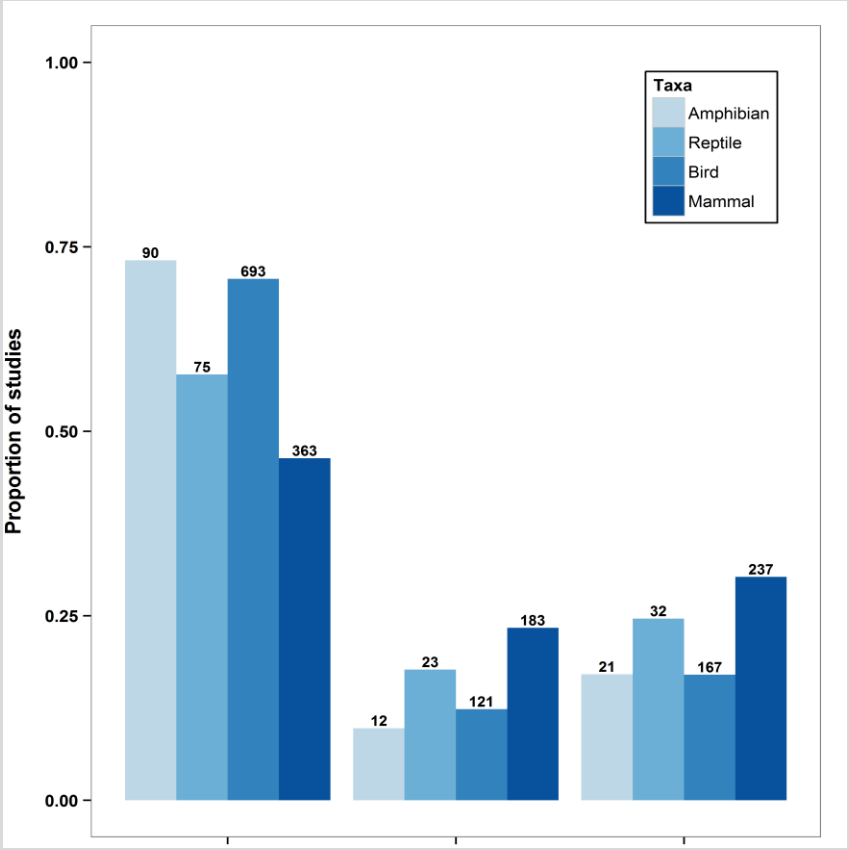
MULTISCALE MOVEMENTS OF A THREATENED POPULATION OF BLACK-CROWNED NIGHT-HERONS IN LAKE ERIE USING SATELLITE AND AUTOMATED TELEMETRY

Kristie A. Stein[1], Laura J. Kearns[2], Chris M. Tonra[1]

[1]The Ohio State University, Terrestrial Wildlife Ecology Lab
[2]Ohio Department of Natural Resources

A SEASONAL BIAS IN ANIMAL ECOLOGY?



A call for full annual cycle research in animal ecology

Peter P. Marra, Emily B. Cohen, Scott R. Loss†, Jordan E. Rutter‡ and Christopher M. Tonra¶

Migratory Bird Center, Smithsonian Conservation Biology Institute, National Zoological Park, PO Box 37012 MRC 5503, Washington, DC 20013, USA

For vertebrates, annual cycles are organized into a series of breeding and non-breeding periods that vary in duration and location but are inextricably linked biologically. Here, we show that our understanding of the fundamental ecology of four vertebrate classes has been limited by a severe breeding season research bias and that studies of individual and population-level responses to natural and anthropogenic change would benefit from a full annual cycle perspective. Recent emergence of new analytical and technological tools for studying individual and population-level animal movement could help reverse this bias. To improve understanding of species biology and reverse the population declines of many vertebrate species, a concerted effort to move beyond single season research is vital.

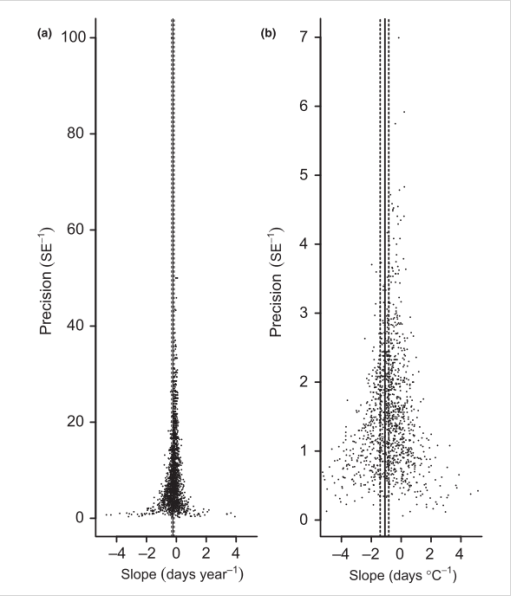
1. Introduction: periods of the annual cycle are inextricably linked

Physical cycles as significant as the rotation of the tilted Earth around the Sun entrain living things into cycles. The ecology and evolution of vertebrates are organized into annual cycles that include reproductive, non-breeding and migration/dispersal periods that vary in duration and location. Spotted salamander (*Ambystoma maculatum*) breeding occurs over several days in early spring when adults migrate to vernal ponds, mate and lay eggs [1]. Soon after mating, spotted salamanders return to terrestrial foraging areas, where they remain for more than 95% of the annual cycle. Leatherback sea turtles (*Dermochelys coriacea*) spend most of their adult life at sea, moving vast distances in search of jellyfish. Every few years, individuals mate at sea then females lay eggs on beaches [2]. Ovenbirds (*Seiurus aurocapilla*) are on breeding areas from May until August, during which time they raise young. Pair bonds then disintegrate, and individuals moult and migrate to tropical wintering areas where they spend more than 70% of

Marra et al. 2015 Biology Letters

MOVEMENT ECOLOGY IN THE ANNUAL CYCLE

- Movement patterns are changing in response to global environmental change
  - Timing (Usui et al. 2017)
  - Strategy (Gilbert et al. 2016)
- Animals utilizing anthropogenic food sources
  - Landfills
  - Zoos
  - Fish cleaning stations



(Usui et al. 2017)

MARINA USAGE ALONG LAKE ERIE

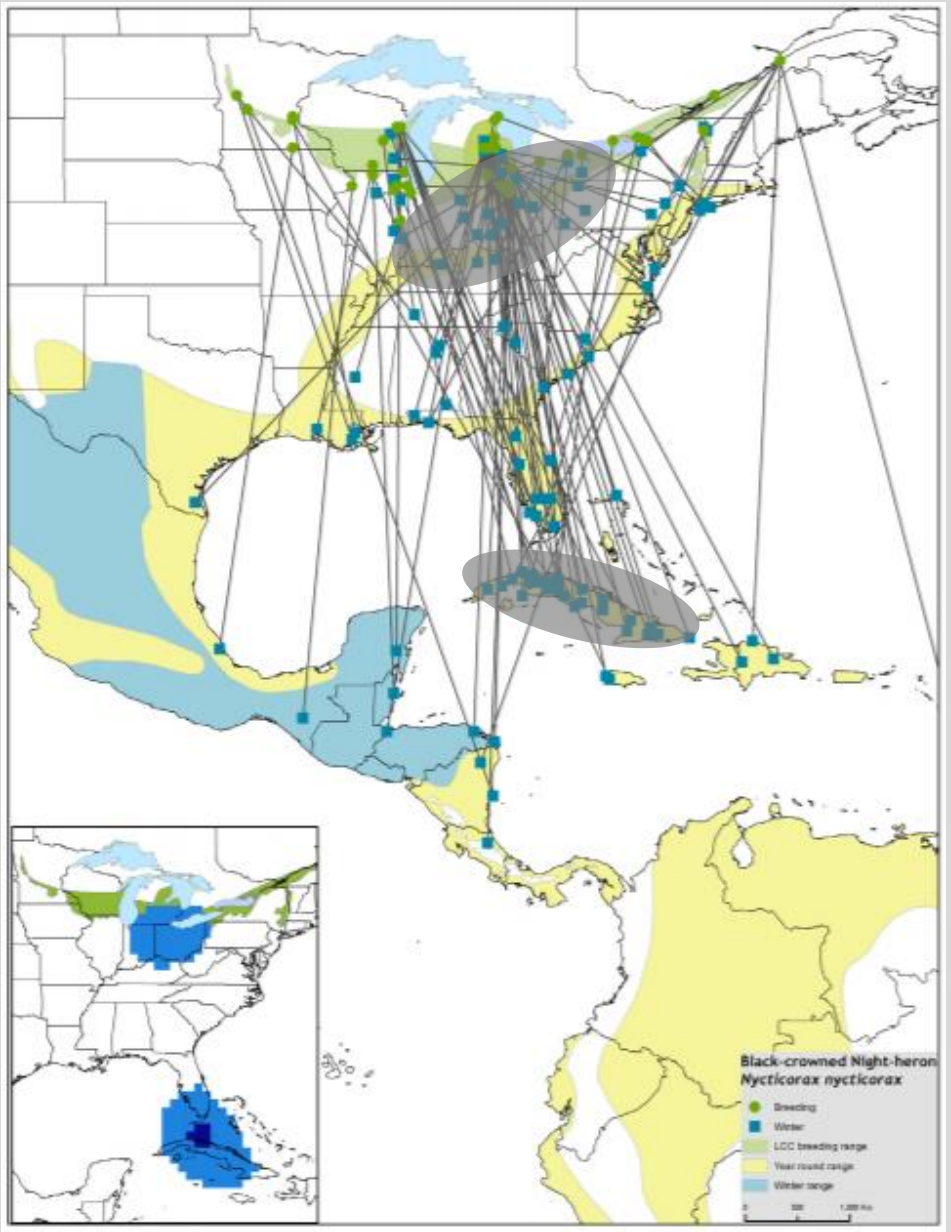
- 6 known stations

POPULATION STATUS

- Listed in 7/8 Great Lakes states
- Within Ohio – threatened
- 19 colonies ⬇ 5
- Largest colony – West Sister Island
- 3000 pairs ⬇ 300

BLACK-CROWNED NIGHT-HERON (*NYCTICORAX NYCTICORAX*)

- No published information on migratory connectivity
- Movement data from band recoveries (114 from GL region)
- Winter locations in GL region and Caribbean



(Marra et al. 2014)

RESEARCH OBJECTIVES

1. Estimate survivorship of pre- and post-fledging juvenile night-herons
2. Determine the migratory behavior and wintering range of adult night-herons

POST-FLEDGING JUVENILES:

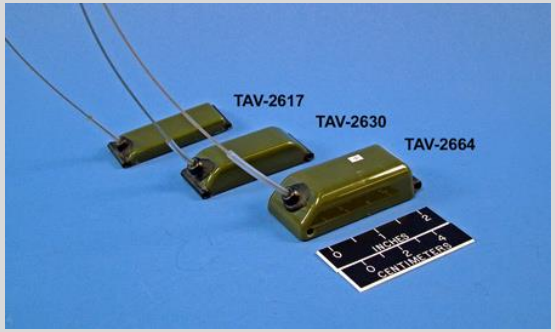
LOCAL SCALE

MIGRATORY ADULTS:

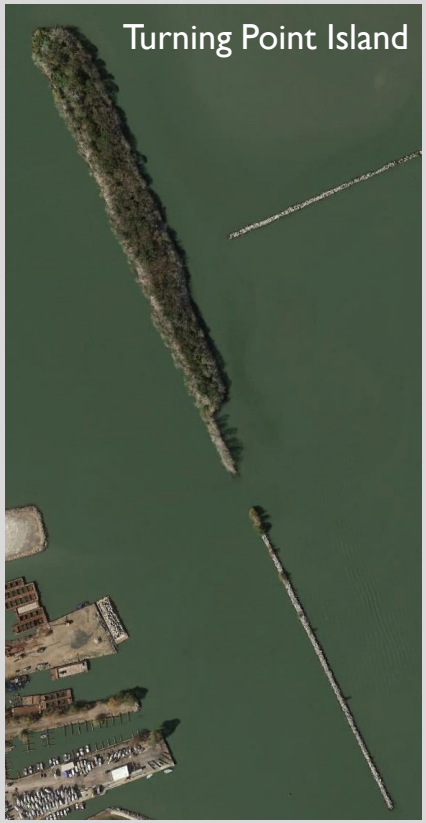
CONTINENTAL SCALE

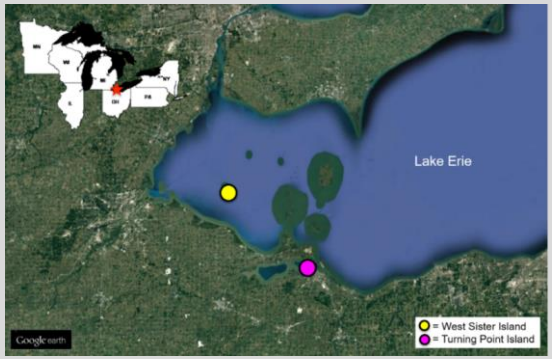
TECHNOLOGY


NTQB
-1
mm
1 cm
2
3


TAV-2617
TAV-2630
TAV-2664
INCHES
CENTIMETERS

STUDY COLONIES





TURNING POINT ISLAND

- Size: 2 ha
- Distance-to-shore: 0.22 km
- Proximity to urban area: 1.5 km to Sandusky
- Manmade

WEST SISTER ISLAND

- Size: 31 ha
- Distance-to-shore: 13 km
- Proximity to urban area: 39 km to Toledo
- Natural

RESEARCH METHODS – OBJECTIVE 1

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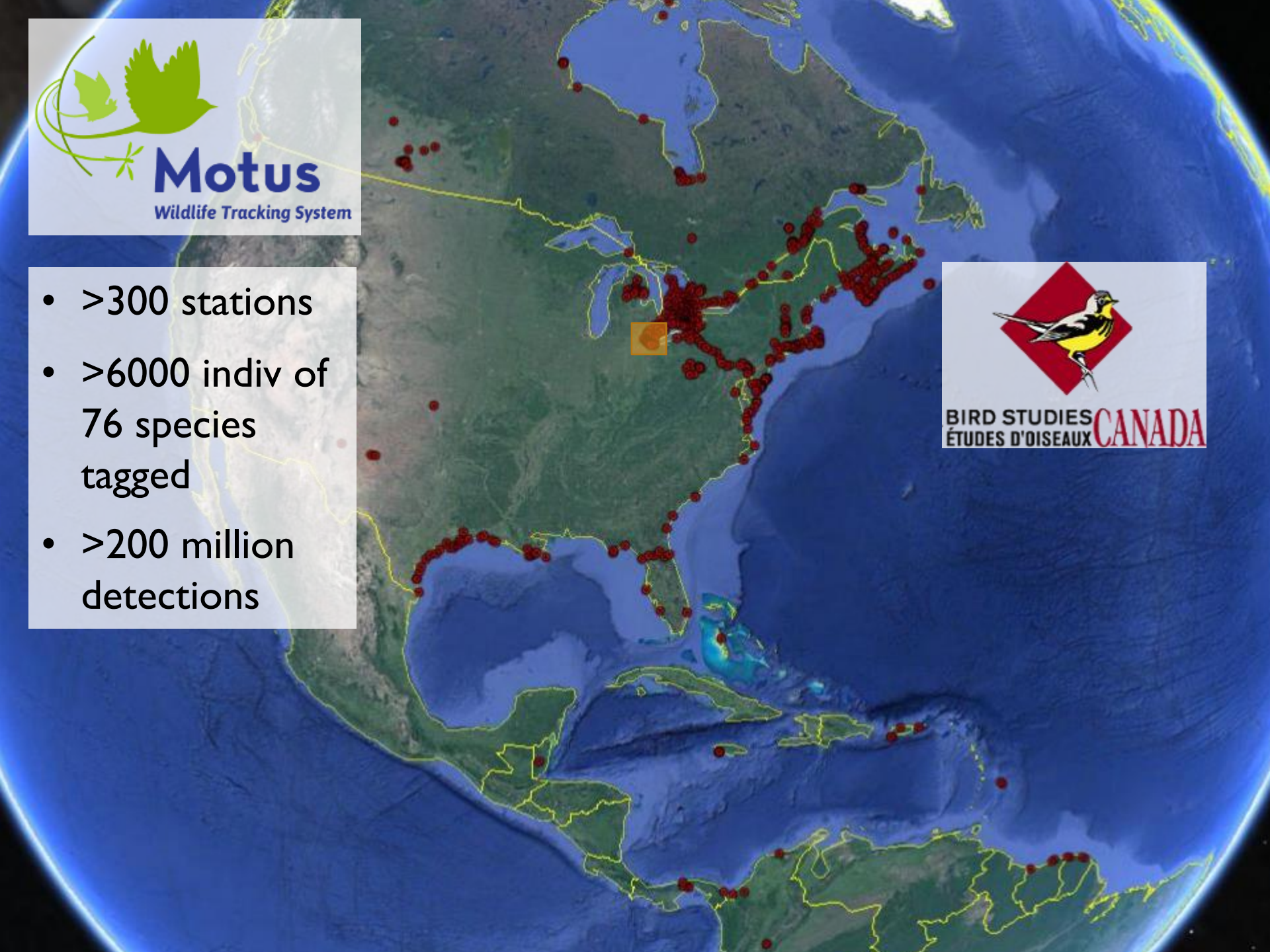
- Hand-capture
- Tag with nanotags and alpha-numeric bands
- Trail cameras

NANOTAGS

- Transmit on one frequency
  - Pulse is unique ID
  - Allows for continuous scanning across hundreds of birds
- Mass ranges from 0.3-2.5g
- Pulse rate can be altered and be on a 12hr on/off cycle
  - Alters battery life
  - Detectability, triangulation considerations

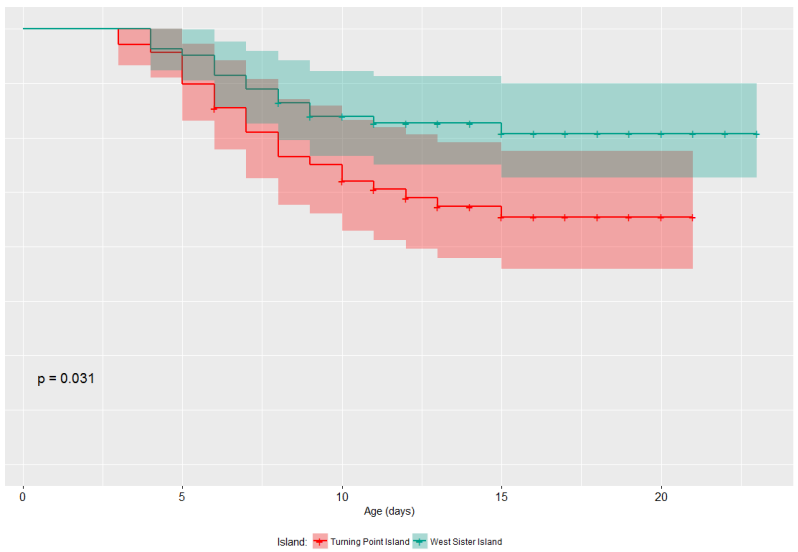


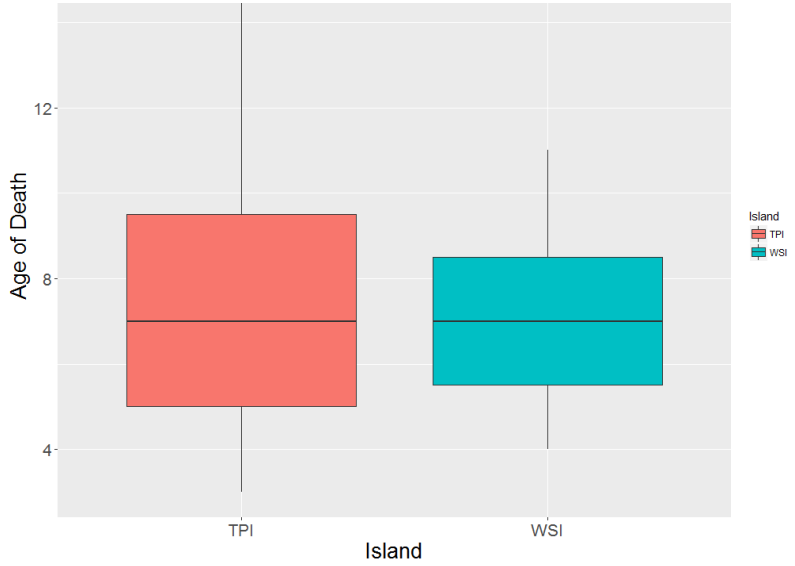
- >300 stations
- >6000 indiv of 76 species tagged
- >200 million detections


Ypsilanti
Ypsilanti Charter Twp
Leamington
Monroe
Sylvania
Toledo
Isle St George
Put-in-Bay
Catawba Island
Lakeside Marblehead
Oak Harbor
Port Clinton
Maumee
Sandusky
Huron
Fremont
Clyde
Milan
Bellevue
23
275
94
401
77
3
75
223
24
280
90
6

RESEARCH METHODS – OBJECTIVE 1

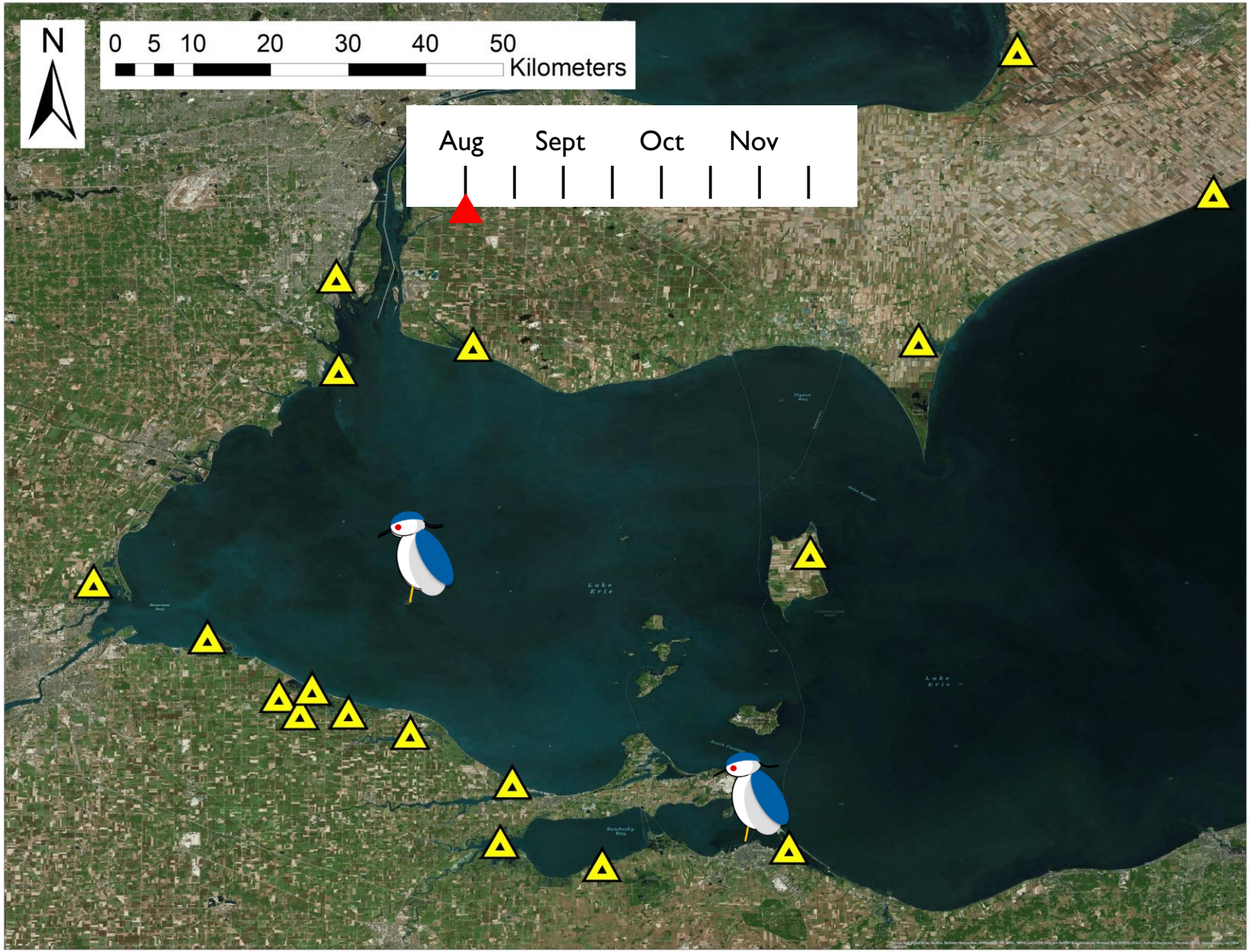
- 13-day survival interval
- 10 intervals
- Located via a combination of:
  - Hand-tracking
  - Vehicle telemetry
  - Aerial telemetry
  - Motus towers



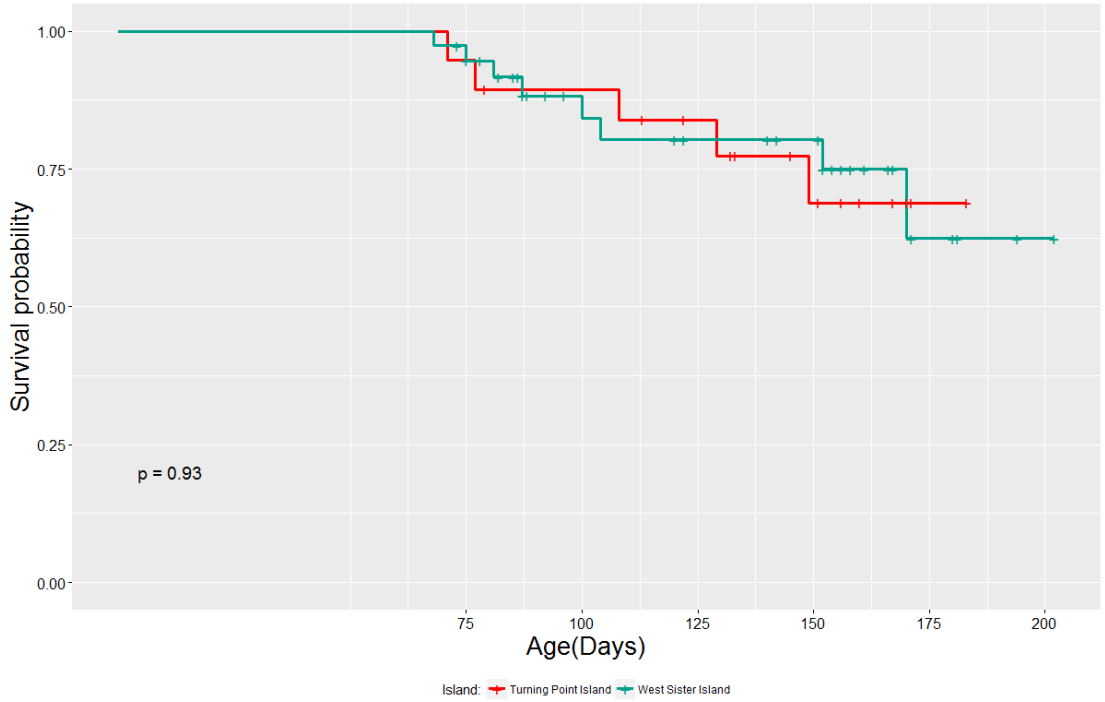


WSI = 75.9% TPI = 56.8% Mean age = 7.4

NESTLING SURVIVAL


N
0 5 10 20 30 40 50
Kilometers
Aug
Sept
Oct
Nov

POST-FLEDGING SURVIVAL



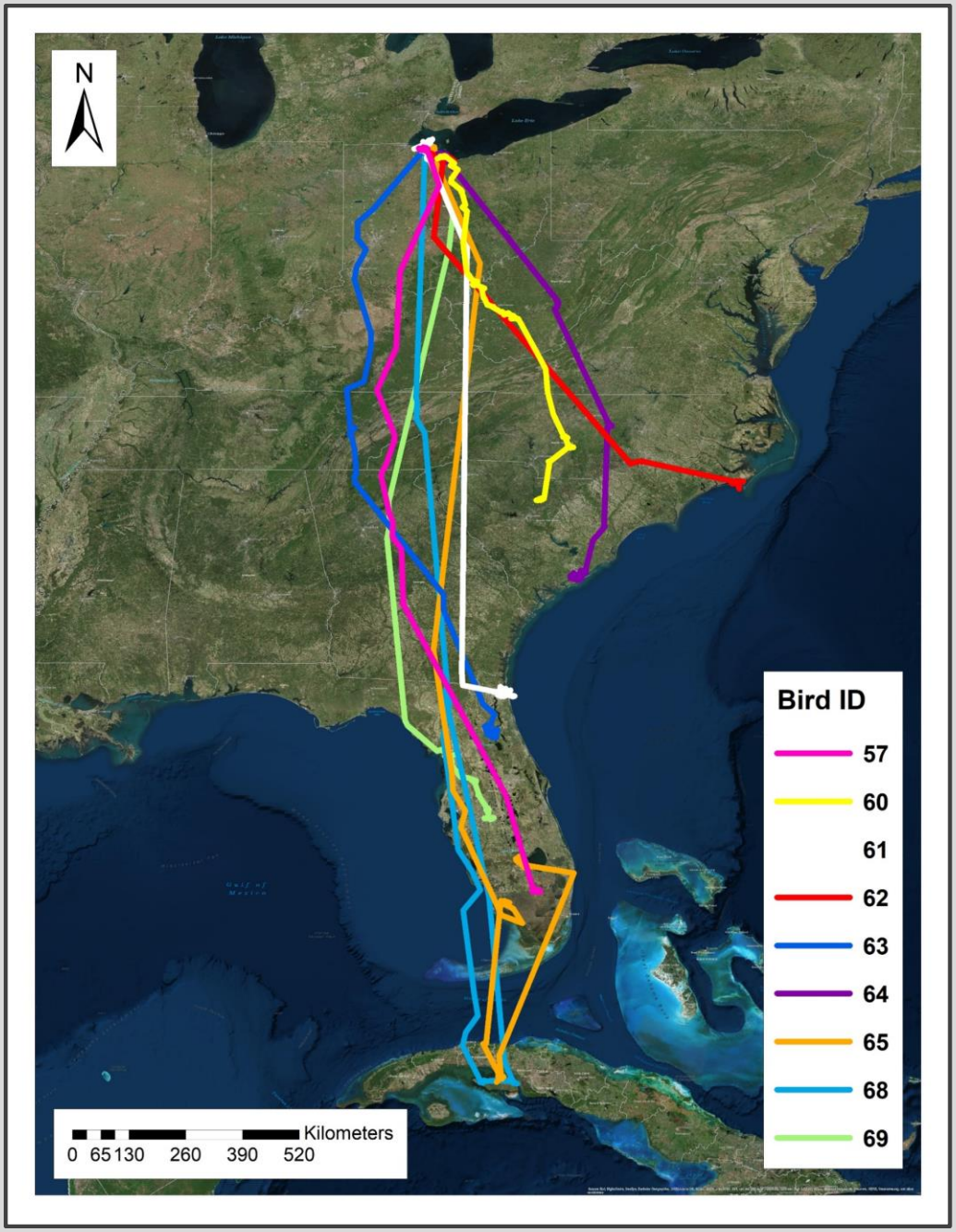
- 68.8% at TPI
- 62.4% at WSI

RESEARCH METHODS- OBJECTIVE 2

Transmitters deployed on adult night-herons:

- 2016 (10)
- 30 g ARGOS PTT via backpack harness
- Alpha-numeric bands
- Measurements, DNA sample

CAPTURE LOCATIONS



MIGRATION

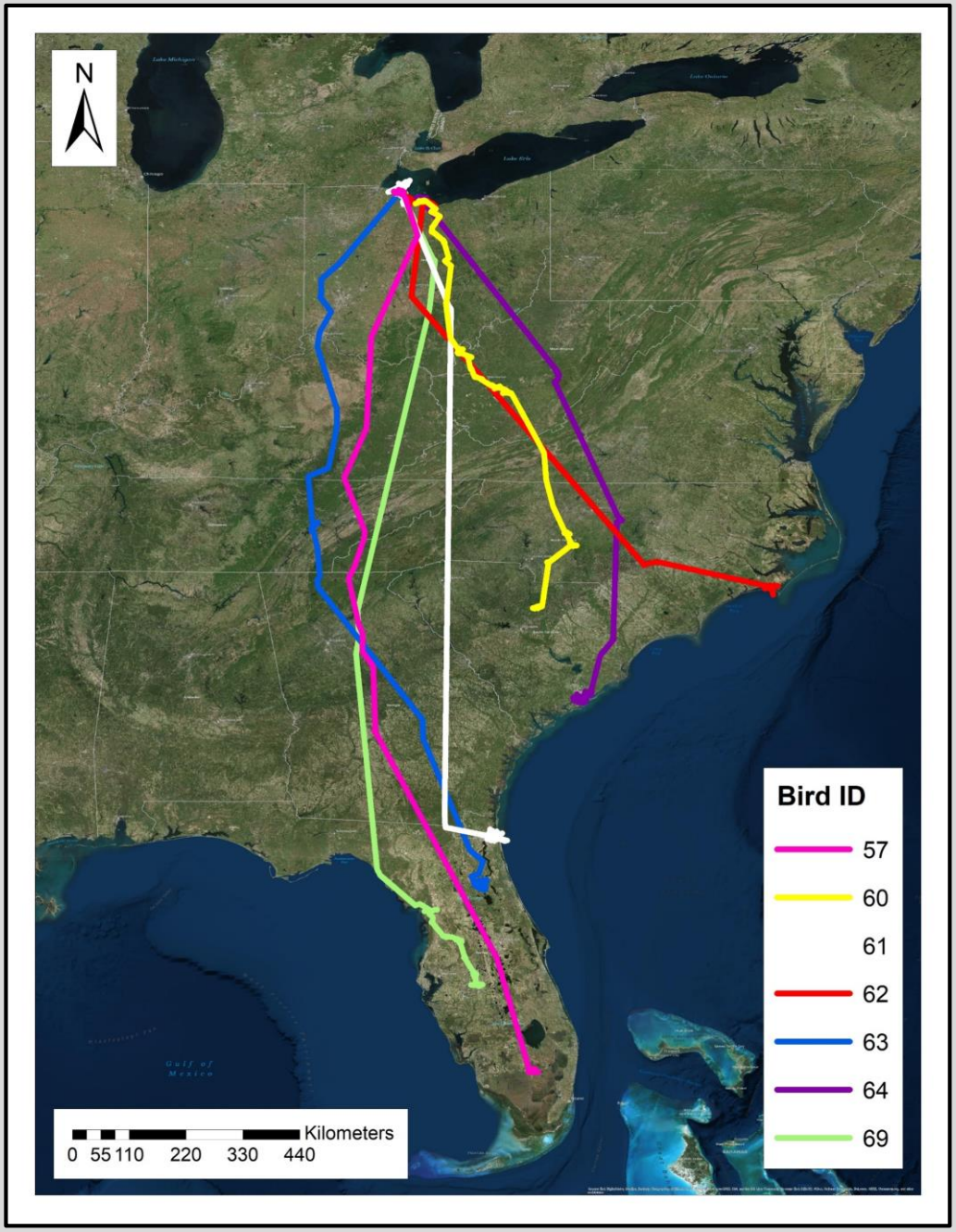
- Routes
  - Southern
  - Eastern
- Departure
  - 3 - Sept
  - 4 - Oct
  - 2 – Nov
- Duration
  - Range: 2 – 57 days

MIGRATORY STRATEGIES

Short-distance (n=7)

- Displacement = 0 – 2000 km

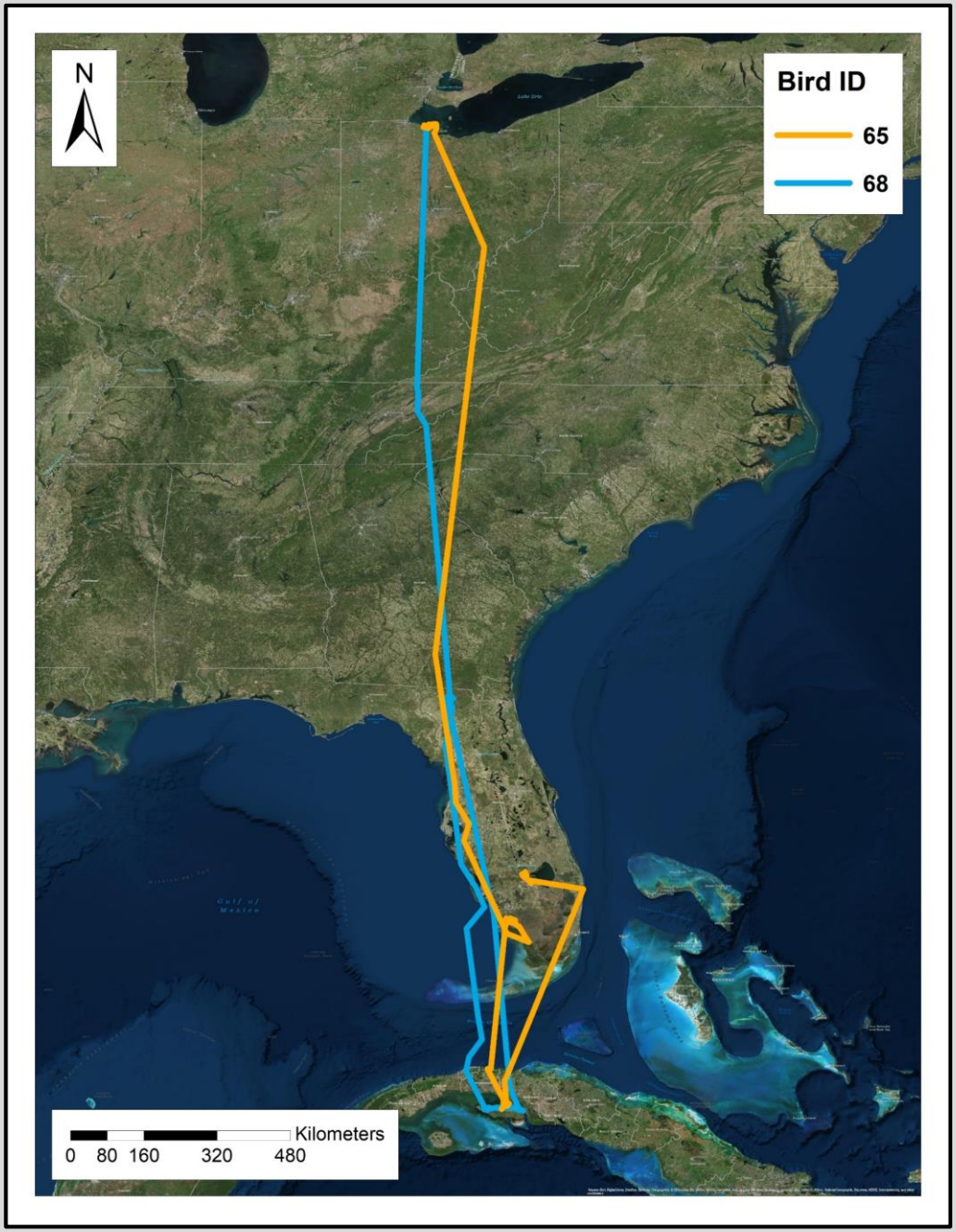
Bird ID	Distance from colony (km)
57	1715.84
60	805.68
61	1257.28
62	951.33
63	1346.06
64	996.03
69	1542.57



MIGRATORY STRATEGIES

Long-distance (n=2)
- Displacement > 2000 km

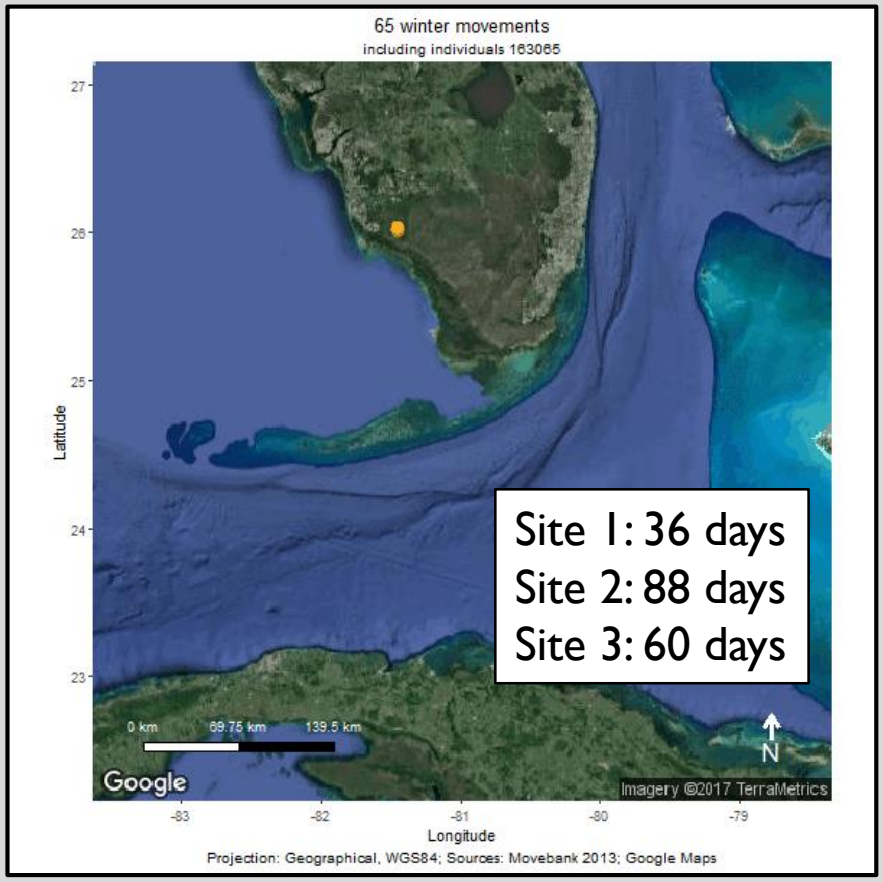
Bird ID	Distance from colony (km)
65	2137.83
68	2150.36

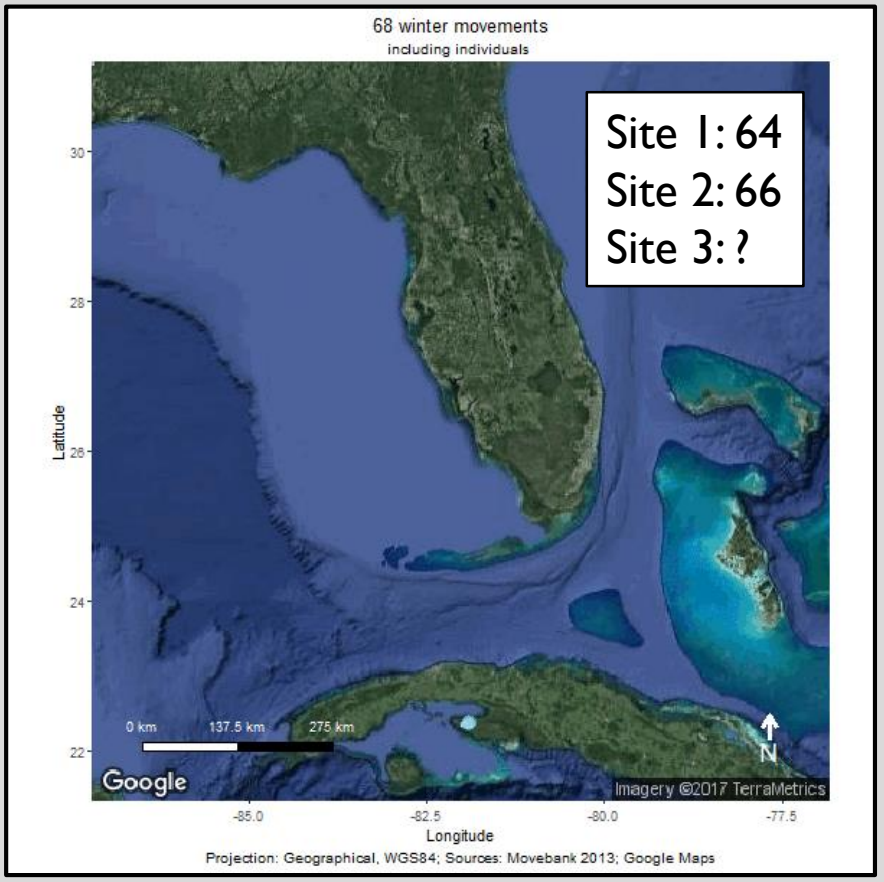


WINTER MOVEMENTS – SHORT DISTANCE

- Avg: 203 days on wintering grounds
- Most movements confined to small winter home range

WINTER MOVEMENTS – LONG DISTANCE





CONCLUSIONS

- Pre-fledging survival: higher at West Sister Island. Post-fledging survival: similar between islands.
- Juvenile birds make large-scale movements during the post-fledging period
- Lake Erie night-herons are migratory and strategies are flexible in time and space
- Long distance migrants made intra-seasonal movements on wintering grounds
















BATS

Silver-haired Bat
Little Brown Bat
Eastern Red Bat

BIRDS

Northern Saw-whet Owl
American Woodcock
Eastern Whip-poor-will
Sanderling
Whimbrel
Hudsonian Godwit
Red Knot
Semipalmated Sandpiper
Barn Swallow
Wood Thrush
Swainson's Thrush
Gray-cheeked Thrush
Bicknell's Thrush
Savannah Sparrow
Saltmarsh Sparrow
White-throated Sparrow
Rusty Blackbird
Kirtland's Warbler
American Redstart
Canada Warbler
Blackpoll Warbler
Northern Waterthrush
Magnolia Warbler
Yellow-rumped Warbler

MOTUS DETECTIONS

THANK YOU!

stein.405@osu.edu
@kristieastein

THE OHIO STATE UNIVERSITY

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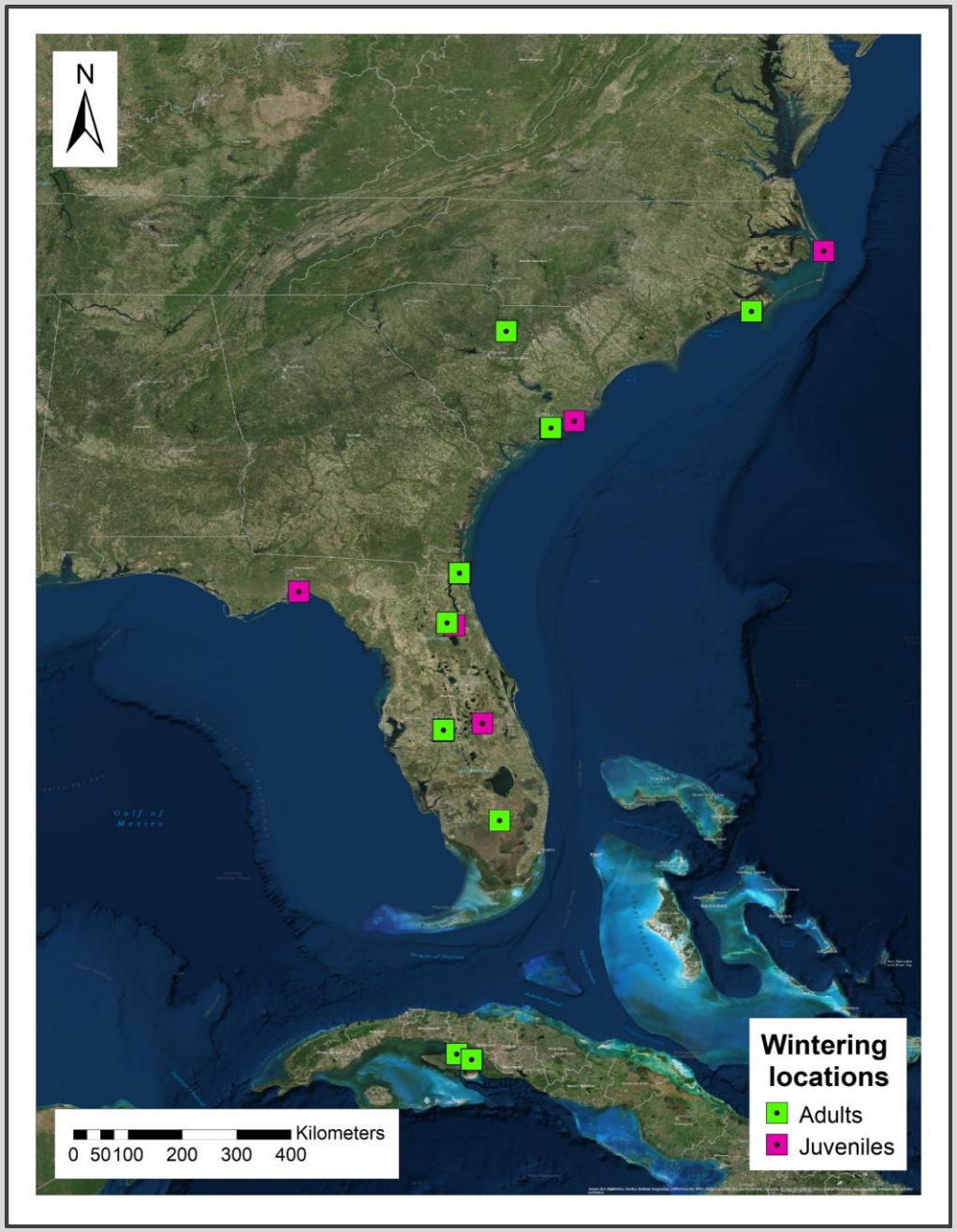


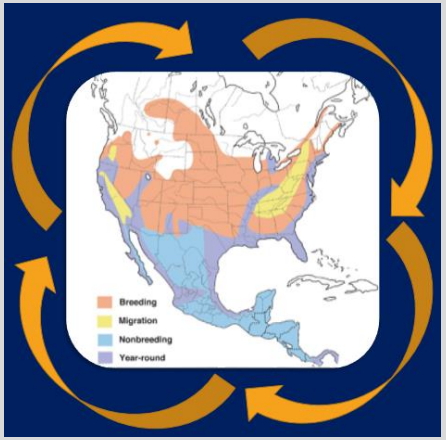
JUVENILE MIGRATION

- Little is known about first migration of night-herons
- Snapshot of wintering locations
- Overlap in adult and juvenile wintering ranges

DATA COLLECTION AND PROCESSING

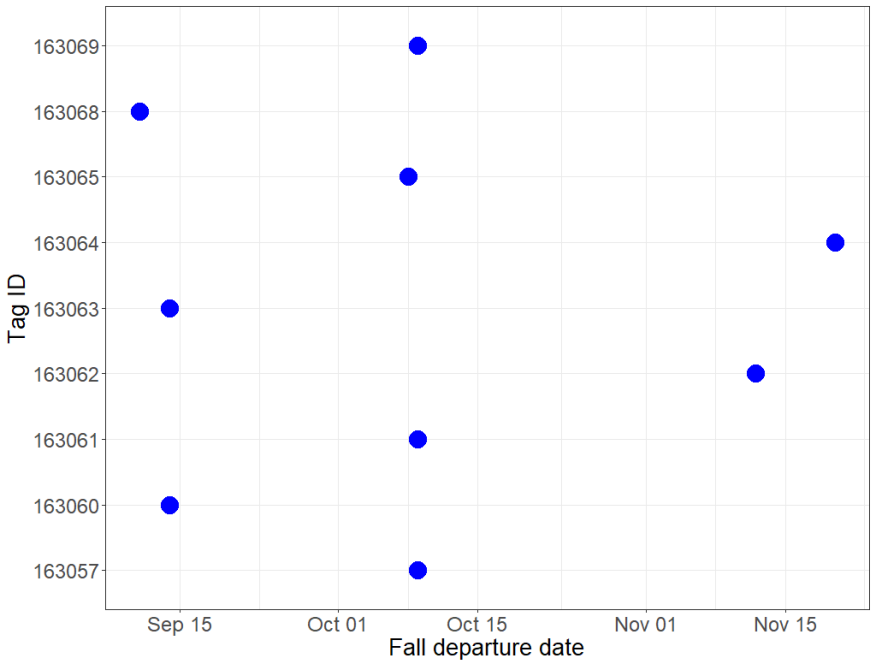
- Variable duty cycle by stage
  - Breeding/post-breeding – 3 day
  - Migratory – 1 day
  - Wintering – 2 day
- Douglas Argos filter (Movebank)
- Defined four annual movement periods: fall migration, wintering, spring migration, and breeding season

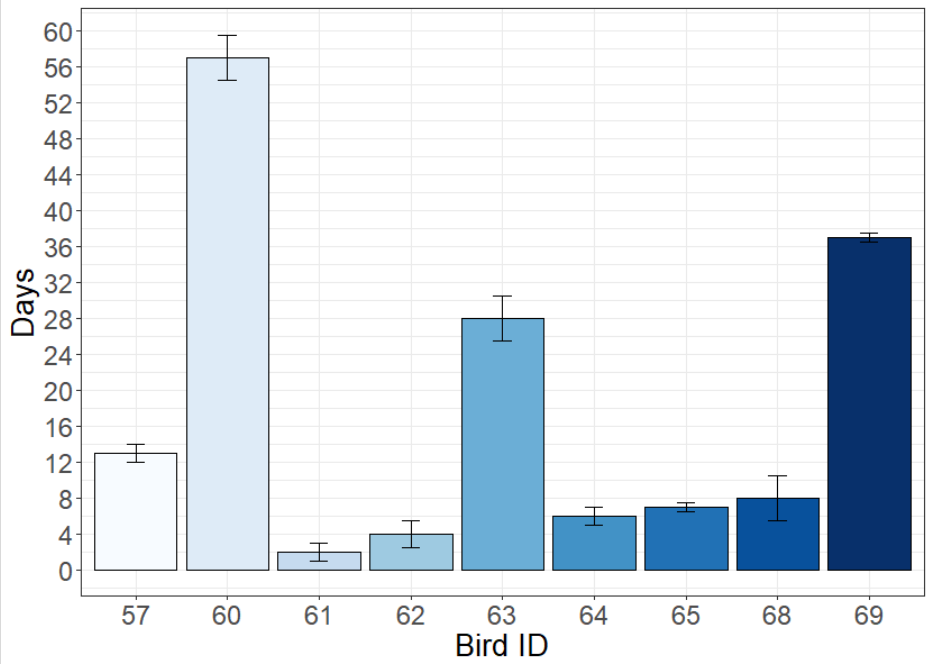
Class	Estimated error (m)
3	<250
2	250-<500
1	500-<1500
0	>1500
A, B	Unbounded accuracy

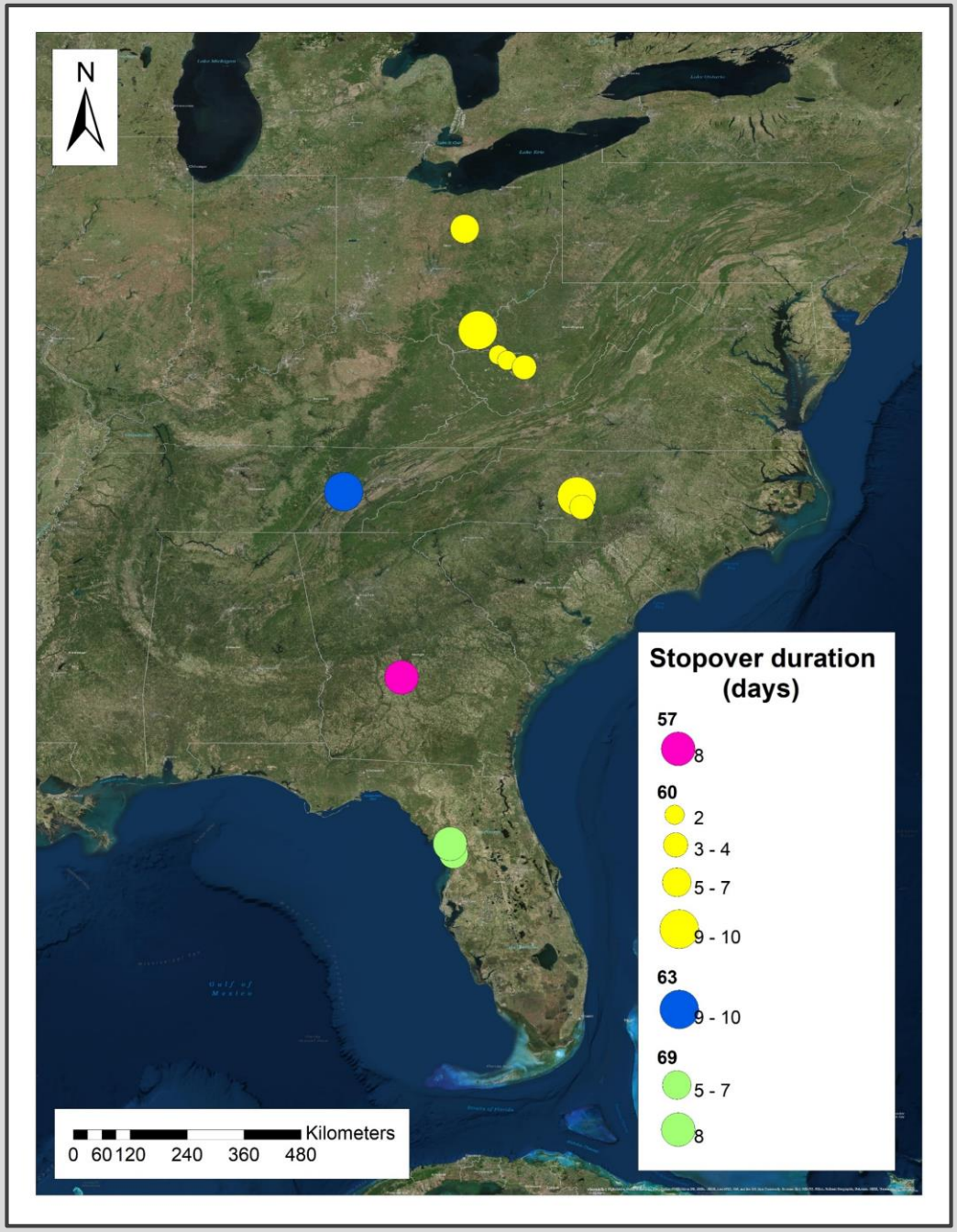


TIMING AND DURATION

- Average departure date: Oct 8
  - Range: Sept 9 – Nov 20
- 9/10 birds initiated fall migration
- Range: 2 – 57 days





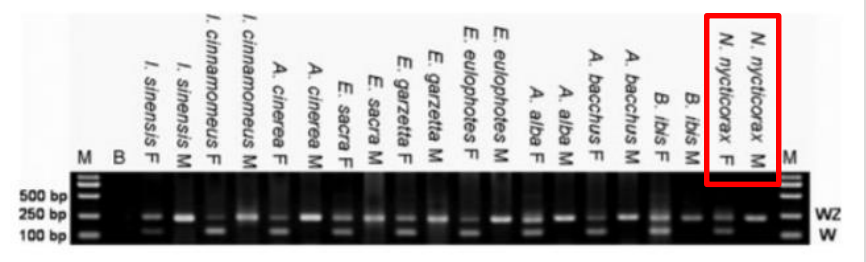


STOPOVER

- 4/9 birds made stopovers of 2-10 days in length
  - Average stopover duration: 4.3 days
  - 1-7 stopovers per individual

COVARIATES OF INTEREST

- **Age:** by molt stage
- **Sex:** DNA analysis of feather samples
- **BCI:** mass regressed on tarsus



(Wang et al. 2011)