

JRC Global Biodiversity Data Services (GBDS): Data Distribution Architecture, REST API and Query Builder

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Abstract

The KCBD Global Biodiversity Data Services (GBDS) developed by the European Commission's Knowledge Centre for Biodiversity (KCBD), hosted by the Joint Research Centre (JRC), provides support to evidence-based biodiversity policy. Building on the former Digital Observatory for Protected Areas (DOPA), the system processes open-access global reference datasets to generate harmonised metrics and indicators on biodiversity, anthropogenic pressures, ecosystem services and conservation funding. These outputs are calculated annually across multiple reporting levels - including countries, and protected and conserved areas - providing consistent and comparable information to support EU and international biodiversity targets, including the Kunming–Montreal Global Biodiversity Framework (KMGBF).

Metrics and indicators produced by the GBDS are made accessible to a broad range of users through a distribution architecture composed of a structured PostgreSQL database, REST API, and a set of user-oriented interfaces. The GBD REST API delivers standardised outputs in formats such as JSON and CSV, while enforcing authentication, access control and rate limits in line with EC security requirements. Data are accessed through several front-end tools, including the Global Biodiversity Data Viewer (GBDV), the Query Builder and the Swagger UI. Together, these tools enable both interactive exploration and direct integration of pre-calculated indicators into third-party platforms. In particular, the Query Builder is designed for non-technical users to retrieve and download indicators without writing code, while the Swagger UI supports developers requiring programmatic access and interoperability with external systems.

By improving accessibility, interoperability and transparency, the GBDS strengthen collective capacity for biodiversity monitoring and reporting and support regional and global partners, including Technical and Scientific Cooperation support Centres (TSCC), in implementing and tracking of progress towards biodiversity targets.

It is the main objective of this report to present the data distribution architecture of the GBDS to a broad audience of potential users requiring harmonised biodiversity indicators for reporting and analysis. It demonstrates the system's policy relevance, explains how indicators are accessed through web services, and provides practical step-by-step guidance on using the Query Builder for non-technical users and the Swagger UI for developers and technically proficient users.

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1. Introduction

The European Commission (EC)'s Knowledge Centre for Biodiversity (KCBD), hosted by the Joint Research Centre (JRC), is supporting the European Union (EU) in translating scientific evidence into actionable policy knowledge. It brings together data providers, research institutions, policymakers, and civil society to ensure that biodiversity-related decisions are grounded in robust, current, and policy-relevant information. Through monitoring biodiversity trends, assessing conservation measures, and tracking progress toward internationally agreed targets, the KCBD serves as an indispensable bridge between science and policy, supporting both EU and global biodiversity policy.

Under the European Green Deal and the EU Biodiversity Strategy for 2030, the EU has committed to halting and reversing biodiversity loss, protecting at least 30% of its land and sea, and embedding biodiversity considerations across all policy sectors. These ambitions align with targets under the Convention on Biological Diversity (CBD)'s Kunming-Montreal Biodiversity Framework (KMGBF)¹, and relevant United Nations (UN) Sustainable Development Goals (SDGs)². Fulfilling these commitments depends on reliable data; however, biodiversity information remains fragmented, inconsistent, and often inaccessible, limiting countries' ability to track progress and meet reporting obligations. Initiatives like the Group on Earth Observations Biodiversity Observation Network (GEO BON)³ and its Global Biodiversity Observing System (GBIOS) (Gonzalez et al., 2023) promote frameworks for improving biodiversity observation and data coordination.

To address these challenges, the KCBD delivers on its mission through the provision of services such as the Global Biodiversity Data Services (GBDS) – formerly the Digital Observatory for Protected Areas (DOPA) – which form the backbone of JRC's capacity to provide the EC with scientific and technical knowledge on global biodiversity (Dubois et al., 2010; Dubois et al., 2013). Established in 2010 as DOPA, the system – now GBDS – annually produces metrics and indicators focusing on biodiversity, anthropogenic pressures, ecosystem services and funding, calculated at country, ecoregion and protected area level (Dubois et al., 2016; Bastin et al., 2017). This service has evolved since 2016 from being protected area-focused to becoming an area-based conservation service. As such, it now produces indicators and metrics on both protected and non-protected areas, acting as a conservation support tool. GBDS' back-end system currently processes up to 1,200 metrics, for more than 300,000 protected areas, in all countries, and terrestrial, marine, and pelagic ecoregions. Importantly, GBDS rely exclusively on publicly available global reference datasets to allow for independent, transparent and replicable policy support. This approach enables consistent, comparable indicators across multiple reporting levels, underpinning both global assessments and national reporting processes, and providing information to support EU and international biodiversity targets, including the KMGBF. For a recent detailed description of the back-end workflow, we refer to Juffe-Bignoli et al. (2024).

Information is distributed through 50 REST endpoints supporting several web applications, including the recent Global Biodiversity Data Viewer (GBDV)⁴ which serves as a front-end to the Global Biodiversity Data (GBD) database (Dubois et al., 2025). Unlike to the former DOPA Explorer, which

¹ <https://www.cbd.int/gbf>

² <https://sdgs.un.org/goals>

³ <https://geobon.org/>

⁴ https://knowledge4policy.ec.europa.eu/biodiversity/gbdv_en

focused on protected areas (Dubois et al. 2015), the GBDV primarily provides country-level biodiversity profiles through an interactive and user-friendly open-access interface. It consolidates key indicators into national summaries, enabling users to explore information on biodiversity and associated pressures. Through the GBDV, users can access a subset of the metrics and indicators calculated by the GBDS.

Access to the full range of available indicators is provided through the GBD web services - formerly DOPA web services-, which enable users to retrieve these data. In addition to the GBDV, the GBD REST API supports other front-end tools, including the Query Builder, a new KCBD-developed application that provides a user-friendly interface for interacting with biodiversity metrics and indicators produced by the GBDS.

Both GBD web services and associated front-end tools comply with latest EC security standards. They also enable other JRC platforms (e.g. Africa Knowledge Platform⁵) and third parties – including key regional partners such as the Central African Forest Commission (COMIFAC), the Regional Centre for Mapping of Resources for Development (RCMRD), and institutions participating in the Technical and Scientific Cooperation Support Centre (TSCC) network - to access pre-calculated GBDS indicators and integrate them into their own systems. Therefore, GBD web services can support regional TSCCs in the implementation of the KMGBF.

In this context, the main objectives of this report are to:

- Highlight the policy relevance of the GBD web services and data distribution interfaces by demonstrating how it can support the implementation of global biodiversity policies such as the KMGBF ([Section 1](#)).
- Provide an overview of the GBDS ([Section 2](#)).
- Explain how the metrics and indicators are distributed through GBD web services and associated interfaces, with particular focus on the Query Builder tool ([Section 3](#)).
- Provide a practical guide on how to use the Query Builder and Swagger UI front-end tools, tailored to different user profiles ([Section 4](#)).

By achieving these objectives, the report aims to equip technical and non-technical experts, partners, and other stakeholders with both the knowledge and skills to make effective use of the GBD web services and data distribution interfaces. In turn, this supports more transparent progress tracking, helps identify implementation gaps, and facilitates the integration of biodiversity considerations into environmental, climate, marine and land-use policies, while strengthening the EU's capacity for evidence-based engagement in global environmental diplomacy.

⁵ <https://africa-knowledge-platform.ec.europa.eu/>

2. The Global Biodiversity Data Services (GBDS)

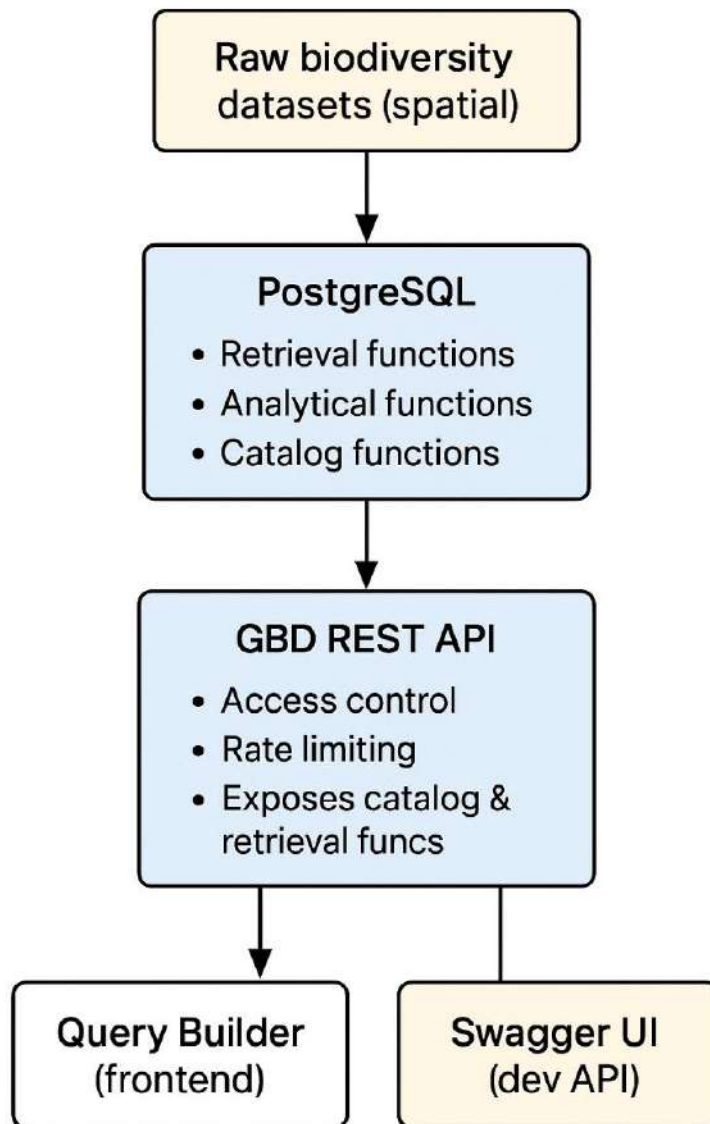
The GBDS rely on extensive open-access global biodiversity datasets that are processed and analysed annually to generate reliable tabular outputs, such as species, habitat, and conservation indicators across various reporting levels. These outputs are disseminated through web services that support a range of web applications (Dubois et al., 2016; Bastin et al., 2017; Juffe-Bignoli et al., 2024; Dubois et al., 2025). An overview of the GBDS workflow and its main components is provided below (Fig. 1):

1. Processing: raw global spatial and biodiversity data are processed annually using geospatial tools (primarily PostGIS and GRASS GIS), then queries and aggregations produce aggregated outputs structured for reporting at various levels (e.g., countries). This step generates the tabular indicators that are subsequently fed into the downstream database and API.
2. Database: aggregated outputs are stored in a non-spatial PostgreSQL database. The database includes tables for datasets and metadata, along with functions that enable efficient retrieval and perform certain “smart” on-the-fly operations (see [Section 3.1](#)).
3. Back end: the GBD REST API consumes the data provided by the database. It enforces access controls and rate limits to ensure fair usage, acting as the engine that distributes outputs to downstream users in standard formats, such as JSON and CSV) (see [Section 3.2](#)).
4. Front end: the front end consumes the data provided by the GBD REST API. It includes:
 - GBDV: an information system that provides simple means to assess, monitor and report the state of biodiversity and associated pressures (see Dubois et al., 2025 for further information).
 - Query Builder: a user-friendly interface that allows end-users, experts or not, to easily interact with available datasets, indicators, and PostgreSQL functions without writing code, and to download outputs in CSV or HTML format (see [Section 3.3.1](#)).
 - Swagger UI: a tool for developers to explore and test the API programmatically (see [Section 3.3.2](#)).

This document focuses on the distribution element of the chain, more specifically on: PostgreSQL functions, GBD REST API back end and the Query Builder and Swagger UI front end.

A glossary of technical terms, software components, and technologies referenced throughout the report is provided in Annex 1 to facilitate understanding of the technical concepts presented

Figure 1. Data flow and services



Source: Own elaboration based on the GBDS architecture

3. Data architecture of the GBDS

3.1. PostgreSQL functions

The PostgreSQL database (non-spatially enabled) forms the operational core of the GBDS.

It hosts a collection of SQL and PL/pgSQL functions that provide standardised and efficient access to processed biodiversity indicators, supporting dynamic queries, filtering, and aggregation by spatial or thematic dimensions (e.g., country, biome, or species group).

Functions are organized into three main categories:

- Retrieval functions: provide direct access to precomputed tabular outputs. Input Parameters correspond to the rows (filters such as country, region, or biome), while Output Parameters correspond to the columns, representing the actual biodiversity indicators such as Protected Area (km²), Species Richness, or Forest Cover (%). For example, filtering by the ISO3 code “ITA” returns Output Parameters for Italy, including Protected Area, Terrestrial Coverage (%), and Marine Coverage (%).
- Analytical functions: perform on-the-fly calculations such as normalization, aggregation, or ranking of Output Parameters; for instance, normalizing indicators by country or selecting an aggregation level for land cover.
- Catalogue functions: expose metadata describing available datasets, data sources, Input Parameters, and Output Parameters used by other functions (see Table 1). These functions perform three main roles:
 - Metadata exposure: provide detailed descriptions of datasets, data sources, Input Parameters, and Output Parameters used by other functions.
 - Front-end support: power both the Query Builder and Swagger UI, which rely on them to automatically display lists of available functions, datasets, and parameter definitions.
 - Versioning and dataset tracking:
 - Allow the selection of the active GBD version (previously DOPA: 4.1, 4.2, 4.3; current version 5.0). While some backward compatibility is generally maintained, indicators and input global datasets have evolved over time. The latest version has dropped support on some legacy functions available on previous versions. Versioning allows tracking changes in source datasets.
 - Document the datasets and data sources used to compute each indicator, including references, enabling reproducibility and traceability.
 - Metadata are therefore accessible both through the front-end interfaces and as standalone catalogue functions within the system.

End users do not interact directly with the PostgreSQL database; all queries and operations are performed indirectly via front-end tools (e.g., Query Builder, Swagger UI), which communicate with the database exclusively through the GBD REST API back end.

This architecture ensures data integrity, consistent access control, and standardized output formats across all interfaces.

Table 1. Catalogue functions – example listing available indicator functions for version 4.3

function_name	function_description	function_link
get_dopa_function_list()	Catalogue of functions	https://dopa.jrc.ec.europa.eu/restapi/api/dopa 43/get_dopa_function_list
get_dopa_function_input_parameters()	Catalogue of function input parameters	https://dopa.jrc.ec.europa.eu/restapi/api/dopa 43/get_dopa_function_input_parameters
get_dopa_function_output_parameters()	Catalogue of function output parameters	https://dopa.jrc.ec.europa.eu/restapi/api/dopa 43/get_dopa_function_output_parameters
get_dopa_function_source_list()	Catalogue of function sources (dataset and/or methods used to calculate indicators)	https://dopa.jrc.ec.europa.eu/restapi/api/dopa 43/get_dopa_function_source_list

Source: Own elaboration based on the GBD version 4.3

The complete list of available catalogue functions is accessible at:

[https://dopa.jrc.ec.europa.eu/restapi/api/dopa_\[version\]/get_dopa_function_list?format=html](https://dopa.jrc.ec.europa.eu/restapi/api/dopa_[version]/get_dopa_function_list?format=html)
e.g., for version 4.3, we have

https://dopa.jrc.ec.europa.eu/restapi/api/dopa 43/get_dopa_function_list?format=html

3.2. Back end: GBD REST API

The GBD REST API acts as the back-end service that consumes the tabular outputs stored in PostgreSQL. It provides controlled access to the data, exposing functions and datasets to front-end applications while enforcing user authentication, access control, and rate limiting.

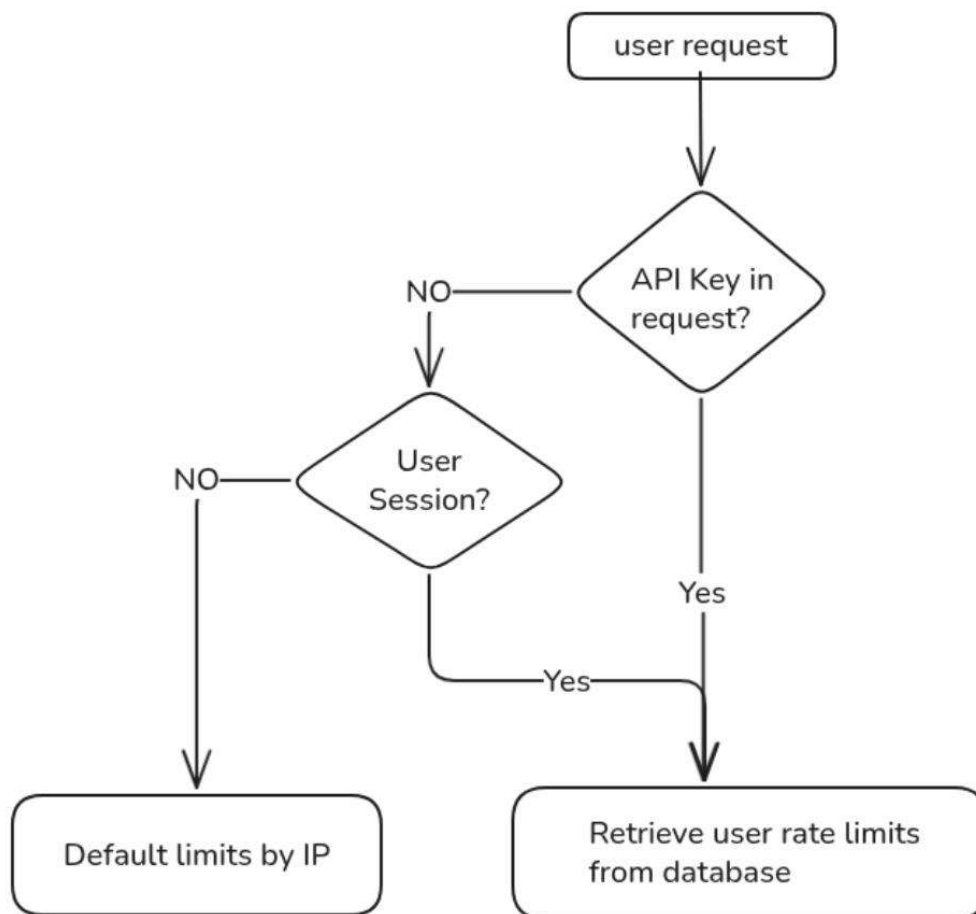
The GBD REST API is a wrapper around PostgreSQL. It is created dynamically from the helper functions in the PostgreSQL schema. That design allows it to easily adjust to schema changes and updates, thus allowing different versions to be served without code changes. A preliminary function executes and creates the Swagger documentation for each endpoint/function available.

Through the GBD REST API, users can query data by specifying Input Parameters (rows/filters) and receive the corresponding Output Parameters (columns/indicators) in standard formats such as JSON or CSV. The API ensures consistent handling of queries and applies any on-the-fly calculations requested by Analytical functions in the database.

The GBD REST API serves multiple front-end tools, including the Query Builder and the GBDV, but can also be used independently. Users and institutions can request programmatic access through API key, by contacting the [KCBD functional mailbox](#)⁶. It is implemented in Python (version 3) using the Flask framework and supports a Swagger interface, which allows developers to explore and test endpoints programmatically (see [Section 3.3.2](#)).

Access to the GBD REST API can be controlled per user, IP address, or API key, monitoring usage and applying rate limits to ensure fair access. The rate limit is placed on a per request basis controlling the frequency of the requests. The diagram below (Fig. 2) shows the flow of a request to the back-end service. Currently, there are 21 requests per minute and 101 requests per day. The limits can be elevated after request by contacting the KCBD functional mailbox. A GDPR policy⁷ is available to cover cases where users request elevated limits, as it requires the retention of sensitive data such as EU Login username and email address.

Figure 2. User request flow with rate limit in place



Source: Own elaboration based on the GBDS architecture

⁶ EC-biodiversity-KC@ec.europa.eu

⁷ <https://dopa.jrc.ec.europa.eu/gbdv/privacy-statement.pdf>

This architecture isolates direct database access, maintains data integrity, standardizes outputs across all interfaces and protects the underlying data from abuse.

3.3. Front end: Query Builder and Swagger UI

The front-end layer consumes the data exposed by the GBD REST API, providing user-friendly interfaces for interacting with biodiversity indicators.

- **Query Builder** allows users without programming skills to extract from the GBD data without writing any code. Users can explore functions, filter outputs, navigate results, and download data in CSV or HTML format. Each selection generates a URL that encodes the query for easy sharing or reproducibility. Access to the Query Builder requires EU Login and explicit user registration (see [Section 3.3.1](#)).
- **Swagger UI** provides a programmatic interface primarily for more technical users and web developers. It lists available API endpoints, documents required Input Parameters and shows the expected Output Parameters. Users can test queries directly in the browser, view returned results and download data in standard formats (see [Section 3.3.2](#)).

Together, these front-end tools ensure that all interactions with the database occur indirectly via the GBD REST API, maintaining data integrity, access control, and standardized outputs.

3.3.1. Query Builder

The Query Builder⁸ is a JavaScript Single Page Application built with front-end frameworks⁹ and UI component libraries¹⁰. It is a reactive web application listing the available functions based on the selected version of GBD. It uses a series of descriptive functions from GBD REST API to retrieve and list the available functions (indicators) to the end user.

Access to the Query Builder interface requires an EU Login account and explicit user registration, as described in Figure 3. The registration process is streamlined for the user and the administrator. The user can access the registration form¹¹ only after using the EU Login. Once the form is submitted, an automated confirmation e-mail from the [KCBD's functional mailbox](#) is sent to the user. At the same time, a notification e-mail is also sent to the developer and the administration team. The administration team must then manually grant access to the user through the Administrator Panel. If the registration is approved, the user receives an automated acceptance e-mail. If the request is rejected, the user is contacted manually.

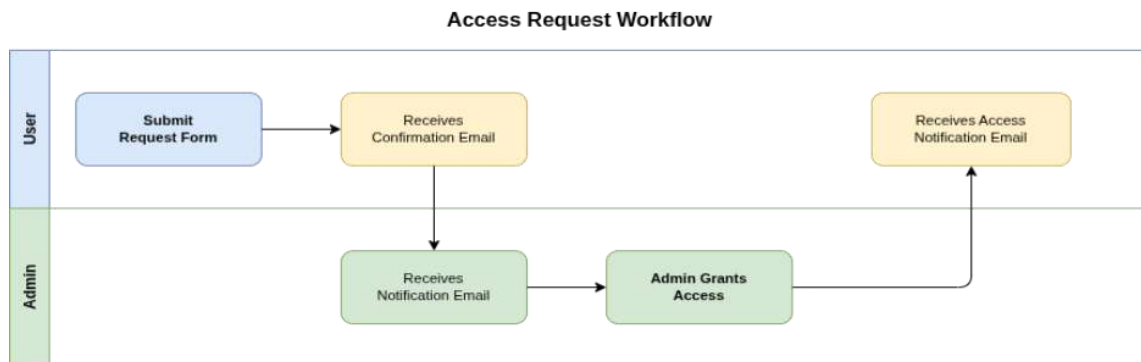
⁸ <https://dopa.jrc.ec.europa.eu/restapi/ui/query-builder>

⁹ Nuxt.js

¹⁰ Vuetify, and ECL libraries

¹¹ <https://dopa.jrc.ec.europa.eu/restapi/ui/welcome>

Figure 3. User registration flow



Source: Own elaboration based on the GBDS architecture

Once authenticated, the Query Builder interface (Fig. 4) offers three main classes to filter available data based on:

- Report level: filter functions according to the reporting level at which metrics are calculated (e.g., country, protected area, etc).
- Theme: filter functions based on their thematic classification (e.g., species, land degradation, etc.),
- Data sources: filter functions by the underlying global datasets used to compute the indicators.

The rest of the interface displays information based on the selected function, generating reactively the list of available output and input parameters. The user can easily select the required output parameters to retrieve, and filter based on the available input parameters.

The last portion of the web page is dedicated to testing the selected function and displaying the available data directly onto the page. For further details on using the Query Builder, see [Section 4.2](#).

Figure 4. Screenshot of the Query Builder interface (only a portion of the interface is shown, as the full page extends beyond the visible screen area)

Query Builder [GUIDE](#)

Query builder is the main documentation of our web services focusing on biodiversity conservation, protected areas, ecosystems, soils, land and marine resources. These services are documented hereafter using a set of a catalogs which have been customized for external users (e.g. Thematic, Datasets, Methods, ...).

Available Versions
 Latest stable version is preselected
 KCBD indicators version: 5.5

Available function list
 Use multiple filter words split by space. Example: `country lcc esa`
 Use the predefined switches for groups of functions

Report Level: ▼ Function Theme: ▼ Data sources: ▼

Filter functions:

Function Name	Function Description	
<code>GET_DOPA_COUNTRY_ALL_IND</code>	Returns all indicators related to countries. This service makes use of dataset available for non-commercial use only. For commercial use of these data, visit https://www.itad-alliance.org	More info
<code>GET_DOPA_COUNTRY_LC_COPERNICUS</code>	Returns percentage and absolute cover of Copernicus Land Cover classes for a given country. Aggregation levels 0 (original Copernicus LC classes) and 2 (DOPA) are available.	More info
<code>GET_DOPA_COUNTRY_PA_COUNT</code>	Calculate number of protected areas in country (using iso3 reported by WCMC), with different aggregations (poly, points; terrestrial, marine, coastal; area over x sqkm). It reports the number of multi-country protected areas included in calculation.	More info
<code>GET_DOPA_FUNCTION_INPUT_PARAMETER</code>	Catalog of DOPA function input parameters.	More info
<code>GET_DOPA_FUNCTION_LIST</code>	Catalog of DOPA functions.	More info
<code>GET_DOPA_FUNCTION_OUTPUT_PARAMETER</code>	Catalog of DOPA function output parameters.	More info
<code>GET_DOPA_FUNCTION_REPORTING_LEVEL_LIST</code>	Catalog of DOPA function reporting levels.	More info
<code>GET_DOPA_FUNCTION_SOURCE_LIST</code>	Catalog of DOPA function sources (dataset and/or methods used to calculate indicators).	More info
<code>GET_DOPA_FUNCTION_THEME_LIST</code>	Catalog of DOPA function themes.	More info
<code>GET_DOPA_SPECIES</code>	Shows for a single species direct and related detailed attributes. This service makes use of dataset available for non-commercial use only. For commercial use of these data, visit https://www.itad-alliance.org	More info

Items per page: 10 1-10 of 20 < >

Source: Query builder

3.3.2. Swagger UI

Swagger UI¹² is a popular method for describing a REST API. It offers specifications and familiar UI visualization as a playground for developers. The documentation is both human and machine readable.

Swagger UI provides programmers and other technical users with a familiar interface to explore and test the GBD REST API. It provides basic functionality for executing REST API requests directly against the GBD back end – the Swagger UI is prebuilt on the fly for the latest stable version of the requested GBD.

As with the Query Builder interface, access to data via Swagger UI requires an EU Login account and explicit user registration via the registration process explained in [Section 3.3.1](#). After registration approval, users can request programmatic access through API key by contacting the [KCBD functional mailbox](#). For further details on using the Swagger UI, see [Section 4.3](#).

¹² https://swagger.io/docs/specification/v3_0/about

4. Query Builder and Swagger UI: User guide

4.1. Disclaimer

Use of the GBD web services requires full understanding and acceptance of the following terms:

- The GBD web services provide metrics and indicators calculated using datasets from third-party sources. The original datasets are not distributed through the GBD web services and remain available from their respective providers.
- Use of the data may be restricted for commercial purposes.
- Proper citation of sources is required when using the data.
- Users are encouraged to consult the authoritative reference sources before applying the data.
- Frequent users of the services are encouraged to inform the JRC of their activities.

Accessing and using data via Query Builder or REST API implies explicit acceptance of these terms.

4.2. Query Builder

Query Builder's main purpose is to list and describe functions available in the GBDS, providing access to the wide range of biodiversity metrics and indicators precomputed by the KCBD. A non-exhaustive list of features offered by Query Builder is the following:

- List available GBD versions and functions
- Filter available functions
- Retrieve a detailed list of a function's sources
- Filter output parameters (indicators) and reduce the volume of output
- Filter input parameters
- Navigate the results withing the interface
- Extract results as CSV, HTML
- Generate URL for the specific combination

Step 1: Accessing the Query Builder via the EU Login account

Access to the Query Builder requires an EU account, the EU Login.

For users who do not yet have an account, register at:

<https://webgate.ec.europa.eu/cas/eim/external/register.cgi>

You will further need to request access to the Query Builder to ensure end-users are agreeing with the various underlying data licenses.

Step 2: Requesting access to the Query Builder

Follow this step if you are not an already registered user:

1. Log in with your EU Login credentials and navigate to:
<https://dopa.jrc.ec.europa.eu/restapi/ui/welcome>
2. Select the “REGISTER” option (Fig. 5, point 1). A pop-up form will appear.
3. Enter a short description of your intended use (Fig. 5, point 2). The “SUBMIT” button (Fig. 5, point 3) activates once this field is filled.
4. Submit the form. If your request is approved, you will receive an automated confirmation email from the KCBD functional mailbox. If needed, the KCBD team will contact you directly.

Once your registration has been approved, you can access the Query Builder by clicking the “PROCEED TO QUERY BUILDER” button.

Figure 5. Query Builder - registration form

European Commission > Knowledge for policy > Biodiversity > Global Biodiversity Data Viewer

Query Builder

Welcome to Query Builder

Query builder (former DOPA REST Services) is the main documentation of our web services focusing on biodiversity conservation, protected areas, ecosystems, soils, land and marine resources. These

Register

CANCEL

Please briefly describe your intended usage of our services.
Our team will review your request and get back to you.
Thank you,
JRC KCBD Development Team

Description **2**

3 **SUBMIT** **CANCEL**

1 In order to proceed to Query Builder, please use the button below to **register**.
You may reach out for further inquiry by [e-mail](#)

REGISTER **PROCEED TO QUERY BUILDER** **PRIVACY STATEMENT**

Source: Query builder

Step 3. Selecting a data version

Once logged in, select the version of the GBD you want to work with (Fig. 6, point 1). The latest stable version is preselected by default. Available functions will load on screen, displayed in green (Fig. 6, point 2).

Figure 6. Query Builder - filters on available data versions

The screenshot shows the 'Query Builder' interface. At the top, there's a breadcrumb trail: 'European Commission > Knowledge for policy > Biodiversity > Global Biodiversity Data Viewer'. Below this is the 'Query Builder' title with a 'GUIDE' button. A paragraph explains that the query builder is the main documentation for web services focusing on biodiversity conservation, protected areas, ecosystems, soils, land and marine resources. It mentions that services are documented using a set of catalogs customized for external users (e.g., Thematic, Datasets, Methods, ...).

The 'Available Versions' section shows a dropdown menu for 'KCBD indicators version' with a red circle '1' next to it. Below this is a warning icon and text: 'Beware that different versions of KCBD indicators might be using different input datasets. Always check the [Function details](#) section.'

The 'Available function list' section has a tip: 'Use multiple filter words split by space. Example: `country loc ess`. Use the predefined switches for groups of functions.' Below this are three filter buttons: 'Report Level', 'Function Theme', and 'Data sources'. A search bar labeled 'Filter functions' is present. Below the search bar is a table with two columns: 'Function Name' and 'Function Description'. A red circle '2' is next to the first row. The table lists several functions: 'GET_DOPA_COUNTRY_ALL_INDS', 'GET_DOPA_COUNTRY_LC_COPERNICUS', 'GET_DOPA_COUNTRY_PA_COUNT', 'GET_DOPA_FUNCTION_INPUT_PARAMETERS', and 'GET_DOPA_FUNCTION_LIST'. Each row has a 'More info' link on the right.

Source: Query builder

Note that there is a fair usage rate limit on a per minute basis. If the user makes excessive requests, then no results will be delivered. You can request a higher rate limit through the KCBD functional mailbox (EC-biodiversity-KC@ec.europa.eu). The authentication can happen with EU Login for web browser navigation or with API key for programmatic access.

Step 4. Filtering functions

Use the filter bar to narrow down the list of available functions (Fig. 7, point 1). You can filter based on:

- Report level (Fig. 7, point 2): filter by the geographic or administrative level at which metrics are calculated (e.g., country, protected area).
- Function theme (Fig. 7, point 3): filter by thematic category (e.g., species, land degradation).
- Data sources (Fig. 7, point 4): filter by the underlying global datasets used to compute the indicators.
- Function's name (Fig. 7 point 5): search for a specific function by name.

You can select the available pills for each category (green outline on grey background) and apply immediately that filtering option (Fig. 7).

Click on a function's name (Fig. 7, point 6) to load its details.

Figure 7. Query Builder – filters on available functions

The screenshot shows the 'Query Builder' interface. At the top, there is a breadcrumb trail: 'European Commission > Knowledge for policy > Biodiversity > Global Biodiversity Data Viewer'. Below this is the 'Query Builder' title with a 'GUIDE' button. A descriptive paragraph follows: 'Query builder is the main documentation of our web services focusing on biodiversity conservation, protected areas, ecosystems, soils, land and marine resources. These services are documented hereafter using a set of a catalogs which have been customized for external users (e.g. Thematic, Datasets, Methods, ...)'.

The main section is titled 'Available function list' (1). It includes a tip: 'Use multiple filter words split by space. Example: `country#ecoregions#all`. Use the predefined switches for groups of functions.' Below this are three dropdown menus: 'Report Level' (2), 'Function Theme' (3), and 'Data sources' (4). A search bar labeled 'Filter functions' (5) is also present.

The function list is displayed in a table with columns: 'Function Name', 'Function Description', 'Theme', 'Source', and 'Reporting Level'. The first function listed is 'GET DOPA_COUNTRY_ALL_IND' (6), with the description 'Returns all indicators related to countries'. Its 'Theme' column contains 'administrative', 'carbon', 'conservation', 'coverage', 'elevation', 'global_forest_cover', and 'land_cover'. The 'Source' column lists 'AGB', 'EEZ', 'GAUL', 'GEMCO', 'GFC', 'GSOC', 'GSW', 'IUCN_SS', 'KBA', 'LC_Copernicus_100m', 'LC_ESA-CCI', 'LPJ', 'MEOW', 'MSPA', and 'WDPA'. The 'Reporting Level' column shows 'country' and 'land'. The second function listed is 'GET DOPA_COUNTRY_ECOREGION_ALL_IND', with the description 'Returns ecoregions and protection status (flattening geometrical overlaps of Protected Areas) by Country'. Its 'Theme' column contains 'administrative', 'conservation', 'coverage', and 'ecosystems'. The 'Source' column lists 'EEZ', 'GAUL', 'MEOW', 'PPOW', 'TEOW', and 'WDPA'. The 'Reporting Level' column shows 'country', 'ecoregions', 'land', and 'mar'.

Source: Query builder

Step 5. Exploring a function and retrieving data

After selecting the desired function, the page area is divided into four parts:

1. Function details: description of the selected function and its original data sources (Fig. 8, point 1).
2. Function output parameters: it is possible to reduce the function's return data/columns by selecting which columns to include in the results (Fig. 8, points 2 and 3).
3. Function input parameters: it is possible to filter the return data based on the predefined parameters (Fig. 8, points 4 and 5). The most common parameter is the country code, which limits the return data to the selected country. A helper pop-up (Fig. 8, point 6) provides a reference table of country names with their ISO 2 and 3 codes.

Output and input function parameters might be an extensive list - in that case, the “filter on name” search bar feature might be helpful (Fig. 8, points 3 and 4).

Figure 8. Query Builder – function information

Function details 1

Each function utilizes a range of sources to perform its calculations. A comprehensive list of the sources relevant to the selected function is provided below. For the most current licensing information, please refer directly to each individual source.

Abbreviation	Description	Reference
GAUL	The Global Administrative Unit Layers is an initiative implemented by FAO within the EC-FAO Food Security Programme funded by the European Commission. GAUL aims at compiling and disseminating the most reliable spatial information on administrative units for all countries in the world. Level 0 (international or country boundaries).	The Global Administrative Unit Layers (GAUL) dataset, implemented by FAO within the CountrySTAT and Agricultural Market Information System (AMIS) projects. Updated and modified by DOPA Version: 2015. Available at: https://data.apps.fao.org/mag/catalog/uvr/ingtotalabg/search?id=12691f/metadata/9c35a10-5649-41c9-bdcf-cb78e9e65554 1
WDPA	The World Database on Protected Areas (WDPA), a joint project of IUCN and UNEP, is the most comprehensive global database on terrestrial and marine protected areas.	UNEP-WCMC and IUCN, Protected Planet: The World Database on Protected Areas (WDPA). Cambridge, UK: UNEP-WCMC and IUCN. Version: Feb 2023. Available at: http://www.protectedplanet.net/ 1

Items per page: 10 1-2 of 2 < >

Selected Function: get_dopa_country_pa_count

Function output filters 2

Q pa_count_es 3

☐	Name	Description	Type
☐	pa_count_es	Numero FPA in target area with size over 1 km2	numeric

Items per page: 10 1-1 of 1 < >

Function input filters COUNTRY HELPER 6 4

Q Filter function parameters

☐	Name	Compulsory	Type	Description
☐	iso3	false 5	text	ISO3 country code (case sensitive, accepts single values; eg: IT). Possible values listed by: get_dopa_region_country_list()
☐	status_multi	false	boolean	Either include or not in the report Disputed or Joint Managed territories.

Items per page: 10 1-2 of 2 < >

Source: Query builder

- Function testing: the information of input and output parameters is formatted as a URL and displayed in the appropriate field, as shown in Figure 9.

Figure 9. Query Builder - reactive URL creation

Function input filters COUNTRY HELPER

Q Filter function parameters

☐	Name	Compulsory	Type	Description
☒	iso3	false	text	ISO3 country code (case sensitive, accepts single values; eg: IT). Possible values listed by: get_dopa_region_country_list()
More info about iso3				
ITA				
☐	status_multi	false	boolean	Either include or not in the report Disputed or Joint Managed territories.

Items per page: 10 1-2 of 2 < >

Function testing

Selected Function: get_dopa_country_pa_count

TEST Copy URL

Available formats: json

HTTP Request: https://dopa.jrc.ec.europa.eu/restapi/api/dopa_43/get_dopa_country_pa_count?format=json&iso3=ITA

Source: Query builder

Click “TEST” (Fig. 10, point 1) to load the function directly into the page, i.e. to display the return data directly on the page. Use the copy URL button (Fig. 10, point 2) to copy the request URL to your clipboard. The URL is displayed on screen (Fig. 10, point 3) for debugging purposes. Different formats are available for data download – select your preferred output format from the dropdown menu (Fig. 10, point 4). The available data returned by the function is displayed below the controls described above (Fig. 10, point 5).

Figure 10. Query Builder – test selected function

The screenshot displays the 'Query Builder' interface. At the top, there's a 'Function input filters' section with a search bar and a table of filters. The first filter is 'iso3' (text, compulsory, false) with a description: 'ISO3 country code (case sensitive, accepts single values; eg: IT). Possible values listed by: get_dopa_region_country_list()'. Below it, a 'More info about iso3' section shows 'ITA'. The second filter is 'status_mtd' (boolean, compulsory, false) with a description: 'Either include or not in the report Disputed or Joint Managed territories.'.

The 'Function testing' section shows the 'Selected Function: get_dopa_country_pa_count'. It includes a 'TEST' button (point 1), a 'Copy URL' button (point 2), and the resulting 'HTTP Request' URL (point 3): 'https://dopa.jrc.ec.europa.eu/restapi/dopa_43/get_dopa_country_pa_count?format=json'. A dropdown menu (point 4) shows available formats: json, xml, csv, html, pdf.

Below the testing section is a 'Filter function results' search bar and a table of results. The table has columns for 'iso3', 'Pa_count', 'Pa_count_marine_10000_100000', 'Pa_count_marine_1000_10000', 'Pa_count_marine_100_1000', 'Pa_count_marine_1_10', 'Pa_count_marine_below_1', 'Pa_count_marine_over_100000', and 'Pa_count_01'. The first row shows results for 'ITA':

iso3	Pa_count	Pa_count_marine_10000_100000	Pa_count_marine_1000_10000	Pa_count_marine_100_1000	Pa_count_marine_1_10	Pa_count_marine_below_1	Pa_count_marine_over_100000	Pa_count_01
ITA	3937	1	3	40	76	27	11	3064

At the bottom right, there's a 'Items per page' dropdown set to 10 and a pagination indicator '1-1 of 1'.

Source: Query builder

4.3. Swagger UI

The Swagger UI¹³ offers a familiar way to programmers and technical users to list and experiment with the GBD REST API. Below (Fig. 11) is a typical screenshot from the Swagger interface.

As with the Query Builder interface, access to the data via Swagger UI requires an EU Login account and explicit user registration via the registration process – if necessary, follow Steps 1 and 2 described in the Query Builder section above.

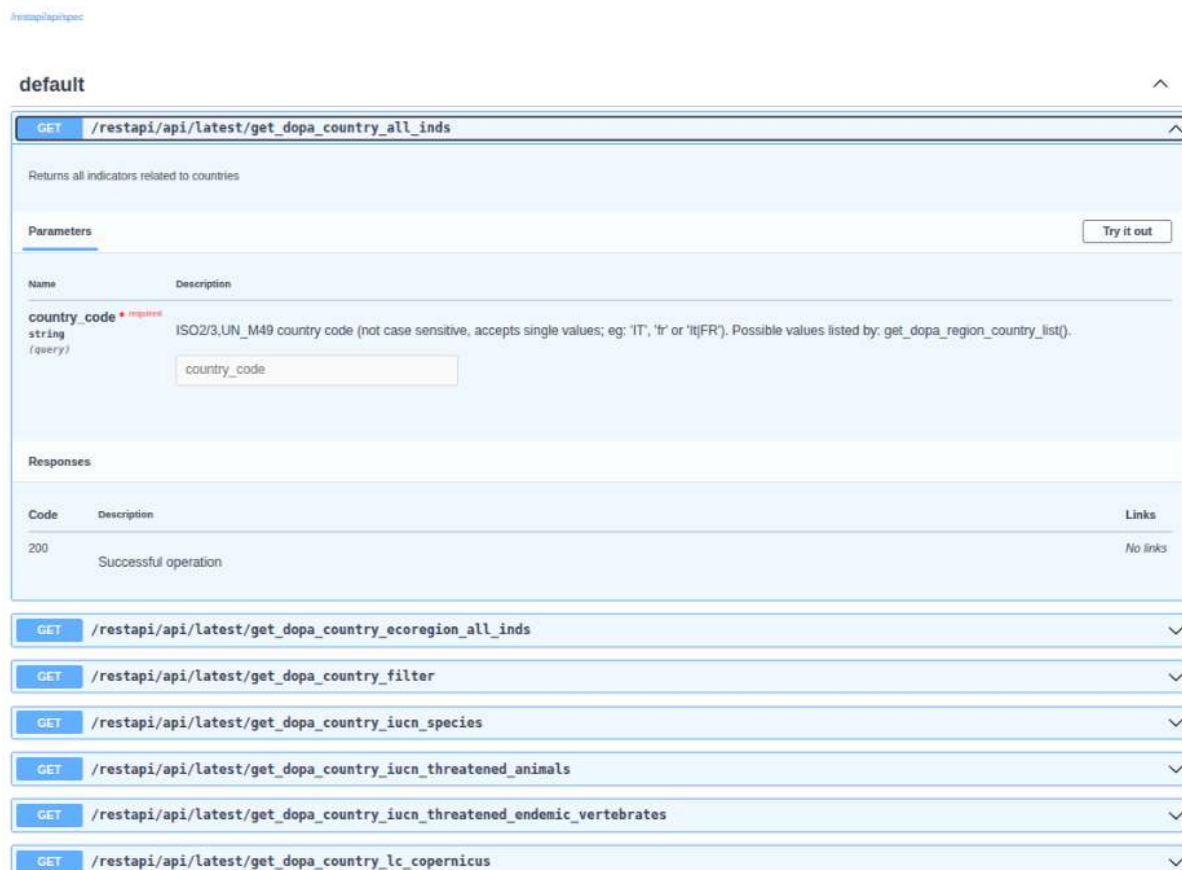
After registration approval, users can request programmatic access through API key by contacting the [KCBDFunctional mailbox](mailto:KCBDFunctionalMailbox@ec.europa.eu). The requested API key will be sent to them manually – this last step will be automated in the future.

¹³ <https://dopa.jrc.ec.europa.eu/restapi/swagger-ui/>

The Swagger interface is auto generated from the OpenAPI specification served from the GBD REST API. Every version of GBD has its own OpenAPI specifications, as there might be changes between releases. OpenAPI specification is well-known among technical users and is self-descriptive.

Swagger interface provides basic functionality to execute REST API queries to the GBDS back end. It serves a fixed default version of the GBD. Users are generally advised to use the Query Builder, which allows better control and experimentation on the data actually available.

Figure 11. Swagger interface



Source: Swagger UI

5. Conclusions

Developed under the KCBD, the GBD web services and data distribution interfaces support the reuse by third parties of harmonised indicators on biodiversity, pressures and ecosystem services. By relying exclusively on open-access global reference datasets and a reproducible workflow, the system ensures that outputs are transparent, comparable and suitable for supporting both EU policy priorities and international commitments under the KMGBF. Through accessible front-end tools such as the GBDV and the newly developed Query Builder, indicators are made available to a wide range of users, from policymakers and researchers to regional partners and technical developers, lowering the barriers to evidence-based decision-making at both national and global levels.

A major strength of the GBDS architecture lies in its distribution framework, which represents a strategic asset for the EU and its partners. By enabling direct integration and reuse of pre-calculated harmonised biodiversity indicators into third-party platforms – via Swagger UI – including those used by regional TSCCs, the system strengthens the scientific knowledge and technical capacity of other biodiversity platforms. In parallel, the Query Builder marks an important step forward in extending access to biodiversity data: by allowing non-technical users to interact with the full range of metrics and indicators produced by the GBDS without writing code, it broadens the community of practice engaged in biodiversity monitoring and strengthens the collective capacity for biodiversity monitoring and reporting, including support for national reporting and global assessments under frameworks such as the KMGBF. Together, these tools ensure that biodiversity indicators can be accessed efficiently by a wide range of users, while maintaining standardised outputs, controlled access, and compliance with EC security requirements.

The GBDS can directly support EU biodiversity-related legislation, while also helping countries track progress, meet reporting obligations under the KMGBF, and inform cross-sectoral spatial planning processes where biodiversity evidence is essential. Users can incorporate GBDS indicators into national reports, dashboards or platforms through various pathways. For example, the Query Builder enables users to select indicators, apply filters and download the results instantly, which can be embedded into reporting templates. Similarly, the GBD REST API enables programmatic access to indicators, facilitating their integration into automated reporting workflows, web-based dashboards, and interoperable data portals. In addition, the catalogue functions expose version-specific metadata, allowing users to reference the indicator version used in a report and to trace any later dataset updates. As the underlying global datasets and indicator methodologies continue to evolve, these versioning capabilities support transparency and reproducibility by enabling users to identify the exact versions used in their analyses and to interpret future updates consistently.

In addition, the catalogue functions expose version-specific metadata, allowing users to reference the indicator version used in a report and to trace any later dataset updates.

Overall, the GBD web services and associated interfaces provide a robust and scalable infrastructure that supports transparency, accountability and informed decision-making, reinforcing the EU's role in advancing global biodiversity monitoring and policy implementation.

References

- Bastin, L.; Mandrici, A.; Battistella, L., and Dubois, G., (2017) 'Processing Conservation Indicators with Open Source Tools: Lessons Learned from the Digital Observatory for Protected Areas', In [*Free and Open Source Software for Geospatial \(FOSS4G\) Conference Proceedings*](#), Vol. 17, Issue 1, p. 14.
- Dubois, G., M. Clerici, S. Peedell, P. Mayaux, JM. Grégoire and E. Bartholomé (2010). A Digital Observatory for Protected Areas - DOPA, a GEO-BON contribution to the monitoring of African biodiversity. In: "*Proceedings of Map Africa 2010*", 23-25 November 2010, Cape Town, South Africa.
- Dubois, G, M. Schulz, J. Skøien, et al. (2013). *An introduction to the Digital Observatory for Protected Areas (DOPA) and the DOPA Explorer (Beta)*. EUR 26207, Publications Office of the European Union, Luxembourg, <https://data.europa.eu/doi/10.2788/31842>
- Dubois, G., Bastin, L., Martinez Lopez J., Cottam, A., Temperley, H., Bertzky, B., Graziano, M. (2015). *The Digital Observatory for Protected Areas (DOPA) Explorer 1.0*. EUR 27162. Publications Office of the European Union, Luxembourg, <https://data.europa.eu/doi/10.2788/436594>
- Dubois, G., Bastin, L., Bertzky, B., Mandrici, A., Conti, M., et al. (2016) 'Integrating multiple spatial datasets to assess protected areas: lessons learnt from the Digital Observatory for Protected Areas (DOPA)', [*ISPRS International Journal of Geo-Information*](#), Vol. 5, Issue 12, p. 242.
- Dubois, G., Goutis, D., Mandrici, A., Delli, G., Lazaro, C. et al. (2025). *The global biodiversity data viewer 1.0*, EUR 40580, Publications Office of the European Union, Luxembourg, <https://data.europa.eu/doi/10.2760/5789070>
- Gonzalez, A., Vihervaara, P., Balvanera, P. et al. (2023) A global biodiversity observing system to unite monitoring and guide action. *Nature Ecology & Evolution*. <https://doi.org/10.1038/s41559-023-02171-0>
- Juffe-Bignoli, D., Mandrici, A., Delli, G., Niamir, A., and Dubois, G., 'Delivering Systematic and Repeatable Area-Based Conservation Assessments: From Global to Local Scales', *Land*, Vol. 13, Issue 9 2024, p. 1506.

List of abbreviations and definitions

Abbreviations	Definitions
CBD	Convention on Biological Diversity
COMIFAC	Central African Forest Commission
DOPA	Digital Observatory for Protected Areas
EC	European Commission
EU	European Union
GBD	Global Biodiversity Data
GBDS	Global Biodiversity Data Services
GBDV	Global Biodiversity Data Viewer
GBIOS	Global Biodiversity Observing System
GEO BON	Group on Earth Observations Biodiversity Observation Network
KMGBF	Kunming–Montreal Global Biodiversity Framework
JRC	Joint Research Centre
KCBD	Knowledge Centre for Biodiversity
RCMRD	Regional Centre for Mapping of Resources for Development
SDGs	Sustainable Development Goals
TSCC	Technical and Scientific Cooperation support Centre
UN	United Nations

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Annexes

Annex 1. Glossary of technical terms and software components

Term	Definitions
API (Application Programming Interface)	A set of rules that allows different software applications to communicate and exchange data
API key	A unique code used to authenticate and authorise access to an API
CSV (Comma-Separated Values)	A plain text file format used to store tabular data that can be opened by spreadsheets and many data analysis tools
ECL (Europa Component Library) ¹⁴	A design system and collection of reusable user interface components developed by the EC to ensure a consistent look and feel across its web applications
Flask ¹⁵	A lightweight Python web framework used to develop web applications and APIs
GRASS GIS ¹⁶	An open-source Geographic Information System (GIS) software for geospatial data management, processing, and analysis
HTML (HyperText Markup Language) format	Data or content presented as a web page using HTML
JavaScript Single Page Application	A web application that dynamically updates content within a single web page without requiring full page reloads
JSON (JavaScript Object Notation)	A lightweight, text-based format for exchanging structured data between applications
Nuxt.js ¹⁷	An open-source framework for building web applications based on the Vue.js JavaScript framework
PostGIS ¹⁸	An extension of PostgreSQL that adds support for storing, querying, and analysing geographic and spatial data
PostgreSQL ¹⁹	An open-source relational database management system
Python ²⁰	A high-level programming language widely used for software development, automation, and data analysis
REST (Representational State Transfer)	A software architectural style commonly used for designing web services
REST API	An API that follows REST principles
REST endpoint	A specific URL through which a REST API provides access to a particular resource or service
SQL (Structured Query Language)	The standard language used to query and manage relational databases
PL/pgSQL	PostgreSQL's procedural programming language, used to create database functions and procedures
Swagger UI	A web-based interface that allows users to explore, test, and interact with API endpoints through a browser
Vuetify ²¹	An open-source user interface component library for building Vue.js web applications

¹⁴ <https://ec.europa.eu/component-library/>

¹⁵ <https://flask.palletsprojects.com/en/stable/>

¹⁶ <https://grass.osgeo.org/>

¹⁷ <https://nuxt.com/>

¹⁸ <https://postgis.net/>

¹⁹ <https://www.postgresql.org/>

²⁰ <https://www.python.org/>

²¹ <https://vuetifyjs.com/en/>

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