EMSEA 2017 Conference
Malta
7th-10th October 2017

University of Malta

Abstracts booklet

The European Marine Science Educators Association (EMSEA) is an informal non-profit organisation which provides a platform for ocean education and promoting ocean literacy within Europe. The rationale of **EMSEA** is educational and scientific.

GOALS

The particular goals and activities of EMSEA are the following:

- Stimulate dialogue between European and international marine educators and scientists;
- Provide training and teaching materials to support marine educators;
- Raise educators awareness of ocean issues and the need for a sustainable future for our coasts, seas and oceans.

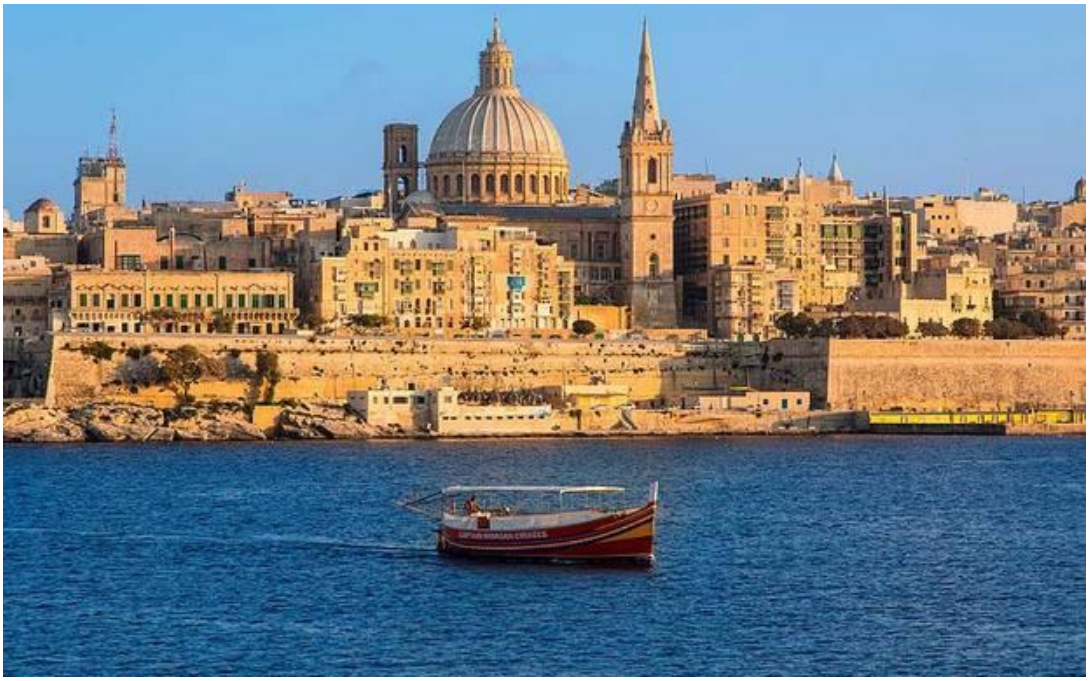
ACTIVITIES

- to organise workshops and conferences for marine educators;
- to build a web portal with links to providers of marine educational and research-based materials;
- to provide a forum for members feedback and communication.

Further information about EMSEA can be gleaned through www.emsea.eu

A landmark activity of EMSEA is the annual conference. The University of Malta hosted the 5th annual EMSEA conference between the 7th and the 10th of October, back-to-back with the Our Ocean conference organised by the EU Commission on the 5th and 6th October, still in Malta. The venue of the EMSEA Malta conference was the evocative building of the Valletta campus of the University of Malta, built by the Knights of St. John during the early 17th century. Valletta will assume the status of European Capital of Culture in 2018.

The following are the full abstract proceedings of all the works presented at the EMSEA Malta conference.



The Organising Committee of the EMSEA Malta conference was composed of:

- Professor Alan Deidun, Department of Geosciences, Faculty of Science, University of Malta (conference convener)
- Professor Paul J Pace, Department of Mathematics and Science Education, Faculty of Education, University of Malta
- Ms Fiona Crouch, Marine Biological Association of the UK
- Dr Francesca Santoro, UNESCO-IOC
- Dr Melita Mokos, University of Zadar, Croatia
- Dr Martha Papathanassiou, Hellenic Centre for Marine Research (HCMR)
- Dr Evy Copejans, Flanders Marine Institute (VLIZ)
- Ms Geraldine Fauville, University of Gothenburg, Sweden
- Mr Peter Tuddenheim, College of Exploration, USA

The organising committee of the EMSEA 17 Malta conference are grateful to the following sponsors:

- Ministry for Sustainable Development, Environment and Climate Change (MSDEC)
- Ministry for Education and Employment (MEDE)
- Environment and Resources Authority (ERA)
- Malta National Aquarium
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MINISTRY FOR THE ENVIRONMENT, SUSTAINABLE DEVELOPMENT AND CLIMATE CHANGE

MINISTRY FOR EDUCATION AND EMPLOYMENT

U.S. EMBASSY VALLETTA, MALTA

MALTA NATIONAL AQUARIUM

HSBC

ERA

FIFTH EMSEA CONFERENCE, MALTA 2017

Foreword

Hailing a new era for ocean literacy

The Maltese Islands, despite their miniscule terrestrial extent, have always managed to punch way above their weight when it comes to the ocean. Hosting the International Ocean Institute, the Islands can also claim a pivotal role in the formulation of the Law of the Sea through the Maltese representative to the United Nations Arvid Pardo. The 'father of the law of the sea', as he is affectionately known, in fact delivered a prophetic speech to the UN General Assembly on 1st November 1967 where he coined the iconic phrase 'the sea as the common heritage of mankind, which still resonates to this very day and which is enshrined within Article 136 of the United Nations Convention on the Law of the Sea.

Europe's seas are currently being assessed more than ever for their blue potential, as Blue Growth gains greater traction throughout the continent. We are plumbing our seas to greater depths in search for elusive minerals, cures, genetic resources, energy sources and a plethora of other as yet untapped assets. In the race to unlock more and more of the ocean's secrets, ocean literacy assumes a more compelling role, in an attempt to revise the paradigm of human impacts on our ocean so far. In fact, the narrative of the human exploitation of the ocean so far has seen us first exert deleterious impacts on the ocean environment, only to become aware of the same impacts and to resort to ocean literacy to generate awareness at a successive stage.

The challenge now is to anticipate things…..to resort to the precautionary approach when venturing into unchartered grounds in our ocean by highlighting potential impacts of our actions before these actually happen. Some might label this utopic……I prefer to call it 'foresight.' For us to reach this stage, governments and institutions must invest heavily in ocean literacy in order to ensure a more responsible Blue Growth. It is imperative for potential investors to have a grounding in ocean literacy principles, paralleling the considerable success that we are having with introducing ocean literacy concepts within school curricula and initiatives across Europe. Ocean Literacy is thus crucial to achieving a more sustainable and responsible Blue Growth.

We are gearing up towards the International Decade of Ocean Science for Sustainable Development, designated from 2021 till 2030 by the UN last June in New York at the Ocean Conference. The considerable number of abstracts submitted for the EMSEA Malta conference (approaching the 70 mark) is ample testimony to the profile that EMSEA has managed to achieve since its establishment a decade ago and to the status that Ocean Literacy has acquired across the European continent and beyond. The same abstracts showcase good practice that the global ocean literacy community has managed to achieve – a great debt of recognition is owed to the same community for putting ocean literacy on the map of societal priorities. Let's keep the momentum going!

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UNIVERSITY OF MALTA
L-Università ta' Malta

FIFTH EMSEA CONFERENCE, MALTA 2017

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1
The digital age of ocean literacy

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A virtual expedition approach to Ocean Literacy in schools

A discussion of the next steps in Ocean Literacy in schools, using a case study of virtual expeditions. With progress having been made in reducing structural barriers to Ocean Literacy through curriculum reform in England, models of education need to be developed that create a cognitive and empathetic relationship between young people and the see. Virtual expeditions, utilising a range of education technologies are one of the models that can serve to create this relationship. This presentation reflects on the success and barriers of using virtual reality 360 media, interactive expedition video lessons and geo-technologies to enhance the teaching of ocean topics in the classroom. The presentation will also reflect on the important distinction between content and context in the teaching of ocean topics. In particular, case studies from the Arctic Live, Coral Live and Submarine STEM education programs will be used during this presentation.

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Increasing Ocean Literacy in the Digital Age: Insight from the Sea Change Campaign

This digital world we live in communicates in one-minute sound bites and 140 characters. This can make it a real challenge to effectively communicate complex messages to the public. The Sea Change project's public campaign is overcoming this obstacle using digital media to successfully engage with European citizens to create a deeper understanding and awareness of how their health depends on the health of our ocean. This talk will highlight how you don't need a team of marketing executives and a massive budget to conduct a successful digital media campaign. It will provide practical tips and tricks on online public engagement, focusing on the digital elements of the Sea Change information campaign, including videos, social media (Facebook, Twitter, Vimeo, YouTube, Storify), infographics, contests, digital pledges and more. The positives and negatives of online engagement will be discussed and there will also be opportunity to learn from audience members who may have tips for successful online campaigns. Sea Change has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 652644.

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The ocean in the new digital age: an opportunity to understand it better using smart and innovative tools

Contributing to Ocean Literacy means also to disseminate the understanding of the ocean's influence on our lives and the influence that our choices and actions have on the ocean. Operational oceanography services developed in Europe (e.g. European Copernicus Marine Monitoring Service - CMEMS) reach nowadays thousands of users dealing with societal challenges such as maritime safety, coastal and marine environment management, climate change assessment and marine resources management. Freely available oceanographic products from CMEMS are transformed and provided to users, private companies and stakeholders through adding-value chains (downstreaming) which consider advance visualization, usage of multi-channels technological platforms and specific models and algorithms. In the new digital age of Ocean Literacy developed products for maritime safety means better and deeper understand the ocean and its features. An example is SeaConditions (www.sea-conditions.com) which provide a user-friendly experience allowing to quickly and easy display of data and access to information to understand the ocean conditions in order to do the best choice for our lives. The other 3 tools developed for the sea situational awareness are the following: • VISIR (www.visir-nav.com), a new service for computation of safe and efficient nautical routes • OCEAN-SAR (www.ocean-sar.com), a service provided to support maritime authorities and operational centres during search-and-rescue operations • WITOIL (www.witoil.com), a service to deliver and disseminate the prediction of the transport and transformation of actual or hypothetical oil spills in the Mediterranean Sea. All the products are available through both web and mobile channels. Such customize services reach more than 100.000 users in the Mediterranean area. Freely available mobile version of SeaConditions can be accessed on the Apple store and Google store.

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The online Marine Training Platform: Europe's response to Blue Growth capacity building requirements

Human capacity building and continuous professional development are key to the development of current and future workforces to answer the needs of the European Blue Economy. It is often stated that there is a major gap between the education offered within European educational institutes and the skills required by the industries. Due to several reasons educational providers struggle to keep pace, follow up and reply to the industry needs. Joining forces via private-public training partnerships may provide solutions to these skills gaps, may enhance ocean literacy and may as well favour the transmission of knowledge to the upcoming blue generation. In the past five years a service platform for marine education and training was developed at Ghent University, within the framework of the Belgian node of the pan-European Marine Biological Resource Centre (EMBRC-ERIC): MarineTraining.eu. MarineTraining.eu services include insights into a comprehensive database focused on higher education institutes and free access to up-to-date data about Marine and Maritime training initiatives for each country, ranging from master and doctoral programmes, to internships, expert trainings and specialist courses. In addition, MarineTraining.eu provides a series of services related to organizational aspects of creating and running a training, including advertisement possibilities, administrative tools (application, registration & certification) and the creation of marine and maritime dedicated e-learning initiatives. All the above-mentioned will soon be part of a more user-friendly makeover and new possibilities will arise to facilitate the educational tasks of teachers and to boost ocean literacy. In other words, MarineTraining.eu is your online one-stop-shop for marine/maritime training in Europe: *www.marinetraining.eu*

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Ocean Literacy loves IT

The common goal of Zoos, Aquariums and Museums (ZAMs) and Ocean Literacy community is to track down the modern society to have an impact on its behavior. Possibly the best way to do that is to follow the tools that are now commonly used by the people and to communicate with them by adopting the devices that are generally operated in a daily life, like smartphones. 'Baltic Museums Love IT' project connects ZAMs with IT-specialists to engage the generation of digital natives. It ties up information and communication technology tools with the knowledge about the ocean. The aim of the project is to create Bring-Your-Own-Device (BYOD) guided tours by using gamification, multimedial content and augumented reality techniques. It will engage the visitors, enhance their experience and make it more involving. First stage is the preparation of the institution staff to provide them with skills needed to reach the modern audience. Varied trainings will be organized, such as: user experience and Generic Learning Outcomes, storytelling, applied video production, engaging the generation of digital natives. The resulting pool of knowledge will be made widely accessible via an open wiki tool. The second stage will lead to development of the project products that will be co-developed by users themselves in a hackathon events. The prototypes of BYOD-guide and supplementary mobile apps will be developed as free software. The third stage starts with letting the visitors use the BYOD-based tours. The visitors' feedback will be evaluated. Appropriate changes will be applied to the guides. The impact will be measured, conclusions drawn and further actions proposed. All this effort hopes to engage generation of digital natives and enlist them to become more ocean literated. The project will be implemented through the European Union under the South Baltic Program in the European Regional Development Program.

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Achieving Collective Impact: The International Ocean Literacy Survey

There are hundreds of efforts in dozens of countries to improve public understanding of the importance of the health of the ocean. There are major, large scale initiatives funded in Europe, Asia and the United States focused on Ocean Literacy. Ocean Literacy has become both a theoretical and conceptual framework for organizing the work of this international movement. Yet, we have little evidence of the impact of our efforts. Many initiatives and even large programs lack either the resources or the expertise to measure our collective impact. When multiple stakeholders come together to achieve "collective impact," it is necessary to have clearly articulated common goals, and agreed upon common measures. Two years ago, dozens of marine science educators, scientists and education researchers from three continents came together to develop a common measure of progress toward improving Ocean Literacy. Because this is an unfunded, grassroots, volunteer effort, we are learning a great deal about international collaborations, and are forced to develop strategies for conducting research in the most efficient and nimble ways possible. We have tested two versions of the International Ocean Literacy Survey in 17 languages in 24 countries. Nearly 7,000 students aged 16-18 have taken the survey, and we have demonstrated that the instrument has a high degree of validity and is reliable for the purpose of measuring knowledge related to Ocean Literacy. The Survey team includes a core of science educators and researchers; volunteers from the Ocean Literacy and Education Research committees of the U.S. National Marine Educators Association; an Advisory Board representing educators, scientists and education researchers from Asia, Europe and North America; and dozens of individuals and organizations around the world. In this session, we will describe the most recent Survey findings, and share fascinating lessons learned about managing large scale, somewhat unwieldy international collaborations.

2
Future scenarios for ocean literacy

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Ocean exploration on alien worlds

On 17th April 2017 NASA astonished the world with news that Saturn's moon Enceladus, like Jupiter's moon Europa, appears to host a deep ocean, with a high likelihood of geothermal activity. See https://www.nasa.gov/press-release/nasa-missions-provide-new-insights-into-ocean-worlds-in-our-solar-system. The conditions encountered on Eceladus and Europa may provide the necessary ingredients for life to evolve independently of any need for sunlight, and offer an incredibly tempting target for future science missions.

Engineers from teams across the world are being inspired to consider the design of missions carrying robotic underwater vehicles that could be delivered to these icy worlds, somehow melt their way through the thick ice, then explore the hidden ocean below, make discoveries, and report the data back to Earth.

For school and university students, the challenges of such missions offer tremendous scope for flights of imagination and the application of ocean literacy, appealing to science students who may wish to consider the technical and engineering challenges, and also to students of the arts who can be inspired to write speculative science fiction about mission, to paint illustrations depicting what may be found, and to consider the philosophical, historical and religious aspects of what it would mean to humankind to encounter even the most primitive of species that had evolved in an entirely independent manner.

As an international Learned Society dedicated to underwater technology and the transfer of knowledge, SUT (www.sut.org) is inspired to consider that the technologies our members have developed for use in this world's ocean could one day have descendants exploring new worlds. By considering the challenges of placing an object of human manufacture in a truly pristine environment without causing harm or contamination, students will also learn how to apply better stewardship techniques here on Earth.

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Blue School PT: All Aboard for Ocean Literacy

Blue School PT was created by three Portuguese entities with an active role on the promotion of ocean literacy (Directorate General for Maritime Policy, Ciência Viva and the Lisbon Oceanário). This program intends to engage the Portuguese schools and the ocean stakeholders in the education of ocean literate citizens.

It results from the need to integrate the great diversity of Portuguese marine education initiatives into a single strategy capable of engaging all players. Only working together, can we build an effective strategy for the implementation of ocean literacy.

The Blue School concept has been discussed in European marine education forums like EMSEA. The definition of an European concept is part of the "Sea Change" project where one of our partners takes part. Blue School PT marks the first time this concept is going to be implemented in the field. We hope that this Portuguese approach, with its achievements and learning opportunities for improvement, will inspire the development of an European Blue School concept.

The Blue School PT concept was defined by a working group that gathered major ocean literacy players: the Ministries of the Sea and Education; universities (marine science and education research centres); UNESCO; NGO's; museums; aquariums; teachers and marine educators.

A Blue School PT must develop an educational project about the ocean, linking different school subjects and levels. This project must accomplish a set of criteria that include encouraging students for action and decision-making in ocean-related issues, developing hands-on activities, and involving local communities and marine stakeholders.

The 2017/18 school year marks the beginning of the program and 30 schools are already confirmed as pilots. This program will consistently contribute to improve ocean literacy in children and youngsters, enabling this generation to feel empowered to make a difference in the future of the ocean.

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Mediterranean Sea Literacy: adapting ocean literacy principles to the Mediterranean region

The Mediterranean Sea region is the cradle of modern civilization, a biodiversity hotspot, the most visited touristic area and home to over 460 million people. Increasing stresses due to tourism, fishing, coastal development, pollution, shipping and climate change are threatening the fragile Mediterranean Sea ecosystem. Sustainable development of the Mediterranean region is integrated in the most important development plans concerning this area e.g. Mediterranean Action Plan, Plan Bleu. Mediterranean Sea Literacy (MSL) was developed as a tool in order to understand the services provided by the Mediterranean Sea, its connection to people and to help understand the need for sustainable development in this region. It was developed following the form of Ocean Literacy principles. A draft version of MSL consists of 7 principles and 46 concepts which describe different aspects of the Mediterranean Sea and its connection to people and society:

1. The Mediterranean Sea, almost enclosed by land of three continents (Europe, Africa and Asia) with many unique features, is connected to the one big ocean of the Earth.
2. The Mediterranean Sea and its living organisms shape the features of the Mediterranean region and its adjacent land masses.
3. The Mediterranean Sea has a major influence on climate and weather of the Mediterranean region.
4. The Mediterranean Sea made the Mediterranean region habitable through its richness of life and its influence on the mainland which then became a cradle of world civilization.
5. The Mediterranean Sea is a marine biodiversity hotspot, with high level of endemism.
6. Culture, history, economy, lifestyle, and well-being of its inhabitants are inextricably connected to the Mediterranean Sea.
7. Even though the Mediterranean Sea has been explored for many years, there is still much to discover and learn about it.

Mediterranean Sea Literacy provides fundamental knowledge about the Mediterranean Sea to educators, teachers, scientists, NGOs, blue economy and business sector, policy makers and general public, thus helping to raise awareness and achieve a blue and sustainable Mediterranean region at all levels of society.

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OLI - Ocean Literacy Italia: raising the newborn italian network and improving its (H)OLI(stic) approach

The momentum for the ocean literacy movement grows continuously. Ocean Literacy, as an essential tool for a sustainable blue society has been also recognized in the recently approved Call for Action of the first ever UN conference on ocean, held in New York on 5-9 June 2017. As the ocean literacy movement is expanding, new regional and national networks are being created. On February 2017 a meeting was organized in Venice by UNESCO to launch the first Italian ocean literacy network. After a plenary session for discussing the main objectives and activities, a point has been made on the need of 'testing' the network in this year's edition of the World Oceans Day (8th June). The network gathered over 120 representatives from Italian research institutions and universities, NGOs, science centres and museums, and public institutions. More than 60 outreach events were organised in 17 locations, following different methods to inform children, students, and general public about the more innovative scientific findings and recent technologies concerning the Future of Our Seas and Ocean. Seminars, movie screenings, citizen science activities, games, exhibitions, educational programs, school-related internships have translates the expertise and decadal experience of the OLI partners in effective communication messages. Prioritising recreational-scientific activities, strengthening relationship amongst artists, sport representatives, researchers and educators, for hands-on laboratories and scientific games, proved to be an effective (h)OLI(stic) strategy for promoting scientific knowledge, resulting in personal and societal growth.

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I know, I am aware, but still I don't act: what are the pre-conditions of effective ocean literacy

The underlying assumption of ocean literacy in ResponSEAble project is that if we raise awareness and educate, people should change their behaviour and start acting responsibly towards the oceans. However, this is not always a straight forward connection and correlation between the two..... Presentation focuses on the link between ocean literacy and the behavioural change, and what should be done in the future to make this work better. For example, economic actors and consumers are not usually among the target groups of ocean literacy. Also, information about opportunities that responsible behavior towards the oceans can give us (in the blue growth sectors) is often lacking. Based on the results and discussions of the ResponSEAble project, we explore and apply the 'theory of dissonance' (I know – but I don't act) and how it affects different actors: consumers, economic professionals. Paper presents recommendations from stakeholder's workshops on ocean literacy which tackle the issues of effectiveness and the pre-conditions for success.

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Systems Science, Systems Literacy, Systems Practice and Systems Thinking to achieve Ocean Literacy

Ocean Literacy is a term that has now achieved a global recognition as the impetus for the need for change in our relationship to the ocean. Different peoples, languages, cultures, and regions have different ways of expressing relationships to the ocean, to the sea, to water. The study of relationships and the links between people, places, and products, boundaries and environments, communication and control among many subjects are studied and described in the systems sciences and systems thinking. When we think about the future path of ocean literacy initiatives we suggest there is need for a greater awareness and application of systems sciences, systems practice and systems thinking. This session will explore connections between ocean literacy and systems literacy.

3
Promoting a further penetration of Ocean Literacy in school curricula

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Exploring methods for incorporating Marine Themes and Ocean Literacy into the Irish Primary School Curriculum framework

The Marine Institute, is Ireland's State agency responsible for marine research and development. In 2006, they identified the importance of developing and working with the education community to introduce marine science and related subjects into the classroom and established the Explorers Education Programme™. Designed to inform teachers and students of Ireland's marine and maritime heritage, and raise awareness of the value, opportunities and social benefits of our ocean wealth, the programme has grown over the last 10 years to reach over 20,000 primary school children and over 500 teachers in the 2016 – 2017 academic year, involving outreach centers around Ireland. Our main goal is to educate primary school children, teachers and educators in Ireland, enabling them to understand and engage in ocean literacy. For it to be accepted by teachers and educators, resources must fit into the national primary curriculum framework. Educational materials were designed, reviewed and trialed by teachers and now include lesson plans, teacher planning guides, teaching schemes, posters, activity sheets and presentations. Teachers who participate in an Explorers school module are asked to feedback on the subject themes incorporated into lessons during participation, and the range of resources they use. Between September and December 2016 (n= 108) science plus three other curriculum subjects were incorporated into lessons on average. The most popular stands included Literacy (English) in 68% of schools, and Geography and Visual Arts in 66%. 90% of teachers indicated that they used resources provided by explorer outreach officers, while only 54% accessed materials online, indicating the importance of introducing teachers to resources during site visits. Teacher professional development workshops and collaboration with other educational providers in Ireland including Discover Primary Science and Maths, Maths Week, and Engineers Week have also been used to promote the incorporation of Ocean Literacy in the Irish School Curricula.

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Advancing teaching and learning of marine energetics fieldwork for Post-16 students

In Post-16 education in the UK the teaching of energy flow in ecosystems through fieldwork has often been limited to gathering data on numbers of organisms at different trophic levels and is often based on studies of freshwater habitats. The Field Studies Council has recently developed a fieldwork activity that allows students to investigate and quantify energy transfer in a rocky shore ecosystem whilst improving awareness and understanding of our impact on marine food webs. The activity uses excel data collecting sheets downloaded onto mobile devices in the field with the capacity to merge datasets from several groups. The sheets convert field measurement of organisms from different trophic levels into biomass and energy values and produce completed food webs and pyramids of energy. If connectivity is available, the results can be analysed and evaluated in the field. This activity and supporting teaching resources allows students to estimate energy flow in intertidal ecosystems, explore the practicalities of collecting species biomass data in the field and consider the importance of 'ocean numeracy'. The activity is a good example of how ICT can enhance fieldwork data collection. It demonstrates how intertidal marine ecosystems can be used to enhance the teaching and learning of a complex yet essential component of marine ecosystems, bridging the gap between textbook theories and real data collection.

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Marine plasticology – a new science for a blue generation

Plastic is a lasting and versatile material, with a huge variety of uses, contributing in many domains to human welfare. However due to its uncontrolled use, 8 million tonnes of plastic reach the ocean each year, with a negative impact on marine organisms and ecosystems.

Therefore, in order to raise awareness about this problem, Oceanário de Lisboa designed a unique outreach educational programme, for students from 6 to 12 years old. The programme, chaperoned by marine educators and developed in schools, includes practical activities that characterise the problem, identifies solutions and promotes behaviour changes.

Furthermore, a manual was created to guide teachers throughout four main subjects: disposable plastic, microplastic, plastic overpacking and plastic related social behaviours. With this manual, teachers challenge students to solve these issues, regarding the need to refuse, reduce, reuse and recycle plastic and above all to re-educate the school and local communities.

Simultaneously, Oceanário promotes workshops for teachers on the same subject, where a set of activities and educational resources are provided in order to enable them to mobilize, empower and engage the school community to change the way plastic is used in various contexts of their everyday life.

In the school year 2016/2017, Oceanário engaged more than 30.000 students, from Lisbon and Oporto, in this educational programme. This was a unique opportunity to develop an impact assessment study which aimed not only to measure the knowledge of the Portuguese students about this issue but also how this project effectively induced behaviour change regarding plastic usage.

With the goal of being a beacon of environmental education for a blue generation, this programme aims to give a step forward in ocean literacy.

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How the Knowledge Broker Impacts the Marine Education under the Framework of CBAM—A Case Study in Taiwan

Marine education, made compulsory for elementary and junior schools in 2010 in Taiwan, has been a popular educational innovation. However, related policy is not evidence-based and lacks consideration for teachers' concerns as well as their actions. One of the researchers has been a teacher for nearly 20 years and been looking for obstacles for marine education--lack of time, expertise, teaching materials, money, to name just a few.

Thus, a broker will be needed to collaborate among stakeholders, and provide customized service for teachers. CBAM, a model based on teachers' concerns to realize innovations, can be an ideal way to help carry out marine education. The researchers form a team of experts and provide a facilitator taking on the role as a broker. The research will deal with the profile of each teacher accepting the intervention, and discuss the implications of implementation of marine education.

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One Watershed - A Catalog of Experiential Activities that Provides a Sustained Connection of Classrooms with their Watershed

Classroom materials should be delivered without divulging the topic's label and with a passion that makes learning "come alive". For example, instead of announcing that "today, we will be learning about center of gravity and buoy science", the "hook" becomes; "The world record for a small buoy holding golf balls is 50. I was wondering if you could help me break that record". This program, "Build a Buoy" is one of 17 programs in the One Watershed Program catalog available to educators in two communities that lie along the Chester River Watershed on the Eastern Shore of Maryland. This delivery is of paramount important. The connection to the watershed is sustained using several, program specific websites that allow data visualization and assist the educators with the selection of lesson plans aligned with required Standards of Learning (including Global Ocean Literacy). K-12 Educators of all disciplines board a research vessel and travel the entire 65 km Chester River from the headwaters to the Bay examining land use, sampling bottom sediments, and using sonar imagery to reveal an 18th century shipwreck. Educators engage in 10 Professional Development workshops that include building buoys that measure water quality, designing, building and operating underwater robots, issues investigation, agro-ecology using QR coded tree tags, bird identification, weather, and global tracking of unmanned GPS equipped sailboats. All programs are woven into curricular matrices and involve hands-on instruction that integrate the materials into impact classroom content. The program strength lies in the cumulative knowledge gained by completing all of the components to get a holistic view of watershed exploration from the headwaters to the Bay. All of the program components are easily adapted to any global watershed. Since 2013 over 90 interdisciplinary educators employed locally have completed 80 hours of training in this program and contribute lesson plans to a shared, online, resource.

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Elements of ocean sciences issues in Greek High school textbooks: Preliminary results

While curricula constitute the official expression of the educational policy of a country, school textbooks are the tools with which this policy is put into effect. Although there are multiple resources available to teachers and students especially nowadays, school textbooks are still of significant importance, because they both keep relying primarily on them. Since the instruction in Greek educational system is basically textbook-led, the production of quality manuals appears to be imperative. The present study attempts to portray whether the essential principles of the OL framework are included in Greek high school education and in what extent. The analyzed material consists of the reading textbooks developed for teaching natural sciences in grades 7-12 (Biology, Geography, Chemistry, Physics, Technology and Natural Resources Management). Content analysis was implemented to assess the presence of relevant information by applying a-priori coding as the requisite categories were the seven OL principles. Analysis revealed that elements of ocean sciences issues cover only 7.2% of the total pages and 3.4% of the total images. All seven principles are cited with the most frequently presented being the first and sixth, whereas the second and seventh the less observed ones. Most of them are traced in grades 7-9, mainly in Geography, while it is rather interesting that Natural Resources Management, the only optional course, presented the most extended references. Therefore, the information included in Greek high school textbooks, regarding elements of ocean sciences issues is extremely limited, fragmented and excursive in most of the cases with many inconsistencies within the same textbooks and among grades. In conclusion, the present study could contribute to a focused future revision of science textbooks towards a more ocean sciences friendly content by the Greek Ministry of Education along with a careful introduction of such topics in the pre-service high school teachers' preparation programs.

4
Ocean and Human Health

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"Un mar sin desperdicio": raising schoolchildren's awareness about marine litter and encouraging them to take action

Marine litter is one of the main problems that seas and oceans are facing and will have to face in the future. Every year 10 million tons of rubbish are dumped into the marine environment worldwide, being the 80% of them plastics. The long-term effects of marine litter are still unknown but it has been proved that it negatively interacts with marine biodiversity (i.e. mortality due to ingestion, entanglement, etc.) and that microplastics are already an element of the marine food chain. These facts, combined with the low degradation rate of litter (which is a never-ending story in the case of plastics), are making marine litter become a major conservation problem that is mostly ignored by society. "Un mar sin desperdicio" ("No sea to waste") is an educational project focused on schoolchildren from 6 to 12 years old. Its main objectives are to raise awareness about marine litter among the students and to encourage them to take action and become part of the solution. To accomplish these objectives two actions have been completed: 1) creating educative resources to promote the work of this subject at school; 2) visiting 10 different schools (reaching 1.063 schoolchildren) from the Mediterranean Spanish coast to encourage them to "sponsor" their local beach. "Sponsoring" the beach involves taking action and collaborating with the Town Hall to improve its environmental status, organizing periodic beach clean-ups, and sharing both the results obtained and the students' ideas to preserve the beach with the Town Hall. This project has been carried out with the support of "Fundación Biodiversidad" from the Spanish Ministry of Agriculture and Fisheries, Food and Environment and ECOEMBES.

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Oceans and Human Health
SeaChange – Results, products and legacy!

SeaChange is an EU Horizon 2020 project involving many European partners, for which the goal is to change the way people view their relationship with the sea. One objective in particular focuses on education and lifelong learning as vehicles for sustainable change. Project partners carried out consultations in their own countries, to gain an insight into barriers and solutions to teaching secondary education pupils about the Ocean. The UK consultation was hosted by Cefas, a world leader in marine science and technology and one of the SeaChange partners.

This presentation will provide an overview of the results from all the in-country consultations which have been published as an overall report identifying ways forward to bring Ocean Literacy into schools in Europe. Many great marine education products have been produced from the SeaChange project. Associated events, networking and liaising have occurred as a direct result of the consultation exercises and have been plentiful across the partnering organisations.

For those of us involved in and passionate about the marine environment it is not difficult to understand the absolute necessity for stewardship of the marine environment. There is an urgency and importance of Ocean Literacy as part of the school curriculum to educate and inform of the role that the oceans play in maintaining a healthy planet. There is a need to empower whole communities to realise the part that they play in keeping the marine environment clean and healthy and in turn keeping themselves healthy. The SeaChange project has ensured a legacy for the future.

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Mr.Goodfish, a Sustainable Seafood Consumption Programme for Aquaculture

The Mr.Goodfish programme has been launched in France, Italy and Spain in 2010. Its aim has been to better manage seafood resources and to secure the sustainability of seafood stocks and Oceans health. It targets the whole chain of custody from fishermen, wholesalers, producers, fishmongers, restaurant owners to direct consumers, and addresses them with a wide range of activities and messages. While doing so, it endorses an exclusively positive approach and promotes the aquaculture and all sustainable fish production process to encourage new consumption patterns. A committee of fish farmers, consumer, scientists, representatives of fisheries and seafood distribution sector, restaurant owners and consumers meet to establish a list of aquaculture species recommendations through easily understandable criteria for the public. Reassuring consumers, this list will help fish grower to develop sustainable aquaculture in Europe.

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Sustainable Fisheries Education - Best practices

For 15 years, ProSea has been conducting and developing courses in sustainability and marine environmental awareness for marine professionals – 'those that work at sea'. These courses are to develop the 'human element' in sustainability at sea, meaning the competence of the seafarer and his/her personal responsibility towards sustainable shipping/fishing.

We work via strict principles and a specific approach that has been finely tuned during these 15 years of work with marine professionals. Some of my personal, favorite principles are to 'challenge, but not accuse', to 'involve on a personal level' and to 'emphasize that marine conservation and economic growth complement'.

The best practices of the ProSea approach and a vision on future projects will be shared in a 15 min' high energy presentation.

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Contraceptive choices and aquatic pollution: attitudes and preferred agents of mitigation in the UK

Waste from human contraceptives contributes to both the physical and chemical pollution of the aquatic environment with significant impacts for animals, in particular vertebrates. Differently to other forms of pollution caused by disposal or excretion of medicines, there is greater patient choice regarding contraceptives. Awareness and attitudes may thus influence the decisions taken by users and so influence directly the types and scale of this pollution.

We explored awareness, attitudes, mitigation options and responsibility initially with a small focus group of relevant professionals (nurse, environmental consultant, teacher) and used the themes that emerged from this investigation to guide the design of an online survey exploring preferred mitigation approaches in our respondents. We received 291 responses to our survey but only analysed the responses from 150 UK residents.

We found that choice of contraceptive was based around effectiveness, side effects and convenience rather than their environmental impacts. Awareness of pollution caused by hormonal contraceptives was lower than that caused by condom litter. When asked who should be responsible for reducing aquatic pollution from contraceptives answers were quite contradictory: there was a slender majority arguing that the pharmaceutical industry, the government and water treatment facilities should take most responsibility for tackling the issue and that healthcare professionals had least responsibility. However, when asked which agents of mitigation might be most effective, health professionals came out top followed by adult education especially through universities and colleges.

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Promoting a further penetration of Ocean Literacy in School Curricula

3D Sea is an important initiative aimed at boosting awareness of ocean literacy. This project was created with the purpose of recovering, recycling and reusing various plastic materials to transform them using 3d printing into objects which are useful for understanding better the fragility of the marine environment and the importance of knowing it and protecting it. During the project, an array of activities will be performed. These include the creation of teaching kits made from recycled plastic for schools and promotional items to disseminate the project further, organizing free lessons in schools and lastly the recovery of plastic from the sea and shores. Scuola di Robotica is a nonprofit association that deals with the teaching of science and humanities through the use of technologies and robotics, divulging, and ethics. SdR is a training institute recognized by Italian Ministry of Education, Universities and Research, has long been leading national refresher courses dedicated to the use of technology in the world of didactics. During the project we will launch many scientific dissemination activities with two main objective: Introduction to the world of 3D printing Respect for the sea and the environment through the recycling of plastic and nylon The activities will be directed at schools and include the realization of a real educational kit and individuals with snorkeling and sea retrieving activities at sea and on the beach. During the conference we will present the educational kit and the creation process for the sightless kit.

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Message in a Bottle: A Participatory Case of Social Innovation in Action

While education and traditional advertising can be effective in creating awareness, numerous studies document that behaviour change rarely occurs as a result of simply providing information, but rather through initiatives delivered at the community level focusing on priorities for an activity while simultaneously enhancing the activity's benefits.

"Message in a bottle" is a participatory event that brings about real actions using a Social Innovation Participation Process (SIPP) framework, co-designed for Sea Change, a Horizon2020 project. "Message in a bottle" manifests ocean literacy using 5 Sea Change Co-Creation Principles (Client, Competitive, Collective, Creation and Change), and a 6P Intervention Mix (Product, Price, Place, Promotion, Partnerships and Policy) to reduce value-action gaps to bring about a more ocean literate population across Spain.

The process of designing and mobilising the event is centred on 7 steps: idea generation, idea evaluation, determination of winning ideas, participation, values, processes and action. The first three steps were based on an ideas bank and its evaluation using the 5 Sea Change Co-Creation Principles. Following this stage, winning ideas were chosen. The next three steps were focused on organizing a participatory workshop to co-design the final event using the 6P Intervention Mix. The last step, occurs when the event is put into action to drive social change.

This presentation will show how "Message in a bottle" transformed from an idea to a national SIPP event. The presentation will also speak about how different eco-friendly bottles travelled around Spain with a challenge inside with the aim to change our relationship with the ocean. 50 participants (schools and organized entities) are currently involved with 50 small actions with the objective to tackle a big challenge of changing Spanish citizens' relationship with the ocean. A communication plan was set up and a social impact of more than 10.000 people is expected.

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Open session

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Ocean Literacy through transdisciplinarity: A roadmap to sustainability

'Transdisciplinarity for Fisheries' (TD) has been developed by the Too Big To Ignore Global Partnership for small-scale fisheries (TBTI) as an innovative research and training strategy with the aim of configuring and propelling a new mindset towards sustainable resource governance. In this regard, the TD is a framework that contributes to ocean literacy not only through the provision of research and knowledge, but also as a mechanism that seeks to transform society by providing the adequate tools to address complex societal problems inherent to natural resource governance. Drawing on the concept of wicked governance problems, we argue that global concerns such as overfishing and depleted marine ecosystems cannot be resolved through mere technical fixes, for these do not address the multifaceted realities hovering within the bigger picture. If they are to be effective, solutions need to be harmonized to the social, economic, political and ecological systems within which they are implemented, and we assert that this can be principally attained through a transdisciplinarity lens. TBTI recognizes that 'Transdisciplinarity for Fisheries' provides the necessary equipment for the way forward in fisheries and ocean governance as it offers an interactive platform that goes between, across and beyond disciplines 'all at once'. This also comprises an ongoing process of bottom-up participation of stakeholders who engage in an open learning process that is experimental, interactive and deliberative. In turn, this co-production and cross-fertilization of knowledges engenders ownership amongst multiple disciplines, and provides a common language that strengthens collaboration in our common mission for sustainable marine resource management.

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Promoting ocean literacy through informal channels…..the Spot the Jellyfish and the Spot the Alien Fish citizen science campaigns in the Maltese Islands (central Mediterranean)

The Spot the Jellyfish (www.ioikids.net/jellyfish) and Spot the Alien Fish (www.aliensmalta.eu) campaigns are two citizen science campaigns conducted within Maltese waters since June 2010, through a collaboration between the University of Malta, the International Ocean Institute (IOI) and the Malta Tourism Authority. The two major objectives of these campaign include a contribution to ocean literacy through informal education (e.g. lectures to students and the public in general on beaches and in Aquaria) and a compilation of a database of sightings reports for the marine species of interest. The two campaigns are contributing towards the operational monitoring of the presence/occurrence of gelatinous species and of non-indigenous species (NIS) within Maltese waters in the central Mediterranean besides informing the public at large, through the use of popular science terms, the mass media and visual tools, of the causes behind complex phenomena such as blooming in jellyfish and the introduction of NIS. This paper reports upon the rationale behind the development of these two campaigns as well as on the methodology followed, the major outputs, lessons learned for future citizen science campaigns and the challenges faced in implementing the same initiatives. A set of recommendations on how the efficacy of the same campaigns can be improved is also proposed.

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Baseline public biodiversity awareness in the coastal areas of Danube Delta in Ukraine and Romania

Stakeholder engagement and provision of knowledge products to end-users is critically important in science. Effective frameworks to reach out to stakeholders and end-users, however, are generally lacking. The PRIDE (Pontocaspian biodiversity RIse and DEmise) project, an EU Horizon 2020 project that studies the evolution of the unique Pontocaspian fauna in the Caspian Sea-Black Sea region, is one of the pioneering programs that incorporates outreach as integral part of its program.

One of the target stakeholder groups of PRIDE's Outreach Plan is: "Citizens in coastal areas of the Danube Delta in Ukraine and Romania". The goal of engagement is to raise awareness on the demise of Pontocaspian biota and to create conditions that support future conservation in the region. Both Romania and Ukraine are parties of the Convention on Biological Diversity (CBD) and have national targets to raise awareness on biodiversity (Aichi Biodiversity Target 1). Both countries share responsibility of Danube Delta Biosphere Reserve and Black Sea coastal area. Furthermore, Danube Delta is an international UNESCO world heritage site that harbours a diverse Pontocaspian fauna that remains largely unappreciated until today.

PRIDE has developed a self-explanatory identification leaflet that includes native marine, brackish and fresh-water mollusc species and alien invasive species that threaten the native fauna. The aim of the leaflet is to raise awareness on the uniqueness of Pontocaspian biota and to encourage local communities to report on the occurrence of these species from the field through an open access data portal and mobile app. To measure the impact of the leaflet on biodiversity awareness, I am currently conducting a study in Ukraine and Romania using a questionnaire to establish the baseline awareness of biodiversity in the abovementioned target group. I present the preliminary results from my studies on public awareness of biodiversity and the implementation of the identification leaflet.

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LEARN-TEACH Pilot: Ocean Literacy in every Research Grant & High School Curriculum

Raising the Ocean Literacy of all levels of society is now a policy priority for the European Commission. The long-term objective is better appreciation of the socio-economic benefits and ecosystem services that the marine environment provides and encourages better stewardship of the seas.

Generally "popularisation of marine research for society" can be resource and time expensive to sustain, and outcomes difficult to quantify.

One long-term and potentially self-sustainable concept is to put sufficient mutual incentives in place so that researchers, teachers and students in high-schools science and mathematics classes accessorize rigid school curricula with the latest marine research results and knowledge.

Summary of preliminary teachers consultations at Copenhagen International School suggest that teachers are prepared to include recent marine research data and knowledge in high school classes, but require guidance and translation of latest research findings by the researchers themselves.

LEARN-TEACH Pilot`s main objective is to test a long-term scalable and locally applicable solution for engaging young people in marine environment issues and challenges, and whet their appetite for cross-disciplinary learning based on real world problems.

LEARN-TEACH sustainability of concept relies on empowering teachers to inject recent research in the school curriculum in order to "increase the level of knowledge among the population of the marine environment" while exposing young marine researchers to the challenges of translating and communicating research to non-academic audiences.

The presentation is based on the "Blue Schools" initiative of Horizon 2020 SeaChange Consortium, an EC Ocean Literacy project (www.seachangeproject.eu)

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The Irish Ocean Literacy Network

The Irish Ocean Literacy Network was established in September 2016 and aims to bring together research institutes, agencies, small and medium-sized enterprises (SMEs), large corporate entities, non-governmental organisations (NGOs), individuals and educators on the island of Ireland who are currently involved in, or would like to become involved in, working towards the vision of achieving an ocean literate society across the island of Ireland.

The Network's direction is informed by its members, and daily operations are performed by a national coordinator.

Although still a fledgling organisation, membership of the Network is growing rapidly, and there have already been a number of collaborative projects instigated within the Network.

This presentation will detail how the Network was initiated and developed, its objectives and achievements to date.

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Sail Training as an Alternative Education Space: how it can be used to promote Marine Citizenship? Case Study Ocean Youth Trust Scotland

Sail Training is a non-formal, alternative education space. It provides adventurous experiential learning on board large, ocean-going sailing vessels for young people up to 25 years old. It facilitates the growth of key competencies through the provision of personal development and active citizenship, whilst in an arduous and challenging environment. This is achieved by encompassing youth mobility, heterogeneity, broadening horizons and assisting the learning of new skills. It embraces adaptability and change whilst raising the awareness of new possibilities though working as crew members to complete the voyage, taking the vessel from one location to another. As such, it is an advocate of social cohesion and cultural awareness with an objective to build positive relationships in the local community and beyond.

Marine Citizenship develops an understanding of human behaviour, pro-environmental lifestyle choices, the human impact and the interdependent relationship to the marine environment by embracing Social Capital, shifting values, motivation and encouraging accountability. Sail Training is a vital platform assisting with the future of maritime Europe whilst inspiring and instilling a passion for Marine Citizenship in young people across both Europe and the wider global community. Through its distinctive approach and venue, it doesn't impersonate mainstream schools, teaching a different curriculum and series of beliefs regarding the optimum learning techniques.

Ocean Youth Trust Scotland is a world leading youth work charity, delivering diverse residential youth work voyages for 12-25 year olds aboard its fleet of sail training vessels. Through a structured approach, cross-curricular learning experiences contribute to accomplishing overall educational achievement. This education methodology empowers young people of all abilities to implement and enhance their academic studies; acquiring qualifications and skills otherwise unachievable. Promoting a shared responsibility through various voyage programmes, close work with 3rd party stakeholders; exploring sustainable lifecycles in healthy marine environments for future and present generations begin to evolve.

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Citizens and scientists work together to monitor marine alien species in Sicilian waters (central Mediterranean)

The spread of alien species is an ongoing phenomenon which is widely recognized as a major threat to biodiversity at different levels. The Mediterranean Sea is an important hotspot for marine alien species (ca. 1,000 such species recorded to date). The creation of early-warning systems is crucial for reducing the risk of invasive species introduction. Since intensive scientific monitoring programs could be very expensive, engaging citizens (e.g. tourists, fishermen, divers) through citizen science could be a useful tool for providing information and scientific data on the occurrence and spread of marine alien species. Citizen science is having an increasing success worldwide. The increase in the number of citizen science projects is possibly due to the wide availability of mobile technologies and internet access that enable an easy and cheap way to communicate and to interchange data.

The value of citizen science has been widely recognized. Despite this, in order to be used for scientific purposes and management decisions, the collected data need appropriate quality assurance measures such as validation and verification by taxonomic experts. We report on the experience of two citizen science projects: the Project "*Caulerpa cylindracea* – Egadi Islands" and the Project "Invasive Algae", included within the "Seawatchers" platform. The first one, sponsored by the STEBICEF Department of the University of Palermo and by the Egadi Islands Marine Protected Area (MPA), aims at creating a database on the spread dynamics of *C. cylindracea* within the Egadi Islands MPA. The second one, coordinated by the Institute of Marine Sciences of Barcelona (CSIC, Spain), collects data on 10 marine invasive alien species. The results of these projects highlighted the important role that citizen science campaigns can have as early-warning systems.

We also present a new citizen science project "Aliens in the Sea", launched in June 2017, aiming to collect data on marine alien species along the wider Sicilian coast and promoting information and public awareness campaigns.

POSTERS

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Non-formal education and ICT, promoters of Ocean Literacy as an independent discipline in the Environmental curriculum in Romania

In the Romanian school curriculum, curricular areas have been set up in accordance with the objectives of education, taking into account the importance of different cultural areas which structures the human personality and the connections between these domains. Thus, environmental education focuses on shaping the future citizen able to form an objective point of view on the surrounding reality, to incite him to participate, thus becoming aware of the future and the fact that life of tomorrow's generations depends, to a great extent, on his options. Environmental education is an education through and for values, which can take concrete forms of realization, at different levels of education, delivering transdisciplinary information content in a formal or non-formal context. In the last period, in Romania, is becoming more and more accent on non-formal education activities, on learning by action (Experiential), leading to the training of student's attitudes and skills indispensable for responsible behaviour towards the living environment in which they exist. Non-formal environmental education projects conducted outside of school, and which integrate Information and Communication Technology (ICT), have become a "prolongation" of school education, bringing additional information to participants, and giving to students the opportunity to use modern technology to enhance learning. In this context, we can try to promote marine education as an optional, self-sustaining discipline which can be taught in any of the years of study, under appropriate conditions provided of the didactic approach, appropriate to the specifics age of students.

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Development of a questionnaire to assess estuary content knowledge

There is an imperative need for the development of knowledge and experience on estuaries, as these systems harbor unique biotic communities and they are considered to be amongst the most productive ecosystems. They also provide social services and cultural value to humans and the society in general. In this context, six Estuary Literacy principles have been identified, each one being underpinned by a series of fundamental concepts (NOAA 2014). However, information concerning the level of Estuary Literacy (EL) around the world is sparse. Assessment of an individual's knowledge about estuaries requires tools which are aligned with the essential principles and the fundamental concepts of EL and possesses well-established psychometric properties. However, to our knowledge, there is a lack of such comprehensive and standardized instruments. The main aim of the present study is to respond to the demand of comprehensive and standardized tools for the measurement of EL, by developing an instrument to assess estuary content knowledge. We developed a structured questionnaire to investigate knowledge related to estuary issues. Thirty knowledge items were created as multiple-choice questions. Content selection was based on the essentials principles and fundamental concepts of EL (NOAA 2014). The instrument also contained a set of questions concerning respondents' demographic characteristics and a question, in which respondents were asked to rate different information sources that potentially contribute to their knowledge about estuaries. All items are close-ended and render the instrument easy to administer, code and score for statistical analyses. The instrument's construct validity and internal consistency as well as its ability to effectively distinguish between individuals with different levels of understandings will be investigated in a sample of Greek pre-service primary school teachers. In this context, the developed instrument could constitute a valuable tool in the assessment of the level of EL, and, thereby, to the improvement of Estuary Literacy.

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Those gorgeous floating creatures - Exhibition of the underwater photography

Natural History Museum Rijeka is a cultural institution, a regional specialized museum. Museum's main activities include collecting, researching and presenting the natural heritage as well as communicating the heritage to the public. With its collections, research and educational programme, the Museum presents a powerful tool which serves to educate audiences about the functioning of the natural world and the environment. The Museum's purpose is to encourage the public to reflect on nature – its past, present and future. In May 2016 an exhibition of the underwater photography Those, Gorgeous Floating Creatures was opened whereby we marked the important dates: the International Day for Biological Diversity (22th May), World Environment Day (5th June), and World Ocean Day (8th June).

The exhibition presents common northern Adriatic macroplancton species, jellyfish and comb jelly. The exhibition was set up at the Rijeka Natural History Museum and at the Fish Market where it was available to the general audience, as well as to those who do not consider visiting the museum. The main goal of the exhibition was to acquire the public through visual attractiveness (underwater ambiental and macro photography) and educate about the macroplancton biodiversity in the Adriatic Sea, the climate changes, marine system functioning, as well as the changes that can be expected in the future.

The second aim was to inform the public about the possibility of joining the International CIESM Jellywatch programme which is carried out by the Institute for Marine and Coastal Research, University of Dubrovnik. The exhibition, alongside with accompanied lectures and workshops, were a part of the events, Science Festival programme and the Festival of the Sea Fiumare 2016 which take place in open areas of Rijeka. With mentioned actions and very limited financial resources, we tried to stimulate public debate about our future and equip our audiences at every level with an understanding science, nature and enviroment.

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Maths skills and the marine environment: does the shape of plankton affect how they sink?

They produce over half of our oxygen; they are the foundation of all marine food chains; they could even be the cure for climate change, yet few people are even aware of the existence of plankton. A workshop has been designed to introduce GCSE-level students to the wondrous world of plankton by showcasing some of their weird and wonderful shapes and abilities. The workshop then goes on to highlight the importance of mathematics and its applications to novel situations. Pupils are introduced to some key phytoplankton species and are then model a selection of them using plasticene. The various models are placed into cylinders of viscous liquid and the descent of the models timed. Using basic fluid dynamics equations, pupils are encouraged use their maths skills to rearrange equations in order to calculate the form drag of the phytoplankton species so as to directly observe how the shape of an organism affects how it moves through the water. The workshop wraps up by highlighting the various mechanisms phytoplankton employ to maintain their buoyancy in the water column in order to access light and nutrients at various depths. It is hoped that the workshop will not only foster an interest in an often overlooked / under-studied aspect of what the lay-person would class as “marine biology” while also showing pupils that the math skills they learn in school have a direct practical application outside of the classroom.

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Do English schools want to be Blue?

The concept of a *Blue School* has been proposed by the H2020 EU-funded project Sea Change to empower school communities to become agents of change towards an ocean literate society in Europe through formal education and life-long learning. In the UK, there is widespread agreement that school communities are under pressure from increased workloads and assessments, a system which is not necessarily serving the futures and aspirations of young children, while is also not enabling learners to truly understand the complexity of the world they live in. A MSc dissertation at Plymouth University involving a survey of teachers aimed to measure the appetite for and the extent to which current practices in primary formal education in England are aligned with education for sustainability, and attempted to identify potential drivers for advocacy. By doing so, this dissertation sought to make a contribution to the ongoing development of the new *Blue Schools* initiative. To achieve this, the study deployed a mixed methods approach involving a self-completion online questionnaire survey and semi-structured interviews. The findings strongly suggested that there is great potential for ocean literacy to add value to education for sustainability and that teachers' beliefs in primary formal education in England are closely aligned with the adequate pedagogies, regardless of personal opinions and attitudes towards sustainability and the ocean. Furthermore, the study identified school leadership, need for capacity building and budgets as some of the fundamental drivers that will enable successful integration of ocean literacy and sustainability in primary schools in England. This work did not seek to contribute to further fragmentation of sustainability education, instead calling for a truly holistic approach as rightfully claimed by advocates in the field, and hopes to represent the start of a conversation that addresses sustainability with acknowledgement of all aspects of the planet's ecosphere.

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Society for Underwater Technology

Can a Lobster be an Archaeologist?

In 2015 the Society for Underwater Technology realised it wasn't reaching the younger audience, with the only schools outreach being the Annual Christmas lectures which were aimed at 16+year olds. In an effort to influence the 10-14 age range, we decided to write a book. A selection of members and friends of the Society wrote chapters for us on exciting stories from their fields of work, these chapters were then illustrated by a professional artist. The poster will show how we created the book. The end result was a huge success and very well received by the young people who read it, but it was also a great accomplishment for the authors, most of whom had not ever produced anything for a young audience. The title of the book, 'Can a Lobster be an Archaeologist?' originates from a story about an 8,000 year old settlement near the Isle of Wight, rediscovered by a lobster digging to create a burrow which was then found by divers.

The book explores topics many people have always wondered about – What really happens in the Bermuda Triangle? Where would we live if there was no land left to build on? How are underwater films made? How do we find missing aeroplanes underwater? And most importantly… is the Loch Ness Monster real?!

Creating this book has enabled us to reach children (and adults alike) who don't encounter enough marine education in their day-to-day lives. The book provokes discussion and sparks the imagination of anyone reading it, of any age. The topics are timeless and are valuable tools to engage youngsters in the exciting underwater world.

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TARA Expeditions Foundation, an educational project based on digital tools

The Tara Expeditions foundation aims at supporting scientific expeditions led on board the Tara schooner, on every ocean. Therefore, to offer the possibility for teachers and students to follow the expedition and learn about its scientific objectives, and have the largest possible impact, the educational program of the foundation has no choice but to be digital. All our educational ressources are free and can be downloaded online: educational reports for teachers, activities, experiments or science data for class activities, pictures, exhibitions,... Live online conferences allow a direct interaction between researchers and students, before becoming an online resource. Above all, it is very attractive for the students to interact directly with the crew on board Tara, currently in the Pacific Ocean to study the coral reefs ecosystems. But it is challenging to create a link and a sense of closeness from remote and to maintain an interest all along the school year. Two projects aims at offering this possibility:

- "Echos d'Escale" (stopover echos): each month, when arriving in a new harbour, the crew send a picture to the students about a local sustainable development issue. Thanks to the expedition poster, the students can locate the schooner and discuss about this place and its challenges, based on educational material available for teachers.
- "Dans le sillage de Tara Pacific" (in the wake of Tara Pacific) : The students are invited to send some questions to the crew. While most of them will be answered in writing, one question will be chosen by the crew to make a video.

In addition, live online conferences from the schooner are organized 3 times a year. Thanks to these educational projects, more than 7000 school children had the opportunity to learn about the ocean while following the expedition over the past school year.

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Can a VR game increase awareness in a sustainable marine behaviour?

As part of the Green Bubbles project[1], a game in virtual reality (VR) was developed to make players experience an underwater environment with the purpose to raise their awareness around environmental issues related to diving and in this way to promote behavioural change. Our assumption was that a high sense of presence would have a positive impact on the players' attitude towards the marine environment: a high sense of presence combined with a passive participant point of view in the virtual environment (VE) would increase environmental awareness in players because it would make them empathise with the story world (the seascape in this case).

The game was tested using the Presence Questionnaire, an accepted tool to measure the sense of presence in VR, during a Science Festival last November with mainly primary and secondary school Italian students.

Our results seem to confirm that players did feel immersed in the VE and developed a high sense of presence. We could however not measure whether increased presence also increased their awareness and sensitivity towards environmental issues and if and how this is also actually translated into a more conscious sustainable behavior while diving. Nevertheless, we believe that VR has potentials to promote behavioural and attitudinal change and plan to further investigate this with *ad hoc* studies.

Based on the literature, we can expect that the level of engagement implied by this high sense of presence should be able to stimulate more awareness in players. As participant in the VE, even if passive, the player feels that the environment is responsive to their presence and this responsiveness increases the perception in the player to be spatially present in the virtual environment. This is where the virtual experience of approaching marine life from close by and of freely rooming in the underwater setting may make the player feel part of it. This is when empathy takes place and when the environmental message can have more chances to be received.

Clearly however, we need to perform more experiments to determine the actual effects of presence and of immersion to promote a sustainable underwater behaviour.

[1]Green Bubbles is financed by the EU H2020 research and innovation programme under the Marie Sklodowska--Curie grant agreement No 643712.

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Marine Biologists: Can the diving system value a neglected profession?

There is a great and effective effort by the present educational approaches to increase awareness of the problems of the sea in kids and young students. As a consequence, the attention of young generations towards the marine environment is rapidly growing, as demonstrated by the increasing number of academic courses focused on marine biology, both at national and international level. The increasing number of people with a master degree in marine biology (about 150/200 degrees per year in Italy) is in deep contrast with the little attention the system is offering to the potential opportunities of our coastlines or the sea in general. The great expectations by several fragments of the civil society towards the Blue Growth strategy of the EU are being addressed, although with limited job opportunities for young marine biologists. To face this embarrassing paradox a new profile of marine biologist, expert in citizen science research programmes, has been designed, inspired by the opportunities available in the scuba diving industry. Citizen Science is now definitively accepted as a credible and effective contributor of scientific data but its impressive potentials are still undervalued, in particular for the benefit of marine environment. Marine biologists expert in CS projects can add value to the offers of a diving centre, involving their clients in several activities, which could represent a unique way to collaborate with local entities as marine protected areas. If adequately coordinated, CS projects could build a strong network at international scale and trigger a win-win-win strategy for scientists, managers and the public at large.

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Sea Change Project citizen science initiative – CRAB WATCH

Crab Watch is an initiative of the EU-funded Sea Change project which aims to increase European citizens' understanding of the ocean's influence on us and our influence on the ocean, also known as "Ocean Literacy". By getting people to become Crab Watchers, visit their coastline and interact with marine creatures in a meaningful way, Sea Change hopes to encourage people to think positively about the ocean and to become advocates for healthy seas and a healthy planet.

Crab Watch was launched on the 28 June 2017 and invites citizens across Europe to play a key role in the scientific process by gathering valuable data to enhance our knowledge of the changing distribution of native and non-native crabs. By establishing a network of Crab Watchers to record and report crab distribution, it is hoped that new arrivals will be detected early and appropriate environmental management action can then be taken quickly.

You can find everything you need to become a Crab Watcher on the Sea Change website: http://seachangeproject.eu/crabwatch. Resources are also available in a number of languages. Plus we have a Crab Watch app available for download on both iOS and Android platforms.

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Scientific communication: point of views from an Italian science journalist

Scientific journalism and communication is important as it should bridge the gaps between scientific community and a non-specialist target audience often by using simple and immediate language but also being rigorous and accurate. Why science journalists are important for the future of Ocean Literacy? Non specialist media often follow and focus on negative developments coming from science and technology, by hitting on the emotional and personal aspects showing conflicts or failures of public authorities. And the results are a real catastrophe: denial of human responsibility for climate change or the recent massive opposition to vaccination in Italy are just some examples. We need to raise new generations of journalist or to build up new communication strategies in order to make people more aware on how to distinguish fake news and avoid the spread of anti-scientific theories.

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Ocean literacy for children and youth – A click away

Children living in inland towns and cities on the continent, often hundreds of kilometers away from the coast, may have a very distorted perspective on the sea. The experience of beaches, sand, sea water, marine creatures and the beauty of underwater sceneries may remain on the books, cartoons, videos and TV documentaries for much of the early years of children and youth. This puts at risk the early engagement of individuals with the oceans, and can lead to insensitivities towards ocean related issues, often being the trigger of ocean illiteracy and lethargy. On the other hand closer proximity to the sea may render the relationship to the sea superficial, instilling an attitude of complacency to things that are taken for granted, and lending to a less stringent exchange with the sea as a result of an abusive confidence. Luckily the internet and other popular media are providing the means to break such barriers and serve to bring relationships with the sea on track. Ocean literacy at the level of children and youngsters needs an applicative, engaging and practical approach. This is the scope of IOI-Kids (www.ioikids.net), a dedicated website on the sea for children, youth, community groups and teachers across the world aiming to share ideas, projects, common issues and experiences with the scope of enhancing knowledge and promoting awareness on the marine environment with the younger generations. IOI-Kids provides an avenue to present knowledge on the marine environment in an appealing form, through a fun and learn-by-playing experience using interactive online games and informative articles. The website encourages authorships from children, youth and teachers to exchange ideas, projects and novel experiences across different cultures and a spectrum of topics related to the sea.

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The role of environmental education in Sicilian Marine Protected Areas

Today, more than ever, we need to be care for our common home: the Earth. The global financial and economical crisis has made evident the inner relationship between environmental degradation, the consequences of the new shift in the geopolitical order, and the cultural conflicts confronting the world. In this contest, the Italian Ministry of the Environment and Protection of Land and Sea (MATTM) promotes Education for Sustainable Development and Environmental Education to empower citizen to live sustainably and in an environmentally conscious manner. From a citizenship perspective, ecological viewpoints play a role in the public debate about land use, large scale fishing, sustainability, climate change, and so forth. Sicily is the Italian region with the highest number of designated MPAs -6 -and more are in the pipeline. This study gives an overview of the various dissemination initiatives being taken within Sicilian MPAs over the past decade to increase public awareness about the importance of such protected areas.

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Sailing for Ocean Literacy

In the years of 2016 and 2017, the Sea Change Project participated in the "Universidade Itinerante do Mar" (UIM) program, a collaboration between the Universities of Porto (Portugal) and Oviedo (Spain) and the School of Portuguese Navy. The program aims at taking students from different fields to experience the sea on board of Creoula, a tall ship from the Portuguese navy, and to increase their ocean literacy with different lectures and hands on activities. Sea Change was involved in three UIM programs: two in 2016 with a total of 49 participants and one in 2017 with 35 participants, from different fields and Universities.

Sea Change project presented eight lectures/activities regarding Ocean Literacy: Marine Conservation (3); The Plastic Sea (1), Seaweeds in you day life (1) and Cetacean monitoring techniques (3). Additionally, a citizen science monitoring program for cetaceans was performed giving students the opportunity to take part in data collection for scientific purposes: a total of 77 sightings of 8 identified species of whales and dolphins were registered.

With this partnership, Sea Change was able to participate in the increase of emotional connection of young people to the sea and increase awareness and knowledge in the field of marine conservation, promoting also a citizen science program with relevant results for research with the UIM students and staff. Creoula vessel became a stage where Ocean Literacy increased, cultural exchange and knowledge were strengthened and people from different fields of interest worked towards a fundamental sea change.

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MARINA, a digital platform for sharing marine knowledge

The MARINA Web Knowledge Sharing Platform is an open collaborative and networking website where users, interested in marine topics, can find each other and interact. They can share information, exchange best practice, co-create solutions to marine societal challenges, raise new ones, initiate new projects, generate action plans and put forth policy recommendations based on Responsible Research and Innovation (RRI) principles.

The platform allows members to connect, set up online discussions and share multimedia resources and tools. Moreover, it hosts innovative services to hold online events, live stream them, invite new participants and share the results.

The MARINA platform is for everyone: citizens, researchers, entrepreneurs, businessmen, policy makers or science communicators. Anyone who wants to use their creative mind to ensure that new marine solutions best serve the European society at large as well as the local communities and individual citizens. It is the place to manifest one's needs, expectations and ideas so that they should be taken into account when local, national and European decisions and innovations concerning marine environment are developed. While reconciling the expectations and ambitions of the European citizens and other stakeholders, the platform is a tool to raise awareness of the full extent

of the economic, social, cultural, medical, political and environmental importance of the ocean to the European society and the whole humankind.

The digital platform is supported by face-to-face mobilisation and mutual learning workshops, policy maker and RRI practitioner meetings and high-level policy conferences all over Europe.

The MARINA platform has been developed in the framework of the EU H2020 funded project to facilitate multistakeholder engagement, science education, open access, gender equality, ethics, sustainability and governance in marine and maritime fields.

If you are a fresh thinker concerned with the health of our oceans, register at *www.marinaproject.eu* to share your resources with the community.

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Promoting ocean literacy in schools – Example of Cascais Municipality

Cascais is a municipality surrounded by sea and highly dependent on the sun and sea tourism activities that are responsible for the main portion of the 466 000 visitors every year. Since 2007 the municipal environmental strategy created different agencies and started a new environmental program focused on marine conservation and biodiversity protection for different target audiences. In 2012 the new municipal strategy integrated those agencies in one called CASCAIS AMBIENTE (Environment Municipal Company of Cascais).

CASCAIS AMBIENTE is responsible for the Cascais Environmental Education and Awareness Program first presented in 2012 and it's for all schools. It concerns different subjects such as Oceans, Nature, Energy, Waste and Citizenship and results from the collaboration between the scientific community and our municipality in accordance with school curricula. With this program we want to create a new behavioral model enhancing the balance between man and environment promoting the adoption of a more sustainable attitude. During the last school year (2016/2017) the environmental education task group of CASCAIS AMBIENTE performed 811 activities for almost 24 000 students raging from kindergarten to secondary school. Those activities were carried out at classrooms, municipal educational centers and outdoor spaces of Cascais and the majority of which were related to OCEANS (231 activities) and NATURE (168 activities).

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Non-formal approach to promote marine and climate issues Examples of a science fair activities

It is a common practice that science is presented out of context and thus it seems irrelevant to peoples' lives. As a result many of young learners easily lose interest. If a young person's own motivation is disrespected, even the most careful preparation on the part of the educator will lead to a failure. People, especially young learners need more positive and realistic demonstrations of the scope and limitations of science and scientists.

Anything which is important to us is related to oceans, from air breathing, water drinking and using, food, entertainment. It comes from or can be shipped by the ocean. No matter how far from the shore people live, oceans affect their everyday lives.

Realizing the base of the modern education, i.e. key elements such as: any kind of learning is valuable, learning is a continuous challenge and that any kind of interdisciplinary approaches creates more opportunities in learning than one type of approach. Therefore, in this poster, we present selected cases of non-formal type of activities in relation to marine environments. We describe a number of local initiatives that promote marine issues among young learners. We stress main focus on the fact that these activities are made both within and outside of schools.

The main focus is put on two particular events, the Warsaw Science Day, from June 2016 and the Sopot Science Fair, which took place on 27 May 2017. Prior to the all day long events, which were held in the town centre, we worked together with teachers and school children, both in school and outside the classroom, to have them prepared for the Fairs. Then their works were presented during the events, and became a part of the presentation stand.

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Little Citizen Science: A new protocol marrying Ocean Literacy and Citizen Science for local children in Mozambique

Resident communities in coastal areas should have a deep connection with the sea. However, this is not always the case. In the coastal village of Ponta do Ouro, Mozambique, the local people have a stronger connection with the land, due to their hunting origins, and rather have fear of the water. The Green Bubbles (GB) RISE project works with the scuba diving industry to establish good relationships with stakeholders such as resident communities, in a shared vision to help conservation and protection of underwater environments. Ponta do Ouro offers opportunities to promote synergies between the scuba diving tourism industry, resident communities, and scientists to disseminate important information to future generations. In collaboration with the Ponta do Ouro Partial Marine Reserve (PPMR) and Reef Check Italia Onlus, GB created a protocol of marine education for local school children, which can be implemented on a regular basis by the PPMR in collaboration with local stakeholders, the local school, and the local scuba diving industry. The first objective of the protocol is to ensure that the future generations in Ponta do Ouro are equipped with basic knowledge of principles in marine biology and environmental conservation and protection. The second objective is to promote synergy among local stakeholders in the marine reserve and in the local area. The third objective is to establish a standardised way to collect scientifically sound data which can be used for research and monitoring. The protocol includes the observation and monitoring of local intertidal environments including the sandy beach and the rocky shore, also to create an obvious connection between exposed and submerged ecosystems, which the local economy depends on. The protocol is divided into two sub-modules: one laboratory and the other field-based. In this presentation, the launch of the protocol is described, and related opportunities and challenges discussed.

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Coastal Classrooms: Education and Conservation in a Marine Environment

Coastal Classroom Wild things! is a social enterprise based in the North of Scotland . Our coastline shares approximately 500km of Scotland's most spectacular marine and coastal environments, which is home to some of our rarest species. The Moray Firth is a Special Area of Conservation, contains SSSIs, Special Protection Areas and Ramsar sites. Since 2010 Wild things! has delivered Coastal Classroom as a methodology for engaging children in learning about coastal and marine environments in an imaginative and inspiring way. To date we have delivered this course to over 1450 children using variety of themes from: 'Coastal Sustainable Enterprise', 'Young 'ologists', 'Nature Interpretation' and currently 'Time Travelling'. In 2013 we also developed a weeklong accredited training course for teachers and outdoor instructors called Coastal Activity Leader Training, which we are currently in the process of getting recognised by the General Teaching Council of Scotland (our Woodland Activity Leader Training Course already has this recognition). To date we have worked with partners such as Whale and Dolphin Conservation and The National Aquarium in Plymouth and are keen to share our experience of outdoor learning in a coastal environment with a wider audience. "I choose this course because I wanted to improve my knowledge of the coast. The location was very important as it close to where I live. I particularly enjoyed being in the aquarium and seeing and experience" "Course was excellent. I wanted to know how to inspire and engage young people with the coastal environment. I got some great ideas and skills to do this" "It really gave me a lot of learning opportunities, especially naturalist information, delivered by really enthusiastic Comments from students on our Coastal Activity Leader Training Courses.

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Example of ResponSEAble EU funded project: co-production of ocean literacy products using 'living lab' approach

This presentation shows an approach developed during the EU funded research project ResponSEAble - (www.responseable.eu). The ResponSEAble approach is based on idea of including in the picture of ocean literacy the economic actors (fishermen, consumers, urban planners, regional actors, etc), whose change in behavior could help lessen the pressures on the state of marine environment. The project also questions what type of scientific knowledge they need to make an effective ocean literacy? The project works on the border with psychology, social and economic sciences to answer these three questions: what knowledge do we need? who should be targeted? and by what communication channel? Project proposes a creative way to avoid 'being lost in translation' where existing scientific knowledge is being mapped in the Knowledge Base to better visualize the link between humans and their activities and the oceans (and to understand our connection with the sea). Using the co-production model of 'living lab' project develops innovative ocean literacy products, which is a real world test to produce effective ocean literacy is efficient which reaches the right actors with the right message and via appropriate channels! Presentation highlights some of these products.

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From macro to micro properties of seawater and its inhabitants

Teaching physical and chemical properties of seawater could be more effective if realized in an interactive way. Even more, if these properties could explain the behaviour of strange organisms as diatoms, or how thermohaline circulation work and why it influences the global climate, to understand them can result even more interesting. It is important to build didactic paths interesting and, at the same time, amusing, able to "activate experiences to understand phenomena in playful contexts". Experiences and experiments must be realizable with easily accessible material. Moreover, we try to enrich them with amazing effects: stimulus based on surprise, wonder and bewilderment is, in fact, a powerful activator of interest and leads learners to the will to overcome the (eventual) initial error of interpretation of a phenomenon. In this didactic journey that we would to present - built to be both an interactive exhibition that a scientific laboratory - chemical, physical and biology go hand in hand, and provide the pupil with a more general picture of what is happening under the surface of the sea, and how many phenomena are intimately interconnected. The interdisciplinary approach and the interactive methodology, that resumes the 5E model based on the IBSE/IBL suggestions, are at the heart of the project, born from a collaboration between the ISMAR – CNR Institute and ENEA-SSPT-PROTER-BES, both carrying out research activities in marine science and moreover involved for years in activities of public awareness and education.

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Best- Practices in Marine Science Literacy: a Report of sample activities in a Long School-Training

"Blue Paths" is a Pilot Project of "Best Practices" in Marine Science Literacy, carried out by a Science Teacher of a Unified School District in La Spezia, ISA 2 "2 Giugno", aimed for teaching the monitoring techniques of coastal flora and fauna in Ligurian and Tyrrhenian Sea. Thanks to a Partnership between Schools (ISA6) Marine Parks, local authorities (Life on the Sea ONLUS); Research Centers, the project promotes the scientific literacy in an incremental and continuous School-Training period, from the Kindergarten to the Secondary School, in order to enrich the students curricula and to create an innovative awareness in School Community for belonging to a Global Citizenship that involves the engagement of students, parents and volunteers to raise awareness for the safeguard of coastal environment.

"Blue Paths" is a Vertical Curriculum in Marine Science and involves students with a key role as Educators for the peers groups and as Researchers in data collection Surveys. The project promotes a gradual scientific literacy through stimulating a conscious attitude towards environmental issues and the growth of scientific skills up to the Higher School and University levels, encouraging the creation of motivated "Team" of students .

This paper highlights the results of a slow and vertical literacy scholar process reached through the gradual learning in recognition techniques of beached and submerged benthic species carried out with: hands-on activities on the beach with the support of a Child-friendly BIO-Guide (student of 5-6 years); International School Meetings (Erasmus+) or local events, Orienting activities in Robotic field (student of 13-17 years) ; "Young -Monitoring Campaigns" (students of 9-13 years) ; Direct and Indirect Visual Census activities in Snorkeling (student in age 11-13 years) or with a Remote Operated Vehicle.

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Challenging Greek sixth graders' knowledge of carbon cycle and ocean acidification

The current study deals with the assessment and enhancement of sixth graders' knowledge of carbon cycle focusing on the effects of carbon dioxide increase on ocean acidification. It was conducted with a convenient sample of 17 experimental and 17 control group students from two classes of different public primary schools in Greece. The research combined quantitative and qualitative methods, namely (a) a structured questionnaire which included an 18-item knowledge scale and a concept inventory distributed to the experimental and control groups as pre-test and post-test, and (b) "rich pictures" drawn only by the experimental group before and after the learning process. The authors developed a program for primary students, based on international scientific educational resources, whose goals were aligned with the Ocean Literacy Scope and Sequence guide. It included 10 hours of inquiry-based and knowledge-integration class activities, such as experiments, concept maps, use of virtual laboratories and interactive online activities regarding carbon cycle and ocean acidification. The findings indicated that, although the experimental group was initially statistically equal to control group, it revealed statistically significant increase in knowledge scale after the intervention, as most students almost doubled their performance. The concept inventory also showed a statistically significant increase in self-reported content knowledge of the experimental group only. The analyses of the students' rich pictures at the beginning of the learning process indicated that most of them possessed an incomplete picture of the carbon cycle and had many misconceptions. On the other hand, students' significantly increased acquaintance with the carbon cycle components and processes was clearly manifested in the rich pictures after the learning process, while, at the same time, some misconceptions were also revealed to steadily remain. This study's findings provide a basis for offering suggestions on ways marine education might foster students' ocean literacy.

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Stories about the ocean - interactive methods in marine education for children

Education is a crucial process of shaping society and preparing it for future challenges. The awareness of connections between people and the ocean and a sense of responsibility for it should be developed as soon as possible in students. On the other hand, teachers of different countries emphasize that the early formal education neglects marine topics. Here is a huge role of the marine educators. But how to develop emotional connection to the ocean in a usually short time that an educator has? Storytelling could be a helpful tool in this case. The Gdynia Aquarium Education Center developed classes for the preschoolers that engage them in an active and entertaining way. The success of delivering knowledge depends on a great number of factors, while the time of the child's concentration capabilities are limited. Knowledge should be transferred cleverly, secretly, during the play. Therefore, the hourly educational activities for the little ones in the Aquarium are filled with various tasks and are conducted in a flexible way, tailored to each group. The educators use lights, decorations, visual materials and music to influence students imagination. At the moment, when the children go into the classroom, they are supposed to feel like entering the underwater world. And the story about the marine world, full of bizarre, ridiculous, beautiful or amusing beings can begin. As children have natural need to move, the lesson is facilitated with numerous physical tasks. Children become the performers and the subjects of the story and play roles of marine animals. Our youngest listeners will spend their entire adult life trying to remember numbers, names and definitions. Storytelling is a way to let them know, that learning about the ocean is fun.

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Saving Our Oceans One Student at a Time

We are a nonprofit organization called One More Generation (OMG) which was founded by two enterprising youth back in 2009 in an effort to clean up our environment and save endangered species for at least One More Generation... and beyond. Our founders have created an award winning Plastic and Recycling Awareness Curriculum that is now available Nationwide here in the US and is being tested in the UK and soon in Australia. The weeklong program revolutionizes the way environmental education is being taught and achieving phenomenal results. Students learn first hand about the threats of plastic pollution and how their daily activities directly affect what is happening to their environment. Lesson plans are hands on and delve deeper into the issue than ever before. The entire program is written to match the latest National Standards for science and they even have math, literacy and art infused throughout. The curricula offers information that the parents of most students are not even aware of which allows the students to become the 'teachers' in their homes. This unique approach empowers the youth and increases the parents participation throughout the entire weeklong program. Our young founders also include various 'action items' that allow the youth to develop solution based programs that will have an immediate and positive effect on their homes, their schools and their greater community. It is possible to save our oceans but if we are to be successful, we need to act now and rethink our approach to environmental education in our schools.

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Learning from Fishers: Exploring the value of local knowledge for marine conservation

The local knowledge of, and about, fishing communities, such as fishers' experiences at sea and their perceptions of marine systems, is a vital component that should be recognized within the ocean literacy scholarship. In this study, I present a methodological insight of how my immersion into the local knowledge circles of Maltese fishers between 2014 and 2016 enabled me to conceptualize a grass-root understanding of the fishing communities, and attain a closer vision of how fishers' knowledge can be utilized for ocean conservation and improved governance. I focus on the Natura 2000 marine protected areas that have been designated within established fishing grounds. Through direct conversations with fishers, I gather important ecological and socio-economic information that is vital for the successful implementation of marine protected areas. In this regard, I argue that fishers' constant contact and interaction with the marine ecological systems makes them an important focal point for marine information, and thus our view of education must be extended to engage the phonetic dimension of fishing as part of our knowledge repositories. This way, ocean literacy would enable horizontal and vertical integration of knowledge which facilitates a direct link between educators, policy-makers, scientists and marine users through an interactive flow of information and hands-on experiences.

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Global Ocean Science Education: Results from the Third International Workshop

Building on the first two Global Ocean Science Education Workshops, the third workshop, held May 23-25, 2017 at UNESCO in Venice, provided an exciting opportunity for ocean scientists, education professionals, policymakers, and business leaders to explore ocean science education issues. The participants from 10 nations addressed ocean science education priorities related to global concerns, including coastal resilience, supporting the implementation of activities in support of the UNESCO Education for Sustainable Development Goal number 14 (related to ocean education and ocean literacy), and enhancing ocean science education to support the 21st-century workforce. This presentation will focus on workshop outcomes, including recommendations for future, collaborative education activities related to the work of five new GOSE working groups, each focused on a key topic related to the ocean literacy of diverse stakeholders. A summary of the 2017 workshop report will also be provided.

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Ocean literacy and behavior change

The oceans command our climate system, they are a source of oxygen, water, energy and nutritious foods and still have applications in biomedicine. As well as having positive effects on our mental and emotional state, the oceans can also affect our physical health. Over the last decade, the thematic of Oceans and Human Health has begun to become more visible to the public. What knowledge we have of the state of the oceans and how it can promote positive change in our behavior is the subject matter of the European project ResponSEAble. In the scope of this project and at the level of Portugal, media content was analyzed, interviews were carried out with stakeholders and the general public, as well as an online questionnaire on the ocean man relationship was made available. This allowed to study what is transmitted, assimilated and with what effect on human behavior. The Internet, TV and print media were identified in this study as the most consulted channels, with marine pollution, climate change and marine biodiversity being the chosen themes. The overwhelming majority (more than 80%) of the participants in the study believe that it can have a positive influence on the state of the oceans and that it translates essentially into two aspects: a greater commitment to waste management (at the consumer level) and environmental education Of children and students. The change in behavior is however motivated by two main concerns: human health and well-being.

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The need to know the sea

The sea is undeniably the unique heritage shared among the world inhabitants. Most of people seem to identify very little or no connection between their activities and the future of the ocean. However, a well preserved ocean may enhance and protect human wellbeing. In this perspective, sea education is a meaningful tool to inspire a sense of attachment and personal responsibility that can be translated as ocean citizenship (OC). There is considerable support in the literature debate to recommend further investigations on this topic and scholars seem to agree with urge to develop sea literacy as key factor to water preservation and ocean environments. In Italy the debate is quite far from being fully taken into consideration, beside its 7.500 km of coasts and the need to save the Mediterranean sea habitat. This work resonates with the recent overseas studies and aims at relaunching the discussion on the meaning of ocean citizenship presenting two distinct case studies, both related to the Italian primary school system. The first deals with an extended analysis on the significance of the sea - stereotypes, representations, feelings - as expressed by more than 500 Italian students aged 9 -10 years old in the form of art works. The other will present the findings of a visual and textual analysis on the largely adopted primary school textbooks to explore how the sea and its related issues are presented and developed. In so doing, we will critically discuss a few insights on the importance of considering OC as a education tool to stimulate and build environmental and citizen education.

OTHER PRESENTATIONS

Ivan Alcolea Conesa[1], Paula Keener[2], Anne Stewart[3] and Ana Noronha[4]

[1,2,3,4]*Atlantic Ocean Research Alliance (AORA)*

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[2]*National Oceanic and Atmospheric Administration, USA*

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Ocean Literacy: An Update and Looking Towards Legacy

The visionary AORA's Galway Statement spurred unprecedented conversations, partnerships and transatlantic programmatic work that is serving as a model for larger international efforts focused on ocean literacy and raising the awareness of sustainable use of ocean resources at the global level. This presentation will provide an update on the AORA Ocean Literacy Working Group's most recent efforts, with recommendations for sustaining investments thus far (legacy) and looking towards the future of ocean literacy within AORA.