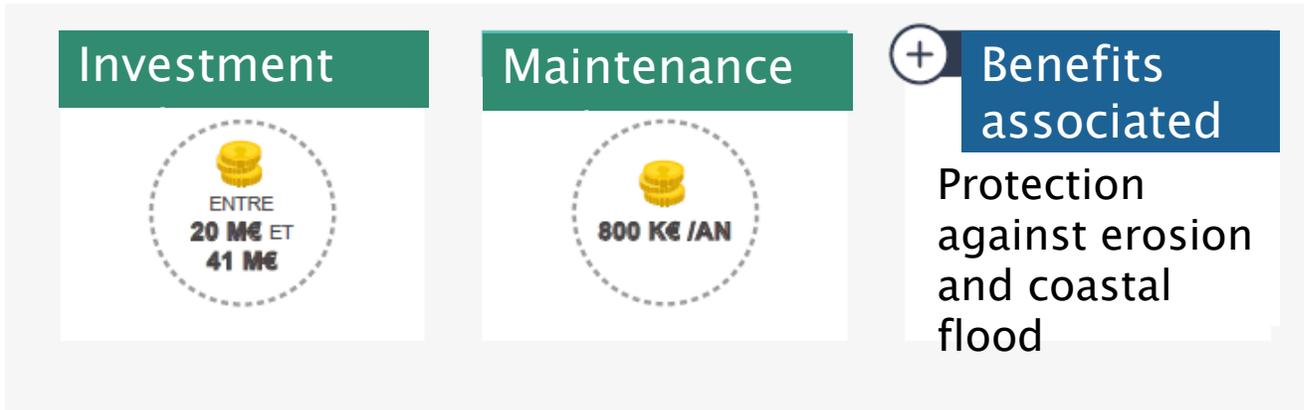
- Bare ground is recolonized by halophilous vegetation
- Increased number and diversity of wintering ducks
- Migrant shorebirds have increased in winter and spring but decreased in summer and autumn
- Some breeding colonial waterbirds have increased
- The function of fish nursery is slowly recovering and migration by Eel is restored



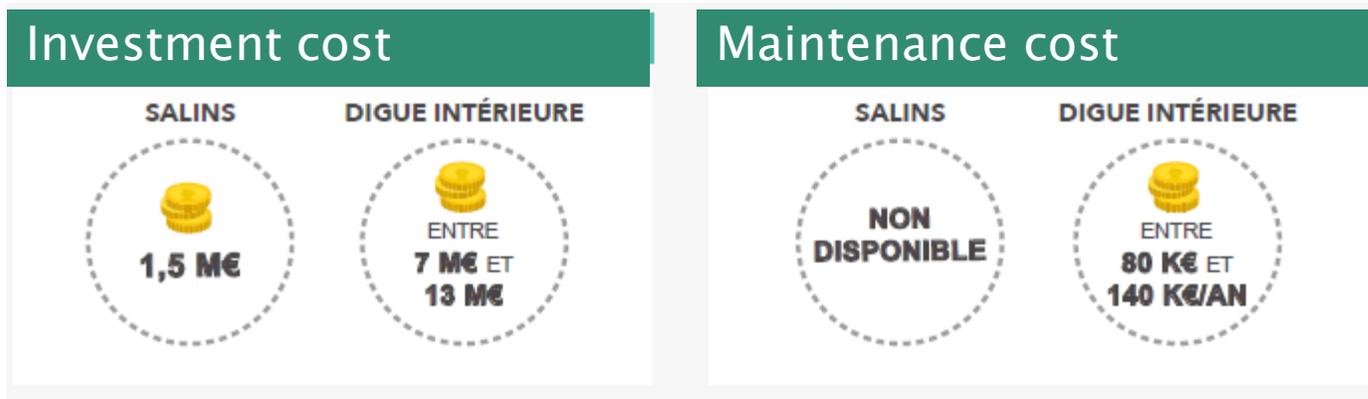
© F. Leborne

# 3 Evaluation: Economic evaluation

## Option 1: Grey infrastructure

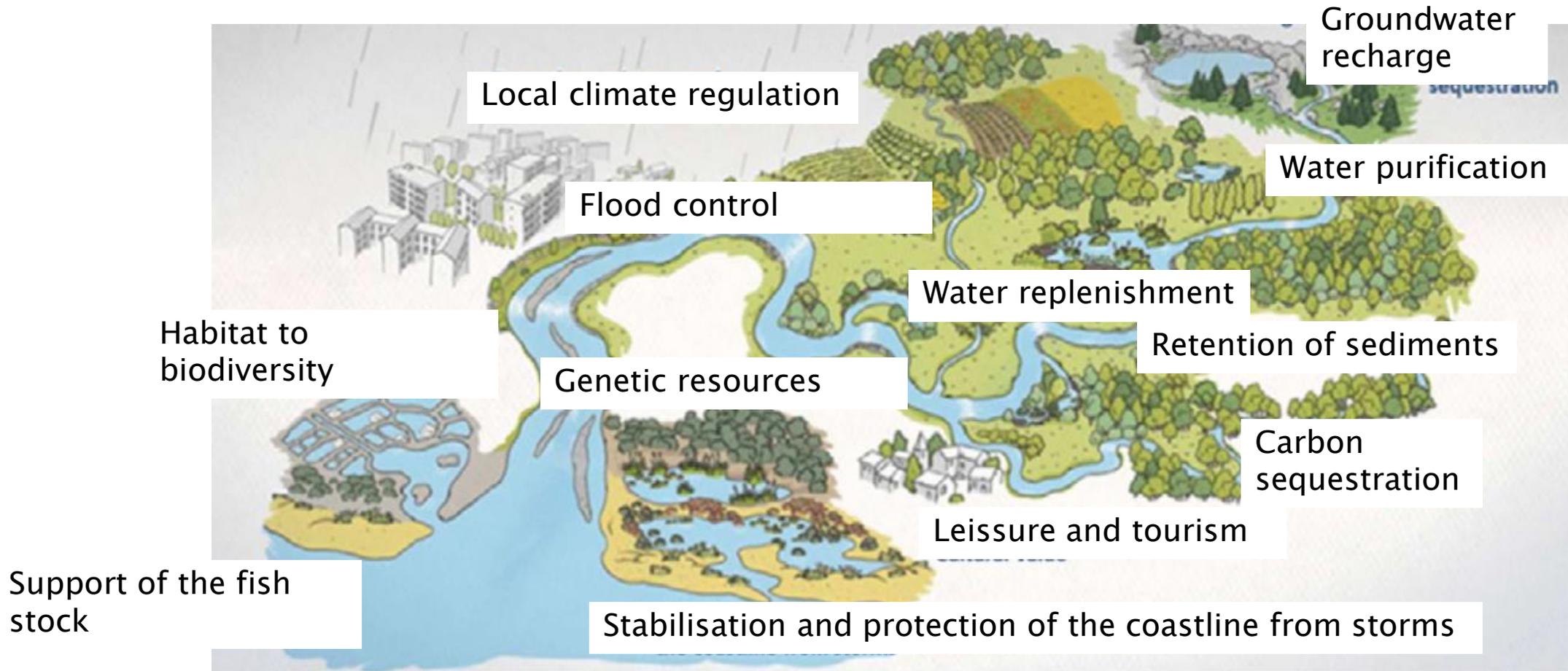


## Option 2: Hybrid NbS



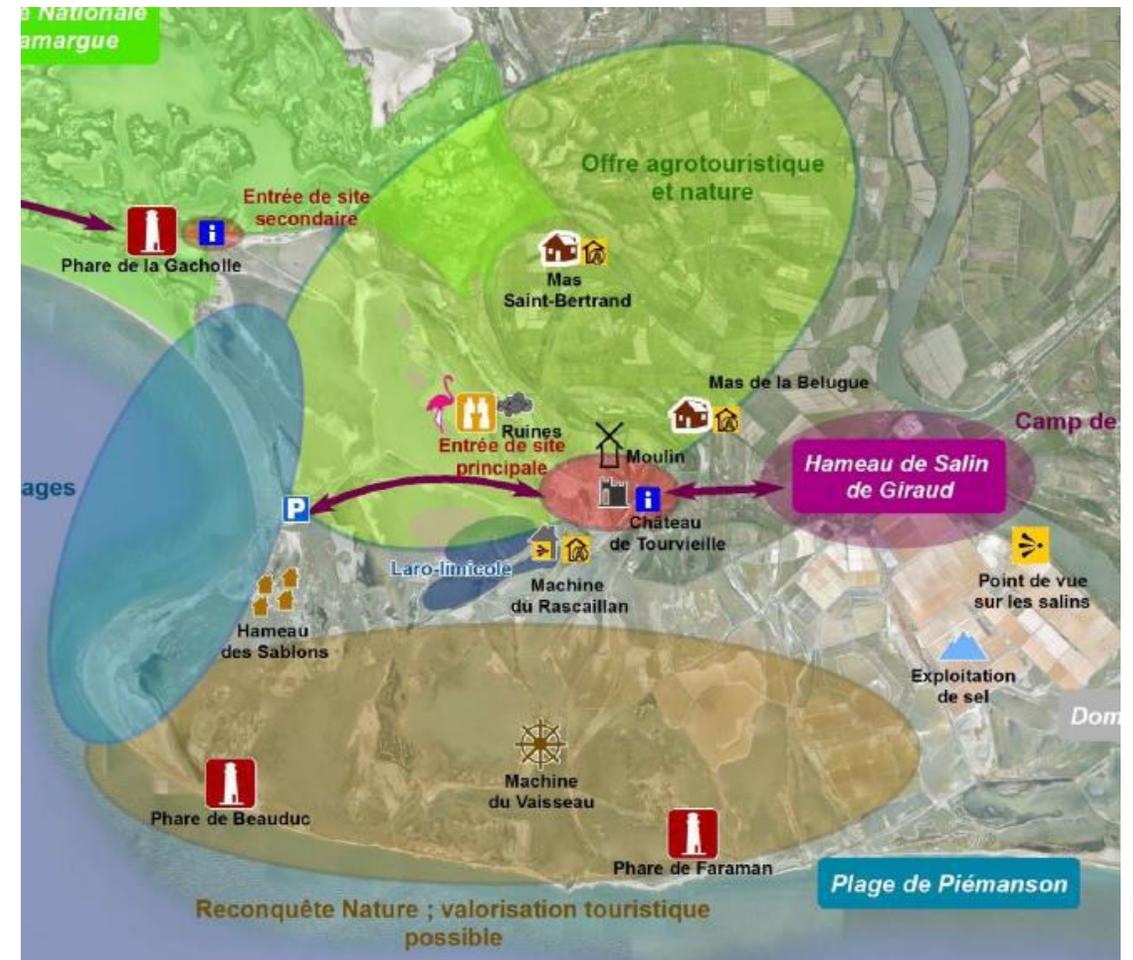
**Which ecosystem services?**

### 3 ECOSYSTEM SERVICES



Source: Adapted from an illustration by the Water Agency Rhône Mediterranee Corse

# These services are enjoyed by the inhabitants and tourists



# Conclusion

- **The former saltworks of the Camargue become a buffer zone, providing a space for water**
- **Creation of an ecological corridor**
- **Habitats are recovering: Natural processes do much**
- **A unique open sky laboratory for coastal protection Nature based Solutions**

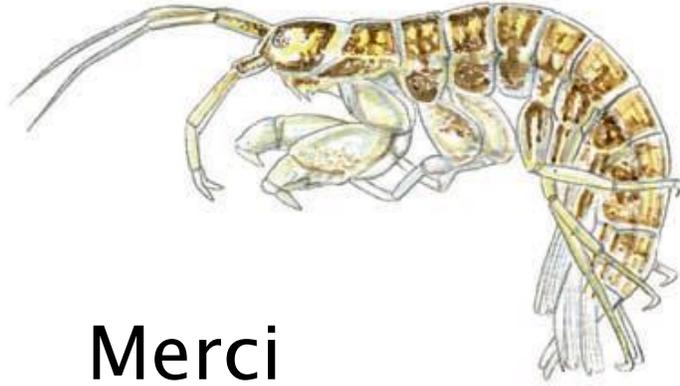


# Key challenges

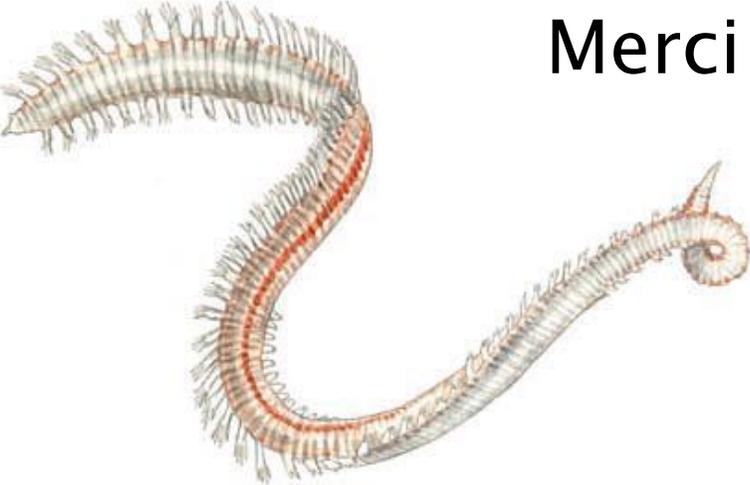
- **Socially accompanying the change and evolution of perceptions at the local level**
- **Monitor, quantify and consider the possible futures of a fast-evolving site**
- **Reconciling issues related to the rewilding process, freedom for public access, and risk management, to meet the expectations of local economic development**



Photo M. Thibault



Merci



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Source: Drawings from Cyril Girard: Biological indicators of water quality improvements

# Advised publications

