POLICY BRIEF

GUARDEN's and MAMBO Contributions to Next-Generation Biodiversity Monitoring through Plant Community Identification

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Context

The EU Biodiversity Strategy for 2030 calls for ambitious and coordinated efforts to improve biodiversity monitoring and halt biodiversity loss across Europe. However, current monitoring frameworks often face significant limitations, notably restricted spatial and temporal coverage, taxonomic biases, and slow data collection processes. These shortcomings create substantial knowledge gaps and hinder the ability to detect and understand the underlying drivers of biodiversity change, whether stemming from climate change, evolving land-use practices, or conservation efforts. Ultimately, these shortcomings can negatively impact the length and quality of decision-making processes of policymakers on the regional, national, but also and especially on European levels.

In this context, the systematic and protocol-based inventory of plant species emerges as a crucial requirement. Only structured, repeatable surveys can reliably capture changes in species compositions and habitat structures over time. Such systematic plant community inventories enable the tracking of subtle or abrupt ecological shifts, providing a robust evidence base to distinguish between changes induced by various factors (i.e climate change, local pressures like agricultural intensification or land abandonment). Moreover, they are essential to assess the outcomes of ecological restoration projects now strongly encouraged by the EU Nature Restoration Law and other Green Deal initiatives.

The GUARDEN and MAMBO projects are addressing these pressing challenges by pioneering innovative solutions for large-scale, automated, and cost-effective biodiversity monitoring. Central to this effort is the development of tools for community-level plant identification through high-resolution image analysis, fully integrated into the Pl@ntNet platform. By enabling rapid, accurate, and systematic identification of plant assemblages from field images, these European projects dramatically enhance the capacity to conduct consistent, protocol-based inventories at local, national, and continental scales.

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"Pl@ntNet is a citizen science platform and is notably known for its widely adopted mobile app for plant identification. Users take photos of plants, and the app uses an image recognition IA to identify the plant. Over the past decade, it has built a large, geolocated database of plant biodiversity, generating data for ecological research and conservation policies."

This advancement not only democratizes biodiversity data collection by empowering a broad range of users—from researchers and conservation practitioners to citizen scientists—but also ensures that biodiversity monitoring keeps pace with the dynamic changes affecting Europe's ecosystems. In doing so, we provide a critical step forward in enabling fine-scale, spatially extensive biodiversity assessments across Europe, aligning perfectly with the EU's ambitions to establish an integrated, evidence-driven approach to biodiversity conservation and ecosystem management.

Insights from Research and Innovation

GUARDEN and MAMBO have contributed to developing and deploying a new service within Pl@ntNet that allows users, including ecologists, conservationists, and citizen scientists, to identify entire plant communities from vegetation plot images. Key technical achievements include:

- Migration of Pl@ntNet's taxonomic backbone to align with global standards (Plants of the World Online checklist managed by Kew Botanical Garden, and the World Geographical Scheme for Recording Plant Distributions, managed by the TDWG community).
- Implementation of advanced AI models to automatically detect and quantify plant species composition and their visual coverage in complex images (based on Vision Transformers).
- Development of a dual-access system:
  - A RESTful web service for IT developers and automated workflows.
  - A user-friendly web interface for field practitioners and non-specialists.

This innovation streamlines biodiversity data collection, facilitates consistent monitoring practices, and democratizes access to complex identification technologies. The integration into Pl@ntNet, already widely adopted across Europe and globally, ensures rapid uptake by existing biodiversity networks, citizen science initiatives, and research infrastructures.

RECOMMENDATIONS

What's next ?

- Support the development and adoption of automated community-level plant monitoring: EU biodiversity policies (e.g., Birds and Habitats Directives, Green Deal targets) can benefit directly from integrating such novel tools into national and European-level biodiversity monitoring frameworks.

- Promote citizen science participation: Simplifying plant community surveys with accessible tools encourages broader public engagement and complements formal monitoring efforts.

- Ensure interoperability and open standards: The Pl@ntNet-based service aligns with FAIR data principles, supporting integration with EU biodiversity data infrastructures (e.g., GBIF, EEA, EBOCC).

- Invest in scaling and capacity building: Additional resources should be allocated to enable experimentation and extension of GUARDEN & MAMBO's solutions to other ecological and geographical contexts as well as to different data acquisition protocols, including support for intensive future data collection from drones and vehicle-mounted cameras, and to train end-users in leveraging these new technologies. These tools are already functional and readily deployable, making them valuable assets for biodiversity monitoring, both for acting agencies and policy-makers. However, continued investment and support beyond GUARDEN's lifespan is crucial not only to refine their capabilities and enhance performance but also to unlock new opportunities for additional features, data integration, and decision-making support in conservation efforts.

Conclusion

Through this community-level plant identification service integrated into Pl@ntNet, we offer a novel, efficient, scalable, and participatory approach to biodiversity monitoring.
Its implementation enhances Europe's capacity to monitor biodiversity changes and, likely to be widely adopted by decision-makers and experts, can further reinforce this ability, supporting evidence-based policymaking and directly contributing to the goals of the European Green Deal and the 2030 Biodiversity Strategy.

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Related scientific publication :

Espitalier, V., Lombardo, J. C., Goëau, H., Botella, C., Høye, T. T., Dyrmann, M., ... & Joly, A. (2025). Adapting a global plant identification model to detect invasive alien plant species in high-resolution road side images. Ecological Informatics, 103129.

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