

SPOTLIGHT

The Marine Biodiversity Observation Network Pole to Pole of the Americas: Building a Community of Practice for Detecting Rapid Changes in Coastal Biodiversity

By Nicolas Moity, Gregorio Bigatti, Frank Muller-Karger, and Enrique Montes

The Marine Biodiversity Observation Network (MBON) is a global community of practice and network that links individuals and groups in an effort to monitor and understand changes in marine biodiversity. MBON functions within the larger framework of the Group on Earth Observations Biodiversity Observation Networks (GEO BON). These networks support mobilization of data to help nations to achieve the Sustainable Development Goals (SDGs) adopted by the United Nations (UN) in 2015 and to address their own internal, local management needs. Marine biodiversity data are important for allowing countries and local communities to monitor changes that result from local human pressures and climate change. Such data enable informed planning and management of coastal areas and resources.

MBON activities align with global initiatives that include the UN Decade of Ocean Science for Sustainable Development (2021–2030) and its programs, such as Marine Life 2030 and the Ocean Biomolecular Observing Network. A key focus is promoting standards for the interoperable collection and publication of marine biodiversity data (Muller-Karger et al., 2018, 2024) that are essential for assessments like those by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES).

Co-design is central to monitoring and using marine biodiversity data. MBON has established this process with marine protected area agencies, resource managers, academic institutions, and private groups across the Americas. This paper outlines the MBON Pole to Pole of the Americas (MBON Pole to Pole) initiative, a regional network of scientists, marine protected area staff, citizen scientists, and stakeholders all working to understand responses of coastal habitats to environmental change and to inform conservation, management, and policy.

MBON POLE TO POLE OF THE AMERICAS: ACHIEVEMENTS AND KEY EVENTS

MBON Pole to Pole (<https://marinebon.github.io/p2p/>) is a trans-national collaboration among institutions designed to implement continental-scale, long-term biodiversity monitoring across diverse coastal and marine ecosystems. It brings together groups with similar research and management interests from at least nine countries across the Americas.

MBON Pole to Pole has co-developed and published several standardized sampling protocols in English and Spanish for monitoring biodiversity on sandy beaches and on rocky shores (Montes et al., 2024). These protocols promote consistent methodologies across regions, ensuring data comparability over time and aiding contributions to large-scale biodiversity assessments and local change understanding. These protocols are publicly available on the UNESCO/IOC Ocean Best Practices repository (<https://repository.oceanbestpractices.org/handle/11329/1142>).

Network participants actively share methods and findings at international conferences and through scientific publications, including periodic GEO BON Open Science Conferences and American Geophysical Union meetings. This cost-effective approach has been embraced by resource managers and scientists across the Americas, including coastal and marine park agencies in Argentina, Brazil, Canada, Chile, Colombia, Ecuador, Mexico, United States, and Uruguay (Figure 1).

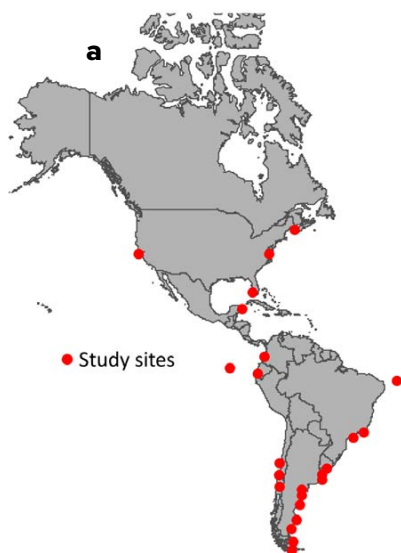


FIGURE 1. (a) Marine Biodiversity Observation Network (MBON) Pole to Pole of the Americas study sites. (b) Rocky shores are monitored using a standardized photo-quadrat method, shown here in the Galápagos Islands. Photo credit: Carlos Espinosa/CDF (c) Argentinian park rangers monitor the low tide rocky shore of Patagonia. Photo credit: Gregorio Bigatti/CONICET

SUCCESS STORIES: CAPACITY BUILDING AND DEVELOPMENT OF A COMMUNITY OF PRACTICE

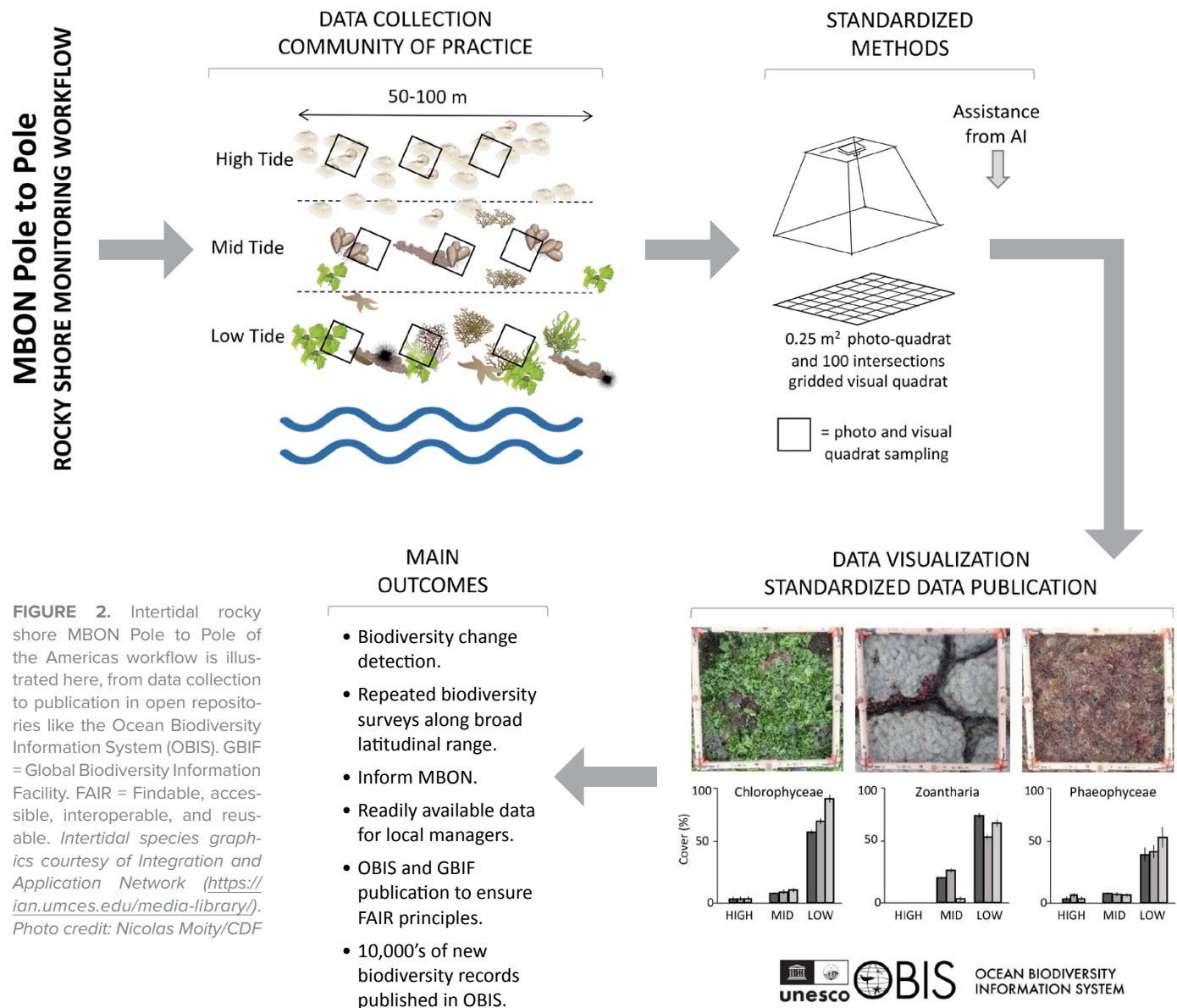
An outcome of MBON Pole to Pole is a community of practice that spans institutions, countries, and regions and that has fostered collaborations and capacity building among scientists and practitioners from diverse backgrounds, thus promoting the exchange of knowledge and best practices in biodiversity monitoring. By involving researchers from multiple countries during several workshops, fieldwork, and working virtually, MBON Pole to Pole has enhanced regional scientific capacity and cooperation and has contributed to the development of expertise in marine biodiversity observation techniques.

The three monitoring protocols produced serve as a collaborative focus for this community of practice. The rocky shore and sandy beach protocols have led to joint scientific publications. For instance, Montes et al. (2021) explored how unbalanced survey designs can optimize large-scale biodiversity monitoring efforts, providing practical insights into sampling strategies that are both efficient and effective. Bravo et al. (2021) demonstrate that artificial intelligence (AI) technologies can achieve faster and more accurate assessments of species composition and ecosystem health (Figure 2). This innovation represents a significant advancement in the way

biodiversity monitoring is conducted, bridging the gap between data collection and the detection of rapid or alarming changes in the intertidal community.

This novel image-based method was applied along the coast of Argentina with the support of park rangers of the National Parks Administration and personnel from state-level marine-protected areas (MPAs) trained to implement the rocky shore monitoring protocol in workshops carried out in March 2023 and January 2024 (Figure 1c). This protocol was co-designed by MPA personnel and scientists during these capacity-building activities, therefore empowering local MPAs to integrate cutting-edge monitoring techniques into biodiversity management. Similar efforts have expanded to Chile and Uruguay and now occur in almost 20 localities (Figure 1), producing more than 20,000 images that are being analyzed by AI at the end of 2024. Additionally, Science Clubs coordinated by the Science and Technology Secretariat of Tierra del Fuego, Argentina, are using this protocol to engage scholars in monitoring coastal biodiversity changes and to promote the conservation and health of marine ecosystems.

Since August 2018, MBON Pole to Pole has conducted numerous workshops on data standardization using the Darwin Core schema that integrates in situ and satellite observations, visualization of data



with open-source tools (R), and publishing in the Ocean Biodiversity Information System (OBIS) and the Global Biodiversity Information Facility (GBIF). As a result, tens of thousands of new biodiversity records from coastal habitats across the Americas, from Canada to Patagonia, are now publicly available in OBIS, with more data continually added. These workshops combine field and laboratory training in surveying techniques and data management, emphasizing standardized data publication to ensure long-term availability. Publishing in OBIS and GBIF guarantees that MBON Pole to Pole data will be permanently archived, accessible to local researchers and policy-makers, and valuable for regional and global assessments.

CHALLENGES: FUNDING, COVID-19, AND SUSTAINING MOMENTUM

MBON Pole to Pole is successful because it is locally led. The need for biodiversity information and the mutual support provided by members of the community of practice have resulted in overcoming significant challenges. Although the geographic reach and community of practice are attractive to funding agencies, one of the primary obstacles has been securing consistent funding to sustain the network's activities. While funding covers workshop costs and necessary instrumentation, researchers involved in MBON Pole to Pole contribute their time voluntarily, which limits the scope and continuity of some initiatives. Reliance on intermittent funding has also made it difficult to maintain momentum following workshops and other collaborative events. To address this, the new standardized photo-quadrat methods using AI are designed to collect high-quality data at low implementation costs.

The COVID-19 pandemic further exacerbated these challenges, particularly by disrupting plans for MBON Pole to Pole's main workshops. However, the group continued working virtually, leading to the publication of a paper that formed the basis for the new AI-based protocol and validating MBON Pole to Pole's utility in several countries across the Americas (Bravo et al., 2021).

FUTURE OPPORTUNITIES AND LESSONS LEARNED

Looking ahead, MBON Pole to Pole offers opportunities for local and regional impact. Securing funding is crucial for sustaining the network and its capacity-building efforts. International workshops and conferences will strengthen the community by sharing success stories, engaging new participants, and refining methodologies.

Future capacity development will focus on new monitoring techniques such as environmental DNA (eDNA) sampling, plankton imaging, acoustic monitoring, and use of drones, which could expand monitoring activities to subtidal zones and over larger spatial domains and also increase sampling frequency. Developing a decision support system to integrate biodiversity data into policymaker-friendly formats will help bridge the gap between science and policy. Including MPA personnel in data collection, alongside AI for rapid analysis, will ensure long-term monitoring success.

In conclusion, MBON Pole to Pole has significantly advanced marine biodiversity monitoring in the Americas. The co-design network fosters collaboration, capacity building, and innovative problem solving. Its success underscores the importance of standardized protocols, technology, and community engagement in biodiversity observation. Sustained funding and momentum are crucial to fully realize its potential. By expanding its scope and adopting new technologies, MBON Pole to Pole can continue providing vital data to support informed decisions on marine conservation and sustainable resource use.

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