

Upscaling Coastal Restoration to enhance natural resilience

Pilot sites (hands-on restoration)
 Modelling support (ESS delivery)
 Legacy (beyond the project)

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Europear Green Deal



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• Define scalable adaptation-through-restoration plans

 \circ Enhance coastal ESS for $\textbf{risk}\ \textbf{reduction}$ and $\textbf{BDV}\ \textbf{gains}$

REST-COAST 9 Pilots + worldwide coasts







Vistula Lagoon (Baltic Sea) New island for BDV &ESS/Dredging impacts



 \circ Restore water/sediment fluxes for gains in resilience + natural capital

Assess risk reduction by new wetlands / beaches (natural dynamics)

REST-COAST 9 Pilots + worldwide coasts



Rhone delta wetlands (N Med) Connectivity & realignment (fluxes in former salt works



Sicily lagoons/wetlands (S Med) Connectivity & water quality for ESS



Restoration design + maintenance: Monitoring + modelling
 Assess restoration contribution to coastal blue carbon and WQ
 Hydro-morphodynamic damping for seagrass transplantation

REST-COAST 9 Pilots + worldwide coasts







Foros Bay (Black Sea) Bay-sea connect/Seagrass transplantation Arcachon Bay (Atl French coast) Biomimetic damping for seagrass restoration)



Business plans for restoration tailored to each Pilot
 Indicators & quick scan tool for restoration potential

REST-COAST 9 Pilots + worldwide coasts





Managed dam/water, endangered/invasive sp.

Wadden Sea (cross-border N Sea) Sed. mangmt. + seagrass + protective struct.

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SI mid-term pattern with overwash "losses": max/average/min rates from calculations + data (CEEPYC/CEDEX)

Ebro Delta Pilot: apparently pristine coast



Coast: micro-tidal + waves/surges





Ebro Delta Pilot: river-delta-coast connectivity (NBS for Q_{susp sed} and Q_{bed load})

Controlled floods: monitored fluxes (no sediment injection) – problem origin



Flood May 5th, 2022

- \circ Discharge released from $\ensuremath{\textit{Flix}}$
- Peak flow Ascó 1,380 m³/s
- Flood wave takes 7:15 h from
- Ascó to Tortosa (58 km \rightarrow 8 km/h)
- Peak attenuation in Tortosa

Monitoring

- Permanent SAIH-SAICA networks
- Doppler v profiles 2 sections
- SSC 7 sections in bridges along the Ebro river
- Images from drone + Sentinel 2



Ebro Delta Pilot: river-delta-coast connectivity (NBS for $Q_{susp sed}$ and $Q_{bed load}$) Controlled floods: monitored fluxes (ex. control section) – problem origin



• SAICA turbid. sensor stopped **function** at high flows

- Q_{sed} uniform distribution in cross section
- Late rise & early fall of sedimentograph in Ascó
 Moderate sed. mobilization: 1250 tons at Tortosa





Ebro Delta Pilot: coastal roughness + room for dynamics (NBS)

Coastal roughness: longitudinal embryo dunes (not barriers) – symptoms



Local geodiversity (profile)



After storm sequence 2023

O Hands-on restoration with embryo dunes for coastal roughness (mimic older dunes)
 O Self resilience under storm waves (duration ≥ conventional nourishment)



CEWS structure





Ebro Delta Pilot: HR predictions validated with risk-generating Med events (Celia storm, March 2022)



Código	Localización	Latitud	Longitud	Profundidad
F1	Somera	41°22.454'N	2°11.602'E	8 m
F2	Profunda	41°22.472'N	2°11.712'E	13.4 m













Ebro Delta Pilot: modelling to design/maintain coastal restoration

<u>EWS</u> for proactive restoration + maintenance + rapid defence measures (cost-benefit ratio of EWS \geq 10 / 1, FT 2023)



• Make **explicit** climatic **risks**, with forewarning (7 day prediction)

Favour preventive adaptation
 (UNEP 2022) pre-storm

 Reduce risks and negative impacts (during storm)

 Improve yield of protection / restoration investments (post storm)



Ebro Delta Pilot: Modelling to project restoration effects Deltaic coast: Embryo dunes + ridge-runnel (coastal barrier)





• Hydro-morpho validated (present) models

• Assess 2030 conditions (past extremes: proxies)



Ebro Delta Pilot: Modelling to steer restoration **Deltaic coast: Protection + blue carbon from seagrass beds**

• Hydraulic models for seagrass (damping via mom.-eq. \uparrow ; but $C_{\rm b}$, $C_{\rm d}$ & sediment transport \downarrow)

• Experimental tests for efficient widths of seagrass berm (checkers board pattern)





Reduction of erosion and mobility by seagrass





REST-COAST legacy (vulnerable coasts)

• Consistency in modelling & interventions from short to long-term (no regret decisions)

Internalising impacts, C footprint and BDV gains (knowledge-based adaptation)

• Explicit uncertainties bound by modelling and monitoring (funding support)

• Coastal Restoration Platforms (underpinning more favourable governance and policies)









REST-COAST project



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