SPANISH PRESIDENCY COUNCIL OF THE EUROPEAN UNION

EurOCEAN 2023
ONE OCEAN ONE VOICE

We have One Decade to accomplish One Mission.
We need One Voice to achieve the One Ocean we want.

EurOCEAN 2023 conference proceedings

Photo credit: Sheila Heymans

2021 2030 United Nations Decade of Ocean Science for Sustainable Development

EU MISSIONS
RESTORE OUR OCEAN & WATERS

EurOCEAN 2023
ONE OCEAN ONE VOICE

SPANISH PRESIDENCY
COUNCIL OF THE EUROPEAN UNION

10-11 October 2023
Auditorio y Palacio de Congresos Mar de Vigo
Vigo, Galicia, Spain

EurOCEAN 2023 conference proceedings

Edited by Fernanda Bayo Ruiz, Ángel Muñiz Piniella, Britt Alexander, Paula Kellett, Ana Rodriguez Pérez, Jana Van Elslander, Sheila J. J. Heymans, with contributions from the EurOCEAN 2023 co-organizers, moderators, speakers and panelists.

Conference co-organized by the European Marine Board (EMB), the Technology Centre of the Sea (CETMAR), the Spanish National Research Council (CSIC) through the Spanish Institute of Oceanography (IEO-CSIC) and the Institute of Marine Research (IIM-CSIC), the European Commission, the Joint Programming Initiative on Oceans (JPI Oceans), the European Marine Research Network (EuroMarine), the European Global Ocean Observing System (EuroGOOS) and the European Centre for Information on Marine Science and Technology (EurOcean).

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The EurOCEAN 2023 conference was an official event of the Spanish Presidency of the Council of the European Union (EU). The EurOCEAN 2023 conference also supported the EU Mission: Restore our Ocean and Waters by 2030 and the UN Decade of Ocean Science for Sustainable Development.

More information at http://www.euroceanconferences.eu/

EU MISSIONS
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#EUmissions #HorizonEU #MissionOcean

2021 2030 United Nations Decade of Ocean Science for Sustainable Development

https://spanish-presidency.consilium.europa.eu/en/events/eurooceans-conference-one-ocean-one-mission-one-decade-one-voice

SUMMARY of the EurOCEAN 2023 Conference

EurOCEAN 2023 took place around the middle of the decade that was declared the UN Decade of Ocean Science for Sustainable Development (Ocean Decade), and the UN Decade of Ecosystem Restoration. It also took place at the mid-point of the European Union's Horizon Europe Framework Programme and the EU Mission: Restore our Ocean and Waters (Mission Ocean). These two political drivers have set up ambitious objectives to be achieved by 2030 to restore our Ocean and waters, and to realise the science we need for this purpose. As such, the EurOCEAN 2023 conference highlighted their achievements, as well as the actions that are still needed for the objectives of the Mission Ocean and the Ocean Decade to be realised.

The conference highlighted how the objectives of the Mission Ocean and the Ocean Decade dovetail with the environmental policies in Europe. It showcased how we can enable ecosystem-based management for conservation and fisheries, how to address pharmaceutical pollution coming from land, how we can transform our ports, how to ensure that Ocean knowledge is incorporated in the Digital Twin Ocean, and how we can enable coastal resilience and enhance humanity's relationship with the Ocean.

EurOCEAN 2023 was the first time that the European Marine Board invited other marine science networks to co-host the conference, and by doing so we were able to achieve the One Voice that we need to accomplish the One Mission we have for the One Ocean we need. The conference ended with the signing of the Vigo Declaration, by the Chairs of all the networks, highlighting that European marine scientists are speaking with One Voice. The Declaration was also made available online for others to sign: https://www.euroceanconferences.eu/form/vigo-declaration

We have One Decade to accomplish One Mission. We need One Voice to achieve the One Ocean we want.

FOREWORD

We, Gilles Lericolais (Chair of the European Marine Board until April 2024) and Fiona Grant (current Chair of the European Marine Board) are delighted to introduce the EurOCEAN 2023 conference report. This publication documents the contributions and discussions that took place in Vigo, Spain on 10-11 October 2023. This 10th EurOCEAN conference, as the nine before, provided a unique opportunity for scientists, policymakers and other stakeholders to discuss the challenges of our Ocean and opportunities that are provided by the marine research community.

EurOCEAN 2023 was a collaborative venture with the Directorate-General for Research and Innovation from the European Commission, but also with the Secretariats of other European marine networks, including JPI Oceans, EuroMarine, EurOcean and EuroGOOS. It highlighted the links between the UN Decade of Ocean Science for Sustainable Development, and the EU Mission: Restore our Ocean and Waters. The conference ended with the signing of the Vigo Declaration, which highlighted that all the marine scientists represented by these networks stand ready to work together with policymakers to ensure that the Mission and the Decade are a success.

During the conference the European Marine Board also launched two new documents: Position Paper No. 27 on Building Coastal Resilience in Europe, and Policy Brief No. 11 on Blue Carbon: Challenges and opportunities to mitigate the climate and biodiversity crises.

Since the 2004 EurOCEAN conference in Galway, EurOCEAN conferences have delivered a Declaration - an agreed position representing the combined voice of the marine science and technology community - which plays a central role in advancing marine science and science policy agendas in Europe. In 2023, it was the Declaration of Vigo.

We would like to thank the members of the EMB Secretariat, Executive Director Sheila Heymans, Jana van Elslander, Britt Alexander, Ana Rodriguez, Fernanda Bayo Ruiz, Paula Kellett, and - especially - Ángel Muñiz Piniella, for their hard work in organising this conference. We thank the Spanish Presidency, CETMAR, CSIC, IEO-CSIC, IIM-CSIC, and the Horizon 2020 Innovation Action Projects EuroSea and EcoScope for financial support and for their help in co-organising the conference. We also would like to thank our colleagues in the Healthy Oceans and Seas Unit of the European Commission, Directorate-General Research and Innovation, for their significant financial support and input in the conference.

EurOCEAN
ONE OCEAN ONE VOICE 2023

Vigo Declaration

The Vigo Declaration was signed on 11 October 2023 at the EurOCEAN 2023 Conference (10-11 October 2023, Vigo, Spain).

Speaking with One Voice to achieve the One Ocean we want.

Climate change, pollution and biodiversity loss are pressing issues for humanity. Considering that the Ocean has long been impacted by human activities, and that all people depend directly or indirectly on the Ocean, we call on Europe to take responsibility and show leadership to live within Ocean and planetary boundaries, promote greater social and economic justice and ensure that all society benefits from our One Ocean. **The European marine science community will work together to provide transdisciplinary, science-based policy advice to all levels of governance (from local to international).**

Current geopolitics call for open strategic autonomy to ensure the resilience of the European Union (EU) through the achievement of long-term objectives of a greener, more digital, and more cohesive Europe. However, there is one global Ocean, connecting all areas of the planet. Actions taken in Europe or elsewhere have an impact both locally and globally. Thus, we must collaborate globally and act responsibly to ensure that we sustainably manage our interactions with our Seas and the global Ocean, while ensuring global equity and sustainability. **Equity and inclusion should be at the core of all actions, ensuring that the best decisions are made to leave no one behind.**

We, the European marine science community, represented at the EurOCEAN 2023 Conference, acknowledge all efforts to advance knowledge of our Seas and Ocean gathered through international, EU, regional, Member and Associated States' research and management initiatives. We support the strategic objectives of the EU Mission: Restore our Ocean and Waters by 2030 and commit to engaging with its implementation and will strive to deliver the science we need for the Ocean we want under the United Nations Decade of Ocean Science for Sustainable Development (2021-2030).

Achieving climate neutrality, reducing pollution and restoring nature will not be possible without Ocean knowledge. We call for:

- **INTEGRATED LAND-SEA POLICIES AND MANAGEMENT**: European, regional, and national governments should ensure that the Integrated Maritime Policy is aligned with land policies for coherent, adaptive management of socio-ecological systems that address multiple-stressors including pollution, climate change impacts and biodiversity loss.

- **SUSTAINED AND BETTER COORDINATED OCEAN OBSERVATION**: Policy makers and science funders at all levels of governance should recognise and support the essential role of coordinated Ocean observation to deliver Ocean knowledge, and an open, accessible, and fit for purpose European Digital Twin of the Ocean.

- **COMMITED CITIZENS**: Science funders and scientific institutions should support all forms of citizen engagement including Ocean Literacy, science communication, citizen science, the arts, and sporting events that focus on Ocean Literacy, to ensure citizen's empathy towards the Ocean and engagement in Ocean sustainability solutions.

To speak with One Voice to advance consensus on Ocean sustainability and provide transdisciplinary, science-based policy advice to all levels of governance, marine science and maritime communities will work together to identify common goals, research objectives, methodologies, and technologies to ensure that data collection take place at the appropriate time and spatial scales, including in Areas Beyond National Jurisdiction. Speaking with One Voice highlights the need for all Ocean scientists to work towards a common goal, as highlighted in the United Nations Decade of Ocean Science for Sustainable Development (2021-2030) and the EU Mission: Restore our Ocean and Waters by 2030. We welcome the vision of the EU's Sustainable Blue Economy Partnership and support the European Commission's efforts to ensure that Europe's Blue Economy is ecologically and socially sustainable within and beyond EU waters. Decarbonising our economy should not create sustainability problems nor damage vulnerable areas, ecosystems, or sectors within or outside Europe, and the extraction of raw materials outside of European waters should not disadvantage global citizens or cause any further biodiversity loss in the Ocean. We will work to co-create the solutions with all stakeholders.

To ensure integrated and adaptive land-sea policies, management should take place across socio-ecological systems at the land-sea interface as done in Integrated Coastal Zone Management (ICZM). We welcome the leadership shown by the EU in setting ambitious targets for achieving Good Environmental Status and for protecting and restoring marine ecosystems. However, managing our marine and terrestrial systems separately creates a discontinuity that hampers the resilience of coastal communities and systems. All aspects of land-sea-society interactions should be holistically included in EU policies. This will require greater support for social sciences and humanities research in relation to our interaction with the marine environment.

To obtain sustained and better coordinated Ocean observation, we call on the next European Commission to deliver the Ocean observation – sharing responsibility initiative as a priority to enable the objectives of the European Ocean Observing System (EOOS) Framework and support the Global Ocean Observing System (GOOS). **To ensure that the European Digital Twin of the Ocean** (DTO) is fit for purpose, open, and accessible to all, we call on its developers and the European Commission to ensure that it is co-designed with stakeholders and adequately supported by Ocean data, managed according to the FAIR and CARE principles. The DTO will only be fit for purpose if its models are initialized and validated with sufficient observations and monitoring data at the appropriate temporal and spatial scales. Therefore, while the DTO is significant, it must not diminish the critical task of tackling ongoing obstacles that impede the coordination and sustained operation of the Ocean and Coastal observation systems, along with the sustained monitoring of Essential Ocean Variables.

To ensure committed Ocean citizens, we call on funders to recognize and fund citizen engagement activities, such as Ocean Literacy, science communication, citizen science, the arts and sporting events that focus on Ocean Literacy. The EU Missions offer an excellent opportunity to highlight the fundamental importance of the Ocean as part of the planetary system to achieve the Sustainable Development Goals, also highlighted in the United Nations Decade of Ocean Science for Sustainable Development (2021-2030). The skills needed for co-creation, science communication and citizen engagement are critical for raising public awareness and empathy towards the challenges facing the Ocean and society and should be recognised and rewarded in academic careers.

If we can agree on a common goal, speak with One Voice, promote a system approach, collect sufficient Ocean data and co-design the DTO to be fit for purpose, we will be closer to managing our interactions with the Ocean to be sustainable.

INTRODUCTION

EurOCEAN conferences are major European marine science-policy conferences organised every 4-5 years. They provide a forum for the marine and maritime research community and wider stakeholders to interface with European and Member State policymakers and strategic planners, to discuss policy issues in marine science. EurOCEAN conferences started in the 1990s, with previous editions held in Brussels (1993), Sorrento (1995), Lisbon (1998), Hamburg (2000), Galway (2004), Aberdeen (2007), Ostend (2010), Rome (2014), Paris (2019), and most recently, Vigo (2023). Since 2000, EurOCEAN conferences are organised by the European Marine Board and the European Commission in partnership with a local host. The 2023 EurOCEAN conference was the tenth conference in the series and took place 30 years after the first EurOCEAN conference.

The EurOCEAN 2023 conference took place on 10-11 October 2023 as an in-person event at the Auditorio y Palacio de Congresos Mar de Vigo, Vigo, Galicia, Spain. The aim of the conference was to highlight the synergies between the EU Mission: Restore our Ocean and Waters, other EU research and innovation, and management initiatives, and the UN Ocean Decade. EurOCEAN 2023 attracted marine scientists, policymakers, science stakeholders and communicators, maritime industry and private sector representatives, and European and national decision-makers and programme managers, i.e. those that set, manage and implement the marine science agenda.

Since EurOCEAN 2019, an **empty chair** has been placed on stage during the panel discussions to allow participants to contribute and discuss with the experts on stage. This approach was welcomed by the EurOCEAN 2023 participants as a way to break the barrier between the panellists and the public, and many participants came up to ask their questions and to make comments.

EurOCEAN 2023 in numbers

357 participants registered
207 organisations registered
62 countries represented in the registrations
53% female participants registered
52% female moderators, speakers and panelists

This conference report provides a summary of the main highlights and key messages delivered by the speakers and panellists at the EurOCEAN 2023 conference. All recorded sessions are available to watch via a dedicated playlist on the EMB YouTube Channel: https://www.youtube.com/playlist?list=PLXKTm_QGiR-jd-TB-pk7sahTEwOe8MFIi.

The presentations, Declarations and reports of all EurOCEAN conferences are available on the EMB website: http://www.euroceanconferences.eu.

Tuesday, 10 October 2023

Welcome and opening addresses

Gilles Lericolais (Chair of the European Marine Board and Advisor of Ifremer CEO) formally opened the EurOCEAN 2023 conference and welcomed the participants on behalf of the 38 Member Organisations of the European Marine Board. He announced that this edition had a double celebration, as the first EurOCEAN conference took place 30 years ago in 1993, and this was the tenth conference in the series. He highlighted that since the previous conference in 2019, key initiatives such as the EU Mission: Restore our Ocean and Waters (Mission Ocean) and the UN Decade of Ocean Science for Sustainable Development (Ocean Decade) have set ambitious objectives to be achieved by 2030, and those have triggered many activities. He emphasised the motto of the conference 'One Ocean, One Voice' and invited the participants to engage in the discussions throughout the conference on how the marine science community can work together and contribute better to societal needs. He announced that the Vigo Declaration would be signed at the end of the conference as a call to action to achieve the Ocean we want. He then invited opening remarks and key notes from the speakers of the opening session.

John Bell (Director of Healthy Planet, DG Research and Innovation, European Commission and Deputy Mission Manager, EU Mission Ocean) provided a video message where he emphasised the fundamental role of science to understand the impact of climate change on the Ocean and the planet in general. He highlighted that the state of the Ocean will determine the future of Europe, and that this decade will be the one in which humans make peace with nature. He asked the scientific community to give confidence to policymakers, hope to citizens, space for innovation and respect to nature. He then highlighted the Mission Ocean and pointed to the role of the Mission Lighthouses and Ocean basins to find social, business and governance solutions. He listed the contributions of Spanish institutions linked to the Mission through Horizon 2020 and Horizon Europe. He continued by saying that Spain has a leading role in the Atlantic maritime strategy and will host the 2024 Ocean Decade conference. He finalised with a call to the marine science community to work with other actors to let them become active players, and to shift from the demonstration phase to large-scale deployment of solutions to restore the health of the Ocean and waters.

Nuria Rodríguez (Municipal Councillor for Environment of the City of Vigo, on behalf of Abel Caballero, Mayor of Vigo) welcomed the participants to Vigo, and expressed that the Municipal Council was happy to host such an event in the city. She highlighted that Vigo has hosted many important conferences and events in the past and emphasised the role of the city as European capital for fisheries. She underlined that science must be the pillar of decision-making in fisheries and Ocean management.

Alfonso Villares (Regional Minister of the Sea, Xunta de Galicia, and Rep. Board of Trustees, Technology Centre of the Sea (CETMAR)) started by reminding the participants that the circular economy was practiced historically in all household regions like Galicia, as everything was used to their full potential in periods of shortage. He underscored that the Regional Government of Galicia supports Ocean research. He expressed support for fisheries in the region, as many men and women make sure it is sustainable and respectful to the environment, as their livelihoods depend on it. He stated that there is a lot of work to do for the Ocean, together with science, culture and heritage, but also with passion.

Gonzalo Arévalo (Director General for Research Planning, Spanish Ministry of Science and Innovation) on behalf of Diana Morant, Spanish Minister of Science) stated that it was an absolute pleasure for the Government of Spain to host this event under the Spanish Presidency of the Council of the EU. He listed the four priorities of the Presidency that aligned with the conference topics, namely the industrialisation of the EU and its strategic autonomy, advancing in the green transition, promoting social and economic justice, and strengthening European unity. He also highlighted the importance of attracting talent to the EU to maintain competitiveness. He quoted the Global Ocean Science Report in its recognition of Ocean science as big science, and reminded the participants of the Ocean challenges ahead, noting that science can inform policymakers to help to address them. He closed by underlining that Spain is committed to Ocean research.

José María Martell (Vice-President of Scientific and Technical Research, Spanish National Research Council (CSIC)) acknowledged the long-term cooperation between many organisations to achieve this conference. He highlighted the Ocean Decade as a key instrument to catalyse new opportunities and deliver science-based solutions to achieve the Sustainable Development Goals of the UN 2030 Agenda. He also pointed to the role of the Spanish National Research Council to provide Ocean knowledge, and the role of the Spanish Institute of Oceanography to provide scientific advice to governmental authorities. He closed by stating that science should be independent, and that the sustainability of the Ocean is the sustainability of our planet.

The welcome session ended with the European Marine Board Young Ambassadors Juliette Aminian Biquet, Alexandra Hahn, Riwan Leroux & Alfredo Garcia de Vinuesa providing an keynote where they highlighted the outcomes from the first EMB Early Career Ocean Professional (ECOP) Network Forum (8-9 October 2023) (report available here: https://www.euroceanconferences.eu/emb-ecop-network-forum) and emphasised the need and value of engaging ECOPs in marine science policy decision-making processes. They pointed out that it is difficult for ECOPs to be involved in policymaking as they do not get taught how to, and the uncertainty of their positions challenge their ability to engage and communicate. They proposed organising transdisciplinary forums that include early career policy makers and/or incentivising the involvement of ECOPs in projects. They highlighted that they are motivated to make their research impactful and encouraged everyone to involve ECOPs in working groups and advisory committees. They also noted that they could help management achieve gender and diversity balance if they are included. They emphasized the need to act together for the future of the Ocean and that they are part of the One Voice to achieve the One Ocean we want.

Session 1: Enabling ecosystem-based management for fisheries and conservation

The first session of the conference was moderated by Susan Steele (Executive Director, European Fisheries Control Agency, EFCA) and co-organised by the European Marine Research Network (EuroMarine). Susan Steele introduced the role of EFCA which promotes standards and coordinates fisheries control under the EU Common Fisheries Policy. She noted that policies do not become a reality unless they are regulated and actively controlled. She thanked the scientific community for the knowledge they provide to policymakers to develop strong legislation, which the EFCA then enforces, and ended by highlighting the need for ecosystem-based management to ensure sustainable fisheries in the future.

The first speaker, Debbi Pedreschi (Senior post-doctoral researcher at the Marine Institute of Ireland) gave a video talk on integrated ecosystem assessment for ecosystem-based fisheries management. She explained that there is no universally agreed definition for ecosystem-based management, even though it is mandated by many policies. She highlighted that ecosystem-based fisheries management should be a whole system approach, including society, but society is diverse in what they think is achievable. She emphasised that integrated ecosystem assessment could be used to achieve ecosystem-based fisheries management, as is done in the Celtic Sea under the Mission Atlantic Project[1]. She mentioned that if environmental drivers are not taken into consideration for single species fisheries advice, there is a risk of getting it wrong. She explained there will be increasing demand for ecosystem-based management, and that more organisations will be adapting integrated ecosystem assessment processes to address this. She concluded that strategic investment is needed to support dedicated multi-disciplinary assessment teams, facilitate meaningful stakeholder engagement, provide advice for ecosystem-based management, and be consistent in its application.

The second speaker, Pablo Martín-Sosa (Researcher at the Spanish Institute of Oceanography) gave a presentation on monitoring of Good Environmental Status and sea floor integrity under the scope of the EU Marine Strategy Framework Directive (MSFD). He highlighted that to achieve the objective of protecting at least 30% of the Ocean will require conciliation between biodiversity, fisheries and climate change. He explained that the Spanish Institute of Oceanography conducts the monitoring for the descriptor on sea floor integrity for the MSFD to map the anthropogenic disturbances, mainly fisheries, and the distribution of the species on the sea floor. He ended by saying that all the information gathered is subsequently put together to make a proposal to the Spanish environmental administration for zoning areas according to different uses and to determine no-take areas in Marine Protected Areas (MPAs).

Susan Steele thanked the speakers and introduced the panellists taking part in the discussion.

Kenn Skau Fischer (Executive Committee Chair of the North Sea Advisory Council) introduced the role of the North Sea Advisory Council and explained that it was set up to gather advice, stakeholder perspectives and build consensus on how to take issues forward for the EU Common

1 https://missionatlantic.eu/

Fisheries Policy. He mentioned that the members of the Advisory Council try to bring in the latest scientific data and knowledge to the discussions.

Patrizio Mariani (Professor at the Danish National Institute of Aquatic Resources and Scientific Coordinator, and president of EuroMarine) reiterated the message of Debbi Pedreschi that integrated ecosystem assessment can be a process to enable ecosystem-based fisheries and MPA management, as used in the Mission Atlantic Project that he is coordinating. The integrated ecosystem assessment process, he explained, could inform not only decision-making processes, but could also benefit science as it provides knowledge from industry, management and indigenous populations, especially for data that can't be observed or extracted by scientific methods.

Anastasiya Laznya (Researcher at the Stockholm Resilience Centre in Sweden) explained that her research focused on resilience of Black Sea ecosystem services in the face of multiple stressors. She highlighted that the Black Sea is data-poor, so assessments need to count on qualitative and quantitative data to apply a holistic approach. This data, she clarified, may come from experts, stakeholders or local populations.

Susan Steele then opened the Q&A session, with the possibility of participation from the audience using the empty chair on stage. The following questions were asked.

- How do you include public and stakeholders' perspectives to make better and realistic policies?

Kenn Skau Fischer replied that a key aspect is the balance in the degree of everyone's involvement in the discussion, as some discussions tend to focus on media headlines and political profiling, and not on constructive debates for providing data and best available knowledge to the decision-making processes.

- Could you explain the role of North Sea Advisory Council in ensuring sustainable fisheries and how it enables ecosystem-based fisheries management?

Kenn Skau Fischer explained that the North Sea Advisory Council, along with other councils, was established 20 years ago as part of the EU's Common Fisheries Policy. These advisory councils focus on specific topics or areas, such as the North Sea, pelagic stocks or markets. Their goal is to unite genuine stakeholders — those with a strong interest in the state of the sea and fisheries management — to facilitate discussions based on the latest knowledge and scientific data. During meetings, the aim is to reach consensus whether participants represent fisheries, NGOs or scientific communities.

- Are you aware of any news for enabling management of ecosystem-based fisheries and marine protected areas? How do you take different perspectives into acccount?

Patrizio Mariani said that the Integrated Ecosystem Assessment (IEA) approach integrates different perspectives including scientific, industrial and traditional local knowledge into the decision-making process. The process for the IEA begins with defining the objective and a conceptual model of the system, followed by identifying indicators to assess the effectiveness of proposed solutions, which can be challenging in complex ecosystems. The IEA facilitates data-driven dialogue with stakeholders, whose knowledge is crucial in shaping the system's conceptual model.

- Can you explain your research on the Black Sea and whether ecosystem-based fisheries management is being used there?

Anastasiya Laznya replied that within the BRIDGE Black Sea Project[2] scientists at the Stockholm Resilience Centre are trying to evaluate Black Sea ecosystem services' resilience by studying how they react to stressors. They collaborate with experts, stakeholders, and local communities to identify patterns in ecosystem resilience, relying heavily on model data from the BRIDGE-BS Project. The Black Sea is semi-enclosed, making its fisheries a shared resource among the six surrounding states, which requires a lot of cooperation for effective fisheries management. For several decades, this cooperation has been lacking, leading to overexploitation of most commercial fisheries. However, in 2014, states were able to come to an agreement that has reduced overexploitation. There is a growing interest to work towards more cooperation and projects continue to work on this.

- Establishing baseline conditions for ecosystem assessment is critical. How can we develop a protocol that can be implemented and compared cross-regionally and inter-institutionally?

Patrizio Mariani highlighted the importance of having and analysing indicators, which can change over time. The challenge is determining the baseline. If long-term data about the indicators are available, certain methods can help identify the resilience of the ecosystem. Instead of aiming for a pristine ecosystem, which may be unattainable, we should focus on preserving key ecosystem functions—which is an achievable goal.

Kenn Skau Fischer explained that the advisory councils are not keen on the word "standardise", which is why they were established regionally. For people to take ownership of an ecosystem-based management system, local conditions must be considered. This is vital to encourage development.

- We have been talking about intergenerational knowledge. How has ecosystem management evolved in this context? Pablo, you mentioned working within the Marine Strategy Framework Directive. How has this approach impacted your scientific work and engagement?

Pablo Martín-Sosa noted that in his 20 years of experience he has felt this shift. He began his career in fisheries, where the aim was to make fisheries economically sustainable. But this also requires protecting resources and habitats. Now the environmental office is in charge, as conserving biodiversity is the main goal. Conservation should benefit society. The goal is to protect biodiversity while supporting compatible economic activities, which is why monitoring small-scale fisheries is key.

2 https://bridgeblacksea.org/

Kenn Skau Fischer agreed that there has been a considerable shift in the focus of the advisory councils and the CFP in the EU over the last 20 years. Previously, the councils focused on managing single stocks individually (e.g. Total Allowable Catch), but today they discuss the ecosystem management approach, pollution, and other factors not directly related to fisheries, but to the framework within which fisheries operate. Consequently, the composition of people and organisations involved in the Advisory Council has changed.

- I wanted to ask about the Fisheries Action Plan. Do you have any feedback on this?

Susan Steele explained that the main challenge with transitioning to ecosystem-based management is whether it can be effectively enforced. This issue will need to be addressed from the perspective of regulatory and control agencies.

- Are new methods being discovered to enable management of ecosystem-based fisheries and marine protected areas? Is there an effort to incorporate various perspectives, including socioeconomic factors?

Patrizio Mariani replied that new initiatives are driving a transdisciplinary approach. The IEA requires a multidisciplinary element, where experts from various fields must "speak the same language" to ensure effective communication. Managing an "Ocean commons" involves trade-offs; protecting one element may require others to give up some right to use that element. We need to develop the science to identify, communicate, and agree on these trade-offs.

Kenn Skau Fischer emphasised that it is an enormous task to safeguard the Ocean, and to understand how our activities affect it. An ecosystem-based approach requires the consideration of many factors and discussions with stakeholders about both coastal and deep-water areas. This transition will take time. Regulating fisheries alone will not solve all of the Ocean's problems. It is also important to involve young people in dialogues with the fisheries sector to facilitate mutual learning and find solutions.

Anastasiya Laznya explained that engaging stakeholders requires ongoing communication, not just extracting the information needed at the start of the process. Regular updates are required to keep stakeholders involved. Adaptive management and adequate mandatory measures are also crucial, and for this, data is essential. Model data can help fill any gaps.

Susan Steele noted that communication is a key aspect of ecosystem-based management, but it is complicated by language barriers.

- What three words would you use to summarise the future and areas of improvement?

Pablo Martín-Sosa said that the key is "true public participation". This is the only way.

Kenn Skau Fischer added "communication", "involvement", and "ownership".

Patrizio Mariani gave two: "people" and "trust". That is what is needed for the future. Communication is of course part of this, as are involvement and a transparent approach.

Anastasiya Laznya said "collaboration", "collaboration", and "collaboration". This could be between different types of scientists, stakeholders, youths and/or experienced professionals - just "collaboration".

Susan Steele thanked the speakers, panellists and the audience participation and closed the session.

Session 2: Addressing pharmaceutical pollution from inland to sea

The second session was moderated by Niall McDonough (Director of Policy, Innovation and Research Support Services at the Marine Institute in Ireland, and Chair of JPI Oceans), who opened the session by mentioning that in 2022 the Marine Institute in Ireland celebrated the delivery of their Research Vesel Tom Crean, which was built in Vigo. He provided a brief introduction about JPI Oceans and their actions, which are oriented to increase efficiency and impact of research and innovation. He highlighted the involvement of the three JPIs on Water, Oceans and Antimicrobial Resistance, together with the European Commission, in supporting the development of the AquaticPollutants ERA-NET[3], funded through the Horizon 2020 program.

The first speaker, Bruno González-Zorn (Professor at the Universidad Complutense of Madrid in Spain, and Advisor to the World Health Organization (WHO)) gave a presentation on "The challenges of Antimicrobial Resistance". He explained how the hidden world of bacteria has colonised humans, animals, and every ecosystem, vastly outnumbering us. These ancient life forms, having mastered antibiotic resistance for the last 4 billion years, pose an increasing threat for humans. He emphasised that while antibiotics have revolutionised medicine, enabling safe surgeries and transplants, our overuse has created a crisis. With no new antibiotic families discovered in the past 30 years, resistance is spreading through our environment – from wastewater to marine animals – fuelled by our high (and increasing) antibiotic consumption. He closed by noting that the reality is more alarming than predictions: antibiotic-resistant bacteria are causing significantly more deaths than anticipated.

The second speaker Marica Mezzelani (Researcher at the Università Politecnica delle Marche in Italy and part of the PHARMASEA Project) presented her research on "Presence, behaviour and risk assessment of pharmaceuticals in marine ecosystems". She presented the PHARMASEA Project[4] , which is funded by the AquaticPollutants ERA-NET. The main objectives of this project

3 https://aquatic-pollutants.eu/

4 http://www.waterjpi.eu/joint-calls/joint-call-2020-aquaticpollutants/aquaticpollutants-rdi-funded-projects-booklet/pharmasea

are to study the presence, distribution and effects of pharmaceuticals in European coastal areas and in non-aquatic species, develop risk assessments procedures, raise awareness, and to contribute to regulation, policies and management practices such as the MSFD. She explained that they are seeking to develop tools that can be used by pharmaceutical companies to test environmental impact and sustainability before releasing pharmaceuticals onto the market.

Niall McDonough thanked the presenters for the opportunity to learn more about the pharmaceutical and contaminants of emerging concern, particularly in the marine environment. He noted the importance of risk assessment and how to communicate those findings to promote the engagement and involvement of the private sector and regulatory bodies. He introduced the other members of the panel and invited the audience to join using the empty chair.

Nenad Gligoric (Founder of ZENTRIX LAB and member of the iMERMAID Project) presented his experience in applying Information and Communication technology to address Sustainable Development Goals for the water domain. ZENTRIX is developing sensors for monitoring of pollutants and providing traceability for contamination in the Horizon Europe Mission Project iMERMAID. He talked about the challenges and gaps of using innovative solutions for monitoring and detecting sources of pollution, noting that antibiotics appear to be one the most impactful pollutants. Finally, he emphasised the work being undertaken to overcome challenges including detection, calibration and costs.

Tainá Fonseca (Researcher at the Centre for Marine and Environmental Research at the Universidade do Algarve in Portugal) pointed out that pharmaceutical pollution starts in our own homes, noting that this is one of the main knowledge gaps in their detection. Every medicine we use is absorbed, distributed, and metabolised internally and then excreted. She emphasised that the number of pharmaceuticals reaching aquatic bodies is considerable and that these substances, even in small amounts, can be dangerous and trigger harmful reactions. She closed by explaining that these substances are putting ecologically and economically important species at risk.

Kelly Thornber (Research fellow at the European Centre for Environment and Human Health at the University of Exeter in UK, and co-director of the Pharmaceutical Pollution Hub) shared the importance of looking at societal drivers (social, cultural, economic, political) which enable pharmaceutical compounds to enter the environment. She presented the Pharmaceutical Pollution Hub[5], a non-profit organisation oriented towards finding solutions to reduce the environmental impact of medicines used in human healthcare. She further explained how the Pharmaceutical Pollution Hub brings together stakeholders in the pharmaceutical sector to develop solutions, using a systems thinking approach. This approach is based on understanding each other's needs (e.g. trade-offs, conflict of interests), and identifying strategies and supporting people to achieve them (e.g. linking academia with industry, government, and other non-academic sectors).

Niall McDonough then opened the floor for questions and comments.

- Can we fix the pharmaceutical pollution problem? If so, what steps can we take? Are there methods such as bioremediation to clean up the environment or can we develop new types of drugs that won't harm the environment?

5 https://www.pharmapollution.org/

Kelly Thornber suggested that there are easy, low impact solutions, but we also need to address the complex, deep-rooted drivers of pollution. The healthcare system is not sustainable now and there is a lack of feedback on the environmental costs of pharmaceutical development and use, meaning the sector focuses solely on clinical effectiveness and economic cost, and not on environmental impacts. She noted that it is important to reduce overall medication use by focusing more on prevention as well as treatment. She highlighted that investment is needed to understand and address social determinants of health such as education level and housing, giving more focus to social aspects.

Tainá Fonseca highlighted that collaboration is key. It is important to connect different expertise and specialisation and focus on nature-based solutions. One research gap is to understand how these drugs interact with the environment and affect humans, especially with so many changing variables. This requires a thorough human health risk assessment.

Bruno González-Zorn mentioned that the work still takes place in silos and there is a need for cross-disciplinarity to tackle pharmaceutical pollution. For instance, understanding human behaviour is crucial, and this should be combined with analyses of the economic impacts of reducing antibiotic use and the profits of the pharmaceutical industry. Sectors need to be brought together, and increased communication is needed between science and policy, as each field alone cannot produce a solution.

Nenad Gligoric suggested having a multidisciplinary repository where different cross-domain datasets can be stored for research but also regulatory purposes, as well as to streamline the tracking and tracing of pharmaceutical pollutants. It is important to collect data, encompassing the entire lifecycle, from production to the end user.

- With a rapidly aging population, the need for pharmaceuticals will continue increasing as well. What is the role of demographics in pharmaceutical pollution?

Bruno González-Zorn agreed that it is a complex problem, with culture and infrastructure playing an important role. He gave the example of India, where the healthcare system depends on pharmacies providing antibiotics over the counter to the population without prescriptions. Most people do not have access to primary health services so requiring prescriptions would cause the system to collapse. Tailor-made solutions are therefore needed for each country.

Kelly Thornber agreed that demographics have a major influence on the release of pharmaceuticals into the environment, but the lack of wastewater treatment plants in some countries are also important. The scientific community needs to better understand the impacts of pharmaceutical pollutant compounds and their distribution to support management.

Tainá Fonseca reiterated that the global population is increasing. This means that pharmaceutical consumption and pollution also increase, as seen for example in the use of anticancer drugs.

Kelly Thornber highlighted a study that measured the pharmaceutical compounds found in rivers around the world, with diabetes drugs being one of the most often found. Anti-depressants are also found in the environment and can have impacts on wildlife. Both these drugs are increasing in the environment and this calls for increased awareness on how to properly dispose of medicine (e.g. by taking it to a pharmacy).

- What should be a critical priority for research on pharmaceutical pollution?

Bruno González-Zorn said that to reduce antibiotic resistance, we really need to know the state of antibiotic prescriptions (how many are prescribed, for what purpose, to whom, etc.).

Marica Mezzelani suggested focusing on a multiple stressor perspective approach, as pharmaceuticals effects can be modulated by mixtures of contaminants, Ocean warming and acidification.

Kelly Thornber highlighted that it would take a long time to obtain a comprehensive view of pharmaceutical pollution, so we need to find a way to take action in the absence of comprehensive data.

Nenad Gligoric stressed the need to have an EU-wide impact assessment to provide accessible information to everyone including in science and industry.

Tainá Fonseca proposed a multi-stressor perspective by combining our efforts with statistics and modelling as these tools can create and apply realistic scenarios. It is important to consider that pharmaceuticals have different behaviours in different environments, e.g. sediments, where benthic species are very affected. We should increase public awareness on pharmaceutical pollution, such as the example given on teaching people how to properly dispose of medicine that are expired.

Niall McDonough thanked the panel for the thought-provoking and interesting discussion.

Closing Day 1: Coastal Resilience and Blue Carbon in Europe

The closing session of the first day of the conference was moderated by Kristin Richter (Senior Scientist at the Norwegian Research Center NORCE, and Co-Chair of the EMB Working Group on Coastal Resilience). She welcomed everyone to this session on Coastal Resilience and Blue Carbon in Europe. She mentioned that there are two Ocean Decade challenges that are particularly relevant for this session: To protect and restore ecosystems and biodiversity; and to increase community resilience to Ocean hazards. She stated that since the beginning of the Ocean Decade, there have been 36 Ocean Decade endorsed projects that directly address these challenges, and over 150 projects aiming to protect and restore marine and freshwater ecosystems and biodiversity. She mentioned projects that have directly contributed to relevant restoration targets including degraded seabed habitats and coastal ecosystems. She explained that during this session, two new European Marine Board documents, namely Position Paper No. 27 Building Coastal Resilience in Europe, and Policy Brief No. 11 Blue Carbon Challenges and opportunities to mitigate the climate and biodiversity crisis. She then introduced the speakers of the session.

The first speaker, Sebastian Villasante (Associate Professor at the University of Santiago de Compostela in Spain, and Chair of the EMB Working Group on Coastal Resilience) officially launched the EMB Position Paper No. 27 on "Building Coastal Resilience in Europe". He presented the definition of coastal resilience as agreed by the EMB Working Group, followed by an overview of the document. The first chapter focuses on the concepts and frameworks to operationalise resilience into concrete policy decisions. Chapter three addresses the pressures and impacts on various European coasts, while Chapters four and five cover the tools, barriers, and enablers that policymakers and users can use to build coastal resilience in Europe. He mentioned that the document presents three case studies in Italy, Belgium, and Ireland illustrating how each country overcame their individual challenges by identifying specific pressures and impacts on their coasts. He highlighted that the document's main outcomes include a six-step approach to building coastal resilience in Europe and five key policy recommendations (available at: https://www.marineboard.eu/coastal-resilience).

The second speaker, Natalie Hicks (Senior Lecturer at the University of Essex in UK, and Member of the EMB Working Group on Blue Carbon) presented the EMB Policy Brief on "Blue Carbon: Challenges and opportunities to mitigate the climate and biodiversity crises". She noted that the document defines Blue Carbon as well as some of the challenges and opportunities in relying on Blue Carbon to help mitigate the climate and biodiversity crises. The document, she continued, also addresses other important components of the biological carbon cycle, and whether they could be considered as Blue Carbon and why. She explained that the most important criteria for being considered a Blue Carbon ecosystem is whether they store carbon for long timescales. She also provided an overview of the co-benefits of Blue Carbon ecosystems as a nature-based solution, but also the limitations such as the availability of

space. She further outlined some of the most relevant uncertainties and questions surrounding the conservation and restoration of Blue Carbon ecosystems, and fishished by presenting the key recommendations of the document (available at: https://www.marineboard.eu/publications/blue-carbon).

Kristin Richter thanked the speakers and introduced the additional panellist for the session, opening the floor for questions.

Ana Isabel Lillebø (Researcher at CESAM - University of Aveiro in Portugal, and coordinator of the A-AAGORA Project) explained that she focuses on applied ecology and nature-based solutions, EU policies and ecosystem services in a transdisciplinary context. She further noted that she is a member of the Council of the Regional Hydrographic Administration for the Portugal Centre Region and the coordinator of the A-AAGORA[6] Horizon Europe Project.

- In the context of climate change, what are the main challenges for the management of coastal socioecological systems and/or Blue Carbon ecosystems?

Ana Isabel Lillebø replied that addressing spatial and temporal scales are very challenging. Everything that happens on land influences the Ocean and vice versa. It is important to be aware that the effects of some management decisions will only be visible in the long term, such as the restoration of Blue Carbon ecosystems. In addition, while extreme events can threaten restoration efforts, they shouldn't be a reason to abandon these initiatives. When considering different scales, the benefits of certain ecosystem services extend beyond the immediate implementation area, e.g. eels breed in the Sargassum Sea, but they are fished and consumed across Europe. Similarly, when discussing scales, we are very good at engaging both with local communities and at higher levels, such as the European Commission; however, we struggle in effectively linking these two levels effectively.

Sebastian Villasante highlighted that holistically assessing the cumulative pressures, such as climate change and biodiversity loss is a key challenge. Another is to understand the social tipping points, where users of a system are not able to further adapt to any ecological shocks. A third key challenge is to improve the connection between land and sea at the policy level.

Natalie Hicks agreed that spatial and temporal scales are very important. We need to be aware that one action will have an effect outside of that habitat, and that while some solutions for climate mitigation might not have an immediate effect on the carbon storage, they will have a quick co-benefit, such as increases in biodiversity values, improved water quality or coastal resilience. It is important to make sure that messaging is more holistic and not just focussed on carbon.

- What are the key knowledge gaps in scaling up the conservation and restoration of Blue Carbon habitats to serve as large-scale nature-based solutions?

Natalie Hicks replied that the biggest gap is understanding the role of greenhouse gas emissions and their future impact. It is also important to consider the specific issues of each coastline when developing nature-based solutions that are climate-proof.

6 https://a-aagora.eu

- What type of cross-sectoral cooperation is required to plan for the restoration of coastal habitats and how can it be enabled?

Ana Isabel Lillebø mentioned that collaboration and building trust are essential. In the A-AAGORA Project, for example, stakeholders were engaged right from the start which led to a partnership with 30 different organisations from companies, local authorities, NGOs, and various sectors including business, academia, environment, governance, and civil society. This is very important for the co-creation process and to promote a multiplying effect in associated regions. The goal is for these actions to be sustainable beyond the project's lifespan, which requires the active participation of all sectors. We need more such cross-sectoral collaboration to have everyone on board, see the big picture and make sure everyone can contribute.

- How can we ensure that both environmental and social implications are considered when making coastal management decisions, so that all relevant concerns are addressed?

Sebastian Villasante replied that when you are managing ecosystems, you are always also managing people. It is critical to consider people and the state of the ecosystems at the same level.

- How can decision-makers deal with uncertainty, e.g. unknown tipping points?

Ana Isabel Lillebø said that it is imporant to clearly communicate about uncertainties during the co-creation process, but this requires transforming our current ways of thinking.

Natalie Hicks agreed that uncertainties are there, but this should not stop us from restoring the ecosystems, because we know they have many co-benefits and are a "low-regret option". Also, most restoration initiatives are led by NGOs and local communities, and this is certainly bridging important gaps. Having this community-led approach is essential since a significant part of Blue Carbon restoration is not driven by academics or government initiatives, but rather by stakeholders or conservation charities.

Sebastian Villasante added that identifying the different aspects that policymakers need to address, such as natural, financial, social, and institutional issues, is important. It is also important to understand how users can cope with different levels of uncertainty, and that the development of trust and transparency throughout the decision-making process is crucial.

Kristin Richter thanked the panellists for the interesting discussion and closed the first day of the conference.

Wednesday, 11 October 2023

Session 3: Transforming ports at the interface between land, society and the Blue Economy

Session three was moderated by Rosa Fernández (Head of Department for Technology, Promotion and Transfer at CETMAR in Spain). She opened the session addressing the challenges faced by ports and harbours, and marine infrastructures that play a vital role in supporting the development of the Blue Economy. She then introduced the speakers of the session.

The first speaker, Capucine Seguin (Mission Head of the Region Sud: Provence-Alpes-Côte d'Azur (PACA) Representation Office in France) presented the Clean Harbours Certification initiative ("Ports Propres[7] "). She explained its evolution into a European Certification that requires port managers to implement five steps towards a Clean Harbour: environmental diagnosis; tackling pollution and improving environmental protection; fighting accidental pollution; capacity development of port staff; and raising awareness and communication. She explained that this certification is valid for 3 years and includes an annual audit. She mentioned that future plans for additional certifications focus on biodiversity and efforts to achieve international recognition for the certification, with results expected by June 2024. She concluded by presenting a voluntary charter, already signed by 114 harbours, which promotes the certification.

The second speaker, Gerardo González (Head of the Projects and Works Division at the Port Authority of Vigo in Spain) presented the "Living Ports[8] " Project promoted by the Port of Vigo as part of their Blue Growth strategy. The Living Ports initiative is part of a consortium integrated by the Port of Vigo, ECONCRETE[9] , CARDAMA[10] , and DTU[11] and it aims to transform 'grey' infrastructure into 'green' infrastructure using natural processes in artificial environments. He explained that they are testing concrete that has special additives and a 3D outer shape to promote the fixation of marine life on the structure. He showcased where these tests were being implemented, the kind of structures that have been built, how they are being monitored, and the results they have obtained by combining the conservation and restoration of ecosystems with port planning and design. He noted that they operate a marine water observatory at the port, which has revealed impressive biodiversity, showcasing the project's success. The observatory promotes sustainability education and strengthens ties between the port and the city.

Rosa Fernández thanked the speakers and introduced the panellists.

Laura Airoldi (Professor at the University of Padova in Italy and member of the World Harbour Project) is a member of the European Academy of Sciences and works in the new field of marine urban ecology and coastal eco-engineering.

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7 https://www.ports-propres.org/en/

8 https://www.livingports.eu/

9 https://econcretetech.com/

10 https://www.astilleroscardama.com/?lang=en

11 https://construct.dtu.dk/

Julie Olivier (Science Policy Officer at the Project Management Jülich in Brussels and German representative for the Sustainable Blue Economy Partnership) represents Germany at the Sustainable Blue Economy Partnership[12] and has relevant experience in the science-policy-business-society interface.

Evelyn Paredes Coral (PhD candidate at Ghent University in Belgium) does research on Ocean literacy and its impact on people's behaviour. She has a background in training and skills development for maritime professionals, focusing on how understanding their connection to the Ocean could help them adopt more sustainable practices.

Rosa Fernández opened the discussion with some questions and also opened the floor for comments and questions from the audience. A brief exchange between Carlos Botana (President of the Port of Vigo)and Elisabetta Balzi (Head of Unit Ocean, Seas and Waters, Deputy Director Healthy Planet at European Commission, DG Research and Innovation) highlighted the importance of building communities with key actors such as ports. The European Commission is engaged in several initiatives to support ports and to provide assistance to smaller ports. Engaging citizens is also important, so adapting solutions to local conditions is essential. They agreed that the Port of Vigo will endorse the Charter for the Mission Ocean.

- What is marine urban ecology and coastal eco-engineering and how can they contribute to make the ports' activities and infrastructure more sustainable?

Laura Airoldi replied that marine urban ecology is a complex multidisciplinary science that focuses on understanding the biodiversity and ecosystem functioning of marine areas that are strongly embedded within an urban context. In the past, urban ecology dealt solely with terrestrial ecology, disregarding the sea. Now there is focus on building infrastructure that brings conservation closer to where people live and where the impact on marine ecosystems has been the greatest. We are also developing materials that promote marine life and have lower carbon emissions and contribute to a circular Blue Economy in the area.

- To what extent do you feel that your activities are impacting not only the local community around the port but also the various stakeholders within the port infrastructure? Do you consistently interact and engage with these stakeholders?

Capucine Seguin said that they are in constant cooperation with all the stakeholders located in the ports to promote best practices and to involve them in the transformation, for instance by organising meetings to hear their thoughts and needs.

Gerardo González replied that they have noticed a really good response from stakeholders, especially after they have been informed about the adjustments and reassured that their activities

12 https://bluepartnership.eu/

will not be negatively affected. An example of this has been the reduction of hard barriers between the port and the City of Vigo, which improved blue growth in the port.

- What were your main findings about the connection between the Blue Economy workforce and the Ocean?

Evelyn Paredes Coral explained that to assess the connection between maritime workers and the Ocean she used a survey to measure and quantify their Ocean literacy. The findings revealed that for certain groups of maritime workers, more knowledge about the Ocean did not translate into more sustainable actions, and older workers reported more positive behaviours, as they have spent more time at sea or near the Ocean, which could strengthen their connection to the Ocean. Overall, the results indicated that Blue Economy workers are very diverse and shouldn't be treated as a homogeneous group. She noted the need to be careful when providing training and promoting best practices, emphasising the need to better characterise these groups to tailor our approaches effectively.

- How do you think the Sustainable Blue Economy Partnership will involve ports and hubs around the Blue Economy concepts and challenges?

Julie Olivier explained that the Sustainable Blue Economy Partnership is a Horizon Europe initiative that aims to advance a neutral, sustainable, productive and competitive Blue Economy across European sea basins.They engage with science, society, business, and policy to deliver impact-driven innovative solutions towards a just and inclusive transition focussing on designing smaller, greener ports, that are key hubs in the Blue Economy. She quoted President of the European Commission Ursula Von der Leyen saying "If the Port of Rotterdam is doing well; Europe's economy is doing well" highlighting that ports are catalysers of the green revolution. Each port is unique, and the Partnership is defining new cooperative activities for marine research infrastructure while fostering synergies with other initiatives.

- To what extent are you considering how your infrastructure can contribute to scientific research? For example, are you involved in data exchange initiatives?

Julie Olivier mentioned that the Sustainable Blue Economy Partnership has a co-design approach that is both multisectoral and transdisciplinary. The week before a workshop incorporating legal, human, and social perspectives was held, which provided robust examples of holistic framing. They discussed important issues such as the rights of seafarers and how to ensure they are not left behind.

Gerardo González highlighted that although the Port of Vigo is medium-sized, they have a strong sustainability strategy. For example, for decarbonisation efforts, a tool was developed to help companies calculate their carbon footprint and identify solutions to reduce it such as using renewable energy. Their goal is to maximise the productivity of companies, while minimising energy consumption.

Laura Airoldi indicated that they have developed a tool for industries to measure their carbon footprint and explore renewable energy options. Additionally, there is a long-standing global effort through the World Harbour Project[13]: a network of over 30 ports dedicated to sharing knowledge and addressing environmental issues. The global collaboration on common tests has enhanced understanding of shared issues and factors affecting port biodiversity. As one solution does not fit all, adapting solutions to local conditions is essential.

Capucine Seguin added that it is important to create some common guidelines that can be adapted according to local needs. This is the aim of the certifications.

Evelyn Paredes Coral mentioned that while looking at the interface between the city and the port, people working at the port shouldn't be forgotten. It is very important to consider their interests, perceptions, and emotions along with environmental factors. Training must be adapted to the people working at each port.

- The Ballast Water Convention came into effect in 2017. Do you have any examples of ports implementing this in a proper way?

Gerardo González highlighted that it was not his speciality but noted that controls exist for ballast waters. He mentioned that companies are developing technology to filter 98-99% of ballast water before it is discharged into the sea.

Laura Airoldi emphasized the lack of information on what ships are discharging in ports. She noted that the insufficient research on this topic needs to be addressed.

Carlos Botana (President of the Port of Vigo), from the audience mentioned that the problem of invasive species in ballast water is very important for the Port of Vigo. Two main strategies are being deployed: first, identifying new species entering the port area, as ships coming into the Port of Vigo often change their ballast water in international waters, and secondly, creating barriers to prevent these invasive species from spreading. Many vessels are now equipped with ballast water treatment systems and are required to provide analyses of the ballast water. The Port of Vigo is a bay, there is a national park, and there are fishing activities, so this is very important. They need to work together with the universities and research centres to tackle this problem. Additionally, climate change is altering water temperatures, which can also introduce new species to ports.

- Is there a standardized approach to monitoring and observing ports? Does this data flow into accessible databases?

Capucine Seguin highlighted that the certification comes with a control audit every year that aims to monitor if ports are aligned with the objectives of sustainable transformation and development.

Gerardo González noted that specific Key Performance Indicators, using a consistent methodology, are available on their website and will be adopted by many ports. Currently, this data is not yet shared, but a network of ports is planned for data sharing and resulting consistency checks.

13 https://sims.org.au/research/flagship-projects/world-harbour-project

Laura Airoldi highlighted that Italy currently has a national project devoted to mapping the biodiversity around their coast integrating old and new methods of monitoring. The integration of different methods is important because in some areas there are problems with accessibility or low visibility. A comparison between methods is expected as a project output.

- How has the electrification of the Port of Vigo impacted local biodiversity? With two factory fishing ships conducting antifouling activities, how are you managing the resulting pollution? What were the outcomes of the Region Sud's efforts to address the damage caused by ships anchoring and destroying vital coral?

Gerardo González replied that the Port has installed several photovoltaic plants and is trying to be as self-sufficient as possible, however, this is not sufficient to meet the future technology demands. As technology has advanced and demand increased, a new photovoltaic plant has been added, achieving a 15% reduction in consumption. The infrastructure needed for the port is massive and very expensive therefore electrification is a slow process. Regarding floating vessels, only minor interventions are allowed while afloat; major modifications occur at the shipyard, with new designs tested in partnership with the local university.

Capucine Seguin said that regarding Region Sud's boating activity, new types of activities that are less polluting are being promoted.

- Concrete is a major source of CO_2 emissions. While you capture carbon, what alternative materials do you use instead of concrete? And, how do you involve citizens in addressing the use of pollutants like antifouling biocides?

Gerardo González highlighted that a new concrete mix is being used, which includes a bio-additive. Thus, while emissions from cement production itself are not being reduced, the final product does help lower CO_2 emissions. It contributes to reducing the overall carbon footprint.

- When monitoring the pollution you are capturing, do you only measure effluent, or do you also measure antifouling agents/chemicals?

Gerardo González highlighted that they are monitoring carbon capture, noise reduction, and the growth of new habitats. However, the chemicals emitted by the new materials are not being tracked. At the port, pollutant levels in the water are measured and the basins are regularly cleaned.

Julie Olivier mentioned that when talking about restoration and biodiversity, the key word is resilience. Resilience in infrastructure is needed, which requires smart technologies. Also, the skills needed to network and coordinate the ports must be promoted at universities. The

regeneration of waterfronts is also needed, transforming ports into beautiful spaces.

Rosa Fernández thanked the panel and audience before closing the session.

Session 4: Ensuring Ocean knowledge in the age of the digital Ocean

The session moderator, Tom Redd (Ocean Governance Manager at HUB Ocean in Norway, and member of the ILIAD Project) introduced the session by explaining that a digital twin is a policy tool or decision-making mechanism that digitally represents an environment or system, allowing users to create "what if scenarios" and understand the impact of making interventions. Creating Digital Twins of the Ocean (DTOs) is a big challenge because the Ocean is vast and there are many places where data is not available.

The first speaker, Elisabetta Balzi (Head of Ocean, Seas and Waters Unit at the Directorate-General for Research and Innovation (DG RTD) of the European Commission) presented the importance of a Digital Twin of the Ocean for the European Union (DTO). She emphasised that the Mission Ocean is at the core of EU policymaking, and that a precursor to a DTO will be delivered by 2024. She explained that the Mission Ocean is a strategic mobilisation that relies on two key enablers: Public mobilisation and engagement, and the digital Ocean and waters knowledge system. She highlighted that enhancing our understanding of Ocean and water systems through digital means is crucial, which is why the EU is investing in the Digital Twin. This tool, she explained, will be a public resource to guide decisions for policymakers and the private sector. She emphasised that for this to happen, stakeholder engagement is key, and there should be as many people involved as possible. The DTO uses a science-driven approach that focuses on social and economic dimensions to integrate and connect a wide range of data, models, and infrastructure, while providing visualisation tools to support citizen engagement with the EU Mission and the DTO. The Digital Twin of the Ocean is designed to be inclusive and open, engaging all stakeholders and offering applications at the local and regional level. The aim is to be interoperable with other initiatives and collaborate with the UN, national governments, and the Sustainable Blue Economy Partnership.

The second speaker, Pierre Bahurel (Director General of Mercator Ocean International) discussed the EU's efforts to develop a Digital Twin of the Ocean. He listed the aims of the initiative to create a global cooperative platform where citizens and policymakers can directly engage with Ocean knowledge, asking questions and receiving answers without predefined assumptions. The EU's approach to implementing the DTO could serve as a landmark example for similar projects worldwide. He explained that the DTO is using all available resources: the Mission Ocean, the Ocean Decade, and other European Commission and Member State initiatives. He stressed that the initiative is breaking down barriers and invited all Ocean modelling projects to contribute. He also clarified that the European DTO is collaborating with national initiatives. Although a Digital Twin is being developed in Europe, it will monitor the entire Ocean and involve international scientists in a community effort to create a lasting impact. He explained that EMODnet[14] and Copernicus[15]

14 https://emodnet.ec.europa.eu/en

15 https://marine.copernicus.eu/

are being used as the foundation, for collecting the data, and provide an architectural basis for the interconnection of assets which will be integrated by the ILIAD[16] project. The processing engine will support the launch of models, AI-driven machine learning, hybrid models, and other applications, consolidating all Ocean data in one place. Once completed, this platform will allow users to interact with the data and explore various policy scenarios, such as achieving zero pollution, protecting biodiversity, or determining the optimal placement of marine protected areas. This tool will provide an evidence-based framework for policymakers across different countries, offering a common frame of reference. He stated that it has taken one year to create an architecture for science to service innovation and demonstrate feasibility, and in one decade it will reach maturity.

Tom Redd thanked the speakers and introduced the panel before asking a question to each of them.

Inga Lips (Secretary General of the European Global Ocean Observing System - EuroGOOS and the European Ocean Observing System Framework – EOOS) mentioned that she represents the data-gathering that is necessary for the Digital Twin of the Ocean.

Kate Larkin (Head of Secretariat of the European Marine Observation and Data Network - EMODnet) explained that as an EC marine data service EMODnet is a key contributor to the European Digital Twin Ocean (DTO), bringing the wealth of *in situ* marine environmental and human activities data from European seas and making these available as cloud-based services.

Deniz Dişa (Researcher at the Institute of Marine Sciences of the Middle East Technical University in Türkiye) is a marine ecosystem modeler who has worked on digital twins, including a digital twin of coral reefs.

- How far have we come in developing the European Ocean Observation System to effectively support the Digital Twin of the Ocean?

Inga Lips started by emphasising that new data, continuous data, and routinely collected long-term data are needed. The community is still quite far from being able to provide real-time data to the DTO, but quality-controlled real-time data is required. Recent advancements include standardising observations and developing near real-time quality control procedures. However, this is mosty physics data, while provision of real-time biochemical data lags behind. In addition, the observations are funded by nations, and so they respond to national priorities, and do not necessarily align with the requirements of pan-European initiatives. Therefore, engaging with nations to provide the observations needed for these initiatives is essential.

- Could you talk about the need for trusted data services in developing digital twins of the Ocean?

16 https://ocean-twin.eu/

What is EMODnet doing to achieve that?

Kate Larkin replied that trusted data services are the foundation of digital twins of the Ocean, and that EMODnet and Copernicus will provide the backbone for this in the European DTO. However, a structured, standardised, and interoperable approach to data is needed, and this is what EMODnet and Copernicus are delivering. These data services already have a large user base that will continue to use these services, with the DTO attracting also wider users who need to perform big data analyses and scenarios with high performance computing and modelling tools. EMODnet provides a trusted service and has built a community because of the data pipelines and partnerships it has developed, with the European Ocean Observation community, and this has been an important foundation for the DTO. EMODnet has been centralising its thematic services and providing a unified framework, for example via a common metadata catalogue.

- As a practitioner, what is your experience with accessing data?

Deniz Dișa responded that she works with 3D numerical models that couple chemical, physical, and biological processes in the Ocean. These models simulate the motion of water and how chemicals are transported and can also simulate how organisms interact with chemicals in water. If this needs to be modelled for a region, the data for each point in the 3D space is needed. This requires large data files that are not user-friendly, but they can be made more so for citizens and policymakers. The number of observations has been increasing and satellites are becoming more powerful. This can provide information on the surface of the Ocean, but more data is needed below the surface. The forecasting power of models very much depends on data availability, so there is still a long way to go.

- Coastal areas are much better known than offshore areas, the water column, and the bottom of the Ocean. However, we lack so much data about the interactions between physical and chemical dynamics and biological responses. What are your priorities in filling these gaps, and how can we deal with the gaps that will remain even 10 years from now?

Inga Lips replied that Europe has set a good example by developing the Argo Floats[17] as their contribution to the global Argo program. Argo floats are currently irreplaceable for studying the interior of the Ocean. They can observe biochemical parameters and collect a wider variety of data and represent a large financial commitment by Europe.

Kate Larkin highlighted that data services can also be part of the puzzle in assessing data gaps. They aggregate a huge amount of data, with EMODnet in many cases providing the most comprehensive pan-European data layers for key parameters, which allows them to analyse where there may be real gaps in Ocean observations and data.

Elisabetta Balzi said that the European Commission is aware of the current gaps in biological data, and there is an ongoing effort to facilitate the integration of this data into the platform.

Pierre Bahurel responded that the challenge is to create an operational service that will meet the requirements of stakeholders. Satellites are sufficient for observations, but *in-situ* observations

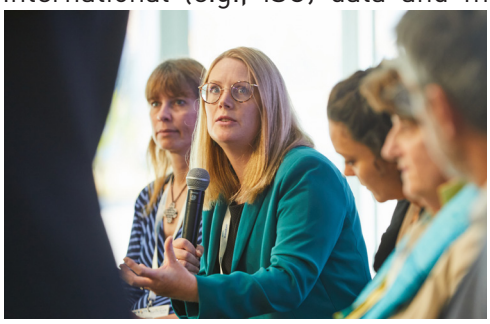
17 https://www.euro-argo.eu/

rely solely on research, which is something that should change.

- Many people do not know about the standards for structuring data. How do we communicate the importance of standards?

Tom Redd highlighted that one of the technical components of the ILIAD project is to create an "Ocean Information Model". This would translate the metadata from researchers into a standardised format. These are crucial topics that are often overlooked, so it is important to recognise the contributions of groups working on such problems.

Kate Larkin noted that EMODnet already applies a number of European (e.g., INSPIRE) and International (e.g., ISO) data and metadata standards, and there is potential to do more to communicate these in dialogue with the Ocean observation community. EMODnet plans to host a webinar early next year, inviting European Mission Ocean and Horizon Europe projects to use EMODnet's standardised templates for their data collection, to streamline the data pipeline and to make the data more fit for ingestion into EMODnet, and making it available via the European DTO.



- The data collected in Copernicus and EMODnet will be a small proportion of the data collected as part of OceanWise. We must be very transparent about this and be careful about what we promise. It will take much more than 10 years to be able to deliver on what we are promising.

Tom Redd agreed that as Pierre Bahurel noted in his presentation, it is a complex challenge to align different communities to bring together the data for digital twins.

Pierre Bahurel commented that there are excellent oceanograhic products in some areas, but in others it is hard to catch up with the expectations of society. He agreed that it would not be wise to publicise digital twins as a magic fix, however he disagreed that it would take over 10 years to be ready. First it is critical that a European infrastructure exists and that it can take all existing data.

Elisabetta Balzi added that there has been a proliferation of initiatives contributing to smaller twins, which is very much needed. The key is facilitating the communication and integration of both research data and citizen data. The goal is not to centralise or monopolise, but to build on the available diversity and try to synergise to reach the objectives more quickly. Citizen engagement and regional engagement are key, so it would be unwise to wait too long to present the Digital Twin to the public, as it may be seen as being imposed on society and hence rejected.

- The Digital Twin will require vast amounts of observational data to function. This data is provided by researchers. When will we see sustained financing of operations to collect data? Could we have a European Ocean Agency, like we have a European Space Agency?

Inga Lips replied that nobody can say when this will happen, but there is the need to work towards that with nations and regions who are financing most observations. Having most of the data come

through research projects is not sustainable. The fragmented observation systems need to be integrated, which requires a lot of political will. For example, when trying to coordinate research programs from different nations, the typical response is that historic long-term datasets must be continued, and not modified.

Elisabetta Balzi reminded the participants that life depends on the Ocean, and all efforts are being made as quickly as possible to be able to provide the required services to support it. The DTO needs to be ready by next year, and it has been a remarkable effort to get this far. Now it needs to remain sustainable. It requires a huge effort to study the Ocean, so a European Ocean Agency would make sense.

Inga Lips agreed, as this was foreseen when building the European Ocean Observing System.

- My concern is that for all these digital twin ideas to be implemented we need not only Ocean literacy, but systems literacy, network literacy, data literacy and model literacy. For citizens to be involved, this needs to be in school curriculums now. How can we include education in our plans?

Inga Lips agreed that Ocean literacy is key. A lot of efforts are being made to educate different generations and communities, such as teaching in schools. But there is also the need to educate citizens and policymakers so that everyone understands the importance of Ocean observations. The Ocean observation community is working towards that.

Kate Larkin mentioned that whilst EMODnet focuses on the professional marine data user, EMODnet also powers the European Atlas of the Seas, which is an EC DG MARE tool for communication and Ocean literacy. The European Atlas of the Seas visualises marine environmental, human activities and some socio-economic data from EMODnet, Copernicus Marine, Eurostat and more. It includes communication and education resources, with many outputs being developed with education professionals, and include storytelling and teaching resources.

Elisabetta Balzi stressed that the European Commission supports education starting with young children and wants to get citizens involved in the design and implementation of the DTO.

Deniz Dișa, responding to a comment from the audience, explained that modelers are unwilling to change their model when they receive new data. She said that models are complex and when one parameter is changed, the whole model may change, and there may be thousands of parameters in the model. This may be why modelers are unwilling to look at new data as soon as it becomes available, but modellers are constantly looking at ways to improve their model.

- Sometimes I have a feeling that the definition of the MPA for biological purposes is feasible, but the difficulty is economical, as it is difficult to restrict fisheries for example. Is this something you can address with the Digital Twin project?

Pierre Bahurel replied that the Digital Twin is an enabler which can be used to activate different things. Tools will be made available regardless of who will use these tools (e.g. to generate regulations on fisheries). Their top priority is to activate research, but he cautioned that it is useless to make the data open without having appropriate training and education to enable people

to decide how to use the data in a way that works for their interests.

- The DTO seems to be serendipitously collecting information and doesn't have a definition of what data it wants, where to get it, and who's going to pay to collect it. What data do you need, and do you have a list so that researchers can say "I can provide this data" and countries will say who will pay for it?

Pierre Bahurel mentioned that there is a list that shows what data are a priority. The question is how to address these priorities, depending on a specific objective. The list is not currently available, but this should not be an excuse for not implementing a capacity program for sustained observations using the excuse that the Ocean is too complex. There is already knowledge on what is necessary to feed these systems.

Kate Larkin added that for more than a decade the Copernicus Marine Service and EMODnet have been evolving their services for users. All those data will be made available in a common data lake. There are also emerging Ocean data such as environmental DNA and data from citizen science activities, and the EMODnet thematics are working to increase these pipelines to further extend the EMODnet offer.

Tom Redd thanked all the panellists and audience for their active participation and closed the session.

Session 5: Changing humanity's relationship with the Ocean: art as an agent of change

The moderator Sérgio Bryton (Executive Director, EurOcean Foundation) opened the session by stating that there are over 110 projects that align with the topic of this session to address the Ocean Decade challenges and 170 actions in the different objectives for Mission Ocean. He said that "change", "youth", and "art" are the keywords that the session will address. However, "art" is the most innovative and is directly connected to emotions. Through art, a change can be made in people's behaviour in relation to the Ocean. He said that in psychology, there is a new field called "emotion science" which explores how decision-making affects emotions and vice versa. Stronger future collaboration between Ocean scientists, artists, and psychologists would be very valuable. He ended by highlighting the qualitative and quantitative aspects needed to assess the impact on the change in people's behaviour towards the Ocean. He then introduced the session speakers.

The first speaker, Ursula Kluwick (Senior Lecturer at the University of Bern in Switzerland) provided insights into how humanity is engaging with the sea in a new and rapidly growing field called "Critical Ocean Studies", or "Blue Humanities". Blue humanities explore how, for the

modern Western cultures, the Ocean is everywhere and nowhere and despite its importance, it is usually overlooked in Western cultural imagination. She explained that humanities scholars study the sea's history in literature, for example by exploring how stories shape our knowledge of the sea. She provided some examples such as the classic novel "Dracula" where the main character uses the water as a means of transportation, creates sea fogs and sea storms for protection, and freely transforms into a water shape. She explained that there are many other authors (e.g. Daniel Defoe, Jonathan Swift, Herman Melville) that use the element of water in their novels, portraying shipwrecks, sea battles, maritime trade, ships, pirates, and drowning. She quoted Richard Kerridge, talking about the connection between the environmental crisis and the identity crisis, stressing that this is why marine scientists, policymakers and other stakeholders should become more interested in Blue Humanities. She closed by stressing the importance of literature to make the abstract tangible and invite readers to imagine different worlds (model scenarios). Literature, she said, holds immense knowledge about the inextricable interrelations between humans, water and the Ocean.

The second speaker, Daniel Rey (Director of the Marine Research Centre at the University of Vigo and Head of Campus do Mar in Vigo, Spain) commenced by talking about how new technology has allowed society to capture beautiful images of marine life, which has helped create awareness about the diversity, vulnerability and beauty of this environment. In the past, many scientists had to become artists out of the necessity to illustrate their work (e.g. creating drawings of phytoplankton under a microscope). This was the beginning of the union between scientific accuracy and artistic expression. Infographics, he explained, are an interesting partnership between artists and scientists since they help to convey complex concepts in an informative, accurate and visually appealing way. However, there are many other ways than graphic design can promote Ocean literacy through the collaboration between scientists and artists, such as documentaries, mini-series, gamification (to teach marine conservation and awareness in an interactive and entertaining manner), street art, and sculptures (e.g. made from recyclable materials or using indigenous knowledge and methods). He explained how the role of art and science communication has changed from being merely visual to a more intricate interaction between science, art, technology, and society, particularly in the last 20 years. He emphasised that understanding the impact of this outreach is critical to navigate the evolving communication landscape effectively. To end, he showcased some research outcomes that demonstrate a slowly declining interest in the environment amongst adults, whereas younger generations are more interested in science and technology, and social media and video platforms are two main channels used for information gathering.

Sergio Bryton posed an opening question to the panel, and then opened the floor for questions from the audience.

One comment from the audience stated that science and art are two ways of accessing knowledge. Knowledge is a mental form of representation that can be transferred from one mind to another. It is not just using art to communicate science, but to use it as an agent of change. Art makes society more conscious of the problems that science demonstrated through evidence.

- How can art drive change? Take the example of your own work where your art acts as a catalyst for co-creating strategies for better management.

Sonia Levy (2023-2024 Artist-in-Residence of the European Marine Board programme EMBracing

the Ocean) explained that her project focuses on the Venetian Lagoon and explores the fragile and turbulent environment below the surface. She noted the lack of a coordinated baseline for monitoring the Lagoon and the pervasive impact of corruption, which complicates understanding of ongoing issues. She shared an underwater recording from the Lagoon while discussing its history with the audience.

Letizia Artioli (Researcher at the Università Iuav di Venezia in Italy and Royal Academy of Art in London, UK) explained that her research examines the relationship between humans and environmental data. She illustrated air pollution through graphs, maps, and a photograph of pollutants, underlining that an environmental crisis is also a cultural crisis, and a crisis of representation. She suggested finding new ways to represent knowledge, not just data, to encourage people to move from being spectators to active participants.

Guillaume Lheureux (Project Officer at the Nausicáa Aquarium in France and facilitator of the European Commission's Youth4Ocean Forum) provided an overview of the Youth4Ocean Forum[18], the EU4Ocean Platform[19], and the Network of Blue Schools[20], all aiming to build a network of Ocean literacy experts across Europe. He emphasised that his focus on engaging with youth originated from two major concerns: the growing sense of eco-anxiety among young people, and the surge of misinformation and conspiracy theories on social media which are deepening the divide between younger generations and senior experts. He noted that youth presentations at conferences often have a unique impact due to the personal and emotional approach they bring. He reiterated the importance of youth as agents of change and introduced a new workshop methodology for international conferences which unites young and senior experts to share inspiring Ocean stories, breaking down barriers between speakers and participants. In this methodology, attendees work in small groups on Ocean-related questions inspired by the talks, followed by a speed-dating-style networking event to foster connections for future collaboration. He also announced plans to launch a Global Youth Consultation at the UN Ocean Decade Conference in 2025, in Nice.

- Art can engage people through emotions, often resonating more quickly and intensely than scientific papers or briefs. However, when art conveys only a single message, its impact may be fleeting. How can we foster better collaboration between scientists and artists to ensure that their combined efforts have a lasting and meaningful impact?

Ursula Kluwick suggested that we should adjust our expectations about art, as it may serve multiple purposes which can be fortuitous. Art can generate a proliferation of meanings and new knowledge which could lead to unexpected conversations.

Sonia Levy highlighted the need to focus on the multiplication of knowledge, noting that art is a form of knowledge that is very good at challenging established paradigms and raising new questions.

Letizia Artioli noted that when art and science intersect they have a dynamic exchange that

18 https://maritime-forum.ec.europa.eu/theme/ocean-literacy-and-blue-skills/ocean-literacy/youth4ocean-forum_en

19 https://maritime-forum.ec.europa.eu/theme/ocean-literacy-and-blue-skills/ocean-literacy/eu4ocean-platform_en

20 https://maritime-forum.ec.europa.eu/theme/ocean-literacy-and-blue-skills/ocean-literacy/network-blue-schools_en

opens interpretive possibilities. When science flows into art, it adds consistency and enhanced perception, while art conveys subjective knowledge in ways that can lead to innovative solutions beyond traditional compartmentalisation.

Daniel Rey explained that to convey an idea effectively, appealing to emotions is essential. Interaction between artists and science is much stronger now than in the past. This ongoing collaboration among scientists, artists, technology, and society allows us to approach questions with a more ethical, moral, and political perspective.

- Can the combination of science and art increase confusion about what is real and what is product of the artists' imagination?

Letizia Artioli argued that confusion itself might be the central concept to experience. Conveying emotions and knowledge carries significant responsibility. It is important to encourage people to ask questions from different perspectives, as this can lead to deeper understanding.

Ursula Kluwick added that, particularly in climate science, being able to experience and reflect on confusion might be useful. Framing is very important when you use art, which means that you should use for instance pictures in an informed way. The emotions that can be stirred with verbal and visual images are enormous.

- Using art to ask questions rather than to provide direct answers requires the audience to engage in critical thinking. However, people often prefer quick, easily consumable information. How can art serve as an agent of change when it challenges the rapid pace of societal evolution?

Daniel Rey replied that selecting the right channel and target group is essential. Communication channels have evolved rapidly throughout history, and we have adapted to use them effectively. Education and a strong cultural background in critical thinking are essential for conveying messages clearly and avoiding misinterpretation.

Sonia Levy said that, ideally, the artwork should create critical thinking that may not have existed prior to engaging with the artwork itself.

Letizia Artioli highlighted that we should stop treating people merely as consumers and start recognising them as citizens with responsibilities and rights.

Sérgio Bryton thanked all panellists and organisers of the event and closed the session.

Closing session - What's next: rallying actions for our Ocean and Waters

The session moderator, Gilles Lericolais (Chair of the European Marine Board and advisor of Ifremer CEO), opened by highlighting the importance of new generations in continuing work towards protecting the Ocean.

In a video message, Vladimir Ryabinin (Executive Secretary at the Intergovernmental Oceanographic Commission of UNESCO – IOC/UNESCO) highlighted that IOC/UNESCO supports the Vigo Declaration and the aim to speak with one voice. He noted their particular support on the calls for integrated land-sea policies and management, the need for sustained and better coordinated Ocean observations, and encouraging citizens to be more committed and involved in a stronger relationship with the Ocean. He explained that all these points are already deeply embedded in IOC/UNESCO's work, as they continuously try to unify the efforts of various communities engaged in Ocean research. Their work is based mainly in capacity development and data, because you cannot manage what you cannot measure. He further explained that integrated land-sea policies and management can unite important experiences in coastal zone management and adaptation, planning, and development. As for the Ocean Decade outcomes, he stated that the topic on "inspiring and engaging" is the one that has helped the most to engage everyone, including citizens, in addressing the Decade challenges. He provided an overview of the Ocean Decade and explained that the Ocean Decade challenges have resulted in many programs, with the most programs being on Ocean observations and Ocean climate. The 2030 vision process will analyse the success of the programs and the 10 challenges of the Decade to understand what is missing and what is needed to achieve the Decade goals. The Decade priorities will be presented at the UN Ocean Decade Conference 2024 in Barcelona. Other conferences such as the Costa Rica Preparatory meeting for the UN Ocean Conference (UNOC), the One Ocean Science Conference, and UNOC 2025 will continue to take Ocean action forward and result in very strong decision support of Ocean management that is based on science. He reiterated IOC/UNESCO's support of the Vigo Declaration and wished everyone a successful continuation of their joint work towards the Ocean we need for the future we want.

Francisco Saborido (Director at Institute of Marine Research (IIM-CSIC) in Spain, and Representative of the Complementary Plan for Marine Sciences of Galicia) presented an ongoing action called the "Marine Science" programme he is coordinating with Rosa Fernández and Daniel

Rey. He explained that the Complementary Plans[21] created by the Spanish Ministry of Science and Innovation are new mechanisms for implementing research and development strategies, coordinated at the national and regional level, which promote collaborative action for common priorities. The Marine Science programme involves seven regions in Spain, half in the Atlantic and half in the Mediterranean, where they are deploying joint research and innovation strategies to address the current and future challenges for restoring the Ocean around Spain. He then explained the three main lines of action of the programme: implementing sustained and integrated observations and monitoring of the marine ecosystems in Galicia; providing healthy and sustainable seafood from aquaculture; and developing methodologies and mechanisms to promote social and economic transformation. He ended by stating that even though they are working regionally, they always aim to build a better global Ocean, therefore he invited other European Union regions taking similar initiatives to work with them.

Javier Ruiz (Director of the Spanish Institute of Oceanography (IEO-CSIC)) explained that the importance of having a science-policy interface is to translate scientific knowledge into a format that is easy to understand for policymakers, and to facilitate better-informed decisions. He specified that IEO's assigned role is to provide scientific advice to the Spanish authorities in management of marine ecosystem issues, so although it is not a political body, it is a recognised political actor. Providing good scientific advice requires expertise and credibility, and advisors need a record of rigorous and impartial research. Independence is essential for providing unbiased advice, so there must not be undue influence from political, commercial, or ideological interests. He said that science must be peer-reviewed, and open, and must have a long-term focus with clear communication and ethical considerations. He acknowledged that many of these elements are already incorporated into the Vigo Declaration. Policymakers, he stated, are not in conflict with scientists in promoting sustainability and other science-based goals. While the current mechanism ensures that decisions are made based on science, there are still complaints about the scientific viewpoint from the public and private actors. He also warned that the scientific community may not always have the independence it currently enjoys in Europe. He advised the younger generation that more experienced colleagues have learnt the need to be strong in their convictions, and to not be swayed by political pressure during their careers.

Andreea Strachinescu (Head of Maritime Innovation, Marine Knowledge and Investment Unit at the Directorate-General for Maritime Affairs and Fisheries (DG MARE) of the European Commission) highlighted the three priorities to focus on for the future. She stated that the Digital Twin of the Ocean will provide knowledge needed to manage land-sea interactions, but more work is needed. She emphasised that marine and freshwater researchers need to cooperate. The second priority she identified was that more coordination is needed for Ocean observations. She identified ways in which Europe is working to improve this. The European Digital Twin of the Ocean will improve efficiency in observations and bring the data into alignment with the FAIR (Findability, Accessibility, Interoperability, and Reusability) principles. She believes that Europe can lead the world in this area. The third priority is the commitment of citizens. Projects have to include communities as beneficiaries. She emphasised that there is a requirement that projects share their work with associated regions to help the spread of new ideas. This will lead to citizens committing to change. We can only make change when we speak with one voice. She concluded that success depends on working together.

21 https://www.ciencia.gob.es/en/Estrategias-y-Planes/Plan-de-Recuperacion-Transformacion-y-Resiliencia-PRTR/Planes-complementarios-con-CCAA.html

Gilles Lericolais gave a farewell message to all conference participants. He hoped that they will now be able to speak with one voice. He emphasised the important role scientists can play in changing society, and how they can provide objective information without taking politics into consideration. He gave examples of how scientists can affect change by bringing their knowledge to the attention of policymakers. The speakers, he noted, have illustrated the need to bring science to policy and have shared this vision with the EurOCEAN participants. The science that the participants are doing is very important for informing policymakers and the participants should continue making knowledge accessible to them. He expressed his belief that all of the organisations participating in EurOCEAN are already moving in the same direction and speaking with one voice. He closed by thanking all of the participants, moderators, panellists, and speakers, as well as the staff who made the event possible, and last but not least the organisers and contributing organisations for their efforts.

Vigo Declaration

Speaking with One Voice to achieve the One Ocean we want.

The Vigo Declaration, adopted at the EurOCEAN 2023 Conference, emphasises the urgent need for Europe to lead in protecting the Ocean amidst challenges such as climate change, pollution, and biodiversity loss. It calls for integrated land-sea policies, sustained and better-coordinated Ocean observation, and active citizen engagement to promote Ocean literacy and sustainability. The European marine science community commits to providing transdisciplinary, science-based policy advice, as well as to support the EU Mission: Restore our Ocean and Waters and the UN Decade of Ocean Science for Sustainable. The Declaration advocates for a cohesive global effort, ensuring equitable and sustainable management of Ocean resources.

In the Declaration, the marine science community, represented by the chairs of the main European marine science networks (European Marine Board, JPI Oceans, EuroMarine, EurOcean, EuroGOOS) calls for:

1. Integrated land-sea policies and management: European, regional, and national governments should ensure that the Integrated Maritime Policy is aligned with land policies for coherent, adaptive management of socio-ecological systems that address multiple-stressors including pollution, climate change impacts and biodiversity loss.
2. Sustained and better coordinated Ocean observation: Policymakers and science funders at all levels of governance should recognise and support the essential role of coordinated Ocean observations to deliver Ocean Knowledge, and an open, accessible, and fit-for-purpose European Digital Twin of the Ocean.
3. Committed citizens: Science funders and scientific institutions should support all forms of citizen engagement including Ocean literacy, science communication, citizen science, the arts, and sporting events that focus on Ocean literacy, to ensure citizen's empathy towards the Ocean and engagement in Ocean sustainability solutions.

The Vigo Declaration was signed by the Chairs of the co-hosting networks at the final session of the EurOCEAN 2023 Conference.

The EurOCEAN 2023 conference was an official event of the Spanish Presidency of the Council of the European Union.

SPANISH PRESIDENCY
COUNCIL OF THE EUROPEAN UNION

The EurOCEAN 2023 conference supports the EU Mission: Restore our Ocean and Waters by 2030 and the UN Decade of Ocean Science for Sustainable Development.

2021 2030 United Nations Decade of Ocean Science for Sustainable Development

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