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Perspective

Unlocking biodiversity data: Prioritization and filling the gaps in biodiversity observation data in Europe



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ABSTRACT

Large quantities of biodiversity data are required to assess the current status of species, to identify drivers of population and distributional change, and to predict changes to biodiversity under future scenarios. Nevertheless, currently-available data are often not well-suited to these purposes. To highlight existing gaps, we assess the availability of species observation data in Europe, their geographic and temporal range, and their quality. We do so by reviewing the most relevant sources for European biodiversity observation data, and identifying important barriers to filling gaps. We suggest strategies, tools and frameworks to continue to fill these gaps, in addition to producing data suitable for generating Essential Biodiversity Variables (EBVs). Our review of data sources shows that only around a third of data-providers provide unrestricted data access. Particularly large geographic gaps exist in Eastern European countries and many datasets are not suitable for generating EBVs due to the absence of long-term data. We highlight examples built on recent experiences from large data integrators, publishers and networks that help to efficiently improve data availability, adopt open science principles and close existing data gaps. Future strategies must urgently consider the needs of relevant data stakeholders, particularly science- and policy-related needs, and provide incentives for data-providers. Hence, sustainable, long-term infrastructures and a European biodiversity network are needed to provide such efficient workflows, incentives for data-provision and tools.

1. Introduction

Despite diverse and significant attempts to reduce biodiversity loss, global biological diversity is declining in the face of numerous pressures. At a regional level, the European Union has adopted ambitious political goals to address this ongoing challenge (European Union,

2011). If these goals are to be attained, it is crucial that biodiversity data are available for research and monitoring. The degree to which such data can be of use depends on their temporal, spatial and taxonomic completeness, and high quality biodiversity data can help to monitor the progress of conservation policy and management from local to global scales (Deinet et al., 2013; Sanderson et al., 2015; Wetzel

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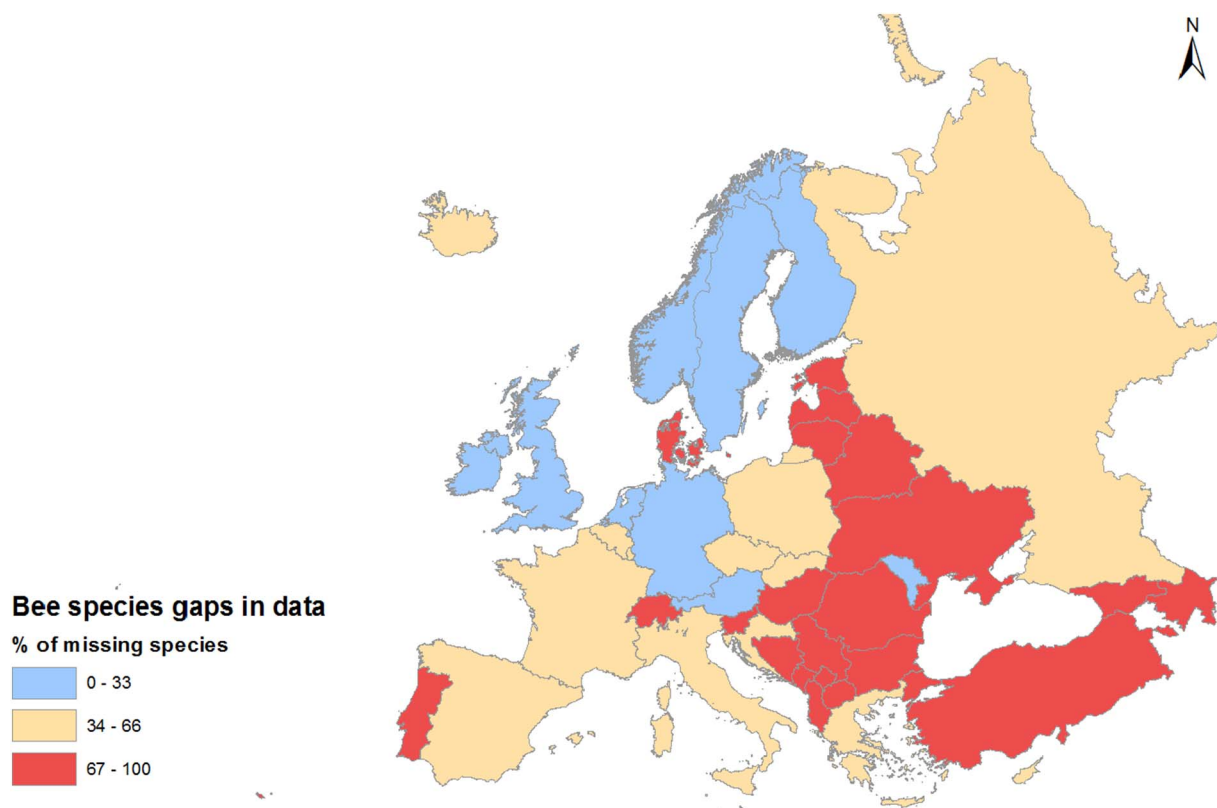


Fig. 1. Spatial gaps in occurrence records on policy-relevant pollinators in the Pan-European region, here exemplified with data on wild bee species (*Anthophila*) in Europe, comparing expert-validated country occurrences and available records in GBIF. This figure visualizes GBIF data gaps, for each country, expressed as the percentage of missing species in a country, ranging from large gaps (red colors, > 67% of species not covered in GBIF) to relatively minor gaps (blue colors < 33%). Despite highly active and skilled amateurs, bee species occurrence data are often not published digitally. A lack of resources for data mobilization at the national level is a likely cause, particularly for fields where the vast majority of experts are amateurs. In addition, such data may be an economically important resource for environmental assessment companies, creating a disincentive to sharing data. A similar situation applies to academic research projects, where data may be used to leverage grant funding. New models of mutual benefit, recognition and participation need to be developed to address these challenges.

et al., 2015; Geijzendorffer et al., 2016).

For conservation policy, biodiversity data are needed to evaluate progress towards conservation targets, to assess the effectiveness of management strategies and to determine conservation responsibilities (Schmeller et al., 2015). Data are also needed to build an understanding of the drivers of biodiversity loss (Proença et al., 2017) and to generate Essential Biodiversity Variables (EBVs) as an intermediate layer between primary observational data and derived indicators (Brummitt et al., 2017; Schmeller et al., 2017a). The resulting reliance on biodiversity data means that gaps and limitations in data can be highly problematic, and may lead to misleading baselines for evaluating the status of biodiversity and its trends (Mihoub et al., 2017). Data gaps may also introduce significant biases in assessments of progress in conservation, especially in biodiversity hotspots (Collen et al., 2008).

Therefore, policy-makers need to be aware of the limitations of the data on which they base decisions, to understand the uncertainties accompanying them, and to support measures to fill identified gaps (Pereira and Cooper, 2006). It is also important that data-collectors in the field are aware of the potential significance of their data at a national and continental scale. In this study, we evaluate European biodiversity data from key data-providers and mediators. We highlight key gaps in (1) spatial, (2) temporal and (3) taxonomic coverage of biodiversity observations, based on the needs of science and the requirements of policy. We further highlight barriers that prevent an efficient collection, analysis and open access to data. Based on our analysis, we propose ways of closing current biodiversity data gaps, and provide detailed recommendations to biodiversity data-providers and stakeholders.

2. Methods and approach

To evaluate data accessibility, we evaluated the level of access permitted by thirteen (Fig. 1) integrators of biodiversity occurrence data in Europe. We define data integrators as platforms or networks that offer data that has mostly been provided by external contributing organizations, institutions, initiatives or projects. Many of these host data from multiple data-providers or national biodiversity reporting systems (e.g. the Global Biodiversity Information Facility (GBIF)). We considered those data integrators meeting the following criteria: (a) the source provides occurrence information for freshwater, terrestrial or marine species in Europe with an adequate coverage of the European continent (meaning that there is no sub-European geographic focus); (b) the source provides at least basic metadata; (c) the source provides data on clearly specified taxonomic groups or species for scientific analyses. Therefore, we excluded data integrators that have a restricted (sub-European) geographical approach (e.g. national platforms).

Data integrators were ranked based on the accessibility of data using three categories: (i) Unrestricted data: characterized by data that can be accessed/downloaded under an open license or waiver. This also includes licenses under creative commons that require users to cite the authors of the source (cc-by), licenses that require modified content to be shared under the same terms (cc-by-sa), and licenses that give open access on the condition that the work is not used commercially (cc-by-nc). (ii) Unrestricted or restricted: data integrators deliver a variety of data, some open and others restricted. (iii) Restricted: data can be downloaded under a restrictive license, re-use must be requested, data can only be browsed online or cannot be accessed.

To assess the completeness of spatial biodiversity data for Europe,

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