GIS Data Sources for Wildlife Tracking

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December 12, 2022

`https://libguides.brown.edu/gis_data_tutorials/wildlife`

Introduction

There is a substantial amount of geospatial data that tracks the location and movement of wildlife, generated by different means: visual observation (from the ground, boats, or aircraft), tagging and monitoring with radio or satellite telemetry, and the analysis of high resolution satellite images.

This document summarizes sources for obtaining wildlife observation and tracking data, search strategies for finding additional sources, and basic steps for visualizing this data in geographic information systems (GIS). Wildlife tracking data is stored in a number of different formats. The most common include TXT or CSV, which contain coordinates that can be plotted and mapped, or shapefiles that can be readily viewed in GIS software. Data is usually packaged in archive files (ZIP, GZ, or TAR) that must be extracted or unzipped prior to opening.

1 Data Sources

1.1 Data Repositories

These repositories are large portals that pool data from many studies and sources, and include species from across the globe. The repositories may contain the actual data or may consist of metadata records that point to data stored elsewhere. Given their scope and depth, they are a good place to begin.

Name : `Movebank.org`

URL : `https://www.movebank.org/cms/webapp`

Summary : Hosted by the Max Planck Institute of Animal Behavior, this is a large and comprehensive portal focused on animal tracking, covering all species and continents. It includes citations for papers and the data that accompanies them, and online tools for visualization.

Access : Explore data in the web app map listed above, or go to the data repository at `https://www.datarepository.movebank.org/discover` and do a keyword search; you can also apply filters by adding a refinement. Data packaged in a number of formats (TXT / CSV, shapefile, Excel). While many datasets are readily available, you must register and create an account on the site to access others.
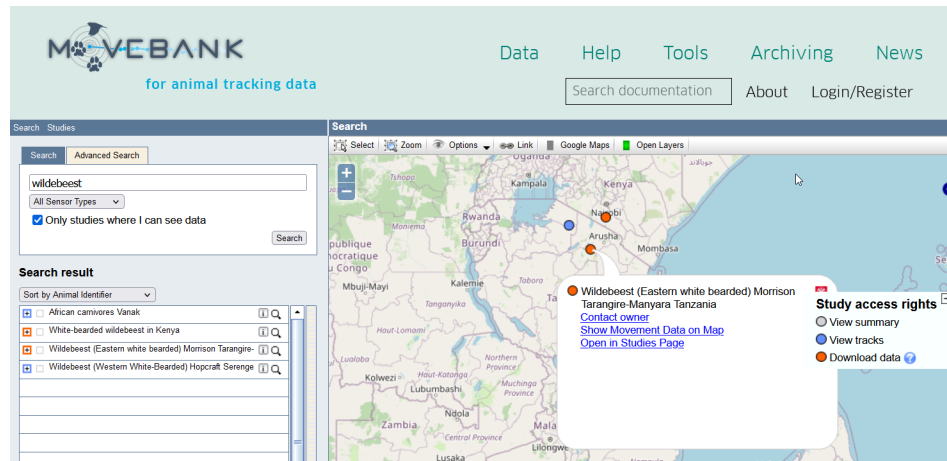
Movebank.org Web App: Search by Keyword and Filter by Studies with Data

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Name : `Zoatrack`

URL : `https://www.zoatrack.org/projects`

Summary : This is an open access project created by academics and researchers for publishing animal tracking data and providing simple web-based tools for visualization and analysis. While it is primarily focused on Australia and Oceania, it has grown to includes terrestrial, avian, and aquatic species from studies around the world.

Access : Use the search box under the map to do keyword searching. In the results, select a record to preview the data and metadata. Look for the shapefile or KML icons for a link to download the data. The coordinate systems for the shapefiles will vary from dataset to dataset. There may be separate files for observations or detections (points) and trajectories (lines).

Name : `Global Biodiversity Information Facility`

URL : `https://www.gbif.org/`

Summary : An international network and catalog launched by the OECD, to provide free and open access to plant and wildlife data. It includes, but is not focused on, animal tracking data. The GBIF is a catalog with records that point to other sources; it does not contain datasets.

Access : Click on *Datasets* and try a search for "tracking". Click on a record to view the metadata. Note that the *Download* button downloads metadata, not the dataset. Scroll through the record and follow the links under *GBIF Registration*. These links will direct you to the website for the data publisher, or to an endpoint for direct download. The GBIF contains many records for gridded raster data, in addition to TXT / CSV files.

1.2 Government Portals

There are a number of government agencies that specialize in conducting scientific research, or fund independent research. Countries with robust IT infrastructures and open data laws make much of their data publicly accessible. This is particularly true in the United States, where both federal and state government agencies host their own portals. Some examples are provided below; these portals include wildlife tracking data amongst many other types of data.

Name : `NOAA NCEI Geoportal`

URL : `https://www.ncei.noaa.gov/metadata/geoportal`

Summary : The National Center for Environmental Information's geoportal includes aquatic wildlife and seabird tracking and observation data in oceans adjacent to North America.

Access : Use a mix of keyword searching and filtering. Click a record in the search results to view a full metadata record. In the record, click *HTTPS* to download the data directly. Click the ZIP file to download, and extract the data from ZIP or TAR files. Data is typically stored as TXT or CSV files with coordinates to plot.

Name : `National Park Service Data Store`

URL : `https://irma.nps.gov/DataStore/`

Summary : This is a smaller portal with wildlife inventories, observations, and some tracking data within US National Parks and Forests.

Access : Do an *Advanced Search*, and under *Reference Type Groups* choose *Dataset* from the dropdown menu, then do a keyword search. Click on a record to view its metadata and to download the data. Data is packaged in several formats including geospatial (shapefiles, geodatabases) and tabular data (CSV / TXT, Excel) with coordinates that can be plotted.

Name : `MOTUS - Birds Canada`

URL : `https://motus.org/dashboard/`

Summary : Sponsored and hosted by Canada's bird conservation program, MOTUS is a global collaborative of researchers that use automated radio telemetry to track hundreds of individual birds from numerous species. This database primarily covers North and South America.

Access : Using the dashboard map, you can click on a station and then use the pop-up menu to view projects, animals, or detections that are available for that station. If you select detections, you can view a table that can be downloaded as a CSV. Subsequently, clicking on any option like a species, project, or tag (for an individual animal) allows you to view and download data associated within it.

1.3 Research Institutes and Non-Profits

While academic and non-profit wildlife researchers are the largest producers of data, these sources are highly diffuse. Their data may appear in large data catalogs and government portals, but might be in smaller repositories that are harder to find. You can discover these sources via keyword searching on the web, or by finding scholarly articles where the authors point to a data archive. See the next section for strategies for finding these sources.

2 Search Strategies

2.1 Searching the Web

- Generate a list of keywords for searching, and use a mix of terms: `Wildlife tracking`, `animal tracking`, `tracking data`, `migration`, `animal observations`, `telemetry`, `GPS`. Also include names of specific species, animals, and geographic locations.

- Use quotes to search for multi-word terms or phrases: `"Gray whales"`, `"Satellite telemetry"`, `"tracking data"`.

- Target websites by adding *site:domain* after the search terms, to focus on a specific type of site while eliminating unwanted commercial sources. Look for .org, .edu, .info, .gov (US government), and two-letter country codes for other governments (.cn Canada, .mx Mexico, etc.). For example: `"gray whales" tracking data site:.gov`.

- Different search engines use different algorithms, and thus yield different results. Try DuckDuckGo and Bing in addition to Google.

2.2 Searching Published Research

Search through academic literature from the library's homepage at `https://library.brown.edu/`. Generate a list of terms similar to those described in the previous section. In *BruKnow*, choose *Articles only* to search across many of the library's scholarly databases. For a more targeted search, scroll down below *BruKnow* and under *Teaching, Learning, & Research Support* choose *Databases*. Select an individual research database to search through. Good places to start include: Science Direct, BioOne, and Academic Search Complete.

Once you discover a promising article, scroll to the end of the text. Before the citations, there are often brief sections for acknowledgements, ethics statements, and a data statement. If the authors deposited their research data in a university or government repository, you may find a reference and direct link to the data. If not, read through the methods section towards the beginning of the article, to see if a reference is mentioned.

In the example that follows, a search in Science Direct for `whale tracking telemetry` yields a number of articles. The first article has a data statement, with a link to the whale tracking data created in the study, stored in the *Australian Antarctic Data Centre*.

Search ScienceDirect for Articles

View an Article and Examine the Data Statement

Follow that Link to Data Stored in Repository

3 Adding Data to GIS

## 3.1 QGIS

QGIS is a free and open source desktop GIS package that runs on MS Windows, Mac, and Linux. Download from `https://www.qgis.org/` and install (download the stable LTR version). Steps for basic tasks are summarized below. Consult our QGIS tutorial for a more comprehensive introduction: `https://libguides.brown.edu/gis_data_tutorials/intro_qgis`.

Adding a shapefile : Open the *Data Manager* , choose the *Vector* tab , browse through your file system, and add the file.

Plotting TXT / CSV :

1. Open the *Data Manager* , choose the *Delimited Text* tab , browse through your file system , and select the file. Name the new layer in *Layer name*.

2. Under *File format* choose *CSV* if the delimiter is a comma, or *Custom delimiters* for other characters.

3. Under *Geometry* beside *Point coordinates* select the longitude column as *X field* and latitude a *Y field*. Optionally, you can indicate elevation / depth as *Z field* and time as *M field* if your data file includes this information.

4. For *Geometry CRS*, you must specify the system that your coordinates are currently in. Most modern coordinate data are in WGS 84 (EPSG 4326). Check the documentation and metadata to verify.

5. *Add* the file, and the points will be plotted. Select the layer in the *Layers* panel, right click, and choose *Export Data*. Browse and save the layer as a shapefile or geopackage. If necessary, you can transform the coordinate reference system as you save the new file.
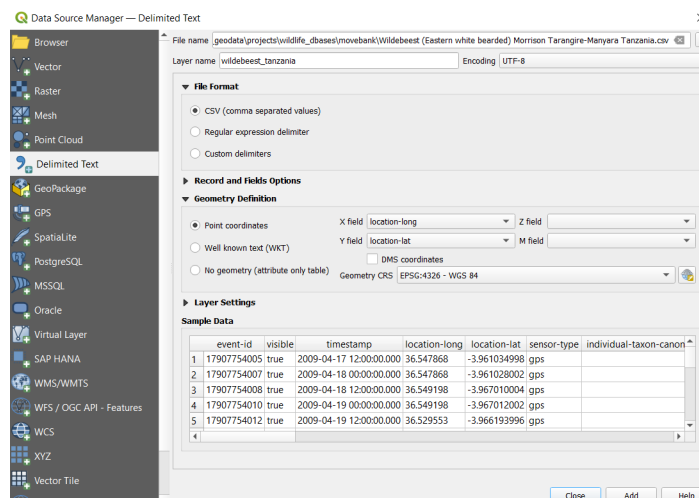
QGIS Add Delimited Text Menu

Symbolizing Data :

1. To add a basemap, look under the *XYZ layers* in the *Browser* panel, and drag the *OpenStreetMap* into the map view.

2. Select a layer in the *Contents* panel, right click, and choose *Properties*. In the *Symbology* tab, change the top dropdown from *Single symbol* to *Categorized*, and choose a column that indicates the individual animal's name or identifier, to assign a different color to each.
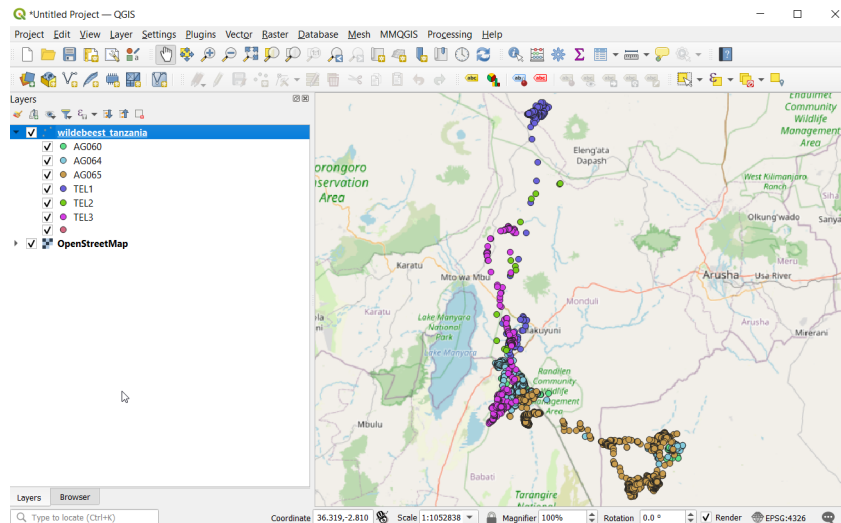
QGIS Points Plotted and Categorized

Points to Paths : To generate migration paths from point data, you must connect points that represent an individual animal to form lines based on a logical sequence, using either a sequential record ID number or a date / time stamp that's stored as a column in the data table. Access the *Toolbox* from the *Processing Menu* at the top of the screen, and search for the *Points to Path* tool. The *Input layer* must be a shapefile or spatial file, not TXT or CSV. *Order expression* is the field that specifies the order in which points should be connected, and *Path group expression* is the field that specifies the individual animal or tag.

Editing : Right click on a layer, select *Open attribute table*. In the toolbar there is a *Select by expression* tool 🐝 , where you can select features by attribute (in columns). Or you you simply sort and select records manually. By entering the *Edit* mode ✏️ , you can delete features 🗑️ . There is a separate tool for deleting columns 📋 . After deleting columns or features, exit the edit mode ✏️ and save your changes.
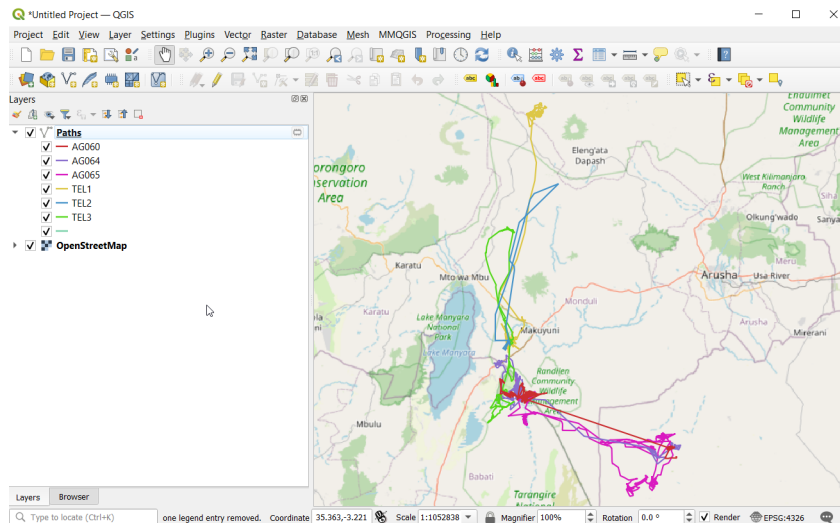
QGIS Lines Generated and Categorized

3.2 ArcGIS Pro

ArcGIS Pro is a proprietary desktop package than runs on MS Windows. Brown students, faculty, and staff can download the software from the Brown Software Catalog and request an ESRI account from Software_Services@brown.edu. Steps for basic tasks are outlined below. See the previous section on QGIS for more details on the general processes. Consult our ArcGIS Pro tutorial for a fuller introduction: `https://libguides.brown.edu/gis_data_tutorials/s4arcpro`.

Adding a shapefile : Use the yellow *Add Data* button on the *Map* ribbon.

Symbolizing Data : Right click on a layer and choose *Symbology*, and change the *Single Symbol* dropdown to *Unique Values*, and choose the field that identifies the individual animal.

Plotting TXT / CSV : Select the dropdown below the *Add Data* button and choose *Add XY Point Data*. Select longitude as *X coordinate* and latitude as *Y coordinate*. After plotting the data, right click, and chose *Data - Export Features* to save it as a shapefile.

Points to Lines : On the *Analysis* ribbon located in the *ArcToolbox*, search for the *Points to Line* tool. Use the *Line Field* to specify the ID for the individual animal, and the *Sort Field* as the time stamp or sequential identifier to specify the order for connecting points to lines.

Editing : Select a layer, right click, and open *Attribute Table*. Access *Select by Attributes* for the expression builder. Look in the *ArcToolbox* for the *Delete Field* tool to delete columns.

3.3 ArcGIS Online

ArcGIS Online `https://www.arcgis.com/` is a platform for creating interactive web maps. Create a free public account, or request access to an institutional one (see ArcGIS Pro above). You can upload a shapefile, or a CSV and specify how to plot coordinates. ArcGIS Online imposes a file size limit of 10 MB for shapefiles, and a limit of 4,000 records for plotting CSV coordinates. Use QGIS or ArcGIS Pro to edit large files to reduce their size, and to plot coordinates to generate shapefiles.