

Working with Nature - soft protection interventions in a barrier-island lagoon (Ria Formosa, Portugal)

1. Policy Objective & Theme

- ADAPTATION TO RISK: Managing impacts of climate change and safeguarding resilience of coasts/coastal systems
- ADAPTATION TO RISK: Preventing and managing natural hazards and technological (human-made) hazards

2. Key Approaches

- Knowledge-based
- Technical

3. Experiences that can be exchanged

Soft interventions in a barrier-island system which include the reinforcement of the dunes using dredged sediments from an inner channel and the relocation of inlets based upon their natural dynamics. Such interventions can be successful in avoiding ocean over-wash while maintaining a good water exchange efficiency necessary to safeguard the ecological functioning of the system.

4. Overview of the case

The Ria Formosa lagoon is a multi-use barrier-island system which has been showing progressive degradation and erosion but also infilling and meandering of some of its channels. This has been intensified by sea-level rise but also human activities (infrastructure, land reclamation that reduced the water body area and volume) which increased the risk of hazards. After a heavy winter storm, in 1995-96, that destroyed part of one of the peninsulas it was necessary to intervene. However, the interventions avoided hard protection techniques and respected the natural dynamics of the area.

5. Context and Objectives

a) Context

The Ria Formosa lagoon, in the South of Portugal, represents a barrier-island system and their geomorphological features are unique in Europe. It is a multi-use area, supporting important activities such as shellfish culture (representing the biggest clam producer in Portugal), salt production, tourism, recreation and leisure. At the same time it is considered a wetland of world interest, due to the importance and diversity of its habitats but also the fauna it houses, particularly resident and migrating birds. These features have granted it special protection status: it is a national Natural Park and is internationally recognised as Natura 2000 and Ramsar sites.

Ria Formosa comprises 2 peninsulas (Ancão and Cacela) and 5 barrier-islands and the water exchange is made through six tidal inlets. Two of these inlets have been opened and stabilised with groynes, while the other four show different patterns and rates of eastward migration. The barriers have been showing a progressive degradation and significant reduction in their area during the last decades, due mainly to over-wash, foot-stepping and coastal erosion. At the same time, the periodic dredging made only in the navigation channels contributes to the diminishing of the water exchange in other parts of the system, which can threaten its ecology and the shellfish production.

It is recognised that the erosion affecting the barrier islands is being influenced by the several groynes installed in Vilamoura (west of Ria Formosa) and the ones in the two inlets, which have reduced the sediment drift eastwards. Furthermore, the

heavy human occupation of some of the islands, particularly since the 1960's construction of some illegal holiday houses and tourism related services in the western Peninsula of Ancão (known as Farol's Island) is thought to affect the natural behaviour and resilience of the barriers, besides increasing significantly the risk of hazard to humans. During the 1995-1996 winter, extensive over-wash associated with storm events led to the destruction of the dune crest in several parts of the western Peninsula of Cacela, leading to the formation of a new inlet in its middle part, in front of Fábrica village. Simultaneously, the lagoon channel in the back barrier was gradually silting up. The continuity of over-wash events could further result in the narrowing of the inner channel, threatening the existing clam and oyster cultures and the exposure of the village to direct wave action during storms.

b) Objectives

To protect the Fábrica village and safeguard the ecological functioning of the system, including the important economic activity of shellfish production, using soft protection techniques.

6. Implementation of the ICZM Approach (i.e. management, tools, resources)

a) Management

Natural Park of Ria Formosa (management entity of the project, which at the time had full responsibility over the area) and Institute for Nature Conservation and Biodiversity is the governmental body responsible for nature conservation and biodiversity policies, and for the management of Protected Areas, which co-financed the works. The Port Authority was the entity sub-contracted to supervise the dredging and provide assistance, and CIACOMAR, a research centre from the University of Algarve provided scientific advice and monitored the effects of the interventions, together with other research centres and Institutes.

b) ICZM tools

Cacela Peninsula: Between October 1996 and February 1997 the channel of Cacela was dredged and the sediments were deposited on the western part of the Peninsula, forming an artificial dune ridge. The nourishment intended to increase the dune crest height to 5,5m above mean sea-level (MSL) along the western 2000 m of the Peninsula, closing the inlet. Between April and August 1997, two longshore sets of fences were placed on the eastern 1200m of the replenished top to trap sediments and increase the dune height. In the beginning of 1998, dune vegetation (*Amophila arenaria*) was planted inside these fences and the natural flora succession began. To avoid the impact of foot-stepping, two above-ground, wooden paths were placed across the dune crest, as this peninsula is used for bathing activities during summer.

Inlets relocation: Ancão inlet was relocated in 1997, approximately 3.5 km west from its position in 1996. Fuzeta inlet was relocated in 1999, only 800 m from its position in 1996. The sediments were used to strengthen the dune barrier.

7. Cost and resources

The estimated cost at the time was equivalent to €10 million for the overall project of recovery of the lagoon system (EU Cohesion Fund). The Ancão inlet operations cost around € 600,000. These values are the costs at the time.

8. Effectiveness (i.e. were the foreseen goals/objectives of the work reached?)

From the beginning of the operations, monitoring was conducted regarding beach and dune profiling, topography surveys in specific areas, water and sediment quality analysis, benthonic populations, water circulation, human occupation and risks to observe the morphological evolution of the area after the interventions.

Cacela Peninsula: The fences installed on the top of the replenishment showed a variable performance from site to site: during the first year increment of the dune crest varied up to 1,2 m. This difference was associated to the bluff height, since dune recovery was almost zero at places with bluff height of 2,5m and increased as the bluff height increased. On a global evaluation the interventions in Cacela accomplished their purposes, as no over-wash episodes and no new inlet formation

have occurred in the subsequent years and only small silting up the inner channels was verified.

Inlets: The Ancão inlet reached dynamic equilibrium only two years after its relocation and since then it has been behaving as expected according to its historical migrating patterns. The width of Fuzeta inlet channel continuously increased at very high rates until it reached its dynamic equilibrium in July 2000. These successful interventions represent one of the first of its kind worldwide.

9. Success and Fail factors

The experience shows that the position where a new inlet is open in relocation interventions is extremely important. The hydrodynamic conditions (both internal and external) at the relocation point and the historic patterns of inlet migration are both factors to be taken into account. The inner channel was not dredged to the design depth (4m below MSL) since rocky outcrops were found. The lack in available sediments resulted in a final difference on the nourishment elevation, with a high value (5,5 m) at the western end and lower (3,5) at the eastern one. The wash-over infilling showed little or no variation. However, the downdrift beaches and foredunes experienced severe erosion. It was estimated that 33% of the total 325,000 m³ of sediment deposited in the Cacela peninsula was eroded in the 2 years that followed the nourishment intervention. The overall process of decision-making was difficult and long but the deadlines associated with the funding mechanism speeded up the conclusions.

These interventions represented a rapid restoration of the area, keeping the natural values and protecting the populations while allowing the natural processes to take place. However, these types of intervention requires continual and periodic maintenance, as the natural evolution of this dynamic lagoon system would lead to a different state from the current one.

10. Unforeseen outcomes

None so far.

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13. Sources

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