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Navigating Ocean Literacy in Europe: 10 years of history and future perspectives

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Abstract

Ocean Literacy (OL) emerged in the USA in the 2000s as a concept developed for the education system aimed at teachers. In 2011, it gained the attention of European educators who formed the first OL network in Europe, the European Marine Science Educators Association (EMSEA). Parallel to that initiative, Portugal started the first initiative to adopt OL content into formal education. Since then, there has been a major shift towards a more literate society in Europe. This paper reviews the development of OL in Europe, elaborates the role of OL for the sustainable future of the European seas, and provides recommendations for OL actions.

Keywords: Ocean literacy; sustainable development; Europe; UN Ocean Decade; SDG 14; EMSEA.

Introduction

The ocean covers over 70% of the Earth, and it is a major feature of the planet. Its role in the Earth ecosystem as well as its role in human society is invaluable. Production of oxygen, climate regulation, biodiversity, food production and economic value are just some of the services the ocean provides for the planet and for the people living on it (Cava *et al.*, 2005). The ocean also plays a critical role in achieving development of a sustainable society (Claudet *et al.*, 2020). However, anthropogenic pressures caused by human activities in the past decades, such as climate change, overexploitation of marine resources, pollution and habitat destruction (Visbeck, 2018), are leading to the deterioration of the ocean, and risking the existence and future stability of marine ecosystems and of their resources. In order to reverse this decline, the United Nations (UN) have proclaimed a Decade of Ocean Science for Sustainable Development for the period 2021-2030. One of the societal outcomes of this Decade is 'an inspiring and engaging ocean where society understands and values the ocean in relation to human wellbeing and sustainable development'. This outcome specifically refers to Ocean Literacy (OL) and calls for a behaviour change in the societies across the world with the aim to change societies' relationship with the ocean (UNESCO-IOC, 2021). Moreover, the Decade seeks to contribute to the achievement of the Sustainable Development Goal (SDG) 14: 'Conserve and sustainably use the oceans, seas and marine resources for sustainable development', which is one of the 17 SDGs of the UN Agenda 2030 for Sustainable Development (Ryabinin *et al.*, 2019). Additionally, Europe's Blue Growth Strategy and the Green Deal are focusing on sustainable economic growth in the marine and maritime sectors (European Commission, 2019). To achieve sustainable Blue Growth it is necessary to accompany economic development with environmental protection and social inclusion (French *et al.*, 2015; Bennett *et al.,* 2020), which require a high level of awareness of ocean and social issues, as well as of motivation and activism. Guest *et al.* (2015) suggested that low levels of 'Ocean Literacy' can be a barrier for citizens to engage in environmentally responsible behaviour. In the report about scenarios and drivers for sustainable

growth from the oceans, seas and coasts, Ecorys (2012) acknowledges the essential role of public acceptance for fully achieving Blue Growth. OL can play a crucial role in this process (French *et al.*, 2015).

OL is defined as 'an understanding of the ocean's influence on you and your influence on the ocean'. This means that an ocean literate individual 'understands the essential principles about the ocean, can communicate about the ocean in a meaningful way and is able to make informed and responsible decisions regarding the ocean and its resources' (Cava *et al.*, 2005; Santoro *et al.*, 2017). Since the beginning of the OL movement in the USA in the early 2000s (Schoedinger *et al*., 2010), a lot has been done in Europe to create a more ocean literate European society. In this paper, we will present a review of OL development in Europe, elaborate the role of OL for a sustainable future and provide recommendations for OL actions.

History of Ocean Literacy and its Beginning in Europe

In 2002 the National Geographic Society (NGS) and the College of Exploration (CoE) began to develop a guide for a curriculum identifying ocean topics that can be used to teach geography. A guide with detailed ocean content was produced. It was divided into four age groups that matched the geography scope and sequence developed previously. The guide was called Oceans for Life. In 2004, CoE with the NGS, the National Marine Educators Association (NMEA), the National Oceanic and Atmospheric Administration (NOAA) Office of Education, the Lawrence Hall of Science in California, the Centres for Ocean Science Education Excellence (COSEE) and NOAA's Sea Grant Program and several other partners across the United States (US), began a process to develop a similar guide for OL. In 2005, a guide to OL was produced following the pattern of the previous work on Oceans for Life. The guide contained the definition of OL, a set of seven principles (Table 1) and 44 concepts (revised in 2013 with the addition of one more concept) divided into four school age groups. It also included a mapping of the ocean content to the existing US science standards. The intent was to provide a guide for teachers to use ocean content to teach science in schools from kindergarten to high school.

Even though OL started as a knowledge concept, over the years it evolved to a multi-perspective approach that promotes interdisciplinary and intercultural competencies (Santoro *et al.,* 2017), which contributes not only to the knowledge, but also to ocean conservation, management and sustainability. This multi-perspective dimension encompasses different perspectives: the scientific, the historical, the geographic, the gender equality, the value, the cultural, and the sustainability (Santoro *et al.,* 2017). Through this process, OL crossed the national boundaries of the United States and was accepted across the world. In some cases, it was even adapted to regional scales such as in the case of the Mediterranean Sea (Mokos *et al.,* 2020a).

Starting from the US and specifically from the NMEA 2011 conference, OL ideas and experiences began to spread in Europe. During that conference, the College of Exploration initiated an international meeting where the work on OL guide was shared. This meeting was attended by several European marine educators who were encouraged to develop a similar network in Europe and, at this meeting, a new network of marine educators was born, the "European Marine Science Educators Association" (EMSEA) (Fauville *et al*., 2013).

Table 1. The Seven Essential Ocean Literacy and Mediterranean Sea Literacy Principles.

	Ocean Literacy principles	Mediterranean Sea Literacy principles
Principle 1	The Earth has one big ocean with many features.	The Mediterranean Sea, semi-enclosed by land of three continents, is part of one big ocean and has many unique features.
Principle 2	The ocean and life in the ocean shape the features of Earth.	The Mediterranean Sea and its living organisms shape the features of the Mediterranean region and its adjacent landmasses.
Principle 3	The ocean is a major influence on weather and climate.	The Mediterranean Sea has a major influence on the climate and weather of the Mediterranean region.
Principle 4	The ocean made Earth habitable.	The Mediterranean Sea made the Mediterranean region habitable through its richness of life thus becoming the cradle of western civilization.
Principle 5	The ocean supports a great diversity of life and ecosystems.	The Mediterranean Sea is a marine biodiversity hotspot, with a high level of endemism.
Principle 6	The ocean and humans are inextricably interconnected.	The culture, history, economy, lifestyle, health, and well-being of the peoples of the Mediterranean region are inextricably interconnected.
Principle 7	The ocean is largely unexplored.	Although the Mediterranean Sea has been explored for centuries, it still remains largely unknown.

In 2012, the first international conference on OL in Europe was organized in the city of Bruges, Belgium. This conference brought together marine scientists, educators and policy makers to address the lack of marine content in science education and emphasized the importance of formal and non-formal education for public involvement and active participation (Copejans *et al.*, 2012). In 2013, the University of Plymouth and the Marine Biological Association of the United Kingdom hosted the first EMSEA conference (Fig. 1). Since then, EMSEA has organized annual OL conferences across Europe, covering different marine science and education topics and workshops (Fig. 2) and hosted a diverse range of marine science expertise.

Legal Framework

While OL started as a grassroots movement in the US and was eventually incorporated into the US curricula (Kelly *et al.*, 2021), the situation in Europe was somewhat different. OL received no legal validation or endorsement of its existence as an essential element that would help in successfully managing and protecting our ocean. Despite this, a number of institutional frameworks were being put in place at the time, which began to highlight the importance that OL would play in the sustainable management of the marine environment and its resources.

In 2013, with the presidency of the European Union (EU) in Ireland, the Marine Institute in Galway, Ireland, hosted an international meeting to promote transatlantic ocean research cooperation, issuing the "Galway Statement" (Fig. 1). This event was one of the milestones in OL history. The agreement, signed by the EU, the US and Canada resulted from the drive for better transatlantic research cooperation and aimed to align ocean observation efforts as to better understand the Atlantic Ocean, to promote the sustainable management of its resources and to promote OL with their citizens. OL is a framing and foundational concept of the Galway Statement and as such, it was cross-cutting among all Priority Areas of the Atlantic Ocean Research Alliance (AORA). An OL Working Group was established and charged with defining a strategic path forward for Transatlantic Ocean Literacy, to be informed by international stakeholders representing ocean science, formal and non-formal education, government, marine education, business, industry and policy (Papathanassiou *et al.*, 2018). The AORA Ocean Literacy Working Group sought alignment and collaboration among key strategic partners working in Canada, the US and the EU to support implementation of Transatlantic Ocean Literacy as conceptualized in the

Fig. 2: European Marine Science Educators Association (EMSEA) conference topics.

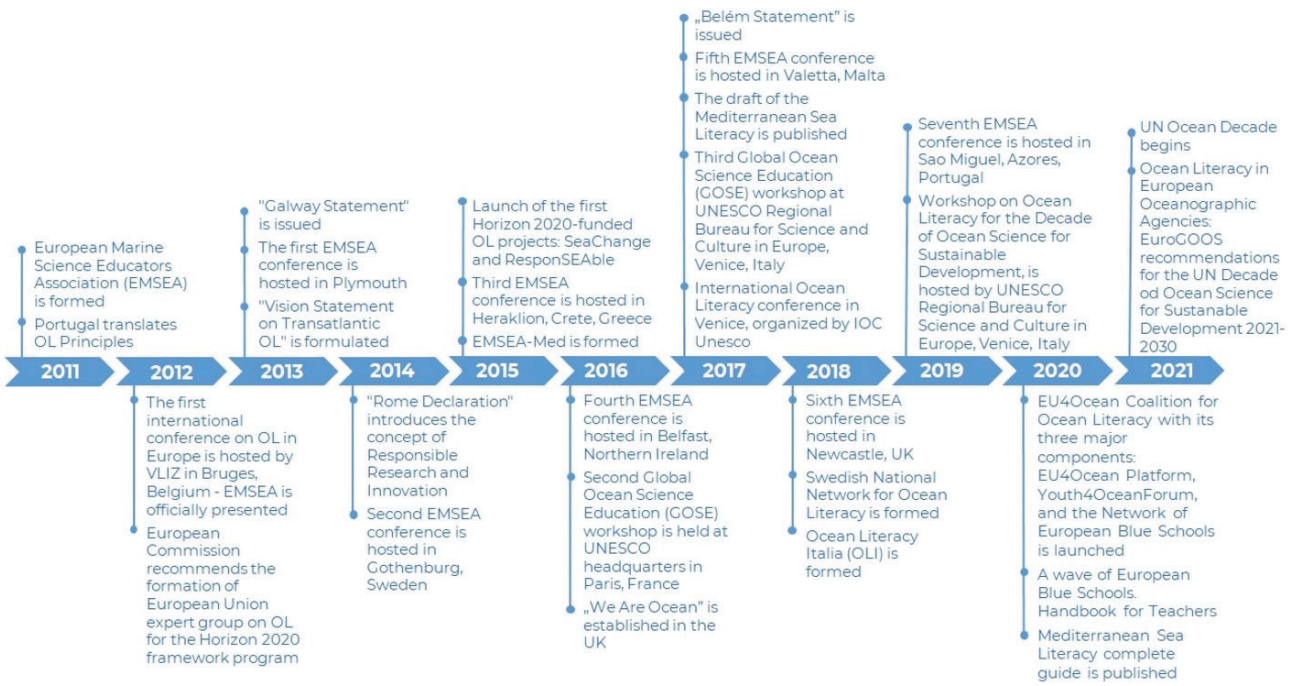

Fig. 1: Timeline of the key ocean literacy steps since its beginning in Europe.

Galway Statement. Building on the momentum created by the Galway Statement, in 2013, participants at the first EMSEA conference formulated the "Vision Statement on Transatlantic Ocean Literacy" (Fig. 1).

Overall, both the Galway Statement and the "Vision Statement on Transatlantic Ocean Literacy" laid the foundation of a new movement towards OL across the Atlantic Ocean. They helped inspire collaborative efforts in communication, education, and research, and promoted the pooling of resources towards mutually beneficial outcomes (CaNOE, 2014).

The following year, the Rome Declaration reinforced the concept of Responsible Research and Innovation (Fig. 1). The Science, Innovation and Society - Responsible Research and Innovation (SIS-RRI) Conference, held in Rome in November 2014, helped the reflection about the stakes and the future of research and innovation on a European scale to move forward (Science and you, 2014). The Conference aimed at debating on the ways that Responsible Research and Innovation (RRI) can increase interest and engage citizens in research and innovation activities, and led to the publication of the Rome Declaration on Responsible Research and Innovation in Europe. The Declaration is the result of major conclusions drawn from more than a decade of research and pilot activities on the interplay between science and society. If research and innovation are to improve society, then these cannot be done without including notions of ethics and societal responsibility, and without engaging citizens by facilitating access to knowledge and to research results and building citizens' trust regarding innovation and technology. Regarding OL, the Rome Declaration can be seen as a major contributor to its development and proliferation, through its overarching goal which is to promote "a wider awareness and understanding of the importance of the seas and ocean in the everyday lives of European citizens" (Mokos *et al.*, 2020a).

Furthering the integrated approach to research and development across the whole Atlantic Ocean and its bordering countries, the Belém Statement was launched in 2017, uniting research in the North and South Atlantic through enhancing cooperation between Brazil, South Africa and the EU. This followed the Galway Statement on North Atlantic Cooperation, and reflected a significant move towards a conjoined, integrated approach to research and development across the whole Atlantic Ocean and its bordering countries. A variety of projects emerged, which included OL as a main pillar, uniting people from across the world with one shared vision and common goal – to create an ocean literate society.

European Commission's Response to Rising Need for Ocean Literacy

In response to its commitment to promoting OL to EU citizens, in recent years the European Commission stepped forward and supported large OL projects and initiatives such as the two Horizon 2020 projects SeaChange and ReponSEAble, and, since 2020, the EU-4Ocean Coalition. The SeaChange project aimed to make a profound "Sea Change" in the way European citizens' view the sea, by empowering them to make environmentally responsible decisions (www.seachangeproject.eu). The goal of the ResponSEAble project was to encourage European citizens to improve their understanding of the human-ocean relationship (www.responseable.eu). In 2020, the European Ocean Coalition (EU4Ocean) was established (Fig. 1) to connect different organizations, projects and people to collaboratively advance OL across European countries. The aim was to increase awareness and engagement of different stakeholders involved in the sustainable management of ocean and seas, and to put OL high on the policy agenda, contributing to the implementation of the EU marine and maritime policies and the achievement of the SDG 14. This coalition established three different components aiming at different stakeholders: a) EU4Ocean Platform, which connects organizations, initiatives and people, to join forces to deliver a more coordinated approach to OL activities in Europe, including the exchange of expertise, knowledge, and best practices; b) Youth4Ocean Forum, a platform for young people between 16-30 where members can develop projects and initiatives addressing ocean challenges (https://webgate.ec.europa.eu/maritimeforum/en/node/4484); and c) Network of European Blue Schools, where teachers have a key role in promoting OL to their students and communities by including the ocean into their classroom. Blue Schools are new school ecosystems that foster the acquisition of ocean knowledge, skills and competencies (Copejans *et al.*, 2020). Marine education will allow students to address local to global challenges and will enable them to become independent while able to perform active, critical and responsible teamwork. This is the step forward to the inclusion of OL in formal education in several European countries.

Rise of the Ocean Literacy Networks across Europe

Networks are a universal aspect of life, helping make sense of the incredibly complex interactions between everyday phenomena (Sayama *et al.*, 2015). The ocean, and the issues it faces, are complex in nature, so it is unsurprising that networks have been fundamental in the development of the global OL campaign to date (Marrero *et al.*, 2019).

Energized by the major achievements of the large actions mentioned above and the growing support across the political spectrum, a bottom-up swell has emerged. OL and marine education networks have been emerging across the world in the last two decades bringing together individuals and organizations united by the common vision of an ocean literate society and interested in making efforts relevant at local, national and regional contexts. Some examples known to the authors include: the European Marine Science Educators Association (EMSEA) in Europe; the National Marine Educators Association (NMEA) in the USA; the Canadian Network for Ocean Education (CaNOE) in Canada; the International Pacif-

ic Marine Educators Network (IPMEN) in the Pacific Ocean; the Asian Marine Educators Association (AMEA) in Asia; the Australian Association for Environmental Education (AAEE) in Australia; and the Latin American Education Network for the Ocean (RELATO) in South America. Overarching these regionally defined initiatives, UNESCO has taken OL to a global level by developing an Ocean Literacy for All: A Toolkit (Santoro *et al.*, 2017) and an Ocean Literacy Portal. In this way, and through the principles of networking and collaboration, a global OL network of networks is forming.

Currently in Europe, there are several OL networks operating at regional and national levels. The first of its kind was EMSEA, which aims to bring together marine scientists and educators to raise the profile of OL across Europe. It serves as a network of marine educators and different marine science experts. It facilitates the exchange of best practices in marine education, provides support to teachers, educators and all sea caring individuals and organizations in order to make European citizens more ocean literate.

However, one of the main challenges in advancing OL in Europe is the diversity of languages and cultures across the continent's sea basins. In order to ensure that the OL movement reaches the wider population of European citizens, it is crucial this diversity is acknowledged with translation of OL content and adaptation of OL resources that are culturally and context relevant. As a result, EMSEA encouraged the establishment of regional groups with the aim of implementing objectives at the local level, currently supporting the work of four regional groups: a) EMSEA-Baltic, b) EMSEA-Atlantic, c) EMSEA-Northern Seas, d) EMSEA-Mediterranean; with an additional group planned: e) EMSEA-Black Sea. These regional groups are intended to facilitate collaboration and focusing efforts by members connected by Europe's different regional seas, and some of these regions have active networks operating at the national level too.

In 2019, the European component of the Global Ocean Observing System (EuroGOOS) of the Intergovernmental Oceanographic Commission of UNESCO (IOC GOOS), which encompasses oceanographic institutes, meteorological offices, and hydrographic agencies, formed the EuroGOOS Ocean Literacy Network (Fig. 1). This network emphasizes OL as a strategic activity area in oceanography (Eparkhina *et al.*, 2021).

Some of the Ocean Literacy initiatives in different European regional sea basins known to the authors are being listed in the following text.

Ocean Literacy in the Baltic Region

Small on the global scale, the Baltic Sea is one of the world's largest and isolated bodies of brackish water. The sea is surrounded by nine countries (Sweden, Finland, Russia, Estonia, Lithuania, Latvia, Poland, Germany, and Denmark) with narrow and shallow connections to the rest of the global ocean through the Danish straits. Its catchment area of 1.6 million km^2 (including human activities such as agriculture, impacts from large cities and heavy industries that are main causes of eutrophication, overexploitation, maritime transport and tourism), which is more than four times larger than the sea itself, is home to 85 million people (HELCOM, 2010). For over more than 20 years now, many OL initiatives have been underway to raise awareness about the state of the Baltic and the need for protection and preservation of its rare beauty.

Sweden

Sweden is among the pioneers of European OL advocates with the University of Gothenburg playing a pivotal role in the process of bringing OL to formal education in Europe. In 1997, the Wallenberg Foundation in Sweden funded Virtual University Education (VirtUE) – a marine education project that fosters collaboration in research, education and outreach between Universities of Gothenburg (Sweden), Maryland (USA) and Bergen (Norway). The project covers different topics across aquatic environments, and provides an opportunity for both fieldwork and classroom (lab) experience. Currently the VirtUE website boasts attracting over 80 countries and over 180 registered users from Sweden, Spain, UK, Germany, Portugal and USA (Frederick *et al.*, 2019). A professional development course "Bring the Ocean to the Classroom" was also designed to fit into the required goals of the Swedish school system (from preschool to high school) and foster teachers' interest in working experimentally with natural science and marine environment based tools and materials (Wulff & Johanesson, 2019).

The Swedish Government has also been proactive in supporting upscaling of international OL efforts (Santoro *et al.*, 2017), having provided the financial support for the development of UNESCO's Intergovernmental Oceanographic Commission "Ocean Literacy for All: A global strategy to raise the awareness for the conservation, restoration, and sustainable use of our ocean' portal, a central repository for educational OL resources for the public, teachers and OL professionals'' (http://www.unesco.org/new/en/media-services/single-view/news/ioc_unesco_and_sweden_strengthen_partnership_for_ocean_liter/). In 2018, the Swedish Government mandated the establishment of the Swedish National Network for OL making Sweden the only Baltic country with a nation-wide OL initiative (EU4Ocean Launch Workshop September, 2020).

Poland

In Poland, OL is still present solely in the non-formal education realm, limited to bottom-up initiatives of non-profit organizations, research and non-formal education institutions. Two major institutions popularizing the concept of OL in Poland are the Gdynia Aquarium Education Center, which is a part of the National Marine Fisheries Research Institute (NMFRI), and the Institute of Oceanology of the Polish Academy of Sciences.

NMFRI is an institution with a long tradition of marine education (Ropelewski, 2001). The need to share the knowledge about marine environment with the general public led to the opening of the Gdynia Aquarium in 1971. Established in 1998, the Gdynia Aquarium Education Centre has been providing marine education to students of all ages with the use of a unique set of specimens collected by the NMFRI over 100 years of ocean exploration. The "Meet the Baltic Sea" project developed by the Gdynia Aquarium and funded by the Municipality of Sopot is one of the major projects that aim at complementing the formal education with marine knowledge in order to help build an ocean literate society. Since 2004, pupils enrolled in local public schools participate in relevant workshops at the Gdynia Aquarium Education Centre (Niedoszytko *el al.*, 2019). The concept of OL along with the seven principles was adopted by the Center in 2015, which subsequently launched a Polish OL website (https://oceanliteracy.pl/), following the second EMSEA conference in Gothenburg.

The Institute of Oceanology of the Polish Academy of Sciences has been conducting outreach activities since 2007 e.g. Sopot Science Days which is a collaboration with local and regional institutions (WWF, Sopot Science Association, Gdynia Aquarium) that aims at engaging the general public concerning the future of the marine environment (http://www.iopan.gda.pl/odn2019/sdn/index.html). In 2019, the Institute of Oceanology of the Polish Academy of Sciences, in collaboration with The Sopot Science Association, organized the first Junior Conference addressed to primary school students who previously attended the World Café workshops "Ocean of changes", and giving them a unique opportunity to experience a scientific conference setting and present their work to their peers (http://www.iopan.gda.pl/odn2019/km/index.html).

Ocean Literacy in the Atlantic Region

The Atlantic Ocean is the Earth's second largest ocean basin and borders lands of North and South America, Africa, and Europe. EMSEA-Atlantic brings together a group of members that are connected by the northern Atlantic Ocean and work together to share information and projects. The group became galvanized at the seventh EMSEA conference in the Azores in 2019 and has since collaborated on initiatives on World Cleanup Day 2020, inviting anyone to participate in clean-ups and share interesting "treasures" on social media. Other initiatives included the 'wear something blue' #IAmOcean campaign on World Ocean Day 2020, and International Youth Day 2020.

Additionally, there are major efforts in promoting OL in this region through the Atlantic Ocean Research Alliance (AORA) where an All-Atlantic Blue Schools Network is being established in 2021.

Ireland

Since 2006, the Marine Institute, Ireland's State agency responsible for marine research and development, has been running an OL educational initiative (the ExplorersEducationProgramme™), aimed at primary schools and involving more than 20,000 students and over 500 teachers from many Irish coastal counties. The outcome of this initiative has been "building a strong marine education network of people engaged in ocean literacy, involving teachers and the education community, outreach practitioners, industry, media, as well as marine science organizations and public bodies" (Joyce *et al*., 2019).

At the national level in the Atlantic region, the Irish Ocean Literacy Network – An all Island Ocean Network (https://irishoceanliteracy.ie) has been active since 2016 and is now supported by over 100 individuals and 40 organizations with a shared website and a rotating secretariat. The mission of the Network is "to create, maintain and develop an informal network of ocean literacy champions to facilitate collaboration, sharing and coordination of marine outreach and ocean literacy projects across the island of Ireland".

Portugal

Due to its geographic position and its maritime tradition, Portugal "was among the first countries to implement OL education projects" (Barracosa *et al.*, 2019). The country was one of the first in Europe to implement OL framework to formal and non-formal education (Santoro *et al.*, 2017). In 2011, the OL content was translated to Portuguese by the effort of Ciência Viva (Santoro *et al.*, 2017). The project "Conhecer o Oceano" was among these early efforts to promote OL in the country, following the OL initiative. In the following years many initiatives and projects, addressing formal education and general public, were implemented across the country by governmental agencies (e.g., Ciência Viva), universities and research institutions (e.g., CIIMAR - Interdisciplinary Centre of Marine and Environmental Research), aquaria (e.g., Oceanário de Lisboa), NGOs, and educator associations. Benefiting from this favourable environment, a number of networks dedicated to the promotion of marine and coastal knowledge, awareness and stewardship now operate in Portugal. Examples worth mentioning includes the *Escola Azul* (https://escolaazul.pt), a government supported network of schools integrating ocean learning in the curriculum across the country, and REASE, a regional school network in the Algarve region (Barracosa *et al*., 2019). Learnings from the *Escola Azul* have been fundamental to inform the development of the European Blue Schools initiative.

Ocean Literacy in the Northern European Seas

A network across Europe's northern seas is under development aiming to bridge collaboration across the

North-East Atlantic, with particular focus on the North Sea.

United Kingdom

Also active since 2016, a collective known as We Are Ocean (https://weareocean.blue/) emerged in the United Kingdom (UK) intent on accelerating OL in UK culture. Following an initial report which set out priorities to achieve this, initiatives by the collective include: i) World Ocean Day for Schools, engaging thousands of children with ocean resources and learning through a free online platform designed to connect, create, and celebrate the wonder and importance of our ocean; ii) the Ocean Mic, an experiment inviting Finisterre customers in the UK to share their human connection to the ocean; iii) the Sea is the Sky billboard campaign, aiming to bring awareness of the connection between rain and the ocean; iv) the WAVES Framework, to explore ways to talk about the ocean that help deepen a sense of connection; and v) the We Are Ocean Summit, which has so far counted two editions in 2019 and 2021 with the aim to create a platform for blue minded talents of all kinds to come together and explore new ways to continue accelerating OL in the UK.

The development of We Are Ocean has been mutually supported by the Marine CoLABoration which is a group of marine and related NGOs taking an innovative values-based approach to exploring collaboratively how to communicate more effectively solutions for the ocean (Chambers *et al.*, 2019).

Ocean Literacy in the Mediterranean Region

During the annual EMSEA conference held in 2015 in Heraklion, Crete, a group of enthusiastic educators and scientists from around the Mediterranean organised to lead the exploration on how OL in Europe might be encouraged around regional seas. By the end of this event, the first regional group was formed, EMSEA Mediterranean (EMSEA-Med) (Fig. 1) with the vision for a coordinated effort for the diffusion of OL across the Mediterranean countries. Since then, the group has worked on the translation of the OL guide to several Mediterranean languages and organized coordinated events at various local and international events to promote OL at the regional and different national levels. Lately, its members focused on the education research program to investigate ocean related knowledge, attitudes and behaviour among the students of Mediterranean countries, very under-studied until then. The first research project was a multi-centric study addressing primary school students in Greece, Italy and Croatia (Mogias *et al.*, 2019), followed by other investigations in individual countries (Realdon *et al.*, 2019; Cheimonopoulou *et al.*, 2019; Mokos *et al.*, 2020b). The research program is currently running with a new study addressing middle school students in eight Mediterranean countries, including two non-European countries (Croatia, Cyprus, Egypt, Greece, Italy, Malta, Spain, and Turkey).

Finally, driven by the need to reflect the specific circumstances of the region, EMSEA-Med adapted the OL guide to the specific features of the Mediterranean Sea and developed the Mediterranean Sea Literacy (MSL) guide (Fig. 1, Table 1) (Mokos *et al.*, 2020a). MSL "serves as guidance for research, education, informed decision-making, and improved citizens' lifestyles, and aims to contribute to environmental protection, conservation, and restoration of the Mediterranean Sea as well as to help to achieve a blue innovative and sustainable economy" (Mokos *et al.*, 2020a). Additionally, the group addressed the need and the importance of OL and MSL for the sustainable future of the Mediterranean Sea, emphasizing that there is an urgent need for advancing OL and MSL across the Mediterranean basin in order to empower diverse societies and cultures, with different behaviours and attitudes, to become informed and to understand critical issues associated with sea related topics (Mokos *et al.*, 2021). One of the following main efforts is to translate the MSL guide into different national languages.

At the national level, there is a strong network operating in Italy and there is currently exploratory work underway for the development of a national network in Greece.

Italy

Ocean Literacy Italia (OLI) (https://oceanliteracyitalia.it/) was born in 2016 by initiative of UNESCO IOC Office in Venice after the first EMSEA Conference in the Mediterranean held in Crete in 2015, and was officially established in Rome in 2018. OLI is intended as the Italian reference point for other international networks and as a meeting and sharing point for national stakeholders from education, research, institutions and the private sector. OLI is aimed at OL education and communication and operates by means of workgroups for formal and non-formal education, for cooperation with other networks and with private and blue economy sectors and for the coordination of the World Ocean Day activities in Italy.

Since its birth, OLI has been involved in national and international conferences, in science communication events, in training courses (for journalists and teachers), in translation, and diffusion of educational resources. A recent OLI initiative aligned with the beginning of the UN Ocean Decade – "Di-segna il tuo mare 2021", involved a contest with a call for videos, multimedia, graphics and photographs submitted by youth, which received hundreds of applications from all over the world.

Impact and perspectives of OL networks in Europe and beyond

The progress of OL efforts globally has tremendously benefited from these emerging national and regional networks. Work at the national and regional levels remains a priority as it enables communities to develop a stronger sense of identity with the ocean through empowering

place-attachment and historical intergenerational interactions informed by local and traditional ecological knowledge. This has been identified as critical to enabling communities to resonate with OL initiatives and therefore progress OL globally (Kelly *et al.*, 2021).

It remains critical, however, that these networks work together in pursuit of effective collaboration (Marrero *et al.*, 2019). OL has primarily been spear-headed by marine scientists and educators (Kopke *et al.*, 2019), but it is a responsibility of all sectors of society (Borja *et al.*, 2020). There is therefore a need to continue expanding collaborations beyond these stakeholders and, through networks, better bridge the gaps between science, policy, and society in a way that is locally relevant. In this context, research collaborations and OL publications are increasing across the world among the authors, organisations and countries (Paredes-Coral *et al.,* 2021).

A promising initiative aimed at establishing a large network of schools engaged in OL (European Blue Schools) has recently been launched by the EU Commission. The first European Blue Schools began their OL projects in the school year 2020/2021, but many more have joined in the following school year. An innovative feature of European Blue Schools is the required collaboration with a local partner, so involving the establishment of links of the schools with their communities. Moreover, many Blue Schools participate also in Erasmus+ or eTwinning projects, widening the involvement of the number of teachers and students actively engaged in ocean education and citizenship.

The role of Ocean Literacy for the Sustainable Future of European Seas

OL is considered as one of the key steps towards achieving the sustainability of the ocean (Santoro *et al.*, 2017; Dupont & Fauville, 2017; Claudet *et al.*, 2019; UNESCO-IOC, 2021). As the ocean is central for achieving a sustainable future, it is necessary to give the ocean a central role in our lives (Claudet *et al.*, 2019; Lubchenco & Gaines, 2019). Moreover, improving public awareness and ocean knowledge is necessary in order to increase motivation for behaviour change and support for the actions which reduce and prevent anthropogenic impacts on marine resources and the environment (Kelly *et al.*, 2021). Understanding the need for, and the importance of, sustainable use of ocean resources is vital for achieving sustainability of the European seas and the objectives of the UN Ocean Decade as well as the SDG 14, thus it is imperative levels of OL improve across Europe (Kelly *et al.*, 2021).

Two large EU-FP7 studies investigated European adults about ocean issues in the last decade: the CLAMER survey, addressing over 10,000 citizens in ten countries in 2011 and a second one, within the KnowSeas Project, addressing 7,000 citizens of seven countries in the same period. (Potts *et al*., 2016; Buckley *et al.*, 2017). Both studies evidenced moderate concern for marine environment, with differences among countries, but generally with a "schism" with a scientific perspective on the same problems. Reported knowledge of marine issues also revealed significant gaps (Potts *et al*., 2016; Buckley *et al.*, 2017). European citizens have a complex and diverse connection with the ocean. But, at the same time, these citizens are often unaware of the importance and the role of the ocean in their everyday lives (Lamy *et al.*, 2020).

At the end of 2019, the European Commission presented the European Green Deal Communication which aims at addressing urgent climate and environmental challenges and turning them into a unique opportunity (European Commission, 2019). A sustainable blue economy, as well as the conservation and restoration of marine ecosystems, will have a significant role in this process. Knowledge, restoration and protection of the European seas will be crucial for achieving the European Green Deal. Additionally, in 2020, the Mission Board for Healthy Oceans, Seas, Coastal and Inland Waters presented a report Mission Starfish 2030: Restore our Ocean and Waters (Lamy *et al.,* 2020). This report calls for "European citizens and policy makers to take responsibility for protecting and regenerating rivers, lakes, seas and ocean and demand urgent systemic change from our politicians and leaders". One of the key challenges for delivering healthy oceans, seas, coasts, and inland waters is the lack of OL across European society. This challenge needs to be addressed at all segments of society, including education, policy, business, general public etc., in order to understand the importance, value and the role of the ocean in our lives but also its role in the Earth's ecosystem.

Disconnectedness from the marine environment is partially linked to low understanding of marine issues and awareness (McKinley & Fletcher, 2010). In fact, OL requires the understanding of the mutual interaction between the ocean and people, enlarged to all kinds of such interactions. Moreover, as different authors have recently highlighted, the concepts itself of OL has been widening its scope, adding several dimensions, in addition to knowledge (awareness, attitude, communication, behaviour, activism, connection to the ocean, emotions and empathy, motivations, and access), also recognizing the influence of multiple internal and external factors on the desired pro-environmental behaviours (Brennan *et al.*, 2019, Stoll-Kleeman, 2019; McKinley& Burdon, 2020).

For instance, the combination of knowledge, behaviour and pro-environmental attitudes is known to improve environmental protection in adults and children (Hynes *et al.*, 2014; Hartley *et al.*, 2015). Moreover, OL is also about the ability of people to protect, conserve, sustainably use and manage marine resources. Achieving and nurturing this understanding, can in turn lead to behavioural change and a positive change across society which will lead to restoration

To improve this connection, European citizens need to engage with organized and structured OL activities thus be exposed to formal and non-formal educational activities and citizen science projects. Kelly *et al.* (2021) identified key drivers for improving OL as well as several limitations regarding the development of OL actions and for adopting the existing OL programmes and resources

beyond western and English speaking countries. This is highly relevant in the European context, where the use of existing OL resources in English can be a challenge due to Europe's large linguistic diversity. To reach out to wider society segments of the European countries, this challenge needs to be addressed. The rising number of networks emerging across the continent are making a significant contribution towards enabling translations into national languages, sharing resources through national channels and using existing platforms to address this challenge.

OL is critical for the success of the Decade, and it is of fundamental importance if the European countries are to achieve the objectives of the Decade. OL is clearly implied in challenge 9 of the Decade: "Ensure comprehensive capacity development and equitable access to data, information, knowledge, and technology across all aspects of ocean science and for all stakeholders", and in challenge 10: "Ensure that the multiple values and services of the ocean for human wellbeing, culture, and sustainable development are widely understood, and identify and overcome barriers to behaviour change required for a step change in humanity's relationship with the ocean" (UNESCO-IOC, 2021). It is also central for the Decade's objective 3: "Increase the use of ocean knowledge and understanding, and develop capacity to contribute to sustainable development solutions" (Fig. 3) (UNESCO-IOC, 2021).

To address the above-mentioned limitations and challenges related to OL, effective multi-stakeholder collaborations to co-design OL actions and initiatives are needed, which should be informed by the four priority areas defined by the draft OL Framework developed by UNESCO: Advancing Policy, Formal Education, Corporate Action and Community Engagement (UNESCO-IOC, 2021). To name a few, there are therefore opportunities for coordinated actions in the development of national OL strategies; integration of OL into school curricula and national education policies; delivery of training programmes for pre-service and in-service teachers, government officials, and the private sector; development of citizen science projects to enable knowledge transfer between scientists and members of society; incorporation of indigenous and local knowledge in OL efforts, etc. However, financial resources remain a crucial limitation for delivering projects, initiatives and actions that can address these topics. To help alleviate this limitation, there is the need to ensure the legacy of major projects such as SeaChange, ResponSEAble, and EU4Ocean, while also supporting and connecting existing OL networks and initiatives to help increase capacity for delivering the needed actions identified above. Equally, there is a great potential to invest in better future ocean governance by expanding networks such as the EU Network of Blue Schools, which take the ocean to the classroom and enable students - the future adult citizens- to connect to the

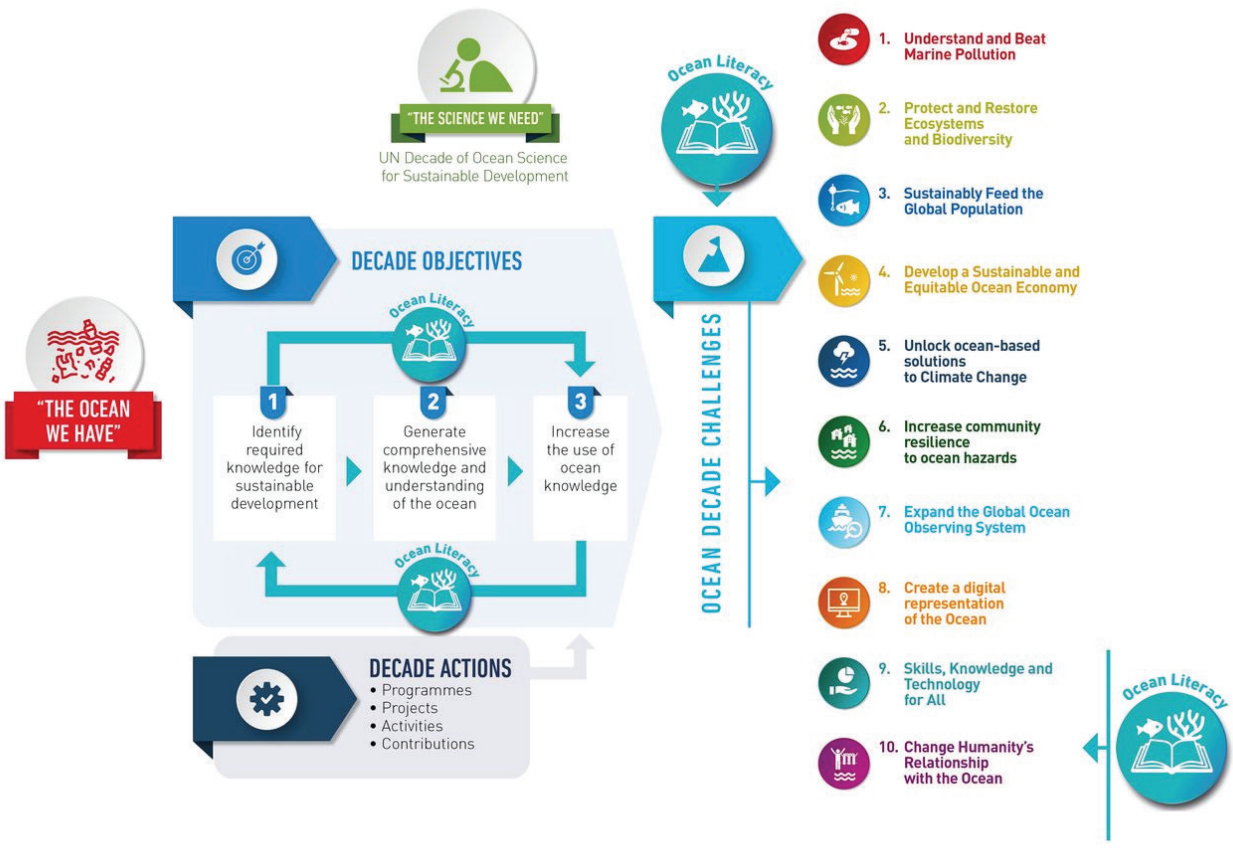

Fig. 3: Contribution of Ocean Literacy to the Ocean Decade Objectives, Actions, Challenges and Outcomes (UNESCO-IOC, 2021).

sea. However, such efforts should not be limited to European countries, but instead expanded beyond geo-political boundaries, such as in the case of the Mediterranean Sea, connecting diverse societies, cultures, languages of both European and non-European countries, reflecting the true connected nature of the ocean.

Conclusions and future recommendations

This article evidences the great momentum gathered in support of OL in Europe, and beyond, in the past 10 years. It remains imperative, however, that existing efforts are continued and replicated, while OL could continue to evolve to be a true lever of change and policy development, inspiring new, innovative initiatives at all levels of society.

In order to achieve ocean literate societies and conserved and sustained seas, it is necessary to collaborate, network and to create partnerships between different stakeholders across communities, countries and regions. In the following section we provide recommendations for future actions that will contribute to this:

- take into account diversity of languages, cultures, and societies
- give special attention to inclusiveness, accessibility and equity, addressing societal needs not always considered in education planning
- include traditional ecological knowledge
- include OL in formal and non-formal education, as well as in the pre-service and in-service teachers training
- promote multiple dimensions of OL and go beyond knowledge - include attitudes, behaviour, communication, activism, stewardship, emotional connection, etc.
- go beyond geographical boundaries, include both inland and coastal countries and communities
- go beyond education - include private sector, stakeholders, policy/decision makers, local communities
- measure the impact of OL activities
- ensure financial resources supporting above-mentioned actions.

This is necessary in order to continue to edge closer to achieving a European ocean literate society that understands the role of healthy seas and values marine life, and to move from the European seas we have towards to European seas we want.

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