# ACTIVITY REPORT

## CIIMAR 2024

ciimar

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# **MESSAGE** FROM THE **BOARD**

In 2024 we maintained ISO 9001 certification and continued implementing the Gender Equality Plan and the Social and Environmental Responsibility Plan. In the 1st FCT Tenure competition, we obtained 9 researcher positions (1 main and 8 assistant positions) that will help us retain talent at CIIMAR. 2024 was also the year of CIIMAR's evaluation by FCT, with the final evaluation visit taking place during our annual event in September.

In 2024, CIIMAR saw an increase in competitive funding, especially at European level (10 Horizon Europe projects) and 10 FCT exploratory projects. Additionally, the CCDR-N launched a competition for University of Norte projects for the sea area, at the end of 2024. Notably, FCT launched the call for IC&DT projects in all scientific domains in 2024, registering an interval of two years. However, the results are still unknown. The 7th CEEC competition was delayed, with the application phase closing at the end of November 2024, and results expected in 2025.

In 2024, we implemented 53 international projects, including 29 funded by the Horizon 2020 and Horizon Europe programmes and 24 supported by the Life, EEA Grants, Interreg Atlantic Area, La Caixa programs, among others. We also implemented 3 projects financed by the PRR, totaling 92 projects and 29.16 M EUR. CIIMAR coordinates, in the Blue Bioeconomy Pact, financed by the PRR, the creation of the Portuguese Blue Biobank, a national network of marine biobanks, including in this network CIIMAR's Biobanco Azul. This biobank currently comprises three collections: LEGE-CC, CM2C and DeepBiobank. New facilities for the Biobanco Azul will be established in 2025 in the basement of the Cruise Terminal building, funded by HUB AZUL. Additionally, we maintained the multi-annual financing UIDB/04423/2020 (3.11 M EUR) and UIDP/04423/2020 (1.12 M EUR) and the financing allocated to CIMAR-LA (2.21 M EUR) for 5 years. We also secured 17 researcher contracts funded by the 6th individual CEEC, 3 assistant researcher positions at CEEC CIMAR-LA and 30 FCT doctoral fellowships.

CIIMAR members published 516 papers in internationally peer-reviewed journals and successfully contributed to the graduation of 44 PhD and 133 MSc students. In 2024, 3 provisional patents were submitted, of a total of 30 patents submitted by CIIMAR members in the last 8 years. This reflects the growing impact of our research and the success of initiatives aimed at increasing technology transfer.

CIIMAR outreach activities were extensive, with 685 news (online, TV, radio, press), 538 visits to CIIMAR and outreach activities including the Open Day in September, which reached over 57,300 people during 2024. Additionally, the Environmental Monitoring and Interpretation Centres (CMIAs) in Matosinhos and Vila do Conde held 582 initiatives engaging about 71,900 people.

Looking ahead to 2025, CIIMAR will strengthen its relationship with the University of Porto and the Polytechnic of Porto, following the approval of the new legal status last November. We will also enhance cooperation with public and private stakeholders to better address upcoming challenges. CIIMAR is working together with the Municipality of Matosinhos and the University of Porto to create the opportunity to establish a new headquarters building that will accommodate our growing community and the upcoming spinoffs. We hope that the upcoming results of the evaluation process will boost CIIMAR on its path toward excellence.

**The director of the Board of CIIMAR**
*Vitor Vasconcelos*

# ABOUT **CIIMAR**

Established in 2000, CIIMAR - Interdisciplinary Centre of Marine and Environmental Research is a leading research and advanced training institution of the University of Porto research ecosystem, working at the frontier of ocean knowledge and innovation.

CIIMAR promotes excellent transdisciplinary research, technological development, advanced training, and support for public policies, contributing to advances in scientific knowledge and sustainability of ocean and coastal environments. This drives innovation and paves the way for future solutions to society's needs, opening new avenues to Blue Economy and job creation. Furthermore, CIIMAR is tackling several societal and economic challenges that humanity faces, contributing to the UN Sustainable Development Goals, and National and European relevant agendas.

CIIMAR is performing research and field monitoring programmes to enhance the physical, chemical, and biological knowledge of the marine environment and ongoing changes, while also addressing land/river/ocean and ocean/atmosphere interactions.

CIIMAR research programmes allow the discovery and study of new species and ecosystems, at different depths of the ocean or in other aquatic systems, and provide basic knowledge and tools to support the protection and management of marine, estuarine, and freshwater ecosystems. CIIMAR research leads to the discovery of marine products with potential biotechnological applications in multiple areas including environmental (bioremediation), human and animal health (drugs, cosmetics, nutraceuticals), and industrial (food and feed; paints and coatings). In addition, CIIMAR has research programmes dedicated to optimizing the growth potential of current and alternative species for aquaculture and to providing high-quality seafood for human consumption, which is vital for tackling nutrition and seafood quality issues.

CIIMAR Research and Innovation programmes are conducted with and for society, with several research projects engaging diverse social actors as partners. The Centre follows an innovation-based strategy to foster the development and transfer of technologies, promoting market-oriented research and industry liaison.

Disruptive ideas and technologies are driven to business ideation and acceleration programmes, enabling knowledge value creation through entrepreneurship.

In addition, CIIMAR promotes ocean literacy and public engagement in marine and environmental research, through dedicated science communication and outreach programmes. These include the management of two dynamic Centres for Environmental Monitoring and Interpretation (CMIA, acronym in Portuguese), through cooperative agreements with Vila do Conde and Matosinhos City Councils.

CIIMAR has a vibrant international community composed of members at all stages of their careers. The Centre is the hosting institution for many Master's and PhD students conducting projects in marine and environmental research. Moreover, researchers and staff can benefit from an advanced training programme that allows continuous education in scientific and transversal topics.

CIIMAR's headquarters are at the stunning Porto Cruise Terminal, in Matosinhos, at the heart of the maritime industry and services in the Northern region of Portugal. The Centre has state-of-the-art facilities, with well-equipped laboratories for marine and maritime research, technological core platforms, large-scale micro and macroalgae cultivation, and animal experimentation facilities for freshwater and marine organisms approved by the Portuguese Veterinary Authority. Moreover, the Centre has supporting offices that strategically contribute to its mission, namely in attracting competitive funding, transferring technology, management of research projects, and promoting advanced training, among others.

Besides its headquarters, CIIMAR comprises other partner facilities at five units from the University of Porto – ICBAS and Faculties of Sciences, Engineering, Pharmacy and Law -, at the Polytechnic Institute of Porto, the Portuguese Institute for the Sea and Atmosphere (IPMA), and the University of Madeira.

Together with the Algarve Centre of Marine Sciences (CCMAR-Algarve), CIIMAR constitutes the Associated Laboratory CIMAR-LA.

# OUR VALUES

- Excellence
- Sustainability
- Partnership and Internationalization
- Public Participation
- Innovation
- Communication with Society

CIIMAR also upholds the principles of freedom of research, ethical conduct, professional responsibility, good research practices, recognition of the profession, non-discrimination, gender equality, guarantee of fair working and training conditions, as well as protection of intellectual property rights.

# SOCIAL **ORGANS**

## GENERAL ASSEMBLY

**PRESIDENT**
Eduardo Rocha

**CHAIRS**
Aires Oliva Teles
Carlos Vale
Francisco Taveira Pinto
Susana Moreira

## BOARD

**PRESIDENT**
Vítor Vasconcelos

**BOARD MEMBERS**
Ana Paula Mucha
Isabel Sousa Pinto
Luísa Valente
Rodrigo Ozorio

## FISCAL COUNCIL

**PRESIDENT**
Luísa Bastos

**MEMBERS**
Helena Peres
Paulo Rosa Santos

# CORPORATE **MEMBERS**

Algaplus
Allmicroalgae - Natural Products, S.A.
Soja de Portugal, S.A.
Flatlantic, Actividades Piscícolas. S.A.
Hydromod
Oceano Fresco
RiaSearch, Lda.
Polytechnic Institute of Porto (IPP)
Ecoinside
Tintex
University of Porto (UPorto)
SONAE MC
NGC
Port Authority Douro-Leixões -Viana do Castelo (APDL)

# COMMITTEES

## EXTERNAL ADVISORY COMMITTEE

Françoise Médale (INRAE, France)

William Gerwick (Scripps Institute of Oceanography - USA)

Mike Elliott (University of Hull, UK)

Laura Giuliano (CIESM)

## BLUE YOUNG TALENT COMMITTEE

Lígia Sousa

Marina Dolbeth Silva

Sérgio Boo

## ETHICS COMMITTEE

Lúcia Guilhermino

Aires Oliva Teles

Maria Emilia Sousa

## PHD COMMITTEE

Diogo Oliveira

Eva Lopes

João Pedro Sousa

Leonor Pizarro

Marta Ribeiro

Raquel Pinto

Rúben Pereira

## ORBEA

**Responsible for CIIMAR:**
Vítor Vasconcelos

**Responsible for supervising animal welfare:**
Helena Peres

**Responsible veterinarian:**
Nuno Ribeiro

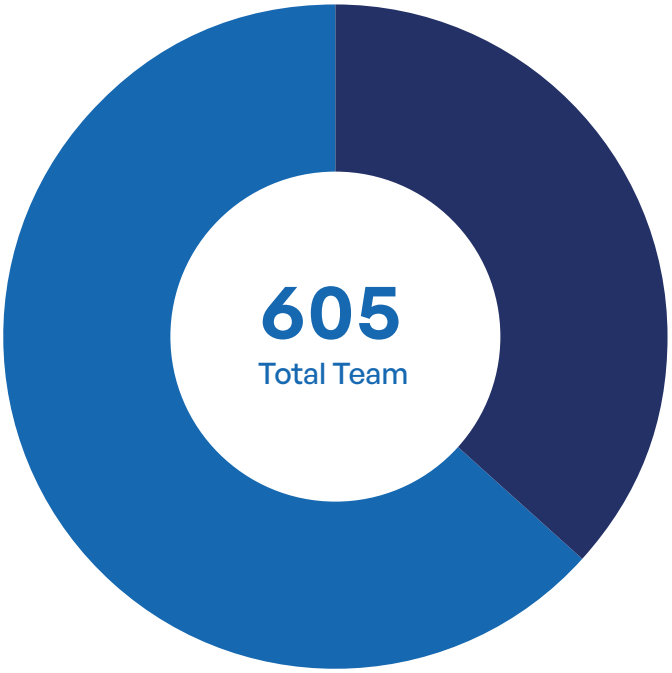
**Scientific responsibles:**
Francisco Arenas
Laura Guimarães
Benjamin Costas Refojos
Luísa Valente

# SUPPORTING **OFFICES**

| OFFICE | HEAD/COORDINATOR |
|---|---|
| Accounting | Susana Barbedo |
| Administrative Services | Isabel Regal |
| Advanced Training & Careers | Ana Salgado |
| Biobank | Vítor Vasconcelos |
| Data Management & Open Science | Maria Paola Tomasino |
| Environmental & Social Responsibility | José Teixeira |
| Financial Services | André Martins |
| Human Resources | Isabel Regal |
| Image, Communication & Outreach | Ana Mena |
| Information Technologies | Vítor Rodrigues |
| Legal Support | Isabel Regal |
| Maintenance & Security | Rodrigo Ozório |
| Onboarding Services | Isabel Regal |
| Project Management | Ana Machado |
| Public Procurement | Isabel Regal |
| Quality Management | Marlene Cruz |
| Research & Innovation Strategy & Funding | Susana Moreira |
| Safe Lab | Renata Soares |
| Secretariat & Events | Emília Afonso |
| Scientific Diving | Óscar Babé |
| Technology Transfer and Business Development | Carla Domingues |
| Treasury | Patrícia Todo Bom |

# FACTS & **FIGURES**

## OUR TEAM




**222**
Integrated PhD holders

**383**
Non-PhD holders

### INTEGRATED PHD HOLDERS

Researchers
148

Professors
53

Post Doctoral Fellows
1

Supporting Offices and Services
8

Lab Technicians
9

Other Professional Situations
3

### NON PHD HOLDERS

PhD Students
159

MSc Students
48

Research Fellows
24

Supporting Offices and Services
34

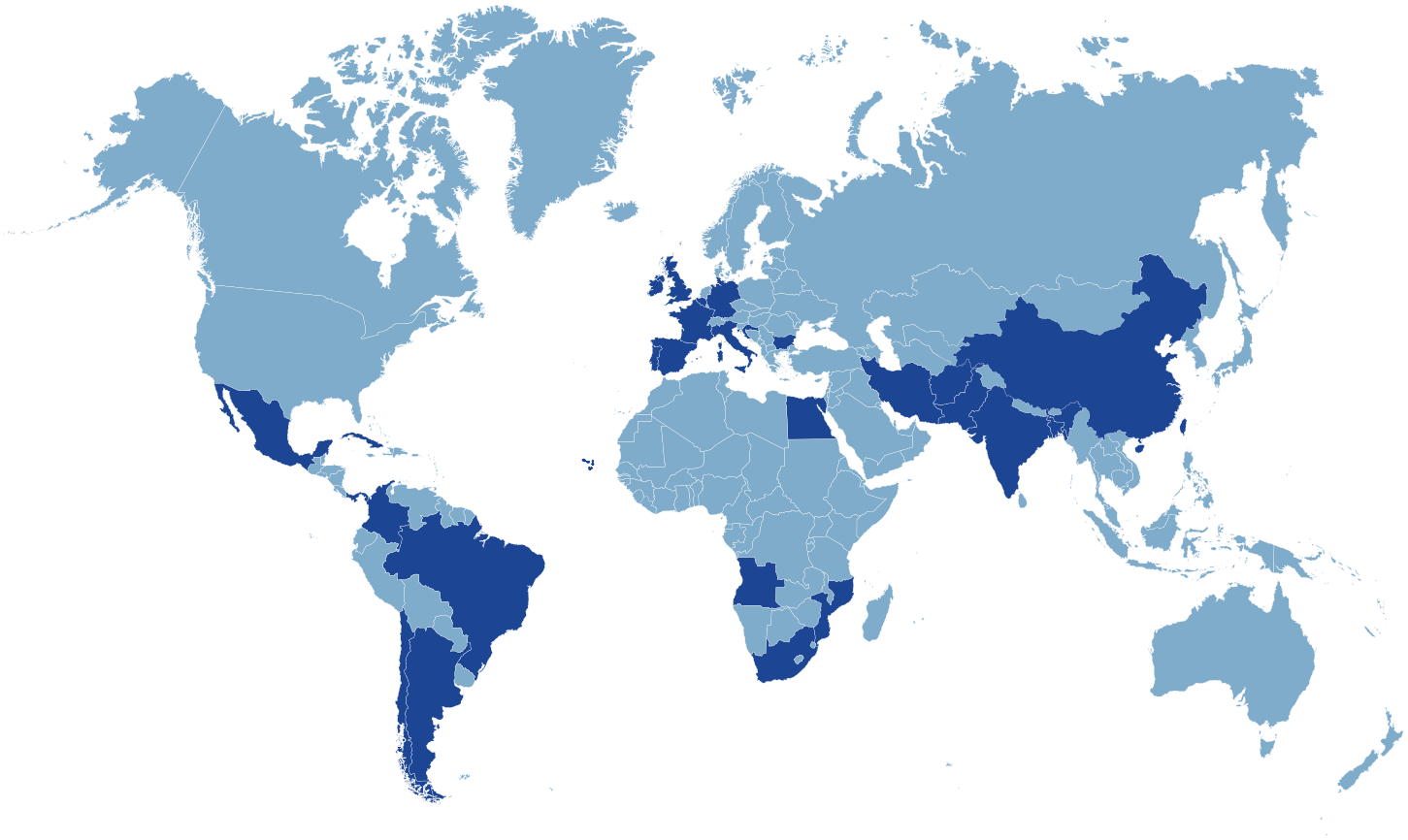
Lab Technicians
52

Other Professional Situations
66

♀ **370**
**Female**

♂ **235**
**Male**

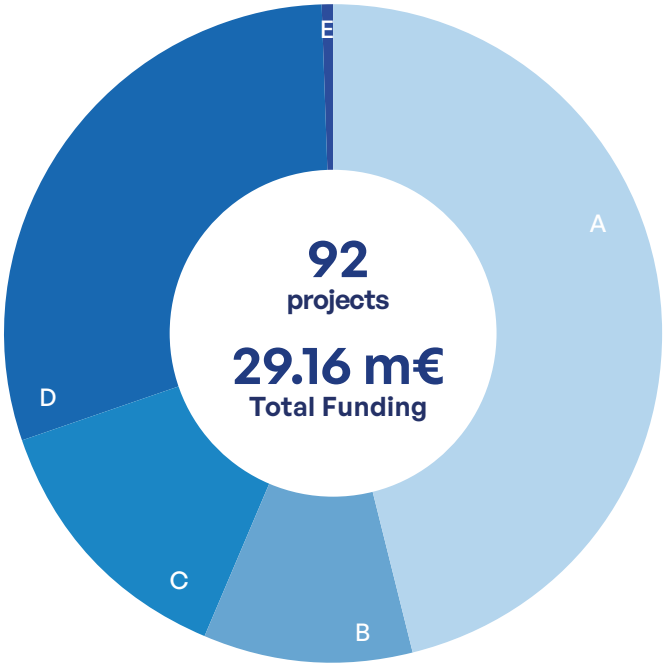
## 26
Nationalities



| | |
|---|---|
| 1 | Afghanistan |
| 1 | South Africa |
| 2 | Angola |
| 1 | Argentina |
| 1 | Bangladesh |
| 2 | Belgium |
| 26 | Brazil |
| 1 | Chile |
| 2 | China |
| 3 | Colombia |
| 2 | Cuba |
| 1 | Cape Verde |
| 4 | Germany |
| 4 | Egypt |
| 21 | Spain |
| 7 | France |
| 1 | United Kingdom |
| 3 | Croatia |
| 2 | India |
| 2 | Islamic Republic of Iran |
| 7 | Italy |
| 1 | Mexico |
| 2 | Mozambique |
| 1 | Panama |
| 1 | Pakistan |
| 506 | Portugal |

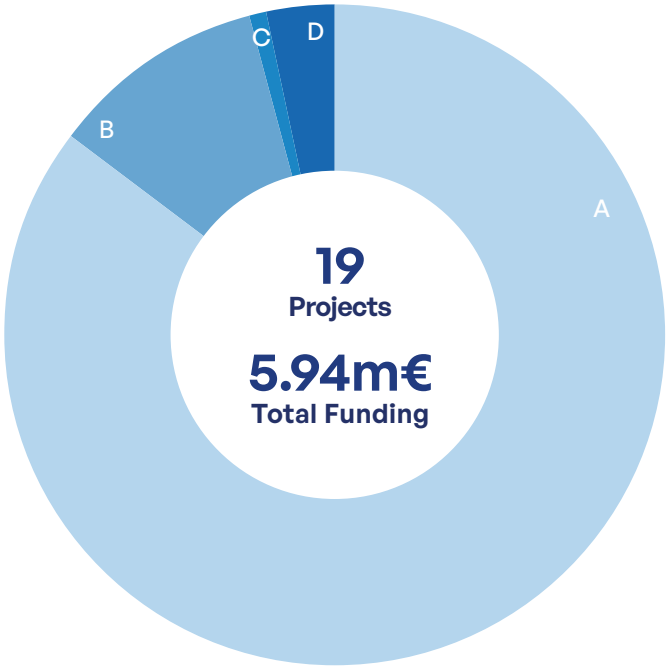
# R&D PROJECTS

## R&D PROJECTS IN EXECUTION DURING 2024 RESULTING FROM COMPETITIVE FUNDING



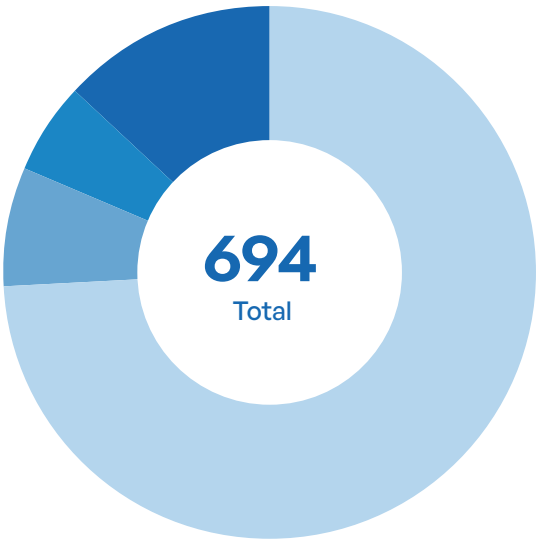

| | | |
|---|---|---|
| A | 13.53 m€<br>29 | **European Funds**<br>Horizon 2020 / Horizon Europe, LIFE |
| B | 2.97 m€<br>24 | **Other European and International Funds**<br>EEA GRANTS, INTERREG, La Caixa, Others |
| C | 3.94 m€<br>31 | **National Funds**<br>FCT |
| D | 8.69 m€<br>6 | **National Funds**<br>PRR |
| E | 0.13 m€<br>2 | **Other National Funds** |

## R&D PROJECTS INITIATED IN 2024 RESULTING FROM COMPETITIVE FUNDING




| | | |
|---|---|---|
| A | 5.07 m€<br>10 | **European Funds/Horizon Europe** |
| B | 0.63€<br>5 | **Other European and International Funds** |
| C | 0.05m€<br>1 | **National funds**<br>FCT |
| D | 0.19 m€<br>3 | **National funds**<br>PRR |

# SCIENTIFIC PUBLICATIONS




**518**
Publications in peer reviewed journals

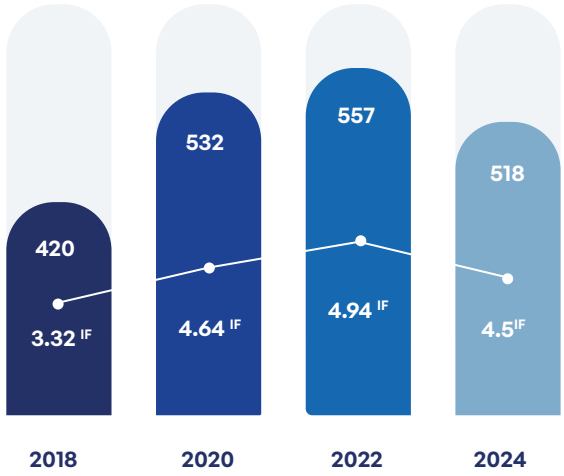
**36**
Books and book chapters

**50**
Edited special issues of journals

**90**
Other publications

## NR. OF PUBLICATIONS IN PEER REVIEWED JOURNALS

IFAverage Impact Factor




**69.20%**
Peer-reviewed publications in open access

**59.4%**
Peer-reviewed publications with international collaborations

# PATENTS

**27**
Active patents

**6**
Granted patents

**2**
International patent applications

**3**
European patent applications

**3**
Provisional patent applications

# PRIZES AND HONOURS

31

# SCIENTIFIC COMMUNICATIONS AND EVENTS


**61**
Scientific events organised

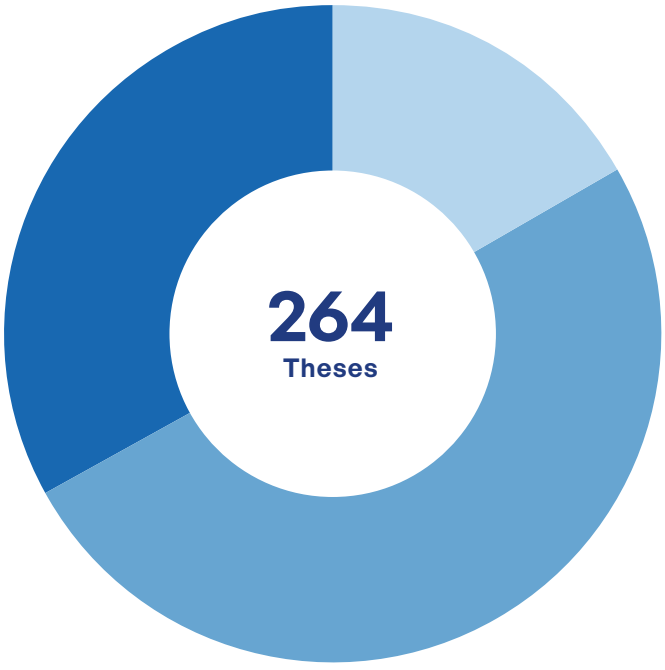
**25**
Scientific seminars at CIIMAR

**470**
Communications in International scientific meetings

**307**
Communications in National scientific meetings

DATA INCLUDE ORAL AND WRITTEN COMMUNICATIONS IN CONFERENCES AND MEETINGS

# ADVANCED TRAINING




**44**
PhD theses

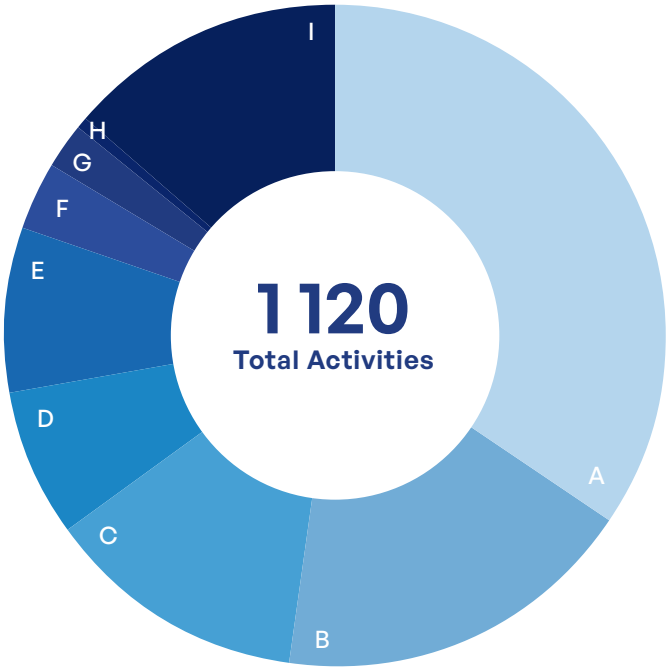
**133**
MSc theses

**87**
BSc theses

**35**
Training courses organised

**760**
Participants in training courses

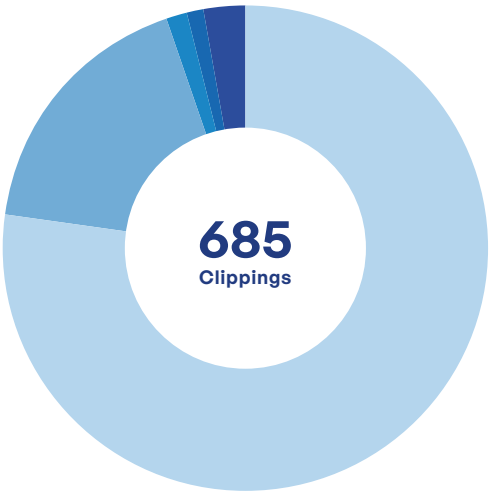
# **OUTREACH** ACTIVITIES




| | | | |
|---|---|---|---|
| A | 386<br>9 476 | Activities and lectures at schools<br>Participants |
| B | 199<br>5 088 | Visits and activities at CIIMAR<br>Participants |
| C | 144<br>3 700 | Visits and activities at CMIAs<br>Participants |
| D | 81<br>2 552 | Outdoor activities<br>Participants |
| E | 92<br>12 155 | Public lectures<br>Participants |
| F | 35<br>30 931 | Exhibitions<br>Participants |
| G | 25<br>710 | Workshops<br>Participants |
| H | 6<br>60 | Training actions<br>Participants |
| I | 152<br>64 547 | Public events<br>Participants |

**These data include figures from CIIMAR, CMIA Vila do Conde and CMIA Matosinhos outreach activities.**

# **MEDIA** OUTREACH




**529** Online news

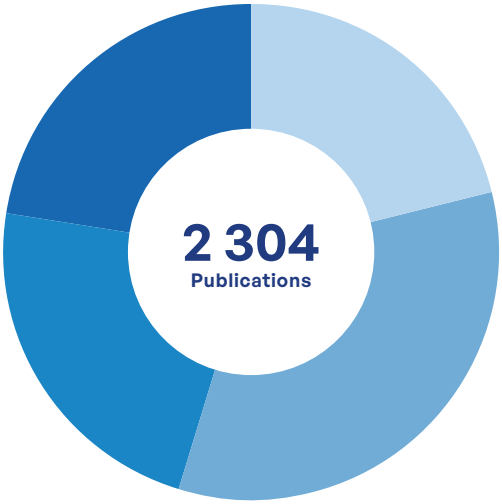
**120** Print press

**10** Radio

**8** TV

**18** Online TV

# **SOCIAL** MEDIA




**489** LinkedIn

**775** Instagram

**523** Facebook

**517** Twitter

**Note: Bluesky channel was created in December 2024.**

# **FINANCIAL**
# KEY FIGURES

| | 2022 (k€) | 2023 (k€) | 2024 (k€) |
|---|---|---|---|
| Revenues from sales and rendering of services | 581 | 704 | 541 |
| Operating subsidies | 7 728 | 10 007 | 11 965 |
| Other operating income | 523 | 542 | 502 |
| Supplies and services rendered | - 2 934 | -3 027 | -3 791 |
| Employee benefits expenses | -5 359 | -7 402 | -8 357 |
| Other operating expenses | -92 | -293 | -293 |
| Depreciation and amortization | -457 | -459 | -583 |
| Cash Flow | 9 | 869 | -96 |
| CAPEX (Capital Expenditure) | 538 | 569 | 604 |
| Net Cash | 1 683 | 2 852 | 2 756 |
| EBITDA (Earnings before interest, taxes, depreciation and amortization) | 451 | 546 | 650 |
| Profit for 2024 | -61 | 46 | 67 |

# 2024 AT A GLANCE

**JANUARY**

- CIIMAR formalizes a memorandum of understanding with IBERBLUE WIND
- 3rd Meeting of the Portuguese Blue Biobank Consortium

**FEBRUARY**

- Secretary of State for Maritime Affairs visits CIIMAR

**MARCH**

- CIIMAR 24th Anniversary
- CIIMAR Blue Woman Talent Award 2024 to Patrícia Todo Bom
- CIIMAR creates "Living Lab" at Lima River
- 3rd edition of the CIIMAR Scientific Photography Contest
- Marta Correia da Silva wins European programme for women entrepreneurs

**APRIL**

- CIIMAR, FURG and FIO celebrate agreement for Oceanic Observation Station in Rio Grande
- Open Call for BYT candidates
- CIIMAR at Mostra UP
- Vitor Vasconcelos receives the Matosinhos Medal of Honour

**MAY**

- First CIMAR-LA meeting

**JUNE**

- 8th Congress of the International Society for Applied Phycology

**JULY**

- Four CIIMAR students highlighted by IJUP2024
- Enzimar project awarded at Educaixa competition
- BYT and BYT+ 2023/2024 Closing Session
- The Regional Secretariat for the Sea and Fisheries of the Azores visits CIIMAR
- CIIMAR joins the Porto Climate Pact
- CIIMAR Watch is launched to monitor the Northern Coast of Portugal

**AUGUST**

- CIIMAR participates in the first campaign of the Ocean Marine Protected Areas Project
- Two CIIMAR projects recognized as Ocean Decade Actions

**SEPTEMBER**

- CIIMAR Annual Meeting
- 5th edition of the Blue Think Conference
- Inauguration of “Mexilhões de Água Doce” (Fresh water mussels) exhibition at SEA LIFE Porto
- CIIMAR Open Day 2024
- Ocean Slim-G project wins 3rd place in BIP Acceleration Programme

**NOVEMBER**

- LEGE-CC biobank achieves ISO9001 certification
- CIIMAR at Science and Technology Week
- Open letter for a restoration plan that pays attention to the sea
- PONDERFUL project awarded at the Braga Science Film Fest
- AlgaBioTec project wins third edition of BluAct competition

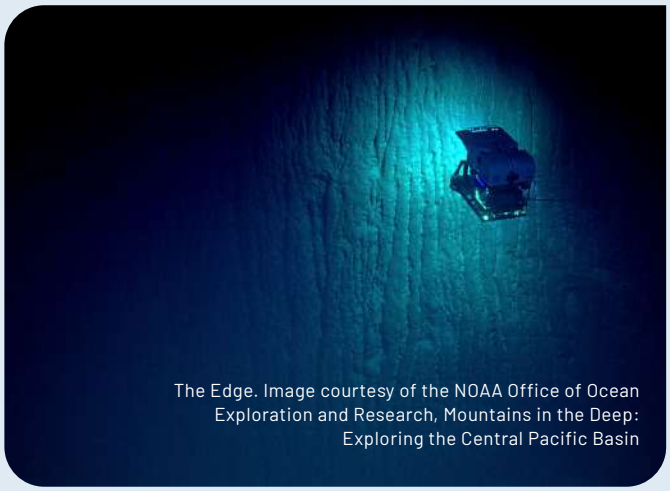
**DECEMBER**

- Isabel Sousa Pinto invited to chair the National Restoration Plan

# HIGHLIGHTS

### TWINDEEPS – A TWINNING PROJECT THAT CAPACITATES CIIMAR IN DEEP SEA EXPLORATION

CIIMAR won a TWINNING project, funded with 1.5M euros by the European Commission, to leverage Portugal R&I capacity in deep-ocean exploration and observation. The TwinDEEPS project, led by Joana Xavier, will partner CIIMAR with top tier European partners, benefitting from the complementary expertise of this multidisciplinary and highly technological consortium.



The Edge. Image courtesy of the NOAA Office of Ocean Exploration and Research, Mountains in the Deep: Exploring the Central Pacific Basin

### OPEN LETTER FOR THE NATIONAL RESTORATION PLAN

Following the approval of the Nature Restoration Act by the European Parliament, researchers from CIIMAR led an open letter to the Portuguese Minister for the Environment and Energy, to encourage a national restoration plan that pays attention to the sea and marine habitats. This letter was signed by researchers from all over the country as well as experts in marine, environmental and social sciences, representatives of national non-governmental organizations and the civil society.


### CIIMAR WATCH LAUNCHED IN 2024

CIIMAR Watch is the new monitoring programme launched by CIIMAR in 2024. It aims to deepen the knowledge of the marine ecosystems of the coastal region of northern Portugal and to understand their dynamics and changes over time. This programme is a response to the need for long-term data series to understand the challenges and changes observed, offering continuous monitoring of the region's biological, chemical and physical data.

### MAR2PROJECT LIVING LAB AT RIVER LIMA

As a partner in the MAR2PROJECT, CIIMAR was responsible for the opening of the new LivingLab created in Viana do Castelo, whose main objective is to guarantee good environmental status and surface water quality in the Lima River estuary. The aim is to prevent the contamination of groundwater from the impacts of climate change and global change through different innovative technologies and nature-based solutions.

# PRIZES AND **HONOURS**

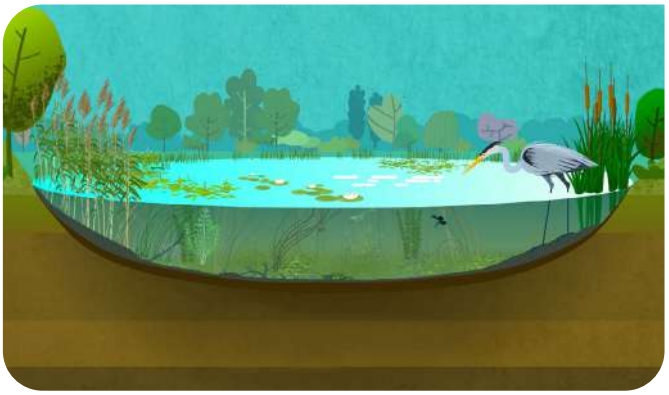
## A SELECTION OF PRIZES AND HONOURS ATTRIBUTED TO CIIMAR MEMBERS IN 2024:


### MARTA CORREIA DA SILVA WINS EUROPEAN PROGRAMME FOR WOMEN ENTREPRENEURS

The OceanCare Chemicals project, led by Marta Correia da Silva, granted the CIIMAR researcher one of the five awards of the 2024 Womenture Competition. This project develops compounds for ship paints that prevent biofouling without harming the ocean. The Womenture Competition is a European women's entrepreneurship programme co-funded by the European Union.

### VITOR VASCONCELOS RECEIVES THE MATOSINHOS MEDAL OF HONOUR

The President of CIIMAR's Board of Directors received the Matosinhos Medal of Honour, within the municipality's celebrations of the 50th anniversary of April 25th. The award recognizes Vitor Vasconcelos outstanding contributions to science and the community.



### PONDERFUL PROJECT AWARDED AT THE BRAGA SCIENCE FILM FEST

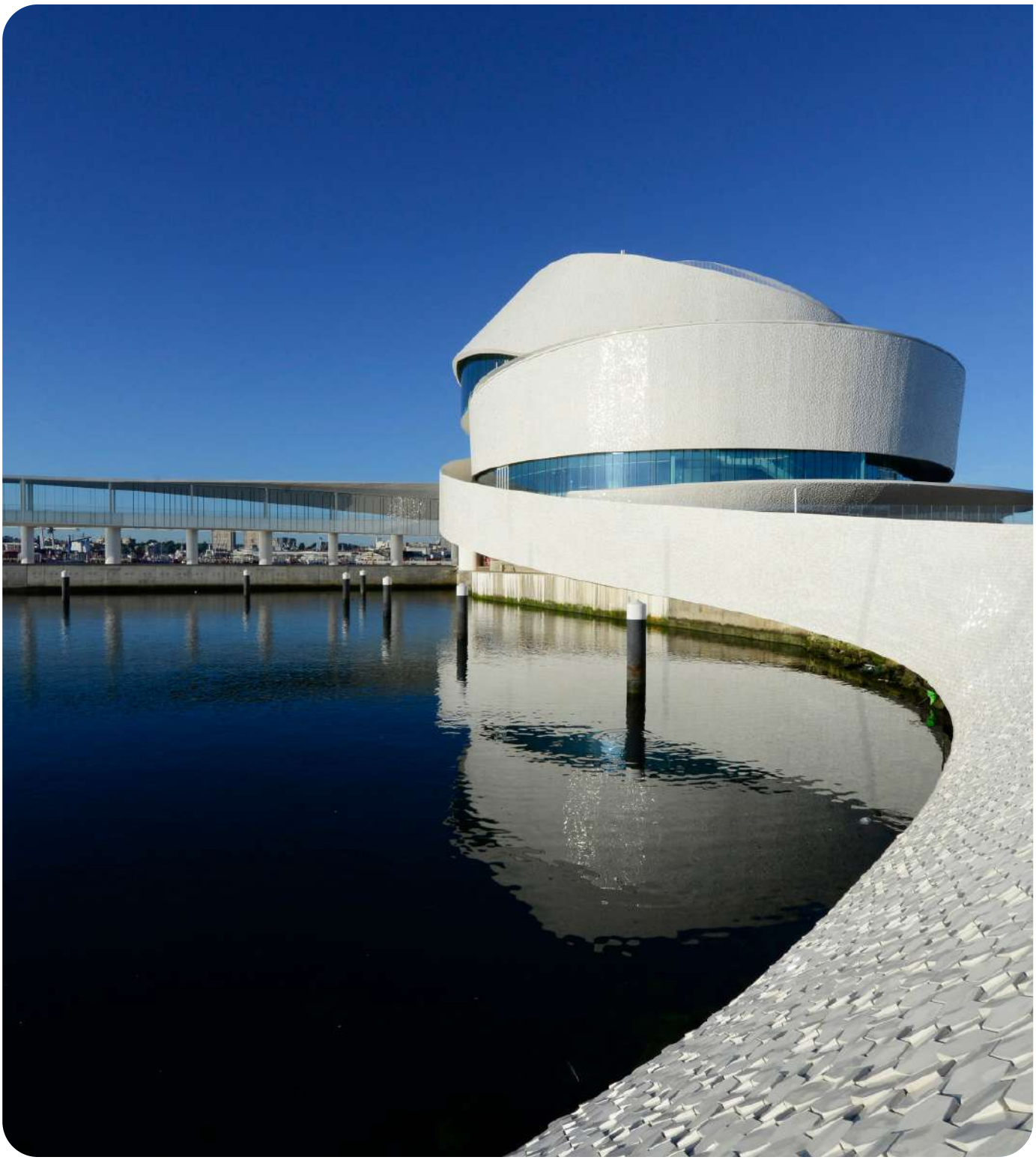
The short film "The Importance of Ponds", produced by the PONDERFUL project, won Braga Science Film Fest's "Audience Award". Competing among 80 films, the film highlights how ponds support biodiversity and ecosystem services and how to create them. It is available in 10 languages on YouTube. The PONDERFUL project is led at CIIMAR by José Teixeira.

### CIIMAR RESEARCHERS WIN THIRD EDITION OF BLUACT COMPETITION

The AlgaBioTec project won the BluAct competition, an initiative by Matosinhos City Council supporting innovative blue economy projects. The team, composed of Isabel Cunha and Isabel Oliveira, from CIIMAR, Raquel Vaz, from University of Coimbra, and Paulo Patrício, developed a fertilising bioplastic that repurposes macroalgae from Portuguese coasts, offering a sustainable solution for agriculture.


## ISABEL SOUSA PINTO NOMINATED CHAIR OF THE COMMITTEE FOR THE NATIONAL RESTORATION PLAN

The Portuguese Government invited Isabel Sousa Pinto to chair the Monitoring Committee of the National Restoration Plan. The CIIMAR researcher will be responsible for overseeing the plan's progress and ensuring proper discussions, working with experts to design and implement a strategy that could include the restoration of marine ecosystems.



# SCIENCE **STORIES**

**2024 WAS RICH IN SCIENTIFIC ACTIVITY. HERE YOU CAN FIND A SHORT SELECTION OF OUR SCIENCE STORIES.**

## CIIMAR AT THE FOREFRONT OF CORAL GARDEN RESTORATION

CIIMAR is at the forefront of coral garden recovery with the BUFFER and RED-COR2 projects focused on the conservation of habitat-forming Mediterranean corals. Led by Jean-Baptiste Ledoux, their main tool is population genetics. A first study assessed the response of colonies of the red gorgonian species *(P. clavata*) to marine heatwaves and shows that Mediterranean coral gardens may inevitably be jeopardised.

## INNOECOFOOD PROMOTES SUSTAINABLE AQUACULTURE ON THE AFRICAN CONTINENT

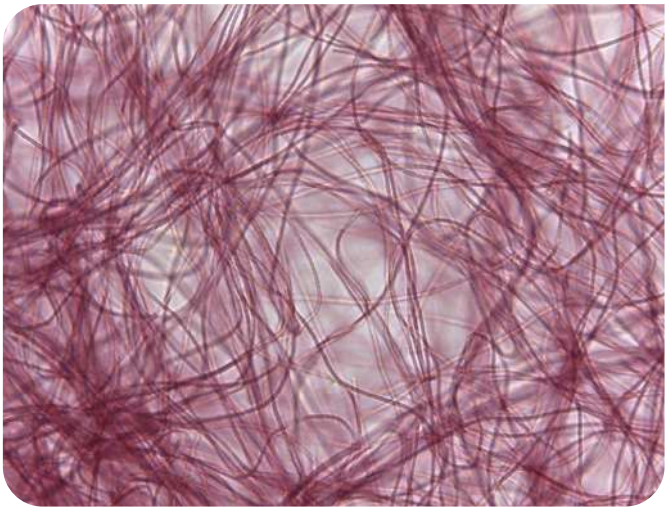
The INNOECOFOOD project, led by António Marques, has started work on developing, testing and demonstrating innovative and sustainable agro-ecological food production systems in six African countries. With the installation of four ECOHUBS and monitoring on six aquaculture farms, the project uses digital technologies that will be the impetus for generating new business areas and training rural farmers and aquaculture producers, young people and women in the African countries involved.

## MARINE FORESTS AS ALLIES IN REMOVING OCEAN CARBON AND FIGHTING CLIMATE CHANGE

A study published in Nature Geoscience revealed that marine kelp forests transport around 56 million tonnes of carbon to sinks in the deep ocean, contributing significantly to regulating the amount of $CO_2$ in the atmosphere and, consequently, the Earth's climate. This discovery opens up new opportunities for mitigating climate change through the preservation and restoration of marine kelp forests. This work resulted from an international collaboration that included researchers from CIMAR-LA, namely Isabel Sousa Pinto (CIIMAR) and Jorge Assis (CCMAR).

## RESEARCHERS REVEAL RECORD SURFACE MELTING ON THE ANTARCTIC PENINSULA

A study led by Irina Gorodetskaya revealed the impact of extremely hot events on the melting of the surface of the Antarctic Peninsula. The study looks at the drivers and impacts of the heatwave on the Antarctic Peninsula in February 2022, the latest in an alarming series of such events in the region, indicating a significantly stronger warming trend compared to the rest of Antarctica.

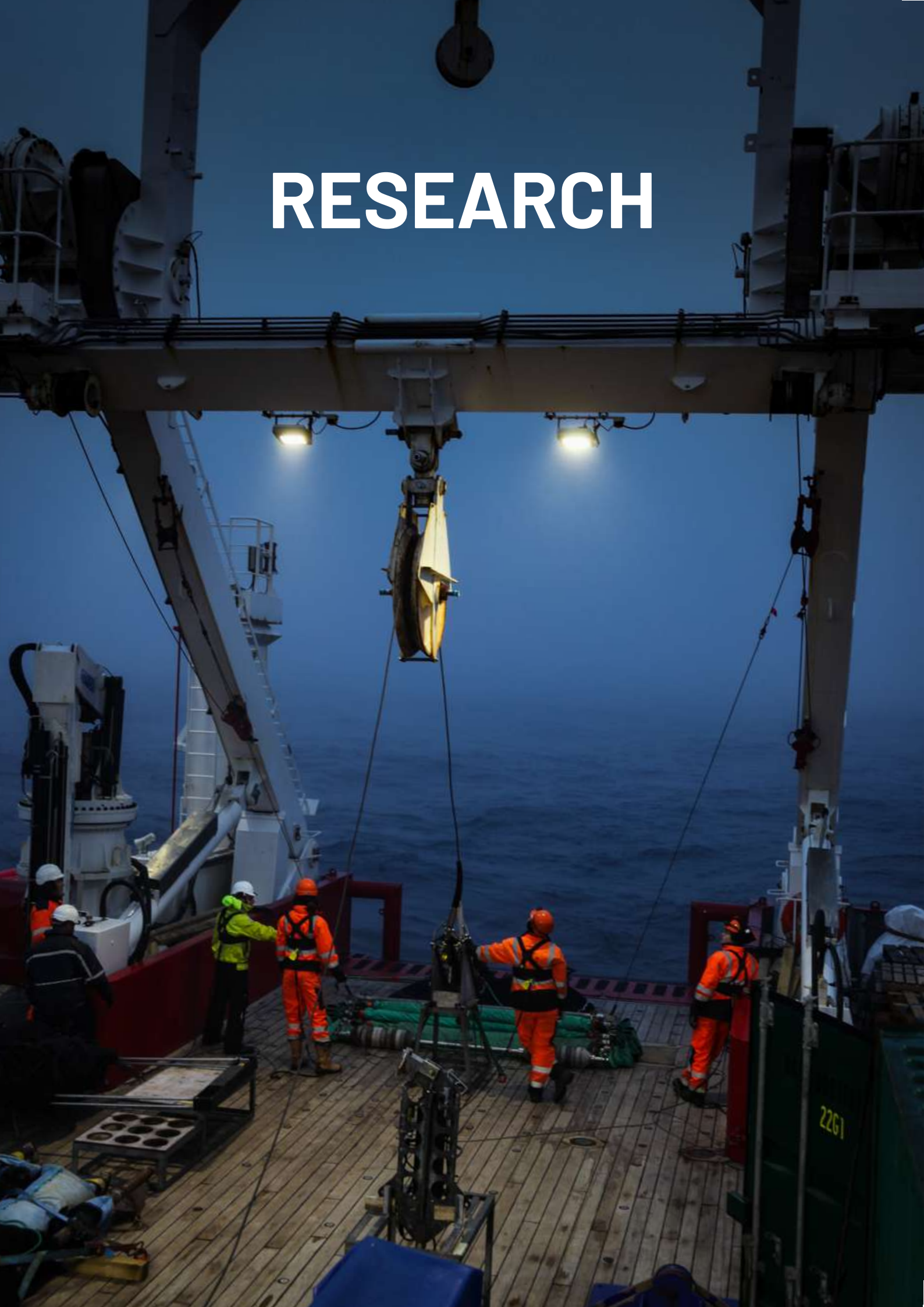


## STRUCTURE OF NATURAL CYANOBACTERIAL COMPOUNDS DISCOVERED 30 YEARS AGO UNRAVELLED

Thirty years of research has finally unravelled the chemical structure of leptochelins, compounds produced by marine cyanobacteria. These molecules show great biotechnological potential for the production of cancer drugs and as chelating agents with uses that can range from the pharmaceutical industry, food industry, agriculture and metal recycling, among other bioremediation applications. Mariana Reis, Leonor Ferreira, João Morais and Vítor Vasconcelos were involved in this international study.

## MARINE CYANOBACTERIA IN THE ORIGIN OF ANTI-INFLAMMATORY MOLECULES WITH DERMATOLOGICAL AND COSMETIC APPLICATIONS

In response to the growing demand for anti-inflammatory solutions for skin conditions, the study carried out in the context of the doctoral work of Janaina Morone, under supervision of Graciliana Lopes, reveals that extracts rich in carotenoids originating from marine cyanobacteria are strong anti-inflammatory ingredients for the skin with dermatological and cosmetic applications of natural, sustainable and vegan origin.


RESEARCH

# RESEARCH

**CIIMAR IS SCIENTIFICALLY ORGANISED IN THREE MAIN RESEARCH LINES.**

## MARINE BIOTECHNOLOGY

CIIMAR research topics include the investigation of the richness of Ocean resourced for the discovery and characterization of new bioactive compounds with ecological, pharmaceutical or other industrial applications. The study of emerging toxins, development of biosensors for early detection systems, and development of bioremediation and phytoremediation tools for ecosystem recovery are other main goals of this research line.

*P.I. Pedro Leão*

## GLOBAL CHANGES AND ECOSYSTEMS SERVICES

CIIMAR provides basic knowledge and tools to support the protection and management of marine, estuarine and freshwater ecosystems. Sustainable exploitation of ocean resources with production of valuable goods and services is fostered through this research line. This work is done in close collaboration with SMEs, international and local authorities, and stakeholders.

*P.I. Lúcia Guilhermino*

## BIOLOGY, AQUACULTURE AND SEAFOOD QUALITY

CIIMAR promotes sustainable aquaculture and innovating sea food extraction, which are vital for tackling nutrition and seafood quality issues. Understanding the diverse traits and needs of key aquatic species, along with their susceptibility to disease, is crucial. Significant scientific advancements and innovation stem from both basic and applied research, benefitting industries and consumers alike.

*P.I. Luísa Valente*

| RESEARCH LINE | RESEARCH GROUPS | GROUP LEADERS |
|---|---|---|
| **GLOBAL CHANGES AND ECOSYSTEM SERVICES** | Aquatic Ecology and Evolution | Elsa Froufe |
| | Aquatic Ecotoxicology and One Health | Lúcia Guilhermino |
| | Benthic Ecology and Environmental Solutions | Francisco Arenas |
| | Coastal Biodiversity | Isabel Sousa Pinto |
| | Contaminant Pathways in Marine Environment | Miguel Caetano |
| | Deep-Sea Biodiversity and Conservation | Joana Xavier |
| | Ecosystem Monitoring and Sustainability | Laura Guimarães |
| | Endocrine Disruptors and Emerging Contaminants | Miguel Santos |
| | Fish Ecology and Sustainability | Sandra Ramos |
| | Hydrobiology | Adriano Bordalo e Sá |
| | Land-Ocean-Atmosphere Interactions | Ana Bio |
| | Marine Ecosystem Modelling | Irene Martins |
| | Marine Energy and Hydraulic Structures | Francisco Taveira Pinto |
| | Microbiome Ecology and Biogeochemistry | Catarina Magalhães |
| | Rivers and Coastal Ecology | Carlos Antunes |
| | Social and Educational Innovation | Clara Vasconcelos |
| | Soil/Water Contamination and Interactions | Natividade Vieira |
| **BIOLOGY, AQUACULTURE & SEAFOOD QUALITY** | Animal Genetic and Evolution | Filipe Castro |
| | Animal Morphology and Toxicology | Eduardo Rocha |
| | Animal Parasitology and Pathology | Maria João Santos |
| | Aquatic Animal Health | Benjamin Costas Refojos |
| | Feed and Seafood Quality | Luísa Valente |
| | Fish Biology and Fisheries | Alberto Correia |
| | Fish Nutrition and Welfare | Aires Oliva Teles |
| | Microbiology and Biotechnology in Aquaculture | Cláudia Reis Serra |
| | Seafood Safety and Processing | Maria Leonor Nunes |

| RESEARCH LINE | RESEARCH GROUPS | GROUP LEADERS |
|---|---|---|
| **MARINE BIOTECHNOLOGY** | Biodiscovery for health | Ralph Urbatzka |
| | Bioinspired Ocean Interfaces | Joana Reis de Almeida |
| | Bioremediation and Microbes for Sustainability | Ana Paula Mucha |
| | Blue Biotechnology, Environment and Health | Vítor Vasconcelos |
| | Cyanobacterial Natural Products | Pedro Leão |
| | Emerging Biotechnology and Seafood Processing | Narcisa Bandarra |
| | Environmental Chemistry and Recovery | Marisa Almeida |
| | Evolutionary Genomics and Bioinformatics | Agostinho Antunes |
| | Marine Natural Products and Medicinal Chemistry | Madalena Pinto |
| | Microbial Biodegradation and Bioprospecting | Maria de Fátima Carvalho |

# CIIMAR **WATCH**

This year, CIIMAR launched a new strategic environmental monitoring programme, CIIMAR WATCH. This initiative brings together nine CIIMAR research teams and 40 researchers, with financial and logistical support from CIIMAR, ensuring continuous data collection and management. The programme establishes a long-term environmental monitoring effort focused on coastal and estuarine ecosystems in northern Portugal.

CIIMAR WATCH includes two key monitoring regions: VIANA WATCH (Viana do Castelo) and PORTO WATCH (Porto), covering essential coastal areas in northwest Portugal. These regions have been the focus of extensive monitoring by CIIMAR research teams, with historical environmental data being integrated into the programme's database. The monitoring stations encompass coastal, intertidal, subtidal, and estuarine environments, including the Douro Estuary and Lima Estuary. This interdisciplinary effort addresses critical environmental challenges such as climate change, pollution, and biodiversity loss, systematically collecting biological, chemical, and physical data across these diverse habitats.

In its first year, CIIMAR WATCH established 16 monitoring stations, conducting seasonal campaigns in winter, spring, summer, and fall. Activities include, water and sediment sampling, cetacean observation, plankton trawling, intertidal biodiversity surveys and subtidal diving. The programme also prioritizes public outreach and education, promoting marine conservation awareness and contributing to the training of graduate and undergraduate students.

To enhance data collection and analysis, CIIMAR WATCH plans to start employing cutting-edge technologies in 2025, including Unmanned Aerial Systems (UAS) and real-time monitoring buoys. The project aims to provide high-quality, open-access data for scientific research, policy-making, and public engagement, supporting sustainable resource management and conservation efforts.

# RESEARCH PROJECTS THAT ENDED IN 2024

## MAELSTROM

**SMART TECHNOLOGY FOR MARINE LITTER SUSTAINABLE REMOVAL AND MANAGEMENT**

European project

MAELSTROM's main goal was to reduce the impacts of marine litter in coastal ecosystems by identifying accumulation hotspots and removing the existing litter from the coastal seabed and the water column of rivers before it reached the sea. This action was supported and enacted through circular economy and societal-oriented solutions.

MAELSTROM has achieved numerous significant results, including mapping areas heavily impacted by marine litter (ML), developing new hydrodynamic models, and creating innovative sustainable technologies to collect, remove, sort, and transform ML from coastal and estuarine ecosystems into new products that contribute to the circular economy. Two innovative technologies were implemented for marine litter removal: a Bubble Barrier in Vila do Conde, Portugal, and a Robotic Seabed Cleaning Platform in Venice, Italy. These initiatives involved local stakeholder engagement, co-design, and multidisciplinary research. The project has facilitated extensive outreach, communication, and network building with a diverse, globally spread audience, resulting in over 40 deliverables and reports. Project outputs also include one Working Group on Marine Litter Management (WG-MLM), ten theses and dissertations, scientific articles in peer-reviewed journals, conference proceedings, an interactive forum, two booklets, a legacy document, two policy briefs, four technology workshops, seven thematic webinars, five international side events, twelve newsletters, five interviews on television, the organization of sixteen MAELSTROM events, and fifteen clean-up initiatives, in addition to more than forty-five talks. MAELSTROM was recognized by the European Commission, receiving the Atlantic Project Award in the Healthy Oceans and Resilient Coasts category. Furthermore, the project was honoured with the Sustainability Leadership Award in Robotics by the European Robotics Forum. These awards reflect MAELSTROM's commitment to its core objectives: protecting marine environments and advancing technological innovation.

Principal Investigator at CIIMAR: **Isabel Sousa Pinto**
Leader Institution: **CNR – Consiglio Nazionale delle Richerche**
Website: **https://www.maelstrom-h2020.eu/**

Funded by the European Union

# APMAR-2024

European project

## ANTARCTIC PENINSULA SURFACE MASS AND ENERGY BALANCE: THE ROLE OF ATMOSPHERIC RIVERS

During the recent years, several extreme warm events were observed around the Antarctic Peninsula (AP). Most of them were triggered by atmospheric rivers (AR) with moisture and heat transport from subtropical Pacific Ocean. The last event in February 2022 brought record high surface melt extent over the AP and its already vulnerable ice shelf. With our previous Antarctic fieldwork projects (APMAR/TULIP/APMAR2) we measured some of the key characteristics of the ARs affecting the AP, including vertical structure of the troposphere, cloud liquid water content, and precipitation profiling using ground-based radar. With the APMAR-2024 project we continued to strengthen our atmospheric observations and precipitation composition analysis at the King Sejong station (King George Island) reinforcing them with additional analysis of precipitation chemical and microbiological composition aiming at understanding the presence of sea salt aerosols (inorganic or biogenic) and their role in cloud phase.

Principal Investigator at CIIMAR: **Irina Gorodetskaya**
Leader Institution**: CIIMAR**

# BLUEFORESTING

European project

## A CLIMATE RESILIENT MARINE FORESTS FOR A SUSTAINABLE FUTURE

BlueForesting project aimed to provide science-based guidance for the design and implementation of nature-based solutions (NBS) to foster sustainable and healthy marine forests in North Atlantic seashores, as mitigation and adaptation solutions to climate change.

As part of the project, we mapped the entire extent of marine forests in northern Portugal and investigated the processes that drive seaweed responses to multiple climate change drivers. To this end, we developed regional downscaled projections of climate change associated with the different Representative Concentration Pathways (RCP) scenarios for the region, assessed species vulnerability and identified potential refugia to climate change (CC). We also tested different marine forest restoration techniques and analysed public perceptions of the value of marine forests and their willingness to support conservation and restoration actions. Furthermore, we initiated the development of CC-informed scenarios for marine forest services and natural capital by combining ecological and socio-economic evidence to provide evidence-based management recommendations for climate-safe NBS. Finally, the project has fostered dialogue between marine researchers, stakeholders, decision-makers and the public to advance the application of BlueForesting solutions. Altogether, BlueForesting work has been published in more than 20 publications and has reached more than 40,000 people through various communication channels (workshops with stakeholders, activities for teachers and schools, dedicated questionnaires, as well as major events for the general public).

Principal Investigator at CIIMAR: **Francisco Arenas**
Leader Institution: **CIIMAR**
Website: **https://blueforesting.com/**

# FUTUREMARES

## CLIMATE CHANGE AND FUTURE MARINE ECOSYSTEM SERVICES AND BIODIVERSITY

European project

The goal of this project was to provide socially and economically viable actions and strategies in support of nature-based solutions (NBS) and nature-inclusive harvesting for climate change adaptation and mitigation. For this, FutureMares developed these solutions to safeguard future biodiversity and ecosystem functions to maximise natural capital and its delivery of services from marine and transitional ecosystems. Its specific goals were to: a) advance our understanding of the links between species and community traits, ecological functions and ecosystem services as impacted by climate change (CC); b) deliver projections of the physical and biogeochemical effects of CC to identify climate hotspots and refugia; c) project the effects of CC on the distribution and productivity of important species and consequences for marine biodiversity and food webs; d) conduct novel, social-ecological vulnerability assessments ranking the severity of effects of CC on various ecosystem services and dependent human communities e) perform economic analyses of implementation scenarios of NBS at real-world demonstration sites and f) co-develop project research with decision- and policy-makers and managers to ensure science-based advice to contribute to CC adaptation and mitigation strategies.

A summary of the main actions and policy impacts can be consulted at the FutureMares website.

Principal Investigator at CIIMAR: **Francisco Arenas**
Leader Institution: **University of Hamburg, Germany**
Website: **https://www.futuremares.eu/**

Funded by the European Union

# NATURE

## NATURE-BASED SOLUTIONS TO REDUCE ANTIBIOTICS, PATHOGENS AND ANTIMICROBIAL RESISTANCE IN AQUATIC ECOSYSTEMS

PROJECT NATURE

European project

The project focuses on using nature-based solutions (NBS) to help reduce antibiotics, antimicrobial resistance and harmful pathogens from wastewater treatment plants all the way to coastal areas, aiming to show how these solutions can improve water quality and reduce pollutants.

Results showed NBS attenuation potential. In Denmark, where small NBS are used, trimethoprim was the most common antibiotic. In Spain, clindamycin and azithromycin were found in the highest amounts in treated wastewater. But NBS outperform conventional wastewater treatment methods. Restoring natural river flows in Spain has improved the breakdown of antibiotics by 30-40% in comparison to non-restored river streams and cut toxic effects on aquatic life by 80%.

In Denmark's restored wetlands reduction was ca. 20-30%. In a Portuguese river estuary, results emphasize the saltmarsh's potential in improving water quality. In all locations, NBS caused a shift in the types of bacteria in the water, indicating minimal negative environmental impact, in contrast with reference technologies without NBS. In Mali, the project found that hospital wastewater discharging into the Niger River was a significant source of antibiotics, highlighting the urgent need for NBS in such areas to reduce the spread of antibiotics and resistant bacteria. NATURE findings have been published in 12 journals and shared with stakeholders through workshops, which is expected to promote the adoption of these technologies in both Europe and North African countries.

Principal Investigator at CIIMAR: **Marisa Almeida**
Leader Institution: **Consejo Superior de Investigaciones Científicas - CSIC**
Website: **https://www.natureproject.eu**

# PONDERFUL

## POND ECOSYSTEMS FOR RESILIENT FUTURE LANDSCAPES IN A CHANGING CLIMATE

Ponderful
PONDS FOR CLIMATE

European project

Even the smallest ponds can play a significant role in fighting climate change. Often overlooked and undervalued, ponds are critical for biodiversity conservation and the heath of ecosystems. Recognizing this potential, the EU-funded PONDERFUL project studied over 1900 ponds and eight DEMO sites to explore how ponds can serve as Nature Based Solutions (NBS) for climate change mitigation and adaptation, biodiversity conservation and the delivery of essential ecosystem services.

Building on this research, the project developed science-based tools to implement pond-pondscape NBS to address pressing societal challenges, such as biodiversity loss, global warming, water scarcity, flood risks, public health and overall wellbeing.

Key outputs include: an inventory of 183 NBS in Europe; CLIMA-Pond designs which showcase prototype ponds designed to address climate challenges in natural, rural, and urban landscapes; a technical handbook on restoring, managing and creating ponds and pondscapes as effective NBS; a guidance document for policy makers, including a guide to developing a national plan for ponds and pondscapes; and a multi-criteria decision-making tool to support the implementation of pond and pondscape NBS.

These resources highlight the transformative potential of ponds as tools for addressing environmental and societal challenges. You can find out more about the project and explore our resources at the PONDERFUL website and our social media platforms.

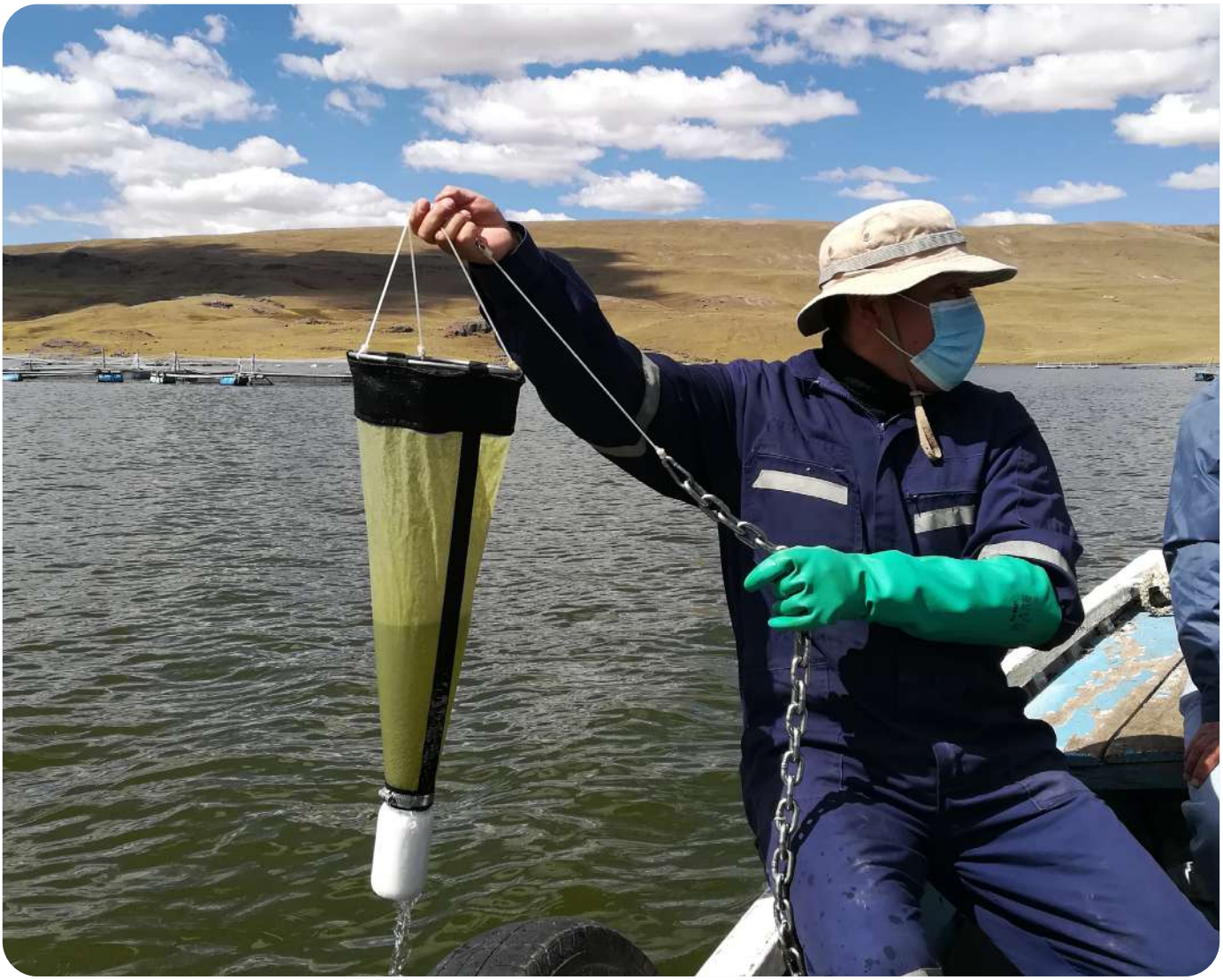
Principal Investigator at CIIMAR: **José Teixeira**
Leader Institution: **Fundacio Universitaria Balmes, Spain**
Website: **https://www.ponderful.eu**

Funded by the European Union

# TOXICROP

**CYANOTOXINS IN IRRIGATION WATERS: SURVEILLANCE, RISK ASSESSMENT, AND INNOVATIVE REMEDIATION PROPOSALS**

European project



An International Consortium, constituted by members from CIIMAR – Portugal, AU – Denmark, USE – Spain, UCA – Morocco, SOU – Egypt, GIAS-UTP and UNAL – Colombia, UNSA and CIENPR – Peru, CEAC – Cuba, LIMNOS – Slovenia, CIFGA – Spain and NOSTOC – Portugal, joined efforts to investigate agricultural risk areas of cyanotoxin occurrence, and to access the fate of cyanotoxins in crops and crop contamination with cyanotoxins. The project sought, among other goals, proposals concerning the maximum levels of cyanotoxins admitted in irrigation waters.

Main achievements of the project include the establishment of methods to monitor and identify cyanobacteria and cyanotoxins; the characterization of contaminants of algal origin in understudied waterbodies; the risk assessment of low-quality waters in agriculture; and the development of nature-based solutions to water treatment.

Principal Investigator at CIIMAR: **Alexandre Campos**
Leader Institution: **CIIMAR**
Website: **https://www.toxicrop.com**

Funded by the European Union

# ATLACE

FCT project

## ATLANTIC INTERACTIONS VIA ATMOSPHERIC WATER CYCLE: EXPLOITING A UNIQUE DATASET FROM THE ANTARCTIC CIRCUMNAVIGATION EXPEDITION FOR BETTER UNDERSTANDING OF CLOUDS AND PRECIPITATION


In the spirit of the first circumnavigation expedition, undertaken by the Portuguese explorer Fernão de Magalhães 500 years ago, that made the scope of the proposal call, ATLACE project explored the unique new comprehensive measurements gathered during the Antarctic Circumnavigation Expedition (ACE) in December 2016-March 2017 to gain unprecedented insight into the precipitation formation processes in the context of the global atmospheric water cycle. The focus of ATLACE was specifically over the regions undergoing significant changes in precipitation with important impacts – marked freshening in the southern Atlantic Ocean sector and anomalous snow accumulation in the Atlantic sector of the East Antarctic ice sheet compensating for the entire ice sheet mass loss from ice melting and contribution to the global sea level rise. Further, ATLACE aimed to extend new process understanding of intense moisture transport, combined with aerosol-cloud interactions, and their effect on precipitation formation gained from observations over the South Atlantic region to the region of Portugal.

Principal Investigator at CIIMAR: **Irina Gorodetskaya**
Leader Institution: **CIIMAR**

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# BEESNESS

FCT project

The BEESNESS project was anchored on previous work and expanded in the collaboration among CIIMAR, Cardiff University and Brazilian researchers, who aimed to unravel diversity patterns, pressures, challenges and opportunities to protect bees and support local farmers and beekeepers. The BEESNESS project provided a wealth of novel information about Caatinga bees and their ecosystems. The project was recognised in 2020 with the Prize for Scientific Research and Technological Development of the Commemorations of the V$^{th}$ Centenary of the Magellan Circumnavigation Travel, which honored the whole team and served as an additional motivation to the whole team. Over 115 outputs were produced, from publications, open access datasets, communications, reports, Master dissertations, contribution to PhD theses, organisation of workshops and seminars, training of other early career researchers and gradution students, app development, outreach activities to school students and the public, and mobilities for exchange, knowledge transfer and networking. From the research work developed we highlight in particular: (i) the assessment of bee biodiversity in the Caatinga biome and in the different areas of production of export fruits, i.e. areas under conventional cultivation with application of pesticides, areas under organic cultivation and areas in transition; (ii) the establishment of a quality profile for melipona honey, with application to quality and origin certification, valuing the local producers; (iii) the assessment of sensitivity to pesticides of several melipona species from the Caatinga, of value to the management of pesticides use in the Valley; (iii) the health assessment of the mandaçaia of the Caatinga, contributing relevant information to the establishement of protection and conservation measurements; and (iv) the omics results obtained, from primers to bees barcoding, to metatranscriptomic data on the native bee species or the protein-ligand modelling approach to understand mechanisms of toxicity and predict hazardous effects. The data gathered provided a basis to the continued inventory of these species, their protection and the sustainable management of agricultural production in the São Francisco Valley. Overall, the work brought new insight and questions for future research and collaboration, related solitary bees, Caatinga melipona species, their life cycle, social structure and behaviour, opening perspectives and setting the ground for continued collaboration.

Principal Investigator at CIIMAR: **Laura Guimarães**
Leader Institution: **CIIMAR**

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# CONNECT2OCEANS

FCT project

## CONNECTING ATLANTIC AND ARCTIC OCEANS TO DECIPHER CLIMATE CHANGE IMPACT ON PLANKTON MICROBIOME FUNCTIONS

This project investigates how the Atlantification of the Arctic Ocean, driven by increased heat inflow from Atlantic Waters, impacts Arctic plankton microbiome diversity and functions. Microbiomes play critical roles in ocean stability, sustaining primary production and food webs, yet their responses to these climate-driven changes remain poorly understood. We hypothesized that warming Atlantic waters would reduce temperature gradients, increased microbiological connectivity, and drove shifts in microbial metabolic regimes with ecosystem-wide implications. We addressed our objectives by leveraging long-term genomic datasets collected from Atlantic and Pacific Arctic monitoring campaigns, alongside controlled Arctic expeditions conducted between 2022 and 2023. These controlled experiments tested the combined effects of Atlantic and Arctic Waters on plankton diversity and functional shifts. To enhance data collection, we validated an autonomous eDNA sampler, in the Arctic, to extend microbiome monitoring in remote and under-sampled environments. This interdisciplinary effort will provide insights into climate impacts on polar microbiomes, delivering data crucial for understanding oceanic biogeochemical processes, ecosystem resilience, and global climate risks.

Principal Investigator at CIIMAR: **Catarina Magalhães**
Leader Institution: **CIIMAR**

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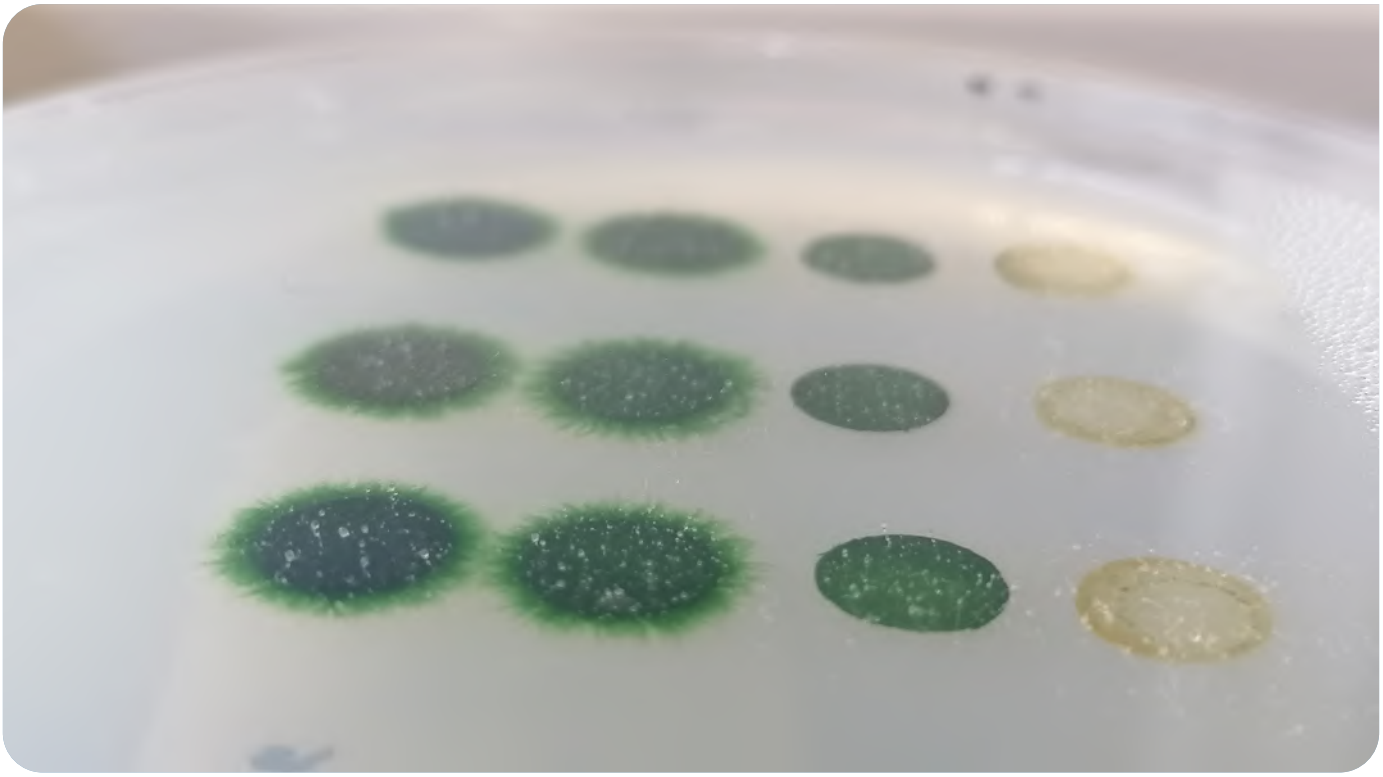
# CYAMOEBA

FCT project

## CHEMICAL-MEDIATED INTERACTIONS BETWEEN CYANOBACTERIA AND AMOEBAE



An estimated 80-90% of BGCs are not usually expressed under standard laboratory conditions. As a consequence, cultivation of individual microorganisms in a laboratory setting may only reveal a small fraction of the metabolic space encountered in nature. Therefore, exploring microbial interactions from an ecological perspective is a particularly fruitful approach to unveil both new chemistry and bioactivity.

Cyanobacteria and amoebae have been known for a long time to co-exist in aquatic environments, however, the interactions between these organisms are poorly understood. So, the aim of this project is to study the interactions between these two organisms in order to find novel natural products mediating this interaction. To achieve this goal, a screening assay was designed in this project to identify the cyanobacterial strains from the LEGE-CC that were systematically resistant to the grazing of a marine and a soil amoeba strains. More than 100 cyanobacterial strains were tested and 6 grazing resistant strains were selected for genome sequence. After bioinformatic analysis of the genome of these strains, the *Synechococcus sp*. LEGE 11428 was selected for further small-scale growth with and without amoebae. A few mass features were identified in more abundance in the co-cultures in comparison with the monocultures, which might represent compounds with a chemical ecological role. The work on this project was presented in several national and international conferences and in the final workshop that was organised in the scope of this project. Two publications regarding this project work are being prepared, including one that was already submitted to a scientific journal. In December 2024, the master student working on the scope of this project, successfully defended his thesis.

Principal Investigator at CIIMAR: **Ana Vieira**
Leader Institution: **CIIMAR**

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# DEEPRESIST

FCT project

## METAL IMPACTS ON THE RESISTANCE AND DENITRIFICATION TRANSCRIPTOME OF DEEP-SEA MODEL BACTERIA

The overall scientific objective of DeepResist was to evaluate the impacts of metal exposure on the resistance and denitrifying transcriptomes of deep-sea microorganisms.

In this exploratory project that lasted for one year and a half, we performed more than 15 incubation experiments in high-pressure bioreactors with two deep-sea model isolates (*Shewanella loihica PV-4* and *Thalassospira indica PB8B*) and investigated their whole transcriptome and metabolic production of $N_2O$, a potent greenhouse gas, under exposure to cadmium (Cd) and copper (Cu), two metals that may be potentially released after seabed disturbance.

Regarding the impacts of the metals on $N_2O$ metabolism in *S. loihica PV-4*, we observed contrasting results between the two metals. While Cd inhibited net $N_2O$ production from PV-4 (Pizarro et al., 2023), Cu appeared to promote net $N_2O$ (article in preparation). In *T. indica PB8B*, preliminary results suggest that Cu delayed $N_2O$ reduction, inhibiting the capacity to fully reduce $N_2O$, while Cd showed no impacts on $N_2O$ metabolism (article in preparation), underscoring the differential impacts between the two metals. In most of these experiments, gene expression patterns, measured by both qPCR and whole transcriptome sequencing, were good predictors of net $N_2O$ production, which is informative for future environmental monitoring strategies. The links between N cycling and metal resistance genes are also being evaluated (article in preparation). Preliminary results indicate that denitrification may be more tightly linked to metal resistance than dissimilatory nitrate reduction to ammonia, two competing pathways for $NO_3^-$.

Methodological advances from these projects, such as high-pressure bioreactor experimentation and gene expression markers, as well as the associated scientific results are contributing to the ongoing discussion on monitoring deep-sea mining's environmental impacts.

Principal Investigator at CIIMAR: **Miguel Semedo**
Leader Institution: **CIIMAR**

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# DEEPRISK

FCT project

## DEEP-SEA MINING AND CLIMATE CHANGE: NEW MODELING TOOLS IN SUPPORT OF ENVIRONMENTAL RISK MANAGEMENT

Over the last four years, a team of scientists from the Faculty of Sciences of the University of Porto (FCUP), the Interdisciplinary Centre for Marine and Environmental Research (CIIMAR-UP), the Portuguese Institute of the Sea and Atmosphere (IPMA) and the Okeanos marine science research institute of the University of the Azores, studied the impacts of deep-sea mining activities and developed innovative tools to support the management of their environmental risk.

Both the models developed and the experiments carried out showed the harmful and/or lethal effects on the deep-sea species studied when subjected to the sulphide particles that could potentially result from the mineral extraction or returning water.

The dispersal of sediments during the mining process is the most immediate and expected consequence of deep-sea mining. However, the research carried out in the project made it possible to discover that mining also releases large quantities of dissolved metals into the water column.

These plumes can potentially spread over long distances, carried by currents and potentially affecting organisms several kilometres from the initial mining source. The researchers assessed the effects of sediment plumes on various groups of coastal organisms, such as sponges, bivalves and deep-sea organisms like cold-water corals, using advanced systems that simulate deep-sea conditions and the results point to negative effects on all the groups studied. The innovative nature of the project has also resulted in the development of new hydrodynamic and ecological models to assess the behaviour of sediment plumes and anticipate the evolution of these ecosystems in the presence of this stressor. The ecological models show that hydrothermal ecosystems impacted by plumes collapse, indicating that they have little resilience to overcome this impact. These data are essential to better characterise the risks of this activity and implement mitigation and management measures to minimise the negative effects.

Principal Investigator at CIIMAR: **Luísa Bastos**
Leader Institution: **FCUP**

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# EDGEOMICS

**FRESHWATER BIVALVES AT THE EDGE: ADAPTATION GENOMICS UNDER CLIMATE-CHANGE SCENARIOS**

FCT project

The main goal of this interdisciplinary project was to integrate ecological experiments, in situ behavioural observations and genomic approaches, to evaluate and predict the impact of climate change in lotic freshwater ecosystems.

The six tasks were fully finalised, resulting in 11 scientific papers; 2 PhD (one being finalised), 2 Master and 1 BSc thesis concluded; 17 oral communications and 6 posters presented in congresses and several outreach activities, including TV news and one podcast. The year 2022 was very dry and through the fieldwork, the team realised that some of the freshwater mussel populations had disappeared due to the drought where they were occurring. Given the lack of long-term monitoring programs and the paucity of hard data on freshwater mussel declines, the team decided to survey their diversity and abundance across Portugal.

Thus, the team surveyed the same 147 sites across Portugal as done previously between 2002-2004 (Reis 2006), following the same methodology. This comprehensive new survey shows an extensive decline of freshwater mussels across Portugal and calls attention to the importance of effective monitoring and conservation actions in freshwater species that are exposed to multiple threats and a rapidly changing environment, including habitat destruction and fragmentation, invasive species, and climate change. All mussel species are rapidly declining and are now risking extinction. More, their new status was included in the Portuguese Invertebrate Red Book. Thus, although not originally planned these results have a huge impact on the project outputs, including outreach.

Principal Investigator at CIIMAR: **Elsa Froufe**
Leader Institution: **CIIMAR**

Fundação para a Ciência e a Tecnologia

# MITES ASSOCIATED WITH RED PALM WEEVIL (RPW; *RHYNCHOPHORUS FERRUGINEUS O.*) IN PORTUGAL AND RECOMBINANT ANTI-RPW ENDOPHYTIC BACTERIA

FCT project

This project aimed at obtaining a Red Palm Weevil (RPW; *Rhynchophorus ferrugineus o.*) RPW laboratory colony as a source of high-quality insects for bioassays; studying mites associated with the invasive RPW in Portugal; and identifying anti-RPW factors and endophytic bacteria as carriers.

We successfully established a laboratory colony of RPW at the University of Porto, replicating its entire life cycle under controlled conditions, which provided valuable biological insights, supported bioassays for anti-RPW factors, and contributed to academic outputs including a conference poster and student theses. We characterized the diversity and ecology of phoretic deutonymphs associated with RPW in Northern Portugal, later extending the study to the south, including Lisbon, the Algarve, and Madeira, revealing regional differences in mite diversity. We also identified five fungal species associated with RPW, including a novel *Fusarium tonkinense* association capable of causing *Fusarium wilt* in *Phoenix canariensis*, highlighting RPW's role as both a pest and a potential vector of palm pathogens. We isolated palm-associated endophytic bacterium *Lysinibacillus irui* and conducted comparative genomics studies to determine the existence of beneficial traits for the plant host. We also identified a *Bacillus thuringiensis* (Bt) pesticidal protein against RPW and new targets for RNAi pesticide in this insect species. Transformed bacteria expressing the Bt toxin or double-stranded RNA of the RNAi target induced the insect death indicating their usefulness for RPW management strategies. This work resulted in conference presentations, student theses and one publication. Two publications are in preparation.

Principal Investigator at CIIMAR: **Camilo Ayra Pardo**
Leader Institution: **CIIMAR**

fct Fundação para a Ciência e a Tecnologia

# PROPELLER

## INVESTIGATION OF A NEW CLASS OF BETA-PROPELLER ENZYME

FCT project

The main aims of this project were to uncover the mechanism underlying BrtB's unusual reactivity and leverage its potential for biocatalysis, and to discover the novel chemistry that is hidden in biosynthetic gene clusters encoding BrtB-homologs.

One of the project's objectives focused on advancing knowledge about the enzyme BrtB and brt biosynthetic pathways. Key accomplishments included identifying 27 new bartoloside variants, correcting misconceptions in the literature, and uncovering BrtB's ability to catalyze both O-C and C-C bonds, highlighting its catalytic versatility. However, structural characterization of BrtB was hindered by its self-proteolytic behavior, complicating efforts to stabilize the enzyme for biotechnological applications. It was also an aim to explore novel chemistry in biosynthetic gene clusters (BGCs) with BrtB homologs. While one pathway was successfully expressed in *E. coli*, resulting in the identification of unique compounds, overlap with independently published findings reduced the novelty of the results. Despite these challenges, the project provided valuable insights into BrtB's function and mechanism, laying a robust foundation for future research and resulting in multiple high-impact publications.

Principal Investigator at CIIMAR: **Pedro Leão**
Leader Institution: **CIIMAR**

Fundação para a Ciência e a Tecnologia

# CIIMAR SEED AND CIIMAR OUT OF THE BOX PROJECTS ENDED IN 2024

CIIMAR created two funding schemes to support the implementation of projects by young researchers - CIIMAR SEED -, and by more experienced researchers - CIIMAR Out of the Box - at CIIMAR. In both typologies, it was compulsory to have researchers from more than two teams to push forward inter-laboratorial and interdisciplinary experiences.

## CIIMAR SEED PROJECTS:

| Title | Acronym | Principal Investigator |
|---|---|---|
| New approaches to assess aquatic toxicity of nanomaterials resulting from trophic transfer | Safenano | Mário Araújo |
| Reliable Pivoting Wave Energy Converter | RPWEC | Gianmaria Giannini |
| *Bacillus* spp. as source of bioactive compounds for aquaculture bacterial diseases control | AquaBakillus | Rafaela Santos |
| Towards an understanding of the selective accumulation and effects of exposure to environmentally weathered plastic particles in Mediterranean mussels (*Mytilus galloprovincialis)* | NaturePlastic | Luiz Barbosa |
| The role of 5-HT system in stress-gut-brain interactions | 5-HT system | Marta Monteiro |
| Discovering Vasco da Gama & Vigo seamounts - expedition to the unknown | GAMA | Ana Mafalda Correia |
| Fish gut-brain axis – a target for health--enhancing strategies | Fish gut-brain axis | Rita Azeredo |
| Sustainability of Seabass: a comparative Life Cycle Assessment of Wild vs Farmed fish | SOS-LCA | Ana Azevedo |
| Mechanism of action elucidation of CIIMAR nature-inspired antifoulants | Antifoulants | Ana Sara Gomes |

| Title | Acronym | Principal Investigator |
|---|---|---|
| Investigation of type II polyketide synthases in cyanobacteria | Type II polyketide | Ana Vieira |
| 2DBD nuclear receptors as targets for Effective Drugs | 2DED | Elza Fonseca |
| Exploring nitrogen cycle modularity and resilience with mixed cultures | NitroCoupling | Miguel Semedo |
| Understanding the spatial organization of the cyanobacterial BrtB pathway | CYANO Click | Amaranta Kahn |
| Ecological Risk Assessment of bioactive metabolites with antifouling activity produced by cyanobacteria for use in aquaculture facilities | ERABiosAFe | Isabel B. Oliveira |
| Cyclicdepsipeptides from cyanobacteria | CYanoCYclic | Sandra Figueiredo |
| Eco-sustainable improvement of habitat restoration methods | EcoReforest | Silvia Chemello |
| Prospecting cellulolytic bacteria to improve the (bio)circularity of natural and semi-synthetic textiles | BactoCell | Diogo Alexandrino |

## CIIMAR OUT OF THE BOX PROJECTS:

| Title | Acronym | Principal Investigator |
|---|---|---|
| Impact of synthetic chelating agents on metal toxicity in deep-sea bacteria | | Diana Resende |
| Computer-Aided Search for Next Generation Antibiotics from Cephalopod's Salivary Glands Proteomes | | Guilhermin Aguero-Chapin |
| Cyanobacterial extracellular vesicles as producer of appetite regulating peptides in fish with applications on aquaculture | | Ralph Urbatzka |
| Cyanobacteria as a novel green route for maximizing the utilization of insect meals as feed ingredient for fish in Aquaculture | Cyano4Feed | Paulo Oliveira |
| A MicroBiome-driven way to assess marine environmental connection and impact on human health | MB WAVE | Joana Almeida |
| Machine Learning Models to Predict Plastic Degrading Enzymes with Application in Blue Biotechnology | | João Carneiro |
| From the sea to the farm using green chemistry principles | SEA2FARM | Isabel Cunha |
| An open-source model for carbon footprint assessment in aquaculture production | OSCAR | Irene Martins |
| Moving Beyond Nature vs. Nurture: Cracking the Code of Social Behavior in Octopuses | | Manuel Nande |
| Marine Actinobacteria as Fluorescent Biotools for textile applications | ActINGlow | Fátima Carvalho |

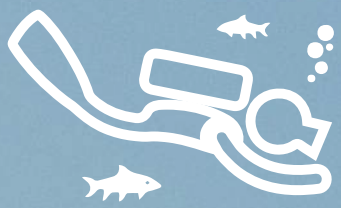
# **RESEARCH PROJECTS** STARTING IN 2024

| Title | Acronym | Funding Programme | Principal Investigator at CIIMAR | Leader Institution |
|---|---|---|---|---|
| Co-Creating Transformative Pathways to Biological and Ecosystem Ocean Observations | BioEcoOcean | Horizon Europe | Isabel Sousa-Pinto | Uppsala Universitet, Sweden |
| Research infrastructure services for sustainable aquaculture, fisheries and the blue economy | AQUASERV | Horizon Europe | Vitor Vasconcelos | CCMAR, Portugal |
| Integrated Research Infrastructure Services for Climate Change risks | IRISCC | Horizon Europe | Vitor Vasconcelos | Luonnonvarakeskus, Finland |
| Aqua Research Infrastructure Services for the health and protection of our unique, oceans, seas and freshwater ecosystems | AQUARIUS | Horizon Europe | Vitor Vasconcelos | Marine Institute, Ireland |
| Integrated Research Infrastructure Services for Climate Change risks | GREASEDLIGHTNING | Horizon Europe | Pedro Leão | CIIMAR |
| Eco-innovative technologies for improved nutrition, sustainable production and marketing of agroecological food products in Africa | INNOECOFOOD | Horizon Europe | António Marques | CIIMAR |
| Reducing bycatch of threatened megafauna in the East Central Atlantic | REDUCE | Horizon Europe | Isabel Sousa-Pinto | Universitat de Barcelona, Spain |
| Advancing area-based management tools to accelerate the protection and restoration of marine biodiversity across the European Sea Basins | BioProtect | Horizon Europe | Joana Xavier | Matis Ohf |
| Lighthouse for Atlantic and Arctic Basin | PHAROS | Horizon Europe | Sandra Ramos | PLOCAN, Spain |

| Title | Acronym | Funding Programme | Principal Investigator at CIIMAR | Leader Institution |
|---|---|---|---|---|
| Twinning deep-ocean exploration and observation capacity for sustainable development | TwinDeeps | Horizon Europe | Joana Xavier | CIIMAR |
| Integrated approaches at local scale for enhancing water reuse efficiency and sustainble soil fertilization from wastewater's recovered nutrients | CIRQUA | Partnership for Research and Innovation in the Mediterranean Area Programme (PRIMA), H2020 | Cristina Calheiros | Democritus University of Thrace (DUTH), Greece |
| Exploring relict deep-sea habitats in Portugal with local fishing communities | DEEPrelicts | National Geographic Society | Joana Xavier | CIIMAR |
| Nature-Based solUtions to protect a temperate coral impacted by extreme climatic events: eFFective consERvation and restoration of Paramuricea clavata in the Parc National Des Calanques | BUFFER | Pure Ocean Foundation | Jean-Baptiste Ledoux | CIIMAR |
| E-DNA, Microbiomes, Photogrammetry and Hormones - Assessment Techniques in Cetaceans | EMPHATIC | Biodiversa+ 2022 Call - BiodivMon | Catarina Magalhães | Institute of Marine Research, Spanish National Research Council, Spain |
| Boosting the resilience of European shellfish production against climate change-related challenges through genetic selection | SHELL-FISHBOOST | SBEP 2023 | Sérgio Boo | CIIMAR |
| Portugal Blue Digital Hub | PBDH | PRR | Ana Paula Mucha | Fórum Oceano, Portugal |
| Key monitoring requirements for effective management of the Portuguese Network of Marine Protected Areas | INDIMAR | PRR | Isabel Sousa Pinto | CIIMAR |
| Shifts in Portuguese Marine Ecosystem Services under Climate Change Scenarios: Impacts on Coastal Tourism | SHIFT-MARES | PRR | Irene Martins | CIIMAR |
| Microphysical and microbiological signatures of precipitation in Antarctica: role of atmospheric rivers and local sources in a warmer climate | MICROANT | FCT | Irina Gorodetskaya | CIIMAR |


INNOVATION

# TECHNOLOGICAL **PLATFORMS**



### ACCESS TO ECOSYSTEMS

CIIMAR Access to ecosystems platform aims to facilitate research activities by sharing its deep and long-term knowledge on the fauna, flora and environmental conditions of the different ecosystems of the North Portuguese coast and by providing logistic facilities and guidance throughout the research activity process. It includes a Scientific Diving Centre, fully equipped to support research at underwater level following European Scientific Diving Standards. CIIMAR ocean research facilities include multi-parametric CTD, underwater deployable light and temperature sensors, water and plankton sampling devices, underwater hydrophone, Van Veen sediment grabs, among other equipment.

*P.I. Francisco Arenas*

### ANALYTICAL LABORATORIES

CIIMAR Analytical Laboratories are well equipped with different analytical equipments, including Segmented Flow Analyzers (SFA), Atomic Absorption Spectrometers (AAS), Liquid Chromatography-Mass Spectrometers (LC-MS/MS) and HPLC, Gas Chromatographs with different detectors (Flame Ionization Detection (GC-FID) and Mass spectrometry), Organic Elemental Analyzer-Isotope Ratio Mass Spectrometer (EA-IRMS), that enables the quantification of a vast array of compounds in different matrices with multiple purposes.

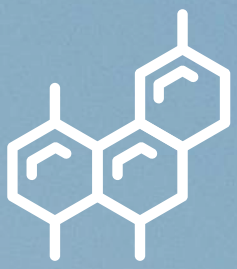
*P.I. Marisa Almeida*

### AQUACULTURE AND ANIMAL EXPERIMENTATION FACILITY

The CIIMAR Aquaculture and animal experimentation facility – Bioterium of Aquatic Organisms (BOGA) - is a fully dedicated and highest standard infrastructure to the experimentation and maintenance of a wide range of aquatic organisms (macro and microalgae, fish, cephalopods and other invertebrates). The facility is licensed and inspected by the Portuguese Authority on the protection of animals used in experimentation with scientific or education purposes (DGAV – Direção Geral de Alimentação e Veterinária).

*P.I. Benjamin Costas Refojos*

## BIODISCOVERY AND OMICS



With an overall goal of providing a sustainable access to the chemical diversity from our ocean, CIIMAR has developed a platform for navigating from biological material to pure compounds. CIIMAR provides large-scale microalgae culture and biomass processing facilities as well as last-generation photobioreactors, a collection of fractionated extracts from marine microorganisms and a growing library of pure compounds. In addition, CIIMAR's Biodiscovery and Omics Platform has the ability to carry out natural products isolation in the miligram scale, structural characterisation and medicinal chemistry iteractions.

*P.I. Pedro Leão*

## BLUE BIOBANK

The Blue Biobank of CIIMAR is a repository of marine biodiversity that includes biological resources with biotechnological potential deposited at three institutional biobanks: the Blue Biotechnology and Ecotoxicology Culture Collection (LEGE-CC), with around 2000 strains of Cyanobacteria and microalgae, the CIIMAR Microbial Culture Collection (CM2C), with around 400 strains of Bacteria and Fungi isolated from environmental samples, and the DEEP-biobank, with around 400 specimens collected at the deep sea. It provides services to the scientific community and the industry. The Blue Biobank of CIIMAR is part of the Portuguese Blue Biobank, a network of national marine biological collections.

*P.I. Vítor Vasconcelos*

## ECOTOXICOLOGY

CIIMAR's Ecotoxicology platform supports research and environmentally sustainable technological development, providing toxicity testing and other ecologically relevant assessments of environmental contamination to researchers, environmental managers, municipalities, wastewater treatment plants and other interested stakeholders. State-of-the-art infrastructures are available for the required testing, which are developed under the guidance of certified personnel.

*P.I. Laura Guimarães*

# TECHNOLOGICAL **OFFERS**

**IN 2024, THE FOLLOWING PATENT APPLICATIONS WERE GRANTED:**

## ANTIMALARIAL AGENT, ITS METHODS AND USES THEREOF

Malarial drug-resistant strains are emerging worldwide, in particular mefloquine and chloroquine-resistant, becoming a significant concern on a global scale. This technology relates to halogenated alkyl-aromatic secondary metabolites, obtained from *Cyanobium* sp. (LEGE 06113), hierridin C, and its derivatives and their use in formulations for treating, preventing, or inhibiting malaria in humans. The technology comprises methods for obtaining the compound from cyanobacterial cultures and methods for chemically synthesizing hierridin C and its derivatives under laboratory conditions.

Inventors: Leão P., Rosário M.M., Costa M., Vasconcelos V., Nogueira F., Domingues V.

Applicants: CIIMAR, University of Porto, Institute of Hygiene and Tropical Medicine, Polytechnic Institute of Porto.

Granted in: Brazil – ref: BR 1120170280159 (this patent was previously granted in Europe, USA and India).

## XANTHONIC COMPOUNDS AND THEIR USE AS ANTIFOULING AGENTS

Biofouling is a severe concern to numerous industrial sectors with costly high maintenance. This solution relates to synthetic small molecules from an important class of heterocyclic derivatives and homologs – xanthonic compounds - and their use as antifouling agents for protection against marine biofouling. These compounds are environmentally friendly and can reduce marine biofouling without inducing toxic effects to target and non-target species.

Inventors: Correia-da-Silva M., Pinto M., Sousa E., Vasconcelos V., Almeida J.R., Geraldes E.

Applicants: CIIMAR, University of Porto, Faculty of Sciences – University of Lisbon.

Granted in: USA – ref.: US 12,030,891 (this patent was previously granted in China).

## ULTRA-VIOLET ABSORBING COMPOUNDS

Ultraviolet (UV) radiation is a harmful and mutagenic component, causing premature skin aging, eye damage, and skin cancer. The patent is related to scytonemin analogs, a novel class of compounds, obtained from natural sources, namely cyanobacteria. These compounds can absorb up to 90% of UV-A radiation and can cover a broader UV to blue light absorption range. The compounds present faint colouration, and some are even colourless, thus being easily incorporated in formulations for cosmetic products, sunscreens or lenses for sunglasses. Furthermore, some of these molecules present interesting antimicrobial properties, acting as multifunctional ingredients.

Inventors: Martins T., Leão P., Reis M., Vasconcelos V., Ramos V., Hassouani M., Sabour B.

Applicants: CIIMAR, University of Porto, Chouaib Doukkali University.

Granted in: China – ref.: CN 113924345.

## HALOGENATED COMPOUNDS AND USES THEREOF

Healthcare-associated infections are the most frequent adverse cases in the healthcare settings worldwide, namely the biofilm-associated microbial infections related to medical devices. This technology relates to novel halogenated fatty acid lactylates, in particular chlorinated fatty acid lactylates, with antimicrobial and antibiofilm activity towards healthcare-associated microbial infections. The novel halogenated fatty acid lactylates – isolated from cyanobacteria - present antibacterial activity against *Staphylococcus aureus* and antibiofilm activity against coagulase-negative staphylococci.

The compounds can be used in medicine with potential applications in the treatment and prevention of biofilm-associated infections.

Inventors: Vasconcelos V., Leão P., Ramos V., Morais J., Castelo Branco R., Oliveira F., Reis M., Soto S., López Y., Cepas V., Lombo F., Villar C.J., Gutiérrez-del-Río I., Redondo-Blanco S., López Ortiz F., Iglesias M.J., Soengas R.G., Rodolfi L., Sampietro G.

Applicants: CIIMAR, University of Oviedo, University of Almeria, Barcelona Institute for Global Health (ISGlobal), Fotosintetica & Microbiologica SRL (F&M), University of Porto.

Granted in: India – ref.: IN 543824, and in China – ref.: CN 114746393.

## URCHIN FEED, METHODS AND USES THEREOF

Sea urchins, such as *Paracentrotus lividus*, face challenges due to overexploitation of their natural stock and seasonal reproductive cycles, which affects the quality and characteristics of their gonads – a prized gourmet seafood. This technology describes a cold extruded, dry and stable sea urchin feed, that enhances gonadal growth and colour of *P. lividus*. The feed can be produced at a large scale and stored for an extended period of time. The ingredients are provided by natural sources including spices, vegetables, seaweeds, microalgae, and synthetic sources.

Inventors: Valente L., Dias J.P., Sá T., Garrido I., Baião L., Guedes A.C., Costa I.

Applicants: CIIMAR, University of Porto, Sparos Lda., ISS Ínclita Seaweed Solutions Lda.

Granted in: Portugal – ref.: PT 117061.

# ENTREPRENEURSHIP

ALGAplus has been dedicated to the controlled and sustainable cultivation of native marine macroalgae from the Atlantic coast, in a system on land as innovative as it is natural, and with organic certification. Located in Ria de Aveiro, within a Natura 2000 area, we are pioneers in Europe in doing so from a circular blue bioeconomy perspective, by integrating organic-certified fish aquaculture throughout the process.
www.algaplus.pt

Cell4Food kickstarts a Cell-Based Agriculture in Portugal. Cell4Food aims to create a network of businesses that will lead the market in the next decade, driven by technological knowledge on Cell-Based protein production. Our goal is to democratize access to new proteins and fibers with origin in cell-based agriculture production. We find many analogies between conventional agriculture and the production of cultivated meat or fish, so the name, Cellular Agriculture, is used.
www.cell4food.eu

Fykia is a young, research-intensive, microalgae biotechnology start-up that develops innovative solutions, based on exclusive microalgae and proprietary technologies to tackle modern problems in healthcare, skincare and agriculture. Fykia is based at CIIMAR's headquarters in the metropolitan area of Porto, Portugal, a bustling hub for algal technology.
www.fykia.pt

Ínclita Seaweed Solutions (ISS) is a Portuguese company that harnesses the power of seaweed to create bioactive ingredients while collaborating with sustainable seaweed producers and applying cutting-edge science to deliver natural and low-carbon products. ISS offers high-quality ingredients to diverse industries such as cosmetic, nutraceutical, petceutical and functional food and beverages.
www.inclitaseaweedsolutions.com

# NETWORKING AND PUBLIC POLICIES

# COLLABORATIVE **& NETWORKS**

**CIIMAR IS A MEMBER OF THE FOLLOWING NETWORKS, INFRASTRUCTURES AND ORGANIZATIONS:**

## EUROPEAN RESEARCH INFRASTRUCTURES

ELIXIR is an intergovernmental organisation that brings together life science resources from across Europe, that include databases, software tools, training materials, cloud storage and supercomputers. The goal of ELIXIR is to coordinate these resources so that they form a single infrastructure, making it easier for scientists to find and share data, exchange expertise, and agree on best practices.

The European Marine Biological Resource Centre (EMBRC) is Europe's research infrastructure for marine biological resources that provide access to marine resources, as well as cutting-edge services and facilities that allow researchers, from both academia and industry, to study the ocean and develop innovative solutions to tackle societal issues. EMBRC facilitates collaboration between researchers and staff at EMBRC marine stations across Europe.

The European Multidisciplinary Seafloor and water column Observatory (EMSO) is a marine multidisciplinary, distributed Research Infrastructure, with the goal to explore, monitor and better understand the phenomena happening within and below the oceans and their critical impact on the Earth. EMSO brings together diverse and numerous scientific partners, Institutes and Research Centres operating in key sites in European seas.

The Microbial Resource Research Infrastructure – European Research Infrastructure Consortium (MIRRI-ERIC) is the pan-European distributed Research Infrastructure for the preservation, systematic investigation, provision and valorisation of microbial resources and biodiversity. The mission of MIRRI is to serve Bioscience and Bioindustry users by facilitating access to a broad range of high-quality bioresources and data in a legal compliant way.

EU-OPENSCREEN is a not-for-profit European Research Infrastructure Consortium (ERIC) for chemical biology and early drug discovery that aims to support the global scientific and economic competitiveness of Europe by delivering public health benefits. EU-OPENSCREEN provides open access to the most advanced screening and medicinal chemistry technologies and expertise.

## INTERNATIONAL COLLABORATIVE ORGANIZATION

The Atlantic International Research Centre is an international collaborative framework to address global challenges and local priorities in the Atlantic Ocean. It promotes an integrative approach to climate and ocean issues in the Atlantic, supported by emerging technological innovations and advances in space, and data science, and through international cooperation.

## SCIENCE-POLICY PLATFORMS

The European Marine Board (EMB) is the leading European think tank in marine science policy. It provides a platform to advance marine research and to bridge the gap between science and policy. The EMB facilitates the transfer of the best scientific knowledge available to the core of marine research policy. This is done by interacting directly with decision makers, and steering discussions between scientists and policy makers on a certain topic. EMB represents the European marine scientific community in different events.

EuroMarine is a member-based network of European marine research organisations and research institutes. EuroMarine's mission is to support the identification and initial development of important emerging scientific topics or issues and associated methodologies in marine sciences, as well as to foster new services relevant to the marine scientific community.

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) is an independent intergovernmental body to strengthen the science-policy interface for biodiversity and ecosystem services for the conservation and sustainable use of biodiversity, long-term human well-being and sustainable development.

The European Platform for Biodiversity Research Strategy is a forum at which natural and social scientists, policy-makers and other stakeholders identify structure and focus the strategically important research that is essential to use the components of biodiversity in a sustainable way; maintain ecosystem functions that provide goods and services; conserve, protect and restore the natural world; and halt biodiversity loss.

The Group on Earth Observations Biodiversity Observation Network (GEO BON) is a global network of researchers dedicated to improving the acquisition, coordination, and delivery of biodiversity information at the global, regional, and national levels. GEO BON and its partners support the monitoring of biodiversity change through the coordination and collaboration among biodiversity observation networks, the generation of Essential Biodiversity and Ecosystem Service Variables, and the development of indicators, forecasts and various information services, making them readily available to all users.

# SCIENCE **POLICY**

For many years, CIIMAR has been contributing to science policies related to ocean and environmental conservation, and to the blue bioeconomy. CIIMAR is a member of several international organisations that are deeply involved in the establishment of science and environmental policies, with some of CIIMAR's members playing key roles in those organisations. Furthermore, in some research projects CIIMAR's researchers are leading work packages focusing on science-policy, aiming at promoting engagement of researcher with policy-makers and other stakeholders, and ultimately contributing to better policies based on the most recent scientific advancements. In some cases, this already resulted in the local implementation of science-based solutions, addressing societal problems that impact nature and the blue economy.

Examples of activities implemented in 2024 in the framework of European research projects include the organisation of events by the Coastal Biodiversity research group that promoted discussion of the main findings of the European project FutureMares: Nature-based Solutions for marine conservation and restoration with policy-makers from the European Commission (DG Environment, DG research, and DG MARE) and other stakeholders, and of the European project Mission Atlantic with Azorean policy-makers and other local stakeholders.

Science-policy meetings were also held in Viana do Castelo to discuss with local stakeholders the main findings of the BlueForesting project, led by the Benthic Ecology and Environmental Solutions research group.

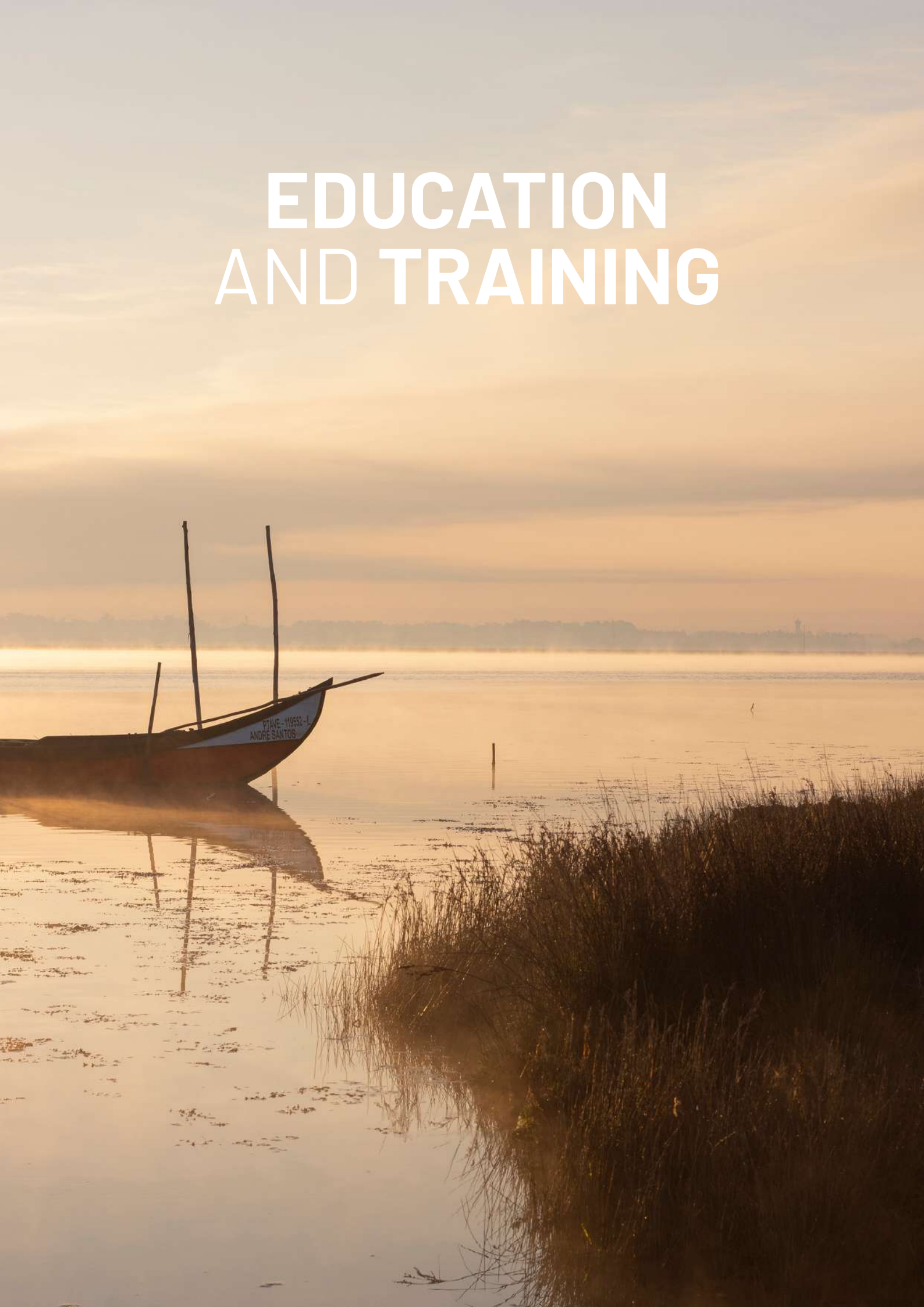
The implementation of a successful bubble barrier that removes plastic from the Ave estuary in 2024 resulted from collaborative work between CIIMAR researchers, the Dutch company The Great Bubble Barrier, the University of Malta, and staff from Vila do Conde Municipality, as part of the European project Maelstrom. CIIMAR organised a session with stakeholders to discuss the main products of this project.

At the international level, CIIMAR researcher Isabel Sousa Pinto participated in two workshops co-organised by the European Commission, and in the framework of the projects MARCO BOLO and DTO-BIOFLOW to discuss how to improve and organise the monitoring of marine biodiversity in Europe. She also presented the marine contribution for the EBOCC: European Biodiversity Observation Coordinating Centre in a meeting to present this plan to the European Commission organised by the EuropaBON project in Brussels, and actively participated in the work to build a European Initiative for Ocean Observations through her work in the steering group of the European Ocean Observation System (EOOS). Furthermore, Isabel Sousa Pinto participated in the MEP panel that provides the scientific overview of the work of the Intergovernamental Science-Policy Platform for Biodiversity and Ecosystem Services (IPBES) and was member of the management committee of its Nexus assessment (Interlinkages among Biodiversity, Water, Food and Health in the framework of Climate change) that was approved by the plenary of Governments in December 2024.

In June 2024, the European Parliament approved a new Nature Restoration Regulation. CIIMAR researchers actively promoted discussions about this topic in Portugal and abroad. A session on science policy in the European Marine Biology Symposium was co-organised by Isabel Sousa Pinto to discuss with policy-makers the existing knowledge and the work needed for the implementation of existing nature-related legislation. In Portugal, a group of CIIMAR scientists joined hands to promote an open letter to the Portuguese Minister for the Environment and Energy, Maria da Graça Carvalho, to encourage the national restoration plan to pay attention to the sea and marine habitats. Hundreds of scientists from all over the country and non-specialists subscribed to this letter.

The year ended with the Portuguese Government nominating CIIMAR Researcher Isabel Sousa Pinto as Chair of the Monitoring Committee of the National Restoration Plan, with the mission of monitoring the Plan's progress and ensuring its proper discussion with all stakeholders.

# EDUCATION AND TRAINING



# BYT– BLUE YOUNG TALENT PROGRAMME

The Blue Young Talent Programme (BYT) is CIIMAR's talent attraction programme in the field of marine and environmental sciences and biotechnology, developed in partnership with industry and SMEs. The programme has three branches: BYT, aimed at undergraduates, BYT+ for master's students, and BYT PhD for PhD candidates. As part of the programme, selected students carry out their work in a CIIMAR research team, with a research grant, and benefit from the training activities offered by the programme.

The 2023/24 academic year was the 11th edition of the BYT programme, the 6th edition of BYT+, and the continuation of the 1st edition of BYT PhD, which began in 2020. Fourteen bachelor's and 56 master's degree proposals were submitted by CIIMAR researchers; of these, 8 BYT and 8 BYT+ internships were selected (with 6 scholarships in each programme).

In the 2023/2024 edition, students had the opportunity to take part in 5 training workshops, namely in Communication and Dissemination, Working Status, Scientific Writing, Career Perspective, and a visit to Next Generation Chemistry (NGC)-KOD Bio company, and 2 science dissemination events, Mostra U.Porto and the Biochemistry Days. The academic year concluded with each student publicly presenting their research projects at the final BYT event that included representatives of the organisations that funded the grants, namely the Amadeu Dias Foundation and Soja Portugal, and the partners, the University of Porto and the KOD Bio & Next Generation Chemistry.

Since its first edition, the BYT programme hosted 92 students from 7 undergraduate degrees at the University of Porto, 53 students from 23 master's degrees at Portuguese universities, and 15 PhD students from 5 different PhDs programmes.

BYT CIIMAR BLUE YOUNG TALENT

# ADVANCED **TRAINING**

As part of its mission to thrive excellence in science, CIIMAR facilitates high-quality advanced training in its laboratories and technological platforms. During 2024, 35 courses in scientific, technical, or transversal skills were organised by CIIMAR researchers or staff, reaching out to 760 participants, out of which 139 were foreign.

Furthermore, the Centre is a host institution for Master's and PhD students interested in conducting research programmes in marine and environmental sciences. It also hosts students undertaking work for a Bachelor's thesis. In 2024, 44 PhD candidates and 133 MSc students successfully completed their PhD and Master respectively.

In 2024, a dedicated office for advanced training and career management was created. It aims to coordinate the vast offer of advanced courses that are available to the community, and to support students, early and senior researchers in their career development.

**STUDENTS THAT FINISHED THEIR PHD AND MASTER THESES WERE ENROLLED IN:**

## PHD CANDIDATES:

PhD programmes

**22**

Portuguese Universities

**8**

International Universities

**3**

## MASTER'S STUDENTS:

MSc programmes

**53**

Portuguese Universities

**7**

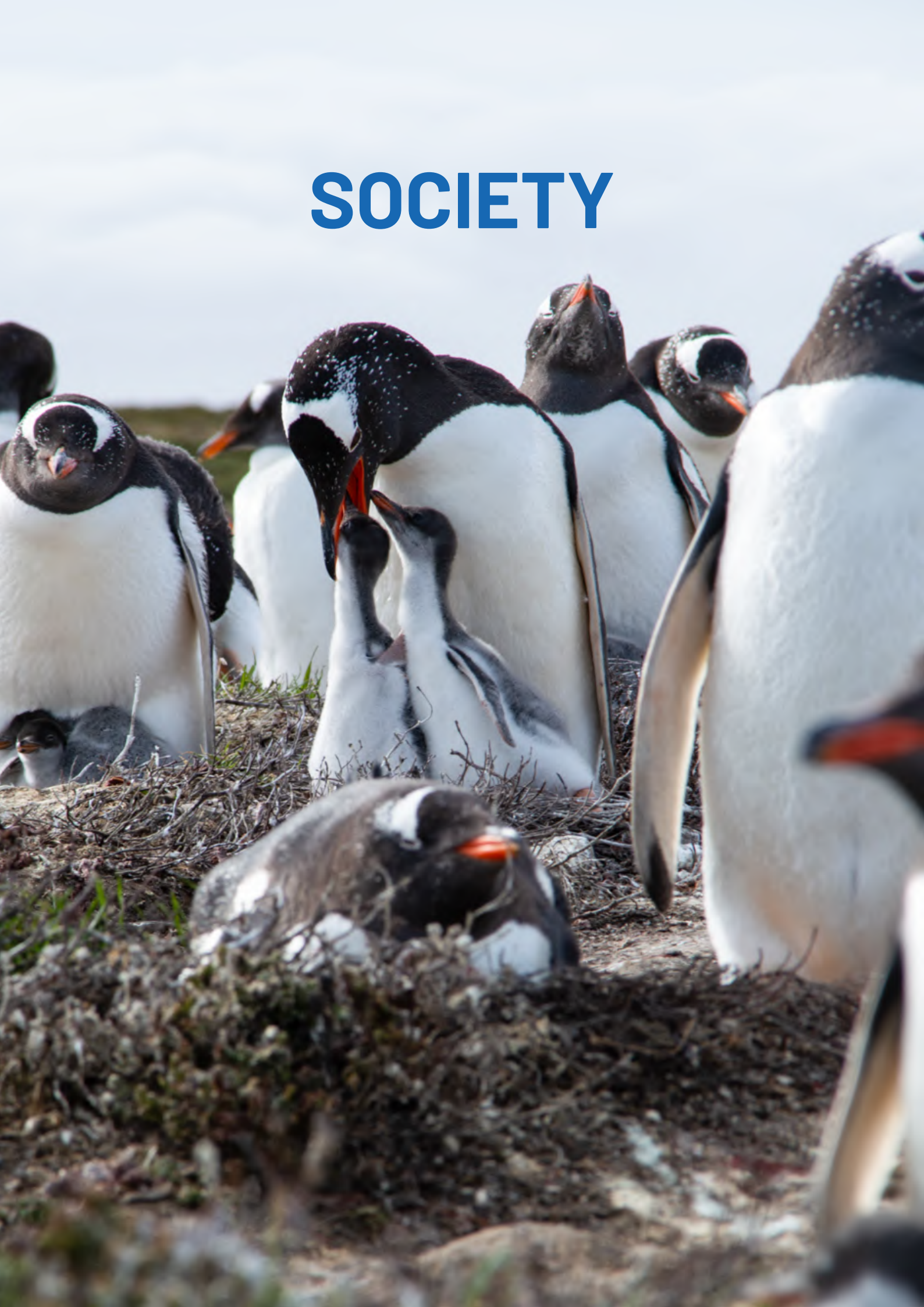
Portuguese Polytechnics

**2**

International Universities

**10**

# SOCIETY



# PUBLIC ENGAGEMENT IN SCIENCE

CIIMAR is dedicated to promote Ocean Literacy and public engagement in marine and environmental research-related topics. To achieve this, CIIMAR runs a public engagement programme targeting different audiences. This programme is led by CIIMAR's Image, Communication and Outreach Office, and benefits from a very active community of scientists, who also organize and participate in several science communication and education initiatives, within the scope of their research projects or as part of their mission to promote science in society. Moreover, CIIMAR coordinates two dynamic Environmental Monitoring and Interpretation Centres (CMIA, acronym in Portuguese) in Vila do Conde and Matosinhos, which run independent programmes that further promote science in society.

The Communication office is responsible for all the institutional communication, including website, press and social media. In 2024, the press office worked closely with the media, sharing a steady stream of stories - including collaborative new articles with other entities - that showcased CIIMAR's research and initiatives, generating widespread visibility and interest. In addition to Facebook, Instagram, LinkedIn, Twitter, in 2024, CIIMAR joined Bluesky social channel. Engagement on these platforms has been consistent, with a growing number of followers actively interacting with the content.

The Communication office also runs an outreach programme targeting different audiences. A comprehensive educational programme was implemented in 2024, with activities for students from primary school to high-school and teachers, and with protocols established with Matosinhos City Hall and with different schools through their Ciência Viva Clubs. The Outreach programme includes online and face-to-face initiatives, from science cafés, to public talks and debates, and the organization or participation in public events. In 2024, we continued our partnership with Serralves Foundation and Parque Biológico de Gaia to further engage society in science. The 2024 edition of the iconic CIIMAR Open Day showcased CIIMAR research to about 17 000 visitors. CIIMAR scientists and science communicators also joined Mostra U. Porto, European Researchers Night, and Encontro Ciência 2024.

With our coordinated actions, we aim to empower citizens with tools to take action in protecting the ocean, estuarine and fresh-water ecosystems.

# CMIAS

The Environmental Monitoring and Interpretation Centres (CMIAs, acronym in Portuguese) in Matosinhos and Vila do Conde were established under a protocol between each City Council and CIIMAR. CIIMAR is responsible for the scientific coordination of both. These local centres are dedicated to scientific dissemination and environmental education, with a focus on the Ocean and the Environment. Both CMIAs are engaged in environmental monitoring and research, environmental education, science communication and outreach, and collaborate with the Blue Flag Programme, being CMIA de Vila do Conde a Blue Center. Their action includes activities related to water quality assessment, monitoring on marine and riverine litter, as well as the monitoring of fauna and flora associated to different ecosystems. Additionally, they run an extensive programme of educational initiatives, which encompasses exhibitions, lectures, workshops, field trips, pedagogical activities, and training activities in schools.

## CMIA VILA DO CONDE

*Scientific Coordinator:* Cristina Calheiros

## CMIA MATOSINHOS

*Scientific Coordinator:* Sandra Ramos

| NUMBER OF PARTICIPANTS | TYPE OF ACTIVITY | NUMBER OF PARTICIPANTS |
|---|---|---|
| 25,714 | Exhibitions | 5,091 |
| 4,759 | Educational Activities | 125 |
| 7,948 | Talks and Seminars | 991 |
| 245 | Training Courses and Workshops | 2,129 |
| 539 | Environmental monitoring, field trips, interpretative trails, and/or beach clean-ups | 1,005 |
| 17,803 | Outreach events | 52,501 |

# SOCIAL AND ENVIRONMENTAL RESPONSIBILITY

Sustainability is central to CIIMAR's culture, reflected in our research, mission, and actions supporting numerous UN Sustainable Development Goals. This commitment is outlined in our annual Social and Environmental Responsibility Plan, coordinated by the Environmental and Social Sustainability Office, with the support of numerous CIIMAR offices and informal groups.

In 2024, new shared community spaces like the "Ecological Dishwashing Station" and "Tea Corner" were introduced, along with dissemination campaigns to promote recycling and reduce waste. CIIMAR GreenLab advanced efforts to reduce our labs ecological footprint. Campaigns like "Precious Racks", second-hand "Circular Markets", and the "Book Sharing" initiative promoted circularity and sustainable consumption.

CIIMAR organised regular leisure and wellness activities, including a collective bike ride for World Bike Day, biweekly yoga classes, football, volleyball and padel groups, and participation in the Porto de Leixões and São João races, a football tournament, and two trail competitions. Our educational programmes and campaigns engaged schools and the general public through lectures, practical activities, beach cleanups, pond creation, field trips, traveling exhibitions, seminars, and media outreach.

**13** Created and 26 restored small waterbodies for biodiversity in public spaces and schools

**2** New community spaces created "Ecological Dishwashing Station" and "Tea Corner"

**10** Kg/month of pipette tip boxes plastic recycled

**100** Second-hand items circulated within the community

**92** Community sports events

**336€** 179 items of clothes, 115 essential goods items donated to local charities in the "Circular markets"

# ACKNOWLEDGEMENTS

**We are grateful to everyone at CIIMAR – researchers, students and staff - who supplied information, text and images used in this report.**

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**PHOTOGRAPHY**
Images used in the report's cover and tabs are from the 2024 CIIMAR's Scientific Photography Contest:

**Cover – "Calming Tension" by Anxo Gende.**
Caption: A common dolphin just before breaking the surface tension of the water to come up for air. The animal appears to have its eyes closed, giving it a calm look. This photo was taken under a marine mammal survey in Galician waters, on board the "Chasula".

**Research tab – "Sampling the mesopelagic" by Ricardo Matias.**
Caption: The deployment of an RMT8 (rectangular midwater trawl) near the Antarctic Peninsula's coast on board of the British Antarctic Survey scientific vessel, RRS James Clark Ross. The sampling of mesopelagic organisms occurs at night when they move to productive surface waters, since during the day they move to higher depths to avoid predators.

**Innovation tab – "The White Fungus Mountain" by Fábio Faria.**
Caption: Macro photography of a Petri plate containing a fungus strain of CIIMAR Microbial Culture Collection (CM2C). The intricate details with ridges and valleys of the fungus growth create an interesting visual texture, reminiscent of a snowy landscape seen from above.

**Networking and Public Policies tab - "Life Amongst Relics" by Daniel Despujols.**
Caption: A coral skeleton rests upon a shelf, its branches reaching silently into the air. A small spider weaves delicate strands of silk across the branches of the coral. Despite its quiet scene, the image speaks volumes: although the coral has died, nature found a way to flourish and persist.

**Education and Training tab – "Sunrise on Ria de Aveiro" by Aires Duarte.**
Caption: As part of Aires Duarte's PhD, he frequently goes to Ria de Aveiro, where he has the chance to see this spectacular landscape.

**Society tab - "It tastes fishy" by Ricardo Matias.**
Caption: A gentoo penguin feeds her two fledgling chicks with the freshest catch. This picture was taken on Christmas Day in 2019, near Bertha's Beach in the Falkland Islands.

Images used in other pages of the report are from the Image, Communication and Outreach Office, and from members of the research groups or of the illustrated research projects.

More information about CIIMAR's activities in:
www.ciimar.up.pt

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