

MARCO-BOLO Policy Brief: Addressing Challenges in the Biodiversity Monitoring Data Ecosystem

July 2025

Summary

Access to reliable and high-quality biodiversity data is crucial for evidence-based decision-making in marine conservation and policy, notably for the implementation of the EU biodiversity and climate adaptation strategies, the EU Habitats and Marine Strategic Framework directive and the Kunming-Montreal Global Biodiversity Framework (GBF). However, despite significant advances in data collection, there remain critical bottlenecks that prevent stakeholders from effectively utilising these data. Key challenges include the **limited use of international and sustainable repositories, inconsistent data formats, poor metadata quality, and a lack of practical data products.**

To better understand stakeholders' challenges, barriers and needs related to biodiversity monitoring data, the **MARCO-BOLO** (MARine COastal BiOdiversity Long-term Observations) project, funded by the EU's Horizon Europe programme, conducted an extensive stakeholder survey. The **MARCO-BOLO** project seeks to enhance the use of marine biodiversity monitoring data for decision-and policymaking by addressing identified challenges contributing to data standardisation, and harmonisation, improved accessibility, pioneering new technologies, and promoting stakeholder collaboration.

This document highlights key findings on current stakeholder practices and challenges, and provides recommendations to enhance data integration and improve stakeholder engagement with biodiversity data, ensuring more effective support for decision-making processes.

Recommendations



For Researchers and Biodiversity Monitoring Institutions

- Contribute to enhanced metadata quality and standardisation by adopting **standardised metadata protocols and minimum metadata standards** for seamless interoperability.
- Use frameworks like Essential Biodiversity Variables (EBVs) and Essential Ocean Variables (EOVs) to **promote global consistency and data integration in trusted international repositories**.



For Governments and Funding Agencies

- Encourage the use of **international platforms** such as EMODnet, GBIF, and OBIS (see Table 1) to **ensure data interoperability and sustainability**.
- **Connect local and project-based repositories with international platforms** to enhance consistency, long-term sustainability, and scalability.
- **Provide sustained financial support** to ensure repositories such as EMODnet, GBIF, and OBIS can manage increased data flows and maintain reliable infrastructures.
- **Invest in training programs** to strengthen data literacy and technical capabilities among Member States.



For Collaborative Research Projects such as MARCO-BOLO

- **Deliver actionable tools and data products** that are directly usable by policymakers, scientists, and conservationists in producing and using integrated and standardised biodiversity data.
- **Facilitate stakeholder engagement** by connecting technical developers and data managers with stakeholders to co-design products and ensure they meet current needs and address identified challenges.
- **Provide effective knowledge transfer** by ensuring that tools and data products are clearly presented and communicated to the respective audiences.
- Align project actions with **established frameworks** and **ongoing initiatives**.
- **Provide capacity-building programs** to improve data literacy across stakeholder groups in different Member States acknowledging existing disparities in data literacy and technical capabilities.

Use of Repositories

There is a diverse capability of biodiversity data services and repositories with each one serving a specific role depending on the users' needs, geographic scale of the data and the "service offer", i.e., the thematic(s) offered within marine and/or other biodiversity domains.

► **Recommendations:** These repositories and services already interoperate, yet more can be done to support FAIR and interoperable data, specifically by ensuring that national and project based repositories feed into international data infrastructures.

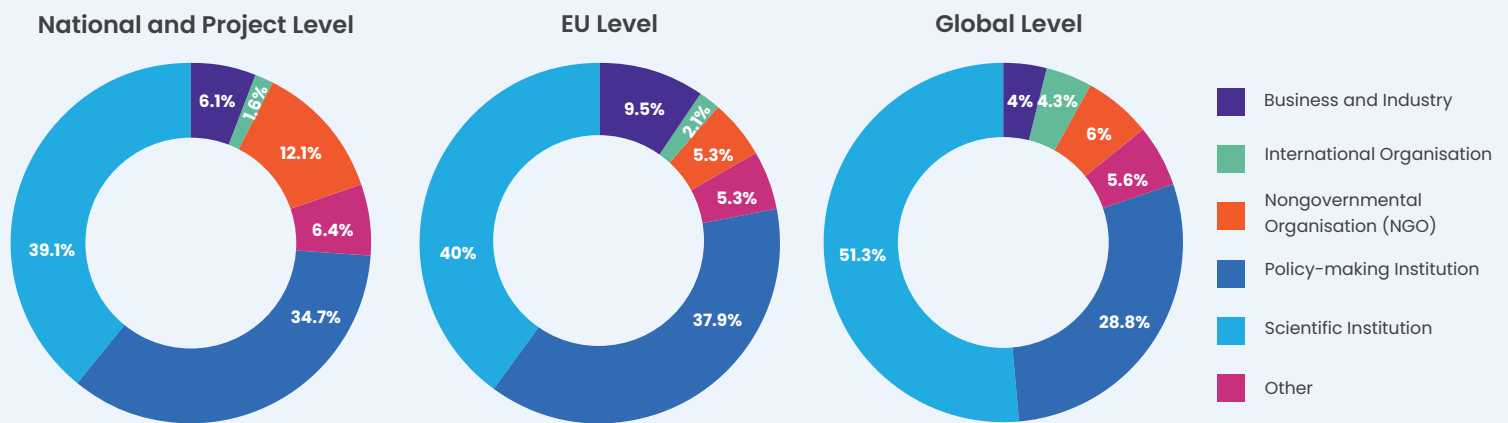


Figure 1 – User affiliation for repositories on different levels

- Overall, scientific and policy-making institutions are the dominant user groups across all levels. **National and Project Level:** Users are primarily from scientific institutions (39.1%) and policy-making institutions (34.7%), with notable participation from NGOs (12.1%). **EU Level:** The highest share of users are from policy-making institutions (37.9%), and scientific (40%), with smaller yet significant shares from business and industry (9.5%), and NGOs (5.3%). **Global Level:** The majority are from scientific institutions (51.3%), followed by policy-making institutions (28.8%). NGOs, international organisations, and business have minor shares.
- There appears to be a distinction whereby global systems are more relevant for scientific purposes, while policy users tend to rely on systems that are closer to the data source.
- National and project-based databases often lack long-term infrastructure and interoperable standards.

Table 1 – Overview of international Biodiversity Monitoring Repositories/Platforms

Name	Scope	Focus	Target Audience
GBIF (Global Biodiversity Information Facility)	Global repository for all biodiversity data (terrestrial, freshwater, and marine)	Broad biodiversity data, including species occurrence records from various sources (museums, citizen science)	Researchers, policymakers, conservationists
OBIS (Ocean Biodiversity Information System)	Community-based global database dedicated to marine biodiversity data	Actionable data and data-derived products on the diversity, distribution and abundance of marine organisms and habitats	Marine planners, scientists, researchers and decision-makers
EMODnet (European Marine Observation and Data Network)	European-focused platform for marine data, products and metadata	Integration of physical, chemical, biological, and human activity data related to Europe's marine waters	Marine policymakers, researchers, environmental agencies

Data Consistency

Survey respondents identified data consistency and lack of metadata as the most common challenges.

► **Recommendations:** Internationally recognised frameworks for data collection (such as **EBVs**¹ and **EOVs**², see Box 1) should be adopted during data collection, where appropriate and possible, whilst adhering to European funding and data/metadata guidelines e.g., INSPIRE Directive and Marine Strategy Framework Directive (MSFD). Metadata collection should be based on interoperable and internationally recognised standards such as the Darwin Core (**DwC**)³ or Minimum Information about any Sequence (**MiXS**)⁴; when studies include the collection of eDNA) when linking them to the associated datasets in the various repositories (addressed by **MARCO-BOLO Deliverable 3.1 “Meta-analysis of current marine, coastal, freshwater and terrestrial biodiversity observation variables, methods/protocols and tools”**).

Box 1 – Essential variables

Essential Biodiversity Variables (EBVs) and **Essential Ocean Variables (EOVs)** are standardised frameworks designed to monitor and assess changes in biodiversity and marine ecosystems. EBVs provide a unified set of measurements to track biodiversity across terrestrial, freshwater, and marine environments, facilitating the integration and comparison of data globally. EOVs focus specifically on marine ecosystems, capturing critical physical, chemical, and biological indicators to monitor ocean health.

- A significant portion of respondents reported inconsistent data (~52%) and a lack of metadata (~46%) (Figure 2) as major barriers to effectively using biodiversity monitoring data for policy and decision-making.⁵ Specific issues include a lack of **information and standardisation of biodiversity observation methods** (addressed by **MARCO-BOLO Deliverable 2.1 “Interim report on the performance of eDNA- based approaches and associated optimal diversity indices for biodiversity observations”**).
- and **non-harmonised monitoring protocols** (addressed by **MARCO-BOLO Deliverable 3.1 “Meta-analysis of current marine, coastal, freshwater and terrestrial biodiversity observation variables, methods/protocols and tools”**).
- Interoperability and accessibility issues were also commonly encountered, with nearly 40% of respondents regularly facing difficulties in integrating data across different platforms.

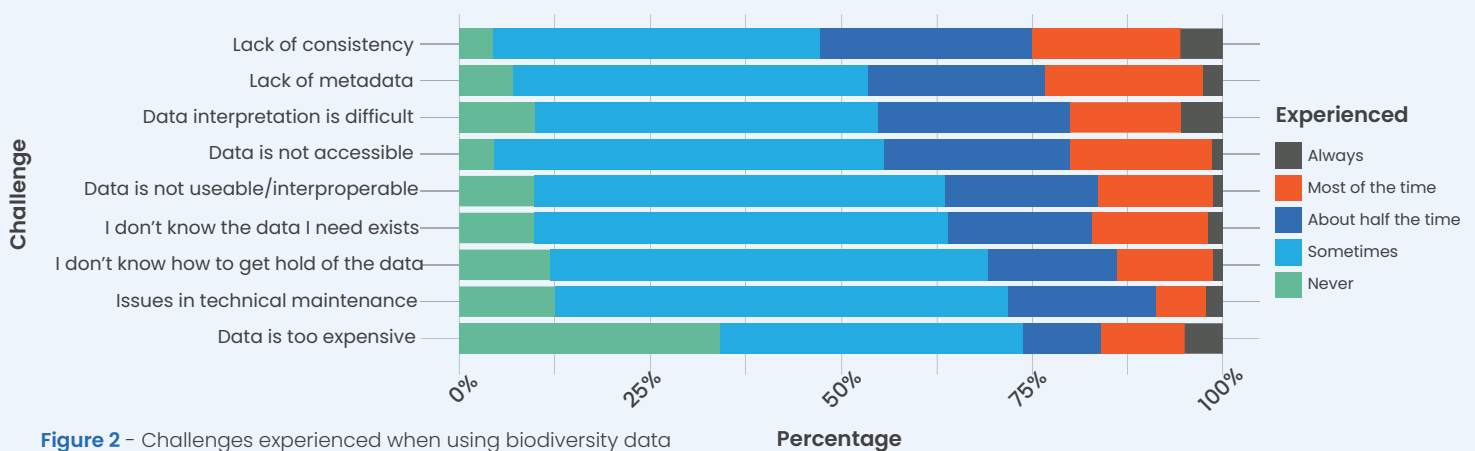


Figure 2 – Challenges experienced when using biodiversity data

Percentage

1 H. M. Pereira et al., “Essential Biodiversity Variables,” *Science* 339, no. 6117 (January, 2013): 277–78, <https://doi.org/10.1126/science.1229931>.
2 GOOS (Global Ocean Observing System), “Essential Ocean Variables – Global Ocean Observing System,” accessed June 13, 2024, <https://goos.ocean.org/what-we-do/framework/essential-ocean-variables/>.
3 J. Wiecek et al., “Darwin Core: An Evolving Community-Developed Biodiversity Data Standard,” *PLoS ONE* 7, no. 1 (January, 2012): e29715, <https://doi.org/10.1371/journal.pone.0029715>.
4 P. Yilmaz et al., “Minimum Gene Sequence (MIMARKS) and Minimum Information about Any (x) Sequence (MiXS) Specifications,” *Nature Biotechnology* 29, no. 5 (May 2011): 415–20, <https://doi.org/10.1038/nbt.1823>; “FAIRsharing | MiXS – MIGS-EU,” <https://fairsharing.org/5920>.
5 Similar challenges were reported by C. Jolly et al., “Value Chains in Public Marine Data: A UK Case Study” (Paris: OECD, July, 2021), <https://doi.org/10.1787/d8bbdcfa-en>.

Practical Products

Stakeholders have a strong demand for integrating data across platforms, as well as for practical products such as maps to support decision-making.

► **Recommendations:** The reported data needs (see Figures 3 and 4) support a shift from simply providing access to data to delivering practical, user-friendly products that stakeholders can directly apply in their work. **MARCO-BOLO's Deliverable 7.2 "Project Data Management Plan"** is a highly practical tool that provides a template for a data management plan, following best practices, that contains clear and precise guidance for scientists. This data management guide helps ensure your data is archived in trusted, reliable, and long-term repositories and helps standardise your data, making it **Findable, Accessible, Interoperable, and Reusable (FAIR)**.

Stakeholders were asked to voice their needs concerning biodiversity monitoring data, this is a sample of their answers:



Figure 3 – Representation of stakeholders identifying and voicing challenges and needs when dealing with biodiversity monitoring data

Asking stakeholders about their needs (Figures 3 and 4), showed that there is a strong need for maps (largely by policymakers) and tools to integrate data (largely by scientists).

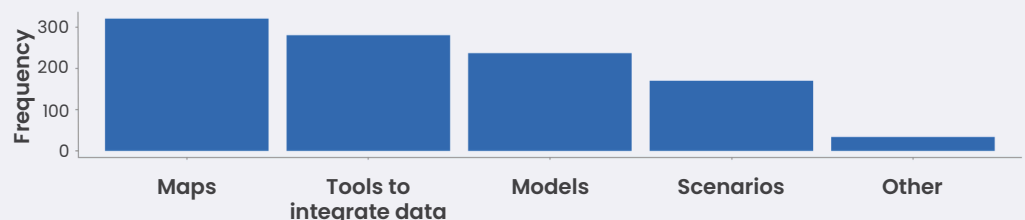


Figure 4 – Stakeholders' responses to products and tools needed

MARCO-BOLO addresses these aspects through:

- Dynamic maps that combine different data layers and sources that can be useful products for policymakers. Maps, although data sources, contain spatial and temporal biases (addressed by **MARCO-BOLO Deliverable 5.4 “Summary of results on the multi-disciplinary mapping of the alien species distribution and impacts on the European coastal and marine habitats” and the use case in cooperation with MPA Europe**).
- A centralised portal providing access to all available tools for data analysis, developed in the context of different monitoring programmes, that can help ensure biodiversity monitoring data is both available and usable for a range of practical user needs (addressed by **MARCO-BOLO Deliverable 3.1 “Meta-Analysis of Current Marine, Coastal, Freshwater and Terrestrial Biodiversity Observation Variables”**).

Method: Stakeholder Survey

This brief is based on a stakeholder survey, conducted by WP6 of MARCO-BOLO. Between June and November 2023, **851 stakeholders representing terrestrial, freshwater, marine and coastal communities participated in the online survey**, resulting in **561 complete responses after data cleaning**. Respondents represented diverse affiliations including universities (146), national governmental institutions (139), research institutions (77), NGOs (58), local or regional governmental institutions (39), business and industry (30), international organisations (14), EU agencies (13), and others. Most respondents predominantly work in EU countries such as France (88), Austria (89), Germany (49), and Italy (49), and 136 participants reported predominantly working outside the EU (Figure 5).

It is important to note that whilst the main focus of MARCO-BOLO and the survey was on marine biodiversity repositories and services (e.g. OBIS, EMODnet, and others), the survey was promoted more broadly across other domains, including terrestrial and freshwater, where users are less likely to be familiar with or use marine biodiversity data repositories.

The survey aimed to explore and understand the **biodiversity monitoring data practices** (i.e., how stakeholders interact and operate with biodiversity data), the specific **challenges** they face, and the tools they need to improve their work with biodiversity monitoring data. The results contribute to a better understanding of the **community of biodiversity data users, producers, and managers**, fostering collaboration and knowledge sharing across these key stakeholder groups.

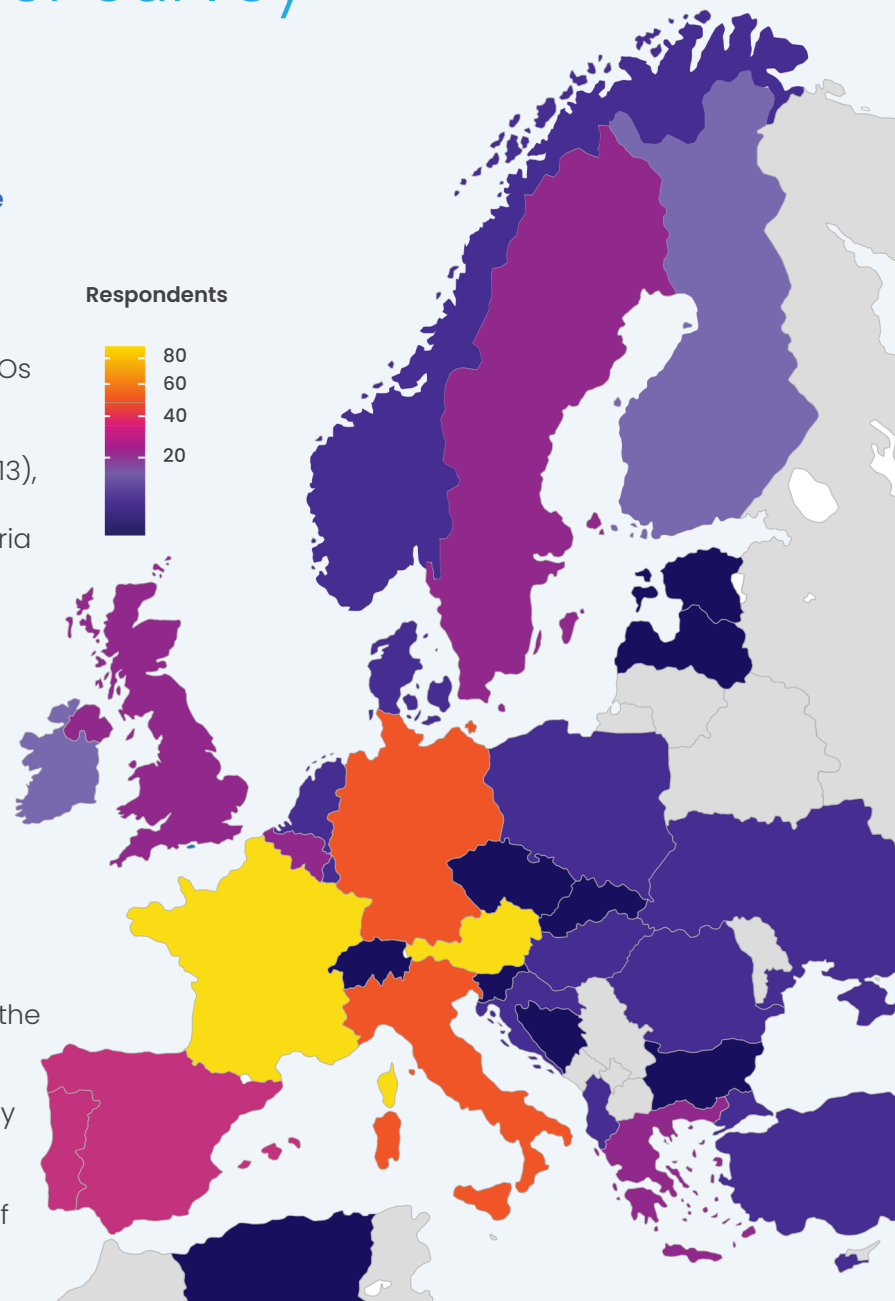


Figure 5 – Distribution of respondents

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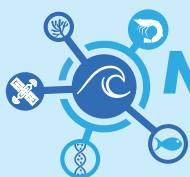
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