Oryx

Tools and resources

Software for research, analysis and writing can be costly to purchase, but free and/or Open Source software is often as good as, and sometimes better than, the commercial equivalent. Here we provide information and links for some of the best software tools of which we are aware.

> The Editor's picks are highlighted.

If you know of good free and/or Open Source tools that we haven't mentioned, please let us know.

Analysis, data presentation and statistics
Bibliography, writing and research tools
Data sources
Geographical Information Systems
Drawing, image editing and management
Operating systems

Analysis, data presentation and statistics

camtrapR is for management of and data extraction from camera-trap photographs. It provides a workflow for storing and sorting camera-trap photographs, tabulates records of species and individuals, creates detection/non-detection matrices for occupancy and spatial capture–recapture analyses, and has simple mapping functions. Requires R, which is available for Windows, Mac and Linux.

Density: spatially explicit capture–recapture uses the locations where animals are detected to fit a spatial model of the detection process, and hence to estimate population density unbiased by edge effects and incomplete detection. Requires R, which is available for Windows, Mac and Linux.

Distance is for the design and analysis of distance sampling surveys of wildlife populations. Requires R, which is available for Windows, Mac and Linux, and is also available as separate Windows software.

DotDotGoose is a tool to assist with the manual counting of objects in images. Rrequires Windows, Mac or Linuix.

EstimateS computes biodiversity statistics, estimators, and indices based on biotic sampling data. Some features require species relative abundance data, others only species presence/absence data. Requires Windows or Mac.

> ggplot2 is a system for creating graphics. You provide the data, tell ggplot2 how to map variables to aesthetics, which graphical primitives to use, and it looks after the details. It can be

> used to produce publication-ready figures. Requires R, which is available for Windows, Mac and Linux.

MARK provides parameter estimates from marked animals when they are re-encountered at a later time. Requires Windows (or under emulation or on a virtual machine on Mac or Linux).

> R is a software environment for statistical computing and graphics. Widely used by conservationists and ecologists, it provides a variety of statistical and graphical techniques and has many additional packages (e.g. camtrapR, Density: spatially explicit capture–recapture, Distance, ggplot2). R is complex but much help is available, both with the system itself and elsewhere. A good starting point is R for Data Science. The RStudio integrated development environment is our favourite way of accessing R. Requires Windows, Mac or Linux.
>
> Veusz is a scientific plotting and graphing package. It is easy to learn and can be used to produce publication-ready figures. Requires Windows, Mac or Linux.
>
> Writing for Conservation provides guidance and video tutorials for presenting publication quality graphics, including examples using ggplot2 and Veusz.

Bibliography, writing and research tools

Beall's List of predatory journals and publishers provides updated links to journals and publishers on Beall's List (originally created by Jeffrey Beall, librarian at the University of Colorado), and links to predatory journals and publishers that have appeared since Beall closed his original list. This updated version of the list is maintained anonymously. *Writing for Conservation* includes a discussion of predatory publishers and how to curate your personal library.

Directory of Open Access Journals is a community-curated list of open access journals. The list aims to include all open access scientific and scholarly journals that use a quality control system.

Google Docs allows you to create documents, spreadsheets and presentations online, and is useful for sharing and collaboration. Files can be uploaded and downloaded in many standard formats. The reference manager Zotero works with Google Docs, allowing you to add citations and bibliographies to your documents.

Google Scholar provides a simple search interface for scholarly literature across many disciplines and sources (but beware that it also indexes material from journals on Beall's List of predatory journals and publishers).

> LibreOffice is an office software suite. It can read and write files from most office software packages. The reference managers Mendeley and Zotero include plugins that allow you to cite references and maintain bibliographies in LibreOffice. Requires Windows, Mac or Linux.

Mendeley is a bibliography tool for organizing and citing articles and for storing pdfs. It integrates with LibreOffice and Microsoft Word. Requires Windows, Mac or Linux.

> Writing for Conservation provides guidance on structuring and improving your writing,

presenting your data, managing your references, curating your library and promoting your writing.

Zotero is one of our favourite software tools. You can use it to collect, manage and cite research sources, and capture citation information from web pages, and store pdfs, document files, images, links and web pages. It integrates with LibreOffice and Microsoft Word, and can download references directly from Google Scholar and other resources. Requires Windows, Mac or Linux.

Data sources

Many of the following sources provide data, in shape file, GeoTIFF and other formats, for use with Geographical Information Systems.

Catalogue of Life is an online database of the world's known species of animals, plants, fungi and micro-organisms.

Earth System Grid Federation provides access to the output of the Coupled Model Intercomparison Project of the World Climate Research Programme's Working Group on Coupled Modeling, used by the Intergovermental Panel on Climate Change. To download data you need to create an account.

Free spatial data includes country and continental level, global climate (past, present and future), species occurrence and elevation data, and LandSat images. If you require only administrative areas use the Global Administrative Areas spatial database, which is more up-to-date.

Freshwater Ecoregions of the World provides a global biogeographical regionalization of the Earth's freshwater biodiversity.

Global 200 is an analysis of global patterns of biodiversity to identify the terrestrial, freshwater and marine ecoregions that harbour exceptional biodiversity.

Global Administrative Areas is a spatial database of global administrative areas and boundaries.

Global Biodiversity and Information Facility provides access to biodiversity data.

Global Lakes & Wetlands Database contains global spatial information on large lakes and reservoirs, smaller water bodies, and wetlands.

IUCN Red List of Threatened Species provides conservation status information for taxa that have been globally evaluated using the IUCN Red List Categories and Criteria, including spatial data for taxonomic groups that have been comprehensively assessed.

Marine Ecosystems of the World is a biogeographical classification of the world's coasts and shelves.

> Natural Earth is a public domain map dataset available at 1:10m, 1:50m, and 1:110 million scales, with integrated vector and raster data.
>
> Protected Planet provides access to the World Database on Protected Areas, a comprehensive dataset of protected areas, including map layers.
>
> SRTM Data provides resampled Shuttle Radar Topography Mission data at spatial resolutions of c. 30 and 250 m on the line of the equator.

Terrestrial Ecoregions of the World is a biogeographical regionalization of the Earth's terrestrial biodiversity.

UNEP Environmental Data Explorer contains > 500 variables, as national, subregional, regional and global statistics or as geospatial data sets, covering themes such as freshwater, population, forests, emissions, climate, disasters, health and GDP.

USGS Earth Explorer allows you to query and download satellite images, aerial photographs and digital elevation and other data. To download data you need to create an account.

An inventory of biodiversity data sources for conservation monitoring has been created by the IUCN SSC Species Monitoring Specialist Group in collaboration with Re:Wild.

Geographical Information Systems

DIVA-GIS is useful for mapping and analysing biodiversity data such as the distribution of species. Requires Windows.

Google Earth lets you view satellite imagery, maps and terrain, and add layers (see, for example, the WWF Project layer). Requires Windows, Mac or Linux, or can be run in the Chrome browser.

GRASS is for geospatial data management and analysis, image processing, graphics/map production, spatial modelling, and visualization. Requires Windows, Mac or Linux.

gvSIG can capture, store, handle, analyse and deploy any kind of referenced geographical information. Requires Windows, Mac or Linux.

OSGeo-Live is a self-contained bootable USB drive, DVD or virtual machine that allows you to experiment with a wide variety of free, open source geospatial software without installing anything. It provides pre-configured applications for a range of geospatial use cases, including storage, publishing, viewing, analysis and manipulation of data. It also contains sample datasets and documentation. Requires Windows, Mac or Linux.

> QGIS is widely used by conservationists and ecologists. It supports many common spatial data formats and has plugins for a range of tasks, such as obtaining Landsat data and displaying tracks from your GPS. Requires Windows, Mac or Linux.
>
> Writing for Conservation provides guidance and video tutorials for presenting publication quality maps, including examples using ggplot2 and Veusz.

Drawing, image editing and management

For editing graphics it is useful to have both vector and raster (bitmap) graphics editors. A vector graphic is a resolution-independent description of shapes and objects; a rasterization engine uses this information to determine how to plot each line and curve at any resolution or zoom level. A raster graphic is bound to a specific resolution and stores an image as a grid of pixels. Vector graphics are more suitable for technical illustrations such as scientific figures and maps, whereas raster graphics are better for photographs and some kinds of artistic drawings. For additional discussion of this matter, see Writing for Conservation. It is sometimes useful to export an illustration or figure in scalable vector graphics format from a scientific graphics package or GIS and perform final editing in a vector graphics editor.

digiKam is photo management software. It can store extensive metadata, including location. Requires Windows, Mac or Linux.

Coblis is a colour blindness simulator. You can use it to check your graphics and make sure they are accessible for people with color vision deficiency.

> Gimp is a raster graphics editor that can edit files in most raster formats. Requires Windows, Mac or Linux.
>
> Inkscape is a vector graphics editor that uses the World Wide Web Consortium's scalable vector graphics file format. Requires Windows, Mac or Linux.

Operating systems

Open Source Linux operating systems (including Ubuntu, Fedora and openSUSE) are increasingly used by conservationists and ecologists. Linux systems normally include software such as LibreOffice, and many of the software tools mentioned above are available for Linux. Ubuntu is available in several flavours, each with their own choice of default applications and settings, some of which are lightweight on resources and thus suitable for older computers. If you need to run Windows software you can use Wine, which can run Windows software under Linux. Requires a downloaded image for the required operating system, which then needs to be written to a USB drive or CD/DVD and used to install the chosen operating system.