

From Vulnerability to Resilience: Coastal Heritage as Environmental Infrastructure

Lia Fedele

Affiliation: Department of Architecture, "G. d'Annunzio" University of Chieti-Pescara
Email: lia.fedele@unich.it

Angelica Nanni

Affiliation: Department of Architecture, "G. d'Annunzio" University of Chieti-Pescara
Email: angelica.nanni@unich.it

Abstract

The contribution investigates the key-role of coastal cultural heritage in a strategic approach to address environmental and climatic vulnerabilities in mid-Adriatic coastal areas. The research hypothesis that coastal heritage can act as resilience factor is considered and tested within the framework of the PRIN 2022 COSTA | Med project. Focusing on two case studies along the mid-Adriatic coast of Abruzzo (Pineto-Silvi and Fossacesia-Vasto), it explores the potential of heritage as environmental infrastructure to support adaptive strategies against climate risks. Through a research-by-design approach, the paper combines vulnerability mapping with design strategies, highlighting the regenerative capacity of existing and latent heritage assets. The study aims to outline planning agendas that integrate ecosystem services, socio-spatial dynamics, and infrastructure transformations, fostering resilience in complex land-sea interfaces.

Keywords: Land-sea, coastal heritage, environmental infrastructure, vulnerability mapping, design strategies.

1 | Introduction

Coastal territories represent a particularly intricate and vulnerable interface between socio-ecological systems (Adger et al., 2005). Significant anthropogenic transformations, climate pressures and cultural stratification are found in this variable-width strip, generating unprecedented challenges for the governance of coastal space (Hoegh-Guldberg et al., 2019). Land-sea interfaces, characterised by intense human occupation and high environmental variability, offer favourable conditions for experimenting with systemic approaches in response to the effects of ongoing climate change. In this framework, Mediterranean coastal areas are particularly vulnerable to a range of environmental challenges, including erosion, hydro-geomorphological fragility, excessive soil sealing, sea level rise, saltwater intrusion, increased surface and water temperatures, loss of biodiversity, marine pollution from plastics, chemicals and eutrophication, extreme weather events, flooding, and subsidence. These issues are further compounded by the presence of a significant concentration of cultural heritage values (Reimann et al., 2018; Bonazza et al., 2018). It is therefore well established in the relevant literature that the analysis of risks associated with climate change cannot be limited to the observation of physical processes alone but must also consider the interactions between the natural and anthropogenic environments (Bruno et al. 2016). This necessitates a departure from conventional risk mapping, which is predominantly relying on the superimposition of layers of information. In lieu of this, there is a requirement for alternative models that can reflect the conditions of vulnerability which emerge from the interaction between environmental pressures and the specific characteristics of places (Turner et al., 2003). In the context of land-sea interface, the risk levels at the "friction points" between anthropogenic uses and naturalistic and ecological values are of particular relevance. In such contexts, systemic assessment becomes crucial for interpreting the dynamics at play and guiding integrated planning processes.

The contemporary urgency of mitigation and adaptation has contributed to a gradual shift in focus from sectoral approaches to systemic perspectives able to address the complexity of territorial interactions (O'Brien and Sygna, 2013). This paradigm change is of particular significance in coastal areas, where the accelerated pace of transformation necessitates active and coordinated responses in terms of integrating environmental and cultural protection. From this standpoint, cultural heritage can only be recognised in its evolutionary dimension, generated and renewed by those who care for it and nourished through continuous interactions with society (Magnaghi, 2020), thus overcoming the static approach that considers it exclusively in reference to its monuments. A systematic analysis of these values necessitates the incorporation of at least two primary categories. The first of these is manifest heritage, which is represented by real estate and tangible cultural assets, protected areas and landscape values. These are bound, protected and recognised not only by the community but also by law. The second component encompasses latent heritage, comprising cultural practices, traditional knowledge systems, human and animal migration patterns that have historically characterised these regions, and maritime

uses. It also incorporates virtuous approaches that have emerged through the historical interplay between human societies and their environments (Lenzerini, 2011). This dual focus enables the identification of heritage resources, including those that are not formally recognised, but which have significant potential to contribute to the resilience of coastal contexts. In recent years, several studies have emphasised the value of Mediterranean identity heritage as a key component of integrated coastal zone management systems (Daire et al., 2012; Khakzad et al., 2015). However, most approaches are anchored in risk mitigation strategies that treat cultural heritage as a vulnerable asset to be protected, rather than as an active infrastructure for territorial adaptation (Fatorić and Seekamp, 2017).

The present paper illustrates the line of research that falls within this framework. It recognises the potential of systemic analysis – both of heritage values and associated risks – alongside the identification of design and transformation strategies. These strategies aim to enable interventions on both tangible and intangible heritage that actively contribute to reducing the vulnerability of coastal areas. The themes mentioned are at the centre of the applied research conducted in recent years by the Department of Architecture of Pescara on the Adriatic coast¹, and in particular the ongoing research project PRIN 2022 – *COSTA | Med: Catching Opportunities for Strategic Transformation and Adaptation of Mediterranean Coasts*² – dedicated to the development of methodologies for the analysis of coastal areas to support strategic transformation and adaptation to climate change in the Mediterranean. The research activity in Pescara focuses on experimenting with innovative ways of recognising and enhancing coastal cultural heritage as a strategic tool for observing coastal transformations and designing degrees of resilience. The central Adriatic coastline of Abruzzo has been identified as a case study of particular interest, with reference to two specific contexts that are distinguished by the specificity of their urbanisation processes and socio-economic and cultural dynamics. However, these contexts are united by the relevance and density of existing heritage values.

The research addresses several key issues, including multiscale mapping of vulnerability levels, identification of the tangible and intangible heritage values that characterise the study areas, and exploration of design scenarios and approaches for risk reduction. Accordingly, particular attention is paid to the ways in which coastal heritage interacts with risk levels, with the aim of guiding the integrated design and planning of coastal areas, providing guidelines that can be transferred and scaled to other Mediterranean coasts.

The contribution specifically focuses on the analysis of selected Adriatic coastal stretches as case studies, and on conceptual reflections regarding the definition of heritage as a resilience factor for reducing vulnerability, with particular attention to design approaches aimed at restoring environmental connectivity.

2 | Territorial Context and Case Studies

2.1 The linear Adriatic city: a fragile and stratified settlement system

The Abruzzo coastal area constitutes a component of the extensive system of the so-termed linear Adriatic city, a settlement pattern spread across the regions of Emilia-Romagna, Marche and Abruzzo, extending into a portion of Puglia. This dense and stratified urban-infrastructure continuum is characterised by the pervasiveness of urbanisation processes and the pressure they exert along land-sea spaces. The coexistence of high building density, linear infrastructure and tourist flows has resulted in a particular configuration of the territory that has attracted considerable critical attention within the relevant disciplinary field. This critical attention began with the definition of the 'medium-Adriatic city' as the result of post-war transformations linked to the construction of the railway line and State Road 16 (Bianchetti, 2011).

The intricacies of this territorial system are not solely attributable to anthropogenic influences, but also to substantial morphological, landscape, socio-economic, and cultural factors. The proximity of anthropogenic and natural landscapes, coupled with the historical interactions between land and sea, has contributed to the definition of settlement patterns along the coast, thereby fuelling the relational dimension of the cultural heritage of these places.

¹ The comparative research propositions guiding the reflections of the PRIN COSTA | Med research are the outcome of activities carried out in recent years within the framework of teaching (master's theses), doctoral research, and university third mission initiatives, conducted in the Department of Architecture, coordinated by prof. Matteo di Venosa.

² More information is given in the Acknowledgements section; further details are available at: <https://costamed.uniroma3.it/>

However, this relational richness is now confronted with growing environmental pressures manifested through land consumption, the reconversion of tourism and production systems, and the effects of the climate crisis.

The result is a fragile geography where multiple critical conditions converge (including the aforementioned coastal erosion, hydrogeological risk, flooding, ecosystem fragility, etc.) associated with seasonal anthropogenic pressure and building densification (Zullo et al., 2015). Linear urbanisation processes have increased soil sealing, resulting in a progressive disconnection between coastal and inland hill ecosystems, thereby interrupting important environmental flows and compromising the resilience of the entire territorial system (Ricci, 2018). ISPRA data (2024) confirm that land consumption rates along the Abruzzo coastline remain at significant levels, contributing to increased territorial vulnerability to extreme weather events.

The intersection of urbanisation dynamics and environmental vulnerability thus engenders a particularly intricate management and planning scenario (di Venosa, 2023), rendering the Adriatic case study emblematic for the examination of settlement dynamics and the manifold levels of risk that typify Italian coastal landscapes. In this context of widespread fragility, the PRIN 2022 *COSTA | Med* research identifies two contexts representative of the morphological and settlement characteristics and environmental issues found along the Abruzzo coast: the Silvi-Pineto context (C1) in the north and the Fossacesia-Vasto stretch, known as the Trabocchi Coast (C2) in the south. The density of heritage values they share, together with the different spatial configurations, recent transformations, and evolutionary potential expressed by the selected contexts, provides a complex picture of the challenges and opportunities within the land-sea interface.

The contexts mentioned represent two distinct models of coastal urbanisation: the first characterized by continuous development and high levels of artificialisation, the second distinguished by an alternation of fragmented built environments and preserved natural areas. This divergence is evident not only in the spatial layout but also in the types of cultural heritage present and in the adaptive strategies developed over time by local communities. As highlighted in studies on cultural landscapes, such settlement patterns give rise to differing forms of vulnerability and resilience, thereby requiring differentiated management approaches (Antrop, 2005).

2.2 The Silvi-Pineto system: urban continuity and ecological fragility

The Silvi-Pineto context (C1), which is bordered by the Vomano river to the north and the Saline river to the south is characterised by an almost uninterrupted coastal urban continuity (Figure 1). The littoral system under examination is a narrow, compact strip consisting of a succession of parallel lines extending from the water towards the mainland. These include the sea defences at Silvi, the shoreline, the Abruzzo section of the Adriatic Cycle Route, the railway corridor, the SS16 state road and the A14 Bologna-Taranto motorway. The most significant physical and perceptual barrier is the Adriatic railway, which separates the historic town of Silvi, located on a hill, from the waterfront settlement. This reflects a pattern typical of many municipalities in Abruzzo, where the main urban nucleus is distinct from the marina, with a relatively differentiated development of the built environment. The urban fabric of Silvi Marina, which alternates with the infrastructure system, has become denser especially since the 1960s. This phenomenon can be attributed to the predominantly flat terrain and early development linked to tourism and seaside resort growth. This has led to a high degree of seasonal specialisation. This spatial expansion has resulted in a progressive loss of functional and visual connections with the hinterland, a condition exacerbated by the construction of north-south infrastructure corridors, which have disrupted the continuity of ecological networks. This territorial fragmentation has contributed to the formation of a spatial system marked, ultimately, by multiple disconnections: between the sea and the hills, between the historical core and coastal development, and between ecological and anthropic systems.

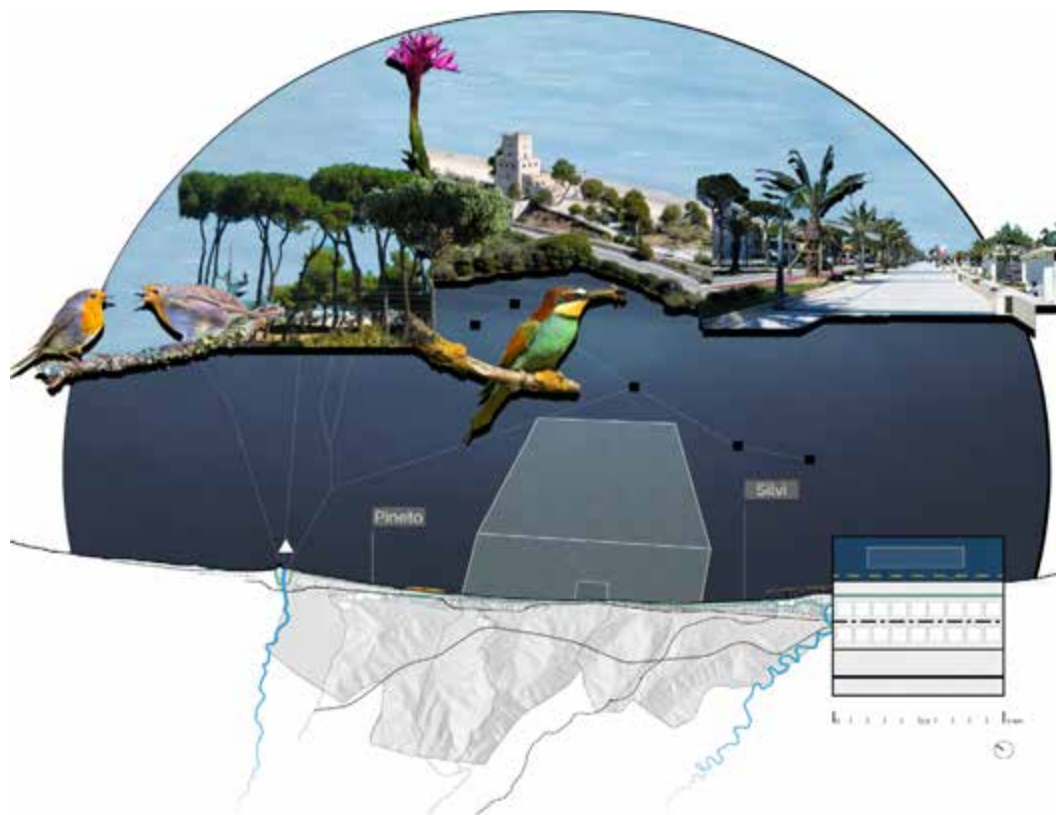


Figure 1: The Silvi-Pineto context (C1). The image illustrates the continuous urbanisation along the narrow coastal strip, punctuated by infrastructure systems and key heritage features: coastal pine forests, the Torre del Cerrano Marine Protected Area, the seafront promenade, and selected elements of local flora and fauna.

The pressure of construction, the functional rigidity of the urban system and the scarcity of open spaces render these areas more vulnerable to current climate dynamics. ISPRA data (2021) indicates that a considerable number of coastal segments between Silvi and Pineto are experiencing structural retreat, resulting in a substantial loss of natural sediments and, consequently, a compromise to the morphological resilience of the coastline. Furthermore, the rigid defence measures adopted in recent decades, such as groynes and breakwaters, have often proved ineffective or even counterproductive in the medium term, with a negative effect on the landscape and the coastal hydrodynamic balance (CIESM, 2012).

Despite the critical issues outlined above, the C1 context evinces elements of historical, landscape and naturalistic value of considerable interest, four of which are particularly noteworthy.

The first is the Torre del Cerrano Marine Protected Area (MPA), one of the few MPAs along the central Adriatic coast, which was established to protect a complex and interdependent ecological system comprising dunes, the coastal zone and the open sea (Ministero dell'Ambiente, 2009). Within the reserve, which covers approximately 37 square kilometres, the Torre del Cerrano plays a central role: an ancient coastal tower dating back to the viceregal era (1568), which has now been transformed into a narrative device illustrating the relationship between land and sea. The Museo del Mare (Sea Museum), located within the tower, features an exhibition dedicated to the Adriatic ecosystem, which progresses from the depths of the seabed to the sea surface, thereby facilitating a vertical and immersive interpretation of the underwater and coastal landscape, articulated across the various floors of the building. This symbolic narrative serves to reinforce the link between cultural heritage, historical memory and ecological perception, thereby positioning the Tower as a physical and conceptual hinge between the terrestrial and marine environments (AMP Torre del Cerrano, 2023).

The second is the system of coastal pine forests dating back to the 19th century, including the Catucci and Filiani Pine Forests. These vegetative formations, originally planted to stabilise the coastal dunes, have now become

significant reservoirs of biodiversity and ecological corridors within the urban landscape (Stanisci et al., 2014). The third comprises the remains of historic agricultural and industrial buildings, some of which have been partially incorporated into urban development. These bear witness to the functional relationships between the coast and hinterland prior to the rise of tourism.

Finally, the fourth consists of a few 20th-century accommodation facilities and traces of social tourism associated with Italy's "holiday culture", including examples of notable architectural quality (Fiadino and Zucconi, 2020).

In recent years, the area has been a fertile ground for experimenting with climate adaptation strategies and coastal regeneration processes, thanks to the implementation of co-management programmes and European projects. The participation of the Torre del Cerrano Marine Protected Area in the MPA NETWORKS project has strengthened the collaborative dimension of local governance, contributing to the adoption of integrated and multi-level approaches to planning (MedPAN, 2020). These initiatives proffer an alternative interpretation of coastal vulnerability, transcending a purely physical and morphological assessment in favour of a more systemic vision.

This approach is exemplified by the planning and management initiatives undertaken by the Municipality of Pineto in recent years. Through integrated policies focused on sustainable tourism, slow mobility, and the enhancement of coastal pine forests, the area has consolidated its role as a laboratory for innovation at the intersection of environmental conservation and local development. The establishment of the Zone 30 coastal area along the Teramo coast – which stretches from Martinsicuro to Silvi, constituting the largest initiative of its kind at national level – is an example of this (Eco dalle Città, 2023).

2.3 The Trabocchi Coast: intermittent landscapes and vulnerability in transformation

The second study context (C2) corresponds to the southern coastal stretch that includes the municipalities of Fossacesia, Torino di Sangro, Casalbordino and Vasto, part of the so-called Trabocchi Coast (Figure 2). In contradistinction to the Silvi-Pineto coastal system, this context exhibits a discontinuous settlement pattern, characterised by alternating promontories, coves and small coastal plains, where natural features still maintain a significant territorial presence.

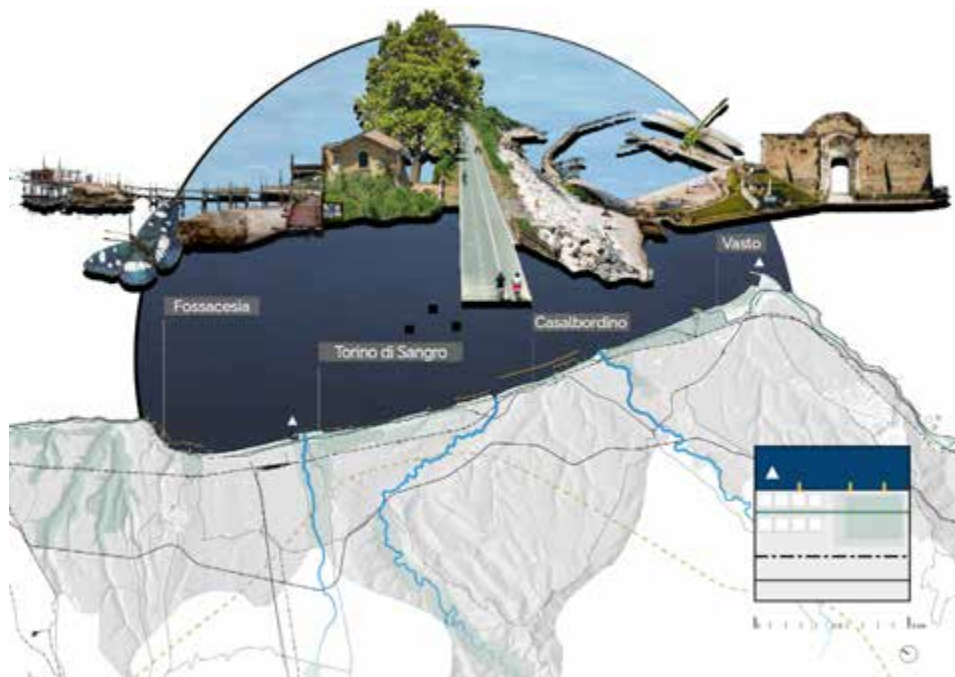


Figure 2: The Trabocchi Coast context (C2). The image highlights the coexistence of fragmented built environments and extensive preserved natural areas. Key features include: the trabocchi fishing structures, the Via Verde with its disused railway stations, the port of Vasto and historical traces, along with elements of flora and fauna typical of the Special Conservation Areas of this stretch.

Here, the orography of the terrain has historically influenced the processes of anthropisation, leading to a lower degree of building pressure and a greater preservation of environmental values in comparison to the northern section of the Abruzzo coast. This is evidenced by the fact that significant parts of the coastal area maintain a high degree of natural characteristics (Stanisci et al., 2014).

Indeed, this particular stretch is distinguished by intermittent natural “episodes” of high value, which are interspersed with infrastructure, industrial areas and seasonal settlements. From north to south, Special Conservation Areas (Habitat Directive 92/43/EEC) have been designated, including the Lecceta di Torino di Sangro, Punta Aderci - Punta Penna, and Marina di Vasto, in addition to two regional nature reserves. However, the restrictions and legal protection measures have not been sufficient to prevent actions with a significant environmental impact, such as the creation of the industrial area of the Port of Vasto or the post-war coastal settlements, sometimes built within 300 metres of the coastline, where building is strictly prohibited according to the Code of Cultural Heritage and Landscape (2004).

In addition to its rich natural heritage, the regional identity of the area is characterised by the distinctive trabocco system, which consists of ancient fishing machines built on stilts. This unique cultural heritage has recently become the focus of tourism and identity enhancement processes (Barone, Marino and Pignatelli, 1999). These structures are an emblematic example of anthropic adaptation to the morphological and hydrodynamic conditions of the coast, bearing witness to a history of symbiosis between humankind and the marine environment through construction techniques handed down through generations. The trabocchi are an embodiment of a living heritage that extends beyond their monumental value, representing a synthesis of technical and cultural expertise that has enabled local communities to devise adaptive strategies in a changing and occasionally hostile coastal environment (Cuzzucoli Crucitti, 2018).

In fact, the Trabocchi Coast is increasingly vulnerable due to the interaction between morphogenetic processes and anthropogenic pressures, particularly in river mouth areas. The most recent data demonstrate an intensification of coastal erosion and hydrogeological risk, with numerous stretches of the coastline being classified as “highly vulnerable” (ISPRA, 2022a). The risk of flooding and landslides is increasing, both in terms of extent and frequency of events, with a progressive expansion of the areas at risk compared to previous surveys (ISPRA, 2022b; ISPRA, 2023a). The area surrounding the mouth of the Sangro River has already been identified as one of the Italian coastal zones most exposed to flood risk by 2100 in the absence of adequate adaptation measures (ENEA, 2018). In recent years, this area has shown growing signs of criticality, particularly due to the increasing frequency and intensity of extreme weather events recorded over the past five years (ISPRA, 2023b).

The C2 context has gained increasing relevance due to recent territorial transformations, particularly the decommissioning of the Adriatic railway line and its conversion into a coastal cycle and pedestrian path. The *Via Verde of Trabocchi Coast* project, launched in 2009 and largely completed by 2020, has redefined the relationship between accessibility and the coastal landscape, offering new perspectives for the appreciation and enhancement of local natural and cultural heritage (Agenzia per la Coesione Territoriale, 2020). The repurposing of the railway corridor has created an opportunity to rethink the interplay between infrastructure and landscape, promoting a model of soft mobility aimed at valorising environmental resources and enhancing territorial resilience – although the latter still struggles to find effective implementation. Moreover, the increased tourist appeal generated by the new infrastructure has accelerated certain dynamics of change that require careful monitoring in terms of environmental impact and human pressure. The growing demand for tourism-related services and facilities along the route risks compromising the very landscape qualities that constitute its main attraction, introducing further elements of vulnerability into an already ecologically sensitive setting. In this light, the *Via Verde* may be understood not only as a sustainable mobility corridor, but also as a strategic infrastructure equipped to reconnect fragmented ecological networks and supporting adaptation strategies. However, to fully realise this potential, it is vital to move beyond conventional sector-based planning approaches and embrace integrated strategies that address the ecological, cultural, and socio-economic complexities of the coastal landscape (Clemente and Nanni, 2024).

In the preparatory studies for the coastal risk assessment of Abruzzo (AnCoRa Research, 2017)³, the exposure analysis considered demographic data, building density, infrastructure, and the presence of environmental and cultural assets. However, in the final evaluation concerning the Trabocchi Coast – the region's most naturalistic stretch – these aspects were often secondary to geomorphological vulnerability alone. This methodological imbalance serves to confirm the necessity for integrated approaches to risk assessment, able to capture vulnerability as a combination of sensitivity and adaptive capacity (IPCC AR5, 2014), proposing reading categories suitable for restoring the complexity of local contexts.

3 | Heritage as environmental infrastructure

3.1 Two coastal landscapes, a common challenge

In both contexts (C1-C2), the conflictual relationship between processes of anthropisation and environmental values clearly emerges, exacerbated by the transformations associated with ongoing climate change. The land-sea interface is configured as a space of tension and opportunity, where critical issues related to environmental emergencies intersect with the potential for transformation and regeneration of the settlement system (Manigrasso, 2023).

The presence of significant heritage elements offers an opportunity to rethink adaptation strategies from an integrated cultural perspective, where the memory of place and the transmission of traditional practices become resources for imagining resilient futures.

In this regard, the selected case studies provide a significant experimental setting in which to test innovative design approaches, grounded in the recognition of heritage value as a strategic lever for reducing coastal vulnerability.

The *design testing phase* carried out in the described contexts, as part of the research undertaken, represents a significant methodological step aligned with the *research by design* approach. This phase aims to identify recurring conditions and design guidelines that can be transferred and scaled to other areas, while maintaining close attention to the specific characteristics of each site and its territorial and community vocations. The experimental phase, developed through educational initiatives, applied research activities, and meetings with experts and stakeholders, highlights the value of design as an exploratory investigative tool. It allows for the description of the conditions and resources that can be activated within a given territory (Marchigiani, 2022), functioning as a cognitive practice in which hypotheses, intuitions, and interpretations are tested and brought into tension (Pasqui, 2017). In line with these considerations, within the framework of the PRIN research project, scenarios and design guidelines were derived through an inductive approach from the experimental activities (see note 1), abstracting the outcomes and emphasizing strategic approaches that are particularly relevant in relation to the evolving dynamics and risk conditions of the coastal contexts under investigation.

3.2 Environmental infrastructure: reconnecting ecological and cultural matrices

With reference to the multiplicity of interactions between risk levels and coastal cultural heritage, as well as to the richness of landscape and natural values found along the examined coastal stretches, this contribution aims to highlight the significant role that design strategies can play in supporting and promoting natural regeneration, restoration, and the enhancement of ecological networks, starting from the reconnection of existing environmental matrices. The literature concerning the definitions and terminology of green infrastructures identifies a key aspect in overcoming the notion of infrastructure or network as a mere sum of elements or parts, which, in order to provide benefits, must be adequately connected. This is not merely a matter of physical-functional connection, but of strengthening and enhancing the networks and the services they can provide (EEA, 2011). The advantages associated with the “stitching together” and “recomposition” of ecological matrices and networks underline the importance of moving beyond sectoral approaches that limit the scope of action to isolated interventions, without recognizing their strategic and structural impacts on ecosystem and territorial balances (Sargolini, 2009).

³ In 2017 AnCoRa research project (Risk Analysis of the Coastal Area of the Abruzzo Region) was developed as part of an agreement between the Abruzzo Region and Univaq - DICEAA. The results are available online at: <https://www.regione.abruzzo.it/content/analisi-e-documenti-propedeutici/>

Therefore, the conceptual and operational background is broader than the framework defined by the narrative of landscape ecology, which focuses on the functioning of environmental systems and emphasizes the description of natural processes while continuing to implicitly separate “natural” from “cultural” heritage (Cevasco, 2007). From the perspective adopted here, natural and human-made ecosystems cannot be understood as separate components; the benefits associated with the functioning of continuous ecological matrices and capillary environmental networks should not be assessed solely in terms of human needs or advantages. Although ecosystem services, as defined by the Millennium Ecosystem Assessment (2005), are anthropocentrically interpreted as the benefits humans derive from ecosystems, it is now clear that they serve as an interpretive tool for understanding the relationships between natural processes and the uses and activities of society (Franchina, 2018).

These very ecosystem services underpin the definition of green infrastructures, conceived as a key system for interpreting the health and well-being of ecosystem components (water, soil, organisms). Accordingly, this contribution adopts a definition of green infrastructure as a system of elements and parts capable of creating conditions and enabling opportunities – an “assemblage” whose functions may vary, but whose entirety can become structure, support, and a base for implementation. In this view, green infrastructures are understood not only as environmental networks, but also as carriers of identity, historical-cultural connections that underscore slow processes of decoding and interpreting places. This perspective informs the research reflections aimed at addressing the fragmentation of environmental matrices, whose spatial configuration in Adriatic coastal systems is associated both with natural edges – currently discontinuous – running longitudinally along the waterline, and with a dispersed distribution linked to interstitial spaces within the linear urban fabric.

Considering heritage as environmental infrastructure – as a strategic approach to reducing vulnerability – brings to the forefront of contemporary planning debate and tools the role of soil itself, which is currently described and indexed in terms of uses that increase its profitability or productive capacities. This is consistent with the territorialist definition of heritage adopted in this research, which goes beyond a merely conservative vision. It recognizes the processual and incremental dimension of heritage, encompassing the identity features of landscapes and grounded in the dynamic interactions between local communities and the “natural” heritage (Magnaghi, 2020). It is not only a matter of material elements and sites, but also of traditions and collective imaginaries of coastal communities. This approach shifts the focus to relational spaces – buffer zones where overlapping and transitions of land-sea uses occur – thus variably defining the range of influence of land-sea interactions.

The heritage dimension is therefore expressed in land-use practices, in the innovation of architectural and urban solutions, as well as in the transformations of production systems in response to diverse environmental conditions. Reactivating these mechanisms through design means recovering adaptive approaches that are still traceable in some indigenous contexts, where social, cultural, and productive dimensions are deeply integrated into ecological practices of natural resource management and use.

However, exploring the potential of heritage as an infrastructure capable of mitigating vulnerability in a complex system such as the coastal one requires that communities once again be placed at the center of territorial transformation processes – as active agents in the very processes of patrimonialisation. Enhancing heritage as infrastructure, in fact, requires the active contribution of communities that resume responsibility for the care of the territories they inhabit through practices of management and maintenance. This is not only about caring for soil as a functional base of the natural and built environment, but also about recovering and transmitting the relationship with the land on which cities are established and continue to evolve (Pileri, 2015). This is the core of what cultural heritage represents: the progressive accumulation of material and immaterial sediments, nourished by continuous exchange with society, which shares its value and transmits it to future generations.

4 | Conclusions

The research presented in this contribution highlights the strategic potential of coastal cultural heritage in supporting adaptive responses to climate and environmental risks within the complex land-sea interface of the mid-Adriatic. By adopting a research-by-design approach and focusing on the coastal systems of Silvi-Pineto and the Trabocchi Coast, the study aims to demonstrate how heritage – both manifest and latent – can be reinterpreted as an active infrastructure, capable of informing and guiding resilience-oriented territorial strategies.

The comparative analysis of the two case studies reveals that heritage values, far from being static or merely preservable assets, constitute dynamic resources embedded in socio-ecological processes. These resources offer interpretive and operational frameworks to reconfigure spatial fragmentation, support ecological connectivity, and strengthen local adaptive capacity. In this regard, the reconceptualisation of green infrastructure as a system of relations – ecological, cultural, and infrastructural – emerges as a critical perspective for moving beyond sectoral planning logics and embracing a more integrated, place-based approach.

Importantly, the study underscores the role of communities as co-producers of resilience. The transition from a protection-oriented vision of cultural heritage to one that frames it as a living infrastructure requires both a conceptual shift and the reactivation of social processes of care, maintenance, and transmission.

The research outputs derived from the design testing phase contribute to formulating transferable planning agendas and strategic design guidelines, which may inform other Adriatic coastal territories experiencing similar dynamics of pressure and change. Ultimately, the integration of heritage and environmental infrastructure perspectives fosters a more nuanced understanding of vulnerability, not as a static condition but as a relational state shaped by history, identity, and the capacity to adapt. In a context marked by accelerating climatic change and territorial fragility, this approach offers a valuable contribution to the development of adaptive planning paradigms, capable of sustaining the ecological and cultural integrity of coastal landscapes over time.

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Author contributions

The contribution is the result of a shared reflection by the authors. However, the following paragraphs were written by Lia Fedele: 3 | Heritage as environmental infrastructure; 4 | Conclusions. Angelica Nanni was responsible for: 1 | Introduction; 2 | Territorial Context and Case Studies. Angelica Nanni was also responsible of the graphic elaboration of the figures included.

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