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Towards a new global database of regional red lists (RegRed): metadata

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Abstract

Conservation biology depends on an assessment of threats to species. This has been done at the global scale through the IUCN red list, and also locally and regionally, e.g. through country-specific regional red lists. The latter quantify the level of threat to a species in a region, irrespectively to its global status (e.g., a species can be non-threatened globally, but threatened or extirpated in a specific region). There are efforts to collate these regional red lists (e.g., the NRL database hosted by ZSL in collaboration with the IUCN National Red List Working Group), but these have gaps, and are in the process of redevelopment with increased input from country focal points.

Here, we announce a renewal of the effort to collate regional red lists. To create it we searched and compiled sources containing species threat assessments all over the world. As a result, we found 2,093 sources in 172 countries, covering 487 broad taxonomic groups. In this paper, we provide the compiled metadata, enriched with geographical and taxonomic information, and details about the source's title, URL, file format, language, and publication date. This is step one in our effort, in which we ultimately plan to digitise all the compiled sources and provide them openly. By announcing this effort here, we aim to actively seek to expand the metadata database and to collate the respective data. Please refer to the section "How to engage?" if you are interested in collaborating with us.

Keywords: conservation biology, endangered species, IUCN, data compilation, conservation assessment

Introduction

Species extinction represents one of the most serious and irreversible consequences of global environmental change, and currently, it is estimated to be between 100 and 1000 times higher than the natural rates (Ceballos et al. 2015, 2017). In order to monitor and prevent species loss, conservation scientists and practitioners have developed systematic approaches to assess the risk of extinction, with Red Lists emerging as the main tool for this purpose (Mace and Lande 1991). The most extensive global Red List, made by the International Union for Conservation of Nature (IUCN), is now the gold standard and reference for determining a species' risk of extinction on a global scale (Rodrigues et al. 2006).

Using standardised criteria based on population size, distribution range, and rate of decline, the IUCN Red List has developed into a sophisticated system since its beginning in 1964 (Mace et al. 2008). To guarantee scientific rigour and uniformity in evaluating extinction risk across various taxonomic groups, these standards have been regularly improved (Mace et al. 2008, IUCN Species Survival Commission 2012). However, even though the IUCN Red List has evaluated over 160,000 species as of 2025 (IUCN 2025) and successfully captures the risk of *global* extinction, it does not represent the complicated reality of species status at the *regional* and *national* levels. This is an important limitation because species can face local extinction or significant population decline within specific countries while maintaining populations elsewhere (Gärdenfors 2001, Drago and Vrcibradic 2020, Brodsky et al. 2023). To address this limitation, many countries and regions have developed their own Red Lists following IUCN categories and criteria (IUCN Species Survival Commission 2012) or other documents of a similar nature, e.g. government lists and decrees of threatened species (Gärdenfors et al. 2001, Miller et al. 2007).

There have been several projects concerned with regional red lists. The most notable is the National Red List project (NRL; https://www.nationalredlist.org/). The NRL was created by the IUCN National Red List Working Group, and is hosted by the Zoological Society of London (ZSL). Their updated website provides access to a subset of predominately mammalia species from the original database of 101 sources from 73 countries (accessed in April 2025) and offers browsing by taxonomic group, species or source. Although the project made a considerable effort to systematise local red lists there was a hiatus in data transfer whilst the database and website underwent significant restructuring to facilitate national focal points in building capacity to contribute and manage their own data (Sophie Ledger from NRL, pers. comm.). Another effort to collate red lists at the sub-global level is the project "PaDRE – Patterns and drivers of regional plant extinctions", jointly led by the Helmholtz Centre for Environmental Reasearch - UFZ, the German Centre for Integrative Biodiversity Research Halle-Jena-Leipzig (iDiv), and Martin-Luther University Halle-Wittenberg (Staude et al. n.d.). Other taxon-specific initiatives have also made important contributions, such as the Red Data Book of European Butterflies (Swaay et al. 1999), which assessed all 576 butterfly species in each European country against IUCN criteria.

Here, we introduce RegRed, a project that aims to create a comprehensive database of available red lists and sources containing information about threatened or extinct species at the national/regional level. We aim to build on, and significantly expand, the red list data that have already been put together (e.g. in NRL). Our aim is not to supersede other projects, such as the NRL, but rather to complement them, as we recognize meaningful differences between our efforts. While the NRL prioritises red lists submitted by national representatives, our objective is to compile a broader range of data from diverse sources to achieve more comprehensive global coverage. By consolidating these data in a single open database, we aim to make these essential conservation tools more accessible to both practitioners and other stakeholders interested in biodiversity conservation.

The RegRed project has two phases:

1) In the first phase, described in this paper, we have manually searched for, and catalogued, a comprehensive list of known published regional red lists (hereafter *metadata*). Even though these metadata do not yet provide the per-species assessments, we see them as large and useful enough to warrant a stand-alone publication. The metadata can serve both researchers, policymakers, and hobbyists to quickly access relevant documents for their needs. Some of the documents, mainly Red Books, even contain photos, illustrations, maps and locally relevant species information possibly serving as excellent freely available field guides or handbooks.

2) In the second phase, not yet described here, we plan to digitise and database the complete sources listed in the metadata. Since we are open for coordination and collaborations on this effort, we also see it as important to first release the metadata in this paper (see the "*Future directions and how to engage*" section below).

Methods

Our metadata-gathering workflow primarily relied on search engines such as Google Search, Google Scholar and ResearchGate. Both national and university libraries proved valuable, and most official IUCN red lists were sourced from the IUCN library. For the search, we established a set of basic keywords that we consistently used for initial searches, adapting them when necessary to suit specific states/regions (e.g. "red list of…", "endangered fauna of …", "checklist of…", "list of endangered species of…"). We worked systematically through continents, focusing on one country at a time (i.e level 0 in GADM, the Database of Global Administrative Areas) to identify all available resources. When sub-national red lists were found for a given country, we recorded them associated with their GADM level 1 or 2. In the cases in which we could not assign sources to standard GADM levels, we categorized them as "custom regions." These custom regions could represent sub-national areas (e.g. Table Mountain National Park), large territories spanning administrative boundaries, or collections of several countries (e.g. the Arabian Peninsula or southern Africa).

Each source containing species threat assessments was entered into our database with detailed geographical resolution and taxonomic scope. Types of sources included official red lists, checklists, government documents, scientific publications, and any other resources where species threat categories were defined. For clarity and to facilitate subsequent filtering, we assigned each entry to the most specific geographical level possible (country, state, region) and identified the lowest common taxonomic unit.

In many cases, a single source covered multiple taxonomic groups, resulting in multiple database entries (hereafter a “record”, a single source per taxonomic group). For example, a "Red list of Reptiles and Amphibians" would generate two separate records—one for reptiles and one for amphibians. Similarly, documents covering "Fungi and Flora" would be separated into two distinct records. This splitting approach was applied wherever practical to enhance the database's utility for researchers focusing on specific taxonomic groups. Finally, we matched the taxa names against GBIF’s taxonomic backbone (GBIF Secretariat 2023) to normalise names and include the higher taxonomic ranks (i.e., kingdom, phylum, class).

For each record, we also collated comprehensive metadata including the source URL, original title, file format, language, and publication date (see the full list of data columns in Table 1). The database can be accessed at https://github.com/petrkeil/RegRed_metadata or through Zenodo (Kadlec et al., 2025).

Column Name	Definition
id	Unique identifier for each record.
continent	The name of the continent in which the record occurs.
level_0	The name of the country according to GADM in which the record occurs.
level_1	The name of the first smaller administrative region than country (e.g., states, provinces) according to GADM in which the record occurs.
level_2	The name of the first smaller administrative region than country (e.g., districts, counties) according to GADM in which the record occurs.
region_custom	The name of the non-standard geographic areas not fitting into GADM levels (e.g., Carpathians, Indochina, Dutch Caribbean) in which the record occurs.
region_detail	The list of countries or regions spanning the custom regions in which the record occurs.
iso_2	The two-letter country code according to ISO standards. For non-standard geographic areas (i.e., custom regions) this is a list of the two-letter country codes it overlaps.
taxa	The verbatim taxonomic classification of the record. The value of taxa is not always a scientific name; it may include ecological groups (e.g., "cave animals"), functional groups, or broader categories (e.g., "animals").
kingdom	The full scientific name of the kingdom in which the taxa is classified.
phylum	The full scientific name of the phylum in which the taxa is classified.
class	The full scientific name of the class in which the taxa is classified.
order	The full scientific name of the order in which the taxa is classified.
family	The full scientific name of the family in which the taxa is classified.
source_name	The original name of the source.
source_link	The URL to access the source.
language	The language in which the source is written.
year	The year of publication of the source.

Table 1: Metadata table column names and definitions.

Coverage

The metadata identifies a total of 3,200 records derived from 2,064 unique sources, covering 170 countries globally (Fig. 1), 223 sub-national regions (GADM level 1), and 83 regions (i.e., non-standard geographic areas). These sources, produced over the past 50 years (Fig. 2), span 483 distinct taxa (Fig. 3), providing comprehensive coverage across the Tree of Life.

Geographically, the metadata cover all continents, with the highest density of records in Europe, followed by Asia and Africa (Fig. 1). This pattern likely reflects both the prevalence of conservation assessment activities in these regions and our search methodology prioritizing more accessible documentation. Conversely, the large number of sources may only reflect the amount of taxa assessments at sub-national levels and not the amount of species covered. For example, Germany has 544 insect group assessments spanning a few species, while the United States makes their data accessible as single sources spanning multiple taxa (e.g., fauna).

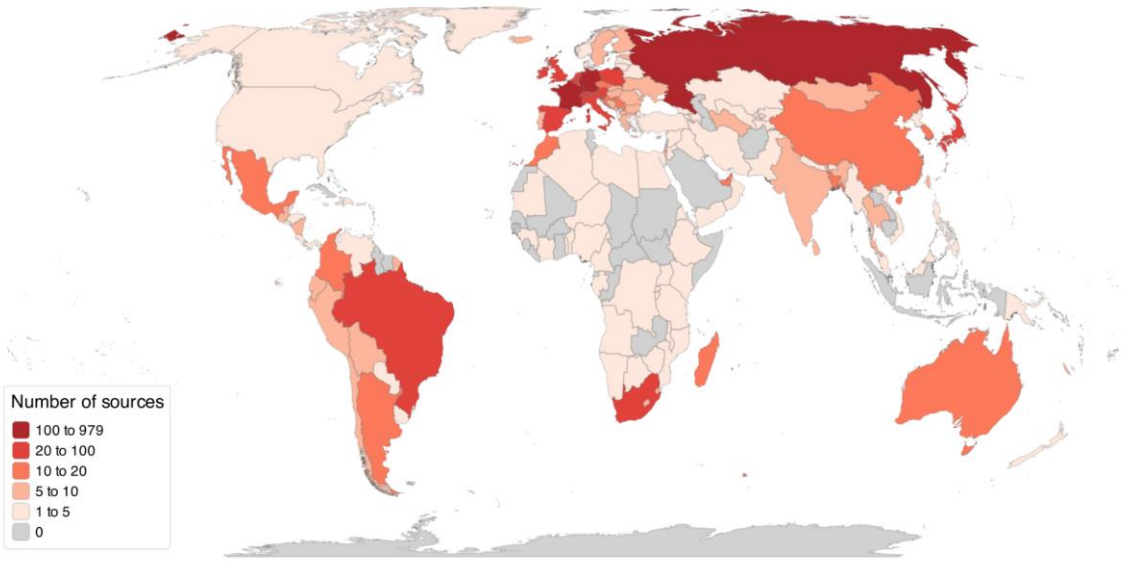

Figure 1. Global distribution of regional red list sources by country. Countries are colored according to the number of unique source documents identified in our metadata collection, ranging from no sources (light gray) to 20 or more sources (dark red). Note that each source may contain multiple regional redlists.

Regarding temporal coverage, our database includes sources published between 1975 and 2024, with almost half of sources (49%) published within the last decade (Fig. 2). The notable peaks in the number of sources per year around 2003, 2010, and 2020, possibly follow the establishment of the IUCN's guidelines for regional red listing in 2003, the increased focus on conservation put by the Aichi Biodiversity Targets in 2010, and the Post-2020 Global Biodiversity Framework report in 2020.

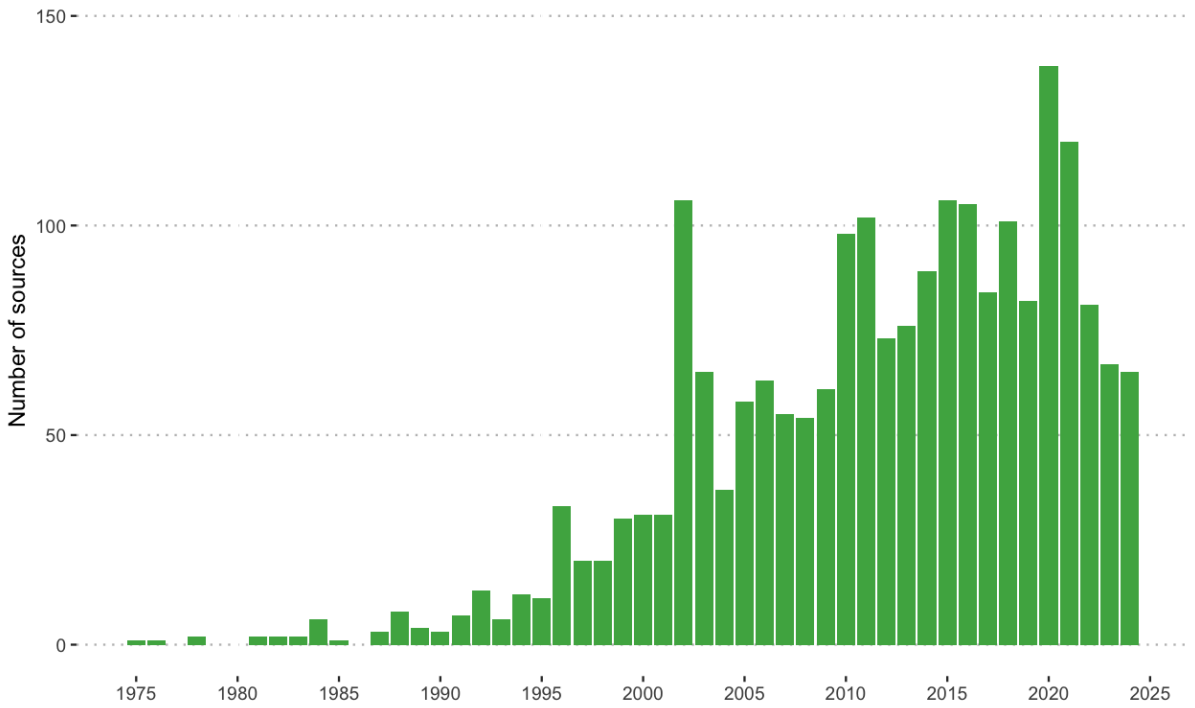

Figure 2. Number of regional red list sources published per year. Sources cover from 1975 to 2024, showing a gradual increase beginning in the early 1990s, with notable peaks around 2003, 2010, and 2020.

Taxonomic distribution within our collection reveals significant variation in coverage (Fig. 3). Globally, our metadata collection contains 2,190 records for Animalia, 898 records for Plantae, and 105 records for Fungi. The Arthropoda phylum dominates with 978 sources, while Chordata represents 815 sources (with vertebrates accounting for 668 sources total), and Mollusca accounts for 71 sources. Breaking down the Chordata sources, we find 202 addressing mammals, 185 covering birds, and the remainder distributed across reptiles (148), amphibians (133), and fish (102). For Arthropoda, insects account for 854 sources and arachnids 47. We also identified 520 broader sources covering multi-taxonomic information. The taxonomic coverage varies considerably across geographic regions (Fig. 3).

Europe has the most comprehensive taxonomic coverage with 2,182 records, predominantly focused on Animalia (1,550 records), followed by Plantae (549 records) and Fungi (75 records). Asia has the second highest number of records (452), similarly dominated by animal assessments. In other continents, the pattern of animal-focused assessments prevails, with significantly lower representation of plant and fungal records. The relative scarcity of fungal records is especially notable, with minimal representation outside Europe, reflecting the historical neglect of this kingdom in conservation assessment efforts despite its ecological importance.

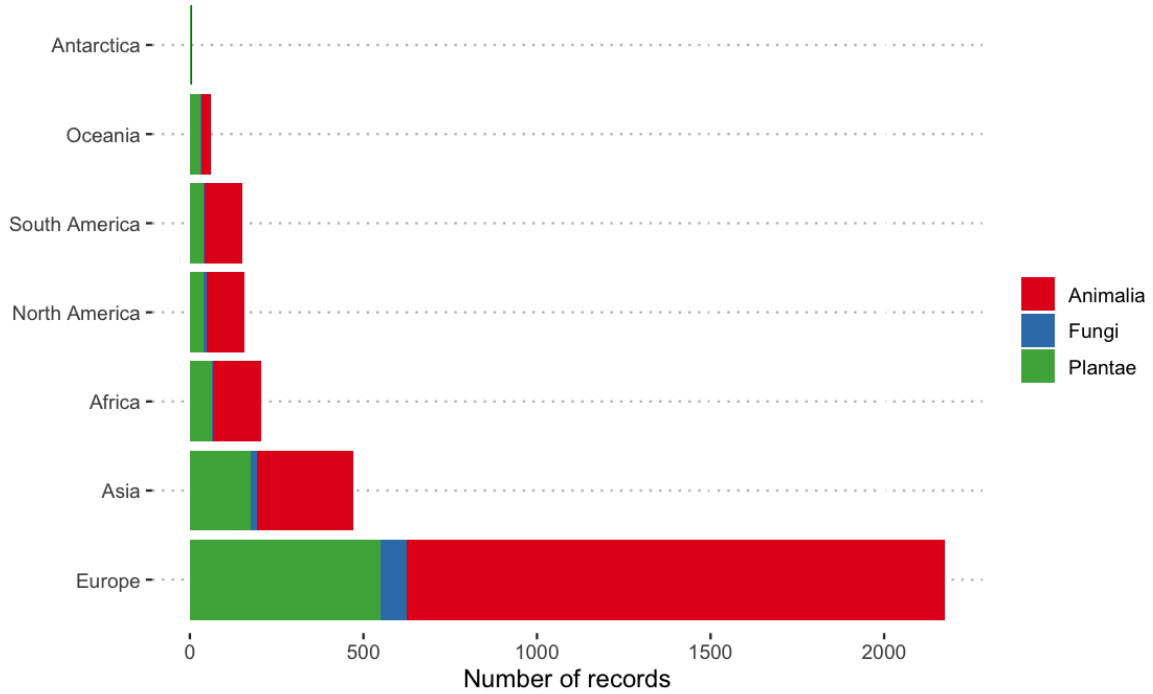

Figure 3: Number of records by continent and taxonomic kingdom (Animalia, Fungi, and Plantae). The three kingdoms are covered in all continents except for South America and Oceania, revealing the predominance of animal records, particularly in Europe, with more balanced kingdom representation in other regions.

Limitations

Our initial assessment revealed that while many countries have published national or regional red lists, their accessibility varies considerably. Some jurisdictions maintain well-organized, freely accessible databases and websites. However, in most cases, these lists are difficult to locate, scattered across various platforms, or hosted on defunct websites. This highlights the value of our compilation effort in making this information more discoverable and accessible to the global conservation community.

Beyond accessibility issues, the collected sources themselves vary in quality, year of publication, language, type, and format. Some are scanned documents and books with little or no optical character recognition (OCR) processing. Not all sources were prepared following the IUCN categories and criteria, which have evolved over time and are currently in version 3.1 (IUCN 2001). Due to language constraints and the project's scale, some records may not include the advertised data, though such cases should be limited.

We detailed the taxonomic higher hierarchy of the groups covered by the sources. However, some records titled with more general descriptors like "Fauna" may

encompass a mix of taxa. For instance, a “Fauna” red list may include vertebrates and invertebrates while others include only birds and mammals. The same issue applies to Flora and other general titles.

The collection is provided as-is, with corrections and additions to be updated in the GitHub repository. Some links may become inaccessible over time, a common issue with large-scale global data hosted primarily on government websites. Additionally, certain websites may experience intermittent downtime due to server-side issues. We have verified the validity of the URL’s at time of publication. If you encounter any dead links, please notify us at the email address provided in the “How to engage?” section of this paper.

Future directions and how to engage

We decided to publish these metadata as a means to engage with others, decentralize the effort, and encourage collaboration. Our overarching goal is to compile available per-species national and regional threat data into a database for further use and sharing. Our team is committed to open science, and the final database will be made available either through a web interface and as a downloadable dataset under a CC-BY license.

The initial focus of the data compilation will be on vertebrate species. Currently, we are developing efficient methods for large-scale and accurate data digitisation. If these methods prove effective, the database may be expanded to include additional taxa.

We are actively seeking to expand the metadata database and to collate the respective data. If you have information regarding regional red lists that we may have missed, identify errors in our data or are interested in collaborating, please contact us at RegRed@fzp.czu.cz.

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