EBONE

European Biodiversity Observation Network:

Design of a plan for an integrated biodiversity observing system in space and time

D1.3: Recommended Institutional framework

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Authors: R.H.G. Jongman, G. de Blust, T. Parr, L. Halada

Reviewer: M. Metzger

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1 Introduction

Within the EBONE project ideas are being developed on how to organise the complex issues of monitoring biodiversity in a coherent way. EBONE acknowledges the different organisations that exist for monitoring as well as their legal and financial positions. At the same time the monitoring data have to be used to meet the objectives that require high quality, reliable and coherent data that has policy relevance (van den Hove & Sharman 2006; van den Hove 2007; Engels 2005).

The area of biodiversity is one of the most challenging areas within the field of global change for several different reasons (Görg et al. 2007). In the definition of the UN Convention on Biological Diversity (CBD) biodiversity includes a broad range of objects, including the diversity within and between species, the diversity of ecosystems, as well as the functioning and interactions of and between these elements. They all can be subject of monitoring as they can be influenced by anthropogenic actions. The range of anthropogenic drivers influencing status and trends of biodiversity is wide and covers not only direct interventions (as in agriculture, forestry and fisheries) but also indirect effects from other sectoral policies such as trade, energy, transport and housing. Moreover, the scales in space and time influencing biodiversity often differ largely from the scales influenced by policy decisions and thus makes it difficult to clearly assess these influences Scholes 2006).

Consequently, monitoring biodiversity means making a choice of measuring basic data that have to be linked to various drivers to be monitored with different methods, at different spatial and time scales, with differences in intensity and with differences in confidentiality.

Monitoring biodiversity and ecosystems has to be organised in such a way that the data can be used to react to these various aspects for any specific question regarding biodiversity issues as well as taking it into account in broader assessments (UNEP-WCMC 2009). In order be inclusive of this diversity of knowledge in decision-making, organising the process of data gathering and analysis needs to be highly flexible, while at the same time employing core methodologies that ensure transparency, scientific rigor, independence and minimization of bias.

The biodiversity research and policy area in Europe has already undergone major changes in the last 10-20 years, but still needs a proper approach to the above mentioned challenges. Monitoring is common in all fields in society, but it seems nowhere so fragmented as in biodiversity. In policy, the development and implementation of major directives, especially the Birds Directive, the Habitats and Species Directive and Water Framework directives have led to an EU-wide common framework for biodiversity protection. However, the reporting on Article 17 over the years 2002-2007 shows, that there is no coherency yet, that many data are unknown and that methodologies differ for member states (European Topic Centre on Biodiversity 2009).

Specifically supported by funding from the EU framework programmes, European Biodiversity Research has started to develop structures which enhance networking, sharing knowledge and infrastructures, but also to provide policy relevant research results.

To bring together the different dimensions of biodiversity monitoring specifically for policy-relevant work the approach has to take into account different challenges:

- Identify and make accessible the best available knowledge and personal expertise in a timely and flexible manner;
- Ensure that the network-process is open and transparent and, if applicable, takes into account all knowledge developed in the field;
- Ensure that primary data providers as well as collators and synthesizers of knowledge from this data are sufficiently acknowledged for their input while being encouraged to provide societal relevant knowledge;
- Ensure that rules and legal issues on data ownership confidentiality and intellectual property rights are properly addressed but do not hamper data sharing.

At the same time, monitoring needs to be carried in a continuous dialogue of data providers with data users and policy makers– the clients for the expertise identified and processed.

2 Data and knowledge challenges

Biodiversity is used at all levels of society and information is provided by a wide range of players, research institutions, Non-Governmental Organisations (NGOs), local to national agencies and administrations. The major clients that use biodiversity information are at the global level the Conventions (CBD, CMS, Ramsar), at the European level the European Commission and its institutions and at the country level the national and regional governments and institutions. A special user is the research community, that usually is interested in specialised data. These levels of clients and users are interlinked through mutual exchange of information. However, lack of European wide information and exchange of knowledge is still a major issue. This can be seen in relation to the discussions of the indicators identified within the “Streamlining European 2010 Biodiversity Indicators” (SEBI2010) process (EEA 2009).

In research various cooperative research platforms exist at the European scale. The use of and interaction between these platforms should be strengthened in this project: Of major importance are the three Networks of Excellence on marine biodiversity (MARBEF), terrestrial biodiversity (ALTER-Net) and taxonomy and systematics (EDIT). For the first two of these the funding has terminated in 2008 and 2009 but the networks are now operating on institutional means and develop further common approaches, including development and communication of research results. This work is currently focussing, in initiatives such as LIFEWATCH that is in its construction phase.

These existing networks are at present linking up with other knowledge holders of biodiversity in Europe as data and knowledge on biodiversity is widely available but scattered across institutions and NGOs in Europe. The data challenge is complex as long term data policy and maintenance are not the prime responsibility of university and research groups but of agencies, related research institutes, museums, NGOs and national and international statistical offices. This means that the long-term success of the European Biodiversity Policy depends upon national and regional agreements that institutes and agencies can make on the use of the data owned by third parties. This also means that a top-down structure of governance and decision making is not likely to be the most appropriate governance structure.

According to GBIF its network currently facilitates access to over 216 million primary biodiversity data records contributed by 318 publishers from 43 countries covering 10371 data resources (GBIF 2010). Most contributions are from developed countries and the largest contributor is the Avian Knowledge Network.. They have developed their own protocol, that is used by a majority of the data publishers. Over 74% of the data records currently accessible through the GBIF network pertain spatially to the Northern hemisphere, mainly in Europe and North America. In Europe these are among others GBIF Sweden, UK national Biodiversity Network, NLBIF, DANBIF and GBIF Spain.

However, data discovery is in an extremely nascent stage across the GBIF network. Metadata catalogues are limited in scope and numbers across the network. GBIF concludes that there is a lack policy on metadata cataloguing across their network. Most of the activities of the participants of the GBIF network are not contributing systematically and do not have a data discovery and publishing strategy and action plans (GBIF 2010). However, for an integration of biodiversity data in the mainstream of environmental information systems this should be required as an essential component of data publishing activities.

For Europe the report on data quality assessment on (European Topic Centre on Biological Diversity 2009) About 27% of the terrestrial species and 57% of the marine species are reported to the ETC Biodiversity as unknown; this is also the case for 17% of the terrestrial habitats and 40% of the marine habitats. Spatial data are collected in many different ways, which makes comparison and European overviews difficult.

3 The GEO BON Concept and governance

The GEO Guiding Principles include several issues with links to governance. The most important principles in this respect are

1. Information sharing: data sharing must allow for the appropriate protection of sensitive data, for instance on the precise location of endangered species; this means develop agreements how and under which conditions this information can be shared and used.
2. Architecture of data systems, standards and Interoperability: common standards are needed, building on existing and established systems and initiatives, harmonising observation methods into a system that is shared and accepted by data owners, data users policy makers and other participating organizations.
3. All data must satisfy scientific quality control requirements; this means traceability of data to originator and the method of collection and transformation; explicit location and date of collection to accompany observations and sufficient information to accompany observations to permit an assessment of their accuracy.
4. A critical requirement for all data is repeatability in such a way that measurements are repeatable to allow for assessing status and trends of components of biodiversity and ecosystems and that data continuity is guaranteed to allow for change detection and monitoring.
5. The sampling frame should provide a statistically sound basis for repeated measurements of biodiversity and ecosystems for status and trends, linking local, national and regional scales and to provide a platform for the inter-comparison of multiple datasets.
6. In situ data collection and management: A significant challenge is how to coordinate, standardize and manage *in situ* data that are collected by disparate institutions and individuals for differing purposes.

GEO is established on a voluntary and legally non-binding basis, with voluntary contributions supporting its activities. Also GEO BON participation is voluntary and non-binding. Any governing or committee body has no authority to direct participants; rather they provide guidance and recommendations to participants and contributors.

The consequences of these guiding principles is that there is a need for coordination and cooperation between European agencies, national and regional authorities, conservation agencies, data collecting NGO's and national data portals. Methods applied in different countries and by different agencies and NGO's will have to be compared and studies have to be carried out for harmonisation. This has to be done for earth observation data, habitat data as well as for species data. As GEO and GEO BON are voluntary organisations the members can only cooperate voluntarily.

4 Agencies, institutions and NGOs in Europe

Biodiversity is used at all levels of society and information is provided by a wide range of players. At global, European and national level coordinating institutions exist that act as clients and coordinators of data monitoring. These organisations mostly have grown organically as institutions have been created on an ad hoc basis to deal with problems and issues as they have emerged. They have been developed in a historic political and scientific situation that has changed over time and the institutions have changed with them. Therefore, there is now a wide variety in institutions that is, however, inherent, given the complexity of governance arrangements, the multiple levels of governance and the broad range of interests (UNEP-WCMC, 2009).

Over the years the United Nations system and related governance processes have demonstrated a steadily increasing interest in drawing on scientific information and advice in order to fulfil their responsibilities to advance human health, welfare, and development, while better managing and conserving the environment and natural resources. This has been done through Multilateral Environmental Agreements through the committees of the Convention on Biological Diversity (CBD), the Animal and Plant Committees of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and the Scientific and Technical Review Panel (STRP) of the Ramsar Convention on Wetlands. UN scientific advisory groups such as the Intergovernmental Panel on Climate Change (IPCC), the leading body for the assessment of climate change makes only use of published scientific information. Ecosystem and biodiversity knowledge is more widespread and not so much published at global or sub-global level. However, biodiversity information is part of the global data needs. The UNEP World Conservation Monitoring Centre (UNEP WCMC) is an organization working in support of governance processes to improve the information available for decision making. But is not a repository for raw biodiversity data.

At the European level the European Environmental Agency (EEA), the European Environment Information and Observation Network (EIONET) of the European Union and the topic centres that service it with data (such as Biodiversity).play an important role. They have been established to support sustainable development with data and knowledge and to help achieve significant and measurable improvement in Europe's environment through the provision of timely, targeted, relevant and reliable information to policy makers. Therefor the EEA has developed BISE, the Biodiversity Information System for Europe. This could serve as the database for information shared by European countries institutions and NGOs.

However, within Europe the responsibility for implementing of and reporting on biodiversity policy is with the national and regional governments. Within the EU there are six decentralised or federal member states (Spain, Italy, Austria, Belgium, Germany and the UK) in which the official responsibility for biodiversity policy is at the regional level. This includes in total 70 regions. In the other 21 member states the implementing and reporting responsibility is officially with the national government, but in practice many implementation tasks are decentralised also there. That means within the European Union there are over 90 users of biodiversity information but in fact there will be more (Jongman et al 2008).

The data providers are even more dispersed. They are partly organised as national or regional agencies. The German Bundesland Nordrhein-Westfalen has its own environmental agency (Landesamt für Natur, Umwelt und Verbraucherschutz) with responsibility for data collection. In Flanders (Belgium) this task is given to INBO a research institute. In Great Britain biodiversity data are collected for Scotland, England and Wales by CEH, a national research institute. In other cases official data collection organisations are decentralised agencies within a country or a region. In the Netherlands vegetation and habitat data are monitored by the 12 provinces and about ten NGOs. There data are then included in a national database.

Beside the national and regional agencies it can also be that national biodiversity data are collected by universities (Northern Ireland, Sweden) and in many cases NGO’s collect data on special species groups. In Europe there are many volunteer groups specialising on monitoring species. Most are focussing on birds, butterflies, mammals, plants, amphibians, reptiles and dragonflies. However, there also are specialist groups on carabids, snails, beetles, spiders and freshwater ecology. All these international, national, regional and local groups build their databases and develop their own governance and data policy.

Birdlife international is a global umbrella organisation of national organisations and a number of global bird monitoring programmes (seebirds, flyways). The BirdLife Europe Partnership consists of 42 conservation organisations with almost 3,000 staff and 1.9 million members. BirdLife Partners exist in: Andorra, Armenia, Austria, Azerbaijan, Belarus, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Faroer Islands, Finland, France, Georgia, Germany, Gibraltar, Greece, Hungary, Iceland, Ireland, Israel, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, The Netherlands, Norway, Poland, Portugal, Romania, Russia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, United Kingdom. The European butterfly protection organisation is much smaller, but expanding as well. The advantage of these European organisations is that they develop standardisation and quality control. Internationally active Non-Government Organizations such as WWF, BirdLife International, the European Butterfly Foundation are at least in Europe important data providers. However also non-Birdlife organisations collect specific bird monitoring data such as Wetlands International (see http://www.wingsoverwetlands.org)

Next to these there are many national and regional monitoring organisations that develop small to large monitoring projects (see http://eumon.ckff.si/). In total there are over 600 registered projects of which the majority on species (Henle et al, 2010).Remote sensing is applied but not on a regular basis and common standards and integration of in situ and RS methods does not yet exist (Van de Borre et al 2011).

Large Infrastructure on Biodiversity research within Europe is under development through Lifewatch. Lifewatch is supported by a number of European countries to bring into operation the facilities, hardware, software and governance structures for biodiversity research. It will consist of facilities for data generation and processing, a network of observatories, facilities for data integration and interoperability, virtual laboratories offering a range of analytical and modelling tools, grid computing systems for data processing and a Service Centre providing special services for scientific and policy users, including training and research opportunities for young scientists. The infrastructure has the support of all major European biodiversity research networks. Lifewatch is supposed to boost developments in biodiversity as a cross-border phenomenon, and the European approach of the facility will most likely lead to substantial synergies. The new infrastructure will integrate the full potential of taxonomic (collection-based) and ecosystem information with genomic data from other sources in an international (virtual) laboratory environment.

Large-scale approaches support among others understanding and managing the impacts of global change (such as changing land use, precipitation patterns, droughts and fires, storms, sea level rise and others) on the distribution, adaptation and functions of biodiversity. Complex and multidisciplinary problems require scientists to collaborate in virtual organisations. Biodiversity e-Science enables ‘distributed large scale’ research. This will be the only way to participate in new developments of science in this area. The facility will support the research necessary to meet the policy objectives in the ‘EC Communication: Sustaining ecosystem services for human well-being’ (2006) and is a major component of the European contribution to GEOSS.

At present in several countries common data infrastructures are being developed and linked partly to the Global Biodiversity Information Facility (GBIF, http://www.gbif.org). However, GBIF is focussing mainly on species, while national information centres also include habitats as these are important for environmental assessments and planning issues. Examples of national data-infrastructures are among others in the Netherlands: http://www.nlbif.nl/ and http://www.gegevensautoriteitnatuur.nl/ , in Sweden: http://www.artdata.slu.se/english/ and in Norway http://www.artsdatabanken.no. In Germany the federal structure of the country is also reflected in the databank: http://www.bfn.de/0501_db.html The datainfrastructures are partly in the national language, partly also in English for international access.

5 The quality assurance of data and metadata

Without trustworthy, reliable data, decision-making becomes a series of guesses. Data must be of high quality to let it be a true representation of the world to which it refers. High-quality data must be complete, timely, accurate, consistent, relevant and reliable. Initiatives that only address portions of the data quality strategy are ineffective and costly in the long term and tend not to be aligned with overall priorities. This means that quality assessment of ecological data is essential and this must vary from data entry standards and measures to technical data validation routines and modelling exercises.

The general conclusion from the Art 17 reporting for the Habitats Directive and the Art 12 reporting for the Birds Directive is that we key data are missing as well as information for 'traditional' nature management. The data users have committed themselves to reaching different sustainability objective and reporting on this such as ecosystem goods and services, health and resilience. However, it remains questionable if this is achievable, realistic and serious with the present lack of fundamental data. There is a big gap between the available data and the policy commitments that Europe has committed itself to. Any policy commitment, vision or target, needs addressing seriously and in a sustainable way data collection, monitoring and the research that is needed for it (European Topic Centre on Biological Diversity, 2009).

Concerning **metadata** the INSPIRE Directive provides rules on its description and requires the following governance actions related to access and use of data to be formulated:

- A set of conditions applying to access and use
- A set of conditions on public use.

The INSPIRE Directive also requires description of the responsible parties for the data and the role of this responsible party.

Data profiling or the systematic analysis of data is the process of gathering measurable information about its quality. Information gathered from data profiling activities is used to assess the overall health of the data and determine the direction of data quality initiatives. This is especially important in the complex situation of multiple decentralised actors collecting data that are inherently different in content. Therefore data standards have to be set for both metadata and data content.

Data cleansing is a continuous process that requires corrective actions throughout the data lifecycle. Data cleansing activities must have adequate and dedicated resources from both the data providers and from the data user side as it is critical to provide context and insight into potential data anomalies.

Data compliance consists of the on-going processes to ensure adherence of data to data provider rules, to data user rules and to legal and regulatory requirements. Data compliance includes four areas, controls, audit, regulatory compliance and legal compliance.

Data traceability follows the lifecycle of data to track all access and changes to the data. It helps to demonstrate transparency, compliance and adherence to regulations. Data traceability, along with data compliance, can be considered part of a data audit process.

A crucial and often forgotten success factor is **on-going assessment of data quality** and support for the data management program. Without a long term commitment to maintaining data quality and appropriate usage, a company, agency or government faces failure, loss of investments and inappropriate knowledge.

6 Towards a governance structure

An institutional framework for monitoring in Europe has to be based on the existing rather complex situation. On the one hand there are existing interests in parts of Europe through data collecting NGOs such as Birdlife International and Wetlands international and the British Bat Conservation Trust (BCT), functioning agencies and services such as the different national forest monitoring programmes and regional and national agencies. Next to these other sources of information do exist that should be included such as (Gill et all, 2008):

- Citizen science: monitoring is designed and implemented by interested volunteers and scientists with the assistance of trained local residents volunteered or employed;
- Local Stewardship: monitoring to document the state of the local environment to address various local issues initiated by local communities or governments;
- Humans as sensors: monitoring via surveying of local residents perceptions of status and change of various phenomena as designed and coordinated by researchers, such as the national phenology networks.

A monitoring program covering large areas and including many responsible agencies and NGOs, different monitoring activities and data sets, must allocate adequate resources for, standardization and metadata on methods and procedures. Successful monitoring will depend on a continuous effort to improve and harmonise monitoring methods and standardise data output. Implementation of standardized monitoring protocols will depend upon identification of relatively inexpensive, repeatable protocols that can be implemented in all Europe by applying common tools and databases that are shared or are built on an exchangeable structure. This require cooperation within countries or regions in National Biodiversity Observation Networks (NBON) or Regional Biodiversity Observation Networks (RBON) (Figure 1). It will also be dependent on the establishment of effective and efficient networks within these NBONs between the executing monitoring agencies, NGOs, science groups and the clients.

The overarching European umbrella organisation can be a federation of National BONs, with supporting exchange mechanisms for the clients, the data providers and the European and global mechanisms such as the reporting for Article 17 of the Habitats and Species Directive and Article 12 of the Birds Directive. Such a national and European organisation can only be formed on voluntary basis and it is likely that it will function best if formed at the lowest formally responsible level of data observation. This can be a country of a region within a country if the responsibility for biodiversity conservation is at that level. The database that they develop should be linked with other databases as sharing and exchange of data can then become feasible. One of the consequences is that sharing of system characteristics and tools is more or less needed: we need more cooperation (Figure 1).

However, every organisation within such a system will set conditions for sharing data to prevent abuse and to make proper management possible. In a number of countries the location of sample points in a randomised sampling scheme will be protected from publicity to prevent influencing of the independency of the sample. Also hotspot locations for certain species will in most cases not made public because of sensitivity of the species and the possibility of disturbance. This will be different for countries and regions of Europe as species distribution and habitats do differ from north to south and west to east.

If countries want to cooperate it also means that quality control should be organised accordingly within and between countries. Species names should be exchangeable, habitat names should be comparable and projection systems the same. This requires quality control committees, making monitoring procedures public (not necessarily the locations) and regular consultation.

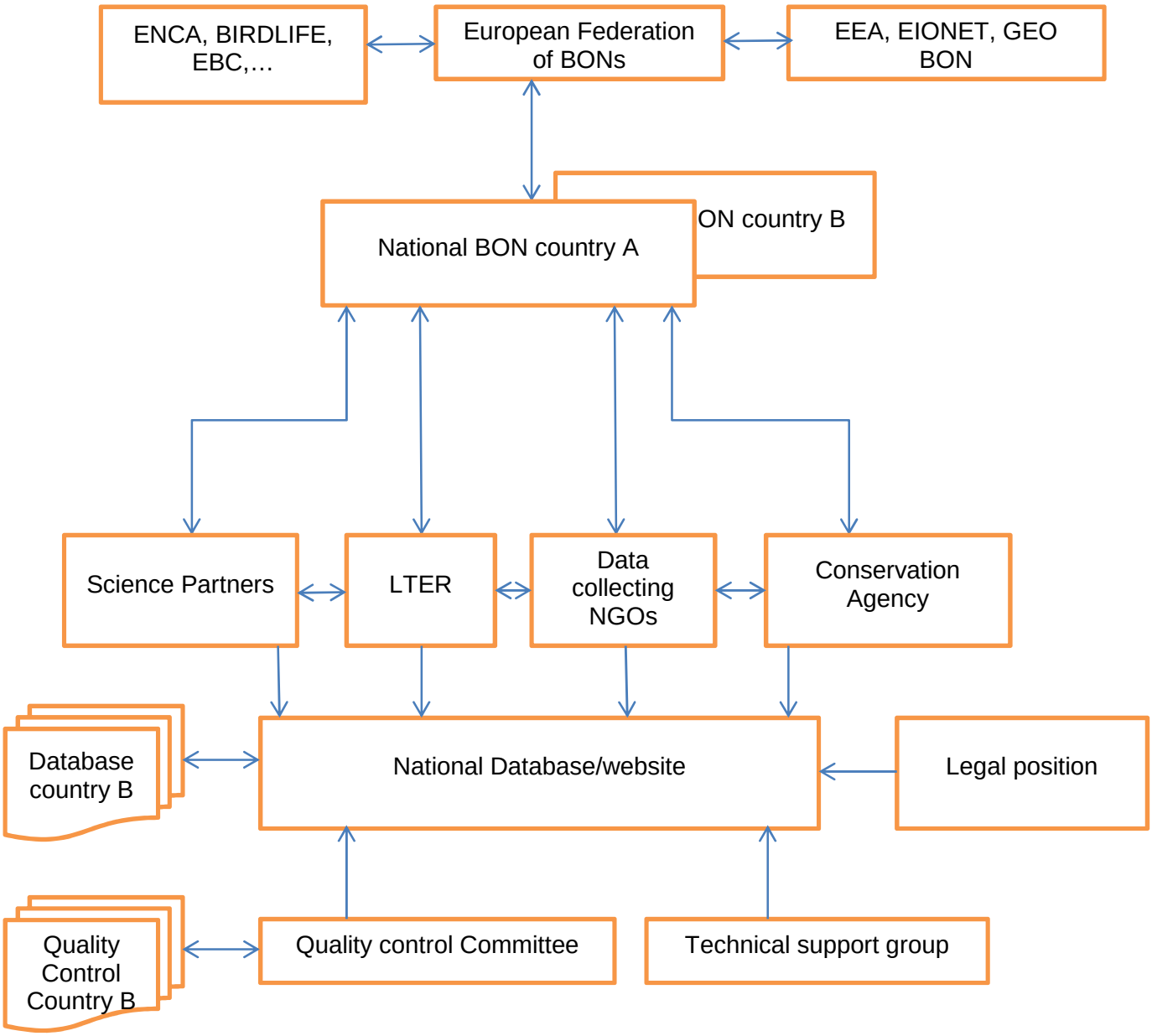

Figure 1. Structure of a national Biodiversity Network in the context of its territory and in relation with international organisations.

National BONs can have different compositions in different countries. There are countries and regions where agencies do not carry out monitoring work, but let this be done by NGOs or consultancies. In some cases institutes and universities dominate the monitoring activities and therefore the BON. There are also countries where NGOs are poorly developed and activities are being carried out by consortia of agencies and universities. There are also countries without LTER sites. Therefore there is not a uniform concept of the constitution of a BON.

The National BONs should be focussing their roles on coordinating and harmonising within countries as well with other countries. It is important that national and regional BONs are proactive in harmonising data sharing policies of the partners in the BON. They also can play a role in developing a national strategy for data acquisition providing data protocols, tools, and standard databases.

It is crucial that according to the INSPIRE Directive metadata policies are being developed for species, habitats and biogeographical regions. The BONs can play an important role in developing guiding documents on the required metadata and carry out a content need assessment under potential clients (in policy, business and NGOs).In this way both the in situ and RS community of information and data collectors can be involved and integrate practical, legal and organisational knowledge on observations of habitats and species and its (legal) reporting..

A second role of the national BONs is to assess the data quality and develop a publication strategy. Therefore at least a quality control committee is required. In a number of countries websites with related access to databases do already exist, but in most countries these are still to be developed. Database management groups are needed, which can consist of the database managers of the participating organisations or be an independent group of experts such as University staff..

As the knowledge is available in several organisations and countries, it would be important that national BONs share this through the federation of BONs as a service to biodiversity observation and conservation. The federation of BONs can become the harmonising level of national data collection as well as a partner at the European level for EEA, EIONET, and GBIF on the one hand and the international NGOs at the other hand. This also will allow better coordinated and more cost-effective monitoring for Article 17 of the Habitats and Species Directive and for Article 12 of the Birds Directive.

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