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European Biodiversity Partnership

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Towards national biodiversity monitoring coordination centres: comparison of governance, data interoperability and standards

Conclusions of the Biodiversa+ Governance pilot

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What is Biodiversa+

Biodiversa+ is the new European co-funded biodiversity partnership supporting excellent research on biodiversity with an impact for policy and society. It was jointly developed by BiodivERsA and the European Commission (DG Research & Innovation and DG Environment) and was officially launched on 1 October 2021.

Biodiversa+ is part of the European Biodiversity Strategy for 2030 that aims to put Europe's biodiversity on a path to recovery by 2030.

The Partnership aims to connect science, policy and practise for transformative change. It currently gathers 80 research programmers and funders and environmental policy actors from 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/

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List of acronyms

AEWA	African-Eurasian Migratory Waterbird Agreement
BCE	Butterfly Conservation Europe
Biodiversa+	European Biodiversity Partnership
BMCC	Biodiversity Monitoring Coordination Centre in Europe (re-labelled EU Biodiversity Observation Centre (EBOC) after the finalisation of this report)
DwC	Darwin Core
EBCC	European Bird Census Council
EML	Ecological Metadata Language
EuropaBON	Europa Biodiversity Observation Network
FAIR	Principles of findability, accessibility, interoperability, and reusability of data
GBIF	Global Biodiversity Information Facility
HELCOM	Baltic Marine Environment Protection Commission (Helsinki Commission)
IPBES	Intergovernmental Panel on Biodiversity and Ecosystem Services
NOVANA	National Monitoring and Assessment Programme for the Aquatic and Terrestrial Environment in Denmark
NSMSBD	National System for Monitoring the Status of Biological Diversity in Bulgaria
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic
WFD	Water Framework Directive

Executive summary

The Biodiversa+ pilot “Towards national biodiversity monitoring coordination centres: comparison of governance, data interoperability and standards" 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 findings of the pilot will feed into the development of the European governance landscape of biodiversity monitoring, most notably the process to establish an European Biodiversity Monitoring Coordination Center (BMCC), under the lead of EuropaBON, a key collaborator of Biodiversa+.

The pilot was tasked to review the governance structures as well as data management and interoperability solutions of national biodiversity monitoring schemes. These provide the foundation for establishing national biodiversity monitoring coordination centres or hubs which will be the national counterparts for the design of the BMCC (or sub-national counterparts in the case of sub-national regions). Also, the use of data and metadata standards (Darwin Core (DwC) and Ecological Metadata Language (EML)) were mapped. All ten participating countries and sub-national regions produced a report to describe their current situation. The analysis presented here is based on these national and sub-national reports, which are available in annexes.

Based on the findings in this report, four key conclusions can be drawn:

- 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 DwC and EML 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 hubs is promising, as already half of the participating countries and sub-national regions report having a national hub in place.

Recommendations for a way forward:

1. Ideally each country (or sub-national region) should have a (sub)national biodiversity monitoring coordination centre or hub, or as a minimum requirement, one identified focal point, to allow efficient connection with the BMCC;
2. Steps towards setting up national and sub-national hubs should be identified, building on the findings of this report, detailed vision, functions and funding model to be presented in the Biodiversa+ Strategic Phase III report[1];
3. Development of national and sub-national biodiversity coordination centres need to be prioritised independently of BMCC (European level) developments so that once it’s

[1] Forthcoming in August 2025

established, the national component of the BMCC will be already covered by a comprehensive and functional network.

The pilot was coordinated by the Ministry of the Environment of Finland, and there were ten active contributors: Autonomous Province of Bolzano, the Azores (Portugal), Bulgaria, Croatia, Czechia, Denmark, Finland, France, Israel, and Sweden.

1. Introduction

Biodiversa+, the European Biodiversity Partnership, aims to promote and support transnational biodiversity monitoring to improve monitoring of biodiversity and ecosystem services across scales. The ultimate aim is to establish a transnational European network of national biodiversity monitoring schemes. The pilot "Towards national biodiversity monitoring coordination centres: comparison of governance, data interoperability and standards" (governance sub-pilot for short) was set up to support that aim by benchmarking the current situation of biodiversity monitoring governance on national/sub-national level.

The findings of the pilot will feed into the design of the general European governance landscape of biodiversity monitoring, most notably the process to establish an European Biodiversity Monitoring Coordination Center (BMCC), under the lead of EuropaBON, a key collaborator of Biodiversa+. Governance can be studied through four main ways: as a structure, a process, a mechanism and a strategy (Levi-Faur, 2012). In this report, governance is mainly studied by looking at the national and sub-national structures: namely, institutions involved in the coordination of biodiversity monitoring based (sub-)national administrative practices or rules.

The pilot was tasked to review the **governance structures as well as data management and interoperability solutions** of national biodiversity monitoring schemes as these provide the foundation for establishing the national biodiversity monitoring coordination centres or hubs which will be the national counterparts for the design of the BMCC. Also, the **use of data and metadata standards** (Darwin Core (DwC) and Ecological Metadata Language (EML)) were mapped (see Fig 1 presenting the three modules of the pilot).

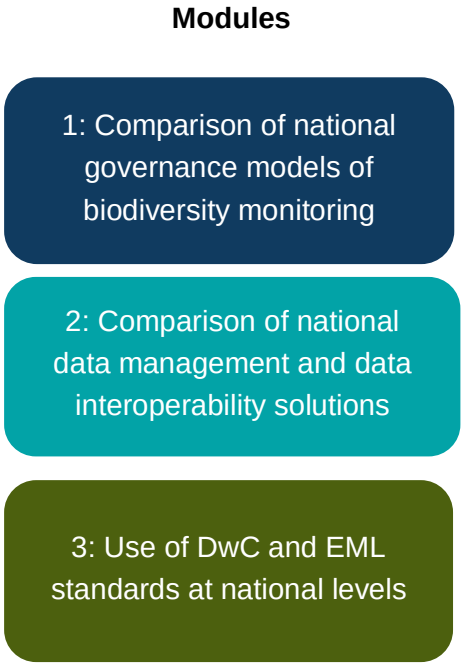

Fig 1: Modules of the governance pilot

Concept of national biodiversity monitoring coordination centres or hubs has been co-developed within Biodiversa+. Following Vihervaara et al. (2023a), national biodiversity monitoring coordination centres or hubs can be "*flexible entities/platforms or refer to a coordinating organisation that is responsible for biodiversity and ecosystem assessments and implementation of international environmental policies and agreements. Hubs can include and host functions such as networking, funding, steering, coordination of biodiversity monitoring, and data management.*" As no final definition is yet in place, in this report the terms national biodiversity monitoring coordination centres and national hubs are used interchangeably.

The pilot was coordinated by the Ministry of the Environment of Finland, and there were ten active contributors: Autonomous Province of Bolzano, the Azores (Portugal), Bulgaria, Croatia, Czechia, Denmark, Finland, France, Israel, and Sweden. The active contributors represented both national and sub-national levels.

Within the pilot, each active contributor was tasked to produce a short national (or sub-national) report, describing the governance, data management and interoperability solutions and use of data and metadata standards in the context of biodiversity monitoring. For the final report, these reports were analysed to produce a meaningful comparison across the participating countries and sub-national regions. Also, specific messages to the process of establishing a BMCC were summarised.

Active contributors had the liberty of freely choosing the method of compiling the needed information: some relied on expert opinions while some held comprehensive interviews with stakeholders or implemented a survey. Each active contributor was also tasked to organise a national seminar to support the drafting of the report, facilitate discussions between monitoring experts and raise awareness of Biodiversa+.

It is important to note that all information presented in this report is based on the national and sub-national reports, which largely rely on subjective assessment. This is both an advantage and a limitation to the work. On one hand, the countries and sub-national regions have had a possibility to describe their current biodiversity monitoring governance, including the roles of different organisations in a rather free format. On the other hand, the information presented in this report should be understood in this context: the report does not present verified and scientific findings, but provides an overview based on the national and sub-national reports.

This report is structured to clearly address the three modules of the pilot. The first three chapters provide an overview and comparison of the biodiversity monitoring governance structures (Chapter 2), data management and interoperability solutions in place (Chapter 3) and the use of data and metadata standards (Chapter 4). Chapter 5 summarises the current state of play with the national (or sub-national) hubs for biodiversity monitoring and includes the key messages to the BMCC based on the reflections within the pilot. The final chapter presents the conclusions and recommendations from the pilot. All country and sub-national region reports from the active contributors are available as annexes.

2. Comparison of governance models

This chapter is a direct contribution to one of the main objectives of the Biodiversa+ governance pilot which states that all active contributors will describe the organisational (i.e. governance) structure of national (or sub-national) biodiversity monitoring networks, and the pros and cons of the current system as well as expectations for future development. In their national and sub-national reports, each active contributor provided valuable information on the main organisations involved in biodiversity monitoring, how they connect to one another, and highlighted the potential benefits and limits of such organisation. This thorough analysis constitutes a necessary and valuable base to then (1) identify how future (sub)national biodiversity monitoring coordination centres will be identified and organised, and (2) pinpoint the concerns and requirements of each active contributor regarding the establishment of a future BMCC.

As each country or sub-national region has specific political and geographical dispositions (e.g. presence of marine and/or overseas territories; centralised or federal state), comparison of such governance models can be arduous. Yet, some general ideas emerged from this exercise.

2.1. General comparison of governance models: from highly coordinated to very fragmented

Firstly, a large variety of organisational set-ups are described, notably regarding the number of organisations involved in biodiversity monitoring (the x axis in Figure 2 below) and centrality of one main organisation in each country or sub-national region for the coordination of monitoring activities (the y axis). Figure 2 shows the (approximate and relative) position of each country or sub-national region in this governance landscape.

As national and sub-national reports have been produced by different people and from countries and sub-national regions presenting different features, the level of details and depth given on the governance system and on the organisations and stakeholders involved may differ from one report to the other. Taking that into account, the number of organisations involved in monitoring was roughly assessed in each report in order to understand whether the governance of biodiversity monitoring activities involves a rather *narrow* number of organisations or a *wide* number of organisations.

In this report, we will distinguish countries in which the governance to coordinate biodiversity monitoring activities is centralised versus countries or sub-national regions with a decentralised coordination of biodiversity monitoring schemes. The axis “x” in Figure 2 indicates if the countries or sub-national regions tend toward a centralised versus decentralised governance.

In a centralised system, authority, responsibility and resources are in the hands of one, central (and often governmental) actor. In our case, this means that all monitoring activities are performed by one central entity which is also in charge of the strategic steering of monitoring. Decentralisation occurs with a transfer of authority, responsibility and resources, through various processes (e.g. delegation, deconcentration) from the centre to lower levels of administrations or to broader governance institutions, such as non-state organisations (Cheema and Rondinelli, 2007). Centralised systems are favoured by values such as

accountability and efficiency, while responsiveness and innovation favour decentralised systems (Witesman, 2020). While they seem to represent opposite approaches to the structure of public organisations, centralization and decentralisation frequently co-exist simultaneously. Consequently, the y axis in Figure 2 is to be seen as a gradient for more or less centralised governance structures.

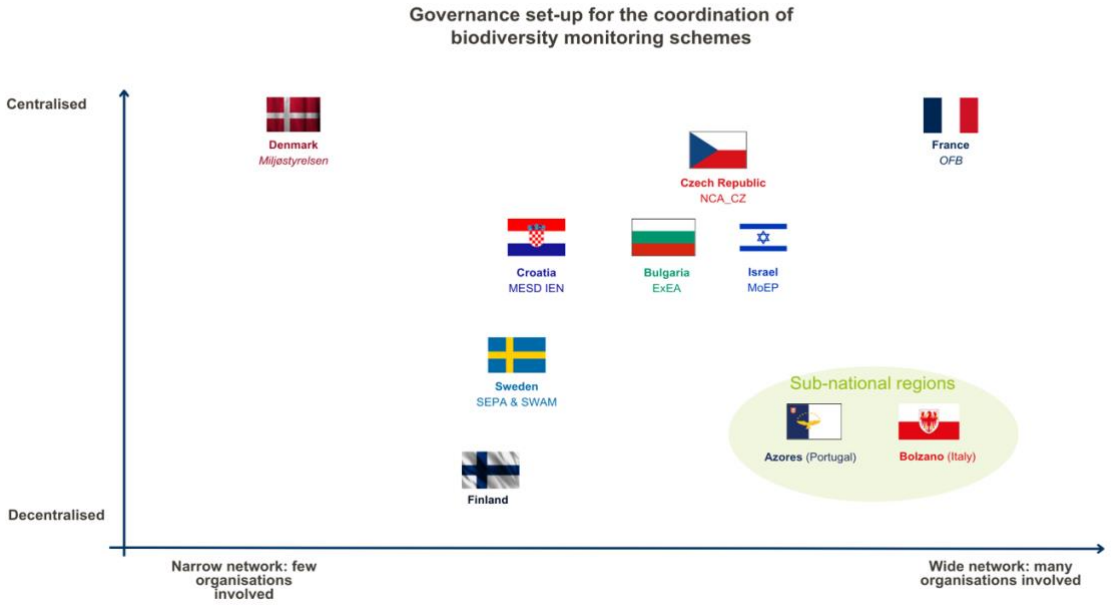

Figure 2. Graphic representation of the governance set-up according to centrality and number of organisations involved in biodiversity monitoring. Sub-national regions are separated from the countries due to differences in scale.

In most countries, Ministries of Environment and/or Environmental Protection Agencies are the main organisations in charge of coordinating biodiversity monitoring schemes (for instance, Environmental Protection Agency NCA in Czechia). Moreover, in some countries, biodiversity monitoring is structured by one central national policy, like in Croatia (Croatian Nature Protection Act), Denmark (Novana) or Bulgaria (National System for Monitoring the Status of Biological Diversity in Bulgaria, NSMSBD). For others such policy is on the way like in Finland (National Development Program on Biodiversity Information). In France, overarching monitoring schemes exist but are distinct for terrestrial, marine, and freshwater environments. In that regard, it is the mandate of one central organisation (the French Biodiversity Agency) to coordinate the three national monitoring schemes and their associated national information systems. Coordination of marine, freshwater and terrestrial biodiversity monitoring is also undertaken by the same organisation in Croatia and in Israel. On the contrary, in Sweden or in the Azores for instance, different institutions are in charge of each realm.

For most countries, external organisations (NGOs, universities, research centres, hired independent experts) and/or associations are one of the main providers of biodiversity data, therefore a large portion of field work is outsourced. The coordination of large-scale monitoring schemes is therefore challenging. In almost all reports, the role of volunteer and citizen science in monitoring is highlighted and the data generated by these groups is massive, yet often not sufficiently standardised at the national/sub-national scale.

In several countries, the national or sub-national Biodiversity Information Facility is cited as playing an important role in biodiversity monitoring, as for instance in Finland where most species monitoring schemes operate through the Finnish Biodiversity Information Facility, or in the Azores (Portugal) where addressing biodiversity on oceanic islands involves unique challenges related to scaling adjustments.

Biodiversa+ report D2.3. (Vihervaara et al., 2023b) provided a mapping of the ministries and other organisations that fund and steer national and sub-national biodiversity monitoring schemes across the network, covering 23 countries. The findings of the two reports (D2.3 and the present one) are coherent in their findings. One key message they both present is that while each country and sub-national region has a unique system in place to organise the monitoring of biodiversity, commonalities emerge from such comparison and provide us with constructive elements, for instance to design the structure of future national and sub-national "focal points" for the BMCC.

2.2. Main issues encountered by contributors for an effective monitoring governance

In their reports, active contributors have highlighted some of the issues and bottlenecks currently hampering an effective biodiversity monitoring governance in their country or sub-national region. These are summed-up in the following table. Contributors most commonly share concerns about the lack of findability and centralization of data, along with the absence of stable and sustainable financial resources.

Table 1: Main issues encountered by contributors for an effective monitoring governance

Issues and bottlenecks identified	Countries concerned
Findability and accessibility of data	Israel, Croatia, France, Finland, the Azores
Lack or decrease of financial resources **Discontinuity in funding sources**	Croatia, Czechia, Finland, the Azores, Bulgaria
Lack of cooperation/coordination between stakeholders **Lack of coherence**	Israel, Sweden, the Azores, Finland, Bolzano
Lack of human resources	Israel, Croatia, the Azores Bulgaria, Bolzano
Lack of standardised protocols	Croatia, France, the Azores
Lack of long-term vision	Croatia
Lack of evaluation of programs	Croatia
Complexity of formal procedures	Czechia
Data management issues	Bolzano
Scale adjustments	the Azores

3. Comparison of data management and interoperability solutions

For this chapter, each country or sub-national region described the status of various aspects of data governance. The overall picture is quite heterogeneous, which is expected when considering that data structures have evolved independently, driven by local needs, parallel rapid development and improvement of software and computing power, and the availability of competences and funding.

In the following, we attempt to summarise the findings and make a preliminary attempt to rank each country based on the maturity and extent of their systems in relation to participating in a BMCC. The aspects addressed in this analysis are data collection, reporting, quality, storage, security and sharing, as well as the maturity of the implementation of the FAIR principles for biodiversity monitoring data. To facilitate a meaningful comparison, we have compiled information on the current situations in each participating country and sub-national region. Full summary of information is available here.

Data collection. Given the broad nature of this question, the responses varied considerably, making summarization challenging. It is fair to conclude, however, that the lack of standardisation in collection methods is a significant and widespread issue that needs to be addressed.

Data reporting A wide variety of methods are employed, including field observations, various monitoring techniques, automatic data collection, or input via standardised forms (whether in paper or electronic format) for gathering primary data. Frequently, specific apps have been developed, for example for collecting data on invasive species.

Data quality. Validation processes are conducted everywhere, but to varying degrees. Quality control often involves both regional and external taxonomic expertise. These processes play a crucial role in maintaining data quality in monitoring programs. In many cases, there are subsequent checks by data hosts to ensure data format and logical consistency.

Data storage. The national and sub-national reports reveal that there are many different types of databases involved in storing biodiversity data. Some are centralised, while others are local, independent, and managed by the data collectors/providers. There is no consensus or trend about the choice of platform used.

Data security: Biodiversity data security governance models in Europe vary widely. Although GDPR compliance is a common thread, specific approaches differ. Sensitive species data often utilise diffuse coordinates or a limited grid, with high-resolution data restricted to authorised personnel. Nature monitoring and habitat data are typically public, but access to species data may require a personalised login.

Data sharing. Biodiversity data sharing generally adheres to open science policies, with some restrictions for research purposes or sensitive data. Some datasets are exclusive to conservation authorities, while others are accessible upon request. In general, the access to biodiversity data is moving towards API sharing, where data can be downloaded via an export application.

Maturity of the implementation of FAIR principles. Biodiversity monitoring data exhibits diverse levels of adherence to the FAIR principles, with participant awareness varying due to limited exploration. While some countries had close to full implementation in some schemes, others do not currently meet the standards.

Overview

The figure below presents a very basic and initial attempt to rank countries or sub-national regions based on their readiness to join a BMCC regarding data governance. It is not feasible to accomplish this in a completely objective manner given the available input, so the figure should be understood as a rough and very preliminary sorting. For each of the seven areas mentioned above, we assigned a score from 1 to 3, where: (1) in development; (2) well underway; and (3) almost mature. The assignments are based on a subjective comparison of the self-evaluations provided in each national and sub-national report and summarised in Table 2.

Table 2: A rough and preliminary sorting of of countries and sub-national regions based on their readiness to join a BMCC regarding data governance.

	Bolzano	Israel	Azores	Bulgaria	Croatia	France	Finland	Czechia	Sweden	Denmark
3.1.1. Current (sub-)national model for data collection	1	2	1	2	2	1	1	2	2	2
3.1.2. Current governance model for data reporting	1	2	2	2	1	2	2	2	2	2
3.1.3. Current governance model for data quality	2	2	2	2	1	2	2	3	3	3
3.1.4. Current governance model for data storage	1	1	2	1	2	2	2	3	2	3
3.1.5. Current governance model for data security	2	1	2	2	2	3	3	2	2	3
3.1.6. Current governance model for data sharing	1	1	2	2	2	2	2	2	2	3
3.1.7. Maturity of the implementation of FAIR principles	1	3	1	1	2	2	2	2	3	2
TOTAL	**9**	**12**	**12**	**12**	**12**	**14**	**14**	**16**	**16**	**18**

This table illustrates the perceived maturity of each country or sub-national region concerning data governance, ranging from relatively low to relatively high (from left to right). The scores are not absolute but are derived from judgements based on the respective national and sub-national reports as described above. The table indicates that all countries are in progress.

While there are gradual differences in maturity, there are no distinct groups, and every country has something to work on and improve.

4. Comparison of the use of data and metadata standards

To promote data interoperability and FAIR principles, it is crucial for data providers to use common data and metadata standards. In this report, the use of DwC data standard and EML metadata standard is mapped.

DwC is one of the most common data standards for biodiversity data. The standard includes a glossary of terms that provides identifiers, labels, and definitions to facilitate data sharing. EML is a widely used metadata standard for describing ecological data. The standard provides a structured way to document key features of data sets to ensure accessibility for both humans and machines. For a more in-depth description of DwC, EML and other common biodiversity data and metadata standards, please see Basset et al. 2023.

4.1 Use of Darwin Core and Ecological Metadata Language

Among the ten active contributors that took part in the Biodiversa+ governance pilot, familiarity with DwC and EML varied considerably. As an example, in Israel most of the monitoring experts that were interviewed for the national report were aware of DwC and EML, whereas in Finland a clear majority of monitoring experts were not familiar with them and thus were not able to assess whether their data could be easily converted to these standards.

Eight active contributors reported that DwC and EML are used to some extent. Based on the findings of this pilot, the DwC is nonetheless more widely used than EML. For instance, Bolzano, Denmark (national monitoring program Novana) and the Azores reported that while DwC is used at least to some extent, EML is not currently used in monitoring programmes that were covered in the national and sub-national reports. In Finland and Israel where both standards are used, the use of DwC is more common than the use of EML. In Sweden, data from many biodiversity monitoring schemes are converted to DwC. In France a data workflow between the national database and GBIF is in place, using DwC and EML. EML is also used to an extent for biodiversity research metadata.

Table 3: Use of Darwin Core and Ecological Metadata Language for biodiversity monitoring data

Country / sub-national region	Yes	No	To some extent
Bulgaria		X	
Czechia		X	
Croatia			X
Denmark			X
France			X
Autonomous Province of Bolzano			X
the Azores			X
Finland			X
Israel			X
Sweden			X

Two active contributors reported that neither DwC nor EML are currently used. Of these two, Czechia uses other data and metadata standards. In Bulgaria, no data or metadata standards are used, but monitoring data could be converted to DwC with considerable technical efforts.

As examples of other data and metadata standards used for biodiversity monitoring data, several standards were mentioned. France, Croatia, Czechia, and Bolzano reported that nationally (or sub-nationally) developed data standards are used, and Finland reported using an adjusted ABCD standard to accommodate practical national needs. Other examples mentioned included e.g. EMODnet, Copernicus, Stancode and INSPIRE, DCAT-AP-Sem ISO19115, DublinCore, DataCite and DDI.

4.2 Results from Darwin Core and Ecological Metadata Language use cases

All active contributors were also tasked with experimenting with the application of DwC and EML on a use case(s) of their choice. The cases included e.g. large monitoring programmes (Biodiversity Monitoring South Tyrol by Bolzano), habitat monitoring schemes (seashore inventory of EU Habitat Directive Annex I terrestrial habitats by Sweden) and species monitoring schemes (Finnish Moth Monitoring Scheme; invasive alien species monitoring based on traps and cameras by Denmark; stag beetle monitoring based on citizen science by Croatia). Please see Annex 1 for all cases.

In general, the tested monitoring data sets were considered to be rather easily convertible to DwC and EML. However, some issues and challenges were identified. One key issue raised was the observation that while DwC's flexibility means that a greater variety of data can be published, the flexibility also poses a challenge for interoperability. Although the fields are defined in the DwC vocabulary, the values of the fields are not standardised to follow a specific controlled vocabulary.

Some cases reported difficulties in applying EML and DwC to existing biodiversity monitoring data due to shortcomings in data entry and in some use cases it was concluded that compatibility with these standards would require alterations even in the data collection. Therefore, it should be noted that promotion of data and metadata standardisation and related capacity building should take into account the entire process of producing biodiversity monitoring data. It was also raised that converting data to these standards may lead to less detailed data due to lack of classification possibilities.

There were also some technical suggestions for further development of the standards (please see Annex 1 part 3.2.3 Case description in the national reports of Bulgaria, Finland, and France).

5. Status with the national biodiversity monitoring coordination centres and key messages to BMCC

5.1 Status with the national biodiversity monitoring coordination centres

There is great variation in the governance setup and therefore preparedness to establish a national biodiversity monitoring coordination centre or hub. Five out of ten participating countries and sub-national regions deemed that they do have an institution, which can be described as a (sub-)national biodiversity monitoring coordination centre.

The most common reason the rest of the active contributors stated that there is no clear national hub was that there were several different institutions, which contributed to biodiversity monitoring and data governance. For example, where academic institutions, rather than government bodies, were responsible for significant data collections. However, it is unclear to what extent this is also true in countries where the active contributors have identified a clear national hub. Their assessment seems to be generally derived from clearly given legislative responsibility for national biodiversity governance, rather than the reality of monitoring coordination or data handling and it is not clear whether such other data collections exist.

For active contributors where national hubs already existed (Bulgaria, Croatia, Czechia, Denmark and France), description of the process of hub establishment varied. Describing the process of establishing national hubs, some emphasised the role of legislative acts which had given the potential hubs a clear legal responsibility (Bulgaria, Denmark). In Czechia and Croatia there has institutionally been one organization in charge of biodiversity monitoring, which forms a good basis for the national hub. In France, organisational changes and mergers of different institutions have led to the creation of OFB, which could fill the coordinating role. **Recognition and acceptance of the coordinating role by other national organizations and institutions and proper funding have been identified as key to successful further development of a (sub-)national hubs.**

These active contributors generally did not mention specific obstacles or needs for integration of their already established potential national hubs into BMCC, with a few notable exceptions (see “Possible concerns”). Their possible involvement in BMCC was described in ways corresponding to functions of the national hubs - data sharing, providing a point of contact, consultation.

Some members suggested drawing inspiration from other EU-wide monitoring networks; for instance, Croatia recommended considering the system facilitated by the Water Framework Directive (WFD). WFD was described as efficient and well-functioning due to its legally binding nature, which has led to the establishment of clear monitoring responsibilities, political support and allocation of resources.

Table 4: Existence of the (sub-)national biodiversity monitoring hubs in participating countries and sub-national regions. For those that already have a hub, the name of the entity is presented.

Country / sub-national region	(sub-)National centre in place?	Name of the entity/comment on possibility	If yes: type of entity
Bulgaria (ExEA)	Yes	National System for Monitoring the Status of Biological Diversity (NSMSBD) managed by the Executive Environment Agency	Government institution
Croatia (MESD)	Yes	Institute for Environment and Nature (IEN) (under Ministry of Economy and Sustainable Development)	Government institution
Czechia (NCA_CZ)	Yes	Nature Conservation Agency of the Czech Republic	Government institution
Denmark (MoE_DK)	Yes	NOVANA (under Danish Environmental Protection Agency)	Monitoring program
France (OFB)	Yes	French Office for Biodiversity (OFB)	Government institution
Autonomous Province of Bolzano (PROV_BZ)	No		
the Azores (FRCT)	No		
Finland (MoE_FI)	No		
Israel (MOEP)	No		
Sweden (SEPA)	No		

Table 5: Identified possible pathways for establishing a national / sub-national hub for those countries and sub-national regions where hubs don't exist yet.

Country / sub-national region	Possible pathways for establishing a National hub
Autonomous Province of Bolzano (PROV_BZ)	Possible to transform any of three candidate organisations into a National Hub, or to set up a new organisation.
the Azores (FRCT)	Preparatory work is needed, given the Azores' unique framework as a Portuguese autonomous region spread across 9 islands. Specific regional constraints and needs could be overcome by the establishment of a dedicated sub-National hub.
Finland (MoE_FI)	Ongoing efforts on governance consolidation, possibility to advance them further.
Israel (MOEP)	There are two main entities dealing with terrestrial & freshwater biodiversity and two for marine biodiversity. Data sharing and clear and universally accepted national hub designation is needed, even though significant efforts in harmonisation and centralisation are reported by one of the entities (Hamaarag, National Ecosystem Assessment Programme)
Sweden (SEPA)	Many components of a national hub exist but are spread across government institutions and other independent key players. Either choosing or establishing an overarching national hub would require significant effort.

Possible pathways for establishing a national hub for countries and sub-national regions where a hub does not exist yet are summarised in Table 5. In most cases (Israel, Sweden, and Province of Bolzano), there are already existing organisations among which one could be appointed as a national hub. In the Azores, a new structure would probably need to be established. In Finland, monitoring governance is rather fragmented, however, there are already ongoing efforts to develop national coordination and cooperation.

Active contributors from these countries mentioned a wide variety of support needed in order to establish a (sub-)national hub. Guidance on various aspects of biodiversity monitoring were emphasised, such as data standards and joining of fragmented monitoring schemes (e.g. Azores, Finland), on quality control mechanisms (Sweden) and legal issues (Azores). Need for hiring new staff was stressed, both with coordinating (Bolzano) and technical (Azores) roles, as well as for developing robust technical infrastructure (e.g. Sweden). Funding and clear (e.g. legal) demand to establish such a hub seems to be an overarching issue among all country reports.

5.2 Key messages to the BMCC

During the pilot, the active contributors identified key messages to the BMCC[2] from a national / sub-national point of view.

Expectations and possibilities

- Establishing a network of coordinated national and subnational biodiversity coordination centres would be important if harmonisation of monitoring activities is to be achieved across different countries. Such a network could provide synergies with an European level initiative (BMCC) and better provide harmonised results at different spatial and policy relevant scales.

BMCC could:

- provide a joint mandate and a new collaborative space to support monitoring coordination and harmonisation between Member States.
- enable and facilitate access to transnational data on biodiversity, help define biodiversity baselines and goals for restoration and develop indicators and Essential Biodiversity Variables in coordination with respective agencies at the European, national, and sub-national levels.
- assist in securing stable dedicated funding of biodiversity data governance at the European levels and assess pan-European priorities in this domain.
- provide coordinated metadata management and promote data standardisation and advocate for open science principles and adherence to FAIR principles.
- enhance data analysis and evaluation, providing guidelines and jointly developed conclusions regarding species, habitats and other biodiversity components.
- provide baseline protocols and methodologies and decide their appropriate level of flexibility. These could then serve as inspiration for national hubs to develop their own schemes with required minimum standards for data sharing or meta-analyses.
- serve as an exchange platform for best practice between national monitoring centres and as a platform for developing a common approach to biodiversity monitoring. This could include development of common monitoring schemes, facilitating exchange of experience, knowledge, monitoring facilities and technologies as well as harmonisation of methods and data collection procedures and use of citizen science.
- provide an incentive for Member States to designate a single national institution (i. e. national hub) as a point of contact for international cooperation, thus promoting data integration on a national level.
- Provide assistance and input to national monitoring and strengthen the position of national biodiversity monitoring centres (e.g. address adequacy of available financial resources).

[2] The Terms of Reference for a Biodiversity Monitoring Coordination Centre in Europe were under preparation by EuropaBON when this report was being finalised.

- coordinate with established national hubs on how to best support and develop standards that more efficiently contribute to reporting needs of European Biodiversity policies (EU Directives and Regulations).
- represent a space for collective thinking on monitoring frameworks, for instance on how to better integrate data on “pressures” and “responses”, or how to approach data on rare and “cryptic” species to obtain a more comprehensive and holistic monitoring of biodiversity.
- centralise and foster collaboration with related international initiatives related to biodiversity e.g. HELCOM, OSPAR and AEWA, IPBES, GBIF.
- issue warnings and recommendations regarding species of special, continent-wide concern (e. g. invasive species, rapidly declining species)

Possible concerns

- It is important that countries and sub-national regions retain the possibility to implement biodiversity monitoring schemes that are relevant to their own needs e.g. for scientific goals or nationally/locally determined policy needs. In that sense, BMCC should not hinder a monitoring scheme's ability to deliver the practical and nationally determined function it has been established for.
- Even though the BMCC is planned to be driven by policy goals, it should rely on the best scientific approach in monitoring species, habitats and ecosystems. To succeed in improving monitoring quality across Europe, novel approaches and the latest scientific research needs to be considered in the development of possible common monitoring programs. Therefore, scientific development and scientific collaboration in BMCC should be encouraged.
- It should also be possible to establish sub-national hubs, when necessary (e.g. in the case of oceanic islands).
- BMCC should build on what already works; thus reinforcing seamless integration into the current organisational setup, encompassing both national and sub-national levels, as well as existing pan-European cooperation structures like BCE (Butterfly Conservation Europe running butterfly monitoring) or EBCC (European Bird Census Council integrating long-term monitoring in Europe).
- BMCC should not only receive data and aggregate EU-level indicators and other knowledge products but also bring added value to countries and sub-national regions in terms of operational monitoring: e.g. by providing capacity building, training, funding. BMCC should actively promote collaboration and facilitate the flow of knowledge between countries.
- Requirements for national hubs should be flexible and adaptive to the country’s reality: if the requirements are too high or complicated, the workload will not justify any of the benefits that the BMCC can supply. Highly probable difficulties surrounding governance changes or the process of financing of national hubs should be taken into account (e.g. highlighted in the national reports of Croatia and Czechia).
- Ideally BMCC’s funding should not come from current national budgets to avoid negative impacts on biodiversity monitoring activities themselves. In addition to funding BMCC, the European Commission should also direct financial assistance to national hubs to

deliver the work needed for BMCC (both expert and administrative work, contact point positions).

- It is crucial to uphold national and local autonomy. Therefore, BMCC should generally play a supportive role and contribute to the advancement of initiatives and methods. In other words, a supporting role would be ideal.
- BMCC should be a joint effort and governed democratically.

6. Conclusions and recommendations

As the chapters illustrate, there is great variation between countries and sub-national regions in terms of biodiversity monitoring governance, data management and interoperability solutions and use of data and metadata standards.

Countries and sub-national regions were ranked based on the centrality of one organisation and the number of organisations involved in biodiversity monitoring, thus identifying models of more centralised or decentralised governance. There is variance between countries and sub-national regions, where Denmark, France, Finland and Bolzano can be seen as representative examples to illustrate this variance. Denmark has the most centralised governance model and a narrow network of organisations involved in monitoring, while France represents a centralised governance model with a wide network of organisations. Finland's governance model can be described as decentralised with a moderate network of organisations involved, while the sub-national region Autonomous Province of Bolzano represents a decentralised model with a wide network of organisations. Also issues and bottlenecks currently hampering effective biodiversity monitoring governance were identified, the main ones being the findability and accessibility of monitoring data and the lack of continuous financial resources for monitoring.

Data management and interoperability solutions were compared to produce a figure illustrating the perceived maturity of each country or sub-national region concerning data governance. It was concluded that while there are gradual differences in maturity, there are no distinct groups and every participating country (or sub-national region) has something to improve.

Regarding data and metadata standards, a clear majority, 8 out of 10 participating countries and sub-national regions, reported that DwC and EML were used to some extent for biodiversity monitoring data. As for the remaining two countries, one of them reported using other data and metadata standards and one country stated that no data and metadata standards are currently used. Some challenges and concerns on the use of DwC were also shared.

All three aspects highlighted above are important background information for understanding the current biodiversity monitoring governance landscape in Europe. While further cooperation and harmonisation is being planned, most notably in the process of establishing a BMCC, it is important to consider the existing differences.

In this report, governance structures were not ranked based on their possible compatibility with the BMCC. Within the pilot there was a shared understanding that countries and sub-national regions should be able to establish and maintain a governance structure that is fit for their purposes: interphase with an international structure, such as a BMCC or GBIF, can function through a competent and well-mandated focal point arrangement. For data management and interoperability solutions, harmonising efforts will evidently be needed. Therefore, the data governance was assessed based on maturity vis à vis joining a BMCC.

When evaluating governance structures in terms of readiness to join a BMCC as a national hub, five countries or sub-national regions reported already having a governance model that could be considered as a national hub. This assessment primarily relies on the presence of a centralised and legally mandated organisation. In some other countries, the existence of a national hub is open to interpretation, as the information is based on subjective assessment.

Based on the findings in this report, four key conclusions can be drawn:

- 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 DwC and EML is relatively common.
- Biodiversity monitoring governance in countries and sub-national regions differs based on the centrality of one organisation and the number of organisations involved.
- 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 hubs is promising, as already half of the participating countries and sub-national regions have a national hub in place.

Throughout the pilot, the participating countries and sub-national regions interacted actively with national and sub-national organisations involved in biodiversity monitoring to form a comprehensive understanding of the current state of biodiversity monitoring governance. Many reported that this process not only improved understanding of current monitoring governance, but also helped to strengthen their national or sub-national expert networks, which can be considered to be one of the key outcomes of the pilot. To build on these networks when forming national hubs, it is crucial to acknowledge the valuable role of all biodiversity monitoring experts – also outside governmental agencies. **Recommendations for a way forward**

1. Ideally each country (or sub-national region) should have a (sub)national biodiversity monitoring coordination centre or hub, or as a minimum requirement, one identified focal point, to allow efficient connection with the BMCC
2. Steps towards setting up national and sub-national hubs should be identified, building on the findings of this report, detailed vision, functions and funding model to be presented in the Biodiversa+ Strategic Phase III report[3]
3. Development of national and sub-national biodiversity coordination centres need to be prioritised independently of BMCC (European level) developments so that once it's established, the national component of the BMCC will be already covered by a comprehensive and functional network.

[3] Forthcoming in August 2025

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Witesman, E. (2020). Centralization and Decentralization: Compatible Governance Concepts and Practices. Oxford Research Encyclopedia of Politics.

Annexes

National and sub-national reports can be accessed through these links:

The Azores (Portugal): https://www.biodiversa.eu/wp-content/uploads/2024/01/Biodiversa-Governance-Sub-pilot-Azores.pdf

Autonomous Province of Bolzano (Italy): https://www.biodiversa.eu/wp-content/uploads/2024/01/Biodiversa-Governance-Sub-pilot-Bozen.pdf

Bulgaria: https://www.biodiversa.eu/wp-content/uploads/2024/01/Biodiversa-Governance-Sub-pilot-Bulgaria.pdf

Croatia: https://www.biodiversa.eu/wp-content/uploads/2024/01/Biodiversa-Governance-Sub-pilot-Croatia.pdf

Czechia: https://www.biodiversa.eu/wp-content/uploads/2024/01/Biodiversa-Governance-Sub-pilot-Czechia.pdf

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