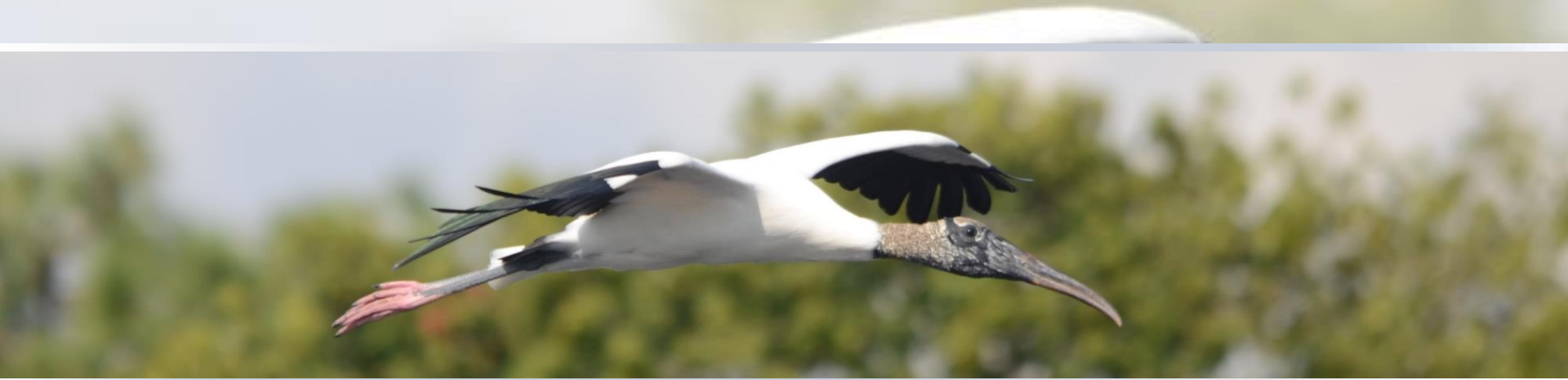


Wood Storks

From Everglades birds to urban dwellers



Simona Picardi

Broward Extension Wildlife Seminar Series, October 24th 2019



Why move?



Find resources



Find mates



Maintain gene flow



Establish territories

Migration



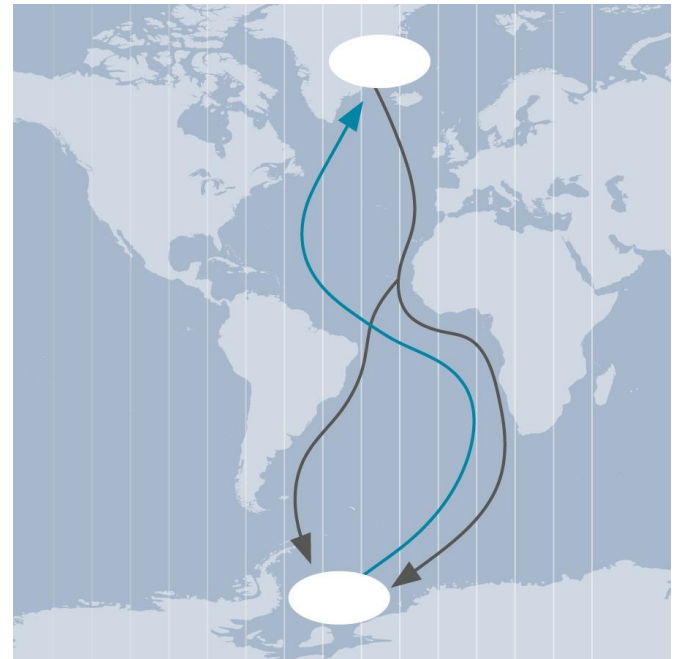
Track environmental heterogeneity
over broad spatio-temporal scales

Thomson's (1926) definition of migration:

"Changes of habitat, **periodically recurring** and **alternating** in direction, which tend to **secure optimal environmental conditions** at all times."

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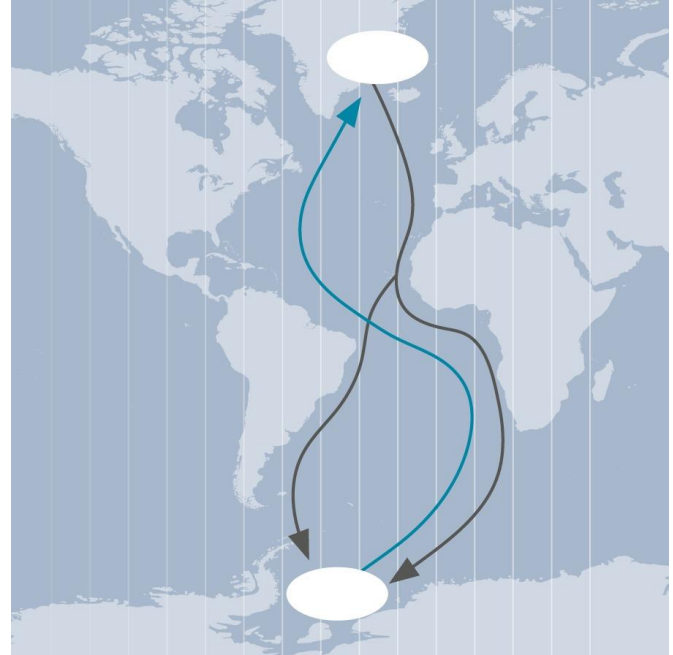


Thomson's (1926) definition of migration:

"Changes of habitat, **periodically recurring** and **alternating** in direction, which tend to **secure optimal environmental conditions** at all times."



But actually...



Seasonality → "Classic" round-trip



Seasonality → "Classic" round-trip



Resource breakouts → Erratic migration



Seasonality → "Classic" round-trip



Resource breakouts → Erratic migration



Resource trade-offs → Partial migration



Seasonality → "Classic" round-trip



Resource breakouts → Erratic migration

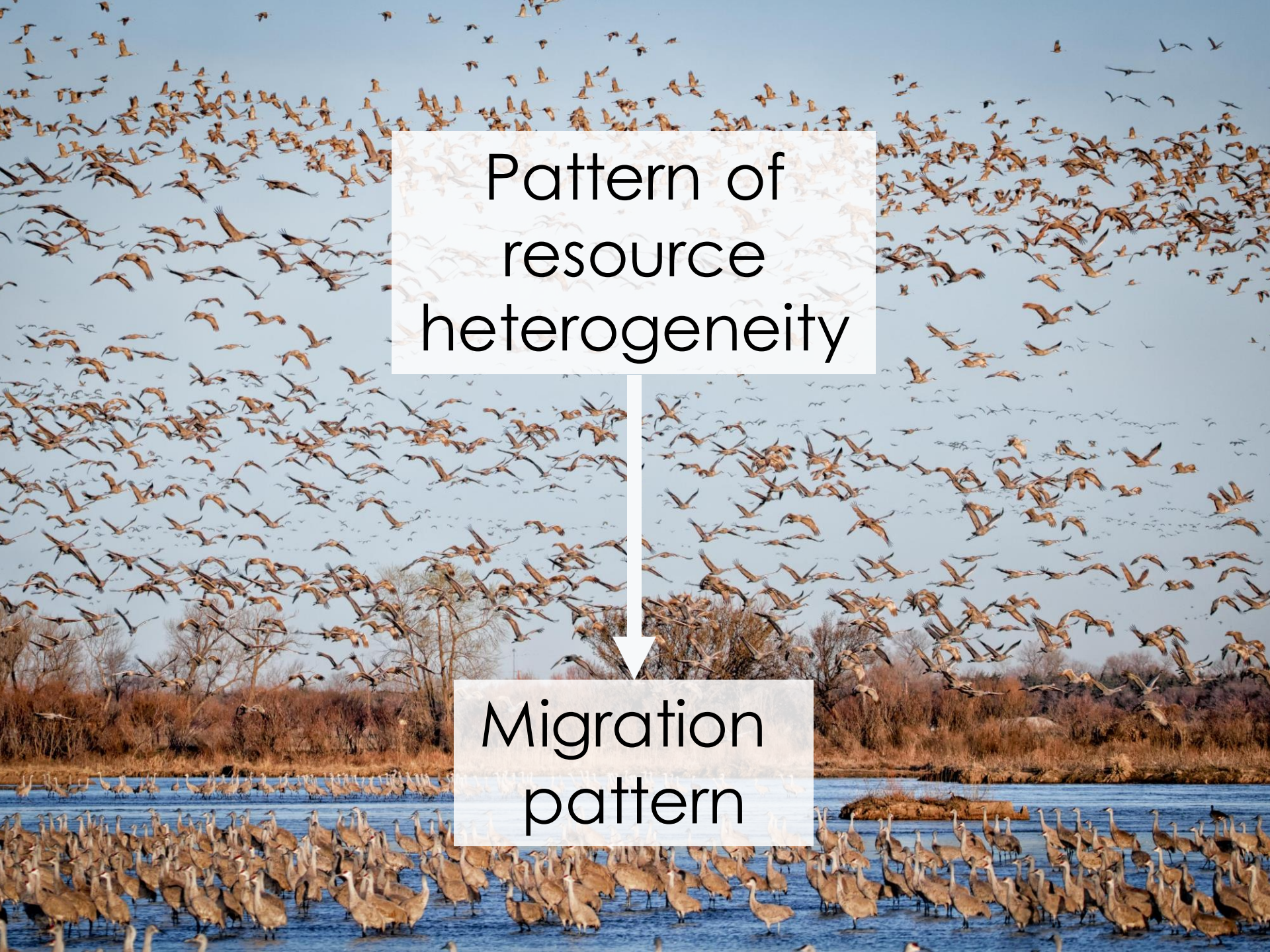


Resource trade-offs → Partial migration



Unpredictability → Facultative migration



A large flock of birds, likely geese or swans, is shown in flight over a body of water. The birds are brown and white, and they are flying in a dense, organized pattern. The sky is a clear, pale blue. In the foreground, a large number of birds are standing in the shallow water, their heads and necks visible. The background shows a line of trees and shrubs along the shore. A white rectangular box with black text is overlaid on the upper part of the image.

Pattern of
resource
heterogeneity

A large flock of birds, likely geese or swans, is shown in flight over a body of water. The birds are brown and white, and they are flying in a dense, organized pattern. The sky is a clear, pale blue. In the foreground, a large number of birds are standing in the shallow water, their heads and necks visible. The background shows a line of trees and shrubs along the shore. A white rectangular box with black text is overlaid on the lower part of the image.

Migration
pattern

Wetlands



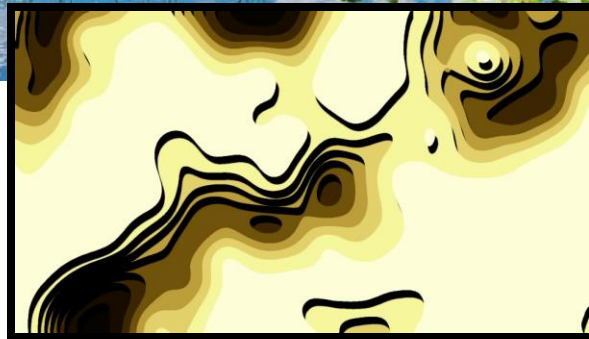
Wetlands



Wetlands



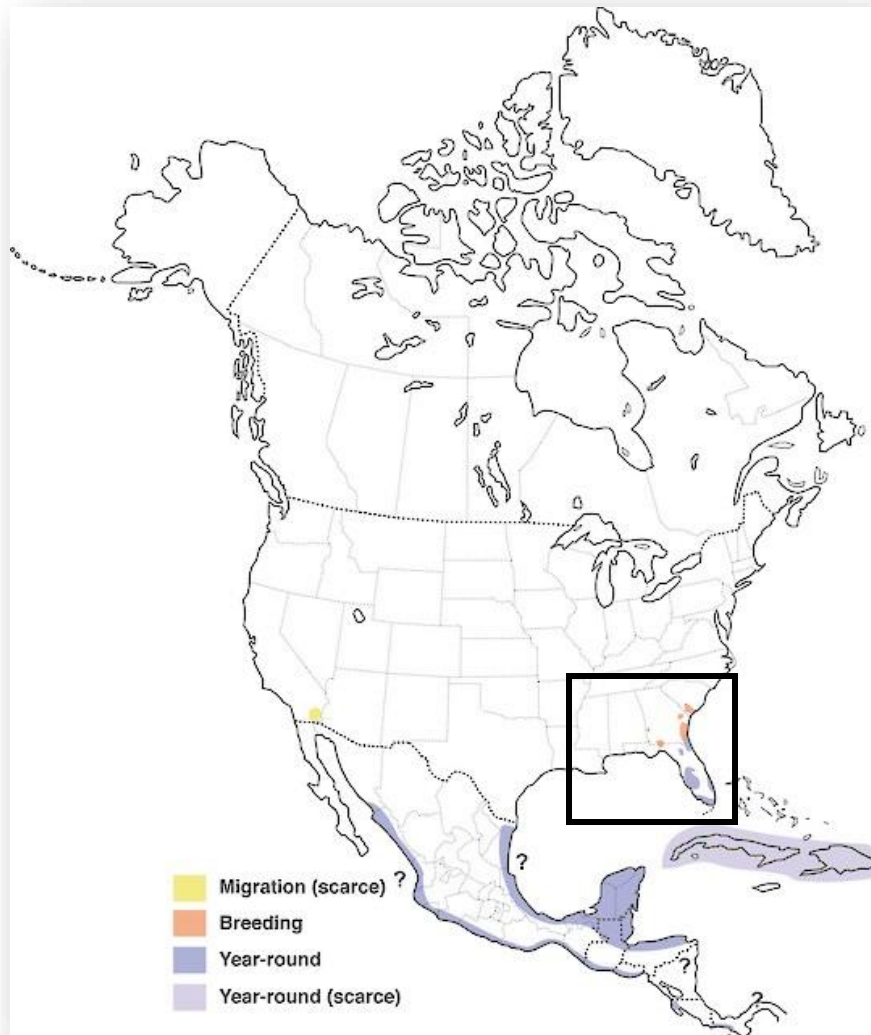
Heterogeneity + Unpredictability



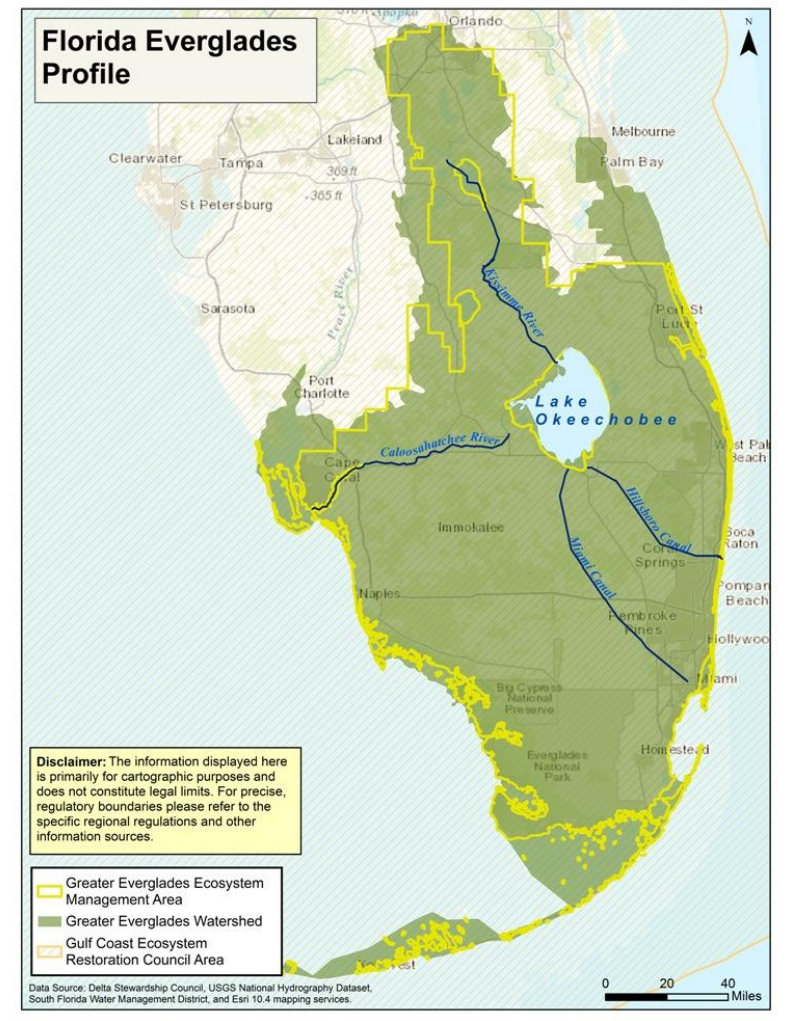
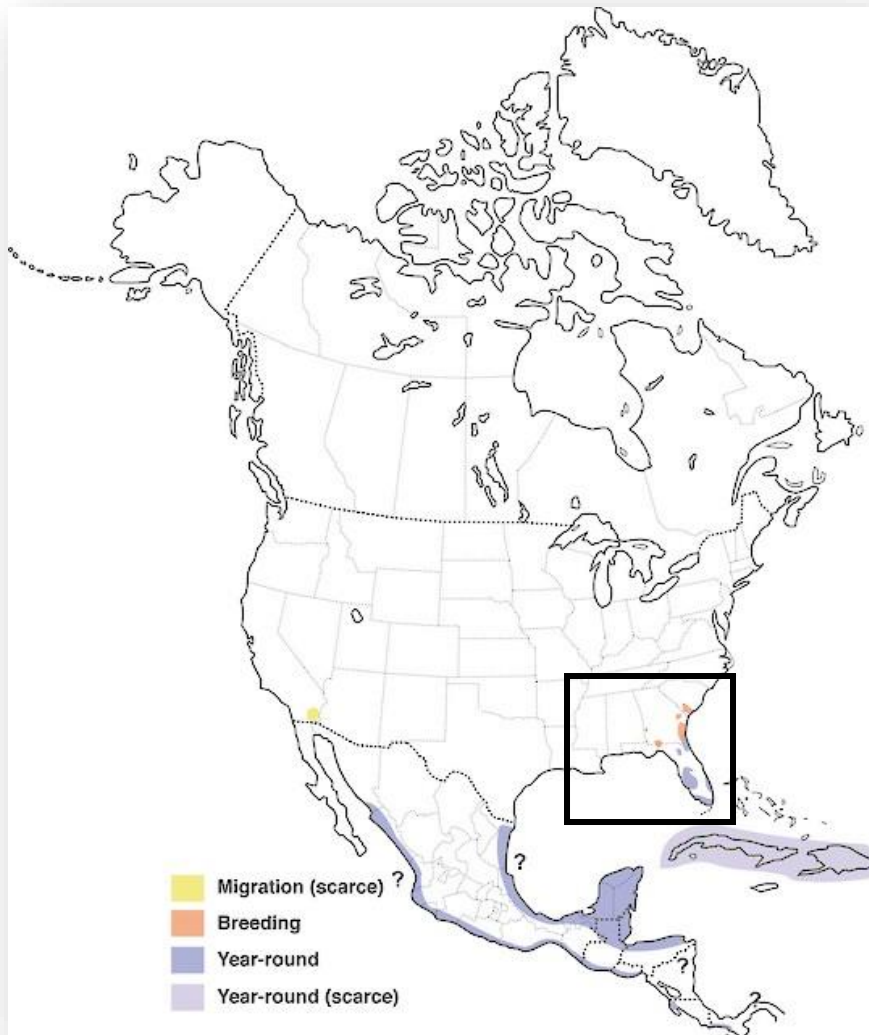
Wood Storks



Wood Storks



Wood Storks



Tactile foragers



Prey need to be concentrated!

Tactile foragers



Prey need to be concentrated!



Tactile foragers



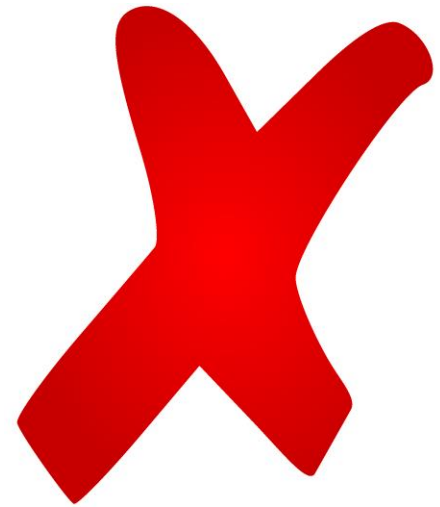
Prey need to be concentrated!



Tactile foragers

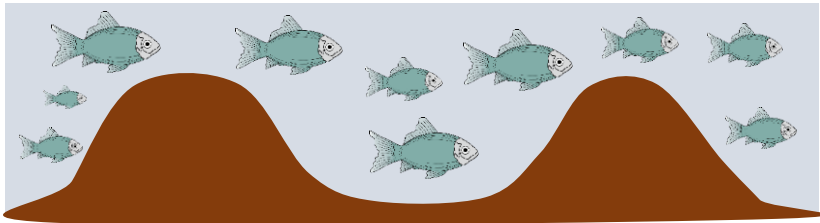


Prey need to be concentrated!



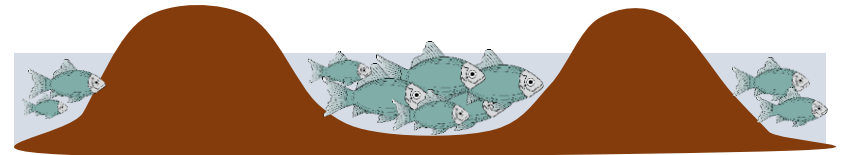
Hydrological Dynamics in the Everglades

Wet season



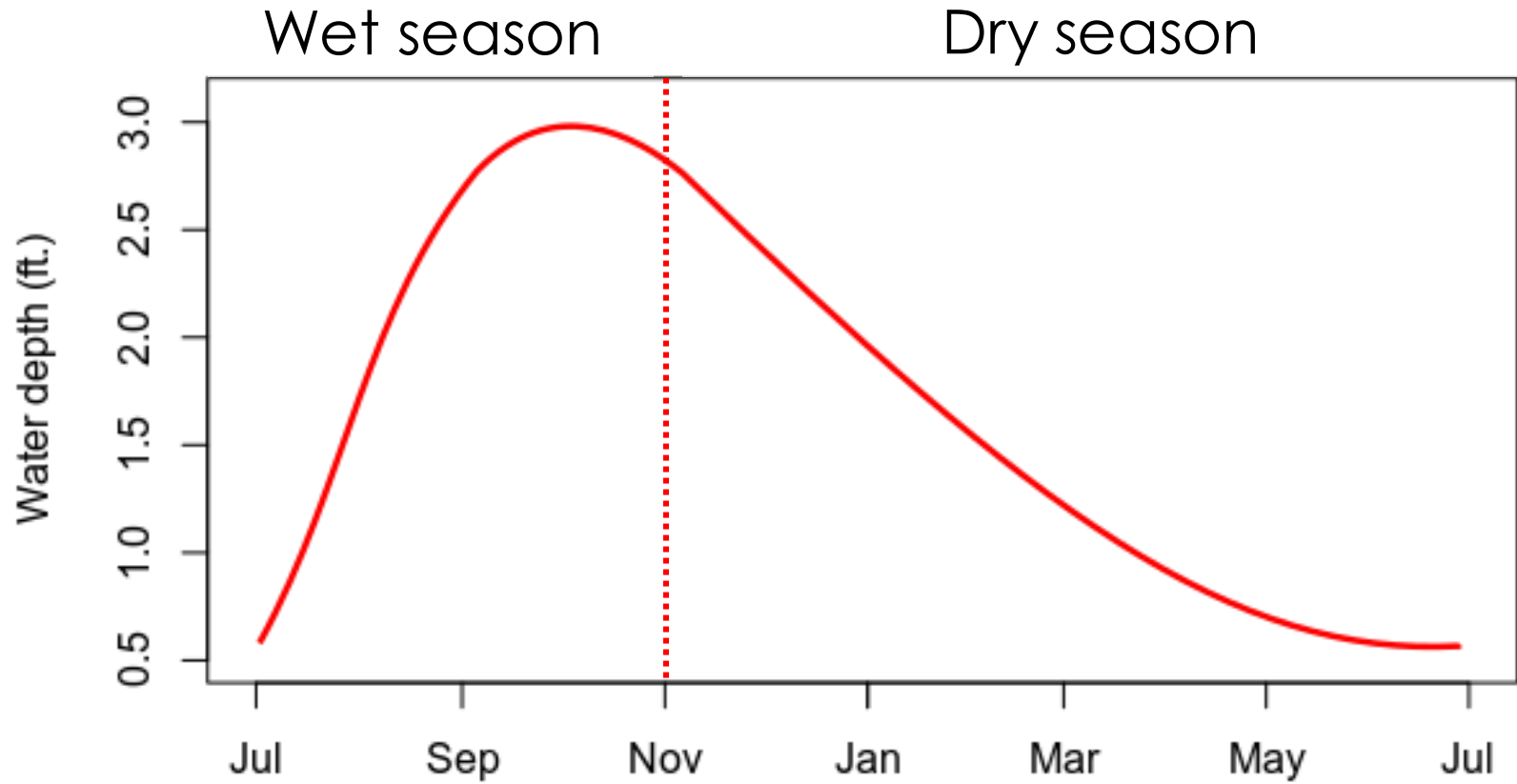
Fish production

Dry season

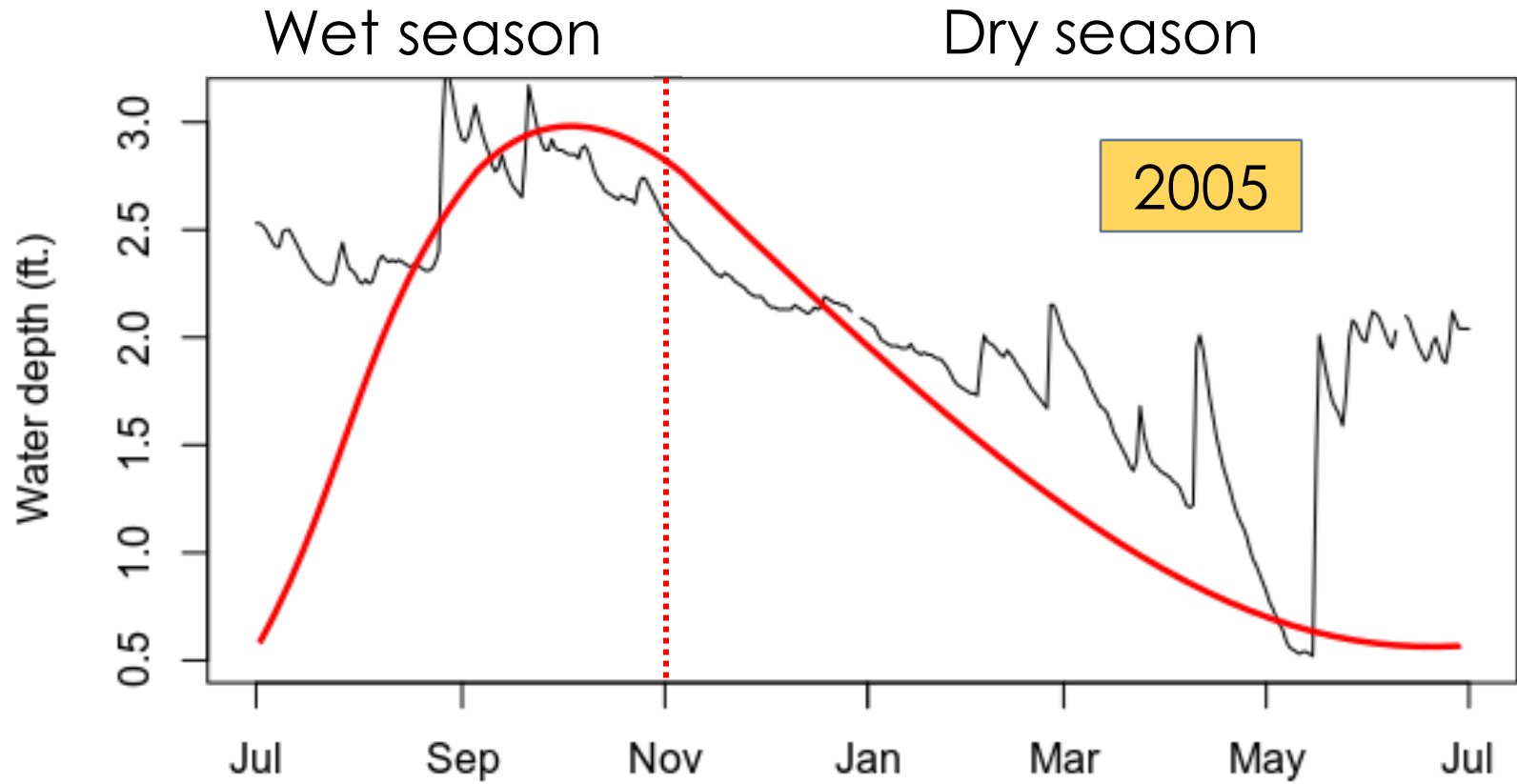


Fish concentration

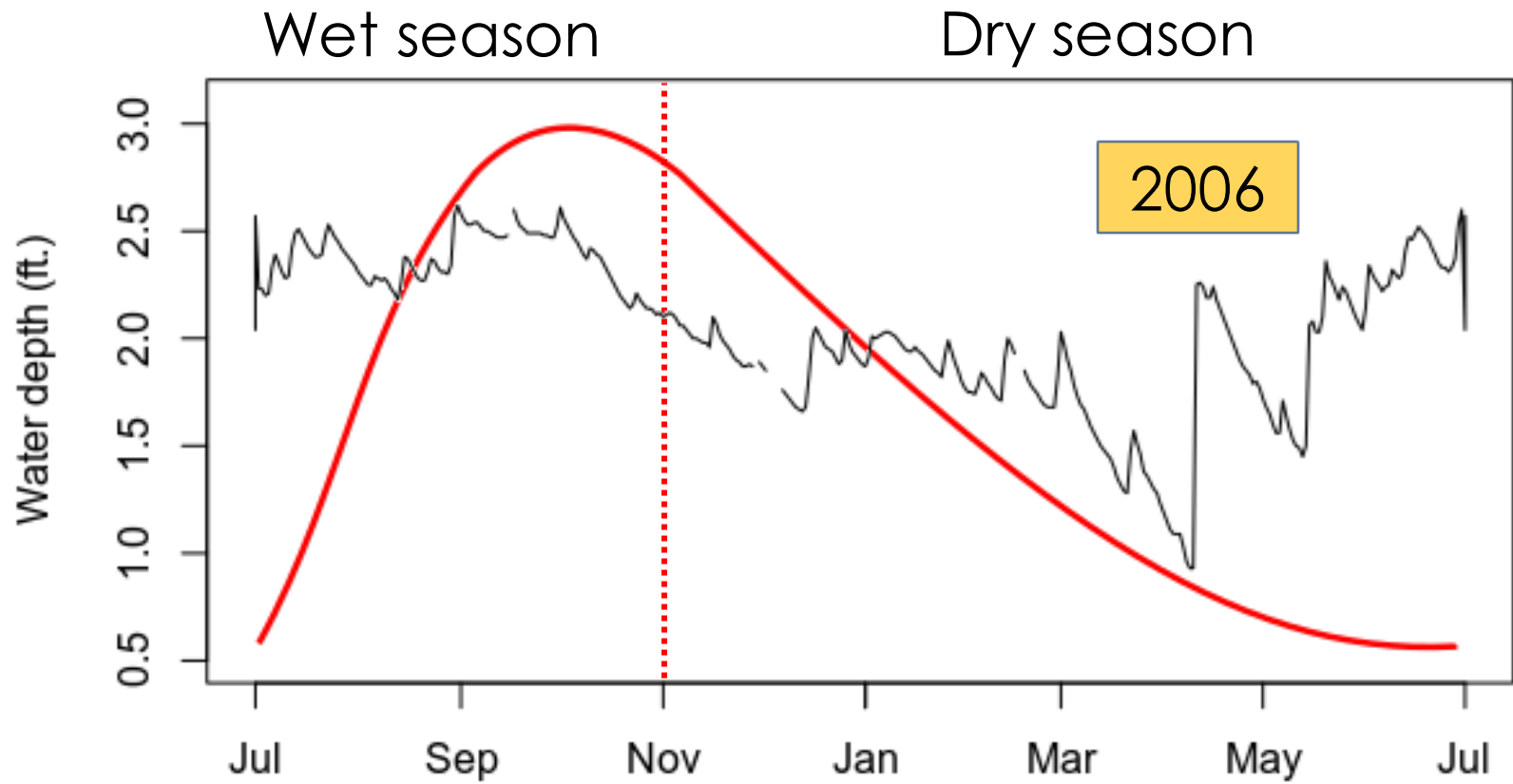
Hydrological Dynamics in the Everglades



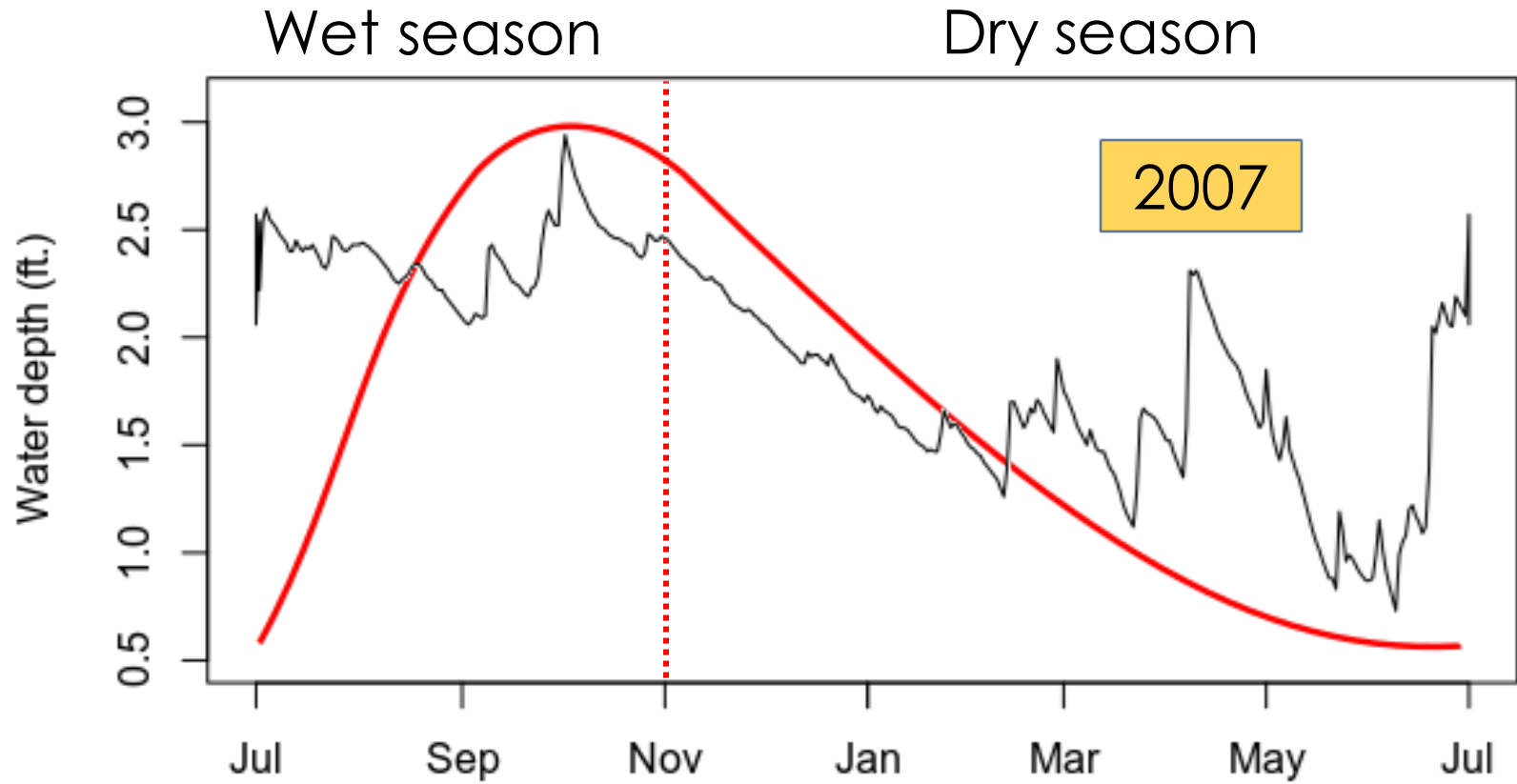
Hydrological Dynamics in the Everglades



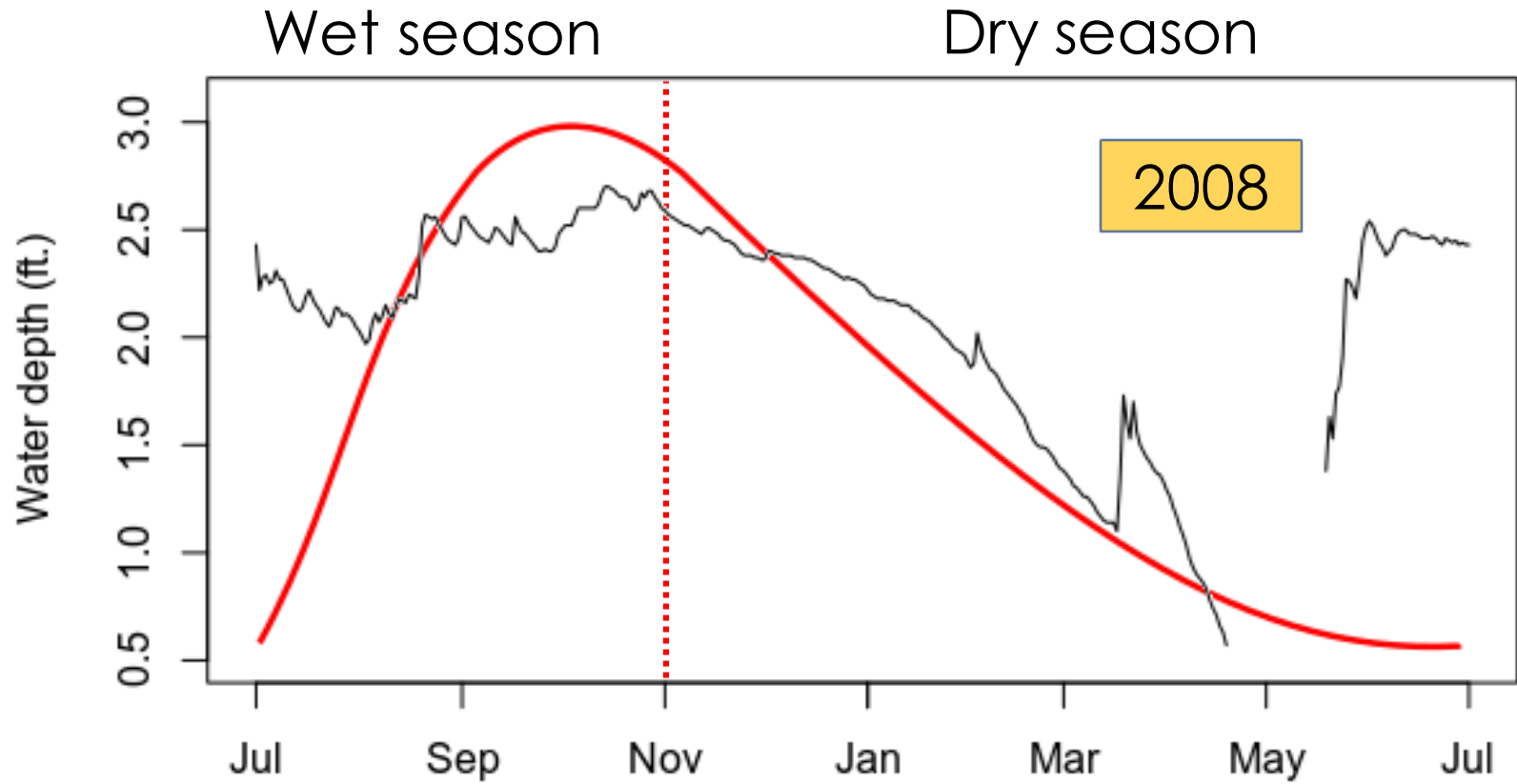
Hydrological Dynamics in the Everglades



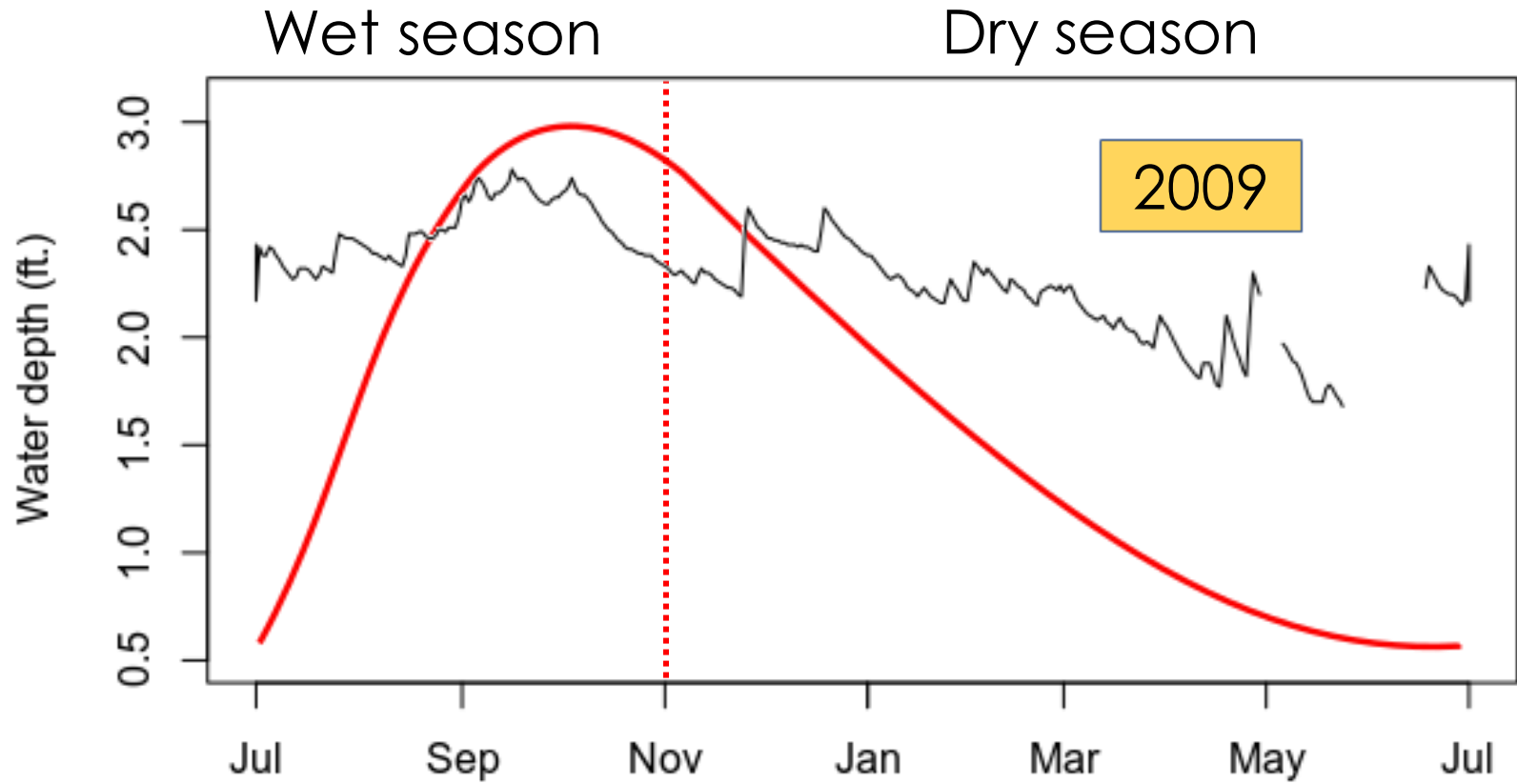
Hydrological Dynamics in the Everglades



Hydrological Dynamics in the Everglades



Hydrological Dynamics in the Everglades





Birds of North America Species Account:
"Not a true migrant"
(Coulter et al. 1992)

Seasonality
+
Unpredictability

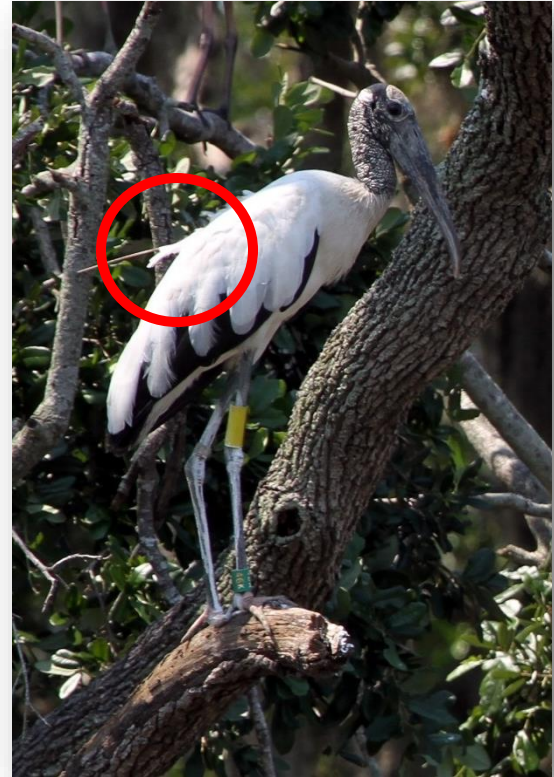
Seasonality
+
Unpredictability



Partial or
facultative
migration

?

GPS-Tracking Data Collection



Captures performed
in 2004-2012
by Rena Borkhataria
et al.

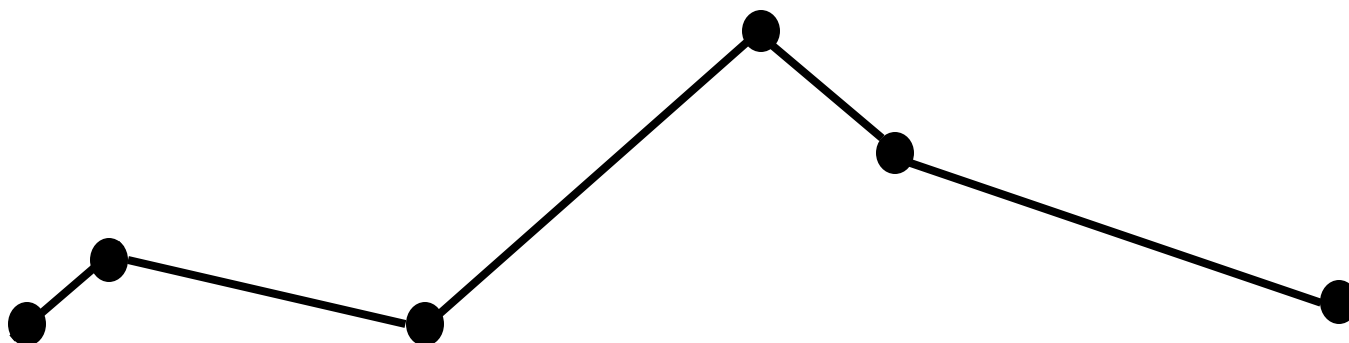


Migration Patterns of Wood Storks in the Southeastern U.S.

Classification of migratory behavior

Migratory choice: y/n
(each year)

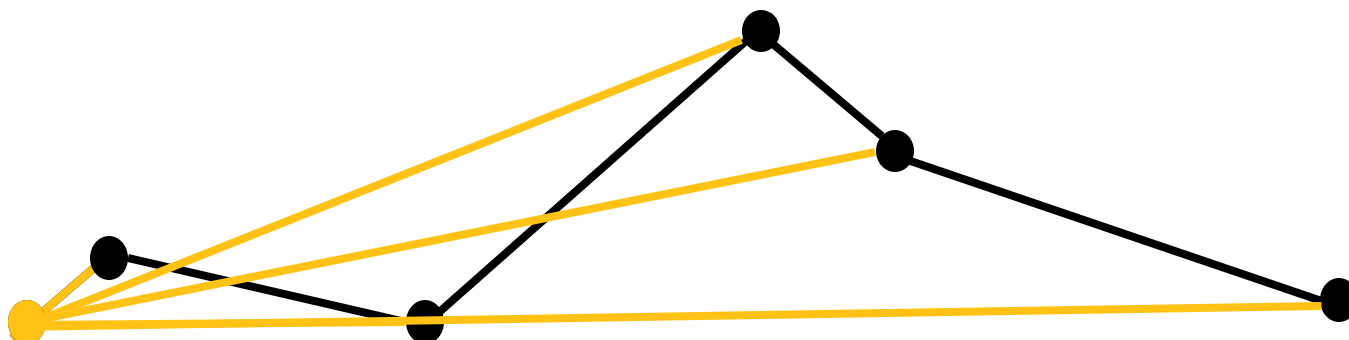
Net Squared Displacement



Classification of migratory behavior

Migratory choice: y/n
(each year)

Net Squared Displacement



Classification of migratory behavior



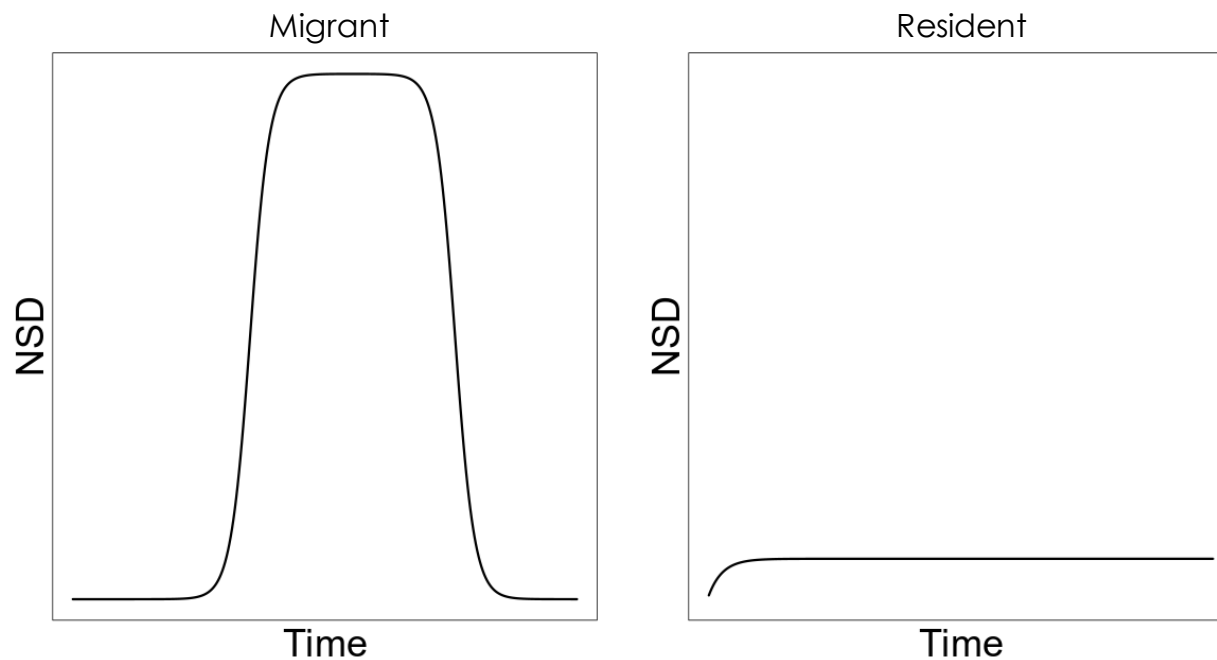
Package
'migrateR'

Migratory choice: y/n
(each year)

Final dataset:
200 individual
years from 64
individuals

Net Squared Displacement

Fit set of alternative non-linear
models to NSD data

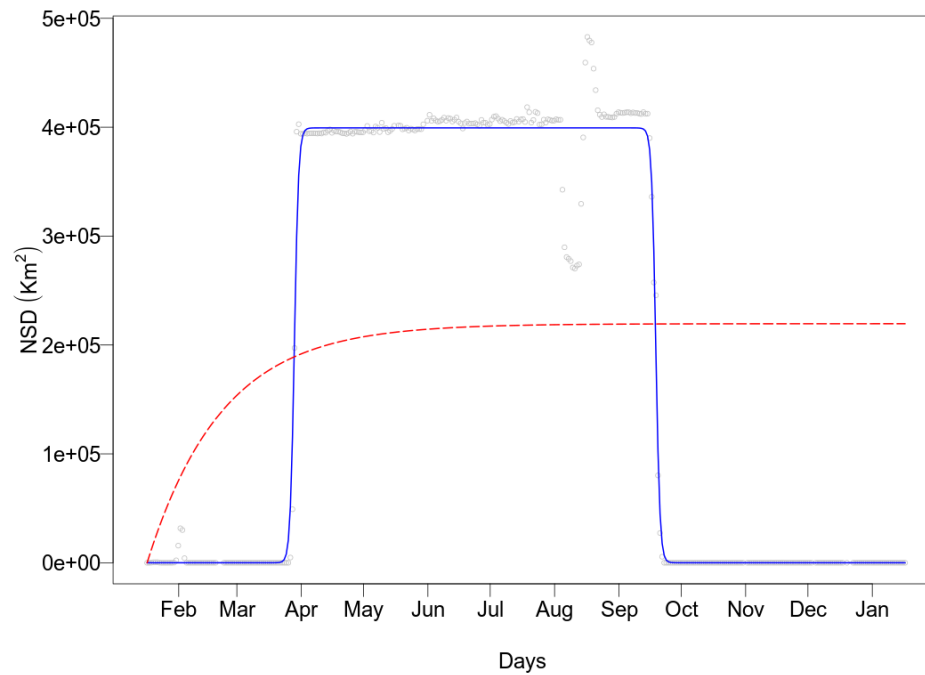


Model selection by AIC

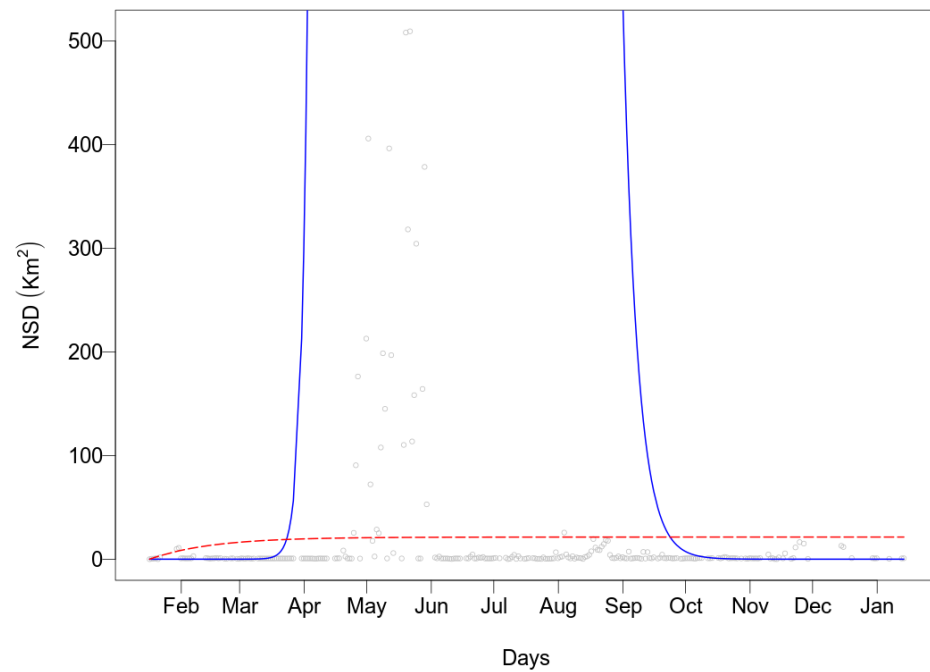
Results

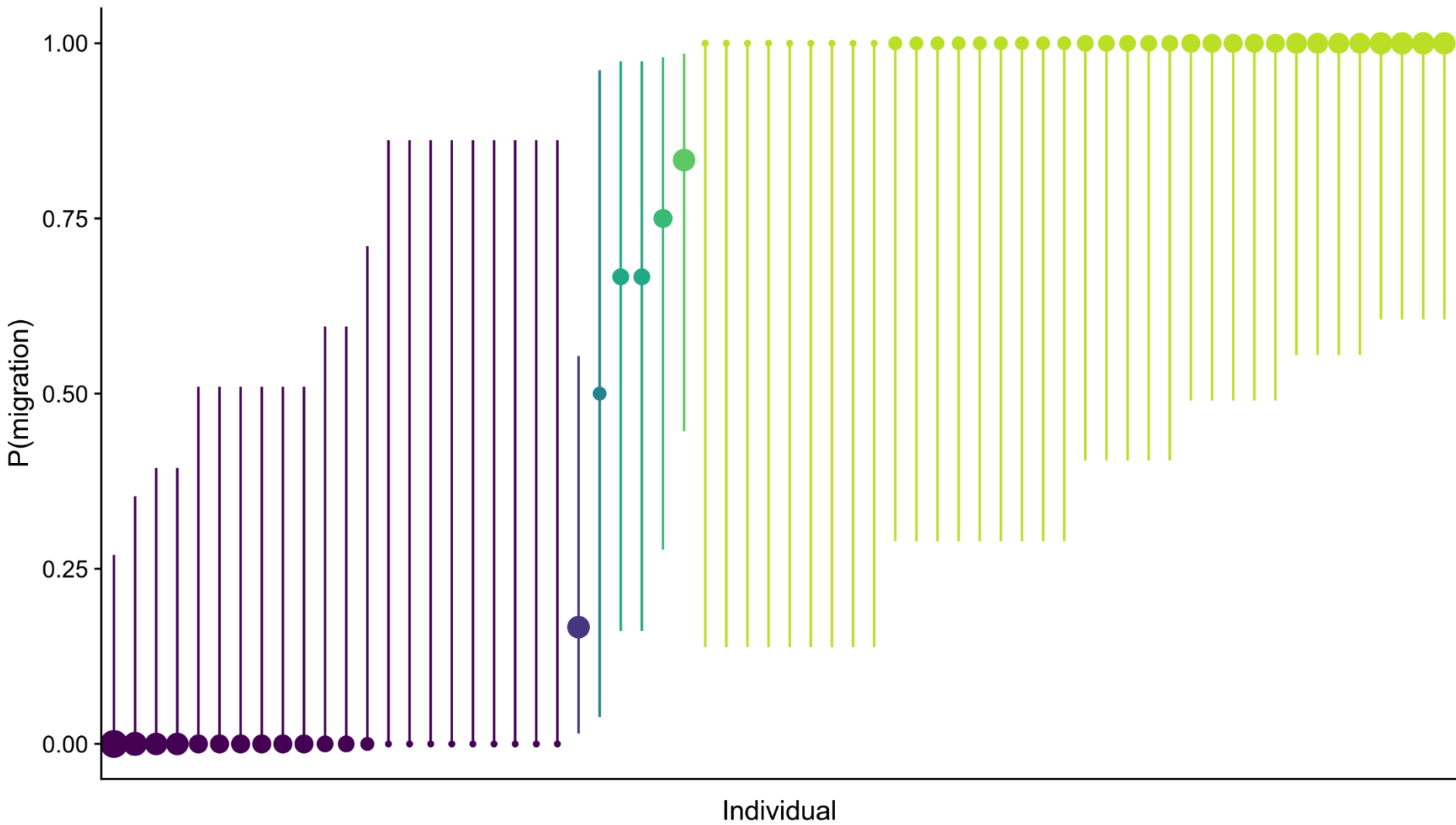


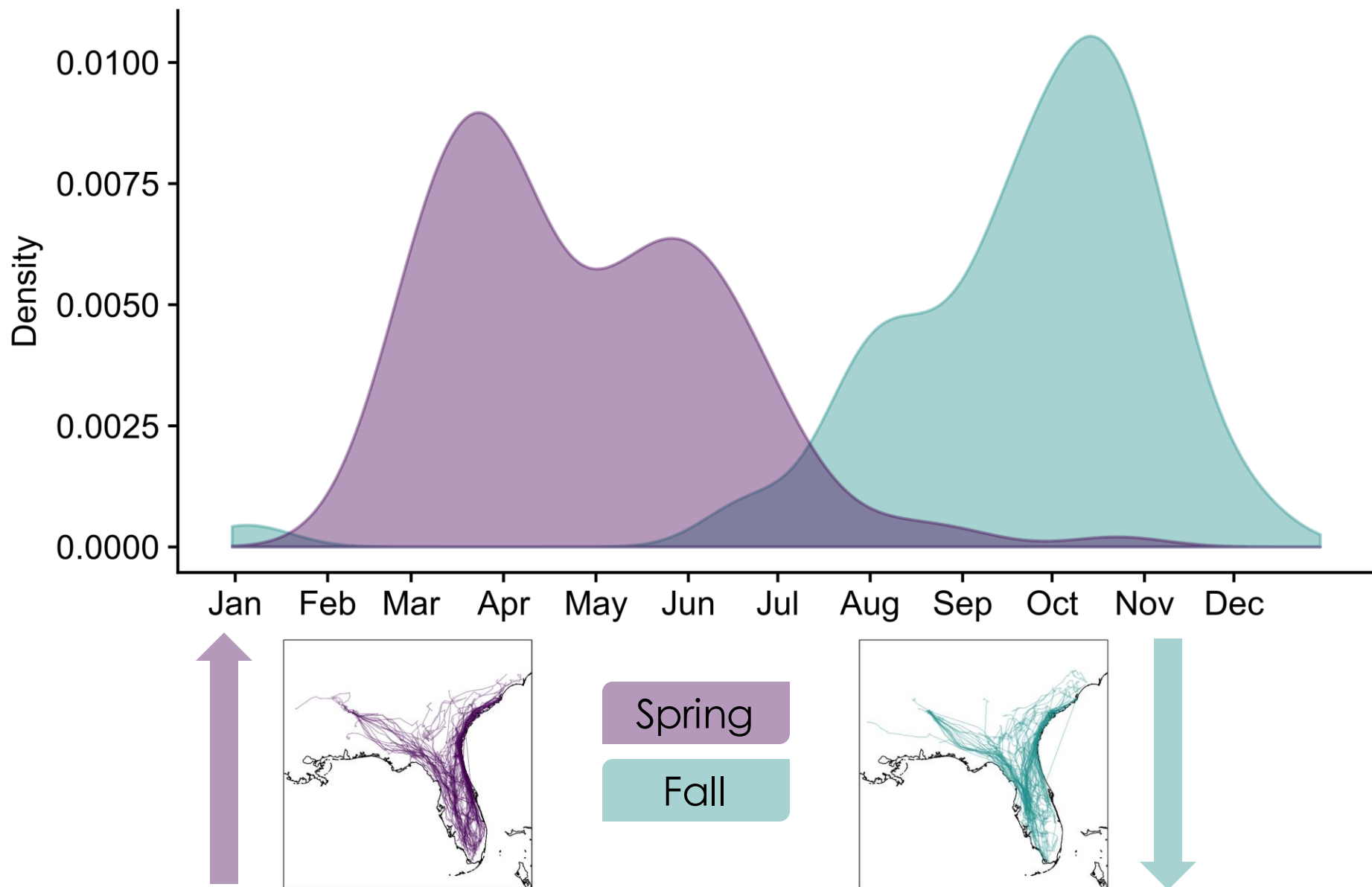
121 migrations (60%)



79 residencies (40%)







Population,
Summer

Population,
Winter



10

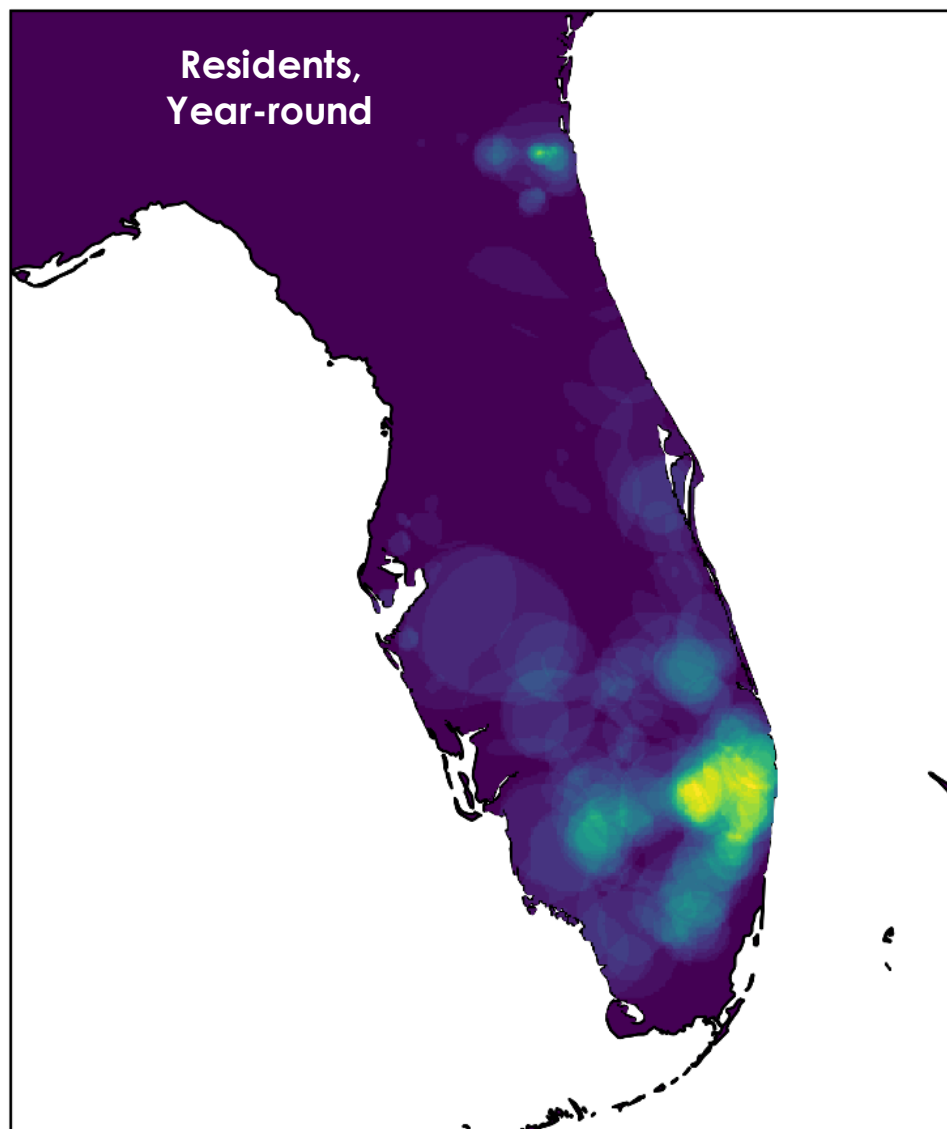
20

30

40

50

Number of overlapping ranges



5 10 15 20 25

Number of overlapping ranges

Seasonality
+
Unpredictability



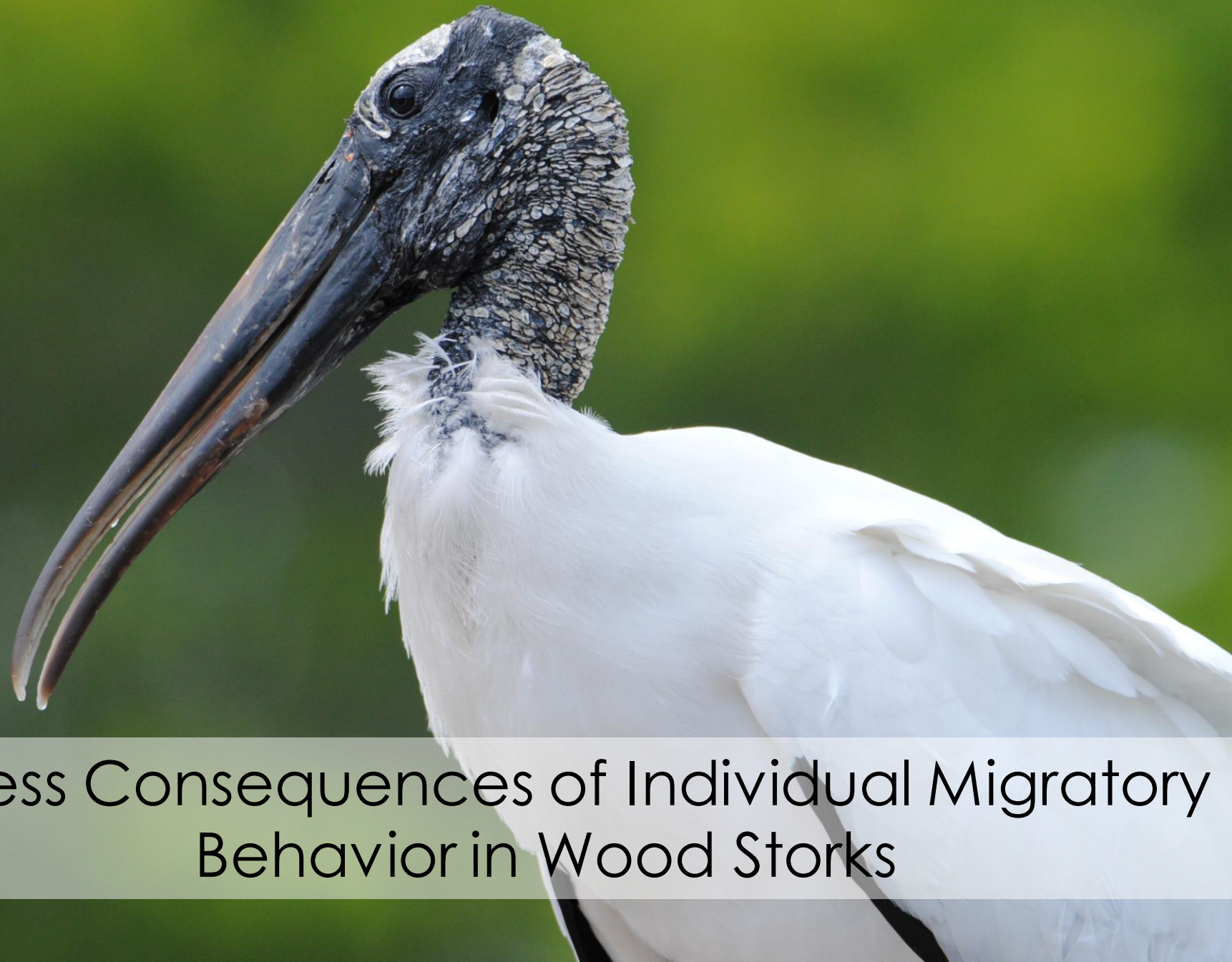
Partial or
facultative
migration





- Are different migratory choices associated with trade-offs in resource acquisition?
- Does this result in different fitness consequences?





Fitness Consequences of Individual Migratory Behavior in Wood Storks

Adaptive value of behavioral heterogeneity in changing environments?

- Barriers to movement
- Phenological shifts
- Anthropogenic food supplementation



Anthropogenic food supplementation

↓ Migration

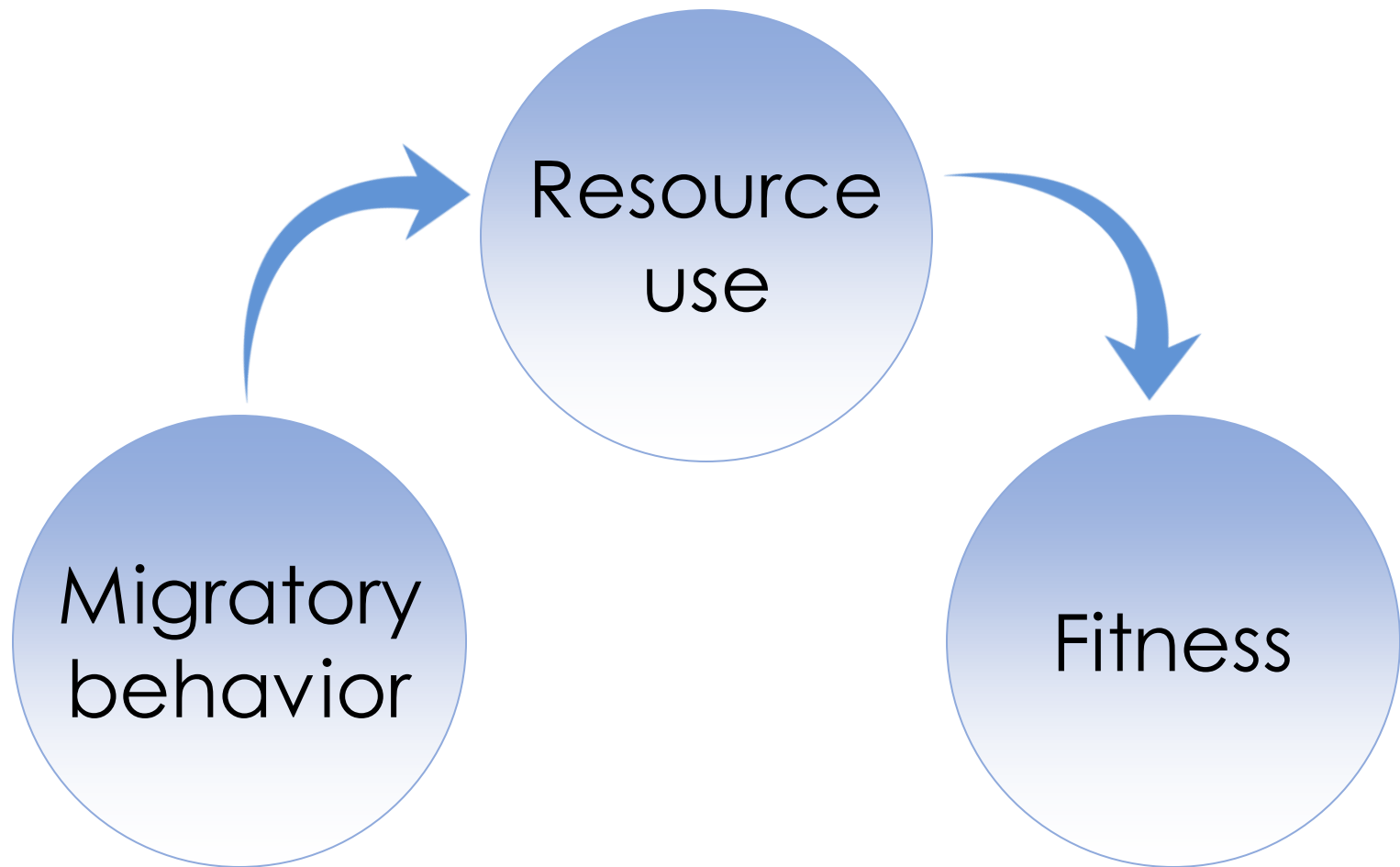
Residency ↑



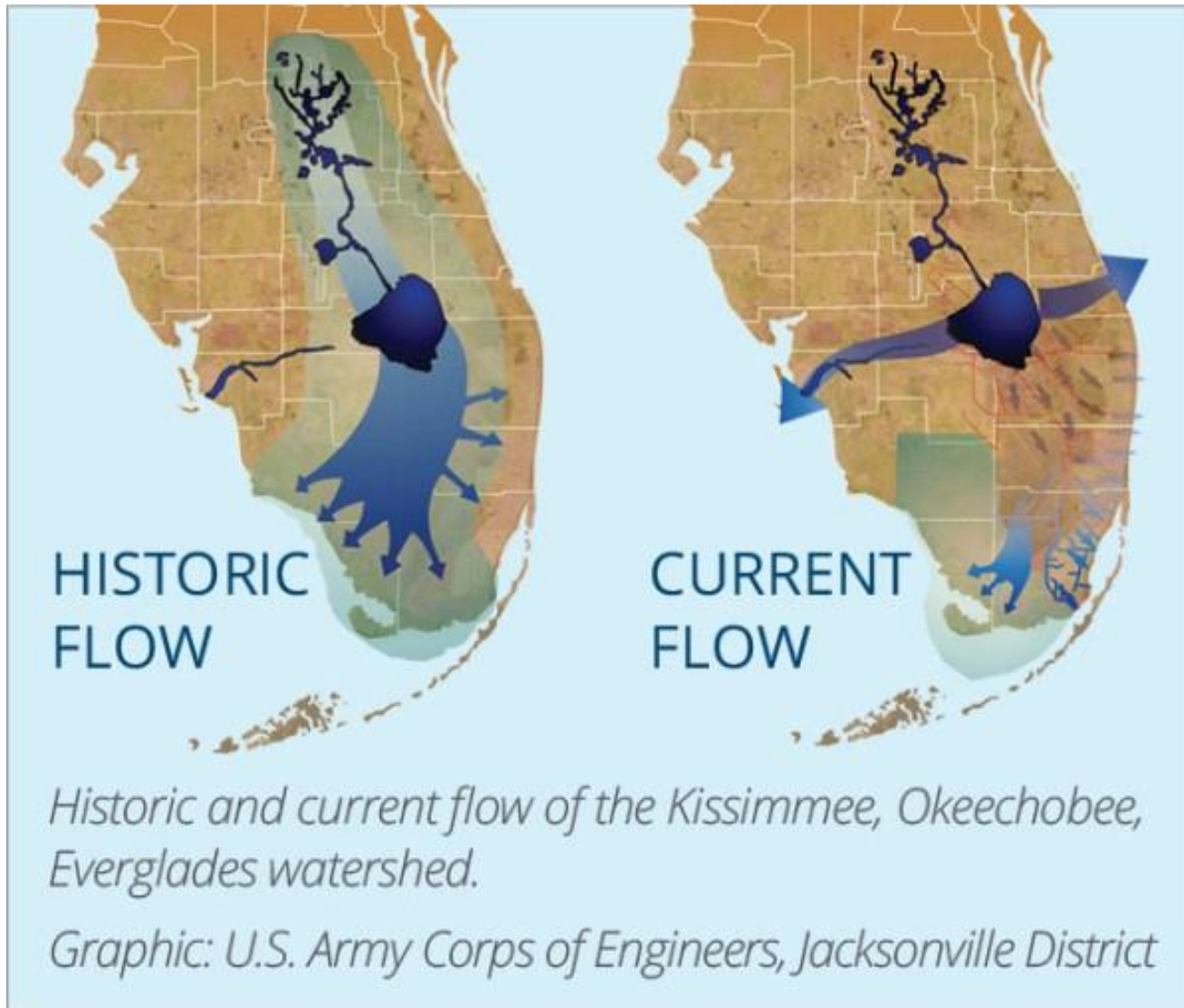
Anthropogenic food supplementation

↓ Migration

Residency ↑



Anthropogenic alteration of natural food sources



Novel anthropogenic food sources

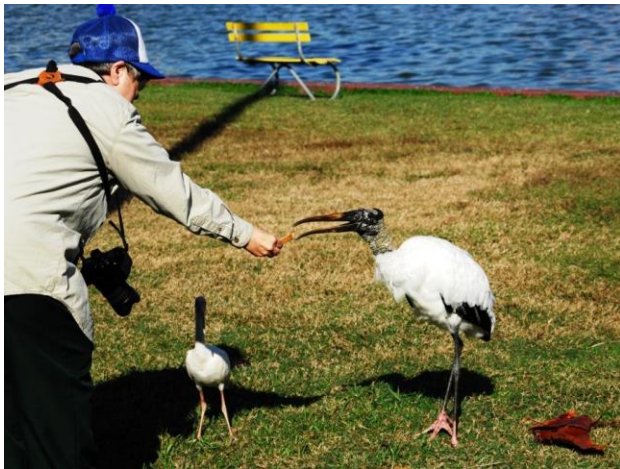
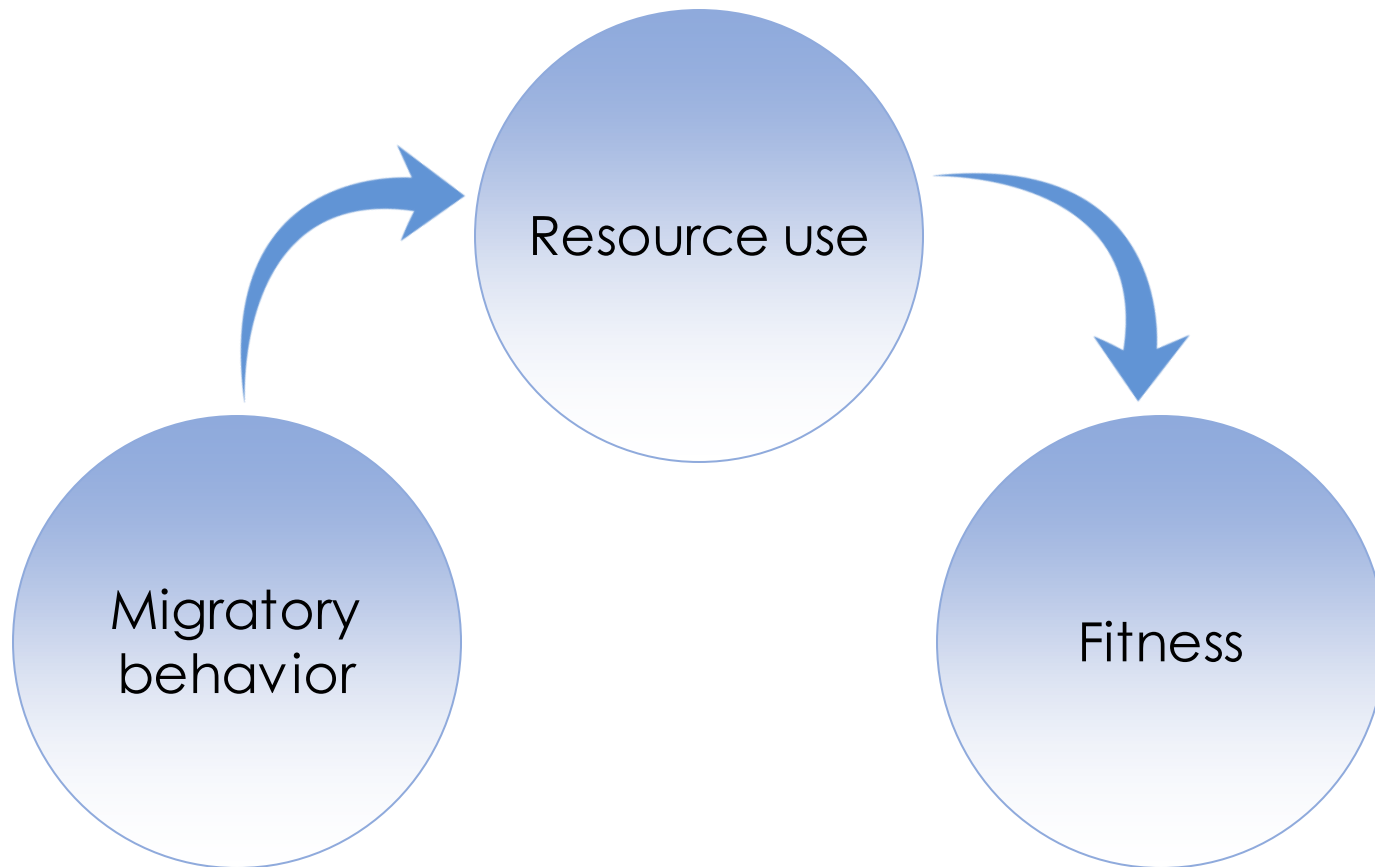


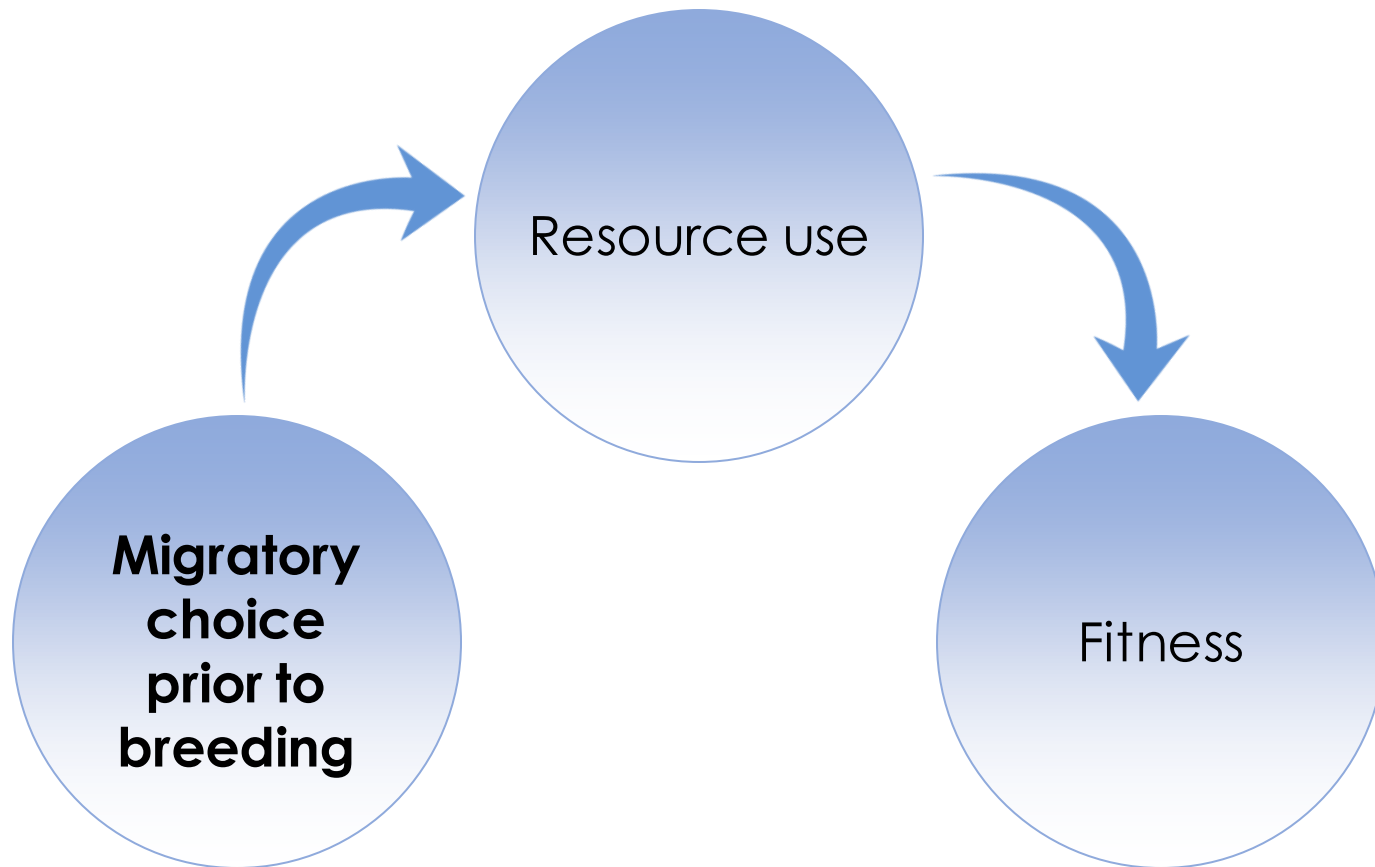
Photo: Tessie Offner



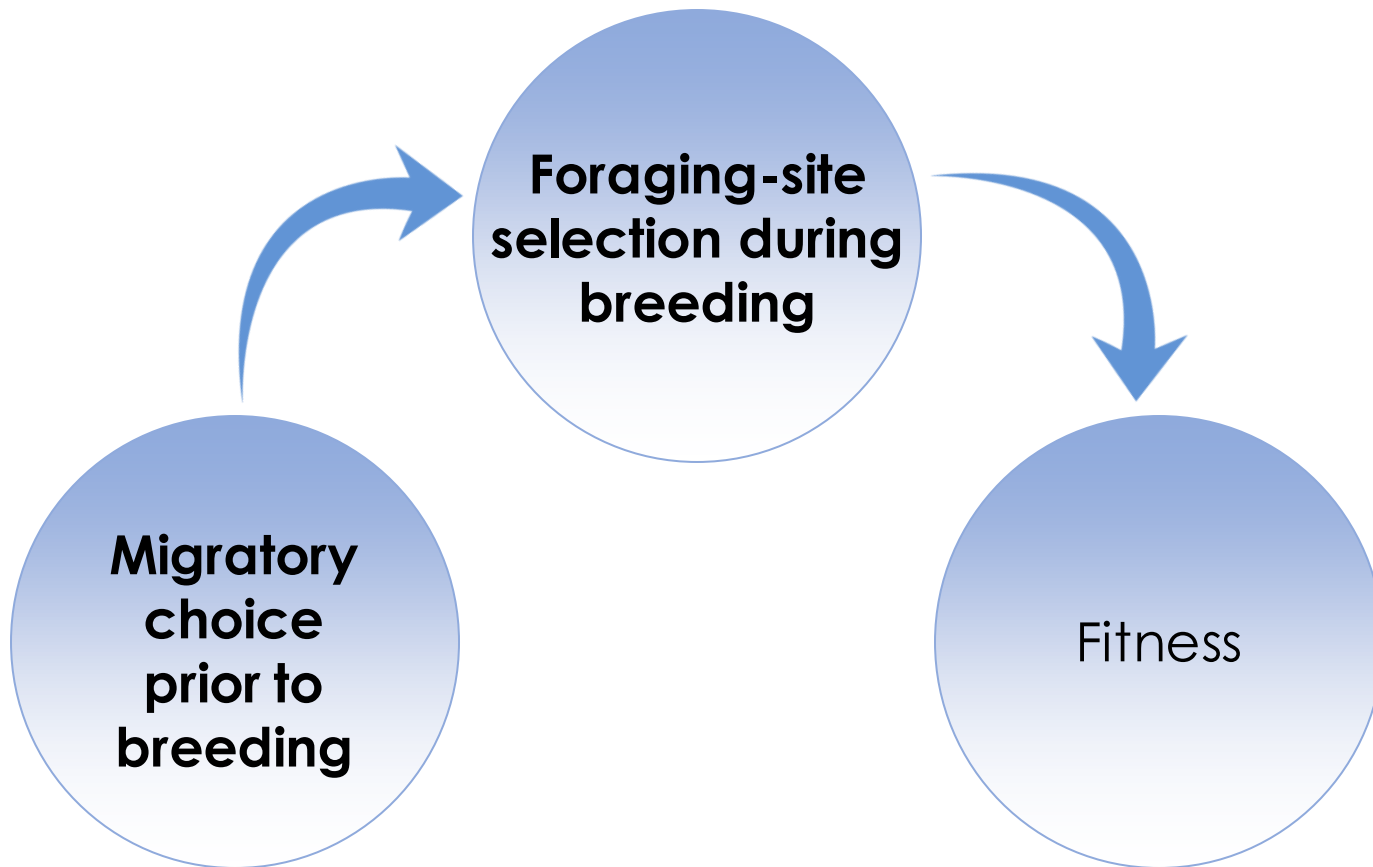
Focus on breeding season



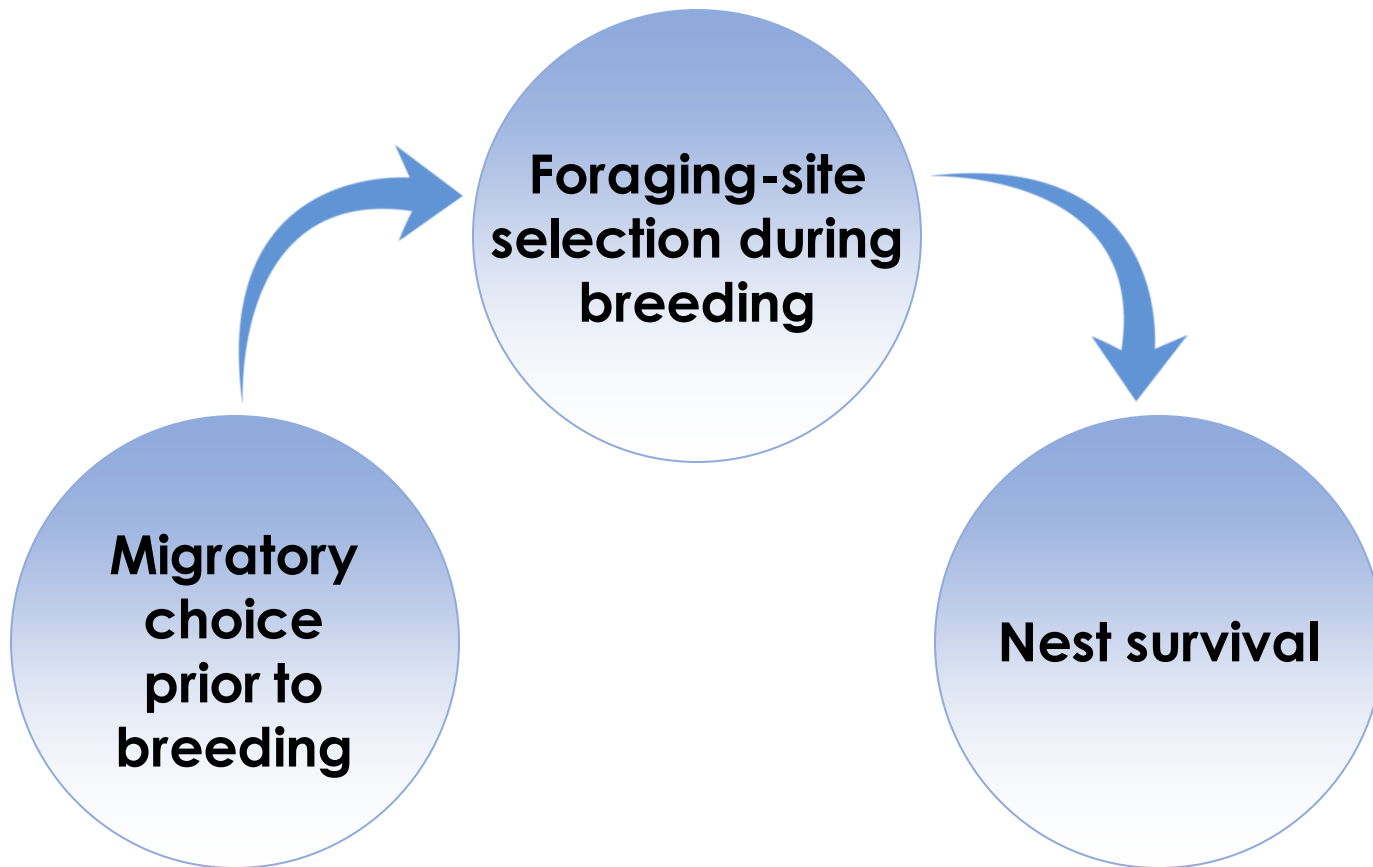
Focus on breeding season



Focus on breeding season

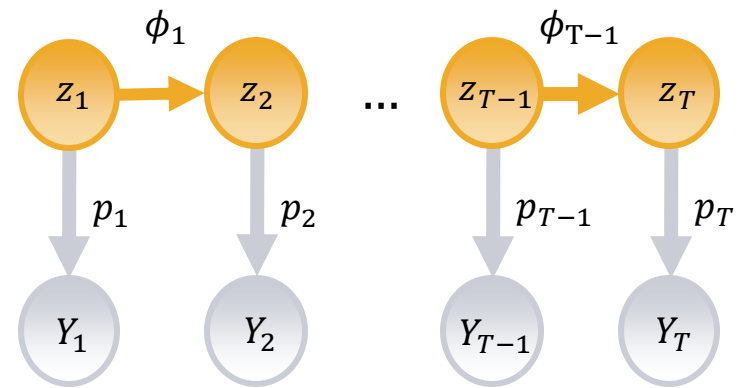
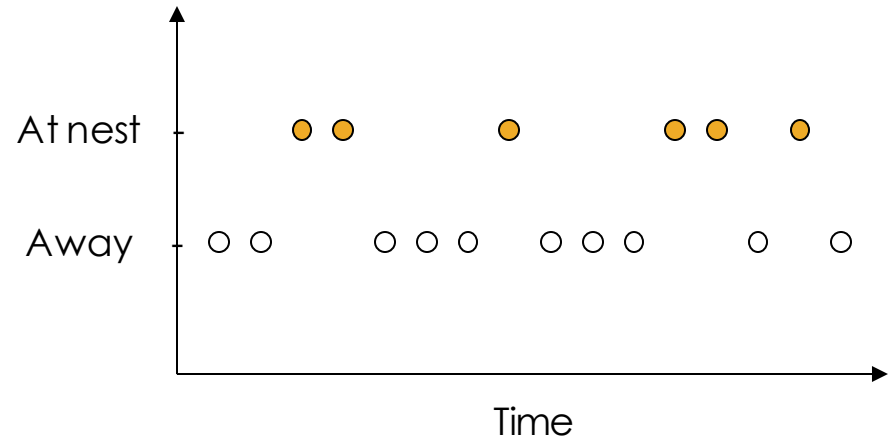
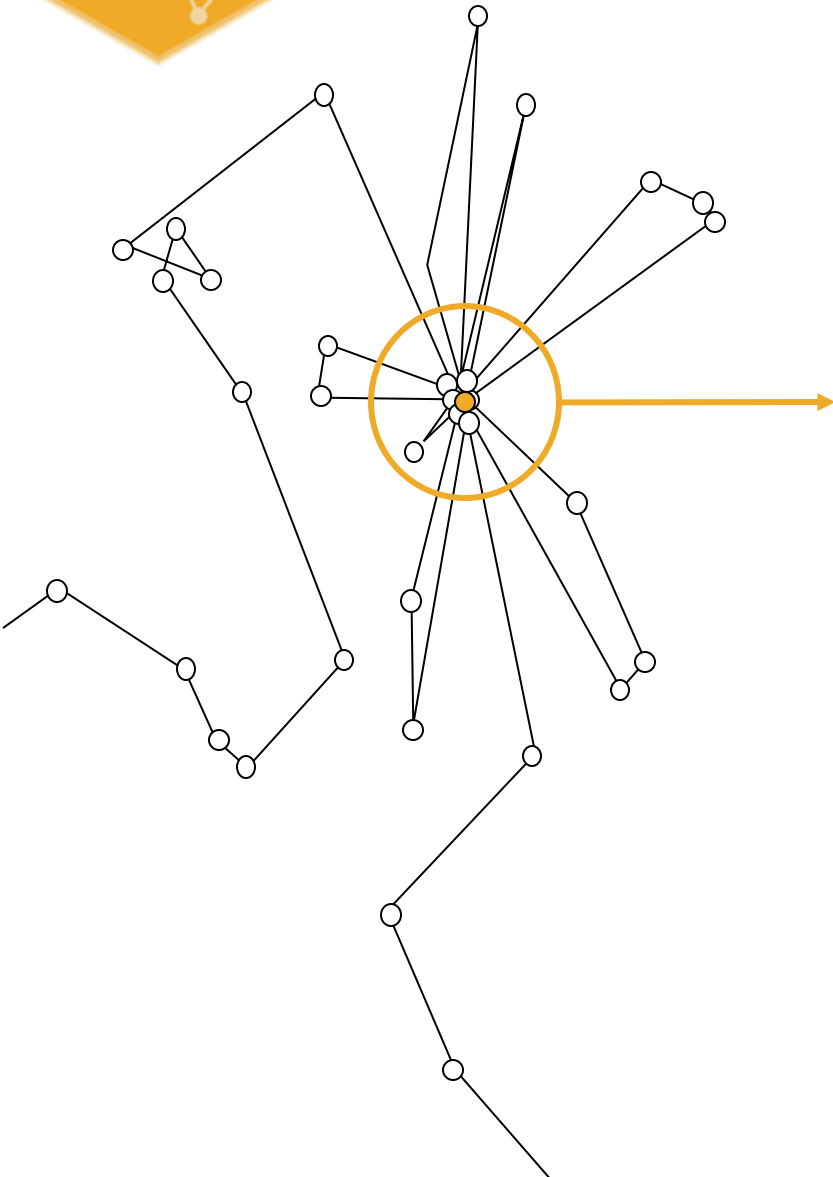


Focus on breeding season

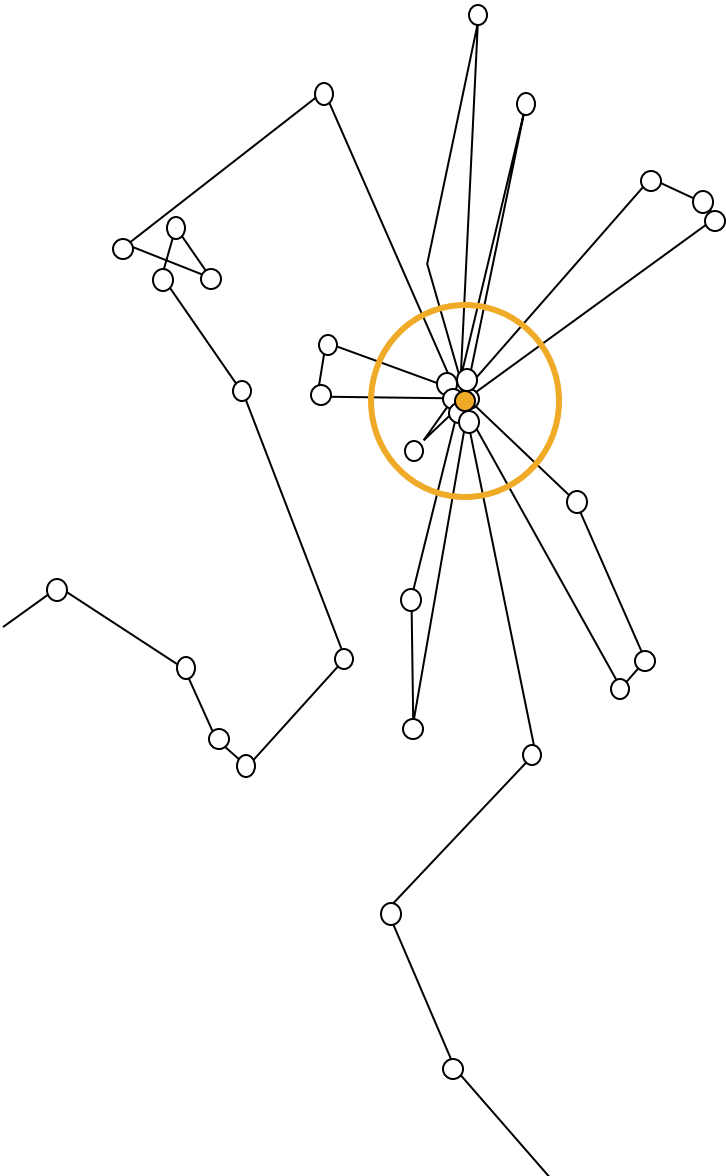




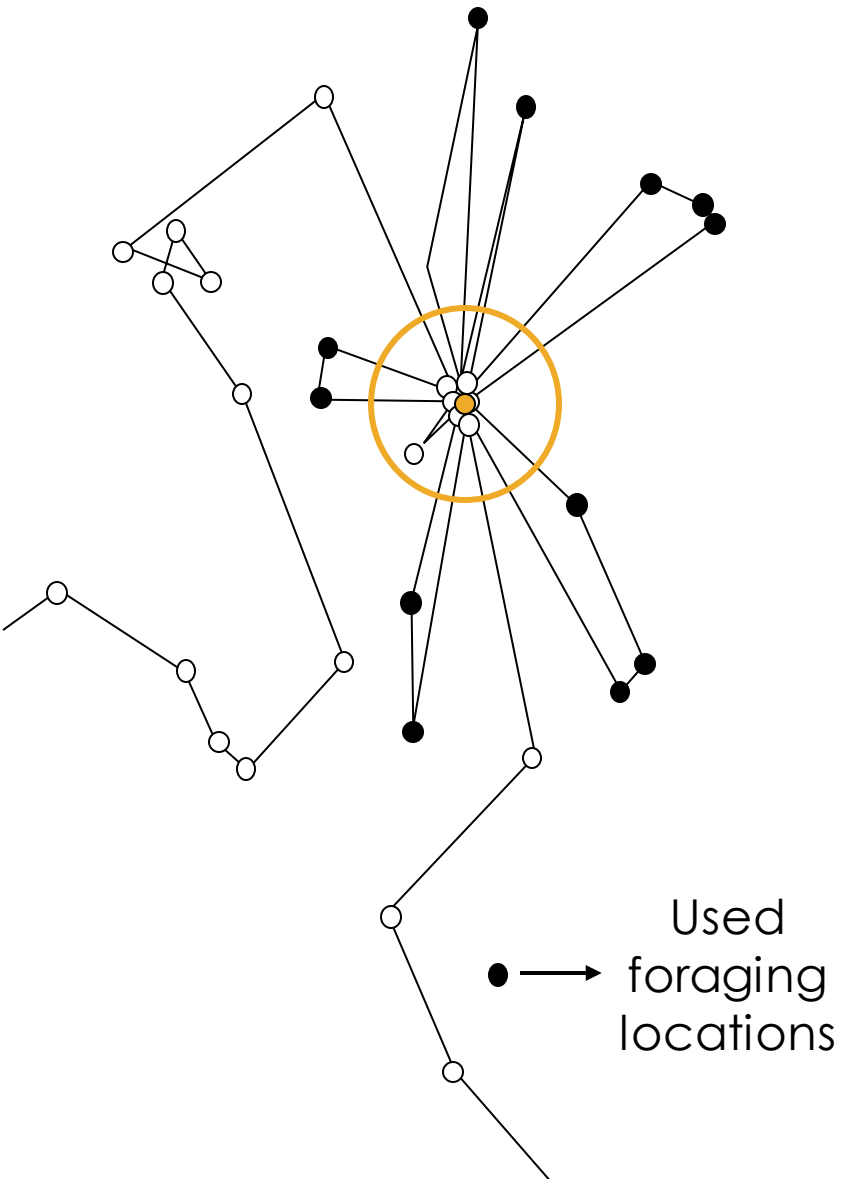
Nest survival analysis



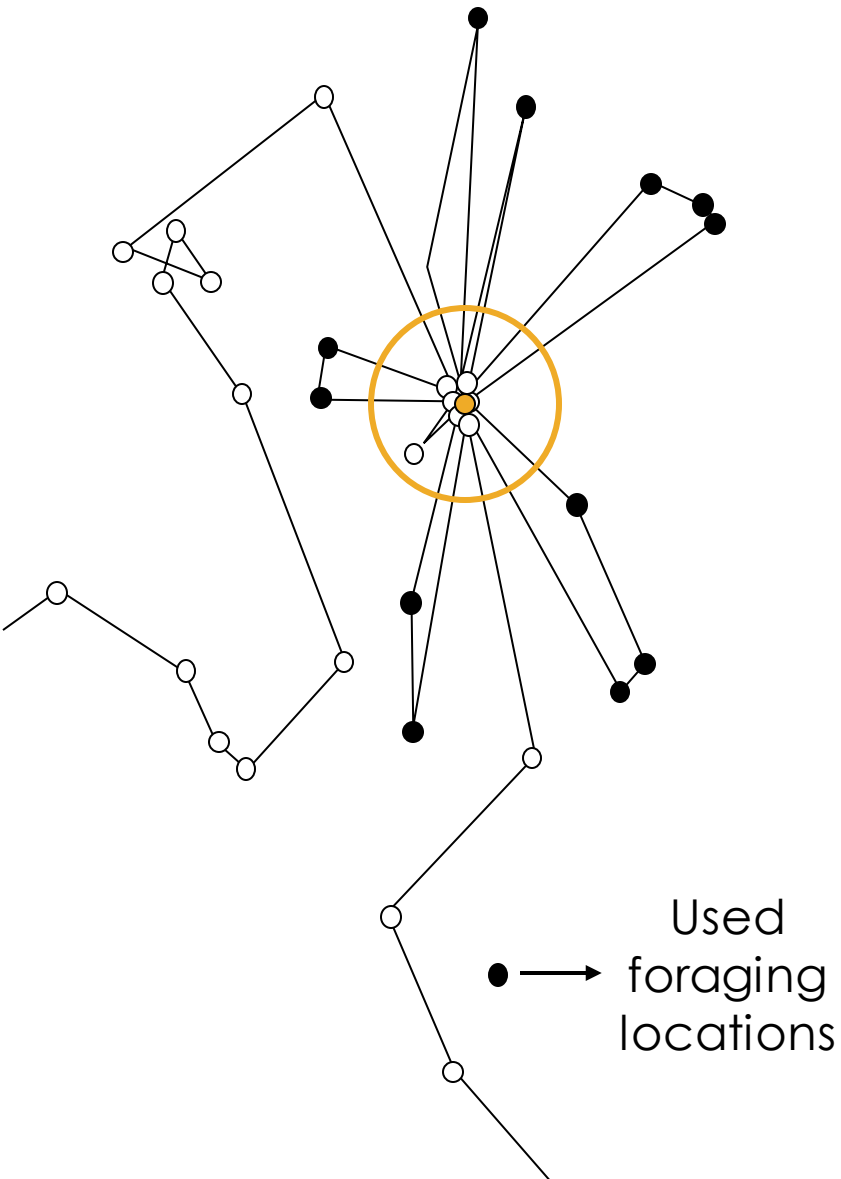
Foraging-site selection analysis



Foraging-site selection analysis

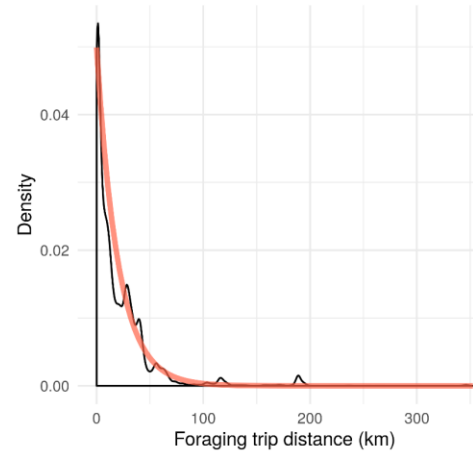


Foraging-site selection analysis

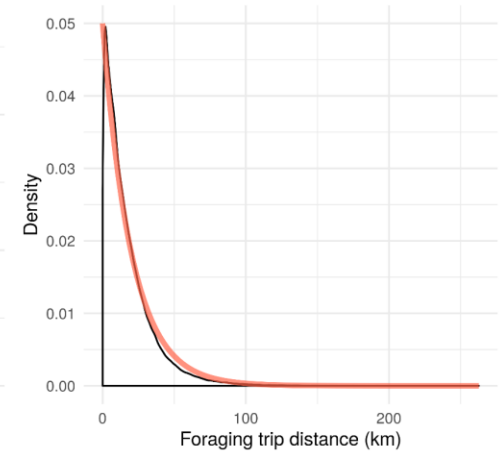


Generated available
locations around the nest

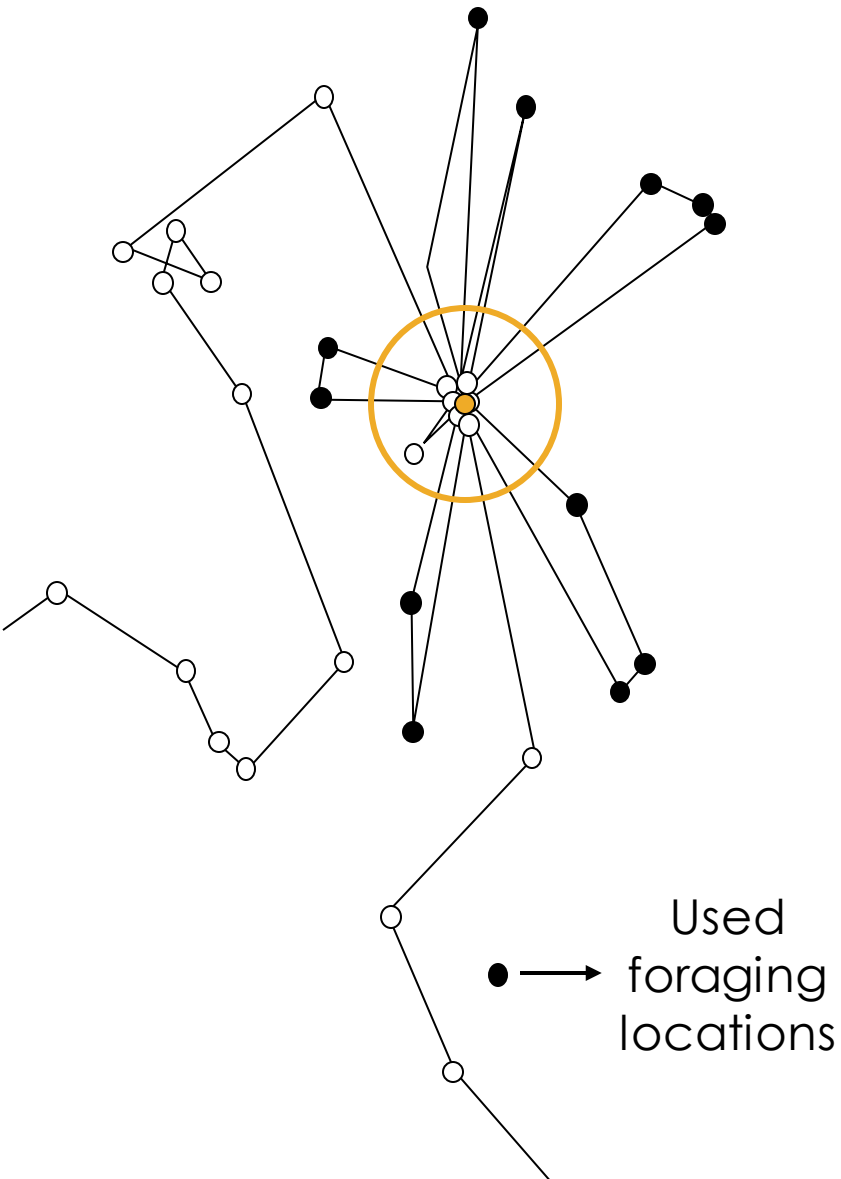
(A) Observed



(B) Simulated

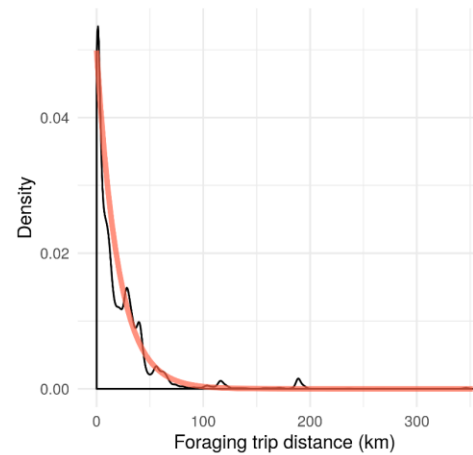


Foraging-site selection analysis

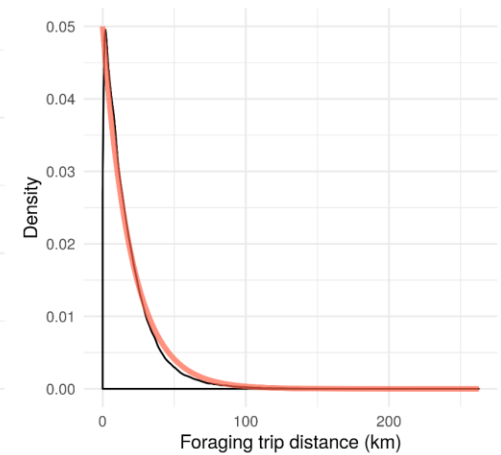


Generated available
locations around the nest

(A) Observed



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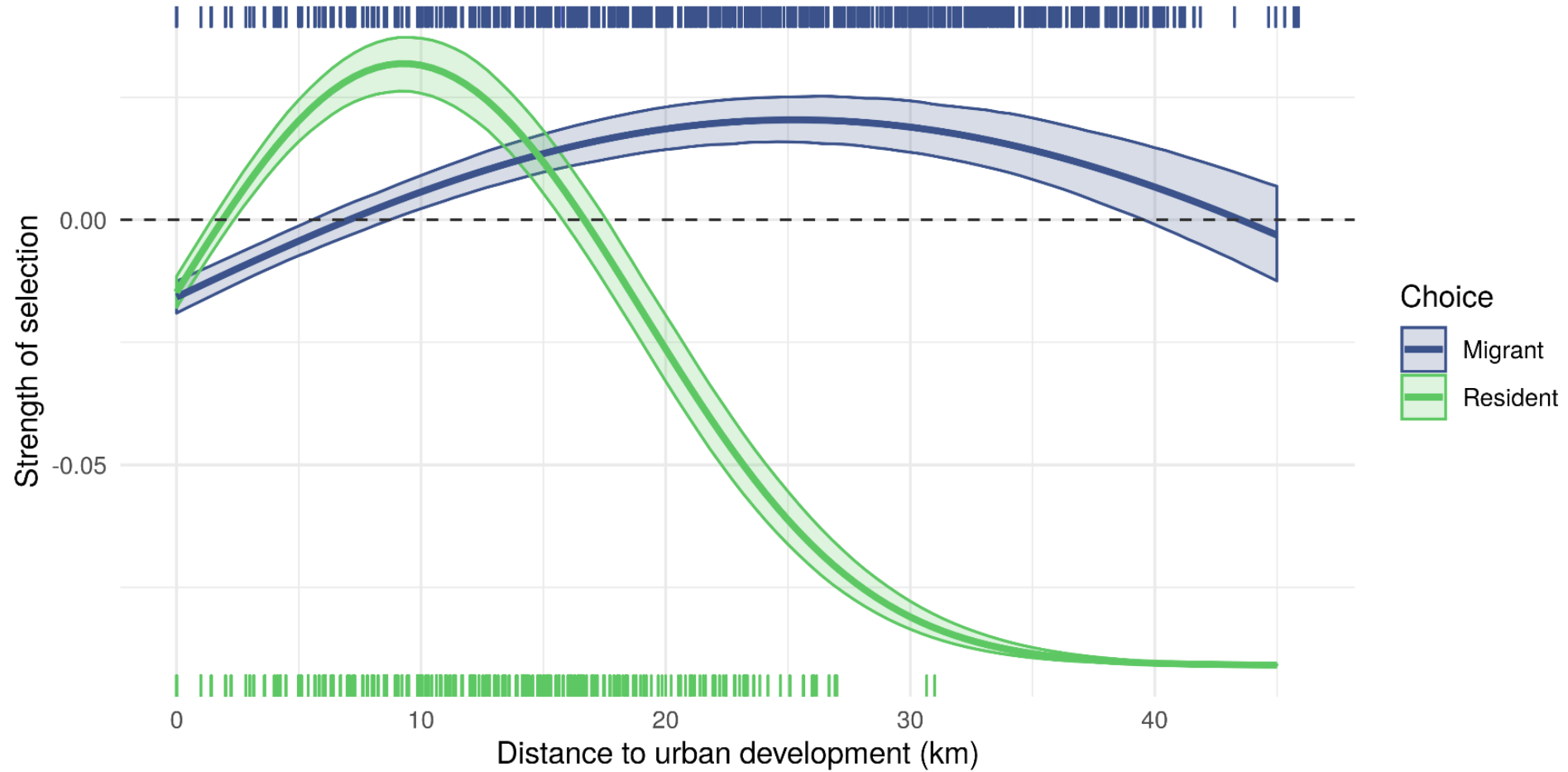
Distance to urban development

Proxy for
anthropogenic
resources

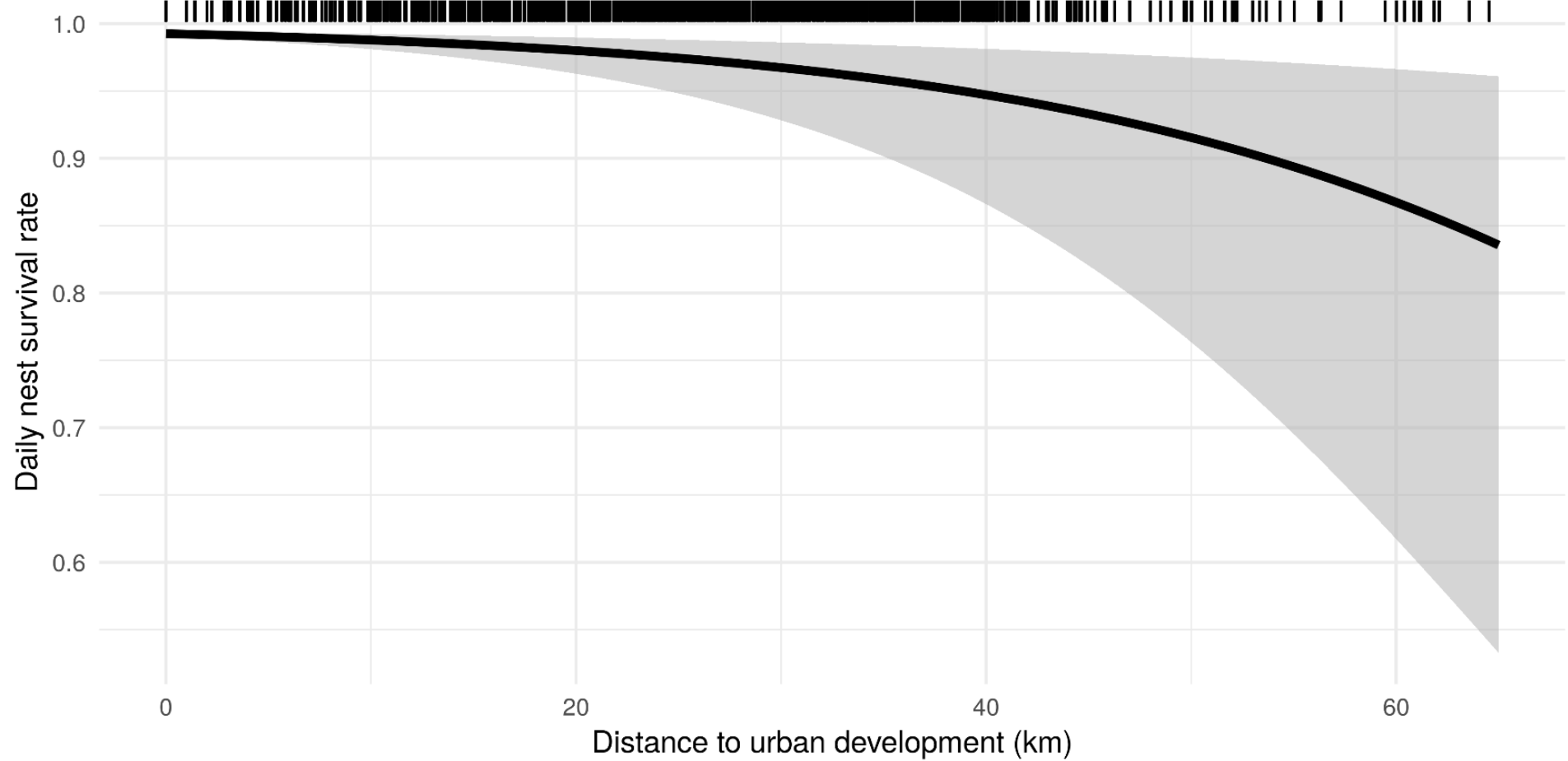
Results



Foraging-site selection



Nest survival





- Foraging-site selection mediates link between migratory behavior and fitness
- If migratory behavior is inheritable, anthropogenic pressure may promote shift towards residency

- Caveat 1: we could not demonstrate heritability; some individuals show plasticity
- Caveat 2: how does individual fitness scale up to the population level?



Thank you!

Questions?



**US Army Corps
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GLADES
FOUNDATION**