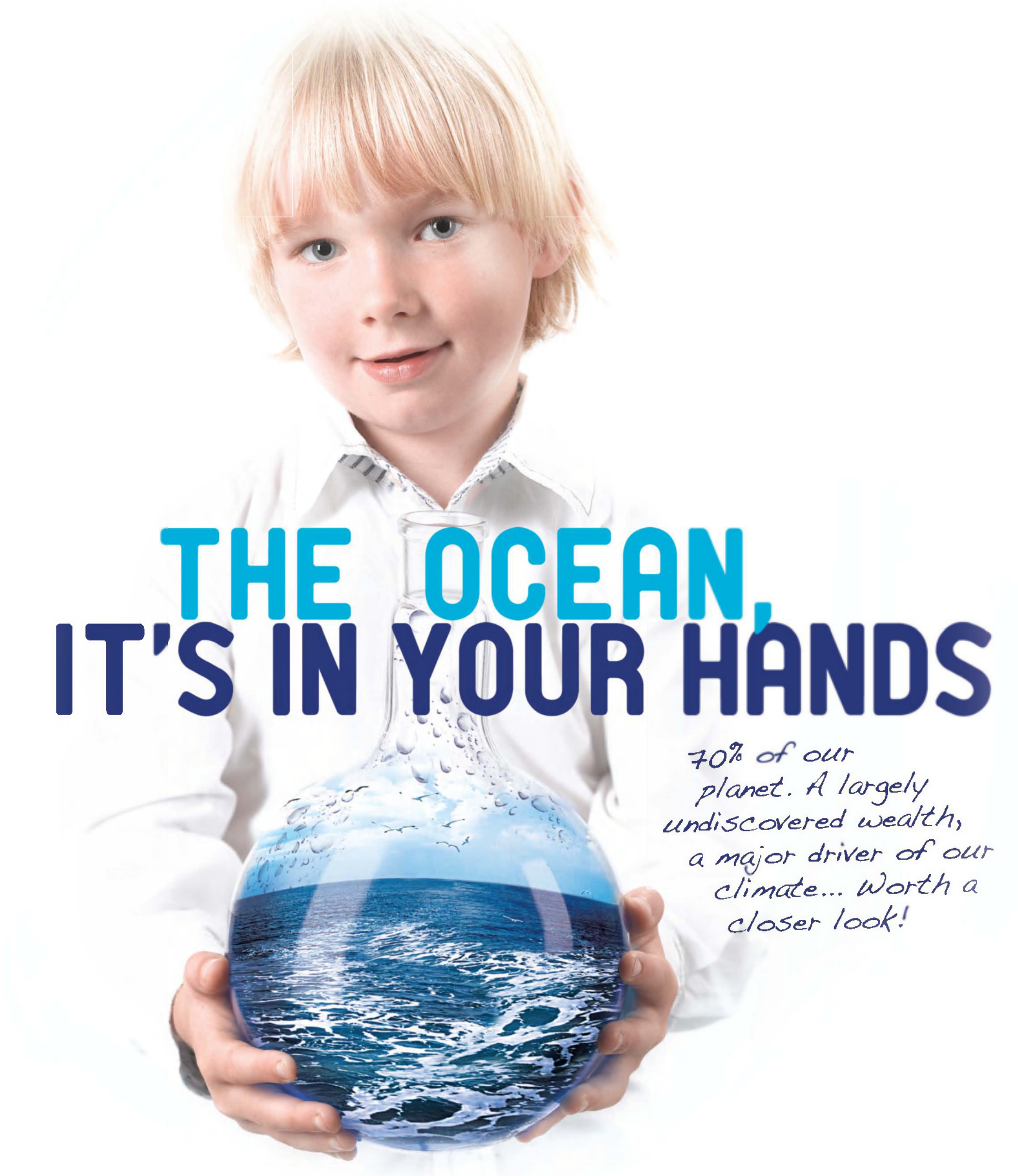

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BOOK OF ABSTRACTS

EurOCEAN 2010

Grand Challenges for Marine Research in the Next Decade

Thermae Palace, Oostende, 12-13 October 2010

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Organised by

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EurOCEAN 2010 – GRAND CHALLENGES FOR MARINE RESEARCH IN THE NEXT DECADE

The EurOCEAN 2010 Conference (Ostend, 12-13 October 2010) provides a unique opportunity for the European marine science community to consider, discuss and respond to new policy developments and achievements since the last EurOCEAN Conference (2007, Aberdeen), and to highlight new challenges and opportunities for marine research in the next decade. The EurOCEAN 2010 Conference and Ostend Declaration (October 2010) comes at a crucial time for the European marine science community to influence how marine science is supported in Europe in the coming decade. It provides a timely opportunity to reinforce the importance of marine science in effective maritime policy making and the key role it will play in the path towards economic growth and recovery in Europe.

EurOCEAN 2010 is a Belgian EU Presidency event, organised in close collaboration with the European Commission and the Marine Board-ESF.

EurOCEAN Conferences are major European marine science policy conferences providing a forum for policy makers and strategic planners both at European and Member State level to interface with the marine research community and marine and maritime stakeholders.

The EurOCEAN 2010 Conference is the 7th Conference in the very successful series of EurOCEAN / MAST Days Conferences which started more than 15 years ago. Previous EurOCEAN Conferences were held in Brussels (1994), Sorrento (1996), Lisbon (1998), Hamburg (2000), Galway (2004), and Aberdeen (2007).

The EurOCEAN 2004 Conference was jointly organised by the European Commission, the 2004 Irish Presidency of the European Union and the Marine Board-ESF. Aside from presenting a wide range of Marine Science challenges and opportunities, it reviewed progress towards a European Research Area for marine science and technology and examined ways to achieve further integration in Europe. The high-level messages from the EurOCEAN 2004 Conference were communicated for the first time through a Conference Declaration, which became known as the "Galway Declaration".

The EurOCEAN 2007 Conference (Aberdeen, Scotland, 22nd June 2007), took place during the final phase of a public consultation process on the EU Green Paper "Towards a future for the Union: A European Vision for the Oceans and Seas", and provided a unique opportunity for the European Marine and Maritime Science Communities to respond through the "Aberdeen Declaration".

The messages from both the Galway (2004) and Aberdeen (2007) Declarations were primarily targeted at the European Commission. The overarching goal of the Galway Declaration was to ensure that critical areas in marine science were adequately supported in the 6th and 7th Framework Programmes. The overarching goal of the Aberdeen Declaration was to embed marine science as a central pillar of a future Integrated Maritime Policy (IMP) for Europe and to call for a European Strategy for Marine and Maritime Research as an integral part the IMP.

EurOCEAN 2010 aims to continue the tradition of the Galway and Aberdeen Conferences with the adoption, during the final session of the conference, of an "Ostend Declaration". This Declaration represents a call from the European marine science community for specific actions from the Member States and the European Union in support of essential marine science and technology research challenges in the coming decade (2010-2020).

Further information on the EurOCEAN 2010 Conference and the Ostend Declaration is available at: www.eurocean2010.eu

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SESSION 1

SCIENCE AND THE SEA: LESSONS FOR THE ROAD AHEAD

Session Chair: Manuela Soares, European Commission,
Directorate-General for Research

THE INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION: FIFTY YEARS OF INTERNATIONAL COOPERATION IN OCEAN SCIENCE, SERVICES AND CAPACITY-BUILDING

Wendy Watson-Wright

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Established in 1960 as a body with functional autonomy within the United Nations Educational, Scientific and Cultural Organization (UNESCO), the Intergovernmental Oceanographic Commission (IOC) serves as the focal point in the UN System for ocean observations, science, services and data exchange and it is recognized by the United Nations Convention on the Law of the Sea (UNCLOS) as the competent international organization for marine science. IOC provides a significant contribution to the work of the United Nations Framework Convention on Climate Change (UNFCCC) and the United Nations Convention on Biological Diversity (CBD) and is an active member of the United Nations coordination mechanism on ocean affairs, UN-Oceans.

After the International Indian Ocean Expedition (1959–65), among the most notable achievements of the IOC are the establishment of the International Oceanographic Data Exchange (IODE) programme (1960), the World Ocean Circulation Experiment (WOCE) (1988-1998), the Global Ocean Observing System (GOOS) (1990), the Global Sea Level Observing System (GLOSS) (1996), and regional tsunami warning systems (2005).

Today the Intergovernmental Oceanographic Commission of UNESCO is providing coordination and expertise on climate change and variability of the oceans, on consequences of ocean warming and ocean acidification, on monitoring marine biodiversity, on management and demarcation of Marine Protected Areas, Marine Spatial Planning, and other management tools, among other emerging issues.

With this mission, IOC is engaged in generating credible and timely scientific information as a necessary asset for nations to engage in the process of responding to the global challenges that affect the marine and coastal environments. Better science linked to improved risk management and adaptive management strategies will help scientists and policy makers cope with the range of expected impacts and the high levels of uncertainty related to mitigation and adaptation alternatives.

FROM GALWAY TO ABERDEEN... TO OOSTENDE – PROGRESS IN MARINE AND MARITIME SCIENCE POLICY

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The Galway Declaration was a spontaneous response of the 2004 EurOCEAN Conference held in Galway in the same year. It represented, for the first time, the clear and unified voice of the European Marine Science Community. And, of equal importance, its message fell on fertile ground.

The aim of this presentation is to trace the path and achievements from Galway in 2004 through Aberdeen in 2007 and here to Oostende in 2010. As such, this presentation provides an important backdrop and introduction to the Ostend Declaration which we will discuss and hopefully adopt during the Conference.

The initial aim of the Galway Declaration was simple – to emphasise the importance of the European Seas and Oceans to the global economy and ecology, and to make a case that this be reflected in the content and scope of the EU's 7th Framework Programme (2007-2013).

Subsequently, the Galway Declaration had a more far reaching effect. Together with the Aberdeen Declaration, it represented the unified voice of European marine and maritime research communities, providing a catalyst to encourage and reinforce efforts within the Commission and Member States, and in particular in DG MARE, to forge ahead with an *Integrated Maritime Policy for the European Union* finally adopted in 2007 and a *European Strategy for Marine and Maritime Research* (2008) which reinforced research as one of the main pillars of the Integrated Maritime Policy.

In parallel, active collaboration between the major European marine and maritime research networks, not only at the Galway and Aberdeen conferences, but at linked conferences and workshops in Brussels (September 2004, October 2005, January 2007), in Bremen (May 2007) and in Lisbon (October 2007) paved the way for the designation of '*Marine science and technology as a priority cross-cutting theme in FP7*'. This in turn opened up opportunities for collaborative marine research across a number of FP7 themes (e.g. food, ICT, energy, environment, transport, etc.) and the launch in 2009 of the *FP7 Ocean of Tomorrow* initiative.

Perhaps one of the greatest lessons learned on the road from Galway to Oostende is that the European Marine and Maritime Research Communities can achieve far more by working together with a common voice, a concept echoed in the *European Research Area* initiative.

Of equal importance is having *the right message, in the right place, at the right time*. Thus the challenge for Oostende is to demonstrate how marine and maritime research can contribute to the challenges of economic recovery, food and energy security, climate change and sustainable development – in essence the *Europe 2020 Strategy*.

MARINE SCIENCE CONTRIBUTION TO SOCIETY AND INDUSTRY

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Seas and Oceans are of major importance for Europe's economic, social and environmental development, and marine sciences and technologies are critical for addressing future global challenges. These challenges include protection of the environment and, in particular, fragile ecosystems, the increasing need for raw materials and energy, and the prevention of natural and anthropogenic risks.

To properly address these challenges, actors from society, industry and the scientific community must be jointly mobilised. Examples will be used here to illustrate how marine science can make a difference in areas such as exploration of the deep sea, the exploitation of mineral and fossil energy resources, marine renewable energy, and blue biotechnology with its numerous potential contributions to societal needs (food, health, energy, marine environment). Opportunities for innovation by small and medium enterprises will also be discussed including, for example, aquaculture development to counterbalance fishing overexploitation. This will require a more pronounced research support to boost European competitiveness. Also critical will be the sustained monitoring of marine environments and ecosystems, which blends the needs for more scientific knowledge with the operational monitoring to address institutional obligations and the validation of technologies to be developed with industry.

In addition we should not forget a major cross-cutting challenge: the supply and access to all marine data and related scientific information. Such data has been traditionally collected by the scientific community to meet its own research needs but observational data and information is becoming increasingly operational and open to all end-users. A new model, able to promote a better linkage of the actors from research, technology and the wider community of users needs to be developed.

To conclude, we face a growing number of complex challenges, which will require a much better networking of all the concerned actors. Through the implementation of a European Joint Programming Initiative of the Member States for 'Healthy and productive seas and oceans', the setting of common platforms and public/private alliances with partners from the maritime and the industrial sectors, the provision for scientific expertise in support to public policies, marine sciences can contribute to these critical and challenging issues.

SCIENCE DRIVING A BETTER MARITIME GOVERNANCE

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Scientific knowledge is the indispensable basis for our management of the marine environment. The development of such knowledge requires that monitoring and research is conducted and that the data generated by these scientific programmes be evaluated using relevant assessment criteria. Where appropriate, targets can be set within the context of a suitable indicator. Finally, the outcomes of the assessment need to be presented in a clear and concise manner such that those responsible for maritime governance can readily understand and act on the scientifically based conclusions. This is made all the more critical by the international nature of maritime governance and the need for collaboration and cooperation across nations that border a particular sea area. Improved scientific assessments, and means of presenting such assessments, have, over recent years, allowed decision makers to better understand status and trends and thus influence their thinking and actions.

Across the North East Atlantic (OSPAR Convention) and wider European waters (European Marine Strategy Framework Directive 2008/56/EC), there is a shared vision of seas which are clean, healthy, safe, productive and biologically diverse. This vision is variously phrased but the sentiments are common. To deliver such a vision requires science-based governance because our seas host an ever-growing number of human activities as well as experiencing the impacts of climate change. There is a need to know how our seas are responding to these pressures and whether or not our responses are working. Science-based maritime governance has driven changes such that there has been a reduction in emissions, discharges and losses of chemicals to our seas, adverse effects of the anti-fouling agent tributyltin (TBT) are decreasing in response to the global ban and levels of radioactive substances in the marine environment have dropped in some areas. However, exploitation of many fish stocks continues beyond sustainable levels, the UN target of reducing the loss of biodiversity by 2010 is far from being achieved in the North-East Atlantic and heavy metals remain at unacceptable concentrations in sediments, fish and shellfish in some areas of the North-East Atlantic. As such, there is a clear need for action which must be supported by sound monitoring, research and assessment to ensure that further actions result in the desired changes.

During 2010 the OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic will publish the Quality Status Report 2010 (OSPAR 2010) which reflects the collective effort made by OSPAR Contracting Parties over the period 1998 to 2008 to manage, monitor and assess the many pressures on the diverse ecosystems of the North-East Atlantic. This scientifically-based report will be used to illustrate not only how such reports in themselves can result in the development of new assessment criteria, original research and fundamentally new approaches to considering cumulative effects, but will also be used to show how scientific data can be presented in an accessible format and how it is also important to look forward with key recommendations targeted at decision makers.

Reference

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A QUESTION OF SCALE – THE REGIONAL SCIENCE APPROACH

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The basic processes in marine biology, chemistry and geophysics are universal, but the scale – globe, ocean, regional sea, lake – is of crucial importance for the functioning, human impact and management of aquatic ecosystems.

The Baltic Sea can be used as an example of how scale-dependent regional characteristics determine system functioning. Biodiversity of the Baltic Sea is low, and food webs are short. Due to the high inflow of fresh water and long residence time, salinity is low creating a unique brackish water chemical environment. The spatio-temporal scales of Baltic Sea hydrodynamics, which are small compared to those of the oceans, have their impact on the horizontal and vertical movement of elements and production.

There are 85 million people living along the shores and catchment area of the Baltic Sea. Human impacts on the system are manifested in the semi-enclosed Baltic Sea with a vast catchment bringing economics, cultural issues and social sciences into the picture. The influence from developed areas (towns, industrial areas, ports, etc.) or economic sectors (transport, energy, agriculture, forestry, etc.) on coastal areas is crucial to properly understand and manage the Baltic Sea and its surroundings. The same applies to impacts of human activities occurring in the catchment as far as a clear cause-and-effect linkage to the environmental problems of the Baltic Sea can be demonstrated.

A regional approach is crucial for understanding and managing marine systems in a holistic way. Given that the environmental management of seas and oceans is regionally organised within UNEP's Regional Seas Programme, Regional Seas Conventions (HELCOM, OSPAR), the EUs Marine Strategy Framework Directive and Common Fisheries Policy, the regional level is the only functioning scale for linking science and policy. In the global context the challenge of linking science and policy is addressed by the Large Marine Ecosystems Programme. Within the European Union appropriate science funding and governance structures to support a regional science approach are under development: in the Baltic Sea the funding cooperation has been institutionalized through the establishment of the 'Baltic Organisations Network of Funding Science EEIG' – BONUS EEIG and starting the BONUS Baltic programme under Article 185 of the EC treaty. The regionally structured ERANET, SEASERA, is developing corresponding governance mechanisms in other regional European seas - the Mediterranean, Black Sea and North Atlantic.

SESSION 2

MARINE SCIENCE 2020: GRAND CHALLENGES AND OPPORTUNITIES FOR THE NEXT DECADE (1)

Session Chair: Mike Thorndyke, Swedish Institute for the Marine Environment, Sweden

THE ROLE OF THE OCEAN IN THE EARTH AND CLIMATE SYSTEM

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Oceans are an integral part of Earth; they are intimately linked to atmosphere and land. Unraveling the links and feedbacks between the different components of the Earth's system is not only scientifically challenging; it is also essential to understand the future of our planet. Another aspect is the vast biodiversity in the ocean. Humankind relies on marine life not only for food but also for natural materials and many ecosystem services. Last but not least, exploring the depths of the oceans opens up an unknown world of trenches, mountains and endless plains and we only have just begun to understand this part of the Earth System.

Global climate models started in the 1970s without taking oceans into account, but step by step a more complex ocean was included in climate models. Now, the next big step will be to integrate marine life in the models in order to arrive at better predictions for CO_2 uptake in the ocean and future climate changes.

Increasing CO_2 in the atmosphere acidifies the ocean, an effect that is independent from other climate change issues. Acidification alters several chemical and biological processes in the ocean, and our understanding of life in a more acidic ocean is still scarce. So far, the largest effects are predicted for the cold polar waters.

Warming of the ocean has numerous effects on ocean currents, stratification, heat transport and distribution of organisms. Particularly obvious is the observed increase in melting of sea ice and glacial ice sheets that lead to shifts in polar eco-systems and sea level rise. Major future problems will therefore arise to a large extent from changes in the polar regions, both Arctic and Antarctic.

The Arctic is warming up twice as fast as the global average; it is therefore an issue of deep concern for the global climate and a topic of intense research. We can consider the Arctic as an early warning indicator for global change. The sea ice cover of the Arctic Ocean has decreased dramatically during the last decades. This development is likely to trigger large changes in physical and biological processes in the Arctic Ocean and to influence global climate. For this reason it is of utmost importance to observe the 'Atlantification' of the Arctic Ocean, monitor changes in sea ice volume and model its future development. Measurements at a long-term deep-sea observation station between Greenland and Spitzbergen show that retreat of sea ice is even felt at the deep-sea floor.

The ocean is not only an essential part of the Earth System, but also of utmost importance for the future of human society. Untapped resources in the ocean are now becoming a target of exploitation. We need to use these resources in a responsible and sustainable way. This is one of the prime tasks of future ocean research.

CREATING A BETTER UNDERSTANDING OF MARINE ECOSYSTEM FUNCTIONING

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European legislation, as existing in the Water Framework Directive (WFD) and being prepared in the Marine Strategy Framework Directive (MSFD), requires knowledge of the ecological status of European marine, coastal and inland waters. Member States must determine the 'good environmental status' of marine waters (MSFD) which should provide ecologically diverse and dynamic oceans and seas which are clean, healthy and productive within their intrinsic conditions, and where the use of the marine environment is at a level that is sustainable.

Good environmental status of the marine waters must be determined, amongst others, on the basis of criteria such as biodiversity, the presence of non-indigenous species, stock health, the food chain, eutrophication, changes in hydrographic conditions and concentrations of contaminants, the amount of waste and noise pollution.

Such criteria are very diverse and not easily combined in a single framework. Some of them are well known whereas others are not and currently subject to research. Moreover, some criteria are difficult to understand for policy makers and legislators, let alone the general public. Marine ecosystems are very complex and are regulated by physical, chemical, geological and biological processes which are all interrelated. Moreover, human impacts depend heavily on local and global socio-economic conditions and are also increasingly changing the functioning of marine ecosystems. Such socio-economic processes also have to be evaluated for their impacts on the marine environment.

There is, therefore, a need for a comprehensive approach to marine ecosystem functioning to provide knowledge at a level that can be understood by stakeholders. The traditional way to provide a framework for studying ecosystems is to start from an ecological model that allows for the combination of physical and biological state variables and processes. Such models can also incorporate interactions between the water column and the atmosphere, as well as benthic-pelagic coupling at the sea floor. However, it is far more difficult to combine such models with biodiversity or human impacts and, the literature on pollution or fisheries for instance is quite specific and separated from the ecological literature.

Besides the necessity to consider a higher number of state variables than can possibly be incorporated in a model, the choice of major processes and parameters is also a difficult one. Recent research on biodiversity, on food webs and on biogeochemical cycles has greatly changed our views on how marine ecosystems function. Both top-down and bottom-up regulations of food webs are important but their relative impact and synergy is unknown. Human impacts have changed from local to global, from pollution and eutrophication to climate change and acidification. Obtaining the relevant knowledge and translating this knowledge into policies for the protection and the sustainable exploitation of the marine environment is a major challenge for the next decade.

OCEANS AND HUMAN HEALTH, AND HUMANS AND OCEAN HEALTH - RISKS AND REMEDIES FROM THE SEA

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Life on earth is fundamentally and inextricably linked to the oceans. Oceanic processes affect climate and determine the food and material resource upon which we depend. How we use the sea can influence those processes to our benefit or detriment. The demands of populations, especially in coastal regions worldwide, may aggravate human influences on the oceans, and increase risks to public health. Understanding the processes and predicting or mitigating the risks, as well as identifying new resources and benefits, requires an integrated approach combining disciplines as disparate as physical oceanography, chemistry, genomics, and epidemiology.

The need for such understanding, prediction and resource discovery as described above led to focused research programs in the US including the novel joint effort between the US National Science Foundation (NSF) and the National Institute of Environmental Health Sciences (NIEHS), which established four Centers for Oceans and Human Health (COHH), and a complementary Oceans and Human Health Initiative (OHHI) by the National Oceanic and Atmospheric Administration. These programs are addressing fundamental biological questions of harmful algal blooms (HAB) and pathogenic organisms in coastal waters, genomic and biological factors determining their abundance, toxicity and pathogenicity, and the hydrodynamic influences on abundance and distribution. The programs have had great success, for example in applying biological advances to forecast blooms of *Alexandrium* red tides, identifying new *Vibrio* pathogens, achieving deep sequencing of microbial communities, establishing sources of pathogens in recreational waters and beaches, development of remote sensing, assessing economic consequences of HAB and pathogen events, and public health benefits deriving from coastal regions. OHH programs also established human pathogen prevalence in marine biota, identified novel therapeutic agents from marine microbes, and are focusing new efforts to understand the significance of cyanobacterial toxins. The Centers established a new Gordon Conference supporting the development of this new integrative field.

The concerns in OHH will not diminish, and meeting the growing challenges will require progress in interconnected areas. Addressing major issues and meeting the growing challenges will depend on: advances in identifying pathogens and other harmful agents (more accurate sensing); advances in technology for sensors (more accurate detection and timely warning); advances in knowledge of chemical toxicant action and dose-response in humans, and identifying the vectors and pathways of microbes and chemicals to humans; advances in epidemiological studies in OHH; advances in screening for novel biologically active agents; advances in policies and practices that encourage health benefits from the sea; advances in applying understanding and technology to address problems in less developed regions, where sometimes problems are much more severe. Based on current indications, frequent communication and collaboration among the leadership and investigators of different Centers will be a significant driver of progress. The ultimate goal of wise use of the oceans, protecting and properly exploiting resources, and serving the public health, requires cooperation, among scientists, agencies, and governments. (Support by: US NIEHS P50 ES012742 and NSF OCE-043072).

DEEP-SEA AND SUB-SEAFLOOR RESEARCH – UNDERSTANDING THE PAST AS A KEY FOR A SUSTAINABLE FUTURE

Achim Kopf

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Although it covers vast expanses of the Earth, the floor of the deep-sea has been studied less than the surface of Mars. Only in recent decades have we begun to really explore it, and to acknowledge the need to comprehensively coordinate research efforts on an international level. What is required now (i.e. within the next decade, or framework programme for that matter) is the establishment of a long-term research approach that considers (i) the sustainable management of the ocean, and particularly the deep-sea in view of increasing human activities (fishery, hydrocarbon exploration); (ii) the necessity to unravel deep-seated geological, biological and chemical processes that drive seafloor ecosystems; and (iii) the value of seabed archives for the reconstruction of paleo-environmental conditions and the improved prediction of future climate change. Such a research approach must fully comply with the needs of society, policymakers and industry and should lead to a sustainable use of the oceans.

Such an approach will offer several important benefits for industry and society, including the transfer of know-how from academic research to industry. This could facilitate, for example, the development of joint ventures dealing with state-of-the-art seagoing technology, or the provision of research results from fields which are of direct commercial interest (e.g. microbiology, hydrothermal ore deposition) or which can identify processes which might have considerable impacts over time (e.g. climate change, submarine landslides, tsunamis).

In any case, both deep-sea exploration and sub-seafloor drilling/sampling by academia can provide two key components in understanding how deep-sea ecosystems currently function, and how they will respond to global change and affect mankind in the future:

a. an inventory of present deep-sea and subsurface processes and biospheres, and their links to surface ecosystems, including seafloor observation and baseline studies, and
b. a high resolution archive of past variations in environmental conditions and biodiversity.

For both components, an international effort is needed to share knowledge, methods and technologies, including mission-specific operations to increase the efficiency, coverage and accuracy of sub-seafloor sampling and exploration (e.g. by tying efforts by the EC and IODP/ECORD).

The deep biosphere has been discovered only within the past two decades and comprises the last major frontier for biological exploration. We lack fundamental knowledge of the composition, diversity, distribution and physiology of sub-seafloor biological communities at Earth's extremes, and their interaction with seafloor ecosystems and life in the deep-sea in general. Equally, there is an emerging need to shed light on geodynamic processes which strongly influence biological activity, and how such processes tie into the emission of geofuels and the formation of hydrocarbons, minerals and other resources. In addition, geodynamic processes may cause natural hazards such as earthquake slip, submarine landslides, or tsunamis with a profound impact on humans and ecosystems. The governing principles and potential triggers for these events are poorly understood, yet they pose a major threat to both deep-sea ecosystems and humans who rely on goods and services from the deep-sea (e.g. seafood, bioactive molecules, oil, gas and minerals) or who live in close proximity to the sea (i.e. >60% of the global population live within the marginal 50km of the continents).

Cross-disciplinary research must underpin Europe's emerging Marine Strategy and Maritime Policy by addressing aspects such as (i) the legal framework related to marine resources (e.g. relatively straightforward for hydrocarbons or minerals, but incredibly complex for microbial medical products); (ii) the socio-economic consequences of their exploitation; and (iii) territorial aspects in the deep-sea, to name just a few. Given the overall cost of seagoing operations and societal demand to exploit the ocean (fishery, minerals, transport, etc.), a synergetic approach across disciplines and borders – potentially tied to larger integrated projects – must follow.

NEW INNOVATIONS IN MARINE SCIENCE AND TECHNOLOGY: EMERGING TECHNOLOGIES... CONVERGING ON THE OCEANS

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The global ocean is critical to the Earth's ecosystem function, central to our continued well-being and to the future prosperity and survival of the human race. The seas and oceans are the heart and lungs of the planet; they represent important trade routes; are a climate regulator and a source of food, energy and recreation. The seas and oceans also face serious threats in terms of over-fishing, loss of biodiversity, climate change impacts and unsustainable exploitation.

Knowledge and understanding is the key to sustainable development and good ocean governance. New knowledge and technologies are emerging daily in all fields of science that facilitate a better understanding of the world in which we live and work. We now have a unique opportunity to harness emerging knowledge and technology from a broad range of sectors and apply it to the seas and oceans – what we term '*emerging technologies... converging on the oceans*'.

New developments, in particular from the Life Science (e.g. eco-genomics, smart sensors), Information & Communications Technology (e.g. cloud/grid computing, digital imaging, etc.) and NanoScience (e.g. miniaturisation, new synthetic materials, etc.) sectors provide an array of possibilities and new innovative tools that can be used to add value to traditional marine sectors, such as in seafood, fisheries and aquaculture, maritime safety and transport, marine leisure and tourism, and can catalyse the creation of new sustainable ocean industries in renewable ocean energy, blue biotechnology and in environmental protection, monitoring and assessment. They can and are also being used in deep-sea exploration, environmental monitoring, climate impact research and are providing solutions to climate change, informing potential mitigation and adaptation strategies.

Incorporating such innovative tools in our marine arsenal, we can begin to realise aims and objectives of the Integrated Maritime Policy, the Marine Strategy Framework Directive (MSFD) and the Europe 2020 Strategy and consolidate Europe's role in global ocean developments and governance.

This presentation will illustrate some of the new and exciting innovations in marine science and technology, borrowed from other disciplines, and emphasise the need to look across scientific disciplines to find new tools to address current marine challenges and opportunities.

REAL-TIME, LONG-TERM INTEGRATED OBSERVATIONS OF EUROPEAN SEAS FOR MONITORING AND RESEARCH

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Marine observations are central to monitoring for societal needs as well as for research to further knowledge and understanding. Applications as diverse as environmental protection, business development, sports and recreation depend on reliable observations of known quality. The observations need to be real-time or near real-time in order to provide timely information to decision-makers.

The observations need to be long-term in order to put the short-term variability in context and detect irregularities. They also need to be long-term in order to detect trends and make assessments on e.g. human impact versus natural variability.

The use of the observations benefit from being integrated in several dimensions: integrated in space and time, integrated between observation platforms including satellites, ships, drifting and moored buoys, integrated between disciplines and primary users, and integrated between nations. For some purposes appropriate integration is best obtained by quite sophisticated model-based data assimilation tools such as those used in MyOcean.

In the marine domain in particular, where so much is yet unexplored and not well understood, there is benefit in connecting observations for research with observations for monitoring. Multidisciplinary co-located observations augment each other. Having additional sensors and parameters available helps explain the observed values of the relatively fewer key or baseline quantities that may be formally required for legal or jurisdictional purposes.

New ways to observe the oceans such as gliders and cable-based observatories provide new opportunities respectively for steering arrays of sensors rapidly into areas of particular interest and for providing continuous high band-width data streams including video from the deep sea
This situation creates formidable challenges and opportunities that Europe has begun to address. Procedures for quality control, data flow and storage benefit from close coordination across many acting institutions. Free access to basic data is crucial for scientific progress and for transparency in the science base for management, but can create problems in sharing of costs. Free and easy access to observations on the other hand creates new market opportunities and stimulates creativity as well as recruitment to marine science and applications. European-scale partnerships between government, industry and research institutions will be crucial to achieve sound and safe use of the oceans in the future.

PROSPECTS FOR A SEABED AND HABITAT MAP OF EUROPE

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In our planning and management of the terrestrial environment, we take for granted the availability of high quality maps, such as those provided by satellite images, which show the terrain and land cover. Yet for decades, the activities in our oceans have been developed and planned with only a scant understanding of the nature of the seabed and its biological resources. It is often said that we know more about the surface of Mars than we do about the seabed around Europe.

The ever increasing uses of our seas place continued demand upon the resources it holds. To use both space and resource wisely, we must plan effectively for its long term sustainable use. This draw on our marine resources is now coupled with increasing policy requirements to protect the marine environment. Perhaps the most significant is the EU Marine Strategy Framework Directive (MSFD), adopted in 2008, which requires Member States to achieve Good Environmental Status (GES) across all European waters by 2020. Achieving GES needs to include protection of biodiversity, including seabed habitats, and maintaining the integrity of the seafloor for ecosystem functioning. The Directive places a specific requirement on Member States to produce maps of special habitat types, whilst effective delivery of the Directive more generally will be hampered without a sound understanding of the nature and distribution of seabed habitats and the pressures upon them from human activities. In addition to MSFD requirements, seabed habitat maps are required to help develop a network of marine protected areas and to support marine spatial planning.

Our level of knowledge on the topography of our seas away from coastal areas (where navigational safety demands high resolution data) is often limited. Our knowledge of seabed sediments is poorer still, whilst the availability of high quality seabed habitat maps (including their biology) is extremely limited. For example, the Interreg-funded MESH project (2004-2008; www.searchMESH.net), which collated available habitat maps across north-west Europe, found that only about 10% of UK waters were properly mapped. Some countries, such as Ireland (www.infomar.ie) and Norway (www.mareano.no) have embarked upon extensive seabed mapping programmes, using state of the art acoustic mapping techniques (e.g. multi-beam echosounder), in recognition of the importance of having high resolution data to support future management of their seas. The task, at a European scale, is both enormous and costly, but the long-term benefits are also very significant.

Whilst the momentum for seabed survey across European states is growing, the prospect of having full coverage high resolution habitat maps for European seas is still many years, perhaps decades, away. However, the need for such information, to meet both industry and policy requirements, is right now. To help fill this vacuum, broad-scale predictive seabed habitat maps are being developed, which provide an interim solution by integrating available physical and oceanographic data. Trialled at a UK scale by Connor *et al.* (2006) (update in 2010), the methodology has been extended to the Baltic Sea (Al-Hamdani and Reker, 2007) and north-west Europe (Coltman *et al.*, 2008). This work is now being expanded within the EUSeaMap project (www.jncc.gov.uk/EUSeaMap) to include the western Mediterranean, as part of the EC-funded EMODnet initiative (http://ec.europa.eu/maritimeaffairs/emodnet_en.html#1).

This presentation will outline the development of European-scale seabed (bathymetric, substratum) and habitat maps and demonstrate the emerging maps from the EUSeaMap project; it will explore future prospects for achieving full coverage mapping of European waters.

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SESSION 3

MARINE SCIENCE 2020: GRAND CHALLENGES AND OPPORTUNITIES FOR THE NEXT DECADE (2)

Session Chair: Peter Herzig, Leibniz Institute of Marine Sciences (IFM-GEOMAR), Germany

MARINE SPATIAL PLANNING - TOWARDS A SAFE AND SUSTAINABLE USE OF MARITIME SPACE

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In recent years, marine spatial planning (MSP) has gained considerable importance as a new paradigm towards ecosystem-based management for marine areas. While various countries have already implemented marine spatial plans, others are currently creating legislation or new policy frameworks that will enable MSP in the near future. MSP has also generated interest among Arctic countries and High Seas experts, as a promising means to conserve valuable marine areas while simultaneously achieving social and economic objectives. A central problem and potential impediment for the future success of MSP, however, lies in the lack of understanding what MSP is really about, what it entails to produce valuable outcomes, and how it is linked to other management approaches. Once adequate authority is in place, for example, MSP should be conducted as an adaptive, participatory, ecosystem-based, integrated and future-oriented management process, not a one-time plan. Despite the considerable work that has been done so far to define the concept of MSP, a number of research gaps remain. This presentation will illustrate three essential research gaps, all of them reflecting challenges that lie ahead which, once addressed, could substantially improve the future application of MSP around the world.

HARNESSING RENEWABLE ENERGY FROM THE SEA

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With strategic development, Marine Renewable Energy has the opportunity to substantially contribute to Europe's energy needs and become a competitive energy source with increased volumes of commercial deployments across Europe. The main sources of Marine Renewable Energy in Europe are offshore wind, wave, tidal range and currents, salinity gradient, thermal gradient and marine biomass.

These technologies are at various stages of maturity with, for example, offshore wind being more advanced than wave or tidal energy. After introducing the range of marine energy opportunities that Europe has to call upon this paper will focus on the two fast emerging technologies of wave and tidal power.

In doing this it will discuss:

- Wave and tidal technologies;
- Future technology development scenarios and deployment targets;
- Research challenges and cross technology synergies and solutions.

This will involve reference to specific industry and research roadmaps and highlighting the challenges surrounding resource, finance, technology, infrastructure, and environment, regulation and legislation as well as a consideration of the priorities between these different elements. In doing so, the paper will cover the progress and development of the technologies as well as current and future plans for the large scale deployment of ocean energy devices and the associated research challenges and priorities from deployment and installation through to environmental considerations.

CHARTING A COURSE- MARITIME TRANSPORT RESEARCH PRIORITIES

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Maritime Transport caters for more than 85% of all goods entering or leaving the European continent. European Shipping companies manage more than 40% of the world fleet. In terms of manufacturing (design and production), Europe lags behind in terms of number of ships built (CGT), but ranks in the top three in terms of value of production. European Shipbuilders are leaders in a number of niche markets including cruise ships, dredgers, naval vessels and heavy lift equipment, and Europe is a world leader in marine equipment supply.

While maritime transport is, without question the most environmentally friendly form of transport, given the magnitude of global waterborne transport, there is a need for structural change in the industry. The ETP WATER*BORNE*, representing all of the major players in the European maritime industry, charted its course in 2005 with its VISION 2020 document. It is structured around three pillars:

- Safe, Sustainable and Efficient Operations;
- A Competitive Maritime Industry; and
- Managing Growing Trade Volumes and Changing Patterns.

Although much has happened (economic crisis) and much has been achieved (new technologies), this document is still valid as our route map, albeit with more emphasis on certain key issues. In the framework of the first pillar, it is of the upmost importance that besides new technologies, we accelerate the introduction of available green technology in existing ships. This will focus on the key factors of friction and speed. Given the global structure of maritime transport, legislation is the only way to ensure progress and here Europe can play its role.

With regard to the second pillar, our efforts will need to concentrate on creating new business to secure the technology base and the required critical mass. The shift in thinking towards the sea and the oceans as a source of food, energy, leisure, safety and security offers ample challenges and opportunities to keep Europe at the forefront of maritime technology. With respect to the third pillar, we need to rethink global shipping. Hampered by the economic crisis, the fast growing trend of shipping was interrupted, but activity now appears to be regaining momentum. To achieve the necessary reduction in the environmental impacts of shipping, legislation will probably not be enough and will take too long to deliver. Technology improvements, delivered through cutting-edge research and development can make the difference, but ship owners need to share the necessary investment costs with their clients.

Do we need to be more restrictive in global transport? Do we need a new balance between costs and needs in global transport? These are some of the questions being addressed through ETP WATER*BORNE*'s involvement in a number of initiatives supported by the European Commission under the 7th Framework Programme. Initiatives such as the Coordination Action EMAR^{2}RES – with its focus on maritime transport – will promote a stronger interaction and future cooperation between maritime and marine science and research. This programme is well underway and has already generated some very interesting views on areas of common interest and how the two communities can assist each other to develop knowledge and applied technology.

SUSTAINABLE HARVEST OF BIOTIC OCEAN RESOURCES

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In 2006 the global harvest of fish and shellfish reached 143 million tonnes, of which 110 million tonnes went for human consumption (food-fish)[1]. The proportion of this yield delivered by aquaculture was 35% of total production and 47% of food-fish production. A critical concern must now be how we develop sustainability in the rapidly growing aquaculture sector and learn from past mistakes to improve the management of capture fisheries. With a rapidly growing demand for fish, shellfish and aquatic plants, and a world population set to reach 9 billion by 2050, marine science holds the key to achieving sustainability, ensuring a healthy harvest for future generations.

At a world scale, ocean fisheries seem to have reached a maximum yield of about 92 million tonnes. Many fish stocks are overexploited, and marine food webs seem to have been fished down, with predatory fish stocks being substantially reduced. The alarming prognosis of world fisheries collapsing completely in the next forty years has received substantial attention, based on the poor development of world fisheries the last years.

However, recent analyses show that effective management measures were implemented for many fisheries during the nineties and in many ecosystems around the world, fisheries are now managed within the range of maximum sustainable yield, which is now also the target for European fisheries management and the advice provided by ICES.

In the years to come, prosperous fisheries will depend upon much better knowledge and research to advise on sustainable management of biotic ocean resources. This especially implies improvement in monitoring and surveying methods and technologies, better understanding of marine ecosystem dynamics, especially related to the effects of climate change and a higher CO_2 content in the sea, development of adequate ecosystem based assessment methods, and development of fishing methods with little impact on habitats and non target species and also with a reduced carbon footprint. This must be followed by effective management measures, control and functional sanctions within coastal states and in an international context.

World aquaculture now accounts for nearly 51 million tonnes, and is expected to increase to over 92 million tonnes by 2027 if growth continues at 3% annually. This means that an increasing demand for seafood must be met from aquaculture, and not from traditional fisheries.

There is an increasing awareness towards sustainable development of the aquaculture industry. This implies providing better knowledge and technology to handle diseases, parasites, escapement, pollution from the aquaculture farms, and management of the aquaculture industry must be done within a holistic coastal zone development strategy. There is also an increasing need to ensure that aquaculture feeds are derived from sources that are harvested sustainably.

Europe has a strong marine science tradition, and should be capable of handling the challenges for sustainable development of traditional fisheries and the aquaculture industry if scientific organizations and industry are challenged and stimulated sufficiently.

[1] FAO: The State of World Fisheries and Aquaculture 2008.

MARINE BIOTECHNOLOGY: REALISING THE FULL POTENTIAL OF EUROPE

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Marine biotechnology is a relatively new field with enormous potential for development. It encompasses those efforts that involve marine bioresources, either as the source or the target of biotechnology applications. If properly supported, marine biotechnology can provide an important contribution to address some of the major challenges faced by our societies, such as the sustainable supply of food, energy and biomaterials, and the development of products, goods and services for the benefit of environmental and human health. With a wide range of possible commercial applications, marine biotechnology can also contribute to economic growth and job creation.

In spite of its potential, in recent decades marine biotechnology in Europe has not advanced according to expectations, in part because of the fragmented nature of the human capital and research infrastructure as well as a lack of coordinated support. To provide a decisive contribution to further develop the marine biotechnology sector in Europe to its full potential, the Marine Board-ESF set up in 2009 a working group of experts in marine biotechnology to (i) provide a strategic assessment of the current scientific understanding of marine biotechnology relevant to European and member states policy; (ii) identify the priorities for further research needed in this field; (iii) analyse the socio-economic context in which marine biotechnology stakeholders evolve; and (iv) formulate recommendations for future policies and critical support mechanisms. The findings of the working group are published in a new Position Paper on marine biotechnology, which sketches the contours of a proactive research and policy agenda for the coming 10-15 years. It provides an updated view of marine biotechnology to policy makers at EU and national levels and to EU and national scientific and administrative officers during research in marine sciences and the related fields of health, food, environment and energy.

This presentation builds on the joint efforts of the members of the above mentioned Working Group on Marine Biotechnology. It will highlight, among others, the main drivers (omics and other life science technologies including cultures and bio-engineering), key areas of strategic importance for European marine biotechnology research, and the most important challenges that lie ahead.

Finally, the presentation will propose the Working Group 'Vision 2020 for the future development of marine biotechnology in Europe' and outline a European strategy for the achievement of that vision as presented in the position paper, including clear and achievable recommended actions and an implementation plan.

REINFORCING THE EUROPEAN MARINE BIOECONOMY

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Today's seas and oceans provide a major contribution to our wealth and well-being. The maritime economy accounts for as much as 5% of our economic activity and the European maritime regions account for almost 40% of its GDP. However, overfishing, pollution and the effects of climate change are dramatically affecting the marine environment, putting fragile ecosystems at risk. Sea level rise, coastal erosion and extreme events are threatening our coasts.

Europe has been hit by a severe economic crisis and at the same time we are facing unprecedented environmental challenges on the global scale. Turning these societal and environmental challenges into economic opportunities is at the core of the Europe 2020 strategy within which the innovation union is key in making change happen: the path to recovery lies in science and innovation.

A strong bio-economy, which is that part of the economy that generates sustainable growth by using renewable biological resources from both land and sea, is important in addressing these complex societal challenges. It will contribute to a move from fossil resource-based industries to more sustainable, efficient and competitive bio-industries; guaranteeing food security while adapting to a changing climate; reducing the environmental impact of agriculture and industry; and maintaining an affordable, safe, healthy and nutritious food supply.

To make the most of our strengths in the bio-economy, the Commission will present in 2011 a communication outlining a common strategy for its coherent development at the EU level, and it will include resources from the seas.

The marine 'bio-economy' which involves marine biological resources, has two main foci: first to guarantee food security (for Europe and globally) by developing aquaculture and ensuring that our fisheries are sustainable and second, to exploit the diversity of marine organisms for industrial applications in a great variety of sectors. The unexploited potential of the sea is still largely unknown, offering a huge potential for discovery of new species and with them applications derived from the so-called 'blue biotechnologies', foreseen to generate 10% annual growth. Full and sustainable exploitation, however, will require significant investment in data collection and analysis.

Currently the Commission supports research on the exploitation of marine living resources under the Framework Programmes for Research and, in particular, through the KBBE theme of FP7 (2007-2013), which also contributes to two cross-thematic joint calls on 'The Ocean of Tomorrow'.

The Eurocean 2010 Conference represents a unique opportunity to recall the huge potential that seas and oceans represent to generate growth and jobs. EU Member States and countries associated to the Framework Programme have high potential for research in marine science and technology but more synergies between all the different actors will be required for the optimal development, processing and use of our marine biological resources.

SESSION 4

SECURING CAPACITY AND IMPACT: TOWARDS A COMPETITIVE EUROPEAN MARINE RESEARCH AREA

Session Chair: Sybille van den Hove, Director of MEDIAN, Visiting Professor at the Institute of Environmental Science and Technology of the Autonomous University of Barcelona (ICTA-UAB), Spain

COMMUNICATION AND OUTREACH – GETTING THE RIGHT MESSAGE TO THE RIGHT PEOPLE

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In a global context of knowledge democratization as a response to natural and social changes, more than ever scientific knowledge is fundamental for a factual social and political decision process. In this context, the science communication process gains a relevance that needs to be properly and transparently addressed.

We can define science communication (e.g. science exhibitions, science journalism, and science media production) as processes aiming to convey science results/findings to non-scientists. It is sometimes done by professional scientists but has evolved into a professional field in its own right. One of the problems of communicating science is to effectively disseminate the information that we want to talk about, i.e. getting the right message to the right people. In order to be successful in this difficult task, it is important to define dissemination, to well frame the information to disseminate and to identify the target audience of the message we want to disseminate. All these components make part of a good dissemination plan.

We understand dissemination as the act of dispersing or diffusing something (e.g. diffusion of knowledge), making available appropriate information to a target audience. It is also important to define information: knowledge obtained from analytical processes of sets of data and descriptors in a manner suitable for dissemination and communication. There are different types of dissemination depending on the target audience we want to address: Dissemination for Awareness, Dissemination for Understanding, Dissemination for Involvement, Dissemination for Action and/or Dissemination for Support. Among these, the most common dissemination types are:

- **Dissemination for Awareness**: intended for target audiences that do not require a detailed knowledge on the message, but to whom it is helpful to be aware of the message;
- **Dissemination for Understanding**: intended for groups/audiences that can benefit from the message, and thus need a deeper understanding of the message;
- **Dissemination for Action**: intended for groups that are in a position to 'influence' or 'bring about change' of practice resulting from the effective use of the disseminated information.

The type of dissemination to use is intrinsically connected with the profile of the audiences we want to reach and the objectives of the message/information towards that audience. Passing a scientific message to the public at large raises different concerns than to policy or decision-makers. For the general public, the element of surprise is the most successful component to make people interested, aware and supportive of the Oceans and of the need of preserving them. Images or/and movies of habitats and inhabitants of the hydrosphere (made possible in recent years by marine technology developments, like ROVs and high resolution underwater cameras) or even live specimens, cause in the public at large a fascination that other fields of science find difficult to match. This is easily confirmed when analyzing the number of visitors to Aquariums/Oceanariums in comparison with other types of science museums.

For policy and/or decision-makers, which have a more obvious need to 'understand in order to better decide', the key components are: 1) solid basic research/facts and 2) a good "translator" of scientific data (that is not immediately usable) to information that can be used in a planning and decision process. In this case materials/tools such as statistical analysis or repositories of information (data/infobases) are often very effective.

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TRAINING THE NEXT GENERATION OF MARINE SCIENTISTS

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Training the next generation of marine scientists does not significantly differ from the training of the former one, except for two aspects: (1) marine science and technology evidently present new challenges, largely evoked in a broad spectrum of papers in all shades from white to deep blue, and (2) policy has shifted.

Training marine scientists is essentially a three-stage process:

- Raising the awareness and sparking the curiosity of youngsters is the first challenge;
- Providing guidance to those youngsters who want to dedicate their life to the sea towards the professional horizon which will optimally meet their personal expectation, is the second challenge;
- Developing education and training schemes and opportunities towards the highest standards of science and technology, to properly match the personal expectations of youth with the expectations of Society, is the third challenge.

The key to success is to stimulate and support initiatives in each of these three stages at the right scale, at the right time, and with the right means. The optimal vehicle for raising awareness and sparking curiosity of youngsters worldwide will be a nebula of small-scale, local, largely "top-down stimulated bottom-up" initiatives, from school classes to youth organizations, sailing schools, diving clubs, etc. supported in a sustainable way by a distributed scheme of micro-funds. Guidance towards professional horizons should optimally be offered in secondary schools and undergraduate programmes by trained lecturers, seconded by networks of professionals from both science and industry. Turning research vocations into qualifications at the highest standards requires large-scale means and resources. Regional clustering and international cooperation around large facilities are inherent to this stage.

Moving from the 'grand messages' to an efficient, sustainable implementation will require a task distribution (who does what, at which level?) and pilot schemes, starting small, thinking big.

EUROPEAN MARINE RESEARCH INFRASTRUCTURES FOR THE NEXT DECADE

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Research infrastructures have been instrumental in the development of new technologies and consequently play an increasing role in the advancement of knowledge, nurturing innovation and new developments in services to the benefit of societies at large. In the last decades, Europe has provided, through the successive framework programmes, the basis for the development of cutting-edge research and technology.

In a joint presentation, Hervé Pero will focus on the European Commission's approach towards the development of the 'Capacities' programme, highlighting generic and multifaceted aspects related to large-scale Research Infrastructures. Activities such as roadmap development and priority setting, long-term financing, stakeholder involvement, communication and commitment at regional and sub-regional level, and the EU strategy towards global Research Infrastructures are part of the vast experience acquired by the Commission in the last decade. The marine scientific community can benefit from this experience for the development of future large-scale marine research infrastructures.

Rudy Herman, who is co-chairing a the Commission's dedicated expert group on marine research infrastructures will focus on the gaps and needs related to such infrastructures. The marine scientific community is already very well connected at global level (e.g. ARGO, GOOS, GEOSS) and there are structuring initiatives ongoing at EU-level (e.g. EMODNET). In fact, Marine Research Infrastructures are high on the agenda and there is a need for the marine scientific community to drive all these developments with a view to preparing FP8 and to ensure a prominent place for oceans and seas within the grand challenges.

To investigate the often complex marine systems and human interactions, a broad range of research infrastructures and technologies is needed. Measurements and monitoring are retrieved from a range of fixed and mobile platforms and require a multidisciplinary approach in order to understand the diversity and complexity of marine systems. The contribution will not be restricted to ESFRI projects under development, such as EMSO, ERICON-AB, EURO-ARGO, ICOS, and LIFEWATCH, but will take into account important infrastructures developed through project and networking initiatives at European, regional and sub-regional scale.

SUPPORTING THE SCIENCE – FUTURE LOOK AT A NEW MARINE SCIENCE FUNDING LANDSCAPE

TOWARDS INTEGRATED MARINE RESEARCH STRATEGY AND PROGRAMMES (SEAS-ERA)

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In 2004, the Galway Declaration highlighted the crucial role that seas and oceans play in the planetary/ecosystem functioning. This was followed by the Aberdeen Declaration (2007) which called for integration across scientific disciplines. Since the development of those Declarations and the publication of various documents by the European Commission that were issued according to the 'Lisbon Strategy' for achieving a 'knowledge-based economy and society', a whole strategy of knowledge generation and management in the marine and maritime sectors has been delineated.

In this respect, the European Marine Strategy Framework Directive (MSFD) stresses the need to achieve the full economic potential of oceans and seas in harmony with the marine environment. This can only be done on the basis of a concerted definition of research needs and priorities leading to a more effective integration of knowledge and resources, enabling a "knowledge based" policy making.

The MSFD calls for particular attention to promote synergies at national and regional level and to mobilise national and regional funding to reach a critical mass to address marine research challenges. Responding to these objectives, a specific instrument dedicated to the co-ordination of national and regional programmes was included in the 6th Framework Programme. The ERA-NET scheme, aiming at networking of national and regional research programmes, was implemented through many thematic focused projects in order to facilitate the strategic planning and implementation of joint activities, including joint calls for research proposals.

The ERA-NET scheme was designed for Research Funding Organisations, specifically those managing competitive research funding programmes. It became a key instrument to tackle fragmentation in the areas of among others fisheries, accidental pollution, climate change and ecosystem impacts. Under FP6 several marine ERA-NETs were developed such as AMPERA, MarinERA and MariFish.

Recently, a new ERA-Net has been launched (SEAS-ERA) under FP7 in a process which is overarching marine research cooperation initiatives. This ERA-NET will be instrumental in promoting the integration of a European Maritime Research Strategy and enhancing and consolidating the marine element of the European Research Area (ERA).

In the context of broadening and strengthening the ERA, the Joint Programming Scheme as defined by the European Commission in July 2008, is a further structural component to be considered in the design of future work programmes, where multilateral cooperation will be enhanced.

These instruments have been and will be fundamental in terms of impact since almost 90% of all public research funding in Europe originates from national and regional programmes. It is therefore crucial that marine and maritime research funding schemes at national level are able to mobilise competitive and non-competitive funds for research in a more coordinated way, through common programs and joint calls. However, each of these funding sources operates according to its specific rules and procedures, introducing barriers to transnational collaboration and benchmarking of excellence across national boundaries. There are still difficulties in the creation of 'common pots' and in the long-term sustainability of initiatives. These are some aspects that require continued action.

SUPPORTING THE SCIENCE – FUTURE LOOK AT A NEW MARINE SCIENCE FUNDING LANDSCAPE

JOINT PROGRAMMING INITIATIVE 'HEALTHY AND PRODUCTIVE SEAS AND OCEANS'

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Europe can surely be characterized as 'blue', with a coastline of 89,000km along two oceans and four seas: the Atlantic and Arctic Oceans, the Baltic, the North Sea, the Mediterranean, and the Black Sea, to which we should add immense overseas territories, as well as connections with inland water ways. Seas and oceans provide indeed an essential part of our wealth and well-being. The fast growing global population will increasingly depend on marine food sources (including sustainable aquaculture). The oceans and seas are also under huge pressure from human activities and climate change. The growing vulnerability of coastal areas, the increasingly crowded coastal waters, the key role of the oceans in the climate system and the continuous deterioration of the marine environment all call for a stronger focus on our oceans and seas. To tackle these issues, Europe needs an integrated knowledge base that enables an integrated policy to make the most of marine resources in a sustainable way, while understanding and mitigating the impact of climate change on the marine environment and coastal areas.

Understanding and mitigating the pressures on European seas and oceans to make the most of their resources is a European grand challenge

Economic and societal drivers
The maritime economy accounts for as much as 5% of our economic activity. The sea is a critical source of food and energy. Exploitation of oil and gas from the sea bottom and an increasing share of renewable ocean energy constitute a considerable part of Europe's energy consumption. Maritime transport is responsible for 90% of EU's external trade and 40% of its internal trade. European tourism, a substantial part of which takes place in coastal areas, accounts for 3 million jobs. Almost one third of the European population lives within 50km of the coast. The unexploited potential of the sea is very large, with still largely unknown resources. Ocean exploration can be as complicated as space exploration. Seas and oceans also play a major role in the regulation of the climate. Climate change is dramatically affecting the marine environment, putting it at risk from uncontrollable changes. Human impact on marine ecosystems must be understood, including planning of the use of marine space for various purposes.

The Joint Programming Initiative (JPI) 'Healthy and productive seas and oceans'
The opportunities and threats are obviously very large, and certainly affect the societal and industrial development of Europe at large. This JPI will be established with due consideration to the numerous valuable on-going initiatives in the marine, maritime and energy fields. By addressing research topics that are cross-cutting in nature, this JPI will promote convergence between marine sciences, climate science and marine industries. It will also help promote convergence of technologies between different marine and maritime sectors (energy, transport, biotechnology, aquaculture, fisheries).

This presentation elaborates on the development the JPI Healthy and Productive Seas and Oceans and place it in a European perspective.

SUPPORTING THE SCIENCE – FUTURE LOOK AT A NEW MARINE SCIENCE FUNDING LANDSCAPE

A SCIENTIST'S PERSPECTIVE

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EU funding for marine science technically began in 1984 with the start of the first Framework Programme. In 1989 marine science was specifically targeted for increased funding and better co-ordination with the MAST (Marine Science and Technology) Programme. This programme was continued through to the end of FP4 in 1998 via the MAST2 and MAST3 programmes but did not continue into FP5. The MAST2 programme developed the concept of the 'large scale targeted project' which brought together scientists from many institutions and many disciplines to tackle large scientific issues. This was later continued in Framework 6 with the 'Integrated Projects' with funding of between 10 and 20 million EUR per project. These large projects had mixed success but some, such as HERMES (Hotspot Ecosystem Research on the Margins of European Seas) worked particularly well. The large projects have many advantages over smaller projects because they can incorporate all the key laboratories, they can properly cover a wide range of disciplines and can still afford an adequate amount of outreach. The fact that they include such a wide range of scientists and labs makes the project well known, and assuming they are working well, this can give advantages when applying for additional funding e.g. from national sources. For example in the HERMES project 74 research cruises were run over the 4 years, all funded from national resources. Because HERMES represented a very large cross section of the deep-water benthic biologists in Europe, it became a natural point of contact for DG MARE and DG Environment to discuss policy related issues. HERMES was, therefore, very much more successful as one large project than it would have been as several small projects.

As the EC moves from one Framework Programme to the next it makes significant changes in the mode of operation of its funding. The integrated projects were not continued in FP7, probably because some failed to work as expected. However, not enough time was given for best practice to be established before the system was changed. Now that we are discussing Framework 8 the 'joint programming' initiative threatens yet again to throw out the current systems and replace them with another initiative. This talk will discuss the advantages of the Framework funding mechanism and why it is necessary to build on it rather than throw it away.

CLOSING SESSION

A CALL FROM THE MARINE SCIENCE COMMUNITY: APPROVAL OF THE OOSTENDE DECLARATION

Session Chair: Edward Hill, National Oceanography Centre (NOC), United Kingdom

Closing remarks from:

- **Máire Geoghegan Quinn**, European Commissioner for Research, Innovation and Science
- **Jan Mees**, Vice-Chair, Marine Board-ESF, Flanders Marine Institute (VLIZ), Belgium
- **Sabine Laruelle**, Belgian Federal Minister for SME, Independents, Agriculture and Science Policy

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L'Atalante: launch of Victor 6000

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Deployment from the stern slip of FS Meteor using a lock latch system