



The Migratory
Connectivity Project









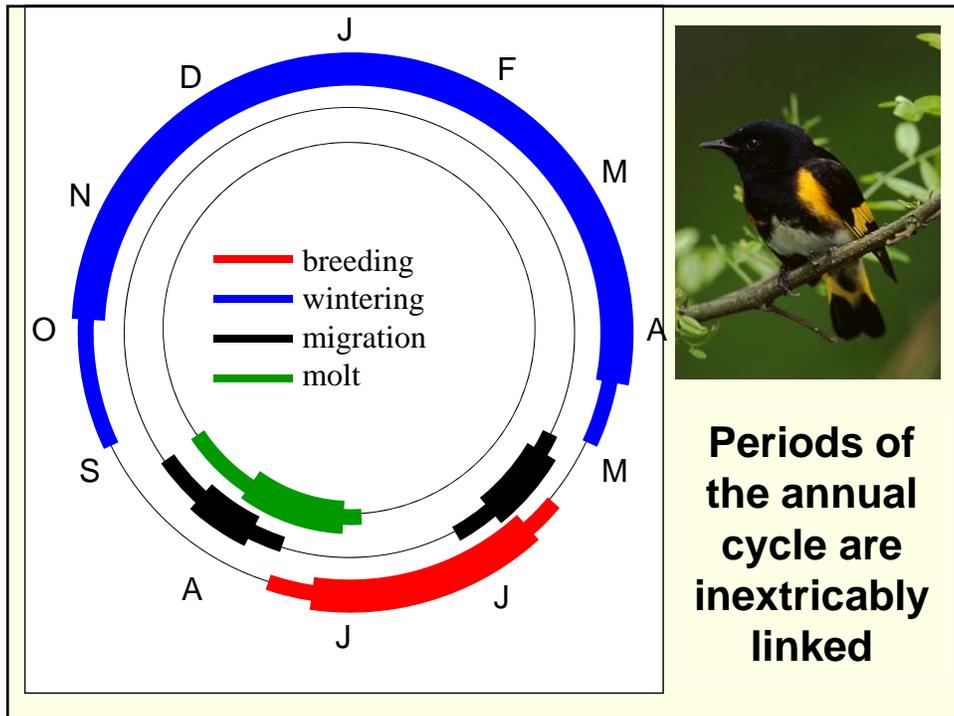




Smithsonian
National Zoological Park



USGS
science for a changing world



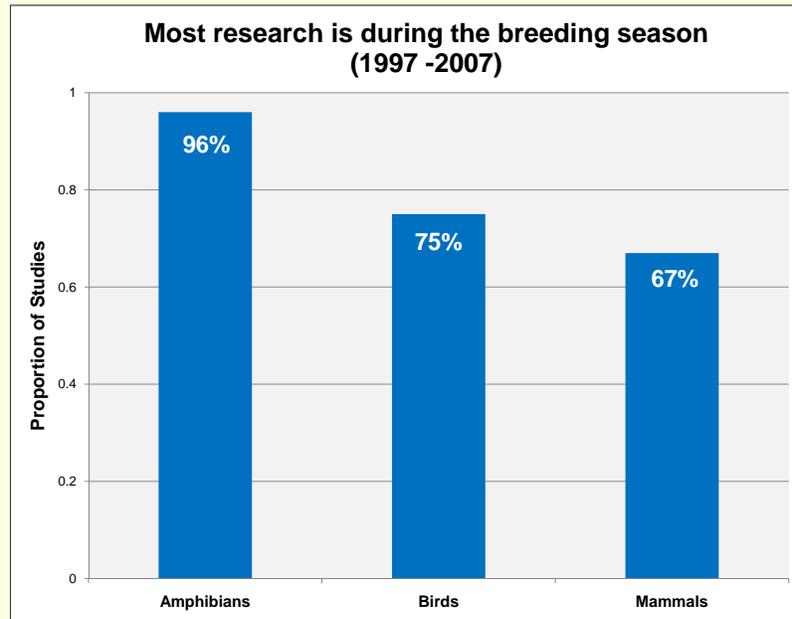
Seasonal Interactions

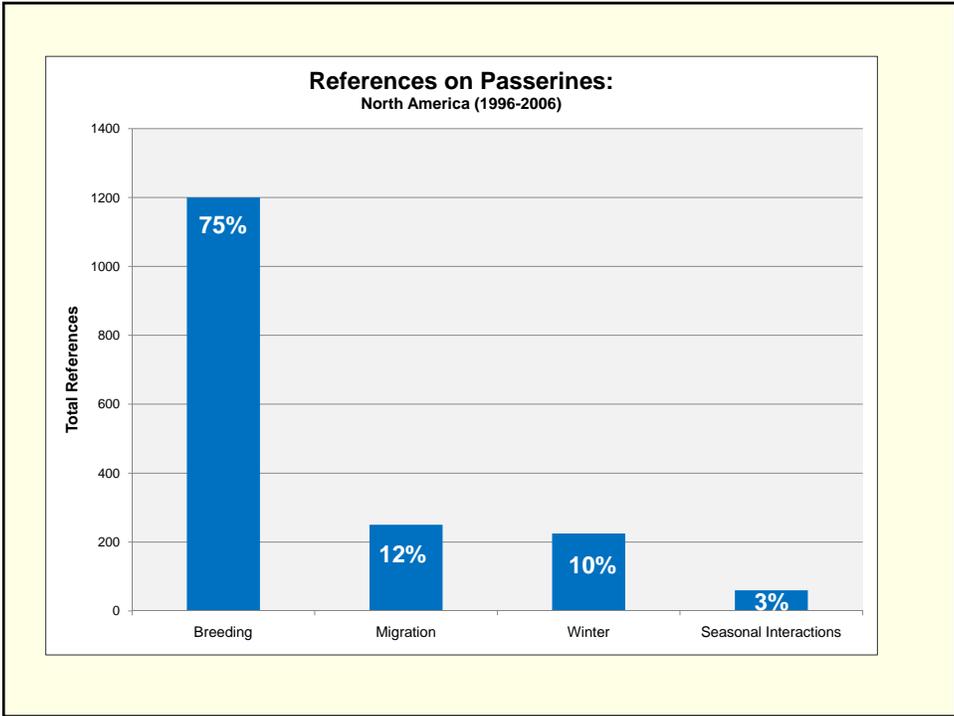
- Circumstances within one period or season of the annual cycle that influence events or traits in a subsequent period.

Ecological

1. Individual (carry-over effects)
2. Population (density, *OSR*)

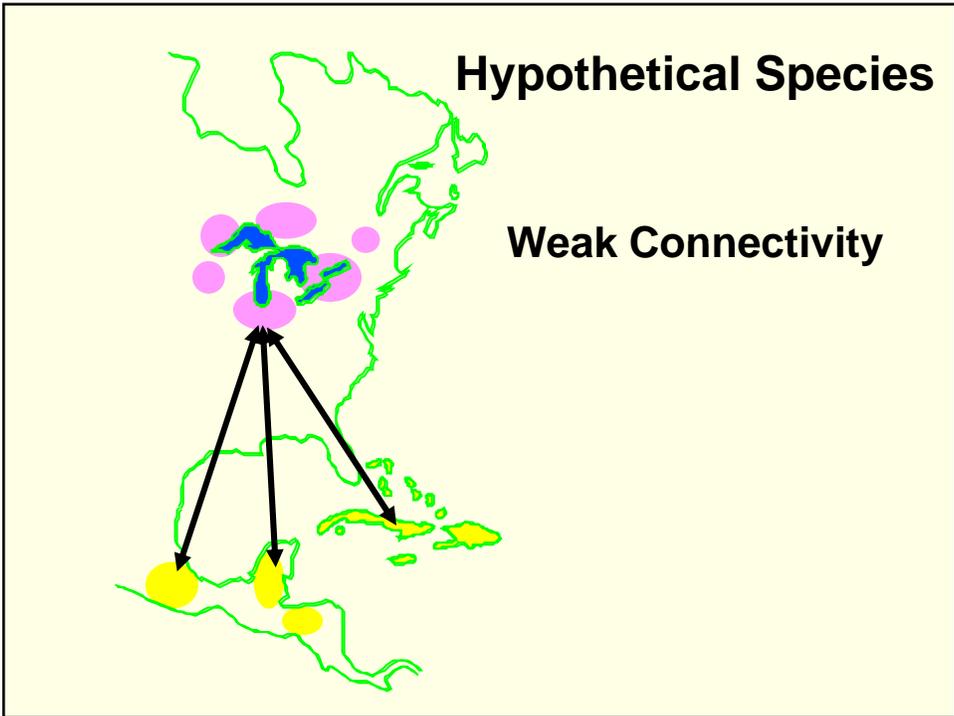
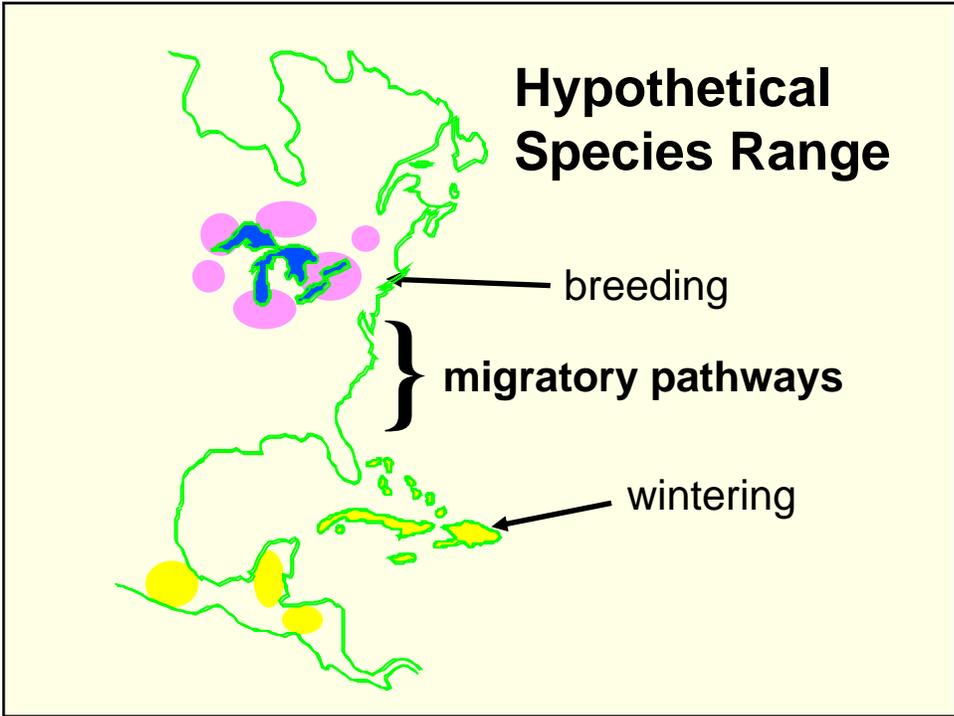
Evolutionary

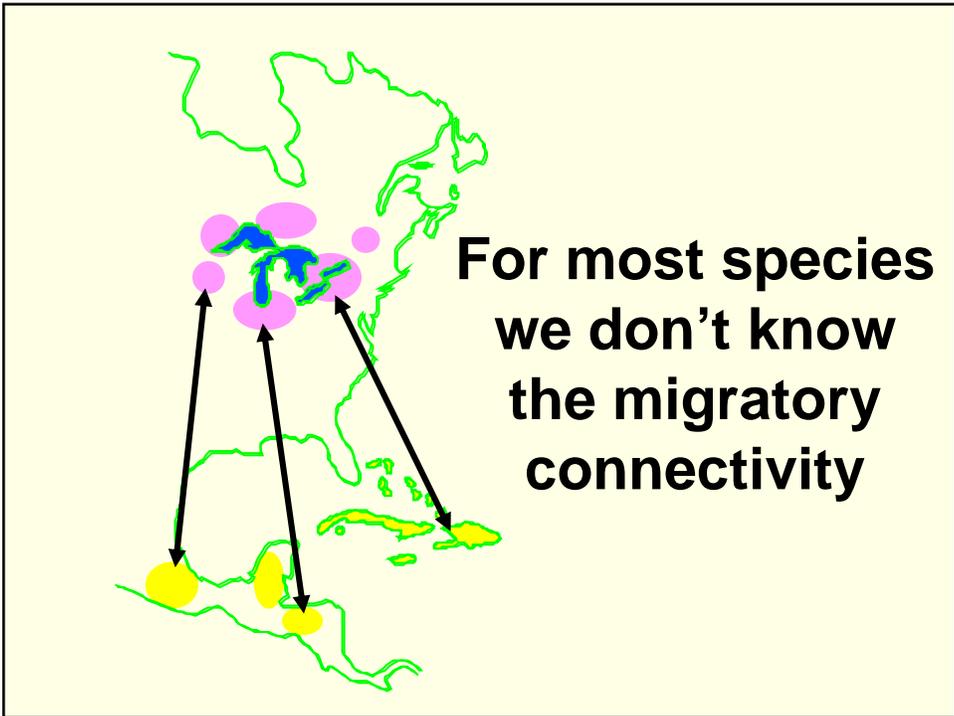
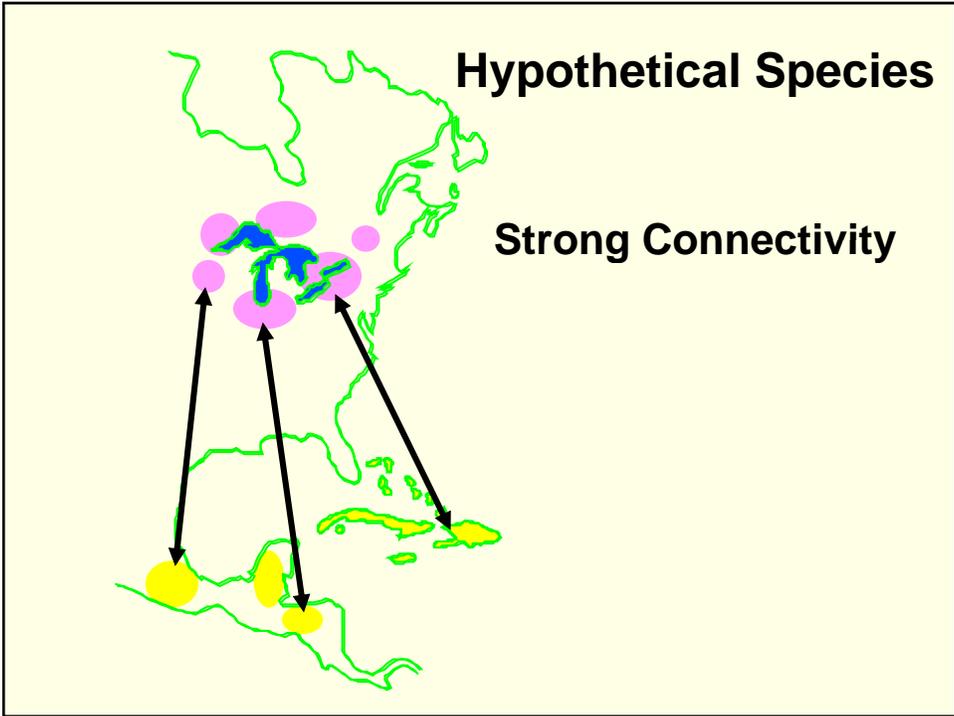




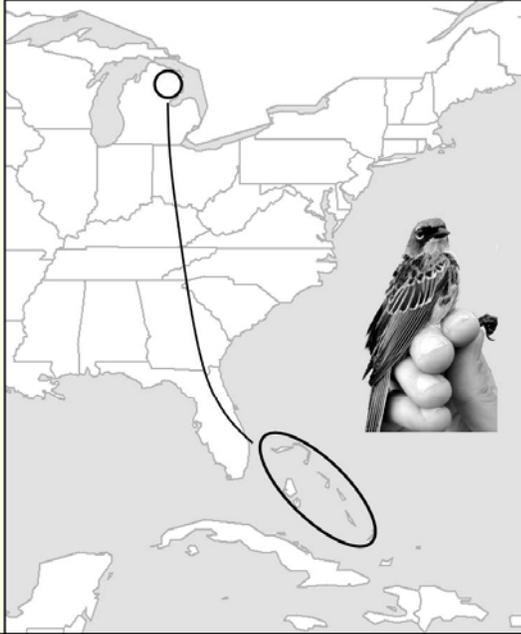
Migratory Connectivity:

The geographic linking of individuals or populations between different stages of the annual cycle, including between breeding, migration, and winter stages.





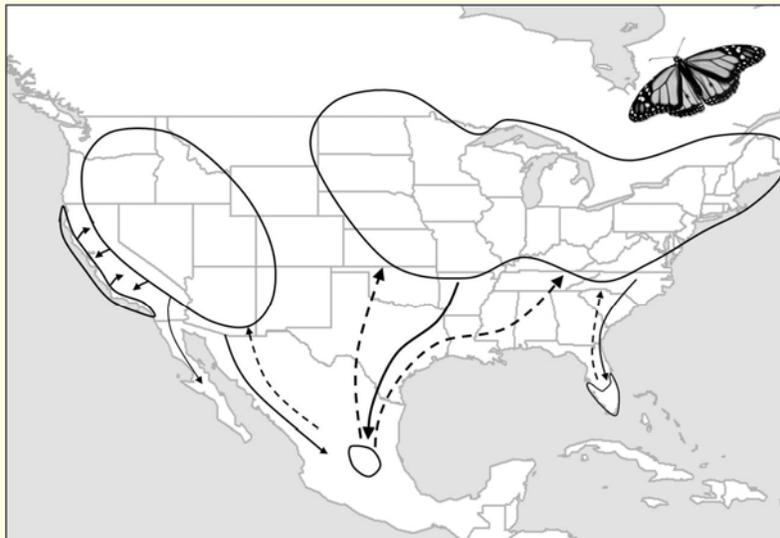
Kirtland's Warbler



**Restricted
breeding
and
wintering
range**

Monarch Butterflies

Broad breeding range/restricted wintering range
lots of mixing



Why study migratory connectivity?

Conservation

- Population vulnerability
- Responsible energy development
e.g., wind energy, oil extraction
- Response to Climate Change

Human Health

- Tracking, surveillance & predicting outbreaks (e.g., HPAI, WNV)

Why study migratory connectivity?

Biological understanding of seasonal interactions

Ecology, Behavior, Evolution

- Population Dynamics
- Natal Dispersal
- Life History Strategies
- Evolution of Body Size
- Sexual Selection

Quantifying Connectivity - Tools

- **Satellite transmitters** have been miniaturized
- **Geolocators** - miniature daylight level data recorders for tracking animals over long periods of time - must be recovered from returning birds
- **Genetic Markers** - rapid throughput sequencing capabilities that now produce 100,000s of variable markers that can track populations throughout the annual cycle.
- **Stable isotopes**, particularly when linked with molecular markers can provide important clues to geographic origin.

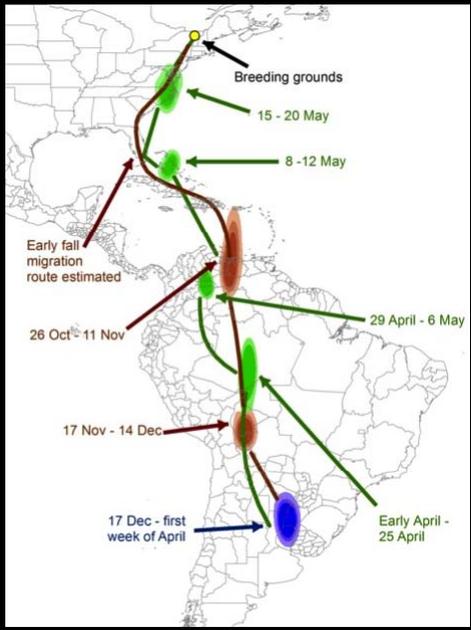


Satellite Telemetry

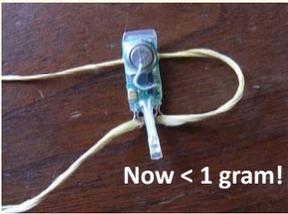


Geolocators

Collects and stores light levels to estimate timing and path of migration over one year



Map showing migration routes of Bobolink (*Dolichonyx oryzivorus*) in North America. Key locations and dates include: Breeding grounds (15-20 May), 8-12 May, 29 April - 6 May, Early April - 25 April, 17 Dec - first week of April, 17 Nov - 14 Dec, and 26 Oct - 11 Nov. An arrow indicates the 'Early fall migration route estimated'.

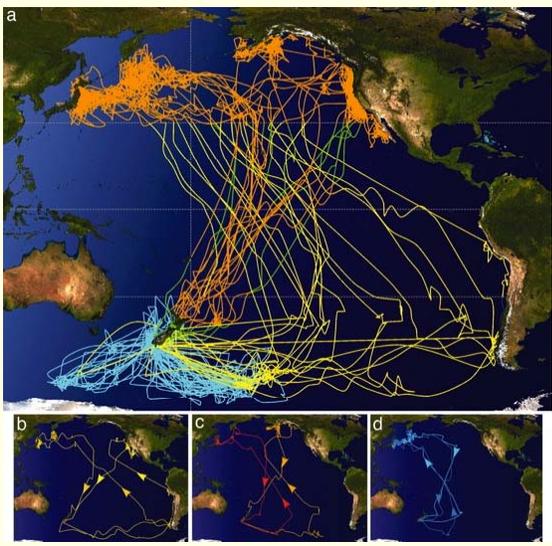


Now < 1 gram!



Bobolink (*Dolichonyx oryzivorus*)
Captured in Vermont

Sooty Shearwater Migrations



Map showing migration routes of Sooty Shearwaters across the globe. The main map (a) shows a dense network of routes connecting the North Atlantic, Europe, and the Pacific. Inset maps (b, c, d) show detailed views of specific migration paths.

Shaffer, Scott A. et al. (2006) PNAS 103, 12799-12802

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PNAS

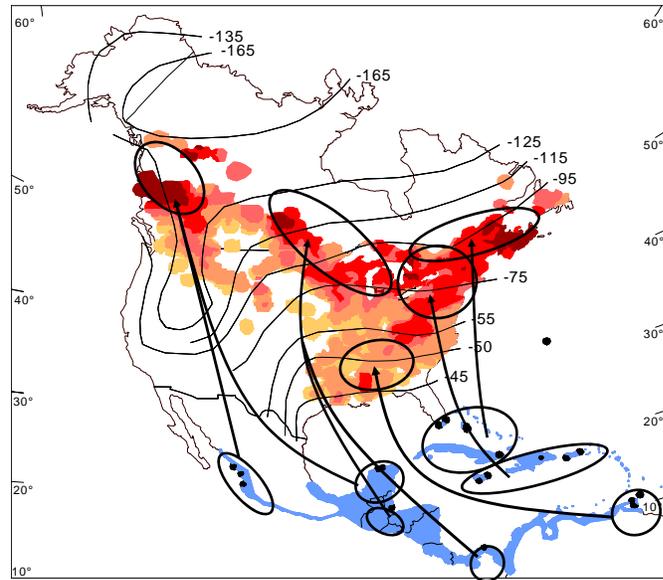
Stable Isotopes



H isotopes and banding data



American redstart
Setophaga ruticilla





Mission Statement:

Advance the science of animal movements and migratory connectivity to promote the conservation of migratory species throughout the annual cycle and at a global scale.



Primary Goals:

1. Facilitate, enhance and encourage the study of migratory connectivity and seasonal interactions at multiple temporal and spatial scales.
2. Advance current technologies and facilitate the development of new technologies to increase the understanding of migratory connectivity



The Migratory
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Primary Goals (cont'd):

- 3. Promote and integrate the use of migratory connectivity knowledge by environmental managers and policy makers to enable informed decision making.
- 4. Communicate the importance of migratory connectivity and international conservation.
- 5. Obtain funding/create a mechanism to support research on Migratory Connectivity.

Executive Committee

| Name | Institution | Expertise/Role |
|----------------|--------------------------------------|--------------------------------|
| Allen, Laurie | USGS National HQ | Wildlife Program Director |
| Lively, Carol | US Forest Service - International | Program Coordinator |
| Briggs, Kay | USGS National HQ | Genetics Program Director |
| Gill, Frank | National Audubon Society | President |
| Hahn, Deb | Assoc. of Fish and Wildlife Agencies | Bird conservation coordination |
| Inkley, Doug | National Wildlife Federation | Senior scientist for GCC |
| Matthews, John | World Wildlife Fund | Climate change/connectivity |
| Myers, Pete | Environmental Health Sciences | CEO |
| Schuler, Carol | USGS | Director - FRESC |
| Wentz, Alan | Ducks Unlimited Inc. | Director of science and policy |

Scientific Committee

| Name | Affiliation | Role |
|-------------------|--|--------------------------|
| DeSante, Dave | Institute for Bird Populations | Population Biology/MAPS |
| Diffendorfer, Jay | USGS Rocky Mountain Geoscience Center | Landscape Ecology |
| Fisher, Robert | USGS California Science Center | Landscape mapping |
| Greenberg, Russ | Smithsonian Migratory Bird Center | Avian Connectivity |
| Hobson, Keith | Environment Canada | Isotopes |
| Kendall, Carol | USGS Water Resources Division | Isotopes |
| Lanctot, Rick | US Fish and Wildlife Service | Shorebirds/radios/PTT |
| Rosenberg, Ken | Cornell Lab of Ornithology | Conservation/PIF Partner |
| Sauer, John | USGS Patuxent Wildlife Research Center | Mig Birds/Stats |
| Takekawa, John | USGS California Science Center | Connectivity/Waterfowl |
| Turner, Woody | NASA | Mapping |
| Wikelski, Martin | Max Planck Institute | ICARUS/MoveBank |

Similar Models *Encyclopedia of Life*

A project to create an online reference source and database for every one of the 1.8 million species that are named and known on this planet.

The screenshot shows the Encyclopedia of Life (EOL) website. At the top, there is a navigation menu with links for HOME, PREFERENCES, LANGUAGE (EN), FEEDBACK, PRESS ROOM, USING THE SITE, and ABOUT EOL. Below the menu is a search bar with a "FIND" button and options for "Names", "Tags", and "Full-text". The main content area is titled "Explore" and features a grid of six species cards, each with a photograph and the species name and common name. The species shown are: *Acamea lignicolora* (Wood-coloured Quaker), *Alchemilla thabetata* (A.Kem.), *Potentilla inclinata* (Ashy cinquefoil), *Koeleria macrantha* (Prairie Junegrass), *Thracia zhaeseolina* (Kidneybean thracia), and *Pilea pumila* (Canadian clearweed). Below the "Explore" section, there are three columns: "EOL Announcements" with a podcast icon and text about listening and subscribing; "Featured" with an image of a forest floor and the text "Pteridium aquilinum (L.) Kuhn Bracken"; and "What's New?" with a list of dates and links to recent content.

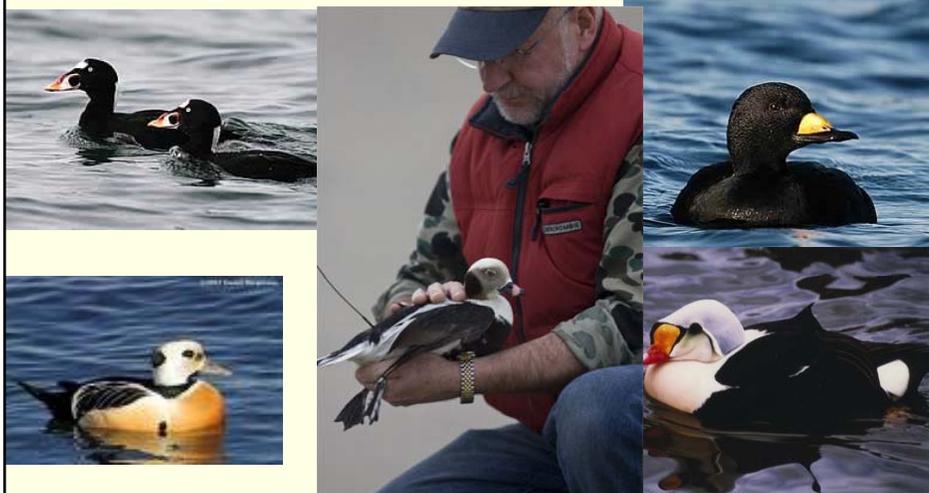
Similar Models *Freedom to Roam*

Freedom to Roam is a non-profit initiative to bring together people, organizations and businesses to enhance and protect wildlife corridors and landscape connectivity in North America

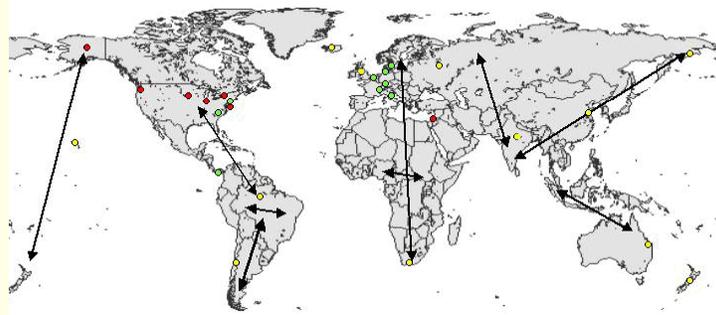


Similar Models

Sea Duck Joint Venture Initiative



ICARUS



International Cooperation for Animal Research Using Space

Goal: to install a system that allows researchers around the world to track small animals on a global scale over the next decades.

MoveBank



Movebank: An online data repository and community for animal tracking.

Developed by Martin Wikelski (Max Planck Inst.), Roland Kays (NY State Museum), Tony Fountain and Sameer Tilak (San Diego Supercomputer Center)

Current Activities

- 1. Conduct vulnerability analysis for North American birds that incorporates both temporal and spatial (i.e. connectivity) data.**
 - A. Preliminary mid-Atlantic project**
 - B. Utilizes BBL data**
- 2. Website development**
- 3. Connectivity Clearinghouse**