

The Return of the Snail Kite



Robert (Rob) Fletcher

Collaborators: Brian Reichert, Wiley Kitchens, Caroline Poli, Jim Austin, Denis Valle, Bill Kendall, Ellen Robertson, Becky Wilcox, Brian Jeffery, Sarah Dudek, Ken Meyer, Phil Darby, Josh Cullen, Laura D'Acunto, Alfredo Gonzalez, Rebecca Kimball, Christine Miller, Kyle Pias, Chris Cattau





Florida's kites



The snail kite

Adult male slate-gray all over

Broad, rounded wings

Eyes red (adult male) to brown

Distinctly thin, curved, hooked bill

Short tail with white base and broad, black subterminal band

Cere and bare facial skin bright red (adult male) to yellow



Everglade snail kite

(*Rostrhamus sociabilis plumbeus*)



- *R.s. plumbeus* genetically distinct from other subspecies
- No evidence of movement between Florida and Cuba

Everglade snail kite

(*Rostrhamus sociabilis plumbeus*)



- Federally endangered species
- Key indicator of the Everglades
- A dietary specialist (99% apple snails)
- Demography, behavior, and morphology tightly coupled with apple snails

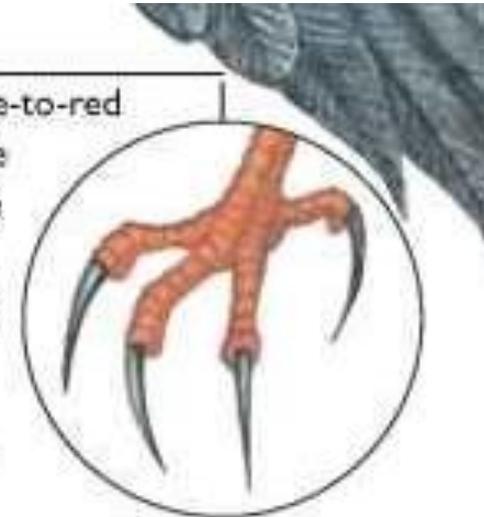
BEAK

The hooked edge of the upper beak is used to cut a snail's spinal muscle, releasing it from its shell.



FEET

The bright orange-to-red feet and claws are longer than those of most raptors and are designed to reach down and grab snails out of the water during flight.



Florida Wildlife Magazine (1967)

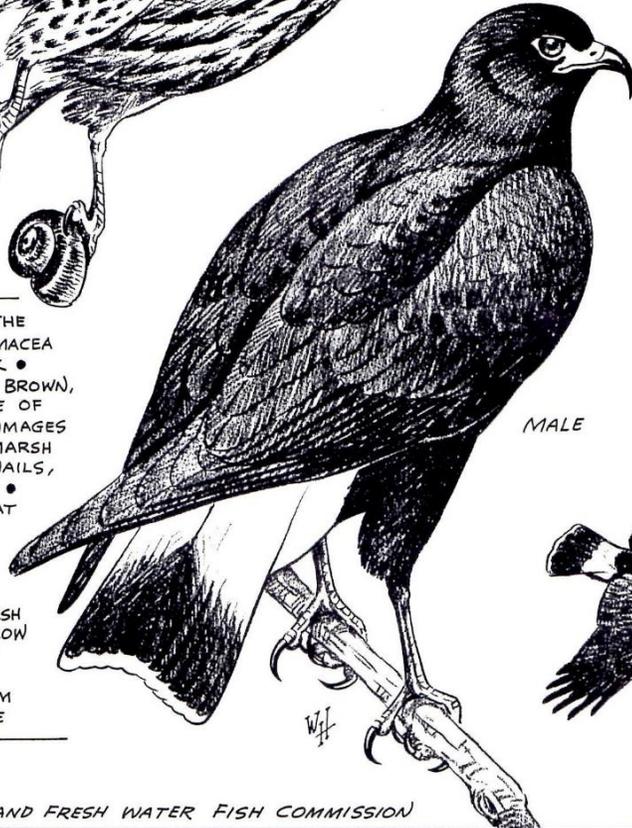
FLORIDA'S OWN, THE - **EVERGLADE KITE**

IS ONE OF THE RAREST BIRDS IN THE UNITED STATES
• LESS THAN 20 ARE KNOWN TO EXIST • THESE ARE FOUND IN FLORIDA - PRIMARILY IN LAKE OKEECHOBEE AND CONSERVATION AREAS 1, 2 AND 3
• HUNTERS AND FISHERMEN FREQUENTING THESE AREAS SHOULD MAKE EVERY EFFORT TO PROTECT THESE UNUSUAL AND BEAUTIFUL BIRDS •

REFRAIN FROM SHOOTING ANY HAWK-LIKE BIRDS
• DO NOT DISTURB NESTS OR REMAIN IN THE VICINITY OF A NESTING SITE AS THESE SENSITIVE BIRDS ARE QUICK TO DESERT THEIR NESTS IF DISTURBED



FEMALE



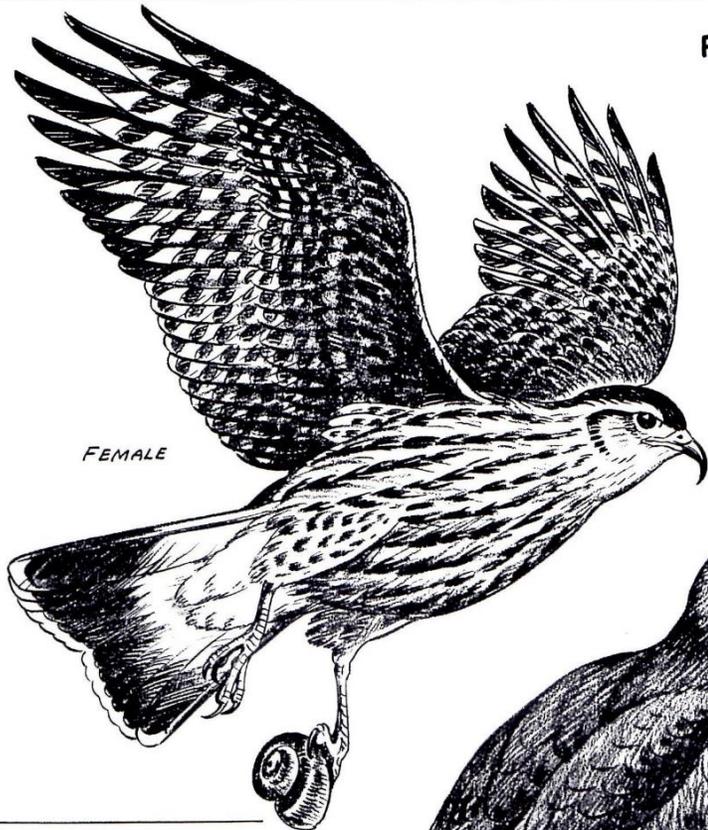
MALE



IT FEEDS SOLELY ON THE FRESH-WATER SNAIL-POMACEA
• ADULT MALE - BLACK • FEMALES AND YOUNG - BROWN, STREAKED BELOW • BASE OF TAIL WHITE, IN ALL PLUMAGES
• FLIES LOW OVER THE MARSH GRASS IN SEARCH OF SNAILS, BILL POINTED DOWNWARD • OFTEN SEEN SOARING AT HIGH ALTITUDE DURING THE HEAT OF THE DAY
• VERY TAME • NESTS ARE PLACED IN AN ISOLATED CLUMP OF MARSH VEGETATION, OFTEN WILLOW TREES • EGGS NUMBER 3 OR 4 • NESTING SEASON EXTENDS FROM JANUARY TO MID-JUNE

Florida Wildlife Magazine (1967)

FLORIDA'S OWN, THE - **EVERGLADE KITE**

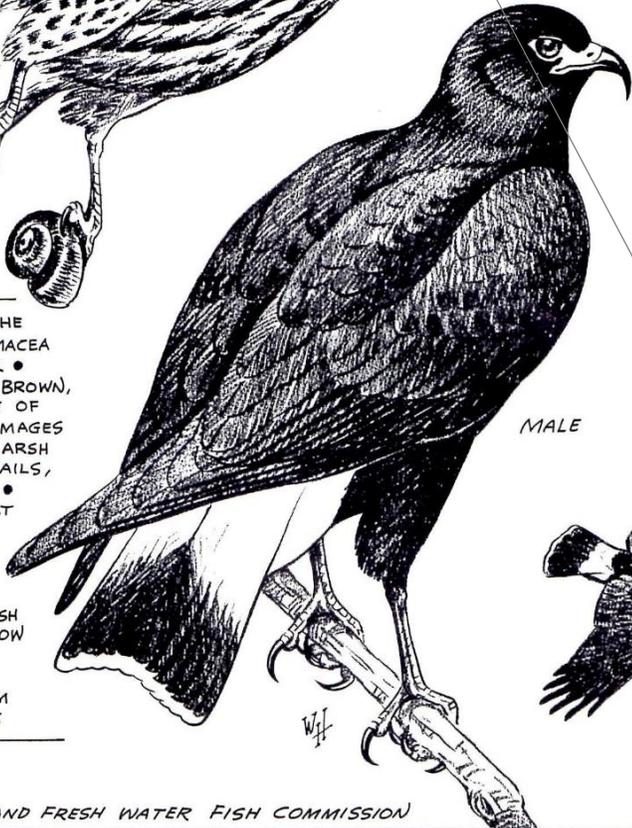


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Payne's Prairie

November 23, 2019



*The story of an endangered bird
and its struggle for existence*

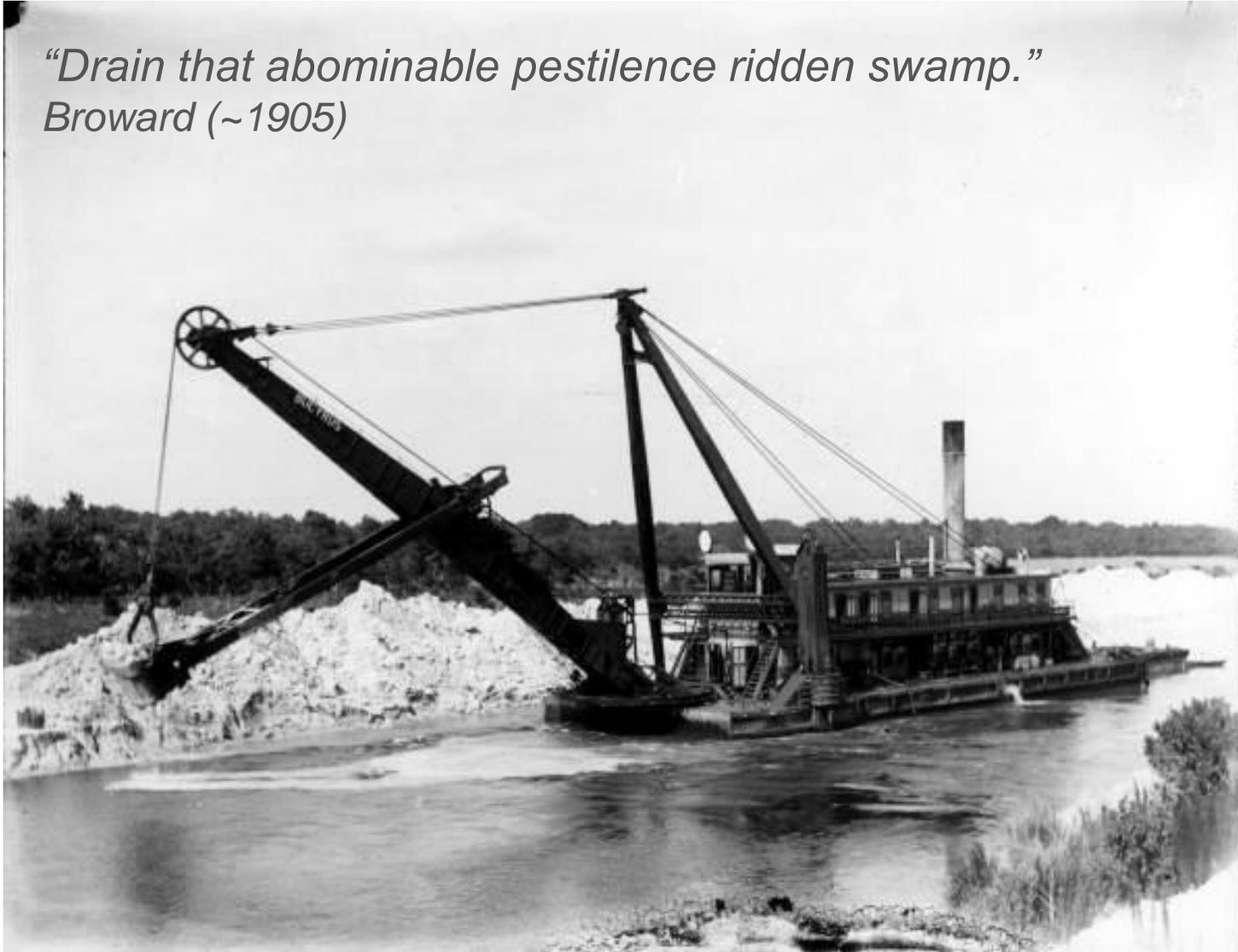


The early years

The dynamics of Florida's wetlands



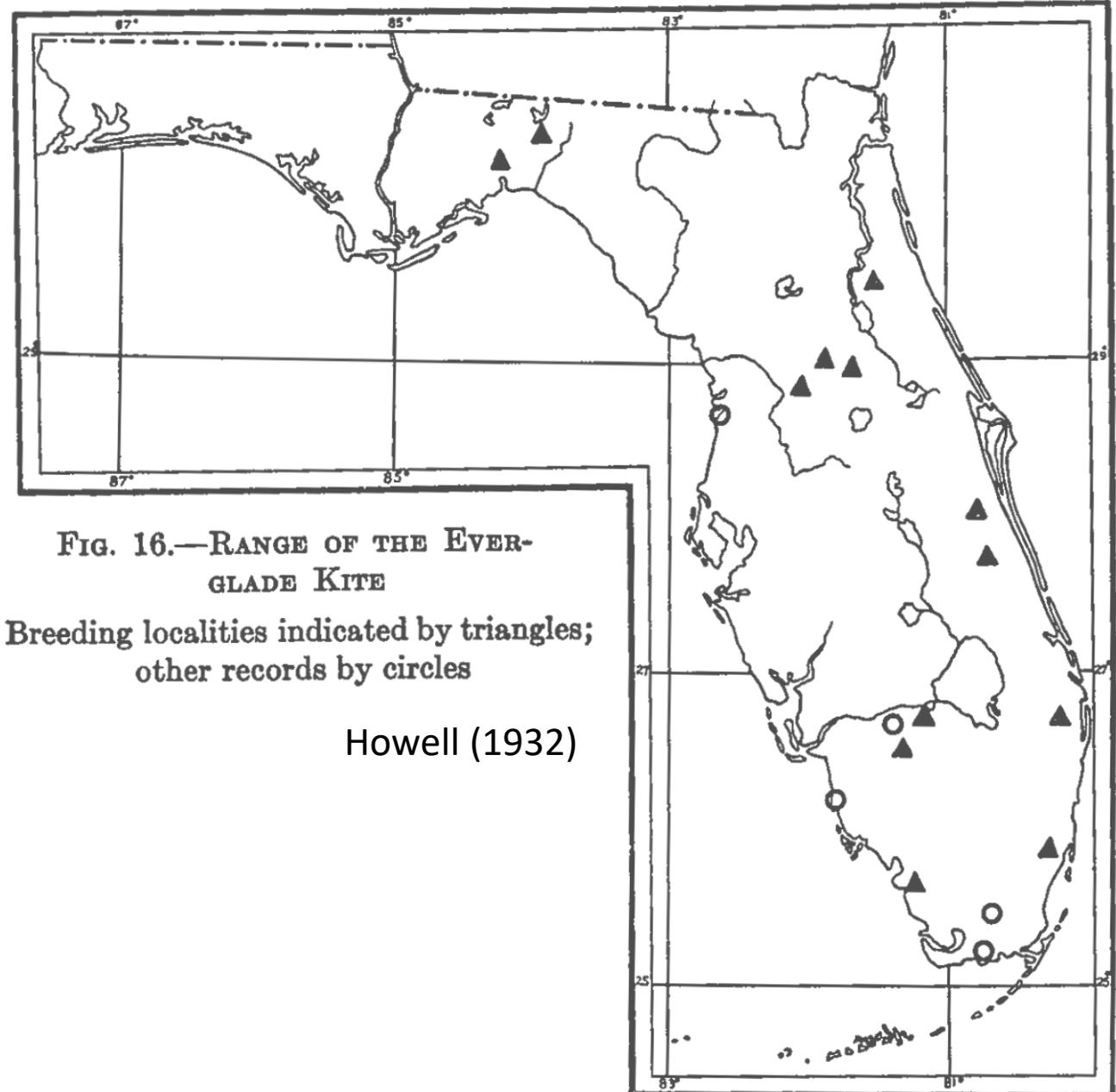
“Drain that abominable pestilence ridden swamp.”
Broward (~1905)



Everglade snail kite

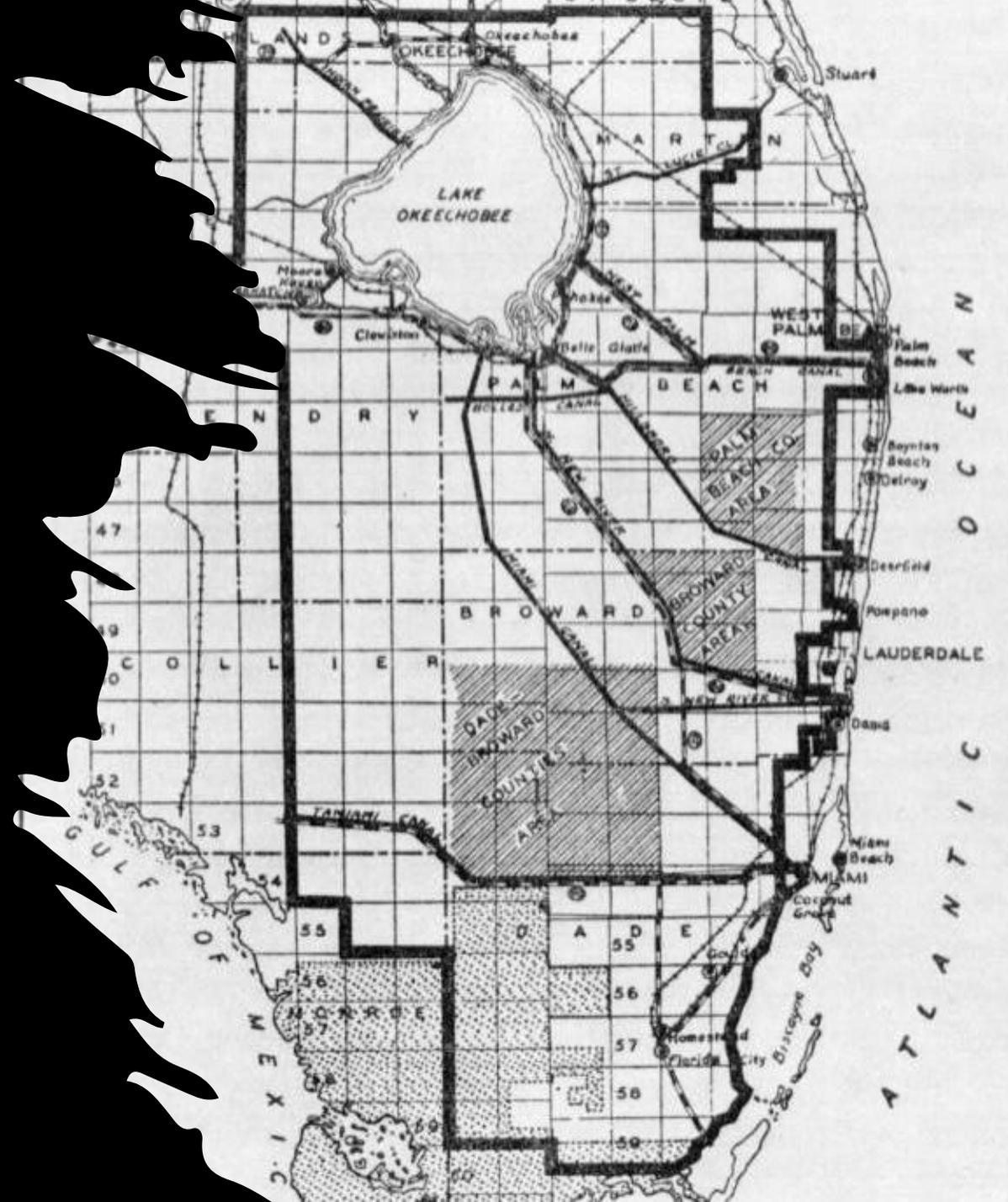
(Rostrhamus sociabilis plumbeus)

- First discovered in 1844 by Edward Harris at the headwaters of the Miami River
- Prior to 1950's, documented throughout much of Florida
- Distribution constricted with wetland loss & degradation

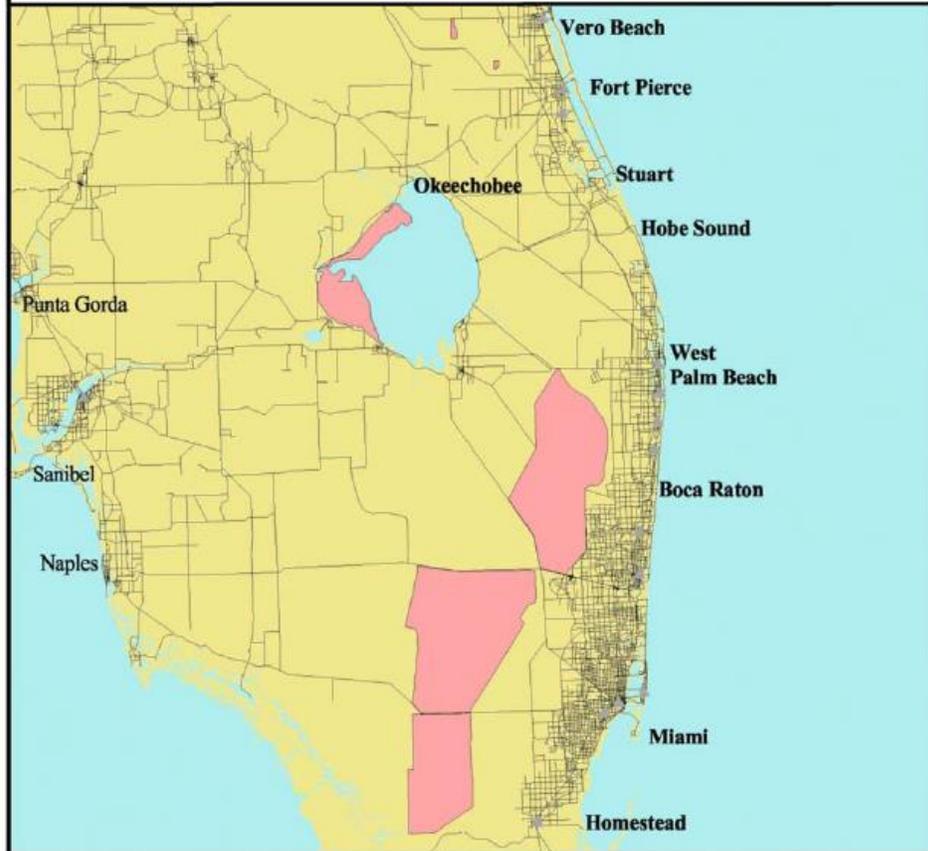


“At present snail kites are restricted to a few localities that are unaffected by drainage operations”

Howell (1932)



General locations of the designated critical habitat for the Everglade snail kite.



General Area



Distance: Miles

0 10 20 30 Miles



Legend

- City/Town
- Major Road/Highway
- Critical Habitat

Use Constraints: This map is intended to be used as a guide to identify the general areas where critical habitat has been designated. Refer to the narrative description published in the Code of Federal Regulations (CFR) 50 Parts 1 to 199 (a copy of this text is printed on the reverse of this map).

By 1954, Sprunt argued that almost the entire population was confined to Lake Okeechobee

In 1967, the snail kite was listed as federally endangered

Lake Okeechobee and WCA3A considered the most important areas between 1967-1980

*The story of an endangered bird
and its struggle for existence*



The decline

A researcher wearing a blue cap, sunglasses, and a red vest is sitting in a wire cage in a field. A large black telescope is mounted on a tripod to the left. The background shows a field of dry grass under a blue sky with white clouds.

After decades of monitoring (1969-1994), the status of the snail kite remained unclear

Snail kite coordinated research and monitoring

- 6 intra-annual, airboat surveys (1995 - present)
- Nest monitoring during breeding season
- Banding of young
- Over 5000 birds banded; over 6000 nests monitored



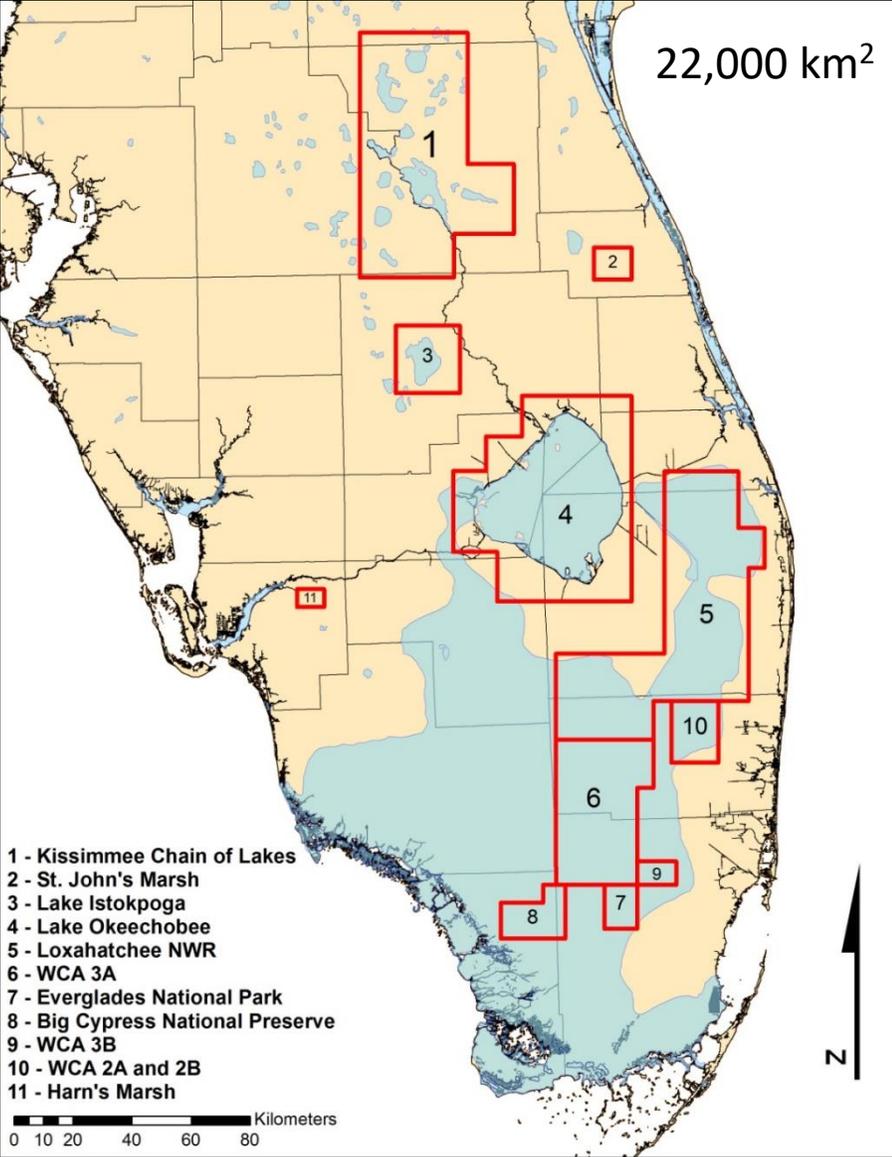
Surveys

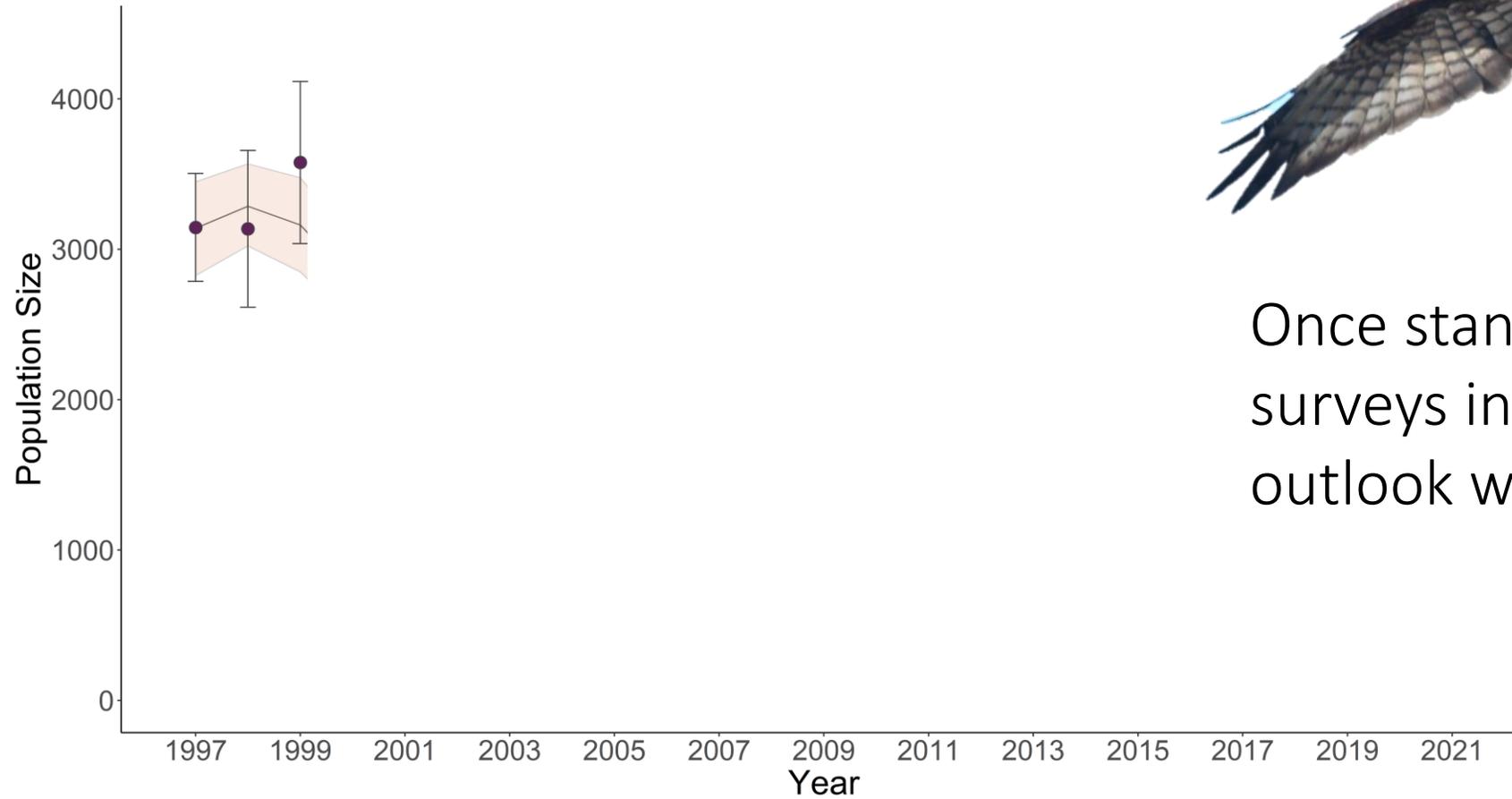


Nest monitoring

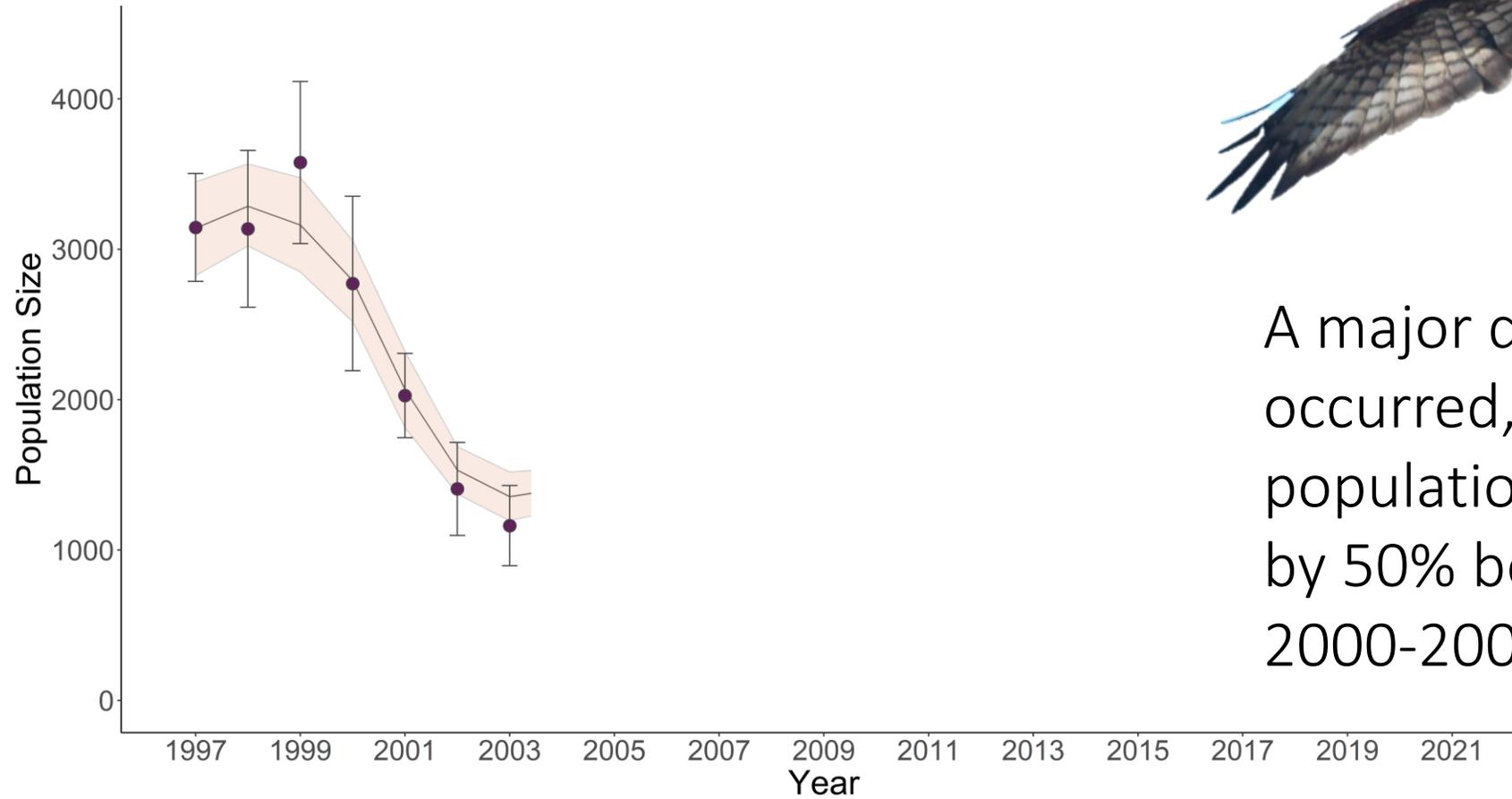


Marking

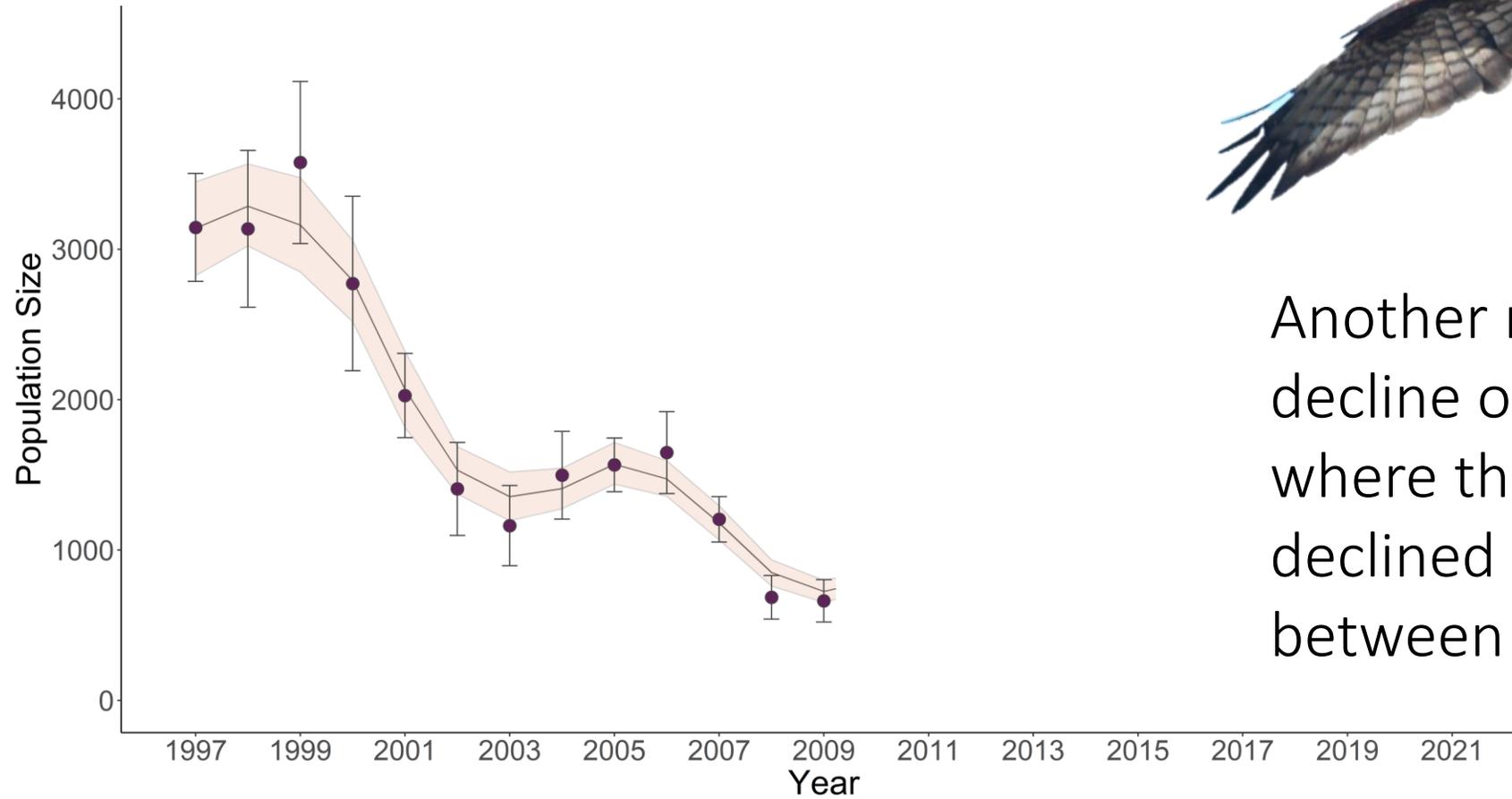




Once standardized surveys initiated, the outlook was good



A major decline occurred, where the population declined by 50% between 2000-2002

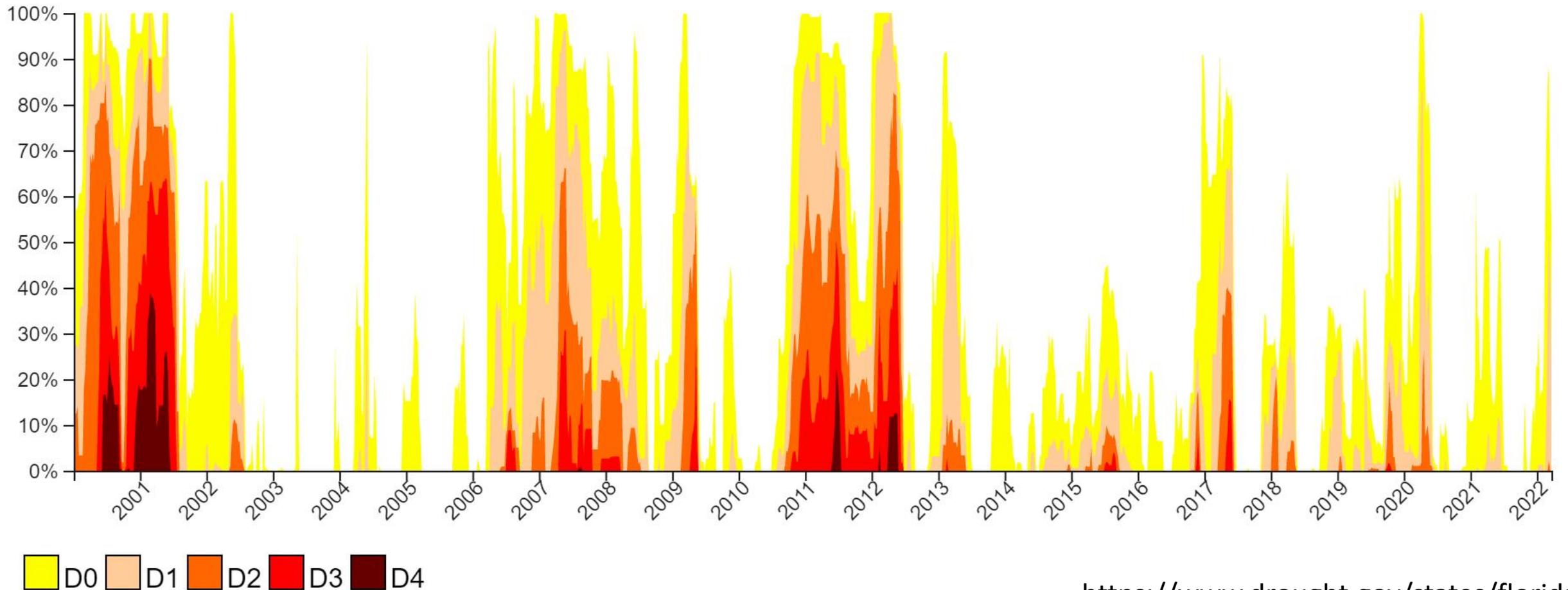


Another major decline occurred, where the population declined again by 50% between 2006-2008

Drought in Florida from 2000–Present

The [U.S. Drought Monitor](#) started in 2000. Since 2000, the longest duration of drought (D1–D4) in Florida lasted 124 weeks beginning on April 11, 2006, and ending on August 19, 2008. The most intense period of drought occurred the week of February 27, 2001, where D4 affected 39.14% of Florida land.

Latest Available Data:2022-03-22

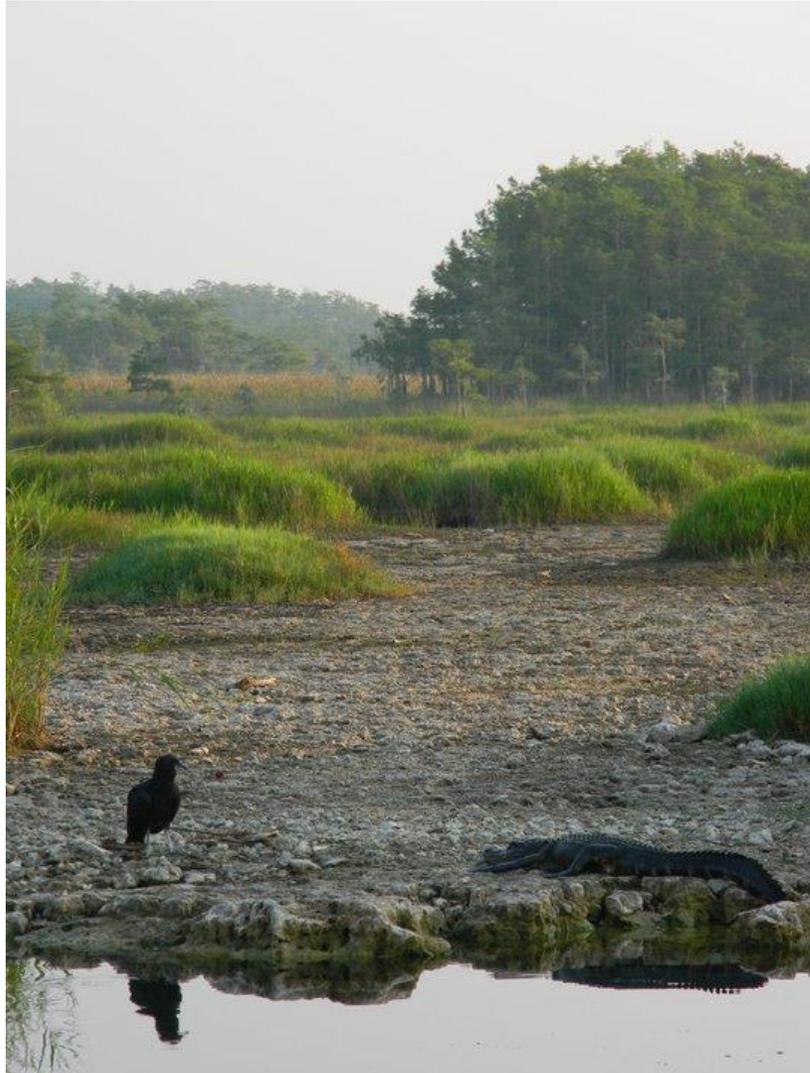


D0 **D1** **D2** **D3** **D4**

Click or hover on legend boxes to interact with the graph.

<https://www.drought.gov/states/florida>

Drought in Florida's wetlands



Drought in Florida's wetlands and the snail kite



Drought in Florida's wetlands and the snail kite



When water dries underneath nests, predators can better access eggs and young



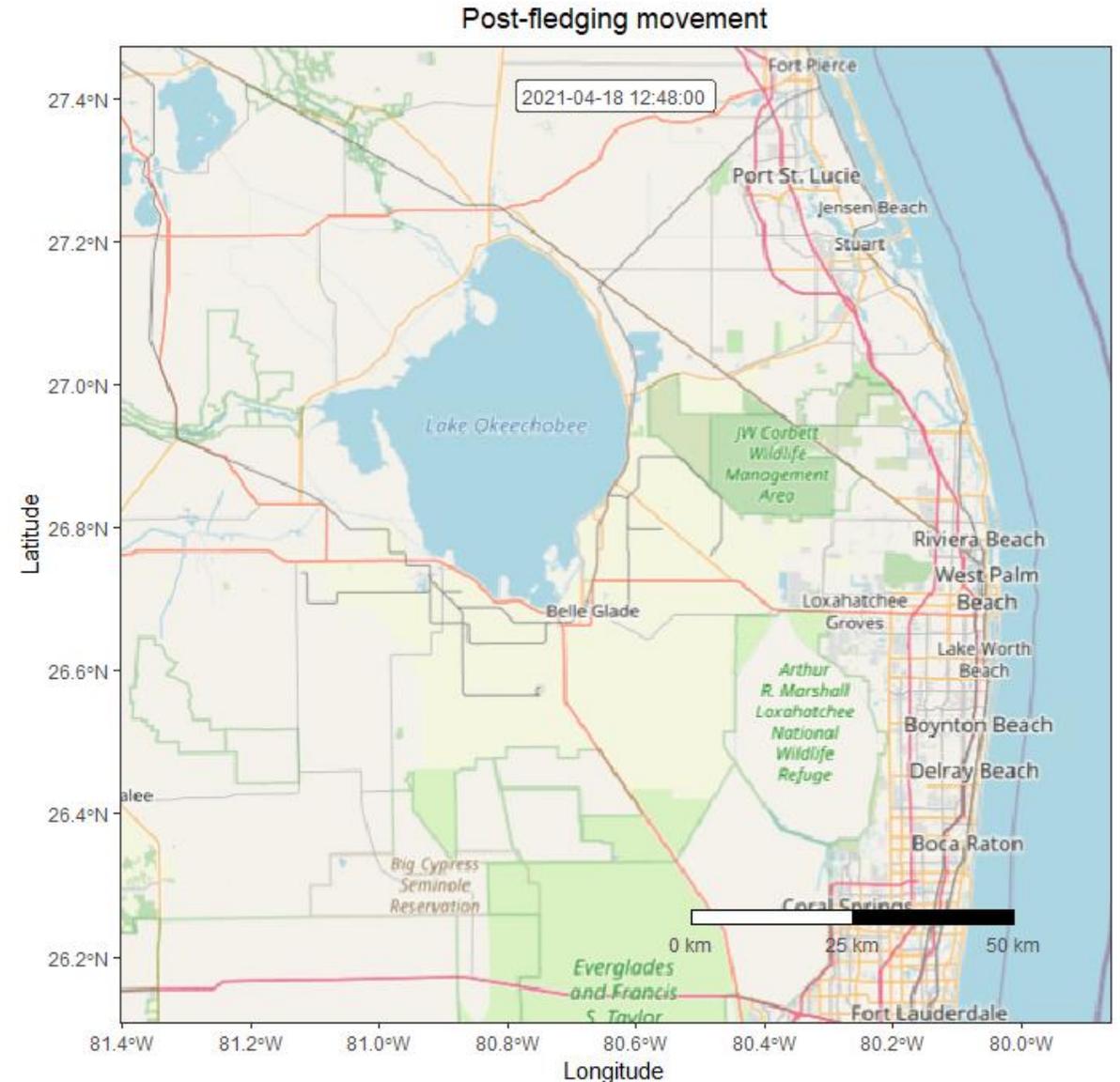
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Drought in Florida's wetlands and the snail kite



When water dries up in wetlands, Fledglings can suffer mortality





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and its struggle for existence*

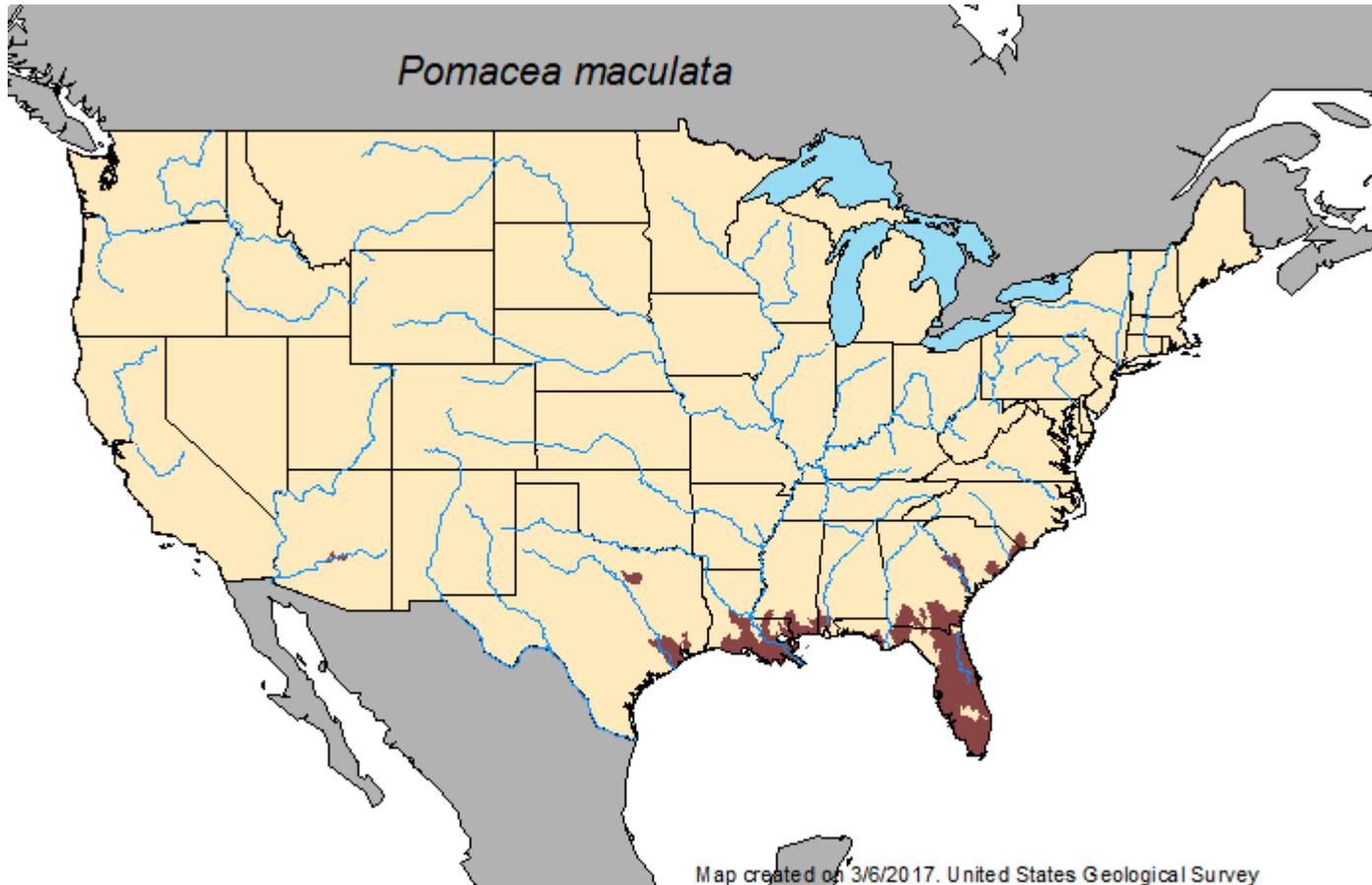


The Everglades...Rewired

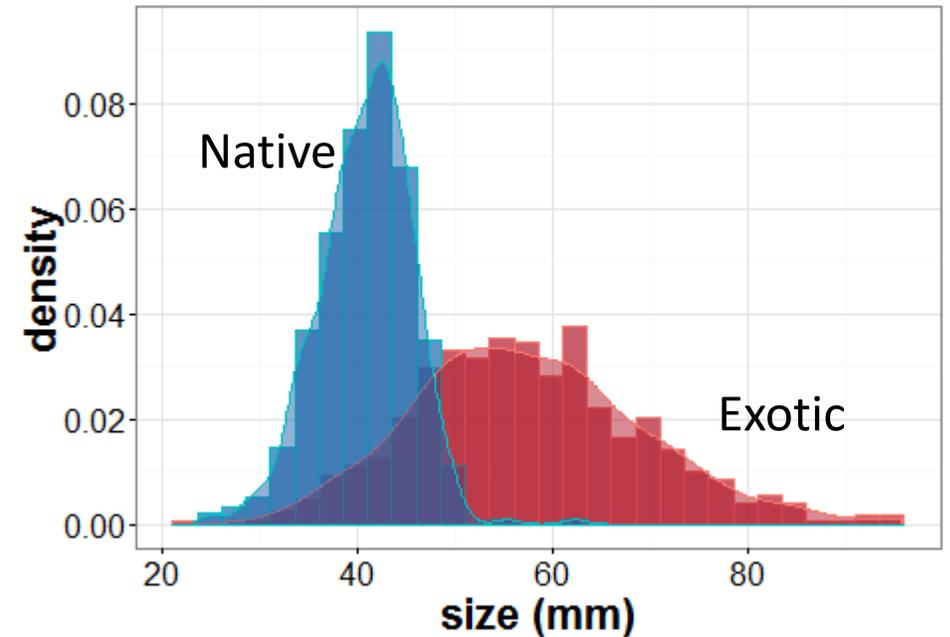
Invasive species and Florida's wetlands



The island apple snail (*Pomacea maculata*): *one of the world's most invasive species*



P. paludosa *P. maculata*



Florida →
apple snail
P. paludosa

←
Island apple
snail
P. maculata



| | |
|-------------------|-------------|
| Status | Native |
| Size | 1.5-2 in |
| Lifespan | 12-16 mo |
| Eggs/clutch | 30-120 |
| Kcal/gram | 4.25 + 0.25 |
| Drought tolerance | Lower |

| |
|-------------|
| Exotic |
| 3-4 in |
| 3-4 years |
| 1800-2000 |
| 3.25 + 0.11 |
| Higher |

Florida →
apple snail
P. paludosa

← **Island apple**
snail
P. maculata



Status

Native

Exotic

Size

1.5-2 in

3-4 in

Lifespan

12-16 mo

3-4 years

Eggs/clutch

30-120

1800-2000

Kcal/gram

4.25 + 0.25

3.25 + 0.11

Drought
tolerance

Lower

Higher

Densities

0.1-1.5 snails/m²
(up to 2-3/m²)

2-5 snails/m²
(up to 10s-100s/m²)

A novel prey: Exotic snails are hard to handle for kites

Florida Field Naturalist 35(3):79-85, 2007.

FOOD-HANDLING DIFFICULTIES FOR SNAIL KITES CAPTURING NON-NATIVE APPLE SNAILS

PHILIP C. DARBY¹, DAVID J. MELLOW, AND MIRANDA L. WATFORD



Biological Conservation

Volume 143, Issue 2, February 2010, Pages 513-520



Effects of an exotic prey species on a native specialist: Example of the snail kite

Christopher E. Cattau¹, Julien Martin², Wiley M. Kitchens³

Waterbirds

Published by: **The Waterbird Society**

Waterbirds 35(2):347-351, 2012

doi: <http://dx.doi.org/10.1675/063.035.0217>

An Artificial Perch to Help Snail Kites Handle an Exotic Apple Snail

Kyle E. Pias^{1,*}, Zach C. Welch² and Wiley M. Kitchens³

Pomacea maculata

Pomacea paludosa

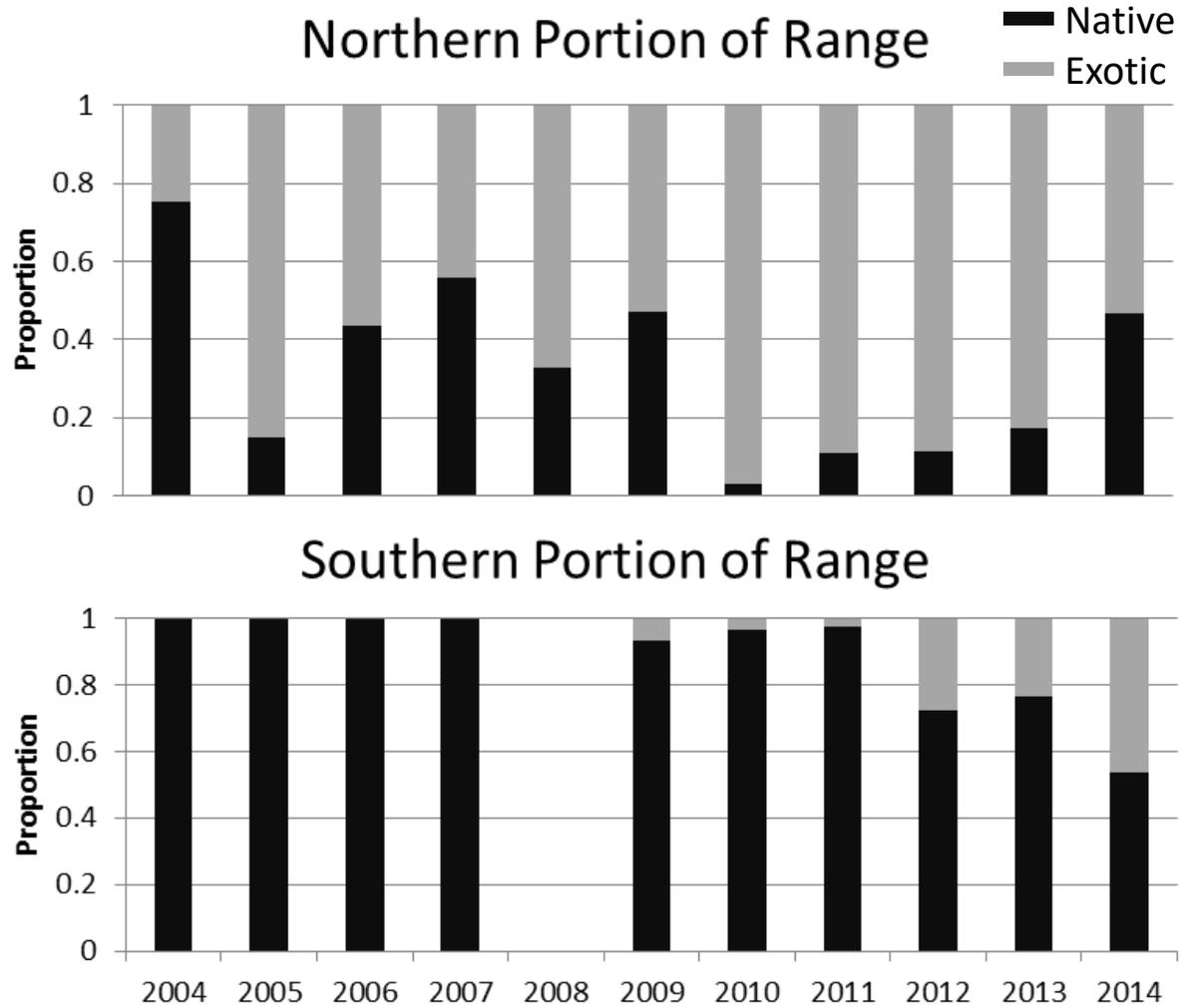


A novel prey: Exotic snails are hard to handle for kites



*Sweetwater Wetlands Park
from Danny Rohan*

Yet kites often consume them



Wilcox and Fletcher (2016)





*Do kites prefer exotic snails,
or is this consumption simply
due to greater food availability?*

Isolating preference: Choice experiments

- 1) Native versus exotic of similar sizes
- 2) Exotics of different sizes



Choice experiments

Becky
Wilcox

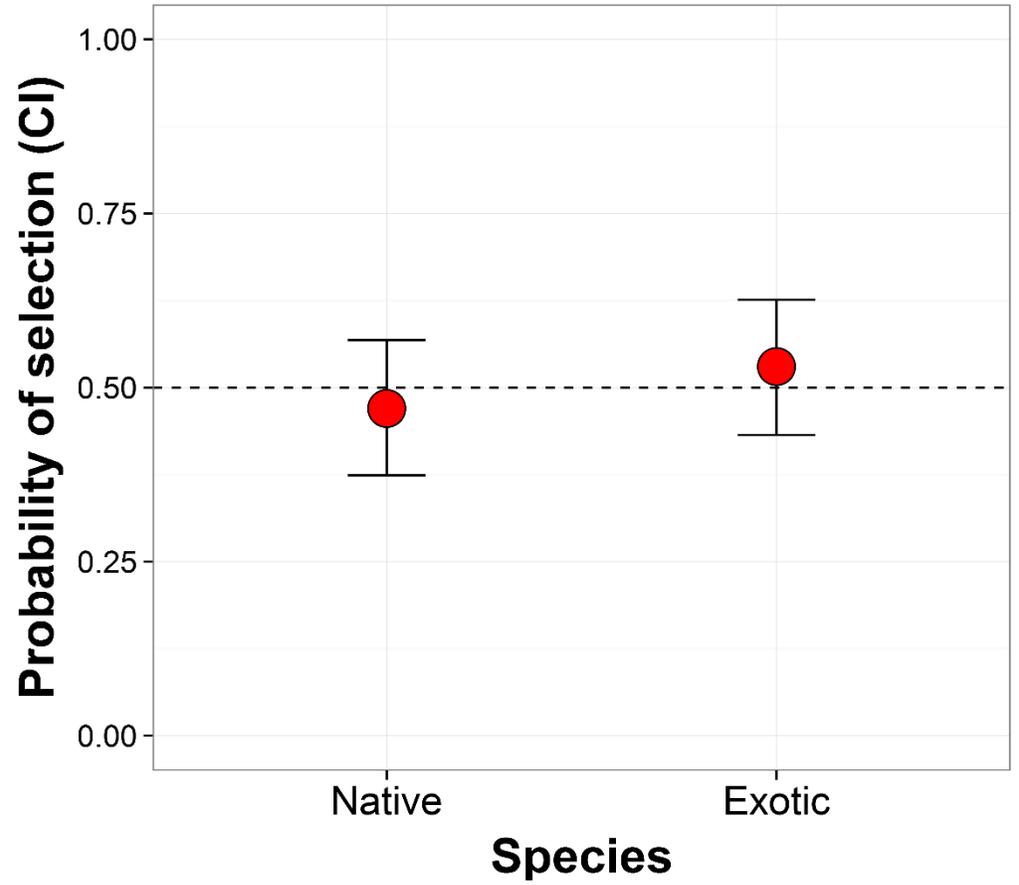


Native

Exotic

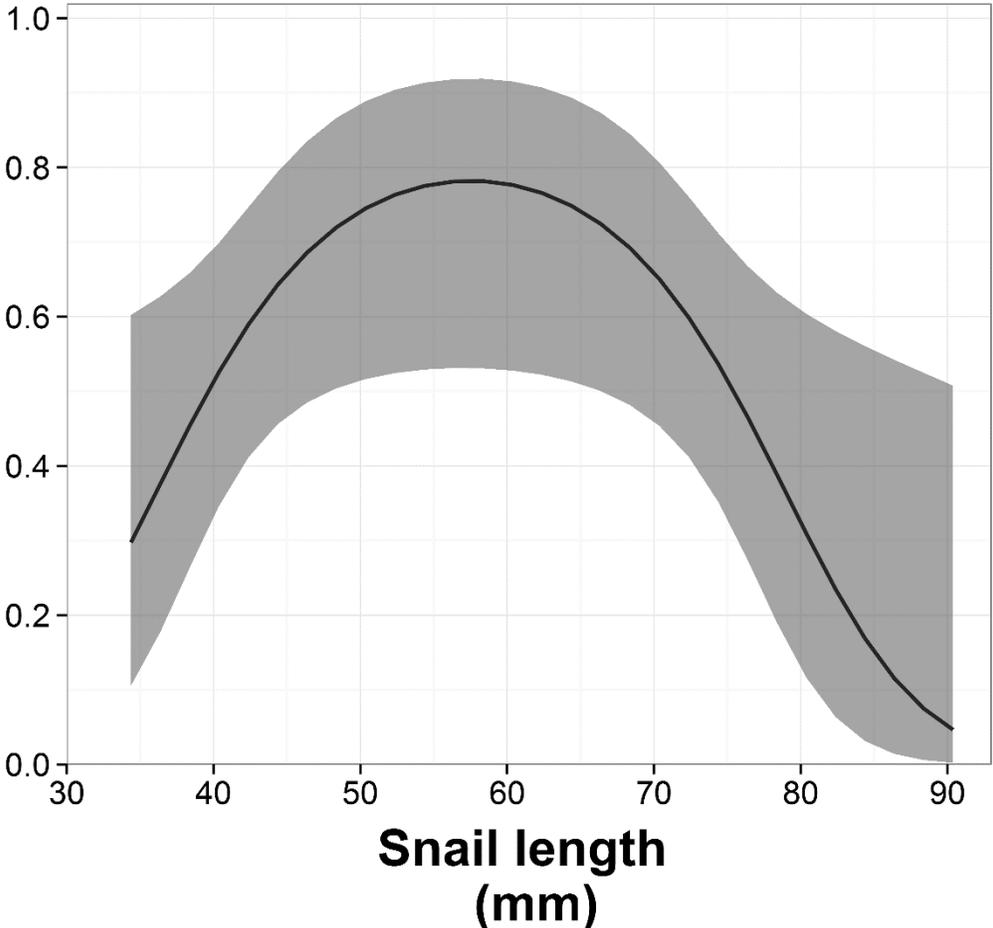
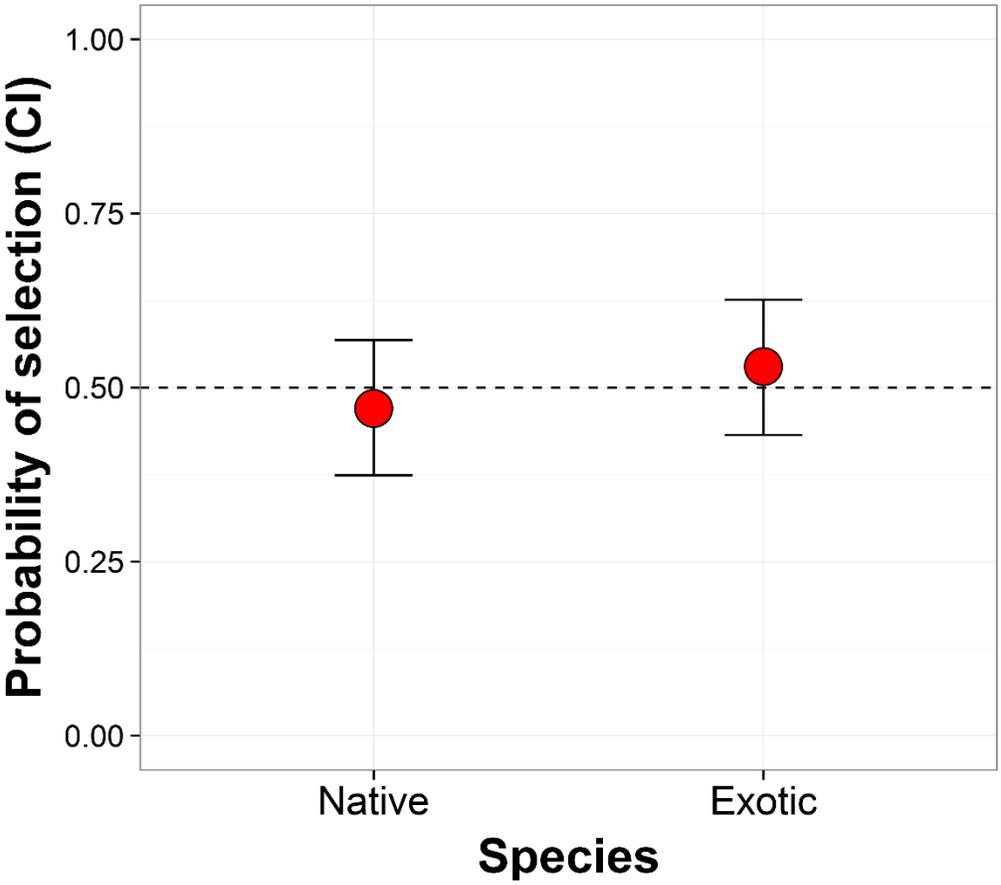


Kites *do not* prefer exotic snails





Kite preference based on snail size



Wilcox and Fletcher (2016)

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and its struggle for existence*



A New Danger...Or a New Hope?

Exotic snail invasion history across the snail kite geographic range

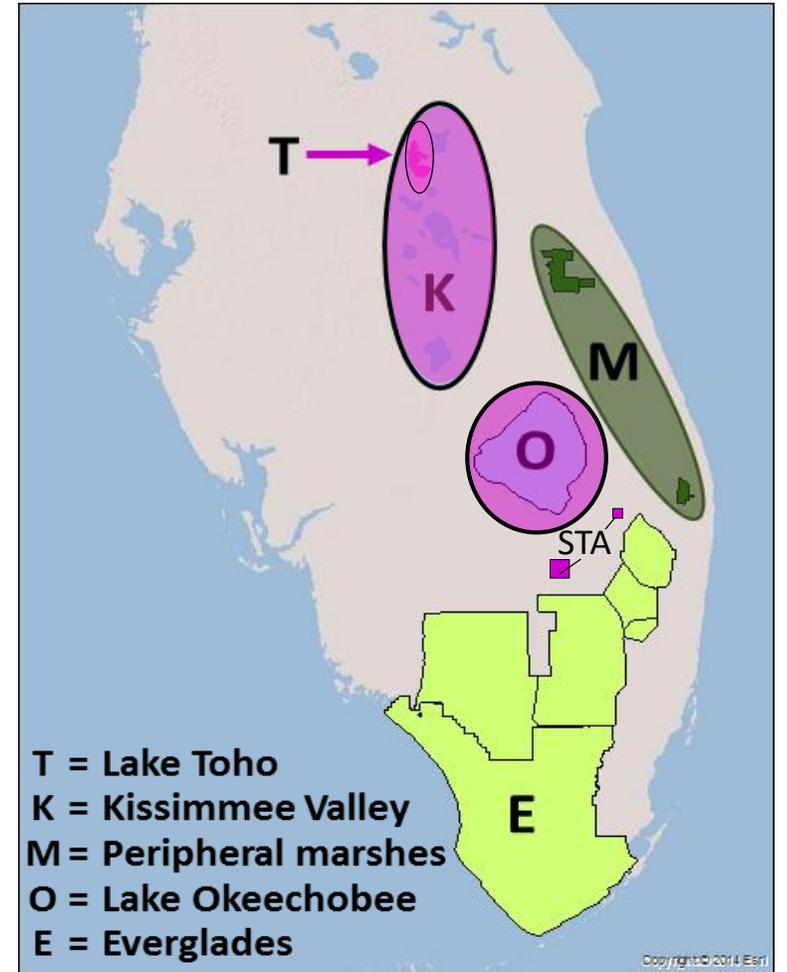
Interpreting changes over time:

| | | <----- Era 1 -----> | | | | | | | | | | | | <--- Era 2 ---> | | | | <----- Era 3 -----> | | | | | |
|---------|----|---------------------|----|----|----|----|----|----|----|----|----|----|----|-----------------|----|----|----|---------------------|----|----|----|----|----|
| | | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 |
| Wetland | T | Green | | | | | | | | | | | | Pink | | | | Pink | | | | | |
| | K* | Green | | | | | | | | | | | | Green | | | | Pink | | | | | |
| | O | Green | | | | | | | | | | | | Green | | | | Pink | | | | | |
| | M | Green | | | | | | | | | | | | Green | | | | Green | | | | | |
| | E | Green | | | | | | | | | | | | Green | | | | Green | | | | | |

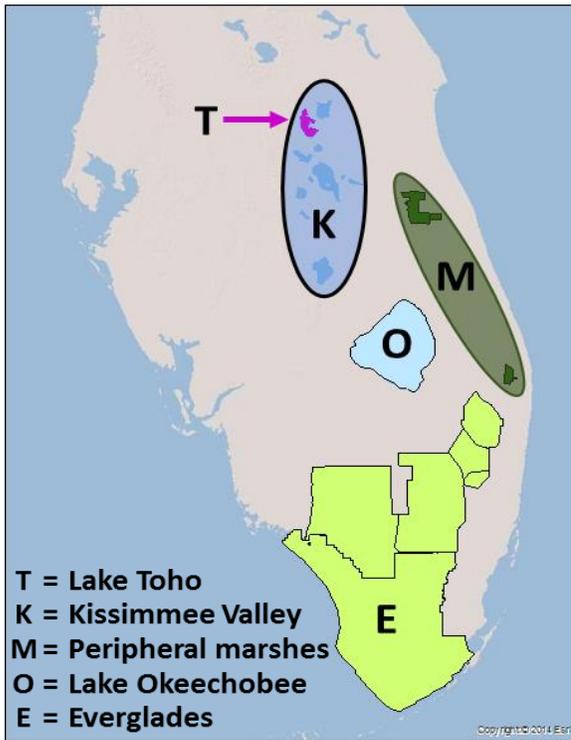
K* = region K excluding T

Exotic absent

Exotic present



Changes in movement and relative distribution of nests



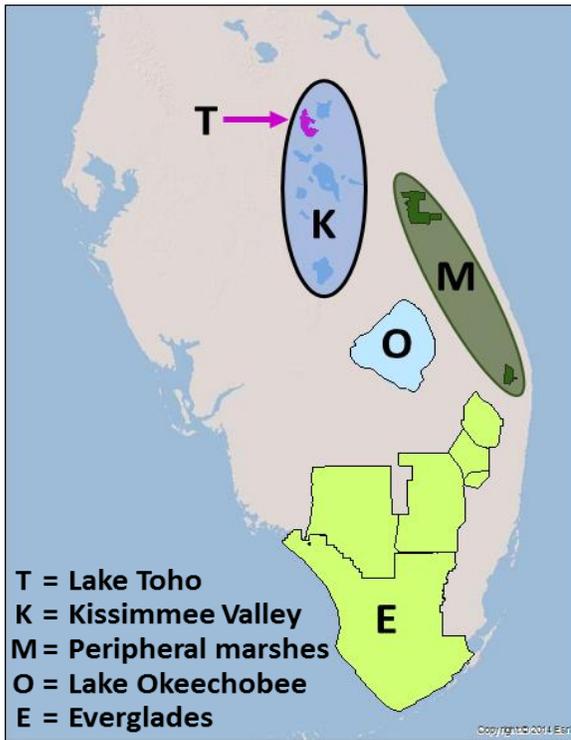
3198 nests (1996-2013)

- Increased movement into invaded wetlands
- Once there, more likely to stay

| | Era 1 | Era2 | Era 3 |
|----|---------|---------|---------|
| | 92 - 04 | 05 - 08 | 09 - 13 |
| T | | | |
| K* | | | |
| O | | | |
| M | | | |
| E | | | |

| |
|----------------|
| Exotic absent |
| Exotic present |

Changes in movement and relative distribution of nests



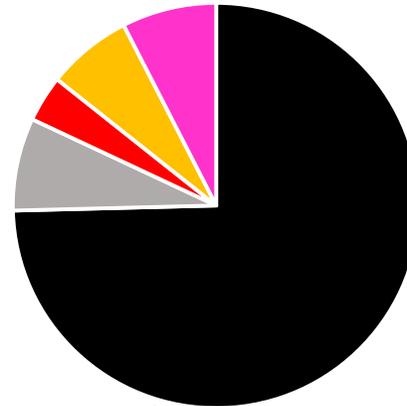
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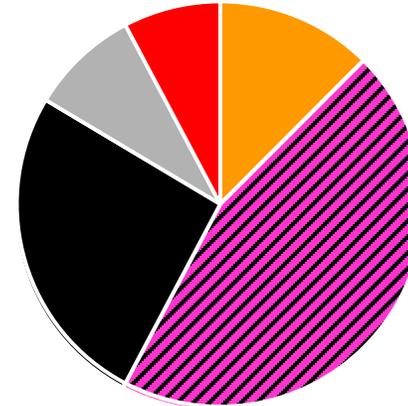
| | Era 1 | Era2 | Era 3 |
|----|---------|---------|---------|
| | 92 - 04 | 05 - 08 | 09 - 13 |
| T | | | |
| K* | | | |
| O | | | |
| M | | | |
| E | | | |

Exotic absent
 Exotic present

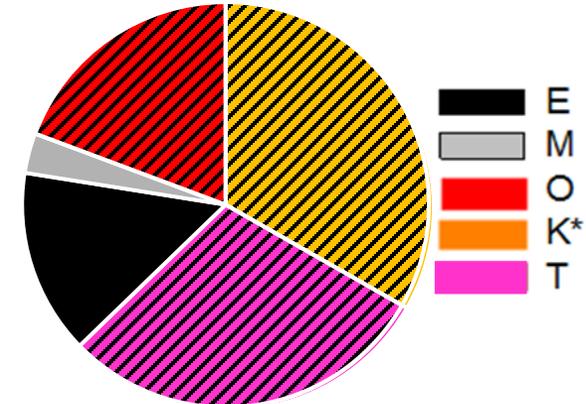
Era 1
 1996-2004



Era 2
 2005-2008



Era 3
 2009-2013



Hatch marks = exotic snails established

Given this tracking of novel prey, are there consequences for the snail kite population?





Juvenile survival increased

Several
aspects of
reproduction
improved

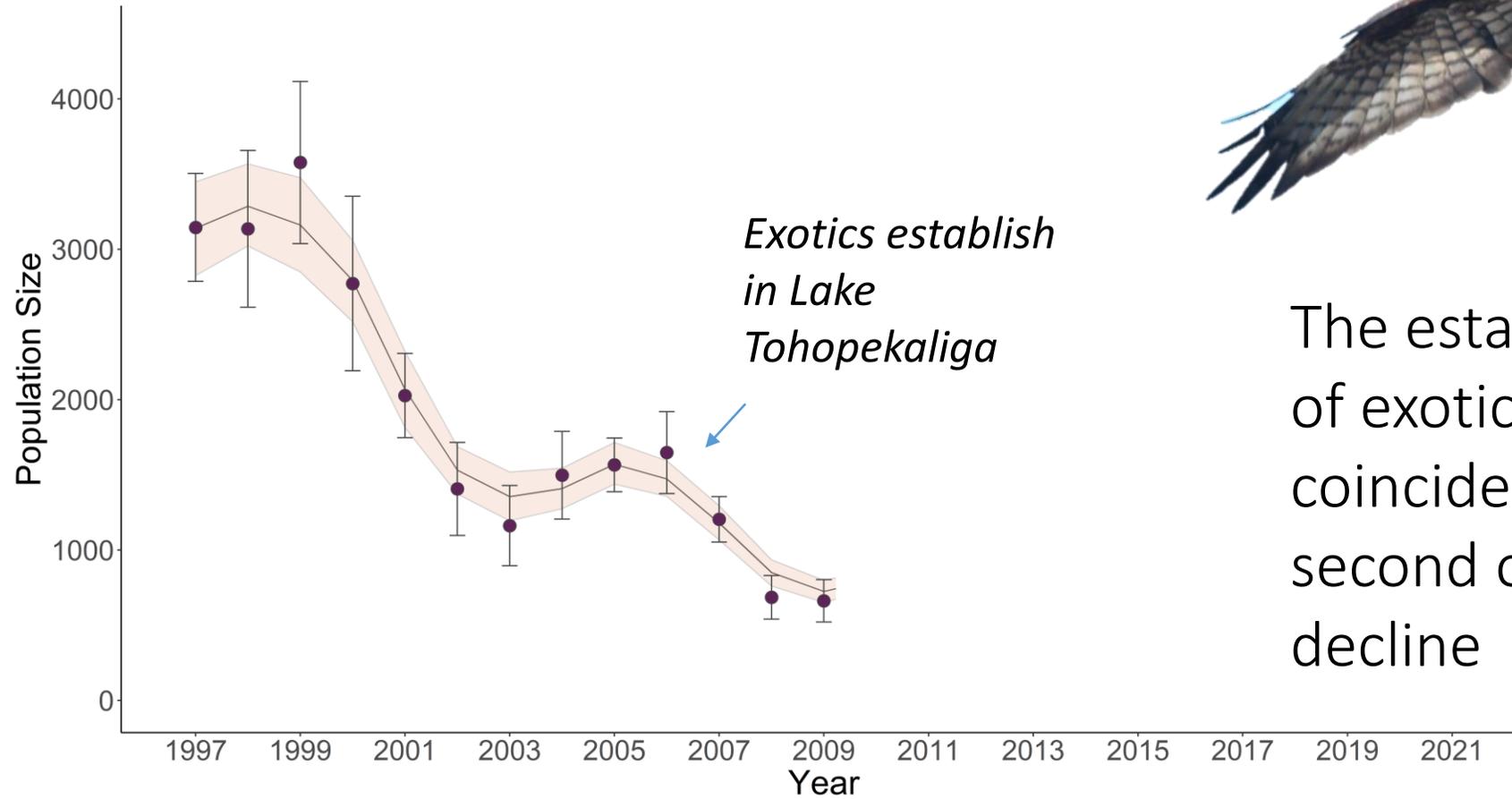


The widespread effects of *Pomacea maculata* invasion on snail kites

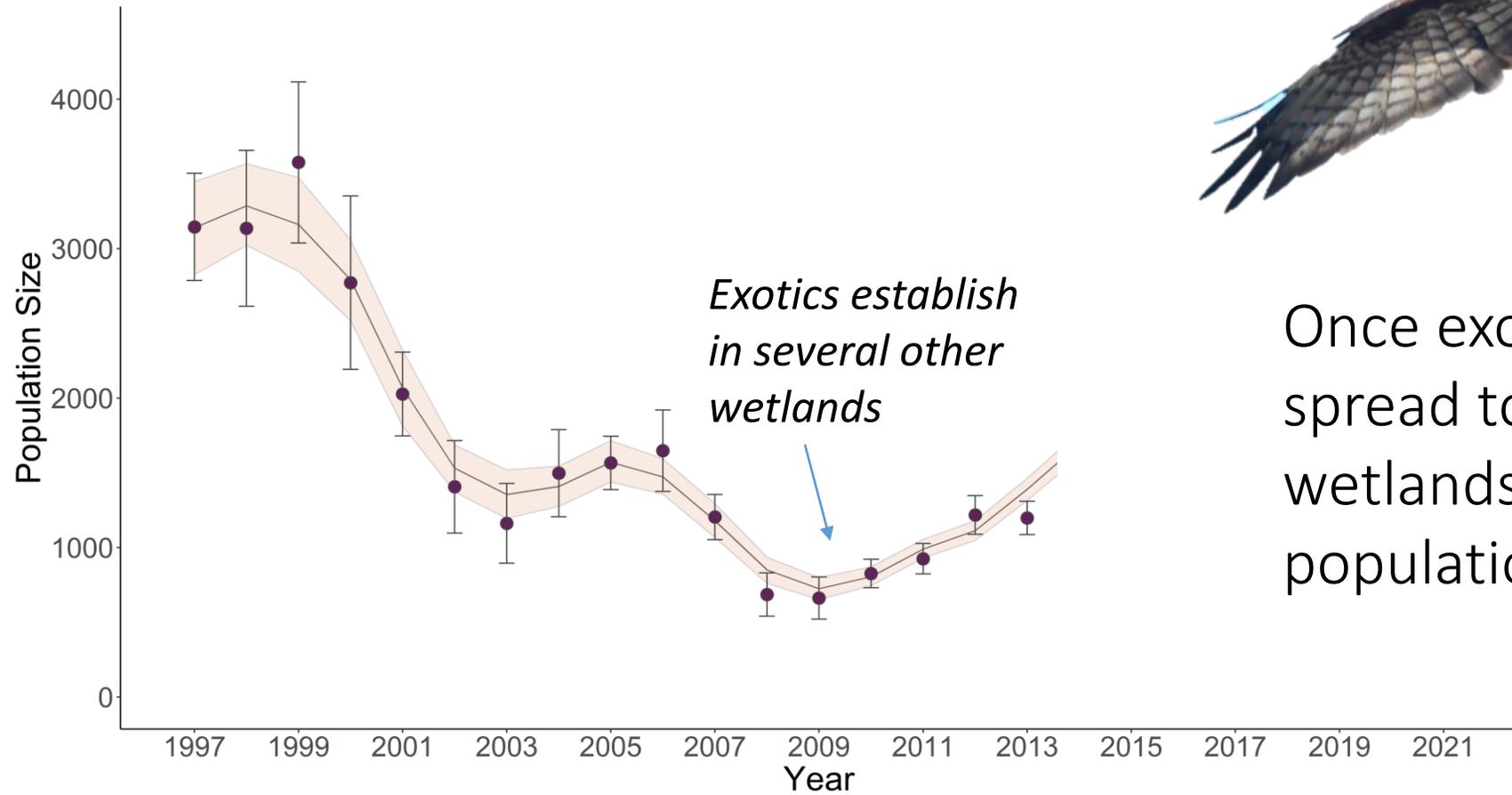


In invaded wetlands (2005-2013):

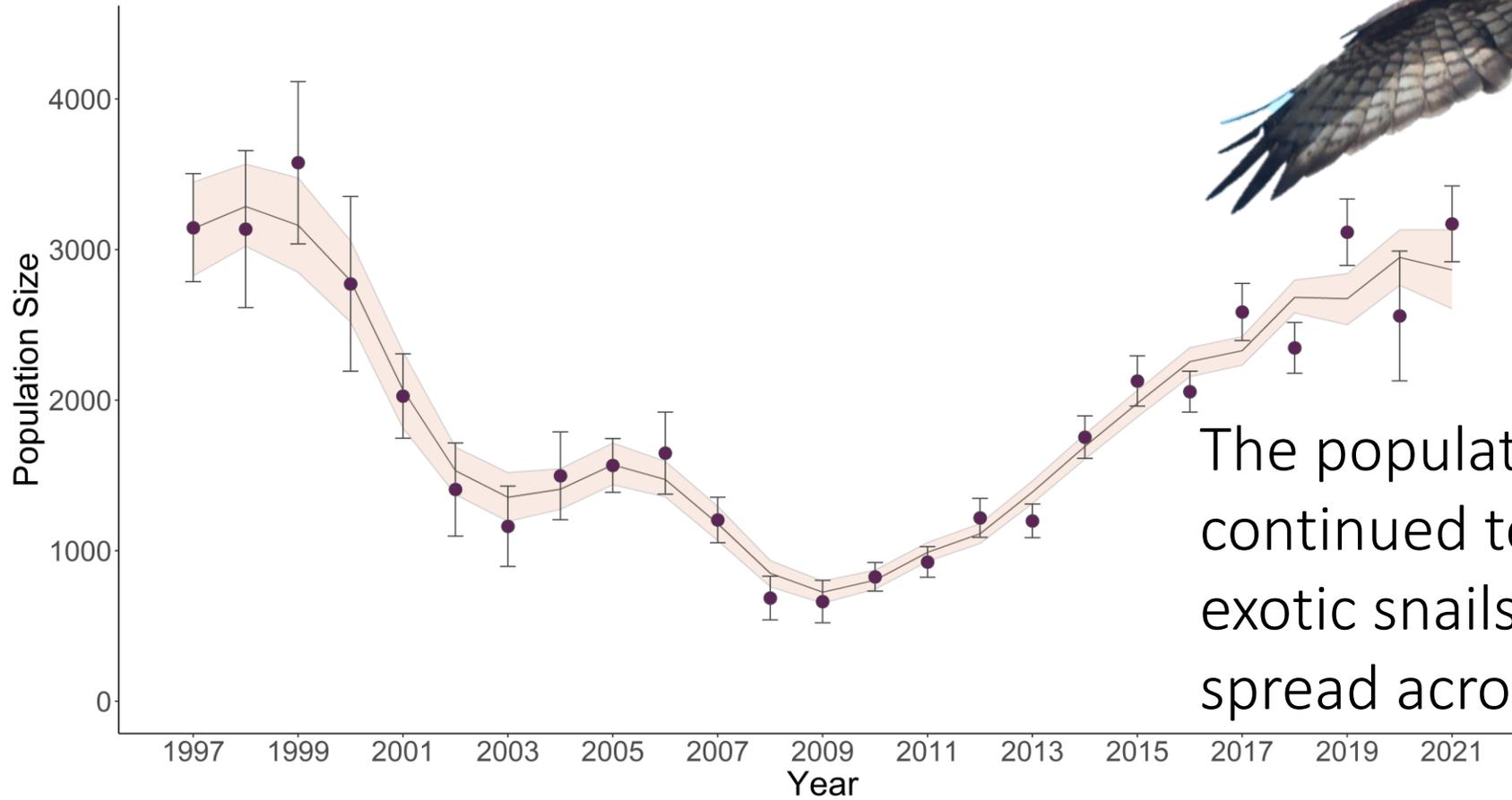
| | |
|--------------------------|-----------|
| Juvenile survival* | + |
| Adult survival* | No effect |
| Breeding probability | + |
| Nest survival | No effect |
| Number of young fledged | + |
| Re-nesting attempts | + |
| Breeding season length | + |
| Site fidelity | + |
| Immigration rate | + |
| Population growth | + |



The establishment of exotic snails coincided with the second observed decline



Once exotic snails spread to several wetlands, the population grew



The population has continued to grow as exotic snails have spread across the range



New habitats and breeding range expansion

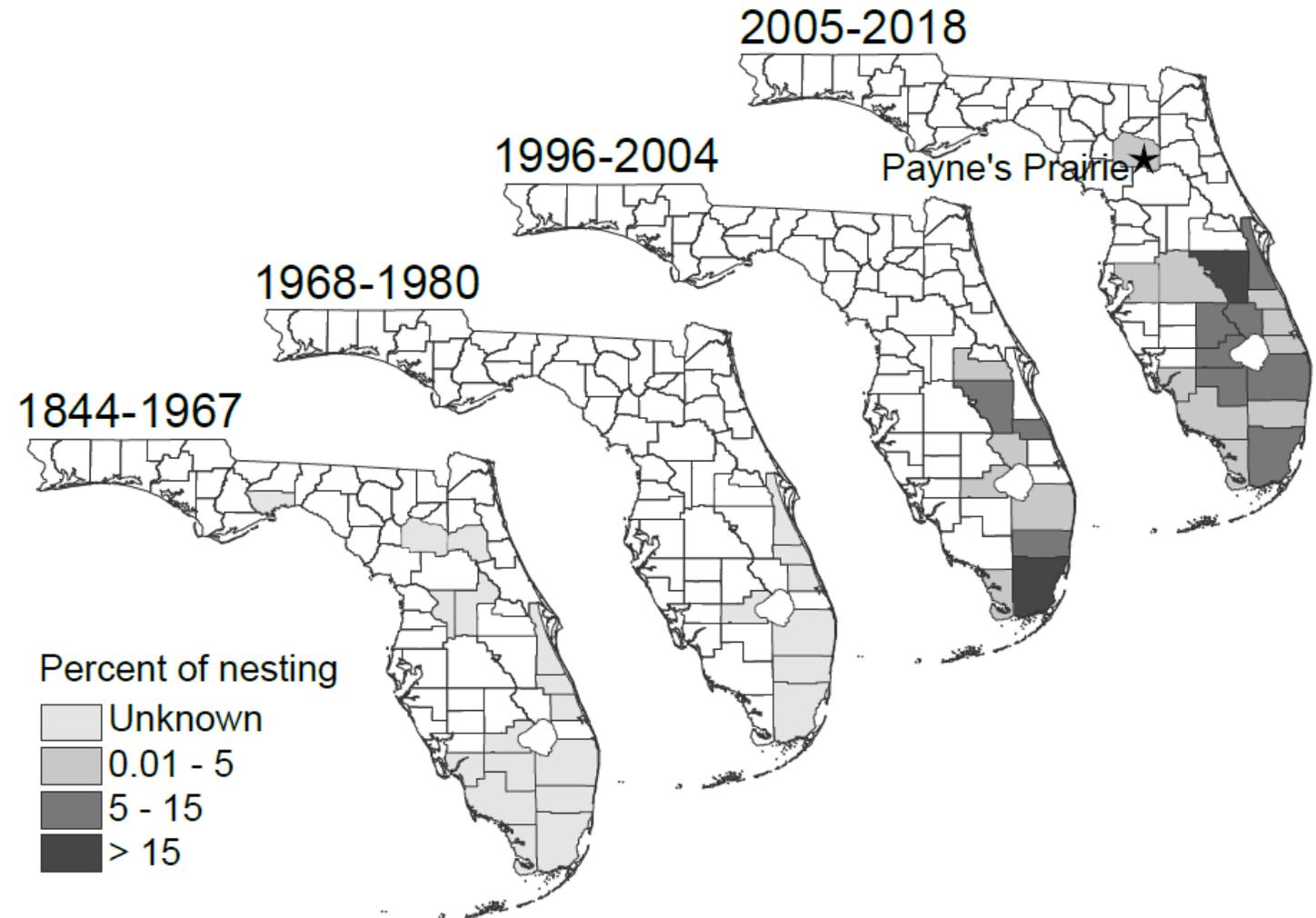
First breeding population in Payne's Prairie in at least 100 years

2018: First recorded breeding

2019-2020: High breeding rates

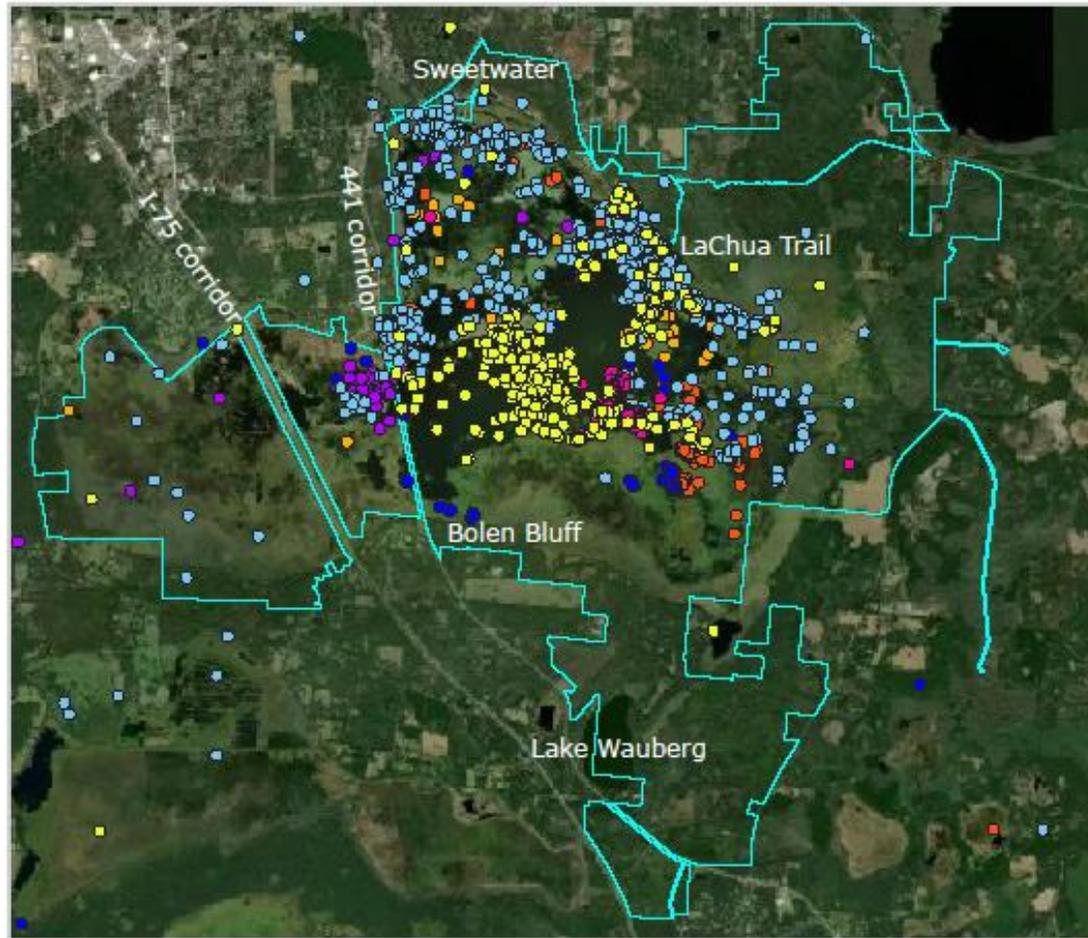
2021: no breeding until December

2022: currently high breeding effort

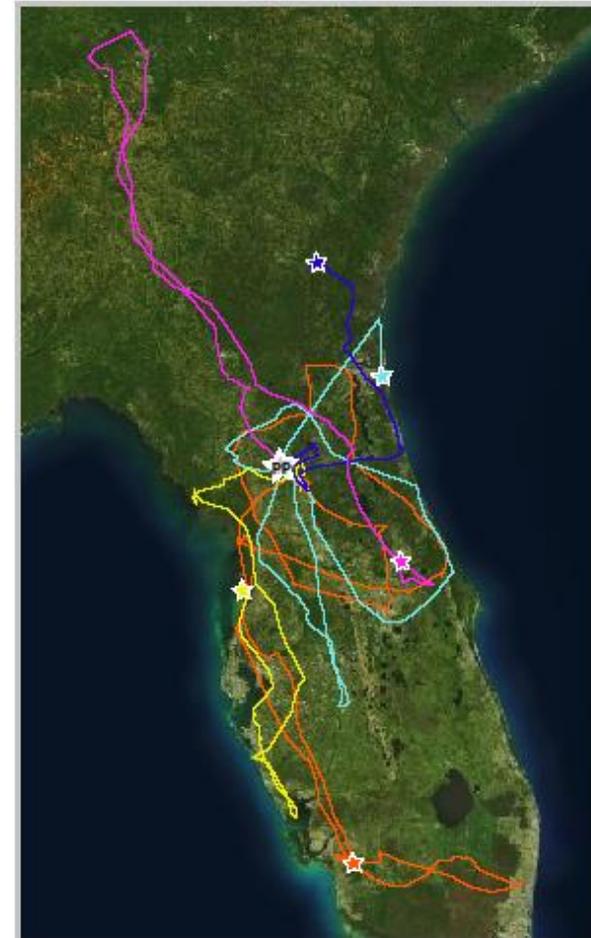


New habitats and breeding range expansion

Locations of 7 tagged fledglings using Payne's Prairie in 2019-2020



Dispersal of 5 tagged fledglings coming from Payne's Prairie in 2019-2020



*Have the non-native snails saved the snail kite?
The ephemerality of the non-native snail*



Mary A Mitigation Bank
June 10, 2015

*The story of an endangered bird
and its struggle for existence*

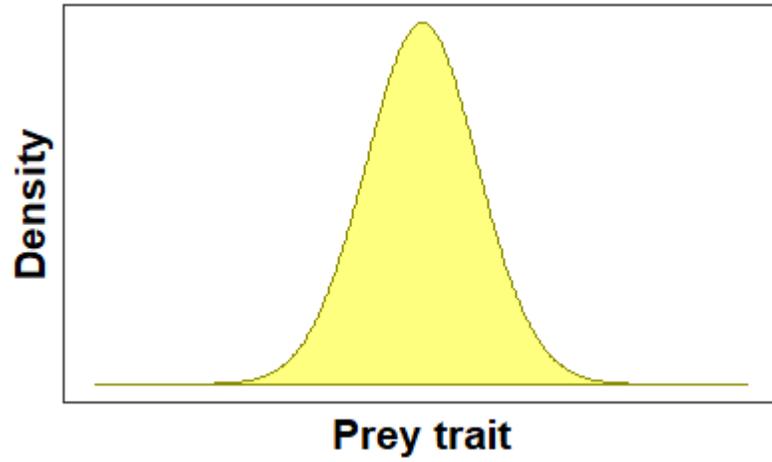


Snail kites...rewired

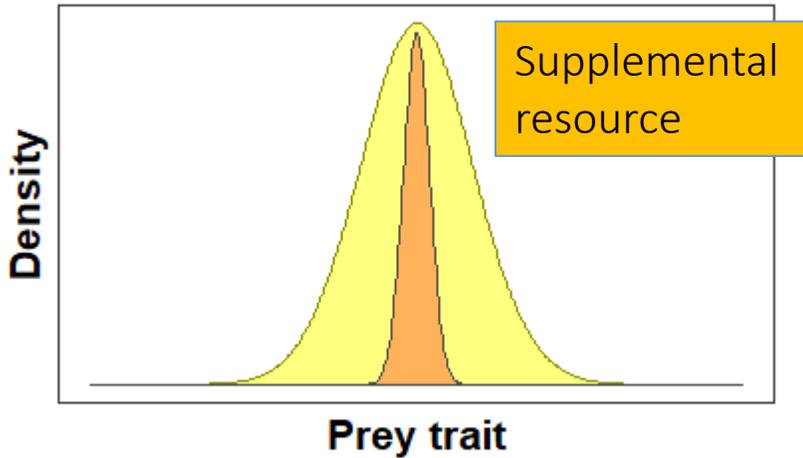
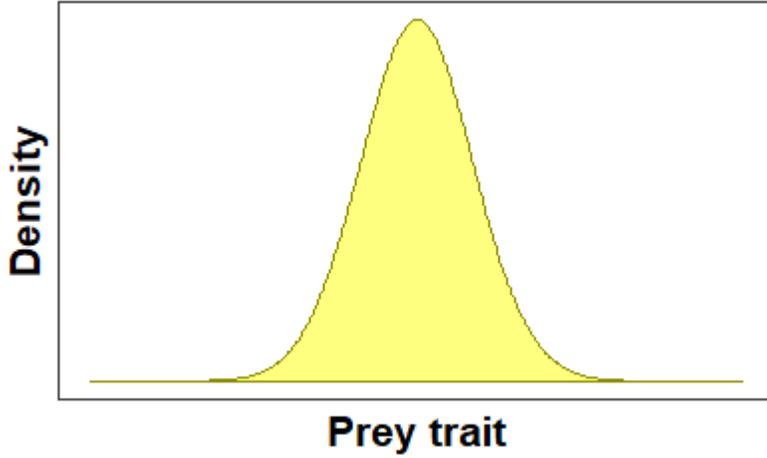
*How are they
doing it?*



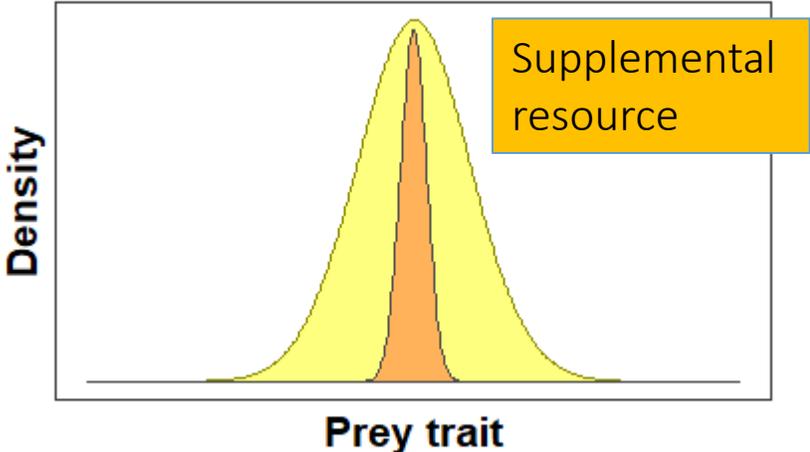
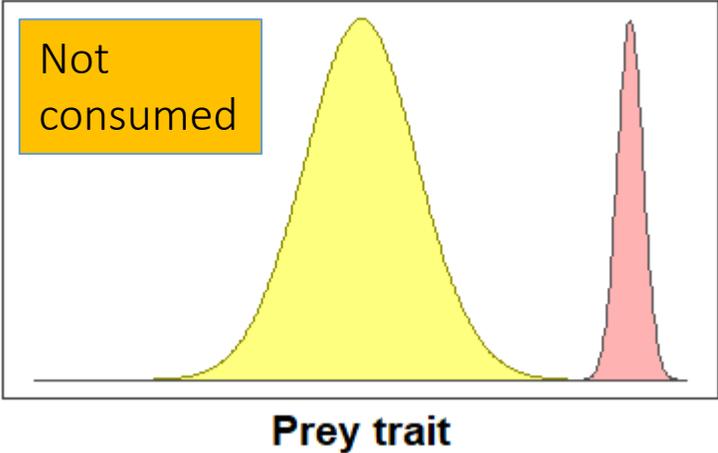
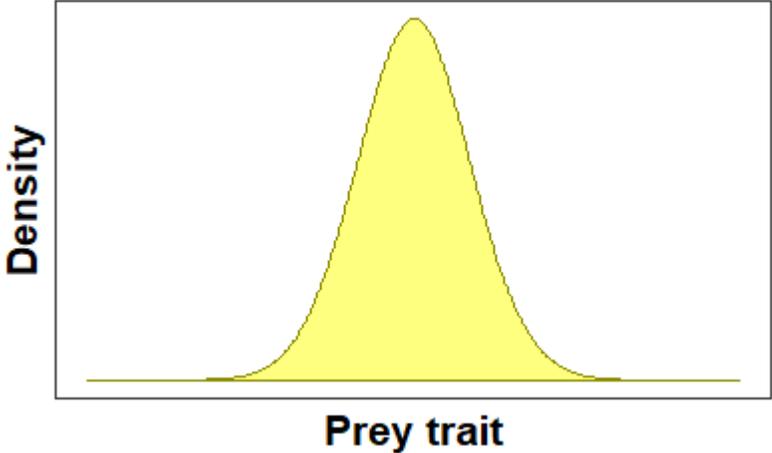
Exotic prey as novel actors



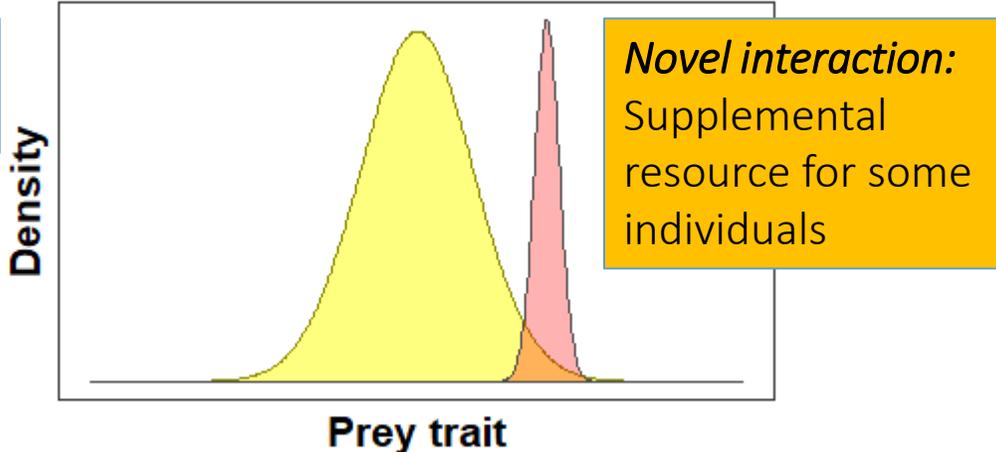
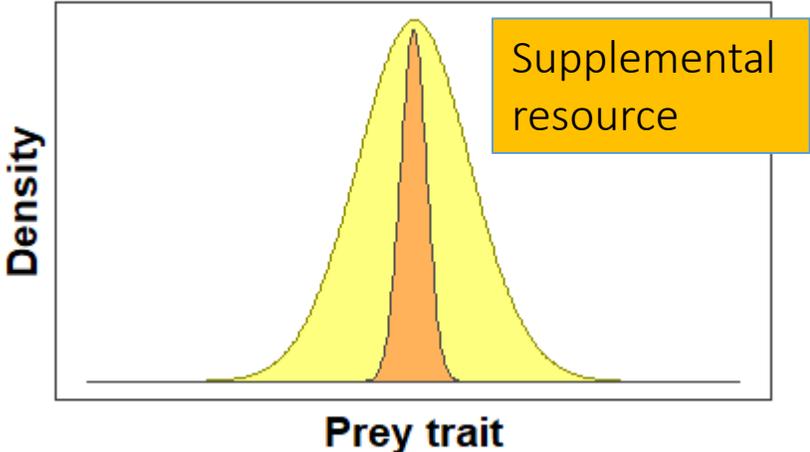
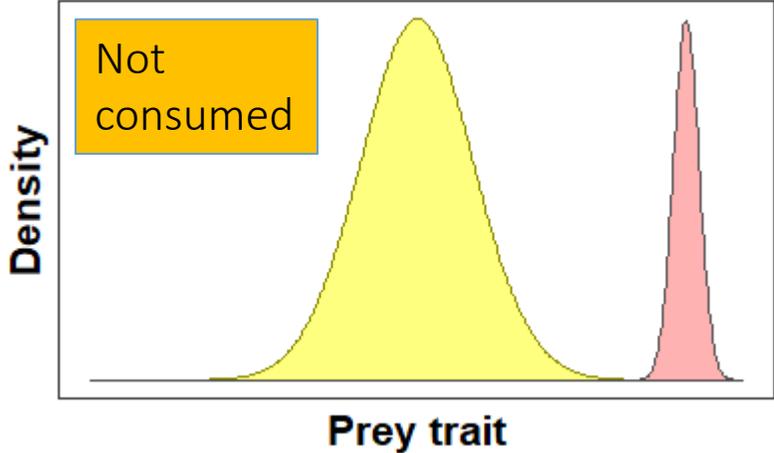
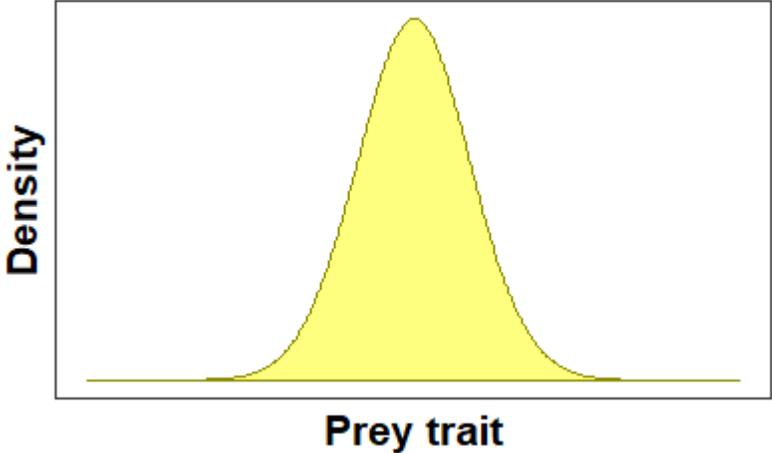
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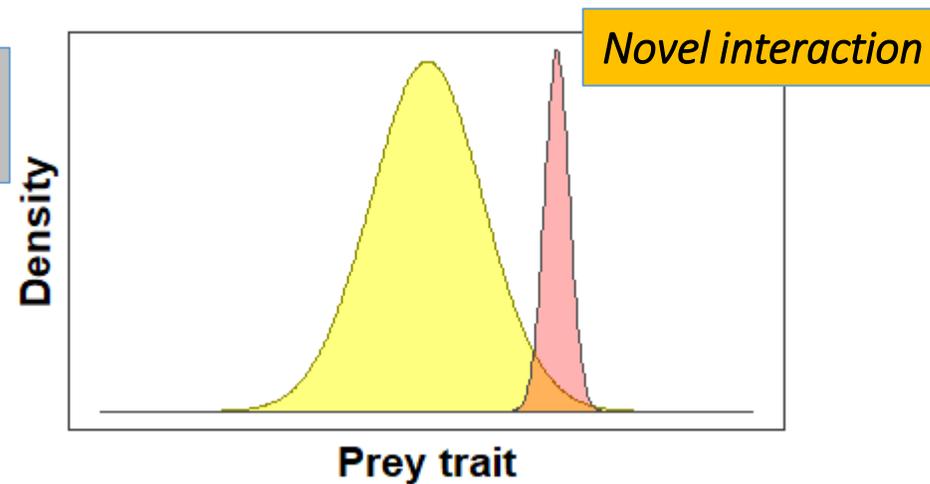
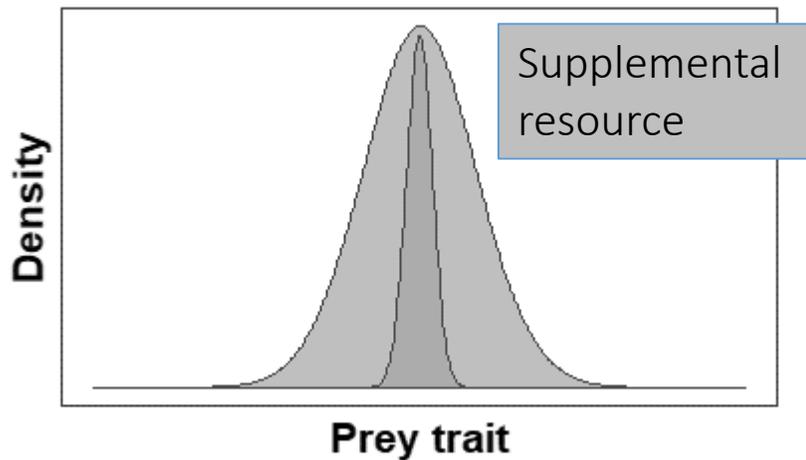
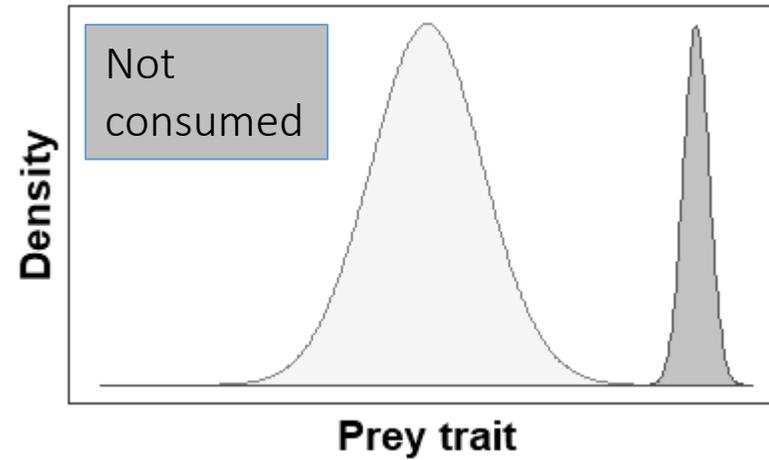
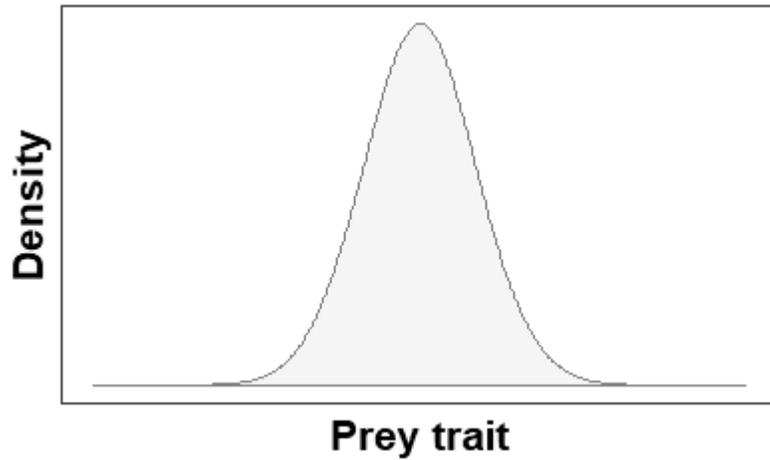
Exotic prey as novel actors



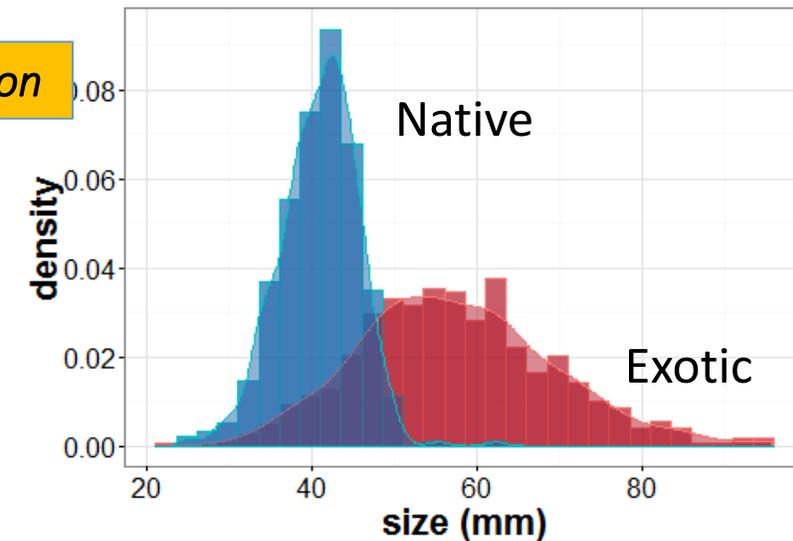
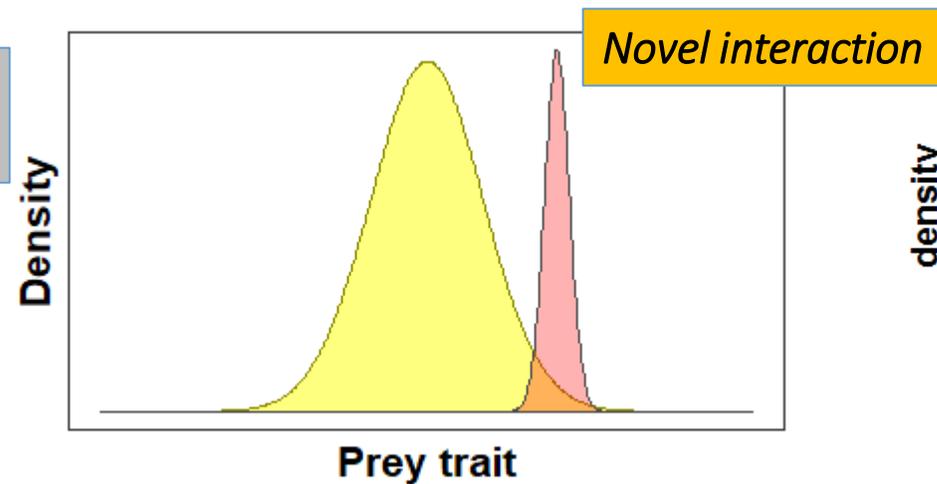
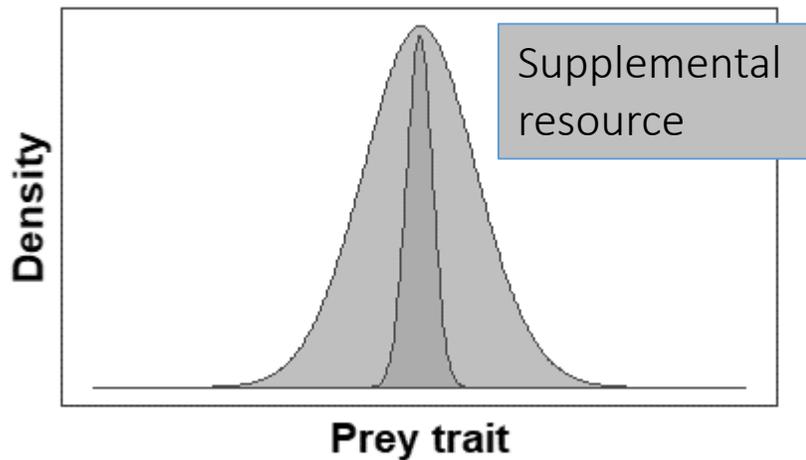
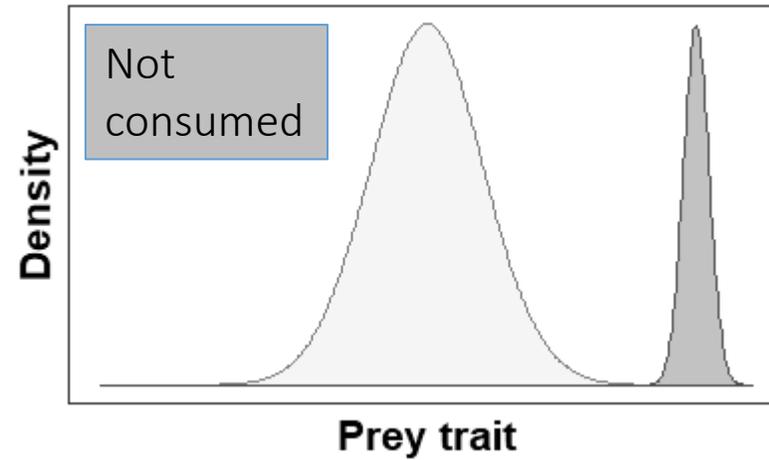
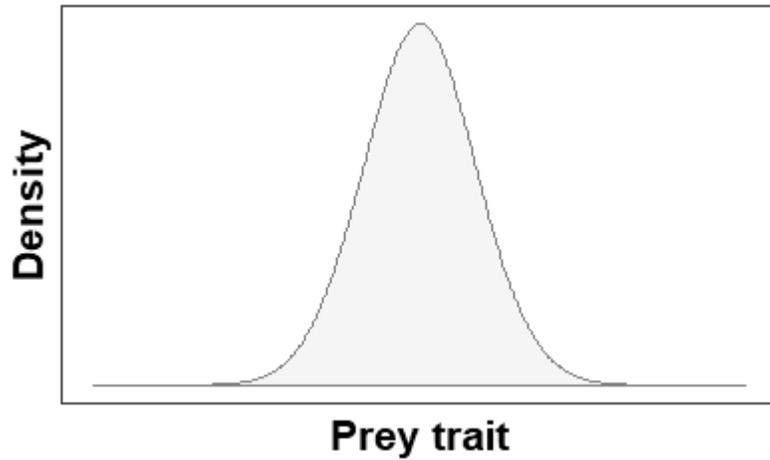
Exotic prey as novel actors



Do these strong ecological effects have evolutionary consequences?

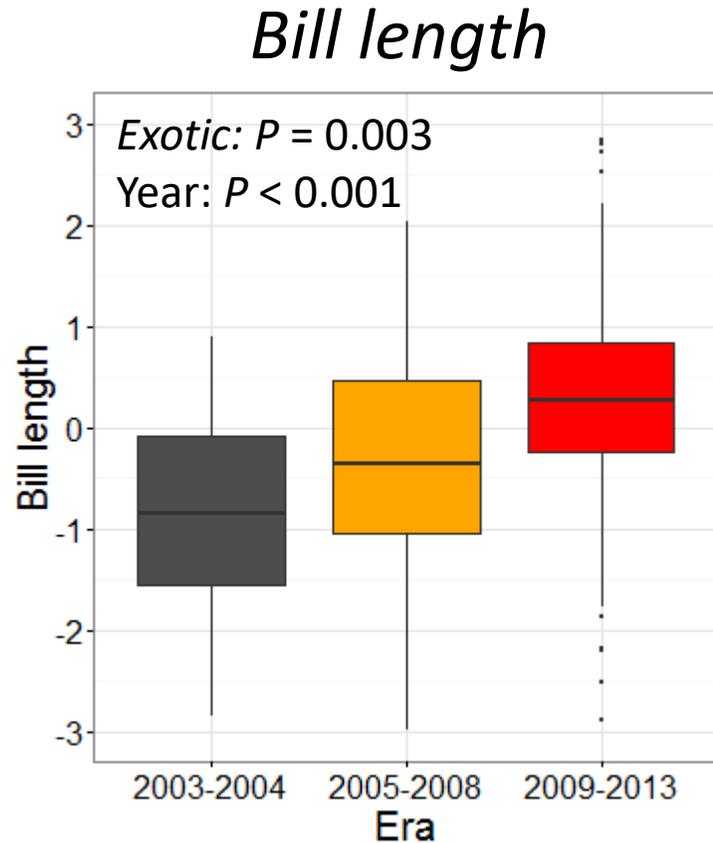


Do these strong ecological effects have evolutionary consequences?



Changes in morphology over time:

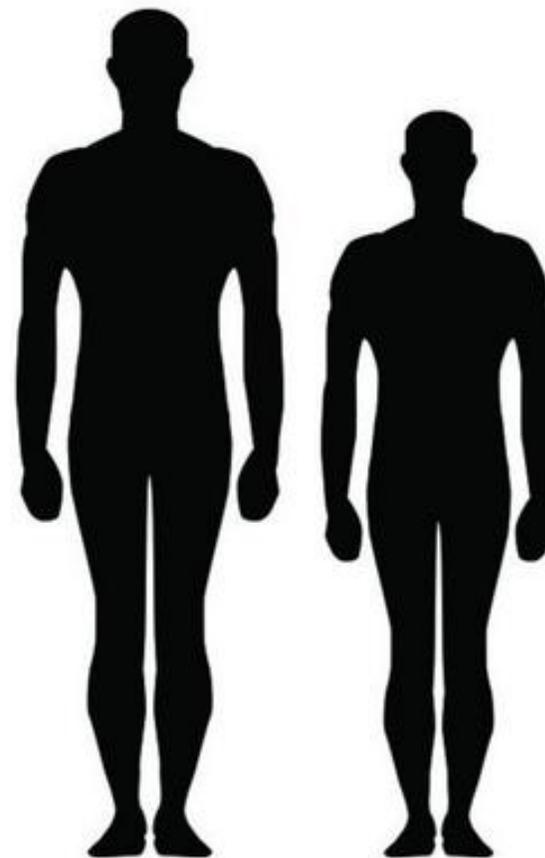
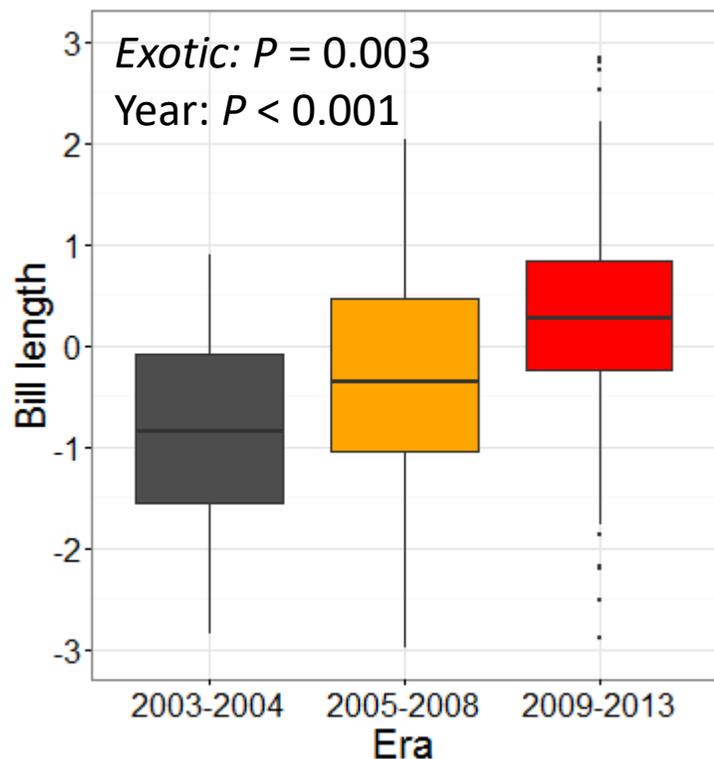
Bill length increased by ~ 1 SD on average, with some birds having > 2 SD greater than observations prior to invasion



Changes in morphology over time:

Bill length increased by ~ 1 SD on average, with some birds having > 2 SD greater than observations prior to invasion

Bill length



Mean male height 5'9"
Standard deviation 4"
...2 SD would be 6'5"

Understanding the change

- 1) Bill size is heritable in snail kites



Estimated using pedigree data

Understanding the change

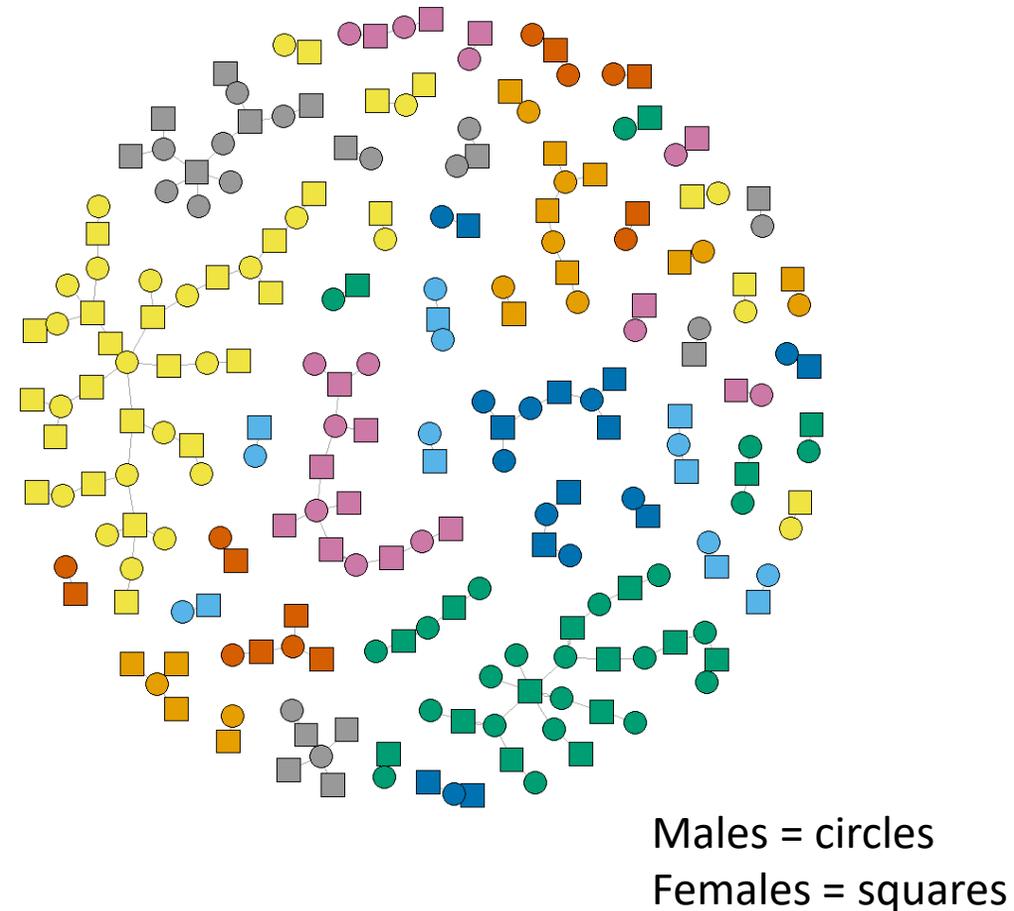
- 1) Bill size is heritable in snail kites
- 2) There was selection on bill size—
the big-billed kites survived better!



Understanding the change

- 1) Bill size is heritable in snail kites
- 2) There was selection on bill size—the big-billed kites survived better!
- 3) Females prefer mating with males that have bigger bills!

The mating network of snail kites



*The story of an endangered bird
and its struggle for existence*



Outlook



The dynamics of Florida's wetlands

What has and has not changed for conservation



Conservation in an increasingly novel world



Acknowledgments

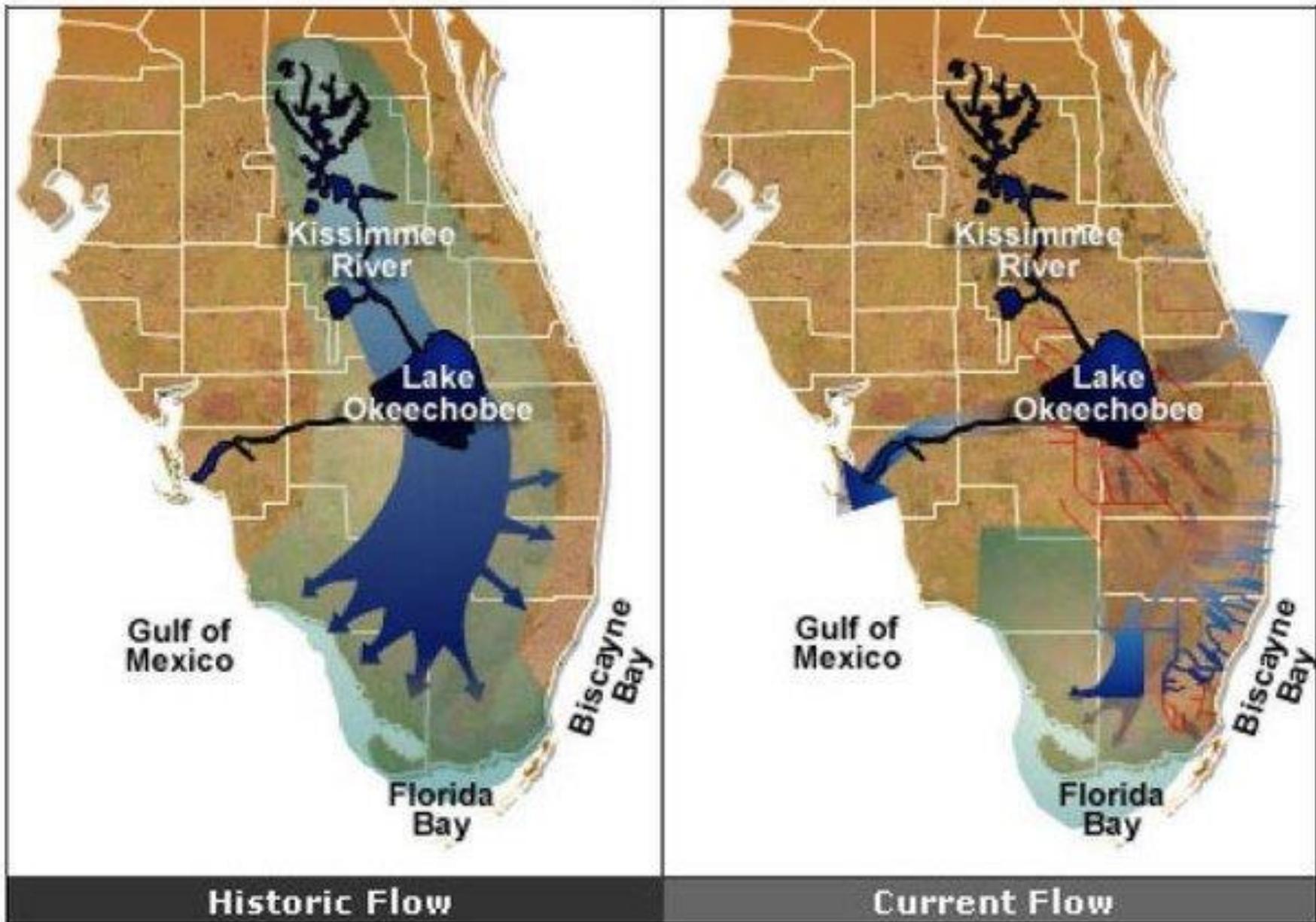
Monitoring design and implementation:

Rob Bennetts, Vicky Dreitz, Don DeAngelis, James Nichols, Bill Kendall, Jim Hines, FL Coop Unit

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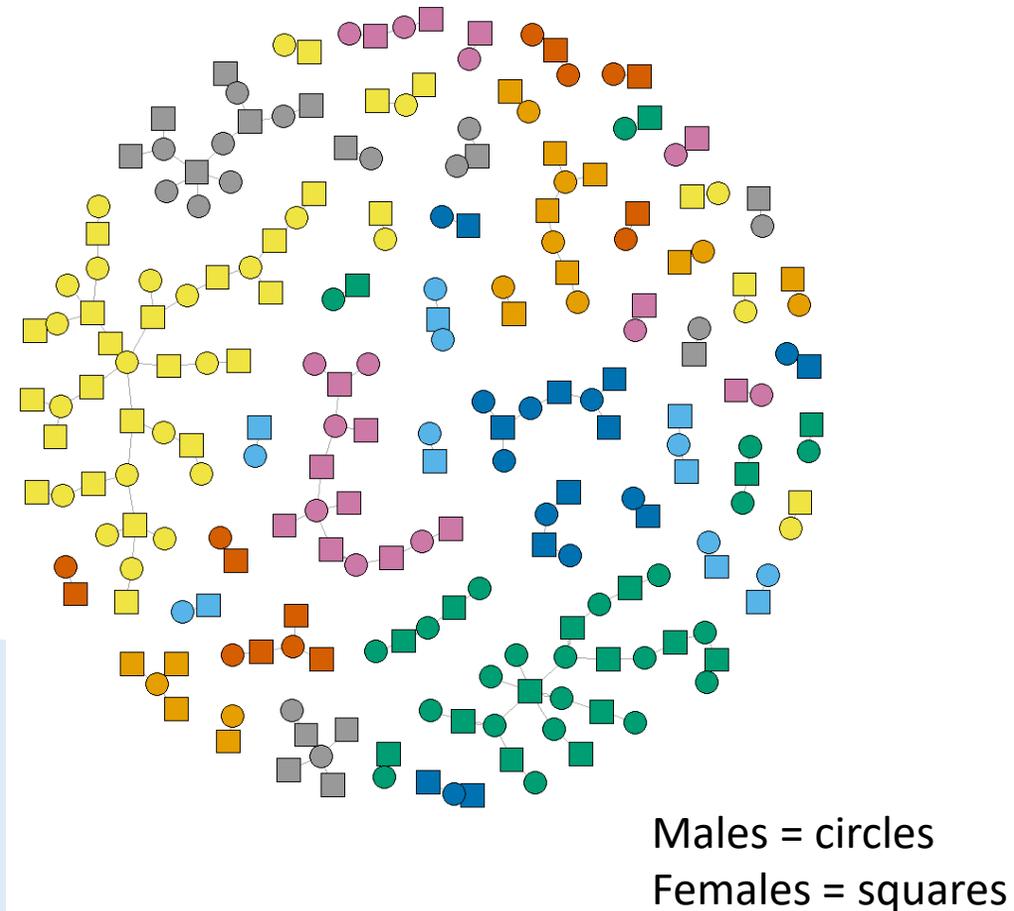


Understanding the change

- 1) Heritabilities (h^2) are high (~30-40%) and similar to morphological traits seen in other species
- 2) There was selection on bill size—the big-billed kites survived better!
- 3) Females prefer mating with males that have bigger bills!

Yet ultimately these effects couldn't explain a lot of the rapid change... 'phenotypic plasticity' was likely a major culprit

The mating network of snail kites



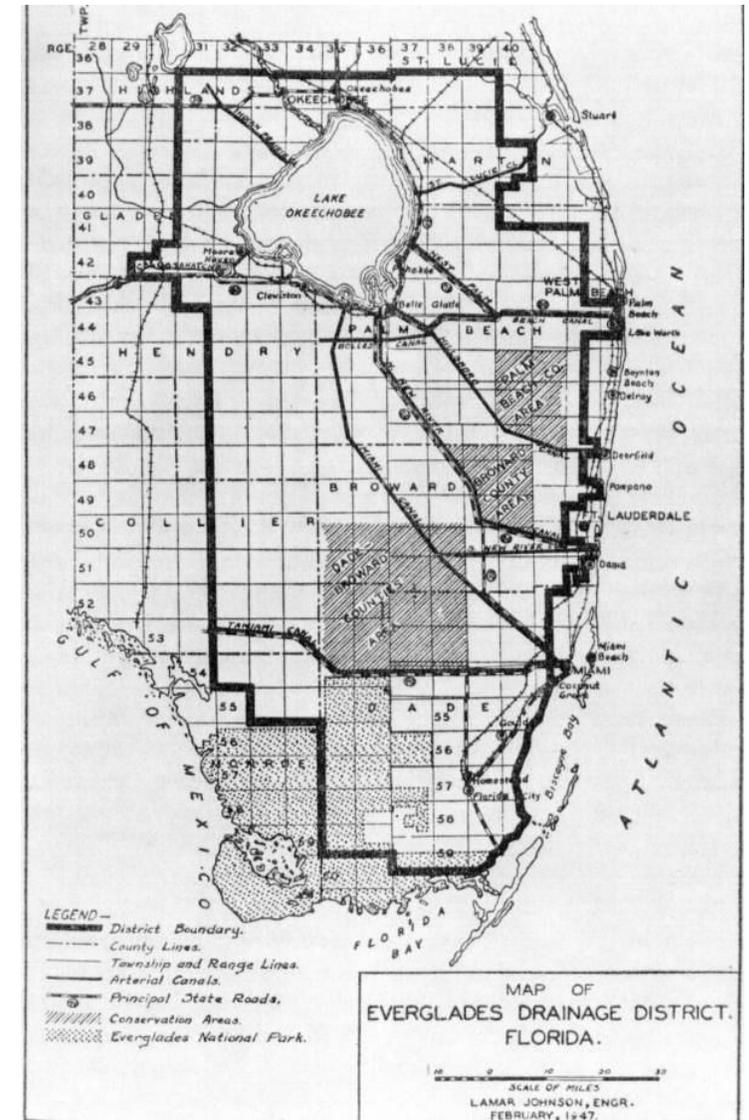
The dynamics of Florida's wetlands



The Central and South Florida Project of 1948

Purposes of the project:

- flood control
- regional water supply for agricultural and urban areas
- prevention of saltwater intrusion
- water supply to Everglades National Park
- preservation of fish and wildlife, recreation and navigation



Everglade snail kite

(Rostrhamus sociabilis plumbeus)

- First discovered in 1844 by Edward Harris at the headwaters of the Miami River
- Distribution first described in 1932 by Howell
- Prior to 1950's, documented throughout much of Florida (recorded in 49% of counties)
- Distribution constricted with wetland loss & degradation
- By 1954, Sprunt argued that almost the entire population was confined to Lake Okeechobee

