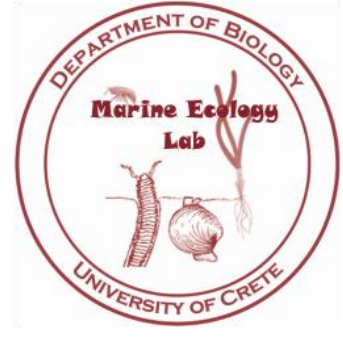


Pilot Study to Evaluate Integrated Mussel–Holothurian Farming in Greece: A Nature-Based Approach for Sediment Bioremediation and Biomass Yield

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Introduction



- ✓ Intensive aquaculture may lead to organic enrichment and sediment degradation.
- ✓ The impacts of climate change, such as mass mortality events of marine organisms – particularly shellfish – act cumulatively and may drive sediment quality to a critical threshold.
- ✓ The co-cultivation of species from different trophic levels provides a sustainable approach to recycle waste and enhance sediment quality.
- ✓ *Holothuria* species (sea cucumbers) are effective benthic bioremediators, ingesting sediment enriched in organic matter, increasing bioturbation and dissolved oxygen levels. They also possess significant commercial value in the food and cosmetic industries.
- ✓ The limited number of real-world demonstrations, particularly involving native species and the adaptability of such systems to the specific socio-environmental conditions of the Eastern Mediterranean sub-basin, highlights the need to acquire new data for the region.

Monitoring

Baseline Study: Initial assessment of sediment and water physico-chemical parameters and organic load to establish reference conditions prior to pilot implementation.

Monthly/bimonthly monitoring of sediment and water physico-chemical parameters throughout the 1 year pilot phase.

Bimonthly measurements of *Holothuria* biomass (weight change) and survival rates to assess growth performance and system viability.

Food safety evaluation through analysis of heavy metals and other toxic elements at both the initiation and conclusion of the pilot phase.

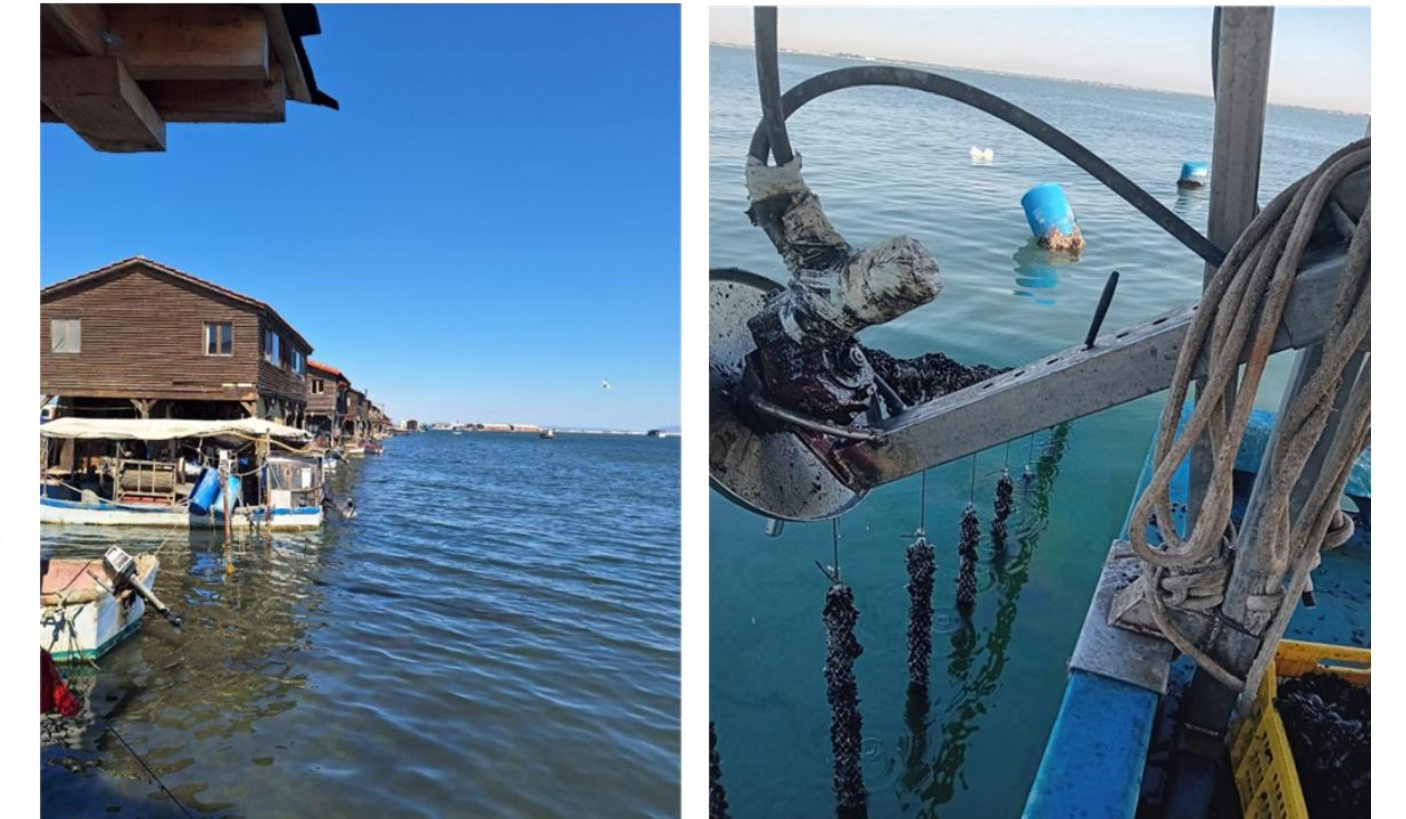
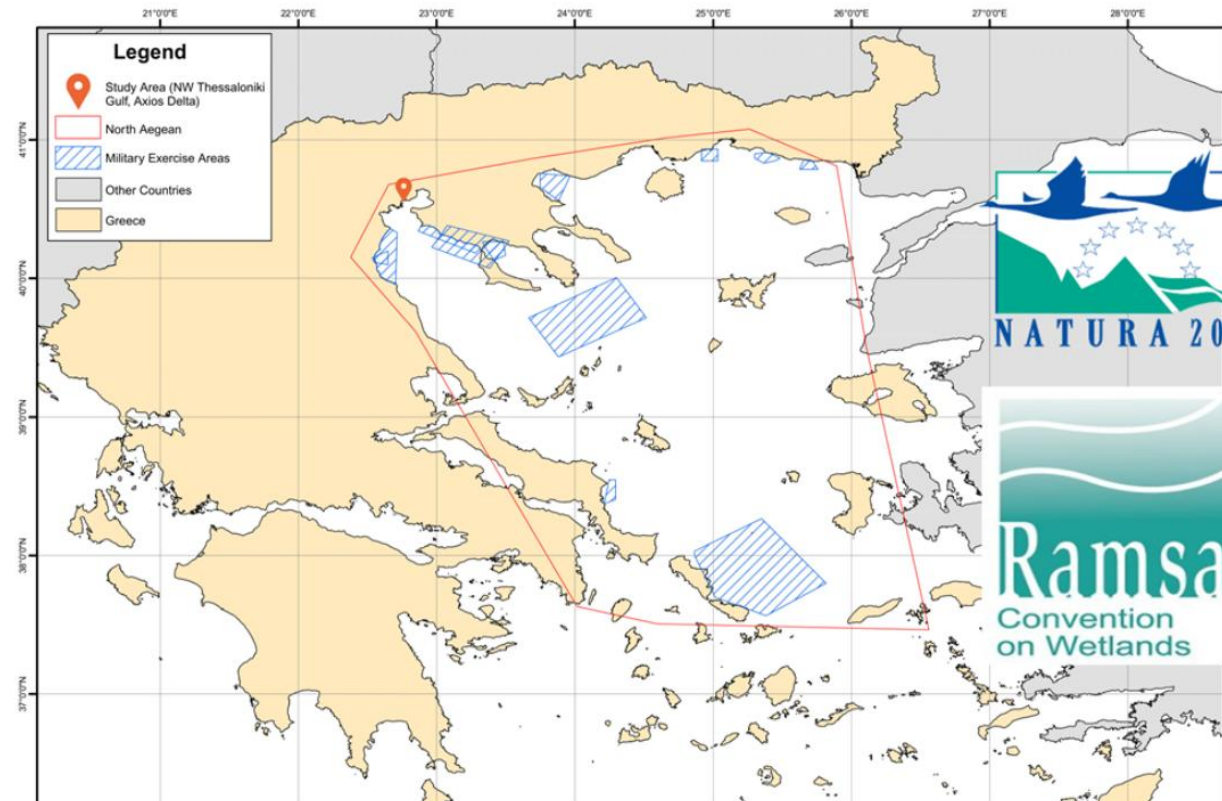
Expected Outcomes

- ✓ Demonstrate the sediment bioremediation capacity and organic waste recycling potential of *Holothuria* species in the North-Eastern Mediterranean sub-basin.
- ✓ Unlock market potential and create new revenue streams by leveraging the high commercial value of *Holothuria* spp. in the food and cosmetic sectors.
- ✓ Develop scalable protocols for integrating *Holothuria* spp. farming into Greek aquaculture to promote sustainable shellfish farming and advance circular economy principles and Low Trophic Aquaculture (LTA).
- ✓ Support sustainable resources use, preventing *Holothuria* species overexploitation.
- ✓ Promote community engagement and inform future grant proposals.

Selected References

- [1] Chatzivasileiou et al. (2024). Holothurians play an important role in mitigating the impacts of aquaculture on sediment conditions. *Mar. Pollut. Bull.* 198:115856.
- [2] Grosso et al. (2023). Evaluating sea cucumbers as extractive species for benthic bioremediation in mussel farms. *Sci. Rep.* 13(1):1457.
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Pilot Design



- ✓ In June 2025, the Institute of Oceanography-HCMR is launching a pilot study to assess the feasibility of integrating seabed *Holothuria tubulosa* and *H. mammata* farms with mussel farms in NW Thessaloniki Gulf, Axios Delta (~12 m depth) for sediment bioremediation and biomass production.
- ✓ The following structures are deployed to replicate natural conditions for in situ *Holothuria* growth and facilitate bioremediation monitoring: Structure 1 – a 3×3×0.5 m stainless steel frame; Structure 2 – nine polypropylene baskets covered with nets. Both structures are equipped with perforations to promote sedimentation of organic waste and facilitate water exchange, and are filled with site-collected sediment to mimic natural seabed conditions.
- ✓ To bring project results closer to the market and improve the link between research and society, a public-private partnership in the form of a Joint Undertaking (JU) has been established.



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