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Editorial

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

Marine Animal Forests: Bridging Science, Policy, and Local Knowledge

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Marine Animal Forests (MAFs) are complex, three-dimensional structures formed by benthic animals (e.g., corals, gorgonians, sponges, bivalves, bryozoans) that act as autogenic ecosystem engineers. These organisms create new ecological niches and colonization surfaces, thereby enhancing ecosystem functions and services (Orejas *et al.*, 2022). When the populations of these tree-shaped animals are dense enough, they form true underwater forests that share several analogies with terrestrial forests. The key distinction, however, lies in their biological composition: whereas terrestrial forests are built by plants, MAFs are entirely constructed by animals (Rossi *et al*., 2017; Nelson & Bramanti, 2020). These animal-built underwater forests function as biodiversity hotspots, playing vital roles in benthic-pelagic coupling, nutrient cycling, and carbon sequestration (Orejas *et al.*, 2022). They also provide essential habitat functions, including shelter, nursery grounds, and feeding areas for a wide array of marine life. Yet, despite their ecological importance, MAFs have historically received less scientific and conservation attention than other marine ecosystems, such as seagrass meadows or coral reefs (Rossi *et al*., 2022).

In recent years, however, the concept of MAFs has gained significant traction in the scientific literature, driven by a growing community of researchers working to consolidate its theoretical foundation and methodological framework. Originally introduced as a descriptive analogy, the term has since evolved into a scientifically robust concept (Orejas *et al.*, 2022), with ongoing efforts to establish standardized definitions, metrics, and monitoring protocols (Lasker *et al*., 2020, 2025). This conceptual maturation coincided with broader recognition outside the academic community. MAFs have been prominently featured in international outreach campaigns, environmental documentaries, and educational initiatives, helping to raise public awareness of their ecological importance. Notably, the International Union for Conservation of Nature (IUCN) recently included MAFs in the list of habitats of ecological importance, further affirming their relevance in global conservation efforts (Keith *et al*., 2020).

Building on this growing interest, both within and beyond the scientific community, this Special Issue seeks to advance our understanding of MAFs functionality, resilience, and conservation needs. Focusing primarily on the Mediterranean Sea and Atlantic Ocean, the contributing papers span a range of spatial scales and methodological innovations from macroecological approaches and cutting-edge 3D imaging to habitat mapping, trophic ecology, and legal framework analysis. This multidisciplinary portfolio reflects a shared aim: to elucidate the ecological complexity of MAFs and the bioenergetic, reproductive, and environmental drivers that underpin their persistence. The Special Issue also highlights the integration of local ecological knowledge, advanced modeling techniques, and science communication as essential components in translating scientific insights into actionable conservation strategies. Together, these contributions offer a comprehensive, multi-scale perspective to support evidence-based management and the long-term protection of these structurally and functionally critical ecosystems.

The foundation of understanding MAF functionality begins with a macroecological study that integrates the Metabolic Theory of Ecology with morphological traits and environmental data to estimate the resource supply necessary to maintain diverse MAF assemblages (Johnson & Ferreira, 2025). This novel framework enables the linking of observable attributes such as colony density and size with fundamental ecosystem processes, including energy flux and turnover, offering a new perspective on the bioenergetic constraints shaping these three-dimensional habitats.

Expanding on this, a complementary study by Di Fabio *et al*. (2025) introduces a cutting-edge 3D photogrammetric method to precisely estimate polyp numbers in the precious red coral *Corallium rubrum* (Linnaeus, 1758). By improving assessments of this key reproductive trait, the method enhances our understanding of red coral ecology and provides a broadly applicable tool for marine anthozoan research and conservation.

Delving deeper into MAF resilience, Ribeiro *et al*. (2025) provide a comprehensive review of the drivers of octocoral persistence amid environmental change, spotlighting trophic ecology as a crucial trait supporting their adaptability. Their work identifies significant knowledge gaps, such as under-studied geographic and bathymetric zones, the links between trophic strategies and reproduction, and impacts of human disturbance, that must be addressed to clarify resilience mechanisms.

Extending ecological insights to spatial patterns, a mapping study of cold-water coral habitats in the northwestern Mediterranean combines data from Remotely Operated Vehicle (ROV) surveys, habitat modeling, and assessments of fishing pressure (Fabri *et al*., 2025). The study reveals pronounced vulnerability associated with bottom-contact fishing, emphasizing the urgent need for spatially tailored conservation measures to protect these sensitive habitats.

On the eastern side of the Mediterranean basin, Salomidi *et al*. (2025) present the first quantitative assessment of live red coral (*C. rubrum*) populations in Greek waters, specifically in the northwestern Aegean Sea. Using ROV and stereo-video SCUBA surveys at two previously exploited sites (47-60 m depth), the researchers measured coral density and morphometric parameters. In addition, they characterized the associated benthic communities and, notably, applied the Mesophotic Assemblages Conservation Status index (Enrichetti *et al*., 2019) for the first time in this region. The study offers essential baseline data on red coral populations and their surrounding mesophotic ecosystems in a largely unexplored area, underscoring the urgent need for continued monitoring and targeted research to guide effective conservation and management efforts.

In a timely contribution to deep-sea conservation science, Parimbelli *et al*. (2025) provide valuable insights into the challenges of modelling the distribution of deep-sea black corals in Irish waters. By comparing two widely used modelling approaches, the authors demonstrate how predictive performance can vary depending on method choice and data quality. Notably, the study introduces a methodological approach for assessing the reliability of predictions in complex, data-limited environments. Ultimately, the research highlights the importance of careful model evaluation and the integration of ecological knowledge to guide conservation planning.

Recognizing the value of human perspectives, another contribution examines recreational scuba divers' perceptions of long-term abundance trends for the Neptune grass *Posidonia oceanica* (Linnaeus) Delile, 1813 and the red coral *C. rubrum* (Mallo *et al*., 2025). While diver observations corroborate ecological data showing stable *P. oceanica* populations, perceptions of *C. rubrum* declines differ, likely because divers primarily explore areas outside of formal protection. The study underscores the value of local expert knowledge as an untapped source of historical ecological data that could enhance monitoring and management of MAFs.

Addressing the broader conservation context, Rizzo *et al*. (2025) review the legal protections currently afforded to MAF-forming species in the Mediterranean Sea. Their analysis identifies significant gaps within the legislative framework and stresses the need for more effective management measures. This baseline assessment is a crucial step toward strengthening the policy environment to safeguard MAFs biodiversity, biomass, and ecosystem function in the Mediterranean.

Concluding this selection, Zorrilla-Pujana and Maggioni (2025) recognize the persistent gap between scientific output and public engagement, and advocate for structured science communication training as a vital component of research excellence. Through a practical, creative, and collaborative training model, their initiative empowers scientists to more effectively share their work with broader audiences, ultimately enhancing the societal impact of EU-funded research and contributing meaningfully to marine conservation initiatives.

Together, these contributions offer a multi-scale, interdisciplinary perspective on the ecology and conservation of MAFs. By bridging scientific innovation, local knowledge, and policy framework analysis, they lay the groundwork for more integrated and effective strategies to inform future management and protection efforts and safeguard these structurally and functionally critical ecosystems.

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References

Di Fabio, L., Giordano, B., Moirand, L., Bramanti, L., 2025. Polyp number estimation through photogrammetry: a proof of concept using the example of *Corallium rubrum*. *Mediterranean Marine Science*, 26 (2), 306-311.

Enrichetti, F., Bo, M., Morri, C., Montefalcone, M., Toma, M. *et al*., 2019. Assessing the environmental status of temperate mesophotic reefs: A new, integrated methodological approach. *Ecological Indicators*, 102, 218-229.

Fabri, M.-C., Dreidemy, J., Estournel, C., Vaz, S., Michez, N. *et al*., 2025. Mapping and conservation of cold-water corals in the Lacaze-Duthiers canyon for transboundary management. *Mediterranean Marine Science*, 26 (2), 349-369.

Johnson, M.P., Ferreira, J.A. 2025. Traits and metabolic constraints affect marine animal forest structure. *Mediterranean Marine Science*, 26 (2), 370-377.

Keith, D.A., Ferrer-Paris, J.R., Nicholson, E. Kingsford, R.T., 2020. The IUCN global Ecosystem Typology 2.0: Descriptive profiles for biomes and ecosystem functional groups. Gland, Switzerland: IUCN, 97 pp.

Lasker, H., Bramanti, L., Tsounis, G., Edmunds, P., 2020. The rise of octocoral forests on Caribbean reefs. *Advances in Marine Biology*, 87 (1), 361-410.

Lasker, H.R., Bramanti, L., Edmunds, P.J., Girard, J.F., Pages, N. *et al.*, 2025. Caribbean octocoral communities: finding the forest for the trees? *Coral Reefs*.

Mallo, M., Ziveri, P., Reyes-García, V., Rossi, S., 2025. Temporal shifts of *Posidonia oceanica* and *Corallium rubrum* in Cap de Creus (NE Spain): Recreational SCUBA diver's perception of change. *Mediterranean Marine Science*, 26 (2), 341-348.

Nelson, H., Bramanti, L. 2020. From Trees to Octocorals: The Role of Self-Thinning and Shading in Underwater Animal Forests. p. 401-417. In: *Perspectives on the Marine Animal Forests of the World*. Rossi, S., Bramanti, L. (Eds). Springer, Cham.

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

Parimbelli, A., Johnson, M.P., Howell, K., Laguionie-Marchais, C., Allcock, L., 2025. Licence to predict – Investigating approaches to modelling low-occurrence deep-sea Irish Antipatharia with a new evaluation metric. *Mediterranean Marine Science*, 26 (2), 400-417.

Ribeiro, E.M., Garcia, T.M., Soares, M.O., Rossi, S., 2025. The gaps in knowledge to understand the link between resilience and trophic ecology in tropical octocorals. *Mediterranean Marine Science*, 26 (2), 312-326.

Rizzo, L., Vega Fernández, T., Necci, F., Grelaud, M., Ziveri, P. *et al*., 2025. Can marine animal forests benefit from existing conservation measures? A systematic approach towards the identification of protected sessile benthic species in the Mediterranean Sea. *Mediterranean Marine Science*, 26 (2), 327-340.

Rossi, S., Bramanti, L., Gori, A., Orejas, C., 2017. An Overview of the Animal Forests of the World. p. 1-26. In: *Marine Animal Forests.* Rossi, S., Bramanti, L., Gori, A., Orejas, C. (Eds.). Springer International Publishing, Cham.

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

Salomidi, M., Marchiò, A., Issaris, Y., Gerakaris, V., Dailianis, T., Gerovasileiou, V., 2025. Advancing knowledge on red coral *Corallium rubrum* (Linnaeus 1758) populations and associated mesophotic communities in the Aegean Sea, Eastern Mediterranean. *Mediterranean Marine Science*, 26 (2), 378-392.

Zorrilla-Pujana, J., Maggioni, T., 2025. Systemic Science Communication Training for Powerful Impact in Marine Animal Forests. *Mediterranean Marine Science*, 26 (2), 393-399.