



## Topic 2: Data Analysis

# Biodiversity data analysis tools

## A whole new world of opportunities

The path to building up knowledge from either user data or data collected worldwide into a broad range of databases goes through data analysis and assessment. There are many different tools already available to help the user, and here we provide only a small taste of the most common applications. The focus is on open-source software, although some of the most common paid-for resources are also mentioned. In order to keep this topic in one factsheet, we collected both biological data analysis tools and Decision Support Systems (DSS) in this document.

### Biological data analysis tools

**R:** It is a free software environment for statistical computing that is widely used for developing statistical software. Although it was not designed explicitly for biological sciences, many of its packages are, and some of them are very useful when ecological and biodiversity data needs to be analyzed:

- Vegan: Statistical analysis package for community ecologists.
- BiodiversityR: Statistical analysis package of biodiversity and ecological communities, including species accumulation curves, diversity indices, GLMs, distance matrices, etc.
- Ade4: Package explicitly designed for multivariate data analysis: ordination, PCA, correspondence analysis, redundancy analysis...

### INTERNATIONAL UNION FOR CONSERVATION OF NATURE CRITERIA

The IUCN raises three questions or criteria to assist in finding the right tools:

1. Purpose of the assessment: Reason for the analysis or assessment.
2. Required outputs: What type of results are needed and in what format (i.e. qualitative/quantitative, spatial/non-spatial)?
3. Practical considerations: How much time, budget, technical skills are required? How much of each is available for the user?

- Marxanui: package of the Marxan decision support tools for conservation planner

**Ecopath with Ecosim (EwE):** It is a free and open-source ecosystem modeling software suite that includes Ecopath, Ecosim, and Ecospace. Especially interesting here is the EcoSIM, an ecosystem simulation software designed to investigate ecological questions but also evolutionary patterns. It consists of an individual based predator-prey system simulation. It allows testing for community patterns with Monte Carlo randomizations (non-experimental data), which can be statistically compared against the communities from the input data.

**EstimateS:** It is a free software application for Windows and Macintosh that computes a variety of biodiversity statistics, estimators, and indices based on biotic sampling data. It comes with a comprehensive User's Guide available online.

**BiodiversityPro:** Free statistical package program for Windows that enables diversity measurements from a dataset of taxa by samples. It allows the user to create graphic plots and to conduct principal components, correspondence, and cluster analyses as well as descriptive statistics.

**PAST:** Free software for scientific data analysis. Enables standard data manipulation, graphical plotting and to conduct univariate and multivariate statistics, ecological analysis, time series, spatial analysis and morphometrics, and stratigraphy.

**Integrated Biodiversity Assessment Tool:** This is an application developed by some institutions from the IUCN in order to provide a basic risk assessment on biodiversity. It uses global biodiversity data from the IUCN's knowledge products (the Red List of Threatened Species, the Key Biodiversity Areas and the Protected Planet or The World Database on Protected Areas). It consists of an interactive mapping tool that allows the identification of biodiversity risks and opportunities for each project. Although the free version is quite restricted, the subscriptions directly support the update and maintenance of three authoritative global datasets.

**TerraSet:** This is a pay-for-use tool that provides the user with a wide range of mapping tools for policymakers and simple and complex ecological analysis. The "Habitat and Biodiversity Model toolset was designed for conservation GIS professionals. It provides tools for modeling of species distributions, habitat assessment, habitat change, and gap analysis, biodiversity analysis, and the planning of reserves and biological corridors.

**Data visualization Tools:** Although not designed for biological data, visualization tools can also be a choice to graph your data in creative and colorful ways. "Candela" or "Charted" may be good options in this sense.



**EstimateS** Statistical Estimation of Species Richness and Shared Species from Samples



**IBAT**



## Decision support tools

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**Marxan:** This is the most widely used systematic reserve planning software in the world and is used explicitly for marine reserves such as the Great Barrier Reef, the Gulf of Mexico marine reserve, or the Global set of Marine Protected Areas. It consists of a suite of tools for conservation planning that supports the design of marine and terrestrial reserves. It can also assess existing reserves to identify vulnerable points such as gaps in protection, areas to include in the reserve, etc. A possible shortcoming of it is the inability to consider connectivity between sites and surrounding ecosystems.



**Multiscale Integrated Earth System Model (MIMES):** This tool integrates different scales of knowledge to understand the ecosystem service (ES) value. It considers biologic agents (biosphere) but also cultural and social agents (anthroposphere). Widely used tool in the scientific literature but also NGOs and policymaking.

**Integrated Valuation of Ecosystem Services and Trade-offs (inVEST):** This software was designed for mapping and valuing ES provided by land and seascapes. It uses changes in ecosystems to measure the ES benefits to people, and it is widely used to inform decisions about natural resource management. No modeling knowledge is required, although basic knowledge of GIS is.

**Toolkit for Ecosystem Service Site-based Assessment (TESSA):** This is an interactive pdf document that leads the user through a simple step by step process to assess the ES provided at a particular site. It can compare the site before and after specific restoration or conservation decisions. No prior knowledge of ES required. Coastal margins included apart from terrestrial habitats but other marine habitats are not available.

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**Artificial Intelligence for Ecosystem Services (ARIES):** It is a tool designed for rapid ecosystem service assessment and evaluation. It quantifies ecological services flows for a study area and builds the agents involved in the interaction (naturals and socials). From there, it creates flow models for each connection. There is a web-based explorer for non-technical users but also a prototype for experienced modelers, where technical training, GIS, and modeling skills are required.



**Social Values for Ecosystem Services (SolIVES):** This GIS application for assessing, mapping, and quantifying social values of ES, derives a 10-point social value metric called “value index”, from a combination of spatial and nonspatial responses to public benefit and preference surveys that calculate parameters characterizing the underlying environment.

**Protected Areas-Benefit Assessment Tool (PA-BAT):** This a WWF developed tool to collate and build information about benefits from protected areas. It can also be used by local communities to identify the interests of protected areas. The creators emphasize that it has to be considered an assessment and not a monitoring tool.

**Co\$ting Nature:** This is a web-based policy support tool for natural capital and analysis of ES. Focus on understanding each resource and the opportunity cost of protecting it to produce ES. It can be used to assess the impacts of human interventions for conservation and planning. Works with GIS but requires no software (Web-based).

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## REFERENCES

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## ABOUT THIS POLICY BRIEF

This Policy Brief is part of a series aiming to inform policy-makers on the key results of the ZMT research projects and provide recommendations to policy-makers based on research results. The series of ZMT Policy Briefs can be found at [www.leibniz-zmt.de/policy\\_briefs.html](http://www.leibniz-zmt.de/policy_briefs.html). This publication was commissioned, supervised and produced by ZMT. DOI: 10.21244/zmt.2016.001

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