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POLICY BRIEF

MAMBO's contribution to the development of the European Biodiversity Observation Coordination Centre (EBOCC)

Toke T. Høye, Pavel Stoev, Pierre Bonnet, W. Daniel Kissling

INTRODUCTION

The biodiversity monitoring data in Europe, which is currently available, is insufficient to generate knowledge that enables development and deployment of well-targeted actions to tackle the drivers of biodiversity loss, in a cost-effective manner and at different spatial scales. This stems from the insufficient spatial and temporal resolution of current monitoring programmes, but also from limitations in access to such data. Together this challenges efforts to quantify the state and trends of species and habitats and their dependence on the pressures exerted upon them. As such, current biodiversity assessments are based on information, which has substantial taxonomic, geographical, and temporal biases and gaps.

Novel methods and monitoring technologies can vastly expand the extent and resolution of biodiversity data. It is now possible to identify organisms from digital data such as images or sound recorded through citizen science projects or via in-situ sensors. Digital recorders (e.g. microphones, cameras, radars and other mobile and stationary sensors) together with artificial intelligence (AI) approaches have great potential for scaling up and automating the monitoring of ecological communities and wildlife species with less-invasive methods. Furthermore, new tools in the realm of high spatial resolution remote sensing have the potential to greatly enrich traditional approaches of ecological monitoring. Finally, the remarkable development of participatory approaches has led to the wider dissemination and use of automated identification tools based on multimedia content. MAMBO aims to increase knowledge and advance tools for monitoring species and their habitats more comprehensively.

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EVIDENCE AND ANALYSIS

The EU Parliament and Commission have just decided on a preparatory action to support the development and deployment of an European Biodiversity Observation Coordination Centre (EBOCC). The Terms of Reference for establishing a permanent EBOCC have recently been formulated by a coalition of significant national and EU-level stakeholders, as part of the EuropaBON project. EBOCC's mission is to coordinate biodiversity-related monitoring efforts in Europe and establish a shared European biodiversity monitoring framework by:

- **Supporting coordination between Member States and organisations involved in monitoring,**
- **Integrating the results of the monitoring schemes and implementing clear data flows to allow the harmonisation of EU, national and local monitoring data,**
- **Analysing the information at EU level, including quality control and modelling to derive indicators and to support policies and stakeholders.**

EBOCC's vision is to operationalise harmonised biodiversity monitoring data flows for the conservation and sustainable use of Europe's terrestrial, marine, and freshwater ecosystems. By 2030, EBOCC will help the EU to coordinate and streamline a system of observations, data assimilation methods, models, knowledge and capacity-building efforts to deliver regular information on the state of biodiversity in Europe, in ways that promote integration and re-use to benefit all EU citizens and institutions.

The MAMBO project is developing novel monitoring tools to enhance knowledge of the state of biodiversity in Europe. Through its demonstration sites and stakeholder engagement, MAMBO is showcasing the effectiveness and added value of its new technologies and thus provides critical input to how biodiversity-related monitoring efforts can be coordinated at the EU level. As such, MAMBO has the potential to substantially improve the ecological monitoring landscape in Europe and beyond. MAMBO contributes to the aims of the EU Biodiversity Strategy for 2030 by ensuring better coordination and streamlining of biodiversity observations in Europe.

POLICY IMPLICATIONS AND RECOMMENDATIONS

MAMBO is ideally placed to contribute to the vision and mission of EBOCC. MAMBO is currently mapping the landscape of stakeholders, synthesizing the needs of the user community and will be engaging this community in the co-design and adaptation of future monitoring tools and technologies. MAMBO is creating dialogue to ensure that its monitoring tools are integrated with key existing research infrastructures related to the harvesting, transformation, publishing and synthesis of biodiversity monitoring data. The technological advancements related to species monitoring tools are focused on joining existing training databases of images and sound and expanding them for underrepresented taxa such as invertebrates for improved spatial and taxonomic coverage. This is leading to better-performing machine learning models, which can work in regions, where such tools are currently unavailable. It is also leading to new image-based monitoring applications, such as a tool to infer community data directly from images of permanent plant plots. New indicators of habitat condition are being derived through remote sensing images and lidar data for better tracking of progress toward ecological restoration and integrated machine learning-powered tools to map habitat types at fine spatial resolution and large spatial extents are emerging through advanced technical developments. The data from MAMBO tools are fed to integrated models interfacing existing and novel data streams related to species and habitats for better hind- and fore-casting and to design adaptive monitoring strategies, where models can pinpoint regions of highest uncertainty in species distribution models. Finally, the cost-efficiency of MAMBO tools is scrutinised to assess under which circumstances their application brings the highest value.

- **MAMBO can work with EBOCC and EU research infrastructures to define a strategy for implementation of novel technology in biodiversity monitoring across the EU;**
- **MAMBO understands and delivers state-of-the-art knowledge in biodiversity monitoring technology development (low TRL levels) and can advise EBOCC on the implementation of emerging technologies in the coming years; MAMBO's innovations and novel monitoring methods of relevance to EBOCC include: AI-based image recognition for European animals and plant communities; Acoustic detection and monitoring of animals; Automatic insect cameras; Satellite and airborne remote sensing (including drone imagery and LiDAR) for mapping the distribution of ecosystems and habitats and for measuring habitat condition.**
- **MAMBO is connected to stakeholders in the private sector, NGO's and public sector and can facilitate private/public partnerships in the future implementation of novel technologies. MAMBO's stakeholder network could add to the network developed within EuropaBON for the needs of EBOCC;**
- **MAMBO is currently demonstrating its tools across the EU and welcomes parties to learn from these tools and technologies and to provide feedback.**

SUSTAINABILITY AND LEGACY

MAMBO is a strong advocate of the FAIR principle. As such, both the raw data, but also the workflows, data management infrastructure, data analysis and models can be embedded in services provided by EBOCC in the future.

For example, the project is contributing to the development of an open-source framework for generating fine-scale maps of the spatial distribution of species from biodiversity occurrence and survey data. This open and scalable framework enables the mobilisation of millions of occurrences on a continental scale for training DeepSDM-type AI models. Deployment of the results obtained, in the form of map rasters and APIs, enables managers to finely analyse the current potential distribution of species, in order to carry out long-term management and conservation actions.

Within the framework of MAMBO, we are also developing automated visual analysis of plant communities, thus eliminating the need to annotate rich and complex visual content. In the long term, this work will make it easier to detect species from photographic surveys, whether taken with cameras or connected objects.

PROJECT OBJECTIVES AND METHODOLOGY

EU policies, such as the EU biodiversity strategy 2030 and the Birds and Habitats Directives, demand unbiased, integrated and regularly updated biodiversity and ecosystem service data. However, efforts to monitor wildlife and other species groups are spatially and temporally fragmented, taxonomically biased, and lack integration in Europe. To bridge this gap, the MAMBO project will develop, test and implement enabling tools for monitoring the conservation status and ecological requirements of species and habitats for which knowledge gaps still exist. MAMBO brings together the technical expertise of computer science, remote sensing, social science expertise on human-technology interactions, environmental economy, and citizen science, with biological expertise on species, ecology, and conservation biology. MAMBO is built around stakeholder engagement and knowledge exchange (WP1) and the integration of new technology with existing research infrastructures (WP2). MAMBO will develop, test, and demonstrate new tools for monitoring species (WP3) and habitats (WP4) in a co-design process to create novel standards for species and habitat monitoring across the EU and beyond. MAMBO will work with stakeholders to identify user and policy needs for biodiversity monitoring and investigate the requirements for setting up a virtual lab to automate workflow deployment and efficient computing of the vast data streams (from on-the-ground sensors, and remote sensing) required to improve monitoring activities across Europe (WP4). Together with stakeholders, MAMBO will assess these new tools at demonstration sites distributed across Europe (WP5) to identify bottlenecks, analyse the cost-effectiveness of different tools, integrate data streams and upscale results (WP6). This will feed into the co-design of future, improved and more cost-effective monitoring schemes for species and habitats using novel technologies (WP7), and thus lead to a better management of protected sites and species.

COORDINATOR

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PROJECT DURATION

September 2022 – August 2026 (48 months)