Ecological insights from the new Arctic Animal Movement Archive – tracking three decades of animal movement across a changing Arctic

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What to do with track data?

www.movebank.org
Environmental-Data Automated Track-Annotation System

Env-DATA

a) Albatross tracks annotated by Ocean NPP

b) Albatross data overlaid on chlorophyll-a

Dodge et al 2013, Movement Ecology
<table>
<thead>
<tr>
<th>Dataset Name</th>
<th>Data Type</th>
<th>Description</th>
<th>Provider</th>
<th>Source URL</th>
<th>Start Date</th>
<th>End Date</th>
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<tbody>
<tr>
<td>ASTER ASTGTM2 Global 30-m DEM</td>
<td>topography</td>
<td>NASA Land Processes Distributed Active Archive Center</td>
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<td>European Centre for Medium-Range Weather Forecasts</td>
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<td>NASA Ocean Biology Processing Group</td>
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<td>S-NPP VIIRS Land</td>
<td>reflectance, other products will be added once available from NASA</td>
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</table>
Reanalysis Datasets

OSCAR Ocean Currents
NASA Daymet
NCEP
NARR
ECMWF ERA5

https://gifer.com
Flying into thin air –
Griffon vultures crossing the Himalaya Mountains

Sherub et al (2016), Biology Letters
New insight on flight strategy

Thermalling circle radius

Air density (≈ elevation)

Air speed
TE 2014: Animals on the move: Remotely based determination of key drivers influencing movements and habitat selection of highly mobile fauna throughout the ABoVE study domain

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Eric Palm, University of Montana
Space Robins

Long term trends in spring migration phenology

Nicole Kirkun’s Space Robin

Oliver et al 2020, Env. Res. Letters
Space Robins

Environment and demography drive migration timing and rate

Oliver et al 2020, Env. Res. Letters
Arctic Animal Movement Archive

Davidson et al 2020, Science
Roughly

2M occurrences
8000 individuals
90 species
220 Studies
Constantly updating
Why Archive?

- Standard quality control procedures
- Common access point
- Uniform metadata
- Uniform data access protocols (GUI, API)
- Data safety
- Data Discoverability, persistence
- Data sharing

The Arctic Animal Movement Archive

The Arctic Animal Movement Archive (AAMA) is a collection of studies in Movebank that contain animal movement and other animal-borne sensor data from the Arctic and Subarctic. As of November 2020, this collection includes 214 studies that contain over 43 million locations of over 12,000 animals recorded from 1988 to the present.
Collaboration!

Large-scale analysis:

Caribou parturition phenology
Caribou population

- Northern mountain (NM, n = 109)
- Southern mountain (SM, n = 127)
- Northern boreal (NB, n = 78)
- Southern boreal (SB, n = 398)
- Barren-ground (BG, n = 918)

* Significant trend
O No trend

- 50% range
- 80% range

May 5 - Jun 14
Year
Elevation (m)
May 5 10 15 20
May 20 25 30
May 4
Jun 4
Jun 9
Jun 14
BG
SM
NB
SB
NM
SM
NB
SB
NM
Long-term analysis:

Golden eagle migration phenology
Multi-species analysis:

Environmental drivers of movement rates
Technology development: Tag-based measurements

R-Move-Windspeed (Weinzierl et al. 2016 *Ecology & Evolution*)
Tag temperatures vs Reanalysis

- Alberta-BC Moose
  - $R^2 = 0.54$
  - RMSE = 7.09°C
  - Intercept = -4.90°C
  - Slope = 0.75

- Alberta Moose
  - $R^2 = 0.93$
  - RMSE = 4.91°C
  - Intercept = -5.08°C
  - Slope = 1.02

- Koyukuk Moose
  - $R^2 = 0.91$
  - RMSE = 7.25°C
  - Intercept = -7.20°C
  - Slope = 1.03

- Yukon Caribou
  - $R^2 = 0.83$
  - RMSE = 4.57°C
  - Intercept = -4.37°C
  - Slope = 0.94

- Mulchatna Caribou
  - $R^2 = 0.68$
  - RMSE = 6.08°C
  - Intercept = -1.93°C
  - Slope = 0.67

ECMWF Temperature (°C)
Coming soon to a migration corridor near you

NASA Ecological Forecasting Y2Y connectivity project
Acknowledgements

**Sarah Davidson** – Movebank curator and chief scientist wrangler

*Env-Data developers:* Martin Wikelski, Roland Keys, Rolf Weinzierl

*Movebank IT team:* Martin Strohas, Friedrich Schaeuffelhut, Matthias Berger

*ABoVE Animals on the Move team*

*All the wonderful people and agencies that contribute data to the Arctic Archive*