MARCO-BOLO - MARine COastal BiOdiversity Long-term Observations

Marine Biodiversity Networking Friday, 16th June 2023

Nicolas Pade, European Marine Biological Resource Centre (EMBRC-ERIC)

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Structure

• Context

• Motivation for the Project

• MARCO-BOLO
  • Objectives
  • Work Packages
  • Stakeholder Engagement
  • Expected Impact

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Context

• Our oceans are under tremendous stress today
  • Climate change
  • Unsustainable harvesting
  • Pollution
  • Biodiversity crisis!

• The oceans are highly topical at the moment
  • The United Nations Decade of Science and Sustainable Development
  • Digital Twins of the Ocean

• Series infrastructure short-comings to improve ocean health

• Addressing the plight of the ocean requires:
  • Effective observation and monitoring framework
  • A thorough understanding of marine ecosystems
  • Effective government and sound decision making
State of Affairs

• Despite decades of research, we still have huge knowledge gaps about marine ecosystems

• Crucial long-term time series are struggling, disappearing and generally not sustainable, particularly in biology
  • The majority are sustained by project funding with no long-term perspective

• Lack of concrete data products and outputs from biological data to decision makers

• Data not finding its way into decision making:
  • Data generated by observation mainly used by scientists
  • 21% private sector
  • 17% government/policy

OECD 2021
The Need

• Need to organize and structure biological observation
• Match the level of organisation and standardisation of oceanography
• Bring biological observation to decision making
• Demonstrate the worth of biological observation data
• Invest in and utilise common frameworks for looking at the ocean
• Go beyond the European sphere, integrating global initiatives
• Strengthen the sustainability of marine biological observation

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# AT A GLANCE

<table>
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<th><strong>PROGRAMME:</strong></th>
<th>Horizon Europe (HORIZON-CL6-2022-BIODIV-01-01)</th>
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<tr>
<td><strong>TYPE OF ACTION:</strong></td>
<td>Research &amp; Innovation Action (RIA)</td>
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<td><strong>DURATION:</strong></td>
<td>December 2022 – November 2026 (48 months)</td>
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<td><strong>COORDINATOR:</strong></td>
<td>European Marine Biological Resource Centre - European Research Infrastructure Consortium (EMBRC-ERIC), France</td>
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<td><strong>CONSORTIUM:</strong></td>
<td>28 participants from 14 countries</td>
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<td><strong>TOTAL BUDGET:</strong></td>
<td>€7.3 million</td>
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The MARCO-BOLO consortium brings together 28 organisations from research, industry, government and the not-for-profit sectors across Europe.
Basic Principles

• Coastal focus: connecting freshwater interphase with coastal observation
• Work only with raw data that is publicly available through our major repositories, e.g. EMODNet
  • The data we are already generating should be fit for multiple purposes
  • Collect once use many times (EU Policy)
• Apply existing standards
• Improve operational framework of biological observation
  • Strong focus on new technologies where standards and practices are still malleable
• Integrate social science approach to our work: understand our users and stakeholders’ needs, motivations, and barriers

MARCO-BOLO aims to deliver a transformative change in how marine, coastal and freshwater biodiversity is monitored and managed.

Researchers will tailor their research and observation data for direct use, delivering practical tools that will allow politicians and companies to:
➢ Determine biodiversity health
➢ Predict and monitor changes from imposed policies
➢ Proactively manage environments
PROJECT OBJECTIVES

MARCO-BOLO will enable a digital framework for biodiversity data streams and data access, building on international standards and approaches to establish the biological component of the coastal, marine and freshwater Earth observation infrastructure in Europe.

Specific objectives include:

➢ Improve acquisition, coordination and delivery of marine, coastal and freshwater biodiversity observations to relevant users.

➢ Enable technologies for cost-effective, timely and accurate biodiversity observations.

➢ Test new tools, technologies and models to better understand biodiversity decline.

➢ Empower European biodiversity observatory operators, data producers and users by creating and sharing best practice guidelines for gathering and using biodiversity data to contribute to biodiversity restoration efforts.
How will we achieve this?

5 Technical “work packages”

• WP1 - Delivering Essential Biodiversity Variables
• WP2 - Validating the use of eDNA
• WP3 - Linking Land & Sea Biodiversity Observations
• WP4 - Mapping biodiversity with autonomous systems
• WP5 - Modelling & Mapping Coastal & Marine Biodiversity

Stakeholder engagement & Community Integration

Communication, Outreach and Project Management
WP1 - Delivering EBVs

**Overall Objectives:** Co-develop and establish robust and lasting specifications for biodiversity (meta)data exchange with biodiversity and validate their fitness for purpose.

- Advance standardized and QC’ed data flows into long-term archives
  - Advance existing standards (e.g. Darwin Core, MIxS)
  - Apply provenance tracking (e.g. PROV, CWL)
- Establish endorsed Essential Variable data delivery
  - Ensure data generated comply with validated EOV & EBV requirements
  - Endorsed by GOOS & GEO BON
  - Tested and validated methodologies will be published in IOC OBPS
- Establish data flows into European biodiversity monitoring systems
  - Co-create specifications and test data pathways for MSFD and WFD reporting
- Demonstrate new data flows and standards with open DMP
WP2 - Validating the use of eDNA

Overall Objectives: Enable eDNA-based approaches for biodiversity monitoring across trophic and functional groups in marine, terrestrial and freshwater systems

• Validate eDNA-based approaches by meta-analysis of existing studies
  • Determine ability to detect spp presence, quantify abundance, estimate diversity

• Tuning & integration of available resources necessary for eDNA monitoring
  • Assess robustness of current sequence databases, functional information, tools etc
  • Test recent standards for eDNA occurrence data integration in databases

• Compare eDNA approaches to traditional methods

• Define eDNA-based variables for EVs, MSFD & WFD frameworks
  • Standardise protocols for amplifying taxa & spp prioritised by monitoring frameworks
  • Define EBVs that are spp or ecosystem-centred based on EBV classes

• Develop standard operating procedures for integration of eDNA-based observation
WP3 – Linking Land & Sea Biodiversity Observations

Overall Objectives: Advance the understanding of direct and indirect drivers of biodiversity loss along a land-to-sea continuum and their interrelations in freshwater, transitional, coastal and marine ecosystems

• Meta-analysis of land and sea biodiversity monitoring variables, methods, and tools and compare them against science and policy requirements
  • Determine ability to detect spp presence, quantify abundance, estimate diversity

• Testing biodiversity and environmental variables workflows in land-river-sea systems
  • to test and validate workflows of existing biodiversity and environmental monitoring programs (e.g., WFD, MSFD, H&B Directives, RIs),
  • to identify chains of effects and connectivity points between land and sea observation,
  • evaluate effects of existing terrestrial and freshwater conservation areas on coastal and marine biodiversity.

• Synthesise and generalise results for use at the European scale and beyond
WP4 - Mapping biodiversity with autonomous systems

**Overall Objectives:** To enable new and advanced technologies for cost-effective, timely and accurate biodiversity observations in coastal and marine regions

- Develop autonomous systems to deliver georeferenced maps of biodiversity attributes including genomic, taxonomic and habitat characteristics
  - Combining different sensor types with geolocation in AUVs: eDNA, imaging (UVP)
  - Combine optics and acoustics for benthos mapping
  - Test mapping of different plankton communities using remote sensing

- Enable a cost-effective network of biodiversity sensors in coastal and marine areas
  - Data transmission and integration for legacy (off-line) and new technology (5G-6G)

- Test multi-sensor biodiversity observation architecture
  - Design for sensor communication, data transmission directly to data repositories, and onboard data processing
WP5 - Modelling & Mapping Coastal & Marine Biodiversity

**Overall Objectives:** Real world demonstrations and analytical use cases supporting better understanding of marine biodiversity decline and ecosystem health

- Demonstrate the creation of new knowledge in biodiversity trends and the direct drivers along with their interrelationships
  - Habitat sustainability modelling
  - Determine casual relationships between external forcing and biological responses
- Document the potential of new and advanced observation approaches and technologies for the improvement of established biological indicators
  - Neural network models to identify early warning indicators for biodiversity change
- Non-indigenous invasive species management tool
  - Use combination of data to produce NIS heat maps and forecasts
- Spatial mapping of Blue Carbon
  - Assign carbon storage indices to maps based on habitat types
WP6 – Stakeholder Engagement and Community Integration

**Overall Objectives:** To ensure that the project outcomes are stakeholder-driven, match end-user needs and feed more effectively into policy process, supporting EU reaching biodiversity targets

- Profiling of data users: potential bottlenecks to data (re)use
- Build a Community of Practice (CoP) of data users and generators
  - Improving the uptake and use of biodiversity data and knowledge in decision making
  - Ensuring that biodiversity observations deliver outputs that interconnect biodiversity research with supporting policies
  - Enabling integration of internationally used (meta)data standards and ensuring interoperability within European and global observation frameworks
  - Feeding more effectively into policy and other processes to support the EU and its Member States in reaching national, regional and global biodiversity targets and restoration efforts
Core CoP - Roles and Responsibilities

- Provide advice on: stakeholder profiling and steer overall stakeholder engagement, who to bring into the wider CoP, Co-Design workshops, legacy of the wider CoP, etc.
- Represent and liaise with broader networks
- Share project updates and communicate/disseminate key outputs on knowledge transfer resources etc.
- Assess impact and uptake of key outputs within respective communities
- Plan and attend two major CoP events (M18 and M46)
- Meet online every 6 months (first meeting tentatively scheduled for July 2023)

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<th>Role</th>
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<tr>
<td>COOR</td>
<td>Frank Muller-Karger</td>
<td>University of South Florida / IOI / MBON</td>
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<td>COOR</td>
<td>Inga Lips</td>
<td>EuroGOOS</td>
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<td>INFRA</td>
<td>Joana Beja</td>
<td>EMODNET Biology / VLIZ / EurOBIS</td>
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<td>COOR</td>
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<td>COOR</td>
<td>Michelle Silva del Pozo</td>
<td>Biodiversa+</td>
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<td>COOR</td>
<td>Miguel Fernandez</td>
<td>EuropabON</td>
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<td>INFRA</td>
<td>Neil Holdsworth</td>
<td>ICES</td>
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<td>INFRA</td>
<td>Pierre-Yves Le Traon</td>
<td>Copernicus Marine Service / EuroGOOS / GOOS</td>
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Marco-Bolo CoP Activities

3 Co-Design & Co-Creation Workshops and 2 CoP Events

Through a series of Co-Design/Co-Creation Workshops and Events, the Marco-Bolo CoP will aim to enable transformative change by bringing together biodiversity observatory operators, data producers and users to innovate across the full biodiversity observation pipeline including:

- Testing and validating new monitoring tools (eDNA, acoustic, optical profilers)
- Creating observation networks using multiple inter-linked sensors
- Developing new modelling tools to predict biodiversity change and related ecosystem function
- Creating pathways linking data collection routines to linked Open Data Objects for direct use in delivering Essential Ocean Variables (EOVs) and Essential Biodiversity Variables (EBVs)
EXPECTED IMPACTS

✓ **Provide new tools and models:** Essential Variables (EVs) based on Environmental DNA (eDNA), real-time biodiversity monitoring methods, causal relationships and indicators between external forcings and biological responses.

✓ **Test of co-designed data streams and work flows:** Validate data exchange across EU and global biodiversity infrastructures, workflows for supporting the Water Framework Directive (WFD) and Marine Strategy Framework Directive (MSFD) monitoring and map blue carbon benefits and risks of non-indigenous invasive species.

✓ **Create a Community of Practice:** Agreed, scalable and transferable pilots and demonstrators producing high quality data streams and supporting a more coordinated approach for EU biodiversity observations aligned with international standards and best practices.
Thank you

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