

Burmese Pythons in Florida:

Biology, impacts, and the importance of detection probability



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Where did they come from?

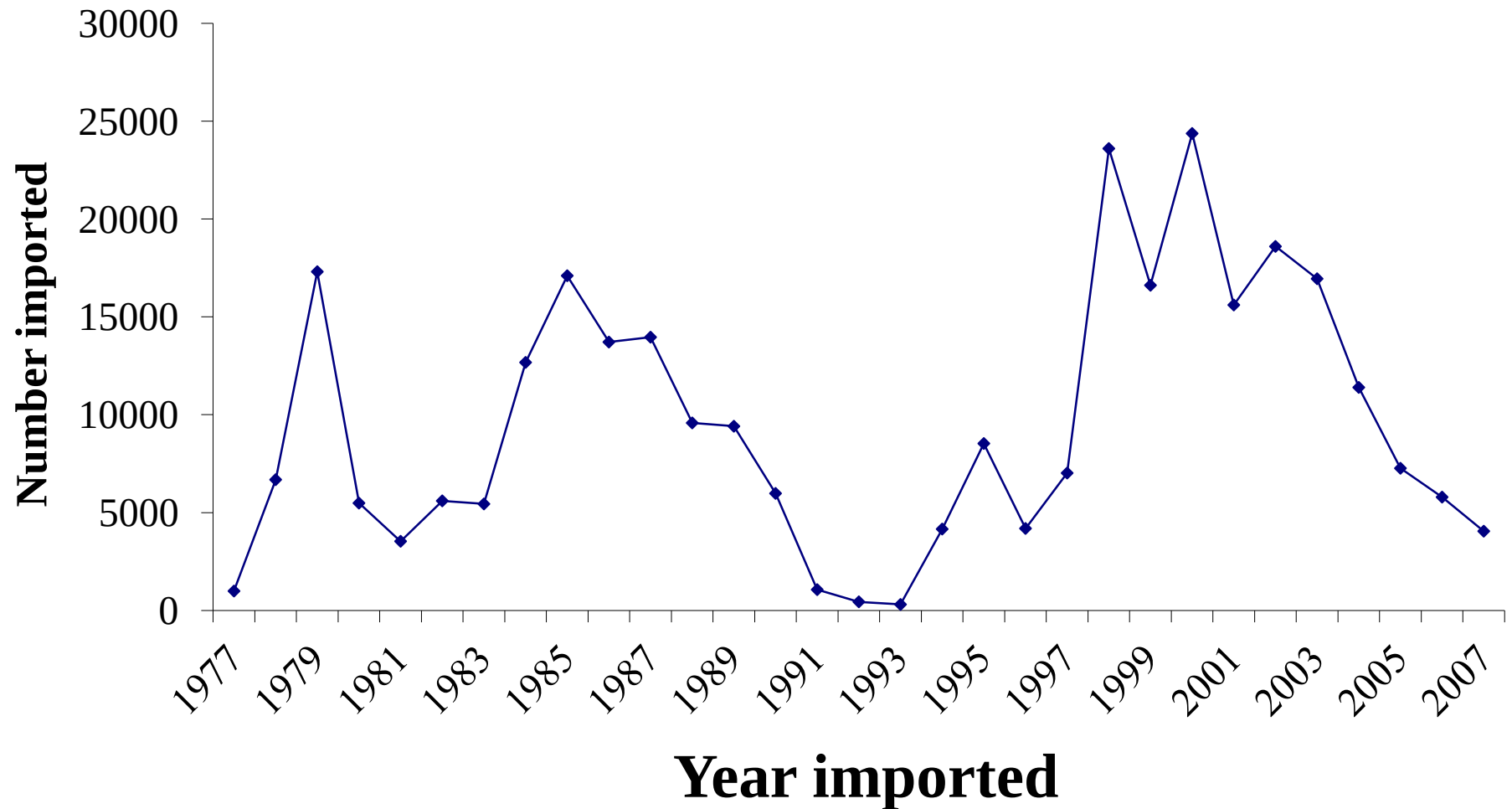


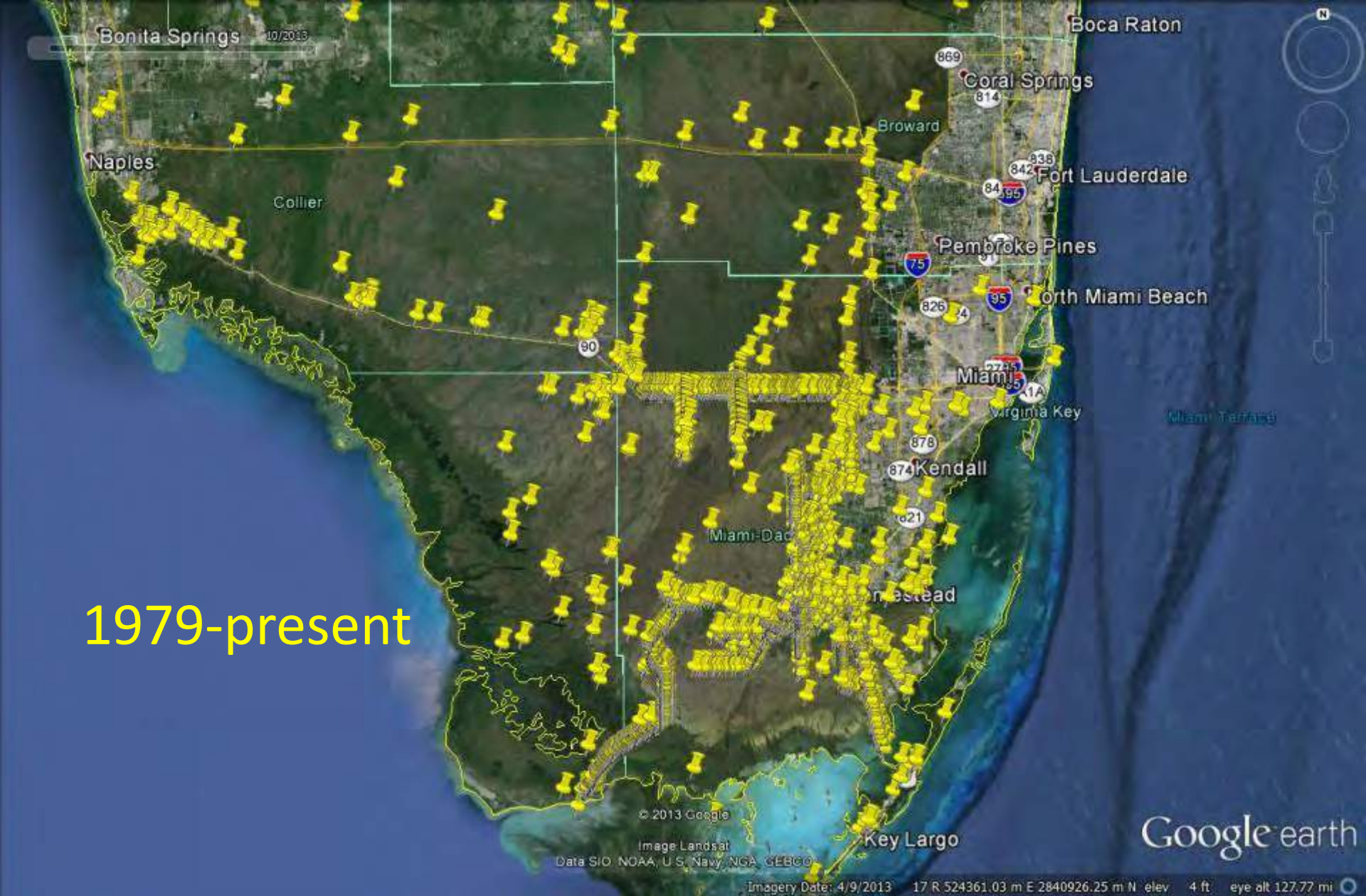
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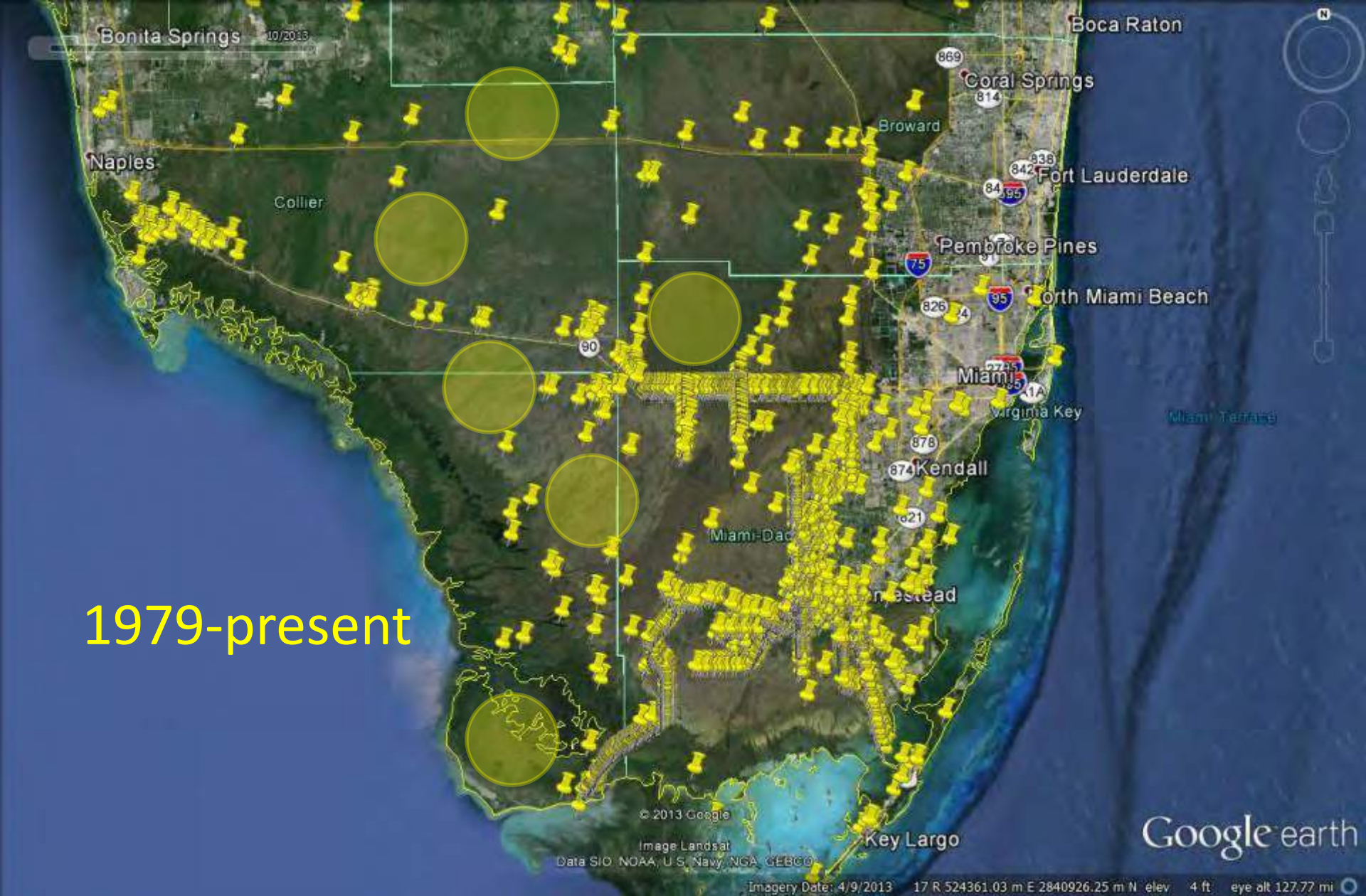
Proximate hypotheses

- Intentional releases
- Escapes from captivity
- Mass releases (Hurricane Andrew, 1992)

Ultimate answer: The live animal trade





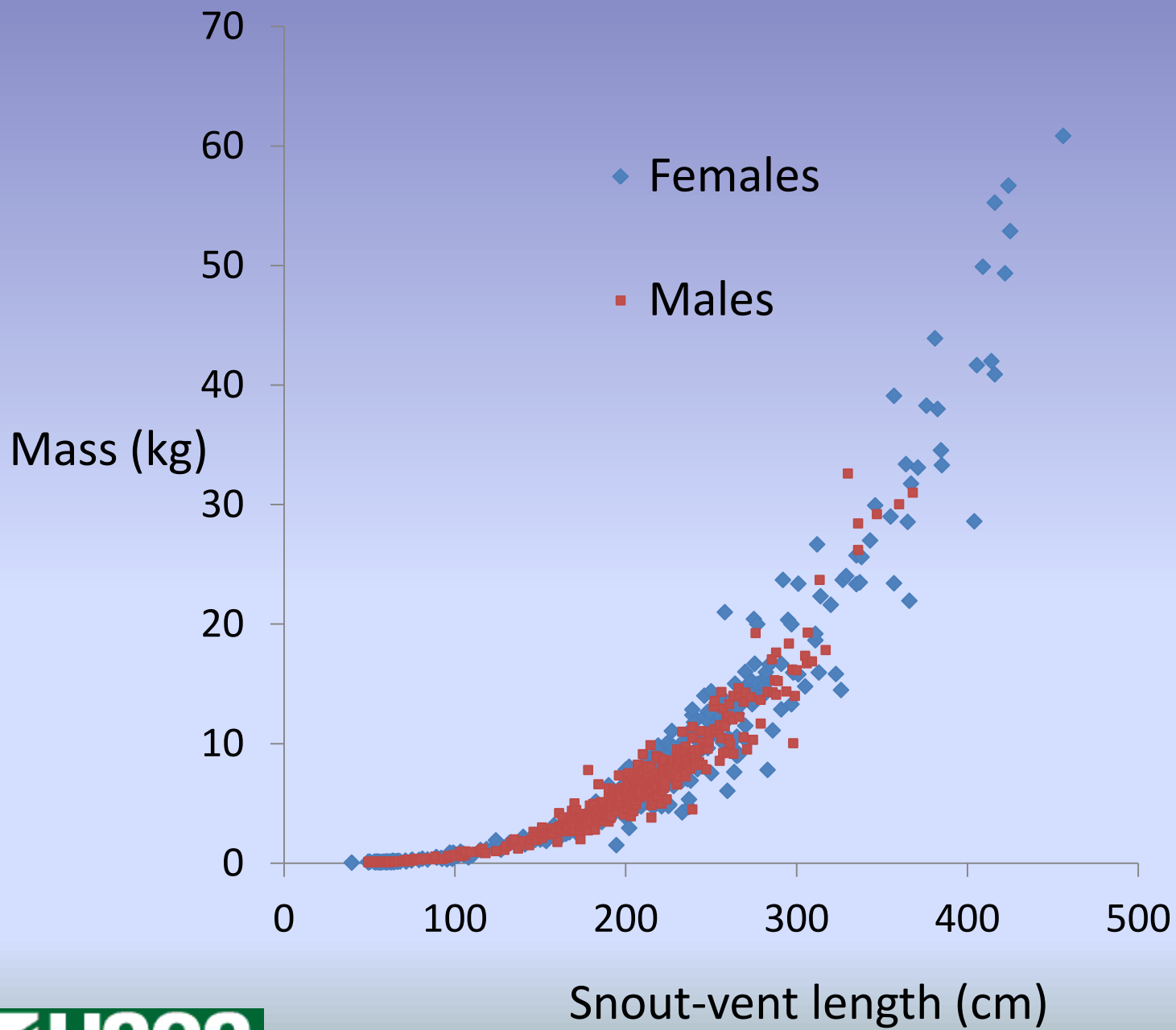


Body size

Average: 3 m, 10-12 kg

Maximum: >5.5 m, >75 kg





Population size: Unknown

>2,000 pythons collected, 90% since 2006

Most credible estimates >>10,000 individuals



Impacts



Birds

Wood stork	Blue-winged teal
Limpkin	Northern pintail
White ibis	Domestic duck
Black vulture	Domestic goose
Great blue heron	Domestic chicken
Great egret	Common moorhen
Snowy egret	Clapper rail
Little blue heron	King rail
Anhinga	Virginia rail
American coot	Sora
House wren	Whimbrel
Magnificent frigatebird	Red-winged blackbird
Purple gallinule	Eastern meadowlark
Pied-billed grebe	

Mammals

Key Largo woodrat
Round-tailed muskrat
Bobcat
Rabbit
Raccoon
River otter
White-tailed deer
Grey squirrel
Domestic cat
Black rat
Opossum
Rice rat
Cotton rat
Cotton mouse
Feral hog

Reptiles: American Alligator

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February 14, 2012 • vol. 109 | no. 7 | pp. 2177–2581

PNAS

Proceedings of the National Academy of Sciences of the United States of America

www.pnas.org

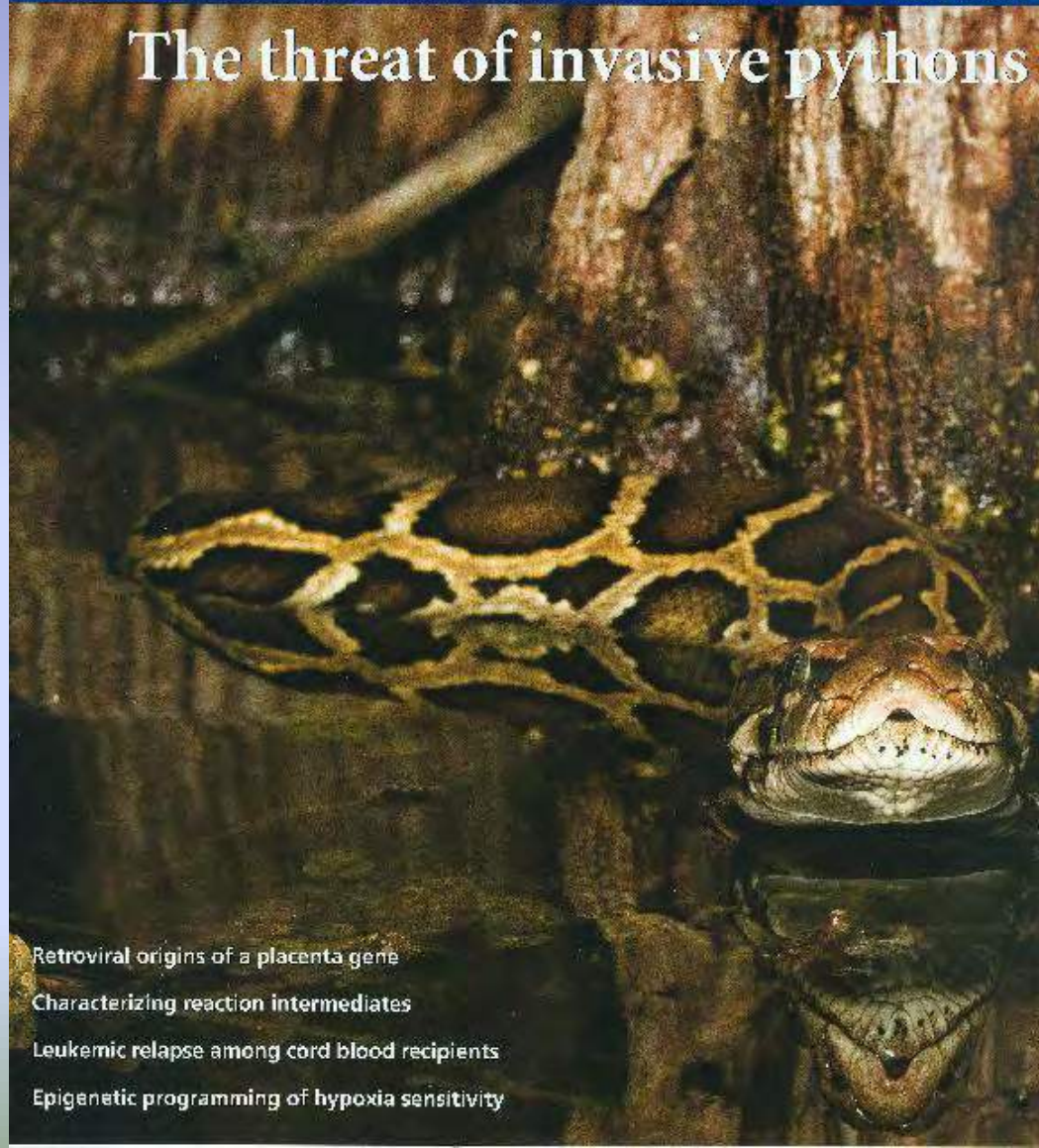
The threat of invasive pythons

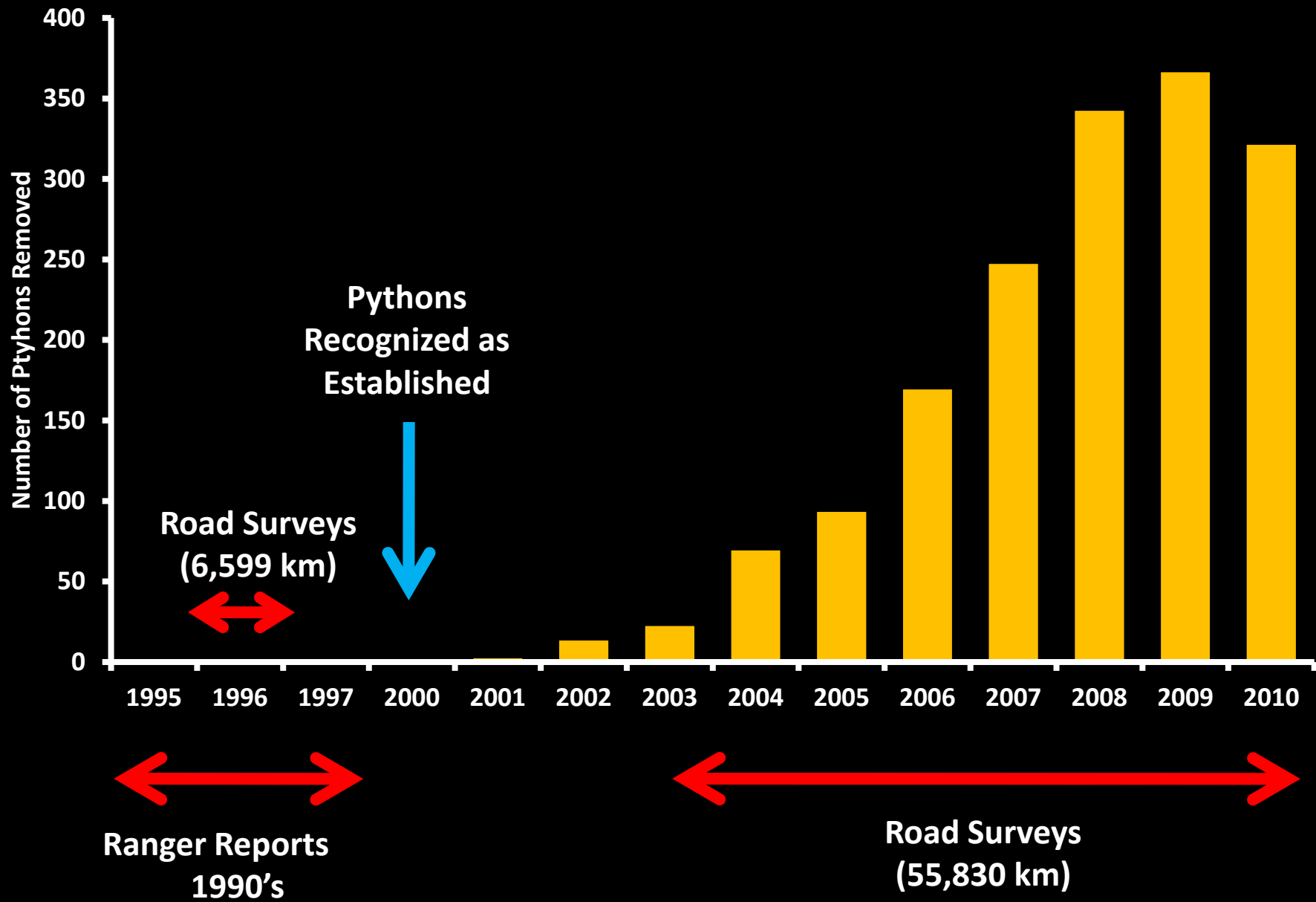
Retroviral origins of a placenta gene

Characterizing reaction intermediates

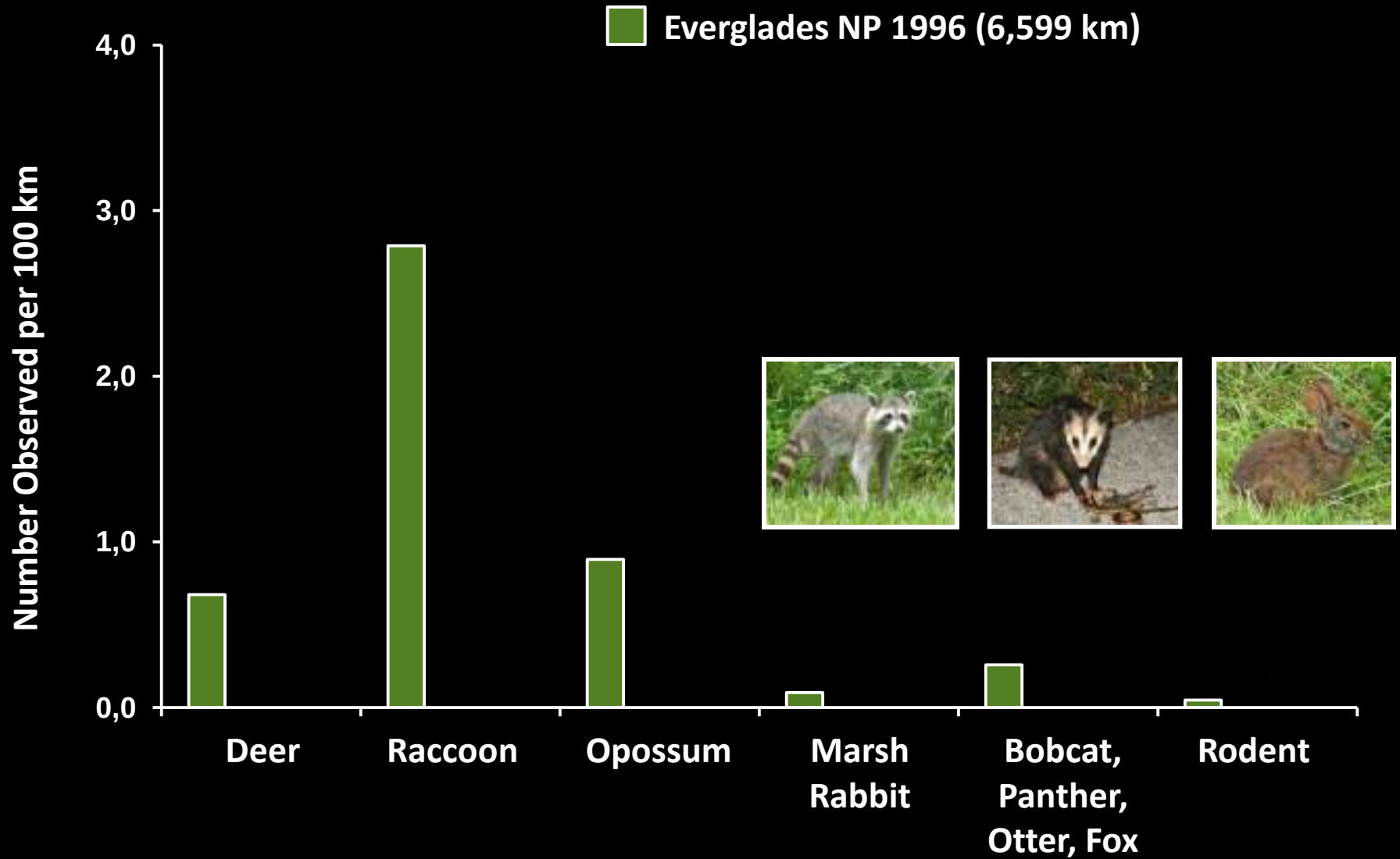
Leukemic relapse among cord blood recipients

Epigenetic programming of hypoxia sensitivity

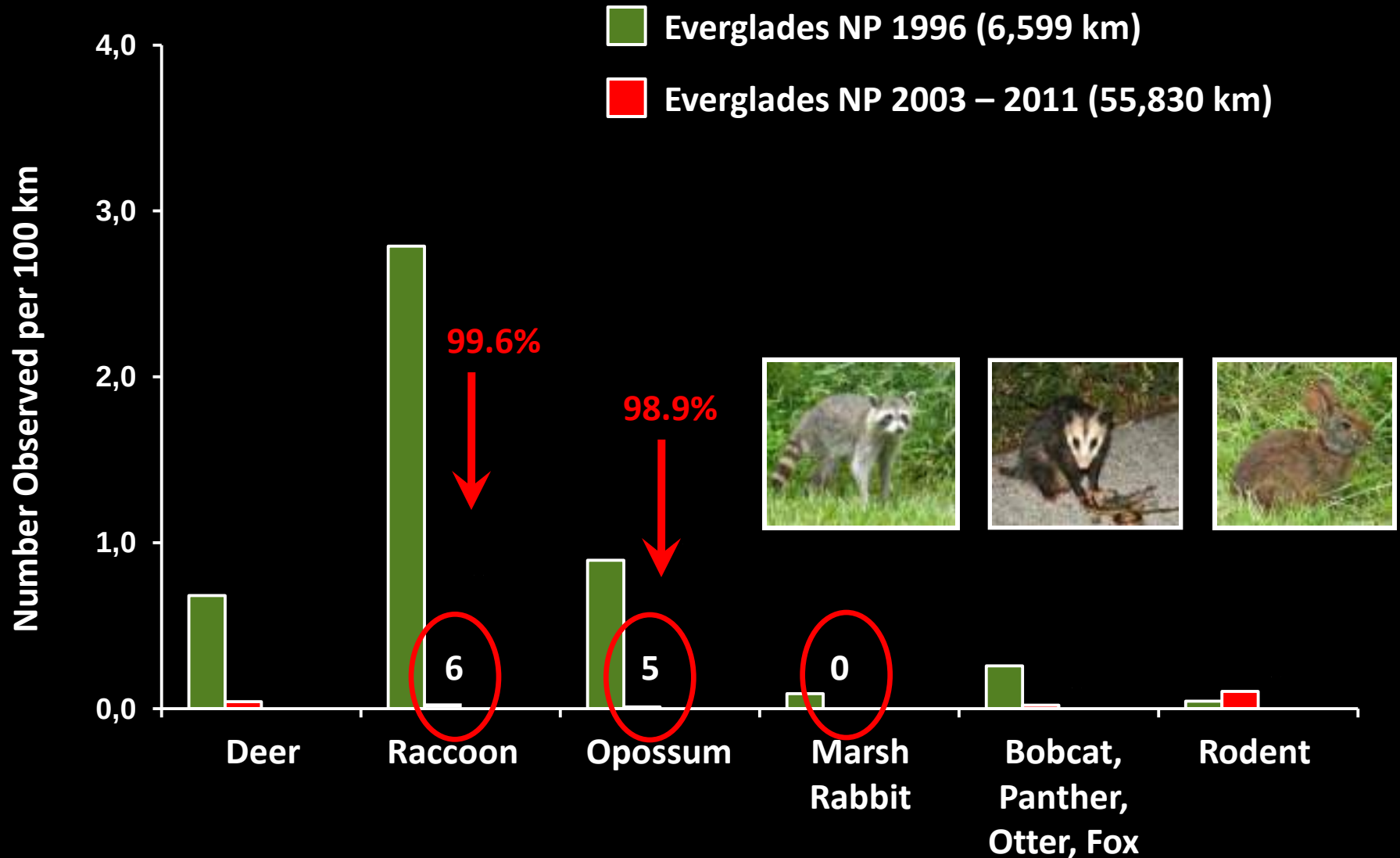




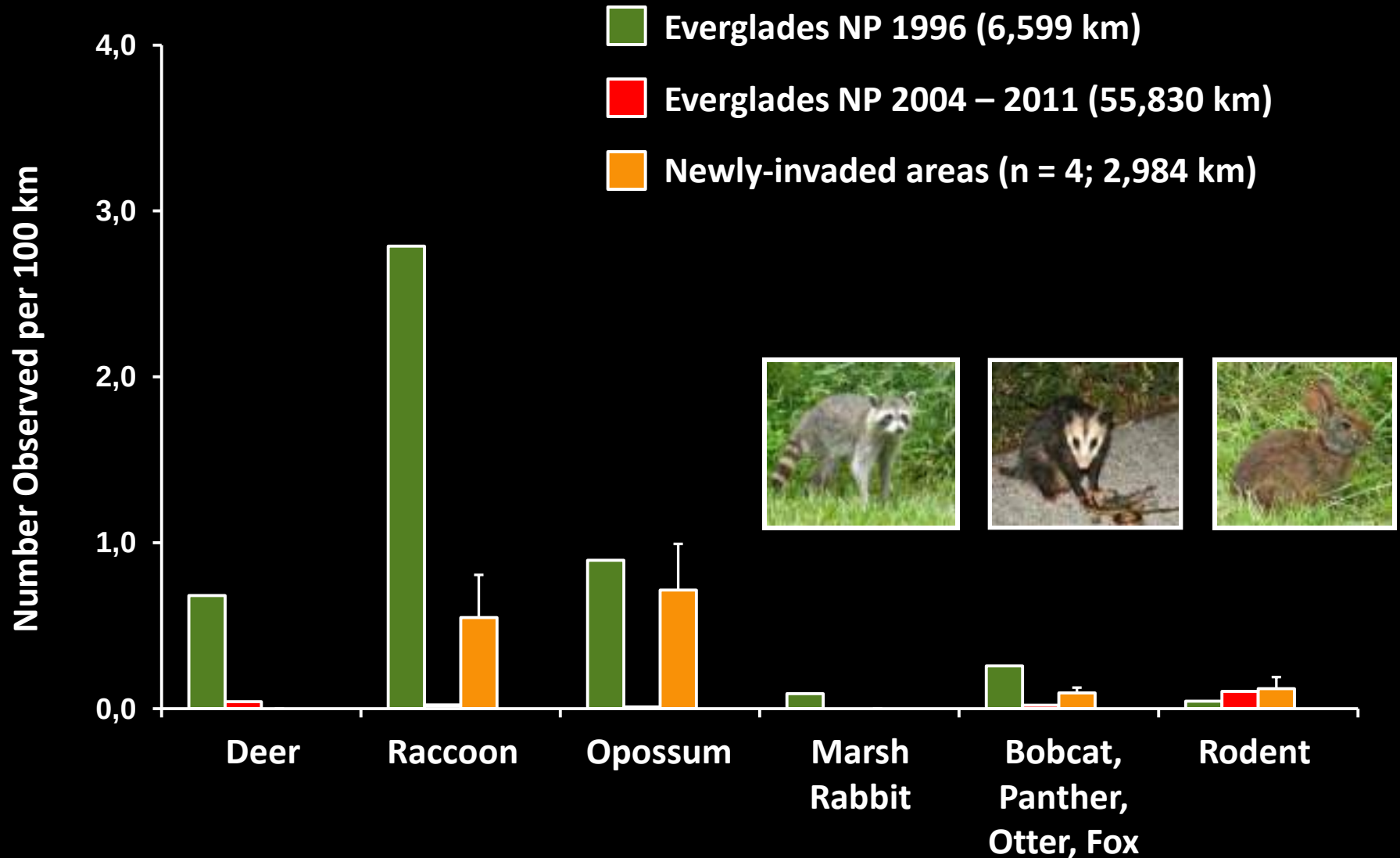
Mammal Abundance in the Everglades



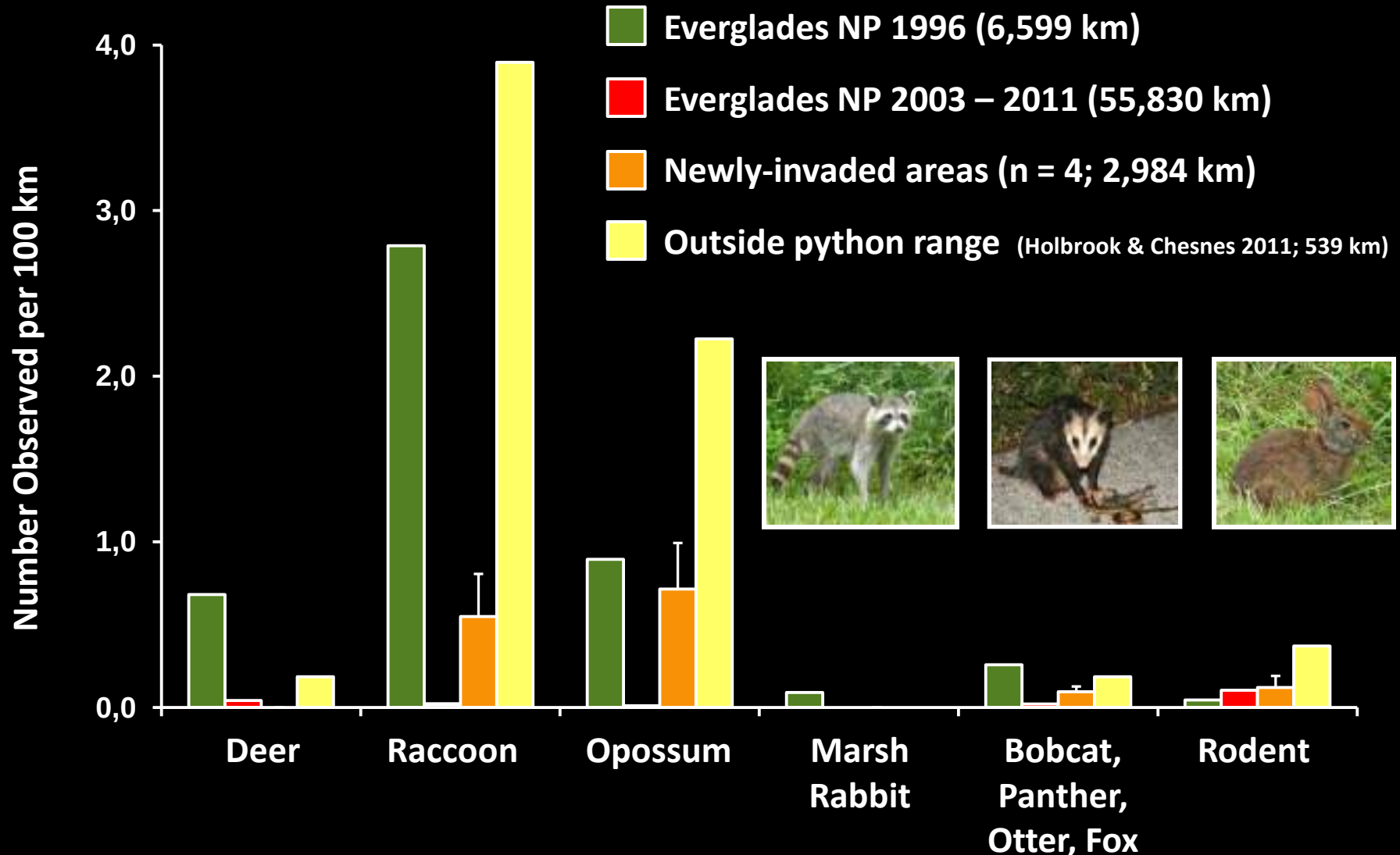
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Detection

Abundance: Number of individuals in a population

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Density: Number of individuals per unit area

Low-density species can be abundant if widespread

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Low-density species can be abundant if widespread

Occupancy: Proportion of an area that is inhabited

Occupancy can be monitored to provide a relative measure of abundance

Back to Brown Treesnakes.....



5 ha enclosed Brown Treesnake population on Guam

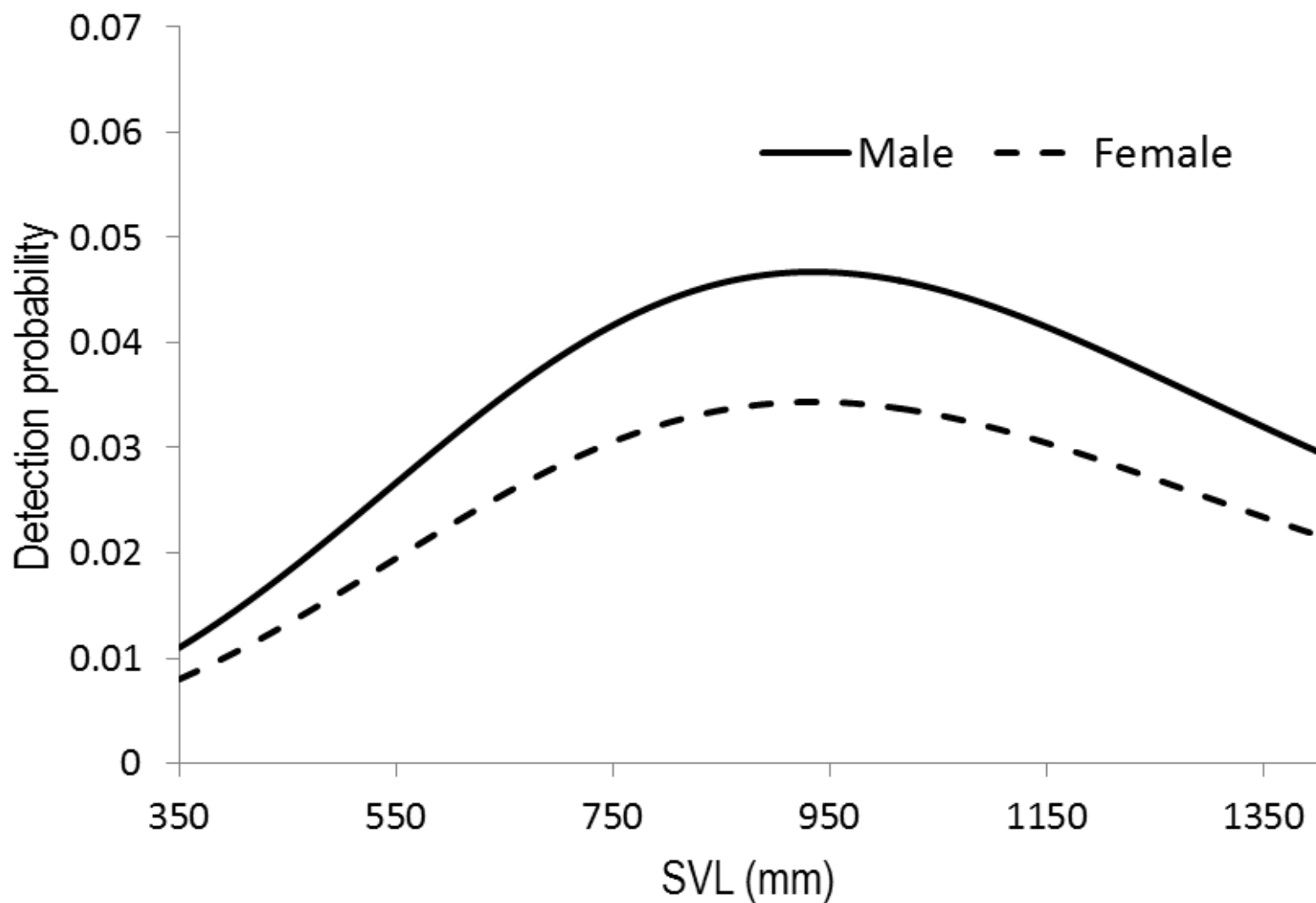
- Nocturnal searches, 192 snakes present
- ~2700 person-hours
- Estimating detection probability (p)

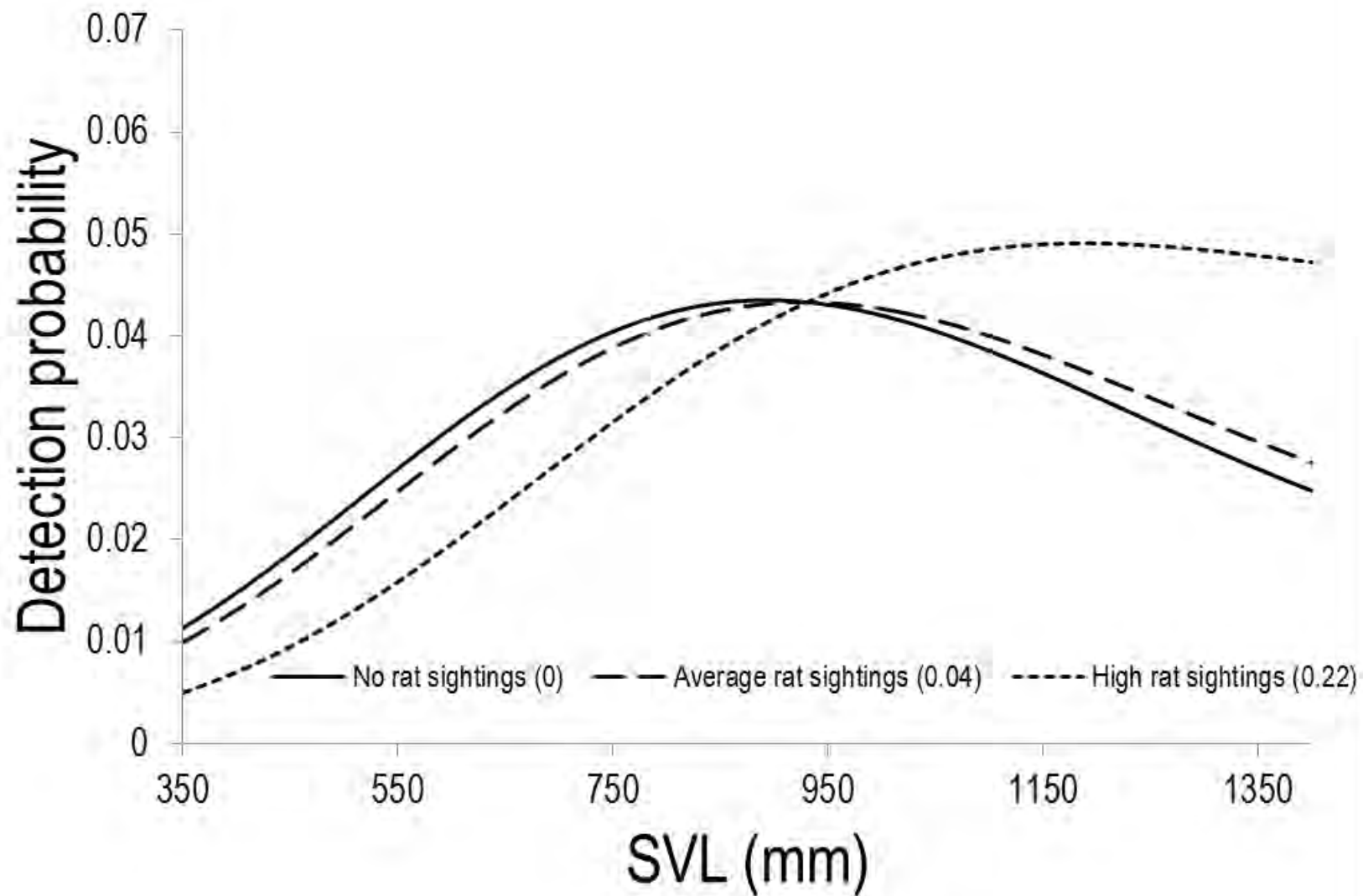


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- Nocturnal searches, 192 snakes present
- ~2700 person-hours
- Estimating detection probability (p)
- Overall $p = 0.04$
- 11 covariates modeled on p







Now back to pythons....

Mark-recapture not possible

How can we estimate detection probability?



Road pythons





Levee pythons



1 in 10?

1 in 100?

1 in 1,000?

Multiple factors influence detection probability



Multiple factors influence detection probability

- Species attributes

Size Sex

Condition Satiety



Multiple factors influence detection probability

- Species attributes
- Environmental context

Weather

Habitat

Season



Multiple factors influence detection probability

- Species attributes
- Environmental context
- Observer biases

Skill

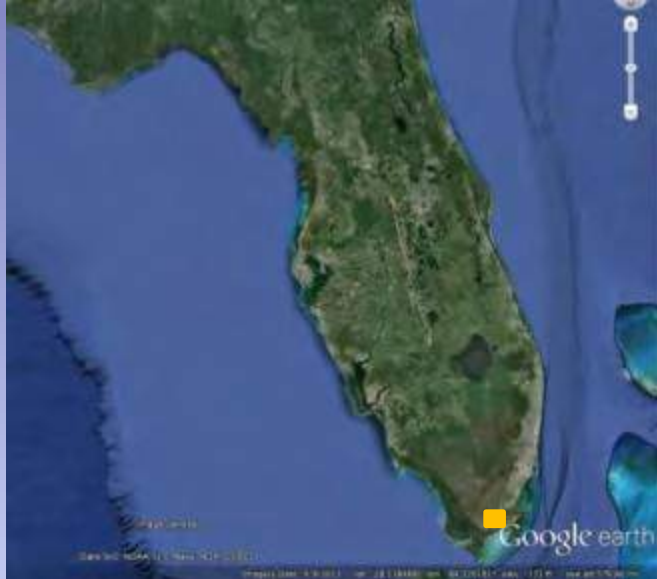
Behavior

Number of targets



2013 Intensive surveys

- C-110 canal surveyed on foot 3x/week
- ≥ 2 independent observers/survey
- Round trip (both sides, ~ 8 km total)



Optimal conditions for detection

- Many pythons
- Accessible
- Good visibility

3 adult male pythons received transmitters

<u>ID</u>	<u>SVL (cm)</u>	<u>Dates tracked</u>
PyMo27	171	16 Jan – 02 Jun 2013
PyMo32	215	16 Jan – 11 Apr 2013
PyMo60	293	01 Feb – 18 Mar2013



Results

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- 11 additional pythons removed from C110 by cooperators

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- 62 locations of 3 telemetered pythons, 16 Jan – 02 July
- One or more pythons on canal or levee on 51 of 62 days
- 198 person-opportunities to see a telemetered python

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Number of times pythons detected during visual search = 0



Results

IF we had found one telemetered python...

Results

Raw detection probability across all opportunities:

$$1/198 = 0.005$$

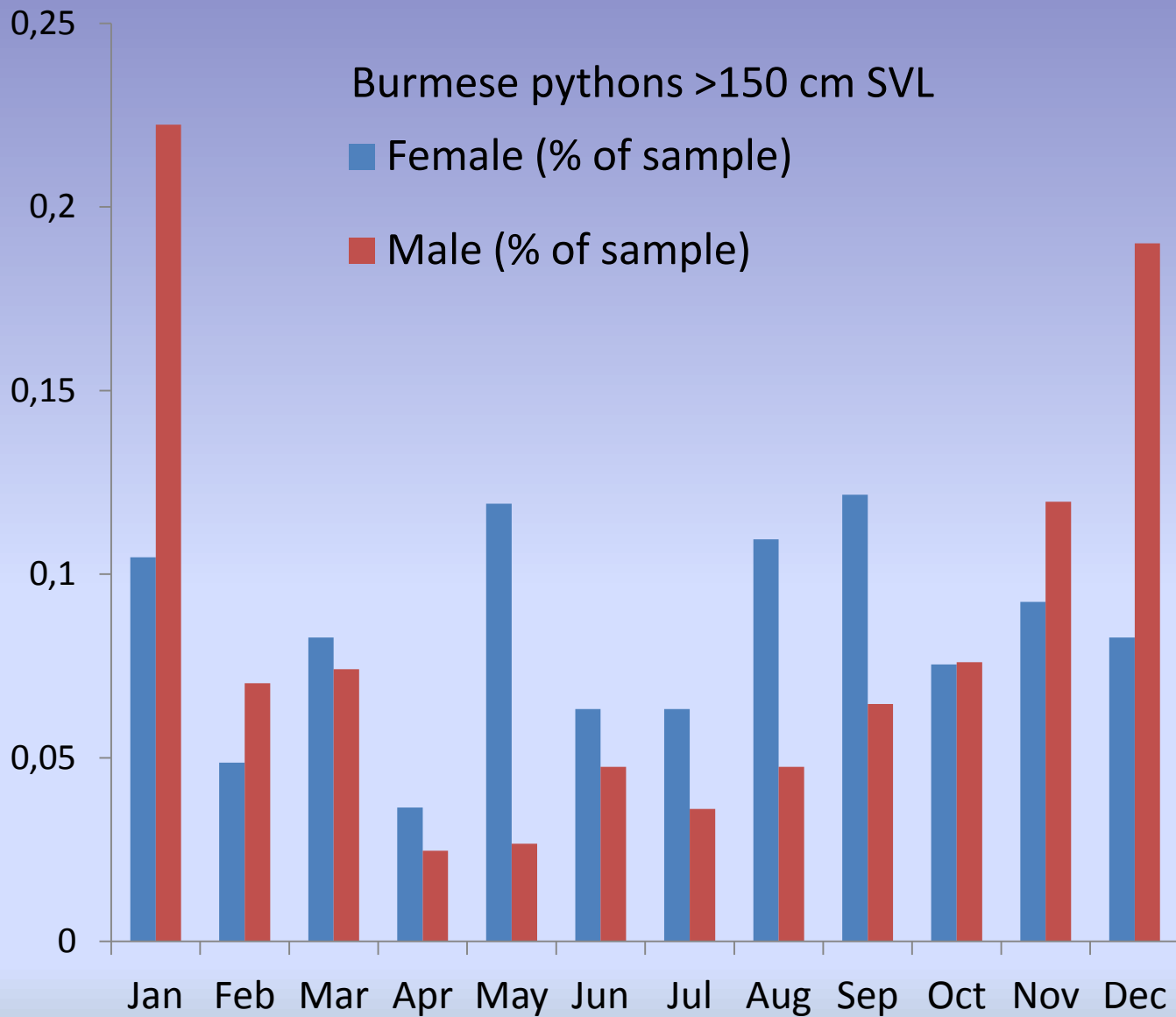
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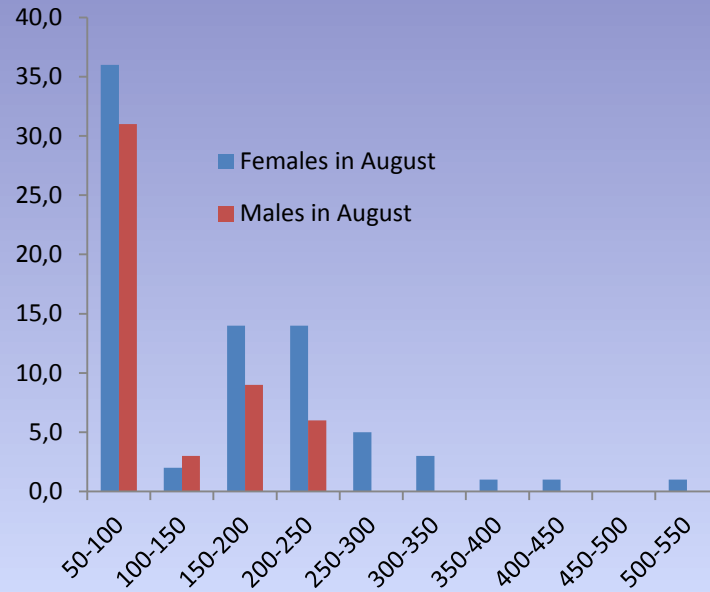
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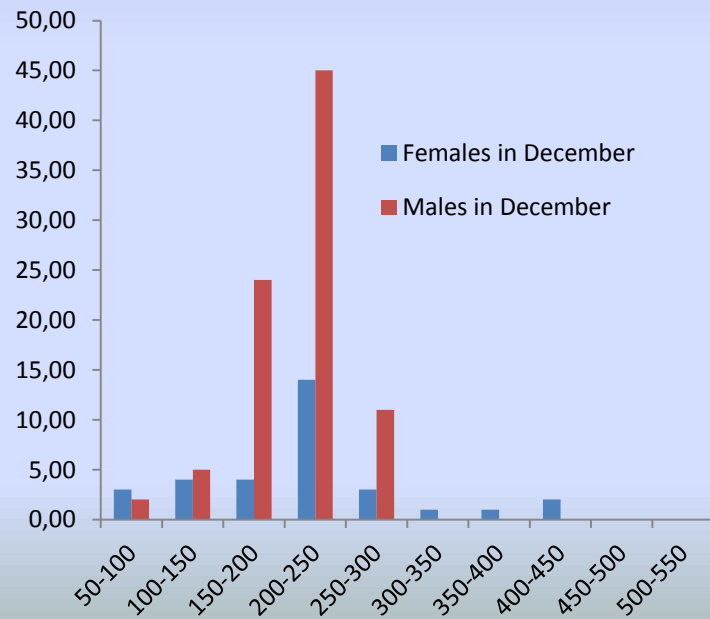
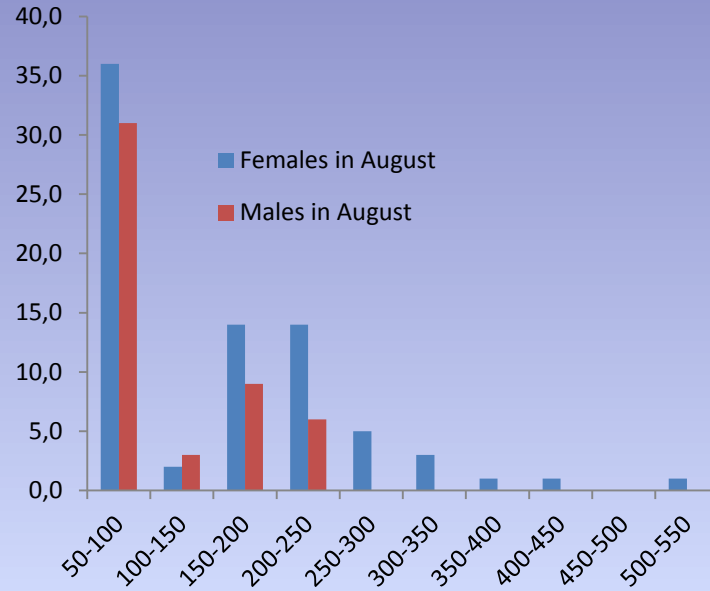
Implications for understanding population biology



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Conclusions from invasive snake studies

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Conclusions from invasive snake studies

- Severe declines of some prey species can be expected
- Snake population biology = detection probability
- Counts are almost certainly misleading
- Snake densities are underestimated
- Communicating these topics is challenging

Acknowledgments:

USGS: K Hart, C Jarnevich, L Bonewell, M Cherkiss, M McEachern,
B Falk, A Yackel Adams, P Klug, L Bonewell

National Park Service: S Snow, T Dean

University of Florida: F Mazzotti, M Rochford

Florida Museum of Natural History: K Krysko

Denison College: P Andreadis

Funding: National Park Service,
USGS Priority Ecosystems,
USGS Invasive Species Program





02/04/2014