



Wingtips at our Fingertips: Understanding the complex lives of migratory animals

Stuart Mackenzie

**BIRD STUDIES
ÉTUDES D'OISEAUX CANADA**

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speaker notes in italics





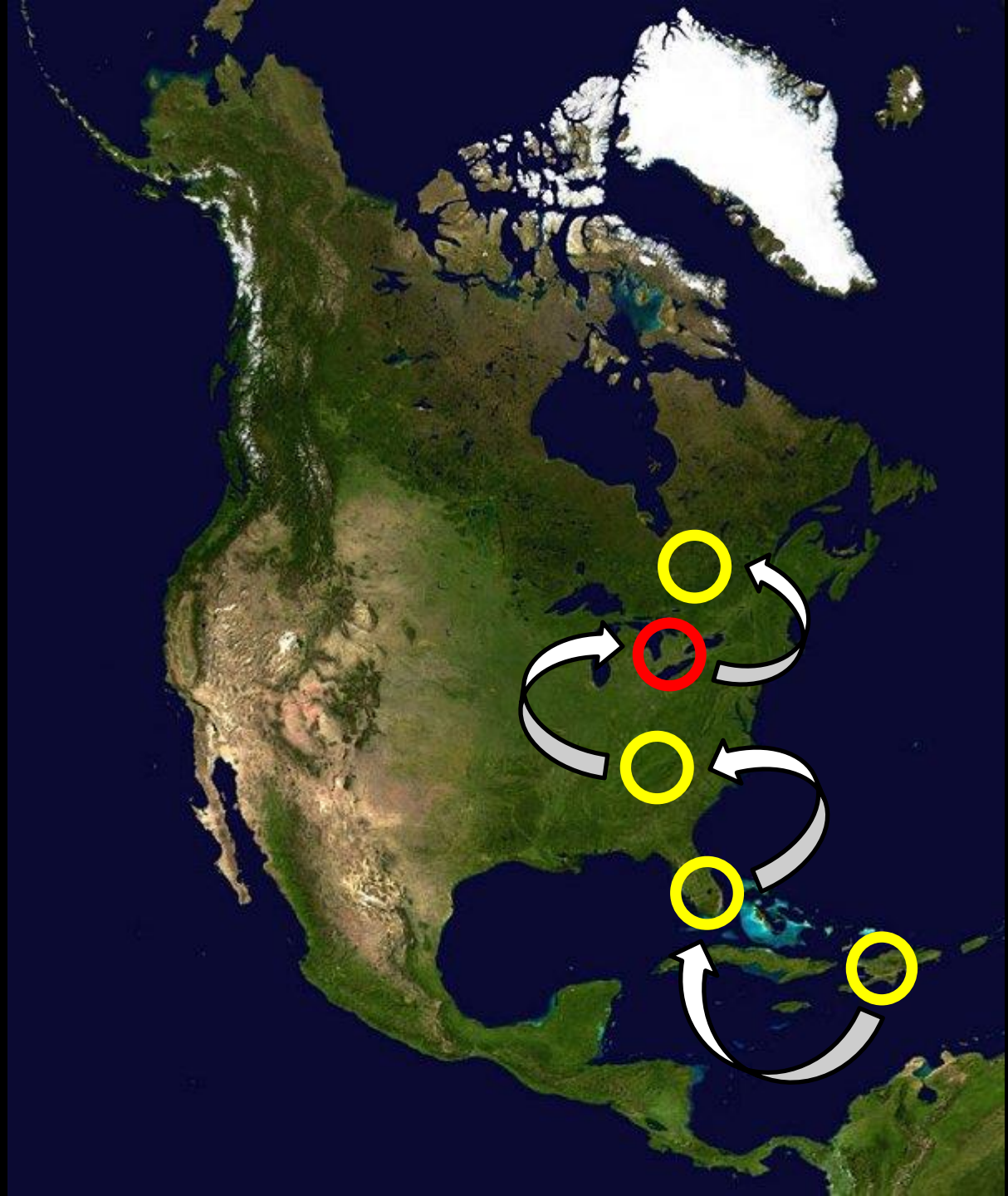
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Canada's Voice for Birds.

One of the responsibilities of being Canada's Voice for birds is collaborating with our partners around the hemisphere to conserve birds and wildlife, and ultimately protect our own wellbeing.

Our mission is to conserve wild birds of Canada through sound science, on-the-ground actions, innovative partnerships, public engagement, and science-based advocacy.

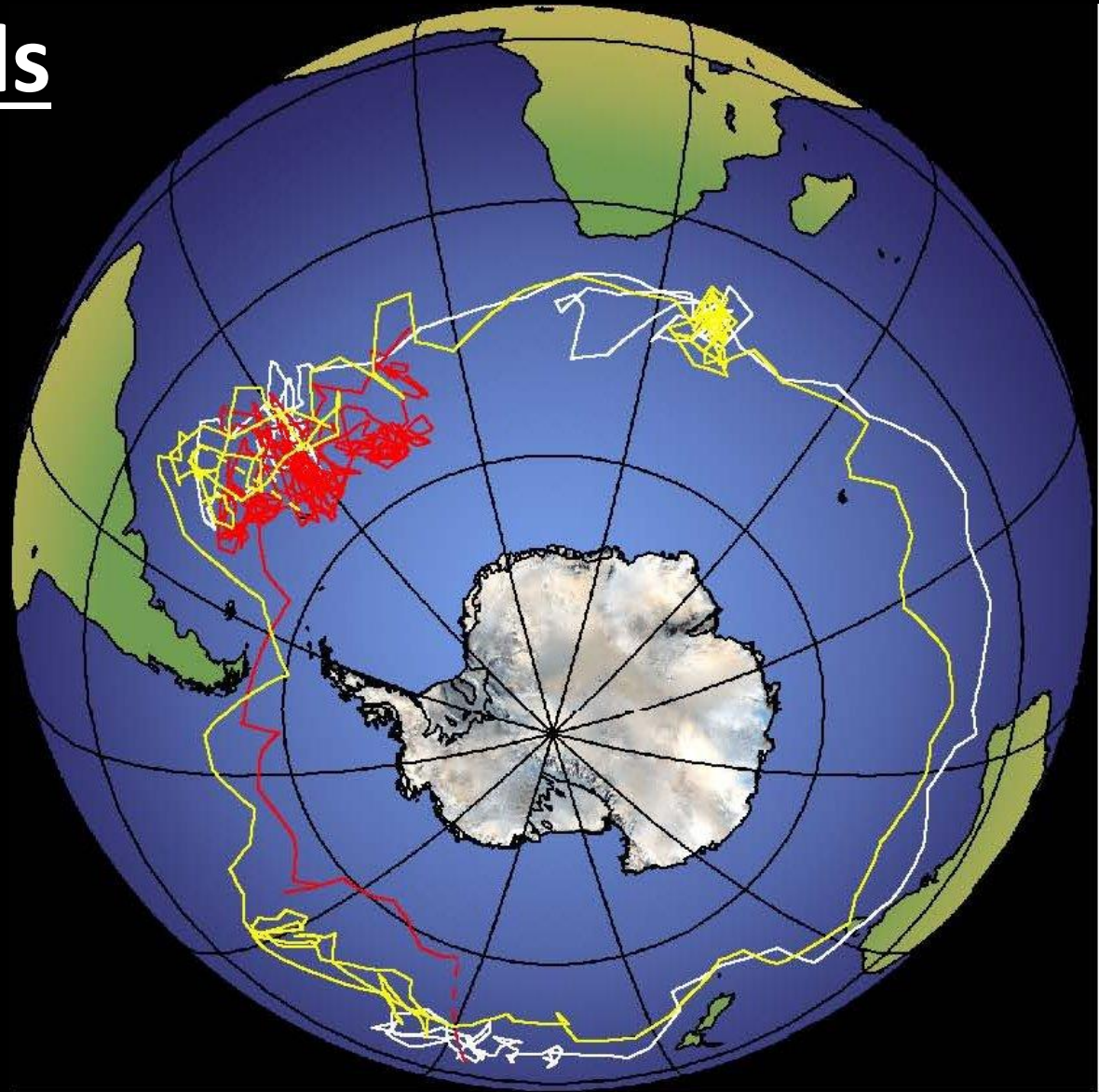




- *Declines in migratory birds require immediate information on factors that might be limiting populations throughout the annual cycle. The holy grail of migratory animal research and conservation is basically to know where all animals are at all times.*
- *A full understanding of the strategies used by migrants to minimize time, and their ecology during stopover however, first requires an examination and understanding of what a stopover actually is. Stopover, for the most part, is loosely defined in most studies, but stopover is generally considered fit into two categories: A or true stopover where temporally and spatially it is defined by the amount of time spent and space occupied between migratory bouts, or, using our study site in the Great Lakes region of North America for example.*

Tracking Animals

- GPS -satellite
- Geolocators
- Banding/Ringing
- Radio Telemetry



There are a number of tools that we can use to get at pieces of this puzzle. Radio telemetry is one of the oldest methods. Recent technological advances have breathed new life into radio telemetry, specifically through digitally-coded tags and automated radio telemetry systems.

Tracking technologies are complimentary



The power of the network doesn't necessarily lie in the tagging technology – a station is a station is a station. Whether it's listening for nanotags, gps tags, or CTT's life tags, is irrelevant, it's not trivial, but it's irrelevant. What important, is the community of stakeholders looking to work collaboratively for a common goal – the pursuit of knowledge and conservation of migratory animals. It takes the most effort is the maintenance and upkeep of infrastructure, the fostering of a global collaborative research network, OPEN and public data!

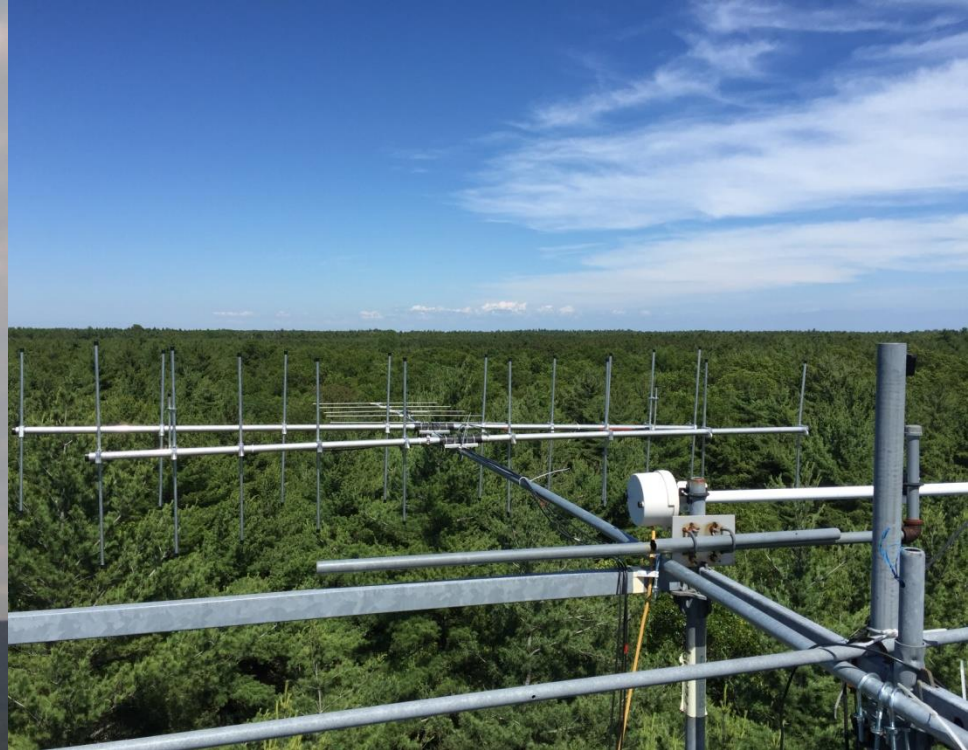


AUTOMATED RADIO-TELEMETRY

- Digital radio tags on the same frequency (0.2 – 3g).
- Stations operate continuously with up to 8 directional antenna .
- Detection distance of up to ~10-20km.
- High temporal and geographic precision.
- Animals do not need to be recaptured.



1000+ increase in probability of recapture (compared to banding) - (Tag life from 15 to 365+ days)



Examples of various stations – Colombia, southern Ontario and Nova Scotia



motus.org



- **A collaborative international research network**
 - **Common/community infrastructure**
 - **Centralized database (*permanently archived*)**
 - **Public data and visualizations**

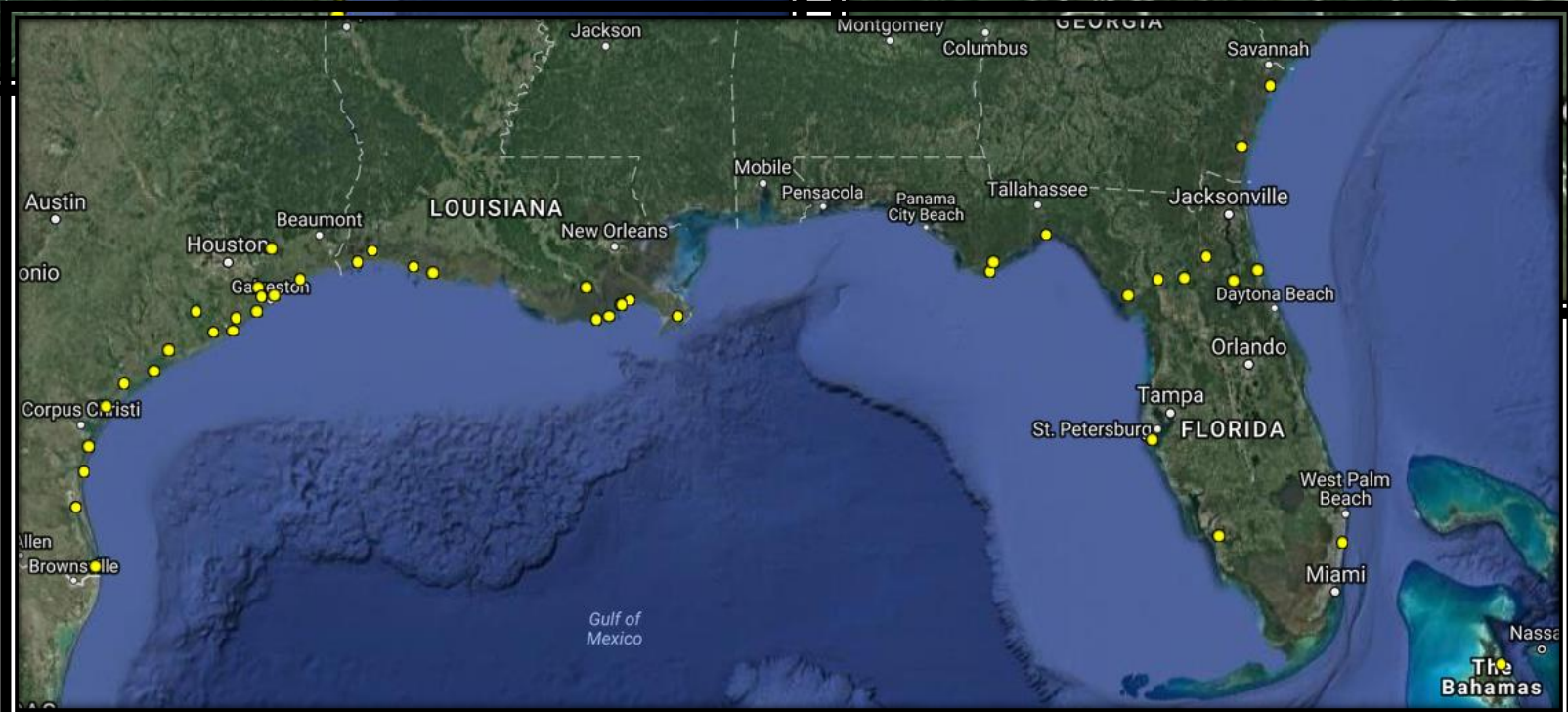
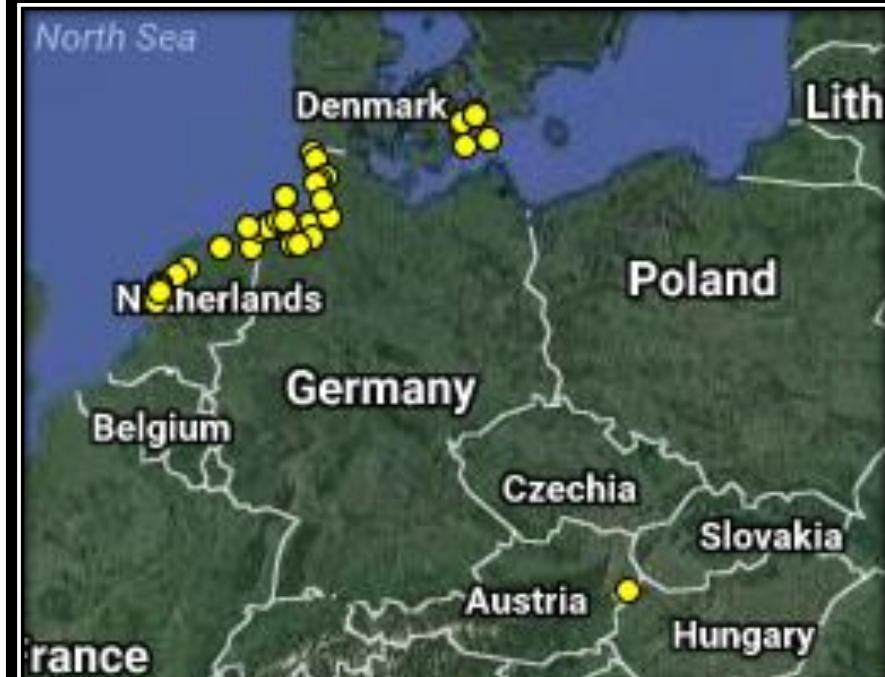
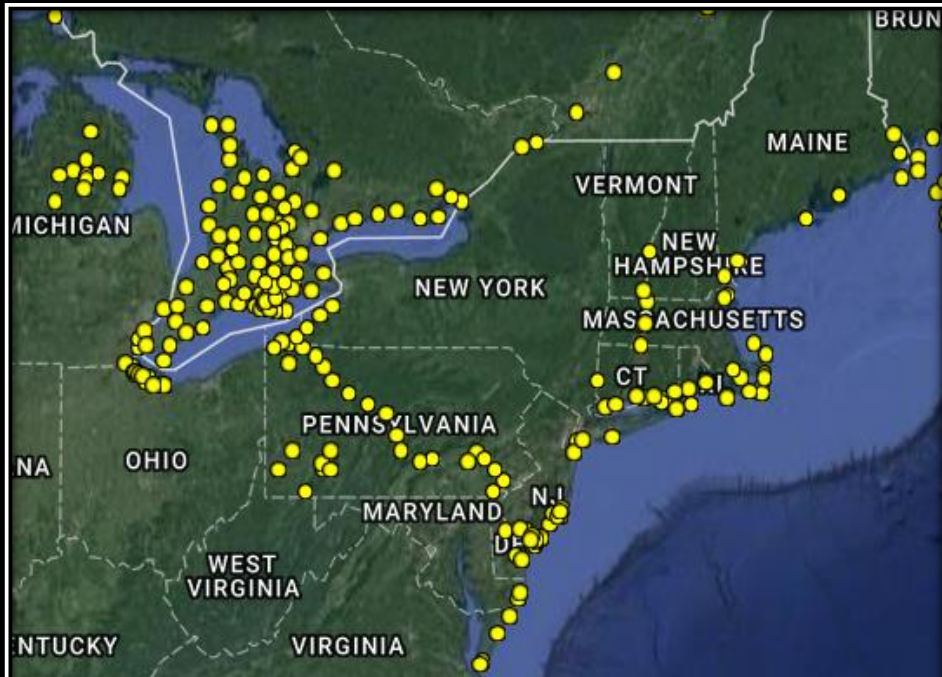
- **A program of Bird Studies Canada in partnership with collaborating researchers and organizations**

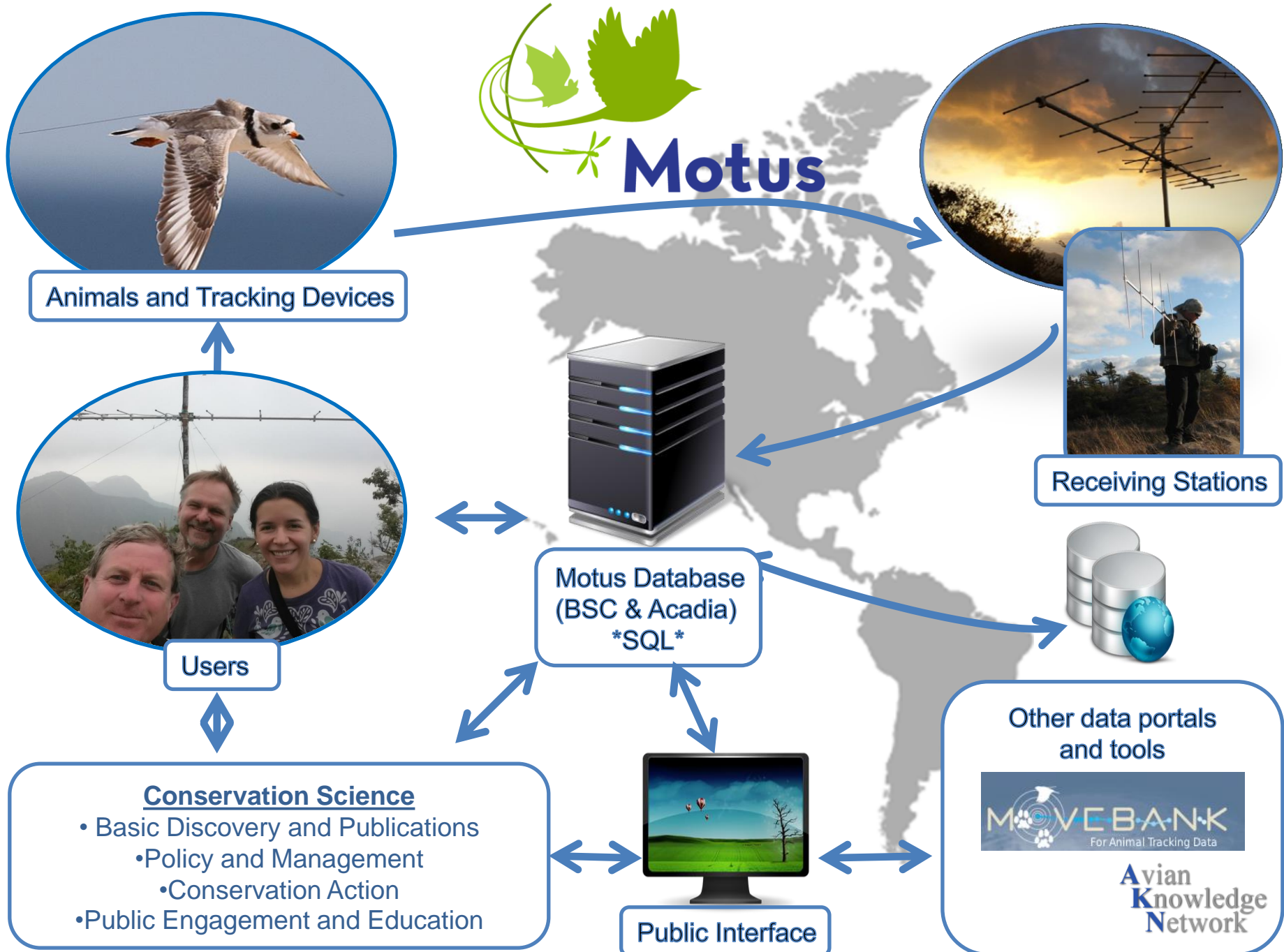
Centralized?

Motus Stations 2014-17



Motus has expanded greatly.





We are not a technology firm, we are a relatively small non-profit, and Motus is a collaborative.

Conservation Science

- Basic Discovery and Publications
 - Policy and Management
 - Conservation Action
- Public Engagement and Education





- **> 500 receiving stations**
- **150 research projects with >300 collaborators**
- **~13,000 animals of >100 species (birds, bats, insects)**
 - **~300 million detections**
- **38 publications and theses and counting**

Centralized?

The Motus Wildlife Tracking System: a collaborative research network to track wildlife movement

Tracking station



Swainson's Thrush

Red Knot

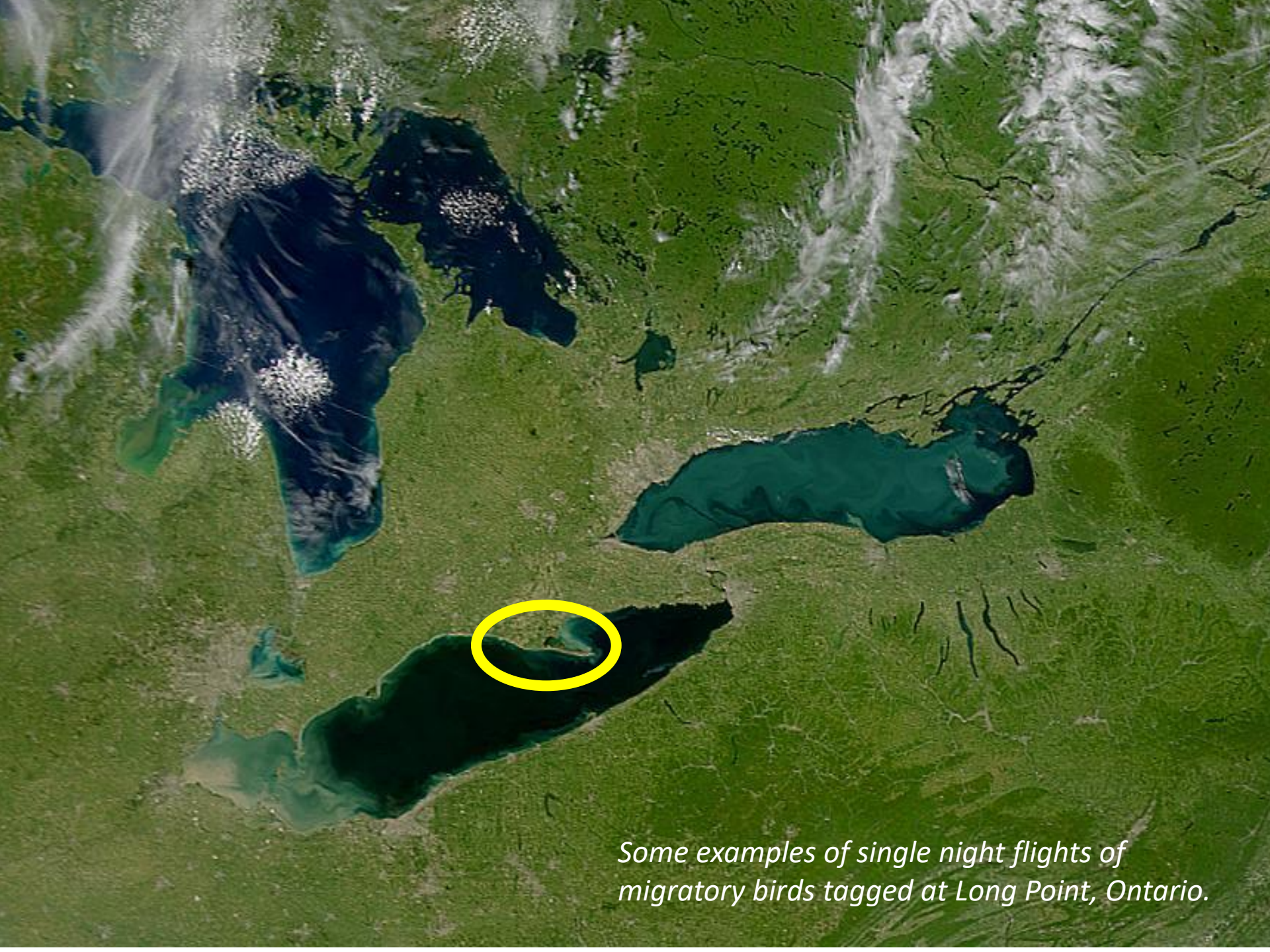


Taylor, P. D., T. L. Crewe, S. A. Mackenzie, D. Lepage, Y. Aubry, Z. Crysler, G. Finney, C. M. Francis, C. G. Guglielmo, D. J. Hamilton, R. L. Holberton, P. H. Loring, G. W. Mitchell, D. R. Norris, J. Paquet, R. A. Ronconi, J. Smetzer, P. A. Smith, L. J. Welch, and B. K. Woodworth. 2017. The Motus Wildlife Tracking System: a collaborative research network to enhance the understanding of wildlife movement. *Avian Conservation and Ecology* 12(1):8. <https://doi.org/10.5751/ACE-00953-120108>

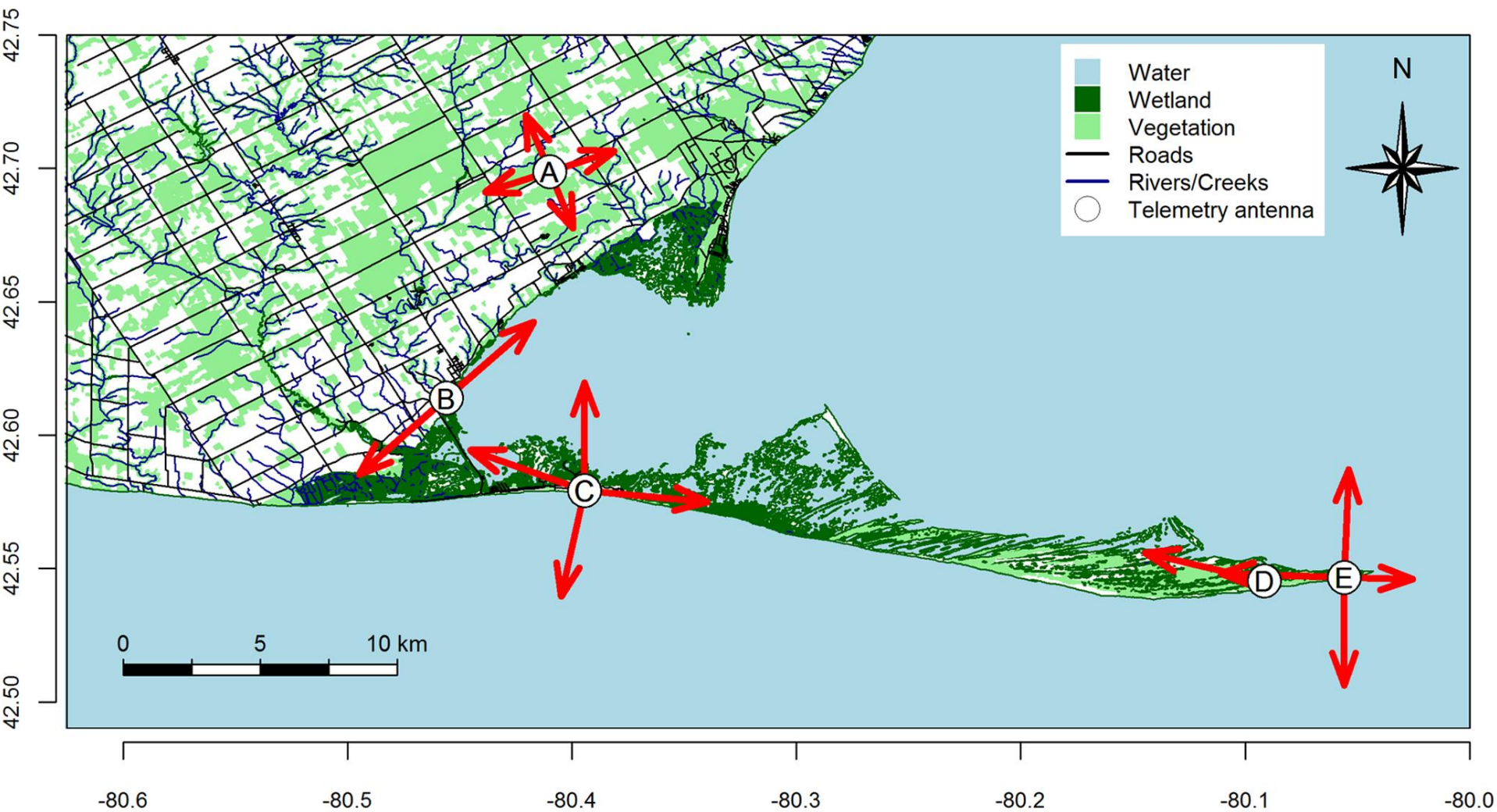


@BirdStudiesCan

Taylor et al. 2017. *Avian Conservation and Ecology*.



Some examples of single night flights of migratory birds tagged at Long Point, Ontario.

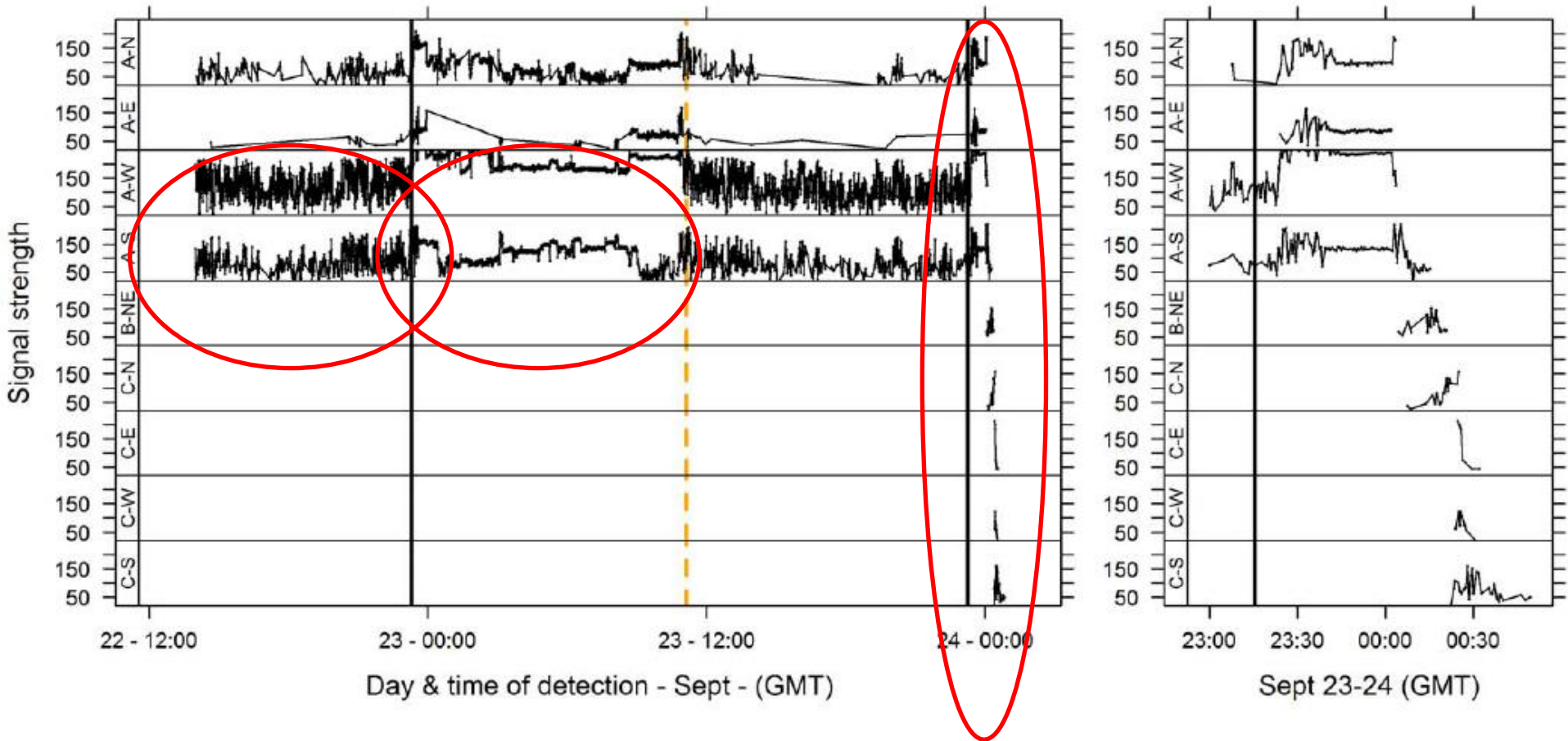


LONG POINT ONTARIO, CANADA.

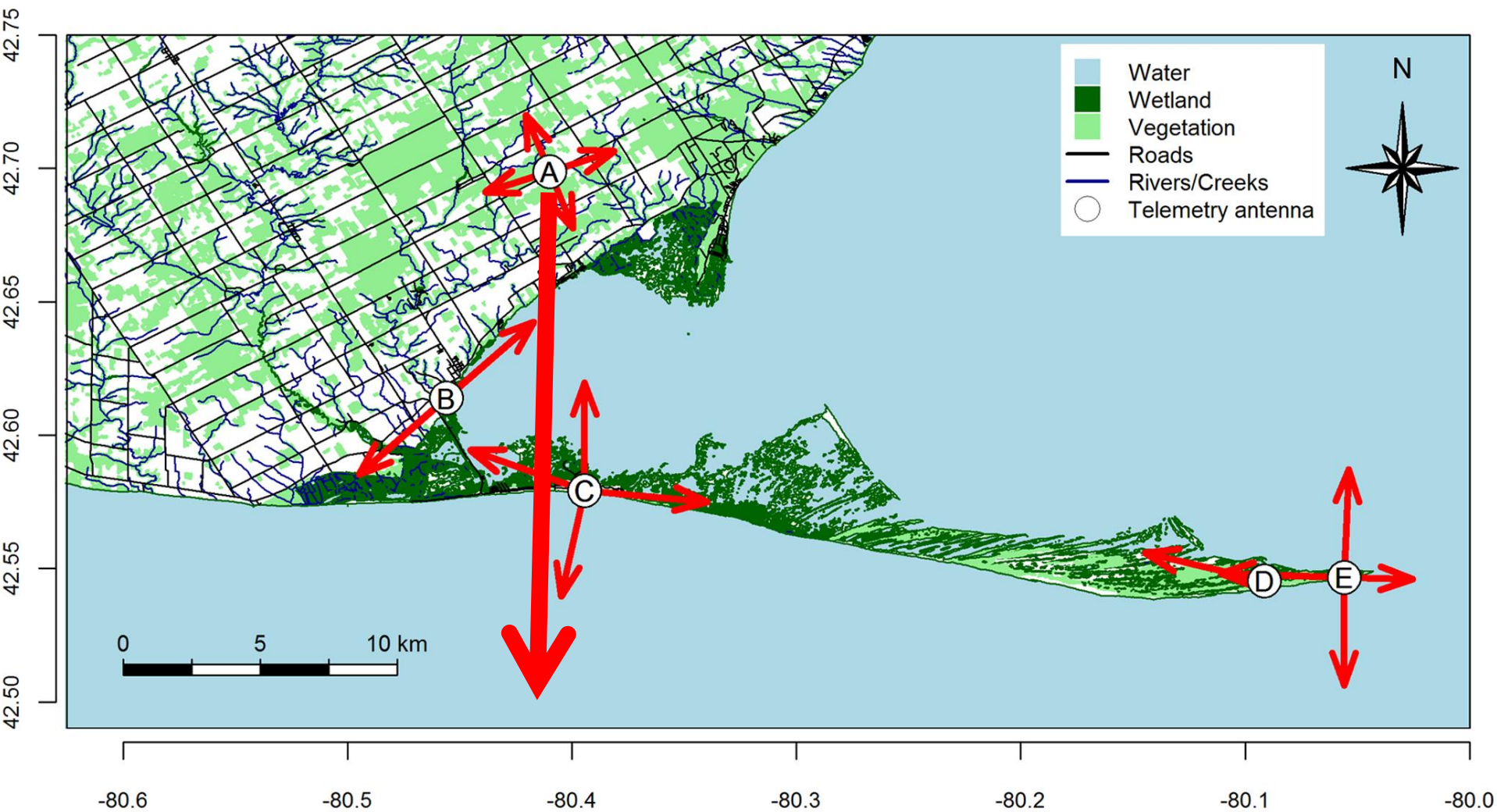
Taylor et al. 2011. PlosOne.



Black-throated Blue Warbler 70.2



Example of raw data – each panel represents an antenna on a different tower – signal strength within each panel – black lines sunset, orange lines sunrise. Active during day, still at night, active during day, quiet at night until the migratory departure shortly after midnight.

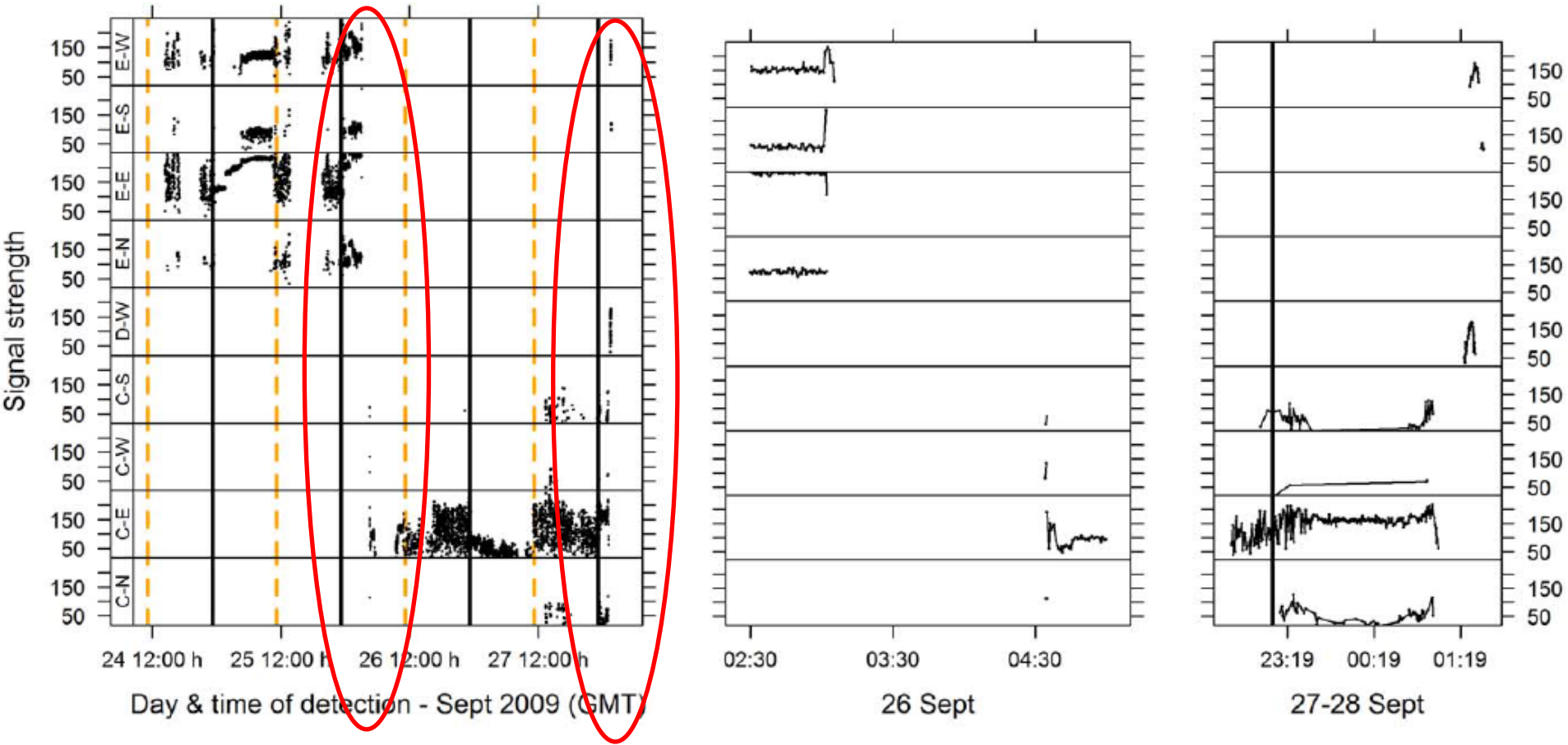


LONG POINT ONTARIO, CANADA.

Taylor et al. 2011. PlosOne.

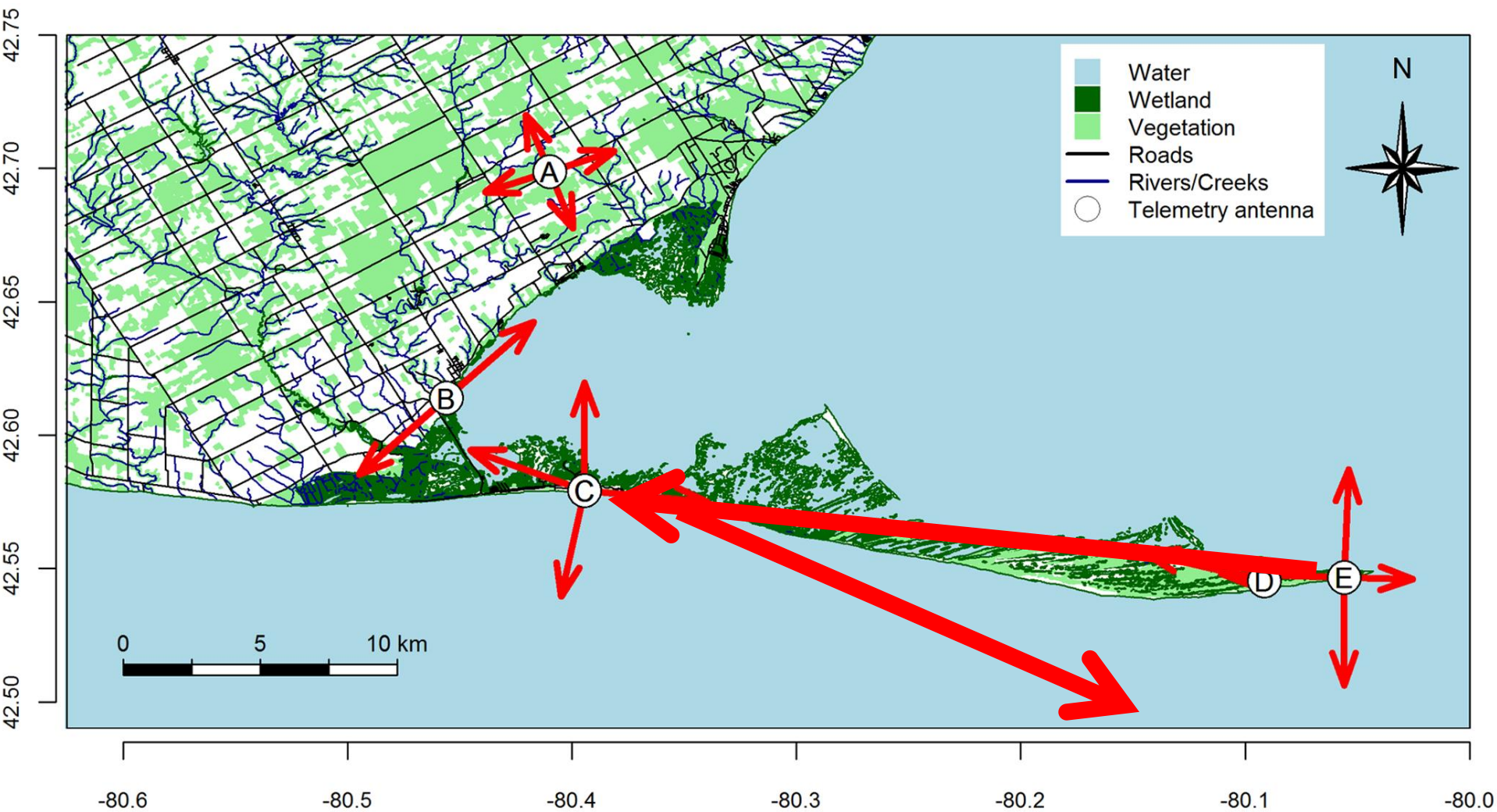


Black-throated Blue Warbler 59



Different example of a movement – bird stays at the Tip for 3 days, moves to old cut for 3 days, then leaves.





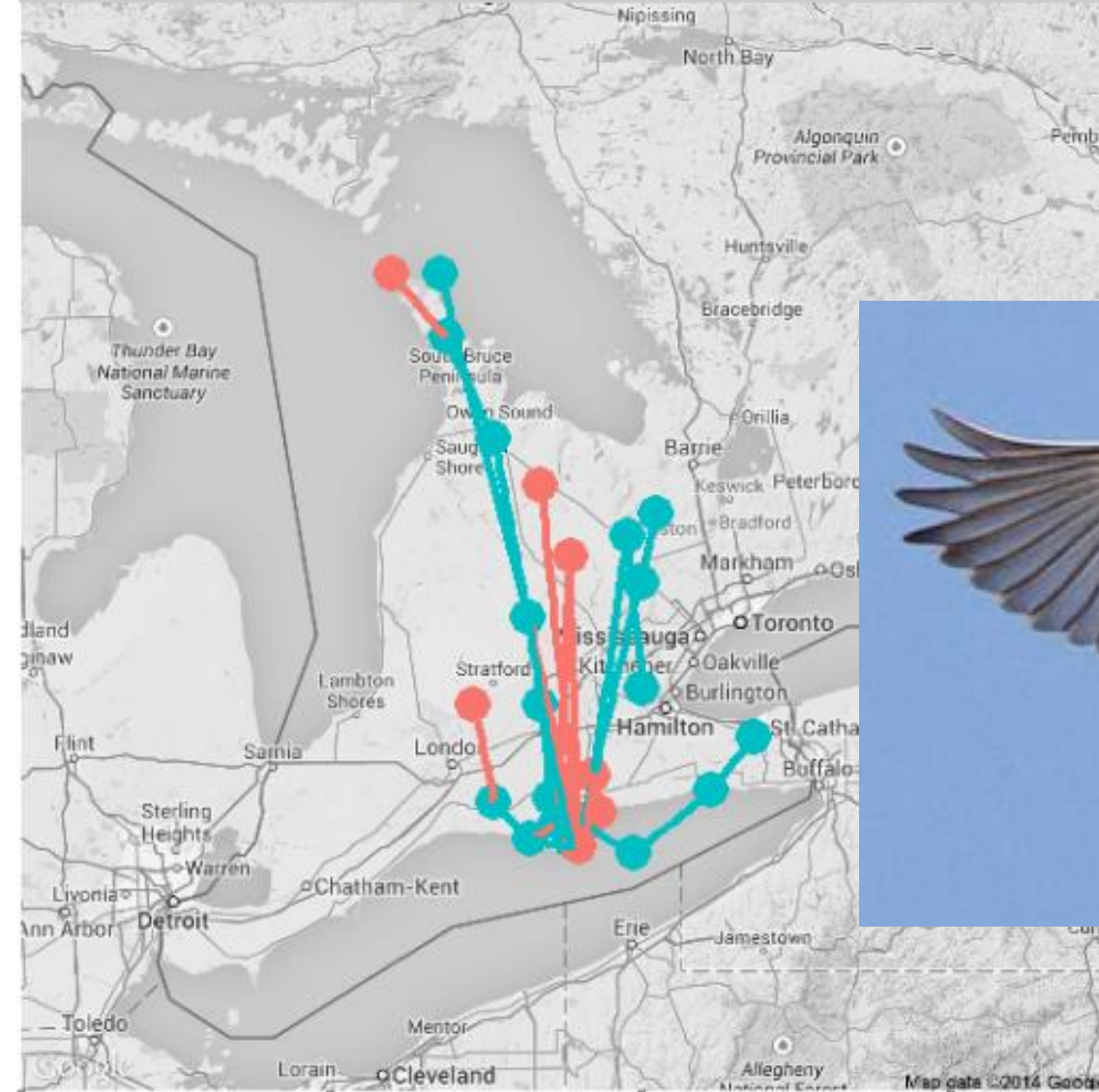
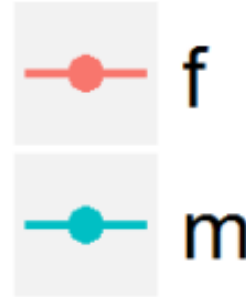
LONG POINT ONTARIO, CANADA.

Taylor et al. 2011. PlosOne.



MYWA

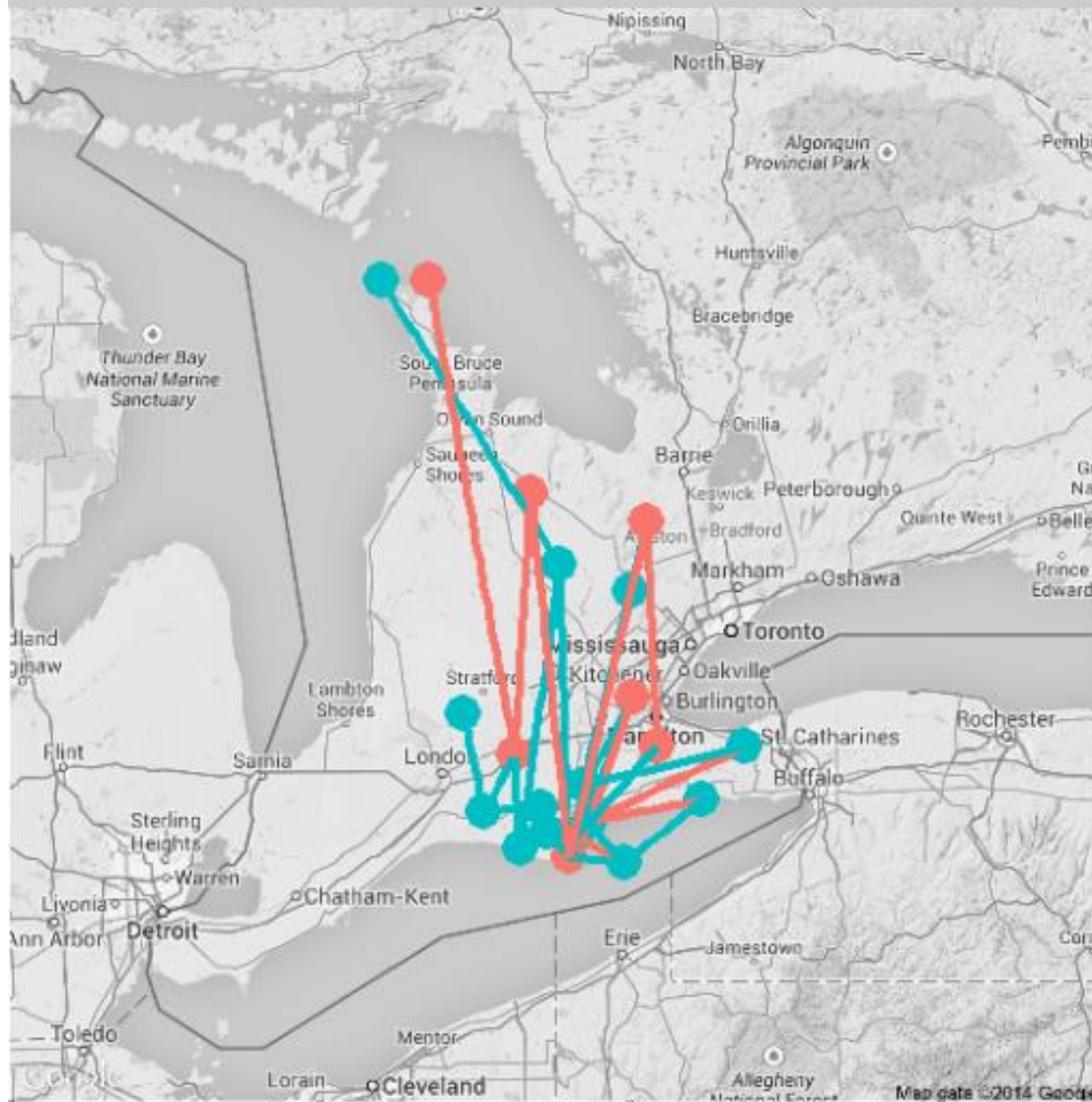
Sex



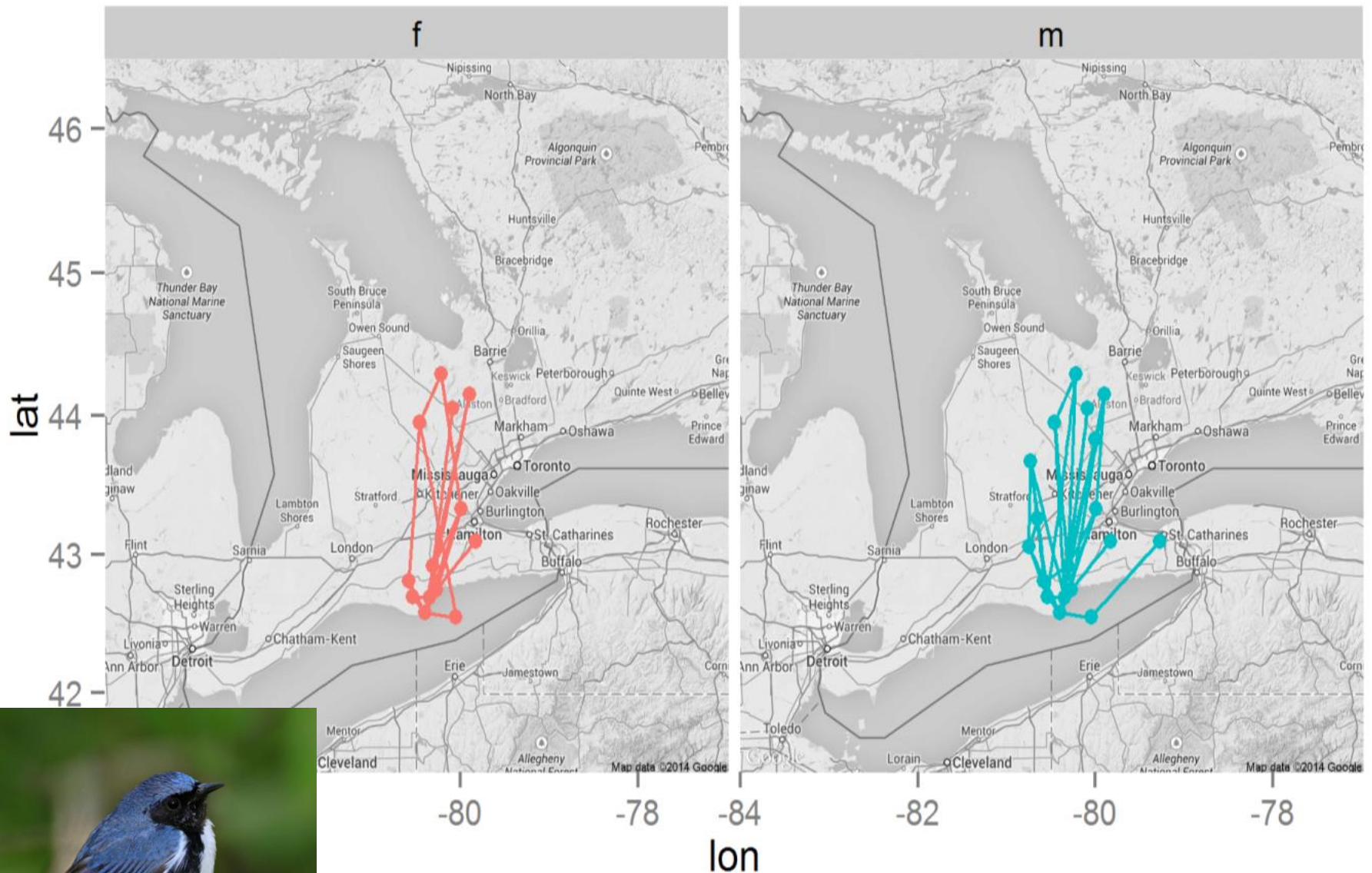
Myrtle – Yellow-rumped Warbler

84 -82 -80 -78

MAWA



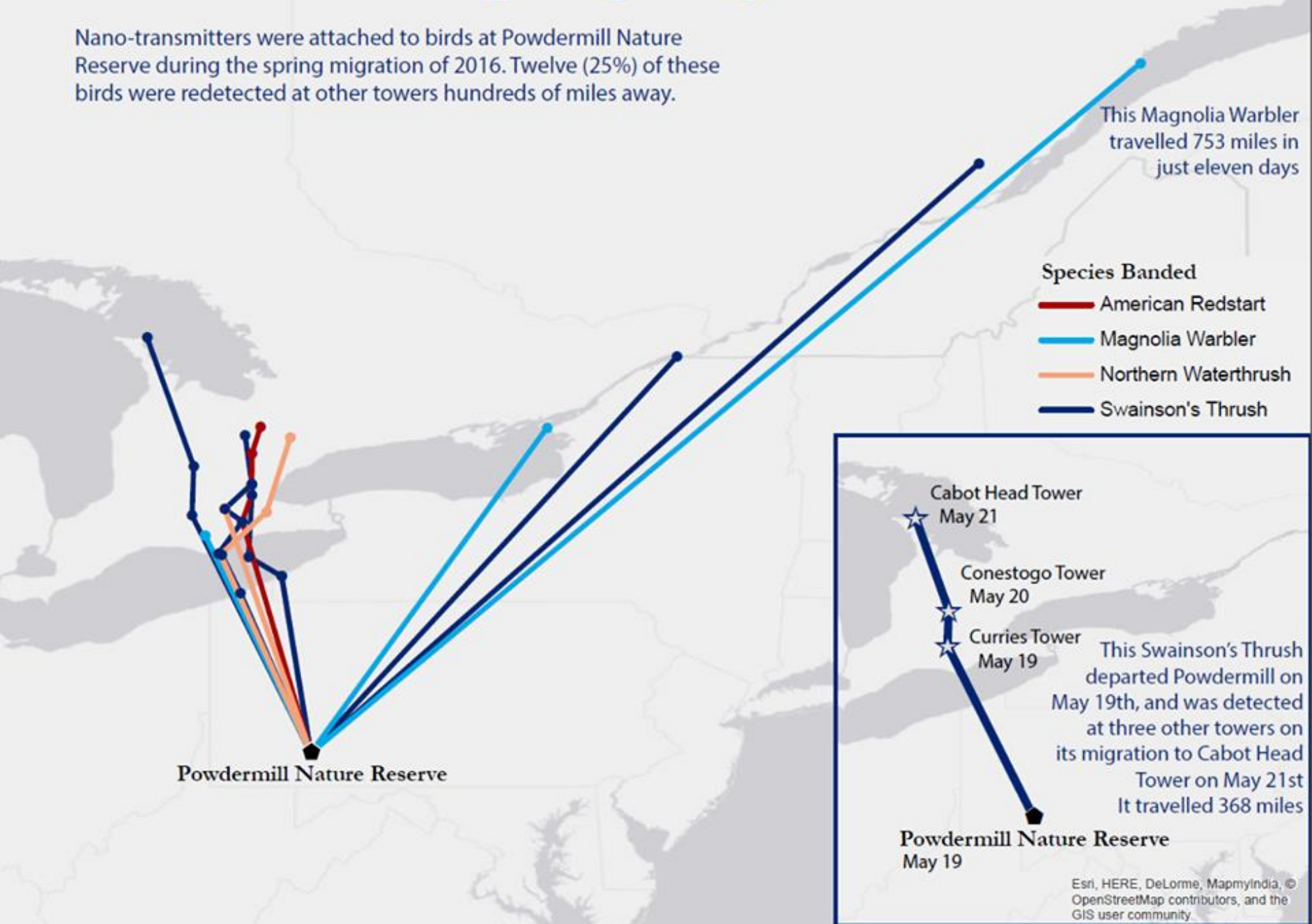
Magnolia Warbler - Simple matter of biology – MYWA and MAWA are diverse temperate/boreal breeders, so it's not surprising they had a northerly trajectory toward these habitats.



Black-throated Blues on the other hand enjoy temperate deciduous forests of ontarios eastern shield region – so it’s not surprising that none of them went through the Bruce Penninsula and they had an easterly kick toward their prime breeding areas near Algonquin Park.

Motus Tower Spring Migration Detection

Nano-transmitters were attached to birds at Powdermill Nature Reserve during the spring migration of 2016. Twelve (25%) of these birds were redetected at other towers hundreds of miles away.



This Magnolia Warbler travelled 753 miles in just eleven days

Species Banded

- American Redstart
- Magnolia Warbler
- Northern Waterthrush
- Swainson's Thrush

Powdermill Nature Reserve

Cabot Head Tower
May 21

Conestogo Tower
May 20

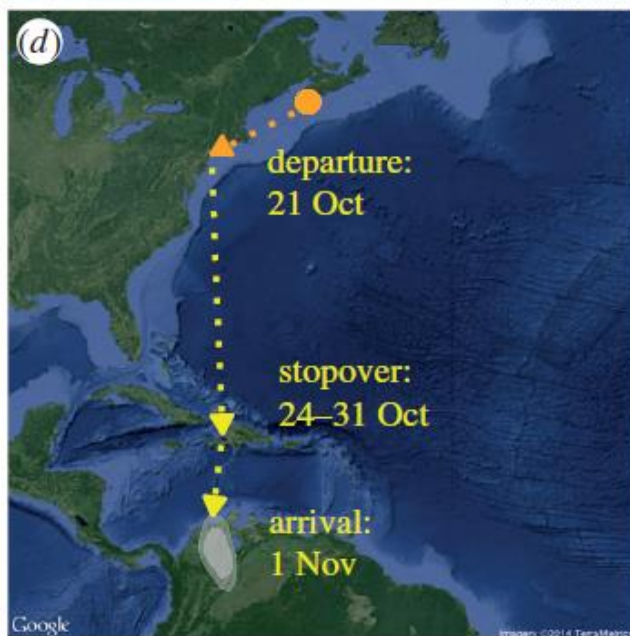
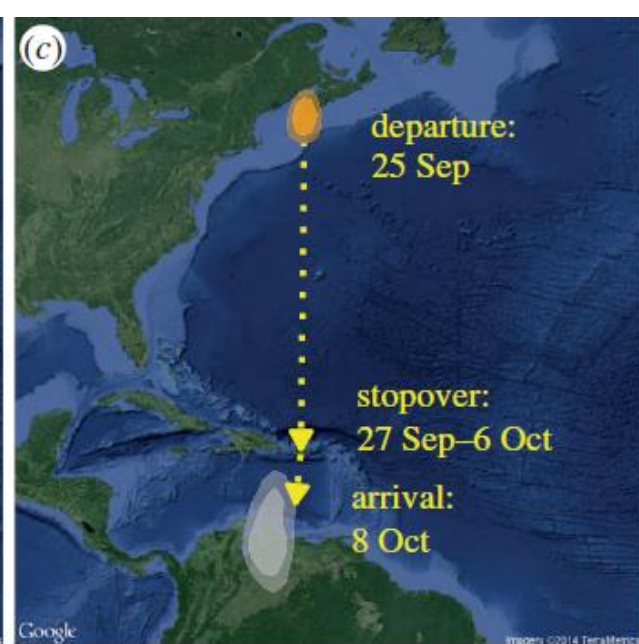
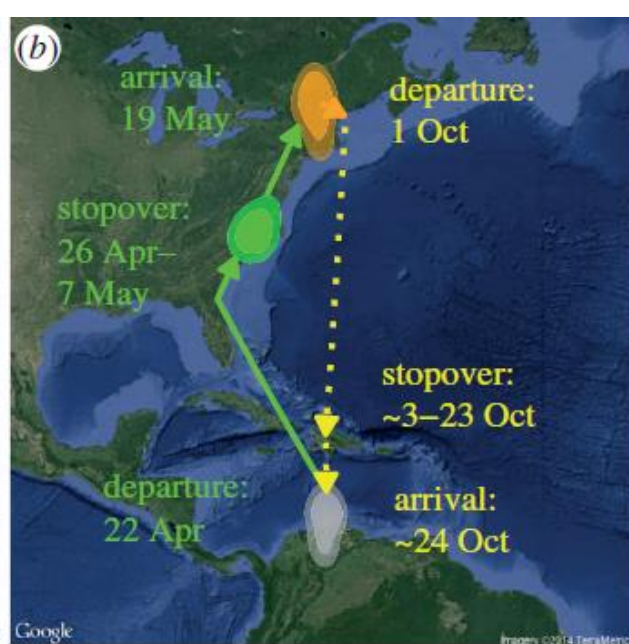
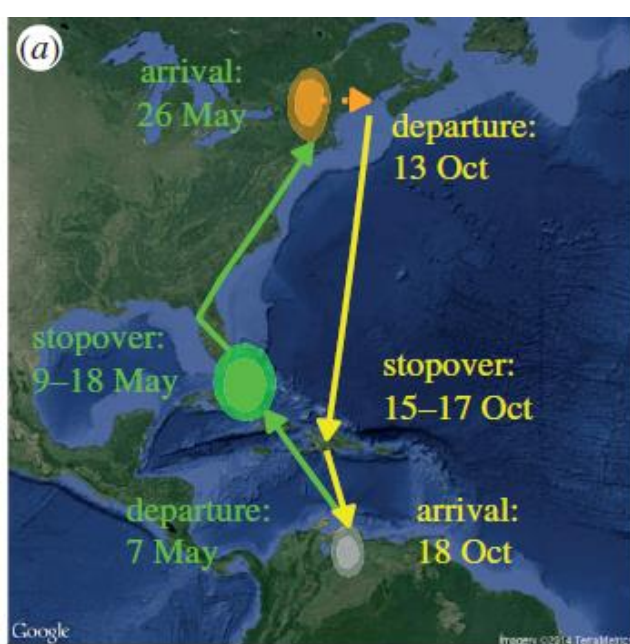
Curries Tower
May 19

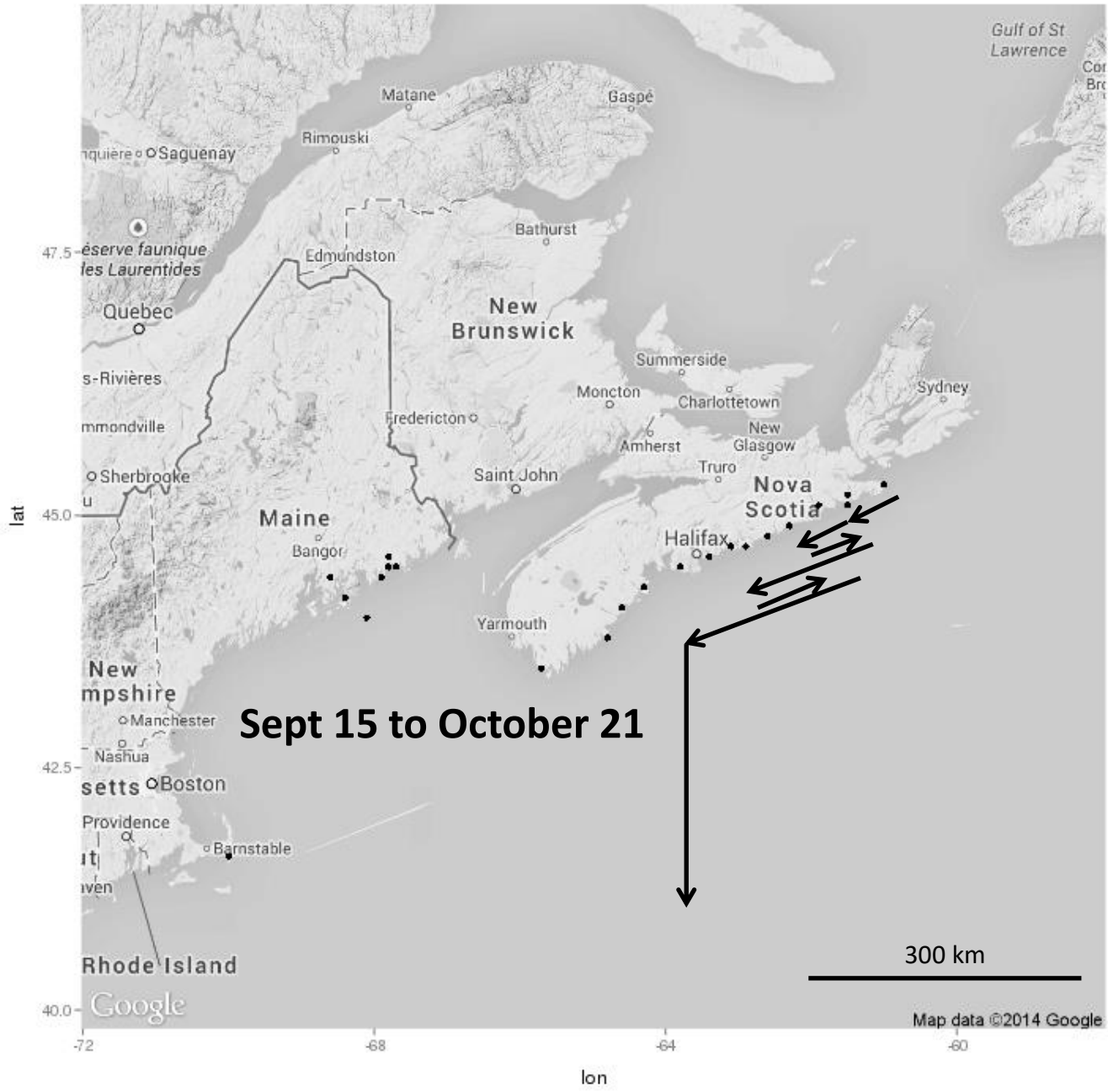
This Swainson's Thrush departed Powdermill on May 19th, and was detected at three other towers on its migration to Cabot Head Tower on May 21st. It travelled 368 miles.

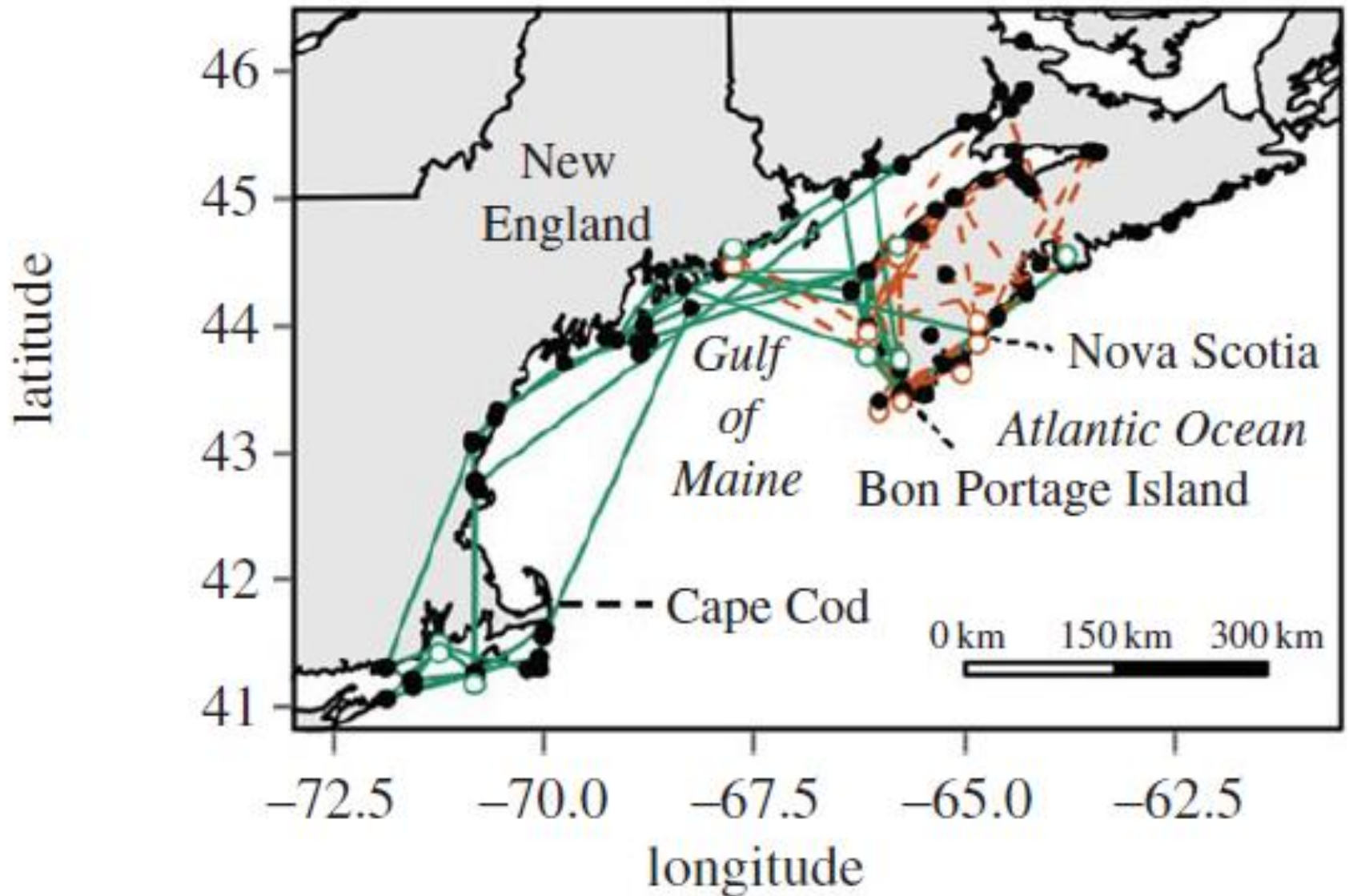
Powdermill Nature Reserve
May 19

Landscape movements of
the Blackpoll Warbler
(*Setophaga striata*).









Brown and Taylor. 2015. *Biol. Lett.* 11: 20150593

Imprecision in geolocator estimates may not entirely be due to error in light estimations, but also considerably movement among animals.

James Bay

James Bay is one of the most important staging areas for migratory shorebirds in the world. Bird staging here double their weight before migrating to the southern US, Caribbean or South America.



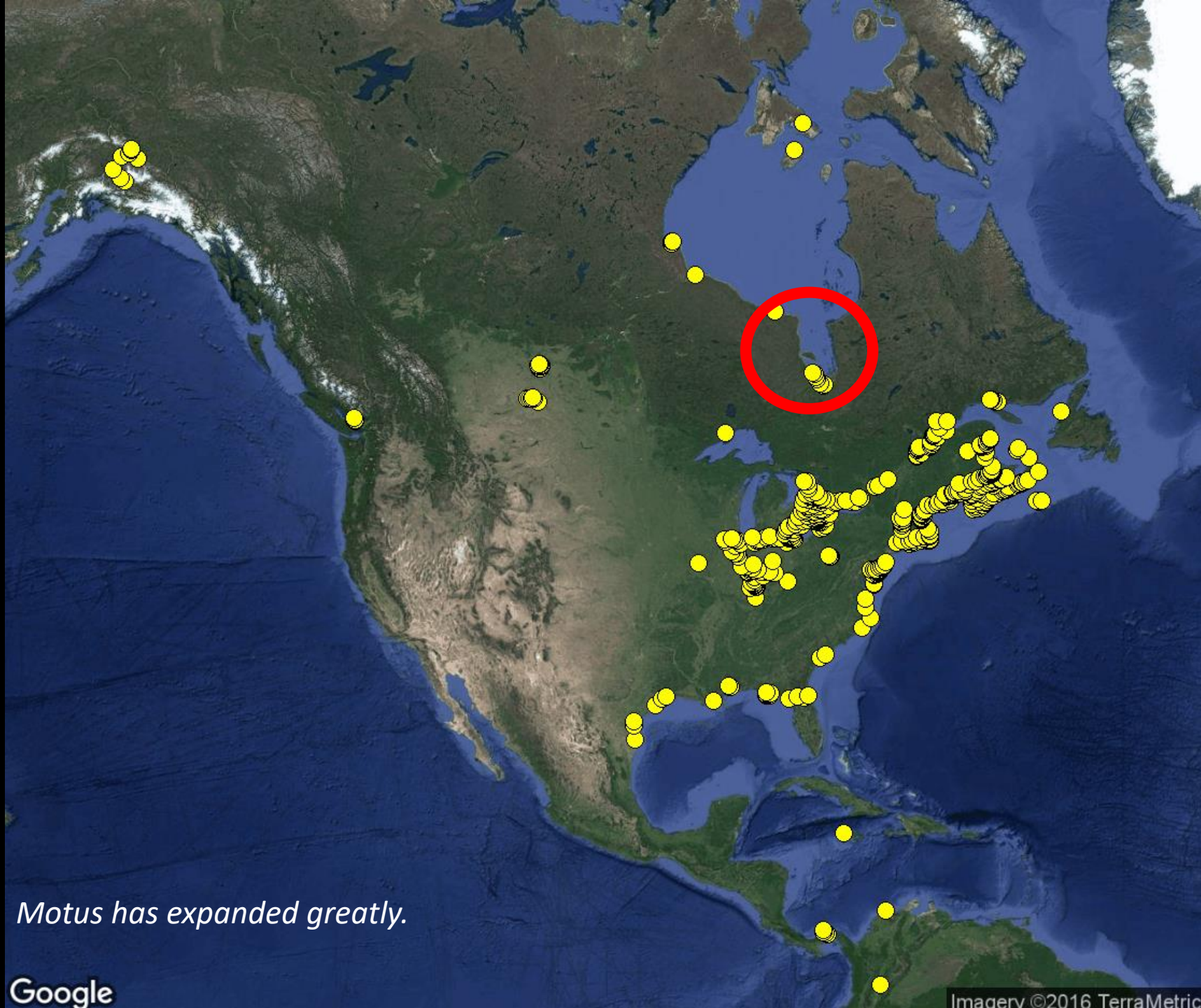
Environment and
Climate Change Canada



Moose Cree
First Nation



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Motus has expanded greatly.



Jean Iron 2014



Akimiski Island

James Bay

Halfway Point

Longridge

Piskwamish

NorthPoint

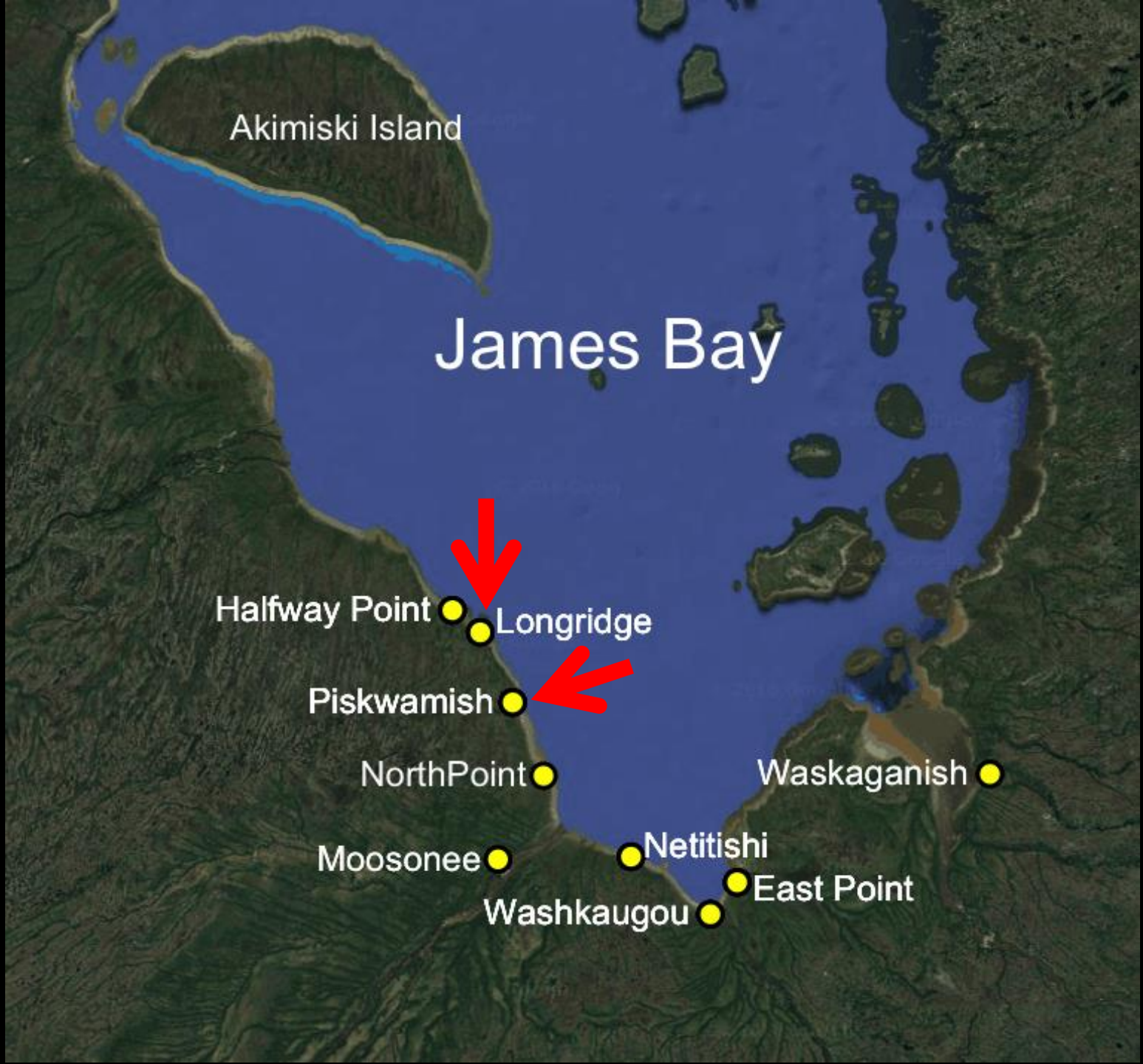
Waskaganish

Moosonee

Netitishi

Washkaugou

East Point



Objectives using Motus for Shorebirds



Barb Charlton photo



- Length of stay and turnover rates
- Timing of departure & arrival
- Movements along the coast
- Migration distance
- Flight speeds
- Future stopover length
- Migration routes
- Survival
- Completing Migratory Networks

Allie include link to maps and animations



Semipalmated sandpiper



White-rumped sandpiper



Pectoral sandpiper

Species tracked



Least sandpiper

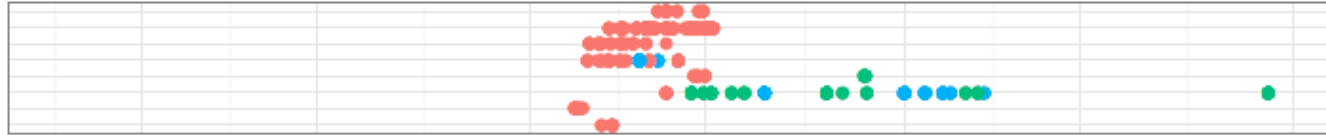


Lesser Yellowlegs



Semipalmated plover

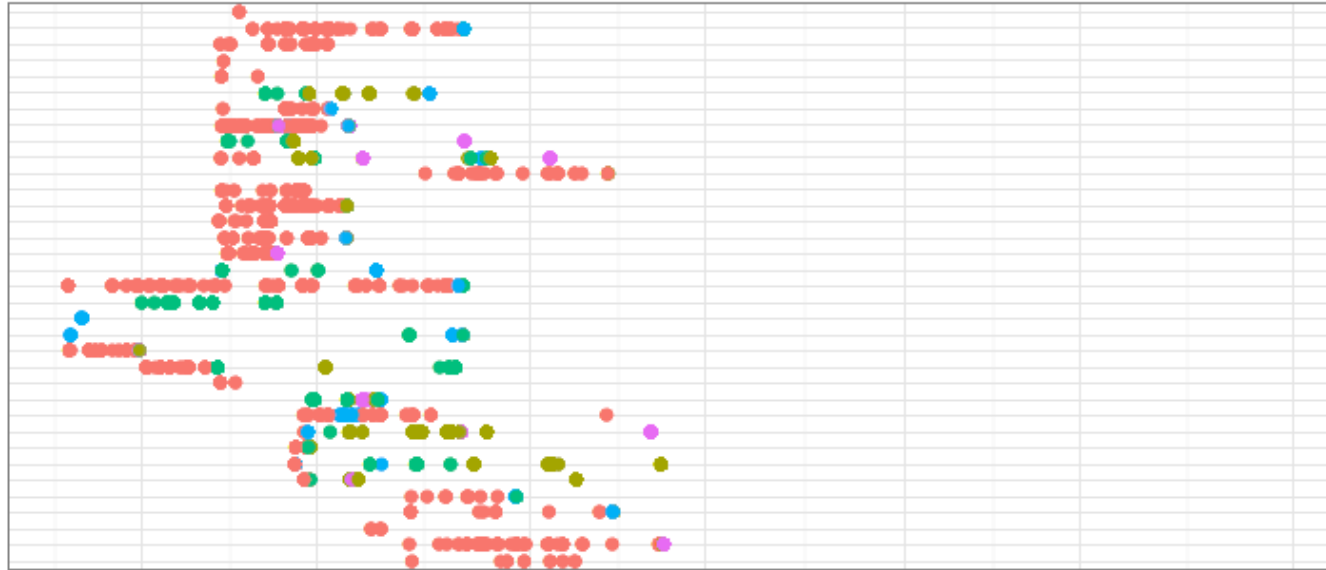
Longridge



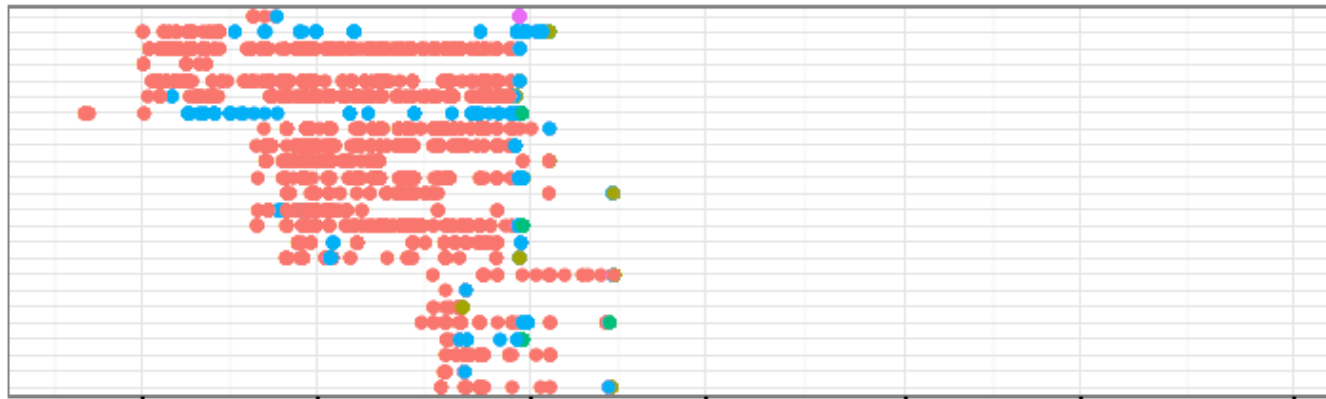
Dunlin



Red Knot



Semipalmated Sandpiper

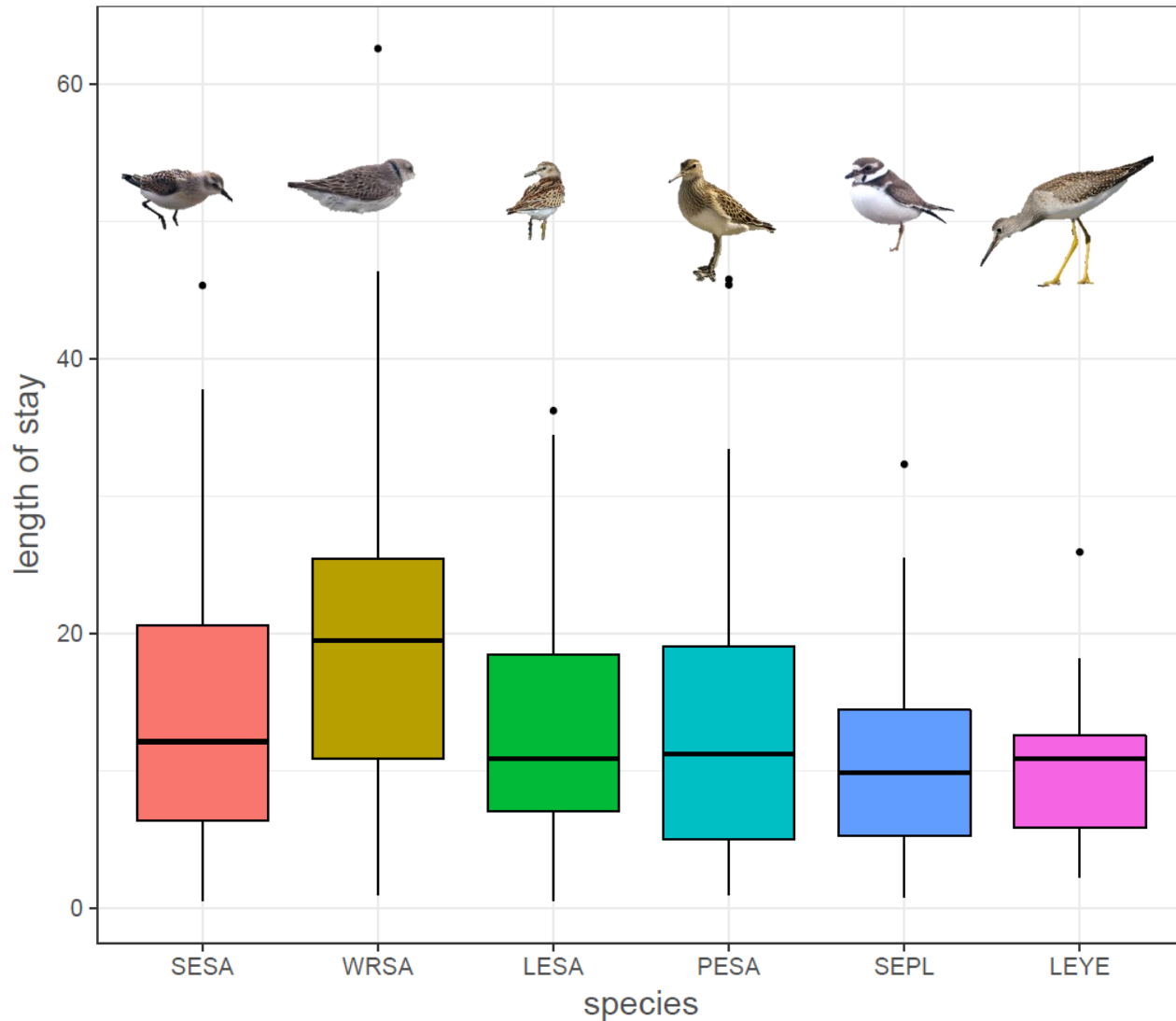


White-rumped Sandpiper

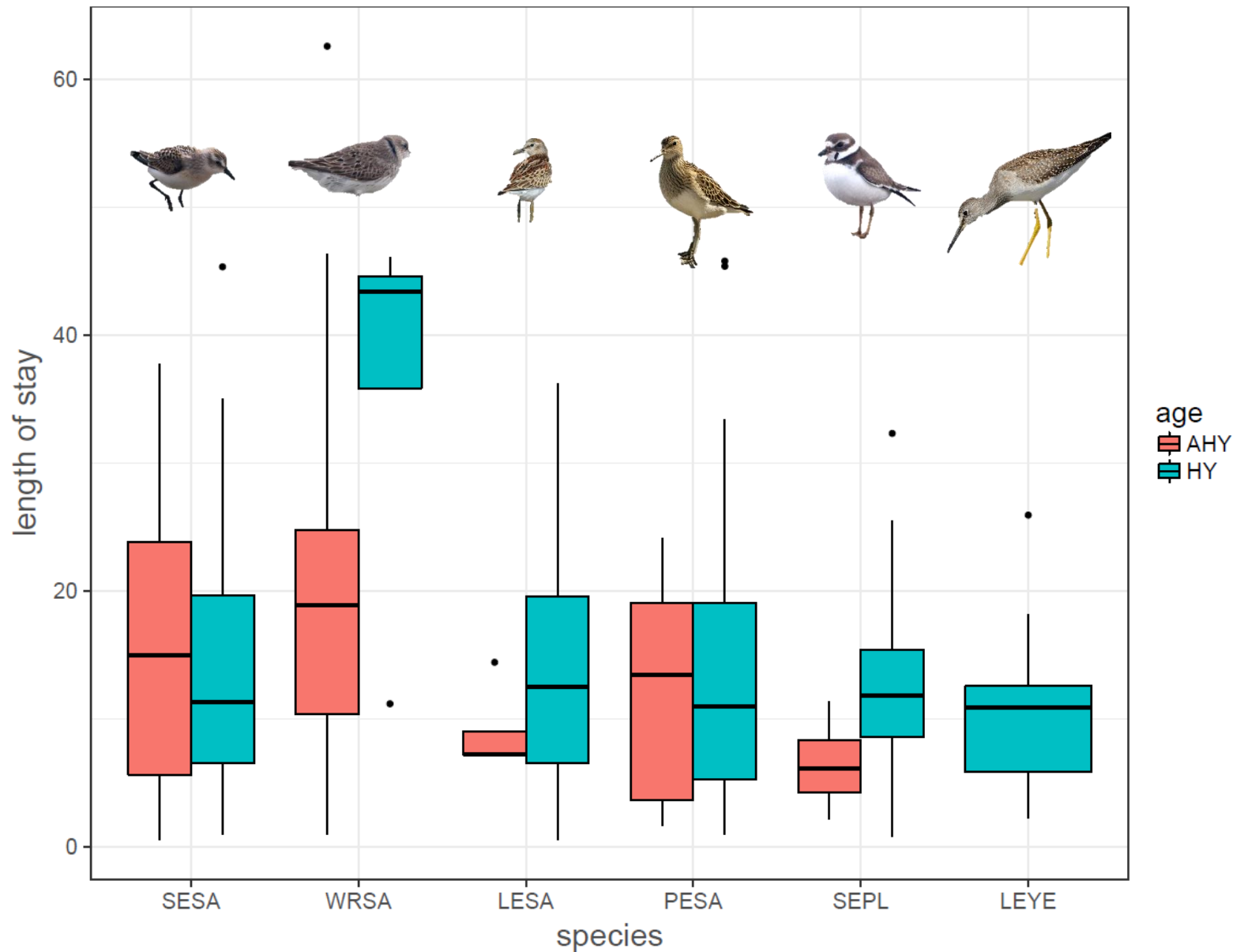
Aug 01 Aug 15 Sep 01 Sep 15 Oct 01 Oct 15 Nov 01

● Longridge ● Netitishi ● NorthPoint ● Piskwamish ● Washkagou

Length of stay in James Bay



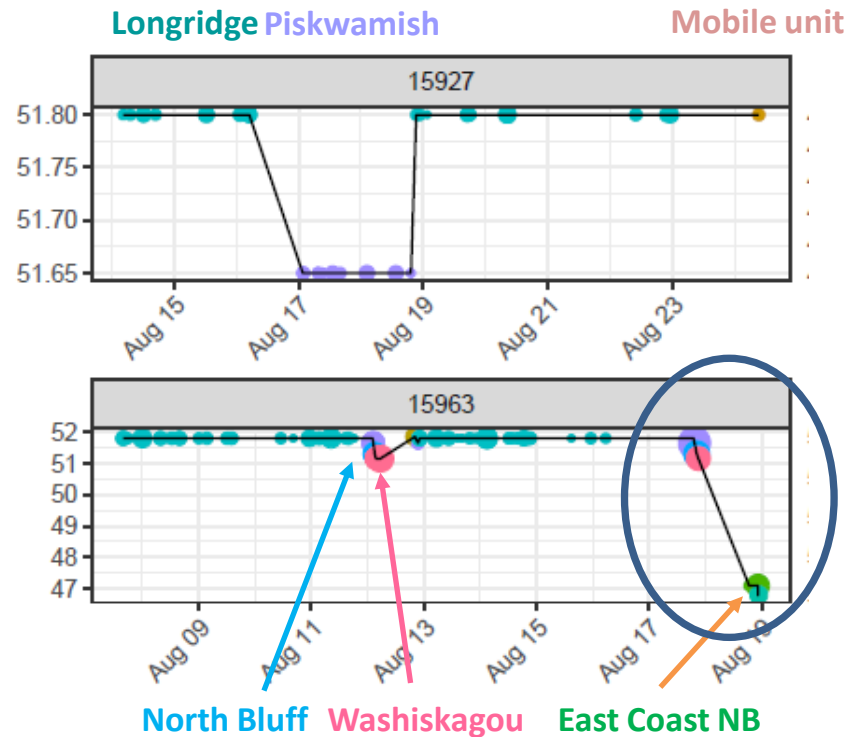
Length of stay by age



Movements during stopover



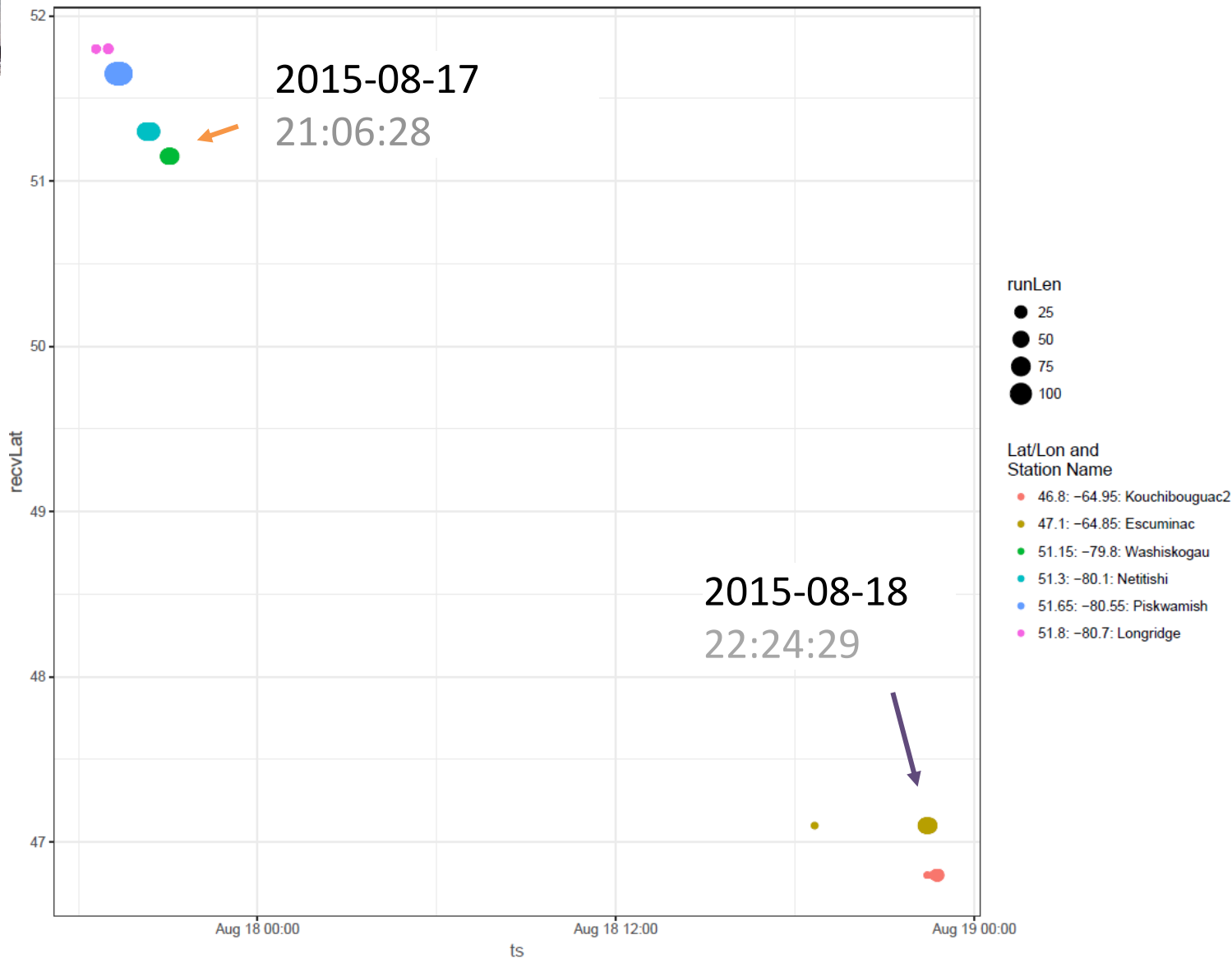
Semipalmated Sandpiper



Tide, weather, body condition

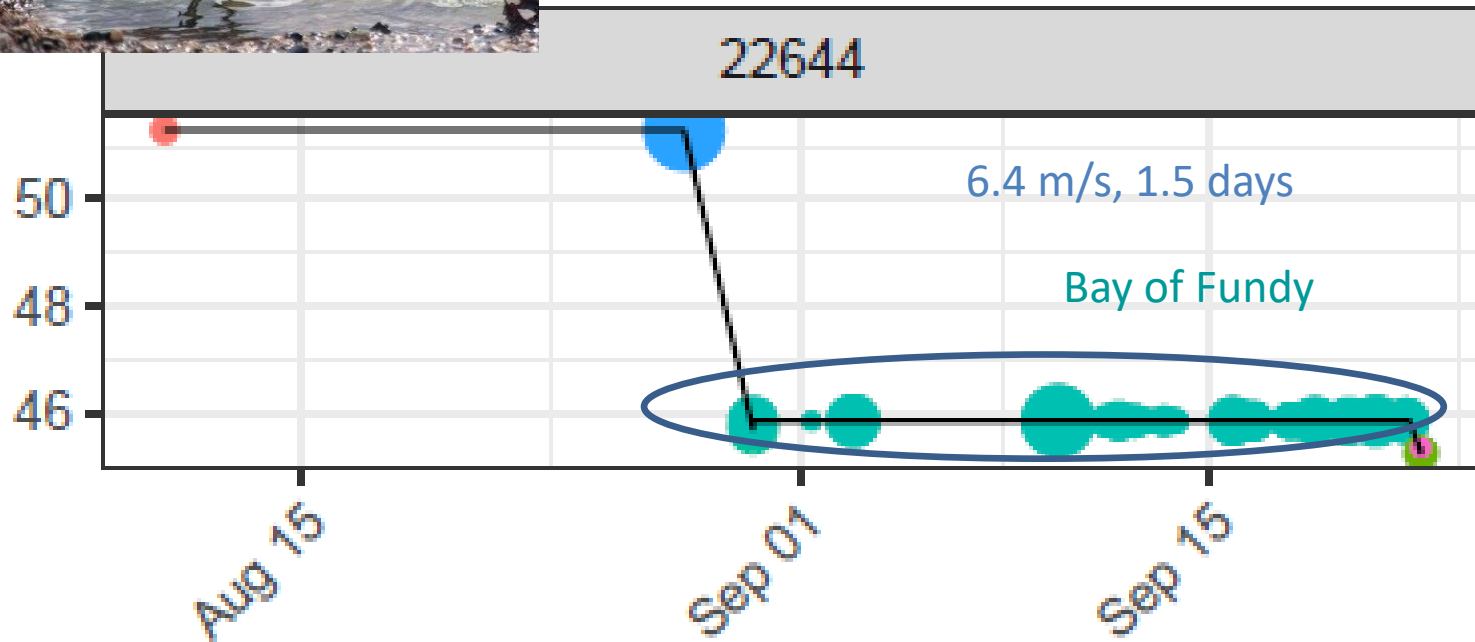


Departure Flights

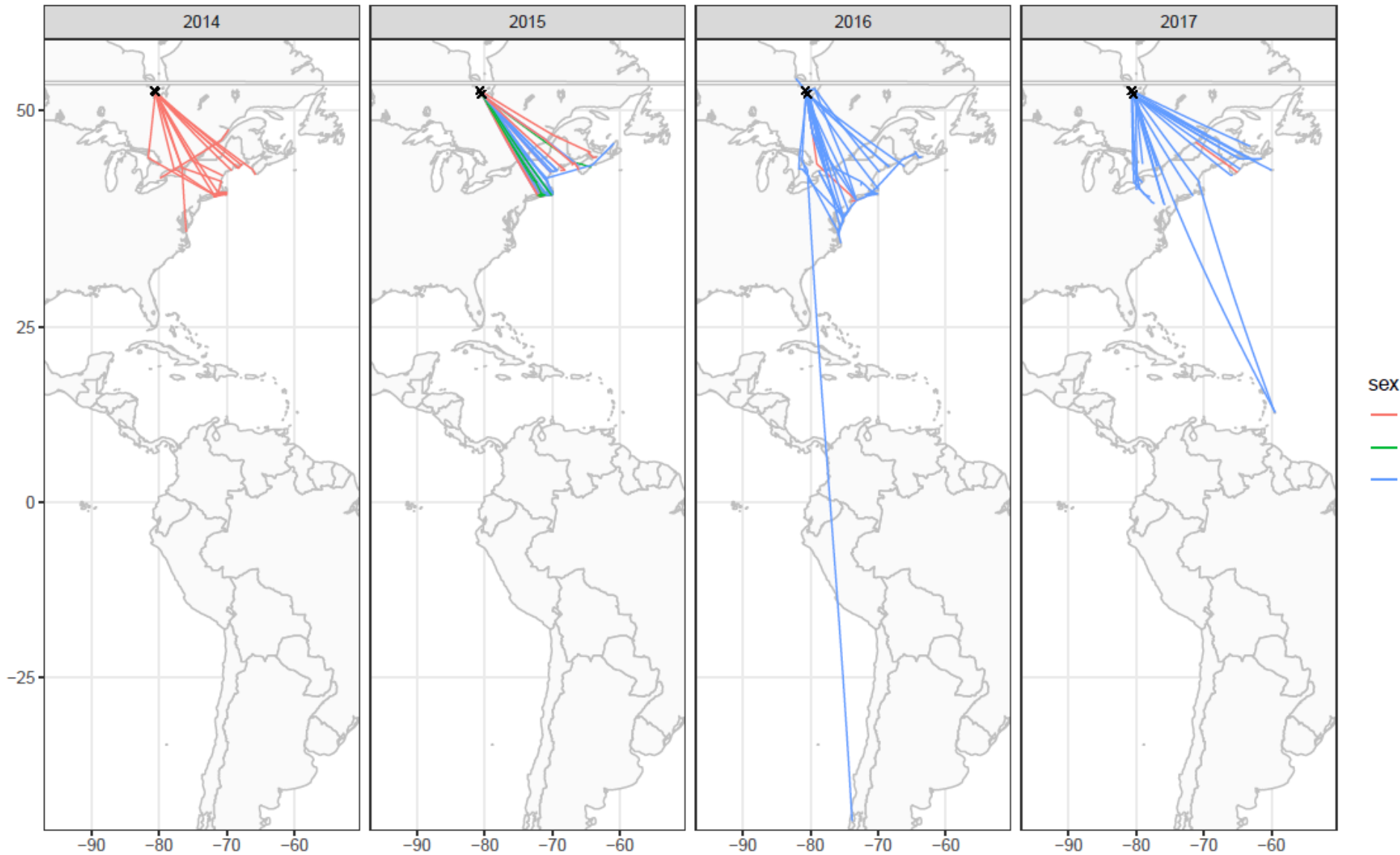


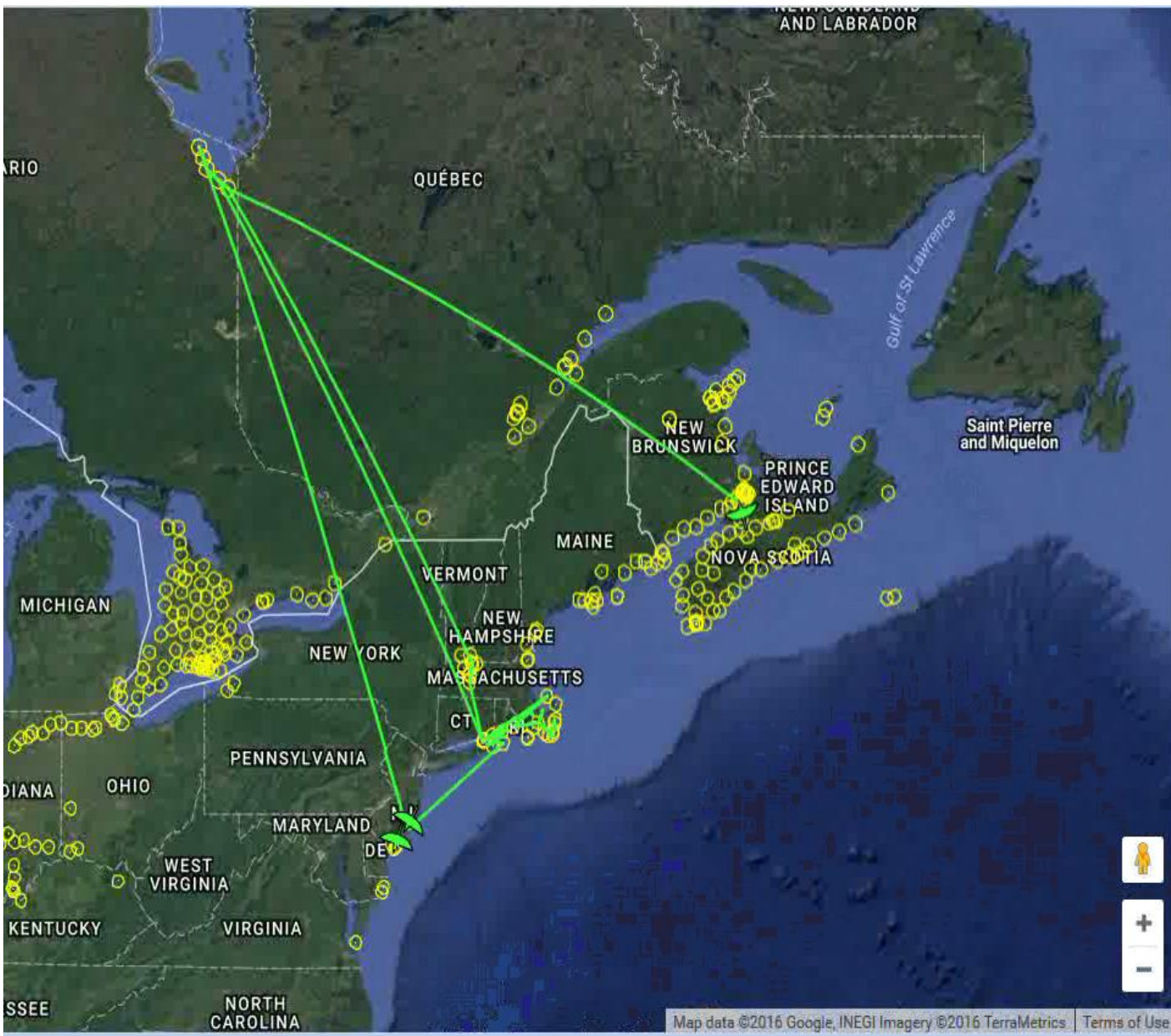
*Tide, weather,
body condition,
wing length*

Subsequent length of stay



White-rumped Sandpiper





Map data ©2016 Google, INEGI Imagery ©2016 TerraMetrics Terms of Use

0 30
1 seconds

Starts: Aug 11, 2015
Showing: Aug 13, 2015
Finishes: Sep 14, 2015

- 31 White-rumped Sandpipers
- 28 Semipalmated Sandpipers
- 4 Red Knots

[More information](#)

This animation was created by



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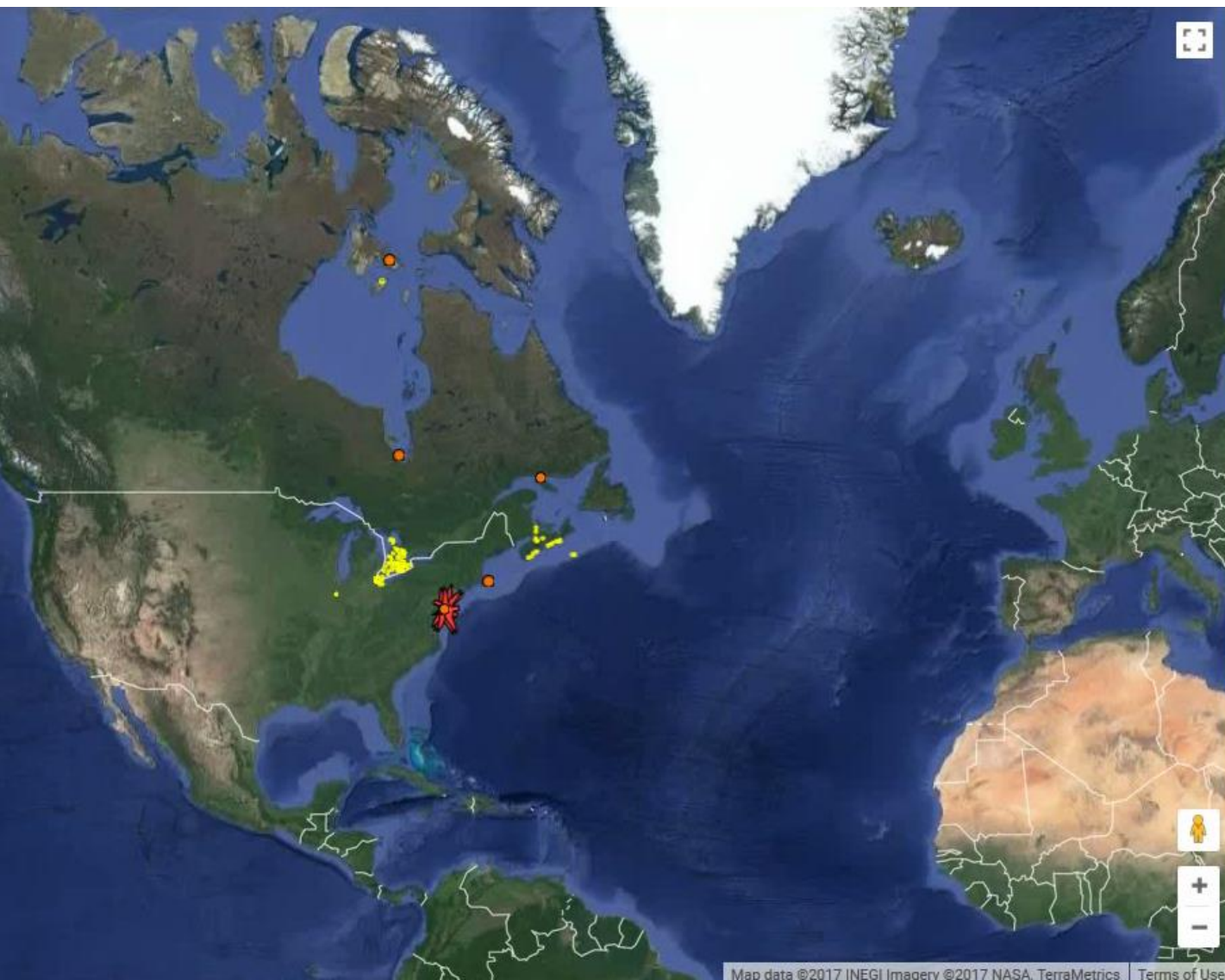
The data displayed were collected by researchers using the



This animation was made possible by funding from the







Map data ©2017 INEGI Imagoery ©2017 NASA, TerraMetrics | Terms of Use

0 60

0 seconds

Starts: May 20, 2014

Showing: May 23, 2014

Finishes: Sep 20, 2016

- 99 Red Knots in 2014
- 217 Red Knots in 2015
- 110 Red Knots in 2016
- Red Knot tagging sites
- Radio-tag detectors

Each line shows the shortest path between two detections, not necessarily the actual path travelled by the bird detected.

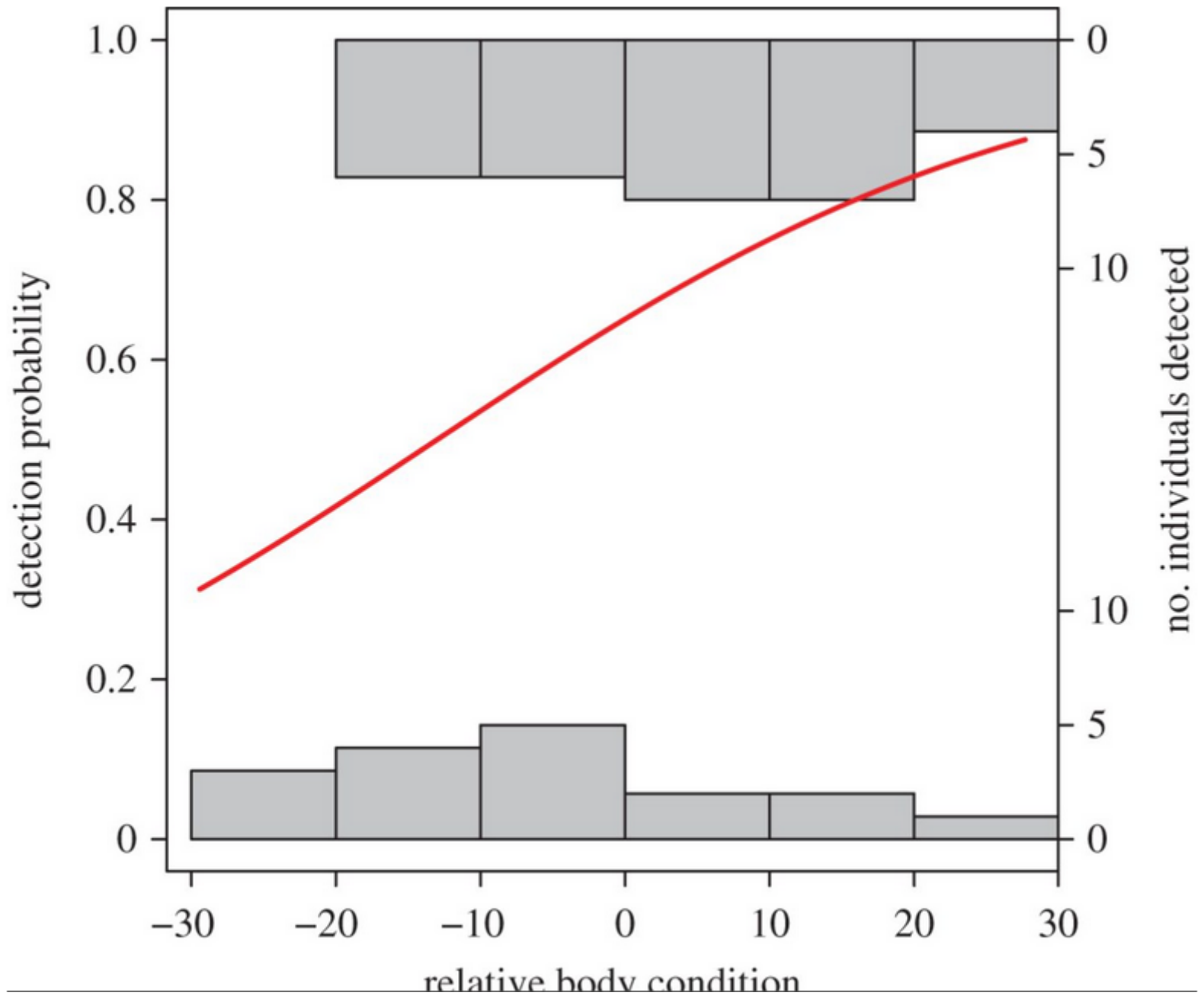
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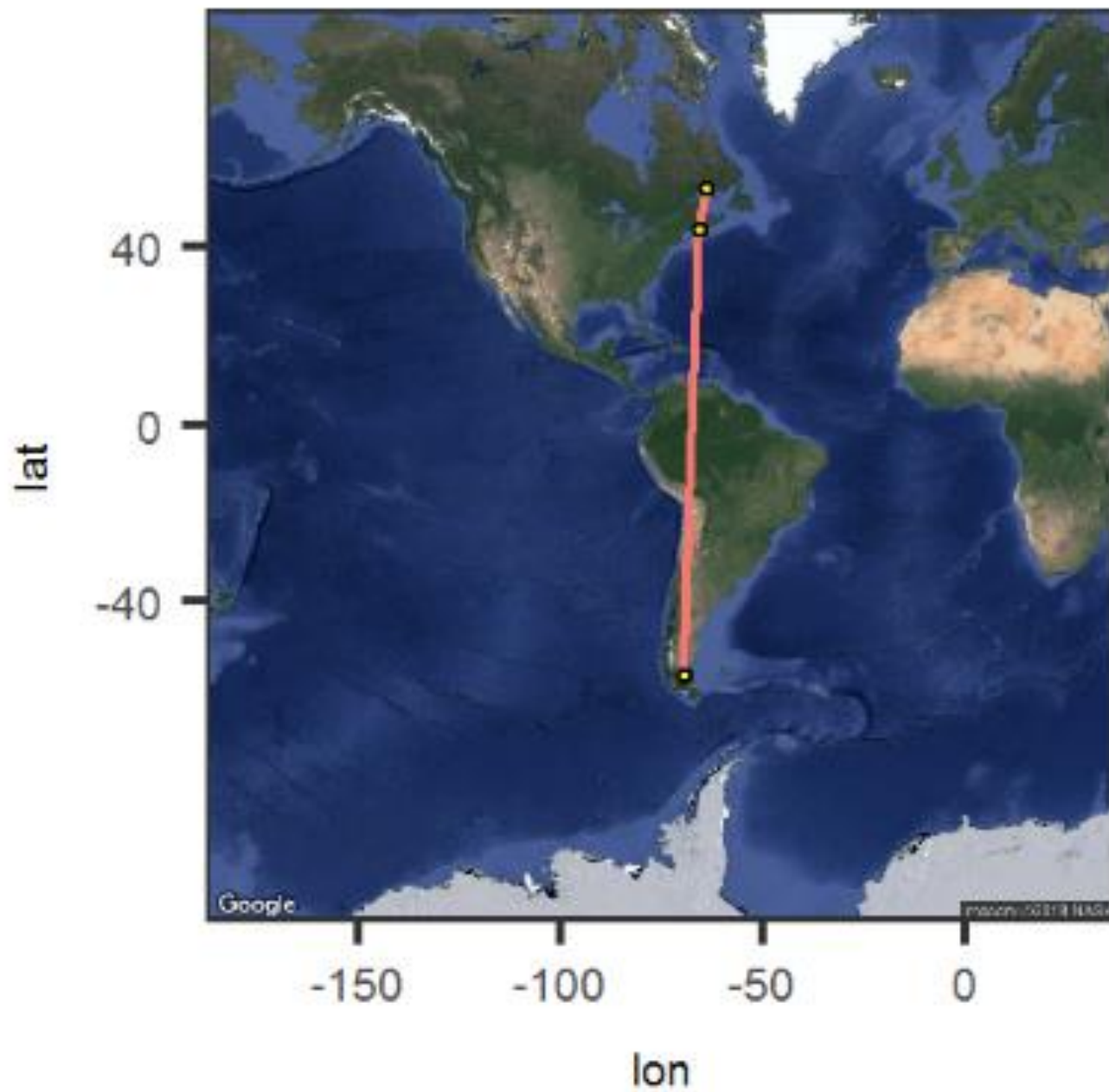
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The data displayed were collected
by researchers using the









Wintering Habitat, Stopover and Migration of *Catharus* Thrush in Colombia.



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Universidad de
los Andes

Colombia



Environment and
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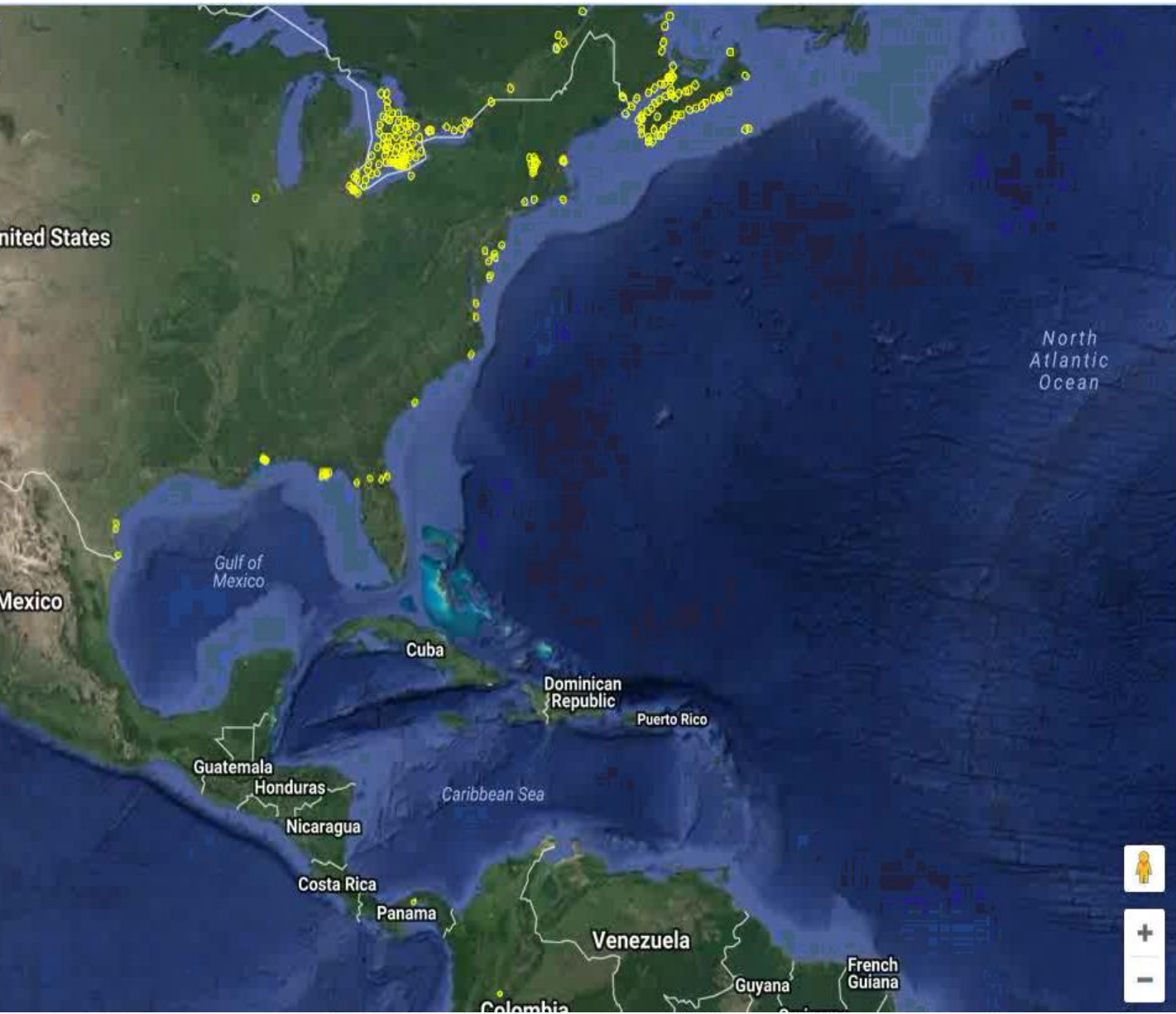


*We're also investigating
over wintering habitat
use and migration.*

since 2015
tagged > 200
CAWA,
SWTH, and
GCTH



Tagged ~ 100 canada warblers, swainson's, and gray cheeked thrush as part of two studies. One to examine any differences in length of stay and migration for birds staying in shade coffee vs. forested locations, and the second studying stopover behaviour on the northern coast of colombia. I'll show you some animations of results from these projects.



0 30

0 seconds

Starts: Apr 5, 2016

Showing: Apr 5, 2016

Finishes: Jun 17, 2016

● 30 Grey-cheeked Thrushes

● 7 Swainson's Thrushes

[More information](#)

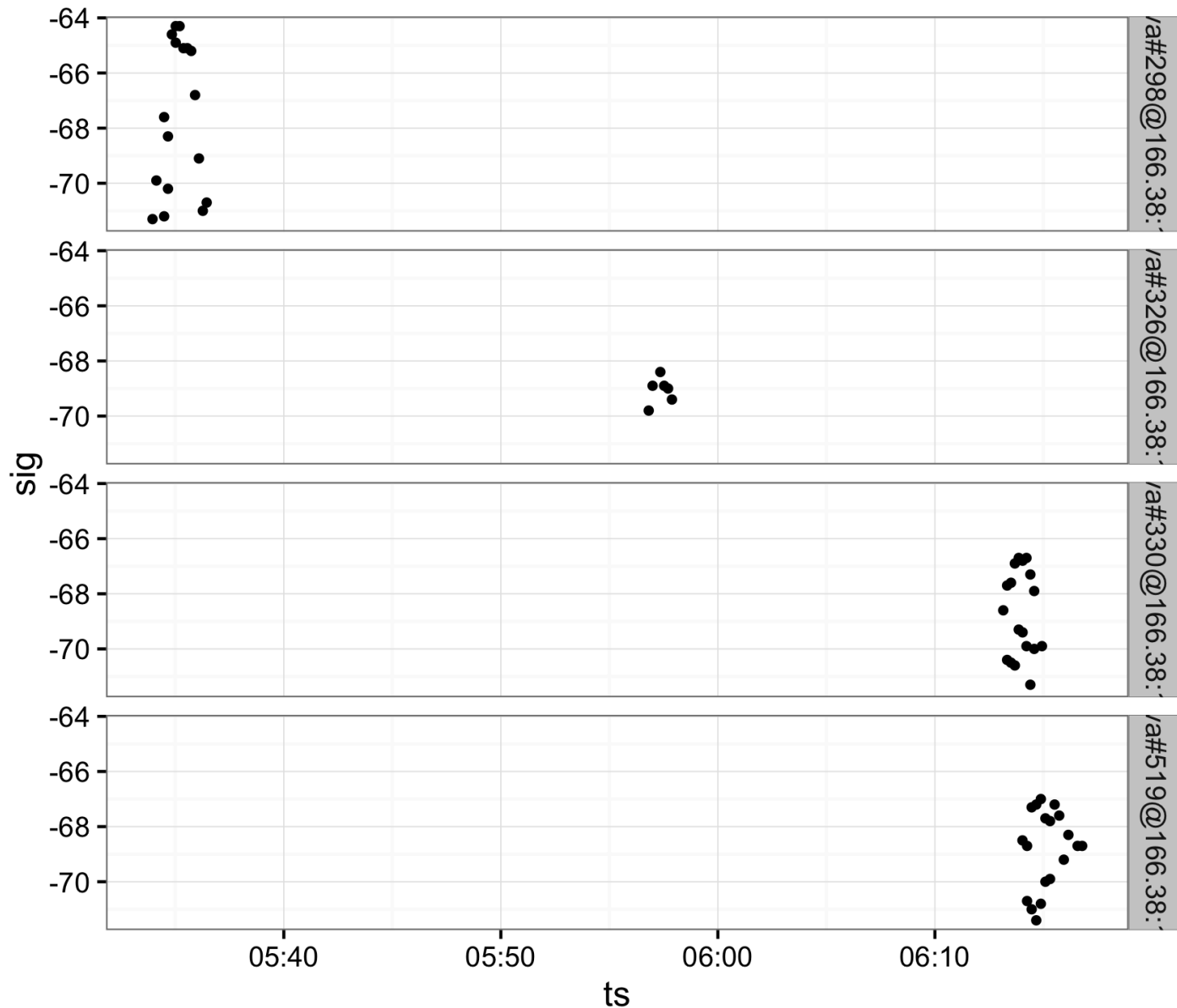
This animation was created by



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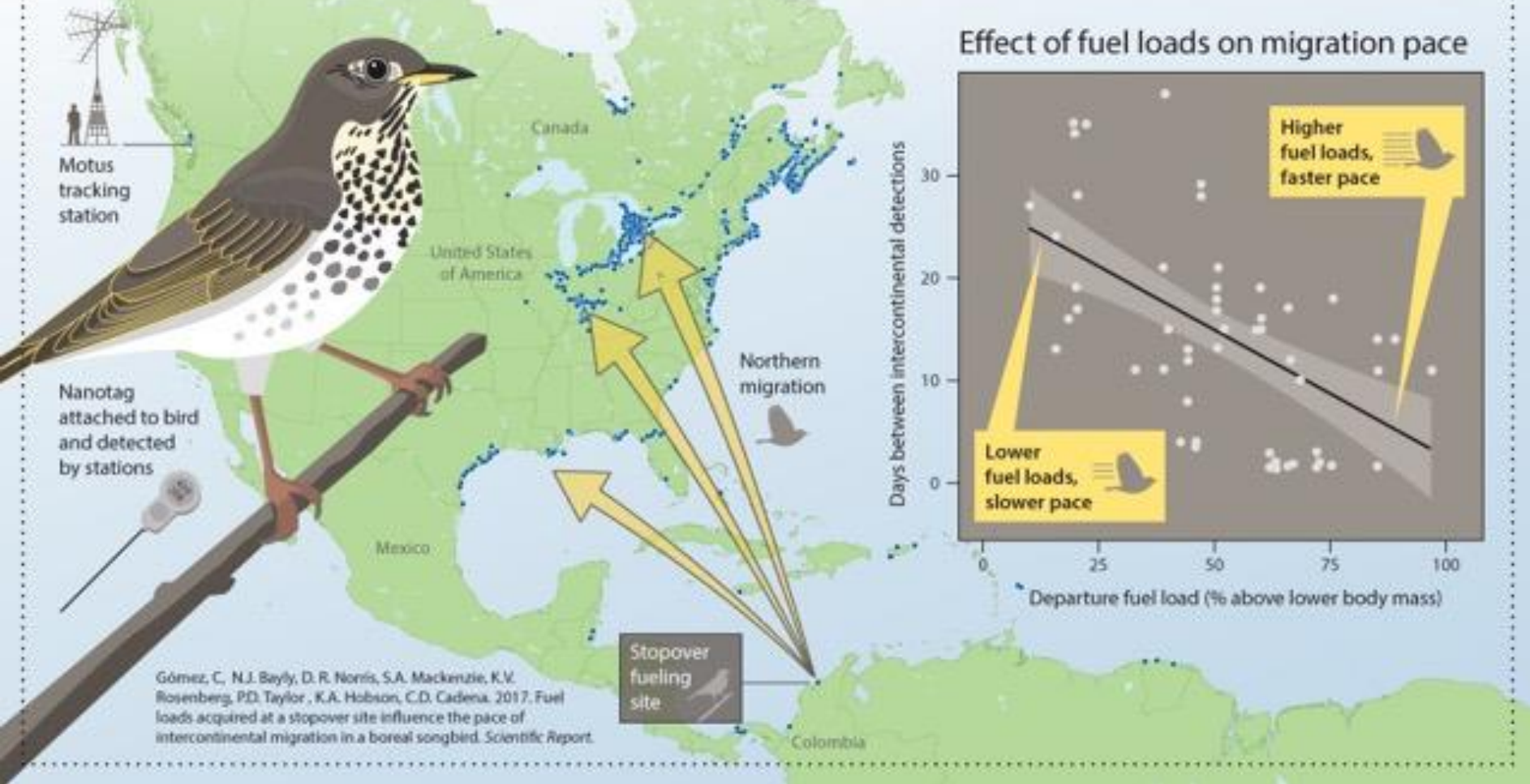
The data displayed were collected by researchers using the





4 GCTH all tagged in Colombia and last detected between May 14 and 16 – all detected in LA on the morning of May 17. Cold front moved through GOM May 13-15 followed by a large high pressure system over the GOM and Caribbean sea– pressure isoclines lined up perfectly from Colombia to GOM.

Fuel load (fat) acquired at a stopover site influences the pace of Grey-cheeked Thrush migration



Gomez et al. 2017. Scientific Reports.

Education, Outreach, and Citizen Science





Motus
Wildlife Tracking System

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One of the world's largest wildlife tracking datasets.

[Explore Data...](#)



Photo: Silver-haired Bat: Brock Fenton

The Motus Wildlife Tracking System is a collaborative research network that uses coordinated automated radio telemetry arrays to study movements of small animals. Motus is a program of Bird Studies Canada in partnership with Acadia University and collaborating researchers and organizations. Learn more [about Motus](#).

Next Steps:

- Further expansion of projects and applications
 - Development of analytical tools
 - Connectivity !!!
- **INTEGRATION** with other tracking technologies and data portals
 - Integration with other tech and infrastructure networks
 - Development of the public interface, education and citizen science components



Looking forward, accommodating and integrating other tracking technologies is critical to long-term sustainability and growth.





**ASSOCIATION
OF ZOOS &
AQUARIUMS**

- A collaborative research network can expand the scale and scope of everyone's work while maximizing scarce resources.





motus.org

Motus

motus.org/motus-partners/



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Motus is truly the sum of its parts.