



The 4th CEMFOS 2025

The International Seminar on Coastal Ecosystem Management for Sustainability



Biogenic Reef Restoration

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UNIBO-UNSRAT Bridging Reef Project



ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

DEPARTMENT
OF BIOLOGICAL, GEOLOGICAL,
AND ENVIRONMENTAL
SCIENCES



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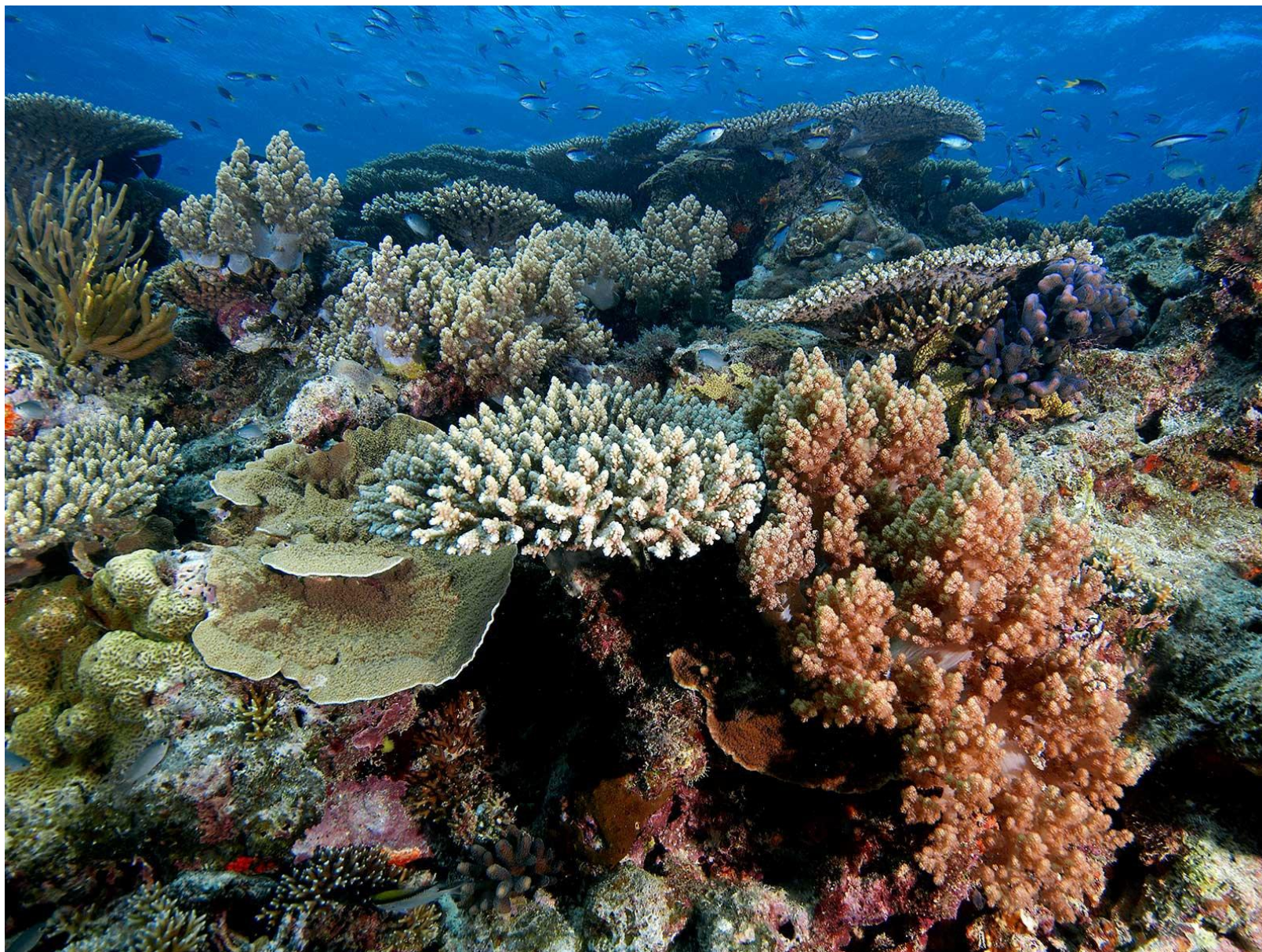
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Biogenic Reefs

Complex, raised (3D) habitats built by living organisms on the seabed, creating essential homes for diverse marine life.

Main Biogenic Reef Builders:

- hermatypic corals
- molluscs
- polychaete worms
- cold-water corals
- sponges
- diatoms
- calcareous algae
- bryozoans



Coral reefs



Oyster reefs



Sabellaria reefs



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Biogenic Reefs ecosystem services

Habitat Creation: They offer complex structures and a solid foundation for other organisms to settle on and live.

Increased Biodiversity: Reefs support a wide variety of marine life, including other invertebrates, fish, and algae, leading to higher biodiversity.

Shelter: They provide shelter and nurseries for juvenile fish and mobile organisms.

Seafloor Stabilization: Reefs help to stabilize sediments and prevent erosion.

Water Quality: Filter-feeding organisms like mussels and oysters help remove sediment and plankton from the water, making it clearer.

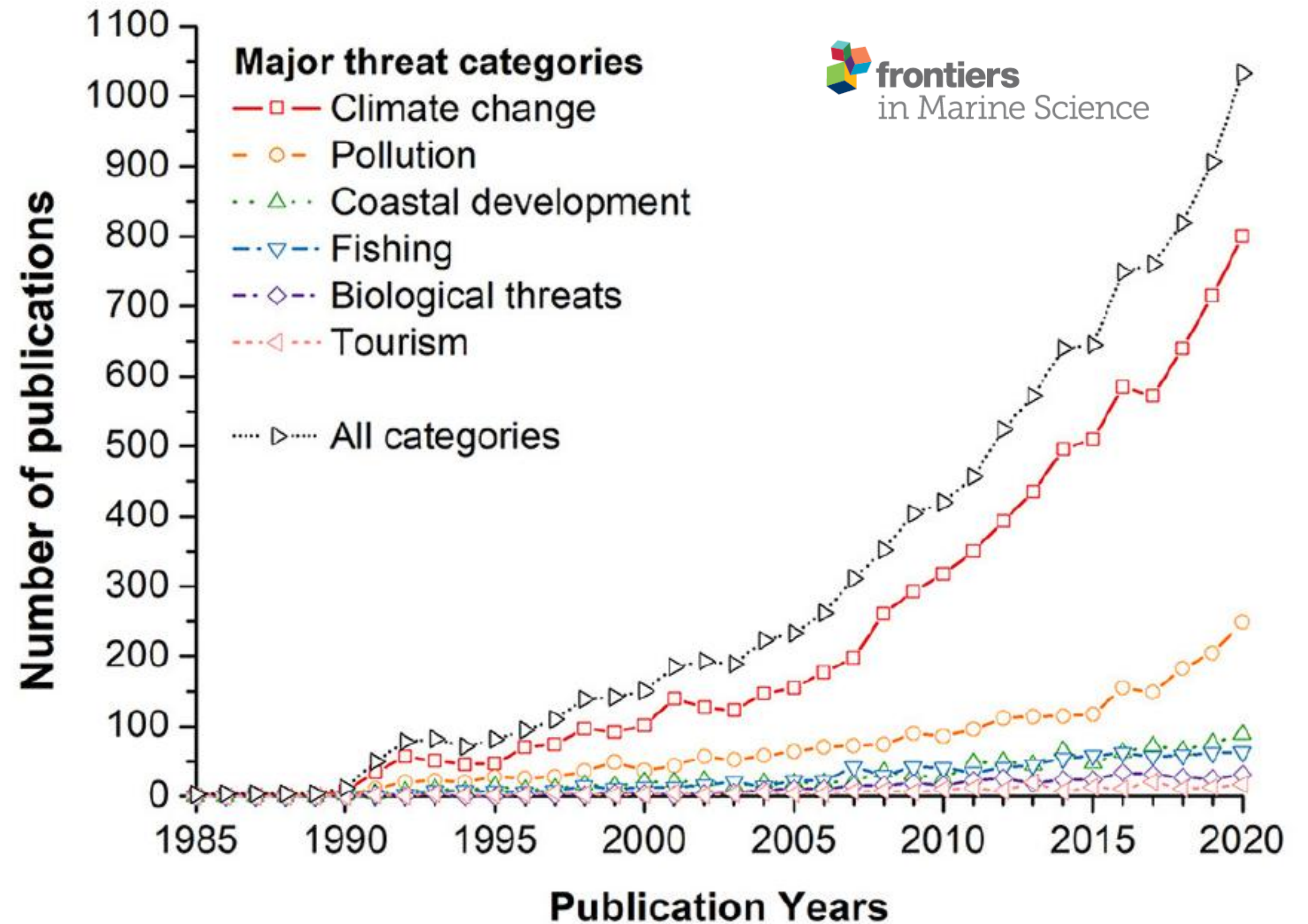


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Biogenic Reefs at Risk

- natural catastrophic events
- local human impacts
 - pollution
 - overfishing
 - coastal development
- global climate change
 - sea warming
 - oceanic acidification
 - increasing storms



Ponti M, Linares C, Cerrano C, Rodolfo-Metalpa R, Hoeksema BW (2021) Editorial: Biogenic reefs at risk: Facing globally widespread local threats and their interaction with climate change Front Mar Sci 8:793038 <https://doi.org/10.3389/fmars.2021.793038>

Marine Habitat Conservation

- establishing marine protected areas (MPAs)
- implementing sustainable fishing practices
- reducing plastic waste and other pollutants
- improve education, awareness and behavior of individuals
- **restoring degraded habitats**





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Biogenic Reefs Restoration

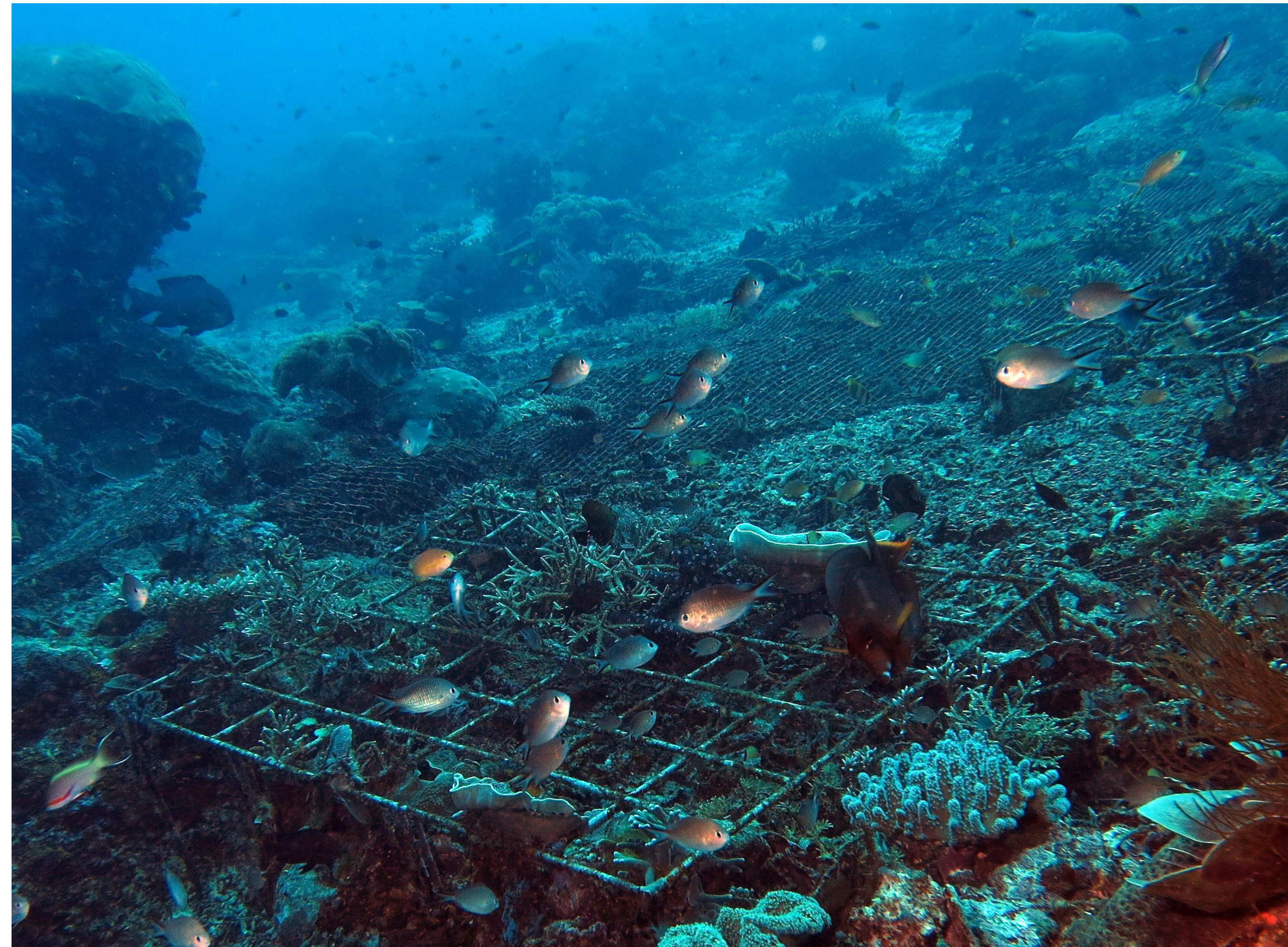
Marine habitat restoration aims to recover original ecological functions and biodiversity of degraded marine habitats.

Passive strategies

- Reduction of human disturbance
- Removal barriers and facilitate population connection
- Substrate stabilisation

Active strategies

Reintroduction and replanting of native species (from donor natural populations or cultivation)



Sawanderek, Raja Ampat, Indonesia (photo by M. Ponti)



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Key principles of marine habitat restoration

- strong scientific basis
- addressing the root causes of degradation
- setting clear objectives
- conducting thorough baseline studies and ongoing monitoring
- engaging stakeholders for long-term commitment
- implementing adaptive management for changing conditions
- restoring ecosystem function
- adequate economic backing and technological (nature-based) solutions
- ensuring efforts are integrated into broad policy and regulatory frameworks



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UNIBO-UNSRAT Bridging Reef Project

Aims to establish a structured **cooperation and exchange program** between the Department of Biological, Geological and Environmental Sciences (BiGeA) at the University of Bologna and the Faculty of Fisheries and Marine Science at Sam Ratulangi University (UNSRAT), Indonesia, focused on the **comparative study and practical implementation of coastal marine habitat restoration strategies concerning tropical (e.g., coral & oyster) and temperate (e.g., oysters and sabellaria) biogenic reefs.**

The initiative addresses the urgent need for **interdisciplinary, cross-regional training in ecosystem restoration** while fostering international **academic cooperation and student mobility.**

**INNOVATIVE PROJECTS UNDER INTERNATIONAL COOPERATION AGREEMENTS
FUNDED BY UNIBO**

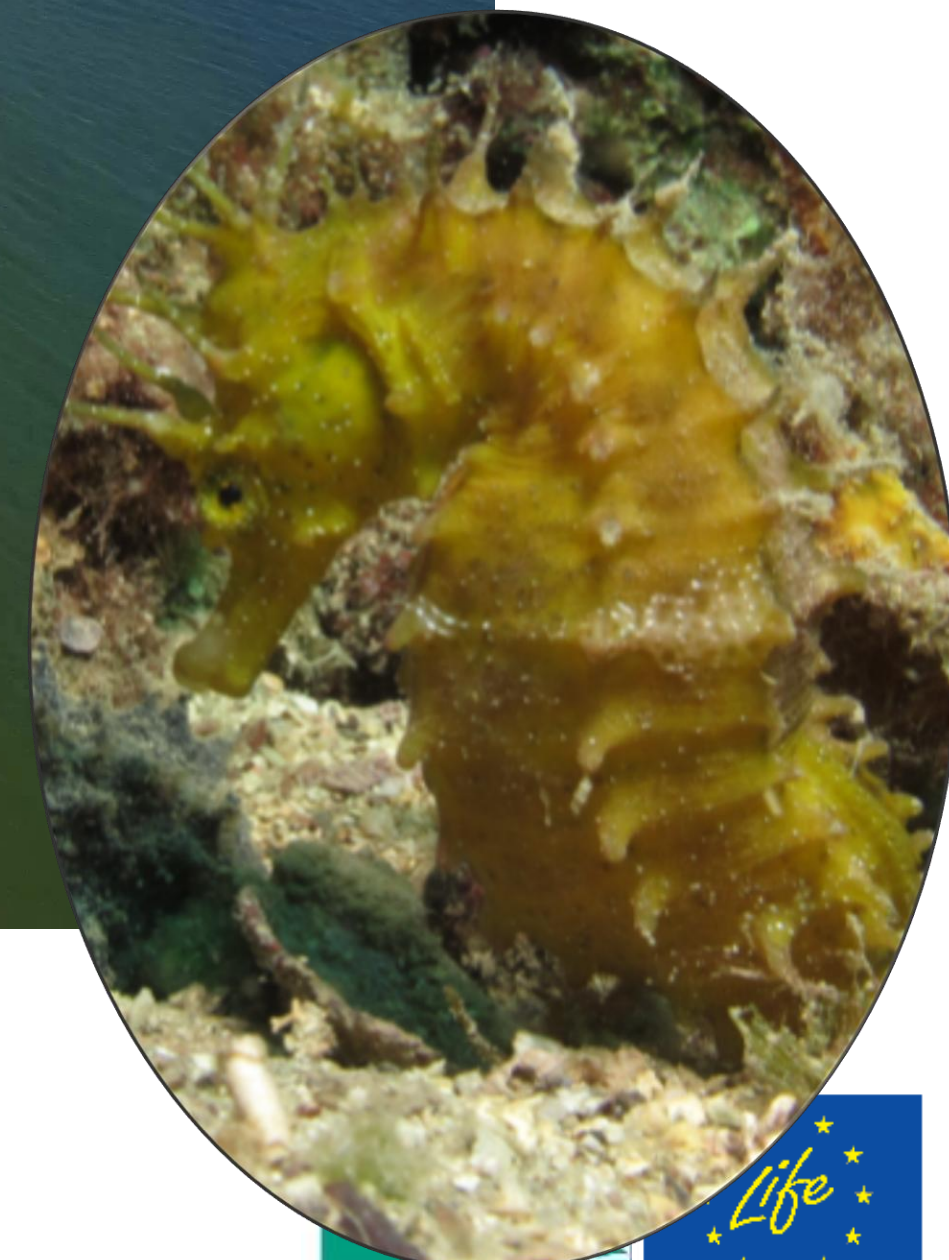
Nature-based reef solution for coastal protection and marine biodiversity enhancement

Restoration of oyster and sabellaria reefs to protect the beach and increase biodiversity at the Bevano River mouth (Ravenna)

High biodiversity still present in some marine and coastal habitats of Emilia-Romagna region



PARCO DELTA DEL PO
EMILIA-ROMAGNA



Threats

- natural and anthropogenic subsidence
- sea level rise
- increase in frequency and intensity of extreme events
- coastal urbanization
- overexploitation of resources



The consequences:

- biodiversity loss
- habitat loss
- floods
- ecosystem goods and services loss



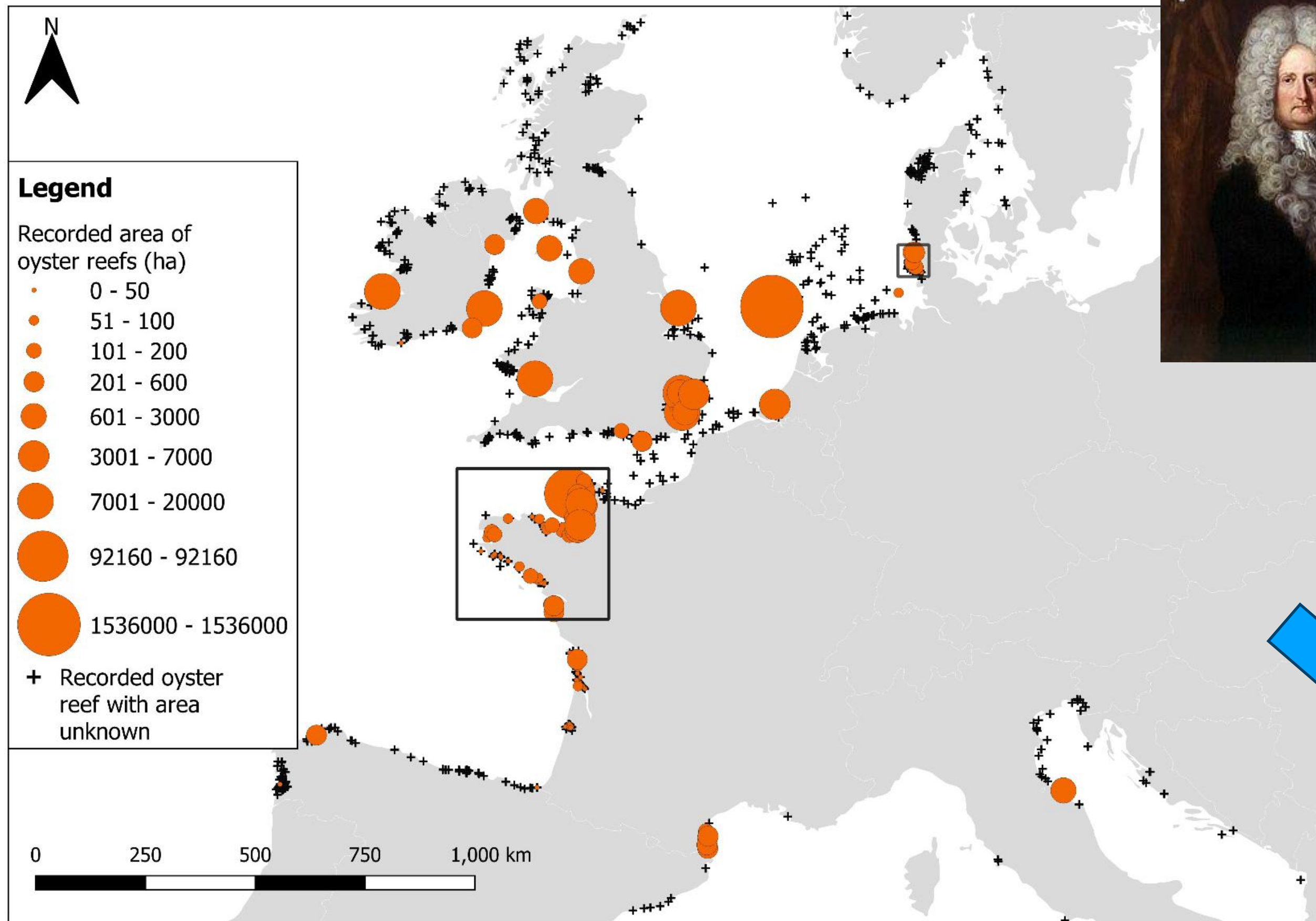
The "engineering" solutions...

- groynes
- coastal walls
- breakwaters emerge
- breakwaters submerged
- beach nourishment



...short-term protection of tourism investments

We have the chance to restore our ancient natural reefs!



Luigi Ferdinando Marsili
Bologna, 1658-1730

Ostrea edulis



Historical reconstruction at the beginning of the 18th century
(courtesy of O. Giovandardi)

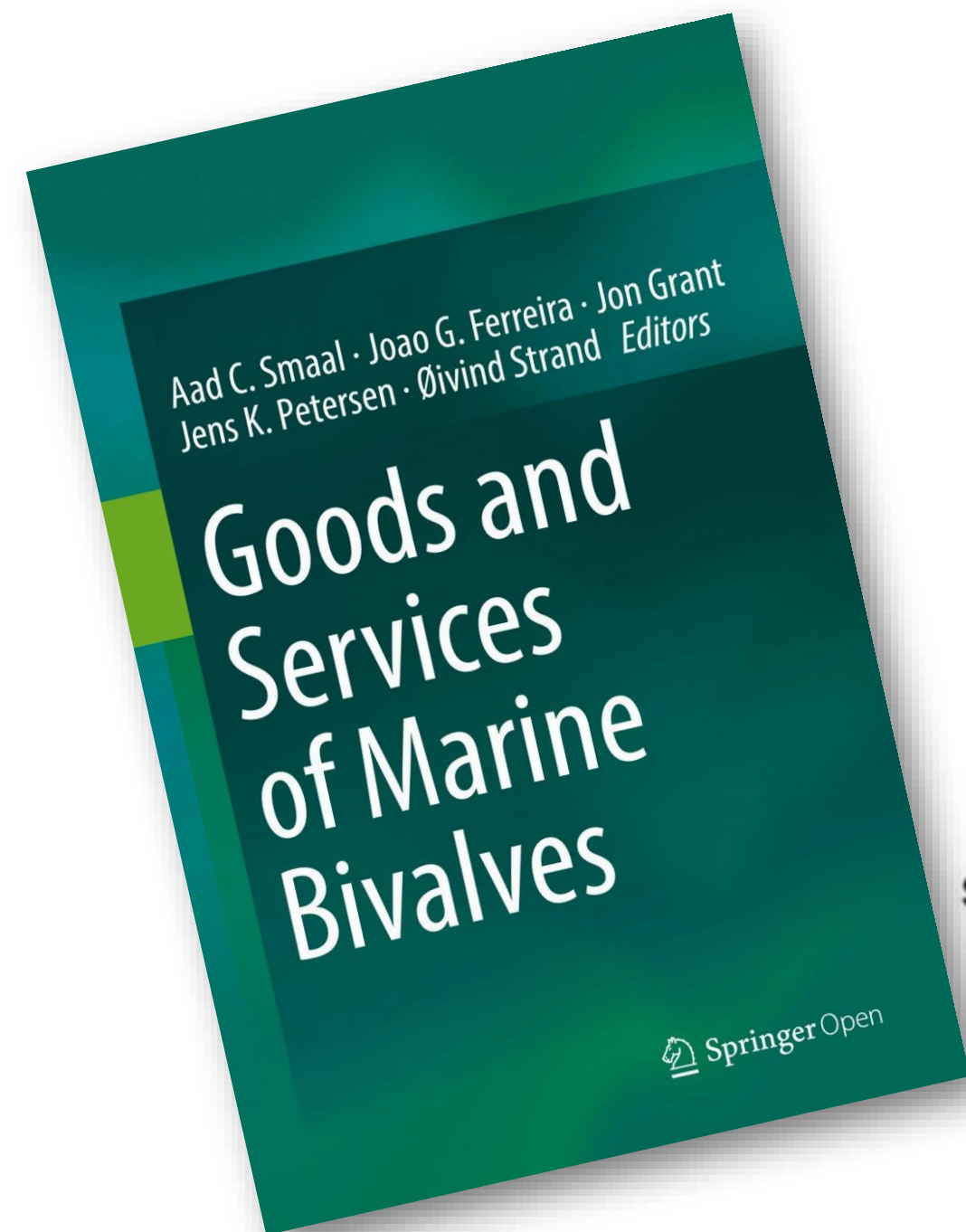
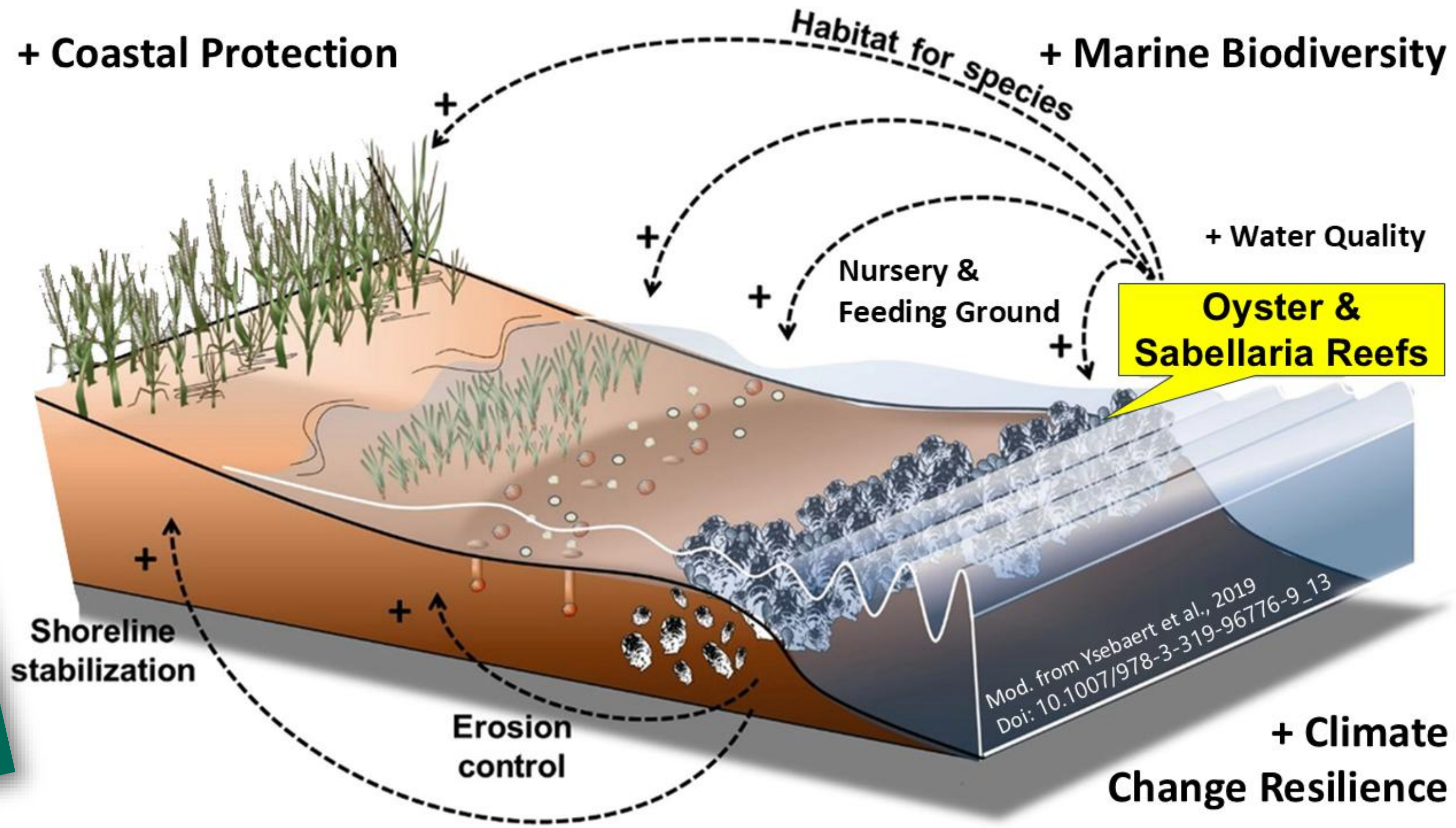
Thurstan et al. (2023) The world was our oyster:
Records reveal the vast historical extent of
European oyster reef ecosystems. doi:
10.32942/x20w43

Today's reports (iNaturalist)



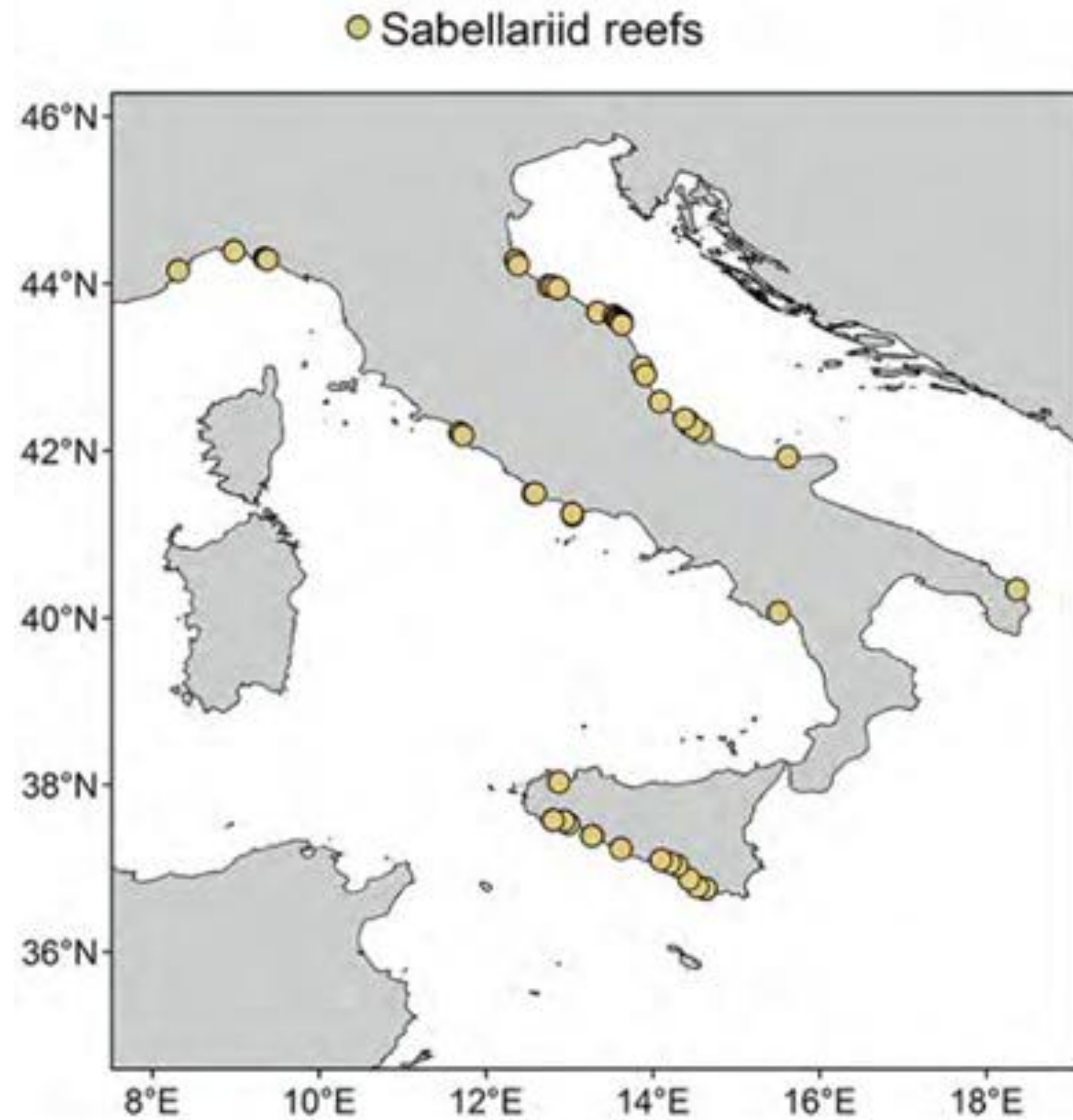
Co-funded by
the European Union

An oyster reef... it's much more than just a pile of shells!

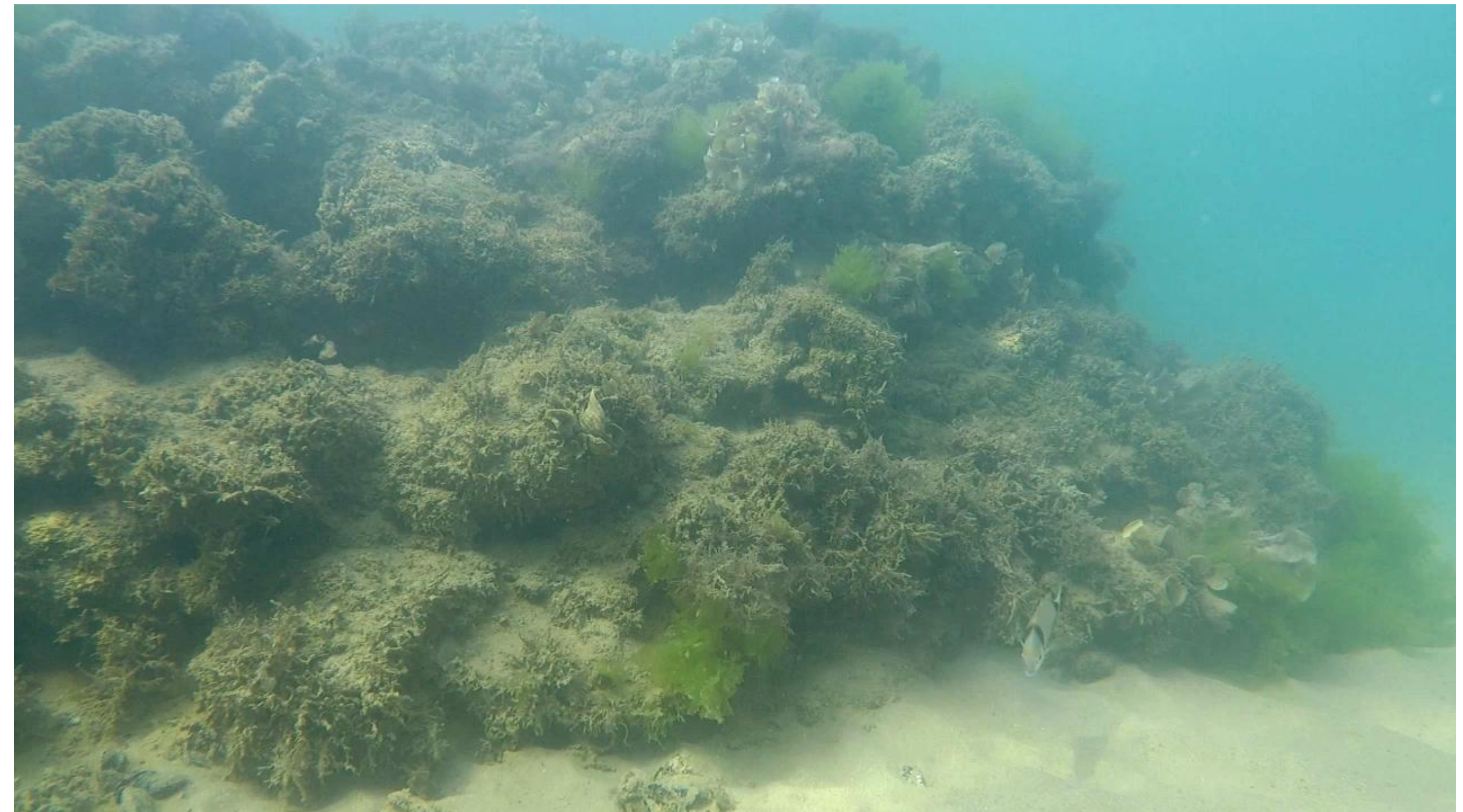


Ysebaert T, Walles B, Haner J, Hancock B (2019) Habitat modification and coastal protection by ecosystem-engineering reef-building bivalves. In: Smaal AC, Ferreira JG, Grant J, Petersen JK, Strand Ø (eds) Goods and Services of Marine Bivalves. Springer International Publishing, Cham, p 253–273.

We have the opportunity to restore our ancient natural reefs!



Current distribution of sabellaria reefs
(Ingrosso et al. 2018)



Sabellaria reef in Marina di Vasto (Abruzzo, Italy)



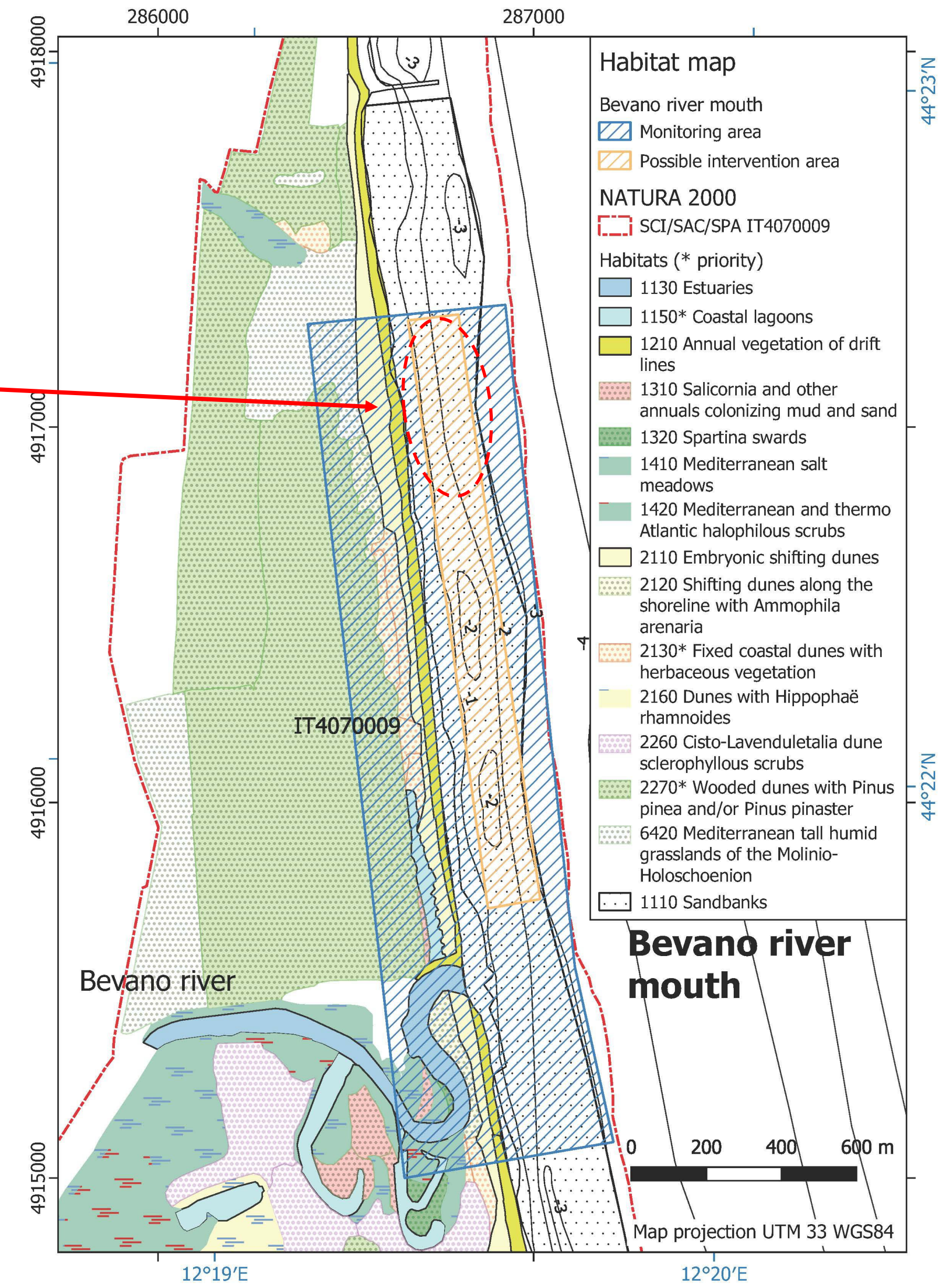
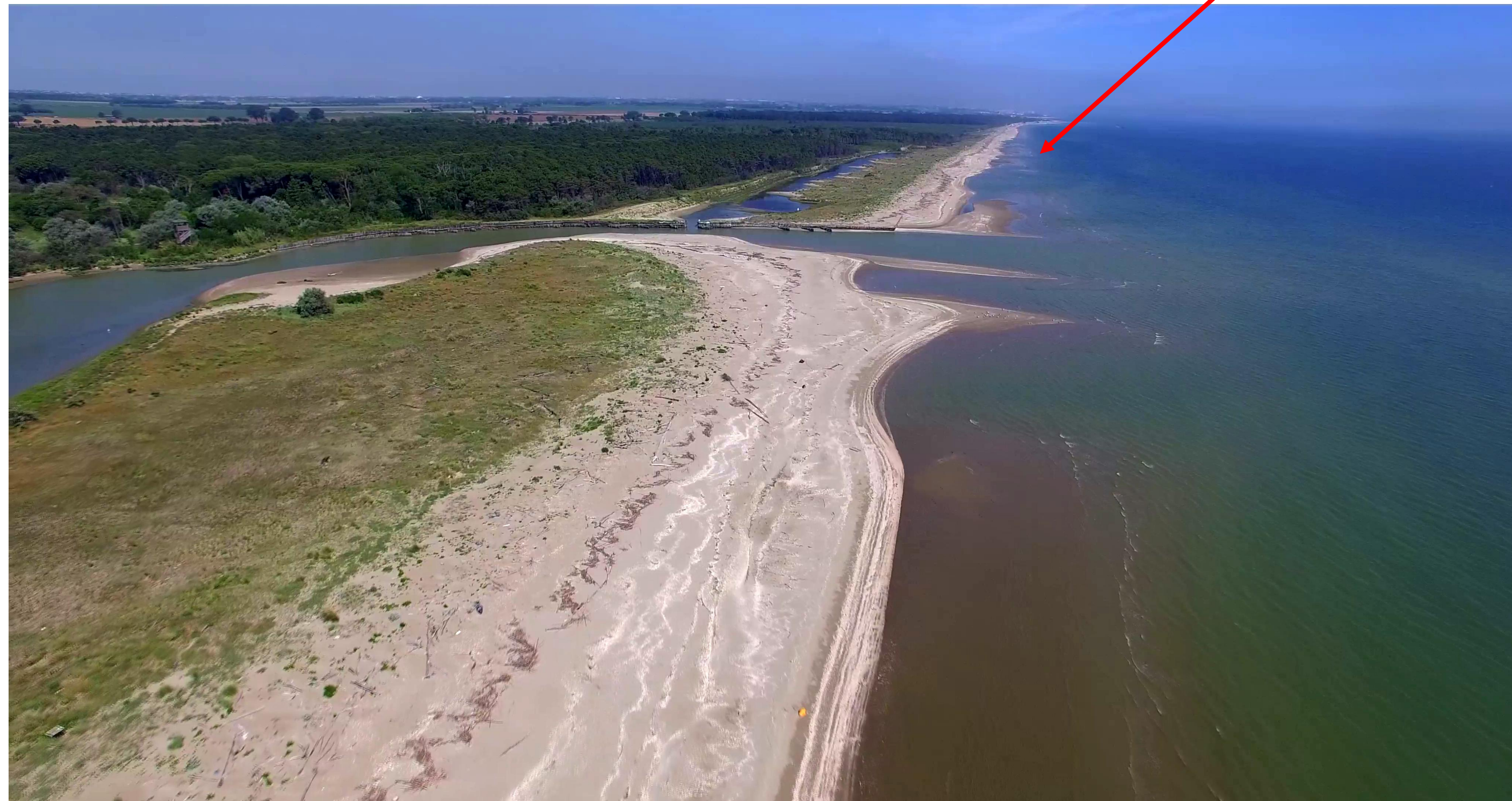
Sandy tubes made by *Sabellaria spinulosa*

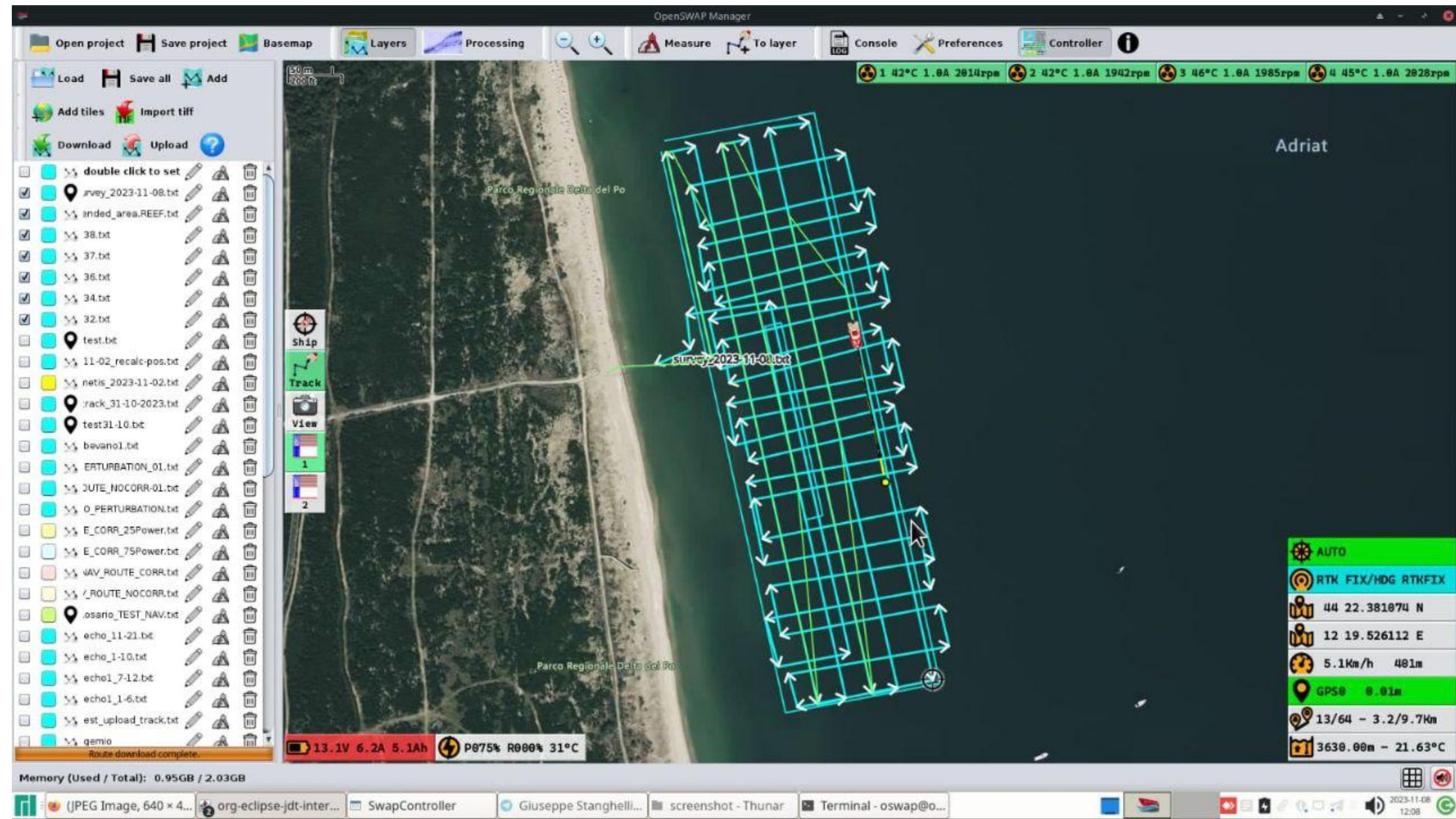
(3D X-Ray CT scan by Eva Turicchia)

The project idea...

Demonstrate:

- the possibility of rebuilding oyster and sandbar reefs
- their effectiveness in protecting the coast
- and increasing biodiversity





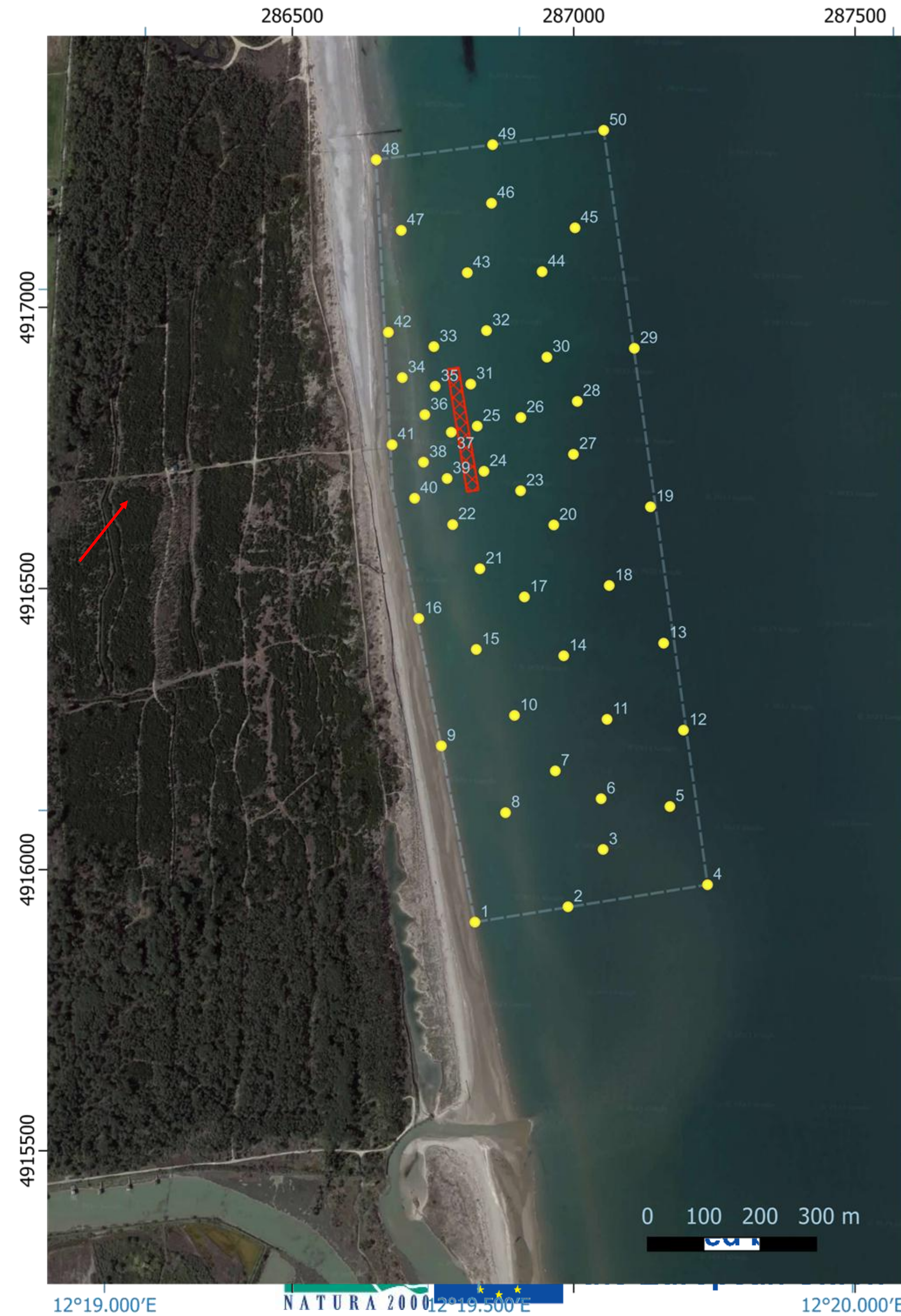
Digital bathymetry survey

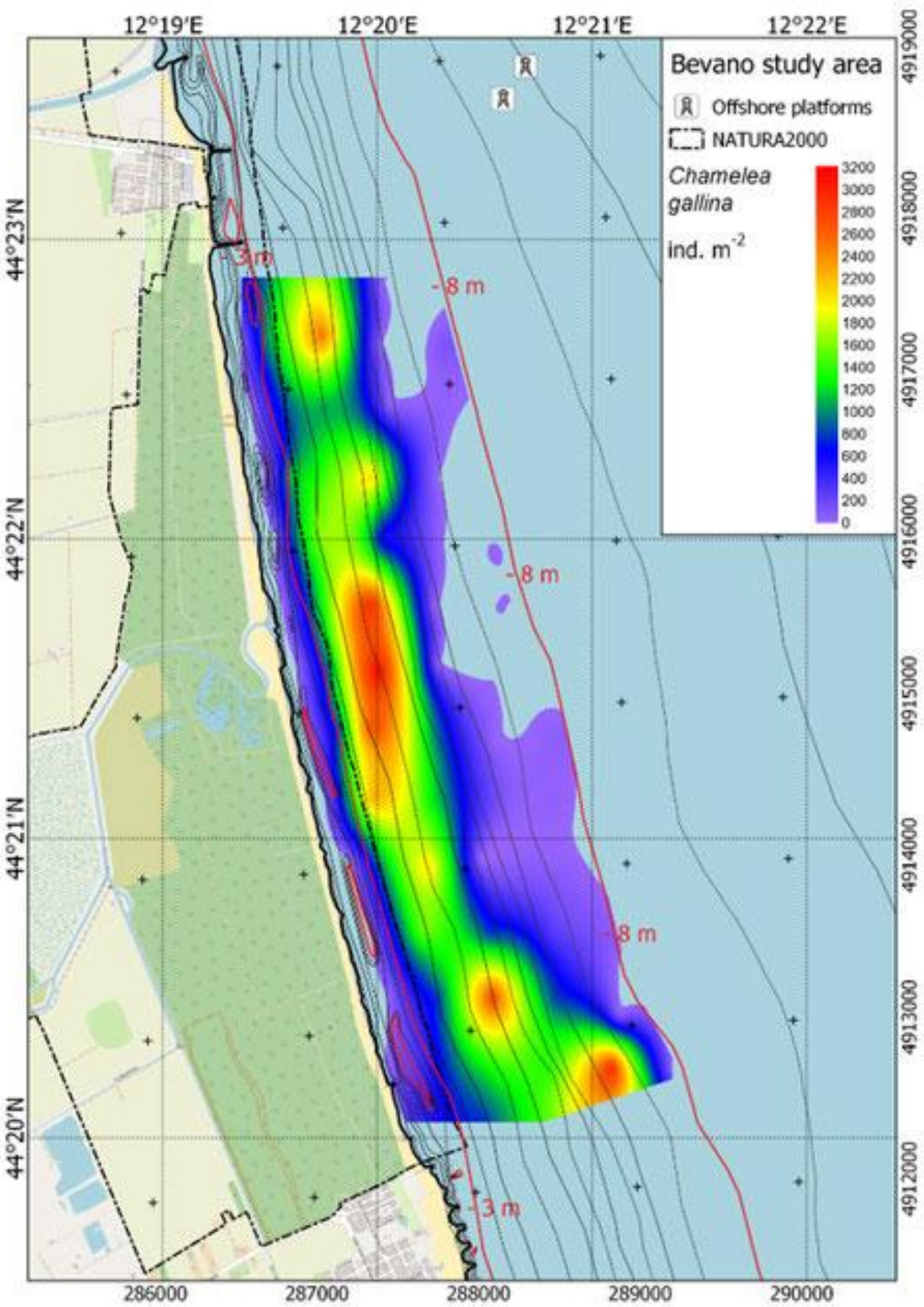
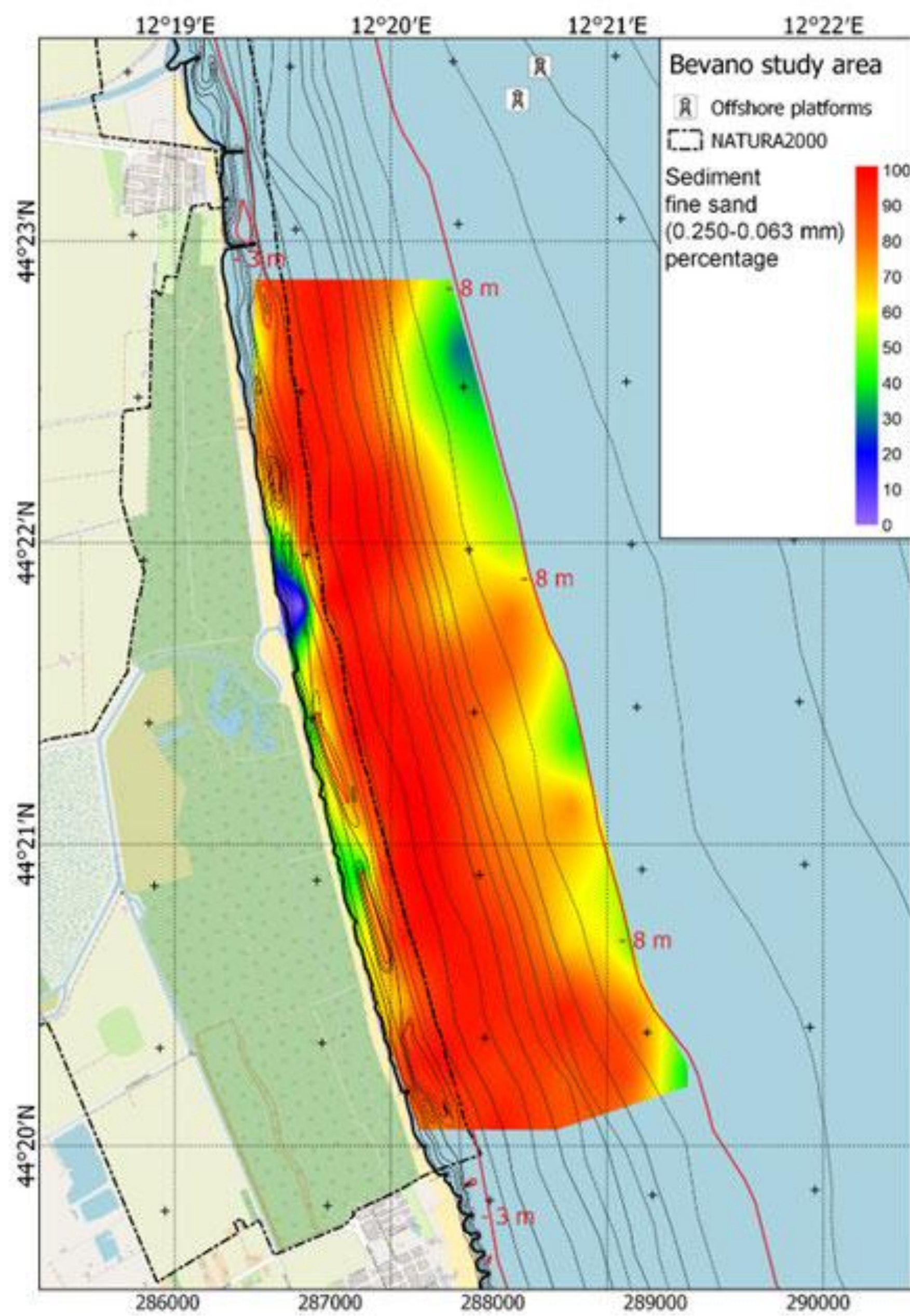
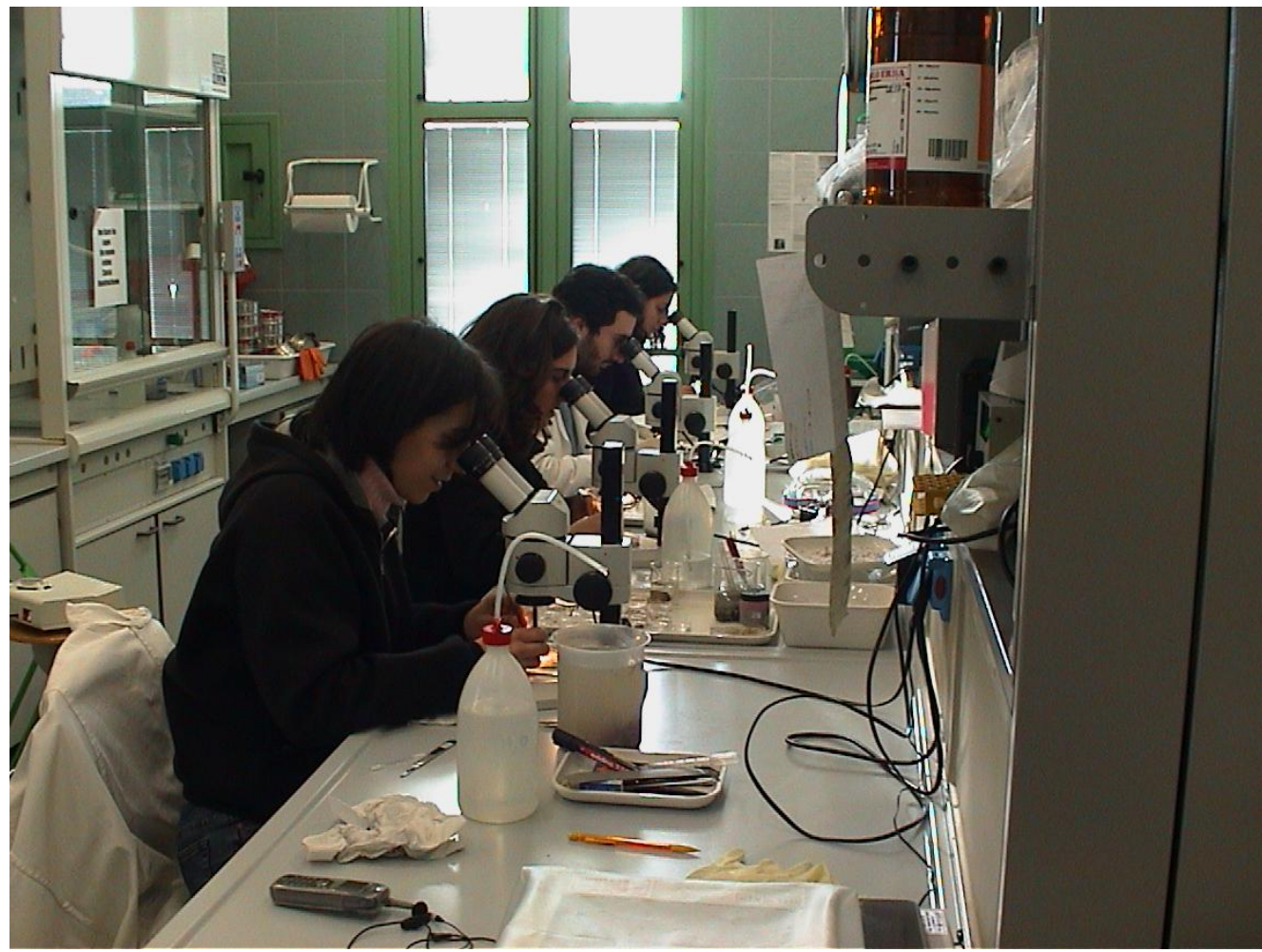
(by PROAMBIENTE)





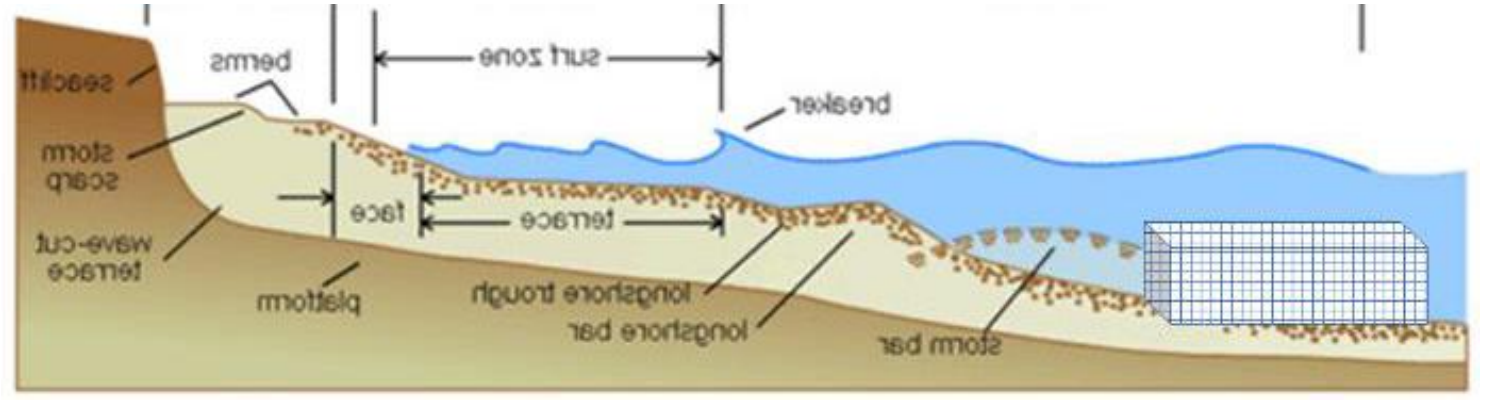
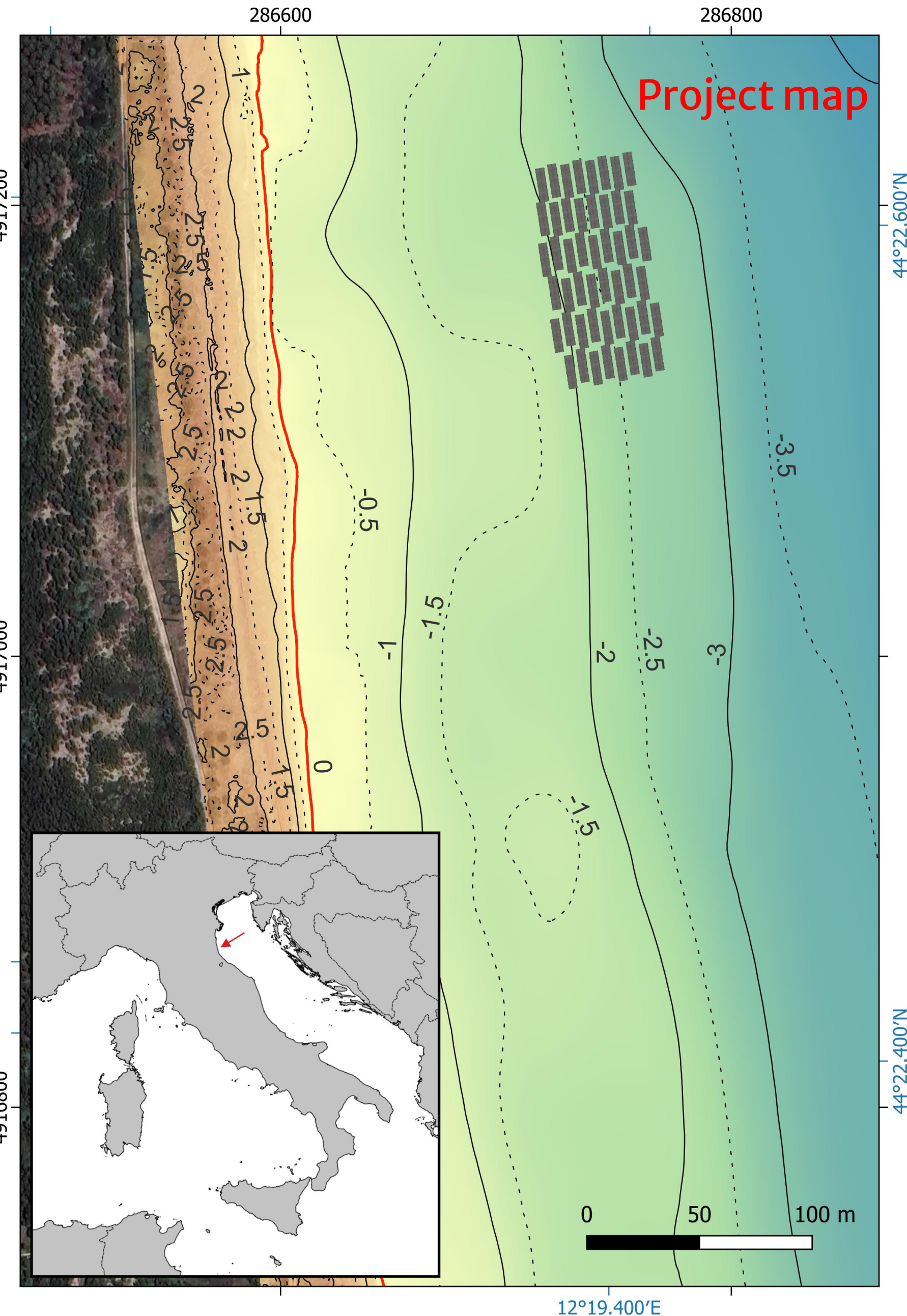
Underwater sampling
(by scientific divers at UNIBO)

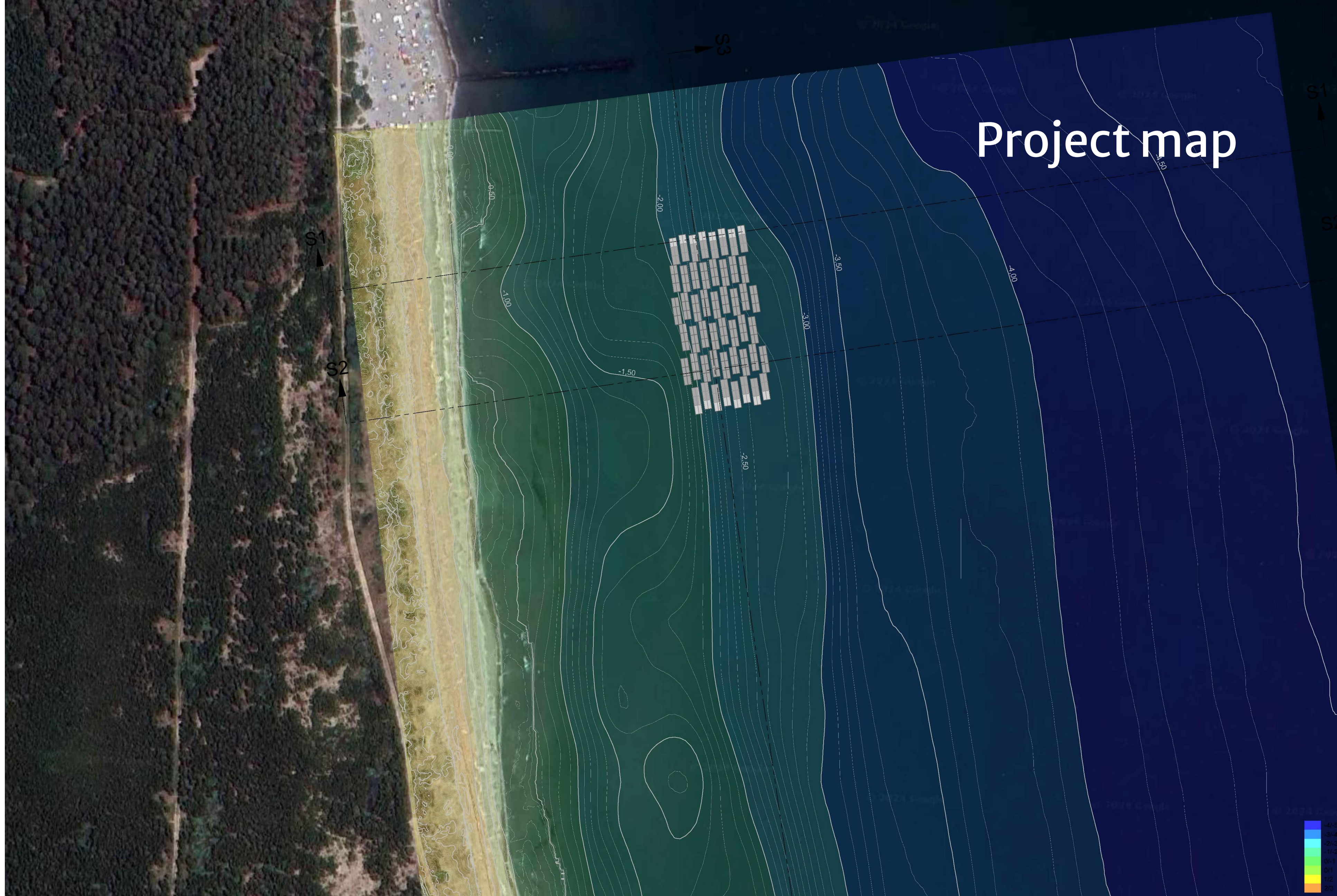


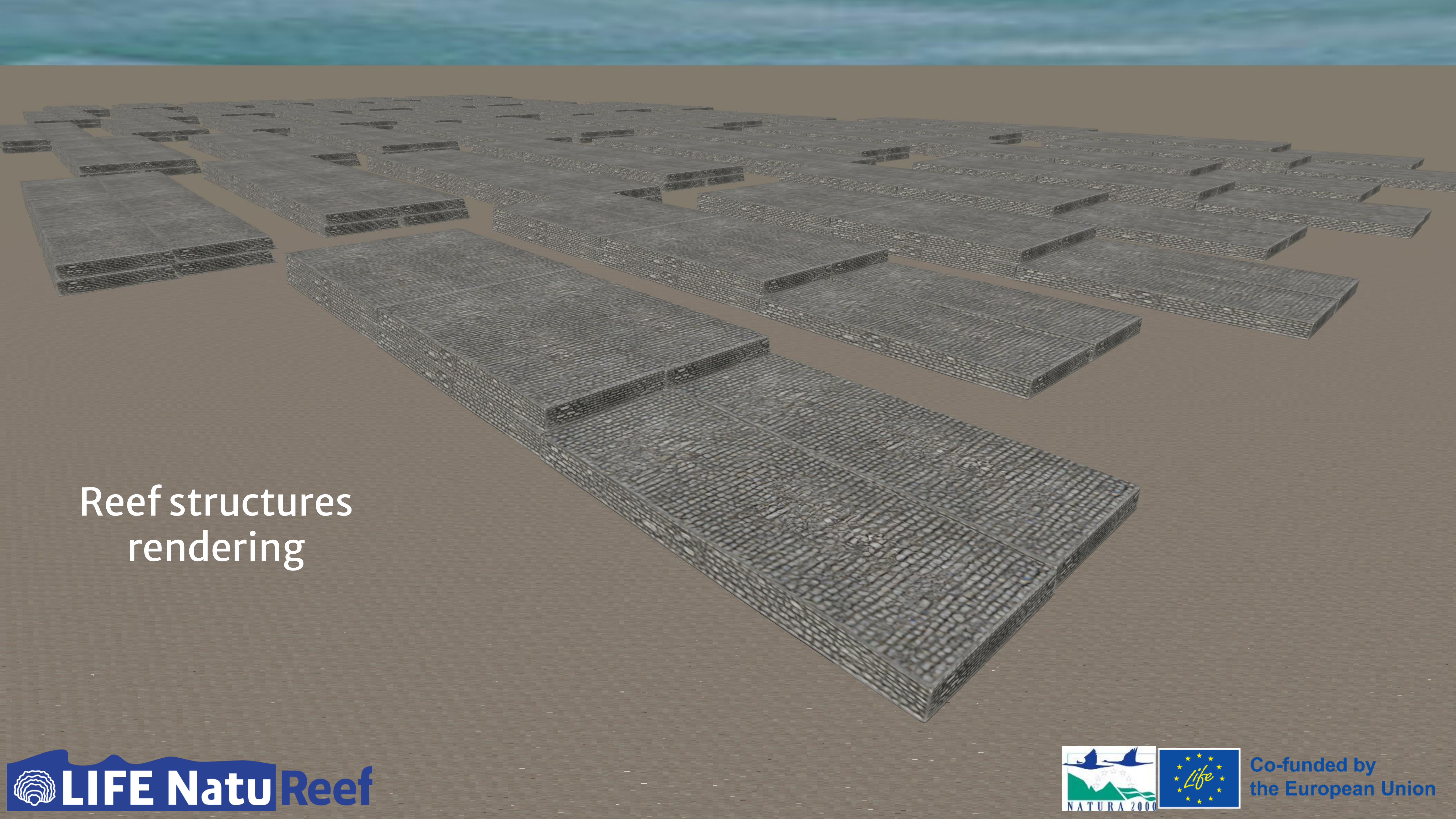


Habitat and species distribution mapping

Location and construction of the reef







Reef structures rendering

LIFE NatuReef

Nature-based reef solution for coastal protection and marine biodiversity enhancement



Co-funded by
the European Union



Programme UE: LIFE

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Comune di Ravenna



Parco Delta del Po
Emilia-Romagna



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