2B-BLUE | Interreg Euro-MED | Co-funded by the European Union

# 2B-BLUE

## Boosting the Blue Biotechnology community in the Mediterranean

© NIB

# 3rd newsletter

# 2B-BLUE: Advancing Mediterranean Blue Biotechnology

June 2026

Contributing partners: Daniel Bosch Ibáñez (NIB), Ernesta Grigalionyte-Bembič (NIB), Silvia Durmishaj Bakiu (ACEPSD), Rigers Bakiu (ACESPD), Amelia Cánovas Muñoz (UMU), Jesús Enrique Argente García (UMU), Salomé La Ragione (PMM), Chrysa Chrysa Efstratiou (HCMR), Ana Rotter (NIB).

UNIVERSIDAD DE MURCIA | ENEA | NIB NACIONALNI INŠTITUT ZA BIOLOGIJO NATIONAL INSTITUTE OF BIOLOGY | hcmr ΕΛΚΕΘΕ | PÔLE MER MÉDITERRANÉE

Albanian Center for Environmental Protection and Sustainable Development | CNR IRBIM ISTITUTO PER LE RISORSE BIOLOGICHE E LE BIOTECNOLOGIE MARINE | ALBANIAN DEVELOPMENT FUND | Ifremer | CTN centro tecnológico naval y del mar

# Contents

# 1. Innovative blue biotechnology practices in the Mediterranean region

The sustainable development of aquaculture is essential to address growing demands for food security, environmental protection and resilient coastal economies in the Mediterranean region. Traditional aquaculture systems face important challenges, including nutrient pollution and climate-related pressures. In response, new approaches, such as Integrated Multitrophic Aquaculture (IMTA), algae cultivation, circular bioeconomy solutions, and waste valorization are emerging as innovative and sustainable alternatives. These practices can create new value chains based on marine resources. Through collaboration among research institutions, industry and local stakeholders, 2B-BLUE partners are developing scalable solutions that support innovation and the long-term competitiveness of the aquaculture sector.

## 1.1. Transferability lessons learned from 2B-BLUE Demonstration sites

The 2B-BLUE Demonstration Sites (DSs) have developed innovative aquaculture and blue biotechnology solutions that can be successfully transferred and adapted across different environmental and regulatory contexts (Fig. 1). A key lesson learned is the importance of strong public–private and private-private collaborations; combining scientific expertise, local knowledge and industry experience to accelerate innovation uptake. Modular and scalable approaches, such as IMTA, algae-based bioremediation, marine product extraction and by-product valorization, proved particularly suitable for replication due to their flexibility and relatively low infrastructure requirements. The DSs also highlighted the need for continuous monitoring, adaptive management and clear legal and operational frameworks. Stakeholder engagement and knowledge transfer activities were essential to ensure local ownership and long-term sustainability. Overall, the DSs generated transferable methodologies and practical experience that can support the wider adoption of sustainable aquaculture practices throughout the Mediterranean region.


*Figure 1. Location of demonstration sites in the 2B-BLUE project. Learn more here. Source: 2B-BLUE.*

### 1.1.1. Albania

At the Albanian DS of the 2B-BLUE project, **ACEPSD** in collaboration with **Alb-Adriatico 2013** implemented IMTA under real farming conditions, integrating shellfish and sea cucumbers into existing fish cage systems. This approach demonstrated that IMTA is a practical and scalable solution for sustainable aquaculture intensification, combining environmental restoration with economic diversification. From an economic perspective, IMTA provided clear opportunities for income diversification, generating about €600 from shellfish (Mediterranean mussel and pearled oyster) and €1,400 from sea cucumbers. This demonstrates how waste streams from fish farming can be transformed into valuable products, reducing risk and increasing farm resilience. Environmental benefits were equally significant. The system achieved a nutrient reduction of over 91 kg/year and improved water quality indicators, including reductions in chlorophyll-*a* and to a lesser percentage in nitrate and ammonia.

These outcomes confirm IMTA as a nature-based solution that enhances ecosystem health while maintaining productivity. For potential adopters, key takeaways include: start with small-scale modular systems, prioritize species with complementary ecological functions, and foster strong partnerships between science and industry. ACEPSD's role in scientific design and monitoring, combined with private sector operational expertise, demonstrates a replicable model for bridging innovation and market uptake in the blue economy (Fig. 2).


*Figure 2. Inspections, collection, monitoring activities and awareness workshops about blue biotechnologies, Albania. Source: Rigers Bakiu, ACEPSD.*

### 1.1.2. France

**Pôle Mer Méditerranée** (PMM) and **Ifremer** aim to provide tailored support mechanisms for small and medium enterprises (SMEs) located in the Provence-Alpes-Côte d'Azur and Occitanie regions in order to foster the development of innovative pilot projects in the fields of blue biotechnology and sustainable aquaculture.

One of these SMEs, **Adict Solutions**, specializes in water quality modelling and aims to expand its activities into the aquaculture sector. Its technologies can be applied to understand and anticipate continental runoff impacts on aquaculture systems, thereby providing a decision-support tool for stakeholders in the sector.

In this context, PMM and Ifremer support Adict Solutions by facilitating networking and strategic partnerships. Moreover, the company has joined the **Centre du Littoral et de la Mer** (CELIMER) platform, which strengthens public–private collaboration (Fig. 3). Their first contract enabled them to integrate the platform for several months, allowing them to connect with key strategic stakeholders. More recently, they signed a second contract to develop an innovative project, benefiting from the expertise and support of the CELIMER teams.

Overall, key structures such as PMM and Ifremer play a strategic role in providing targeted support to stakeholders, enabling the development of innovative solutions within the sector.

*Figure 3. Centre du Littoral et de la Mer (Celimer) platform. Source: PMM.*

### 1.1.3. Greece

In Chalastra, Northern Greece, the **Hellenic Center for Marine Research** (HCMR), as part of the 2B-BLUE project, tested an IMTA approach by integrating sea cucumbers (*Holothuria*) beneath commercial mussel farms near the Axios Delta (Fig. 4). The DS, run in collaboration with **Mydia O Spyros**, showed that sea cucumbers can improve sediment quality and support ecosystem restoration while requiring only minimal modifications to existing farming infrastructure. In parallel, they provide new economic opportunities due to their value in food, nutraceutical and cosmetic markets.

A major lesson learned was the importance of a strong collaboration between public and private organizations. Clearly defined roles, established through the project's T-Labs, supported effective implementation, monitoring and knowledge transfer. Local expertise from farmers, fishers, divers and local actors proved essential for adapting the system to real farming conditions and ensuring operational success.

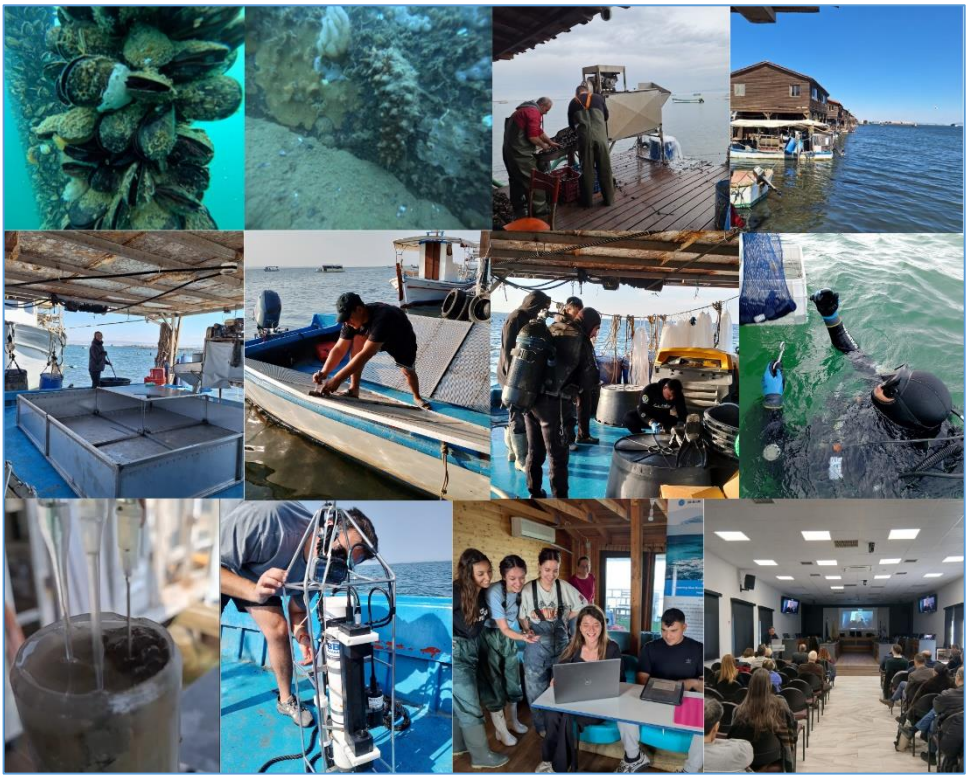

*Figure 4. Greek aquaculture operations in the Thermaikos Gulf. Source: HCMR.*

The DS also highlighted several factors critical for transferability, including the need for training, long-term monitoring and sustainable juvenile supply chains. Hands-on capacity building for farmers, technicians and local authorities will be essential for wider adoption. The solution is considered highly transferable across Mediterranean aquaculture regions because it combines low infrastructure requirements with environmental remediation and economic diversification. The Greek DS confirmed that successful replication depends not only on technological innovation, but also on trust, local engagement and cooperation between science and industry.

## 1.1.4. Slovenia

The overexploitation of marine resources requires the development of sustainable cultivation techniques and the charting of new economic pathways for local communities. In Slovenia, the **National Institute of Biology** (NIB) tackled these challenges using innovative, home-grown solutions (Fig. 5). These activities involved studying the Slovenian legal framework, establishing partnerships with private aquaculture SMEs and startups, and signing memoranda of understanding to protect the intellectual property generated.

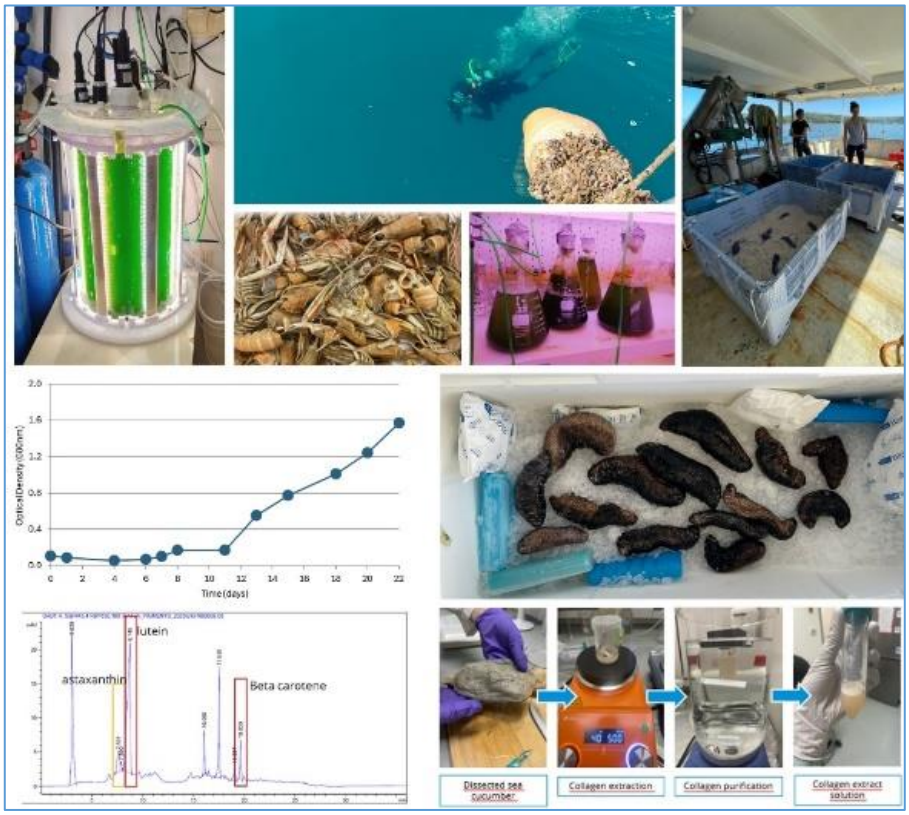


*Figure 5. Activities of the Slovenian demonstration sites. Source: NIB*

In the first DS, NIB developed protocols for the isolation, cultivation and valorization of native microalgae for commercial applications in partnership with **AlgEn d.o.o.** These methods can be adapted to other Mediterranean regions, although sufficient time for strain adaptation must be included in project planning. At the second DS, indoor cultivation of sea cucumbers and co-cultivation with shellfish at sea were tested in collaboration with **Mytilus – Ribištvo školjkarstvo Mitja Petrič s.p.** The experiments showed that nutrient flow is a critical factor for successful indoor cultivation. For outdoor co-cultivation, cage netting must balance nutrient exchange with prevention of sea cucumber escape. The DS also developed protocols for collagen extraction from sea cucumbers using green chemistry approaches that can support further research and commercial development in this emerging field. The third DS, in collaboration with **Okus morja, Prosub d. o. o.**, established transferable systems for the collection, storage and valorization of marine by-products through the extraction of compounds such as chitin and chitosan.

Overall, the Slovenian DSs generated large amounts of practical knowledge and transferable methodologies that can support the expansion of blue biotechnologies in other regions.

### 1.1.5. Spain

Coastal and marine environments are increasingly affected by industrial and urban effluents containing excess nutrients and heavy metals, which lead to the degradation of water quality. The 2B-BLUE Spanish DS developed an integrated solution combining the bioremediation of port waters through macroalgae cultivation, Internet of Things (IoT) monitoring and TokenCO2 (an automated system that tracks $CO_2$) emissions in maritime industries in a transparent and traceable way (Fig. 6).


*Figure 6. Bioremed Algae demonstration site in Alicante, Spain. Source: UMU.*

The system, operated through a public–private partnership involved the **University of Murcia**, the **Marine Technology Centre** (CTN), the **Port Authority of Alicante** and **Mediterranean Algae**, used *Ulva* sp. cultivated in closed tanks to absorb excess nutrients and pollutants from seawater. IoT sensors continuously monitored environmental conditions, while the Token$CO_2$ platform quantified carbon emissions and $CO_2$ capture, linking environmental performance with transparent carbon management.

The Spanish pilot demonstrated that macroalgae-based bioremediation systems can be successfully adapted to industrial and port environments with relatively limited infrastructure, making them suitable for replication in other coastal regions. Key lessons learned included the importance of early collaboration between scientists, technical teams and private stakeholders, as well as the need for adaptive management and regular sensor calibration under marine conditions. The project also highlighted that successful transferability depends not only on technological innovation, but also on effective data management, stakeholder engagement and the development of viable biomass valorization pathways within the circular economy.

**Visit our website at www.interreg-euro-med.com/2B-BLUE/ to learn more about our results & co-creation activities!**