

The cape flows to the sea (and back again)

Santa Pola (ES)

Introduction

Living conditions result from a continuous negotiation between living organisms at all scales: bacteria, viruses, fungi, animals, plants, rocks, water, and more are all part of a non-hierarchical web of relationships and interdependencies. At the same time, **living beings alter and shape their environments** to improve their own living conditions. **The balance among these diverse and complex needs is what we call nature.** Today, this balance is under threat due to **climate change** and the extreme weather events it brings—droughts, floods, rising sea levels—which are disrupting natural dynamics.

From this perspective, **nature** is no longer seen merely as an object of study or contemplation, but as **a subject with its own agency**. In responding to the challenge of “re-emerging from natural elements,” we began a reflection on how to give these elements the power to act—to **initiate transforming processes that could evolve on their own in an autopoietic way.**

A polycentric co-dependent territory

Santa Pola was originally founded as *Portus Illicitanus*, the port of the Roman colony of *Illici*, located in *La Alcudia* (between Elche and Alicante). Today, Elche, Alicante, and Santa Pola continue to function as part of **a connected metropolitan area**, each playing a distinct yet complementary role.

Alicante serves as the administrative and cultural capital—a coastal hub that concentrates services, transportation infrastructure, and regional connectivity. Elche is the industrial and logistical center, driving economic activity and employment. Santa Pola acts as a hinge between the two: the natural and ecological counterpart, currently focused primarily on residential coastal tourism. The rural area in-between the tree cities is a first class agricultural productive plain, dating its use since at least the roman period (traces of centuriatio).

However, Santa Pola has the potential to become a vital link between urban areas and the surrounding protected natural landscapes. It can also rediscover and valorize its tangible and intangible heritage—both natural and human-made.

The Territorial Strategy of the Valencian Community (ECTV) highlights the innovation corridor between the two productive cities and identifies **Santa Pola's role as an emerging ecological cluster**. At the same time, the city of Santa Pola has developed in the past year different strategies to gain a new centrality in the territory.

Re-emerging from the sea

Re-deefine the atoll: a natural and anthropic system

1. Geological and natural system

During the Quaternary period, **an organic reef formation emerged from the sea—the fossil atoll of Cabo de Santa Pola**. Today, the close interaction between the sea and the sierra continues: water carves ravines and feeds the shoreline, while the movement of the sea floods and reshapes the land. This is coastal dynamics in action—a cyclical co-dependence and a fragile, yet rich ecotone.

At the same time, Santa Pola's marine ecosystem offers an opportunity to trigger new processes by integrating ecological dynamics into the project area. Each year, approximately **10,000–12,000 kg of Posidonia**

oceanica is washed ashore and then transferred to the quarry. It is a seagrass endemic to the Mediterranean, with a remarkable capacity for CO2 absorption. Its underwater meadows renew each season, and dead plants are deposited on the shore by tidal movements. Traditionally, *posidonia* has been used **as organic fertilizer**, and more recently, it has gained interest as a **bioconstruction material**. In Santa Pola, it has been tested in a pilot project for regenerating and stabilizing the quarry's slopes¹—demonstrating its potential as a circular resource within ecological restoration strategies.

2. Human Settlement and Territorial Transformation

Over time, **urban development has shaped the slopes of the atoll**. Santa Pola and Santa Pola de l'Est have grown to the south, in contact with the sea, while Gran Alacant has expanded to the north, bordering the Clot del Galvany wetlands and the coastal dune system, on the atoll slope. **The current urban planning framework (PGOU) proposes new development that completes a ring of construction around the Cape of Santa Pola**. This includes fast-access lanes from Elche and Alicante, enabling the transformation of existing arteries—such as the N-332 and the Elche–Santa Pola road—into metropolitan boulevards, as envisioned in the Territorial Strategy of the Valencian Community. In parallel, green infrastructure and public services were being planned at the edges of the Cape and along the ravines, **creating a gradient between the built environment and the natural system**. The Santapola Avant plan underscores the strategic importance of the Sierra, proposing a management model for its protected areas that enables tourism, cultural, and environmental uses in a controlled and sustainable way.

3. The vision: the atoll as a system

The core vision of the project is to reinterpret **the entire atoll as an integrated system—both natural and anthropic**—linked to the wider territorial triangle of Alicante, Elche, and Santa Pola. Activating the ecological and spatial dynamics of this unit provides a foundation for broader territorial relationships and regenerative practices.

From this systemic perspective, **the ecotone between the city and the Cape becomes a space of opportunity**. Conceived as a green corridor, it serves both people and nature. It functions as a protective buffer, delivering key ecosystem services: water retention and filtration—especially during extreme events such as DANA; the spread of pioneer flora adapted to climate change; and the creation of an alternative, horizontal pathway that distributes and facilitates access to the Cape from multiple neighborhoods.

This is not just a transition zone—it is a space where nature and urban life flow into each other.

The Cape flows to the sea... and back again.

1. University of Alicante, CIMAR of Santa Pola, Cubarse and Santa Pola municipality.

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Integration: a human and ecological system

Ensanche del Varadero neighborhood

Currently, the Ensanche del Varadero neighborhood presents a complex urban-natural interface marked by ecological fragmentation, seasonal use, and spatial disconnection. The Ronda del Norte is now as a significant barrier, severing both human access and ecological continuity between the city and the Sierra de Santa Pola. On the other side, the coastal edge is under increasing pressure from urban development, climate change, and rising sea levels. Within the neighborhood itself, the urban fabric is characterized by a predominance of secondary residences, with inactive ground floors and a strong seasonal character—used primarily in summer—resulting in a lack of vibrant street life and limited urban continuity. In short, this is a territory that neither makes city nor supports ecological flows, and therefore requires a fundamental rethinking of how urban and natural systems can coexist.

The project proposes an integrated landscape and urban strategy based on three co-dependent systems:

- **A Cabo–City Buffer** that restores ecological continuity with the Cape and the Sierra;
- **A City–Sea Buffer** that protects the coastline while enabling a resilient, productive edge;
- **A Transversal System of Ravines** that connects mountain, city, and sea through ecological and civic infrastructure.

Together, these systems support both human and ecological well-being, recognizing their co-dependence in the context of climate change and urban transformation.

Cabo–city Buffer: restoring the ecotone

The Ronda del Norte is reimagined as a green ecotone—a transitional space where urban and natural systems meet, interact, and coexist. While the current PGOU foresees the continuation of this road through a topographically complex area, the project proposes an alternative strategy: rather than extending the car infrastructure, a green corridor is introduced, designed on the traces of a limestone path, adapted to the topography. It prioritizes pedestrian and bicycle mobility and reinforces ecological connectivity, redefining the perimeter as a space of movement, leisure, and climate comfort. Vehicular traffic continues along Juan Sebastián Elcano Street, preserving mobility while reducing fragmentation and environmental impact. This intervention transforms a planned infrastructure barrier into a landscape-based connector, restoring access to the Sierra and enhancing both ecological and social value.

The buffer becomes a corridor for the migration of species adapting to drought, heat, and changing ecological conditions. Through the introduction of pioneer and locally resilient species, the zone becomes a biodiversity node, aiding natural succession and promoting ecosystem health.

City–Sea Buffer: a resilient coastal edge

Along the coast, the Avenida Santiago Bernabéu and its surrounding hardscapes are reimagined as a resilient buffer zone—a hybrid space designed to mediate the impacts of sea-level rise, extreme weather events such as DANA, and growing urban pressure.

In the area of Varadero Beach, the intervention focuses on targeted dune restoration, reinstating natural coastal dynamics and offering protection against erosion and flooding. These regenerated dunes become living systems that stabilize sediment, provide habitat for coastal flora and fauna, and reinforce the coast's ecological identity.

In contrast, the Varadero Breakwater Park presents a highly artificial coastal condition due to the presence of the dike, which interrupts sediment transport and natural dynamics. Here, rather than attempting to replicate natural processes, the project embraces the site's artificiality and proposes the creation of a Breakwater Park. This space is designed as a protective edge against sea-level rise, while supporting a mix of light nautical activities—such as kayaking and diving—and beach-related uses like volleyball and informal gathering areas. The park becomes an active, flexible zone where recreation, protection, and social life converge.

Throughout this coastal system, the buffer integrates water retention infrastructure into urban public spaces to manage flash flooding and reduce impermeable surfaces. At the same time, it supports a diversified range of uses and promotes a blue economy that links ecological preservation with local livelihoods. The result is a coastline that is both more resilient and more accessible, where ecological and social values reinforce one another.

Ravines: transversal ecological-civic connectors

The network of ravines that cut through the territory is reinterpreted as transversal green corridors, weaving together the coastal, urban, and mountainous systems. These natural depressions become the backbone of a decentralized and distributed urban ecology.

The ravines serve as habitat corridors, enabling the movement of species across urban obstacles. They connect fragmented green patches, helping ecosystems reorganize and adapt under climate stress.

These corridors offer new spaces for everyday life—public facilities, such as schools, shaded paths, local activity centers—outside of the city center. They bring green infrastructure into the neighborhoods, mitigating the urban heat island effect, and improving year-round urban comfort and environmental equity.

A new interconnected urban landscape

The ravines form a transversal system that decompresses the saturated coastal edge and restores access between the sea and the Cape. In the south, the coastline is transformed into a coastal park, where ecological value and urban life coalesce.

This project recognizes that ecosystems cannot adapt alone. As climate change accelerates, landscapes must support the assisted migration of species blocked by human infrastructure. By creating diaspora cores of vegetation—diverse, resilient, and productive—the intervention ensures that nature not only survives but thrives in and through the city.

In turn, these ecological systems improve urban life—cooling the air, filtering water, providing space for rest, movement, and community.

The city is no longer an obstacle, but a platform for regeneration.

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The cape gateway: the quarry

"Restoration constitutes the methodological moment of recognition of the work of art, in its physical consistency and in its double polarity, aesthetic and historical, for its transmission to the future." — Cesare Brandi, 1969

The Santa Pola quarry stands as a unique monument, both natural and anthropic, where the intrinsic values embedded in its geological and historical traces are acknowledged and preserved. The project embraces the visible marks left by decades of extraction and the intrinsic values of the place as key drivers for its regeneration proposal.

Continuously reshaped landscape

Positioned on the atoll's foothills, the quarry's shape results from both human extraction and gradual natural erosion by ravines—Barranco del Boixot and Barranco de Fondo—which mark its fragile yet promising boundaries.

The quarry site is topographically complex, composed of two distinct sectors: the northern part abuts the Sierra, while the southern section borders the urban fabric and the northern ring road. The project focuses into two complementary strategies.

Northern part: renaturalization and water management

- **Topography** becomes the **primary tool** to restore and condition the quarry zone by addressing **both water scarcity and episodic extreme reinfall events** (increasing with climate change).
- Capture and channel the scarce precipitation typical of Santa Pola's arid climate by **enhancing natural drainage** through targeted topographical modifications. This **concentrates humidity in specific low points and channels runoff to the ravines**, fostering spontaneous vegetation growth and initiating natural regeneration and ecological evolution.
- **Reopen and widen the eastern ravine** where topography allows, creating **temporary water retention basins to mitigate flooding during extreme meteorological events** (such as DANA storms) and to protect adjacent urban areas. This renaturalization restores the natural flow, improving resilience and habitat quality.
- **Maintain and protect the scenographic walls**, originated by quarry exploitation. Rocky-reefy cliffs explain the geological origin of the atoll and its preciousness and at the same time are also a **refuge for rocky birds**.
- The northern part of the quarry is **unaccessible to visitors** (except for safety and maintainance), to enhance the wild evolution and the character of refuge for non-human species.
- The **only program introduced in the northern part is an open air theatre**, embraced by rocky cliffs, and a belvedere to observe the evolution of the renaturalized zone.

Southern part: urban integration and public space creation

The southern quarry area interfaces with a **node of facilities: a yet-to-be sports complex, a social-public tertiary use lot, the geriatric residence and an undeveloped residential zone**.

The project recalibrates connections with the urban fabric by shifting and redistributing building volumes while creating new connections.

Connections

Former industrial paths are transformed into accessible pedestrian routes, main connections inside the quarry. An elevator facilitates access between the southern part and the northern part of the quarry. Some elevated paths, using existing pillars scattered inside the quarry, give access to walkways and panoramic views over the restored landscape and the sea.

The node with the Ronda del Norte is reshaped as a park with facilities, hosting a new facility building and a parking area, which substitute the removed parking lots of the beach. At the quarry entrance there is a bus stop to the protected area of Cabo de Santa Pola, the beaches and the city centre.

Program

The existing structures of the quarry exploitation are reused and refunctioned. The main building at the entrance is repropose as an **interpretation and visitors centre** about *Posidonia oceanica*, its ecological functions and its applications.

A new building makes a junction with the existing facilities node around Ronda del Norte. The aim is to improve a **research and experimentation pole around *Posidonia oceanica* applications in a context of increasing drought climates**. The centre experiments with its use as an organic fertilizer and as bioconstruction material. A **big surface of *Posidonia* stockage is implemented**. The quarry site is also used as an experimental field for pioneer species (such as *Tetraclinis articulata*) maintained with minimal irrigation.

Open spaces ecology

Santa Pola's climate, characterized by approximately 300 mm of annual rainfall, lies on the **threshold of aridity**. To address this, the project proposes an **ecological oasis strategy** that introduces living niches as catalysts for sustainable dynamic systems capable of self-perpetuation. The implementation steps are: increasing humidity through excavation; planting pioneer species able to resist to hard conditions such as drought and strong sun exposure; developing multilayer vegetation (beneath the canopy, fruit trees and other delicate plants can thrive); organic matter feeding. This multilayer plantation aims to produce **low-water-consumption crops** such as dates, almonds, olives, carobs, lentisk, and cereals, promoting a circular economy while enhancing ecological resilience.

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The sea gateway: the coastline

The urban connection

The section of Calle Almeria, which connects the quarry area with the sea, is planned to undergo a strategic transformation aimed at enhancing climatic comfort and strengthening ecological connectivity. By reducing parking spaces along this street, the design prioritizes **pedestrian comfort and microclimate improvement** through increased permeability and potential green infrastructure interventions. This creates a slower traffic flow, reducing heat generation, while serving as a **visual and functional corridor** linking the urban quarry area with the Varadero Beach and the Breakwater Park at the old shipyards. It could be replicable to other transversal axis.

The sea gateway

A key aspect of the project is the **planned retreat of the coastline inland**, a forward-looking adaptation strategy that acknowledges the inevitable impacts of SLR. This excavation-based approach relieves pressure on current shorelines and creates space for natural coastal processes to unfold.

Playa del Varadero is envisioned as a **dynamic dune beach system** shaped by prevailing easterly oblique winds. This naturalistic intervention not only restores coastal morphology but also functions as a **natural buffer against sea level rise** (SLR) and storm surges. Dune systems offer vital ecosystem services such as sediment retention, wave energy dissipation, and habitat provision for coastal flora and fauna, thereby enhancing shoreline resilience to climate extremes.

Inland, the existing longitudinal park is reimagined as a pine grove integrating sports facilities and children's play areas, contributing to the multifunctionality and ecological value of the coastal landscape.

The Breakwater Park—an artificial urban coastal park—serves as a **hard coastal defense line**, engineered to protect the inland urban fabric from rising seas. It establishes a robust boundary between urban areas and the marine environment, offering protection from flooding while also **enabling recreational and sporting activities** such as beach volleyball and light water sports. In doing so, it fosters community wellbeing and strengthens social resilience. The park incorporates a variety of recreational amenities and **small-scale structures** designed to accommodate additional community-oriented functions.

Small piers, integrated into the urban grid, provide direct access to the sea, reinforcing the human-nature connection and encouraging the sustainable use of coastal resources.

Breakwaters are designed as habitat-forming structures, with their stone configurations creating microhabitats for marine life such as crabs, mussels, and other small organisms. These ecological niches contribute to biodiversity and strengthen local marine food webs.

The long Astillero dike is reimagined as an **open-air museum**, featuring benches and interpretive signage that tells the story of this historically significant site, which is recognized as part of the region's industrial heritage.

The project also includes the active maintenance of *Cymodea nodosa* and *Posidonia oceanica* and meadows. These meadows stabilize sediments, improve water quality, and provide habitat and nourishment for numerous marine species. Moreover, *Posidonia* is a significant carbon sink, playing an essential role in blue carbon sequestration and climate change mitigation.

Appendix

The urban planning instruments to develop this transformation:

Targeted Modification of the POUM:

A modification of the structural planning framework of the general urban plan is proposed, through the alteration of the land-use classification of the Ensanche del Varadero neighborhood. The objective is to adjust the overall land uses in accordance with the development criteria established by the current planning regulations.

Special Plan for the Quarry:

This is proposed as a derivative planning instrument aimed at implementing detailed zoning and adapting the intended uses in common non-developable land, in accordance with the provisions of the general urban plan and the conditions set by sectoral regulations.

City-Cap Ecotone:

The proposed action does not involve any change in the land-use classification, which remains as protected non-developable land. The objective is environmental conservation and water management through the consolidation of the trace of a pre-existing limestone path, adapted to topography, which is non-buildable and has minimal impact. This intervention is planned to be carried out through municipal and, if necessary, environmental authorization. If the required authorizations are insufficient or the intervention exceeds acceptable limits, a Special Urban Plan will be processed to justify the public interest, territorial compatibility, and landscape integration of the proposal.

Breakwater Park and Varadero Beach

The proposed interventions within the Breakwater Park and Varadero Beach fall within the zona marítimo-terrestre (ZMT) and therefore require prior authorization from the competent coastal authority. The project will be developed in accordance with the applicable coastal regulations, ensuring compliance with public domain management principles while promoting a balanced integration of environmental protection, climate resilience, and recreational uses.

Consulted documents:

Plan general municipal de ordenación urbana de Santa Pola (PGOU)
Estrategia territorial de la comunidad valenciana (ETCV)
Plan de acción territorial forestal (PATFOR)
Plan estratégico Santapolavant
PAT Infraestructura verde del litoral (PATIVEL)
Plan Director Destino Turístico Inteligente Santa Pola
Plan Director del Cabo de Santa Pola
Plan De Movilidad Sostenible De Santa Pola 2024
Agenda urbana 2030 Santa Pola
Ley de costas valenciana