

Marine Science Communication in Europe

A way forward

European Marine Board IVZW

The European Marine Board provides a pan-European platform for its member organizations to develop common priorities, to advance marine research, and to bridge the gap between science and policy in order to meet future marine science challenges and opportunities.

The European Marine Board is an independent and self-sustaining science policy interface organization that currently represents 35 Member organizations from 18 European countries. It was established in 1995 to facilitate enhanced cooperation between European marine science organizations towards the development of a common vision on the strategic research priorities for marine science in Europe. The EMB promotes and supports knowledge transfer for improved leadership in European marine research. Its membership includes major national marine or oceanographic institutes, research funding agencies and national consortia of universities with a strong marine research focus. Adopting a strategic role, the European Marine Board serves its member organizations by providing a forum within which marine research policy advice is developed and conveyed to national agencies and to the European Commission, with the objective of promoting the need for, and quality of, European marine research.

www.marineboard.eu

European Marine Board Member Organizations



European Marine Board IVZW Future Science Brief 8

This Future Science Brief is a result of the work of the European Marine Board Communications Panel¹ (EMBCP) and other contributors. Full details of contributing authors can be found in Annex 1.

Coordinating Author and WG Chair

Jan Seys

Contributing Authors

Lucy Cox, Ezgi Şahin Yücel, Daria Ezgeta-Balić, Marco Faimali, Francesca Garaventa, M. Carmen García-Martínez, Claudia Gili, Kathrin Kopke, Kelle Moreau, Francesca Petrera, Dominique Simon, Andreas Villwock, Tymon Zielinski

Series Editor

Sheila J. J. Heymans

Publication Editors

Muñiz Piniella, A., Kellett, P., van den Brand, R., Alexander, B., Rodriguez Perez, A., Van Elslander, J.

External Reviewers

Fiona Beckman, Ronaldo Christofolletti

Internal review process

The content of this document has been subject to internal review, editorial support and approval by the European Marine Board Member organizations.

Suggested reference

Seys, J., Cox, L., Şahin Yücel, E., Ezgeta-Balić, D., Faimali, M., Garaventa, F., García-Martínez, M-C., Gili, C., Kopke, K., Moreau, K., Petrera, F., Simon, D., Villwock, A., Zielinski, T., Muñiz Piniella, A. (2022). Marine Science Communication in Europe – A way forward. Muñiz Piniella, A., Kellett, P., van den Brand, R., Alexander, B., Rodriguez Perez, A., Van Elslander, J., Heymans, J. J. [Eds.] Future Science Brief 8 of the European Marine Board, Ostend, Belgium. 48pp. ISBN: 9789464206166 ISSN: 2593-5232 DOI: 10.5281/zenodo.6444143

www.marineboard.eu

info@marineboard.eu

Design

Zoeck

We give special thanks to the EMBCP members and other communication experts who facilitated the surveys in their countries and organizations, and the 80 experts and 1861 students from all over Europe who responded to the surveys, as well as the teachers that supported them.

First edition, June 2022

¹ <https://www.marineboard.eu/embcpc>

Foreword



The Ocean is finally on its way to getting the attention it deserves. Not only due to its beauty and dangers, but also as a critical component of our climate, health, culture, and as an important enabler of our future and the Sustainable Development Goals. Current initiatives such as the UN Decade of Ocean Science for Sustainable Development (2021-2030) and the European Union (EU) Mission: Restore our Ocean and Waters by 2030, only re-iterate the increasing interest in the Ocean from policy and society, and these offer the opportunity to work together for a better Ocean, and in turn, for a sustainable society.

Ocean research offers solutions to many challenges, but the outcomes, findings, opportunities and added value of Ocean research need to be shared and communicated to all parts of our society. From school children and communities dependant on the Blue Economy, to directors of companies and advisors to national Ministers. Marine science communication is a critical tool to translate our scientific findings and add value to society.

The European Marine Board Communications Panel (EMBCP) is a pan-European platform for experienced marine science communication professionals operating since 2006, and is supported by the European Marine Board (EMB) Secretariat. Its Members are appointed by the EMB Delegates. As an outcome of the panel review in 2016, the EMBCP became a strategic permanent panel and it was recommended to collaborate further with EMB. After the successful 3rd International Marine Science Communication Conference in December 2018 (CommoOCEAN 2018), the EMBCP decided to write this policy document, under the auspices and with the support of the EMB, responding to the higher sense of priority among researchers and research organizations to invest in Marine Science Communication. We welcome this Future Science Brief as one of many collaborations between EMB and its communications panel.

On behalf of the EMB, I would like to thank the members of the EMBCP for writing such a topical Future Science Brief. We give special thanks to the external reviewers, additional contributors (Annex I), the EMBCP Members and other communication experts who facilitated surveys in their countries and organizations, and the 80 experts and 1861 students from all over Europe who responded to the surveys, as well as the teachers that supported them. My thanks also go to the EMB Secretariat, for their work in supporting the drafting of this document, namely Ángel Muñoz Piniella, Paula Kellett, Britt Alexander, Ana Rodríguez Perez, Jana Van Elslander, Rebecca van den Brand and Sheila Heymans.

Gilles Lericolais

Chair, European Marine Board
June 2022

Table of Contents

Foreword	4
Executive summary	7
1 Marine science communication (MSC): Needed more than ever	9
1.1 Is ‘marine’ science communication different?	9
1.2 Purpose of this publication	9
1.3 Three surveys, three target groups	10
1.3.1 Expert group	10
1.3.2 Students	11
1.3.3 EMB Member organizations	11
2 Increasingly visible?	13
2.1 The Ocean is attractive in itself	13
2.2 Is the Ocean more visible in the media now?	14
2.3 How and why does Ocean news reach young people?	14
2.4 Topics covered in marine science communication?	16
3 What is the current capacity of marine science communication?	18
4 What can we learn for the future and who should have a role in marine science communication?	20
4.1 Lessons learnt from daily practice	20
4.2 Role of various stakeholders	22
4.2.1 Scientists	22
4.2.2 Policy-makers	24
4.2.3 Industry representatives	24
4.2.4 Communication experts	24
4.2.5 Educators	24
4.2.6 Media	25
4.3 Future expectations	25
4.3.1 More Ocean news	26
4.3.2 Intuitively attractive, but lagging behind and often linked to scary news: how to change the messaging?	27
4.3.3 Structures, conditions and incentives in place?	28
4.3.4 New technologies	30
4.3.5 What can we expect from the ‘UN Decade of Ocean Science for Sustainable Development’ in terms of MSC?	30
4.3.6 How to get prepared	31

5 Recommendations & key actions	34
References	36
List of abbreviations and acronyms	37
Annexes	
Annex 1: European Marine Board Communication Panel (EMBCP)	39
Former EMBCP members who contributed to the document	39
Other contributors	39
Annex 2: Ocean News survey to experts	40
Annex 3: Ocean News survey to students	43
Annex 4: EMB Member organizations survey	46

Executive summary

Marine Science Communication (MSC) aims to increase understanding and to raise awareness of Ocean science. It also increases curiosity about scientific discoveries and issues related to our Ocean. MSC is a tool to improve understanding of the importance of Ocean science, to help create awareness and inspire responsible behaviour at all levels of society, and to advocate for policy that is committed to a sustainable Ocean and planet.

The purpose of this Future Science Brief is to shed light on the state of the art, the impact, the visibility and the future of MSC actions in Europe. This document aims to highlight MSC as a critical field of activity, and to share recommendations for its future development. It also examines lessons learnt during the process of MSC, considers the role of different stakeholders in this process, and highlights the challenges and opportunities that arise when communicating about Ocean science. Finally, it delivers specific recommendations on how to recognize, support and improve MSC in Europe.

The main target audience are professional communicators within Ocean/marine research institutions, Ocean conservation organizations, or scientists who communicate their own research. This document is also aimed at marine scientific organization managers, research funders, European and national policy-makers and NGOs, who support a healthy Ocean, the local economy, food provision, tourism, etc.

Over the coming decade, MSC will become critical to achieve a more Ocean literate and sustainable society. To strengthen the capacity of MSC in Europe, we make the following recommendations:

1. Marine Science Communication should not hide facts, but should avoid only presenting the **‘negative bias’** in Ocean news. It should also show the opportunities, and when possible, the positive side of a story.
2. Marine science institutions and funders should change their culture in order to **stimulate science communication** and to acknowledge and value science communication.
3. Marine science communicators should look for **connections with science communicators outwith marine science**, and with **communicators in non-scientific domains** (e.g. marketing). Communication experts should increase interaction with all stakeholders (scientists, citizens, media, aquaria & science centres, students, policy-makers, industry, educators) in the MSC process.
4. A marine science communication **platform** or **database** should be developed by the communication community **to share expertise and resources**, especially to help those with reduced resources.
5. **Additional funding and human resources** are needed to cope with future MSC needs. The European Marine Board Communications Panel recommends that marine science institutions should dedicate at least **10% of their staff time** to MSC. This can include both staff dedicated to MSC and/or time spent on MSC by scientists and other staff.
6. Marine science communicators should make better use of **new technologies and approaches** to reach the wider public in order to **enhance successful traditional methods** (story-telling, hands-on activities, arts, visuals, etc.), ‘to make the invisible visible’, to stimulate curiosity and hunger for knowledge, and to actively connect with a wider audience.
7. There is a clear need for professional communication and outreach **training** programs, workshops and events (e.g. the CommOCEAN conferences), both for marine scientists and for other MSC stakeholders. It is recommended that a structural means for supporting the continuation of these conferences is sought, possibly in partnership with the European Commission.
8. Marine science communicators should communicate as much as possible under the umbrella of the **Ocean Decade** and of the **EU Mission: Restore our Ocean and waters by 2030**, both unique opportunities to enhance MSC. An evaluation by the conveners of these efforts should be made in order to learn from the experience and to be prepared to underpin similar future actions.
9. A **general communication baseline** for marine science should be established by the communication community, which emphasizes the ‘Why’ of Ocean science and MSC. This should be based on the rationale shaping the international Ocean Literacy movement.



2021 United Nations Decade
of Ocean Science
2030 for Sustainable Development

The ‘UN Decade of Ocean Science for Sustainable Development’² (Ocean Decade) will require appropriate and impactful marine science communication and dissemination. This Future Science Brief and its recommendations support the Ocean Decade in a number of ways.

This Future Science Brief provides recommendations to support Societal Outcome 7: An inspiring and engaging ocean where society understands and values the Ocean in relation to human wellbeing and sustainable development. It does so by highlighting how marine science communication can support and advocate for a more Ocean Literate society through promoting positive stories about the Ocean and highlighting the added value of Ocean science to society.

This document addresses Ocean Decade Challenge 4: Generate knowledge, support innovation, and develop solutions for equitable and sustainable development of the Ocean economy under changing environmental, social and climate conditions. It does so by discussing how marine science communication should focus on positive messaging related to the Ocean, for instance by focusing on solutions to environmental issues. It also recommends strengthening marine science communication efforts to bring the latest discoveries and innovations to the attention of the stakeholders and public. This document also addresses 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. It does so by presenting how marine science communication professionals can make connections with and learn from other science communicators and with communicators in other domains. It recommends to make better use of the Ocean Literacy movement, underpinned by scientific research, considering the willingness to use the opportunities provided by the Ocean, while meeting the challenges of doing so in a sustainable way.

² <https://www.oceandecade.org/>

1 Marine science communication: Needed more than ever

“A vibrant democracy requires informed citizens.”

(Professor Jane Lubchenco, Marine Ecologist, Oregon State University, USA, 2020)

In times often regarded as the post-truth era³, practicing and sharing science is more relevant than ever. By widely communicating results based on the scientific method, science forms a solid counterweight against fake news and the misconception that in a free society, we can ignore and undermine science and its findings without creating far-reaching impacts on other people or the planet. Science also unearths facts, figures and knowledge that would otherwise stay untouched or unseen. The latter is highly relevant to the marine realm, as this environment is often seen by people as remote, hostile and far from everyday routine.

Meanwhile, the Ocean and seas, which play a vital role in the Earth's systems, are experiencing increasing pressure from human activities. More than ever, there is a need to improve our understanding of Ocean science to help create awareness and inspire responsible behaviour at all levels of society, and to advocate for policy that is committed to a sustainable Ocean and planet. These insights have set the stage for a global 'Ocean Literacy' movement, involving an in-depth public interaction and engagement exercise. The Ocean Literacy concept and its principles⁴, proposed in the US around twenty years ago, are now being advocated around the world.

1.1 Is 'marine' science communication different?

Science communication aims to increase understanding of science, raise awareness of science-related topics, and increase curiosity about scientific discoveries and issues. Marine Science Communication (MSC) is part of the much broader science communication landscape. We define a MSC action as any activity that translates and shares Ocean scientific knowledge with the wider public and with specific target audiences. It includes media actions, publications, documentaries, events, etc. It is the public 'voice' of marine science, and covers a wide range of topics, and

reflects the diverse disciplines of marine scientists, including marine social sciences. Consequently, a cross-disciplinary approach is a major and fundamental feature of the activities of marine science communicators.

Compared to other branches of Earth Sciences, Ocean research often requires more high-tech infrastructure and equipment. Therefore, some knowledge of and familiarity with technology is important when acting as a marine science communicator.

Probably the most relevant aspect of the work of marine science communicators is the huge impact that the Ocean has on climate and on the life of the entire world's population. This is in sharp contrast to the remoteness and 'invisibility' of the marine environment and the disconnect that many people feel with it, which is why the Oceanic realm and its role is still less well understood than terrestrial environments. Human beings are terrestrial animals, and are generally focused on what happens on the land, with little awareness and knowledge of what happens in the world's Ocean and its role in Earth systems. Therefore, the main challenge for marine science communicators is to make the invisible visible.

1.2 Purpose of this publication

This document presents the current state of the art in MSC in Europe and then looks forward to understand how it will need to evolve to address future needs. It also presents survey results on how Ocean experts and students perceive, receive and engage with MSC and Ocean information. Based on the experiences of the EMBCP Members and survey respondents, it presents lessons learnt in MSC and considers the different stakeholders and their roles in the MSC process. It closes with recommendations on how to develop MSC in Europe. With this document, the EMBCP aims to highlight the importance of MSC and to propose how it could be further developed in the future.

³ <https://theconversation.com/post-truth-politics-and-why-the-antidote-isnt-simply-fact-checking-and-truth-87364>

⁴ <http://oceanliteracy.wp2.coexploration.org/>



Researcher and oceanographer Jon Albretsen (IMR, Norway) is being interviewed by NRK about the launch of a new service that can predict water temperatures along the coast of Norway. NRK is the Norwegian radio and television public broadcasting company, and the largest media organization in Norway.

Credit: Ambjorg Arnesen/Institute of Marine Research

1.3 Three surveys, three target groups

In order to provide a picture of MSC in Europe, the European Marine Board Communications Panel (EMCP) carried out three surveys targeting different stakeholder groups from across Europe. The results of these surveys underpin this document. Two main, in-depth surveys were carried out, one targeting experts (Ocean scientists, marine policy-makers, industry representatives, media professionals and Ocean communication or education experts) and the other targeting secondary-school students (17-18 years old).

A more restricted survey examined the current status regarding MSC staff working at EMB member organizations⁵.

The two main surveys provided answers to questions including:

- How visible is the Ocean in the media, and how visible are various Ocean topics today?
- What are the most successful communication actions? What are the elements that have fuelled this success? What can go wrong and how can this be prevented?
- How should one deal with topics that are highly visible (e.g. marine litter)?
- What is the role of the media and other stakeholders in the communication process?

- How has MSC changed over time?
- What changes are expected in the future and how should we prepare?

The following sub-sections provide details on the participants of the three surveys.

1.3.1 Expert group

Using EMBCP Members as intermediaries, a group of Ocean experts was recruited to answer a 15-minute online survey in English between May and July 2020 (see Annex II for full survey). The survey had both multiple-choice and open text questions. Throughout this document, direct answers are indicated in italics and with quotation marks (“ ”).

The 80 Ocean experts came from six stakeholder communities (25 scientists, 9 communication experts, 16 education experts, 8 industry representatives, 12 policy-makers, and 10 media experts) and 16 countries, evenly distributed across the six European sea basins: Atlantic Ocean, Baltic Sea, Black Sea, Eastern Mediterranean Sea, Western Mediterranean Sea, North Sea & Channel (Figure 1.1).

⁵ <https://www.marineboard.eu/members>

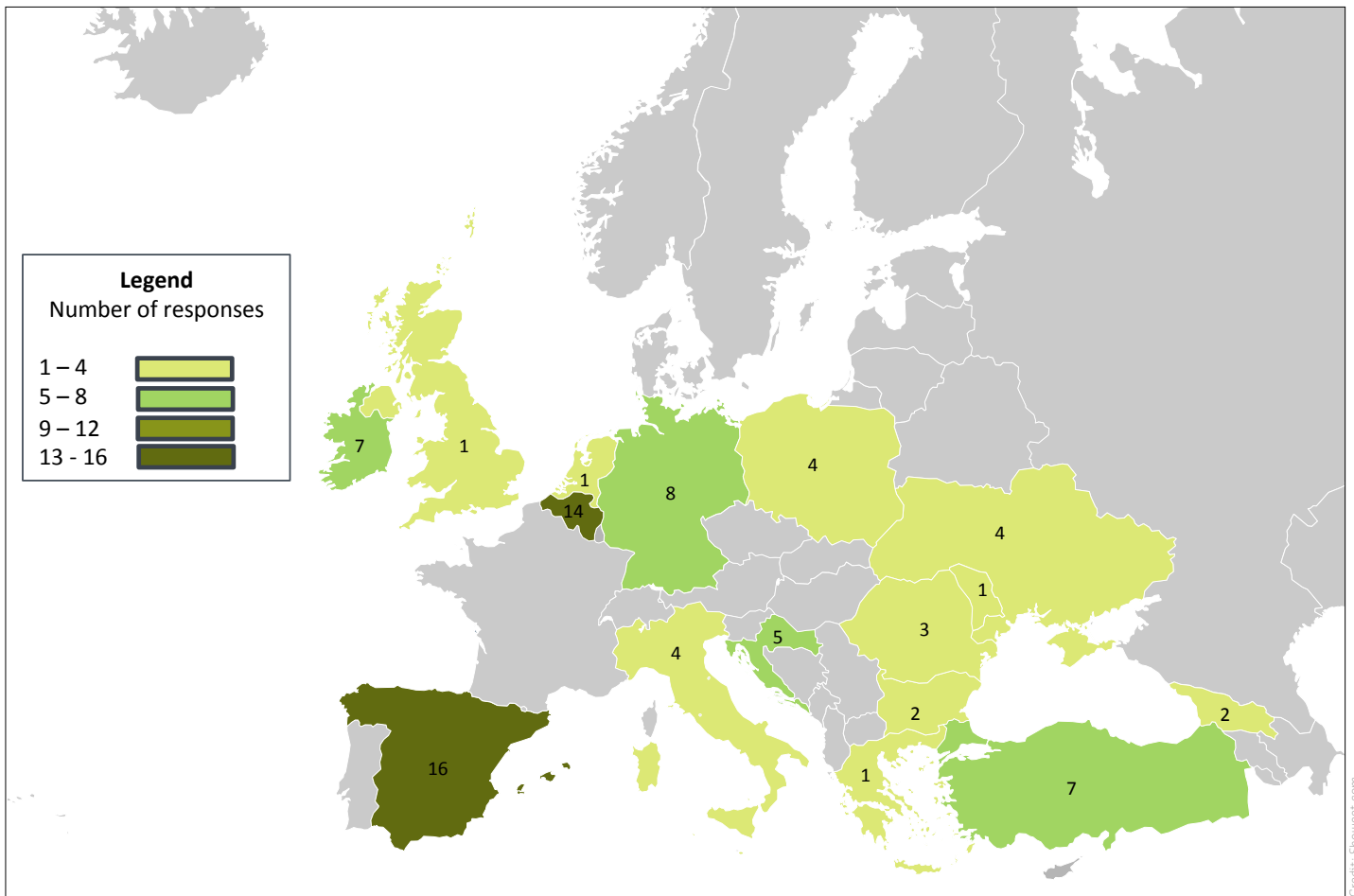


Figure 1.1. Number of respondents by country for the expert survey.

1.3.2 Students

From September to December 2020, a 10-minute survey was conducted with 17-18 years-old secondary school students. The students and schools were recruited using EMBCP Members as intermediaries, who assisted in translating the survey into the local language where needed. The student survey did not include any open text questions (see Annex III).

The initial goal was to recruit 1,000 students but the final number rose to 1,861, from 13 countries (Figure 1.2.). The number of participants was spread evenly over countries in most European sea basins. However, the Black Sea region had a substantially larger number of students participating in the poll (1,079), due to the efforts of Ezgi Şahin Yücel (Middle East Technical University (METU)) within the framework of the EU H2020 Black Sea CONNECT⁶ project. Within the Black Sea region, there was an uneven distribution among countries, with 743 surveys completed in Romania alone. Due to this imbalance, we discuss the results separately for the Black Sea versus non-Black-Sea students, highlighting differences between the two groups.

A slightly higher number of female students (57%) completed the survey. The vast majority of students (97%) attended a free-to-attend

government school ('public' school). Most students (96%) attended a science-related program, and were taught some science as part of their current school curricula: only 4% of the students had less than one hour of science lectures per week, 46% had between one and three hours of science a week, and 50% had over three hours a week.

1.3.3 EMB Member organizations

The third survey was conducted to map the communication capacity among the EMB Member organizations. Data was obtained from 23 of the 35 EMB Members (i.e. about 65%). In this survey, we asked the organizations to describe the personnel in their (marine) science communication departments (see Annex IV). Many of the respondents expressed difficulties in obtaining the exact numbers of staff working on MSC. Some EMB Members are consortia of different universities or institutions, and particularly at universities, there is no clear distinction between the staff dedicated to marine versus non-marine communication activities. The same applies to research councils or funding agencies, whose work is dedicated to different fields of science. In other cases, there are no specific staff dedicated to communication, and researchers or other employees use a part of their time to carry out communication activities in addition to their other tasks.

⁶ <http://connect2blacksea.org/>

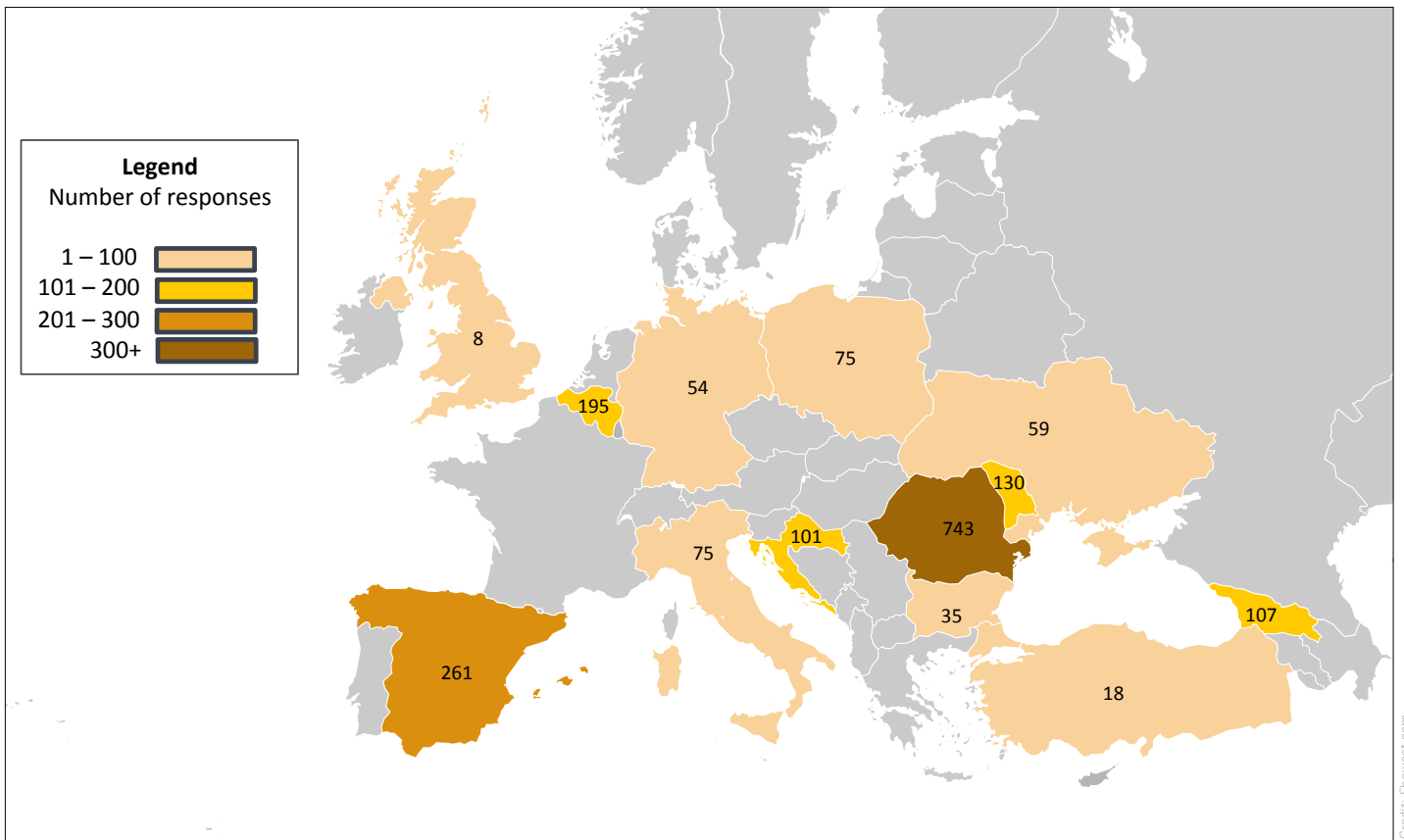


Figure 1.2. Number of respondents by country for the student survey.



During the annual Science Day (Dag van de Wetenschap) VLIZ opens the doors of its Marine Station Ostend and the RV *Simon Stevin* for the public at large, to explain their research and facilities. The event is coordinated by the Flemish Government and Technopolis.

2 Increasingly visible?

Based on the survey results, there are opposing views on whether it is more or less challenging to communicate Ocean science than other scientific disciplines. There is also a perception that there has been an increase in Ocean news in mass media, in line with the general increase in science news. Young people get their Ocean news from social media, TV and school. Interesting, scary or fake-sounding news are most likely to capture their attention.

2.1 The Ocean is attractive in itself

Over 60% of students and just over 50% of the experts did not consider communicating MSC as a very challenging task compared to communication in other scientific fields. When asked if they perceived communicating about marine science as 'less', 'as' or 'more' challenging than communicating other science, 18% of experts and 25% of students answered less challenging and 34% of the experts and 41% of the students answered 'as' challenging as other sciences.

Respondents gave some specific reasons for why they thought MSC is not too challenging.

These included that: *“Marine science is appealing to the public at large”; “Everybody knows the Ocean and it offers an interesting context”; “Oceanography covers all fields of science and is visually attractive, with plenty of pictures and footage of the deep blue, whales and sharks, etc., available for the public and journalists”; “In comparison with mathematics, theoretical physics or cell biology, marine science is driven by curiosity and empathy”; and “There is a basic fascination with the Ocean and it makes people happy as it has connections with positive experiences (rest, love, holidays, sea mammals, etc.)”.*



The Ocean is visually attractive with many facets, and this can help to engage people with the Ocean and marine science.

Conversely, some experts also highlighted the complex nature of Ocean science and the biased attitude of the public towards ‘cute and cuddly’ aspects as factors that complicate MSC. It is hard to get beyond the attractive animals and pretty footage to communicate about crucial Earth system processes that occur in remote parts of the Ocean and are often invisible (acidification, climate change, large-scale Ocean-atmosphere interactions). It is challenging to make the connection with people’s everyday lives and needs – compared to, for instance, when communicating about health research. The societal relevance of Ocean science still requires a lot of explanation. Other difficulties identified included a lack of marine topics in educational programmes and materials, and a lack of teacher-scientist collaborations. In other words, there is a need for more Ocean Literacy, also in schools; an aspect that is increasingly being addressed (e.g. through the All Atlantic Blue Schools Network⁷, and the EU4Ocean Network of European Blue Schools⁸).

2.2 Is the Ocean more visible in the media now?

The student survey indicated that they receive Ocean news (in any possible format) on an irregular basis: daily (5%), weekly (23%), monthly (34%) or less than monthly (38%). The majority (72%) of the surveyed experts received Ocean news more frequently, i.e. daily or weekly.

Marine science was perceived to be more visible now in the media than before. This is due to several ‘hot’ Ocean topics (e.g. plastic soup, the role of the Ocean in the climate change debate, Blue Economy) and thanks to efforts to stimulate Ocean Literacy. Almost all of the experts (89%) perceived an increase in Ocean news over the past twenty years (Figure 2.1.). The same applies to 17-18 years-old students, of which 67% felt that there was more Ocean news now than two years ago.

When asked whether the Ocean received a similar increase in attention compared with other fields of science (e.g. space, medical science), the answers also seemed to support a recent perceived increase in importance of the Ocean. 45% of experts perceived that this increase in attention for Ocean news was in line with that of other fields compared to 20 years ago. 45% of students also perceived that marine science now receives more or as much attention, in line with other fields, over the past five years (Figure 2.2.). When asked for an explanation, the experts who saw a rise in Ocean news mainly attributed this to the current global challenges and opportunities (such as climate change, sea-level rise, plastic debris, offshore wind, aquaculture, etc.).

With science popularization gaining momentum, and the internet and social media facilitating knowledge exchange (i.e. allowing more people to read about science, join virtual expeditions, directly interact with scientists, etc.), all fields of science communication and outreach seem to be growing. There is also an increasing ‘eco-consciousness’ among the public, for instance in the Fridays For Future⁹ movement and in consumer concern and expectations around environmental issues: e.g. survey by Tetra Pak of 7,500 consumers in 15 countries. Both the growth in science communication and great eco-consciousness have also served to promote interest in Ocean issues. In addition, a strong promotion of Science, Technology, Engineering, and Mathematics (STEM) at least in some European countries has created a wealth of opportunities in terms of education and engagement in related fields.

Some experts felt that MSC is still lagging behind compared to the growth in communication in other scientific fields. They argued that the Ocean is *“still a far-away friend for many”* and that too often it has a negative news connotation (oil spills, tsunamis, harmful algal blooms, plastic debris, etc.). Space science or medical science are seen as *“more challenging and spectacular”*, *“more technologically attractive”*, *“better supported by the government”*, *“more relevant to society”* and *“communicating ‘hope’ rather than the ‘hopelessness’ of most Ocean news”*. One expert added that *“Ocean issues attract the attention of the media in case of accidents, otherwise they remain in the background.”*

2.3 How and why does Ocean news reach young people?

Students were asked where they obtained their Ocean news from (e.g. social media, digital news providers, newspapers, TV, friends, school) and how often they thought that these news outlets provided important content that caught their attention. Pooling the categories ‘often’, ‘very often’ and ‘always’ shows that most Ocean news that reached students came from social media (53%), television (45%), school (38%) and other digital media (34%). Friends (22%) and newspapers (12%) were less important sources.

When the students were asked about the main reason why certain Ocean news stories caught their attention, the answers *“because it is scary and it makes me worry for the future”* (47%) and *“because it is new and I realize that I learned something valuable”* (40%) had the highest scores. The fact that the news was humorous (5%), or that they were obliged to learn about it, e.g. at school (8%), were much less important reasons. More in-depth questions on specific negative Ocean news showed that it caught their attention primarily because it scared them and made them worry (61%) or *“when it sounded like fake news”* (25%). Whether it ‘offended people’ was not considered as a main reason to engage with that news (5%).

⁷ <https://allatlanticblueschools.com/>

⁸ <https://webgate.ec.europa.eu/maritimeforum/en/frontpage/1485>

⁹ <https://fridaysforfuture.org/>

Do you feel like there is less, more, or as much communication on marine science/ocean issues now than there was twenty years ago (in the 1990s)?

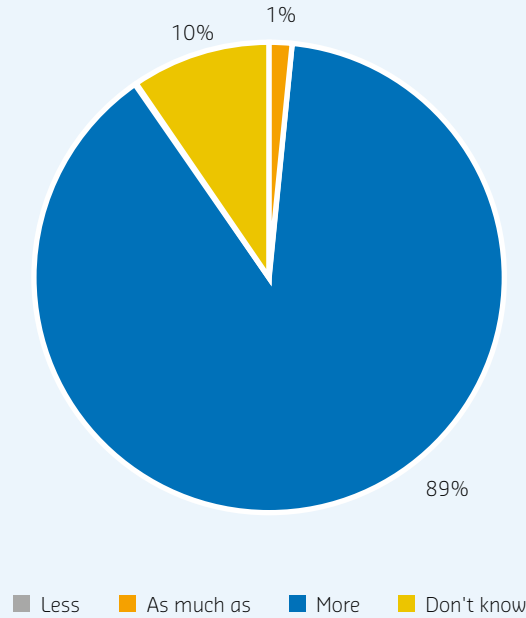


Figure 2.1 Perception from 80 experts of how visible Ocean news is compared to twenty years ago.

Do you think that science related to the Ocean in particular, has received less, more, or as much attention compared to other fields of science over the past five years?

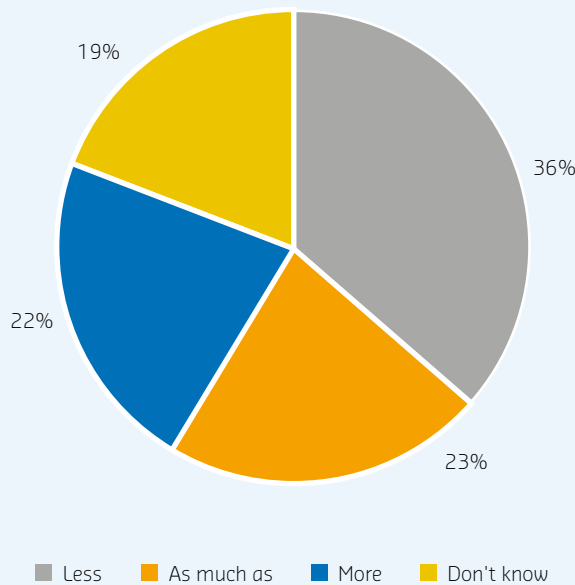


Figure 2.2 Perception from 1,861 students of how visible Ocean news is compared to other fields of science (e.g. space, medical science).



Credit: Picture from the OGS archive

Engaging students in practical learning using the SciFabLab sandbox at OGS during the science festival Trieste Next, held in Trieste (Italy) from 24 to 26 September 2021.

2.4 Topics covered in marine science communication?

In the surveys we presented eight Ocean research topics to the students and experts: ‘marine litter’, ‘chemical pollution’, ‘climate change’, ‘biodiversity and ecosystems’, ‘fisheries and aquaculture’, ‘marine bio-products’, ‘underwater noise’ and ‘offshore energy’. Table 1 shows how well these topics performed – in the opinion of the respondents – in receiving visibility among the wider public during the past five years.

The results highlight two topics in particular that were perceived as highly visible: ‘marine litter’ and ‘climate change’ (including sea level rise). For ‘climate change’ we see a marked difference in visibility between Black Sea students (18%) and students from other European regions (38%). Topics such as ‘offshore energy’, ‘underwater noise’ and ‘marine bio-products’ were perceived as much less visible. Among students, ‘chemical pollution’ was perceived as more visible than among experts. For ‘biodiversity/ ecosystems’, the opposite is true: the topic was more visible among experts.

When asked whether certain topics received too much attention in the news, a minority of the students (17%) and about half of the experts (53%) responded in an affirmative way. However, when challenged to score the visibility of certain topics, both experts and students rarely gave the score ‘too much attention’, even for the categories ‘marine litter’ (experts 8%, students 5%) and ‘climate change’ (experts 6%, students 9%). One expert mentioned that: *“Overall, I would say there are some topics highly and some other less represented. Over-represented, none (generally speaking there is overflow of information, today, including scientific information).”* With regards to marine litter, another expert stipulated that while plastics and micro-plastics are issues of concern, the communication might be overstating the problem: *“Climate change, Ocean acidification, overfishing, and chemical pollution also deserve a key position in our attention, but the communication (strategy) is not helping very much... just creating panic”.* By contrast, a third expert highlighted that the high visibility of marine litter could help to place other marine issues on the (political) agenda.



An Ocean Literacy event hosted by OGS during the science festival Trieste Next, held in Trieste (Italy) from 25 to 27 September 2020.

Table 1. Visibility of topics – in % of respondents – as perceived over the past five years by 80 experts, by 1,079 17-18 year-old students from the Black Sea region and by 782 students from the rest of Europe. Respondents could select ‘undervalued’, ‘not visible’, ‘visible’, ‘highly visible’ or ‘too much attention’ as possible answers to the multiple-choice question. In the table below we only present the categories ‘highly visible’ and ‘not visible’. Blue indicates high visibility scores (>20% see the topic as ‘highly visible’); yellow indicates low visibility values (>20% consider the topic as ‘not visible’).

TOPIC	EXPERTS		BLACK SEA STUDENTS		NON BLACK SEA STUDENTS	
	Highly visible	Not visible	Highly visible	Not visible	Highly visible	Not visible
Marine litter	40	1	27	14	33	9
Climate change	50	6	18	15	38	4
Biodiversity & ecosystems	24	2	11	19	11	14
Chemical pollution	12	6	22	17	18	10
Fisheries & aquaculture	12	4	12	17	8	15
Offshore Energy	6	14	6	32	3	23
Underwater noise	0	45	6	36	2	32
Marine bio-products	0	27	10	22	2	21

3 What is the current capacity of marine science communication?

The survey on the number of people working on communication and outreach tasks within the respective EMB Member organizations found that there was substantial variability in the efforts made by different organizations in employing communication staff, and that in most cases, the number of dedicated staff does not reach 5% of the total workforce. In general, we are still far from having multidisciplinary teams that can communicate and disseminate research activities and results in an integrated way.

European MARINE BOARD COMMUNICATIONS PANEL

Box 1: The European Marine Board Communications Panel (EMBCP)

The European Marine Board has 35 members from across Europe, representing more than 10,000 scientists and technical staff. Currently, 20 organizations have representatives in the European Marine Board Communications Panel¹⁰ (EMBCP). This panel of experts provides a pan-European platform for marine science communicators to promote and exchange outreach activities in marine science

communication, and to advocate for Ocean Literacy. The EMBCP members meet twice a year to exchange ideas and practices. EMBCP Members contribute to the dissemination of EMB publications, and advise on communication activities to increase the uptake and impact of these publications. The EMBCP Members regularly participate in conferences and events, to promote the importance of communication and Ocean Literacy. In addition, the EMBCP organizes sessions on science communication at events, fora and conferences, and the Members are involved in the communication of different research projects.

The EMB Members were surveyed and asked about the number of staff they employ that formally perform duties in outreach, science communication and education, and about the more specific roles they play (see Annex IV for the survey). We received 23 responses covering about 65% of all EMB Member organizations.

The first and very surprising result from the survey was the difficulty that some of the consulted organizations encountered in gathering the requested information. Sometimes this was due to the lack of a dedicated communications office or someone with a similar role. In other cases, it was due to the type of organization, some of which are consortia and/or universities where the communications capacities are not divided according to disciplines, making it impossible to identify the specific staff working in MSC. Finally, in other institutions the staff devoted to these activities sometimes worked on communications voluntarily, with no coordination or specific roles. This is often related to the fact that MSC activities are not evaluated for career progression in many organizations.

There was also substantial variability in the resource allocation made by different organizations towards communication staff, with numbers ranging from 0.5 to 22 Full-Time Equivalent (FTEs) staff members, and an average of 5.5 FTEs per institution. In order to put these numbers into perspective, we calculated the percentage of staff dedicated to communication tasks in relation to the total number staff in each organization. This provides a better idea of the resources that each organization allocates to communication and outreach. The percentage ranged from 0.1 to 9.3%, with an average of 2.2%. In any case, all scientific organizations knew the importance of having staff dedicated to communication tasks, and all of them make a considerable effort to maintain dedicated personnel, although in most cases it was observed that this percentage did not reach 5% of the total workforce.

In general, 'communications staff' are dedicated to tasks such as managing communications, media relations, public relations, and engagement. There were only eight organizations with in-

¹⁰ <https://www.marineboard.eu/embcpc>



The public engaging in the 2019 GEOMAR open day 'Experience marine research live' in Kiel, Germany.

house personnel dedicated to photography, video, and web design, but sometimes these tasks are outsourced. In general, the organizations with larger staff numbers are the ones that have the capacity to dedicate personnel to these specific tasks related to communications or dissemination. Conversely, the organizations with smaller total staff numbers generally have scientific personnel dedicating part of their time to communication and dissemination activities, sometimes voluntarily.

The EMB Member organizations are still far from having multifaceted communication teams that allow communication and dissemination of research activities in an integrated way. In most cases, the ideal of having teams that are able to carry out the whole process from concept, design of programs, production of audiovisual material, writing press releases, etc. has not been reached. Very often, that puts additional burden on the scientists and on the science communication process at an institutional level.

4 What can we learn for the future and who should have a role in marine science communication?

Over the coming decade, we can expect a growing need for MSC, in line with a general increase in science communication, and with a greater awareness of the need for an Ocean Literate society. In this science communication process, various stakeholders (scientists, policy-makers, industry, communication experts, educators, media) occupy different roles. There are tools available to support science communication, and new technologies to support communications provide interesting prospects. However, there are still challenges to be overcome, including the lack of incentives for scientists to engage in communications due to their many other priorities. The UN Decade of Ocean Science for Sustainable Development (2021-2030) and the EU Mission: Restore our Ocean and Waters by 2030 present a great opportunity to showcase and promote the crucial role of the Ocean for the planet and for human society. Wider collaboration, more training, sufficient funding and a clear strategy are the most important suggestions made by the experts in order to facilitate and improve the MSC process.

4.1 Lessons learnt from daily practice

In the expert survey, we asked the respondents what they had learnt from successful and less successful MSC practices. They emphasized the importance of the following key points (or 'Rules of thumb') that underpin every successful (marine) science communication action. Under each rule of thumb, we give a brief summary from the reactions of the experts, without further comment.

Get to know, connect with, and expand your target audience.

'Connecting with your target audience' is the key message of every communication action. It allows you to tailor your message to your audience and to connect to people's everyday lives with facts, figures, visuals, games, stories, etc. Academic experts, un-supported by communication experts, often struggle to really connect with their audiences and focus instead on sticking to the facts. Scientists aim to be correct while neglecting a deeper interaction with the audience. This might work at an academic level, but with a more diverse audience or with schoolchildren, the communication will probably fail. Academic experts need to be trained in communication and/or coached by communication experts to overcome this issue. Alternatively, they should stick to priority target groups (e.g. policy-makers) and, for instance, co-design activities with schools and the wider public together with communication specialists.

Some of the answers of the experts go deeper into the interaction with the audience: *"Hands-on-experience helps to keep children (even young people) engaged and helps them deepen their learning". "Try to give people an active role in communication actions". "It is important to communicate openly and truthfully (show the facts with references; don't simplify, just explain)." "People need to be triggered; their curiosity needs to be sparked."* *"Keep it simple and understandable; focus on the positive."*

A clear communication strategy ensures success.

Several experts pointed out that outreach events planned without a clear communication strategy have a high chance of failing or missing their intended target. This can lead to insufficient impact compared to the effort needed to produce scientific results. For instance, lacking a clear set of key messages and visuals to underpin policy-oriented research results, will hamper its communication. The 'Keep It Simple and Straightforward (KISS)' principal is important: Clear, simple, and concise messages work well, so keep the narrative simple and understandable for a wide audience. The use of good storytelling and strong visuals (outstanding photography, footage, cartoons, etc.) are the key to success and a gateway to people's emotions and imagination.



an octopus can change the colour of its entire body in just three-tenths of a second, mimicking objects, plants, rocks and sand under the sea

 **Foras na Mara**
Marine Institute www.marine.ie

Credit: Marine Institute, Ireland

Marine Facts – Octopus. The Marine Institute in Ireland developed a series of 52 Marine Facts to raise awareness about the Ocean, including this one about an octopus. The illustrated facts have been used on social media, in online campaigns and at outreach events.

Evaluation is a tool for future progress.

Sometimes campaigns have no prior evaluation of the expected impact, and few or no indicators of either qualitative or quantitative impact after the event. *“Often campaigns (are) not focused on all stakeholders”. “(They show) short term gains with focus on quantitative results.”*

Learn from communication and marketing experts.

In order to create a more Ocean Literate society we need both good science and Ocean ambassadors. Currently, every 'big' scientific project has a communication component. However, some research centres consider these activities merely as 'tick-the-box' tasks rather than a much-needed, genuine marine news and data dissemination effort. The marine research centres need to recognize that subject matter experts may not be the best communicators. They should train scientists and/or involve communication and marketing experts, and share expertise. Basic communication skills among scientists might not be sufficient to help embed science in society. Some scientists may benefit from specialized training, and should learn from best practices and know-how by communication and marketing experts.

Lessons learnt in summary

Based on the experiences of the 80 experts from across Europe that were surveyed, we can derive rules of thumb when setting up a MSC activity:

- Get to know, connect with, and expand your target audience.
- A clear communication strategy ensures success.
- Evaluation is a tool for future progress.
- Learn from communication and marketing experts.

In addition, one should also take into account the following aspects:

- Use active and positive hands-on interaction;
- Keep it simple and underpin your communication with quality visuals and storytelling; and
- Learn both from the interaction with your audience and from other communicators.



Ocean Action Workshop organized by the project "I Live by the Sea", dedicated to youth aged 9-18 years who want to expand their knowledge regarding the Ocean. The aim of these interactive workshops is the establishment of a modern society that operates based on the philosophy of the Sustainable Development Goals.

Suboptimal communication impact arises when scientists are not sufficiently trained in communication skills and/or not supported by communication experts, when there is no communication strategy or impact assessment, and when there is a lack of ambassadors for science.

4.2 Role of various stakeholders

In the process of MSC, various stakeholders (scientists, policy-makers, industry representatives, communication experts, educators and the media) play different roles. It is a complicated process with a lot of potential for positive impact, and few rules. Surveying the 80 European experts on communication processes provided interesting insights into their current and desired roles. Some of the most frequent and/or inspiring statements and quotes (see: *italics*) from the expert survey, are grouped and summarized below according to various perspectives. This is generally a very nuanced discussion and the quotes provided are intended to give an indication of the perspectives held by people working in the field. They should not be seen as concrete recommendations based solely on individual quotes.

4.2.1 Scientists

KEY SOURCE OF KNOWLEDGE! TO TAKE A POSITION OR NOT?

All experts agreed that scientists should play a key role as a source of knowledge and informed opinion. Some of these scientists like to share their fascination and translate new research results into a language that is understandable to a larger public (including policy-makers) without losing the scientific accuracy of the communication (oversimplification). However, there was disagreement on which role they should have in the public discussion. One expert stated that scientists should behave as ambassadors as they *"have a 'social obligation' to transmit the results of their work to society"*. Another expert added: *"They should be active on social media reporting on their activities as in the opinion of most people they have a very interesting job"*. However, experts differed in opinion on whether scientists should take a position or not in the public debate. Some felt that researchers *"do need to take a more direct role in the public discussion, being more proactive in sharing their knowledge and in explaining science. They should regain the space that is occupied by NGOs and be proactive in communication policies and practices"*. This statement seems to imply that some experts see scientists as a more trustworthy and impartial source of information compared to NGOs. Others had the opinion that *"scientists should stick to their traditional role and not become advocates of certain topics or issues"* (a role that NGOs for instance can take up). Another statement by one of the respondents was *"scientists provide objective information, data, results and recommendations, and therefore, do not usually take a stand unless the data is clear"*.



Credit: Cushla Dromgoor-Regan

The Marine Institute's Explorers Education Programme in Ireland, provides primary school classes with Seashore Safari's - a fieldtrip to the seashore to learn about marine animals. To accommodate online learning, the Explorers Programme developed a series of short films about the seashore, activities, and workbooks for teachers to use in the classroom.

SCIENTISTS WHO WANT TO ENGAGE IN PUBLIC DISCUSSION NEED TRAINING AND SHOULD HAVE TIME ALLOCATED TO SPEND ON COMMUNICATION

All scientists – as well as science management – would benefit from some basic training in public outreach and communication. Those who want to fully engage in public discourse need enough time to invest in communication and training, including on how to collaborate with graphic designers, film-makers, storytellers, etc. *“Not all scientists have the public relations skills to be able to communicate their latest findings to the wider public in an understandable manner”*. And, *“marine scientists living in the 21st century need to be trained in Ocean outreach and Ocean Literacy methods. This should be part of the educational system at universities, as well as part of the daily tasks of scientists. At an institutional level, Ocean Literacy activities should be part of the overall communication effort of an institution, and should be available both at the institution, as well as at schools (e.g. training teachers)”*. *“Scientists should have the time to do this on a regular basis”*.

INTERACTION WITH COMMUNICATION EXPERTS

The general perception of experts is that: *“Scientists play a key role as experts in the field but need help from communication experts”*, especially when training and time to work on communication are not available. In other words, *“scientists provide the knowledge, facts, and information and ensure these are accurately portrayed in the communication process”*. In turn, communication experts ensure the attractiveness of the messages, while keeping an eye on the scientific rigor. They have expertise in graphic design, film making, story-telling etc., or know how to cooperate with experts having those skills. One respondent stated that: *“scientists can learn how to communicate effectively with the public themselves or provide robust scientific information and concerns to a communication expert, who can then communicate these effectively to the public”*. According to another respondent, it helps *“when scientists are trained in communication, and when communicators are scientifically trained”*. There was also a plea for a timely interaction: *“researchers need to notify their communication departments on time about potentially good content and activities, so that these can be communicated effectively”*. Finally, one expert added: *“scientists should also be in contact with educational centres to be able to interact with children and adolescents. This should be done through the appropriate channels, with assistance from communicators able to convey the message adapted to the capacity and interests of the children and adolescents they are addressing”*.

4.2.2 Policy-makers

KEY ROLE IN IMPLEMENTING SCIENTIFIC RESULTS

All experts agreed that policy-makers have a key role in implementing scientific outputs and in connecting society with the science. According to the respondents, policy-makers can for instance *“help to manage our sustainable use of the marine environment by facilitating communication and consultation, regulation and planning”*, and by *“acting as intermediates to bring relevant educational actors together”* (e.g. in order to include Ocean knowledge in primary and secondary school curricula). One respondent added that *“they [the policy-makers] should also provide funding to both research, communication and education”*.

INTERACTION WITH SCIENTISTS

The multifaceted interaction between policy-makers and researchers goes both ways, with both the policy-makers and the scientists having a responsibility to engage. These are some statements from respondents on the interaction between policy-makers and scientists: *“Policy-makers should rely more on expert knowledge and use scientific evidence to design policies and draft legislation. The level of implementation of this evidence highly depends on the way scientists and policy-makers communicate with each other”*. *“Policy-makers should actively involve scientists by telling them what scientific knowledge they need in order to avoid a mismatch between the scientific supply and the political demand”*. *“Science should be part of public policies, and science-diplomacy should be a curricular skill for both scientists and policy-makers”*.

4.2.3 Industry representatives

DIVERSE POTENTIAL RESPONSIBILITIES

The surveyed experts mentioned several potential roles for Ocean industry in terms of MSC: *“Industry representatives are both recipients and stakeholders in the MSC process”*. First, *“industry can collaborate with public institutions in the dissemination of marine science”* and its use in education. *“For some specific issues, relevant industry representatives can help shape the debate around policy implementation”*. Second, industry has the practical know-how, and one respondent noted that industry *“communicates with the scientific community in order to develop products useful for society and equipment for scientists”*. Third, within the framework of sustainable Ocean management respondents suggested that *“industry can actively advertise engagement towards sustainable development and innovation”*, and *“communicate what steps they are undertaking in order to mitigate, minimize and finally eliminate these effects”*. Finally, *“industry can play a role in the financial (e.g. sponsorship of media attention) and technical (e.g. hardware, research vessels, etc.) support of scientific activities”*.

STICK TO BUSINESS, RESPECT THE OBJECTIVITY OF SCIENCE

The respondents mainly agreed that industry should only communicate about their business. Some comments went one step further and included that *“industry representatives should be fully aware that by asking scientists for help, they are not contracting them and hence do not own the information, data, results and recommendations scientists will gather and provide to inform them. Scientists should remain objective at all times”*.

4.2.4 Communication experts

CRITICAL IN DETERMINING HOW THE MESSAGE CAN COME ACROSS IN THE BEST WAY

Generally, all respondents agreed that communication experts are key actors in the translation process between scientists, the public and policy-makers. These are some of the quotes made by the experts: *“They [communication experts] translate complex scientific topics into clear, concise, understandable messages to inform the wider public”*; *“communication experts are trained to identify target audiences and the best strategies for engaging and sharing messages”*; *“they know how to support scientists with social media knowledge, how to turn scientists’ work into stories, and how to address the media”*; and *“they look for new ways of communicating and innovate the process of MSC”*.

THEY KNOW HOW TO BUILD STORIES AND HOW TO CREATE IMPACT

Communication experts are trained and have knowledge on how to build stories and generate an impact on the public discussion. With this expertise, they are key players in the process of MSC. This is seen in several quotes made by the respondents of the expert survey: *“Science communicators should be storytellers. They should use entertainment and persuasion while helping scientists to communicate effectively with non-scientific audiences. They should help to build support for science, promote understanding of its wider relevance to society, and encourage more informed decision-making at all levels, from the government to communities to individuals”*. Where possible, they should *“embrace more cross-disciplinary work and more collaborations with policy-makers”*. *“They have an important role and need to balance the attention given to each audience and topic (cf. marine litter)”*. These statements were made under the assumption that communication experts have a sufficiently wide view on society, e.g. *“it helps when they have some background in marine science and marine issues, apart from their communication skills”*.

4.2.5 Educators

EDUCATING THE NEXT GENERATIONS

Educators (i.e., teachers, guides, people working in museums and aquaria, etc.) have an important role in *“communicating information at different levels of the education system”*. *“They form a specific part of the (marine) science communication landscape”*. *“Educators in schools are key to developing scientific curiosity among their students”*. *“By sparking interest among the younger generation, they enhance scientific literacy”*. They are *“a crucial part of upgrading curricula and transforming new scientific insights into teaching materials”*. Marine educators are able to turn young people’s attention to the Ocean and to promote a responsible attitude towards the preservation of the marine environment. *“They offer inspiration and (online) resources for marine science education and organize hands-on activities (including summer-schools and other practical activities in labs and outdoors) for students”*. Educators should try to involve *“scientists to establish direct communication with children and adolescents”*. Cooperation between educators and scientists is highly recommended: *“Working closely with scientists also enables integration of marine science and oceanography into curricula and thus fosters Ocean culture in education”*.



The Director of the Oceanographic Center of Malaga (IEO, Spain), M. Carmen García-Martínez, being interviewed.

4.2.6 Media

A WIN-WIN, WITH A ROOM FOR GROWTH

All respondents were aware of how important the media (both main stream and social) are in terms of having social impact from a marine science perspective. *“The media are very important in communicating marine science. It is an effective way of communicating messages to millions of people worldwide”. “They are the amplifier of MSC work”*. In turn, the media need the scientists in different ways. *“The media need scientists in order to deliver high-quality rigorous products with content”. “They should acknowledge the role of marine science in the societal challenges of today, report on marine scientific breakthroughs, on the importance of marine science in blue policy or economic developments, and contribute to an Ocean Literate population”*. Several experts believed that *“the media are in a position to cover a wider range of marine science topics since so much is of societal interest in one or more ways”*. One expert claimed that *“the media should have journalists specialized in marine science or, at least, more journalists specialized in science*

to transmit the knowledge acquired by the scientific community to society”. Some experts raised the uncomfortable relationship that can arise between scientists and the media, as scientists do not want to speak out without complete evidence while journalists are looking for quick and easy news. One expert claimed that *“the media could be more active in everyday communication, tell more detailed stories instead of looking for sensational or easy news”*. *“Instead of presenting black and white perspectives of impacts or profits, they should contribute to a better understanding of all services provided by the Ocean and seas”*. According to these experts, the media could be more accessible and *“take better care of the scientific credits and accuracy of their products”*.

4.3 Future expectations

From the surveys we have extracted some insights, conclusions, and recommendations on the future expectations of how to create greater impact and visibility in terms of MSC in Europe. Direct answers are in italics and with quotation marks (“”).

4.3.1 More Ocean news

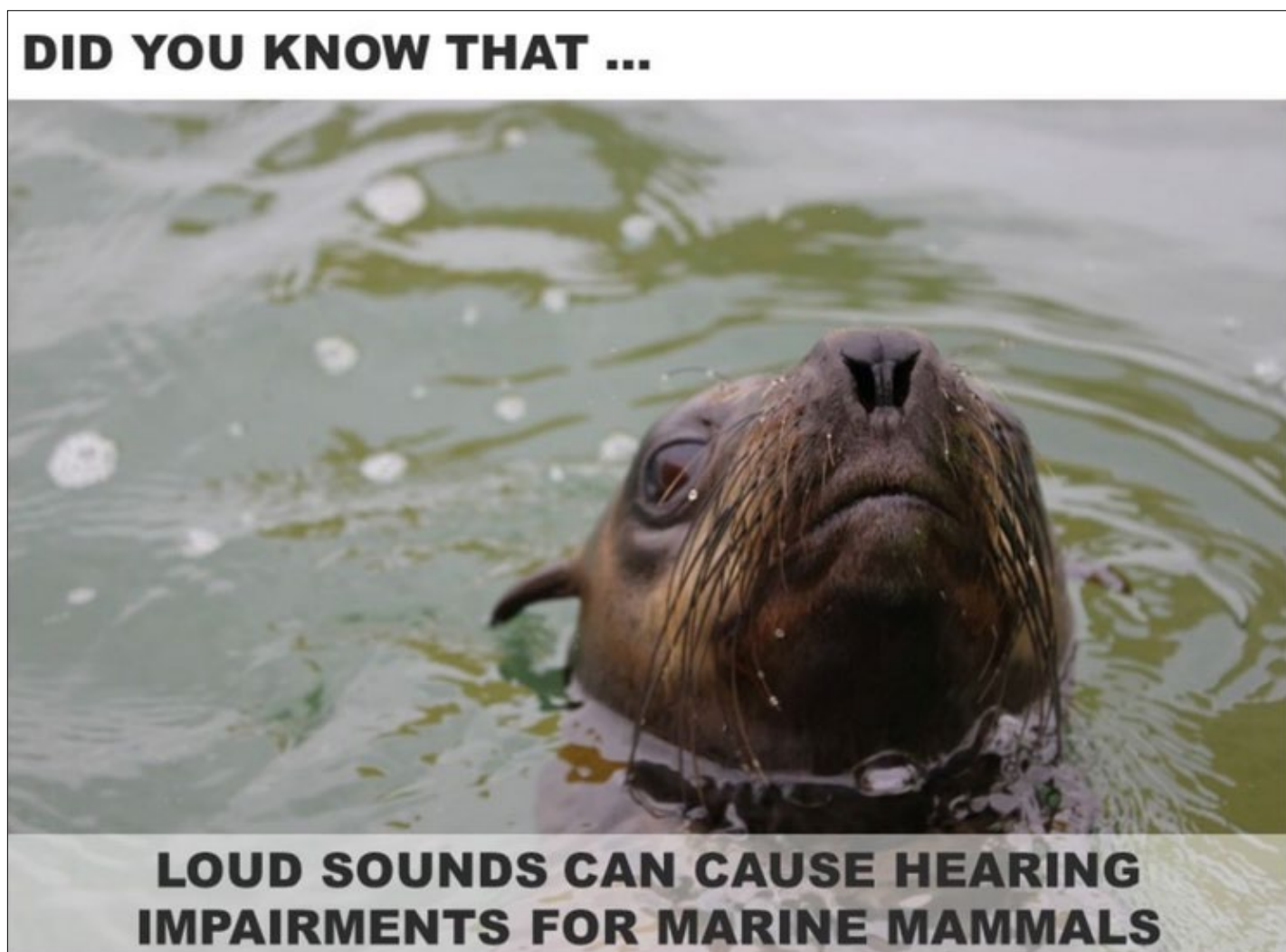
Over half of the experts and students indicated a perception of an increase in Ocean news, in line with a general increase in scientific news. Similar observations emerged during separate questionnaires completed by school students (age 14-18) from Poland, Romania and Germany during different events (Ocean of changes¹¹; I live by the Sea Ocean Action¹² workshops; Ocean@Home Summer School¹³) organized in 2019-2021 by the Institute of Oceanology of the Polish Academy of Sciences (IOPAN) and partners (T. Zielinski, personal communication). Whether this perception of an increase is supported by statistics is hard to verify as social media feeds are curated to the interests of its users using algorithms.

From our student survey, we learnt that young people obtain their Ocean news predominantly from social media, TV and school (see Chapter 2). In a UK DEFRA online survey on Ocean Literacy among 8,440 people over the age of 16 (DEFRA, 2021), the main sources of knowledge about the marine environment were TV or radio (48%), wildlife and nature films (47%) and online news and newspapers (46%). In both the DEFRA and our surveys, family and friends were less important as sources of information. This is in line with the results of the latest Eurobarometer survey, carried

out among 37,103 respondents in 38 countries, in April-May 2021 (Eurobarometer, 2021). The Eurobarometer is a series of public opinion surveys conducted regularly on behalf of the European Commission and other EU Institutions since 1973. These surveys address a wide variety of topical issues relating to the EU throughout its member states. The 2021 survey found that most EU citizens get their information about developments in science and technology from television (63%), followed by online social networks and blogs (29%), or in online and print newspapers (24%).

Both the experts and the students that we surveyed expected that MSC **would** become even more important in the future (experts: 92%; students: 90%). When we asked the students whether they thought MSC **should** become more important, that score was even higher (94%). In other words, there is a need for additional capacity in MSC in order to keep pace with the expected growth in the need and appetite for Ocean news. There is a need for more “*financial resources*”, “*better visuals*”, “*more staff*” and “*secure contracts for career opportunities in MSC and education*”.

The main reasons why experts expect such growth are presented in the sections on the following page.



European Marine Board shares interesting facts linked to its publications on its Instagram account, like this one linked to its underwater noise publication.

¹¹ www.oceanofchanges.com
¹² <https://todaywehave.com>
¹³ www.geomar.be/ocean-at-home

A MORE OCEAN LITERATE SOCIETY

In the UK survey mentioned earlier (DEFRA, 2021), citizens were also asked about the expected outcomes of visits to the marine environment. Improvements in both mental (84%) and physical health (80%) had the highest scores. In both our student survey and in the DEFRA poll, citizens demonstrated mixed emotional responses to the Ocean and seas, with highest scores for ‘concern’ (47% and 49% respectively) and ‘awe/wonder/learn something new’ (40% and 42% respectively). One expert from our survey expressed it in the follow way: *“More and more the public seems to turn their heads towards the Ocean”*. Fuelled by the Ocean Literacy movement, the public realizes that *“the more we need to understand, protect and use wisely marine resources, the more we will need MSC. MSC is important for marine resource management, to make seas and Ocean degradation visible, to promote tools for protecting ecosystems and more. Consequently, it has even greater importance to educate responsible Ocean citizens, positively influence policy-makers in decision-making processes, and to create Ocean-friendly industries”*. The role of engaging with the younger generation was emphasized: *“There is a need to educate young people about the crucial role of the Ocean in our daily life. Without this understanding, one cannot expect citizens to make, support and understand responsible choices in a sustainable transition as part of the European Green Deal”*.

AN OCEAN OF CHALLENGES AND OPPORTUNITIES NEEDS A BALANCED EXPLANATION

The Ocean is facing environmental degradation due to anthropogenic-driven pressures including climate change, pollution, overfishing and biodiversity loss, which affects many aspects of our lives. The surveys demonstrated that marine litter and plastic pollution are considered the most visible ‘Ocean news’, an observation that is confirmed by the DEFRA study, where the highest perceived threat to the marine environment was litter and plastic pollution (74%; DEFRA, 2021).

On the other hand, there is now more activity related to the Blue Economy, highlighting the opportunities the Ocean provides. *“Future conflicts between the use of marine resources and marine protection will require solutions that need to be explained by experts and can be understood by non-specialists”*. *“It makes an increase in the generation of content for scientific dissemination and specialized communication essential”*. In addition, there are many positive drivers when dealing with MSC and sharing Ocean news with the wider public. Most people regard the Ocean as an inviting place.

The public values the Ocean and seas, and is open to the wide spectrum of visually attractive scientific news derived from that blue realm. Moreover, Ocean science is curiosity-driven and for many the Ocean can be associated with good health and other positive feelings (H2020 SOPHIE Consortium, 2020). On top of that, the experts and students who were polled did not consider MSC as more challenging than communication in other fields of science (although working in this vast and mostly invisible environment is sometimes quite challenging).

INCREASE IN SCIENCE COMMUNICATION IN GENERAL

Both the experts and the students we surveyed expected MSC to become even more important in the future (92% experts, 90% students). This is in line with the growth in science news in general that we could expect thanks to the possibilities provided by the internet, social media, and better visualization tools. Human beings are social creatures, for whom communication is essential. Some related statements from the experts include: *“All types of science communication will become more important as modern democratic societies want to know more about our Ocean, climate change, biodiversity, pandemics, bio-materials etc.”* *“The broad avalanche of scientific knowledge, and its restyling for public consumption in many guises, is important to mitigate the devastation of a post-truth world”*, a world in which people are more likely to accept an argument based on their emotions and beliefs, rather than one based on facts. In Flanders (Belgium), according to the 2021 Science Barometer¹⁴ trust in scientists increased by 18% during the COVID-19 crisis. Almost two out of five Flemish citizens said that they appreciate the role of science in society more than before the pandemic. This resonates with the results from the latest Eurobarometer survey on ‘European citizens’ knowledge and attitudes towards science and technology’ (Eurobarometer, 2021). It showed that 86% of EU citizens think that the overall influence of science and technology is positive, and reveals a high level of interest in science and technology (82%) and a desire amongst citizens to learn more about it (54%). In many areas, EU citizens’ interest in, expectations of, and engagement with science and technology have grown in recent years. EU citizens have a positive view of scientists and their defining characteristics, such as intelligence (89%), reliability (68%) and being collaborative (66%). More than two thirds (68%) believe that scientists should intervene in political debates to ensure that decisions take scientific evidence into account. This gives hope that support for marine scientists will increase, both politically and financially.

4.3.2 Intuitively attractive, but lagging behind and often linked to scary news: how to change the messaging?

Despite Ocean Literacy efforts to bring Ocean science into the spotlight, almost half of the students (45%) and 38% of the experts thought that marine science news, although growing, still lag behind the growth in other scientific news. This is perhaps due to its typically ‘pessimistic’ nature. The main reason why Ocean news captured the attention of the 1,861 students across Europe was *“because it was scary and it made them worry for the future”* (47% of students). This is in line with the results of the DEFRA poll of UK citizens (DEFRA, 2021), which showed that ‘concern’ was the most important emotional response to marine news. Instead of stimulating the fascination and exploration for the Ocean realm, Ocean communications very often focus on topics that have a negative angle (e.g. marine litter, climate change). When students follow the news via their favourite media (i.e. social media, other digital media, television, school), those threats are the topics they see and connect with the Ocean. This is a consequence of the natural bias towards threatening news rather than towards things that are going well. It evokes greater physiological arousal from us

¹⁴ <https://www.ewi-vlaanderen.be/wetenschapsbarometer>



The annual international science festival 'Pint of Science' invites scientists to a bar to inform interested citizens about the latest news from the world of science, such as this 2019 event in Ostend, Belgium.

and our brains are wired to pay more attention to unpleasant news (called the 'negative bias'; see (Vaish *et al.*, 2008)). What is attractive for the public is what the media will work with. Some people argue that knowledge on solutions to environmental issues, rather than knowledge on causes and implications, may be a stronger motivation for pro-environmental behaviour (Jefferson *et al.*, 2021; Kolandai-Matchett, Armoudian, Thrush, *et al.*, 2021). Consequently, any communication on Ocean issues should provide the scientific facts, but preferably add possible solutions for the problem that is raised, rather than stick to that negative news only. Otherwise this can provoke a 'freeze' response, where the reader is terrified, feels sad and powerless, or personally guilty which can provoke anger, denial or avoidance. It is a challenge to achieve a balance between encouraging people to take personal responsibility via small actions and making them feel guilty for things that are far out of their control and need to be addressed at a much higher policy level.

4.3.3 Structures, conditions and incentives in place?

Half of the experts thought that the structures, conditions and incentives are already in place to have a growing MSC community in the future, meaning that the other half feels this is not the case, and they provided a variety of reasons for this.

COMMUNICATION TOOLS ARE THERE, PRIORITY IS STILL MISSING TO SOME EXTENT

Overall, in most countries, experts indicated that the structures and tools for a variety of MSC exist and work well. According to some of the experts, the sense of priority, where it comes to investments in science communication, outreach and education, is still partly lacking. Scientists are expected to publish scientific publications, and often are not stimulated to spend time on giving lectures, writing articles and/or organizing events for non-scientific audiences. Some experts suggested *"there could be more time within mainstream media"* and *"more support from politicians and decision-makers for science communication"*. One expert pointed out that *"there are not enough scientists aware that it is important that their research leaves their institutes and continues spreading. More 'traditional' marine scientists are primarily focused on the hard science of the Ocean. The only scientific output that they consider valuable is getting their results published in peer-reviewed academic journals and not communication activities"*. Some of the answers from experts on the question of whether there will be sufficient incentives for marine scientists to engage more in MSC in the future are: *"They [the scientists] see 'communication' as something less 'serious', designed to entertain rather than educate"*. *"Education and incentives for scientists are needed so they can convey the*

results of their work in ways that the public will understand and appreciate and that governments will recognize and take action on". "Communication to the public should not be an add-on to science and scientists should not feel punished if they communicate 'instead' of doing real science". An "institutional culture that stimulates science communication" is crucial, as is the enhancement of the role of science communication in non-scientific papers within career progression. On the other hand, another expert mentioned that "marine science institutions are increasingly aware of the importance of science communication and the media seem to pick up Ocean-related items quite well". They also stated that: "This evolution towards a higher priority for communication among young marine scientists caused many of them to have supported initiatives in the field of MSC and outreach".

MORE NEEDS, MORE FUNDING

Several experts indicated that the need for MSC experts is growing, and therefore more specific funding and a dedicated workforce are needed to meet future needs. For scientists, "science communication is often at the expense of their research or teaching activities". "Communication, especially scientific dissemination, is not free and communication and marketing experts are needed". In addition, in several marine organizations, there are a limited number of staff dealing with communication, education and outreach. In our survey of EMB Member organizations, the relative number of FTEs working on MSC was generally below 5% of the total workforce (0.1-9.3%; mean: 2.1%; median: 1.4%). With an expected growth in Ocean news, there seems to be a need for more (science) communication capacity in the departments of scientific institutions and universities.

JOINING FORCES, AGREEING UPON A GENERAL BASELINE

The complicated and multifaceted process of MSC requires that all stakeholders join forces and agree upon an overarching framework

(i.e. answering the question: 'Why do we need marine science and MSC?'). That 'WHY' is a crucial part of any inspirational leadership (cf. Simon Sinek's 'Golden Circle'¹⁵). Probably the most inclusive message for MSC today is the one shaping the international Ocean Literacy movement. It states that: "Knowing and understanding the Ocean's influence on us, and our influence on the Ocean is crucial to living and acting sustainably. By sharing the world's Ocean knowledge, we are committed to building a global Ocean movement to protect the planet on which we live"¹⁶. This two-way interaction, underpinned by scientific research, takes into account the desire to use the opportunities offered by the Ocean, while facing the challenges of making it happen in a sustainable way. This is a useful concept and motive for MSC. It has strong links with the concept of sustainability and with the 17 Sustainable Development Goals (SDGs), as stipulated by the 2030 Agenda for Sustainable Development¹⁷, adopted by the United Nations in 2015. Both the EU Mission: Restore our Ocean and Waters by 2030¹⁸ and the Ocean Decade can play a key role in implementing this global MSC baseline.

Some experts perceived "a shortage of global initiatives" and/or saw "MSC occurring sometimes in isolation". Most institutions do have a communication strategy and the experts suggested that "institutions must create communication plans for MSC (short, medium and long-term). These plans need to include a stable budget, an increase in human resources with training in communication, key messages and topics identified". The plans need to start from a positive, open and truthful attitude ("it is important to communicate openly and truthfully"). Some experts saw little progress nationally, experiencing "a lack of (seed) money and a lack of initiatives (including funding)". The fact that "Ocean observation and research are scattered across many government departments (in comparison with e.g. meteorology which is supported by one weather department per country) makes coordination difficult and it is therefore hard to come up with clear messages".



Exhibition "Future Ocean" at German Unity Day, Dresden, 2016.

¹⁵ <https://simonsinek.com/commit/the-golden-circle>

¹⁶ <https://oceanliteracy.unesco.org>

¹⁷ <https://sdgs.un.org/2030agenda>

¹⁸ https://ec.europa.eu/info/research-and-innovation/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/eu-missions-horizon-europe/healthy-oceans-seas-coastal-and-inland-waters_en

4.3.4 New technologies

Technology is playing an increasingly significant role in society, and thus also in MSC. However, there was a clear difference in how the (young) students and (older) experts surveyed looked at new technologies, such as new media, visualization techniques, etc. Most students (86%) saw new opportunities in the way innovative technology can help shape Ocean news. However, only half of the experts (51%) shared that view. Expert opinions include those presented below.

NEW TECHNOLOGIES DO NOT AUTOMATICALLY REPLACE SUCCESSFUL TRADITIONAL METHODS

Several experts pointed out that MSC does not necessarily need new technologies. There are many tools available, with some already having a proven impact and relevance (e.g. hands-on approaches, storytelling, visuals/images/infographics). Some experts pointed to the fact that *“no computer or software will automatically replace that”*. *“If you can't tell the story, then some magic technology will not solve the problem”*. On the other hand, it is clear that new technologies (e.g. apps, games, online platforms) can assist with enhancing these traditional methods. *“Technologies and tools are a way to reach the general public, but sometimes it works better the other way around: master the technology or tool the public prefers and spread your messages accordingly”*. Moreover, *“still a lot of experts active in MSC are not able to fully make use of these techniques, so training might be appropriate (e.g. in film editing, graphics, social media)”*.

Technical and other tools function together with the emotional experience that originates from learning about the Ocean and its living organisms. These merging feelings stimulate curiosity and hunger for knowledge, together with physical and mental participation with our five senses, thus resulting in active engagement. Filling the gap with the appropriate tools might include not only good communication, but also a more pragmatic and open approach. This is a field of social science that should be included in marine science communication (McKinley *et al.*, 2020).

AN EVEN MORE IMPORTANT ROLE OF VISUALIZATION IS TO BE EXPECTED

It is expected that visualization (footage, photography, Virtual and Augmented Reality, etc.) and mass media (e.g. social media, virtual formats, press) will continue to play an important role. MSC should invest in better use of these tools. Visualization will continue to constitute an important element of MSC to make the invisible visible. Experts in our survey pointed to *“quality footage, cheap and better cameras, aerial and marine drones or robotics, virtual and augmented reality and other technologies (e.g. sensors) in allowing smart observations (i.e. for exploring the Ocean twilight zone) dramatically changing and improving MSC”*.

TECHNOLOGY AS A DRIVER FOR A GREATER INTERACTION BETWEEN SCIENTISTS AND OTHER STAKEHOLDERS

The COVID-19 pandemic has massively increased the use of online communication tools. New technologies, including artificial intelligence and big data (Guidi *et al.*, 2020), allow citizens to contribute actively to marine science ('citizen science'; (Garcia Soto *et al.*, 2017)). Furthermore, it is believed that *“a still better internet connection (e.g. Starlink satellite system¹⁹, providing low latency communication and coverage around the globe and the Ocean), together with improved connections on ships and better imaging technologies, could help”* to make the invisible visible.

4.3.5 What can we expect from the 'UN Decade of Ocean Science for Sustainable Development' in terms of MSC?

Experts foresaw untapped opportunities on the horizon which the Ocean Literacy community should take advantage of. Actions should be conducted in the context of the Ocean Decade, as well as other ongoing and new challenges and opportunities at sea (e.g. Blue Economy).

It has been specifically stated that the Ocean Decade is embracing a participative and transformative process, bringing together scientists, policy-makers, managers, and service users to deliver the Ocean science required for a sustainable Ocean. The UNESCO website states that *“scientists, policy makers, managers, and service users can work together to ensure that Ocean science delivers greater benefits for both the Ocean ecosystem and for society. This Decade will be designed to facilitate global communication and mutual learning across research and stakeholder communities. It will work to meet the needs of scientists, policy makers, industry, civil society and the wider public, but it will also support new, collaborative partnerships that can deliver more effective science-based management of our Ocean space and resources.”²⁰* Furthermore, it is expected that the Ocean Decade will promote more targeted and effective information flow as well as innovative ways of conducting and using Ocean science.

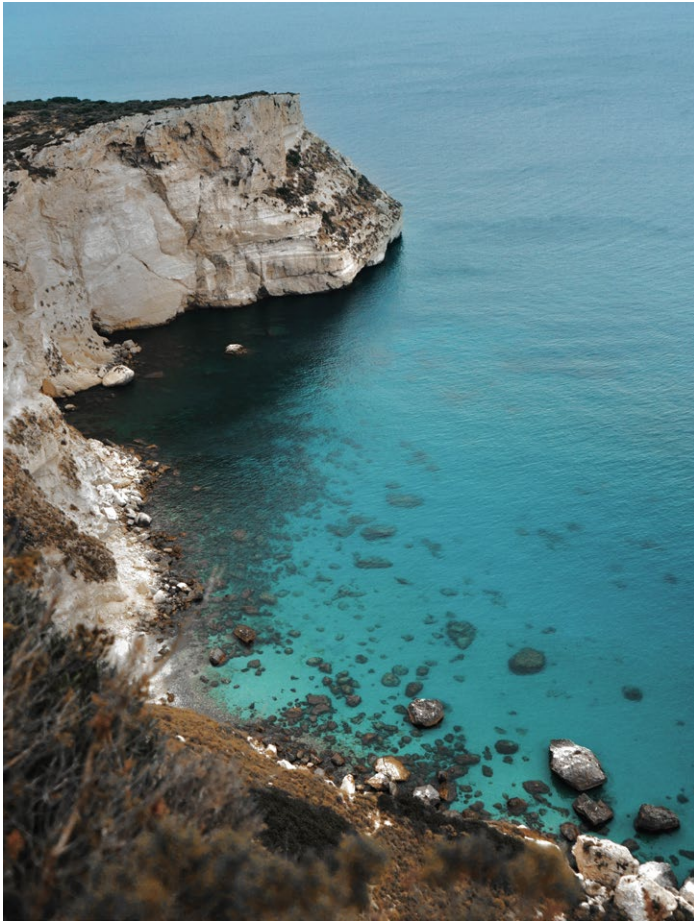
Some 16% of all the students we surveyed had already heard about the Ocean Decade, although the survey was conducted months before the full communication on the Ocean Decade started. This figure is expected to increase, stimulated by actions taken in schools within the context of the Ocean Decade. When the experts were asked what impact they expected from the Ocean Decade, the majority (79%) thought that there would be more networking, more resources (staff, financial stimuli), more tools, and more opportunities to share knowledge. The main reasons for that are presented below.

THE POWER OF COORDINATED ACTIONS

The Ocean Decade is a major international effort, *“collecting all information and events in one place”*. There has never been such a transdisciplinary Ocean-specific decade before and hence, *“it is a unique opportunity”*. Usually, UN campaigns *“attract the attention of media, policy-makers, schools, universities and companies, so this is an opportunity to foster the importance of communication*

¹⁹ <https://en.wikipedia.org/wiki/Starlink>

²⁰ <https://en.unesco.org/ocean-decade/about>



Credit: Surmeon-Elizagola, Pexels

An aerial image of a cliff in Sardinia, Italy, taken using a drone.

about Ocean issues”. *“This highly relevant initiative could, as used to be the case with other large activities of the Intergovernmental Oceanographic Commission (IOC), catalyze Ocean Literacy activities and create many opportunities to inform the public at large and to let them participate or ‘experience’ Ocean science”*. However, the Ocean Decade is voluntary and there will only be a significant impact if marine science communicators use this opportunity. Therefore, *“marine science communicators should communicate as much as possible under this umbrella (refer to it) and/or create one large platform feeding into it (e.g. using hashtags, a dedicated website/platform)”*. One expert also pointed at *“other international efforts with similar roles and goals such as the EU Mission Ocean”*. Similar messages also arose during the 8th EMB Forum on Supporting the Ocean Decade in Europe, which took place on 1 December 2021 (European Marine Board, 2022).

IT IS TIME TO PUSH MARINE AGENDAS

People are now more aware of topics of Ocean sustainability. *“The Ocean Decade will help push the marine agenda with media and policy-makers. It supports efforts to reverse the cycle of decline in Ocean health and gather Ocean stakeholders worldwide”*. Behind this common framework, *“it will ensure that Ocean science can fully support countries in creating improved conditions for sustainable development of the Ocean”*. In addition, *“there will be an increase in scientific activities, more resources and networks, more tools, and hopefully more funding”*.

4.3.6 How to get prepared

We asked the experts how MSC professionals should prepare for the future, in terms of sharing Ocean science effectively with a wider audience, and which recommendations they have for development.

A BROADER AND DEEPER COLLABORATION AND INTERACTION AMONG THE STAKEHOLDERS OF MSC

All the experts we surveyed called for more collaboration among the different stakeholders, each with their own specific role and responsibility, and with mutual respect.

Many experts pointed out that there is *“the need for more collaboration among a wide range of stakeholders to achieve the full dimensions of MSC”*. They suggested *“a coordinated approach across institutions and an integrated and joint effort of communication experts, scientists, policy-makers, industry and educators”*. That coordinated effort, *“creating an ‘ecosystem’ of scientists, will attract the attention of the wider public”* and *“provide more visibility through high impact events and connectivity”*. Some players deserve special attention in deepening that collaboration. Scientists, for instance, need to work more with the media and need to better understand the audience, while preparing good stories, supported by video or photo material. *“Alliances with the media”* could also include journalists accompanying scientists while working on a project.

It was suggested by respondents that MSC experts should look for connections with other science communicators and communicators in other domains. *“An open source news agency/news platform could be helpful”*, as well as workshops where marine science communicators develop strategies and share ideas in teams, rather than working on actions as individuals. This networking could have a positive impact on sharing information and on reaching wider audiences. *“Social scientists and policy-makers should also be included in this process”* as they can help to investigate and find the best way to encourage the public to pay attention to a certain topic.

The audience for marine science communications should be *“as wide as possible, using appropriate communication channels (traditional and new technologies) to reach as many people as possible”*. *“By getting insight into how science news is reaching (or not reaching) different target groups and by finding strategies to overcome the groups that are missed, younger as well as older generations can be reached with science communication”*. *“Investing in young generations”*, as well as *“talking to local communities”* and exploring the *“science-industry environment”*, is important. A good understanding of each specific audience is essential, *“recognizing the audience profiles, focused messages and appropriate language”*. ‘Ocean messages’ need to have a ‘what’s in it for me’ component and *“touch the target audiences at a visceral level in order to empower them to take actions that are within their capability”*.

Although we did not ask the experts how they would create that enhanced cooperation among the different stakeholders, we can easily imagine some ways forward. One way would be to ride the wave of the Ocean Decade and its ‘Generation Ocean’ campaign²¹, and to share knowledge via the Ocean Decade Stakeholder Forum²². This could be a driving force in shaping a network of

²¹ <https://ioc.unesco.org/news/welcome-generation-ocean-new-global-movement-grow-awareness-and-drive-action-protect-ocean>

²² <https://www.oceandecade.org/sign-up/>



A marine picture book created by kindergarden children in Croatia.

Ocean communications networks using the power of existing partnerships. Many smaller marine institutions and organizations do not have press capacity or a communications plan, and could benefit from interaction with experienced communications teams and stakeholder groups elsewhere (IOC, 2021).

It makes sense to also ensure that more project proposals within new research calls demonstrate a pre-planned communication and implementation strategy with end-users. The communication should consider the various audiences and interactions in order to achieve maximum impact and reach as many groups as possible. Furthermore, there is a growing need for events where relevant stakeholders (i.e. scientists, policy-makers, industry, and citizens) convene and share content, aided by communication experts. CommoOCEAN conference series²³ (Box 2) is a good venue to make that happen, with sessions stimulating interaction with marketing experts and science communicators from fields other than oceanography for instance.

TRAINING, TRAINING, TRAINING

As noted before, there is a clear need for professional training programs in communication and outreach, with relevant curricula,

including (developments in) new technologies and tools (e.g. social media, visualization, presentation). This should be the case for both marine scientists and other stakeholders within the process, such as communicators and staff at the management decision-making level. Science communicators should have a background in Ocean science, while researchers need training and toolkits on how to work with the media, and on how to develop and use key messaging, framing strategy, storytelling, images and simple digital assets (Kolandai-Matchett, Armoudian, & Thrush, 2021; Kolandai-Matchett *et al.*, 2021). For marine communication to take the next step, it requires both the training of science communicators and of scientists.

Other suggestions made by experts were: “*Summer schools for marine science communicators*”; “*a true service point with trained marine science communicators giving advice, training and guiding both junior and senior marine scientists and marine science communicators*”; and “*media grants or other funding of specific professional development programs aimed at preparing communicators with the needed knowledge*”.

²³ <https://commocean.org/>



Credit: Cushla Dromgool-Regan

The Explorers Education Outreach team provide Continued Professional Development training to primary school teachers in Ireland, including on marine topics and resources. The Explorers Education Programme is funded by Ireland’s Marine Institute.



Box 2: CommOCEAN – the international marine science communication conference

The CommOCEAN conferences²⁴ started in 2014, arising from a need among marine science communicators to share expertise beyond the small EMBCP group meetings. Since then, CommOCEAN has evolved into the main international marine science communication event, building knowledge, and educating both marine scientists and communicators side-by-side. The first edition took place in Porto in 2014 (under the name IMSCC²⁵). Later editions followed in Bruges (2016), Southampton (2018) and Sopot (2020: online). The 2022 edition will take place at Sète (France) and online.

²⁴ <https://commocean.org/>

²⁵ <https://noticias.up.pt/ciimar-reune-especialistas-internacionais-em-comunicacao-de-ciencia/>

5 Recommendations & key actions

Based on the outcomes of three surveys (80 experts, 1,861 students, 23 EMB organizations) and in response to an expected rise in the need for marine science communication (MSC), we recommend strengthening MSC activities in Europe.

Society requires a higher sense of priority among researchers and research institutes to invest in MSC and more balance in terms of how the news is delivered (i.e. solutions and threats). A coordinated approach and a global strategy are needed to deepen and widen the interaction among different stakeholders in the process of MSC. The UN Decade of Ocean Science for Sustainable Development and the EU Mission: Restore our Ocean and Waters by 2030 can help to make this happen. Finally, more dedicated science communication capacity is needed, as well as a platform for sharing expertise and dedicated training programs that make use of new technologies and approaches, in conjunction with more traditional methods.

Following on from the three surveys and from the suggestions made by survey respondents, we make the following recommendations:

1. Marine Science Communication should not hide facts, but should avoid only presenting the '**negative bias**' in Ocean news. It should also show the opportunities, and when possible, the positive side of a story. For instance, by focusing on solutions to environmental issues (marine litter, climate change, etc.), instead of just presenting the problems. In addition, the very high visibility of certain Ocean related issues should be used as an opportunity to share other news about the Ocean.
2. Marine science institutions and funders should change their culture in order to **stimulate, acknowledge, and value science communication**. Although a scientist's first priority should be to do research and communicate their science to other scientists, they should also be trained in science communication, thereby equipping them with the skills to communicate their research and pass 'simple concepts' on to non-specialists.
3. Marine science communicators are well-positioned to act as ambassadors of Ocean science. In addition to the interaction they have with their peers, with marine scientists and with the media, they should look for **connections with science communicators from fields outside marine science**, and with **communicators in non-scientific domains** (e.g. marketing). Where possible, communication experts should increase interaction with all stakeholders (scientists, citizens, media, aquaria and science centres, students, policy-makers, industry, and educators) in the MSC process.
4. Many smaller marine institutions and organizations have no press capacity or communications plan, and could benefit from interaction with more experienced communications teams and stakeholder groups elsewhere. It would be useful to develop a **platform or database for sharing expertise and resources** with regard to marine science communication experiences.

5. There is a need for **additional funding and human resources** in order to cope with future MSC needs. In several marine scientific institutions, there are at present no dedicated personnel or only a limited number of staff dealing with communication, education and outreach. EMBCP recommends that marine science institutions aspire to dedicate at least **10% of their staff time** to MSC. This can include both staff dedicated to MSC and/or time spent on MSC by scientists and other staff.
6. Marine science communicators should make better use of **new technologies and approaches** to reach the wider public, including innovative visualization (e.g. mixed reality, apps, drone imagery, games), mass media techniques, artificial intelligence, big data and citizen science in order to **enhance successful traditional methods** (e.g. story-telling, hands-on activities, arts, visuals), 'to make the invisible visible', to stimulate curiosity and hunger for knowledge, and to actively connect with a wider audience. Training staff in the use of these tools and providing a platform to present lessons learnt ('what works for what type of engagement') and hands-on experience on how to use them would be very useful (see also recommendation 4).
7. There is a clear need for professional **training** programs, workshops and events (e.g. the CommOCEAN conferences) in communication and outreach, both for marine scientists and for other stakeholders within the process of MSC. It is recommended that structural means for supporting the continuation of these conferences is sought, possibly in partnership with the European Commission.
8. Marine science communicators should communicate as much as possible under the umbrella of the **UN Decade of Ocean Science for Sustainable Development** and of the **EU Mission: Restore our Ocean and waters by 2030**, both unique opportunities to enhance MSC. An evaluation by the conveners of those efforts should be made in order to learn from their experiences and to be prepared to underpin similar future actions.
9. It is timely to agree among the communication community on a **general communication baseline** for marine science, emphasizing the 'Why' of Ocean science and MSC. For this purpose, we recommend adopting the existing and inclusive rationale shaping the international Ocean Literacy movement. It is a two-way societal interaction, underpinned by scientific research, taking into account the willingness to understand and use the opportunities provided by the Ocean, while meeting the challenges of doing that in a sustainable way. This **Ocean Literacy** baseline has strong links with the SDGs stipulated by the 2030 Agenda for Sustainable Development, adopted by the UN in 2015. Both the EU Mission: Restore our Ocean and Waters by 2030 and the UN Decade of Ocean Science for Sustainable Development (Generation Ocean campaign) can play a role in providing a context and implementing this MSC baseline.

References

- DEFRA. (2021). Ocean Literacy in England and Wales. In *Headline Findings Report*.
- Eurobarometer. (2021). European citizens' knowledge and attitudes towards science and technology. In 237 / 516.
- European Marine Board. (2022). Supporting the Ocean Decade in Europe. In P. Kellett, R. van den Brand, B. Alexander, A. R. Perez, Á. Muñiz Piniella, J. Van Elslander, & S. J. J. Heymans (Eds.), *8th EMB Forum Proceedings*. <https://doi.org/10.5281/zenodo.5814763>
- Garcia Soto, C., der Meeren, G. I. van, Busch, J. A., Delany, J., Domegan, C., Dubsy, K., ... Zielinski, O. (2017). Advancing Citizen Science for Coastal and Ocean Research. In V. French, P. Kellett, J. Delany, & N. McDonough (Eds.), *EMB Position Paper 23*. Ostend, Belgium.
- Guidi, L., Fernandez Guerra, A., Canchaya, C., Curry, E., Fogliani, F., Irisson, J.-O., Malde, K., Marshall, C. T., Obst, M., Ribeiro, R. P., Tjiputra, J., Bakker, D. C. (2020). Big Data in Marine Science. In S. J. J. Heymans, B. Alexander, Á. Muñiz Piniella, P. Kellett, & J. Coopman (Eds.), *EMB Future Science Brief 6*. <https://doi.org/10.5281/zenodo.3755793>
- H2020 SOPHIE Consortium. (2020). *A Strategic Research Agenda for Oceans and Human Health*. <https://doi.org/10.5281/zenodo.3696561>
- IOC. (2021). Advisory Report on the Communication Strategy for the Ocean Decade. In *IOC/2021/ODS/25*.
- Jefferson, R., McKinley, E., Griffin, H., Nimmo, A., & Fletcher, S. (2021). Public Perceptions of the Ocean: Lessons for Marine Conservation From a Global Research Review. *Frontiers in Marine Science*. <https://doi.org/10.3389/fmars.2021.711245>
- Kolandai-Matchett, K., Armoudian, M., & Thrush, S. (2021). Communicating complex marine science: Does media format matter? *Aquatic Conservation: Marine and Freshwater Ecosystems*, 31(7), 1772–1790. <https://doi.org/10.1002/aqc.3560>
- Kolandai-Matchett, K., Armoudian, M., Thrush, S., Hillman, J., Schwendenmann, L., Jakobsson, J. *et al.* (2021). Marine ecosystem science and the media: Exploring ways to improve news coverage through journalist–scientist working relations. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 31(11), 3034–3055. <https://doi.org/10.1002/aqc.3708>
- McKinley, E., Acott, T., & Yates, K. L. (2020). Marine social sciences: Looking towards a sustainable future. *Environmental Science & Policy*, 108, 85–92. <https://doi.org/10.1016/j.envsci.2020.03.015>
- Tetra Pak. (2019). *Consumer Environmental Trends Report 2019*.
- Vaish, A., Grossmann, T., & Woodward, A. (2008). Not all emotions are created equal: The negativity bias in social-emotional development. *Psychological Bulletin*, 134(3), 383–403. <https://doi.org/10.1037/0033-2909.134.3.383>

List of abbreviations and acronyms

BS	Black Sea
CIIMAR	Centro Interdisciplinar de Investigação Marinha e Ambiental
CommOCEAN	International marine science communication conference
CoNISMA	Consorzio Nazionale Interuniversitario per le Scienze del Mare
CPD	Continuous Professional Development
DEFRA	Department for Environment, Food and Rural Affairs
EMB	European Marine Board
EMBCP	European Marine Board Communications Panel
EMSEA	European Marine Science Education Association
EU	European Union
FTE	Full Time Equivalent
GEOMAR	Helmholtz-Zentrum für Ozeanforschung
HI	Havforskningsinstituttet
IAS-CNR	Istituto per lo Studio degli Impatti Antropici e Sostenibilità in Ambiente Marino del Consiglio Nazionale delle Ricerche
IEO	Instituto Español de Oceanografía
Ifremer	Institut Français de Recherche pour l'Exploitation de la Mer
IMSCC	International Marine Science Communication Conference
IOC	Intergovernmental Oceanographic Commission of UNESCO
IO PAN	Instytut Oceanologii Polskiej Akademii Nauk
IUEM	Institut Universitaire Européen de la Mer
IZOR	Institut za oceanografiju i ribarstvo
MaREI-UCC	SFI Research Centre for Energy, Climate and Marine research and innovation at University College Cork
METU	Middle East Technical University
MI	Marine Institute
MSC	Marine Science Communication
NBS	Not Black Sea
NGO	Non-Governmental Organization

NIOZ	Koninklijk Nederlands Instituut voor Onderzoek der Zee
NOC	National Oceanography Centre
Ocean Decade	UN Decade of Ocean Science for Sustainable Development
OGS	Istituto Nazionale di Oceanografia e di Geofisica Sperimentale
OL	Ocean Literacy
RBINS	Royal Belgian Institute of Natural Sciences
RCN	Norges forskningsråd
STEM	Science, Technology, Engineering and Mathematics
SZN	Stazione Zoologica Anton Dohrn
TV	Television
UK	United Kingdom
UM	Réseau des Universités Marines Françaises
UN	United Nations
VLIZ	Vlaams Instituut voor de Zee

Annexes

Annex I: European Marine Board Communications Panel (EMBCP)

NAME	INSTITUTION	COUNTRY
Writing Group members		
Jan Seys (Chair of the Writing Group)	Vlaams Instituut voor de Zee (VLIZ)	Belgium
M. Carmen García-Martínez (Co-Chair of the Writing Group)	Instituto Español de Oceanografía (IEO)	Spain
Sheila Byrnes	Marine Institute (MI)	Ireland
Daria Ezgeta-Bali	Institute of Oceanography and Fisheries (IZOR)	Croatia
Francesca Garaventa	National Research Council - Institute for the Study of Anthropogenic Impacts and Sustainability in the Marine Environment (CNR-IAS)	Italy
Claudia Gili	Stazione Zoologica Anton Dohrn Napoli (SZN)	Italy
Géraldine Guillevic	Institut Français de Recherche pour l'Exploitation de la Mer (Ifremer)	France
Kathrin Kopke	SFI Research Centre for Energy, Climate and Marine research and innovation at University College Cork, Ireland (MaREI-UCC)	Ireland
Kelle Moreau	Royal Belgian Institute of Natural Sciences (RBINS)	Belgium
Mette Mila	Norges forskningsråd (RCN)	Norway
Maike Nicolai	Helmholtz-Zentrum für Ozeanforschung Kiel (GEOMAR)	Germany
Francesca Petrerà	Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS)	Italy
Kim Sauter & Aaike van Oord	Koninklijk Nederlands Instituut voor Onderzoek der Zee (NIOZ)	The Netherlands
Dominique Simon	Institut Universitaire Européen de la Mer (IUEM) – Réseau des Universités Marines (UM)	France
José Teixeira	Centro Interdisciplinar de Investigação Marinha e Ambiental (CIIMAR)	Portugal
Tymon Zielinski	Instytut Oceanologii Polskiej Akademii Nauk (IO PAN)	Poland
Peter Ryde	National Oceanography Centre (NOC)	United Kingdom
Ferdinando Boero	Consorzio Nazionale Interuniversitario per le Scienze del Mare (CoNISMa)	Italy
Former EMBCP members who contributed to the document		
Lucy Cox	National Oceanography Centre (NOC)	United Kingdom
Marco Faimali	National Research Council - Institute for the Study of Anthropogenic Impacts and Sustainability in the Marine Environment (CNR-IAS)	Italy
Andreas Villwock	Helmholtz-Zentrum für Ozeanforschung Kiel (GEOMAR)	Germany
Other contributors		
Ezgi Şahin Yücel	Middle East Technical University (METU)	Turkey

Annex 2: Ocean News survey to experts

We thank you, as an expert, for your much-appreciated help in completing this 15' survey. The aim of the survey, conducted by the European Marine Board Communications Panel (EMBCP), is to get an idea of how Ocean science results find their way towards a wider public in Europe. It focuses on successes and lessons learnt. The final report (2021) will analyze this information and provide recommendations for the future.

WG-EMBCP on Marine Science Communication

Personal information

- Your *country of residence* is (menu list);
- The nearest *Ocean/sea basin* to your home address is (menu list);
- To which *category* do you belong? Tick the most appropriate category:
 - Scientists;
 - Policy-makers;
 - Industry representatives;
 - Communication experts;
 - Media;
 - Education experts.

Communicating the Ocean

- Is communicating *Marine Science* *more, less or as challenging* as communicating other fields of science? What do you think? [Less challenging/As challenging/More challenging/Don't know];
- Please explain briefly why you think so.

Marine Science in the Media

- How *often* do you see news about marine science (via press, events, publications, social media, etc.)?
 - Daily;
 - Weekly;
 - Monthly;
 - Less than monthly.

Marine Science Communication in Europe

- Do you feel like there is less, more or as much *communication on marine science/Ocean issues* now than there was twenty years ago (in the 1990s)? [Less/As much/More/Don't know];
- Is that *in line* with the evolution in attention for other fields of science (such as 'space', 'medical science',...) during the past twenty years? [Yes/No/Don't know];
- Please explain *why* you think so, what were the causes?

Good and less successful practices

- What *good examples of marine science communication practices* have you or your institution/company participated in? Please name no more than three (with links to websites if available).
- What *good marine science communication practices* have you noticed in which you or your institution/company were not involved? Please name three (with links to websites if available).
- What have you *learnt from* all those good practices? Please provide maximum three lessons learnt.
- Have you been involved in marine science communication practices that were not successful or *less successful than you had hoped*? Please describe them and provide links to websites if available.
- If so, please *explain why*, in your opinion, the activity was not so successful.
- What have you learnt from that? Please provide maximum three lessons learnt.

Impact of society

- What *topics* do you think have drawn most and least attention over the past 5 years? In other words, what topics were most or least visible around you and/or were or were not the focus of your institution’s activities? Which topics, in your opinion, got too much or not enough attention? Score each of the topics.

	UNDER-VALUED	NOT VISIBLE	VISIBLE	HIGHLY VISIBLE	TOO MUCH ATTENTION
Marine Litter					
Chemical pollution					
Climate incl. sea-level rise					
Biodiversity & ecosystems					
Fisheries & aquaculture					
Marine Bio-products					
Underwater noise					
Offshore Energy					

- Do you see certain topics that were over-represented and got most of the attention in terms of news reporting? [Y/N];
- If yes, please name the topic or topics.

Roles of Stakeholders in the Process

- What is/should be the *role of scientists* in the process of marine science communication?
- What is/should be the *role of policy-makers* in the process of marine science communication?
- What is/should be the *role of industry representatives* in the process of marine science communication?
- What is/should be the *role of communication experts* in the process of marine science communication?
- What is/should be the *role of educators* in the process of marine science communication?
- What is/should be the *role of the media* in the process of marine science communication?

Future of Marine Science Communication

- Do you think *Marine Science Communication* will become more important in the future? [Y/N]
- Please explain why you think so.
- Do you think the *structures and conditions* are in place to make it happen? [Y/N]
- Please explain why you think so.
- Do you think there will be enough *incentives* for marine scientists to make it happen? [Y/N]
- Please explain why you think so.
- Do you expect *new technologies/tools* for Marine Science Communication that can dramatically change the landscape? [Y/N]
- Please explain.
- Do you think the *UN Decade of Ocean Science for Sustainable Development (UNDOSS: 2021-2030)* will have an impact on Marine Science Communication? [Y/N]
- Please explain.
- How do you think marine science communicators can get prepared, in terms of sharing Ocean science effectively with a wider audience, for the future? What would you *recommend*?

Thank you for helping us with your insights and opinions!

Annex 3: Ocean News survey to students

Dear student, thank you for your help in completing this 10' survey, your input is much appreciated. Your answers will help us, the European Marine Board Communications Panel (EMBCP), to understand how science results related to the Ocean, find their way to the public in Europe. It focusses on successes and lessons learnt, and the final report will analyze this information and provide recommendations for the future.

The Ocean covers 70% of our planet and is vital for all life on earth. So, with your help we can make sure that what happens there and what scientists learn from it, can be shared with others in the most effective way.

WG-EMBCP on Marine Science Communication

Personal information

- Your *country of residence* is (menu list);
- The nearest *Ocean/sea basin* to your home address is (menu list);
- What is your *gender*? [Male/Female/other];
- Your *school* is a:
 - Private school;
 - Public school.
- During your secondary school (12-18 yr), on overage, you had courses in science (biology, geography, chemistry, physics,...):
 - Less than 1 hour a week;
 - Between 1 and 3 hours a week;
 - More than 3 hours a week.

The Sea around you: how to make it visible?

- Do you think that *sharing Ocean facts* is more, less or as challenging as communicating other science? [Less/As much/More/Don't know].

Marine Science in the Media

- How often do you see news about marine science (via press, events, publications, social media, etc.)?
 - Daily;
 - Weekly;
 - Monthly;
 - Less than monthly.
- Do you feel like there is *more news about the Ocean now than there used to be*?
 - 5 years ago? [Yes/No/Don't know];
 - 2 years ago? [Yes/No/Don't know].

- Do you think that science related to the Ocean in particular, has received less, more or as much *attention* compared to other fields of science the last 5 years [Less/As much/More/Don't know].

Good and less successful practices

- *Have you noticed news about Ocean science? And where do you see that Ocean/sea news?*

	NEVER	RARELY	OFTEN	VERY OFTEN	ALWAYS	DON'T KNOW
Social media						
Digital news providers						
Newspapers (hardcopy)						
Television						
Talking to friends & relatives						
At school						

- What is the main reason *why* certain Ocean news stories catch your attention? Because:
 - It is funny;
 - It is scary and makes me worry for the future;
 - It is new and I realize that I learnt something valuable;
 - I am obliged to learn it (e.g. at school).
- Can you remember when you heard or saw Ocean science news that drew your attention in a very *negative way*? If so, where did you find it?

	NEVER	RARELY	OFTEN	VERY OFTEN	ALWAYS	DON'T KNOW
Social media						
Digital news providers						
Newspapers (hardcopy)						
Television						
Talking to friends & relatives						
At school						

- *Why* did it catch your attention in such a negative way? Because:
 - It sounded like fake news;
 - It was scary and made me worry for the future;
 - It offended people;
 - Not applicable (I answered ‘Never’);
 - Other.

Impact of society

- What *topics* do you think draw the most and least attention over the past 5 years? In other words, what topics were most or least visible around you? Which topics, in your opinion, got too much or not enough attention? Please score each of the topics.

	UNDER-VALUED	NOT VISIBLE	VISIBLE	HIGHLY VISIBLE	TOO MUCH ATTENTION
Marine Litter					
Chemical pollution					
Climate incl. sea-level rise					
Biodiversity & ecosystems					
Fisheries & aquaculture					
Marine Bio-products					
Underwater noise					
Offshore Energy					

- Do you think certain topics may have been over represented in the news reporting? [Y/N]
 - If yes, please name the topic or topics.

Future of Marine Science Communication

- Do you think there will be *more Ocean science news* in the future? [Y/N/Don’t know]
- Do you think there *should be more* Ocean science news in the future? [Y/N/Don’t know]
- Do you expect to see *new ways* of bringing Ocean science news to the attention of the public in the future? [Y/N/Don’t know]
- Have you ever heard about the *UN Decade of Ocean Science for Sustainable Development (UNDOSS: 2021-2030)*? [Y/N]

Thank you for helping us with your insights and opinions!

Annex 4: EMB Member organizations survey

- When was your organization created (year) & how many institutes does it have (if applicable)?
- How many employees does your organization have (total number of staff)?
- How many employees does the marine communication department/team of your organization have? (number of staff in FTE, e.g. 3 comms officers + 0,5 graphic designer + 0,25 social media manager). If you have a general communication department, please specify only those working on marine content.
- Can you specify the roles of the staff at the (marine) communication department, following these roles?

ROLE (please modify if applicable)	FULL-TIME EQUIVALENT (FTE)
Communications Officer/Manager	
Media Relations Officer/Manager	
Public Relations Officer/Manager	
Public Engagement Officer/Manager	
Outreach Officer/Manager	
Education Officer/Manager	
Social Media Officer/Manager	
Graphic Designer	
Photographer	
Videographer	
Web designer/builder	
Event Manager / Team assistant	
Journal technical editor	
Communications Administrator	
Office of the CEO/Senior Leadership	
Project Communications institute wide	

Cover Picture: A way forward?
Credit: VLIZ

European Marine Board IVZW
Belgian Enterprise Number: 0650.608.890

Wandelaarkaai 7 | 8400 Ostend | Belgium
Tel.: +32(0)59 34 01 63 | Fax: +32(0)59 34 01 65
E-mail: info@marineboard.eu
www.marineboard.eu