NATURE-BASED INTERVENTIONS IN VENICE TO RESTORE COASTAL WETLANDS

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INTRODUCTION

The city of Venice as well as other inhabited islands are located at the centre of the largest lagoon of the Mediterranean region and one of its few tidal systems (CNV, 2016). Since the 16th and 17th Centuries the largest rivers were deviated from the lagoon to flow directly to the Adriatic Sea to reverse the trend of the lagoon silting up, turning it into a net sediment-deficit ecosystem (CNV, 2016). Furthermore, current economic activities mainly linked to maintaining port access for larger ships and protecting the city from the increasing frequency of flooding (the MOSE mobile barriers) challenge the physical and ecological stability of the lagoon system.

Since the beginning of this Century, the sediment dredged from capital and maintenance dredging activities of the Port of Venice has been used to build morphological infrastructures in the lagoon. The objective of cost-effective sediment disposal was combined with the benefits of infill creation to break up extensive areas of open waters. Many hectares of "artificial wetlands" were constructed to mitigate the impacts of the mobile barrier construction, under the terms of the Piano Europa (Bidinotto e Cerasuolo, 2018). Results are mixed ranging from reclamation sites that have remained largely underdeveloped with regards to natural features like vegetation cover and morphology, sites that changed into functional wetlands and others that were significantly reduced in size by erosion.

In 2023 We are here Venice (WahV) and DEME, through its Italian Branch SIDRA, started a collaboration to develop techniques for the optimization and acceleration of the infill re-naturalisation and greater resilience of the Venice lagoon ecosystem. This collaboration is also assessing new approaches to determining the added natural, social and economic value generated by ecosystem restoration in practice, with specific attention to Venice's wetlands as a representative example of Mediterranean wetland ecosystems. One site in particular has already yielded interesting results that will be described here.

PIOVEGO BUORA

In 2021, the Port Authority of Venice executed an infill designed by the Provveditorato Interregionale per le Opere Pubbliche per il Veneto, Trentino Alto Adige e Friuli Venezia Giulia (Provveditorato) as a new artificial saltmarsh. It is positioned alongside an existing natural marsh. This infill used sediment from Port channel maintenance dredging. As for all the other elements of morphological infrastructure, the sediment was pumped hydraulically and collected within the purpose-built containment area demarcated by wooden poles with a strong geotextile lining. Reached the target elevation, deposition stopped. The new reclaimed area was left to naturally develop with the expectation that it would spontaneously acquire vegetation, other biodiversity and develop inner channels and tidal pools comparable with natural saltmarsh.

THE PILOT

SIDRA and WahV designed low-impact interventions on Piovego Buora to improve and accelerate the natural dynamics and interactions governing the transition of the reclaimed areas into the desired functional wetlands.

The critical and founding element guiding the design of the Piovego Buora pilot is to functionally reconnect the infill with the surrounding tidal-driven ecosystem. Drainage channels are a key morphological feature for natural wetlands (D'Alpaos 2007). Like blood vessels in human bodies, channels are vital for regulating the fluxes of water, nutrients and seeds in a wetland. Especially the inundation dynamics are fundamental for the development of vegetation as well as establishing morphological equilibrium.

Figure 1 – June 2023, opening interventions. Top: removal of geotextile and poles. Bottom: removal of geotextile only.

In March 2023, interventions were introduced along the infill perimeter. Five openings were executed by the local contractor Nautilus S.r.l.. In three openings at the natural marsh side, both poles and geotextile were removed. For the

latter two, the poles were left in place (without geotextile) to reduce the risk of excessive erosion where the hydraulic gradients were the highest. Positioning of the openings was on the basis of the morphological evaluation of the pre-intervention DTM, to follow and leverage upon the prevailing natural dynamics. All openings were about 1.5 m wide, based on the theoretical aspect ratio of the channels in the natural saltmarsh of the lagoon (D'Alpaos, 2007).

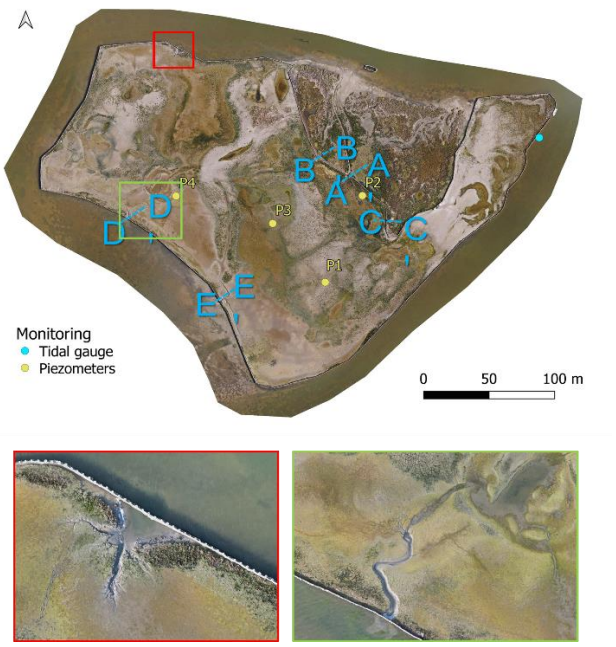

Figure 2 – September 2023, third drone survey. Top: Plan view of Piovego Buora, with the natural marsh on the North side. A-A' through E-E are the five openings. Bottom left: morphological evolution of untouched perimeter, red square. Bottom right: channel forming from the location where the geotextile was removed, green squared.

RESULTS

At the time of the submission of the abstract, about 6 months of data were collected, most of which is still under analysis. However, three drone surveys clearly show the development of natural-looking channels especially at the mudflat side. These also show a clear difference in morphological development between the location where the interventions were carried out (e.g. developing channels) versus other locations where water forcing its way through the solid boundary causes unstable siphons to form and broader shoreline erosion. The analysis of the data will continue in early 2024 with more precise quantification of morphological evolutions, such as areas and volume of erosion and sedimentation; vegetation and fauna colonization (invertebrates, birds); and potential biodiversity improvements and GHG sequestration rates.

At the date of the abstract, a preliminary business case has been formulated with identification of key stakeholders and mapping of interrelations and / or transfer of benefits from the infill revitalisation. These have been drawn in a flow diagram, to highlight specific needs and their mutual correlations. An initial assessment of the ecosystem value of a functional wetland is being assessed, in comparison to a non-functional wetland or open water.

Dissemination activities focused on participation at key events in the lagoon, to highlight the importance of ecosystem restoration and the opportunities that it offers to the Venice lagoon.

DISCUSSION AND CONCLUSIONS

The importance of wetlands, ecosystem restoration and nature-based solutions for climate resilience and sustainable development is recognized in the international scientific and in a large part of the policy makers community (USACE 2022, The World Bank 2017). This pilot, which represents a collaboration between a local NGO and a large international marine contractor, intends to provide a concrete application in the field. This with the intent to demonstrate such solutions in practice and to export the lesson learned in future-proof marine infrastructure development projects.

The underlying philosophy is that infrastructures and human economic activities are intrinsically embedded in the natural ecosystem. As much as possible, these should work with nature and leveraging on the natural processes at place, which should be well understood. In fact, each project and infrastructure should intrinsically include a significant part of ecosystem development, rather than limiting to do no harm at best. Preliminary observations from this pilot appear to confirm that by observing, analysing, understanding, and implementing flow behaviour and saltmarsh dynamics, ecosystem restoration can be accelerated and improved, producing natural features that are more stable and sustainable in the long-term. It also indicates that ecosystem delivers more benefit to more stakeholders potentially justifying dedicated public /private co-investments.

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