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Contribution to the Special Issue: Marine Animal Forest of the World (MAF WORLD)

Systemic Science Communication Training for Powerful Impact in Marine Animal Forests

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Abstract

In the not-so-distant past, scientific research operated within the confines of academic journals, isolated from broader communication channels. However, the landscape has evolved significantly in the last two decades, with science communication breaking free from the academic ivory tower to embrace diverse platforms in great measure thanks to the internet and social media. Despite this evolution, a noticeable gap remains in researchers' soft skills, hindering their ability to convey research outcomes to the public effectively. This paper highlights our efforts to address this gap through the Marine Animal Forest of the World COST Action (MAF WORLD), showcasing dedicated science communication training. We delve into the identified gaps and our attempts to bridge them through a training school focused on Marine Animal Forests, emphasising the development of soft skills such as creativity and teamwork. Training in, and the outcomes of scientific communication should be included when evaluating a scientist. Employing a practical and holistic approach, our initiative seeks to amplify the impact of EU-funded research and encourage co-creation and originality to engage diverse stakeholders. This forward-thinking strategy positions the MAF WORLD as a case study on science communication training within a scientific network of excellence, demonstrating the need for these skills for scientists and contributing to the global ocean conservation discourse.

Keywords: Science Communication; Training Programs; Capacity Development; Stakeholder Engagement; Ocean Literacy; Marine Conservation.

Re-engaging society from a top-down perspective

The European Commission's Framework Programmes have shaped Europe's research and innovation landscape since 1984. Notably, beginning with Framework Programme 6 for Research, Technological Development and Demonstration (FP6) (2002–2006), the programmes began embedding social sciences and humanities (SSH) and promoting public engagement, marking a conceptual shift towards connecting science with society. FP6 marked a turning point by integrating social sciences and fostering a more transversal and comprehensive approach to research and innovation (EU, 2020). This evolution reflects a growing recognition of the need to connect science with society, not only through research content but also by involving citizens, stakeholders, and communities throughout the research process (Keraudren, 2018; Sonetti *et al*., 2020).

Horizon 2020 and Horizon Europe further institutionalised this shift, embedding public engagement, Responsible Research and Innovation (RRI), and science communication as cross-cutting elements across disciplines and funding instruments. The Missions introduced under Horizon Europe exemplify this integration by tackling societal challenges through co-creation, public dialogue, and cross-sectoral collaboration. The importance of such efforts is increasingly recognised globally, where restoring society's relationship with the ocean through inclusive and effective communication is seen as crucial to achieving the objectives of the UN Ocean Decade (Glithero *et al*., 2024).

While Figure 1 primarily illustrates the growing financial investment in EU Framework Programmes over the past 40 years, it also coincides with this broader evolution in scope and objectives to include SSH in its programming. This shift is reflected not only in the increasing budgets but also in the evolving policy goals and implementation strategies of each programme, always emphasising the need to bridge the gap between science and society.

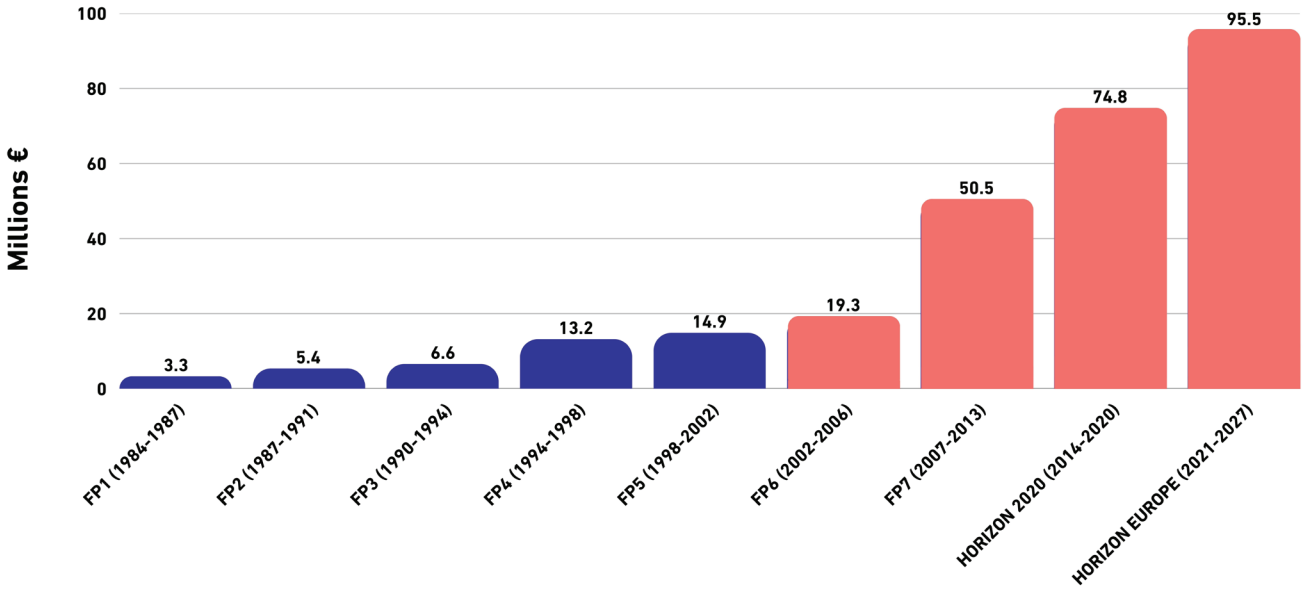

Fig. 1: Budget evolution during the 40 years of EU framework programmes. Data source (European Commission, 2020; European Commission, 2021). The blue bars represent FP1 through FP6, which were primarily focused on advancing technology and competitiveness, though FP6 marked the beginning of a conceptual and structural shift towards integrating societal considerations. The red bars represent FP7, Horizon 2020, and Horizon Europe, programmes that more explicitly prioritised the integration of societal challenges, stakeholder engagement, and science communication as core components.

Why Communication Skills Matter

Historically, scientific research was confined to academic circles, primarily shared through peer-reviewed journals and conferences, which limited its broader impact. However, the so-called ivory tower is beginning to open its doors, creating new opportunities for broader engagement.

Science communication has long been a vital tool, even before it was officially recognised. The British Association for the Advancement of Science, founded in 1831, formalized science communication, but naturalists and explorers had already been sharing scientific knowledge for centuries. From its beginning, science communication has been an inherently multidisciplinary effort, with scientists acting as artists, writers, or collaborators with illustrators to share discoveries with a wider audience.

For example, Carl Linnaeus, the father of modern taxonomy, published *Systema Naturae* in 1735, a work that classified living organisms systematically that was more accessible to a broader educated audience beyond academic specialists. Similarly, Charles Darwin's *On the Origin of Species* (1859) was not just a scientific treatise, but a carefully written narrative designed to be understandable by a larger segment of the literate public, sparking widespread discussion and interest in evolutionary theory. In the 18th and 19th centuries, natural history illustrators like Maria Sibylla Merian and John James Audubon played crucial roles in documenting biodiversity, making science visually engaging and easy to understand. More recently, Jacques Cousteau, a pioneer in ocean exploration, used film and television to bring marine science to the public. His documentary *The Silent World* (1956) won an Academy Award and introduced audiences to the wonders of the deep sea, inspiring generations of marine scientists and conservationists.

Another example is the BBC series *Blue Planet* (2001) and *Blue Planet II* (2017), and OCEAN (2025), narrated by David Attenborough, which combined marine science with breathtaking cinematography. The documentaries used new filming techniques, such as deep-sea submersibles and time-lapse photography, to reveal previously unseen oceanic phenomena, sparking global discussions on ocean conservation.

The necessity for diverse perspectives to enhance the accessibility of marine science remains unchanged. The growing demand for societal engagement in research requires scientists to possess strong communication skills and to collaborate with a well-regarded team of science communicators (Gani *et al.,* 2024). As science increasingly intertwines with policy, education, and community action, the ability to convey complex information to non-specialist audiences becomes more critical than ever. However, many scientists still lack the training needed to meet these expectations. Moreover, science communication efforts are rarely recognised as part of formal evaluation or career advancement criteria, which discourages researchers from investing time and energy into developing these competencies. Without institutional incentives or frameworks that value public engagement, many scientists lack the motivation to pursue or apply communication training meaningfully ('Advising governments about science is essential but difficult. So train people to do it', 2024).

Initiatives like the Marine Animal Forest of the World COST Action (MAF WORLD) (Rossi *et al.,* 2022) aim to consolidate knowledge in this emerging field and promote bridging this gap by equipping network members with the tools and confidence to communicate effectively.

In today's context, communication is widely recognised as a critical skill with significant potential to amplify research impact. Its inclusion among the seven core competencies for research management defined by the European Commission (European Commission, 2025) underscores the need for targeted communication training to enhance efficiency and maximise the true impact of research funding management.

Breaking Barriers: The Need for a Science Communication Training School

While audiences such as policymakers, educators, students, and the public have long been central to science communication, the rise of the internet and social media has dramatically expanded opportunities to reach them more directly and interactively. These platforms have also enabled scientists at various career stages to present their work in accessible, diverse formats, bringing research closer to the concerns and realities of society (Wiseman, 2023).

Yet, many scientists still struggle to convey their work effectively, often due to a lack of structured communication training (Miller & Fahy, 2009). Overcoming this challenge requires more than developing technical skills, it demands a shift in mindset that embeds communication into research practice. Such an approach is critical not only for broader engagement but also for maintaining public trust, safeguarding research integrity, and reinforcing transparency and ethical standards in times of uncertainty (Morgan, 2024; 'Science communication will benefit from research integrity standards', 2024; Cologna *et al*., 2025).

A statement included in Thorp & Phelan (2025), mentions that "*Although engaging with sceptical reporters and critics can be daunting, proactive communication is essential for preserving credibility and ensuring that science continues to serve society effectively.*" With this statement, they highlight the need to rethink science communication education. A dedicated training school would prepare scientists to handle these challenges, enabling them to communicate responsibly, incorporate policy considerations into outreach, and ultimately reinforce the role of science in society.

The Training School: Connecting the Dots in Communicating Marine Animal Forests

Inspired by Steve Jobs' belief that true innovation emerges from connecting seemingly unrelated ideas, MAF WORLD launched in 2022 "Connecting the Dots in Communicating Marine Animal Forests", its first training school dedicated to MAF science communication, to connect ideas and techniques for better communication. Marine Animal Forests (MAFs) refer to benthic ecosystems dominated by large suspension-feeding invertebrates, such as corals, sponges, bryozoans, sea pens, oysters, among others, that build complex three-dimensional structures providing habitat, refuge, and nursery grounds for many other species (Orejas *et al.,* 2022).

Developed in collaboration with MAF WORLD network members (https://maf-world.eu/networking/maf-cost-action-network/), which includes researchers, science communicators, educators, and marine conservation practitioners from across Europe, the program's structure was co-created to reflect the diverse experiences and communication needs within the Marine Animal Forests network. The four-day programme was shaped to integrate different inputs from the MAF WORLD COST Action network, resulting in six dynamic modules that blended theoretical and practical learning. This training program seeks to empower researchers to overcome barriers and forge new paths in making the message across. By merging diverse perspectives, participants collectively advance how MAFs are communicated to broader audiences (Fig. 2).

Conducted in a post-pandemic context, the program empowered diverse professionals to engage in reflexive science communication. This approach emphasises critical self-awareness, ethical transparency, and sensitivity to social context. By reflecting on their assumptions and values, participants were encouraged to develop communication practices that are not only effective but also inclusive, dialogic, and aligned with societal needs.

The training school strengthened connections across diverse Marine Animal Forest initiatives, including research, restoration, citizen science, education, and policy outreach, by creating a multidisciplinary and interactive setting where participants could share knowledge, challenges, and communication approaches from their respective fields. Innovative strategies included participatory co-creation methods, such as collaborative storytelling, audience mapping, and real-time group prototyping of outreach campaigns.

Co-creation has emerged as a resilient framework in scientific research and communication, emphasising the active involvement of multiple stakeholders, researchers, educators, policymakers, and the public, in the knowledge production process (Achiam *et al.*, 2022). While the MAF WORLD science communication training school did not formally involve external audiences in a Multi-Actor Approach (MAA), it adopted internal co-creation among network members as a guiding principle. The programme was developed through a series of iterative consultations among members of the network, which includes scientists from marine ecology and conservation, early-career researchers, outreach professionals, and educators from across Europe. These contributors were invited to a pre-training co-design process during virtual planning meetings and working groups, where they shared communication needs, existing knowledge gaps, and preferred training formats. Their feedback informed the structure, content, and pedagogical strategy of the school.

The four-day training functioned as a hybrid experience combining learning, testing, and iterative co-creation. Participants, selected based on their active involvement in MAF-related communication or outreach, were asked on the first day to reflect on their expectations, pri-

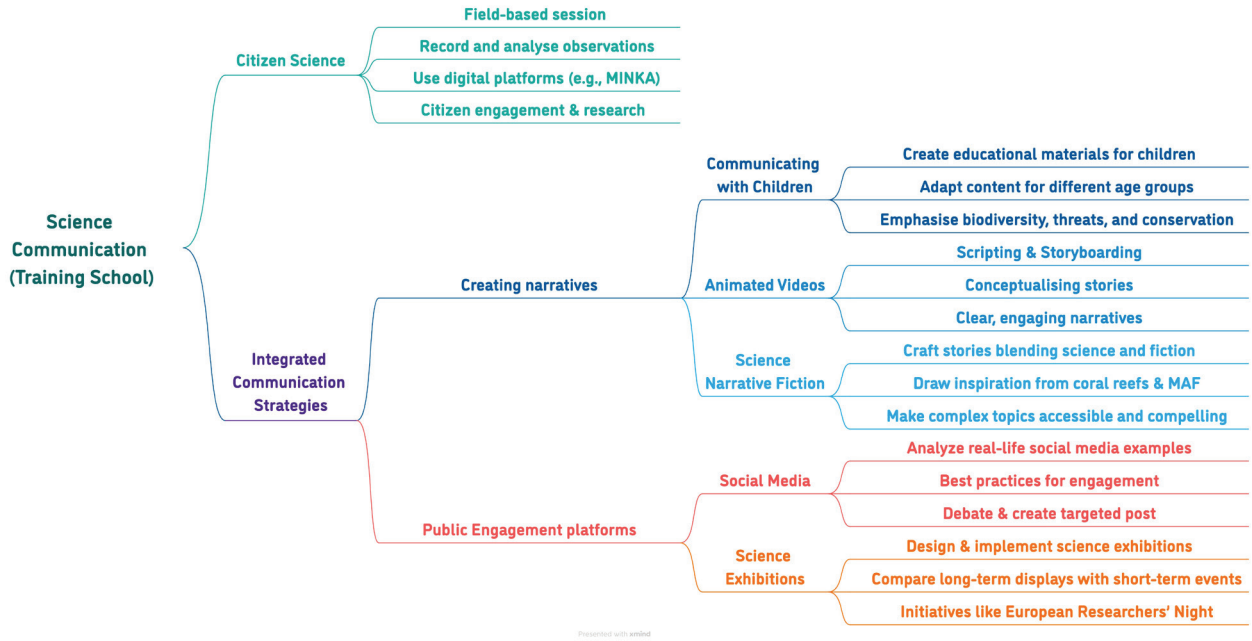

Fig. 2: Systemic structure of the MAF WORLD Training School Dedicated to Science Communication.

or experience, and challenges. These inputs shaped how facilitators adapted exercises in real time and provided a foundation for tailoring the interactive components of each module. Sessions such as integrated communication strategy were explicitly designed as hands-on workshops, where participants co-created outputs in small interdisciplinary teams, testing tools and methods in real-world-inspired scenarios.

While four days were not sufficient to provide comprehensive training on every topic covered in the six modules, the focus was placed on providing immersive, experiential exposure to core tools and reflective practices that could be further developed after the school. For example, participants engaged in rapid prototyping of communication products, practiced narrative framing through peer feedback, and collaboratively mapped stakeholder engagement strategies. These activities were consolidated in a final reflection session, where participants discussed best practices and shared suggestions for improving future editions.

Overview of participants' expectations and take-home messages

To avoid the standard end-of-course satisfaction survey and foster a more reflective and emotionally engaging closing, a participatory exercise was designed as the final activity of the training school. We had a total of 18 participants from 12 nationalities. They were asked to share their thoughts on two separate prompts: one board collected their Expectations at the beginning of the training, while the other gathered their Take-Home Messages at the end. This activity aimed to capture both their initial hopes and motivations, as well as the key insights and lessons they gained throughout the experience. The notes served as a visual representation of their learning journey and a tool for collective reflection.

A total of 84 responses were collected across both the *Expectations* and *Take-Home Messages* boards, including 37 Expectations and 47 Take-Home Messages (Fig. 3).

We conducted a qualitative content analysis to gain deeper insight into the participants' statements, both for Expectations and for take-home messages in two separate stages. Each note was reviewed to identify recurring themes and underlying motivations, revealing what participants were most curious about or aiming to achieve. This method was chosen for its suitability in analysing short, open-ended responses and identifying patterns in the participants' expressed intentions and aspirations. The analysis followed a thematic coding approach, used to identify, analyse, and interpret patterns or themes within the collected textual data. It involved assigning codes to segments of text based on meaning, then grouping these codes into broader categories that reflect recurring ideas or topics across the dataset**.**

From this analysis of expectations statements, we identified five categories that reflect key areas of interest and anticipated learning: 1) Inspiration & Motivation, 2) Knowledge Acquisition, 3) Networking & Exchange, 4) Practical Application, and 5) Training & Skill Development.

The same coding process was applied for the *Take-Home Messages* responses (n = 47), in which we identified five categories: 1) Professional Development and Collaboration, 2) Communication Excellence, 3) Innovation and Creativity 4) Knowledge Acquisition 5) Specialised topics.

Regarding expectations, participants expressed a strongly outward-looking set of hopes. The most frequent theme was Networking & Exchange, ranging from simply *"meet new people/experts*" and "*share ideas with MAF network members*" to ambitions of building lasting bonds with "*MAF network experts*." A second cluster, Knowledge Acquisition, centred on learning "*new tools and methods in science communication*" for Marine An-

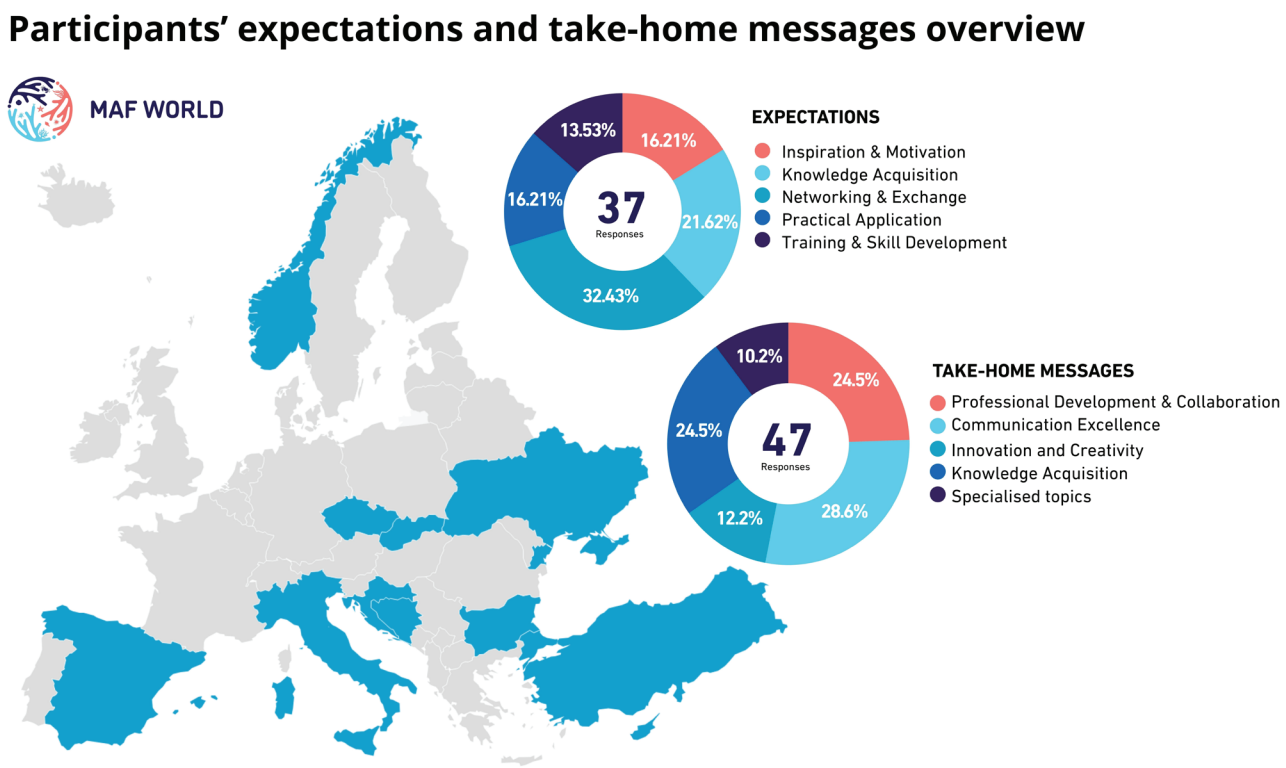

***Fig. 3**:* Identified categories of Expectations and take-home messages shared by attendees from various European countries during the training school. In blue are highlighted the nationalities of the training school attendees.

imal Forests and, more broadly, "*just expecting to learn something new on how to communicate about MAF.*" Inspiration & Motivation captured an affective dimension, requests for "*inspire the public to act*" or "*guidance on how to promote awareness of this important topic*". Participants also hoped to have Practical Application, asking for "*case studies, strategies to communicate MAF science to different target groups*" or "*something I will apply in my country.*" Finally, Training & Skill Development signalled a desire for concrete upskilling: "*improve communication skills*", "*learn new communication tools and methods*" and even a candid note that "*the road to communication was not for me at all*" hinting at apprehension that the workshop might not fully meet advanced needs.

The tone of the participants' statements in the *Take-Home Messages* board shifted from anticipation to confident action plans. The largest category, Professional Development & Collaboration, celebrated newly formed partnerships - "*I've met new people I can collaborate with",* and personal growth *"After the training, I feel more confident doing it, it's easier than I thought".* Statements that fell under Communication Excellence highlighted the need for strong, clear, practical communication skills to be learnt throughout the career of any scientist and reminded that science communication is "a *scientific field in its own right.*"

Many notes were grouped under the Knowledge Acquisition category, citing "*I've learnt many tools I didn't know before*" and "*I've got insightful contributions about how to communicate about MAF within my network and to make it more understandable for the public*". Statements under the Innovation & Creativity category praised "*new ways of thinking about communicating MAF brainstorming methods, and the challenge of turning beautiful ideas into tangible outputs".*

Finally, Specialised Topics highlighted the importance of including Citizen Science and a multidisciplinary approach in the field of MAF. A good start is to give a framework within the principles of Ocean Literacy (Mokos *et al.,* 2022), as has been done in other cases (Alvisi *et al*., 2022) to further enrich this approach by combining Citizen Science, communication, and participation. During the training school, some applauded their inclusion, while others urged "*more consideration"* of these areas, signalling room for deeper exploration.

Overall, the take-home statements closely echo, and in many cases exceed, the expectations of participants. Networking hopes were met, with participants repeatedly citing "*many people I can collaborate with*", "*new connections*", and successful collective brainstorming sessions. Aspirations for knowledge acquisition also materialised, with numerous mentions of newly discovered tools, methodologies, and fresh perspectives on Marine Animal Forests. The quest for Inspiration & Motivation resurfaced as a surge of confidence and a resolve to "*just do it*" confirming that the school generated a mindset shift as well as technical know-how. Where gaps emerged, they reflected the inevitable limits of a four-day format: citizen-science techniques received only an introductory treatment, and several creative ideas lacked time for full implementation. Participants therefore recommended two clear priorities for future editions: (i) devote more

hands-on time to niche or under-served themes, especially citizen science and project prototyping, and (ii) establish post-school follow-ups, such as webinars or project clinics, to turn initial sparks and new bonds into sustained, real-world impact.

Conclusion

The MAF WORLD science communication training school demonstrates the transformative potential of equipping researchers with foundational communication skills. By fostering creativity, collaboration, co-creation, and confidence, this initiative bridges the gap between science and society, amplifies research impact, and supports global conservation efforts. As science communication evolves, embedding these practices within research networks like COST Actions will be essential for addressing today's complex challenges.

Feedback from participants confirmed that the training school effectively balanced technical instruction with the vital soft skills of networking and inspiration. Attendees valued the chance to connect with colleagues from diverse backgrounds, expand their professional networks, and gain fresh, innovative approaches to communicating about marine animal forests, highlighting the value of multidisciplinary and interactive training sessions. The outcomes of the school, including feedback collected through participatory evaluation exercises and qualitative analysis of take-home messages, have since been used to refine the structure for future iterations of the training. Some of the lessons learned include the value of mixing practical and reflexive components, the importance of grounding communication in real case studies, and the benefit of creating peer-learning spaces. As a result, this training model is now being adapted into a scalable framework for future workshops and COST Action activities, with the aim of making it replicable across different marine science communities.

This training format confirms that instead of treating research and communication as separate domains, it is crucial that funding supports their integration. Comprehensive, cross-cutting strategies are necessary to ensure broader societal engagement and maximise the responsible impact of scientific findings. This valuable insight reinforces the idea that effective communication is not an add-on, but an integral part of the scientific process.

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References

Achiam, M., Kupper, F., Roche, J., 2022. Inclusion, reflection and co-creation: responsible science communication across the globe. *Journal of Science Communication*, 21(4).

Advising governments about science is essential but difficult. So train people to do it, 2024. *Nature*, 636 (8041), 8.

Alvisi, F., Baldrighi, E., Merlino, S., Locritani, M., Panfili, M. *et al.*, 2022. Walking on the Sea Traces: Developing a platform to bring Ocean Literacy and Citizen Science at Home. *Mediterranean Marine Science*, 23 (2), 389-404.

Cologna, V., Mede, N., Berger, S., Besley, J., Brick, C. *et al.*, 2025. Trust in scientists and their role in society across 68 countries. *Nature Human Behaviour*, 1-18.

European Commission, European Competence Framework for Research Managers, RM Comp: The European Competence Framework for Research Managers - European Commission. 2025.

European Commission: Directorate-General for Research and Innovation, 2021. Horizon Europe, budget – Horizon Europe - the most ambitious EU research & innovation programme ever. Publications Office of the European Union.

European Commission: Directorate-General for Research and Innovation, Lagher R., Delaney N., Tornasi Z. *et al.*, 2020. Science with and for society in Horizon 2020 – Achievements and recommendations for Horizon Europe. Publications Office.

Gani, S., Arnal, L., Beattie, L., Hillier, J., Illingworth, S. *et al.*, 2024. Editorial: The shadowlands of science communication in academia – definitions, problems, and possible solutions. *Geoscience Communication*, 7, 251-266.

Glithero, L., Bridge, N., Hart, N., Mann-Lang, J., McPhie, R. *et al.*, 2024. Ocean Decade Vision 2030 White Papers – Challenge 10: Restoring Society's Relationship with the Ocean. *The Ocean Decade Series*, 51.10. Paris, UNESCO-IOC.

Keraudren, P., 2018. The Contribution of Social Sciences and the Humanities to Research Addressing Societal Challenges. Towards a Policy for Interdisciplinarity at European Level? p. 43-57. In: Tressaud, A. (Eds). *Progress in Science, Progress in Society.* Springer, Cham.

Miller, S., Fahy, D., 2009. Can science communication workshops train scientists for reflexive public engagement?: The ESConet experience. *Science Communication*, 31 (1), 116-126.

Mokos, M., De-Bastos, E., Realdon, G., Wojcieszek, D., Papathanasiou, M. *et al.*, 2022. Navigating Ocean Literacy in Europe: 10 years of history and future perspectives. *Mediterranean Marine Science*, 23 (2), 277-288.

Morgan, R., 2024. *Communicating with integrity - Supporting researchers with best practice in communication*. League of European Research Universities (LERU). Advice Paper, No 34, 14 pp.

Orejas, C., Carreiro-Silva, M., Mohn, Ch., Reimer, J.D., Samaai, T. *et al.*, 2022. Marine Animal Forests of the World: Definition and Characteristics. *Research Ideas and Outcomes*, 8, e96274.

Rossi, S., Bramanti, L., Horta, P., Allcock, L., Carreiro-Silva, M. *et al.*, 2022. Protecting global marine animal forests. *Science*, 376 (6596), 929.

Science communication will benefit from research integrity

standards, 2024. *Nature*, 635 (8037), 8.
Sonetti, G., Arrobbio, O., Lombardi, P., Lami, I., Monaci, S., 2020. "Only Social Scientists Laughed": Reflections on Social Sciences and Humanities Integration in European Energy Projects. *Energy Research & Social Science*, 61, 101342 p.
Thorp, H.H., Phelan M., 2025. Breaking the silence. *Science*, 387 (6735), 701.
Wiseman, S., 2023. In conversation with Andrew Huberman. *Nature Neuroscience*, 26 (8), 1312-1315.