

Biodiversa+ strategic biodiversity monitoring governance document (Phase II)

Recommendations to better harmonise biodiversity monitoring schemes at a transnational scale



Document Information

Grant Agreement number:	101052342
Project acronym:	Biodiversa+
Project full name:	The European Biodiversity Partnership
Biodiversa+ duration:	7 years
Biodiversa+ start date:	<u>Start date:</u> 1 st October 2021
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Deliverable title:	Strategic biodiversity monitoring governance document (Phase II): Recommendations to better harmonise biodiversity monitoring schemes at a transnational scale
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Work package title:	WP2 Promote and support transnational biodiversity monitoring
Task or sub-task title:	Task 2.5 “Establish a transnational network of national biodiversity monitoring schemes”
Lead partner:	Ministry of Environment, Finland (MoE_FI)
Picture credits	©Pixabay (cover picture)
Release date:	July 2024

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What is Biodiversa+?

The European Biodiversity Partnership, Biodiversa+, supports excellent research on biodiversity with an impact for policy and society. Connecting science, policy and practise for transformative change, Biodiversa+ is part of the European Biodiversity Strategy for 2030 that aims to put Europe's biodiversity on a path to recovery by 2030. Co-funded by the European Commission, Biodiversa+ gathers 81 partners from research funding, programming and environmental policy actors in 40 European and associated countries to work on 5 main objectives:

1. Plan and support research and innovation on biodiversity through a shared strategy, annual joint calls for research projects and capacity building activities
2. Set up a network of harmonised schemes to improve monitoring of biodiversity and ecosystem services across Europe
3. Contribute to high-end knowledge for deploying Nature-based Solutions and valuation of biodiversity in the private sector
4. Ensure efficient science-based support for policy-making and implementation in Europe
5. Strengthen the relevance and impact of pan-European research on biodiversity in a global context.

More information at: <https://www.biodiversa.eu/>

List of acronyms

Biodiversa+	European Biodiversity Partnership
EBOCC	EU Biodiversity Observation Coordination Centre
EBV	Essential Biodiversity Variables
EC	European Commission
EEA	European Environment Agency
EuMON	EU-Wide monitoring methods and systems of surveillance for species and habitats of Community interest
EuropaBON	Europa Biodiversity Observation Network
GBF	Global Biodiversity Framework
GEO BON	Group on Earth Observations Biodiversity Observation Network
CBD	UN Convention on Biological Diversity

Executive summary

This report presents key results, findings and recommendations developed under Biodiversa+ in its two first years regarding development and harmonisation of transnational biodiversity monitoring schemes. Although a significant amount of work lies ahead within the partnership, already the two first years have provided valuable lessons to be considered while developing transnational biodiversity monitoring in the European context:

- **Biodiversity monitoring must meet specific needs to be effective.** Building the relevant framework to identify these needs, i.e. identify actors who use biodiversity monitoring results and compile their use cases, is a necessary step to properly set biodiversity monitoring priorities. This includes identifying needs for harmonising and development of common indicators that can be communicated from local to global scales.
- **The establishment of common biodiversity monitoring frameworks is essential for effective mainstreaming of existing biodiversity data and emerging tools (i.e. novel technologies) into policy.** Overcoming this constraint requires the deployment of collaboration tools and effective capacity building efforts. Such a collaborative approach helps to ensure data quality, interoperability, and stakeholder engagement. The proposed harmonisation framework aims to align stakeholder interests, foster collaboration, facilitate data sharing, and promote effective biodiversity monitoring across various scales.
- **For a better use of outputs from biodiversity monitoring schemes by end-users (both public and private), it is necessary to design full workflows from biodiversity observations, via data processing and towards the uptake of such information in decision making processes.** Such workflows are ideally implemented via a federated approach, involving (multiple centres of) experts, research infrastructures and actors in policy making and businesses.
- **In terms of governance, each country (or sub-national region) should promote the establishment of a biodiversity monitoring coordination centre.** When a more complex structure is not feasible, as a minimum requirement, well-resourced focal points with a comprehensive overview of the national or subnational biodiversity monitoring systems should be in place to allow for efficient transnational cooperation. Biodiversa+ will identify steps towards setting up national and sub-national centres and develop a detailed vision, functions, and a funding model in the coming years.
- The Biodiversa+ biodiversity monitoring pilots have demonstrated that **when developing new monitoring schemes at the transnational scale, several new operational issues and bottlenecks emerge and need to be addressed and solved.** For instance, in monitoring involving physical samples that need to be transported and analysed in a centralised laboratory (e.g. soil biodiversity monitoring), the monitoring scheme will have to overcome hurdles related to national rules for collecting, sending and receiving of these samples. New schemes should be built on and learn from the experiences of existing transnational monitoring schemes.

I) Introduction

Biodiversa+, the European Biodiversity Partnership, in collaboration with EuropaBON and other large-scale initiatives, seeks to harmonise and coordinate national and sub-national biodiversity monitoring schemes at a transnational scale. The main steps of this work are described in Figure 1.

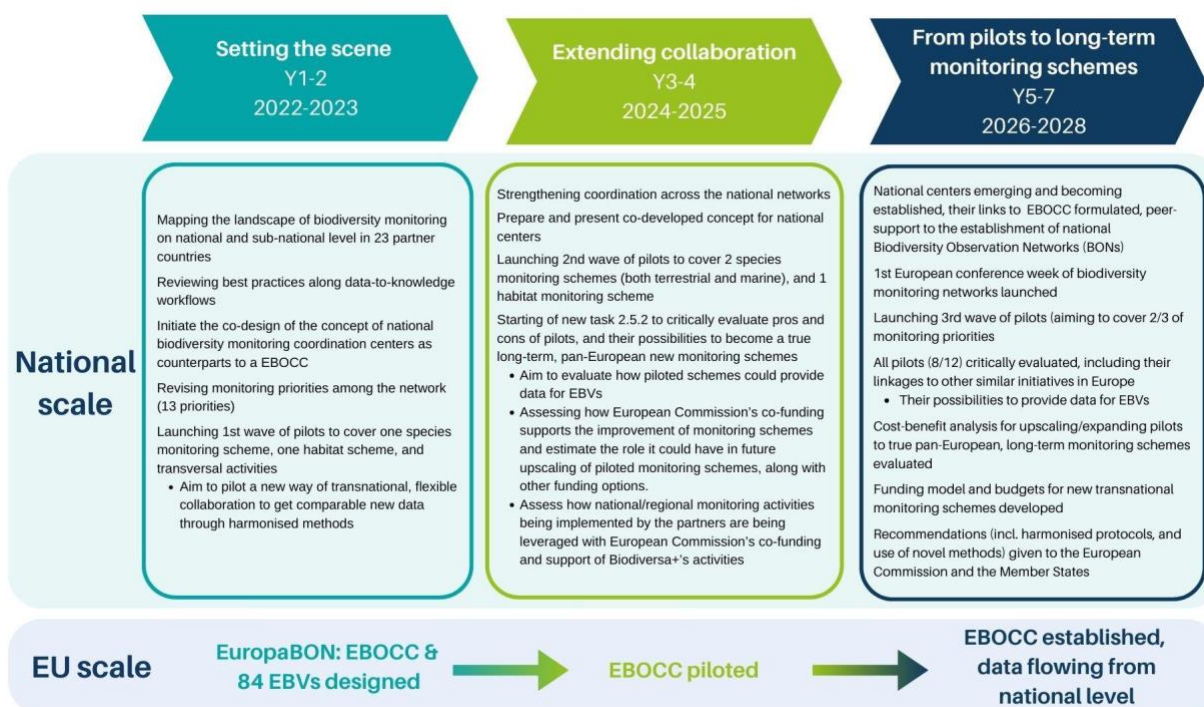


Fig. 1: Theory of change of Biodiversa+ biodiversity monitoring activities

In this context, Biodiversa+ released the first [Strategic Biodiversity Monitoring Governance Document \(Phase I\)](#) in May 2023 (Vihervaara et al. 2023a). The Phase I report describes the state-of-the-art of current national and sub-national biodiversity monitoring schemes in order to inform on the more general development of a European biodiversity monitoring governance model and the possible coordination of biodiversity monitoring schemes in the future. The report combined national and EU-level perspectives by presenting the views of national experts from the ministries of environment and environmental protection agencies, and the European viewpoints based on the biodiversity monitoring experts from academia, international organisations as well as the European Commission (EC).

In the Strategic Phase I report, six key recommendations for future steps were given that still remain relevant.

Recommendations from the Phase I report

- 1) Continuing to foster the development of harmonised protocols for prioritised biodiversity monitoring schemes and testing the applicability of the EBV framework for an integrated assessment of biodiversity change across participating countries. It is important to pay attention that the suggested new biodiversity monitoring schemes are applicable across the different biological and geographical scales, so that the data collected is relevant to both national and European purposes. So far, the EBVs remain rather conceptual and poorly known by Ministries of Environment and Environmental Protection Agencies. More time, pro-active engagement, and emphasis will be needed to detail out their potential beyond an academic background and demonstrate their usefulness for operational monitoring and reporting schemes.
- 2) Promoting and developing interoperable data infrastructures for national and EU levels. This should also consider the need for data management of big data volumes provided by novel technologies. Further investigations are needed to study options of universal data models (such as GBIF) and facilities of current international data infrastructures to support national data solutions. It still remains unclear how the hosting of biodiversity monitoring data could be arranged in Europe. This will need further investigations and discussions between the Member States and EU, and the key initiatives.
- 3) Dataflows between governments and the private sector should be defined and improved when existing, and ways forward should be investigated to improve the use of biodiversity monitoring data for sustainability assessments (including product life cycle assessments and footprint indicators).
- 4) More concrete next steps will be a continuous exchange of ideas among the key biodiversity monitoring entities.
- 5) A better overview of the costs of national biodiversity monitoring schemes, data integration and coordination is needed. This will be surveyed across the organisations that steer and fund biodiversity monitoring. This is also important to realise how the in-kind funding of Biodiversa+ can leverage harmonised and more comprehensive European biodiversity monitoring, and how to sustain the long-term monitoring, for instance, by the support of EC's top-up for Biodiversa+. Funding options should be expanded.
- 6) Biodiversa+ aims at supporting the development of the concept of national biodiversity observation/monitoring centres, in close collaboration with the design of the proposed European Biodiversity Observation Coordination Centre by EuropaBON.

The current Phase II report complements the first overview of the European biodiversity monitoring governance landscape by introducing the outcomes of the two first years of Biodiversa+'s work on biodiversity monitoring. Biodiversa+ aims to develop a transnational network of national biodiversity monitoring schemes across Europe and the work streams within the partnership have been aligned to support this aim. Chapter 2 of this report presents the progress in promoting and supporting transnational biodiversity monitoring and sheds light on:

- Shared priorities, adequate coverage, and indicators for biodiversity monitoring to better fit research, society and policy needs ([chapter 2.1](#))
- Harmonisation of protocols, methods, databases, and data formats ([chapter 2.2](#))
- Use of biodiversity monitoring data by research and by decision makers ([chapter 2.3](#))
- Governance of biodiversity monitoring and a transnational network of national biodiversity monitoring schemes ([chapter 2.4](#))
- Building transnational monitoring schemes through Biodiversa+ pilots: experiences from soil biodiversity and invasive alien species monitoring ([chapter 2.5](#))

Since the release of the Phase I document, the European biodiversity monitoring governance system has taken significant steps forward. The EuropaBON project has drafted the Terms of Reference for a proposed EU Biodiversity Observation Coordination Centre (EBOCC) (Liquete et al., 2024). The European Parliament has already allocated funding to pilot the Centre, underlining its importance (Council of the European Union, 2023). The final chapter of this report, [chapter 3](#), will also address the draft Terms of Reference for this proposed EBOCC in the light of national and sub-national viewpoints from Biodiversa+, while identifying steps forward with developing national and sub-national biodiversity monitoring coordination centres. The concept for national centres will be presented in the Phase III report, expected in August 2025.

II) Progress in promoting and supporting transnational biodiversity monitoring

2.1. Shared priorities, adequate coverage, and indicators for biodiversity monitoring to better fit research, society and policy needs

Biodiversa+ designates a set of biodiversity monitoring priorities to better fit research, society and policy needs. These priorities frame monitoring activities of the partnership, for instance with respect to indicators, harmonisation, governance or the pilot programme. The designation process is iterative, with biodiversity monitoring priorities being refined over time.

Biodiversa+ has defined a list of biodiversity monitoring priorities that have been developed since 2021. The priorities have already undergone a first revision to prepare the second cycle of the partnership (2023–2025). The revision process was based on a variety of resources such as topics emerging from the Biodiversa+ pilot programmes, workshops with Biodiversa+ partners and stakeholders, surveys to partners and the Biodiversa+ Advisory Board, as well as relevant reports and documentations (e.g. Hoyer et al. 2022; Moersberger et al. 2022; Junker et al. 2023). For a full description of the process, a comprehensive description of priorities as well as the initial version of priorities, see Basille et al. (2023).

The updated list of biodiversity monitoring priorities covers:

- 1. Protected Areas:** Biodiversity monitoring within protected areas in terrestrial, freshwater and marine realms, including Natura 2000 sites
- 2. Habitats:** Ecosystem perspective on habitats in terrestrial, freshwater and marine realms, with a particular focus on remote sensing
- 3. Marine Biodiversity:** Monitoring coastal and offshore marine biodiversity, from plankton to marine megafauna and seabirds
- 4. Invasive Alien Species:** Detection and monitoring of Invasive Alien Species in terrestrial, freshwater and marine realms, including Non-Indigenous Species in marine realm
- 5. Soil Biodiversity:** Monitoring micro-, meso- and macrofauna of topsoil and litter, from bacteria to earthworms
- 6. Insects:** Monitoring insect biodiversity, with a particular focus on butterflies and other pollinators
- 7. Wildlife Diseases:** Biodiversity facets linked to health issues, from animal and human perspectives
- 8. Urban Biodiversity:** Monitoring biodiversity in urban, peri-urban and urban-fluvial environments
- 9. Bats:** Monitoring the status and trends of bats across Europe
- 10. Genomic & Genetic Monitoring:** Applications of genetic approaches to biodiversity monitoring across levels of biodiversity: harmonisation and gaps

- 11. Wetlands:** Integrative biodiversity monitoring of European wetlands, including mires and peatlands
- 12. Common Species:** Standardised multi-taxa approaches for monitoring common biodiversity across Europe
- 13. Transversal Activities:** Non-specific biodiversity monitoring aspects: governance, information, metrics.

The revision process highlighted several issues that should be taken into account when designing transnational biodiversity monitoring. Most importantly, the revision process highlighted the need for a proper framework to define biodiversity monitoring priorities. Such a framework should put biodiversity monitoring in different contexts (“monitoring biodiversity for action”), such as assessment, management (conservation/restoration/sustainable use of resources), awareness and research. Each context then has its own needs of biodiversity monitoring data at all scales from global to local. The compilation and synthesis of these needs would in turn provide a list of relevant biodiversity monitoring priorities in a generic sense. A structured collective decision process will be put in place to devise this generic framework, and ultimately use it as a basis for Biodiversa+ to select priorities for the third cycle of the partnership (2025-2028).

As an extension of the biodiversity monitoring priorities for the partnership, specific work has been undertaken to define common indicators to communicate to users. Biodiversa+ carried out an overview of ongoing and planned European and global indicator work, including a survey to Biodiversa+ partners focusing also on needs for indicators. Detailed results are presented in Naeslund et al. (2023).

The overview of the current state of play for European and global indicators suggests that further harmonisation and development of biodiversity indicators is strongly needed. Especially for habitats, where questions of habitat quality, extent and connectivity have attracted more attention with the goals of the EU Biodiversity Strategy for 2030. In particular, there is a need to develop indicators for the goals of establishing a functional network of protected areas and launching an EU nature restoration plan. Also, suggestions for mapping and assessment of European ecosystems and their services and ecosystem accounting (i.e. System of Environmental-Economic Accounting Ecosystem Accounting, SEEA EA) are still not tested on larger scales. The upcoming soil and forest strategies also suggest indicators on habitats and ecosystems. There is also a need to develop indicators to follow pressures, especially pressures from invasive alien species. These needs for harmonisation and developments for biodiversity indicators are also reflected in the priorities for work on indicators within Biodiversa+, and together with the monitoring priorities (described earlier in this chapter) serve as guidance for the future work in Biodiversa+.

In the second instalment of Biodiversa+ (2023-2025), Biodiversa+ will continue to support harmonisation and development of biodiversity indicators according to these priorities, including development of guidelines for indicator development building on best practices for harmonising protocols (Silva del Pozo et al. 2023). The partners also wish to continue to share good practices for

work on biodiversity indicators and increase the cooperation, both within and between countries, and between different policy areas. In addition to this work, it is planned to explore the possibilities of listing and sharing of national information on indicators, and/or establish dashboards on indicator information. Biodiversa+ will also investigate the possibility to further coordinate Biodiversa+ indicator work with other ongoing indicator development for the priority indicator themes. This includes continuous close contacts and collaboration with the European Environment Agency, relevant projects, and groups such as EuropaBON, as well as follow the work within the EU Biodiversity Platform's (EUBP) Expert group on monitoring and assessment, and groups within the Convention on Biological Diversity (CBD) working on the indicators for the Kunming - Montreal Global Biodiversity Framework (GBF). An expert workshop to compare possibilities for development of biodiversity indicators based on monitoring data is also planned at the end of 2024 to strengthen collaboration and sharing of best practices across countries.

For the third instalment of Biodiversa+ and onwards (2025-2028), there is support for an increase of work on indicators within Biodiversa+, especially work on those used for public policies evaluation, and indicator harmonisation and/or development related to EU and global strategies such as the EU Biodiversity Strategy for 2030 and CBD's GBF. Future pilots that include the harmonisation of major biodiversity indicators and/or development within the suggested priority indicator themes should also be considered.

2.2. Harmonisation of protocols, methods, databases and data format

As part of its mission to establish a transnational network of national biodiversity monitoring schemes across Europe, Biodiversa+ actively promotes data interoperability and the harmonisation of biodiversity monitoring protocols. Our results from years 1 and 2 comprise two significant outputs.

Firstly, a [Report on the harmonisation and interoperability of datasets across regions and countries](#) (Basset et al. 2023) was completed. This report is derived from two workshops that were organised, addressing biodiversity monitoring data harmonisation and interoperability at both European and global levels, as well as at the (sub-)national scale. Through this collaborative effort, several key gaps hindering data harmonisation and interoperability were identified such as lack of data standards, technology needs and governance needs and have already been presented in the [Strategic Phase I document](#) (Vihervaara et al. 2023a).

Secondly, we have developed a [Guide on best practices to harmonise biodiversity monitoring protocols across scales - Support to effectively integrate monitoring results](#), (Silva del Pozo et al. 2023). This guide draws upon a literature survey on transnational biodiversity programmes and insights gathered from an expert workshop evaluating European capacities for harmonised biodiversity monitoring concerning data workflows and governance (Silva del Pozo & Body 2022). Strategies for harmonising protocols were examined and three main recommendations have been derived:

1. Monitoring protocols should be tailored to specific contexts, considering existing schemes, coverage gaps, and resource availability. Comparability can be promoted by adapting existing protocols to fit common minimum requirements.
2. Adopting a parallel data workflow that includes both raw datasets and Essential Biodiversity Variables (EBV) offers flexibility and comprehensive insights while addressing compatibility concerns.
3. Establishing common frameworks among monitoring communities is essential, necessitating collaboration and the formation of technical expert groups to define minimum requirements. This collaborative approach ensures data quality, interoperability, and stakeholder engagement. The proposed harmonisation framework aims to align stakeholder interests, foster collaboration, facilitate data sharing, and promote effective biodiversity monitoring across various scales.

The ongoing efforts within these Biodiversa+ activities are currently focused on identifying the minimum requirements for a cross-scale biodiversity monitoring programme to allow cross-scale inclusion and on identifying the best solutions for data interoperability and data storage in Europe. Additionally, we will aim at developing capacity building actions and supporting key stakeholders with best practices and training to optimise the use of standards. This will involve providing training and education workshops to equip stakeholders with the knowledge and skills necessary to adopt and implement common data standards, vocabularies, and harmonisation practices by semantic approaches, with a particular focus on the Darwin Core standard for biodiversity monitoring, including monitoring of EBVs.

Additionally, we will support cooperation and collaboration among European institutions and organisations involved in biodiversity data management to ensure consistency and harmonisation across the region. These workshops will also serve to identify best solutions for data interoperability and data storage, as well as capacity-building activities on data standards and data management. The outcome of these activities will be analysed and summarised as recommendations in a deliverable report on best solutions for data interoperability and data storage in Europe.

To effectively coordinate transnational biodiversity monitoring, there is a need to have a better overview of existing biodiversity monitoring schemes across Europe. EuropaBON already developed a database¹ in order to describe workflows on monitoring efforts delivering biodiversity information in Europe, mapping data flows and EBV production through the monitoring stakeholders and institutions. This service is focused on the coordination effort around these data, more than on the monitoring schemes themselves. To complete the needs in having a better overview of the landscape but more with a scheme and data production focus, Biodiversa+ is proposing to conceive and develop an informatic tool, BioDash. It would gather descriptions of existing monitoring schemes at different scales (local, national, transnational) and on the three natural habitats (terrestrial, marine, freshwater and their interfaces), with an EBV-based approach. Here, EBV-based approach means ability to describe which type of biodiversity information is provided by the monitoring schemes listed

¹EuropaBON monitoring database: <https://monitoring.europabon.org/monitoring/>

in the dashboard (e.g. a species abundance, geographic repartition etc.). This could enable synthesis on the monitoring landscape and bring schemes closer by using this EBV criteria. Other synthesis could be done regarding other criteria, such as stakeholders involved, species or habitats monitored, and scales studied. BioDash aims thus to enhance biodiversity monitoring efficiency, regarding the strategies for monitoring programmes (prioritisation, identification of gaps and overlaps, harmonisation, evaluation, improvement), the clarity of the monitoring landscape, the identification and valorisation of programmes (find relevant and qualitative data sources, understand the data) and the coordination between programmes and stakeholders while networking at a transnational scale.

The pre-guidance of this project consisted in a state-of-the-art of existing similar databases at national and transnational scales. It aimed to have first thoughts on BioDash position among this monitoring data landscape (e.g., hosted by the future EBOCC, integrated in national organisations, make it a European information node of GEO BON), and to identify teams we should work with, with the aim to ensure that BioDash will be complementary to and integrated in this landscape (as EuMON, EuropaBON and GeoBON). A cooperation with these projects should be to identify if we can conceive data flows between them and BioDash to re-use the existing data but also to organise the several projects to make these tools complementary. Also, Biodash features should be built in order to be complementary to what already exists, in terms of data, functionalities, scales and schemes. Also, pre-work was done on identifying users' categories (e.g., monitoring strategists, funders, schemes leader, data analysts) and monitoring stakeholders needs that could be handled by BioDash to meet an improvement of the monitoring landscape at different levels. At a programme level it could enable to valorise and evaluate monitoring schemes and ease the access to the understanding of it by sharing for instance contact information and data sources. At an inter-programmes level, it will enable searching and comparing existing monitoring schemes. At a monitoring landscape level, it could help in defining monitoring strategies by identifying data gaps, analyse if information produced fit with policy needs and highlighting available funding sources. By working with a service approach, the dashboard could become a support for a transnational monitoring coordination if an effort is made to ensure its long-term viability and added value among the biodiversity monitoring landscape. To do so, identifying and working with existing transnational initiatives and anticipating the global evolution of the European monitoring strategy is essential.

The next steps will be dedicated to the conception and the mock-up of the prioritised BioDash user interfaces and the conception of an interoperable and viable technical infrastructure (functional and technical specifications), to the definition of BioDash governance and long term strategy to ensure a sustainable position within the monitoring landscape (BioDash roadmap), and to the development of a primary informatic product, in order to deploy it among a user community of biodiversity monitoring stakeholders. One of the side outcomes of this work will be the analysis of the solutions and limits to deploy a supportive informatic project among a transnational network that is in constant evolution.

2.3. Use of biodiversity monitoring data by research and by decision makers

One of the long-term objectives of Biodiversa+ is to establish a transnational network of national biodiversity monitoring schemes that are well linked with research and innovation as well as policies. By reinforcing the links between biodiversity monitoring schemes outputs with end-users, Biodiversa+ aims to better inform on the status and trends of biodiversity, hence supporting decision making.

To start supporting the use of biodiversity data by research, Biodiversa+ organised a first expert workshop in 2022. The workshop focussed on how to use biodiversity monitoring data to produce trends and scenarios (i) and how to harmonise trend analysis for a better use at larger scale (ii). The main results of this workshop fed into the first [Biodiversa+ strategic biodiversity monitoring governance document \(Phase 1\)](#) (see chapter 1.6 therein). Future work, and a future expert workshop to be organised in the fall 2024 will, among others, build on these conclusions.

To better support the use of biodiversity monitoring data in decision making processes, Biodiversa+ decided to first focus on private decision-making processes as a way of complementing the work of EuropaBON, our key collaborator. Also building on the outcomes of a workshop gathering several private sector stakeholders, a dedicated *Report of the use of biodiversity monitoring data in private decision making* (Heck, 2023) provides elements to answer the question: “what is needed to facilitate the use (and sharing) of biodiversity data by the private sector?”. As the main conclusion, the report identifies that private sector actors need further guidance as well as capacity building support with the accessibility, availability, findability, and standardisation of biodiversity data. To meet these needs, Biodiversa+ plans to provide guidance documents to 1) help private sector actors find useful data and compare it with the pressures for biodiversity, to be better able to report for the policy needs, and to 2) give better insight for the private sector actors on FAIR data, data standards and data sharing, answering to questions like What is FAIR data or Darwin Core standard, and why should the private sector actors follow FAIR principles. Biodiversa+ plans to do this collaborating more closely with key European initiatives and projects such as for example the [EU Business & Biodiversity Platform](#), the Task Force on Nature-related Financial Disclosures [TNFD](#) and the [ALIGN project](#). Collaboration is important in order not to overlap with already existing efforts to provide guidelines for business on how to use biodiversity data to report on / improve their biodiversity footprint and on how to better share biodiversity data produced by private sector actors in accordance with the FAIR principles. Capacity building workshops are also foreseen to promote the use of biodiversity data in life cycle assessments and to improve understanding of EBVs by the private sector.

2.4. Governance of biodiversity monitoring and a transnational network of national biodiversity monitoring schemes

Biodiversa+ aims at developing a transnational network of national biodiversity monitoring schemes across Europe. In the first two years, Biodiversa+ work towards this goal resulted in two reports, which serve as key background resources for the development of transnational biodiversity monitoring governance in Europe. The first report, [Mapping of national and sub-national organisations that fund and steer biodiversity monitoring schemes](#) (Vihervaara et al. 2023b), concluded that in most of the countries, Ministries of Environment and/or Environmental Protection Agencies are the actors in charge of steering and governing biodiversity monitoring schemes. Biodiversity governance is split by realms (e.g., terrestrial and aquatic) in 2/3 of the countries. The second report, [Biodiversa+ strategic biodiversity monitoring governance document \(Phase I\)](#) report (Vihervaara et al. 2023a), compiled a first overview of current national and sub-national biodiversity monitoring schemes, and synthesised this knowledge to inform the more general development of a European biodiversity monitoring governance and coordination for the future.

Building on the findings of these reports, the Biodiversa+ pilot [Towards national biodiversity monitoring coordination centres: comparison of governance, data interoperability and standards](#) was launched in January 2023 (Lipsanen et al. 2024). The pilot was set up to support the establishment of a transnational European network of national biodiversity monitoring schemes by benchmarking the current situation of biodiversity monitoring governance on a national/sub-national level. The pilot compiled and analysed information from 10 participating countries and sub-national regions, and concluded that:

- There is great variation between countries and sub-national regions in terms of biodiversity monitoring governance, data management and interoperability solutions. However, the use of common data standards such as DarwinCore and metadata standard Ecological Metadata Language is relatively common.
- Biodiversity monitoring governance in countries and sub-national regions differs based on the centrality of one main responsible organisation and the overall number of organisations involved in biodiversity monitoring.
- Regarding data management and interoperability solutions, no distinct clusters of countries (or sub-national regions) emerge: while some are more advanced than others, each have areas that require improvement.
- State of play in developing the national centres is promising, as already half of the participating countries and sub-national regions report have a national centre in place.

Based on the findings of the pilot, there are several issues that should be kept in mind while further developing the transnational network of national biodiversity monitoring schemes. In terms of governance, it would be crucial for each country (or sub-national region) to establish a (sub)national

biodiversity monitoring coordination centre, or as a minimum requirement, well-resourced focal points, to allow efficient use of available information in policy and enhanced transnational cooperation. This is also needed for smooth interaction with the future EBOCC. Next, steps towards setting up national and sub-national centres should be identified, and a detailed vision, functions and a funding model should be presented in the Biodiversa+ Strategic Phase III report (forthcoming in August 2025).

While EBOCC forms an important framework for developing the transnational governance for biodiversity monitoring, it should be emphasised that the development of national and sub-national biodiversity coordination centres needs to be prioritised independently of EBOCC development. Regardless of the outcome of the EBOCC, transnational cooperation and enabling governance models are needed. Ideally, once EBOCC will be established, the national component of its governance model will be already covered by a comprehensive and functional network of national biodiversity monitoring coordination centres.

Biodiversa+ will continue to work closely with EuropaBON and other selected key bodies (JRC, EEA) to define a strategic framework that defines a common vision (end-goal) for biodiversity monitoring across Europe, as well as the major steps, collaborations and governance options to reach it. An important step in this regard was taken in the form of a dedicated workshop on Biodiversity Monitoring Governance in Europe, organised in Helsinki in May 2023. The workshop produced a preliminary list of possible functions for the national biodiversity monitoring centres, as well as a list of possible challenges in its setup. In the following workshop, organised in Tallinn in April 2024, the justification and possible activities for each function were collaboratively drafted. The concept for national centres will be presented in the Phase III report, to be published in August 2025.

In the coming years, the work towards a transnational network of national biodiversity monitoring schemes will focus on further developing the concept of national centres, finding out detailed budgets used for biodiversity monitoring in European countries as well as exploring the options to set-up long-term sustainable pan-European biodiversity monitoring schemes. An important aspect will be to strengthen cross-border collaboration and networking, including through an annual symposium / workshop with the European ministries, agencies and organisations that fund and steer biodiversity monitoring. These activities are directly following up the recommendations 4-6 given in the Strategic Phase I report.

2.5 Building transnational monitoring schemes through Biodiversa+ pilots: experiences from soil biodiversity and invasive alien species monitoring

The biodiversity monitoring pilots are actions launched by Biodiversa+ to be carried out by Biodiversa+ partners. One of the main objectives of the pilots is to support the harmonisation of biodiversity monitoring programmes on a pan-European scale by testing, for example, the use of a common protocol or a combination of protocols (when relevant), by testing the use of new

technologies, and by exploring how to better connect the different models of governance of biodiversity monitoring.

The pilots are a tool to foster harmonisation and increase the availability of data across time and scales in Europe, address biodiversity monitoring needs of the Biodiversa+ partners, and tackle some of the Biodiversa+ biodiversity monitoring priorities. The pilots are not a research programme but really a programme which is intended to be implemented by the national organisations in charge of biodiversity monitoring programmes, relying where relevant on research and outputs from other sufficiently mature programmes.

The pilots represent the first phase towards the establishment of transnational networks of national biodiversity monitoring programmes. Lessons learnt from the pilots will be an important element in the subsequent support from Biodiversa+ towards implementation of transnational long-term monitoring schemes.

Leading up to the launch of the first three pilot studies, thirteen pilot candidate proposals grouped under species, habitats and governance were developed with consideration to Biodiversa+ biodiversity monitoring priorities. For the first wave of the pilots, three pilots were chosen: i) monitoring of invasive alien species through introduction sites, ii) soil biodiversity in Natura 2000 sites and iii) comparison of governance, data interoperability and standards. The invasive alien species and soil biodiversity pilots will continue until the end of 2024, but provide already now some preliminary findings for the development of transnational biodiversity monitoring schemes. For the governance pilot, please see [Chapter 2.4](#).

2.5.1. Transnational monitoring of invasive alien species

Invasive alien species are, by definition, a problem that needs to be addressed at the transnational scale (IPBES 2023). The pilot [Monitoring invasive alien species with image-based methods](#) aims to pave the way for and evaluate scalable methods using novel technologies for monitoring invasive alien species at the geographical scale of the partnership (Høye et al. 2024).

The pilot works on two modules (a plant module and an insect module), which both employ image-based monitoring approaches to the monitoring of invasive alien species. The data from each module can feed directly into a transnational database and image processing pipeline for generation of transnationally standardised and automated monitoring data.

The image recognition tools developed locally, will be of great value at the transnational scale. One important perspective is that the tools can be used to monitor species already introduced to the country. Another important perspective is that models of species found in one country can be used for early detection of species as they may become introduced in other countries. Third, the economic burden of maintaining the digital infrastructure for databases and image-recognition will be much smaller for each active partner, if shared at a Pan-European scale. Finally, the image-recognition models will be more robust, when trained on data across a larger geographical scale with different

plant and insect communities. Among the opportunities and perspectives identified are the scalability of the methods trialled in this project. In the long-term, the image-based approaches offer highly cost-effective means to map and monitor the distribution of invasive alien species and can substantially shorten the time from when an observation is made until it enters databases and decision support systems on which management decisions are taken.

Final conclusions of the pilot will be available in early 2025.

2.5.2. Transnational monitoring of soil biodiversity

Long-term trends in changes in soil biodiversity related to global change remain poorly understood. Therefore, a transnational monitoring scheme is urgently required to define measures for conserving and restoring soil biodiversity. The pilot [Soil biodiversity in protected, near-natural forests](#) scrutinises and tests the necessary steps towards such a monitoring scheme (Seeber, 2024) building on the experiences of SoilBON — Global Soil Biodiversity Initiative and Land Use/Land Cover Area Frame Survey LUCAS.

During the first year of the pilot, a step-by-step protocol based on the SoilBON — Global Soil Biodiversity Initiative and LUCAS protocols was implemented to collect and analyse soil samples for their properties, as well as microbial and invertebrate diversity. A comparison was made between traditional and molecular species identification methods to provide methodological recommendations for a future transnational monitoring scheme. Additionally, administrative and logistical obstacles were identified, and possible solutions were suggested.

The first year of the pilot has revealed that a transnational monitoring scheme requires:

- a harmonised, well-defined, and easy-to-use protocol,
- clear instructions to reduce the risk of contamination for eDNA analysis,
- a list of minimum infrastructure requirements for participating institutions, and
- administrative support for understanding national regulations concerning the Nagoya protocol and the possible sending/receiving of soil and invertebrate samples.

Final conclusions of the pilot will be available once the pilot is completed.

III) Emerging landscape of transnational biodiversity monitoring in Europe: the way forward

This report has presented the key results, findings and recommendations regarding the development of transnational biodiversity monitoring under Biodiversa+ in its two first years. As the partnership is functional until the end of 2028, it is obvious that a significant amount of work still lies ahead. However, already the two first years have provided valuable lessons to be considered while developing transnational biodiversity monitoring in the European context:

- Biodiversity monitoring must **meet specific needs** to be effective. Building the relevant framework to identify these needs, i.e. identify actors who use biodiversity monitoring results and compile their use cases, is a necessary step to properly set biodiversity monitoring priorities. This includes identifying needs for harmonising and development of common indicators that can be communicated from local to global scales.
- The **establishment of common biodiversity monitoring frameworks** is essential for effective mainstreaming of existing biodiversity data and emerging tools (i.e. novel technologies) into policy. Overcoming this constraint requires the deployment of collaboration tools and effective capacity building efforts. This collaborative approach ensures data quality, interoperability, and stakeholder engagement. The proposed harmonisation framework aims to align stakeholder interests, foster collaboration, facilitate data sharing, and promote effective biodiversity monitoring across various scales.
- For a **better use of outputs** from biodiversity monitoring schemes by end-users (both public and private) it is necessary to design full workflows from making biodiversity observations, via data processing (to produce status and trend information) towards the uptake of such information (iteratively) in decision making processes. Such workflows ideally are implemented via a federated approach involving (multiple centres of) experts, research infrastructures and actors in policy making and businesses.
- In terms of **governance**, each country (or sub-national region) should promote the establishment of a biodiversity monitoring coordination centre. When a more complex structure is not feasible, as a minimum requirement, well-resourced focal points with a comprehensive overview of the national or subnational biodiversity monitoring systems should be in place to allow for efficient transnational cooperation. Biodiversa+ will identify steps towards setting up national and sub-national centres and develop a detailed vision, functions and a funding model in the coming years.
- The Biodiversa+ biodiversity monitoring pilots have demonstrated that when developing new trans-national monitoring schemes, several **practical issues and bottlenecks** need to be addressed and solved. For instance, in monitoring involving real samples that need to be analysed in a centralised laboratory (e.g. soil biodiversity monitoring), the monitoring scheme will

have to overcome hurdles related to national rules for sending and receiving these samples. New schemes should learn from the experiences of existing transnational monitoring schemes.

At the time of publication of this report, EuropaBON is finalising the Terms of Reference (ToR) for the European Biodiversity Observation Coordination Centre, EBOCC. The publication of the ToR and the piloting of the EBOCC following the funding from the European Parliament will mark significant steps towards a truly transnational biodiversity monitoring in Europe. As a co-author, Biodiversa+ has been actively involved in the development of the ToR, and worked towards ensuring that national and sub-national viewpoints have been reflected in the discussion.

Although it seems probable that the EBOCC governance model will not allow the sub-national regions to join EBOCC independently, Biodiversa+ will continue to develop a transnational network of national and sub-national biodiversity monitoring centres, in order to facilitate the transnational monitoring efforts. As noted earlier (Lipsanen et al. 2024), the development of this network needs to be prioritised also independently from the EBOCC process, although the ideal outcome will naturally be a multiscale governance model supported by coordination at EU level, national level and sub-national levels.

The Strategic Phase III document is foreseen to be published in August 2025. The report will tentatively present the Biodiversa+ concept for national biodiversity monitoring coordination centres and latest achievements towards transnational biodiversity monitoring in Europe.

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