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Workshop Findings: Key Challenges in Marine Biotechnology

BLUEBIO ALLIANCE

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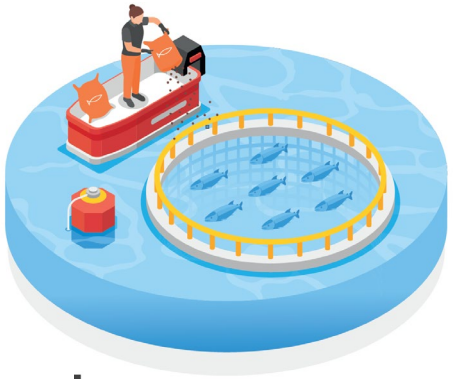
27th of September 2024

3 THEMATIC PRIORITIES



1 innovations for an efficient, sustainable, and resilient aquaculture

2 omic and observation technologies for preserving marine biodiversity and restore the oceans' health

3 marine-derived products for industrial applications

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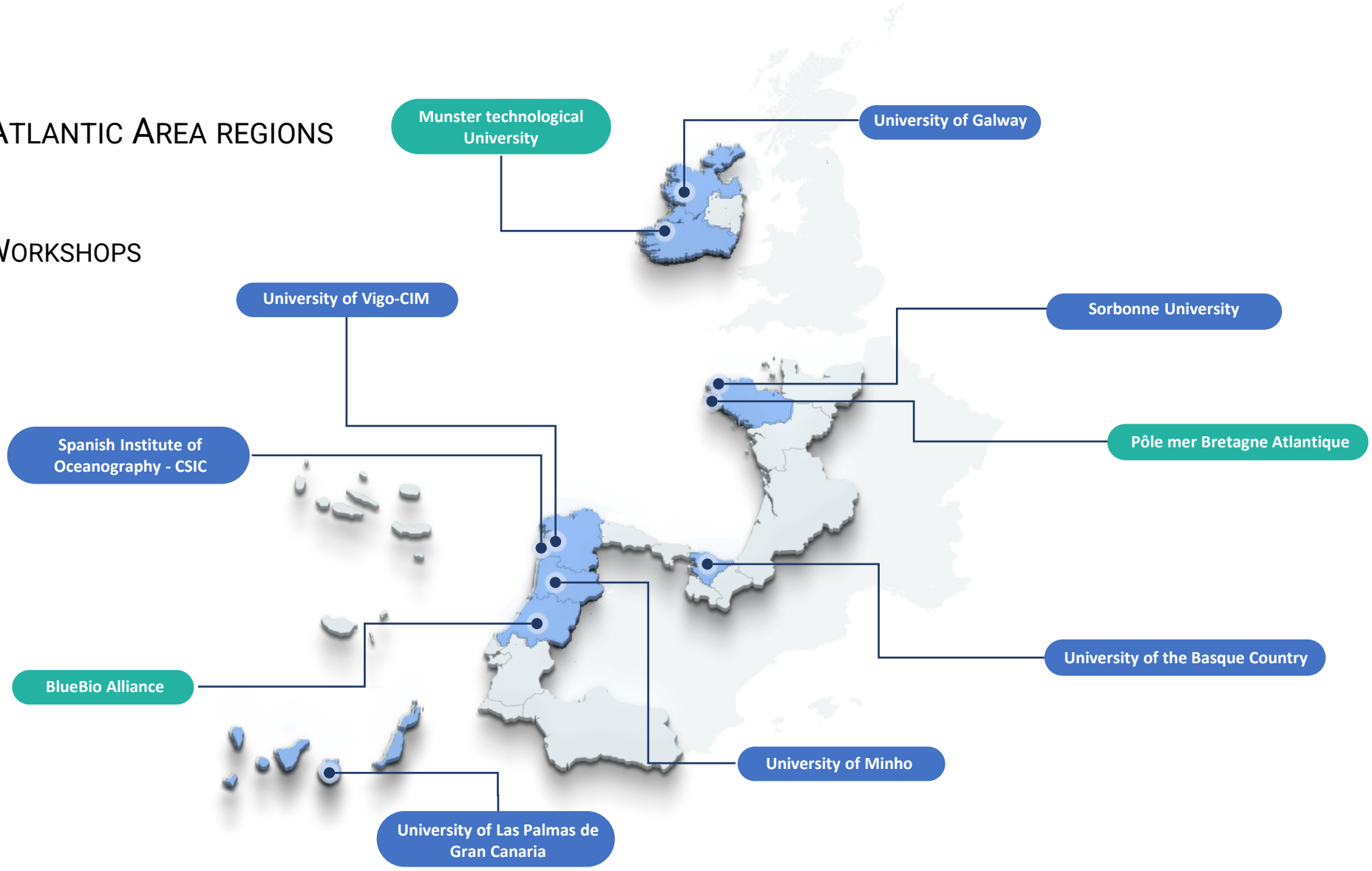
8 ATLANTIC AREA REGIONS

6 WORKSHOPS



Research Partner

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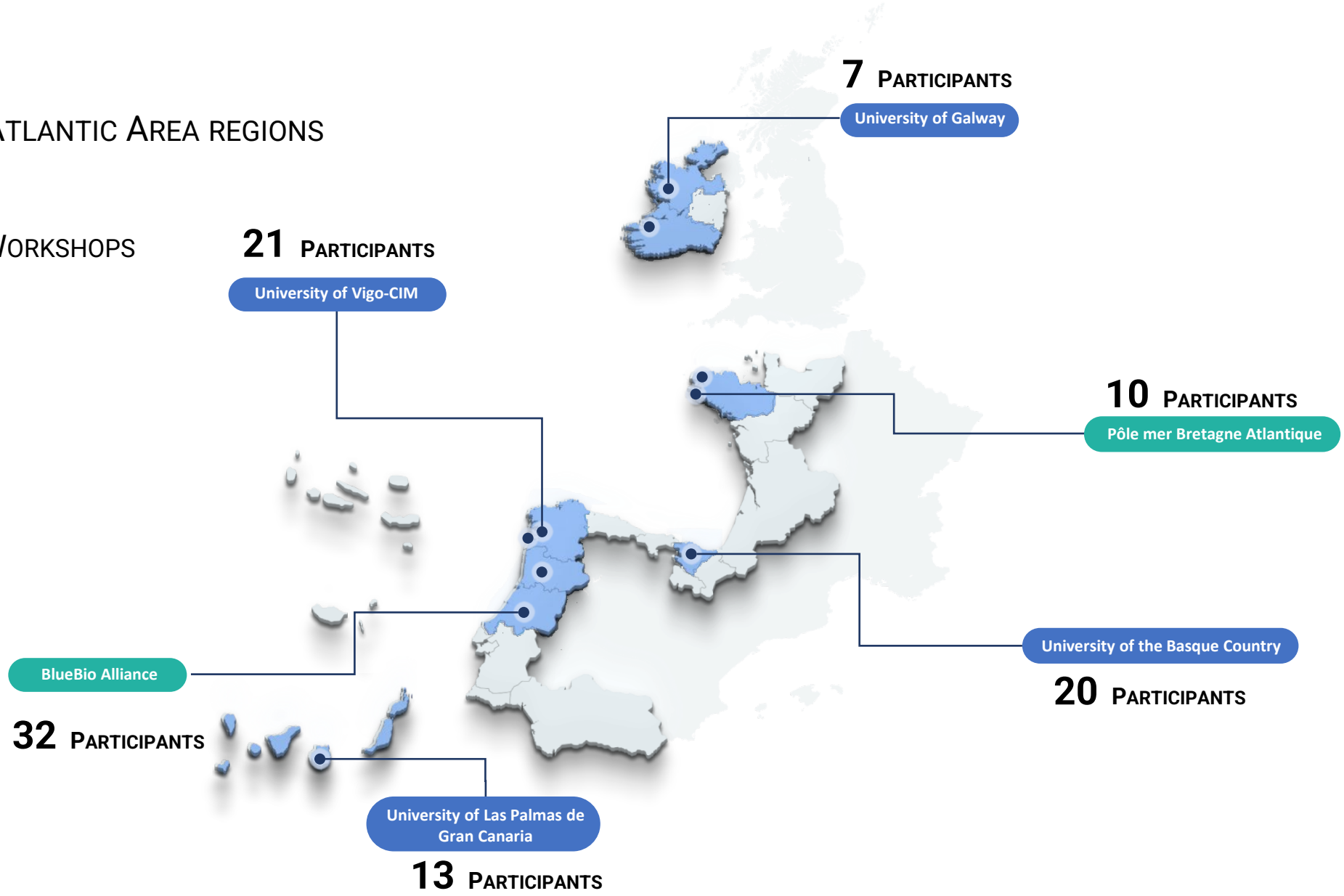
8 ATLANTIC AREA REGIONS

6 WORKSHOPS



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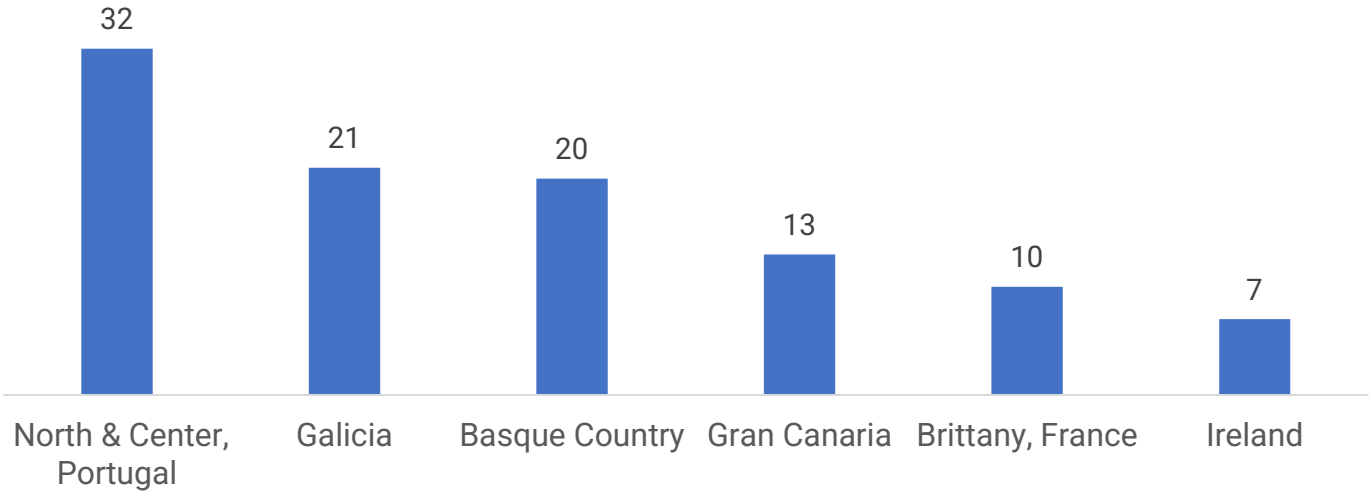
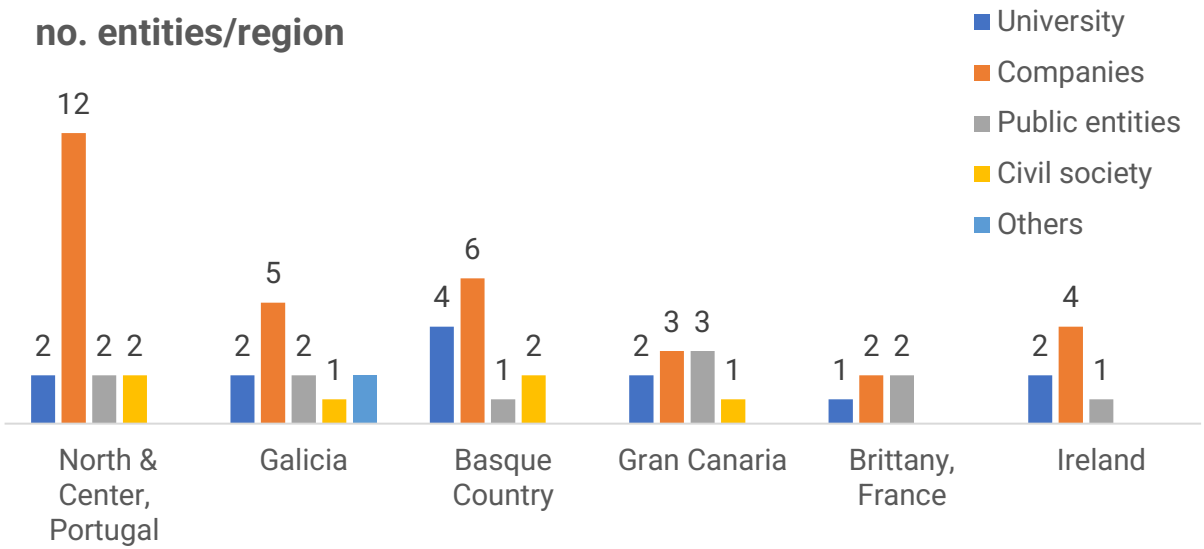
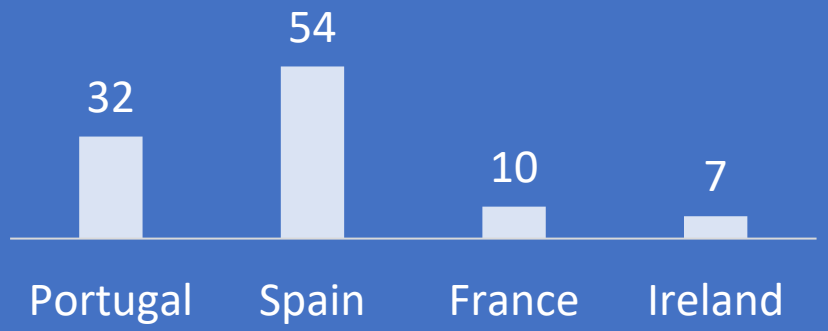
no. participants/region



no. entities/region



no. participants/country



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TRANSNATIONAL R&D&I
COOPERATION NETWORK
OBJECTIVE
THEMATIC PRIORITIES
IMPACT
EXPECTED RESULTS
PÔLE MER
BRETAGNE ATLANTIQUE


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TRANSNATIONAL R&D&I
COOPERATION NETWORK

Blue Biotech Workshops on Biotechnology Platforms

1 innovations for an efficient, sustainable, and resilient aquaculture

- ✓ Summary of **challenges per country**
- ✓ **Challenges identified** &
- ✓ **Opportunities** discussed

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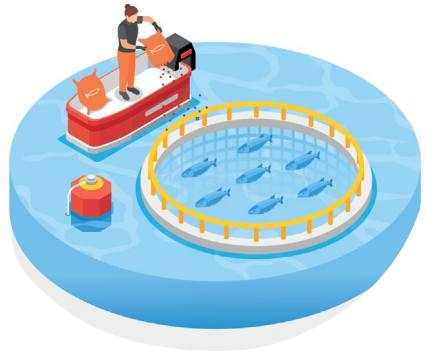
BP1 Summary of challenges per country

	Spain	Portugal	France	Ireland
Develop **alternative ingredients and functional ingredients for aquafeed**	✓	✓		✓
Early **detection of pathogens and methods to ensure assessment of animal welfare**	✓	✓		✓
Support the production of non-fed species because of their low carbon fingerprint, genetic improvement, and reproduction of species	✓	✓		
Development of a **sustainable aquaculture** based on **new fish species** of low trophic level, including the production of feed for this species (ex- mackerel) and Implementation of RAS systems	✓	✓		
Monitor and predictive tools to anticipate no-go zones for bivalves		✓		
Monitoring & sensors: environmental and **infectious diseases** (e.g cod fish); kits for diagnostic; nondestructive systems and tools fostering detection of parasites and separation of polychaetas hosted by bivalves	✓	✓		✓
Shel life extension strategies across value chain, before go to consumers		✓		
Improve **hatcheries** (including bivalves)	✓			
Increase value of **side stream, include, circular economy** concept	✓	✓		✓
Improve **halophytes production**	✓	✓		
Macroalgae strains improvement, **production systems** and protocols; **Develop seaweed farming**; sustainable supply chains	✓	✓	✓	✓
Use of **macroalgae surplus** for **fertilizers;** conduct proper tests with scientific confirmation for bioactivities		✓		
Epigenetics in aquaculture, improve genetic strains			✓	
Scale microalgae production; optimize diatoms cultivation practices	✓	✓	✓	
Knowledge transfer between academia and business	✓	✓		
Consumer awareness for acceptance of aquaculture species	✓			
Activities and advice for increase value from **TRL3 to TRL7**	✓	✓		
Market information and first customers **– market studies** available		✓		
Regulation, market, legal challenges and administrative processes for aquaculture and species production and commercialization of products	✓	✓	✓	
Blue skills in entrepreneurship and bluebiotech	✓			

BP1 Challenges

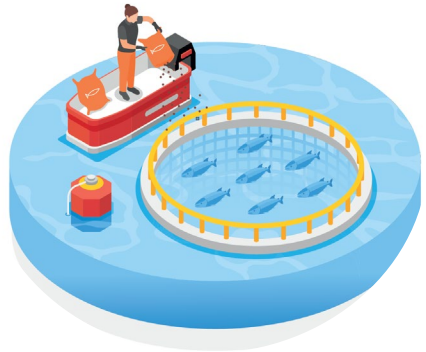
1 innovations for an efficient, sustainable, and resilient aquaculture



- Develop knowledge and technology for using **wastes and by-products** from circular economy to enhance sustainability through **new ingredients or additives** for aquafeeds
- **Green aquaculture** for minimizing carbon foot-print improving sustainability
- Develop knowledge on genetics, protocols, and production systems for **macroalgae production**
- Scaling-up of **microalgae production**
- Developing reliable, low-cost, and non-stressful methodology for assessment of **fish welfare**
- **Improving diagnostics** of pathogens through reliable, fast, and low-cost technologies
- Better knowledge on **reproduction and genetics** of cultured species to select strains and improve reproductive outputs
- Study of biology, genetics, reproduction, population dynamics and ecology of putative **new species** to be cultured, especially from **low-trophic** level

BP1 Opportunities

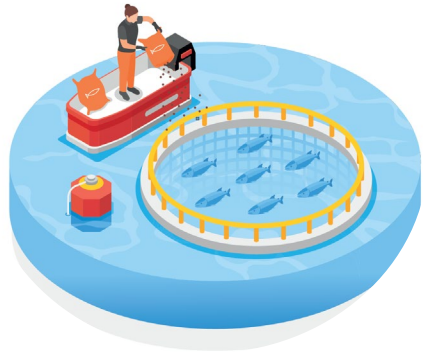
1 innovations for an efficient, sustainable, and resilient aquaculture



- **Positive regulatory frame** through European Farm to fork strategy, and Green Deal actions
- **Trans-regional cooperation programs**
- Close cooperation of actors involved (4 Helix)
- Society demands on a greener, more **sustainable aquaculture**
- Society concerns on **animal welfare**
- Available knowledge to **develop new technologies**
- **Valorization of waste and by-products**
- Increased importance of aquaculture in **food security**
- Potential of **IMTA aquaculture**

BP1 Conclussions

1 innovations for an efficient, sustainable, and resilient aquaculture



Regional workshops identified **common challenges in the Atlantic**, including sustainability, circular economy, and green aquaculture practices, with **specific regional concerns** such as macroalgae production in Bretagne and bivalves in Galicia

Key Conclusions:

- **Sustainability**: Need for circular economy solutions, such as using waste/by-products for aquafeeds.
- **Green Aquaculture**: Emphasis on practices to reduce carbon footprints and enhance sustainability.
- **Collaboration**: The 4 Helix model facilitates innovative solutions across regions.
- **Opportunities**: European strategies (e.g., Green Deal, Farm-to-Fork) offer funding for cooperative projects.
- **Innovation**: Focus on advancing genetics, welfare assessments, and pathogen diagnostics to support sustainable practices.

Blue Biotech Workshops on Biotechnology Platforms

2 omic and observation technologies for preserving marine biodiversity and restore the oceans' health

- ✓ Summary of **challenges per country**
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BP2 Summary of challenges per country

	Spain	Portugal	France	Ireland
Detection of the **presence of pathogens** introduced by alocton species or aquaculture practices; **Control and prevent bacteria in fish -** vibrio	✓			
FAIRness of data; Information and data flow across the sector	✓			
Monitor and identification of exotic and invasive species, blooms; Development of **early warning systems, ballast water** control;	✓	✓		✓
Impact of **climate change on coastal and estuarine populations**	✓		✓	
Ecosystem resources and **bioprospection**	✓			
Antibiofouling solutions	✓			
Identification of the most CO_2 **sequestration algae species**	✓			
Scientific **fish stock management**	✓			
Preservation and **restoration of natural resources**			✓	
Enhancing the value of **little-described organisms** and achieving large-scale cultivation at low carbon and economic cost			✓	
Valorisation of plant-based biomass; Reduce costs in drying halophytes, increase shelf lifetime, reduce cost in production competition in the market; carbon capture market; infrastructures to support saltmarshes		✓	✓	
Improvement of **microalgae growth off-shore**; optical systems and space available for prototype		✓		
Ensure compliance of **microalgae with environmental regulations – diatoms - for microcapsules in aquaculture**, monitoring protocols		✓		
Commercial acceleration, access to **wild bioresources**			✓	
Understanding and monitoring of marine environments	✓			
Re-direct activities to a working scenario "One Health"	✓			
Need for **stable funding for biodiversity monitoring**	✓			
Biodiversity inventories. Lack of information about ecosystem function and services. Data inconsistencies and many qualitative assumptions in relation to nature conservation impacts. **Regulatory challenges.**				✓
Training sector	✓			

BP2 Challenges

2 omic and observation technologies for preserving marine biodiversity and restore the oceans' health

- **Administration and funding** challenges in biodiversity observation.
  - Lack of stable and strategic funding for monitoring programs
  - No flow of information between effective/scientific observation and management
  - Management/law enforcement and monitoring disconnected form state of the art science
  - Regulations and bureaucracy (new aquaculture facilities, marine renewable egnergies, Nagoya protocol…)

- **Global challenges associated to climate change**, need for safe bioresources, pollution, anthropisation and new uses of the maritime space
  - Invasive species, threatened species, chemical pollution, food quality, antimicrobial resistance, acidification, storms…
  - Early warning on existing threats

- **Technical limitations** and constrains imposed by a research culture of data handling.
  - Insufficient milking of the information obtained from traditional and modern biodiversity biomonitoring programs.
  - Information is not shared, it is no open
  - Lack of functional information associated to species inventories and biodiversity observation that could be linked to sustainable bioresource utilization activities downstream
  - Common/validated observation protocols
  - Restoration and mitigation measures

BP2 Opportunities

2 omic and observation technologies for preserving marine biodiversity and restore the oceans' health

- **Administration and funding** challenges in biodiversity observation.
  - Sharing existing information under the open science and FAIR data rules
  - Education (EVANGELISATION), outreach, multidisciplinarity, synergies between stakeholders, transregional collaboration, utilization of existing data
  - Put current science to the service of periodic structural monitoring
  - Change of paradigm "ocean health" to "One health"

- **Global challenges associated to climate change…**
  - Intrinsic regulatory need for biodiversity monitoring
  - Exploit the need to find new bioresources providing food and biomaterials, preserving the quality of the stocks already (over)exploited, preserving "One-health". Domestication of new species…

- **Technical limitations and constrains**
  - Common/validated observation protocols (new omic techniques coupled to analytical chemistry and biomarkers analysis, early warning tools, new sensors)
  - Restoration and mitigation measures (blue carbon, bioremediation, "One-health"…)
  - Current wave in favor of data FAIRification and Open science
  - Existing laboratory protocols have to be deployed at the service of bidouversity observation in the environment

BP2 Conclussions

2 omic and observation technologies for preserving marine biodiversity and restore the oceans' health

Workshops revealed **common challenges across regions** related to biodiversity monitoring, including global issues such as climate change, pollution, and the need for effective data-sharing and funding

Key conclussions

- **Global Challenges**: Toxic algal blooms, pollution, and climate change impact all regions.
- **Data and Funding**: Lack of stable funding and limited data sharing present obstacles, with opportunities in open science and FAIR data principles.
- **Biodiversity Monitoring**: The need for validated observation protocols and advanced techniques (e.g., omic technologies).
- **Regional Collaboration**: There's a clear opportunity to unite stakeholders for better data sharing and monitoring practices.
- **Innovation**: New bioresource discovery and restoration technologies can improve biodiversity and bioresource management.

Blue Biotech Workshops on Biotechnology Platforms

3

marine-derived products for
industrial applications

- ✓ Summary of **challenges per country**
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BP3 Summary of challenges per country

	Spain	Portugal	France	Ireland
Improvement of the efficiency in the **extraction of valuable composites from macroalgae and microalgae**. Implementation of biorefinery to cope large seaweed farming biomass circularity	✓	✓		✓
Identification of **bio based materials of interest** and **scale up from laboratory to production scale**, Bio based **materials using microalgae**: understand regulation, value of residues, how to scale from lab to market in algae to wellbeing and welfare; Scale up tech in extraction of resources to pilot and industrial scale; complex processing methodologies	✓	✓		
Bioprospection and biobanks: Bioproduction of active ingredients and mechanism of action; Unaware of the compounds or bioactive properties of raw materials, that are applicable to nutraceutical sector.	✓	✓	✓	✓
Plant based ingredients, add value to halophytes to enter other market than rather food	✓	✓	✓	
Insufficient utilization of **data from studies and experiments**	✓			
Industry involvement at larger scales to prove **viability in pilot projects**	✓	✓		
Discovering of **new marine products for food**; New products with industrial opportunities, explore new marine resources like invertebrates (not only algae)	✓	✓		✓
Commercial acceleration, access to **wild bioresources**	✓			
Taking sustainable development into account in the development of marine bioresources, **marine biomimicry**	✓		✓	
Standardization and Identification of **sources of side streams**, stock and preservation, collaboration between industry and academia; Add value to side streams from **canning industry** – scale up; create a platform for data mapping;	✓	✓		
Recycle and upcycle polymers , eg polystyrene, from different stages on the value chain. -Transition to bio-based materials or recycled materials for vessel construction. Issues of materials selection, availability, knowledge of reproducibility, structural properties.		✓		✓
Trainee in the blue biotechnology area	✓			
Consumer perception on marine bioresources and of by-products revalorized	✓			
Knowledge transfer between industry/business and academia	✓			
Regulation for side streams use	✓	✓		
Bureaucratic hurdles affecting the implementation of **innovative processes**	✓	✓		
Connect design to the blue for consumer acceptance		✓		

BP3 Challenges

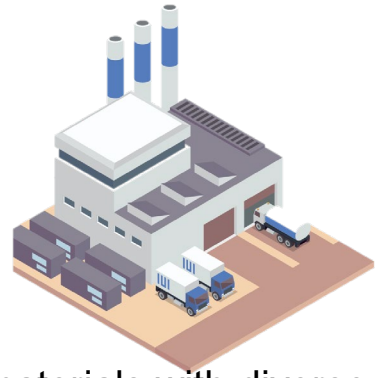
3

marine-derived products for industrial applications

- **Efficiency in Extraction Processes:**
  - Low yields and high costs due to inefficient extraction methods for valuable compounds and materials.
- **Scalability and Commercial Viability:**
  - Complex processing methodologies hinder scalability from laboratory to industrial scale.
  - Limited industry involvement at the pilot stage, resulting in uncertainty around the commercial feasibility of technologies.
- **Reproducibility and Standardization:**
  - Issues with the reproducibility and structural properties of bio-based compounds and materials, limiting standardization in the development of products.
- **Regulatory and Bureaucratic Constrains:**
  - Unclear regulations for using marine biomass, including by-products, for innovative biotechnological processes.
  - Complex bureaucratic processes affecting the development of novel marine products and their commercialization.
- **Consumer Perception and Market Acceptance:**
  - Lack of awareness about the potential of marine-derived by-products.

BP3 Opportunities

3 marine-derived products for industrial applications



- **Biodiscovery from Marine Resources:**
  - Exploration of untapped marine resources can yield novel bioactive compounds and materials with diverse industrial applications.
  - Biobanks as platforms for identifying, characterizing, and preserving unique marine organisms for future research and development.
- **Development of Bio-Based Materials:**
  - Transitioning to bio-based or recycled materials, namely marine-derived biopolymers and composites, in different industries, addressing environmental concerns.
  - Implementing biorefineries toward full use of biomass, promoting circularity and zero-waste concept.
- **Collaboration for Industry Readiness:**
  - Enhancing collaboration between academia and industry to a more efficient scaling up.
  - Developing market-driven products using safe and sustainable by design (SSbD) principles.
  - Data sharing to establish standardized methods aiming to improve product quality and reproducibility.
- **Commercial Acceleration and Market Integration:**
  - Clearer regulations and quality assurance processes can facilitate market entry and acceptance.
  - Demonstrating the feasibility and profitability of marine innovations through pilot projects can attract industry investment and speed up commercialization.

BP3 Conclussions

3 marine-derived products for industrial applications

Workshops identified key challenges in the value chain of marine bioproducts, from extraction inefficiency to commercialization and market acceptance, with opportunities in research, innovation, and industry collaboration.

Key Conclusions:

- **Challenges in Production**: Extraction inefficiencies and scalability issues limit commercial viability.
- **Regulatory Burdens**: Complex regulations hinder product development and commercialization.
- **Market Acceptance**: Lack of consumer awareness and reluctance towards new marine-derived products.
- **Opportunities**: Biodiscovery, bio-based materials, and biorefineries offer exciting new avenues.
- **Collaboration**: Enhanced academia-industry partnerships and clear regulatory processes will accelerate commercialization.

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