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Bridging the gap between biodiversity data and policy reporting needs: An Essential Biodiversity Variables perspective

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Summary

1. Political commitment and policy instruments to halt biodiversity loss require robust data and a diverse indicator set to monitor and report on biodiversity trends. Gaps in data availability and narrow-based indicator sets are significant information barriers for fulfilling reporting needs.

2. In this paper, the reporting requirements of several international biodiversity policy instruments were reviewed using the list of Essential Biodiversity Variables (EBVs) as a framework. The reporting requirements for the most comprehensive policy instrument, the United Nation's Strategic Plan for Biodiversity 2011-2020, were compared with the indicator set actually used for its reporting, to identify any currently existing reporting gaps. To explore the extent to which identified gaps could be bridged, existing datasets were analysed to assess the potential contribution of data mobilisation and further processing of existing data.

3. The limited breadth of information requirements for reporting per policy instrument indicates which trends decision makers are currently being insufficiently informed of. The information gap between the reporting requirements for the Aichi targets and the BIP indicators set comprised three of the six EBV classes. Based on the results presented, the following options were identified to bridge the information gaps: i) for some classes there may be existing data available that requires mobilisation, integration or modelling efforts, as is the case for the EBV class Ecosystem Structure, ii) EBV classes lacking primary data require additional monitoring efforts, such as is the case for the EBV classes Genetic composition and Ecosystem Function, but iii) reporting could already be improved by using existing indicators as proxies for other EBV classes, such as for Community Composition, Ecosystem Structure, and Ecosystem Function.

4. *Synthesis and applications:* Using EBVs as a tool, theory-driven comparisons can be made between the biodiversity information gaps in reporting and indicator sets. Existing data showed considerable potential for bridging information gaps by using existing indicators as proxies for other EBVs, or by more comprehensive and integrative use of data.

Key words: biodiversity data, Biodiversity Indicator Partnership, Convention on Biological Diversity, data mobilisation, data sources, indicators, instrument, monitoring, policy, reporting.

Introduction

Globally, biodiversity continues to be lost (Butchart *et al.* 2010) and due to its importance for human well-being, an increasing number of political commitments aim to halt the loss of biodiversity. This has resulted in the "greening" of existing policy instruments (e.g., in the case of the European Common Agricultural Policy[1]), the establishment of new collaborative platforms (e.g., the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES)[2]) and the continuation of existing efforts for global biodiversity conservation (e.g., the convention on the Conservation of Migratory Species of Wild Animals (CMS)[3]). In line with this trend, the Parties to the Convention on Biological Diversity (CBD) adopted the Strategic Plan for Biodiversity 2011-2020, which includes a shared mission and 20 targets, collectively known as the Aichi Targets (CBD 2010).

Reporting on biodiversity changes is required for tracking and evaluating the progress of biodiversity-oriented policy instruments, as well as informing decision makers of possible positive or negative side-effects of other policy decisions (Niemelä 2000; Osinski *et al.* 2003; Pullin *et al.* 2009), such as those resulting from urbanisation, land abandonment, bio-energy production or the industrialization of marine fisheries. All biodiversity-related assessments face similar challenges regarding indicator selection and data availability (Collen *et al.* 2008; Walpole *et al.* 2009; Butchart *et al.* 2010; Lindenmayer *et al.* 2012), leading to a gap between the information that would ideally be used to assess biodiversity trends, and the biodiversity information which actually is used.

There is much scientific literature on what constitutes an ideal indicator and on indicator set selection for biodiversity monitoring, but in reality the indicator actually implemented for reporting depends on many more factors than mere scientific criteria (Noss 1990; Feest 2013), for example stakeholder interests, data availability and practical *ad hoc* solutions for immediate needs. In addition, unfortunately very few biodiversity datasets of sufficient quality across broad taxonomic, temporal and spatial scales are available for official reporting, all of which result in a reduced ability to reliably detect biodiversity change. This leads to information gaps and geographical, temporal and taxonomic biases in reporting efforts worldwide; for example, most data come from less biodiverse areas such as North America and Europe rather than biodiversity-rich areas such as some parts of the tropics (Collen *et al.* 2008; Mora *et al.* 2008; Pereira *et al.* 2012) and developing countries (Butchart *et al.* 2010). Similarly, vertebrates are much better covered than other taxa (Pereira *et al.* 2012) and many marine habitats and species are

[1] http://ec.europa.eu/agriculture/cap-post-2013/index_en.htm
[2] www.ipbes.net
[3] http://www.cms.int/

under-represented (Costello *et al.* 2010). In global assessments such as the Global Biodiversity Outlook 4 (CBD 2014) this leads to the predominant use of bird data for many biodiversity indicators, while data for more threatened vertebrate groups are often absent (Pereira *et al.* 2012). These biases not only undermine the comprehensiveness of reporting, but also influence policy responses based on these reports.

Information gaps and biases can originate from the indicator set used, or a lack of robust and reliable data. Limited availability of biodiversity data can, for instance, be due to data confidentiality, usage restrictions, limited accessibility of datasets, the remoteness of ecosystems (e.g. the deep sea and marine areas beyond national jurisdiction, (Webb *et al.*, 2010)) or data integration and quality issues (e.g. sampling bias, taxonomic inconsistencies (Henry *et al.* 2008)). These practical barriers require increased efforts before biodiversity data can be used in assessments. Further mobilisation of existing data and the collection of new data could help to bridge current information gaps (Kot *et al.* 2010). The potential for data mobilisation is internationally recognised, and a number of long-term initiatives have focused on mobilizing biodiversity data and metadata (e.g. the Global Biodiversity Information Facility (GBIF), and the Ocean Biogeographic Information System). These initiatives aim to connect data owners with each other, to fill gaps and to simultaneously build bridges between citizen volunteers, scientists and policy makers (Jetz *et al.* 2012). Apart from long-term initiatives, project-based incentives are also funded to provide technical and organisational infrastructures as a backbone for scientific and voluntary efforts (e.g. the EU BON project (Hoffmann *et al.* 2014), EBONE (Bunce *et al*. 2011) and EU MON (Schmeller *et al.* 2009).

Monitoring and interpreting biodiversity trends are complex tasks, so, following the example of the climate community and their Essential Climate Variables (GCOS 2003), the Group on Earth Observations Biodiversity Observation Network (GEO BON[4]), an international network of biodiversity and ecology experts, as well as data users and providers, have developed a tentative list of Essential Biodiversity Variables (EBVs) (Pereira *et al.* 2013), comprising a set of essential variables for detecting major dimensions of biodiversity change. The EBVs were developed to facilitate data integration by providing an intermediate abstraction layer between primary observations, indicators and assessment possibilities, i.e. providing a theory-driven, rather than a data-driven, approach (Niemeijer 2002) (see Box 1 for more details). As such, the EBVs could be used as a tool to identify existing biases in policy reporting and indicator use, through which comprehensiveness of biodiversity reporting can be

[4] https://www.earthobservations.org/geobon.shtml

enhanced. Additionally, the use of EBVs could help prioritise data mobilisation efforts and facilitate data integration over large spatial scales and across a broad taxonomic spectrum, and to generate improved information on past and current biodiversity change at all biological levels (genes, populations, species and ecosystems). For example, an EBV estimating population abundances for a given species at a particular location lies between the raw observations and an aggregated population trend indicator that averages multiple species and locations. In this way, different countries may monitor populations of a variety of threatened taxa while allowing the observations to be aggregated into a relevant EBV (e.g. Population Abundance). This would facilitate the measurement of that biodiversity indicator regardless of which species were monitored, and so help to provide an index of national, regional and global trends in threatened species populations (for an example on bird data see Gregory *et al.*(2005) or for marine data Duffy *et al.* (2013)).

The objective of this study is to use EBVs as a tool to evaluate biodiversity reporting and to identify where data could be mobilised or further processed to bridge existing information gaps. For this objective, a first analysis identified the comprehensiveness of reporting under a selection of existing policy instruments by relating data requirements to EBVs. In a second analysis, the information gap between the information actually provided by the indicators and the information asked for the reporting under the CBD was determined. Finally, the potential for bridging these gaps was explored by identifying indicators that could be used as proxies for other EBVs and by determining which EBV classes could be quantified using existing datasets, through data mobilisation, integration and modelling steps. The three EBV-based analyses presented in this paper are indicated by black arrows in Box 1.

Material and Methods

EBVs as an analysis framework

The candidate list of EBVs is grouped into six main classes, each consisting of multiple variables, which are (abbreviation and number of variables included indicated in brackets): Genetic Composition (GC, n=4), Species Populations (SP, n=3), Species Traits (ST, n=6), Community Composition (CC, n=2), Ecosystem Structure (ES, n=4), and Ecosystem Function (EF, n=3; see Appendix S1 in Supporting Information and Pereira et al. (2013)). As with the Essential Climate Variables, the EBVs will be continuously revised and developed to remain responsive, and therefore relevant to changes in biodiversity monitoring in all realms.

Biodiversity data requirements by policy instrument

For the first analysis of comprehensiveness of reporting data requirements, policy instruments were selected based on two criteria. Firstly, biodiversity data had to be required for reporting under the objectives of the policy instrument. Secondly, the policy instrument had to be an implemented international convention. For each of the selected policy instruments, biodiversity objectives were identified and, for each, the data needs were linked to specific EBVs; important biodiversity elements not covered by the EBVs were noted. Detailed tables of EBV coverage per policy instrument were compiled and circulated to additional experts with in depth knowledge of specific policy instruments for feedback. Results for each policy instrument were summarised as the percentage of EBVs needed per EBV class and per policy instrument (Table 1).

The CBD Biodiversity Indicator set

The second analysis addressed the link between the proposed EBVs and the set of biodiversity indicators implemented for the reporting to the CBD, namely those developed by the Biodiversity Indicators Partnership (BIP, www.bipindicators.net/). The BIP indicators were selected for this purpose since the Aichi Targets can be considered as the most important and inclusive biodiversity instrument globally. There are currently 42 BIP indicators across the 20 Aichi Targets, and individual indicators may be applied to more than one target (http://www.bipindicators.net/globalindicators). For the analysis, scores were attributed to individual BIP indicators. A direct score (D) was attributed when the BIP indicator was identified as representative for and using data from an EBV. An indirect score (I) was attributed when the BIP indicator could be used to indirectly measure and quantify an EBV after additional steps of data consolidation and processing. If the indicator did not have any relevance for any of the EBVs, no score was attributed. The scores were thereafter sent out to the partners of the BIP for feedback. Here, a subset of results is presented including the most commonly known BIP indicators, and their relation to each EBV class is represented as the percentage of direct or indirect BIP relevant indicators for EBVs per EBV class (Table 2, complete list in Appendix S2). Based on these tables, conclusions were drawn regarding the actual use of EBVs in reporting and the potential that existing indicators could have to bridge the information gap between current reporting requirements and actual indicator use.

Data availability for EBVs

The third analysis was based on the underlying assumption that if data are currently available for EBVs for which there are information gaps, then data mobilisation, development of data integration methods and modelling efforts could be used to bridge the current information gap between reporting requirements and indicators. If data were not available for EBVs, additional monitoring efforts would be required to bridge the information gap.

Data availability for EBV classes was estimated based on a range of known existing data sources. Data sources were defined in the paper as either dataset holders or data providers that offer direct access to actual biodiversity datasets. Selection of data sources was based on two criteria. First, to allow for data harmonisation and interoperability, the data source should have metadata available in addition to the biodiversity data themselves. Second, to allow for independent use, only data sources that offered data sets with unrestricted access, or at least offered access to parts of the datasets, were considered. Although open data access is increasingly recognised as important (Costello *et al.*, 2014), the second criterion was a significant restriction on the number of potential data sources considered for the analysis. The final selection of data sources (Appendix S3) aimed to represent the current spectrum of biodiversity datasets available.

Scores were attributed to data sources based on the metadata of datasets. The data sources were considered to contain data that could be used to quantify a specific EBV class (value 1) or not (value 0). Additionally, the datasets were further described according to i) the spatial scale covered (global, regional or national levels); ii) the realms covered (marine, terrestrial or freshwater); iii) the accessibility, namely if access was unrestricted or partly unrestricted. Based on this information, strengths, possibilities and limitations of existing biodiversity datasets were identified in relation to the EBV classes (Table 3).

Two notes of caution: i) most datasets contained data for only some specific EBVs and not necessarily for all EBVs within that EBV class, and ii) a considerable number of datasets included in the final selection can only be used to quantify baselines and not indicators of biodiversity change because they do not comprise successive measurements through time.

Results

The data requirements for reporting under the selected policy instruments differed across instruments and the representation of EBV classes showed instrument-specific patterns. Of all the policy instruments examined, reporting for the Aichi Targets, Ramsar and the Convention on the Conservation of Migratory

Species of Wild Animals (CMS) were found to be the most comprehensive in their biodiversity data requirements, requiring data from all EBV classes (Table 1). Furthermore, very well-known biodiversity policy instruments, such as the European Birds and Habitats Directives, had the lowest EBVs coverage. EBVs from the classes Species Populations, Ecosystem Function and Ecosystem Structure were most often required for reporting, whereas EBVs from the class Genetic Composition were least often required for reporting.

[Print Table 1 here]

The detailed analysis of policy instruments also showed that some biodiversity dimensions were not covered by any of the EBVs, for instance the spatial extent of protected areas, or the structure and function of protected habitats as required for reporting under the European Habitats Directive. Some of these dimensions could be considered as non-biodiversity aspects, because they reflect the progress of measure implementation rather than biodiversity itself. This was also found for the BIP indicators (e.g., the Biodiversity Barometer in Table 2), some of which capture information on drivers or pressures on biodiversity not captured by EBVs although they might be essential for biodiversity trend interpretation.

For each of the EBV classes, there was at least one BIP indicator that could be considered to be relevant for that class, although it should be noted that this does not mean that the indicator was relevant for each EBV within the class considered (Table 2, Appendix S2). Conversely, while some BIP indicators were only required by one Aichi Target, they could be considered to represent several EBV classes (e.g., the "Marine Trophic Index" is relevant for three EBV classes).

Species Populations was the EBV class measured most directly by BIP indicators and for which data were found to be most widely available (Table 3, Appendix S3). For the EBV classes Ecosystem Function and Ecosystem Structure, few BIP indicators were considered relevant, even though these classes are often required for reporting. For the EBV class Genetic Composition, only one out of four EBVs was represented by a BIP indicator (Breed and variety diversity). A number of indicators were considered to provide proxies for three EBV classes, in particular: Community Composition, Ecosystem Structure, and Ecosystem Function.

[Print here Table 2 and Table 3]

The analysis of the selected existing data sources showed a highly heterogeneous group in terms of their spatial and temporal resolutions, geographical coverage and the ecosystems considered (Table 3; Appendix S3). For the class Species Populations, spatial coverage ranged from global (e.g. GBIF, the IUCN Red List of threatened species), to regional initiatives such as European databases on taxonomy (e.g. PESI, the European species directories infrastructure, or DAISIE, the alien invasive species inventory).

Data sources most often contained relevant datasets for three EBV classes: Species Populations, Species Traits and Community Composition. It has to be noted, however, that the actual number of data processing and modelling steps that could be required to render the data usable are not taken into account here. There were also multiple datasets available for the EBV class Species Traits, such as specific trait databases for plants, mammals and even bristle worms (databases *Try, YouTHERIA* and *Polytraits*, respectively). Comparatively few datasets were publicly available for the classes Genetic Composition and Ecosystem Function.

Discussion and recommendations

The limited breadth of information requirements per policy instrument for reporting indicates the elements which decision makers are currently being insufficiently informed of. The information gap between the reporting requirements for the Aichi targets and the BIP indicator set comprised three of the six EBV classes. Based on the results presented results, the following options to bridge the information gaps were identified: i) for some EBV classes there may be existing data available that requires mobilisation, integration or modelling efforts (e.g. Ecosystem Structure), ii) EBV classes lacking primary data require additional monitoring efforts (e.g. Genetic Composition and Ecosystem Function), but iii) the reporting could already be improved by using existing indicators as proxies for some EBVs (e.g. for Community Composition, Ecosystem Structure, and Ecosystem Function).

Strengthening the information basis of biodiversity reporting

Henle *et al.* (2013) proposed reducing existing data bias in reporting by prioritising data collection efforts within the focus of the policy instrument based on topical (habitats and species) and geographical criteria. Although this would very likely reduce the reporting bias, the EBV analysis in this paper has illustrated that this would not address the existing reporting gaps outside the scope of individual policy instruments. If not all EBVs are monitored, important biodiversity changes risk being overlooked, especially those arising from the impact of non-biodiversity oriented policy instruments. This was also confirmed in the EBV open consultation round of 2013, during which respondents estimated the importance of coverage of all EBVs for biodiversity monitoring, by ranking all EBVs at 3 and above (on a scale of 1/unimportant to 5/critical). Initiatives such as IPBES would be a very suitable forum for addressing the reporting gaps identified by EBVs. Although the IPBES research program for the coming three years (Decision IPBES-2/5) currently focuses on EBVs for which data are more readily available, it could in the future focus on existing reporting gaps.

The comprehensiveness of reporting under individual instruments could also be improved by using aggregated indicators developed from standardised EBVs to harmonise and streamline data and indicators for multiple reports. For example, the EBV Phenology could be based on a selected number of taxa (e.g. plant, bird, and butterflies) which could be integrated into a global indicator describing phenology changes in response to climate change. This indicator could both contribute to the reporting under the Birds and Habitats Directives as well as future reporting under the CBD.

Identifying and bridging the information gap

The BIP indicator set used all EBVs in an unequal fashion which did not follow the information requirements for reporting, resulting in an information gap. For instance, EBVs in the class Ecosystem Structure were only represented by one BIP indicator, whereas this class is much demanded for reporting. The respondents of the EBV open consultation round in 2013 also considered EBVs of this class as critical (modal score - 5) for tracking biodiversity change. This information gap between the information required versus the actual coverage could be the result of lack of data availability, but the analysis of data sources showed that this gap could be bridged further through the mobilisation of data, integration of datasets and modelling efforts.

Additionally, the quantity and diversity of BIP indicators that could serve as indirect proxies for EBVs (Table 2) suggests that information gaps in reporting could already be bridged to a certain extent by incorporating proxies for missing EBVs. Although use of the same indicator for multiple reporting objectives could theoretically help harmonise reporting and monitoring efforts, limited literature is available to support this (but see Osinski *et al.* 2003 and Geijzendorffer and Roche 2013). However, the use of proxies must be done in a transparent manner to avoid augmentation of the existing bias on more readily available data.

Many data sources within the selection considered in this paper demonstrated potential for bridging the information gap by providing data for several EBV classes (Table 3). This suggests that if datasets from different data sources could be mobilised, integrated or included in modelling efforts, an increase in information covering all dimensions of biodiversity could be achieved (Chavan and Peven 2011). Recognising this potential, the European Commission has funded research projects such as EU BON (Hoffmann *et al.* 2014) to develop methods for data mobilisation and integration of relevant biodiversity data.

For successful data mobilisation, data standards need to be developed across spatial scales, datasets and the full spectrum of biodiversity (Duffy *et al.* 2013), such as those that have been developed by the Biodiversity Information Standards (http://www.tdwg.org/) and the Genomic Standards Consortium (http://gensc.org/). In addition, limitations, such as gaps in spatial and temporal coverage, may be solved by integrating different datasets (Weber *et al.* 2004; Henry *et al.* 2008; Lengyel *et al.* 2008). Dataset integration methods for quantifying indicators are increasingly available (Duffy *et al.* 2013) and bird and butterfly data have already been used to demonstrate the added value of dataset integration for species abundance trends at broad geographical scales (e.g., De Heer *et al.* 2005; Gregory *et al.* 2005; 2009). In addition to the interoperability and quality of datasets, limited access is a key barrier for data mobilisation that is recognised by both funding bodies and scientific initiatives (Chanev & Penev 2011; Costello *et al.* 2014).

Although the options of data integration, modelling and the identification of relevant proxies are important options to bridge the information gap, in the absence of primary data, these options can only add limited value. Results within this paper show that for some EBV classes, such as Genetic Composition and Ecosystem Function, additional data collection efforts would be the most efficient way to start bridging the information gap. However, in determining the most optimal data collection investment, post-collection data processing options could be considered to prioritise collection efforts.

EBVs: future use and development

For the analyses in this paper, EBVs were used as a framework to identify the current information gap between the biodiversity reporting requirements and the information actually available and used. Although it worked well overall, some challenges were identified that need to be addressed if EBVs are to be used as a future assessment.

The robustness of EBV use could currently not be indicated in the EBV assessments. For instance, a dataset which is able to quantify an EBV for one taxon at a one location currently has the same score as a dataset which can quantify the same EBV across many taxa and over a long period of time. Coverage of datasets and indicators of various spatial and temporal dimensions and taxa are important considerations for identifying biases, but this currently remains invisible.

Additionally, for certain policy targets, data requirements seemed to be directed at EBV class level while a relevant individual EBV was not included in the current list. For instance, ecosystem service-related targets seem to require data from the class Ecosystem Function, but apart from Biomass provision, EBVs for other specific ecosystem functions were missing (e.g., pollination or soil decomposition rates).

This analysis also highlighted that reporting required additional indicators on non-biodiversity variables, and similarly that several BIP indicators measured non-biodiversity variables. These variables included the drivers of biodiversity change, progress in policy implementation, public awareness, and policy and management responses (e.g. nitrogen pollution or coverage of protected areas) rather than measures of biodiversity (Walpole *et al.*, 2009; Butchart *et al.* 2010). For instance, the Marine Strategy Framework Directive requires indicators for the identity of the driver of impact (recognised threats and pressures) and the actual positive or negative impact on species, habitats and ecosystems (for an example see Descriptor 5 "Eutrophication" (EC 2010)). These non-biodiversity variables are not covered by the current EBV list, as the EBVs were explicitly developed solely for 'state' and 'biological' variables (Pereira *et al.* 2013). Clearly, comprehensive interpretation of biodiversity trends requires the integration of other topical data, notably on drivers and pressures for biodiversity. Feest (2013) faced a similar challenge in his analysis of the SEBI (Streamlining European Biodiversity Indicators, biodiversity.europa.eu/topics/sebi-indicators) for CBD reporting. In that paper, Feest opted to weight non-biodiversity indicators based on the proof of their impact and connection to biodiversity. This, however, does not provide a coherent framework to answer the particular need to better integrate EBVs and environmental change assessments for improved reporting of biodiversity change.

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Tables

Table 1. Reporting biodiversity information requirements of selected biodiversity policy instruments, expressed as the percentage of EBVs required per EBV class. The EBV classes are: Genetic Composition (GC), Species Populations (SP), Species Traits (ST), Community Composition (CC), Ecosystem Function (EF) and Ecosystem Structure (ES).

Policy instruments*	**Geographic scope**	**EBV classes**					
		GC	**SP**	**ST**	**CC**	**EF**	**ES**
CBD (CBD 2010)	Global	100%	100%	100%	100%	100%	100%
Ramsar (Ramsar 2012)	Global	50%	100%	100%	100%	100%	100%
CMS (UNEP CMS 2014)	Global	75%	100%	67%	50%	100%	100%
Habitats Directive (EC 2011)	EU	0%	67%	0%	0%	25%	65%
Birds Directive (EEA 2011)	EU	0%	100%	50%	0%	25%	67%
MSFD (EC 2008; 2010)	EU	0%	100%	17%	100%	75%	100%
WFD (EC 2000)	EU	0%	100%	33%	100%	50%	67%

*Policy instrument abbreviations explained: CBD = Convention on Biological Diversity; Ramsar = Ramsar convention on Wetlands; CMS = Convention on the Conservation of Migratory Species of Wild Animals; MSFD = Marine Strategy Framework Directive and WFD = European Water Framework Directive.

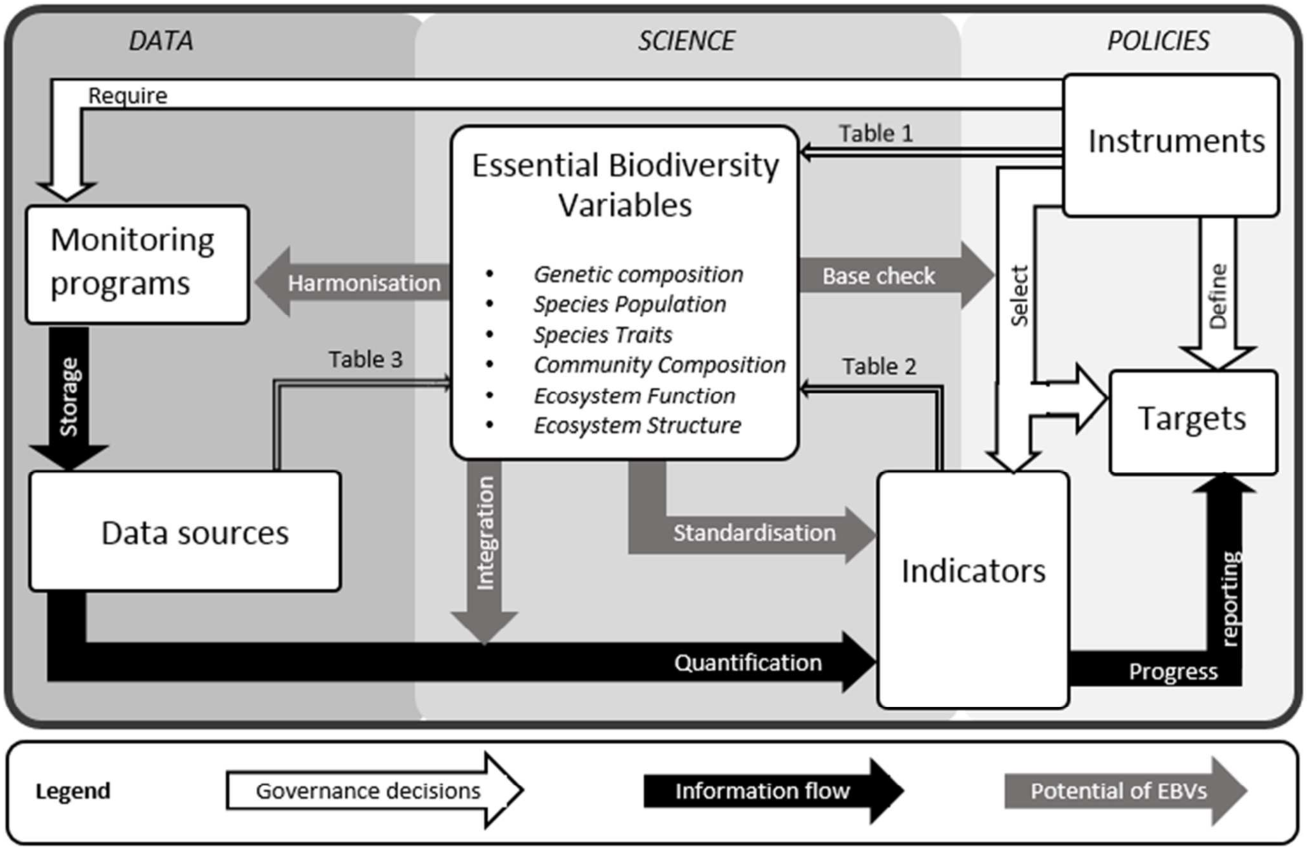
Table 2. Examples of indicators currently used for CBD reporting and the proportion (%) of EBVs they represent relative to EBV class (for the full list of Biodiversity Indicators Partnership (BIP) indicators see Appendix S3). Indicators were considered to be a direct measure of an EBV if no additional computation steps are required. An indicator could potentially to be an indirectly measure of an EBV when the indicator and its data could be used as a proxy after additional data consolidation and processing.

BIP indicator	Aichi Target(s)	Essential Biodiversity Variables Classes											
		Genetic Composition		Species populations		Species traits		Community composition		Ecosystem Function		Ecosystem structure	
		Direct	Indirect	**Direct**	Indirect	**Direct**	Indirect	**Direct**	Indirect	**Direct**	Indirect	**Direct**	Indirect
Ex-situ crop collections	13	**25%**	0%	**0%**	0%	**0%**	0%	**0%**	0%	**0%**	0%	**0%**	0%
Extent of forests and forest types	5	**0%**	0%	**0%**	0%	**0%**	0%	**0%**	0%	**0%**	0%	**66%**	0%
Extent of marine habitats	5	**0%**	0%	**0%**	0%	**0%**	0%	**0%**	0%	**0%**	0%	**66%**	33%
Forest fragmentation	5	**0%**	0%	**0%**	33%	**0%**	0%	**50%**	0%	**0%**	0%	**33%**	66%
Genetic diversity of terrestrial domesticated animals	13	**25%**	0%	**0%**	66%	**0%**	0%	**0%**	0%	**0%**	0%	**0%**	0%
Living Planet Index	5,6,12	**0%**	0%	**66%**	33%	**0%**	33%	**0%**	50%	**0%**	0%	**0%**	0%
Marine Trophic Index	6	**0%**	0%	**0%**	100%	**0%**	17%	**50%**	50%	**0%**	25%	**0%**	66%
Proportion of fish stocks in safe biological limits	6	**0%**	0%	**66%**	33%	**0%**	17%	**0%**	50%	**0%**	0%	**0%**	0%
Red List Index	5,6,10,12,14	**0%**	0%	**100%**	0%	**66%**	0%	**50%**	0%	**0%**	0%	**33%**	0%
River fragmentation and flow regulation	5	**0%**	0%	**0%**	0%	**0%**	0%	**0%**	0%	**0%**	25%	**33%**	33%
Wild Bird Index	5,6,12	**0%**	0%	**66%**	33%	**33%**	0%	**0%**	50%	**0%**	0%	**0%**	0%
Wildlife Picture Index	5,12	**0%**	0%	**33%**	66%	**0%**	33%	**0%**	50%	**0%**	0%	**0%**	0%

Table 3. Selected datasets containing biodiversity information at various scales and representing different EBV classes: Genetic Composition (GC), Species populations (SP), Species traits (ST), Community composition (CC), Ecosystem function (EF), Ecosystem structure (ES). The scoring indicates whether the dataset contained data of direct relevance for the EBV class (1) or not (0). Topical realm coverage includes: Marine (M), Terrestrial (T) and Freshwater (F). Data access was described as unrestricted (U) or partly restricted (P) access to data.

Data source	Scale	Realm	Access	GC	SP	ST	CC	EF	ES	URL
GBIF	Global	M/T/F	U	0	1	0	0	0	0	http://www.gbif.org
GenBank	Global	M/T/F	U	1	0	0	0	0	0	http://www.ncbi.nlm.nih.gov/genbank/
IUCN Knowledge Products - Red list's spatial data	Global	M/T/F	U	0	1	1	0	0	1	http://www.iucnredlist.org/
Biofresh	Global	F	P	0	1	0	0	0	0	http://data.freshwaterbiodiversity.eu/
Pangaea	Global	M/T/F	P	0	1	0	0	1	1	http://www.pangaea.de/
Fishbase	Global	M/F	U	0	1	1	0	0	0	http://www.fishbase.org/
Trait databases (Polytraits, Try, YouTHERIA ...)	Global	M/T/F	P	0	1	1	1	0	1	(1) http://polytraits.lifewatchgreece.eu , (2) http://www.try-db.org/TryWeb/Home.php , (3) http://www.utheria.org
Movebank	Global	M/T/F	P	0	1	1	0	1	0	https://www.movebank.org/
Landsat	Global	M/T/F	U	0	0	0	1	1	1	http://landsatlook.usgs.gov/
ENVISAT	Global	M/F/T	U	0	0	0	1	1	1	http://landsat.usgs.gov/Landsat_Search_and_Download.php
LTER	Regional*	M/T/F	P	1	1	0	1	1	1	https://portal.lternet.edu/nis/home.jsp, http://deims.enveurope.eu/search/dataset
ICES (Datras)	North East Atlantic	M	U	0	1	1	1	1	0	http://www.ices.dk/marine-data/data-portals/Pages/DATRAS.aspx
Delivering Alien Invasive Species Inventories for Europe (DAISIE)	Europe	M/T/F	P	0	1	1	0	0	0	http://www.europe-aliens.org/
Pan-European Species directories Infrastructure (PESI)	Europe	M/T/F	P	0	1	0	1	0	0	http://www.eu-nomen.eu/portal/
European Red deer genetic monitoring program	Europe	T	P	1	1	0	0	0	0	*please find more information in the EuMon Database http://eumon.ckff.si/monitoring/*

Box 1. Representation of the potential place and value of EBVs for biodiversity monitoring, data and policy instrument reporting.



This chart provides an overview of the information flow and governance decisions in international (but also national) environmental policy. Policy instrument include targets and for the reporting on the progress towards the targets, suitable indicators are selected. To ensure primary observation data for indicator quantification, monitoring programs are required. The potential role of EBVs (which is composed of six EBV classes) is presented by grey arrows. EBVs can be used to harmonise monitoring programs, to provide integration methods for data sources to support indicator quantification, to standardise indicator quantification methods, and to identify the base of both biodiversity targets and indicators in terms of EBVs covered. The result tables of this papers are indicated by the small black arrows.

For example, for the reporting requirements of the Birds Directive in Europe include an assessment of changes in species population over time and space. The raw data for the assessment is collected by expert ornithologists and volunteers at focal sites in monitoring programs. Most of the data collected is coordinated and stored by regional or national data hubs. The data are then used to quantify indicators describing changes in distribution range and population trends of species which are included in the Birds

Directive. The indicators “bird distribution map and range size” and “species trend / population trend” represent information from the EBV class Species Population. Computation of the indicator could be standardised, even over multiple taxa, so that this EBV and the indicators could be used in multiple reporting efforts. Distribution data from multiple sources could be integrated to provide robust indicators at multiple scales across realms. The collection of the necessary data could be harmonised over monitoring schemes, scales and some taxa.

Bridging the gap between biodiversity data and policy reporting needs: An Essential Biodiversity Variables perspective

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ONLINE SUPPORTING MATERIAL

Appendix S1: List of the suggested EBVs for the open consultation round in 2013

EBV Class	EBV	Measurement and scalability	Temporal sensitivity	Feasibility	Relevance and related CBD 2020 targets
Genetic composition	Co-ancestry	Pairwise relatedness among individuals or inbreeding coefficient of selected species, within and among populations of each species.	Generation time	Available for many species but few populations, and little systematic sampling over time.	This variable provides a good measure of the genetic independence of allele frequencies among individuals and their susceptibility to lowered fitness. Aichi Targets: 12.
	Allelic diversity	Allelic richness from genotypes of selected species (e.g. endangered species and domesticated species) at multiple locations (statistically representative of the species distribution).	Generation time	Data available for several species and for several locations, but little global systematic sampling.	It is one the most used variables to measure genetic diversity, and can support the estimation of indicators such as "Trends in genetic diversity of selected species" and the "Red List Index". Aichi Targets: 12, 13.
	Population genetic differentiation	Gene frequency differentiation (Fst and other measures) among populations or of a subpopulation compared to the metapopulation of selected species.	Generation time	Data available for many species but often for a limited number of populations. Easy to augment datasets.	Beta diversity analogue; this variable captures the variation among populations. This variable can also help to identify local genetically-based adaptation and help provide a 'population adaptive index'. Aichi Targets: 12, 13, 15.

	Breed and variety diversity	Number of animals of each livestock breed and proportion of farmed area under each local crop variety, at multiple locations.	5 to 10 years	Large datasets have been compiled by national organizations and FAO for livestock breeds, but there is insufficient systematic sampling for coverage of local crop varieties.	It is an essential variable to estimate the indicator "Trends in genetic diversity of domesticated animals and cultivated plants". Aichi Target: 13.
Species populations	Species distribution	Presence surveys for groups of species easy to monitor, over an extensive network of sites with geographic representativeness. Potential role for incidental data from any spatial location.	1 to >10 years	Presence surveys are available for a larger number of species than population counts and can make use of existing distribution atlas. Some efforts for data compilation and integration exist (GBIF, IUCN, Map of Life). There is an increasing trend for data contributed by citizen scientists (Observado, iNaturalist).	Abundance & distribution of populations/taxon per se is an intuitive biodiversity metric with public resonance. Abundance & distribution contributes to extinction risk indicators and indicators of supply of ecosystem services associated with particular species. Range shifts are expected under climate change. Aichi Targets: 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15.
	Population abundance	Population counts for groups of species easy to monitor and/or important for ecosystem services, over an extensive network of sites with geographic representativeness.	1 year	Population counts underway for a significant number of species in each of the following groups: birds, butterflies, mammals, plankton, important fisheries, coral reef fishes. Most of these extensive networks are geographically restricted. Much of the data are currently being collected by citizen science networks.	
	Population structure by age/size class	Number of individuals or biomass of a given demographic class of a given taxon or functional group at a given location.	1 year	Available for some managed species (hunting and fisheries), usually geographically restricted.	

	Phenology	Timing of periodic biological events for selected taxa/phenomena at defined locations. Examples include: timing of breeding, leaf coloration, flowering, migration, oceans flow pattern shifts, intermittent flows in rivers, extant of wetlands.	1 year	Several ongoing initiatives (Phenological Eyes Network, PhenoCam, ClimateWatch, etc.), some making use of citizen science contributions.	Phenology is expected to change with climate change. Aichi Targets: 10, 15.
	Body mass	Body mass (mean and variance) of selected species (e.g. under harvest pressure), at selected sites (e.g. exploitation sites).	1-5 year	Data available for many important marine fisheries, but little data available for bushmeat and other exploited species groups.	There is evidence that mean body mass of some species may be changing in response to pressures such as harvesting. Aichi Targets: 6, 7.
	Natal dispersal distance	Record median/frequency distribution of dispersal distances of a sample of selected taxa. In marine species larval lifetime it may be a useful surrogate.	>10 years	Banding/marking and observation data available for some birds, mammals, turtles, fish, temperate trees	Required in order to assess the impact of habitat fragmentation on species, project the spread of invasive species, and project the impact of climate change on species and to combine with abundance data to assess extinction risk. Aichi Targets: 5, 6, 9, 10, 11, 12, 15.
	Migratory behaviour	Presence/ absence/ destinations/ pathways of selected migrant taxa.	1 to >10 years	Banding/ marking/ tagging and observation data available for some birds, mammals, turtles, fish and butterflies.	Migratory behaviour is expected to change under climate change and habitat fragmentation. Riverine migrations are expected to be susceptible to damming etc. Aichi Targets: 5, 6, 10, 11, 12.
Species traits	Demographic traits	Effective reproductive rate (e.g. by age/size class) and survival rate (e.g. by age/size class) for selected taxa at selected locations.	1 to >10 years	Data available for some fisheries, birds, mammals, reptiles, plants, and other taxa, but little trend data available.	Necessary to combine with other factors for assessing extinction risk and vulnerability to threats. Aichi Targets: 4, 6, 8, 9, 12, 15.

	Physiological traits	For instance, measurement of thermal tolerance or metabolic rate. Assess for selected taxa at selected locations expected to be affected by a specific driver.	1 to >10 years	Some data available for corals, lizards, amphibians and insects.	May determine susceptibility to climate change impacts and may change under climate change. Aichi Targets: 4, 6, 8, 9, 12, 15.
Community composition	Taxonomic diversity	Multi-taxa surveys (including by morphospecies) and metagenomics at selected in situ locations at consistent sampling scales over time. Hyper-spectral remote sensing over large ecosystems.	5-10 years	Many intensive long-term research sites have excellent but uncoordinated data, and there are abundant baseline data for many locations in the terrestrial, marine and freshwater realms. Metagenomics and the possibilities of remote sensing are emerging fields.	This is a basic measure of interaction of species i.e. which species live together. It is the basis of community classification and ecosystem health assessments. Functional type composition of the ecosystem is often derived from species composition of observed communities. Aichi Targets: 8, 10, 14.
	Species interactions	Studies of important interactions or interaction networks in selected communities, such as plant-bird seed dispersal systems.	5-25 years	Some studies have monitored the structure of species interaction networks such as mutualistic networks (pollination and seed dispersal), soil food webs, host-parasite and herbivore-plant interactions. There is a lack of global or regional representativeness of these studies.	Global change is affecting species interactions, which are determinants in ecosystem functioning and services. Aichi Targets: 7, 9, 14, 15.
Ecosystem Function	Net primary productivity	Global mapping with modelling from remote sensing observations (FAPAR, ocean greenness) and selected in situ locations (eddy covariance).	<=1 year	A network of regional networks of in situ measurements exists (FLUXNET), and some global maps based on models and remote sensing are available. GCOS is also addressing this EBV.	Indicator of the energy flow through ecosystems and a measure of health/degradation; Supports biodiversity at multiple dimensions/trophic levels, regulates climate, impacts on human wellbeing, possible indicator of shifts into alternate

					ecosystem states; underpins all production-based ecosystem services. Aichi Targets: 5, 8, 14.
	Secondary productivity	Measurement of secondary productivity for selected functional groups, combining in situ, remote sensing, and models. Example functional groups include: fisheries, livestock, krill, and herbivorous birds.	1 year	FAO and national statistics on fish and livestock production.	Important for assessing ecosystem functioning and ecosystem services. Aichi Targets: 6, 7, 14.
	Nutrient retention	Ratio of nutrient output from the system to nutrient input, measured at selected in situ locations. Can be combined with models and remote sensing to extrapolate regionally.	1 year	Some intensive monitoring sites have nitrogen saturation monitoring in some acid-deposition areas; phosphorus retention monitoring in some impacted rivers and estuaries.	Nutrient loss or accumulation affects biodiversity and ecosystems services. Aichi Targets: 5, 8, 14.
	Disturbance regime	Type, seasonal timing, intensity and frequency of event-based external disruptions to ecosystem processes and structure. Examples: sea surface temperature and salinity (RS), scatterometry for winds (RS), trawling pressure (in situ), flood regimes (in situ), fire frequency (in situ, RS), cultivation/ harvest (RS), windthrow and pests (in situ).	1 year	Abundant data is available for several perturbations, sometimes at the global scale, although harmonization and integration is needed.	Key determinant of ecosystem function, structure and composition; changes in the disturbance regime lead to changes in biodiversity. Aichi Targets: 5, 7, 9, 10, 11, 14, 15.
Ecosystem structure	Habitat structure	Remote sensing measurements of cover (or biomass) by height (or depth) classes globally or regionally, to provide a 3-	<=1 year	Global terrestrial maps available with RS (e.g., LIDAR). Marine and freshwater habitats mapped by combining RS and in	Proxy for biomass in ecosystems; key determinant of habitat suitability for biodiversity; basis for land cover classification. Relevant

		dimensional description of habitats.		situ data.	for Aichi Targets: 5, 11, 14, 15.
	Ecosystem extent and fragmentation	Local (aerial photo and in situ monitoring) to global mapping (satellite observations) of natural/semi-natural forests, wetlands, free running rivers, coral reef live cover, benthos cover, etc.	1-5 years	Global maps of forests, assessment of fragmentation for major river basins, and local to regional maps of coral reefs already exist, but comparable observations over time are limited and a distinction between natural and modified ecosystems (e.g. natural forests versus plantations) is often not made.	This is a key measure of human impacts on ecosystems. It can be used to derive indicators such as extent of forests and forest types, mangrove extent, seagrass extent, coral reef condition. Aichi Targets: 5, 7, 10, 14, 15.
	Ecosystem composition by functional type	Functional types can be directly inferred from morphology (in situ) or from remote sensing.	5 years	Implicitly part of current ecosystem maps. Some models (e.g. DGVMs, marine ecosystem models) are based on functional groups.	This is a basis for ecosystem classification and lends itself to remote sensing. It can be used to predict ecosystem function and ecosystem services. Aichi Targets: 5, 14, 15.

Appendix S2: Gap analysis of the coverage of Essential Biodiversity Variables (www.geobon.org) against indicators to measure the CBD Aichi Targets (www.bip-indicators.net). For the analysis, each BIP indicator was identified as using data either directly applicable as an EBV, i.e. no additional computational steps are required and data collection is well organised (attributed score D), or that the BIP indicator could potentially be usable as an indirect source of data, i.e. after additional steps of data consolidation and processing, or the data is not currently being used to directly measure that EBV but it could be (score I), or if indicators were unusable for or unrelated to any of the EBVs, no score was attributed. Indicators have not yet been developed and adopted for Aichi Targets 2, 3 and 15.

			Genetic Composition				Species populations			Species traits						Community composition		Ecosystem Function				Ecosystem Structure		
BIP indicator	**CBD Strategic Goal**	**Aichi Target**	Co-ancestry	Allelic diversity	differentiation	diversity	Species distribution	Population abundance	age/size class	Phenology	Body mass	Natal dispersal distance	Migratory behaviour	Demographic traits	Physiological traits	Taxonomic diversity	Species interactions	Net primary productivity	Secondary productivity	Nutrient retention	Disturbance regime	Habitat structure	fragmentation	Ecosystem composition by functional type
Biodiversity barometer	A	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ecological footprint	A	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I	I	-	-	-	D	I
Status of species in trade	A	4	-	-	-	-	I	I	I	-	-	-	-	I	-	-	-	-	-	-	-	-	I	-
Wild commodities index	A,B	4,6	-	-	-	-	I	D	D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Areas of forest under sustainable management:	B	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	D	D	D

degradation and deforestation																								
Climatic impacts on European birds	B,C	5,6, 7,12	-	-	-	-	I	D	D	D	-	-	D	-	-	I	-	-	-	-	-	-	-	-
Extent of forests and forest types	B	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	D	D
Extent of marine habitats	B	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I	D	D
Forest fragmentation	B	5	-	-	-	-	I	-	-	-	-	-	-	-	-	D	-	-	-	-	-	I	D	I
Living Planet Index	B,C	5,6, 12	-	-	-	-	I	D	D	I	-	-	I	-	-	I	-	-	-	-	-	-	-	-
Red List Index	B,C, D	4,5, 6,8, 9,10 ,12, 14	-	-	-	-	D	D	D	-	-	D	D	D	D	-	D	-	-	-	-	-	D	-
Red List Index for seabirds	B,C, D	4,5, 6,8, 9,10 ,12, 14	-	-	-	-	D	D	D	-	-	D	D	D	D	-	D	-	-	-	-	-	D	-
River fragmentation and flow regulation	B	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I	I	D	-
Wild Bird Index	B,C	5,6, 7,12	-	-	-	-	I	D	D	D	-	-	D	-	-	I	-	-	-	-	-	-	-	-
Wild Bird Index for farmland birds	B,C	5,6, 7,12	-	-	-	-	I	D	D	D	-	-	D	-	-	I	-	-	-	-	-	-	-	-
Wildlife Picture Index	B,C	5,12	-	-	-	-	D	I	I	I	-	-	I	-	-	I	-	-	-	-	-	-	-	-
Marine Trophic Index	B	6	-	-	-	-	I	I	I	-	I	-	-	-	-	I	D	-	-	-	I	I	-	I
Number of MSC-certified fisheries	B	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Proportion of fish stocks in safe	B	6	-	-	-	-	I	D	D	-	I	-	-	-	-	I	-	-	-	-	-	-	-	-

biological limits																								
Area of agricultural ecosystems under sustainable management	B	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I	I	-
Areas of forest under sustainable management: certification	B	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	D	I	-
Loss of reactive nitrogen to the environment	B	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	D	-	-	-	-
Nitrogen deposition	B	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	D	-	-	-	-
Water Quality Index for Biodiversity	B	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	D	-	-	-	-
Trends in invasive alien species	B	9	-	-	-	-	D	D	D	-	-	I	-	I	-	-	-	-	-	-	-	-	I	-
Cumulative human impacts on marine ecosystems	B	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I	D	I	D	I
Ocean Health Index	B	10	-	-	-	-	D	D	I	-	-	-	-	-	-	-	-	-	-	D	D	I	D	D
Coverage of protected areas	C	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I	-
Management effectiveness of protected areas	C	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Protected area overlays with biodiversity	C	11	-	-	-	-	D	-	-	-	-	-	D	-	-	-	-	-	-	-	-	-	I	-
Ex-situ crop collections	C	13	-	-	-	D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Genetic diversity of terrestrial	C	13	-	-	-	D	-	I	I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

domesticated animals																								
Biodiversity for food & medicine	D	14	-	-	-	-	D	D	D	-	-	I	-	I	-	-	-	-	-	-	-	-	I	-
Health & wellbeing of communities directly dependent on ecosystem goods and services	D	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I	-
Nutrition indicators for biodiversity	D	14	-	-	-	I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ratification status of the Nagoya protocol	D	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Status of NBSAPs	E	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Index of Linguistic Diversity	E	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Status and trends of linguistic diversity and numbers of speakers of indigenous languages	E	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
VITEK	E	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Number of maintained species inventories being used to implement the CBD	E	19	-	-	-	-	I	-	-	-	-	-	-	-	-	I	-	-	-	-	-	-	-	-
Official development assistance in support of the Convention	E	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix S3: Final selection of evaluated dataset sources containing biodiversity information at various scales and representing the different EBV classes: Genetic Composition (GC), Species populations (SP), Species traits (ST), Community composition (CC), Ecosystem function (EF), Ecosystem structure (ES). The scoring indicates that the dataset contained data with direct relevance for the EBV class (1) or that no data representing EBVs was available (0). Topical coverage includes the following realms: Marine (M), Terrestrial (T) and Freshwater (F). Data access was described as unrestricted access to data (U) or partly restricted access to data (P) (e.g., data could be browsed online, online request for usage needed).

Data source	Scale	Realm (M/T/F)	Access	GC	SP	ST	CC	EF	ES	URL
Amphibian Species of the World	Global	T/F	U	0	1	1	0	0	0	http://www.eurobis.org/data_access_services
Aquamaps	Global	M	U	0	1	0	1	0	0	http://www.aquamaps.org/
Barcode of Life	Global	M/T/F	U	1	0	0	0	0	0	http://www.seaaroundus.org/
Biofresh	Global	F	P	0	1	0	0	0	0	http://data.freshwaterbiodiversity.eu/
Dryad	Global	M/T/F	P	1	1	1	1	1	1	http://research.amnh.org/vz/herpetology/amphibia/
ENVISAT	Global	M/F/T	U	0	0	0	1	1	1	http://landsat.usgs.gov/Landsat_Search_and_Download.php
Fishbase	Global	M/F	U	0	1	1	0	0	0	http://www.fishbase.org/
GBIF	Global	M/T/F	U	0	1	0	0	0	0	http://www.gbif.org
GenBank	Global	M/T/F	U	1	0	0	0	0	0	http://www.ncbi.nlm.nih.gov/genbank/
IUCN Knowledge Products - Red list spatial data	Global	M/T/F	U	0	1	1	0	0	1	http://www.iucnredlist.org/
Landsat	Global	M/T/F	U	0	0	0	1	1	1	http://landsatlook.usgs.gov/
MODIS	Global	M/T/F	U	0	0	0	1	1	1	http://www.boldsystems.org/
Movebank	Global	M/T/F	P	0	1	1	0	1	0	https://www.movebank.org/
OBIS	Global	M	U	0	1	0	1	0	0	http://www.iobis.org/
Pangaea	Global	M/T/F	P	0	1	0	0	1	1	http://www.pangaea.de/
Seaaroundus	Global	M	U	0	1	1	1	0	0	http://www.seadatanet.org/
Trait databases (Polytraits, Try, YouTHERIA ...)	Global	M/T/F	P	0	1	1	1	0	1	(1) http://polytraits.lifewatchgreece.eu , (2) http://www.try-db.org/TryWeb/Home.php , (3) http://www.utheria.org
LTER	Regional*	M/T/F	P	1	1	0	1	1	1	https://portal.lternet.edu/nis/home.jsp, http://deims.enveurope.eu/search/dataset
Pan-European Common Bird	Multi- national	T	P	0	1	1	1	0	1	http://s1.sovon.nl/ebcc/eoa/

Monitoring (EBCC)										
Continuous Plankton Recorder	North Atlantic/ North Sea	M	U	0	1	1	1	1	0	http://www.sahfos.ac.uk/
ICES (Datras)	Northeast Atlantic	M	U	0	1	1	1	1	0	http://www.ices.dk/marine-data/data-portals/Pages/DATRAS.aspx
EurOBIS	Europe +	M	P	0	1	0	1	0	0	http://euroveg.org/eva-database
European Breeding Bird Atlas 2	Europe	M/T/F	P	0	1	0	1	0	0	http://datadryad.org/
European Vegetation Survey Archive	Europe +	T	P	0	1	0	0	0	0	http://easin.jrc.ec.europa.eu/
Behavioral ecology of wild european carnivores	Europe	T	P	0	1	1	0	0	0	*please find more information in the EuMon Database http://eumon.ckff.si/monitoring/*
Corine Land Cover Data	Europe	T/F	U	0	0	0	1	1	1	http://www.eea.europa.eu/data-and-maps
Delivering Alien Invasive Species Inventories for Europe (DAISIE)	Europe	M/T/F	P	0	1	1	0	0	0	http://www.europe-aliens.org/
European Red deer genetic monitoring program	Europe	T	P	1	1	0	0	0	0	*please find more information in the EuMon Database http://eumon.ckff.si/monitoring/*
Invasive Species EASIN	Europe	M/T/F	U	0	1	1	0	0	0	http://modis.gsfc.nasa.gov/data/
Monitoring of thrips in the Carpathian region	Europe	T	P	0	1	0	0	0	0	*please find more information in the EuMon Database http://eumon.ckff.si/monitoring/*
Seadatanet	Europe	M	P	0	1	1	1	1	1	http://www.seadatanet.org/
Pan-European Species directories Infrastructure (PESI)	Europe	M/T/F	P	0	1	0	1	0	0	http://www.eu-nomen.eu/portal/
Brown Long-eared Bat Roost Monitoring	national	T	P	0	1	0	0	0	0	please find more information in the EuMon Database http://eumon.ckff.si/monitoring/
Common Plants Survey	national	T	P	0	1	0	1	0	0	please find more information in the EuMon Database http://eumon.ckff.si/monitoring/
Ecoscope	national	M/T/F	U	0	1	0	1	0	0	http://www.fondationbiodiversite.fr/programmes-phares/ecoscope
French Common bird monitoring (STOC)	national	T	P	0	1	1	1	0	1	http://vigienature.mnhn.fr/page/le-suivi-temporel-des-oiseaux-communs-stoc
Irish Butterfly Monitoring scheme	national	T	P	0	1	1	1	0	1	http://butterflies.biodiversityireland.ie/
Macrofungi community monitoring	national	T	P	0	1	0	1	0	0	
Monitoring of aquatic macroinvertebrates	national	F	P	0	1	0	1	0	0	*please find more information in the EuMon Database http://eumon.ckff.si/monitoring/*
Netherlands Red Listed Lichen	national	T	P	0	1	0	1	0	0	

Monotoring										
Sand lizard monitoring programme	national	T	P	0	1	0	0	0	0	
Social Wasps and Bumblebees in the Cultural Landscapes of Poland	national	T	P	0	1	0	1	0	0	
Widespread amphibian monitoring	national	F	P	0	1	0	1	0	0	