



D.2.3.1_Climate Change Adaptation Plans and counter-measures

Veneto Regional Park Authority of the Po Delta

UNESCO World Heritage Site: Po Delta

1. Summary at a glance

The Climate Adaptation Plan represents a tool for directing and coordinating adaptation measures for the UNESCO MAB site, and in particular for the Caleri and Scardovari lagoons, two brackish wetlands located in the northern and southern part of the Po River Delta. The identification of main actors as well as societal and economic groups and sectors, followed by an analysis of risks and vulnerabilities of the area, represent the two preliminary steps in the elaboration of the plan. The definition of the knowledge base framework was achieved via interviews, bibliographic research, data collection and analysis of the results derived by the implementation of the participatory process (living Labs) and by the WP1 of the project.

Subsequent steps involved the identification of the main climate drivers, followed by the definition of the areas of intervention and the identification of specific objectives. The Delta lagoons resulted highly vulnerable to sea level rise that will dramatically increase the risk of flooding. Longer drought periods in summer are projected to create increasing problems of salt intrusion, affecting the agricultural production in the hinterland. Changing temperatures and other climate conditions will also affect the physical-chemical conditions of the water bodies, with possible risks of eutrophication, anoxia, and loss of species. This affects fish and mussel farming, key traditional activities for the local economy.

The plan identifies 20 measures to address these risks in the areas of morphology, habitats and species, development of sustainable economic activities, governance models, research, and monitoring. Each measure is described through a detailed factsheet.

Regarding the prioritization of measures and monitoring of the plan, for each of the measures, a set of indicators for progress in implementation and evaluation of effectiveness was identified. Where possible, indicators were referenced to ongoing monitoring activities to optimize resource use and favour a consistent implementation of different environmental policies.

Regarding the plan's development timeline, three time horizons were identified: short term (2026-2030), medium term (2030-2035), and long term (2035-2050).

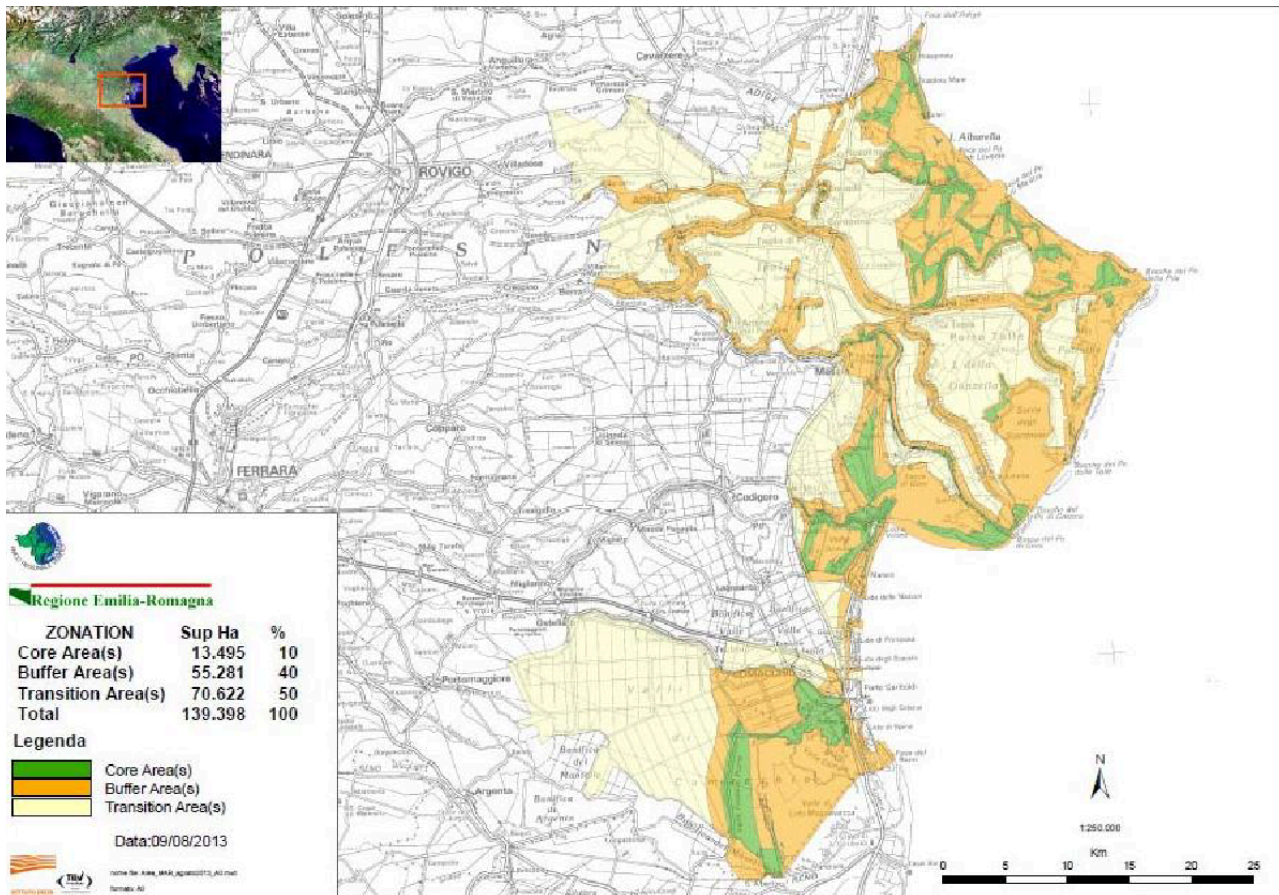
2. MAB UNESCO Biosphere Reserve - Po Delta

The Po Delta was designated a UNESCO Biosphere Reserve in 2015. This complements the UNESCO World Heritage designation of "Ferrara, City of the Renaissance, and its Po Delta" and the area's designation as a Regional Natural Park (the Emilia-Romagna Po Delta Regional Park, established in 1988, and the Veneto Po Delta Regional Park, created in 1997).

The delta territory is located in northeastern Italy, spanning the two bordering regions of Veneto and Emilia-Romagna. The Biosphere Reserve territory encompasses 15 municipalities belonging to the provinces of



Rovigo (Veneto) and Ferrara (Emilia-Romagna). It covers a total area of 139,398 hectares, comprising: (i) a core area (13,495 hectares) subject to a legal framework that ensures the long-term protection of ecosystems and the animal and plant species within them; (ii) a buffer zone (55,281 hectares) adjacent to the core area, where permitted activities contribute to conservation while also allowing for certain human activities linked to natural resources; and (iii) a cooperation area (transition zone, 70,622 hectares), where settlements and the majority of human activities are located.



The "Veneto Po Delta Regional Natural Park" Authority is the body promoting and coordinating the Reserve, assuming overall legal and administrative responsibility in close synergy with the Emilia-Romagna Po Delta Park Authority.

Pilot areas: the Caleri and Scardovari lagoons

The Caleri and Sacca degli Scardovari lagoons are located in the northern and southern sections of the Po Delta area, respectively, within the Veneto region. They form part of a wetland system situated between the Adige River to the north and the Po di Goro to the south. Like the other lagoons in the delta (Figure 1-2), they constitute complex, dynamic brackish-water environments characterized by shallow depths, high morphological variability, and a delicate balance between marine forcing and continental inputs. These are shallow transitional environments where light penetration to the seabed and rapid water warming foster intense biological and biochemical activity, rendering them extremely sensitive to hydrodynamic and morphological alterations and particularly vulnerable to climate change. Moreover, they are key systems for



combating climate change, as they mitigate coastal erosion, dissipate wave energy, and sequester carbon dioxide.

3. Methodology

The approach used to develop the “CAP document” can be broken down, as far as possible, into the following steps: (i) laying the groundwork for adaptation by identifying key institutional and technical stakeholders as well as social and economic groups, and by assessing the stance and willingness of the relevant authorities; (ii) assessing risks and vulnerabilities; (iii) identifying and evaluating adaptation options; (iv) defining an implementation pathway and a priority framework; and (v) establishing a monitoring process.

The first two steps are summarized in the description of the Knowledge Framework found in Part II of document. The initial phase of the work involved meetings and interviews with local stakeholders, literature research and data collection regarding trends, risks, and potential climate impacts, and an analysis of existing plans as well as recent and ongoing projects. A fundamental role in defining the Knowledge Framework was played by the results of the participatory process carried out through the Living Labs, as well as the findings from WP2 of this project.

The next two steps involved identifying the main climate drivers, followed by defining areas of intervention and specific objectives (Part III). The plan’s final overall structure was aligned with the model used in the CAMPUS project to ensure harmonized outputs that are easier to consult. Furthermore, the analysis and the aim of aligning with the perspectives and objectives set out in the MAB Reserve Management Plan served as the general guiding principle for the activity.

The plan identifies 20 measures across the following areas: morphology, habitats and species, sustainable economic development, governance models, and research and monitoring. A dedicated fact sheet was created for each measure.

4. Participatory process and stakeholder evidence

The Living Lab had the primary objective of engaging local stakeholders and decision-makers in exploring their perceptions, expectations, and trade-offs regarding climate change adaptation measures for UNESCO sites. The meeting also aimed to discuss the potential integration of the project’s monitoring system into existing frameworks,

CONTRIBUTION of first living Lab session, on 2025 November 27 : The discussion highlighted the need for informed water management.

The average ground level of approximately -1.5 meters from sea level requires the constant use of pumping stations for reclamation. Furthermore, during periods of severe drought (e.g., 2022), the problem of salt wedge intrusion arises, compromising natural environments, habitats, and crops.

The intrusion of the salt wedge, the periodic shortage of water for irrigation, the costs associated with reclamation, and the low competitiveness of local production are placing agricultural activity, historically one of the main local economic sectors, in serious difficulty.



Climate change is evident and, in some cases, such as the presence of alien species, is already an emergency.

CONTRIBUTION of second living Lab session, on 2025 December 16: The changes in the salinity percentage of water, in case of huge storms or severe drought, could define the loss of some environments and biodiversity but could also determine the lack of work opportunities because of economical crisis in some fields (agriculture or aquaculture). Consequently, water management is one of the most pressing and necessary issues.

One of the instruments the territory could use to combat climate changes should be wise forestry: tree planting would improve air quality, retain water in the soil and mitigate drought, mitigate high temperatures in urban centers and the countryside, regenerate the soil, and promote biodiversity.

Renaturalizing suburbs, reclaiming abandoned areas and regulations for photovoltaic panels emerged as a necessity to fight a bad use of land.

CONTRIBUTION of third Living Lab session, on 2026 January 29 : It is necessary to plan the distribution of fresh and brackish water for the future. The increase in fresh water due to flooding or torrential rains, as well as drought and the intrusion of the salt wedge, would compromise the protection of lagoons and habitats, in addition to damaging crops by altering the salinity levels of the brackish water present in lagoons and fishing valleys.

Controlling the amount of freshwater entering the lagoons also means ensuring a constant flow throughout the year.

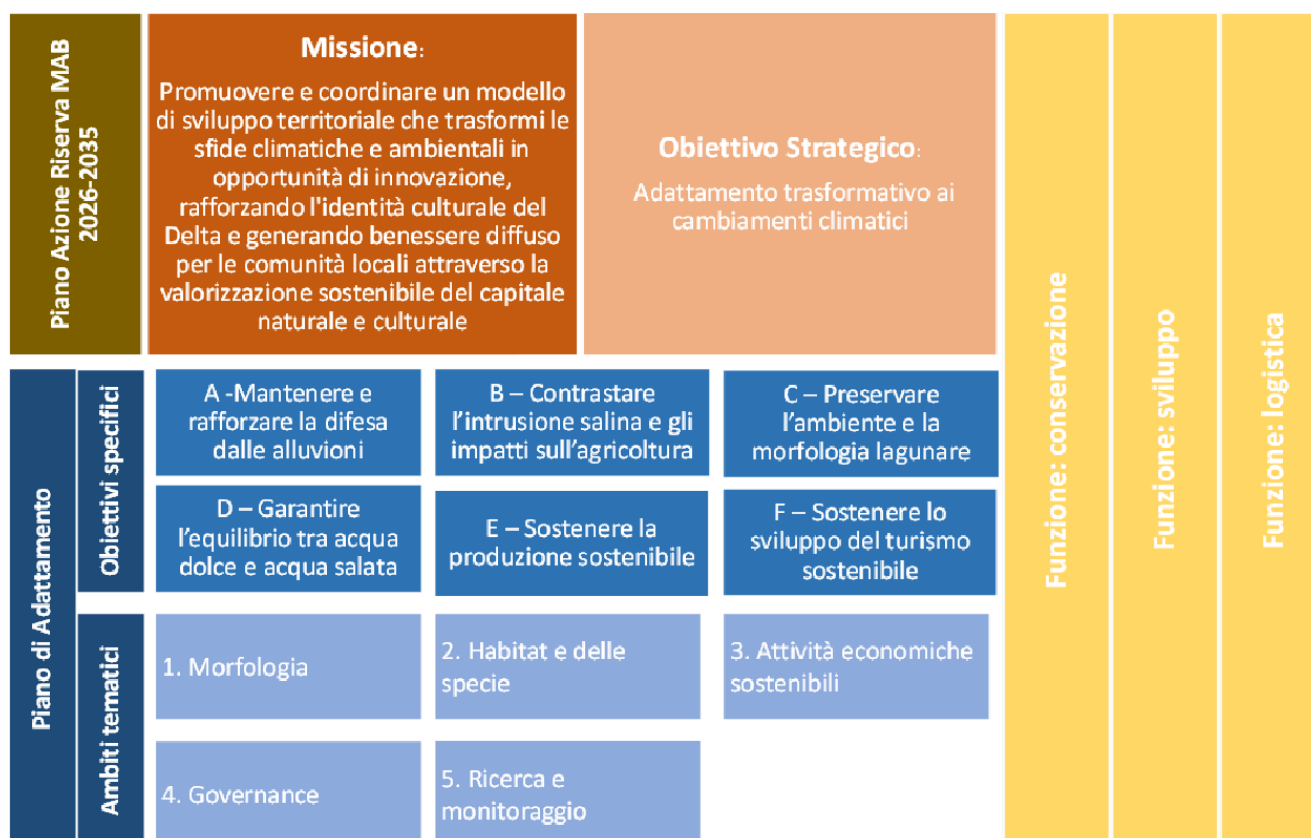
5. Objectives of the plan

Five specific objectives

No.	Objectives
A.	Maintain and increase flood defence
B.	Counteract salt intrusion and related impact on agriculture
C.	Preserve the lagoon environment and morphology
D.	Adopt a systemic approach to guarantee a correct balance of salt and fresh water in lagoons
E.	Preserve and support sustainable development of fishery and aquaculture
F.	Support the development of sustainable tourism



5.1. Structure of the plan



5.2. Summary of findings from the CAMPUS project for the MAB Po delta Reserve

The climate trends outlined in Chapter 2.5 interact with the physical and hydrodynamic characteristics of the Po Delta area, exacerbating environmental issues already present in the Po Delta wetland system.

Evidence gathered under Task 1 of the CAMPUS project (IUAV, 2025a) confirms that rising temperatures, more frequent heatwaves, and intensified extreme weather events can act as drivers for the establishment and expansion of alien species—such as the Louisiana crayfish or plant species like **Ailanthus altissima**—that thrive in warmer waters and possess high colonization capabilities. At the same time, native species (such as eels and sturgeon), already subject to multiple environmental stressors, may experience reduced resilience, thereby rendering ecosystems more vulnerable to biological invasions. These dynamics can also impact habitats of priority interest—specifically type 7210* (Calcareous fens with **Cladium mariscus** and species of the **Caricion davallianae**) and type 91E0* (Alluvial forests with **Alnus glutinosa** and **Fraxinus excelsior**)—which, while covering limited areas within the territory, are highly representative and closely linked to the dynamics of the Adige aquifer.



5.3. Details of the Plan's Objectives

In alignment with the Strategic Objective of “Transformative adaptation to climate change” within the new Action Plan for the Po Delta MAB Reserve, the overall aim of the PAC is to serve as a strategic reference for implementing climate change adaptation actions. These actions are designed to enhance the site's capacity to prevent damage and mitigate associated risks. More broadly, the Plan contributes to the Reserve's Mission for the 2026–2035 decade and helps preserve its three core functions: conservation, sustainable development, and logistics.

The Plan encompasses measures addressing the five thematic areas introduced in this PAC (second section) and is structured around six specific objectives, described below.

A – Maintain and strengthen flood defenses. Rising sea levels, combined with land subsidence, increase the risk of coastal flooding. Flood protection relies on a system of embankments; however, their long-term effectiveness may prove insufficient to ensure safety under climate change scenarios. The objective is to maintain and reinforce these defenses by combining "hard" engineering interventions with nature-based solutions. By fostering the renaturalization and biodiversity of lagoon and delta ecosystems, the latter also contribute to achieving other plan objectives (Objectives B, C, and D).

B – Combat saltwater intrusion and its impacts on agriculture. Rising sea levels and increased variability in river flow—leading to prolonged summer droughts—promote lagoon salinization and saltwater intrusion along the branches of the Po River. The objective is to understand the dynamics of saltwater intrusion linked to ongoing climate change and to implement effective solutions.

C – Preserve the environment and lagoon morphology. The delta's coastal wetlands represent valuable ecosystems, the protection of which is of exceptional importance for the provision of numerous ecosystem services. While they include habitats and species vulnerable to the effects of climate change, Coastal wetlands provide a natural defense against flooding and storm surges, helping to mitigate and counteract coastal erosion. The goal is to safeguard the biodiversity and morphological diversity of these environments through nature-based solutions, which in turn can help support traditional economic activities such as fishing, aquaculture, and tourism (objectives E-F).

D – Ensure a proper balance between fresh and salt water. River inflows, exchanges with the sea, and the complex morphology of the delta system allow for the coexistence—within the same area—of conditions that are typically marine and conditions strongly influenced by freshwater inputs. In the context of climate change—characterized by increasingly irregular precipitation, variations in flow regimes, and rising sea levels—maintaining this balance is crucial, as it is at risk of destabilization. Maintaining this balance—primarily through measures to revitalize and morphologically restore lagoon environments—is essential for supporting fishing and aquaculture (objective E).

E – Support sustainable production. Human activities related to fishing and aquaculture in the Delta wetlands are of great economic and employment significance, as well as being historically and traditionally important. Extensive shellfish farming (clams, mussels, and more recently introduced oysters) is a cornerstone of the local economy but is threatened by climate change, which fosters anoxia and the invasion of alien species. The objective is to sustain the fishing and aquaculture sector by promoting diversification, developing complementary activities to supplement income, and providing training for operators, thereby strengthening the sustainability and resilience of production.



F – Support sustainable tourism development. In addition to their ecological importance and role in supporting shellfish and fish production, the Delta's lagoon environments feature distinctive landscapes of great interest to tourists. The aim is to foster the development of sustainable, experiential tourism that integrates local knowledge, food and wine culture, education, and environmental restoration. Promoting this type of tourism encourages behavior that respects an area vulnerable to climate change, while also creating synergies with the maintenance of sustainable production (Objective E).

5.4. Plan Monitoring

Defining an appropriate set of indicators is a crucial step in monitoring the progress of the adaptation pathway outlined in the PAC over time. These indicators should be capable of tracking both the implementation progress of the adaptation measures identified in the Plan and the associated adaptation outcomes (such as risk reduction and increased resilience).

Although the need for and importance of identifying adaptation indicators are universally acknowledged, monitoring progress proves particularly complex in practice and is rarely carried out systematically. This stems from various factors, such as the difficulty of setting easily measurable targets, the lack of a shared baseline against which to assess changes, the challenge of linking effects (which often only become apparent in the long term) to specific actions, and the difficulty of conceptualizing "avoided impacts" (e.g., a flood that did not occur) rather than tangible, realized benefits.

6. Updates to local planning and regulation

The Plan serves as a tool to guide and coordinate adaptation measures for the UNESCO MAB site, specifically the Caleri and Scardovari lagoons. Regarding these lagoon areas, the Veneto Po Delta Regional Park Authority is uniquely positioned to act as a liaison and a focal point for diverse needs, drawing on the multidisciplinary nature of its competencies.

Harmonization across the various planning levels, administrative management areas, and sectoral domains is, however, essential. Within the context of the UNESCO site, coordination must be maintained between all parties involved in the Management Plan and those affected by the Adaptation Plan. This document seeks to lay the groundwork for such coordination, primarily by identifying shared timeframes, particularly regarding the initial years of planning (the coming decade).

7. Governance

The primary governance mechanism for the entire Delta territory—including the area falling within the Emilia-Romagna region—is the UNESCO MAB Reserve's "Coordination Group," a strategic body responsible for policy-making, decision-taking, and setting general direction. This working group comprises all key local institutional stakeholders: the two Park Authorities (serving the Veneto and Emilia-Romagna regions), the



Provinces of Rovigo and Ferrara, the municipalities within the Reserve, the Po River Basin Authority, land reclamation consortia, representatives from the Regional Superintendency for Environmental and Cultural Heritage, and local universities. The coordination capacity demonstrated over the years is particularly significant given the operational challenges of aligning two Park Authorities that operate across distinct territories and under different regional regulations; indeed, over time, horizontal coordination mechanisms have been developed to leverage local specificities within a shared strategic vision.