Tools for transboundary wildlife monitoring on Movebank

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Large Carnivores Workshop
5th Conference of the Forum Carpaticum
Eger, Hungary
15 October, 2018
Movebank is a **global database** for animal movement data and a **tool** for working with data throughout its life cycle.
DATABASE

1.1 billion

1.4 billion

822

20,004

Content as of October 2018
FUNDING

Long term
Max Planck Society
University of Konstanz

Current grants
German Aerospace Center (DLR)
U.S. National Aeronautics and Space Administration (NASA)
U.S. National Science Foundation

Previous grants
German Science Foundation
NASA
U.S. National Science Foundation
DATA TYPES

Individual animal tracks and related attributes

PostgreSQL database

Kranstauber et al. 2011, Environmental Modelling and Software
DATA TYPES

Individual animal tracks and related attributes

Tracking methods

- GPS
- Argos Doppler Shift
- Radio transmitter
- Solar geolocator
- Bird ring
- Natural mark

PostgreSQL database

Kranstauber et al. 2011, Environmental Modelling and Software
DATA TYPES

Individual animal tracks and related attributes

Tracking methods

Other bio-logging sensors

- Accelerometer
- Barometer
- Light levels
- Magnetometer
- Temperature

PostgreSQL database

Kranstauber et al. 2011, Environmental Modelling and Software
DATA TYPES

Individual animal tracks and related attributes

Tracking methods

Other bio-logging sensors

Animal, tag, and deployment info

PostgreSQL database

Kranstauber et al. 2011, Environmental Modelling and Software
You retain ownership and control access.

Data Managers (read-write)
Collaborators (read only)
Public

OWNERSHIP

SHARE

Permissions

Visibility of study name and summary: Public
Default visibility of tracking data: Collaborators Only

It is possible to override the visibility of tracking data at the level of individual animals. Here you can undo all settings done on individual animals:

- Reset visibility of tracking data to default

You may allow users to see your tracking data on a map, but restrict their ability to download data, e.g. in Excel, csv or kml format.

- Restrict data downloads to Data Managers Only

Users downloading your data for the first time, are prompted to accept the license terms. For some external applications this feature is not desirable and may therefore be disabled.

- Prompt users to accept license terms?
**IMPORT DATA**

Supported or custom CSV

---

**What Movebank sees in your file**

<table>
<thead>
<tr>
<th>date</th>
<th>time</th>
<th>long</th>
<th>lat</th>
<th>species</th>
<th>tag</th>
<th>individual name</th>
<th>speed</th>
<th>heading</th>
<th>height</th>
<th>visible</th>
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<tbody>
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<td>12:21:19.001</td>
<td>8.98558828</td>
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<td>Aythya ferina</td>
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</table>

**Map other Attributes**

**How Movebank will save the data**

<table>
<thead>
<tr>
<th>Sensor Type</th>
<th>Timestamp</th>
<th>Location Lat</th>
<th>Location Long</th>
<th>Animal Id</th>
<th>Tag Id</th>
</tr>
</thead>
<tbody>
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<td>GPS</td>
<td>2008-12-18 12:21:19.001</td>
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<td>Common Pochard F</td>
<td>420</td>
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<td>47.738281</td>
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<td>420</td>
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<td>47.73807</td>
<td>8.9857624</td>
<td>Common Pochard F</td>
<td>420</td>
</tr>
</tbody>
</table>
DATA FEEDS

Argos GPS-PTTs: Microwave, GeoTrak (coming next: Lotek)
Argos DIAG: all PTTs
DATA FEEDS

Argos

GSM-GPS: CTT, Ecotone, e-obs, Druid, Fleetronic, FollowIt Wildlife, madebytheo, Microwave, MoveTech, Ornitela

Iridium-GPS: FollowIt Wildlife
DATA FEEDS

Argos
GSM-GPS
Iridium-GPS
Coming soon: ICARUS
Email Notifications

Substitute here for daily or weekly email notification containing basic statistics of your recent data. These include information on when data have been last collected and what distances were traveled.

- Argos
- GSM-GPS
- Iridium-GPS
- ICARUS

[Image of email configurator interface]

- Subscribe for email: (Uncheck to revoke subscription)
- Schedule: Daily, Weekly
- Day of week: Monday
- Time of day (GMT): 9:00
- Send to: support@movebank.org
- Email format: ASCII, HTML
- Hide undeployed data
- Hide outliers
- Include Argos Doppler Shift Statistics
- Attach KMZ file
- KMZ data interval: Unlimited
- Include GPS Statistics
- Attach KMZ file
- KMZ data interval: Two weeks
- Detect mortality

[Save, Send mail now, Close buttons]
GPS tracks publicly visible in May 2017
### Display Options

**Sensor Type**: Taivo Lion Study  
**Animal**: GPS, Kiboche

<table>
<thead>
<tr>
<th>Timestamp</th>
<th>Location Lat</th>
<th>Location Long</th>
<th>Manually Marked Outlier</th>
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</thead>
<tbody>
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</table>

**Event Editor**

- **Map**  
- **Satellite**

**Outlier**

**Mombasa**

**Kitui**

**Goshil**

**Araba Lodge**
QC & OUTLIERS

Data filters
- Argos
- Duplicate
- Value Range
- Speed

Filter duplicates
- The filter will flag records for which all key attributes are duplicated.

Filter by value range
- The filter will retain records that match the ranges provided, and flag records outside the ranges.
  - Keep null values
  - Remove null values
  - Match all of the following
  - Match any of the following
  - Location Error Numerical
  - Max. plausible speed (m/s): 35
  - Max. location error (m): 100

Filter by speed (experimental)
- Read about speed filter algorithms
  - Max. plausible speed (m/s): 35
  - Max. location error (m): 100

Used algorithm:
- Valid anchor
- Longest consistent track
- Simple outlier
Download tracking data

Available Sensor Types
- GPS

Filter by date
- From: yyyy-MM-dd
- To: yyyy-MM-dd

- Csv
- ESRI shapefile
- Excel 97
- GoogleEarth (Tracks)
- Excel 2007
- GoogleEarth (Home Range)
- Include undeployed locations
- Include points marked as outliers
- Add UTM coordinates
- Add study local time

Download Close
API & SOFTWARE

R package “move”

R package and Shiny web app “ctmm”

Calabrese and Fleming 2016, Methods in Ecology and Evolution

github.com/movebank
PUBLIC OUTREACH

Environmental Data Automated Track Annotation System

Link animal movement data to global environmental datasets

Annotate generic time-location records or areas

funded by the Max Planck Society, NASA and NSF

Dodge et al. 2013, Movement Ecology
ENV-DATA

75 products, 586 variables

Topography
Weather and climate
Surface temperature, vegetation, fire, land cover
Ocean surface conditions
Demographics

movebank.org/node/6607
User interface to browse and select variables
Access files from providers
Transform formats/projections
Interpolate values
Provide results and documentation
Datasets are reviewed, published and receive a DOI.
Datasets are reviewed, published and receive a DOI.

Data from: Costs of migratory decisions: a comparison across eight white stork populations

When using this dataset, please cite the original article.


Additionally, please cite the Movebank data package:


Abstract

Annual migratory movements can range from a few tens to thousands of kilometers, creating unique energetic requirements for each specific species and journey. Even within the same species, migration costs can vary largely because of flexible, opportunistic life history strategies. We uncover the large extent of variation in the lifetime migratory decisions of young white storks originating from eight populations. Not only did juvenile storks differ in their geographically distinct wintering locations, their diverse migration patterns also affected the amount of energy individuals invested for locomotion during the first months of their life. Overwintering in areas with higher human population reduced the stork's overall energy expenditure because of shorter daily foraging trips, closer wintering grounds, or a complete suppression of migration. Because migrants can change ecological processes in several distinct communities simultaneously, understanding their life history decisions helps not only to protect migratory species but also to conserve stable ecosystems.

Keywords

animal tracking, avian migration, Ciconia ciconia, Env-DATA, Movebank, movement ecology, white storks

MPIO white stork lifetime tracking data (2013-2014)-gps.csv
TRAINING

Resource and step-selection models in Movebank, EnvDATA, R
Lectures & scripts: https://movebankworkshopraleighnc.netlify.com
Moving in the Anthropocene: Global reductions in terrestrial mammalian movements

COLLABORATION

6 PIs
~50 animal movement datasets
~30 collaborating institutions

above.nasa.gov
github.com/ABoVE-AotM/above
ACKNOWLEDGEMENTS

PIs
- Martin Wikelski
- Roland Kays
- Gil Bohrer

Development and support
- Matthias Berger
- Sarah Davidson
- Friedrich Schaeuffelhut
- Martin Storhas

Collaborators
- David Douglas
- Wolfgang Fiedler
- Bart Kranstauber
- Kamran Safi
- Anne Scharf
- many others!

Funding

Partners

- DFG
- NSF
- NASA
- DLR
- USGS
- ARGOS
- EURODEER
- WRAM
- BirdLife
- EMPRES
- FAO
- THE OHIO STATE UNIVERSITY
- WILDLIFE AND ECOSYSTEM HEALTH

- Scientific Task Force
THANK YOU!

Sarah C. Davidson
Data Curator
Max Planck Institute for Ornithology
The Ohio State University
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Photo by William C. Campbell