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Human health, wealth require expanded marine science, experts say

In Rome, European experts publish a 'common vision' of priorities for marine research and action through 2020

Some 340 European scientists, policy-makers and other experts representing 143 organizations from 31 countries spoke with one voice today, publishing a common vision of today's most pressing marine-related health and economic threats and opportunities.

In a declaration concluding a three day meeting in Rome, EurOCEAN 2014 participants also released an agreed, five-year roadmap to achieve expanded, more integrated and effective policy-oriented ocean scrutiny.

EurOCEAN 2014 was convened by the Italian Presidency of the Council of the European Union, the European Marine Board, the European Commission and three esteemed Italian partner institutions: the National Research Council, National Inter-university Consortium for Ocean Science (CoNISMa) and the National Institute of Oceanography and Experimental Geophysics (OGS).

In addition to a rising tide of ocean-related threats to human health and economics, the conference statement points to major opportunities in such areas as marine biotechnology, offshore energy, and sustainable aquaculture to create much-needed jobs after one of the worst economic crises in recent history.

Making such "blue growth" sustainable, however, requires a greater investment in science — research to deliver knowledge, tools and advice on sustainable management of marine resources and a better understanding of ecosystems underpinning the maritime economy.

Demands on the seas for food, energy, raw materials and transport are steadily increasing, the statement notes. And while oceans "can provide solutions to many European and global policy challenges ... (they) are neither inexhaustible nor immune to damage. In the context of rapid global change and human population growth, it is imperative to balance economic benefit with environmental protection and human wellbeing."

"As a research community, it's now time to reassess and reinvigorate our efforts to support these policy ambitions."

Says Jan Mees, Chair of the European Marine Board: "To truly progress our knowledge, European scientists across a broad range of disciplines and domains must make a quantum leap towards holistic approaches and integrated research on a scale which will help us to much better understand, protect, manage and sustainably exploit the seas and oceans which surround us. This is a Grand Challenge; not just Europe, but for human society as a whole."

He notes that the estimated gross value added of the European maritime economy is €500 billion per year. An investment reflecting just 1% of that value would equate to €5 billion in research in Europe, more than double the current level of €2 billion.

Participants identified four high-level policy goals:

1. Valuing the ocean

Promoting a wider understanding of the importance of the seas and oceans in the everyday lives of European citizens.

2. Capitalizing on European leadership

Building on our strengths to reinforce Europe's position as a global leader in marine science and technology

3. Advancing ocean knowledge

Building a much greater knowledge base through ocean observation and fundamental and applied research

4. Breaking scientific barriers

Addressing the complex challenges of blue growth and ocean sustainability by combining expertise and drawing from a full range of scientific disciplines.

Among top priorities in the 18-point action plan:

A coordinated interdisciplinary and integrated programme on Oceans and Human Health, understanding and managing the risks and benefits of our interactions with the seas

A major increase in the promotion of ocean education and literacy, using best practice in communication, training and social marketing. (A recent study of 700 Canadian students showed better informed citizens are also more interested in learning about maritime jobs and careers.)

Advanced and agreed mechanisms for attaching monetary and non-monetary value systems to marine ecosystem services and benefits for use in management and decision-making;

- A coherent blend of fundamental research and industry-driven and policy-oriented research;
- A significant further investment in collaborative marine research in Europe, designed to address complex challenges to sustainably manage our ocean resources;
- Fast-tracked funding support, combining a diverse range of funding mechanisms, for the construction and long-term operation of key marine research infrastructures, addressing identified gaps, in particular the further development of a technologically advanced and integrated European Ocean Observing System (EOOS), compatible within the global observing infrastructure;

A recognition that seas and oceans research cuts across all research domains which requires cross-cutting research initiatives to address complex challenges;

Practical incentives for researchers to engage and work with colleagues in different disciplines and sectors (including industry) across the full range of natural, social and economic sciences.

Says the declaration: "With a coherent and targeted support from the EU and members States, it is possible to achieve an integrated research effort, supported by world-class infrastructures and data, delivering knowledge, tools, solutions and policy options towards achieving GES, driving Blue Growth and cementing Europe's global leadership in marine and maritime science.

"With this vision, the European marine science community calls on the support of Member and Associated States, the European Commission and Parliament to shape together the future agenda for marine research."

Appended: Text of the statement in full

Linking Oceans and Human Health

In a recent paper, European Marine Board scientists point to a host of emerging human health issues requiring accelerated research.

The increase in man-made toxic nanoparticles and micro-plastic marine pollution as well as concerns emerging about higher seawater temperatures leading to the transformation of chemical pollutants into degradation products that may represent an additional problem with regard to toxicity, are among new perils to human health cited.

On the other hand, rising water temperatures may reduce the toxicity of some organic pollutants, such as pesticides and aromatic hydrocarbons through more rapid "ageing" by oxidation in the environment or in living organisms.

"This complex antagonism between the positive and negative effects of increasing water temperatures requires significant further research, not least to assist in the generation of more accurate predictions on the future consequences of climate change in the marine environment and the implications for human health."

More familiar water temperature-related concerns include the changing distribution of fish stocks, impacting livelihoods and diet, and more frequent and intense harmful algal blooms.

Micro-plastic pollution, also called "plastic dust," fragments less than 5mm in diameter now found throughout the marine environment.

"In a recent investigation by the University of Ghent, mussels retrieved from the North Sea contained about one particle of microplastic per gramme of tissue. Particles can enter the human blood circulation and can even be transferred through the placenta after consumption of mussels with microplastic contaminants."

Chemical pollution of the sea: Of the approximately 100,000 chemicals produced for sale in Europe, about 30,000 are produced in volumes of one tonne or more per year and have been on the market for more than 20 years.

"The list of substances classified by the American Chemical Society as toxic includes more than 282,000 compounds. Yet, the number of chemicals normally analyzed during characterization campaigns is around 100-120 compounds."

Nanoparticles: "The toxicity of a new class of emerging contaminants called nanoparticles, i.e. particles with a size ranging from 1nm to 100nm in at least one dimension, is based not only on their chemical composition but on their physical characteristics of shape and size. Nanoparticles (both inorganic and organic) have been shown to be toxic for animals, plants and microbes."

Toxic phytoplankton: Phytoplankton organisms can harm human health in two ways: through the production of potent biotoxins, or through the production of massive blooms which result in oxygen depletion leading to mass mortality of marine life.

"To date, of the 5000 known algal species, more than 300 have been listed as being toxic or harmful."

Ocean-related extreme events, including tsunamis, hurricanes and cyclones, leading to trauma, drowning, starvation, water and vector-borne disease, mental illness and malnutrition.

Sea-level rise and acidification, destroying fish habitats and nursery grounds, decreasing nutrition and occupational opportunities, saltwater intrusion into freshwater supplies and the release of toxic and other wastes caused by inundation of coastal landfill sites.

Viruses: A large, diverse group of viruses in the ocean cause human gastroenteritis; others such as poliovirus or Hepatitis A virus, grow in the human gut but produce their main clinical symptoms elsewhere. "Unlike bacterial and protozoal pathogens, the viruses which are recognized to be potentially transmitted via seawater are generally human in origin. Thus the role of the sea is in recycling human viruses back to humans."

Aquaculture: Concerns include the impact on human health of replacing fish oil feed aquaculture with alternatives due to declining pelagic fish oil sources.

Blue Gym: The paper underscores that a healthy marine environment is the source of health benefits, of course: healthy food, pharmaceuticals and related products derived from marine organisms, and recently-documented contribution to physical and mental well-being from a close association with the coastal environment — the "Blue Gym" effect.

According to the European Marine Board, needed to produce a coordinated, integrated and interdisciplinary programme on oceans and human health are community and human capacity building, greater international cooperation, strategic analysis and policy assessment, and stronger stakeholder engagement.

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Rome Declaration

Setting a vision for seas and ocean science:

Delivering impact, global leadership and sustainable blue growth for Europe

Europe is emerging from the worst financial crisis in recent history. Rebuilding our economies demands that we identify sustainable opportunities for jobs and economic growth. The ocean is a source of food, water, energy and raw materials, a medium for tourism, transport and commerce, and can provide solutions to many European and global policy challenges. But the ocean is neither inexhaustible nor immune to damage. In the context of rapid global change and human population growth, it is imperative to achieve human wellbeing by combining economic benefit with environmental protection. This presents a highly complex challenge. Collaborative and cross-disciplinary European research is the key to providing the knowledge and tools that we need to achieve ecosystem-based management and protection of valuable marine resources and services.

The four Rome Declaration Goals

1. Valuing the ocean

Promoting a wider awareness and understanding of the importance of the seas and ocean in the everyday lives of European citizens.

2. Capitalizing on European leadership

Building on our strengths to reinforce Europe's position as a global leader in marine science and technology

3. Advancing ocean knowledge

Building a greater knowledge base through ocean observation and fundamental and applied research

4. Breaking barriers

Addressing the complex challenges of blue growth and ocean sustainability by combining expertise and drawing from a range of scientific disciplines and stakeholders.

Connecting science, policy and people

Since the launch of the European Research Area in 2000, substantial progress has been made in integrating European marine science. This progress is based on a simple premise: that we can achieve greater impact if we work together, transcending national barriers to scientific cooperation. EU policy developments have significantly advanced an integrated approach to managing maritime space and resources. The EU integrated Maritime Policy, its environmental pillar, the Marine Strategy Framework Directive, the Maritime Spatial Planning Directive, and reformed Common Fisheries Policy, have provided a powerful basis for Member State cooperation in addressing shared maritime challenges and responsibilities. Furthermore, the Blue Growth Strategy has set in context the contribution that science can make to develop a sustainable European maritime economy.

A recent policy statement by the new European Commission President¹, highlights the need to focus on the key challenges ahead for our economies and societies, *"be it with regard to the digital age, the race for innovation and skills, the scarcity of natural resources, the safety of our food, the cost of energy, the impact of climate change, the ageing of our population or the pain and poverty at Europe's external borders."*

¹ A New Start for Europe: My Agenda for Jobs, Growth, Fairness and Democratic Change. Political Guidelines for the Next European Commission, Jean-Claude Juncker, Strasbourg, 15 July 2014 (http://ec.europa.eu/about/juncker-commission/docs/pg_en.pdf)

This Declaration is a statement of intent by Europe's marine scientific community for how we can work together in the next five years to undertake more integrated science; understanding stakeholder needs, underpinning policy needs, environmental sustainability, targeted societal impact and advancing European leadership in a global context. We call on Member and Associated States, the European Commission and Parliament, the European Investment Bank, and the private sector to support us in promoting the following four high-level goals and associated actions:

1. Valuing the ocean

Goal: Promoting a wider awareness and understanding of the importance of the seas and ocean in the everyday lives of European citizens.

With the global population set to reach 9 billion people by 2050, we need new ways to provide food and energy and to ensure a safe and sustainable use of marine space. But many people have little awareness of the importance of the seas and ocean in their daily lives; the impact these have on human wellbeing; their role in global change; the importance of the maritime economy; the rich natural and cultural heritage; and the need to protect vital ocean resources. By achieving a transformation in appreciation and understanding of the ocean's role across society as a whole, we can create better conditions for investment and sustainable blue growth.

We call for:

- Sustained support for ocean literacy, best practice in science communication, citizen science initiatives and knowledge transfer to be embedded in marine research projects and programmes;
- A coordinated, cross-disciplinary and integrated programme on *Oceans and Human Health*, targeted at understanding and managing the risks and benefits to human physical and mental wellbeing from interactions with the seas;
- Further initiatives towards advanced and agreed methodologies for the evaluation and use of monetary and non-monetary (e.g. cultural, recreational, health promotion, etc.) value systems and indicators for marine ecosystem services and benefits;
- Recognition that regional seas diversity from the Atlantic Ocean and its links with the Arctic, to the Baltic Sea, North Sea, Black Sea, and outermost areas, is a European asset to be valued to promote Blue Growth. The specificity and sensitivity of the Mediterranean Sea calls for particular attention which is acknowledged by the proposed Blue Growth Research and Innovation Initiative for the Mediterranean.

2. Capitalizing on European leadership

Goal: Building on our strengths to reinforce Europe's position as a global leader in marine science and technology

Europe is a truly maritime continent with an ocean jurisdiction that includes the largest part of the world's exclusive economic zone (EEZ). We are world leaders in shipping and ship-building, dredging, subsea drilling and mining technologies, ocean energy technologies, coastal tourism, seafood production systems, and have significant potential in blue biotechnology and ocean renewables. We are also developing and implementing advanced policies and practices for responsible management of our seas.

In the research domain, we are leaders in key fields in marine and maritime science and engineering. European nations own and operate the most advanced research fleet in the world and we are continually expanding our ocean observation capacities, a key goal of the EU Marine Knowledge 2020 initiative. Added to this, through EU Framework Programmes and coordinated national investments, Europe has built an unparalleled know-how in organizing research at international scale. With European leadership and expertise comes an opportunity and responsibility to foster a global perspective, engage in international dialogue, and exercise influence for the sustainable management of global ocean resources

and services. To maintain our leadership and competitive advantage will require advanced knowledge and innovation.

We call for:

- A detailed assessment of whether the current level of European investment in marine and maritime research is sufficient, given the high value and importance of the European maritime economy²;
- Support for the development of public-private partnerships in research and innovation, focusing on strategic technologies, including data sharing, to underpin growth and jobs in crucial sectors for a resilient knowledge-based European blue economy and society;
- Increased support for collaborative research with partner countries, overcoming barriers to joint funding and capacity building, taking account of the progress already made by the Transatlantic Ocean Research Alliance³;
- Further development of transparent mechanisms for the use of science in supporting evidence-based policy-making.

3. Advancing ocean knowledge

Goal: Building a greater knowledge base through ocean observation and fundamental and applied research

Recent advances in our knowledge of the marine environment have served to illustrate the sheer complexity of the ocean, the enormous and changing diversity of marine life, and the interplay between ecological, biogeochemical, physical and social processes which regulate the ocean ecosystem. There remains a significant challenge to understand and quantify the role of the ocean in the Earth system and its influence on human populations on timescales from days to centuries, and on spatial scales from local to global. We urgently need to further map marine environments, to understand complex marine processes, to study the complex interactions between the ocean, seafloor and sub-seafloor, land, ice and atmosphere, to predict and prepare for future changes and cumulative impacts resulting from human and natural pressures. Moreover, actions are needed to address the rapidly-growing opportunities and challenges in advanced ocean measurement technology and effective management of increasing volumes and diversity of information and physical, chemical and biological data from marine observing systems that are fit for purpose including being capable of informing assessments of good environmental status.

We call for:

- The inclusion of marine and maritime research topics across the full range of societal challenges in Horizon 2020 and across multiple thematic levels in national and regional research programmes;
- A significant further investment in collaborative cross-disciplinary research and technology development, designed to address complex challenges towards sustainably managing our ocean resources, identifying scenarios of change and associated adaptive strategies, and achieving Good Environmental Status in European regional seas;
- Better alignment and more effective use of a diverse range of funding and coordination mechanisms (including ESFRI, EU investment and structural funds), for the construction and long-term operation of key marine research infrastructures and facilities, addressing identified gaps.
- A fully operational EMODnet, ensuring collected data are well managed and freely available, to support science, industry and policy, aligned with further development of the European Ocean Observing System (EOOS), integrated at the global level (including GOOS, GEO, Copernicus).

² The combined annual EU research investment in marine and maritime research is currently estimated at €2 billion. The EU Blue Growth Strategy estimates the gross value added (GVA) of the European maritime economy at €500 billion per year. The Barcelona target commits the EU to increasing its research investment to 3% of GDP, one third of which (i.e. 1%) should come from the public sector. In terms of the maritime economy, 1% would equate to a €5 billion annual investment, more than double the current level of investment.

³ Galway Statement on Atlantic Ocean Cooperation. Launching a European Union – Canada – United States of America Research Alliance. (<http://ec.europa.eu/research/iscp/index.cfm?lg=en&pg=transatlantic-alliance>)

4. Breaking barriers

Goal: Addressing the complex challenges of blue growth and ocean sustainability by combining expertise and drawing from a range of scientific disciplines and stakeholders.

By charting an ambitious course and continuing to break down barriers (disciplinary, practical, cultural, financial, legal and political), the European seas and ocean research community can set a standard for the broader European research community. We already have a strong track record in working together, but we aim to go further by transforming the way we do training and research; focusing on impact, engaging with stakeholders, creating a platform for sustainability, and boosting jobs. Innovation in the provision of undergraduate and postgraduate training and enhancing skill sets and career pathways for marine professionals will be essential, in line with the EC Communication on Innovation in the Blue Economy.

We call for:

- Education and training to encompass and foster cross-disciplinary training, the ability to work across science-policy interfaces, team-based approaches, entrepreneurship, and the broad range of specialist technical and ICT skills needed to underpin modern marine science;
- Improved support, incentives, and recognition from higher education and research institutions, funding agencies, and professional bodies, for established researchers to undertake cross-disciplinary research and to engage with stakeholders and society;
- Europe to be the most attractive place for top talent by offering an internationally competitive environment, innovative career pathways across sectors, mobility, and blue jobs.

The EurOCEAN 2014 legacy: A vision for seas and ocean science in Europe

The European marine science and technology community can provide a crucial service to wider society, directly addressing the most pressing questions, including food, water and energy security, climate change and human wellbeing. Marine and maritime science can contribute towards advancing international sustainable development goals, supporting new jobs and growth, promoting resource efficiency including the circular economy, and achieving Good Environmental Status in European waters. A more detailed analysis of strategic research priorities in seas and oceans science is set out in the Navigating the Future IV⁴ paper, a key reference for the next research programmes at EU, macro-regional and Member State level.

With this vision, the European marine science community calls for the augmented, coherent and targeted support of Member and Associated States, the European Commission and Parliament, the European Investment Bank and the private sector, to shape together the future agenda for seas and ocean research.

The Rome Declaration was adopted at the EurOCEAN 2014 Conference, Rome, 08 October 2014.

The logo for EurOCEAN 2014 features the text "EurOCEAN" in a blue, sans-serif font, with "2014" in a smaller font to the right. A blue wavy line underlines the text.

⁴ European Marine Board (2013). Navigating the Future IV. Position Paper 20 of the European Marine Board, Ostend, Belgium. ISBN: 9789082093100 (www.marineboard.eu/images/publications/Navigating%20the%20Future%20IV-168.pdf).