

ALTERNATIVE SCENARIOS REPORT

Pilot area name: Special ornithological reserve Palud - Palù

Partner Name: Public Institution Natura Histrica

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INTRODUCTION

This document has been developed within the framework of the project *GREW - Governance of Wetlands* in the Italy–Croatia Cross-Border Region, a cross-border initiative aimed at improving the governance and long-term management of coastal wetlands under increasing climate change pressures.

Coastal wetlands in the Italy–Croatia cross-border area represent ecosystems of high ecological value, providing important habitats for biodiversity and delivering essential ecosystem services to local communities and visitors. However, these areas are increasingly exposed to multiple and interacting pressures, particularly those related to climate change, such as rising temperatures, altered precipitation patterns and increasing variability in hydrological regimes. Additional challenges, including habitat degradation, pressures from human activities and insufficiently coordinated management approaches, further affect their ecological stability and resilience.

In this context, there is a growing need to strengthen management practices, improve stakeholder coordination and develop adaptive approaches that can respond to ongoing and future changes. Scenario-based analysis is used as a tool to explore possible future developments, assess risks and uncertainties, and support informed and strategic decision-making.

The following sections present the trend scenario, which reflects the continuation of current conditions and practices and serves as a baseline for understanding potential future developments in the absence of more targeted and coordinated interventions.

TREND SCENARIO

This scenario aims to replicate the continuity of current trends across three strategic pillars: governance, environment, and economic and social development. In this context, citizen engagement remains limited, and management and conservation policies do not effectively encourage the participation of all territorial stakeholders. As a result, the scenario reflects a continuation of the existing development pattern and is not considered an optimal framework for achieving objectives related to preventing the degradation of natural areas. For each pillar, the main problems affecting the pilot wetland area their related impacts, and the likely trends under this scenario are identified.

Scenarios are developed to explore possible future developments of the wetland under different conditions and management approaches. They help to better understand how ongoing pressures, such as increasing climate variability, changes in hydrological regimes, and the growing influence of certain wildlife species, may affect the ecosystem over time. By comparing different scenarios, it becomes possible to identify risks, anticipate challenges, and support more informed and strategic decision-making for the sustainable management and conservation of the wetland.

TREND SCENARIO			
Strategic pillar	Problem	Effects	Trends and critical issues
G. GOVERNANCE	PG1. Increasing climate variability creates operational challenges for wetland management, while existing governance tools remain insufficiently adapted to these changes	Recent climate patterns are characterized by longer dry periods, higher frequency of heat waves and increasingly irregular rainfall distribution, including short but intense precipitation events. These changes directly affect the water regime of the wetland, causing fluctuations in water levels, seasonal drying of certain zones and occasional sudden inflows that alter sediment distribution and habitat conditions. Such variability creates practical challenges for day-to-	Under the trend scenario, climate variability continues to increase, amplifying pressures on the wetland system and making management conditions more unpredictable. At the same time, governance practices evolve slowly, without the introduction of specific operational tools, guidelines, or decision-support mechanisms tailored to changing climate conditions. As a result, management responses remain largely improvised and short-term,

		day management, including difficulties in planning maintenance activities, regulating access and ensuring the stability of key habitats. However, existing management tools, operational protocols and planning practices are not sufficiently adapted to these dynamic conditions. Climate-related parameters are not consistently monitored or translated into concrete management actions, limiting the ability to adjust interventions in a timely and coordinated manner.	focusing on immediate issues rather than long-term adaptation. The lack of structured procedures for dealing with extreme events and gradual changes leads to repeated disruptions in management effectiveness and contributes to the progressive instability of the wetland ecosystem.
	PG2. Limited operational capacity for monitoring, supervision and enforcement within the wetland area	Current monitoring and supervision activities are constrained by limited human resources, absence of continuous field presence and insufficient use of technological solutions (e.g. automated monitoring, surveillance tools). As a result, large parts of the wetland remain only intermittently controlled, reducing the ability to detect and prevent inappropriate activities in real time. This creates conditions in which behaviors such as uncontrolled vehicle access, informal parking, movement	Under the trend scenario, the need for increased supervision and improved monitoring remains only partially addressed. Investments in monitoring technologies, digital tools and enforcement capacity are limited, while human resources remain insufficient. As a result, pressures on the wetland ecosystem persist or increase, while governance continues to rely on reactive and incomplete control mechanisms. This reinforces a pattern of insufficient oversight and contributes to the gradual degradation of natural values.

		outside designated paths and occasional illegal disposal of waste can occur without timely intervention. In addition, the lack of systematic and continuous data collection limits the understanding of ongoing environmental pressures and reduces the capacity to link observed changes in the field with management responses.	
	PG3. Unregulated access and insufficiently structured management of roads, pathways and parking areas	The current system of access to the wetland is characterized by the presence of unclassified roads, informal pathways and a lack of clearly designated and managed parking areas. This results in dispersed and uncontrolled entry points, making it difficult to guide visitor movement and concentrate on activities in less sensitive zones. Consequently, certain parts of the wetland are exposed to repeated physical disturbance, including soil compaction, damage to vegetation and disruption of fauna. During periods of increased visitation, the absence of an organized parking system leads to spontaneous parking in ecologically sensitive areas, further intensifying localized pressures and creating conflicts between	Under the trend scenario, the need to regulate access infrastructure remains only partially addressed. Interventions related to the improvement of roads, pathways and parking management are implemented sporadically and without a comprehensive spatial or operational framework. As a result, access remains largely uncontrolled and visitor pressure continues to be unevenly distributed across the wetland. Without clear zoning, physical guidance measures and consistent supervision, the cumulative impact of these pressures increases over time, contributing to habitat degradation and reducing the capacity of governance

		conservation objectives and recreational use.	structures to manage visitor use in a sustainable way.
E. ENVIRONMENT	PE1. Climate variability affecting hydrological stability and ecological conditions of the wetland	Increasing variability in precipitation patterns, combined with longer dry periods and higher temperatures, directly affects the hydrological balance of the Palud wetland. Fluctuations in water levels, including seasonal drying and irregular inflows, alter habitat conditions for aquatic and semi-aquatic species. In addition, prolonged dry periods and reduced freshwater input can contribute to increased salinity levels in the wetland, leading to excessive salinization that further stresses freshwater-dependent habitats and species. Changes in temperature and water availability influence vegetation dynamics, including shifts in species composition and accelerated succession processes in certain zones. Variability in hydrological conditions also affects the timing and availability of key habitats for fauna, particularly birds and other water-dependent species. Elevated salinity may additionally favor	Under the trend scenario, climate variability continues to intensify, leading to increasingly unstable hydrological conditions and reduced predictability of ecological processes. Periods of low water availability are likely to further increase salinity levels, exacerbating stress on sensitive habitats and contributing to long-term ecological changes. While technical solutions such as the planned water regulation infrastructure (e.g. flow control structures) exist, their role in broader ecosystem adaptation remains limited without a comprehensive management framework. As a result, fluctuations in water regime and salinity progressively affect habitat quality and availability, weakening ecosystem stability and increasing sensitivity to additional environmental pressures.

		salt-tolerant species, potentially alter ecological balance and reduce overall biodiversity. Although certain activities, such as monitoring water quality, sediment conditions and hydrological dynamics, are already being carried out, their results are not always fully integrated into adaptive ecosystem management.	
	PE2. Insufficient knowledge base on key ecological pressures and species dynamics	Despite ongoing efforts in monitoring water and sediment quality, significant knowledge gaps remain regarding the status and trends of biodiversity within the wetland. In particular, the lack of systematic research on certain species and ecological interactions limits the understanding of ecosystem dynamics. This is especially relevant in the case of species such as wild boar, whose population size and spatial behavior are not sufficiently assessed, despite their potential impact on habitat structure, soil conditions and vegetation. The absence of coordinated data collection, including the use of external sources such as local hunting associations, reduces the ability to evaluate	Under the trend scenario, research activities remain fragmented and project-dependent, without the establishment of a continuous and comprehensive biodiversity monitoring system. Key ecological pressures are only partially understood and management decisions continue to be made with limited empirical evidence. As a result, the impacts of certain species and ecological processes may remain underestimated or unaddressed, leading to gradual habitat degradation and reduced effectiveness of conservation measures.

		pressures and design appropriate management responses.	
	PE3. Increasing pressure of wildlife (e.g. wild boar) on habitat structure and vegetation	The presence and potential increase of certain wildlife populations, particularly wild boar, can significantly affect wetland habitats through rooting, soil disturbance and alteration of vegetation cover. These activities may lead to changes in microhabitats, increased erosion, and degradation of sensitive areas, especially in zones already affected by hydrological stress. In the absence of reliable population data and coordinated management approaches, these impacts are difficult to quantify and control. The interaction between wildlife pressure and other environmental factors, such as fluctuating water levels and vegetation changes, can further amplify ecosystem disturbance.	Under the trend scenario, the lack of systematic monitoring and management of wildlife populations persists, while environmental conditions become more variable due to climate influences. Without coordinated action and data exchange (e.g. with hunting stakeholders), pressures related to wildlife may increase or remain unbalanced. This contributes to ongoing habitat disturbance and reduces the capacity of the ecosystem to recover from other stressors, reinforcing negative trends in habitat quality.
D. ECONOMIC AND SOCIAL DEVELOPMENT	PD1. Limited awareness and understanding of the ecological value of the wetland	Insufficient information and educational activities related to the ecological importance of the Palud reserve reduce public understanding of its role in biodiversity conservation and ecosystem functioning. This limits the capacity of local	Under the trend scenario, educational and awareness-raising activities remain sporadic and dependent on individual initiatives rather than being systematically integrated into local frameworks.

	among the local population	communities to recognize the benefits provided by the wetland and to actively support its protection. The lack of structured and continuous educational initiatives results in weak social engagement and reduces the potential for developing local stewardship and long-term support for conservation and sustainable management practices.	As a result, the level of public awareness remains relatively low and the connection between the local community and the wetland does not significantly strengthen over time. This limits the potential for building social resilience and collective responsibility in the context of increasing environmental pressures.
	PD2. Underutilized potential for the development of sustainable and ecological agricultural practices	The potential for developing ecological and environmentally friendly agricultural practices in the surrounding area remains insufficiently explored and supported. Limited analysis of opportunities, lack of targeted guidance and weak incentives reduce the motivation of local producers to transition toward more sustainable production models. This limits the contribution of agriculture to biodiversity conservation and reduces the potential for creating added value linked to environmentally responsible practices. At the same time, conventional practices may continue to exert pressure on natural resources, particularly	Under the trend scenario, the transition toward ecological agriculture remains slow and fragmented, without a clear strategic framework or coordinated support mechanisms. Climate variability further challenges agricultural stability, while opportunities to align production practices with conservation and climate adaptation objectives remain underused. As a result, the role of agriculture as a positive driver of ecosystem resilience is not fully realized and economic opportunities linked to sustainable land use remain limited.

		under changing climate conditions.	
	PD3. Potential impacts of including the wetland in the tourism offer without a strategic plan	Tourist presence can disturb wildlife, trample vegetation and generate waste or noise that affects sensitive habitats. Without clear guidelines and management strategies, the ecological integrity of the wetland could be compromised and opportunities for aligning tourism with conservation objectives would remain underdeveloped. The lack of a strategic framework increases the risk that any future tourism activities would inadvertently conflict with the wetland's primary role as a protected natural area.	Under the trend scenario, initiatives to integrate the wetland into tourism could arise sporadically, but without a coordinated plan, their potential impacts on biodiversity and ecosystem functions would not be adequately addressed. The absence of proactive planning or regulatory frameworks may lead to incremental pressures on the wetland over time, reducing habitat quality and resilience.