

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?



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Welcome Raptor Workshop (raptor)



About | Help

Taxon (e.g. Passer) ?

Aves

Search within map boundaries

Search

Search results (17 studies found)



+ BCI Toucans [n=9]	i	Q
+ Black Kite [n=4]	i	Q
+ Denali Golden Eagles [n=43]	i	Q
+ Egyptian Vulture - Spain [n=2]	i	Q
+ Eleonora's Falcons [n=13]	i	Q
+ Eleonora's Falcon - Spain [n=6]	i	Q
+ HawkWatch International Raptor Migration Study [n=102]	i	Q
+ Karen Steenhoff Falcons [n=28]	i	Q
+ Marc Bechard Hawks [n=2]	i	Q
+ Mark Martel Ospreys [n=48]	i	Q
+ Montagu's Harrier - Spain [n=18]	i	Q
+ NYSDEC Bald Eagle and Osprey [n=11]	i	Q
+ Oilbirds [n=35]	i	Q
+ Osprey Reintroduction -Spain [n=10]	i	Q
+ Short-toed Eagle - Spain [n=2]	i	Q

Hold ctrl key to select multiple individuals.



www.movebank.org

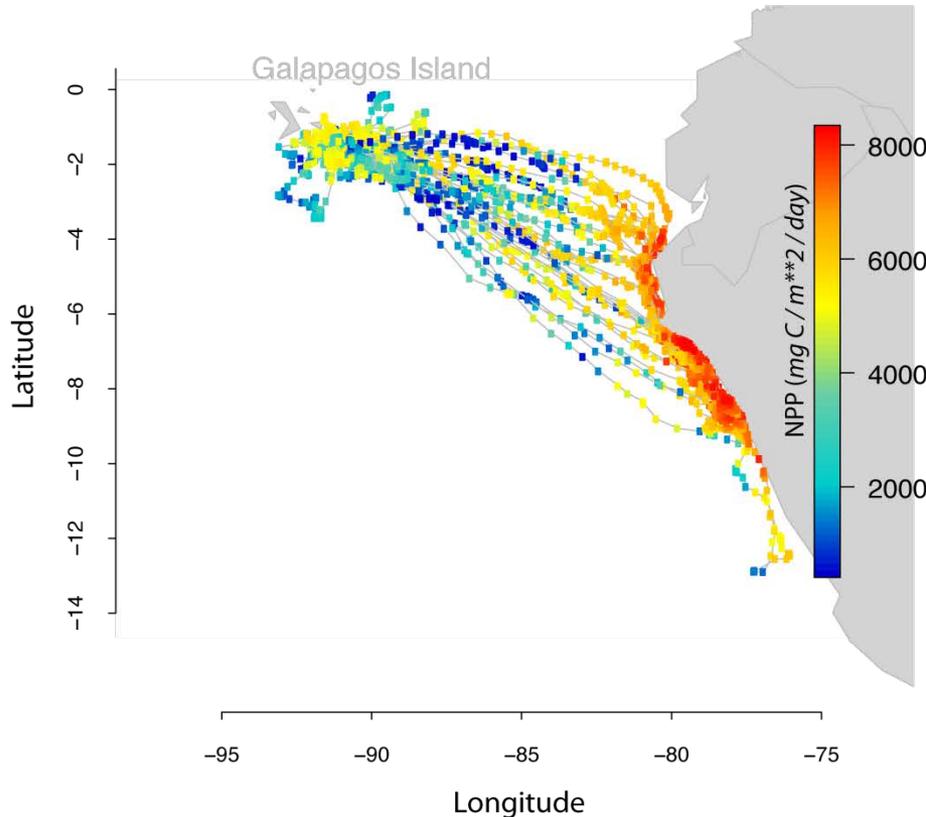
POWERED BY Google

Map data ©2009 Tele Atlas, MapLink/Tele Atlas, EuroParagon Technologies - Terms of Use

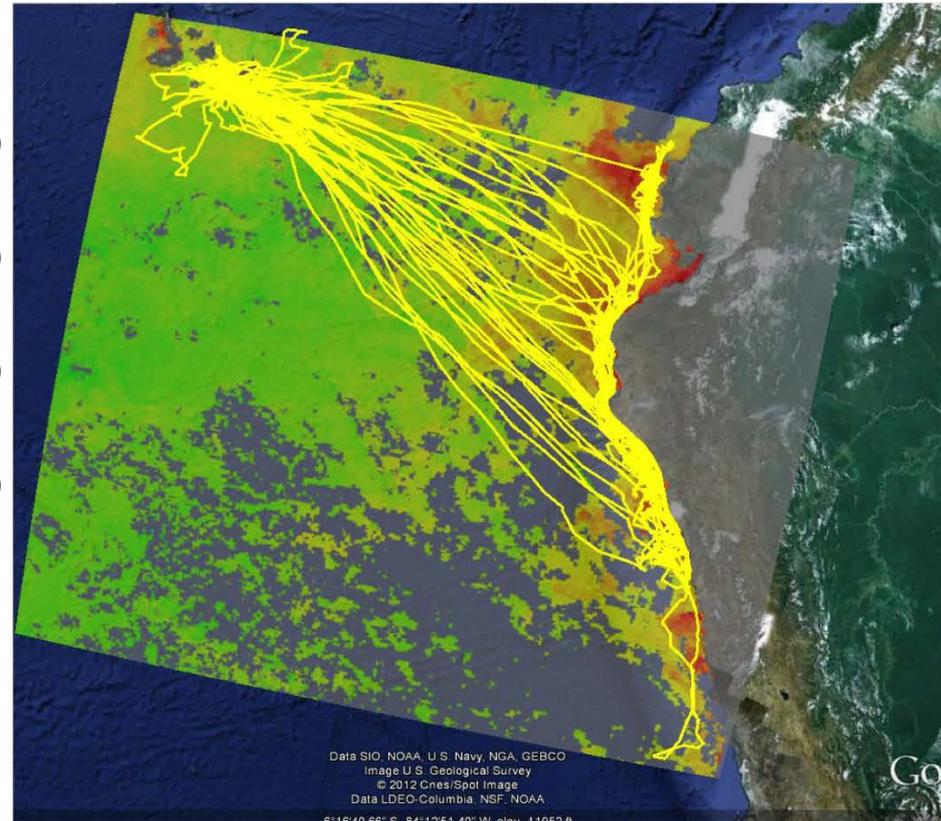
Environmental- Data Automated Track-Annotation System

Env-DATA

a) Albatross tracks annotated by Ocean NPP

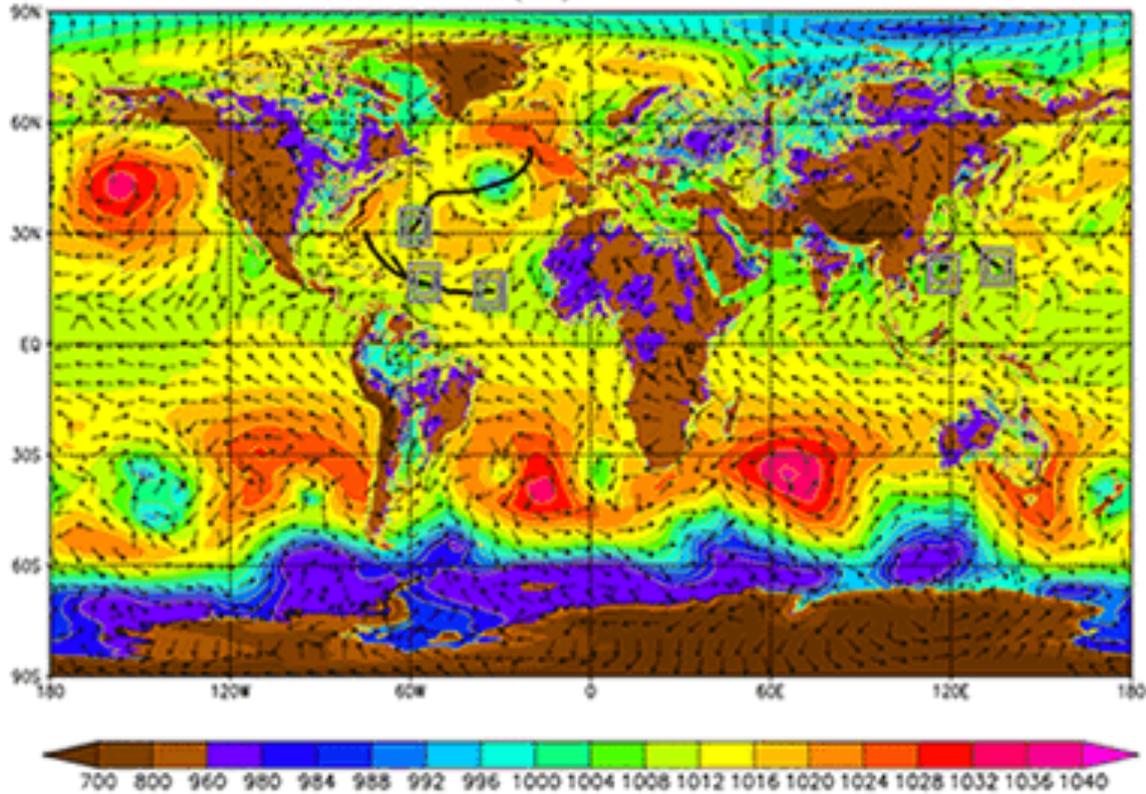


b) Albatross data overlaid on chlorophyll-a



ASTER ASTGTM2 Global 30-m DEM	topography	NASA Land Processes Distributed Active Archive Center https://lpdaac.usgs.gov/dataset_discovery/aster/aster_products_table	-
ECMWF Global Atmospheric Reanalysis	weather, atmosphere, hydrology	European Centre for Medium-Range Weather Forecasts http://apps.ecmwf.int/datasets	1979–present
ETOPO1 1-arc-minute Global Relief Model	topography, bathymetry	NOAA National Geophysical Data Center	-
Global Precipitation Measurement (GPM) and Tropical Rainfall Measuring Mission (TRMM)	precipitation	NASA Goddard Space Flight Center https://storm.pps.eosdis.nasa.gov/storm/	1997–present
GlobCover	land cover, land use	European Space Agency http://dup.esrin.esa.it/page_globcover.php	2009
MODIS Land	surface temperature, vegetation, land cover, fire, evapotranspiration	NASA Land Processes Distributed Active Archive Center https://lpdaac.usgs.gov/dataset_discovery/modis/modis_products_table	2002–present
MODIS Ocean	SST, chlorophyll, PIC, POC	NASA Goddard Space Flight Center Ocean Biology Processing Group http://oceandata.sci.gsfc.nasa.gov	2002–present
MODIS Snow	snow cover	National Snow and Ice Data Center https://n5eil01u.ecs.nsidc.org	2002–present
Movebank Derived Variables	orographic and thermal uplift	Movebank movebank.org	1979–present
NASA Distance to the Nearest Coast	distance to coast	NASA Ocean Biology Processing Group https://oceancolor.gsfc.nasa.gov/docs/distfromcoast/	-
SEDAC Human Population Density	population	NASA Socioeconomic Data and Applications Center (SEDAC) http://sedac.ciesin.columbia.edu/data/collection/gpw-v3/sets/browse	1990–2000
NCEP North American Regional Reanalysis (NARR)	weather, atmosphere, hydrology	NCAR/UCAR Research Data Archive http://rda.ucar.edu/datasets/ds608.0	1979–present
NOAA Global Climate Indexes	climate teleconnection patterns, indexes and anomalies	NOAA National Weather Service Climate Prediction Center http://www.cpc.ncep.noaa.gov	1950–present
Oregon State Ocean Productivity Reanalysis	ocean net primary productivity	Oregon State University http://orca.science.oregonstate.edu/data	2002–2015
Ocean Surface Current Analysis Real-time (OSCAR)	ocean surface currents	Earth and Space Research http://podaac.jpl.nasa.gov	1992–present
S-NPP VIIRS Land	reflectance, other products will be added once available from NASA	NASA Land Processes Distributed Active Archive Center https://lpdaac.usgs.gov/dataset_discovery/viirs/viirs_products_table	2012–present
S-NPP VIIRS Ocean	SST, chlorophyll, PIC, POC	NASA Goddard Space Flight Center Ocean Biology Processing Group https://oceandata.sci.gsfc.nasa.gov	2012–present
SRTM 90-m DEM	topography	CGIAR Consortium for Spatial Information http://srtm.csi.cgiar.org/	-

GLOBAL NNMB - Resolution 27:09:03km - Start Date 2010-08-29 00Z
DANNIELE06L EARLO7L FIONA08L LIONROCK07W KOMPASU08W
Surface Pressure (mb) Forecast Hour 003

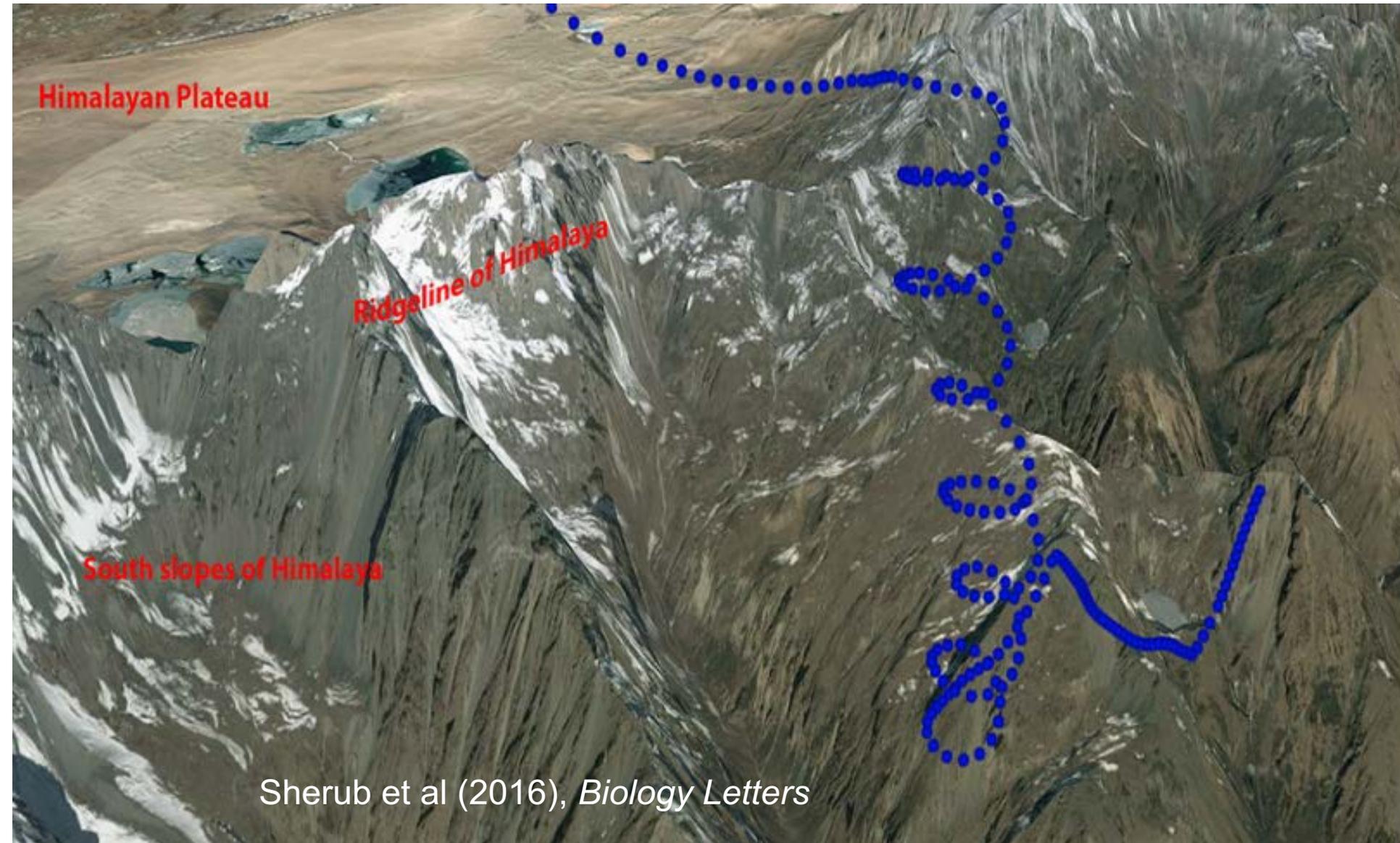


Reanalysis Datasets

<https://gifer.com>

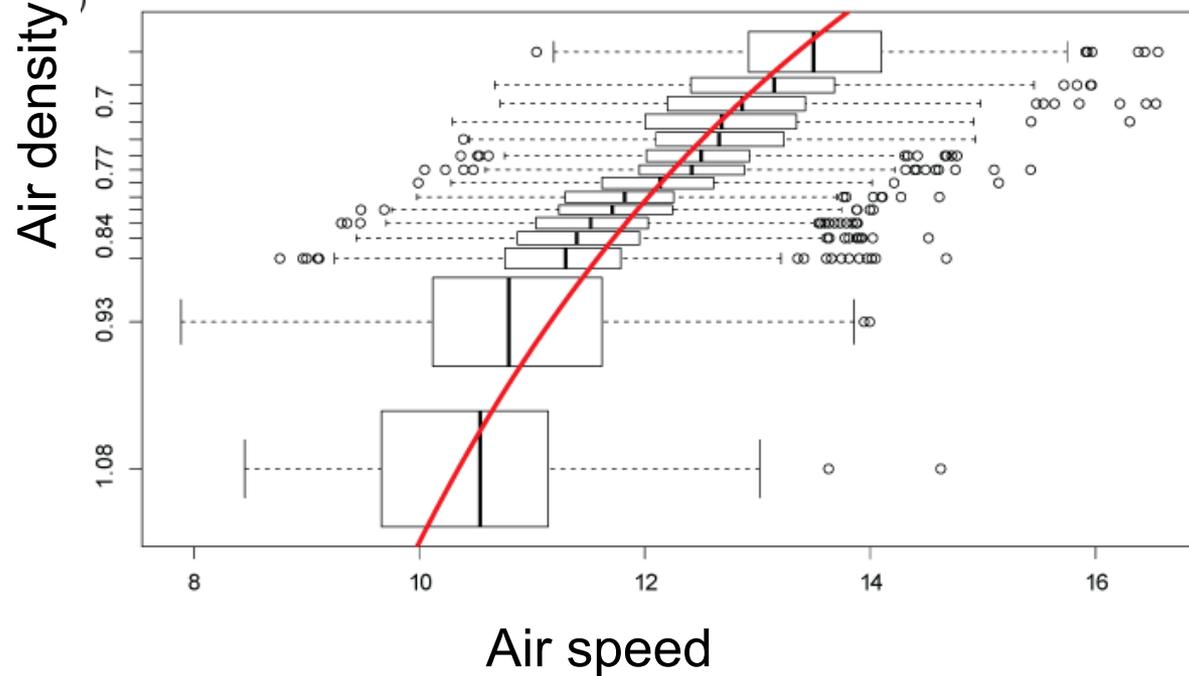
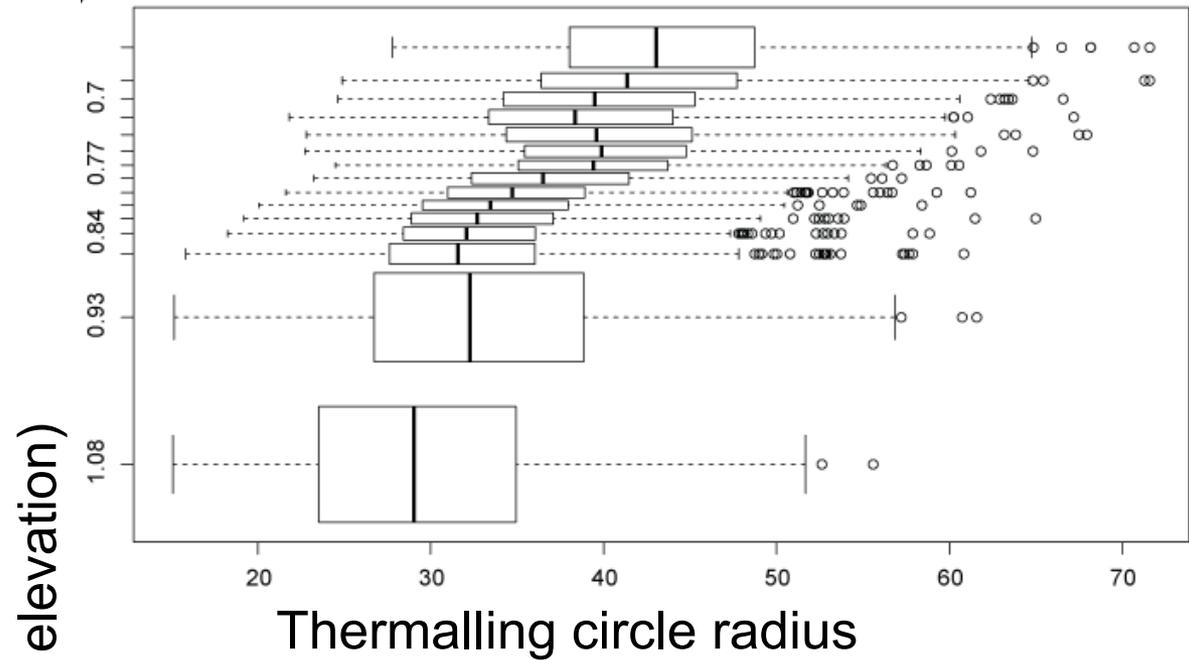
OSCAR Ocean Currents
NASA Daymet
NCEP
NARR
ECMWF ERA5

Flying into thin air – Griffon vultures crossing the Himalaya Mountains



Sherub et al (2016), *Biology Letters*

New insight on flight strategy





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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Co-Investigator(s)

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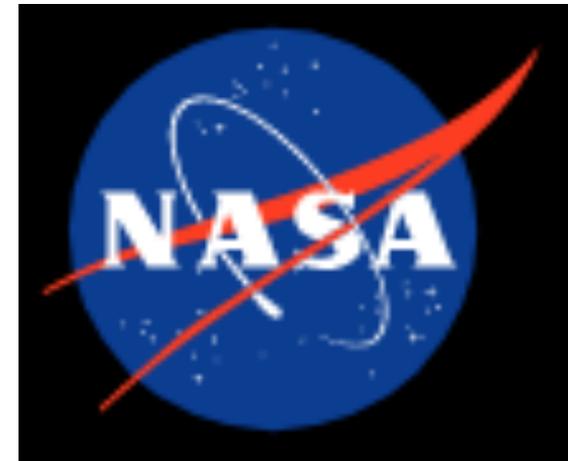
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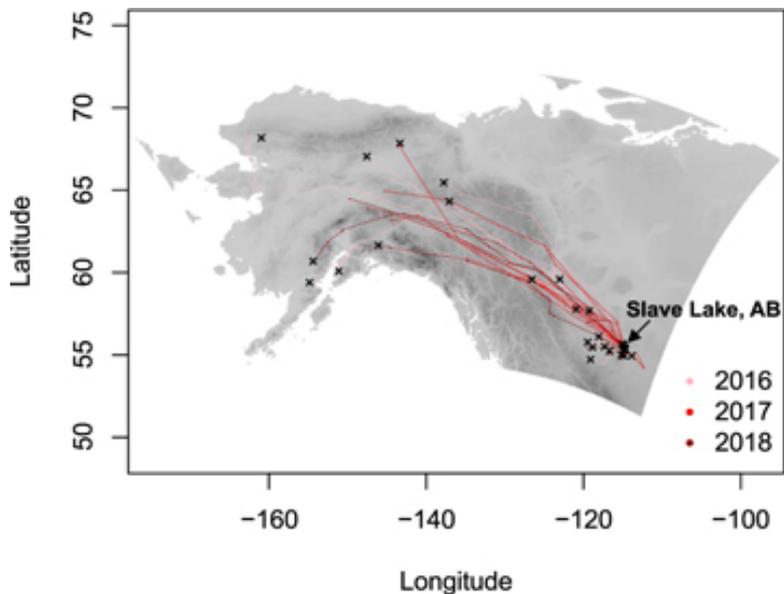
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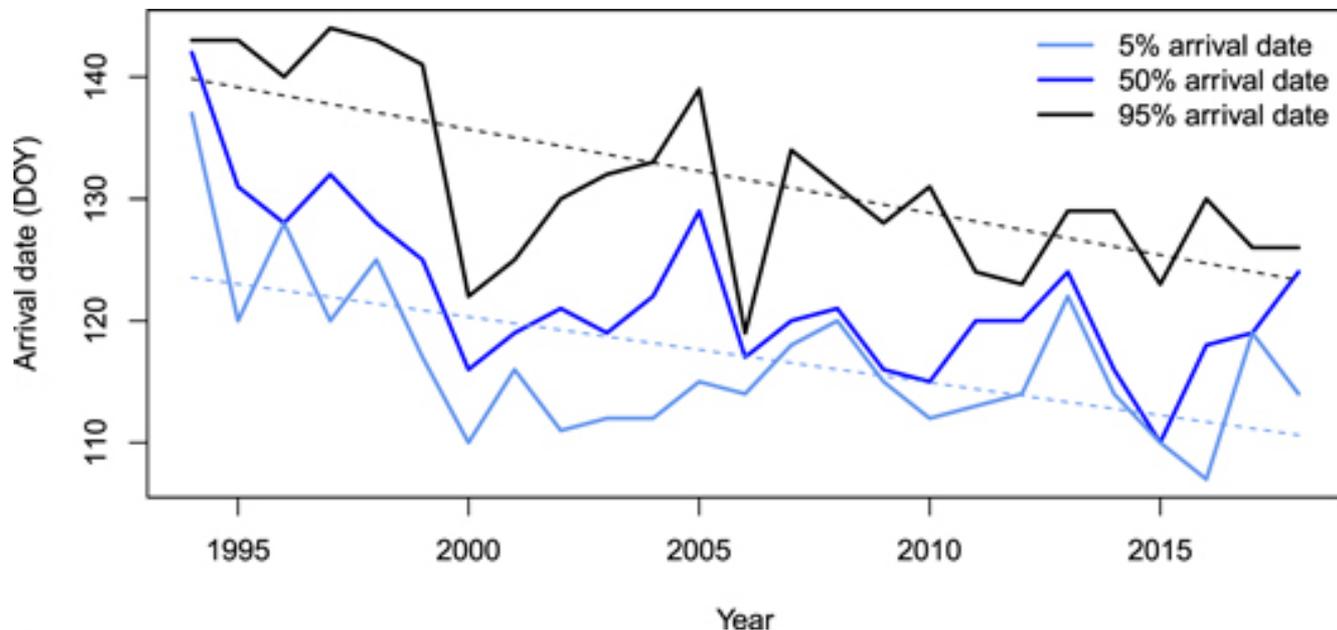
[Eric Palm](#), University of Montana



Space Robins

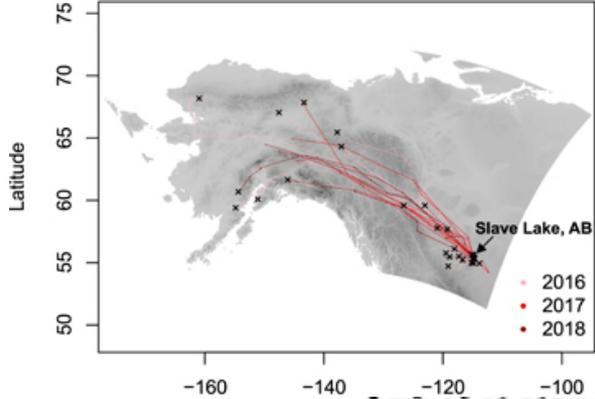


Long term trends in spring migration phenology



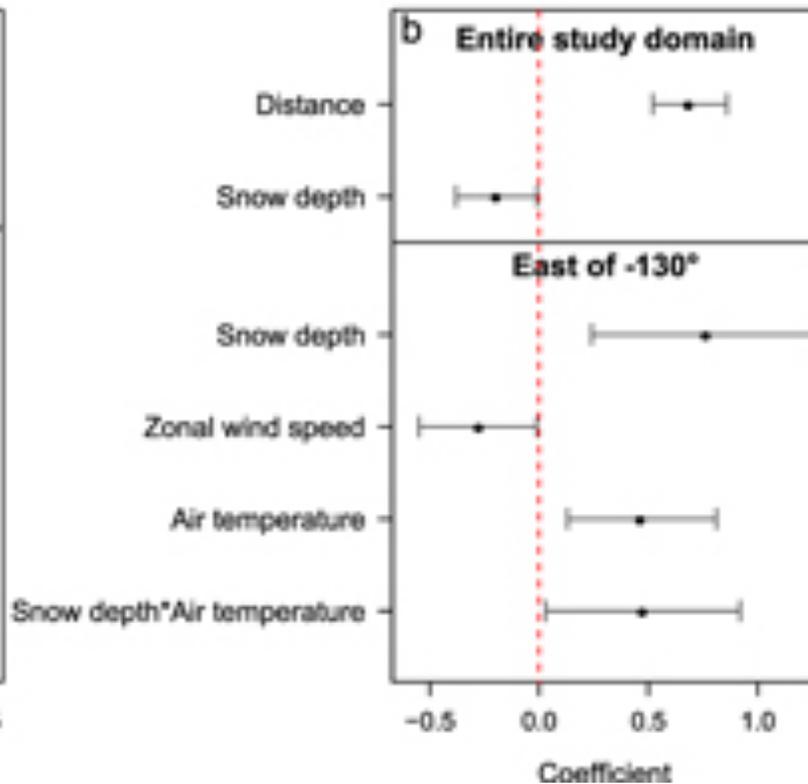
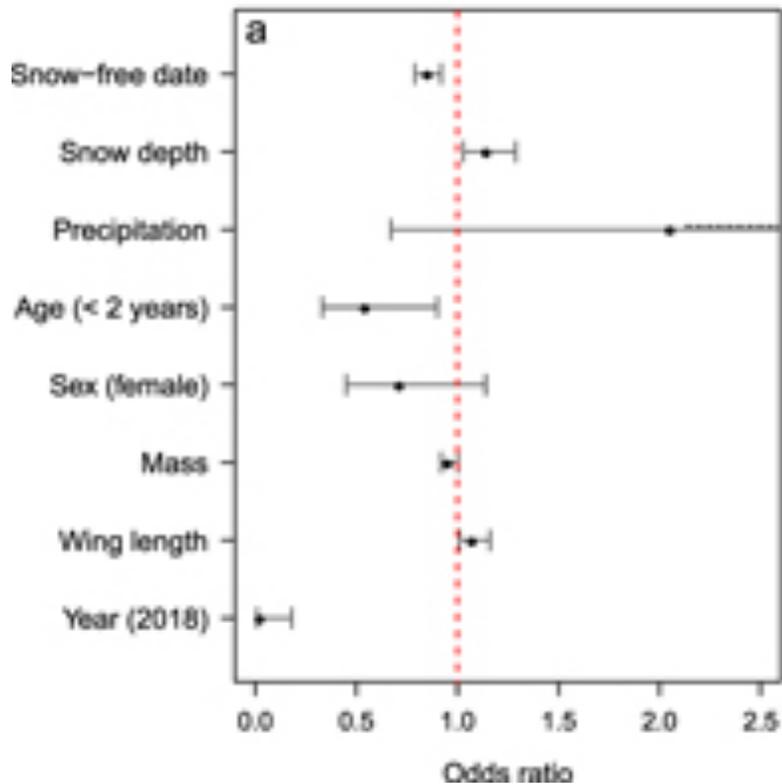
Space Robins

Environment and demography
drive migration timing and rate

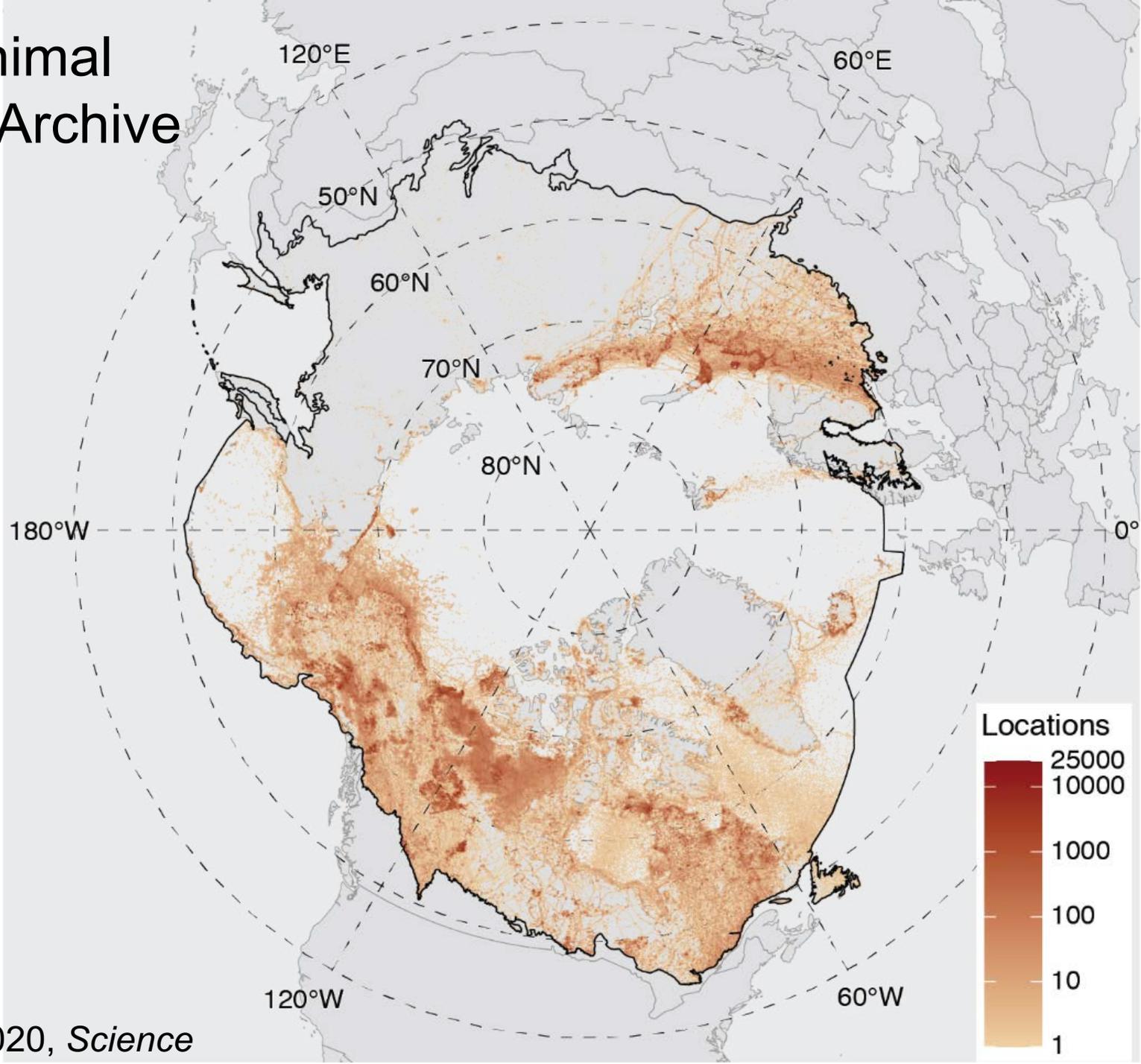


Arrival at stopover site

Migration rate



Arctic Animal Movement Archive



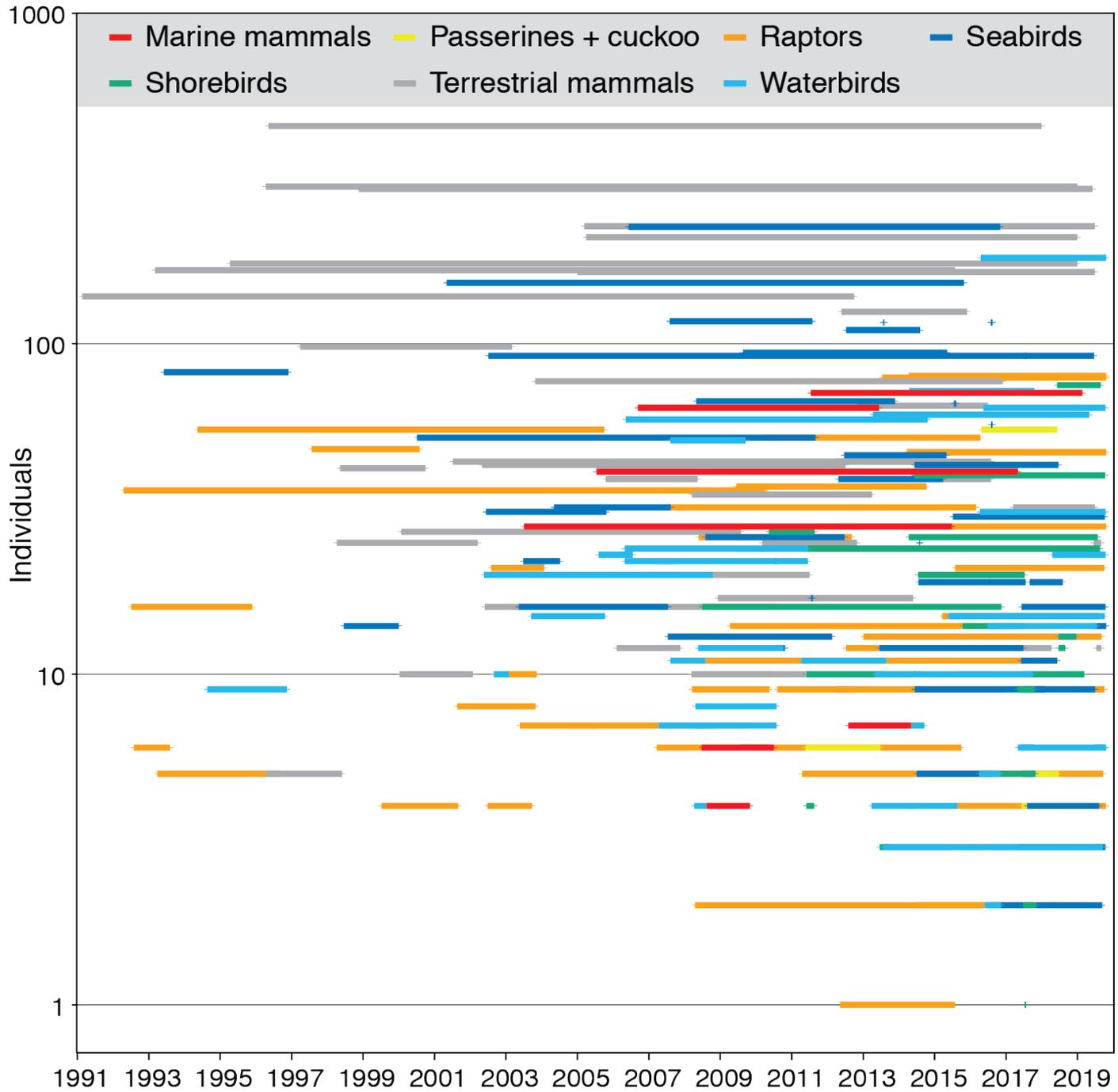
Roughly

2M occurrences

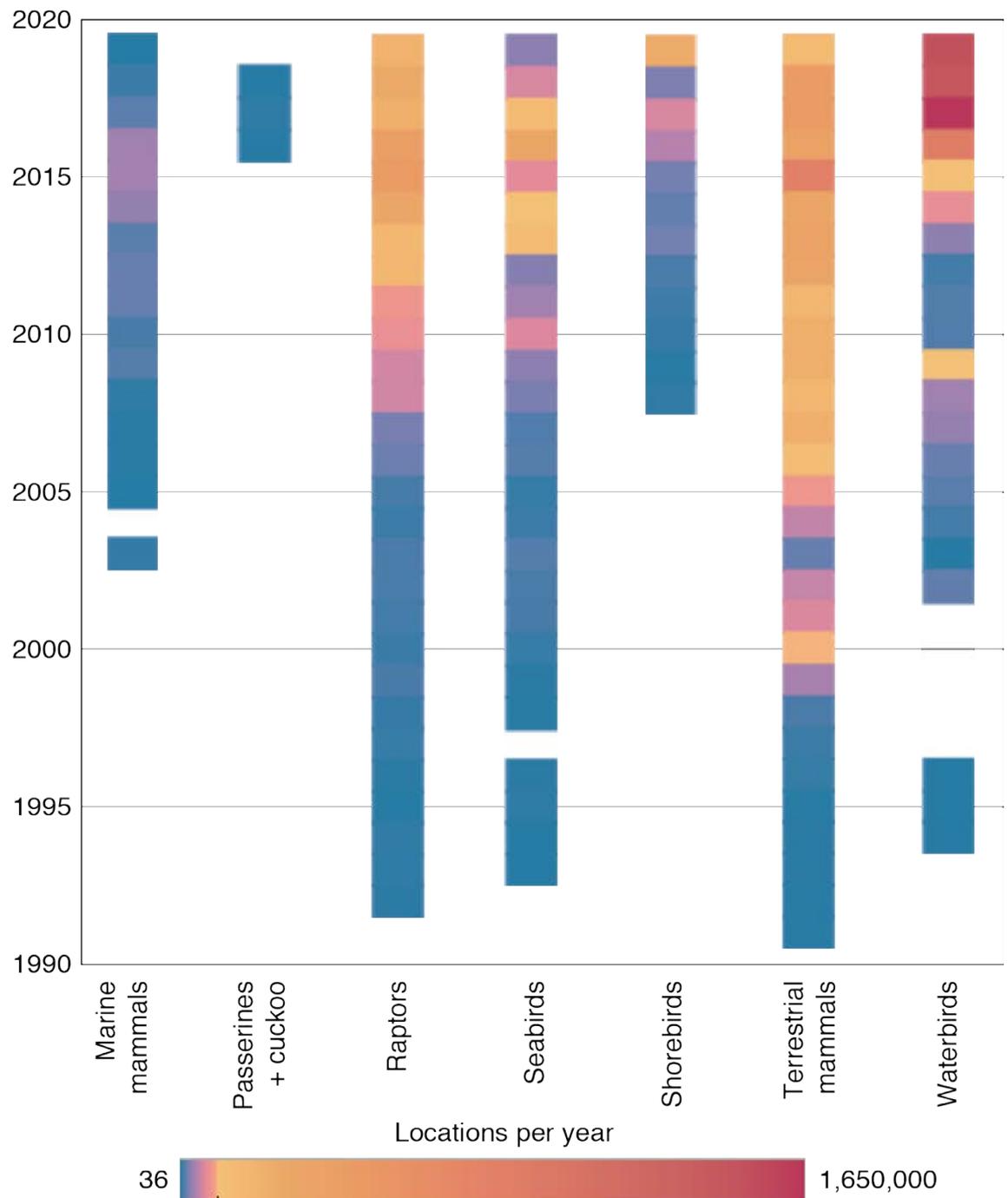
8000 individuals

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



for animal tracking data

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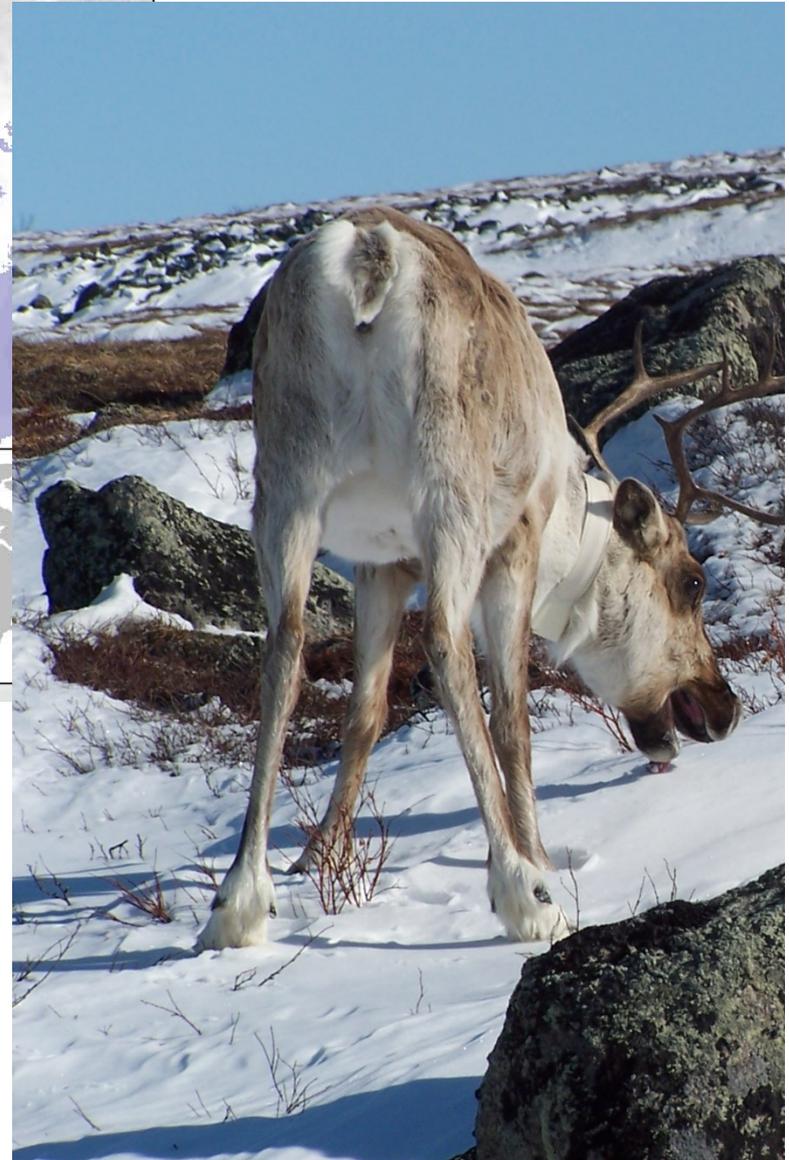
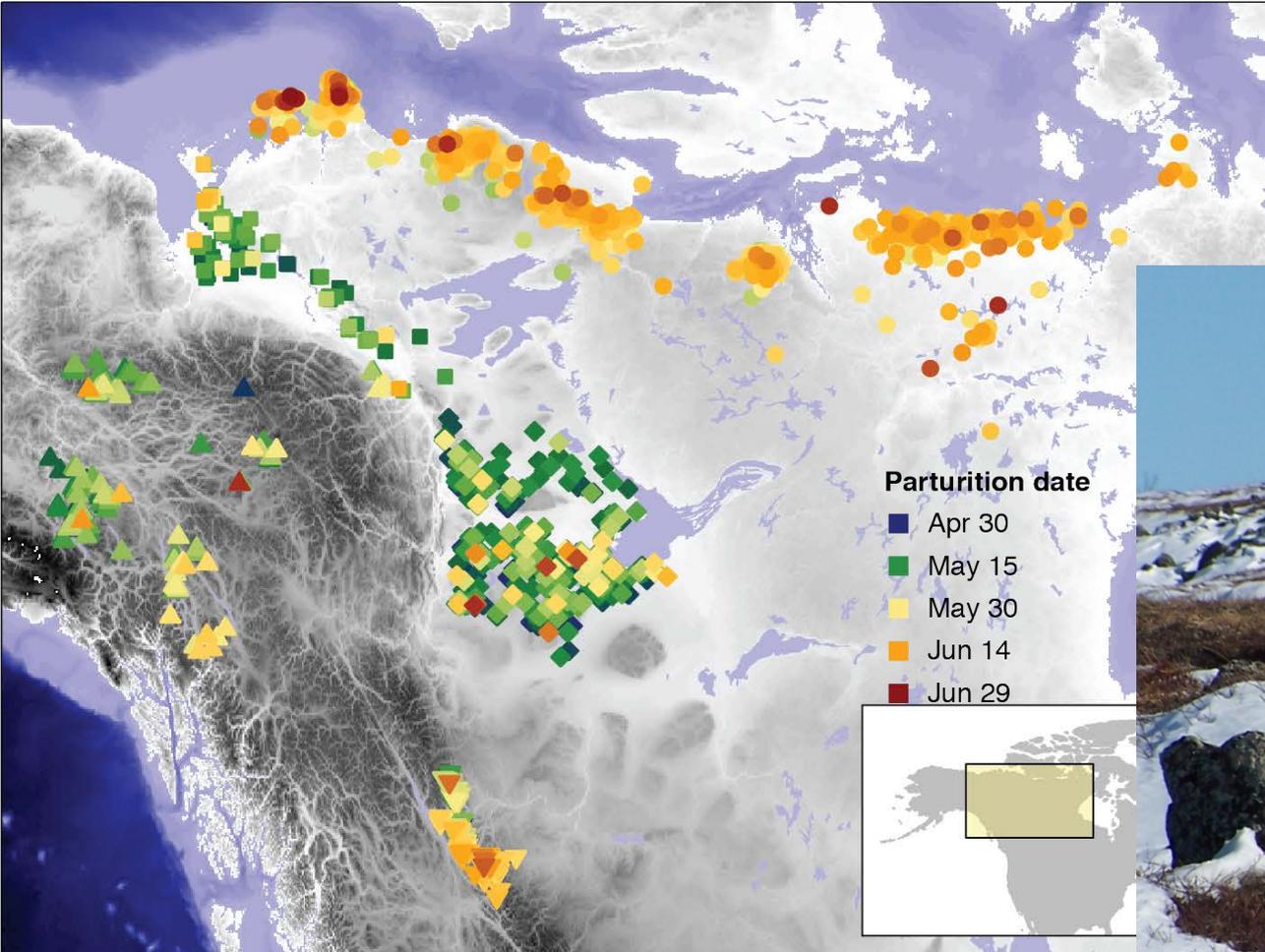


The Arctic Animal Movement Archive

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!

Sarah C. Davidson, Gil Bohrer*, Eliezer Gurarie, Scott LaPoint, Peter J. Mahoney, Natalie T. Boelman, Jan U. H. Eitel, Laura R. Prugh, Lee A. Vierling, Jyoti Jennewein, Emma Grier, Ophélie Couriot, Allicia P. Kelly, Arjan J. H. Meddens, Ruth Y. Oliver, Roland Kays, Martin Wikelski, Tomas Aarvak, Joshua T. Ackerman, José A. Alves, Erin Bayne, Bryan Bedrosian, Jerrold L. Belant, Andrew M. Berdahl, Alicia M. Berlin, Dominique Berteaux, Joël Bêty, Dmitrijs Boiko, Travis L. Booms, Bridget L. Borg, Stan Boutin, W. Sean Boyd, Kane Brides, Stephen Brown, Victor N. Bulyuk, Kurt K. Burnham, David Cabot, Michael Casazza, Katherine Christie, Erica H. Craig, Shanti E. Davis, Tracy Davison, Dominic Demma, Christopher R. DeSorbo, Andrew Dixon, Robert Domenech, Götz Eichhorn, Kyle Elliott, Joseph R. Evenson, Klaus-Michael Exo, Steven H. Ferguson, Wolfgang Fiedler, Aaron Fisk, Jérôme Fort, Alastair Franke, Mark R. Fuller, Stefan Garthe, Gilles Gauthier, Grant Gilchrist, Petr Glazov, Carrie E. Gray, David Grémillet, Larry Griffin, Michael T. Hallworth, Autumn-Lynn Harrison, Holly L. Hennis, J. Mark Hipfner, James Hodson, James A. Johnson, Kyle Joly, Kimberly Jones, Todd E. Katzner, Jeff W. Kidd, Elly C. Knight, Michael N. Kochert, Andrea Kölzsch, Helmut Kruckenberg, Benjamin J. Lagassé, Sandra Lai, Jean-François Lamarre, Richard B. Lanctot, Nicholas C. Larter, A. David M. Latham, Christopher J. Latty, James P. Lawler, Don-Jean Léandri-Breton, Hansoo Lee, Stephen B. Lewis, Oliver P. Love, Jesper Madsen, Mark Maftai, Mark L. Mallory, Buck Mangipane, Mikhail Y. Markovets, Peter P. Marra, Rebecca McGuire, Carol L. McIntyre, Emily A. McKinnon, Tricia A. Miller, Sander Moonen, Tong Mu, Gerhard J. D. M. Müskens, Janet Ng, Kerry L. Nicholson, Ingar Jostein Øien, Cory Overton, Patricia A. Owen, Allison Patterson, Aevan Petersen, Ivan Pokrovsky, Luke L. Powell, Rui Prieto, Petra Quillfeldt, Jennie Rausch, Kelsey Russell, Sarah T. Saalfeld, Hans Schekkerman, Joel A. Schmutz, Philipp Schwemmer, Dale R. Seip, Adam Shreading, Mónica A. Silva, Brian W. Smith, Fletcher Smith, Jeff P. Smith, Katherine R. S. Snell, Aleksandr Sokolov, Vasiliy Sokolov, Diana V Solovyeva, Mathew S. Sorum, Grigori Tertitski, J. F. Therrien, Kasper Thorup, T. Lee Tibbitts, Ingrid Tulp, Brian D. Uher-Koch, Rob S. A. van Bemmelen, Steven Van Wilgenburg, Andrew L. Von Duyke, Jesse L. Watson, Bryan D. Watts, Judy A. Williams, Matthew T. Wilson, James R. Wright, Michael A. Yates, David J. Yurkowski, Ramūnas Žydelis, Mark Hebblewhite

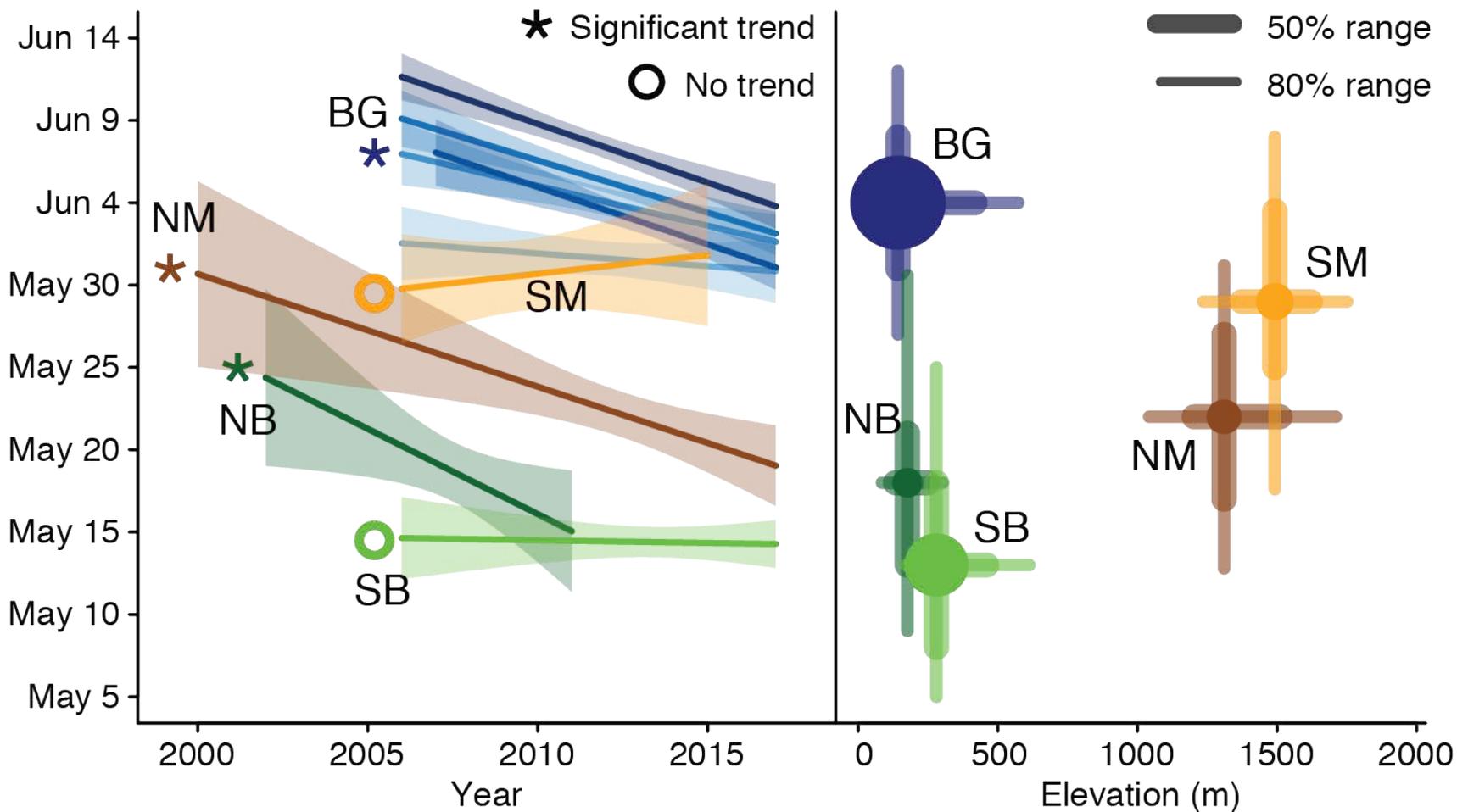


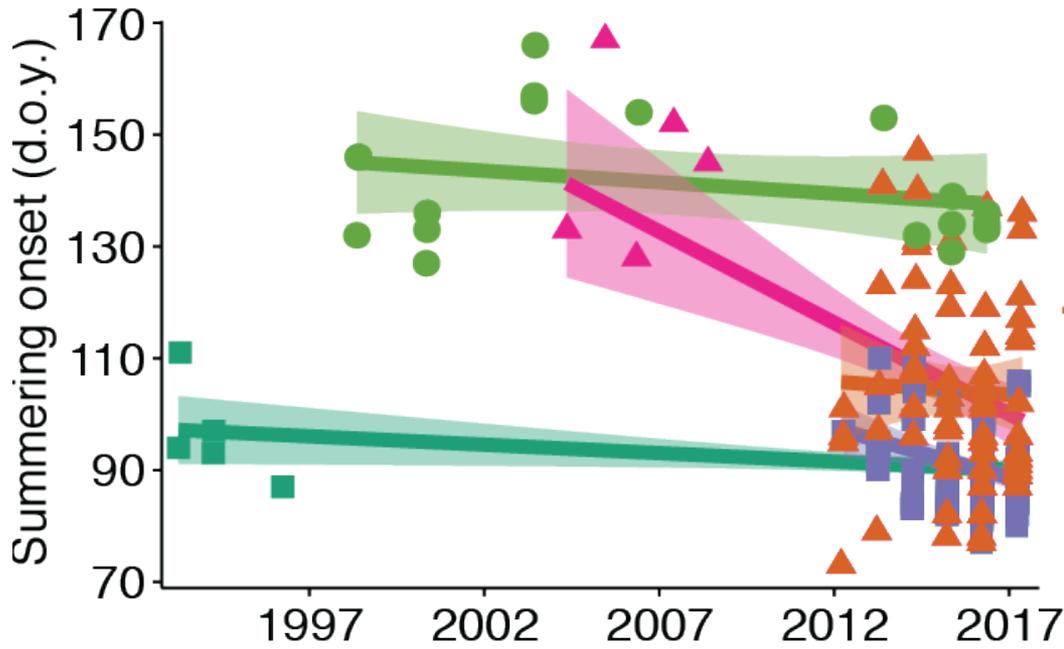
Large-scale analysis:

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)





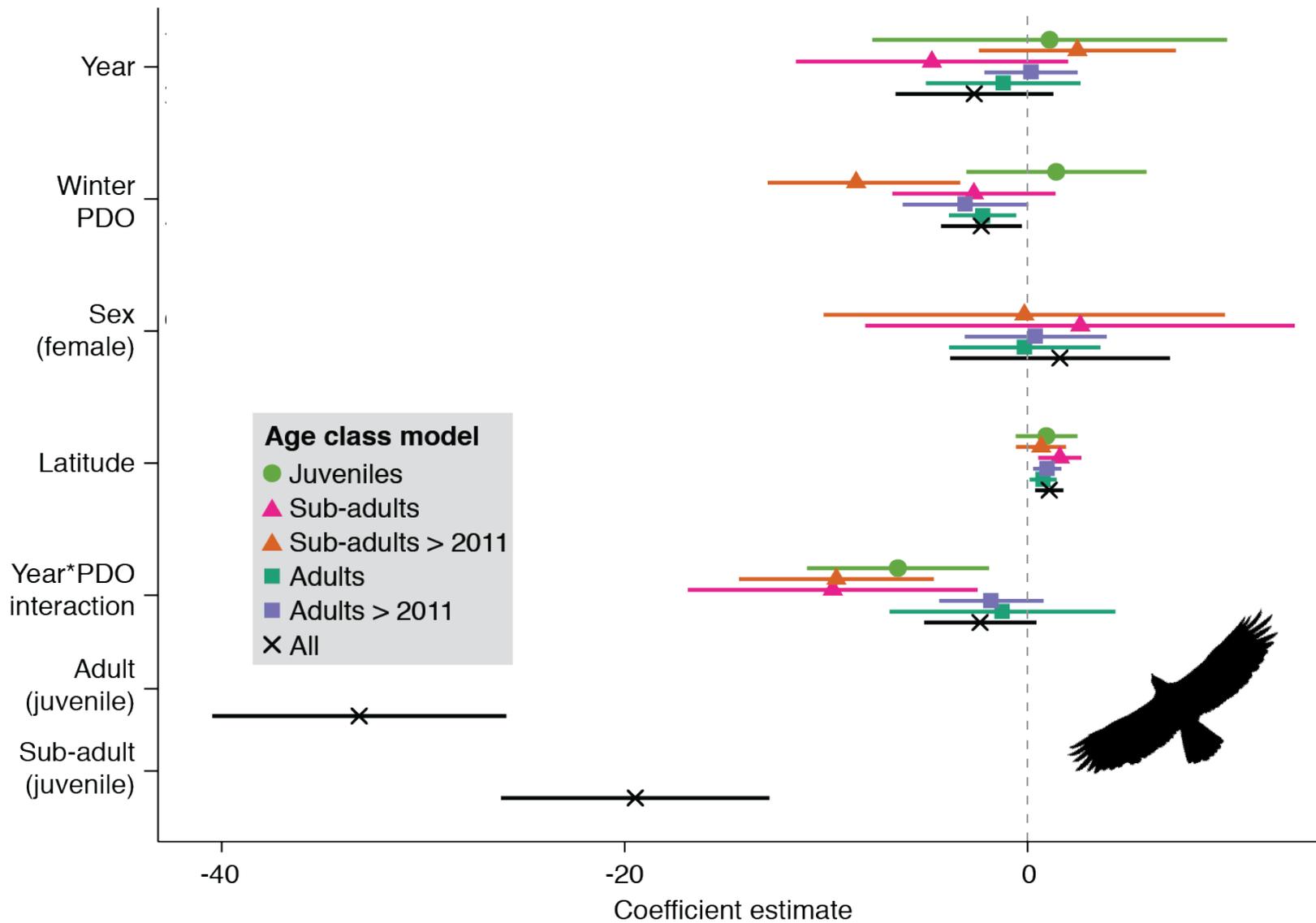
Age class model

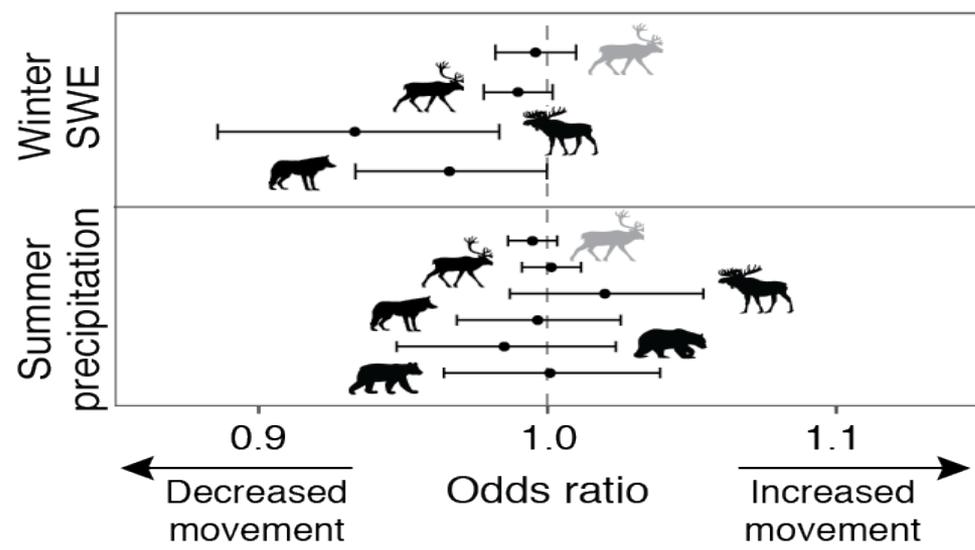
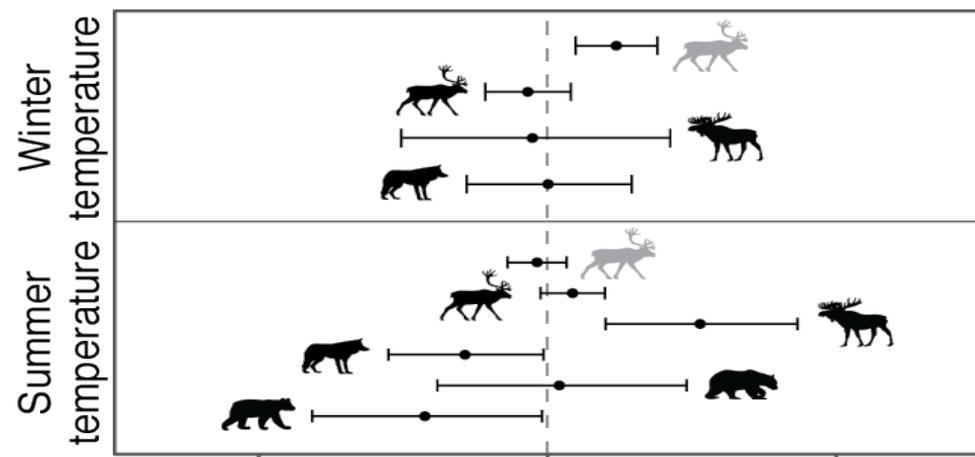
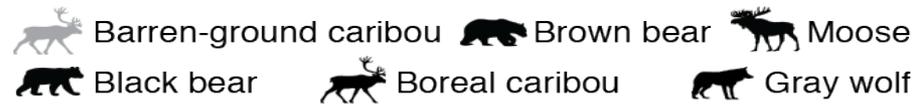
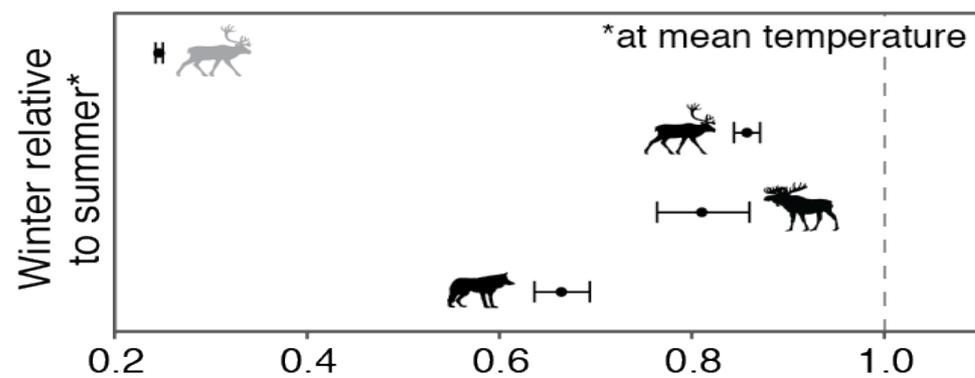
- Juveniles
- ▲ Sub-adults
- ▲ Sub-adults > 2011
- Adults
- Adults > 2011
- × All



Long-term analysis:

Golden eagle migration phenology

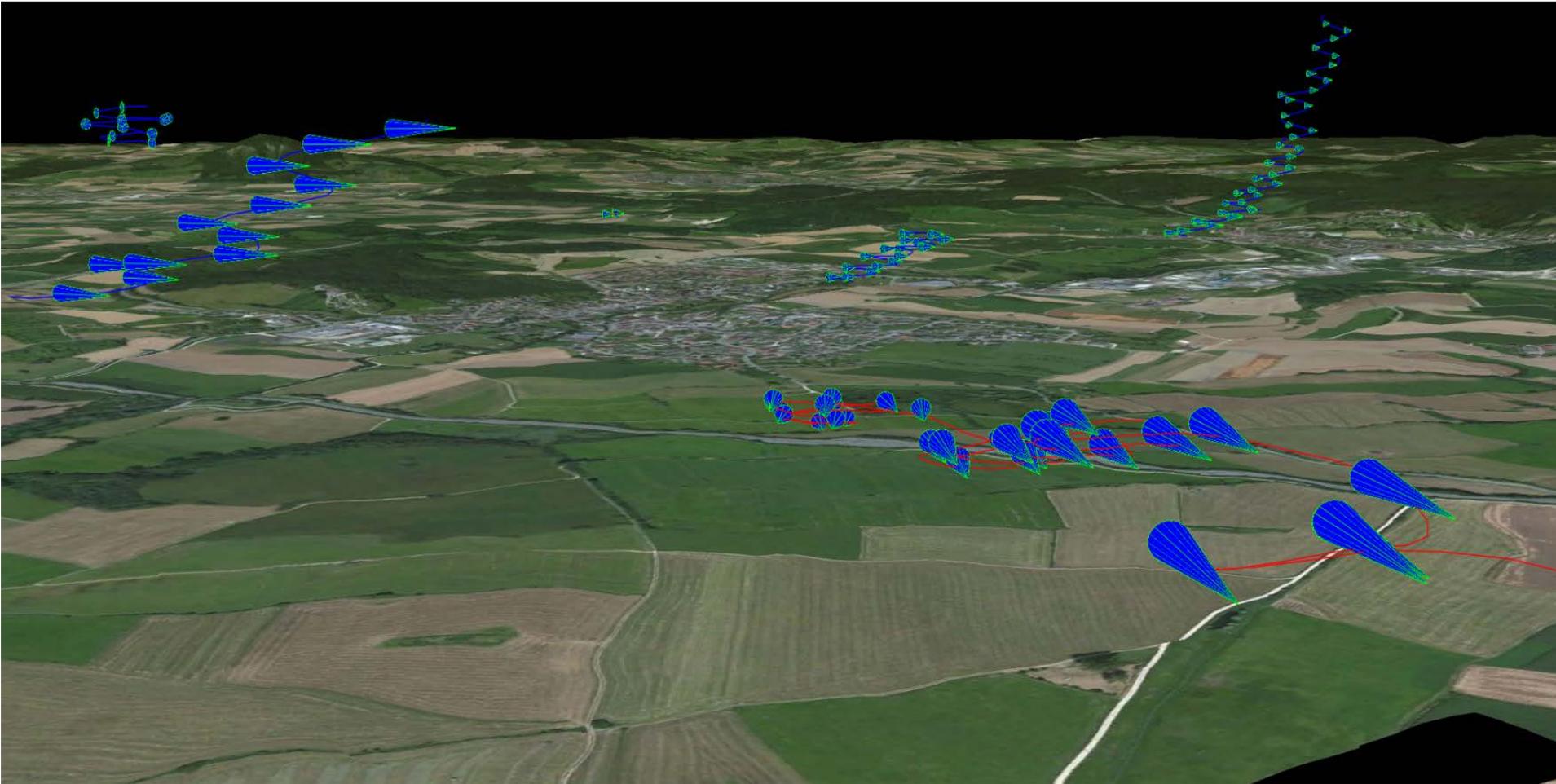




Multi-species analysis:

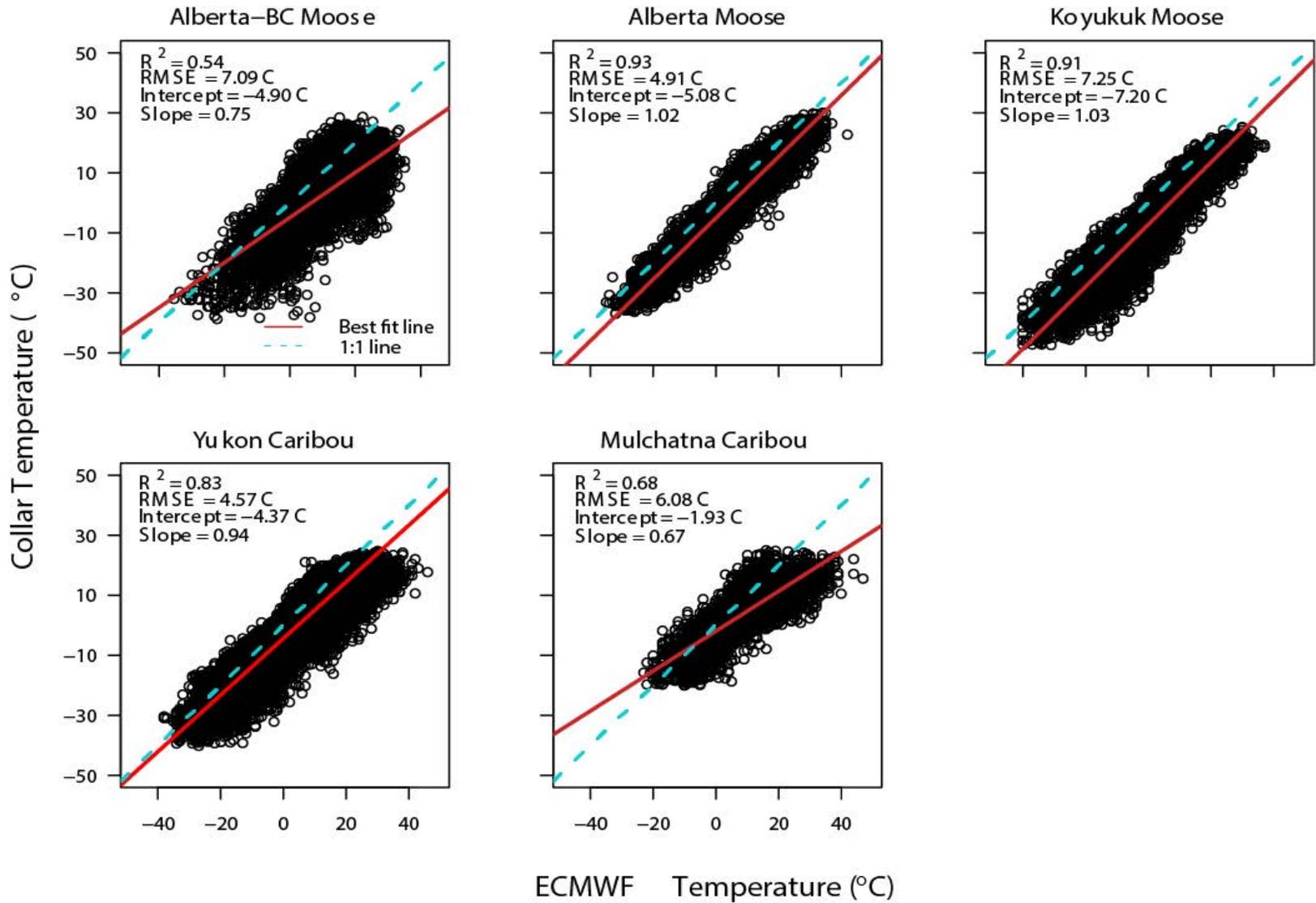
Environmental drivers of movement rates

Technology development: Tag-based measurements

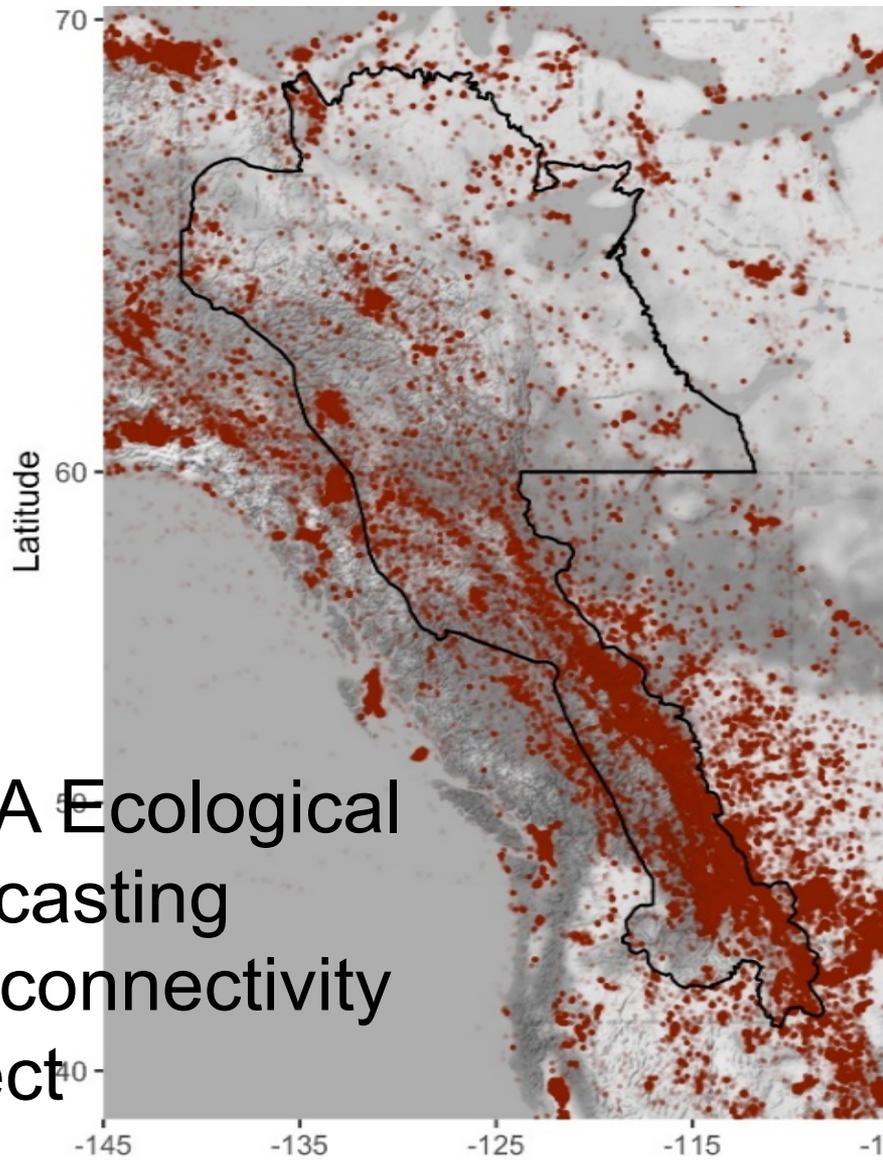


R-Move-WindSpeed (Weinzierl et al. 2016 *Ecology & Evolution*)

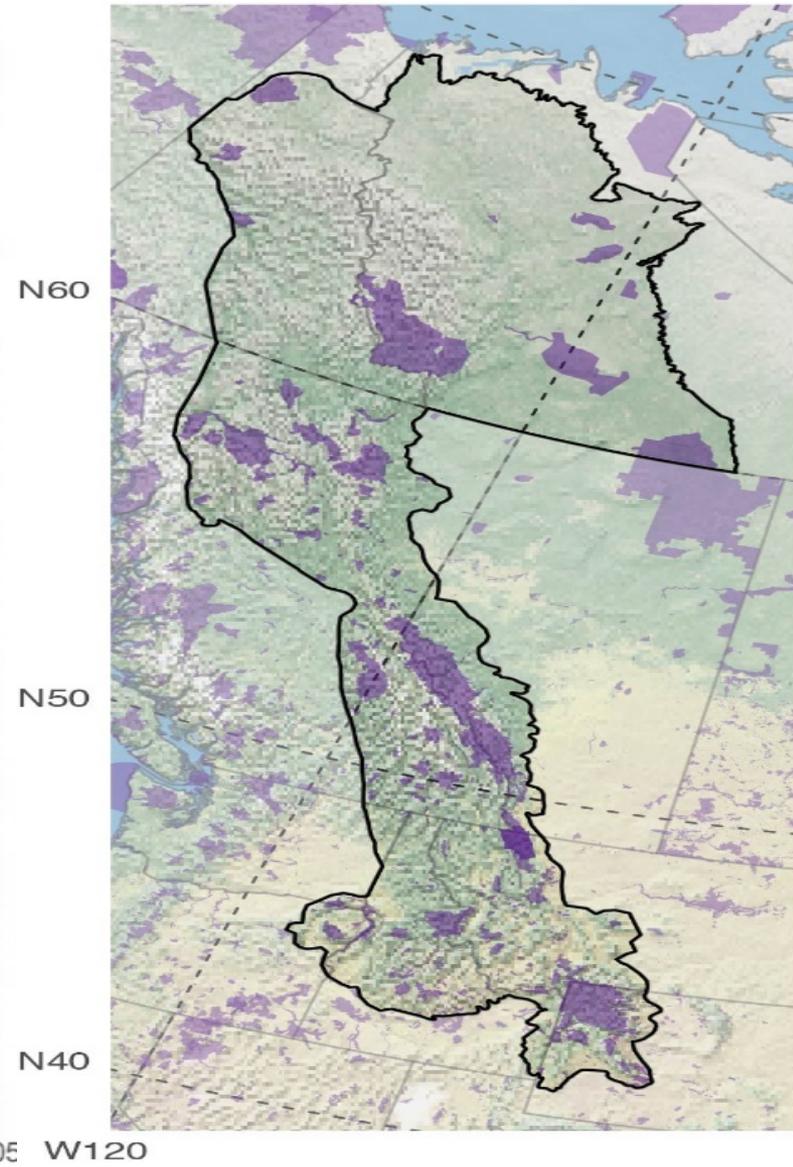
Tag temperatures vs Reanalysis



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

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National Science Foundation
WHERE DISCOVERIES BEGIN



For Animal Tracking and Photo Monitoring Data