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POLICY BRIEF 2026

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Ensuring the future of the Ria Formosa wetlands

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Executive summary

Due to **sea-level rise**, the Ria Formosa faces challenges such as coastal retreat, accelerated erosion, saltwater intrusion, and wetland ecosystem degradation. In the long term, these changes are likely to result in **territory loss** and a **decrease in both ecological and socio-economic value**, jeopardising the region's natural capital, local populations, and the development of certain economic activities. Analysis of lagoon landscape dynamics and predictive models indicates that, between 2025 and 2100, approximately **15 % of the salt marsh areas could be lost**. The most significant reduction is expected in the high marsh habitat, which could disrupt the complete ecological succession of the wetland and result in a **decline in local biodiversity**.

Recommendations

Developing a long-term conservation and restoration strategy is essential, leveraging cross-sectoral and intermunicipal collaboration. This strategy should be built on four key pillars: (1) **enhancing scientific knowledge**, (2) **strengthening management frameworks**, (3) **support conservation** and r**estoration** initiatives, and (4) **empowering stakeholders**, actively **involving the local community**, and promoting shared responsibilities in management.

Target

This policy brief is intended for public administration managers, as the Environemntal Protection Agency and the Instititue for Nature Conservation and Forests.

The global change

*Anticipating future changes in lagoon areas and salt marshes due to **sea-level rise** is essential for implementing responsible and effective management strategies.*

According to the IPCC's 6th Assessment Report (AR6), the average sea-level could rise by approximately 80 cm by 2100, leading to

significant physical and ecological changes in wetland ecosystems worldwide (IPCC, 2023).

Scientific studies have already demonstrated the negative effects on the ecology and geomorphology of these ecosystems, resulting from increased flooding duration due to rising average water levels (e.g., Kirwan et al., 2016; Mason et al., 2025). The main challenge in coastal management is to monitor and anticipate tipping points or potential collapses of the various habitats within wetlands, as these events can significantly undermine the ecosystem services they provide.

(Sporobolus maritimus, pioneer vegetation in the low marshes of the Ria Formosa, © Inês Carneiro, 2025)

The importance of Ria Formosa Wetlands

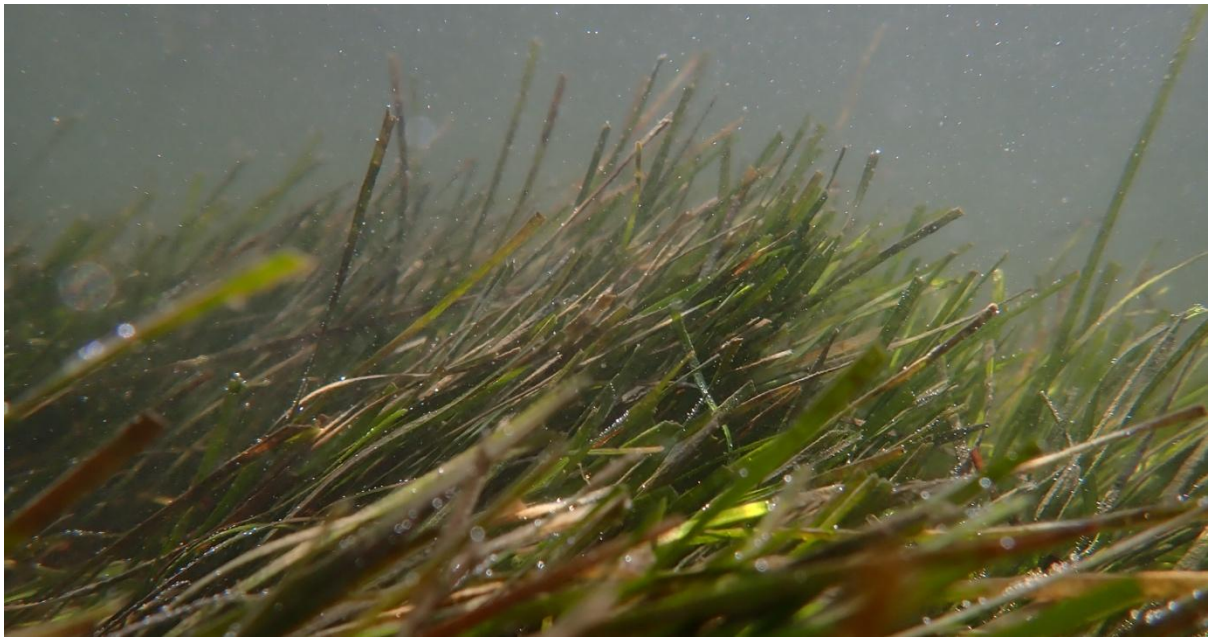
The Ria Formosa barrier island system is a natural coastal formation comprising five barrier islands and two peninsulas, enclosing a large lagoon area from the Atlantic Ocean. This lagoon ecosystem includes extensive salt marshes, seagrass meadows, and tidal flats composed of muddy sediments.

The wetlands of the Ria Formosa provide a variety of goods and services to the cities of Faro, Olhão and Tavira, as well as to the entire Algarve region and the country (Figure 1; Newton et al., 2018). They are crucial for climate regulation, water purification, and nutrient storage. In addition to carbon sequestration, they act as natural barriers, safeguarding coastal cities from extreme events such as storms, floods, and droughts.

These areas function as essential habitats and refuges for diverse animal species, including numerous endangered and threatened bird species. They also deliver important ecosystem services that support local economies and cultural practices.

Figure 1 – Coexistence between the Ria Formosa lagoon area and the city of Faro. The higher, open areas correspond to the low and high marshes.

(© A Rita Carrasco, 2023)



(*Zostera noltei*, species of seagrass commonly found in tidal flats of the Ria Formosa, ©Inês Carneiro, 2025)

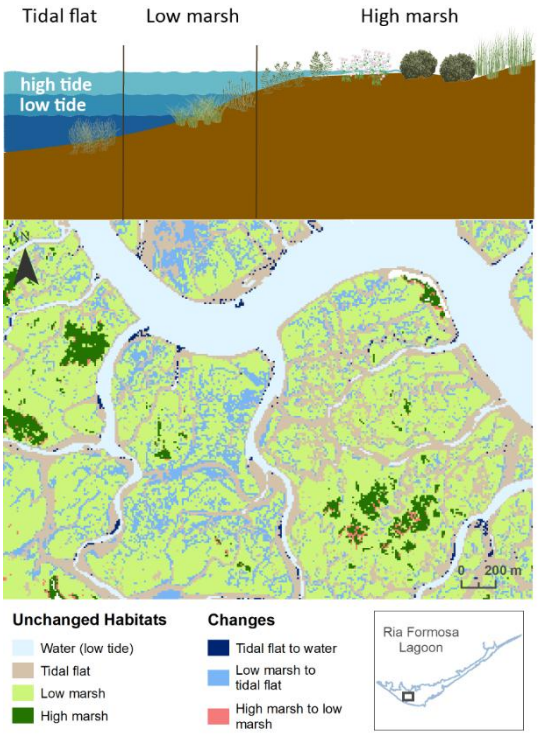
What can we expect by 2100?

The most optimistic (i.e., 0.4 m by 2100) and most pessimistic (i.e., 0.8 m by 2100) sea-level rise scenarios project different levels of wetland ecosystem loss in the Ria Formosa. Integrating remote sensing data with predictive models indicates that, by 2100, approximately 15 % of the total salt marsh area in the Ria Formosa is expected to be submerged or lost due to rising sea-levels.

Recent studies indicate that under a maximum sea-level rise rate (pessimistic scenario of 0.8 m by 2100), the wetlands of the Ria Formosa are expected to experience substantial ecogeomorphologic disruptions, resulting in alterations to the landscape (i.e., changes in habitats and ecological succession), and ultimately causing a progressive inland retreat of the marshes. (Figure 2; Carrasco et al., 2021).

A gradual infilling of the lagoon area and expansion of tidal flats vegetated by seagrass meadows are anticipated. Additionally, coastal squeeze of the high marsh is expected, as its inland migration will be restricted in areas bordering towns and agricultural fields (Figure 2).

Figure 2 – *In the upper image, ecological succession is illustrated; in the lower image, a zoomed-in view of a detailed area in Ria Formosa depicts changes in wetland ecosystems, projected up to 2100, based on the predicted rise in average sea-level under the pessimistic scenario (SSP5-8.5).*

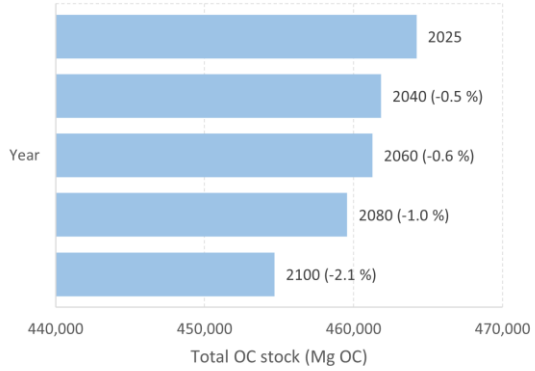


The high marsh will be replaced by the low marsh, and this will be replaced by the tidal flat (Figure 2). Overall, when compared to 2025, a loss of around 12 % is predicted in the low marsh and 30 % in the high marsh.

Sea-level rise effects on the ecosystem services of the Ria Formosa Wetlands

By 2100, no significant losses in organic carbon stocks are expected (-2 %, Figure 3), as losses related to reductions in low and high marsh areas may be partly offset by gains in seagrass meadows. Seagrass meadows make an important contribution to the organic carbon stock in sediment.

Figure 3 – Organic carbon stock in the wetland ecosystems of the Ria Formosa and its variation relative to 2025.



It is possible to mitigate losses in organic carbon stocks and enhance the region's blue carbon potential through ecological restoration, specifically by recovering and restoring inactive artificial wetlands.

The projected loss of low and high marsh habitats by 2100 will, however, have substantial implications for the ecological stability of these wetlands. The reduction in habitat area may compromise key ecological functions, potentially resulting in decreased biodiversity, such as declines in plant diversity and birds' populations. Additionally, these habitat losses are likely to impact the wetlands' capacity to serve as effective natural flood barriers near urban areas, undermining their role in flood attenuation and coastal protection.

Safeguarding WetlandsHúmidas

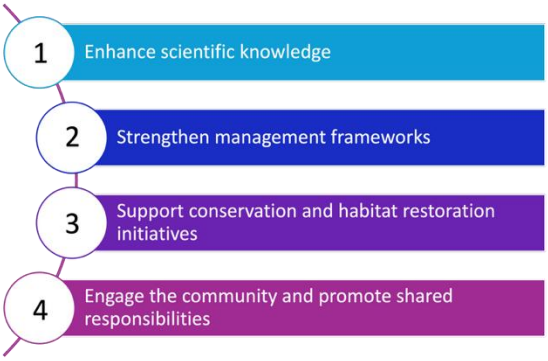
Building on existing knowledge of wetland characteristics and dynamics, there is an urgent need to develop flexible and participatory management frameworks that accommodate the complexity and diversity of these ecosystems. These tools should be adaptable over time and grounded in ongoing environmental monitoring.

The development of conservation strategies, the implementation of adaptation measures in areas vulnerable to sea-level rise, and the preservation of organic carbon stocks all require the active participation of all stakeholders and the allocation of sufficient funding. This involves establishing a long-term conservation and restoration strategy for the wetlands of the Ria Formosa Natural Park, leveraging cross-sectoral and inter-municipal collaboration. The strategy should be designed to operate across multiple temporal and spatial scales, from local to national levels.

Recommendations

The preservation of the ecosystem services provided by the Ria Formosa salt marshes should be founded on four key pillars: (1) enhancing local scientific understanding of the current ecological status and potential future trajectories of the marshes; (2) strengthening territorial management frameworks by prioritizing the development and implementation of regional monitoring and assessment plans; (3) supporting conservation and habitat restoration initiatives; and (4) securing funding for capacity-building programs for diverse local stakeholders and actively engaging the community in sustainable management practices (for instance through the implementation of living labs, to promote knowledge exchange and shared responsibilities shared responsibilities; Figure 4).

Figure 4 – Recommendations to ensure the preservation of wetland ecosystem services in the Ria Formosa are based on four key pillars.



Efforts to restore coastal wetlands may involve establishing new areas, rehabilitating degraded sites, decreasing human pressure on the coastal zone, effectively managing existing lagoon areas, and enacting legislation specifically aimed at protecting ecologically important habitats.

Support knowledge acquisition

Monitoring and scientific research are crucial for understanding the interactions between vegetation and morphology, as well as changes within marsh habitats. This understanding enables us to anticipate potential losses and support the implementation of Nature-based Solutions for various purposes.

Supporting wetland-based adaptation and mitigation approaches only makes sense if the habitats themselves are resilient and capable of enduring future challenges.

Conclusion

The loss of intertidal habitats in the Ria Formosa wetlands, resulting from the rise in mean sea level, has substantial socio-ecological consequences, directly affecting local communities.

These habitat losses can be countered and their ecosystem services maximized through conservation and ecological restoration. Such efforts must be carried out collaboratively, involving all local stakeholders, from communities to decision-makers.

(*Limoniastrum monopetalum*, vegetação típica do sapal alto nas zonas húmidas da Ria Formosa, ©A. Rita Carrasco, 2023)

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