BOOK OF ABSTRACTS

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First Conference on Ocean Literacy in Europe:

The FIRST CONFERENCE ON OCEAN LITERACY IN EUROPE is an important milestone in developing an ocean literate society. While worldwide people express serious concern for the protection and the health of the ocean, Europe has yet to provide a structure to make Ocean Literacy its priority. Ocean Literacy is understanding how the ocean affects us and how we affect the ocean.

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Preface

Man is inextricably tied to the oceans. Making sure that citizens – whether they live on the coast or inland – understand how the oceans affect their daily lives and how mankind affects the oceans, is what Ocean Literacy is all about. As the oceans are changing rapidly and over a range that can have a profound influence on human societies, ocean literacy becomes important because sooner or later informed decisions will need to be taken to address the impacts of the changing oceans. While there is a worldwide movement of people expressing serious concern about the protection and the health of the seas and oceans, Europe has yet to provide a structure to make Ocean Literacy its priority. There is an urgent need for a consensus on what Ocean Literacy means for the continent and what European citizens should know about the marine realm to allow them to make informed and responsible decisions regarding the seas and oceans and their resources. However, the large cultural diversity across Europe – e.g. in the many languages, educational systems and traditional ways of living with the sea – complicates the implementation of a unique and consistent Ocean Literacy plan. Data and information on what people know, want to know and should know about the oceans is scarce. This suggests that ocean knowledge of the wider public is (too) limited, and that in most European countries ocean sciences and knowledge are underrepresented and not integrated in the school curricula. On top of that, no direct reference is being made in European key marine policy documents on how to strengthen the position of ocean sciences in science standards.

The First Conference in Ocean literacy in Europe is therefore a timely and important milestone in developing a more ocean literate society. Scientists, educators and policy makers discuss the future societal challenges related to the European seas. The conference also addresses the lack of ocean-related content in science education standards of the formal educational system(s) at the same time emphasizing how outreach projects and informal education efforts (e.g. public aquaria, science centres, museums, NGOs, media) are essential tools for more public involvement and active participation.

Ocean Literacy is a prerequisite for Europe's quest for a more ocean-oriented society and economy. Preparing an entire community for a closer interaction with the sea is rewarding for the marine research community and for the science policy-makers. A more informed public will better understand and support investments in ocean sciences and the need to manage the marine ecosystem in a science-based, sustainable and respectful way.

Jan Mees

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TABLE OF CONTENTS

PREFACE

ORAL PRESENTATIONS

POSTER PRESENTATIONS

ORAL PRESENTATIONS

The European Marine Science Educators Association (EMSEA), providing learning opportunities and resources for teachers

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Why should teachers learn more about ocean sciences?
If teachers have little to no knowledge regarding to ocean science principles and no awareness of the challenges the ocean and coasts are facing, can we expect them to teach students effectively?
Teachers and environmental educators are thus important agents for the ocean. But an effective educational transformation depends upon how motivated, capable and supported our science teachers and educators in coastal centres or aquaria are. So it is critical to pay close attention to how we engage each one of them to develop a long lasting and caring attitude towards the marine and coastal environment.

The European Marine Science Educators Association (www.EMSEA.eu) is dedicated to provide such opportunities by co-organising multiday conferences for professional development throughout Europe, starting with the First Conference on Ocean Literacy in Bruges, 2012 and the EMSEA-conference taking place in Plymouth (UK) in 2013. With these conferences EMSEA strives to establish meaningful relationships between educators and members of the ocean science community and to facilitate the exchange of best practices in marine education. Europe has much to offer in terms of valuable marine projects and educational materials, but the efforts are often poorly visible, and thus seldom used by others.

During the EMSEA-conference in Plymouth (2013), co-organised by the Marine Biological Association (MBA), both new and experienced teachers and educators from all over Europe will have the opportunity to share ideas, experiences and resources, network and to participate in interesting scientific lectures and excursions along the beautiful Devon coast.
Investing in collaborations with teachers and educators will no doubt have considerable currency for many years to come.

Inspiring people to care about the ocean: the National Geographic Society's support of ocean literacy

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We will discuss the work that the National Geographic Society's Ocean Initiative is doing to support a healthy and productive ocean that benefits people and nature, with a focus on our programs that are directly related to ocean literacy.

We will give examples of how National Geographic's education programs are based upon the Ocean Literacy Principles (found at http://oceanliteracy.wp2.coexploration.org/).

We will highlight stories of success, including our Marine Ecology, Human Impacts and Conservation curriculum unit; our two-year National Teacher Leadership Academy focused on ocean education; our marine recreation stakeholder workshops; our online activities for use by classroom teachers and informal educators, and others.

Educating the next generation of marine scientists

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Ocean education, like the ocean itself, is in essence global.

Ocean science and technology are closely entwined, and ocean science itself is a subtle blend of many disciplines. Training scientists and engineers of the sea hence calls for a multidisciplinary approach, in marine academies providing full-fledged, dedicated bachelor-master programmes in ocean science and technology. They will provide to society the professionals needed for the marine and maritime sector. The ocean is to our planet what the human body is for humanity: if the study of the human body deserves an autonomous, topical and full-size educational track, from the bachelor level onwards, the study of the ocean *a fortiori* does.

Such dedicated marine academies are less utopia than one might expect. If and when they meet the expectations of the professional world, the maritime transport and offshore energy sector in particular, this sector will be prepared to mobilize resources for securing its brainpower needs. There are significant grounds for synergy.

A global vision in ocean science and technology is optimally served by a regional implementation, to pool established ocean science and educational institutions with marine observatories, aquaria and regional fleets, within an action radius allowing operational efficiency. The supporting fleet entity will address – in a flexible mission-specific platform approach – scientific, industrial, commercial, naval and recreational vessels. Win-win situations will result.

Each regional focus of marine education will be backed by an international network of educators and host an international population of trainees. The regional foci will join forces in a global network. The diversity of marine environments used by the regional clusters for field training will offer to the global network a broadband thematic coverage. At the local scale, marine academies will contribute to ocean literacy and help to catalyse excitement about ocean science and technology in schools and recreational environments.

The concentration of brainpower and resources in such marine academies, embedded in a global network, will allow to address both specific issues of critical importance – such as sustainable food supply from the oceans – and emerging operational challenges – such as the Arctic.
Furthermore, centres of excellence in marine technology embedded in such marine academies will provide the incubation space for designing and breeding the urgently needed high-tech, green and clean fleets of the future, scientific and commercial, to become hybrid platforms for both sustainable economic development and marine and maritime training.

Education or entertainment? Television's relationship with the oceans

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Of all television genres natural history is perhaps unique in its appeal. All countries, all cultures tend to value the natural world and wildlife television delivers it to their living rooms. It is cross-generational and, generally, uncontroversial. And, from a purely commercial point of view, it is easy to tweak for a new market; change the voice-over and you have a product to transmit. Natural history television at its best, then, reaches audiences of hundreds of millions across the world. Why then could natural history television not play the role of spokesman for the oceans, not help educate and inform the public about the oceans?

To a certain extent it can. A BBC production, Blue Planet, an eight-part series specifically on the oceans, was also sold to over 100 countries after it was first broadcast in 2001. Yet however as much as the makers of Blue Planet wanted the series to raise awareness of the oceans and to educate the public, to the commissioners at the BBC1 and to all the other buyers it was primarily entertainment. It was a series to compete against dramas, soap operas and football matches. Nothing illustrates that better than the fact that the environmental programme that accompanies the series in the United Kingdom was relegated to less popular time on a secondary channel.

Since then the battle for audience share has become even more intense. With the proliferation of channels, the major channels get smaller audiences for big event transmissions than they did a decade ago. However, at the same time it is evident that audiences will seek out good content through different media – by download from websites, on YouTube and through streaming to mobile devices. This allows the possibility of opt-in additional educational content being offered. Meanwhile as awareness of global warming has risen, so has the demand for information. Broadcasters can be a little bolder in putting natural history into an environmental – and educational – context.

Ocean literacy: mobilizing society to tackle ocean challenges, what can the EU do?

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Ocean challenges are complex. They entangle socio-economic and environmental issues in relation to climate change and pressures on biodiversity. They involve a range of socio-economic stakeholders, at different levels and in different manners. Because of this complexity, it is difficult to get a comprehensive perspective on ocean related challenges. At the same time, in order to address these challenges, it is of crucial importance to involve stakeholders. As the examples of climate change and fisheries management show, it is necessary but not sufficient to provide adequate scientific advice to policy makers. Society and particularly marine / maritime stakeholders must take responsibility for managing ocean related activities differently. This necessitates a minimum of scientific understanding of the complex issues involved. It also requires new ways of generating and sharing knowledge, in which science interacts with marine / maritime stakeholders to generate social innovation. The European Commission has been supporting such new approaches as in the SIS-MML (Science in Society – Mutual Mobilisation and Learning) programme of FP7 (7th research framework programme). As institutional discussions are on-going for the adoption of the future research and innovation programme, consideration must be given to the continuation of these innovative approaches, particularly suited to the complexity of ocean challenges.

Advocating the ocean literacy principles in Europe

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How to communicate oceans and ocean science to the wider community is a daily challenge for marine science communicators in Europe and abroad. The public considers seas and oceans as a hostile or remote environment or a place for leisure only. As an open-ended operational pan-European network of science communicators focused on marine science communication, education and outreach, the Marine Board Communication Panel (MBCP) can play a role in advocating ocean literacy in Europe. The group was first set up in 2000, and after having been reactivated in 2006, has grown to the current team of 15 communication professionals from as many Marine Board member institutes in 12 European countries. Supported by the Marine Board, this panel is well placed to link up marine science in Europe with communication and outreach efforts, and to assist in bridging the national and European efforts in this domain.

Within this respect, in 2010 the MBCP drafted an 'Action plan to Upgrade and REinforce Ocean Literacy in Europe' (AUREOLE). This plan should be used as a general guideline for the future, rather than as a real action plan with dedicated funding. AUREOLE included (1) the identification of ocean science essential principles and fundamental concepts for Europe and for individual countries (based upon the exercise being carried out in the US and Portugal); (2) the launch of a network of marine scientists and educators to improve educational opportunities and outcomes for learners of all ages (the European Marine Science and Education Association – EMSEA); (3) an inventory of ocean literacy and information needs; (4) a screening and update of educational curricula in all European countries on ocean content; (5) an inventory/compilation of existing high-quality educational/curricular ocean science material and educational resources (portal)(EMSEA); (6) assisting in the implementation of the essential principles of ocean science into educational curricula across Europe; (7) stimulating a more intensive information exchange with other Ocean Literacy-initiatives (U.S., Pacific = IPMEN: www.ipmen.net,…); (8) addressing the need for active collaboration between marine scientists, ocean educators and the public in future European projects (e.g. by organising teacher-training sessions). On top of that, ocean literacy initiatives should also try to collaborate with existing operational oceanography activities.

The importance of ocean space for Europe

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The seas around Europe traditionally play an important role in human activities such as transportation, fisheries, and exploration. Favourable climate conditions around 1000 AD also stimulated, due to population growth and urbanisation the development of marine fisheries and trade in Europe. In the Low Countries this successively led to the metropoles of the North Sea: Brugge, Gent, Antwerp and finally Amsterdam.
Spanish and Portuguese explorers of the fifteenth century set out to discover the world. They started to explore and exploit the 'other side of the ocean' by discovering and then exclusively claiming sea-routes to the East Indies and Americas. In the wake of this, human activities such as piracy, whaling, and slavery flourished for centuries.

Scientific exploration of the ocean started in 1872 with the circumnavigation of the globe during the British Challenger Expedition. Following oceanographic research by European countries led to a perception change. From then the ocean was seen in 3D, and teeming with life. The sea seemed an inexhaustible and free resource for various human activities. This perception change from 2D to 3D matured into a 4D-vision during the last quarter of the twentieth century. The notion of 'ocean space' elegantly reflects this. We now know that the oceans jointly form an immense space with time as a fourth dimension. The ocean has a 'memory' that allows for ocean and climate forecasting, and a wide variety of ocean services.

Rapid population growth, and as a consequence a fast increase in human activities have a downside. This is expressed in the overexploitation of many marine species, waste full fisheries, pollution, and global warming. Although the negative effects of human activities are known at the local level for centuries, and at the regional one for decades, the global dimension of them is now also dawning through, sea-level rise and ocean acidification. Both are threatening the activities that are causing them at a local to global scale. Small changes in the temperature of the upper part of ocean space have outsizing effects on its chemistry as well as its ecology. Half of the coral reefs have died or suffered a sharp decline; hundreds of so-called 'dead zones' are found in the coastal seas and especially in front of the outflows of large rivers. In Europe, the Baltic is, despite many efforts to manage the system, still the worst polluted sea since decades.

Outer space exploration showed us the real dimensions of our planet, wrongly called Earth. Perceptions as Spaceship Earth, System Earth, Mother Earth or the Blue Pearl colour our visions towards the planet we share with so many other life forms. We are just part of a complicated and hardly understood planetary system. Yet, some scientists strongly advocate a new era dominated by human activities: the Anthropocene. This notion rapidly became popular, but is also misleading as it suggests the idea that we should and could save our planet or that we could manage it through new and innovative bio- and geo-engineering skills. On the other hand, conservation organisations like IUCN, WWF and NGOs such as Greenpeace, strongly argue for the establishment of marine parks etc. for conservation purposes.

But, how will we conserve things we hardly know about or understand? That was one of the central questions during the 1998 International Year of the Ocean. It's still a central question in all new policymaking like Europe's Integrated Maritime Policy (2007). Outreach, a well-structured and focussed outreach at various levels in Europe, has to be the answer on how to inform the taxpayer and voter about the relevance and social and economic importance of ocean space in their daily live. Through education this awareness raising process should become an intrinsic part of the thinking of Europe's citizen of tomorrow. Together, focussed educational and outreach efforts will make young people, the next generation, aware of an 'ocean of opportunities' in the age of twitter and the other new media.

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10 years of Ocean Literacy in the USA and beyond: actions, results, reflections and discussion

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This three part session will: 1) trace the path of the Ocean Literacy Campaign in the USA, including the actions and results to date; 2) highlight the processes and principles that are promoting an ocean literate world; and then 3) engage conference delegates in a short discussion.

In the USA in 2002 scientists, educators and policy makers began a national conversation about how to include the ocean in the mainstream K-12 curriculum, and also what about the ocean is most important to teach, both in geography and science. The National Geographic Society, the National Oceanic and Atmospheric Administration, the National Marine Educators Association, the Centers for Ocean Sciences Education Excellence and The College of Exploration began a process of building a grass roots Ocean Literacy Campaign. After an online conference of scientists, educators and, policy makers, a definition for Ocean Literacy was drafted, and 7 essential principles and 44 fundamental concepts were agreed upon. From this beginning the work has continued to include developing a comprehensive K-12 conceptual scope and sequence, to influence the direction of new national science education standards, government ocean policies and public understanding of the importance of the ocean to all life.

The direct involvement of hundreds of scientists and educators in the process has built a shared language and ownership of all aspects of the Ocean Literacy Campaign. We have facilitated national conversations and large-scale decision making with the support of asynchronous technologies and a technology supported facilitation process. The Campaign has now influenced whole systems that establish funding and set priorities related to ocean science education within the national conversation about science education.

The work in the USA has prompted several other countries to consider the extent to which ocean subjects are included in school curriculums and other aspects of the education system. Other ocean literacy efforts in Japan, Portugal, Chile, China, Australia, Canada, and South Africa are in various stages of development.

In most countries the ocean is not a part of the school curriculum. The majority of populations have little or no knowledge about the issues concerning the ocean nor the role the ocean plays in our lives from food to energy to weather and climate to international trade to the air we breathe. The ocean must be a part of every student's education.

As the quest for an ocean literate world progresses we must be sensitive to regional and national priorities and realities and the use and nuance of language in building shared understandings. Making the ocean meaningful and relevant to every individual's life by building connections through the web of water, and connecting to global issues of climate change and energy may offer directions to follow. To be ocean literate, or to know the ocean, must be a holistic experience, engaging all our senses and inspiring our lives by touching our souls not only through science and geography, but art, music, business, policy, essentially to include all disciplines and subjects.

After the two presentations we will facilitate a discussion about the challenges and processes of enhancing ocean literacy on a local, regional, country and global basis.

Conhecer o Oceano, a navigation chart for ocean literacy in Portugal

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From the 90s onwards, significant steps were taken both in Portugal and in the European Union (EU) towards a real marine policy. Due to the relevance of the sea for Portugal, with the third largest exclusive economic zone in Europe, a National Strategy has recently been established. Disseminating knowledge about the ocean is therefore a key area for Ciência Viva, as the Portuguese agency for scientific culture.

The project 'Conhecer o Oceano' (Knowing the Ocean), is part of this strategy. This initiative is based on the North-American project Ocean Literacy that resulted from a wide consultation with scientific and educational institutions.

Ciência Viva coordinated the adaptation of this initiative to the Portuguese reality, in collaboration with research institutes of Marine and Education Sciences. A 'navigation chart', pinpointing ocean topics in the national curriculum, is an example of a support material to help educators through ocean literacy and the corresponding resources.

World Ocean Network (WON): our progress and new prospects towards the blue society

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World Ocean Network was mobilized during the International Year of the Ocean (1998) and launched after the 2nd International Meeting by 20 organisations in 2002.
It assembles 450 participating institutions: aquariums, educational and science centres, natural history museums, media, and NGOs worldwide. They educate the public on marine sciences to improve the awareness of the world's ocean's role in sustaining life on Earth and to empower stakeholders and civil society to adopt responsible attitudes through:

- promoting and helping to coordinate World Oceans Day (WOD) events to celebrate the world's oceans and human connection to them on June 8 every year.
- organising youth forums and parliaments for the ocean to empower young people as future decision makers and users of marine resources, to convey their message to decision-makers and UN bodies.
- fostering sustainable attitudes and consumption patterns through information and mobilization campaigns such as Mr. Goodfish, a sustainable seafood consumption programme.
- providing educators with resources and tools to raise awareness: the online Ocean Info Pack, the World Ocean Academy...
- developing a vision of Blue Society.

The Blue Society is a new vision of society in a spirit of sustainability, well-being and equity and in harmony with the World Ocean. It is an economic, social and technological approach based on the tremendous opportunities offered by the ocean for new resources, innovative solutions and positive experiences to get out of the global crisis that we currently experience. It involves all actors in defining and implementing new and innovative solutions to better use ocean resources for the well-being of all humanity.

Aquariums have an important role to play in developing the Blue Society. They have means to mobilize the civil society and they can reach millions of people every year. They have acquired credibility and trust of economic actors, policy makers and the public at large. They can bring together researchers, policy makers, economic stakeholders, local authorities and the general public in dialogue, mutual learning, and action in order to develop the Blue Society concept. To implement it, they will identify innovative research themes and governance modes and promote them to be duplicated elsewhere.

They will create the framework of the Blue Society by working with civil society, youth and other stakeholders in Europe thanks to the Sea for Society project. They will join efforts with the World Ocean Network, the Global Ocean Forum and the Alliance for the Seas and Oceans to feed, promote, and implement the concept of Blue Society worldwide. They will mainstream ocean education so as to have governments and international organisations endorse marine education implementation in the formal and informal learning and to integrate marine sciences in education curricula and school activities in support of the Rio+20 Ocean decisions and solutions to marine challenges.

How to share ocean's health with aquarium visitors

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Annually, aquariums receive a few hundred million visitors worldwide. The last decades the role of aquariums has changed from bringing a simple 'aquarium show' to the development of a much more educational environment. Conservation and spreading information became very important issues, if not the most important ones. Aquariums do not have iconic ambassadors such as big mammals but they are well-positioned to show a variety of animals, including marine mammals and sharks in a semi-natural setting.

While looking at the beauty of e.g. a school of fishes, the visitor can be overwhelmed. This makes him or her receptive to well-chosen messages presented in an easy understandable and recreational manner. In this way aquariums can also communicate about the problems associated with climate change, environmental threats, etc. and propose actions that stimulate an active participation of the public.

The European Union has organised a few surveys on the public's awareness on oceans and their problems. Similar surveys have been conducted in the US and probably also elsewhere. Aquariums have been actively involved in these exercises. This presentation deals with the outcome of some of these surveys. It demonstrates, among other results, that the public considers aquariums as a reliable source of information. They also appreciate the educational material that is being developed and offered for free.

See the oceans through Scientix: European marine sciences initiatives and learning resources

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Scientix is a community for science and math education in Europe, managed by European Schoolnet on behalf of the European Commission's Directorate-General for Research and Innovation. The objective is to facilitate dissemination and sharing of best practices in science education in primary and secondary schools across the EU.

Scientix collects and presents European and national science and math education projects and its results (teaching materials, lesson plans, research reports). Teachers, science communicators and other science educators can browse through the projects in the project library and search for innovative teaching materials and learning resources. Registered users may also request translation of the teaching materials into any of the 23 languages of the EU.

The presentation will focus on education in marine science and related fields, and showcase how both marine science projects and marine science educators can benefit from the Scientix community. It will present several education and outreach projects in these fields, their learning resources and provide information how to take part in the Scientix platform and its activities.

Ocean in focus: science and education for sustainable development

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The United Nations declared 2005-2014 the decade of Education for Sustainable Development (ESD). ESD provides a coherent and holistic vision of the role and purpose of education within our fragile, fast changing world. For UNESCO and its Intergovernmental Oceanographic Commission (IOC), ESD is the best framework for addressing environmental challenges by systematically engaging with the three foundations of sustainable development – the environmental, social and economic pillars – as well as by highlighting the scientific, cultural and ethical dimensions. ESD offers not only an overarching frame of reference but also an approach that is enriched by the contributions of many other disciplines. Education is key to development challenges such as the threat to human security, and is central to re-shaping our knowledge, understanding, values and attitudes to take the future of the planet actively into account.

To address ocean and environmental challenges more progress is needed on many fronts: producing less greenhouse gases, inventing new green technologies, and changing our behaviour. Progress is also needed in providing education and public awareness to create informed citizens. The need for educating and learning about the ocean and global change is urgent and should be interdisciplinary and holistic, integrating scientific, social, gender, economic, cultural and ethical dimensions as well as incorporating local, traditional and indigenous knowledge perspectives and practices. Ocean and environmental education should be part of an education for sustainable development that helps people to develop the attitudes and knowledge to make informed decisions for the benefit of themselves and others, now and in the future.

Nowadays scientists and students look at the world through many lenses, including human interactions with the planet, to better understand how we impact and are impacted by the world in which we live. UNESCO and its IOC strive to bring our picture of the Ocean, its beauty, diversity and fragility to educate scientists, policy makers and new generations about the broad vision needed to address today's global problems.

The importance of the ocean in geography education

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When we look at the different school curricula in various European countries no real mention is made of an 'ocean studies' course. Mostly it is divided into study of marine life (in biology) and coastal processes and basics on sea currents (in geography or sciences).
As a result, the role of oceans in a lot of real important ecological and environmental studies we are facing today is not enough accentuated. A better understanding of earth's global systems is only possible if more attention would be given to the importance of the oceans. Therefore we use the concept of ocean literacy as developed by the Ocean Literacy Network. They define ocean literacy as 'an understanding of the ocean's influence on you and your influence on the ocean'. This was translated into seven essential principles:

1. Earth has one big ocean with many features.
2. The ocean and life in the ocean shape the features of Earth.
3. The ocean is a major influence on weather and climate.
4. The ocean makes Earth habitable.
5. The ocean supports a great diversity of life and ecosystems.
6. The ocean and humans are inextricably interconnected.
7. The ocean is largely unexplored.

For each principle a conceptual flow chart was developed, a specialised form of a concept map, that not only shows what should be taught, but also in what order.

When analysing the different flow charts we notice the interfaces with geography education, thus making it easier to match with the curricula. After identifying these matches an attempt is made to create a learning line in ocean literacy.

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POSTER PRESENTATIONS

Teaching ocean sciences issues in primary school using interactive whiteboard

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This paper presents a teaching suggestion, which utilizing Interactive Whiteboard potentials, aims to students of 4th grade to acquire knowledge on coastal lagoons, which constitute a common type of coastal environment worldwide, as well as to create positive feelings about coastal environments conservation. The important development of interactive environments of teaching and learning that is observed during the last years, and the educational interactive applications that continuously grow, introduce modern education technology products and offer to the teacher the possibility to actively and educationally engage the use of new technologies in teaching and learning (Twiner *et al.*, 2010; Warwick *et al.*, 2010). The teaching suggestion in question could be included in the effort of promoting and incorporating in the curricula more and more ocean sciences issues, having as ultimate goal the preparation and the gradual shaping of ocean-literate persons (Craig *et al., 2007;* Schoedinger *et al.*, 2010). For instance, it could enrich the curriculum of primary education in Greece, whose references in ocean sciences issues are few and fragmental. The suggestion is composed by the teaching of three units, which can be implemented in at least three teaching hours. Students can work in teams of three-four persons. The teaching is performed with a polytropic presentation of clear information, with the utilization of interactive internet applications and the filling in of work sheets (Beeland, 2002; Mercer and Littleton, 2007; Alexander, 2010). In the first teaching unit, students discuss and note down in work sheets, with the use of interactive whiteboard, their pre-existing knowledge on issues regarding the basic characteristics of coastal lagoon environment, the biodiversity, functions and values of coastal lagoons, as well as their alterations caused by human activities. Thereafter, through interactive activities, they are dealing with issues and information on the basic abiotic components of the coastal lagoon ecosystem (Guelorget and Perthuisot, 1992; Kevrekidis, 2004). In the second unit, with the varied presentation of information through incorporated software tools of the interactive whiteboard, students get in touch with information concerning morphology, biology and ecology of characteristic species of macroalgae, angiosperms, benthic macroinvertebrates, fish and birds of the lagoon ecosystem, as well as the coastal lagoon food web (Nicolaidou *et al.*, 2005). In the third teaching unit, students collect information from the internet, discuss and answer questions in work sheets that focus on the multiple natural functions of coastal lagoons and the values arising from these functions for the human being, as well as they note down the problems that coastal lagoons come up against because of human activities. At the end of the teaching units, students discuss all together, fill in an electronic work sheet by answering questions concerning the issues developed and record their suggestions regarding the actions that are necessary for the protection of coastal lagoons. By taking into account that the utilization of new technologies when teaching sciences has many positive results (Hennessy *et al.*, 2007; Higgins *et al.*, 2007; Warwick and Kershner, 2008), it is expected that the application of our teaching suggestion will contribute to the preparation and the gradual shaping of ocean-literate persons. Moreover, by generalizing, it is expected that the proper utilization of new technologies, when teaching ocean sciences issues, will contribute to a more efficient development of the ocean literacy.

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Are Greek pre-service teachers literate on marine pollution issues?

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To achieve an ocean literate society, ocean sciences must be integrated into educational practice, research, curricula, textbooks and assessments (Tran *et al.*, 2010). Considering that teachers play a key role in the environmental literacy of future generations (World Commission on the Environment and Development, 1987), it is a reasonable assumption that successful integration of ocean literacy in schools requires the commitment of teachers who have a secure knowledge of ocean literacy principles and positive attitudes towards the marine environment. Marine pollution is one of the fundamental concepts which support the principle that the ocean and humans are inextricably interconnected (Cava *et al.*, 2005). This study aims a) to assess Greek pre-service primary teachers' knowledge, attitudes and self-reported behaviour related to marine pollution issues and b) to examine the relationships of these variables with background factors.
A structured questionnaire, based on a previous instrument concerning an environmental literacy assessment (Yavetz *et al.*, 2007), was administered to 435 pre-service primary teachers of the Democritus University of Thrace, Greece. The questionnaire included three Likert-type scales, namely knowledge, attitudes and behaviour related to marine pollution, as well as a set of questions regarding background factors.

Cronbach's alpha showed an adequate internal consistency for all the items in each of the three scales. Exploratory factor analysis revealed one factor for the knowledge scale, three factors for the attitude scale, identified as willingness to pay, locus of control and attitudes towards the environment and two factors for the behaviour scale, identified as individual action and collective action.

Pre-service teachers demonstrated a relatively moderate level of knowledge about marine pollution issues having, though, misconceptions, possibly because they attain information mostly from mass media and less from formal education. They scored high or relatively high on all attitude factors, namely they demonstrated very positive attitudes towards the marine environment, an internal locus of control and a rather strong willingness to pay; all three of them being important characteristics of future teachers who can positively influence their pupils' attitudes towards the environment. They scored moderately high on individual action and low on collective action probably reflecting their perception of responsible environmental behaviour, as well as the way Greek society addresses environmental issues. Pre-service teachers grown up in a coastal hometown environment demonstrated a significantly higher level of collective action compared to students from a non-coastal hometown environment, probably indicating that childhood experiences of the coastal environment can stimulate their collective action while their mother's education significantly affected their individual and collective action.

Considering the growing focus on the necessity of ocean literacy, our findings can be utilized for improving marine education in teacher education programs so as to equip pre-service teachers with secure knowledge on marine pollution issues, appropriate teaching strategies and necessary skills to act. Then, probably, they themselves, as well as their future students will be able to make informed and responsible decisions regarding marine pollution issues and to act both individually and collectively for the protection of the marine environment.

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Knowledge exchange: plankton education and outreach activities

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Plankton are at the base of the marine food web supporting almost all marine life. They produce around 50% of the world's oxygen and remove several million tonnes of carbon from our atmosphere every year. Without marine plankton our planet would be a very different place. The Sir Alister Hardy Foundation for Ocean Science (SAHFOS) is an international charity responsible for running and maintaining the Continuous Plankton Recorder (CPR) survey. The CPR survey has been collecting plankton samples from the North Atlantic and the North Sea for more than 80 years and has sampled more than 6 million nautical miles of ocean. Plankton are highly sensitive indicators of environmental change and the data collected by the CPR survey provide essential information on the ecological health of our oceans. SAHFOS has been educating students and society about CPR research and plankton ecology for more than 13 years. This well-developed program aims to promote a better understanding of the importance of plankton and SAHFOS science to teachers, educators, schools, A level students, undergraduates and the interested general public.

Aquaria-clays and architectural models form a modern educational tool for the environmental education, fisheries and aquacultures

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The theoretic knowledge provided to university students on the subjects of applied fisheries and aquaculture can be completed and become more efficient when combined with practical exercises, visits to fish farms, field study of fish pathology and applied methods of treatment and prevention. Since the aquatic environment is inextricably connected to the previously mentioned scientific fields (which form the core of the fishing industry), an overall knowledge is a prerequisite for a correct management of the coastal zone, a place which reflects the strongest impact of human pressure. The often lack in financial funds for education, available resources and materials, as well as the long distance between education centres and practice areas, make it almost impossible to implement the educational support activities. Hence, in order to overcome these obstacles, it is necessary to find alternative methods of practical training. The use of simulation models is proposed as an alternative educational tool. Such models can be **architectural models** which depict land fish farms (types of aquaculture farms, facilities, etc.) and **aquaria-clays** of different sizes which can be used for the depiction of different ecosystems. The materials used for the constructions can be either natural (sand, stones, corals, sponges, shells) or artificial (plaster, gauze, cork, wooden items, and polymeric materials). Painting can be effected by using acrylic paints, primers and varnishes. Clay models can also depict organisms in different development stages with emphasis on anatomic characteristics as well as healthy and pathological states encountered in fisheries and aquaculture products. The construction and usage of such models form a new approach in both the theoretical and practical education. It is a relatively cheap solution which highly meets the teaching needs for the environmental education as well as for fisheries and aquacultures. Another fruitful proposal is the involvement of students for the construction of the architectural models within the frame of their graduation thesis. The students will better understand the theoretical knowledge given to them while they will be able to express their ideas on a certain matter, to develop trial methods, to improve an experimental idea and, finally, to develop a strategic thought in problems solving.

Do people have sufficient basic knowledge concerning oceans and seas?

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Very few studies have been conducted in Europe regarding the level of basic marine knowledge and education. These few studies however all indicate the very limited level of knowledge regarding Oceans and Seas and its absence in educational curricula. In 2005 the Flanders Marine Institute (BE) performed a study about the basic marine knowledge of the public. They questioned approximately 1200 secondary students and senior citizens about their knowledge and interests, and concluded that their basic comprehension about oceans and seas was insufficient. This study was taken as a starting point for two publications on how to upgrade basic knowledge of oceans and seas through secondary education. Both papers confirmed the absence of marine topics in biology lessons and its minor role in geography classes. Ocean related issues are treated as a footnote and consequently class resources are fragmented restricted to some isolated facts and illustrations in text books. To answer the question on how basic marine knowledge of the public could be upgraded through the secondary educational system, both papers offered long- and short term recommendations. Basic marine knowledge needs to be integrated in the secondary educational curricula, forcing schools to implement it in the class rooms. Since changes like that take time, a list of marine topics that could be integrated in the existing curricula and ways how to 'marinate' the content of biology and geography classes were given. These conclusions and recommendations were achieved through a focus group method implemented on students of the second and third grade, their science teachers and a board of marine researchers. First research question was whether all groups agreed on the necessity to upgrade basic marine knowledge of the public and whether it was part of their own interest. The answer was a definite overall 'yes'. Secondly the topics of their interest and necessity (in case of the researchers) were listed and evaluated, taken as a starting point for the above mentioned long- and short term recommendations and an analysis of the current biology and geography curricula was performed. At last ready-to-teach packages were developed based on these results as part of the short term solutions and a topic-list to implement in the future curricula was created, to serve as a scientific justified basis for curriculum changes.
Since these extensive and valuable studies were published in 2008 no steps towards a long-term solution were taken yet and the upgrade of basic marine knowledge of the public of the future still depends on the voluntary motivation of the individual teacher.
Seen the unquestionable importance of Oceans and Seas this lack of basic marine knowledge of Oceans and Seas of the broad public and the lack of initiative of the enforcement bodies is rather inexplicable.

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‘Kit do Mar’. The Portuguese educational project for the ocean

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The ‘Kit do Mar’ is an education project for the ocean developed by the Task Group for the Extension of the Continental Shelf (EMEPC). The aim of this project is to promote the awareness for the ocean knowledge among children and youngsters, leading to more informed and responsible citizens, more conscious of the strategic importance of the sea in our country.

The philosophy of this project is to enhance research, collaborative work and social intervention in our education practices.

This educational resource is a set of project sheets in accordance with the national basic curriculum guidelines. An interdisciplinary and inquiry approach provide a support tool for the educators, teachers and educational technicians to implement ocean related projects in school, or other non-formal educational contexts.

Our project sheets are developed in cooperation with both private and public sectors e.g., fisheries, ocean related museums and sea centres, harbours, and navy vessels.
The upcoming project ‘High School Kit do Mar’ is a pilot project that aims to implement education strategies based on scientific inquiry and will include laboratory activities in a real investigation context. A partnership between EMEPC and the Portuguese Institute of the Sea and Atmosphere (IPMA) was created in order to provide a learning experience in which students work with scientist during one scholar year.

Other projects like ‘Teachers on board’ and ‘Kit do mar teachers training’ are related to ‘Kit do Mar’. The ‘Kit do Mar teachers training’ is a program for all professionals that aims to implement the sea subject in the formal and non-formal teaching through the educational resource ‘Kit do Mar’. The goal is to train teachers, educators and environmental technicians, in specific subjects related to the sea, improving the implementation of ‘Kit do Mar’ as an educational project. During the course, ocean related knowledge, tools and practices are worked out and discussed with trainees bringing a better knowledge on the ‘Kit do Mar’ methodology and allowing an increase in scientific knowledge on the sea.

‘Teachers on board’ is a national project that allows the participation of science teachers in scientific cruises in the North-Atlantic ocean. This project aims to give teachers a clearer insight about ocean sciences, and a better understanding about ocean technology and research studies in order to increase their level of science literacy. The ‘Teachers on board’ program provides a unique learning environment and is driven by the active participation of teachers in hands on research activities.

After the cruises, participants are invited to share their experiences with students, colleagues and other education communities and to bring to schools real scientific data that can be used with their classes.

Major impacts on how teachers teach (namely inquiry), on how they think about science (nature of science and research) and on a personal level have been achieved (Costa, R. pers. commun.).

Oceanteacher global classroom pilot project

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With the establishment of the IOC Project Office for IODE in April 2005 in Oostende (Belgium), IODE was able, for the first time, to organise a sustained training programme for both data and information management. Since then, the programme has been able to organise an average of 8 courses/year over the past 5 years and welcomed over 1000 students from 120 countries. However, due to the limited budget, only 1-2 students per country can be invited to attend each course, which does not ensure the desired long-term impact. Travel time to Ostend is usually long, especially from Asia and Latin America, for both trainers and trainees, which combined with the jet lag and the limited one week duration of the courses, does not provide and optimal learning experience for the students.

In order to address some of these issues, the IOC Project Office for IODE will develop the OceanTeacher Global Classroom Pilot Project during 2013. Its main objectives will be to: (i) establish pilot regional and specialised training centres in India, Russia and Kenya; (ii) extensively test and fine-tune video streaming technology in the pilot regional and specialised training centres; and (iii) organise 2 courses in 2013 that will make use of the distributed and video streaming approach to lecturing. The expected results of this pilot project are to: (i) Expand the learning experience from OceanTeacher's current 20 students/course to hundred(s); (ii) Combine focus on local/national priorities with a global view; (iii) Achieve true lecturer flexibility: make the best lecturers available anywhere in the world without the need for expensive, tiresome and time-consuming travel; (iv) Link classrooms in geographically dispersed locations: Oostende, Obninsk, Hyderabad and Mombasa; and (v) To obtain an improved long-term impact of our training efforts.

The project will undertake the following activities: (i) organisation of training courses in the selected locations (Oostende, Hyderabad, Mombasa) with simultaneous video streaming to other locations; (ii) evaluation of user-friendliness, technical quality and reliability, student appreciation of the method and employed technologies. The evaluation results will be used to determine the feasibility of a global network of training centres (OceanTeacher Global Classroom) using video conferencing/video streaming, planned for 2014-2018.

An innovative illustrated field guide for the observation and monitoring of marine biodiversity by citizen scientists

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A popular activity during summer holidays is the discovery and exploration of the sea shore and marine life. Engaging in this recreational activity can have a real educational impact and can even result in lifestyle changes. However, because there are so many interesting marine organisms, for which the newcomers and average swimmers know almost nothing, they can find it difficult to memorise their characteristics. BIO-WATCH system (http://www.bio-watch.com) is a new and innovative method of information, learning and entertainment (Dounas, 2009). It includes a set of waterproof field ID cards, with high-quality images of the organisms likely to be encountered, and additional interacting print or electronic resources, such as special editions, CDs and DVDs, websites, databases etc. (Dounas and Koulouri, 2011). BIO-WATCH system provides a series of interactive tools supporting self-training in the identification of a group of organisms, terrestrial or marine, which live in a certain region. It also gives users interactive control of the information collected from the field as well as the consolidation of this information by incorporating additional knowledge sources. This is not only a support for users in the process of learning marine and terrestrial biodiversity but can offer entertainment and also provide environmental awareness.

A pilot project, COMBER (Citizens' Network for the Observation of Marine BiodivERsity, http://www.comber.hcmr.gr), which has been initiated under the European funded FP7 project ViBRANT (2010-2013) and co-ordinated by the IMBBC, aims at engaging citizen scientists – that is, all persons interested in nature – in a coastal marine biodiversity observation network. Within the framework of this pilot project, an illustrated and waterproof BIOWATCH ID card has been used for the identification of Mediterranean coastal fishes. This specific BIO-WATCH application includes the forty most common fish species of the Mediterranean coastal environment and it differentiates them on the basis of morphological characteristics (e.g. body shape, fin morphology), colour pattern, and habitat. COMBER is currently operating in the Cretan (Greece) coastal environment with the potential to expand to the whole Mediterranean basin or any other European region. Each participant (citizen scientist) is equipped with a BIOWATCH ID fish card which is used both to identify species and directly note down observations during the dive. Fish species were chosen as a target taxon for the implementation of the pilot project since they are abundant and most frequently attract the attention and interest of the wide audience. A website has also been developed and functions as the main communication and promotion vehicle of the network, offering data-entry tools for collecting information which, at a later stage, are channelled to large data aggregators (e.g. GBIF) and publication media (e.g. PENSOFT).

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The Kodiak Ocean Science Discovery Program bridging the gap between working scientists and classroom science

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The cooperation between the Kodiak Laboratory of the National Marine Fisheries Service, the Kodiak Borough Assembly, Kodiak Island Borough School District and the Kodiak College supports the Kodiak Ocean Science Discovery Program (KOSDP) by promoting locally based Ocean Science and Marine Stewardship through a combination of formal and informal education. A curriculum based core program provides age appropriate ocean science lab units for grades 3-8. Additional informal education modules offer a variety of public outreach, art, and in-depth after school programs as well as special units for the six remote k-12 village schools in the district. During annual visits to the KOSDP, all Kodiak public school students gain exposure to hands-on Marine Science lessons in a state-of-the-art laboratory with access to a seawater research facility and public touch tank, while scientists and volunteers are given opportunities to share their ocean knowledge and passion with the students.

Topics for grades 3 through 5 include the marine food web, keystone species, and an introduction to scientific experimentation. Grades 6 through 8 explore the chemistry and biological effects of ocean acidification, and the ocean's role in energy and matter cycling. Application of scientific techniques, a field trip to a working fisheries management facility and exposure to local scientists and fisheries managers interact systemically to create interactive learning experiences, which are reinforced through different units every year until high school. The high school curriculum is enhanced through KOSDP opportunities for Marine Science classes, guest speakers, a state-wide student competition, and internship opportunities. Embraced by the community, the Borough, scientists, students, teachers, parents, artists, fisheries managers, fishermen and ocean conservation groups, the Ocean Science Discovery Program has become a gateway of Marine Science education in Kodiak.

Ocean literacy through art: a partnership between art educators and marine scientists

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Learning about the ocean is certainly not limited to formal education. Also, extramural activities can enhance ocean literacy. In the 'Marine Art' project three partners will go into a unique co-operation to enhance ocean knowledge, observation and curiosity by a creative process:

- Marine science & knowledge: At the University of Ghent 24 research units are involved in marine research. Recently they united in the interfaculty research consortium **Marine@UGent**.

- Creativity, art: **The Academy for Visual Arts of Ghent** organises art education for children, youngsters and adults in the extramural circuit (on evenings and in weekends) to enhance creative skills and learn several techniques in the disciplines drawing, painting, printmaking, sculpture, mixed media, ceramics, illustration & cartoon, photo art or animated film.

- Co-ordination: **The Flanders Marine Institute (VLIZ)** is the coordination and information platform for marine scientific research in Flanders. Among others, it promotes the visibility of marine science and ocean knowledge to the public at large by means of popularisation and science communication.

During the first semester of the academic year 2012-2013, the students and teachers of the Art Academy will be brought into contact with scientists of the Marine@UGent consortium. The students will be introduced into the different marine research topics practiced at the University of Ghent – by means of a presentation, a dialogue, a visit to the lab or the field. Aim is to 'infect' the art students with curiosity in the sea and coastal processes, and give inspiration for work of art created by the artists in-spe.

End-point of the project is an exposition for the public at large in the weekend of February 2, 2013. The art work will be displayed in confrontation with the science that gave the initial inspiration. A catalogue will be elaborated for the exhibition.

Objectives of the project:
- make ocean sciences and marine knowledge approachable to people previously disconnected to it
- enhance new perspectives to look at the marine environment
- engage experimental learning through creative interaction with the scientific process and content
- by giving a personal meaning to scientific information art students become ocean literate participants
- build bridges between marine researchers and art students, who both need good observation, curiosity, creativity and intuition
- attract an even wider audience to marine research by means of the art exhibition.

When a maritime author and a marine biologist write a cookbook…

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Learning about the ocean is certainly not limited to schools. Visiting an aquarium, browsing on the internet, television, newspapers and books can have a large share in the informal or free-choice learning.

Cookbooks are very popular on the book market at the moment. Especially foodies and cooks – professional as well as amateur chefs – are very eager to read and learn more about the product's origin.

A seafood cookbook with bits and bites of ocean knowledge and marine science results in between the recipes can offer science communicators with a great opportunity to make ocean science understandable for a different kind of public. It may enhance the knowledge on species that don't belong to the charismatic megafauna such as dolphins and whales.

In Belgium the brown shrimp Crangon crangon is considered a delicacy: a regional product with a rich history and tradition. But the brown shrimp is also the research subject of many marine scientists: ecologists, fisheries biologists, food technologists, fishing technicians, etymologists, historians and archaeologists.

In the commercial publication 'Garnalen' – a cookbook annex information book – the maritime journalist Katrien Vervaele takes the public on a tour through today's and former Belgian shrimp fishing and processing. The marine biologist Nancy Fockedey punctuates the stories and interviews with fascinating historic anecdotes and scientific tidbits.

In addition, famous national and less famous international shrimp recipes are presented in between the chapters. The book is illustrated with professional food photography. Additional scientific information, data and visuals are provided through the website www.vliz.be/wiki/garnalen.

For all of us who eat shrimps regularly, this book opens up a whole new world and provides us with a thorough scientific and cultural understanding. The book is a compromise on what a scientist thinks people should know about shrimp and what a journalist considers an interesting story to tell. The difficult but interesting co-operation between the journalist and the scientist was to translate the scientific background in a language people can understand and read easily, without lapsing into scientific jargon, nor oversimplifying the content - an exercise in balance.

Technical information:
Katrien Vervaele and Nancy Fockedey. Garnalen - Verhalen en recepten van vroeger en nu.
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A matter of choice – ocean literacy, marine education, and YouTube

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Communicating our knowledge of marine sciences to younger audiences can be rather challenging. Science educators are routinely faced with poorly motivated adolescent school kids. No simple magical solution to solve this problem can be given here. However, making marine science educational content a matter of choice rather than obligatory might be a more effective approach in reaching out to these target audiences. Short, entertaining and informative YouTube videos, that present fascinating ocean-science content might be an option to better serve the needs of younger people.

The poster will address various aspects of marine-science-related YouTube videos: the communication department of MARUM started producing videos in 2007, and set up its own YouTube channel in 2008. Presently about 70 videos in German and English are available on MARUM TV. To compare and classify these products, the poster will also discuss similar activities carried out by other eminent European and overseas marine research institutes.

Moreover, obvious questions regarding the relative success and the evaluation of YouTube activities will be discussed: How effectively can the above-mentioned audience be reached? How should YouTube videos best be communicated? What role could additional communication via social media play? Does the incredible YouTube upload rate of currently 60 hours of video material per minute – a tenfold increase from the 2007 rate – negatively affect ocean-related educational efforts?

Finally, the poster will present a novel approach that is currently being undertaken in Bremen to produce entertaining YouTube videos covering scientific issues.

Marine education and marine environmental awareness for all. Expertise, partnerships, people but no funding?

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The Centre for Environment, Fisheries and Aquaculture Science (Cefas) is an internationally renowned aquatic scientific research and consultancy centre and also a prominent establishment and important employer within the local community. On a national and international scale, Cefas strives to achieve excellence in marine environmental, fisheries and aquaculture science. This, combined with the local maritime links past, present and future, provides an excellent basis for providing marine and coastal education initiatives within the community. However as a government executive agency gaining funding for marine education initiatives appears to be very difficult.
Cefas has vast resources and expertise for everything from underwater acoustics to aging fish and even has a volunteering scheme which would allow some of our experts to deliver and assist in some of the education initiatives. In terms of funding, if we could provide extra jobs within the community or specifically include activities for groups such as women and girls or boys and men for example, there might be a light on the horizon but marine education and environmental awareness for the whole community (schools, youth groups, minority groups and the general public) is not so high on the agenda.

So we potentially have the perfect partners locally and nationally and a range of education initiatives and ideas such as a Coastal Outdoor Discovery (COD) and Beach Schools programme led by Suffolk Wildlife Trust and developed in collaboration with Cefas scientists. COD is aimed at 13 to 25yr olds. Targeting groups from high schools, academies, homeless adults and children, etc. The beach schools initiative is for school groups and will provide practical activities and recognises the importance of outdoor learning. The beach schools are to be complimented by in school marine workshops. Workshops include sights and sounds of the marine environment; beach litter; renewable energy; aggregate dredging; fishing industry; marine biodiversity; coastal erosion and leisure activities to name a few. All youth activities also promote personal capabilities and scientific skills such as team working skills, communication, investigation, critical thinking, problem solving and encourage students to think about their surrounding environment and its long-term sustainability.

The complementary skills of Cefas and Suffolk Wildlife Trust will provide information on the marine environment for an objective and thought-provoking discussion and programme of education initiatives regarding the marine and coastal environment. Cefas has a wealth of expertise and resources that can be accessed for the various initiatives and Suffolk Wildlife Trust has the expertise in outdoor education that will allow a safe, innovative and hands-on approach. So armed with a network of people, places, partners and ideas our remaining hurdle is to find funding for Cefas to facilitate and co-ordinate these initiatives in collaboration with the other funded partners so that the very experts in the environment, fisheries and aquaculture science are not left high and dry.

The Ghent University sustainable seafood project and the role of educational institutions in raising awareness about sustainable seafood

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This poster gives an overview of the efforts that were taken by Ghent University towards sustainable seafood purchasing with which we hope to enthuse other universities, colleges, secondary schools and research institutes to follow this example.

In 2012, the ecological sustainability of seafood purchasing at Ghent University was evaluated and goals were set to adopt better buying practices in the future. In a second step, awareness was raised among students and university personnel about the consequences of overfishing for fish stocks and marine habitats. This was done through a series of events concentrated in the first Ghent University Sustainable Seafood Week from 7 to 11 May 2012 (more info at www.ugent.be/duurzamevis). At the end of the Sustainable Seafood Week, the rector of Ghent University signed a charter on sustainable seafood in which Ghent University commits to sourcing all seafood from sustainable fisheries and aquaculture in the shortest term possible.

Large educational institutions could potentially play a key role in the sustainable seafood movement because of two reasons. First, they are often large purchasers of seafood and can therefore urge their suppliers to adopt better practices. Second, educational institutions have a great influence on public opinion. By taking up responsibility, universities and colleges may contribute to shifting purchasing decisions towards sustainable choices.

Dolphin science workshops: a new approach to marine science education

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There is an observed lack of marine education, particularly in relation to the offshore marine environment, in the UK National Curriculum and ORCA aims to address this worrying issue through the launch of a new Dolphin Science Education Programme. ORCA has developed a three stage, curriculum-linked education programme consisting of: In-school dolphin science workshops; half-day excursions to teach dolphin research skills; and 3-day field trips to conduct whale and dolphin (cetacean) surveys at sea. This programme is currently delivered to local primary schools at Key Stage (KS) 1 and 2 (children aged 3-11 yrs.) in the Metropolitan Borough of North Tyneside, North East England. Over a three month period, March-May 2012, ORCA delivered the three stages of the Dolphin Science Education Programme to a group of KS 2 students (aged 9-10) from St Peter's Church of England Primary School. Staggering the interaction over this 3-month period we observed a discernible level of information retention amongst students between sessions and a noticeable improvement in the student's scientific investigation and enquiry skills over time. The programme gives students access to new opportunities, including the chance for many to see their first cetacean during the survey. ORCA is working in partnership with a commercial ferry operator to deliver the Dolphin Science Education Programme, making this an affordable and accessible marine science education programme for local schools to participate in. ORCA have demonstrated that providing a mix of interactive educational activities whilst utilising a variety of memorable learning environments is a successful way to engage students and faculty members in marine science and encourage advocacy of the local marine environment. Over the next year ORCA plans to promote the offering of the Dolphin Science Education Programme to more local schools as part of its regional outreach project 'Your Seas'.

Discover oceanography – bringing the classroom to sea

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Discover Oceanography sessions offer a 3 hour, hands-on, comprehensive introduction to marine science, providing an insight to the fields of Physical Oceanography, Marine Biology, Chemistry and Geology, delivered using modern and historical sampling techniques. The sessions are highly adaptable and can be altered to accommodate different levels of comprehension and understanding. Conducted on board the University of Southampton's research vessel *Callista* groups of up to 36 people can be accommodated. The sessions are delivered by university staff and students, and take place throughout the year. The Discover Oceanography Program has been delivering marine education at sea for more than 6 years. The truly unique feature is that of the floating classroom, with capabilities of taking these sessions to new areas and to reach schools and groups who normally have, if any, limited access to the sea. To date we have successfully delivered over 300 sessions to a variety of schools, colleges, universities and interest groups.

In addition to the sessions afloat, the Discover Oceanography team have attended a number of events; such as boat shows and festivals. Using *R.V. Callista* as a static platform, such events have showcased a wide variety of marine science demonstrations and interactive experiments, making current research from across the university accessible to a mass audience. The flexibility of hosting these sessions on a vessel enables us to cover a wide geographical area. We benefit from the ability to take our message to the audience and not expect them to come to us, demonstrated by a footfall of over 20,000 people during the last three years.

Discover Oceanography is a simple yet highly effective platform to bring marine science into mainstream education and to the general public.

Join the virtual classroom at sea

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In May 2013, European researchers will embark on a voyage from Europe all the way across the Atlantic Ocean to America as part of the EU funded EuroBASIN project. En route they will collect a whole host of different data that hopefully will provide us with a better understanding of the marine ecosystems in between the two continents. 0n board the very modern research vessel G.O. Sars will also be a teacher and a cameraman who will teach lessons developed for high school students live via satellite link as the cruise happens. Winners of a pre-cruise student contest will have the researchers on the ship collect data for their very own research project.

A model for successful implementation of ocean literacy concepts for elementary school educators: the importance of focusing on early childhood for ocean stewardship

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Researcher Louise Chawla (1999) demonstrated that the two biggest factors influencing environmental stewardship are having had positive experiences in nature and strong role models as a child. Children learn very powerfully by observing the actions and attitudes of adults. Indeed, modelling has been shown to help children become problem solvers, critical thinkers, and decision makers (Braus, 1999). Rachel Carson also believed that early childhood years are critical in providing the 'fertile soil ' for the seeds of knowledge about the natural world to grow (Carson and Pratt, 1956).

In order to build a society of people who are informed and passionate about the ocean, we should build a system of public education for children that gives them, not just the ability to read and write, but the ability to think holistically and critically, solve problems, make connections, communicate effectively, think globally, understand ecosystems and one's sense of place in it, and respect the natural world through direct experience in it. Such an education system is a challenge to implement in the United States (US) with its focus on the subjects of reading and math in early childhood education. However, novel approaches to teaching ocean literacy principles (OLPs) can be applied within the existing system that seem to work. One approach we tried combines providing direct and positive experiences in nature during the earliest years of education with a curriculum that builds upon that bond in subsequent years, providing an even deeper understanding of and appreciation for the ocean. These ingredients of knowledge and passion for the ocean form the basis for life-long stewardship.

Our model for ocean literacy emphasises the importance of early childhood experiences in inspiring ocean stewardship, relies upon multiple levels of partnerships, and integrates OLPs into an existing curriculum. The US ocean resource agency, NOAA, tested the model with great success. Experts across NOAA, a State Department of Education, a local public school district, and a conservation organisation, brought educators through the fundamentals of ocean science leading up to an understanding of ocean resource sustainability and management, spanning many concepts of the OLPs. Educators were provided with the opportunity to engage with stakeholders involved in resource sustainability. The success of the pilot demonstrates the power and importance in building partnerships at all levels federal, state, and county - (i.e. local school district) and across sectors to effectively implement OLPs and concepts 'on the ground. '

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Marine citizenship: are we ready? A UK case study

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Marine governance is undergoing a significant change, moving towards citizen-driven management and policy strategies, as recommended by international legislation, including the EU Marine Strategy Framework Directive (2009), the UK's Marine and Coastal Access Act (2010); Australia's National Oceans Policy (1998) and Canada's Ocean's Act (1997) (Foster *et al*., 2005). Historically, the marine environment has been managed on a sector-by-sector basis; however, this on-going shift is encouraging enhanced levels of community involvement in the development of effective marine governance. However, in order for this to be achievable and successful, we need to engender a marine literate society. Indeed, NOAA recognises a marine literate citizenry as being vital to achieving international marine management goals (NOAA, 2007). Further to this, research has suggested that individuals with higher levels of literacy would be more likely to behave in a favourable manner towards the environment, exhibiting a higher level of awareness of issues and the impacts of their behaviour on the marine environment (Haklay, 2002). While this is the ideal, research has indicated that levels of public literacy and awareness are low (Fletcher *et al*., 2012; McKinley, 2011; McKinley and Fletcher, 2010; Fletcher and Potts, 2007; Fletcher *et al*., 2009; Steel *et al*., 2005).

This paper investigates the current capacity of UK citizens to facilitate the 'turn to citizenship' (Valencia-Saiz, 2005), focusing specifically on the role of marine citizenship (proposed by McKinley and Fletcher, 2010; 2012), and evaluating current capacity for public involvement in this process, examining levels of public ocean literacy, through a two pronged case study approach. Community interviews were conducted at five UK case study locations to assess levels of public understanding and knowledge of marine issues, while 3 schools participated in a questionnaire survey to evaluate the levels of literacy currently exhibited by the younger generations. Overall, it was evident that while there is a high degree of public concerns for the marine environment, interviewees were not aware of issues facing the marine environment, and had limited understanding of the relationship between their own lives and the marine environment. The research assessed some of the barriers to meaningful public involvement in the development and delivery of sustainable marine governance, concluding that a lack of personal connection, lack of awareness of societal behavioural impacts and a perceived level of expense associated with involvement are the primary challenges to marine governance bodies. The results of this study suggest low levels of public awareness, ineffective delivery of marine related education through formal processes and a limited understanding of the correlation between individual lifestyle choices and the marine environment. While this limited understanding poses significant challenges to participative marine governance strategies, earlier research has suggested that improving access to education and information and opportunities for meaningful engagement in the process will be central to the successful inclusion of citizens (Steel *et al*., 2005; McKinley and Fletcher, 2010; Castle *et al*., 2010; Roth, 1992). Therefore it is recommended that improved inclusion of the wider public as stakeholders of the marine environment through wider access to the process should be a key objective of marine managers and governance bodies. Additionally, it is recommended that improving the balance between formal and informal education strategies as a mechanism for enhancing public marine literacy. Finally, the research emphasises that if the goals set by contemporary marine governance are to be met, it is imperative that levels of literacy, awareness and the overall sense of citizenship towards the marine environment be improved.

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Why is it so hard to set MSFD indicators and targets? Messages from the plankton

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Unprecedented basin-scale ecological changes are occurring in our seas. As temperature and carbon dioxide concentrations increase, the extent of sea ice is decreasing, stratification and nutrient regimes are changing, and pH is decreasing. These unparalleled changes present new challenges for managing our seas as we are only just beginning to understand the ecological manifestations of these climate alterations. The Marine Strategy Framework Directive requires all European Member States to achieve Good Environmental Status (GES) in their seas by 2020; this means management toward GES will take place against a background of climate-driven macroecological change. Each Member State must set environmental targets to achieve GES; however, in order to do so an understanding of large-scale ecological change in the marine ecosystem is necessary. Much of our knowledge of macroecological change in the North Atlantic is a result of research using data gathered by the Continuous Plankton Recorder (CPR) survey, a near-surface plankton monitoring program which has been sampling in the North Atlantic since 1931. CPR data indicate that North Atlantic and North Sea plankton dynamics are responding to both climate and human-induced changes, presenting challenges to the development of pelagic targets for achievement of GES in European seas. Thus the continuation of long-term ecological time-series such as the CPR is crucial for informing and supporting the sustainable management of European seas through policy mechanisms.

Are Greek students ocean literate? Analysing ocean science issues in primary education textbooks

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The ascertainment that ocean sciences are among the most underrepresented disciplines in K-12 educational curricula has led to the development of the Ocean Literacy Campaign in the USA. Within this framework, the knowledge required to be considered ocean literate in accordance with the National Science Education Standards was outlined; ocean literacy was defined and seven essential principles and forty four fundamental concepts of ocean sciences were identified (e.g. Cava *et al*., 2005; Strang *et al*., 2007; Cudaback, 2008; Schoedinger *et al*., 2010). The present study attempts to portray whether these essential principles and the corresponding fundamental concepts of ocean literacy are included in textbooks of Greek primary education, and to what extent. One key issue on ocean literacy is school curricula and whether these have an ocean literacy oriented perspective. Considering the latest transitions in education worldwide, the Institute of Educational Policy in Greece started planning the revision of the Greek curricula in 2000. Maintaining the centralized character of the curriculum, the Institute proceeded to many educational innovations, based on new pedagogical and psychological theories (The Institute of Educational Policy, 2003). The textual corpus analysed in our study, consisted of textbooks used for the teaching of science issues in Greek primary education. Four textbooks were taken in consideration ('Studying the Environment', 'Geography', 'Science' and 'Environmental Education Interdisciplinary Activities Guide'). All textbooks were analysed by employing the content analysis method (Krippendorff, 1980; Mayring, 2000). Our analysis applied an a priori coding, as the requisite categories were the seven Ocean Literacy Principles (OLPs); the whole page was determined as the analysis unit, containing either phrases or depictions (photographs, drawings, charts, maps). Each textbook was studied and all the relative pages were isolated and recorded. Analysis showed that ocean science issues cover 162 out of the total 1,125 pages of all textbooks, corresponding to 15.1%; their percentages varied, among textbooks, between 7% (in 'Science)' and 29.7% (in 'Geography'). Not all seven principles, neither all fundamental concepts per principle are cited. OLP 7 is not reported at any textbook or grade. The most frequently observed principles are the first, fifth and sixth; most of them occur in 'Geography' and the 'Activities Guide', whereas the fewest in 'Studying the Environment' and 'Science' textbooks. Furthermore, OLPs 1, 4 and 6 have most of their fundamental concepts covered, followed by the second, third and fifth principle. In conclusion, our study revealed that very few of the fundamental concepts are included in detail, while most of the others are represented by an almost abstract and fragmented pattern, with many inconsistencies within the same textbook or among different grades; therefore primary education students receive little information about oceans and oceanic life, and their importance not only to our own well-being, but to the welfare of the whole planet. Given the fact that Greece is a country with specific characteristics, deriving from its geographical location and maritime heritage, it is interesting to investigate the secondary education textbooks as well, in order to obtain a clearer picture of the formal education contribution to the Greek students' ocean literacy status.

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Mediterranean and Black Seas: a case for disseminating and communicating marine science through European projects

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The HCMR is the main research Institute in the southern Mediterranean area to coordinate two large EU-funded research projects under FP6 (SESAME) and FP7 (PERSEUS), both of which explore and study the natural and man-made pressures on the Mediterranean and the Black Seas and assess their effect to understand past and future ecosystem changes. Natural and social sciences were closely merged to predict the long-term effects of these pressures, while emphasis was given to dissemination and outreach activities, specifically built into both projects' work structure to target the general public and schoolchildren in particular.

The SESAME project, involving almost 400 scientists from 59 institutes in 24 countries, collected data on every aspect of the Mediterranean and Black Seas and went beyond science, as it committed to improving capacity building, training, dissemination of results and public outreach, integrated into one information platform. SESAME set in action activities fostering cooperation among Black sea and Mediterranean scientific communities, thereby providing opportunities for mobility of researchers, training of PhD students, graduate and post-graduate opportunities and summer schools. Regarding education, the project reached out to schoolchildren by inviting them to take part in its research activities, a plan thoroughly embedded in SESAME's strategy from the very beginning. SESAME accomplished virtual 'participation' of schools in the planned oceanographic cruises and online visits of the vessels prior to departure. The project also organised two school competitions via the School outreach program, which attracted the attention of 18 classes from 6 countries. Teaching aids were prepared and provided to all children, while the competition raised the interest of schoolchildren in marine research, increased awareness on human impacts and climate change and was positively perceived by all teachers. The 'SESAME Club', which originated in Bulgaria through the collaboration of researchers and the Natural Sciences Gymnasium, was one of the most positive and encouraging outcomes of the educational programme.

PERSEUS, a 4-year research project, will assess the dual impact of human activity and natural pressures on the Mediterranean and Black Seas. By providing strong links between natural and socio-economic sciences, it will help to predict the long-term effects of such pressures on marine ecosystems and design an effective research governance framework, to provide the basis for policymakers to turn back the tide on marine life degradation.

The project, implemented by 54 partners, has a clear and concise Communication Strategy plan, to target different stakeholder groups, ranging from scientists and policy-makers to schoolchildren and the general public at large.

Youth and schoolchildren will be particularly encouraged and stimulated through the two PERSEUS Citizen-Scientists initiatives: the Jellyfish spotting and the LitterWatch campaigns, which both require the public's active participation by recording their sightings (jellyfish and litter) and sending photos by e-mail/posting them on the PERSEUS website through Smartphone applications; this activity will help scientists monitor changes in jellyfish migration patterns and litter distribution. Posters, flyers, social media platforms and large media partnerships will all help in raising the campaign participation numbers.

Fishpop vzw: for sustainable fish populations

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The problem of overfishing is nowadays putting big concern on the conservation and survival of our Oceans' fish populations all over the world. Climate change and habitat destruction are synergic forces that make the situation even more urgent. Obviously, the main reason for overfishing is fish consumption and the fish business, and on the other hand, the lack of awareness that at the base of every human activity there are natural equilibriums trying to keep the peace. Crucial stakeholders like fishermen and restaurants' managers are key points where to start acting from, in order to make a change in this context.

Fishpop vzw is a non-profit organisation which aims at connecting the sustainable fishery sector with the restaurants themselves, providing a link and 'free of charge' guidance to the restaurants when they are up to choose the fish species they want to provide in their menu. But of course, Fishpop vzw interests and goals do not only consider the sole business around the matter, but also acknowledge the fundamental importance of education in a global context of human improvement. The understanding of nature processes and equilibrium and their implementation in everyday choices and personal lifestyles are a must if we are up to protect and conserve our oceans. For this, Fishpop vzw integrates in its program the outreach of general public via public events and talks, and the 'in situ' education of restaurant customers who are not only able to have a 'sustainable choice' in their menus but also to read and learn what makes this species sustainable while enjoying its taste. With this poster we want to outline and present the activities and goals of Fishpop vzw.

Providing training in ocean observations for developing country scientists: the POGO experience

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Since its early days, the Partnership for Observation of the Global Oceans (POGO) has strongly emphasized training and education as a central part of its agenda. As a result of its São Paulo declaration of 2001, which drew attention to the world imbalance between Northern and Southern Hemispheres in the capacity to observe the oceans, POGO set up training initiatives for scientists from developing countries. These have, over the years, grown into a comprehensive and renowned capacity building programme, intended primarily for scholars from developing countries. It is multi-pronged, including:

- The Nippon Foundation-POGO Centre of Excellence in Observational Oceanography, under which ten scientists from developing countries, annually, are supported to study for ten months in an intensive programme related to ocean observations.

- The POGO-SCOR Fellowship Programme, annually, under which scientists from developing countries can spend up to three months training in a major oceanographic institution.

- The POGO-AMT Fellowship Programme, under which one scientist annually can participate in a major oceanographic cruise (the AMT cruise), and spend time at a participating major oceanographic institute before and after the cruise to experience cruise preparation and data analysis.

- The POGO Visiting Professor Programme, under which one senior scientist, annually, visits a developing country to conduct training in ocean observations.

- The POGO-UCT Bursary Programme under which one African graduate student, annually, is supported to study at the University of Cape Town, South Africa.

- Travel support for participants from developing countries attending Austral Summer Institute courses at the University of Concepcion, Chile.

Together, these training programmes are making significant contributions to reducing the deficit in trained observers of the ocean in developing countries. Some 450 young scientists from 63 countries have received advanced training through POGO capacity-building initiatives, while the massive over-subscription for POGO training schemes provides ample proof that the effort is responding to a genuine need. Since 2010, POGO has been developing a Network of Alumni trained under the joint Nippon Foundation-POGO programmes. The aims of the Network are to maximise the benefits to the alumni from the training they have received; to facilitate active contacts among the alumni and with the training faculty; and to promote joint research activities that will build on the training. The Network comprises over 150 members, has a website and biannual newsletter, and launched, in 2012, four collaborative, regional research projects conducted by the alumni.

Although POGO's efforts have been directed towards young people already engaged in science (generally Masters or PhD level), POGO also recognises the importance of educating children from an early age, and has engaged in a number of outreach and educational events over the years. The latest example is the Expo 2012 Yeosu Korea, where a series of public lectures was organised in June 2012.

OpenAIRE: 2nd generation open access infrastructure for research in Europe

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The OpenAIREplus project builds on achievements in OpenAIRE and Driver. The project's mission is to facilitate access to the entire Open Access scientific production of the European Research Area, providing cross-links from publications to data and funding schemes. OpenAIREplus brings together 41 pan-European partners, including cross-disciplinary research communities. Main goal of the project is to create a robust, participatory service, cross-linking peer-reviewed scientific publications with associated datasets.

As scholarly communication touches upon many disciplines, the project's horizontal outreach will facilitate collaboration across data infrastructures, providing information to scientists, non-scientists as well as to providers of value-added services. The current publication repository networks will be expanded to attract data providers from domain specific scientific areas.
The project will establish an e-Infrastructure to harvest, enrich and store the metadata of Open Access scientific datasets. Innovative underlying technical structures will be deployed to support the management of and inter-linking between associated scientific data. Liaison offices in each of the project's 31 European countries work to support the needs of researchers in Europe. OpenAIREplus will also actively leverage its international connections to contribute to common standards, data issues and interoperability on a global level.

References

www.openaire.eu

Whale and dolphin education at sea – empowering ocean citizens

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There is a perceived lack of awareness amongst the general public of the richness, diversity and importance of UK and European seas. To address this, ORCA operates a successful Wildlife Officer Education Programme on commercial passenger ferries across Europe, bringing marine conservation closer to home for thousands of people. ORCA is a UK based marine conservation charity, which focuses on marine wildlife education and whale and dolphin (cetacean) research in NW Europe. Currently in its fifth year, ORCA's Wildlife Officer Education Programme recruits experienced Wildlife Officers on-board busy passenger ferries to provide interpretation about the local marine environment. The uniqueness of this project comes from the reality of giving people opportunities to encounter whales and dolphins while travelling at sea. Building on the excitement and surprise many people feel during these first encounters, ORCA is able to empower people to care for our oceans and take action to protect our seas. As a result of interaction with the Wildlife Officer Education Programme many passengers join ORCA's Citizen Science research programme, which trains volunteers to conduct vitally important cetacean surveys in UK and European waters. Currently, the Wildlife Officer Education Programme reaches over 10,000 ferry passengers each year. In 2011 Wildlife Officers spent 780 hours on deck with passengers and recorded sightings of 11 cetacean species including; harbour porpoises, white-beaked dolphins, fin whales and sperm whales. ORCA has forged strong partnerships with commercial ferry operators to deliver the Wildlife Officer Education Programme at a relatively low cost. Through this project, ORCA has demonstrated that facilitating personal and memorable marine wildlife experiences can empower a network of ocean citizens and inspire the public to actively participate in marine conservation activities. There is scope to take this form of low cost, in-situ marine education across Europe to further promote international ocean citizenship.