

# SCIENCE OFFICE RESEARCH

A photograph of a forest stream with mossy banks and tall trees. The stream flows through a dense forest, with the water reflecting the surrounding greenery. The banks are covered in thick, vibrant green moss and grasses. Tall, slender trees with light-colored bark line the stream, creating a serene and natural setting.

**Pinelands Commission Meeting  
February 13, 2026**

# SCIENCE OFFICE PERSONNEL

A photograph of a forest path with a sunburst effect in the background. The path is made of dirt and is surrounded by tall, thin trees. The ground is covered with red and orange leaves, suggesting autumn. The sun is shining brightly from the upper right, creating a starburst effect.

**John Bunnell (37 years in December)**

**Patrick Burritt (18 years in March)**

**Chris Jeitner (3 years in April)**

**Christine Healy (2 years in November)**

**Tyler Christensen (~3 weeks)**

# CURRENT RESEARCH AND MONITORING

Groundwater Level Monitoring

Surface Water Level Monitoring

Pinelands-wide Water Quality Monitoring

Frog and Toad Monitoring

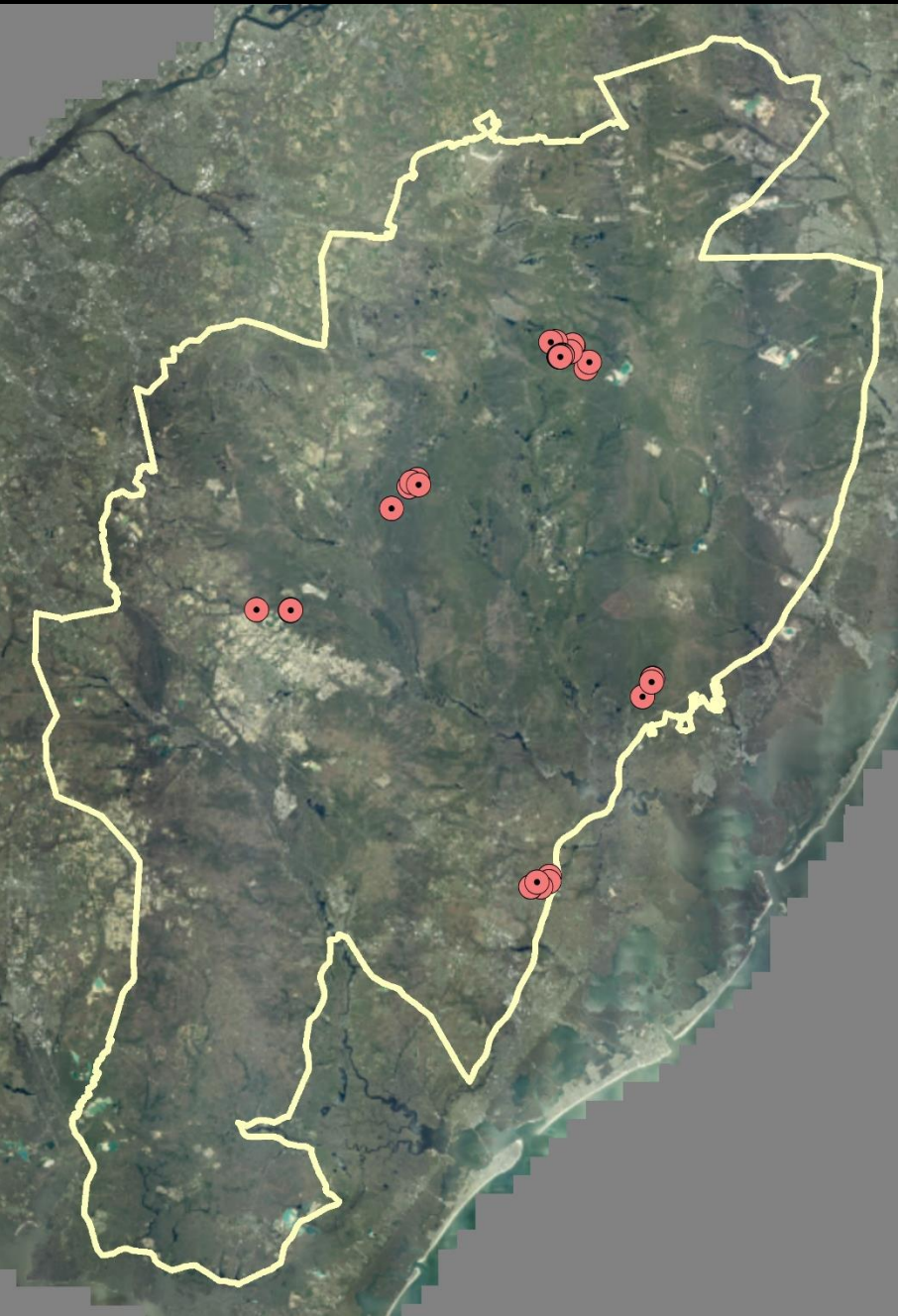
Rare Snake Monitoring

Snake Fungal Disease Monitoring

King Snake Study

Box Turtle Study

# GROUNDWATER MONITORING



**Joel Mott from Communications Office**

**Measure groundwater in 33 forest plots**

**5 forest plots monitored since 1987**

Installed for Dr. Zampella's PhD work

38 years so far

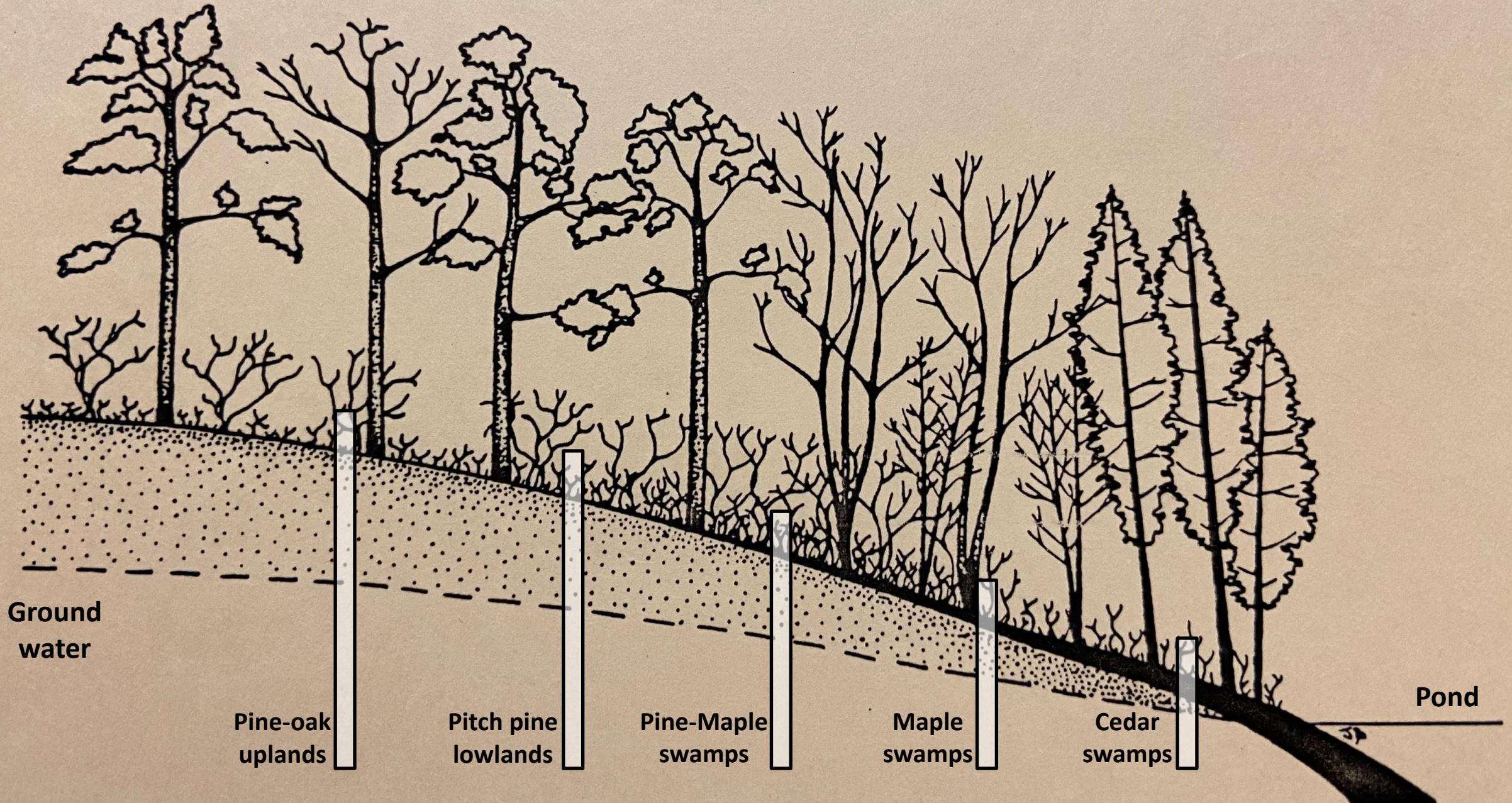
**28 forest plots monitored since 2004**

Installed as part of the Kirkwood-Cohansey Project

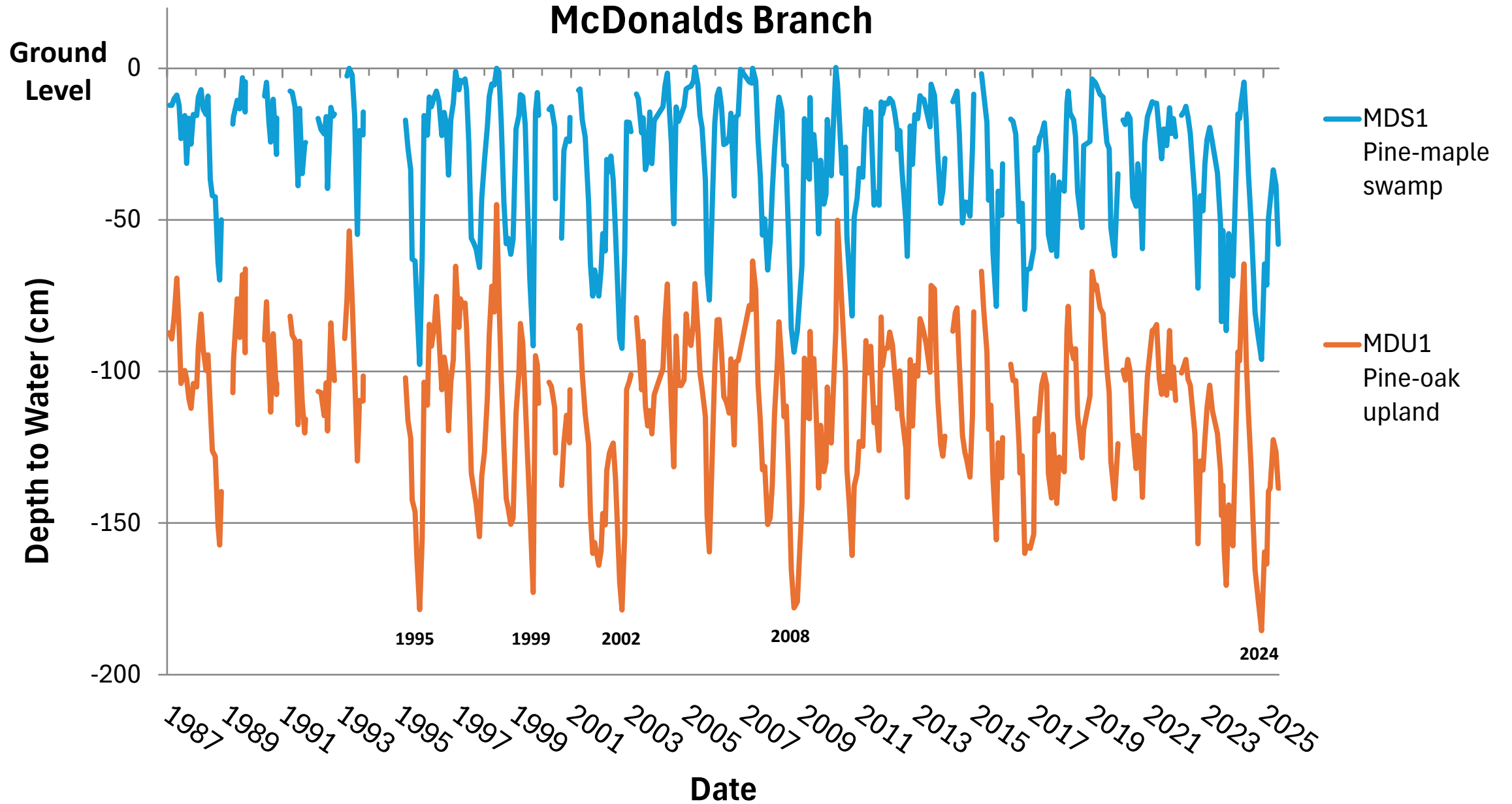
21 years so far

**WHY? To monitor changes in  
groundwater levels over time**

# GROUNDWATER MONITORING



# GROUNDWATER MONITORING



# GROUNDWATER MONITORING



**This forest plot in McDonalds Branch was measured manually every month since 1987**

**USGS installed metal well for KC Project**

**In 2017, a data logger was installed**

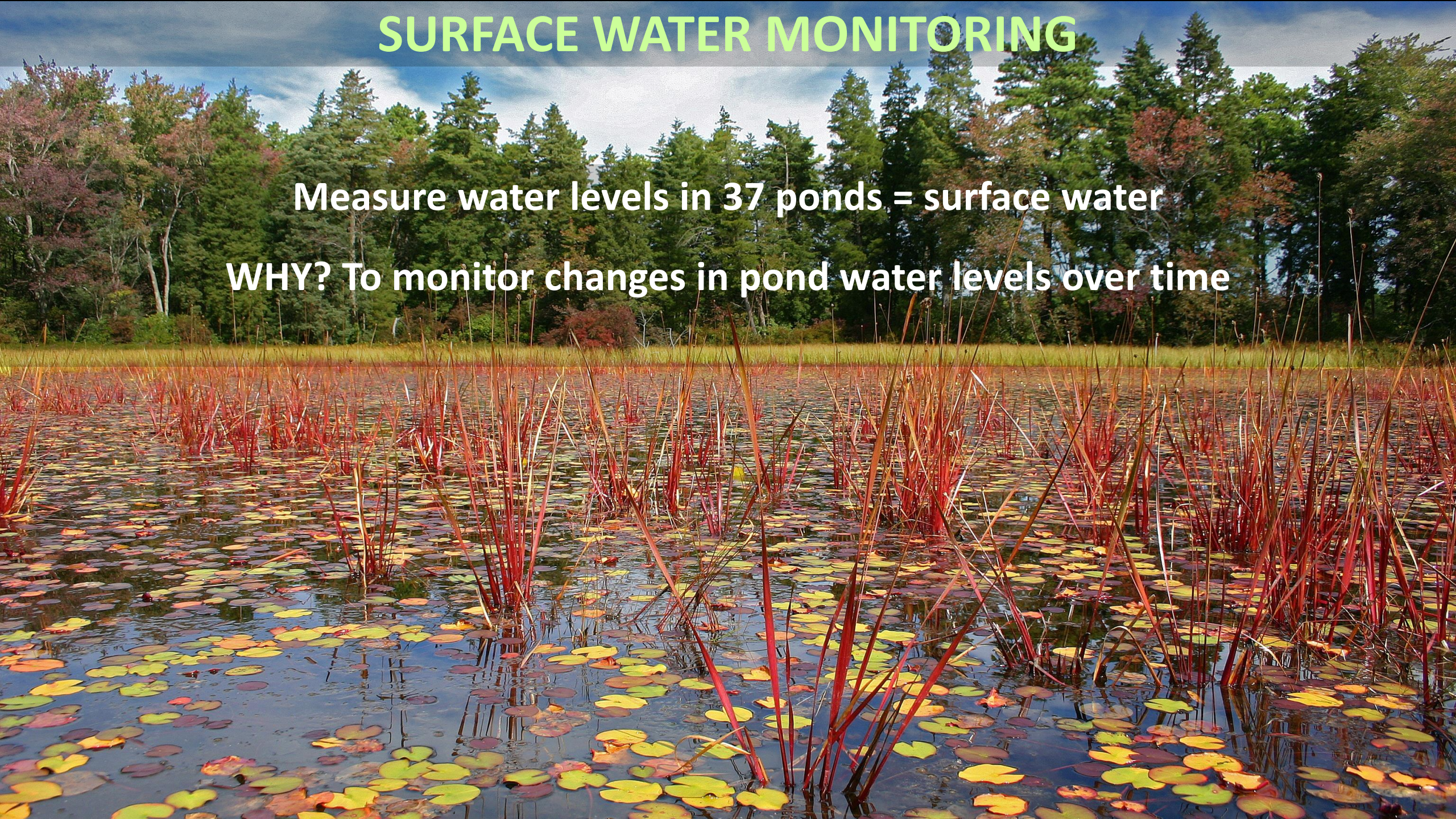
**A data logger automatically measures and records groundwater levels**

**The data logger has been recording groundwater hourly since 2017**

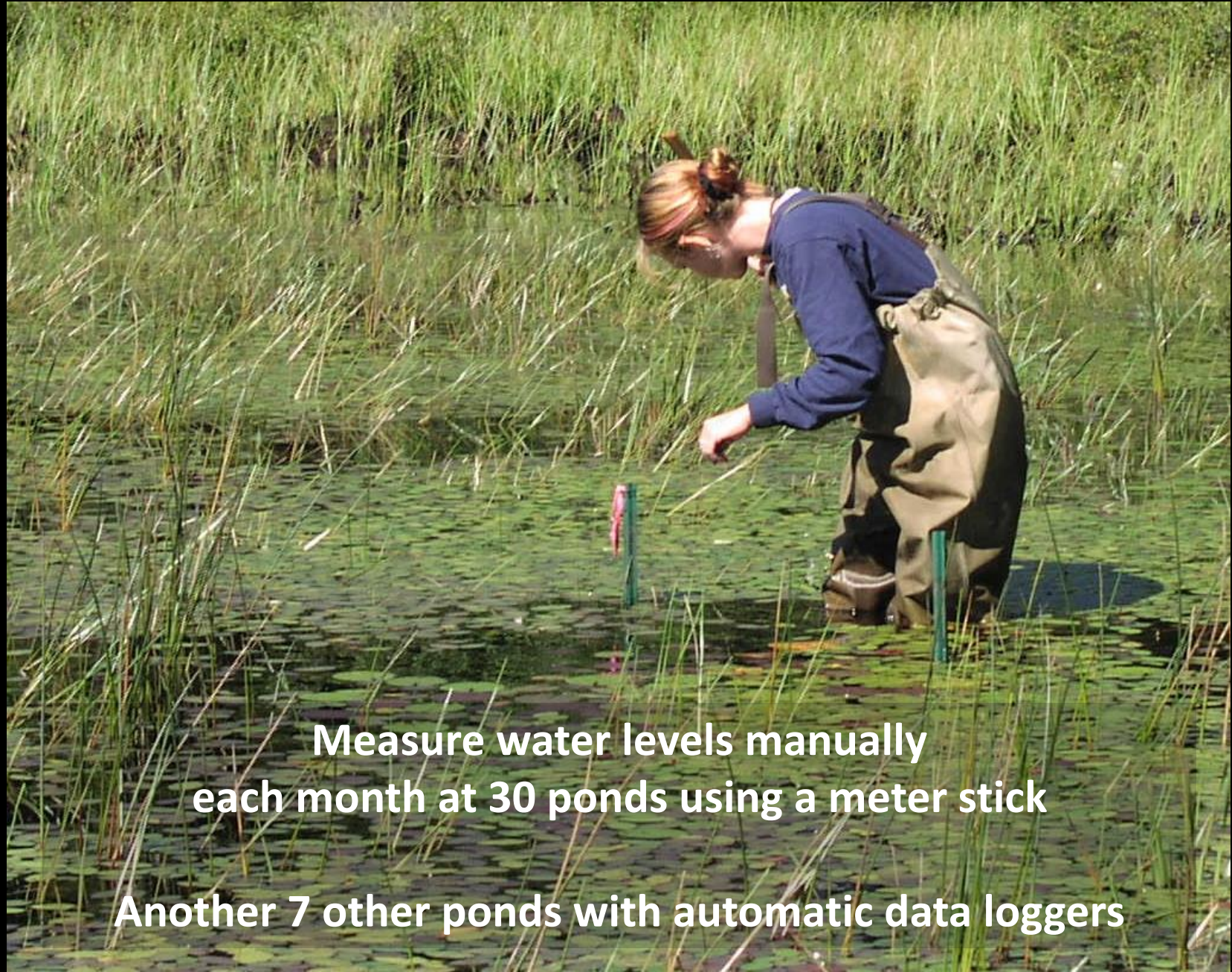
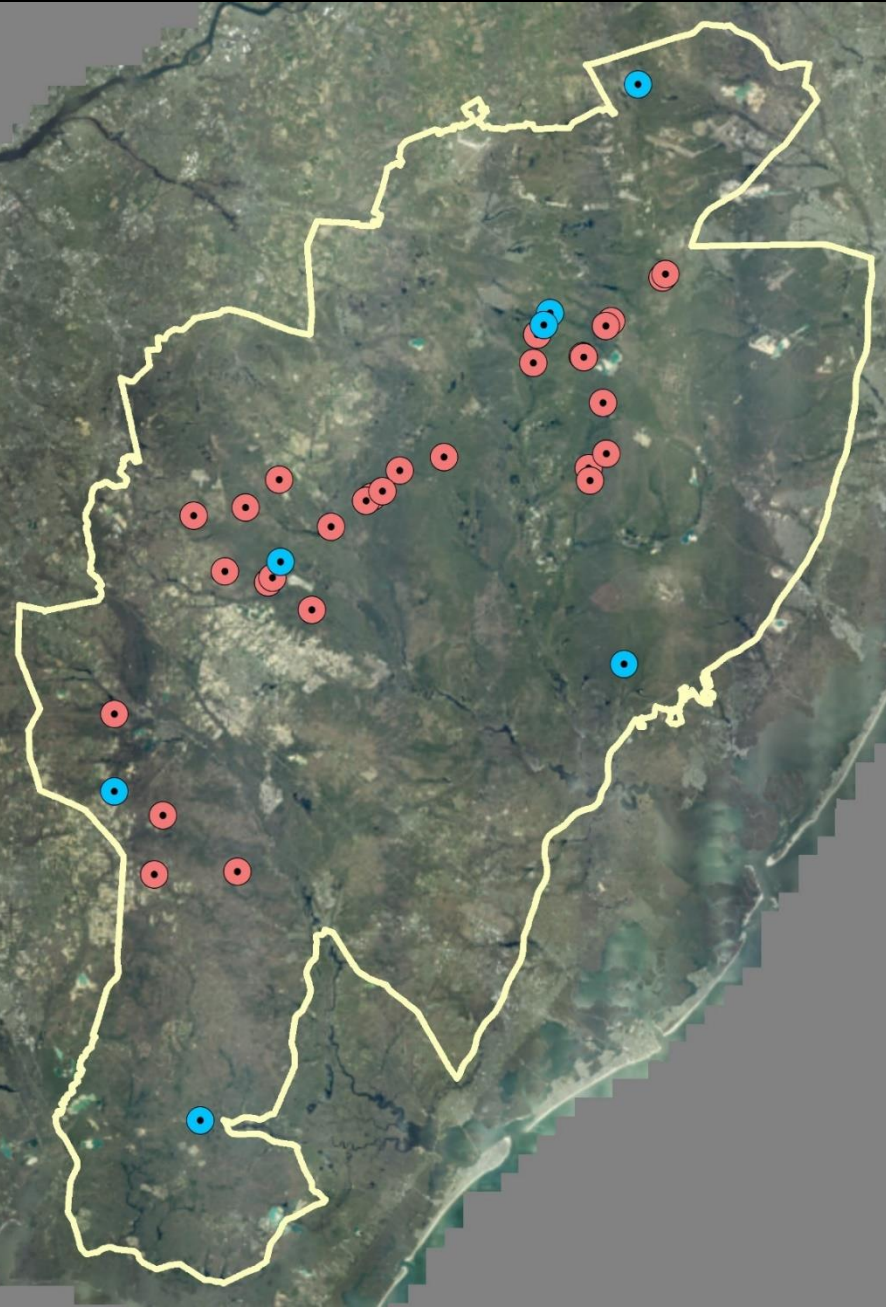
# SURFACE WATER MONITORING

Measure water levels in 37 ponds = surface water

WHY? To monitor changes in pond water levels over time



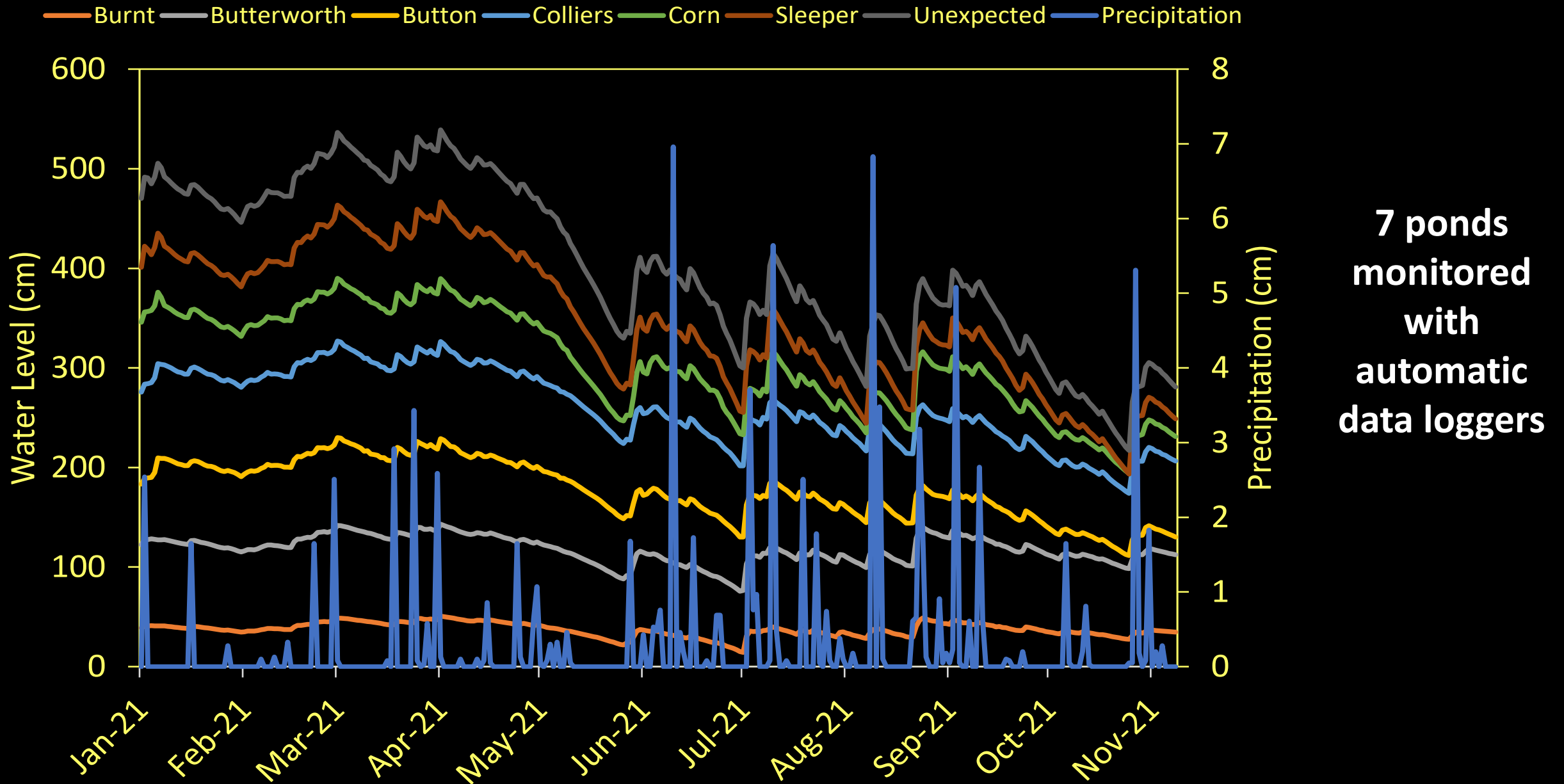
# SURFACE WATER MONITORING



Measure water levels manually  
each month at 30 ponds using a meter stick

Another 7 other ponds with automatic data loggers

# SURFACE WATER MONITORING



# SURFACE WATER MONITORING

**Chris Jeitner has been  
replacing water level data  
loggers with weather stations  
(3 of 5 installed)**

**Solar powered**

**Air temperature**

**Humidity**

**Precipitation**

**Barometric pressure**

**Water depth**

**Water temperature**



# SURFACE WATER MONITORING

Weather station at Colliers Pond  
in Colliers Mills Wildlife Management Area  
October 2024

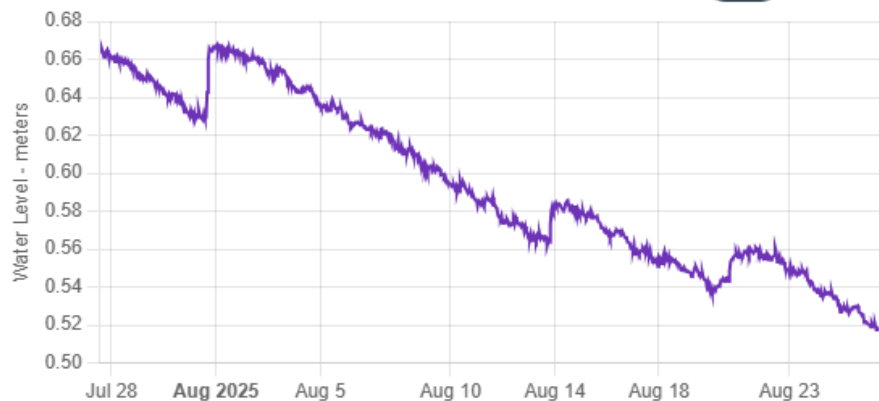


# SURFACE WATER MONITORING

## Colliers Mills - Water Level (m)

10 Minute(s) - AVG

Smart Y

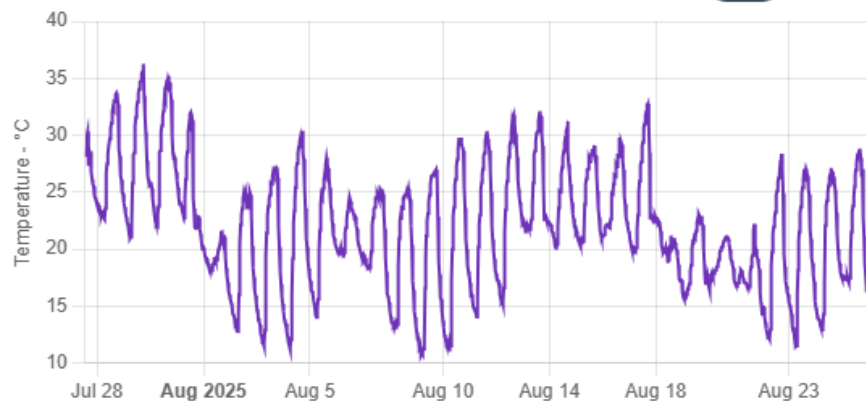


Water Level

## Colliers Mills - Air Temp

10 Minute(s) - AVG

Smart Y

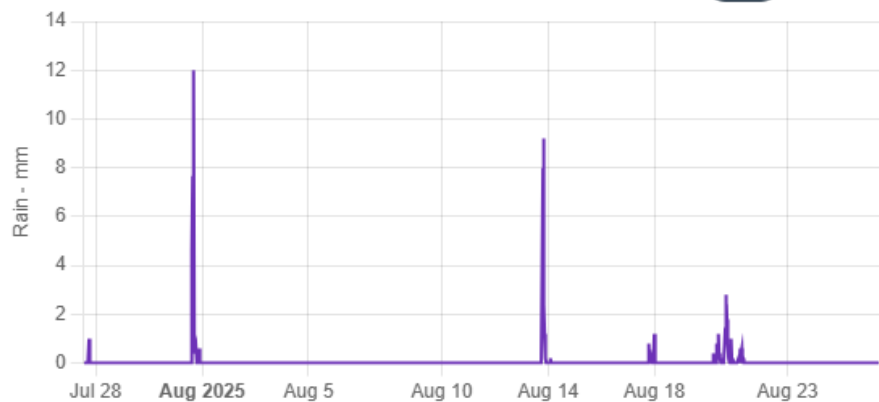


Air Temp

## Colliers Mills - Rain (mm)

10 Minute(s) - AVG

Smart Y

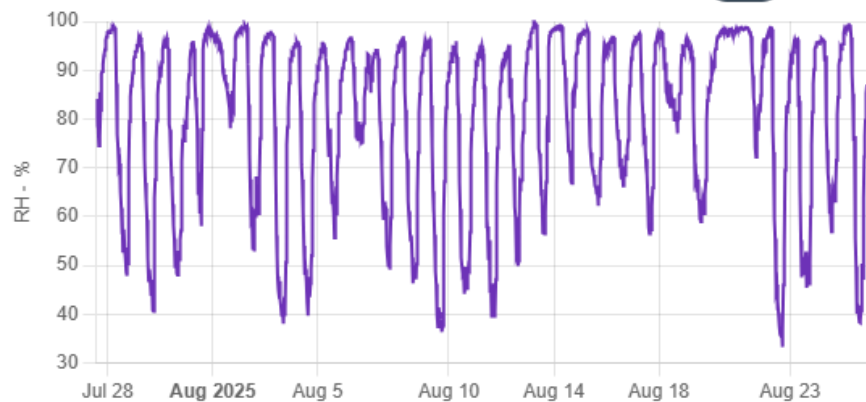


Rain

## Colliers Mills - Humidity

10 Minute(s) - AVG

Smart Y

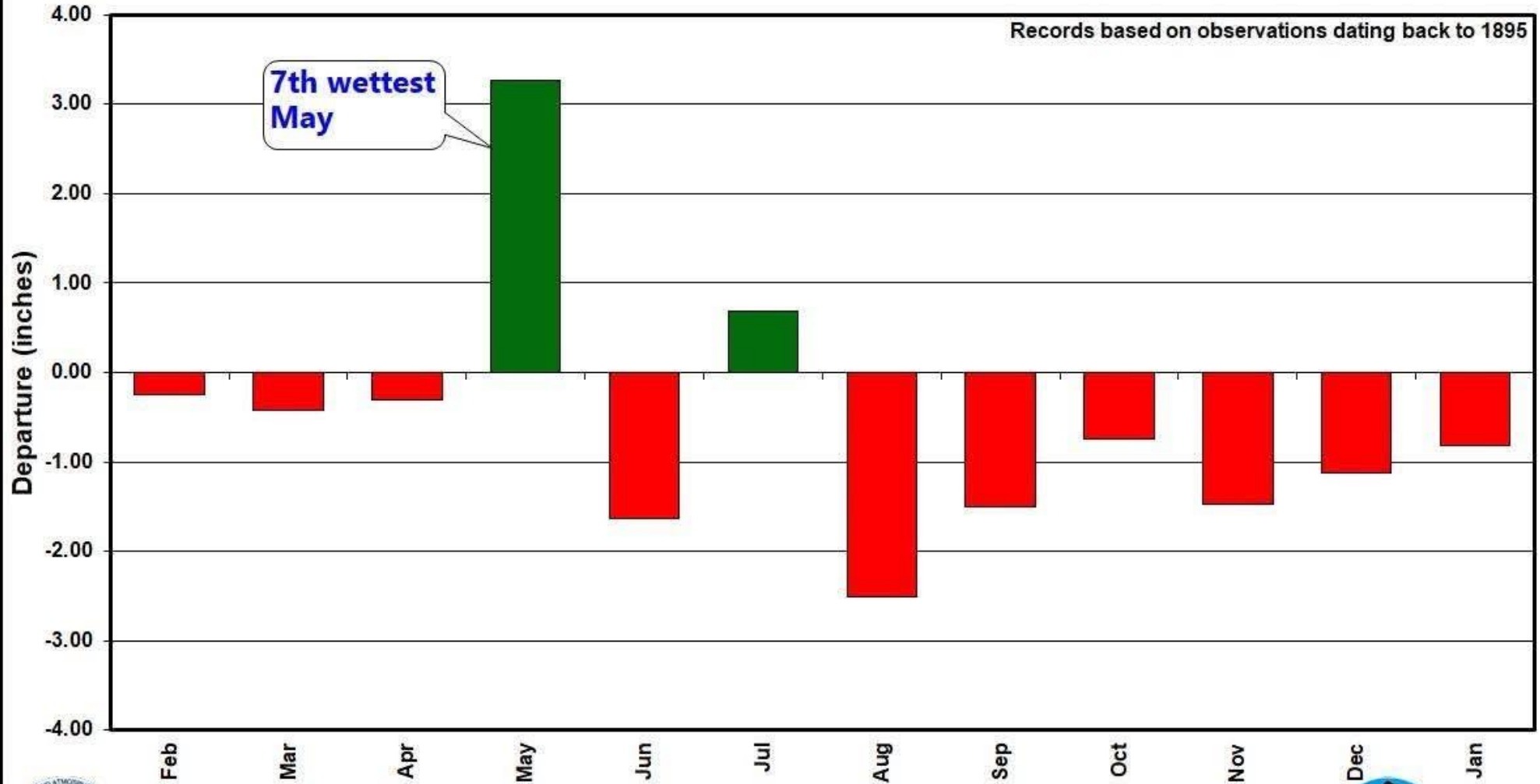


Humidity

# PRECIPITATION DATA

## NJ Monthly Precipitation Departures (February 2025 – January 2026)

Departures calculated from differences between observed monthly precipitation and 1991–2020 monthly averages

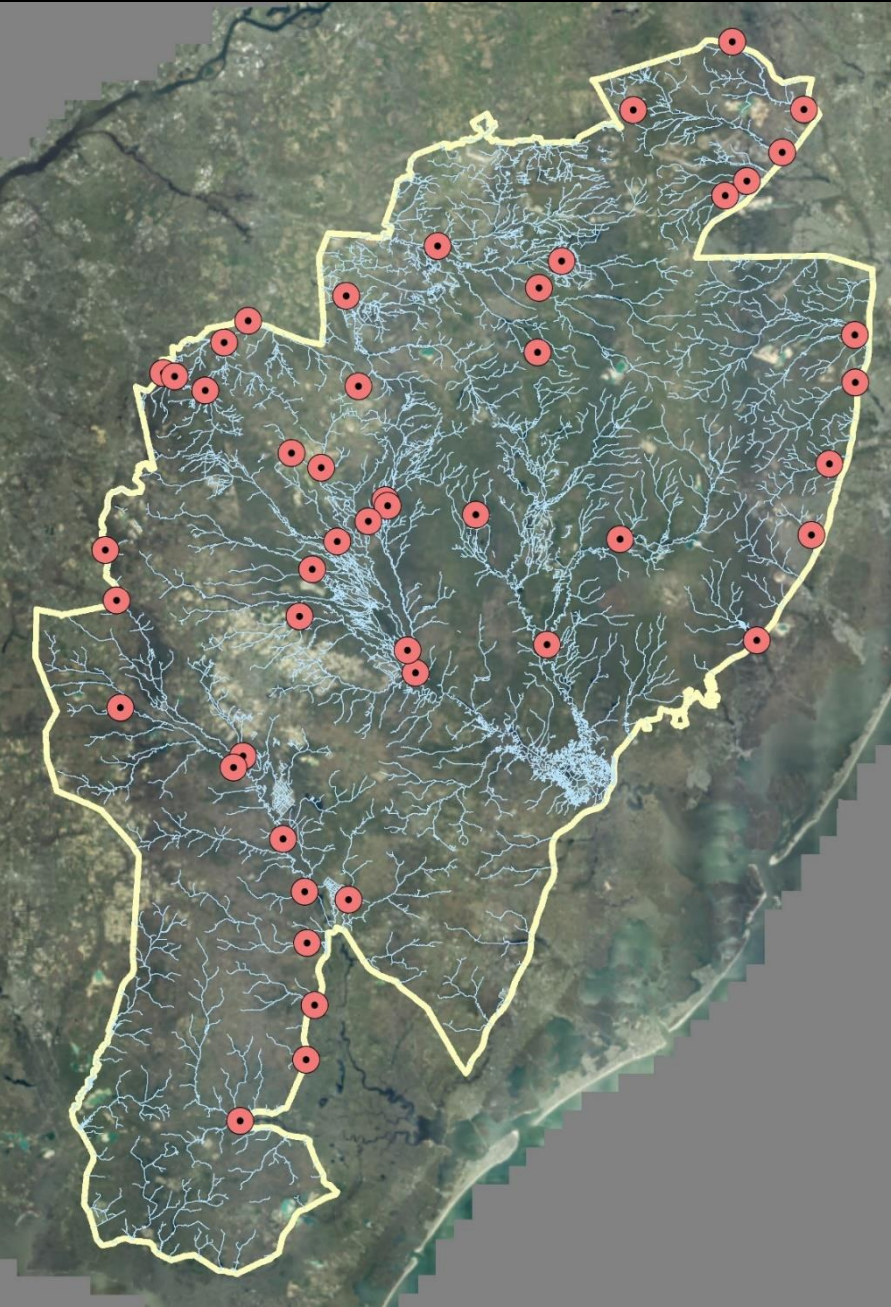


NATIONAL CENTERS FOR ENVIRONMENTAL INFORMATION

Month



# PINELANDS WIDE WQ MONITORING



**Four Pinelands watersheds  
Mullica, Rancocas, Great Egg, Barnegat Bay**

**Selected 47 stream sites covering a  
range of land use and water quality conditions**

**Monitored annually since 2005**

**April, June, August, and October**

**WHY? To monitor for changes in water quality overtime**

# PINELANDS WIDE WQ MONITORING

**Measure pH**  
**how acid the water is**

**Measure specific conductance**  
**Ability of water to conduct an electrical current**

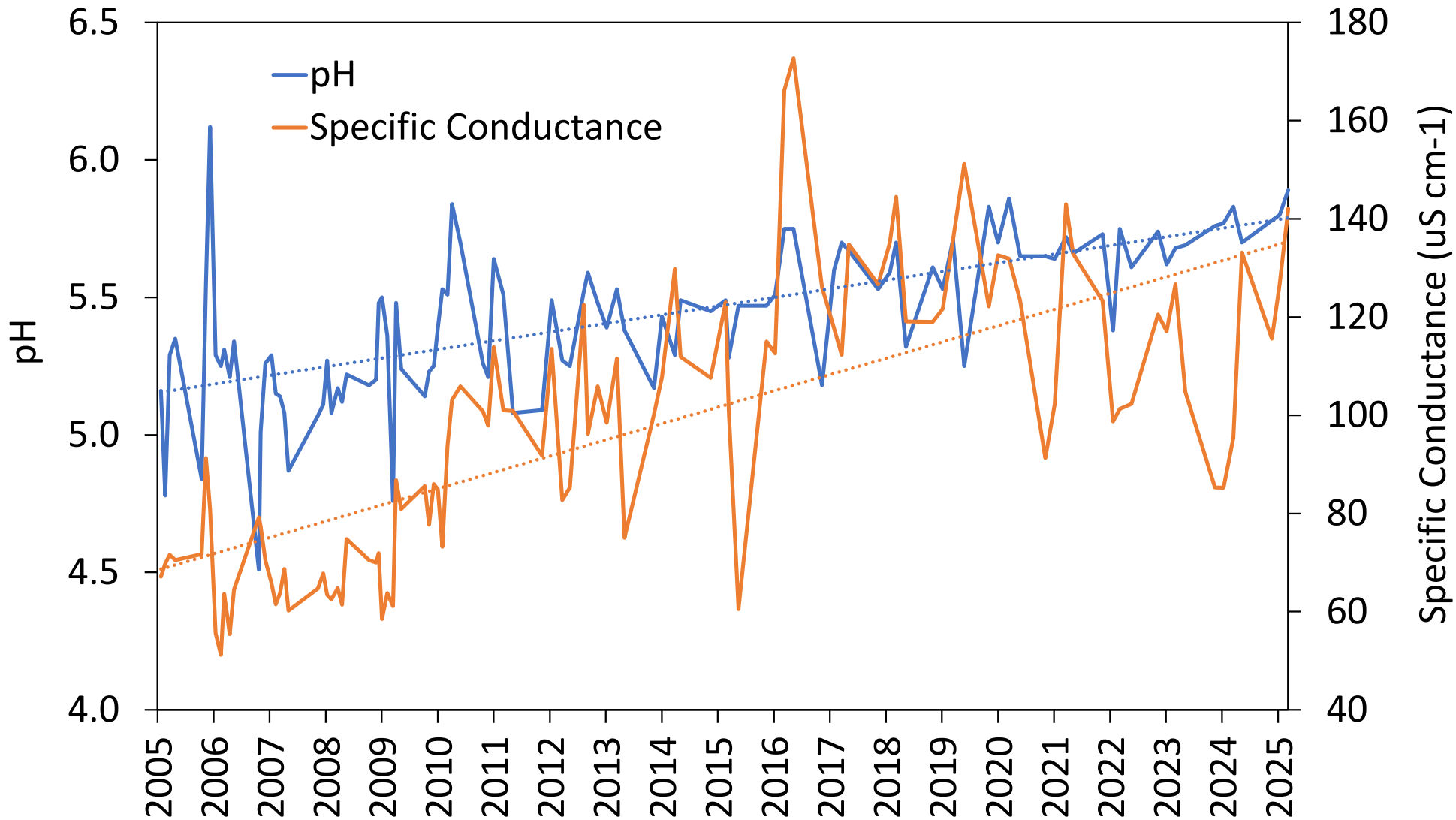
**Some positive ions:**  
**Ca, Mg, Na, K, Fe**

**Some negative ions:**  
**H, Cl, SO<sub>4</sub>, NO<sub>3</sub>, PO<sub>4</sub>**



# PINELANDS WIDE WQ MONITORING

## Four Mile Branch at Lighthouse Drive



**Pinelands  
reference  
water  
quality  
conditions**

**pH ~ 4.5  
SC ~ 40**

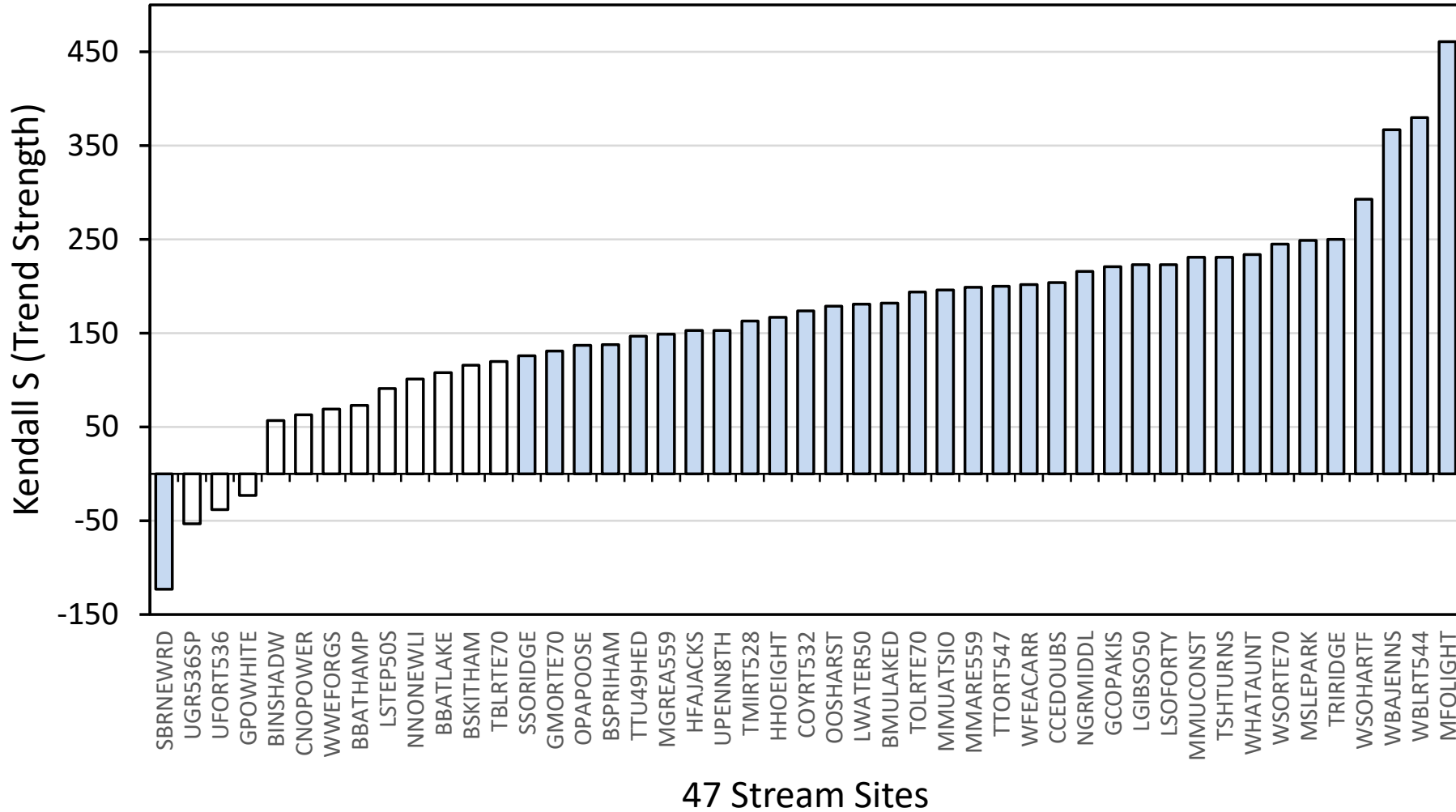
# PINELANDS WIDE WQ MONITORING



**Dr. Marilyn Sobel, retired Commission research scientist, has been rehired to analyze the 20-year data set and draft a manuscript for publication**

# PINELANDS WIDE WQ MONITORING

## Trends in pH

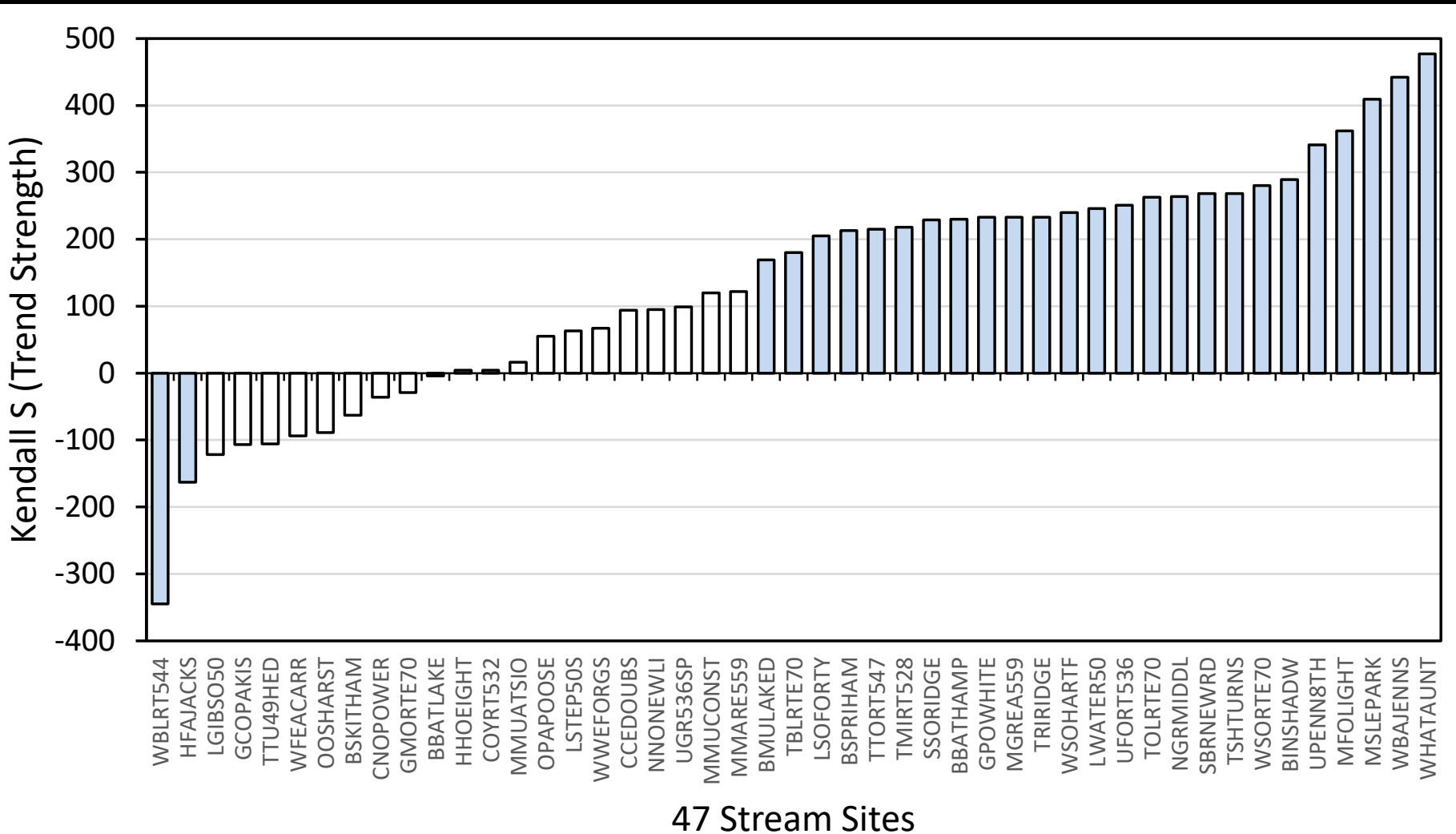


**34 of 47 sites  
(72%) significant  
increase**

**1 of 47 sites  
(2%) significant  
decrease**

# PINELANDS WIDE WQ MONITORING

## Trends in SC

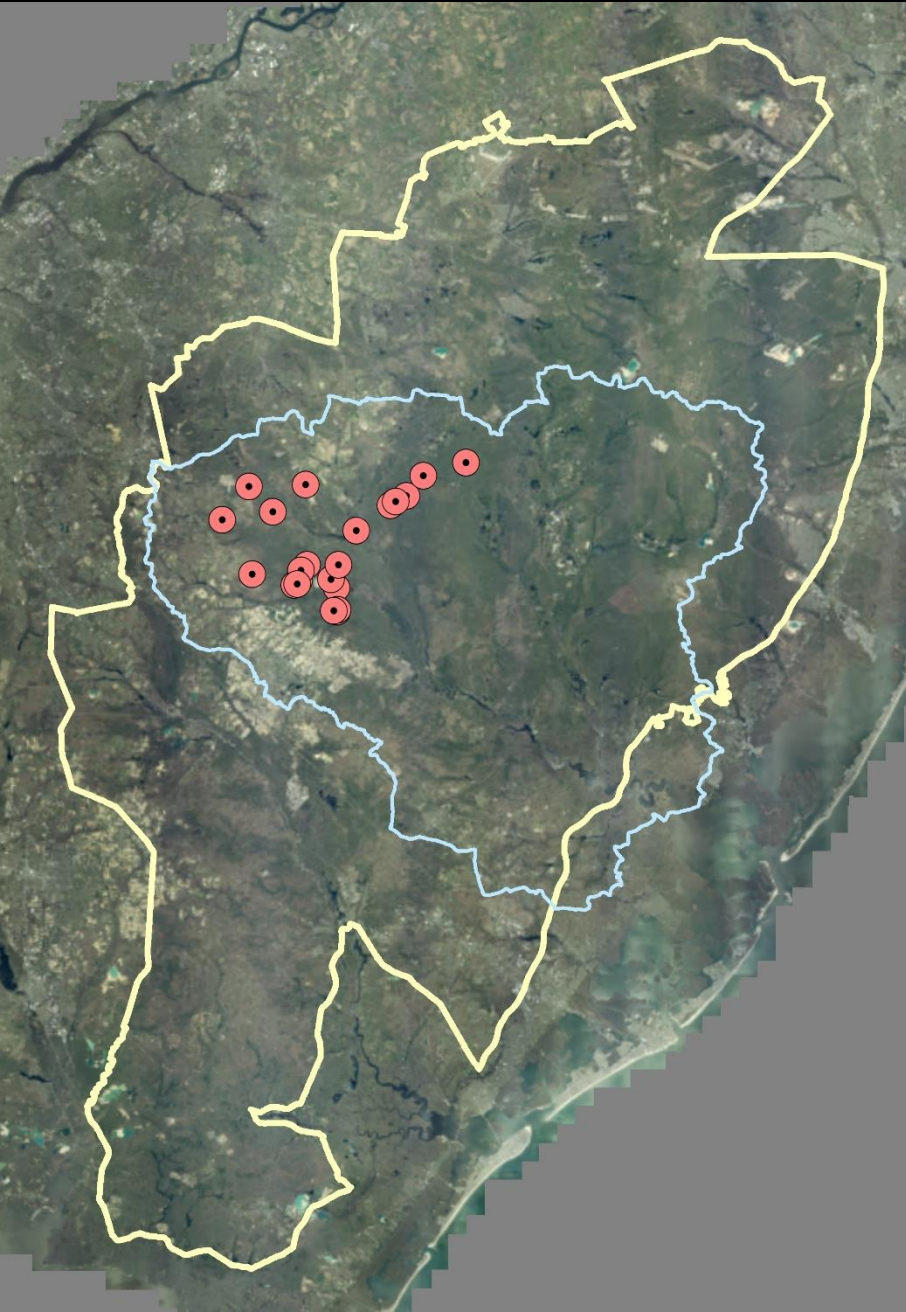


**25 of 47 sites  
(53%) significant  
increase**

**2 of 47 sites  
(4%) significant  
decrease**

**More to come in  
the future**

# ANNUAL FROG AND TOAD MONITORING



22 ponds  
in the  
Mullica River  
Basin

Springtime  
vocalization  
surveys

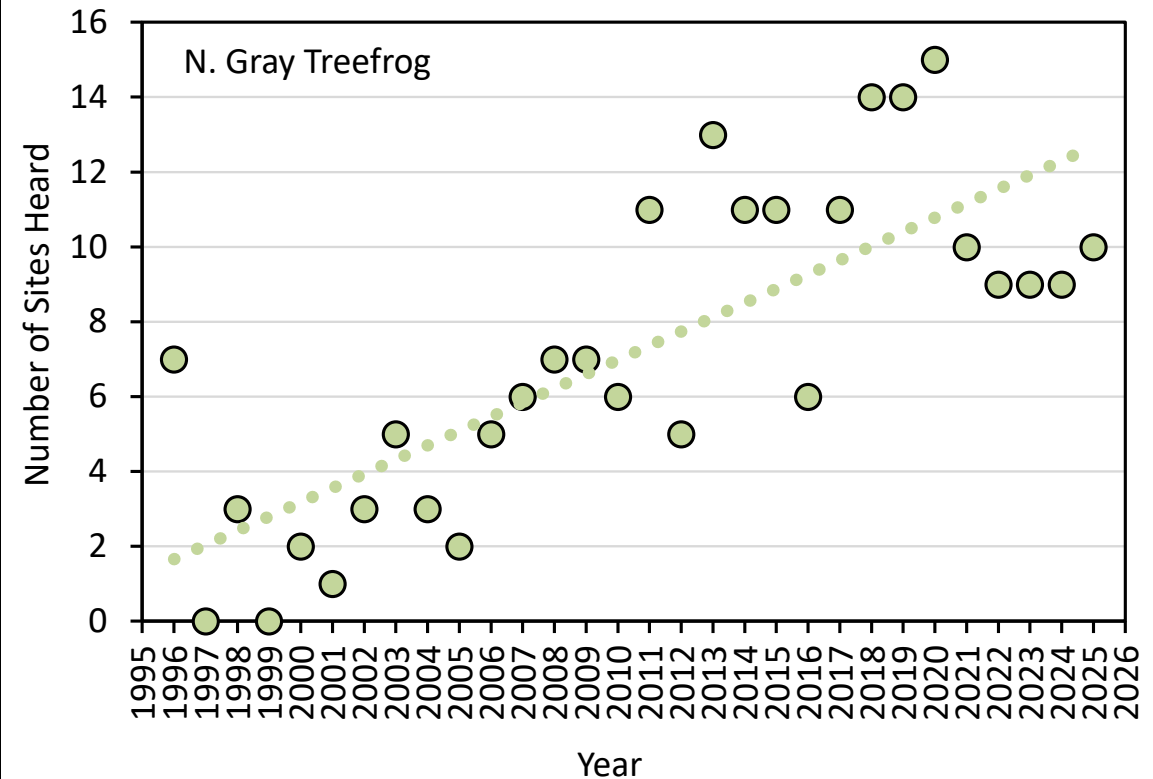
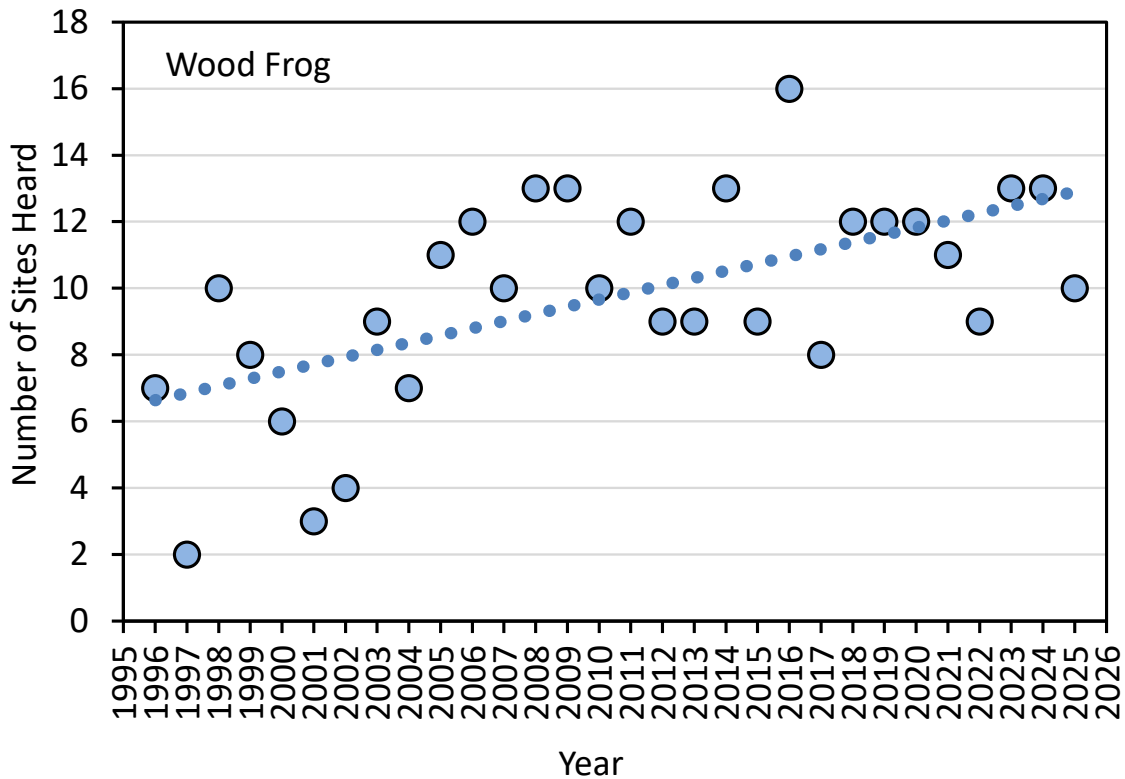
**WHY?**  
To monitor  
changes in calling  
frogs and toads  
over time



# ANNUAL FROG AND TOAD MONITORING

30 years of vocalization surveys

Christine Healy will be analyzing trends in calling frogs and toads soon



# RARE SNAKE MONITORING

Corn snake (endangered species)



Northern pine snake (threatened species)



# RARE SNAKE MONITORING

Weigh and measure snakes

Passive Integrated  
Transponder (PIT) tag for  
permanent ID



# RARE SNAKE MONITORING



## Radio telemetry

**Surgically implant radio transmitters in corn snakes and pine snakes**

**Surgeries done by Commission scientists trained by Dr. Howard Reinert of TCNJ**

**Use a receiver and antenna to relocate snakes**

# RARE SNAKE MONITORING

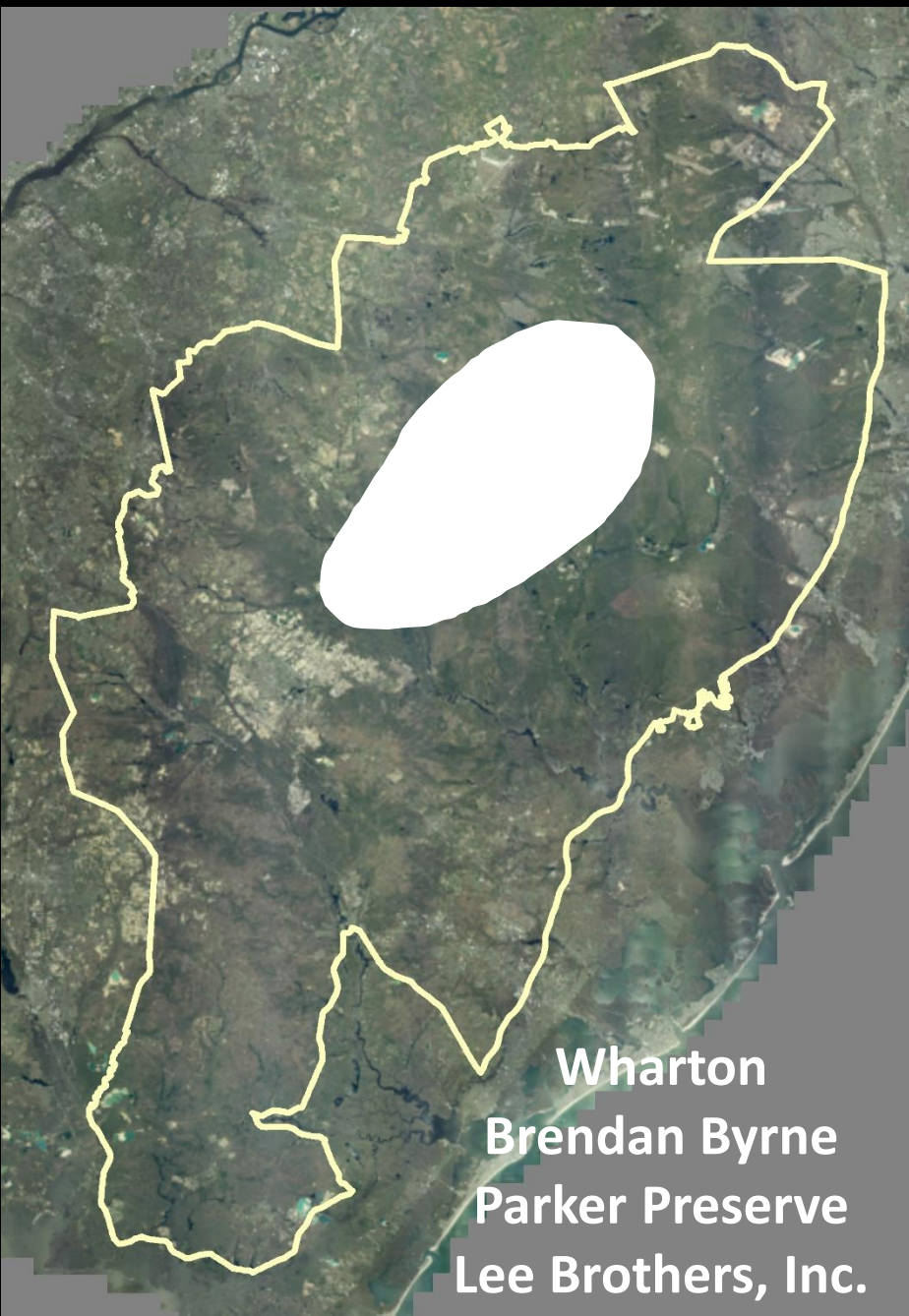


**No surgeries after  
September 15<sup>th</sup>**

**Not enough time  
to heal up before  
winter**

**Attach a radio  
transmitter to the  
tail using tape**

# RARE SNAKE MONITORING



Wharton  
Brendan Byrne  
Parker Preserve  
Lee Brothers, Inc.

## WHY?

1. Locate hibernacula and nest areas
2. Overwintering and emergence timing

Development application surveys  
Vegetation management on utility ROWs  
Forest Stewardship and Cedar Restoration  
Enduro events

3. Habitat types that animals use

Trigger surveys for development applications  
NJDEP Landscape Project  
Habitat management

# RARE SNAKE MONITORING



**Pinelands**  
**Hibernacula**

**Human made**

Buried junk  
Rubble piles  
Old foundations

**Natural**

Mammal burrows  
Stump holes



# RARE SNAKE MONITORING



**Little data on long-term rare snake trends in the Pinelands**

**Hibernacula corrals are a non-invasive method to census snakes**

**No disturbance to hibernacula or hibernating snakes**

**Camera monitoring network for security**

# RARE SNAKE MONITORING



Box corrals  
are used  
near roads  
and trails



# RARE SNAKE MONITORING

## Hibernacula

### Corn snakes

100 corralled

35 not corralled

### Pine snakes

34 corralled

31 not corralled

Numbers change  
over time



# RARE SNAKE MONITORING

Corn snakes often nest in mole tunnels



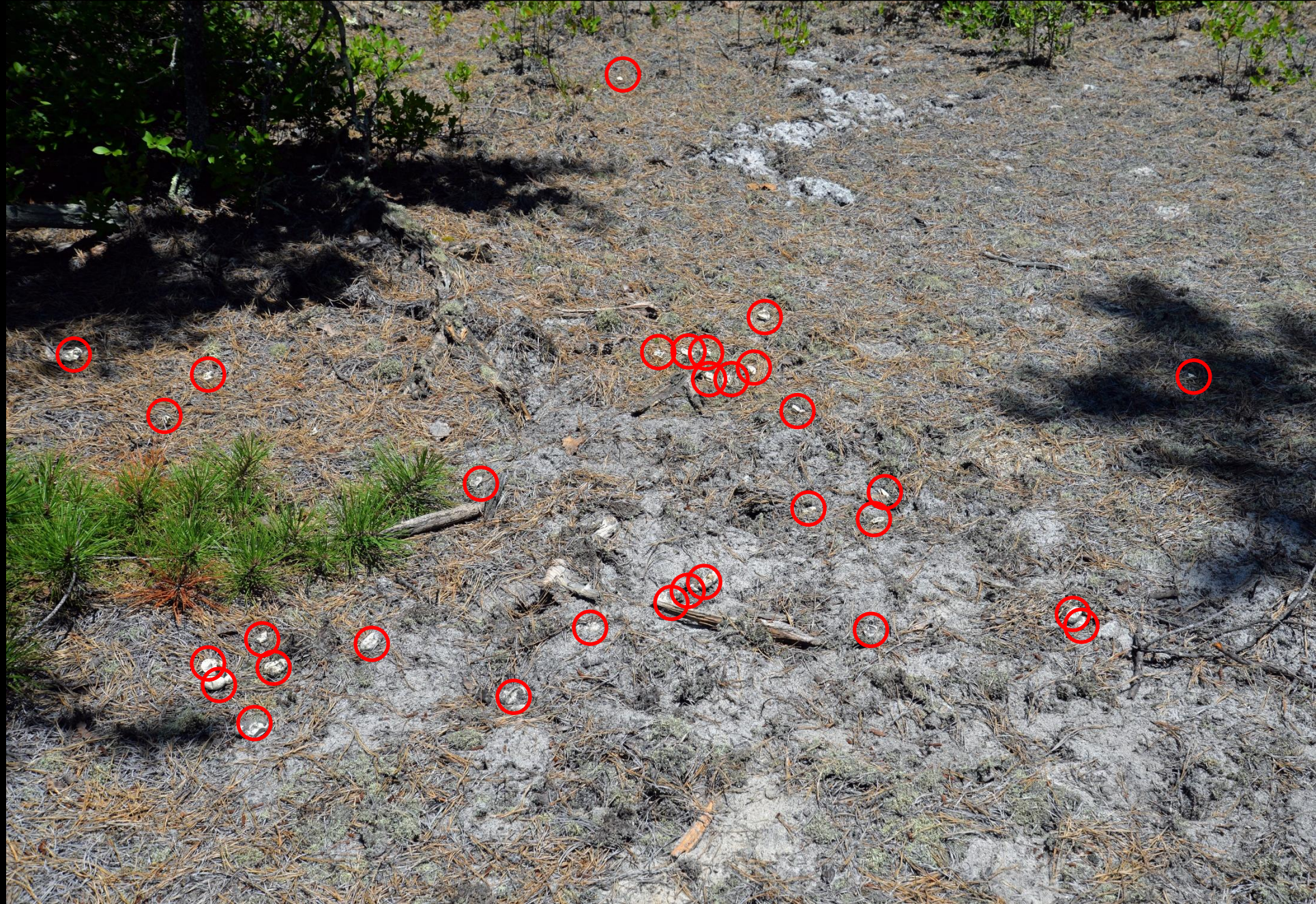
Look for nest  
areas

Also focus on corn  
snakes and pine  
snakes



# RARE SNAKE MONITORING

Communal corn  
snake nest area  
destroyed by  
predators



# RARE SNAKE MONITORING

Female pine snakes dig their own nests



# RARE SNAKE MONITORING



# RARE SNAKE MONITORING

PIT tag for permanent ID

Weigh and measure

Release at nest site

**Corn snake hatchlings**



**Pine snake hatchlings**



# RARE SNAKE MONITORING

Number of **unique** individuals captured during the monitoring program

Snake Species	# Non-hatchlings	# Hatchlings	Total #
Northern water snake	1	-	1
Eastern ribbon snake	2	-	2
Northern redbelly snake	2	-	2
Northern scarlet snake *	2	-	2
Timber rattlesnake **	6	-	6
Black rat snake	12	-	12
Eastern garter snake	14	-	14
Rough green snake	14	-	14
Eastern milk snake	23	-	23
Eastern hognose snake	37	58	95
Eastern king snake	92	110	202
Northern black racer	213	10	223
Northern pine snake *	327	401	728
Corn snake **	484	860	1344
Total Number	1229	1439	2668

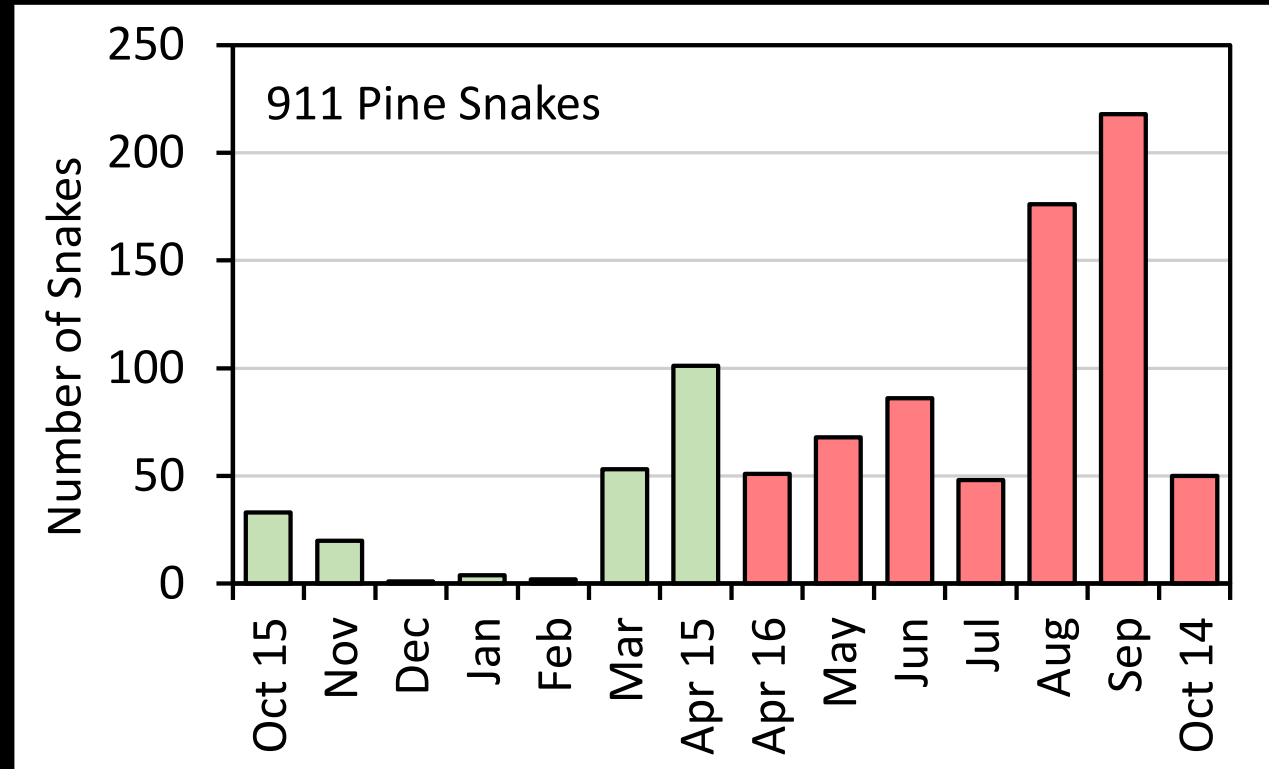
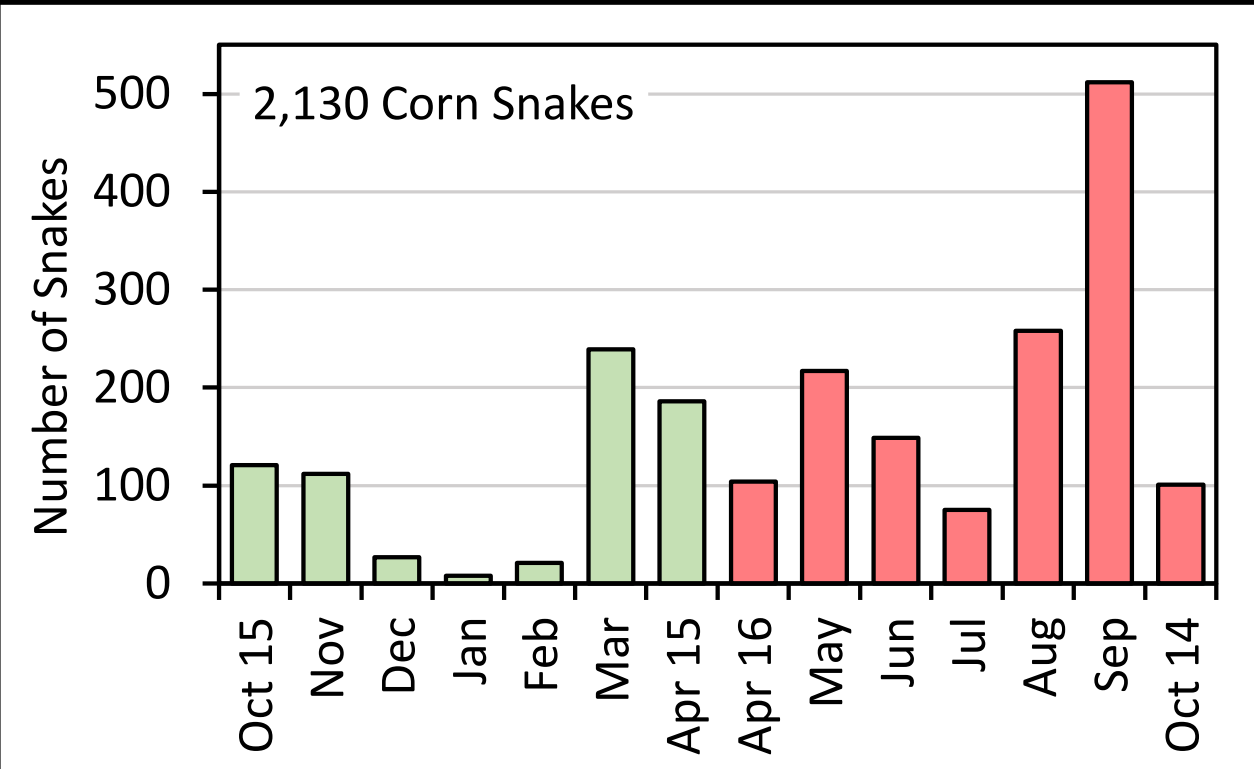
# RARE SNAKE MONITORING

Number of **unique** individuals captured during the monitoring program

Snake Species	# Non-hatchlings	# Hatchlings	Total #	# Recaptured	% Recaptured
Northern water snake	1	-	1	0	0%
Eastern ribbon snake	2	-	2	0	0%
Northern redbelly snake	2	-	2	0	0%
Northern scarlet snake *	2	-	2	0	0%
Timber rattlesnake **	6	-	6	0	0%
Black rat snake	12	-	12	0	0%
Eastern garter snake	14	-	14	5	36%
Rough green snake	14	-	14	2	14%
Eastern milk snake	23	-	23	5	22%
Eastern hognose snake	37	58	95	4	4%
Eastern king snake	92	110	202	43	21%
Northern black racer	213	10	223	39	17%
Northern pine snake *	327	401	728	109	15%
Corn snake **	484	860	1344	282	21%
Total Number	1229	1439	2668	489	18%

# RARE SNAKE MONITORING

Enduro events are permitted from October 15th - April 15th  
NJDEP F&W asked about the timing of snake activity



**34% of corn snakes and 23% of pine snakes on the surface October 15th – April 15<sup>th</sup>**  
**Concentrated near their hibernacula, cold, sluggish and more vulnerable**

# RARE SNAKE MONITORING



## Spring Emergence

iButtons are small electronic devices that measure temperature and store the data

External iButtons  
at hibernacula

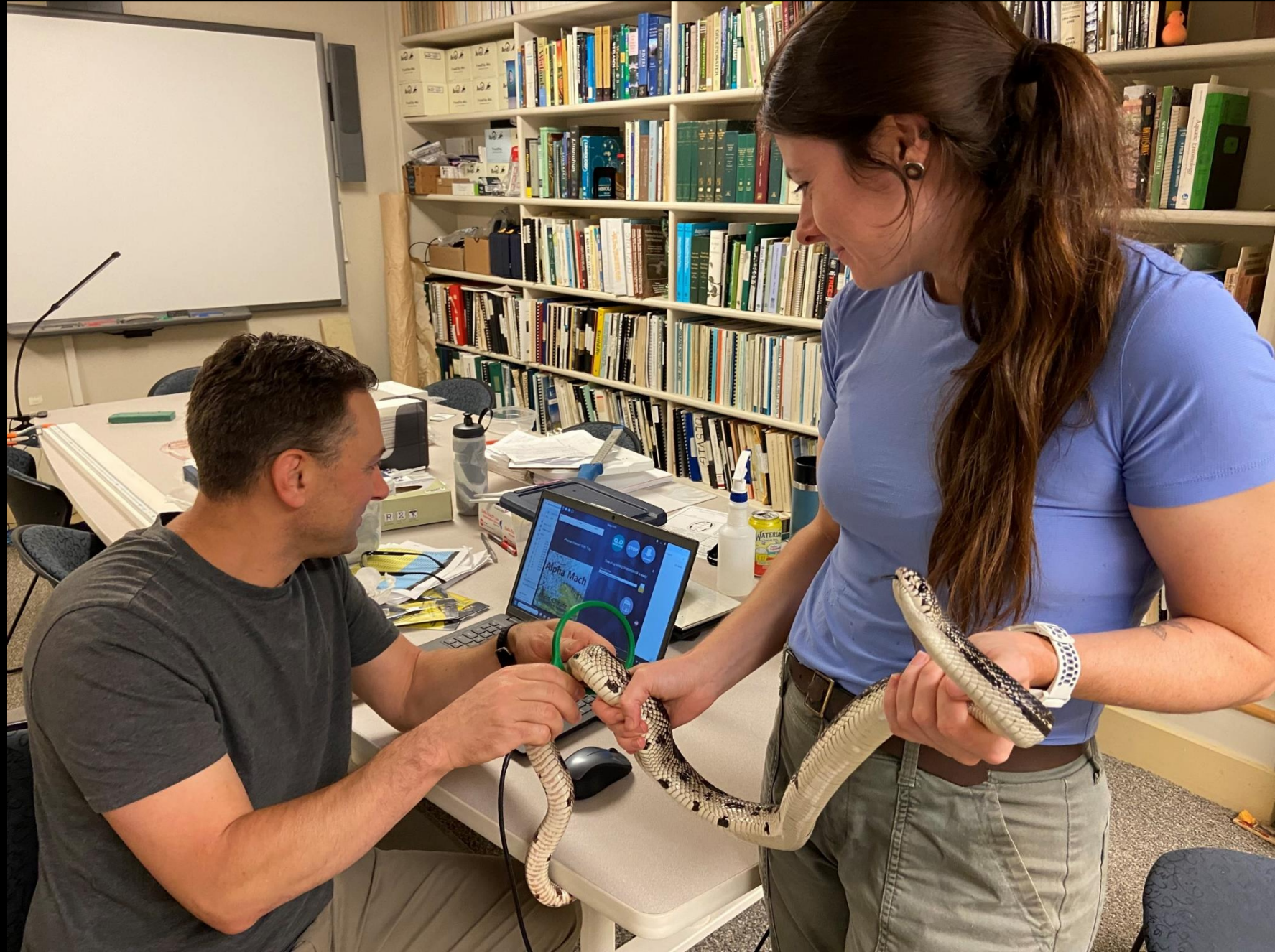


Internal iButtons  
inside snakes

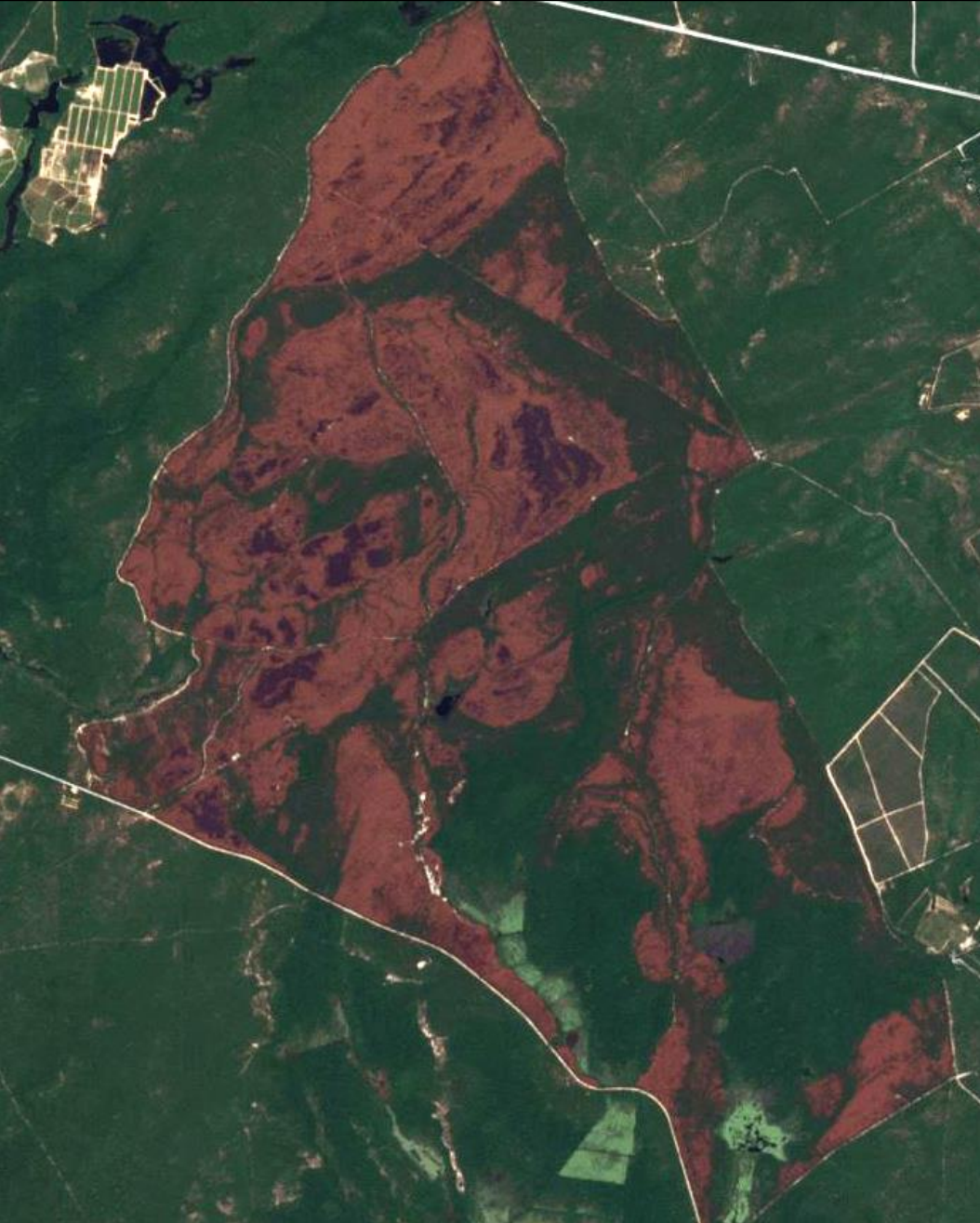


# RARE SNAKE MONITORING

Program iButton  
and download  
temperature data  
through the snake



# RARE SNAKE MONITORING



## Tea Time Hill Wildfire

Wharton State Forest  
Started July 4, 2024  
Burned 4,300 acres

Burned our plywood snake cover  
Burned up all known shed logs  
Burned out stump hole hibernacula



# RARE SNAKE MONITORING



# RARE SNAKE MONITORING



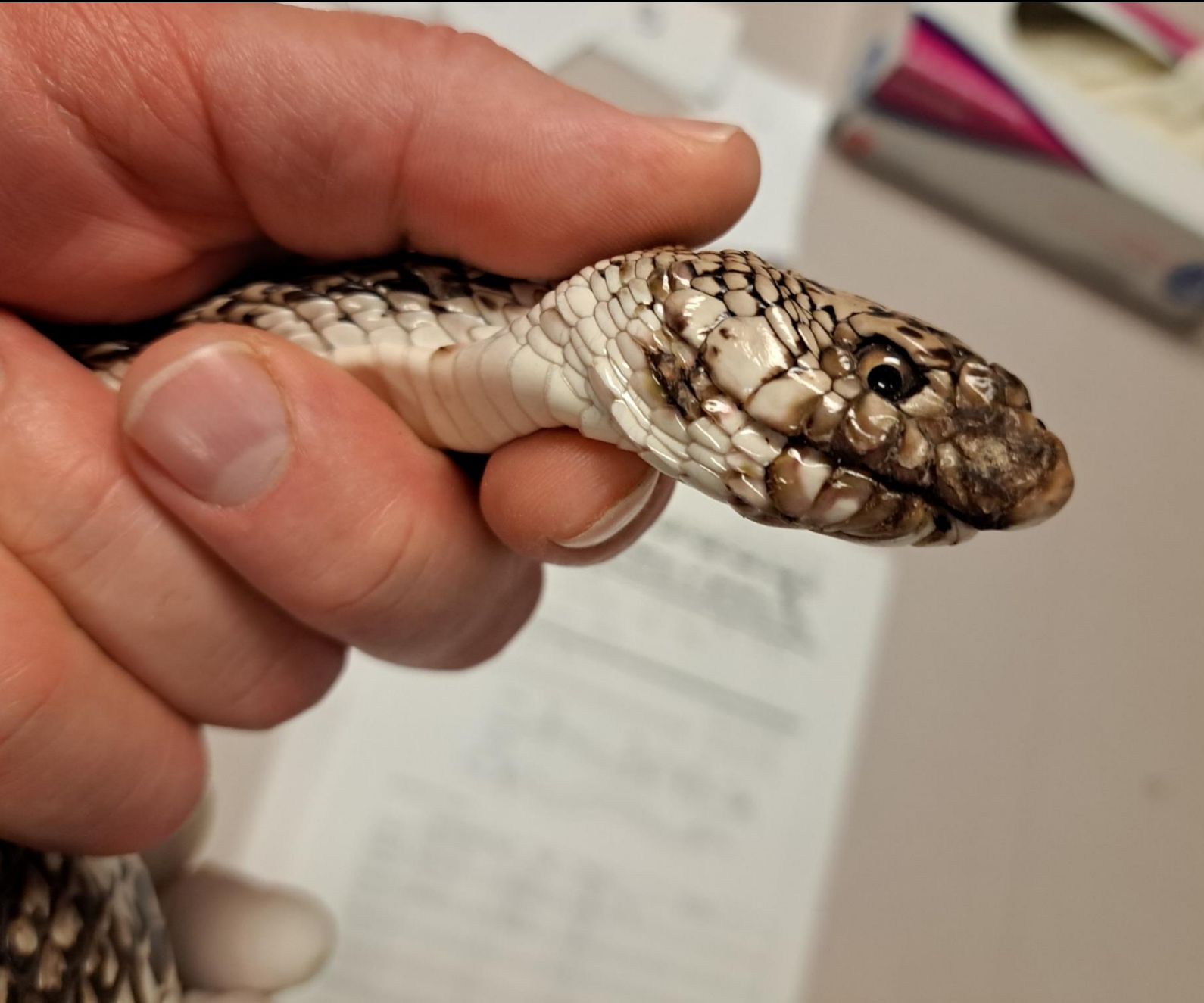
**Melted 61  
hibernacula  
corrals**

**All corrals have  
been repaired**

# RARE SNAKE MONITORING



# SNAKE FUNGAL DISEASE MONITORING



Caused by a fungus

*Ophidiomyces  
ophiodiicola*

Collaborating separately with  
Rutgers/HA  
and Virginia Tech

WHY? To better understand  
impacts to rare snake  
populations

# SNAKE FUNGAL DISEASE MONITORING

Rutgers/HA

Excavate several pine  
snake hibernacula  
every winter

~40 years

In 2018, we began  
swabbing the snakes  
for SFD



# SNAKE FUNGAL DISEASE MONITORING

## Four papers published to date

1. Campbell, L.J., J. Burger, R.T. Zappalorti, J.F. Bunnell, M.E. Winzeler, D.R. Taylor, J.M. Lorch. 2021. Soil reservoir dynamics of *Ophidiomyces ophidiicola*, the causative agent of snake fungal disease. *Journal of Fungi* 2021, 7, 461. <https://doi.org/10.3390/jof7060461>

2. Burger, J., M. Gochfeld, R. Zappalorti, J. Bunnell, C. Jeitner, D. Schneider, K. Ng, E. DeVito, and J.M. Lorch. 2023. Prevalence of *Ophidiomyces ophidiicola* and epizootiology of snake fungal disease in free-ranging Northern Pine Snakes (*Pituophis melanoleucus melanoleucus*) in New Jersey. *Environmental Monitoring and Assessment*, 2023, 195, 662. <https://doi.org/10.1007/s10661-023-11259-w>

3. Burger, J., C. Jeitner, R. Zappalorti, J. Bunnell, K. Ng, E. DeVito, D. Schneider, and M. Gochfeld. 2024. Snake fungal disease in free-ranging Northern Pine Snakes (*Pituophis melanoleucus melanoleucus*) in New Jersey: Lesions, severity of sores and investigator's perceptions. *Journal of Fungi* 2024, 10, 125. <https://doi.org/10.3390/jof10020125>

4. Burger, J., C. Jeitner, R.T. Zappalorti, J. Bunnell, K. Ng, E. DeVito, D. Schneider, M. Gochfeld. 2025. Snake fungal disease (Ophidiomycosis) in Northern Pine Snakes (*Pituophis melanoleucus melanoleucus*) in New Jersey: Variations by year, sex, and morphological sampling site. *Journal of Fungi* 2025, 11, 206. <https://doi.org/10.3390/jof11030206>

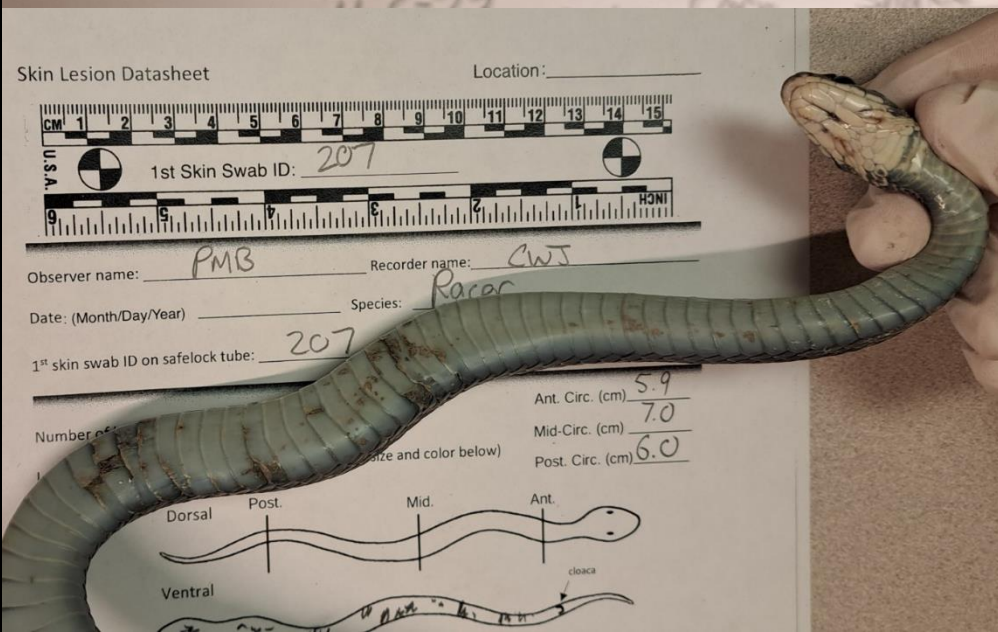
5. New manuscript submitted in 2026

# SNAKE FUNGAL DISEASE MONITORING

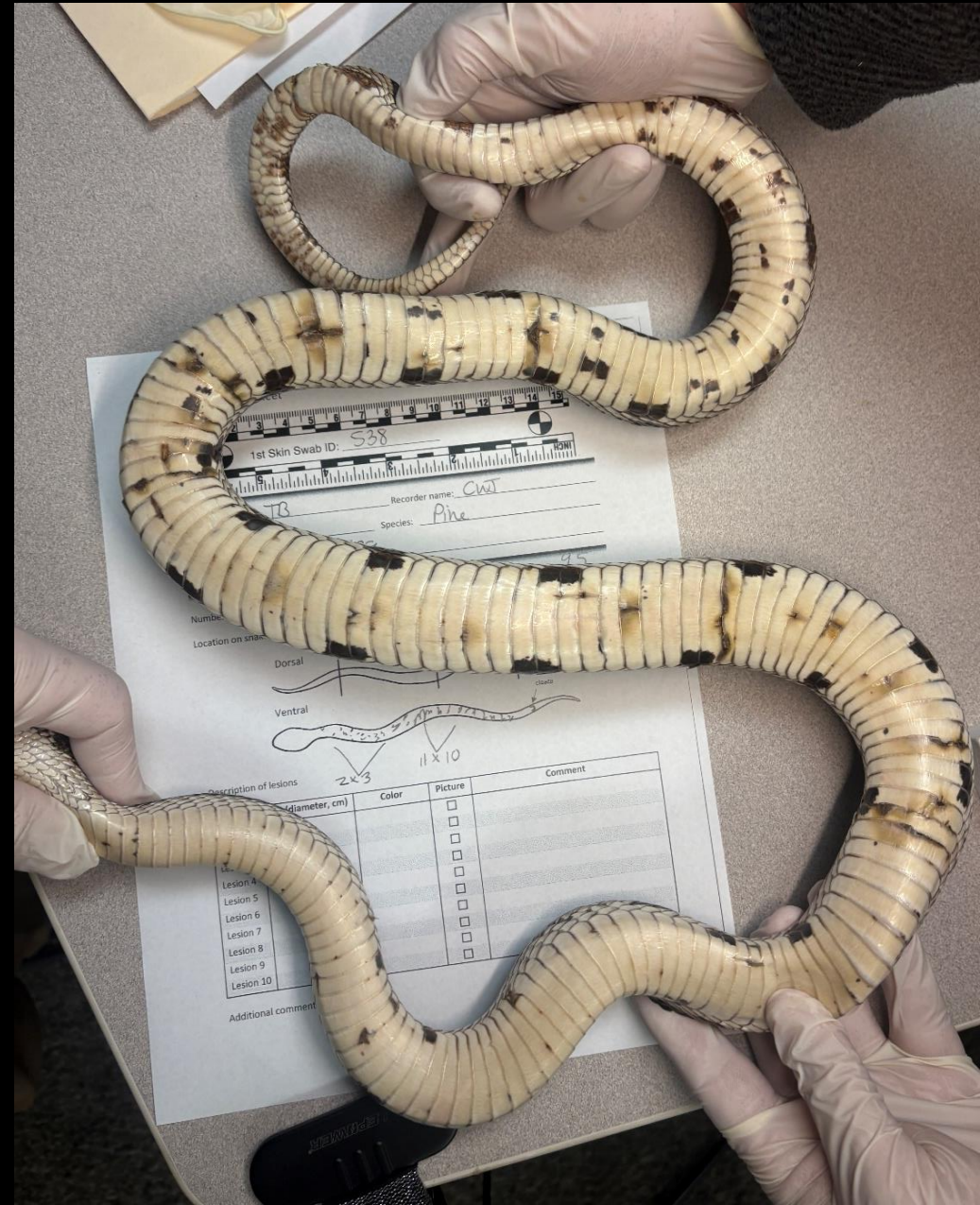


Virginia Tech

Swab every snake we find



Measure and swab lesions



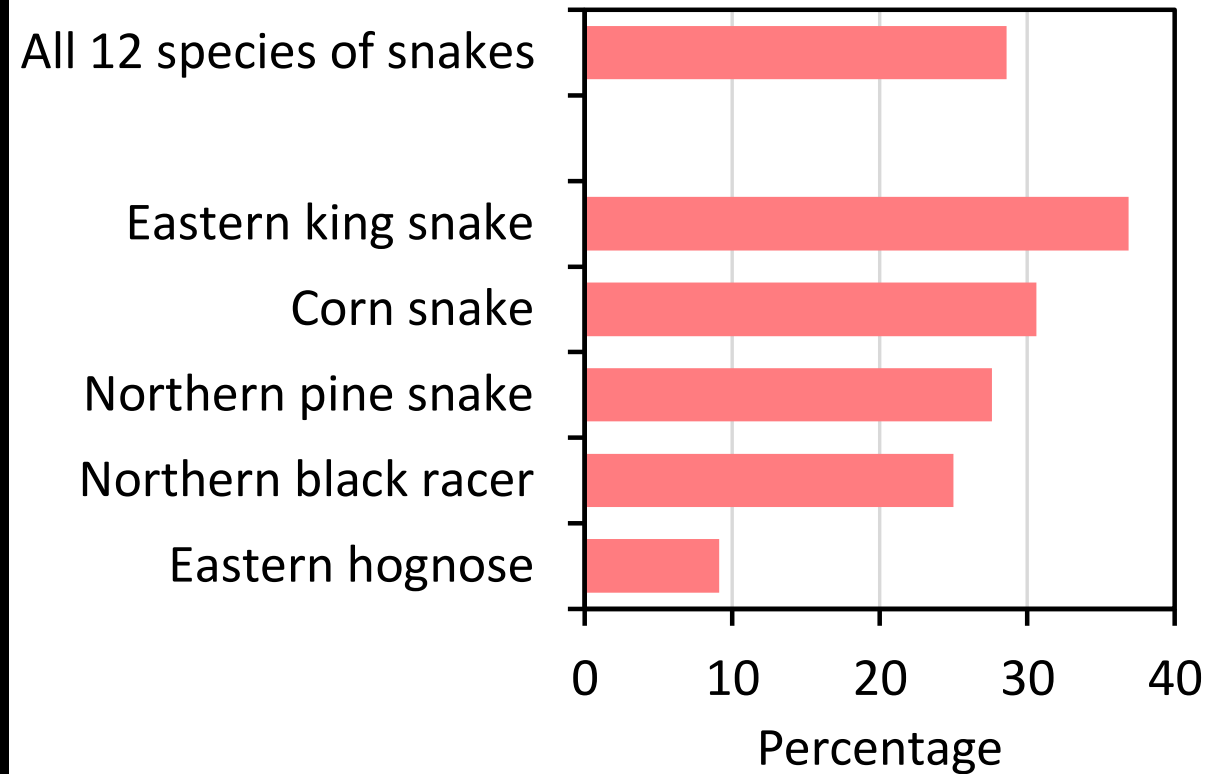
Description of lesions (diameter, cm)	Color	Picture	Comment
Lesion 4		<input type="checkbox"/>	
Lesion 5		<input type="checkbox"/>	
Lesion 6		<input type="checkbox"/>	
Lesion 7		<input type="checkbox"/>	
Lesion 8		<input type="checkbox"/>	
Lesion 9		<input type="checkbox"/>	
Lesion 10		<input type="checkbox"/>	

# SNAKE FUNGAL DISEASE MONITORING



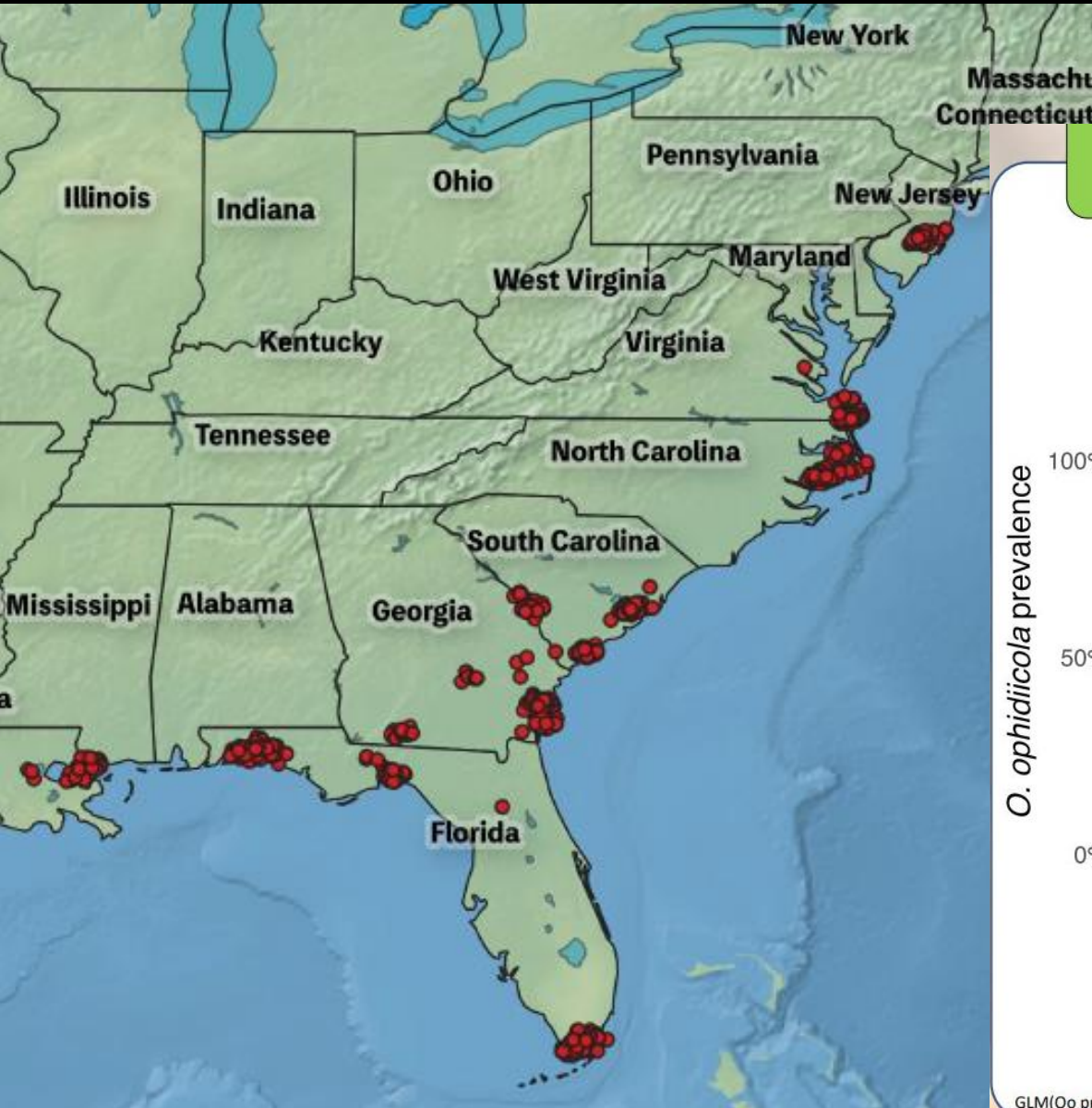
## Results for 2023 - 2024

### Snakes positive for *O. ophiodiicola*

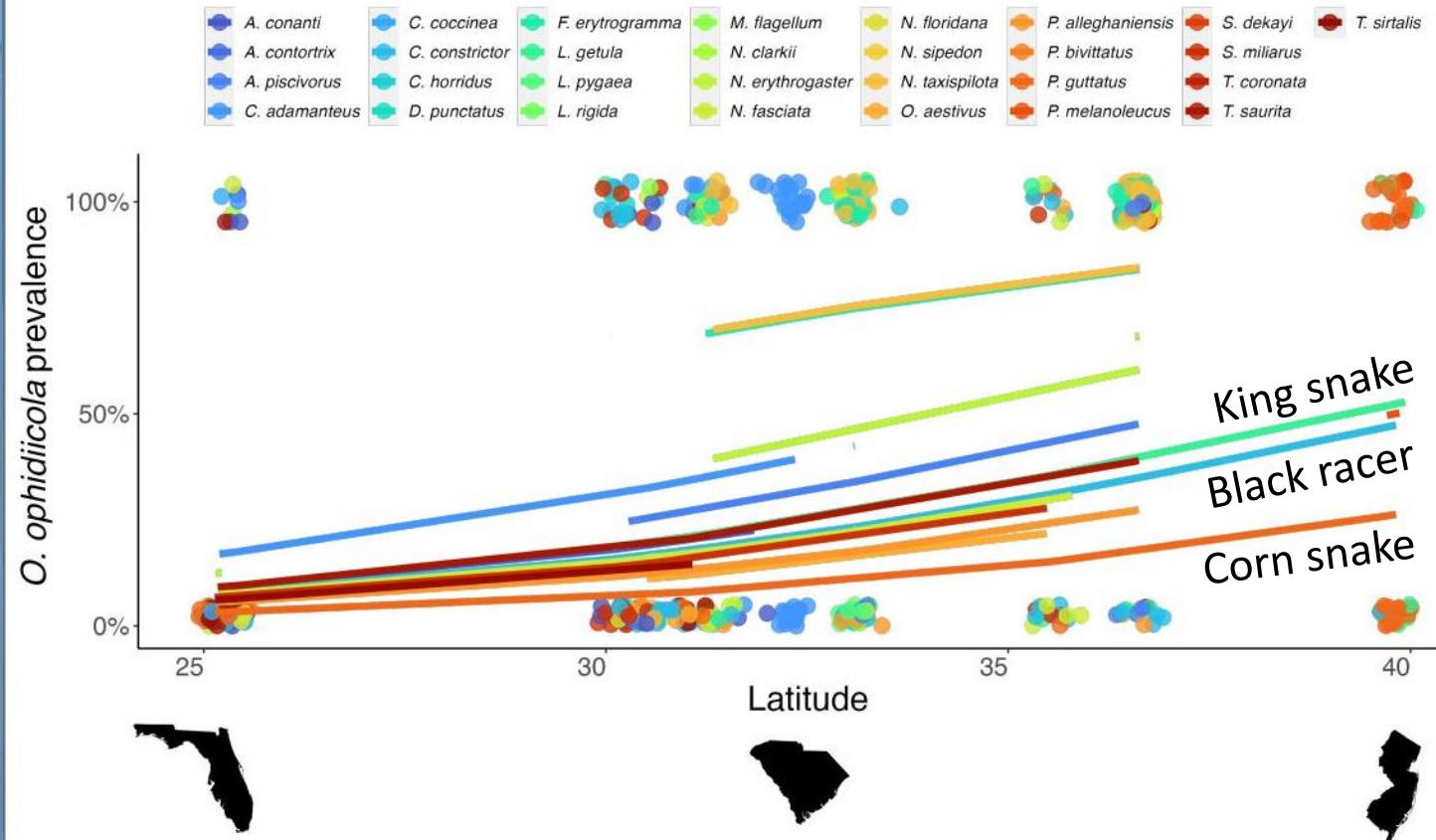


# SNAKE FUNGAL DISEASE MONITORING

Prevalence of *O.o.* increases with latitude  
from Florida north to New Jersey



## Geographic variation



GLM( $O_o$  prevalence ~ Latitude + Species, Binomial distribution), Latitude effect = coeff: 0.143 ± 0.035,  $P < 0.0001$

# EASTERN KING SNAKE STUDY

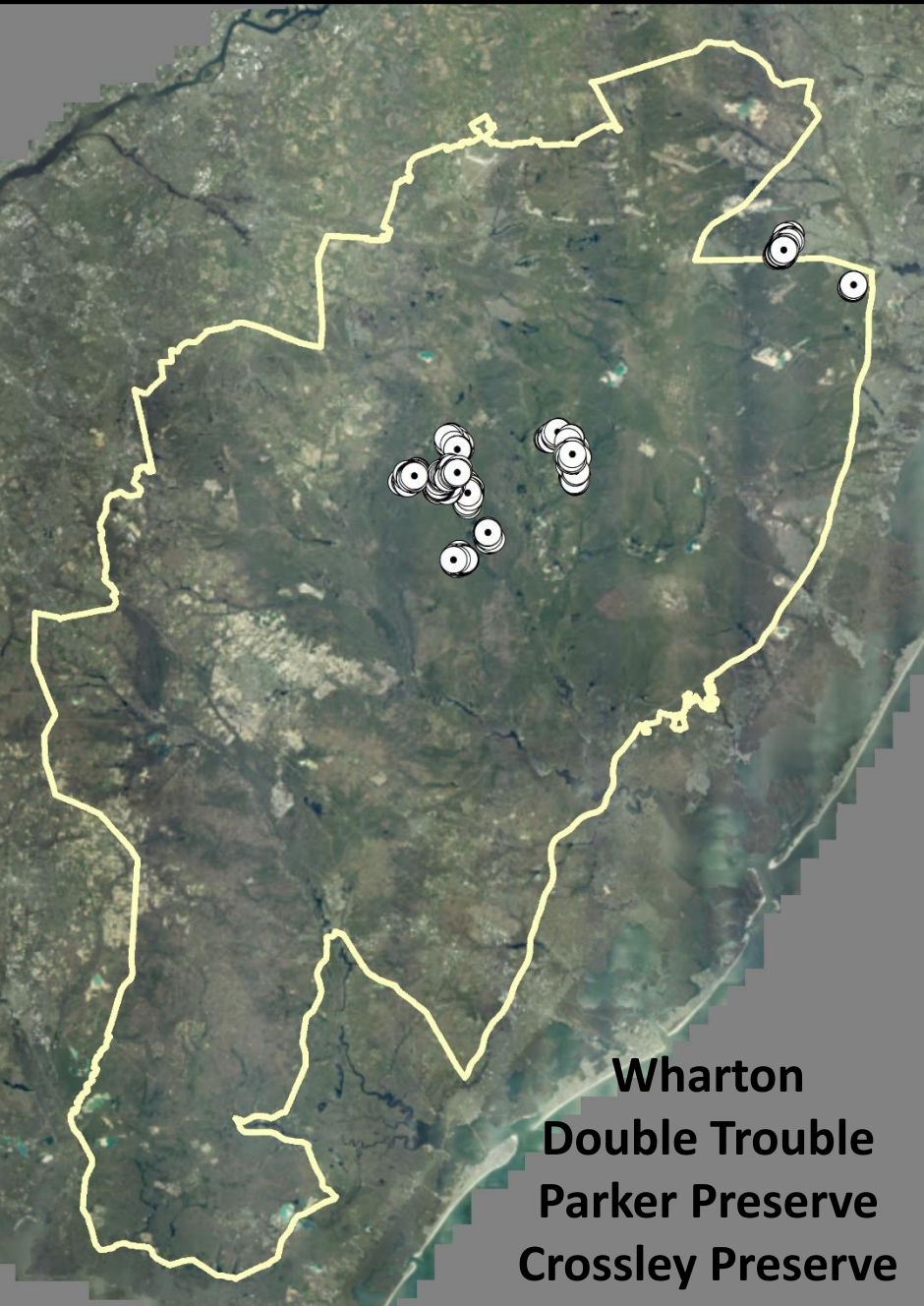


## WHY?

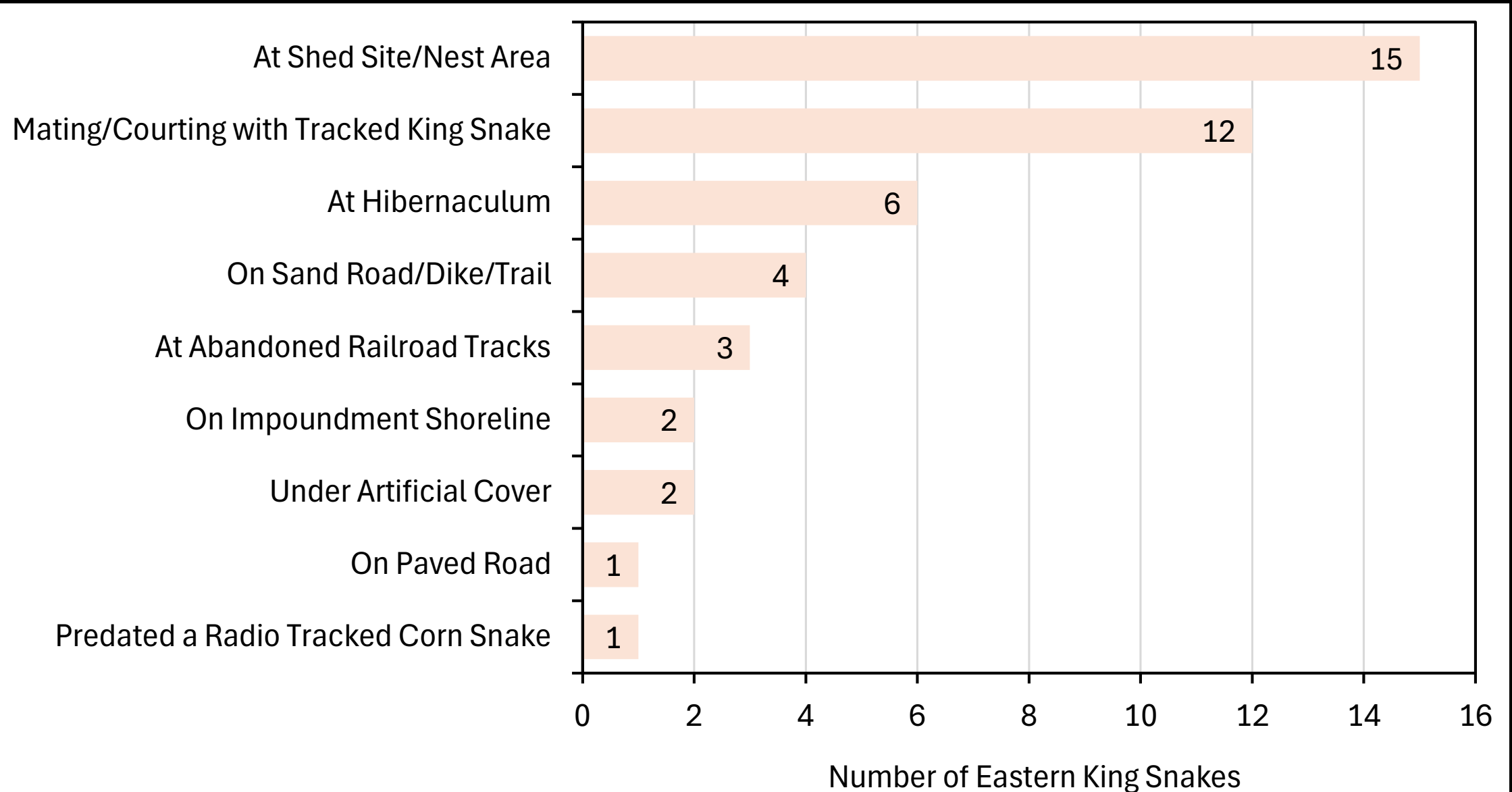
Listed as a Species of  
Special Concern

Threats, regional  
declines, and  
unknown status in NJ

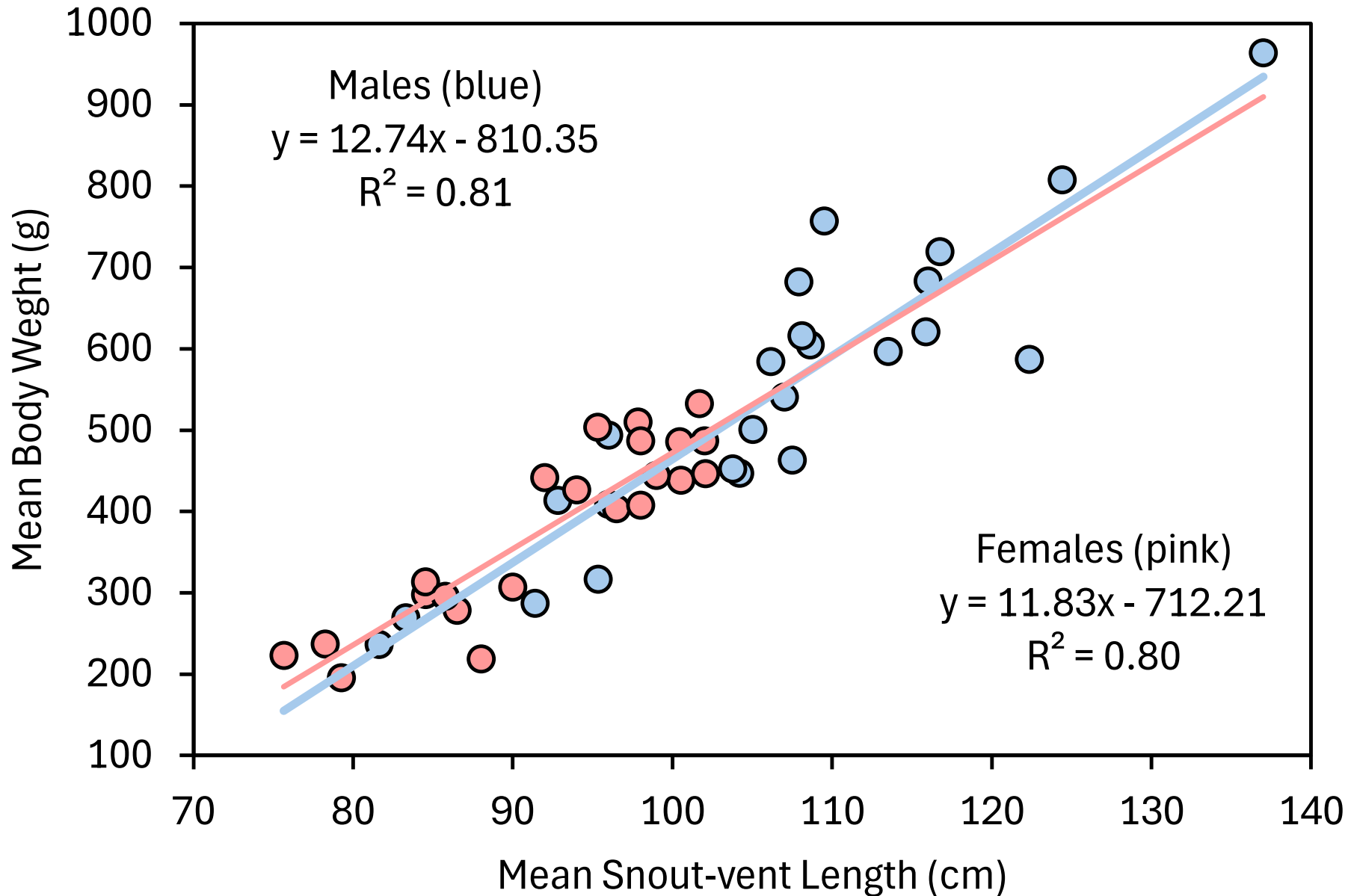
# EASTERN KING SNAKE STUDY



# EASTERN KING SNAKE STUDY



# EASTERN KING SNAKE STUDY

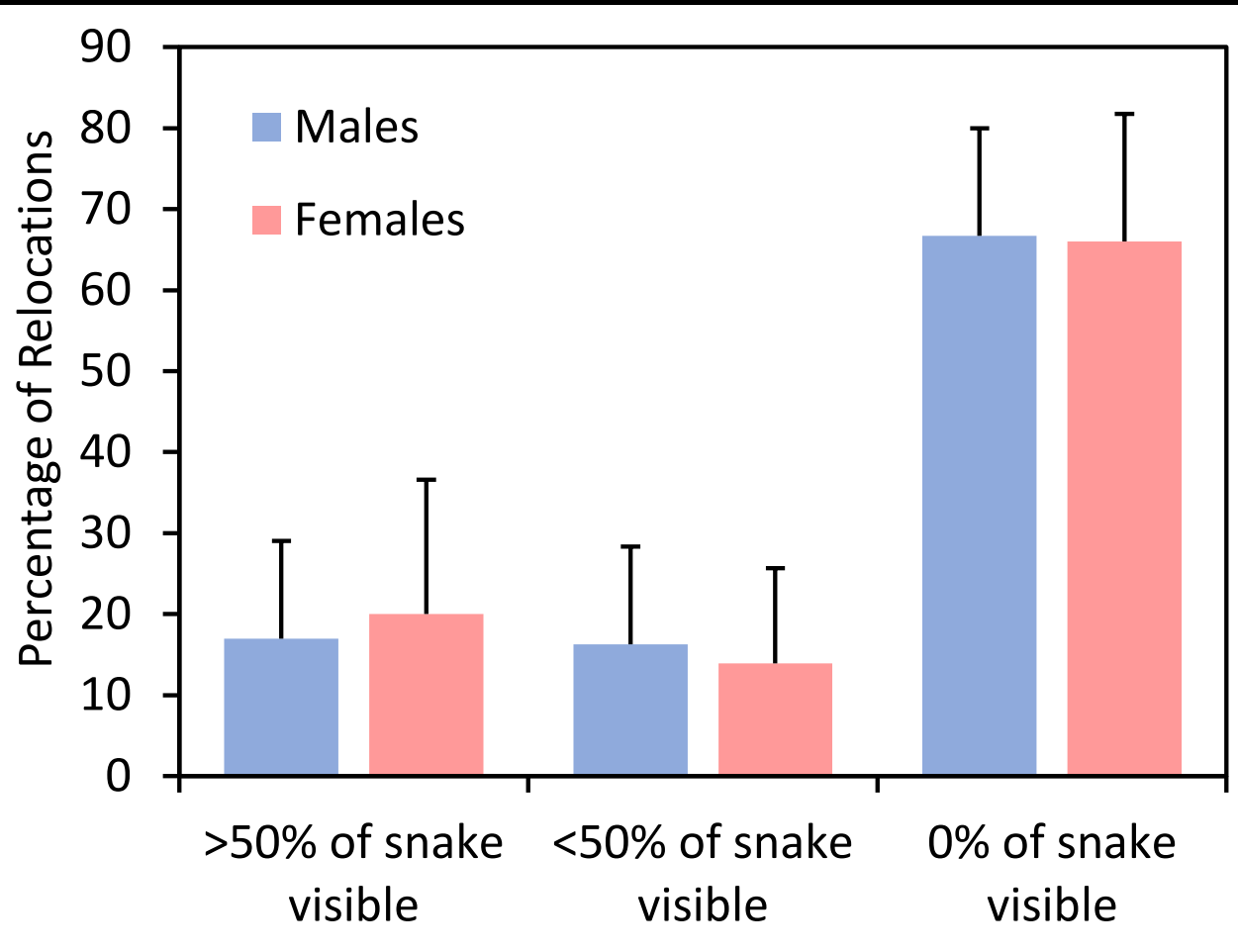


**Strong relationship  
between body length  
and weight**

**Males significantly  
larger than females**

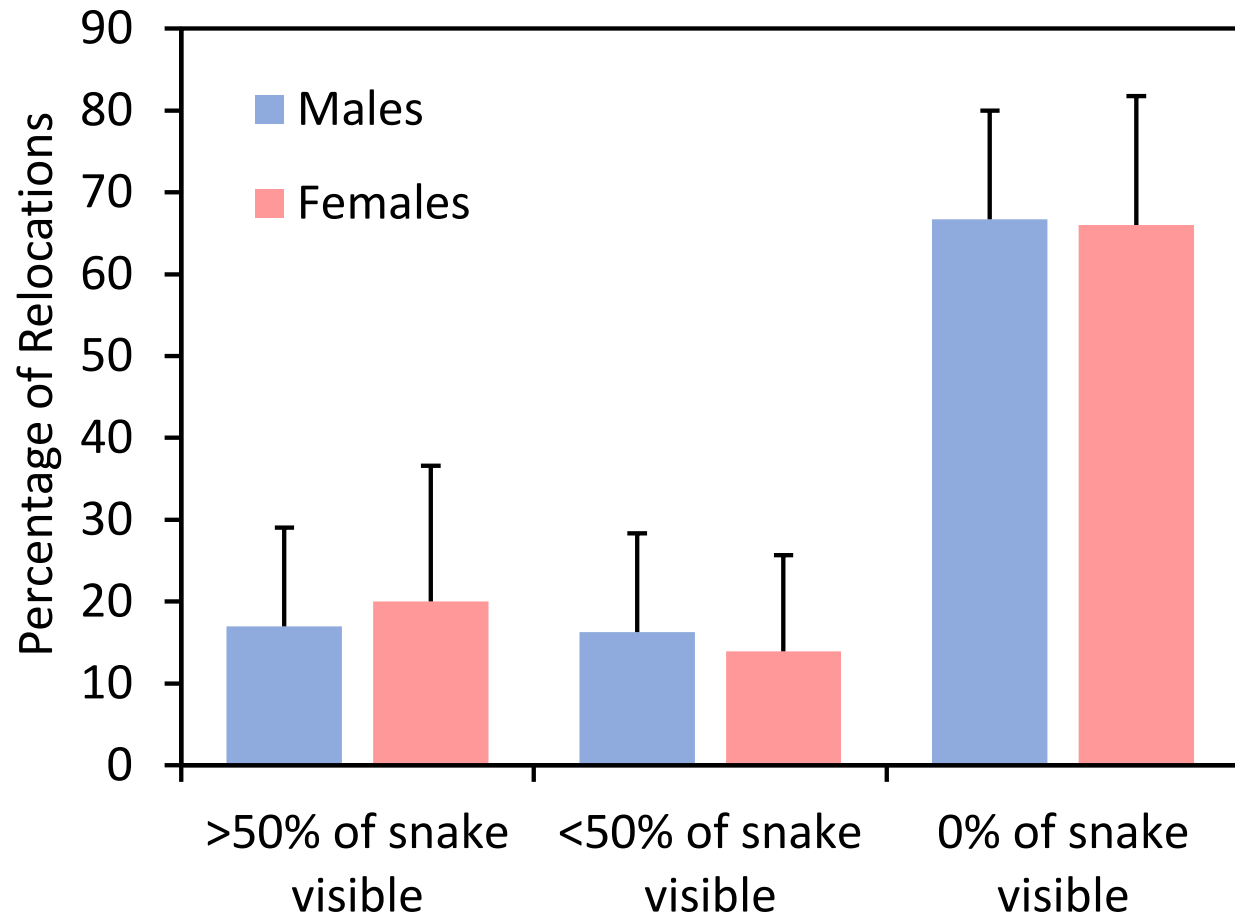
# EASTERN KING SNAKE STUDY

King snakes are usually concealed from view

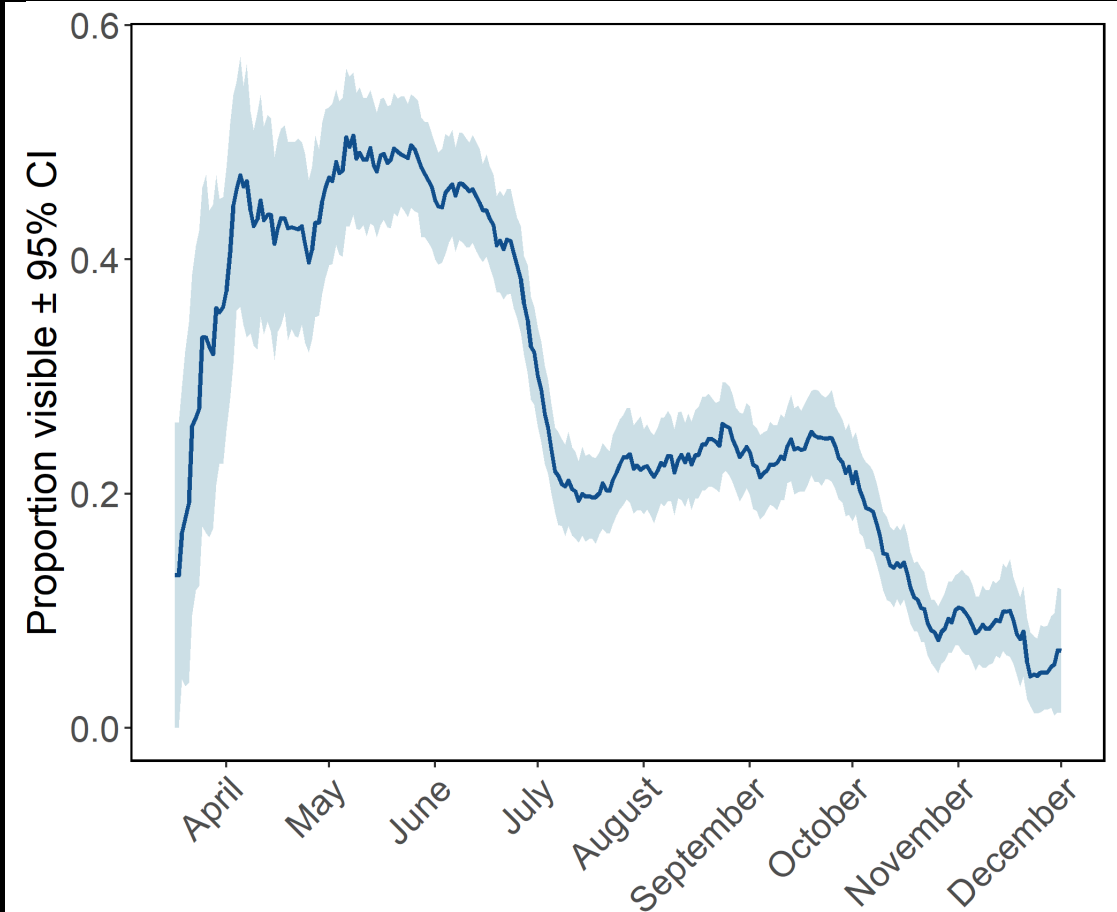


# EASTERN KING SNAKE STUDY

## King snakes are usually concealed from view

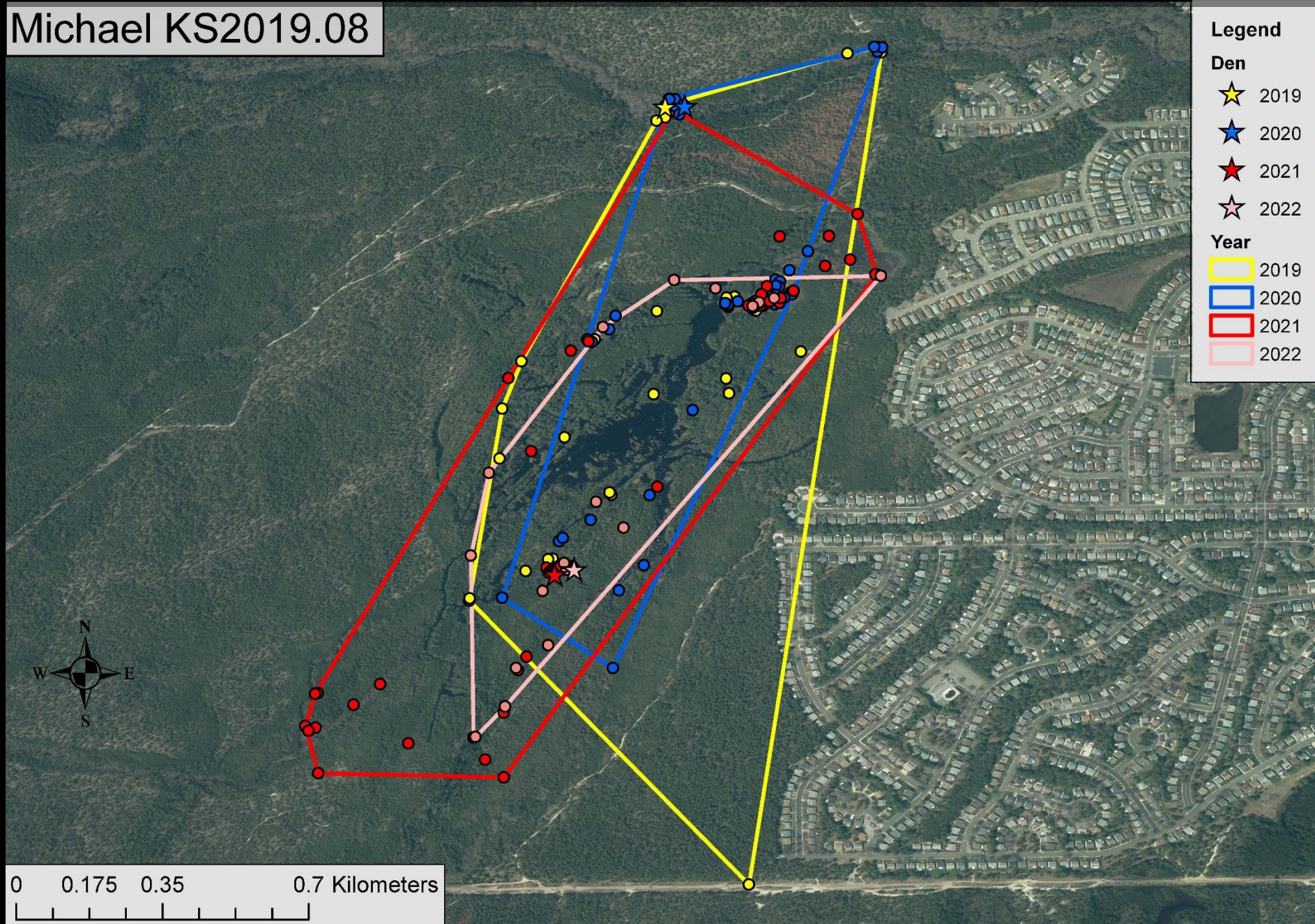


## Snake visibility varies by time of year

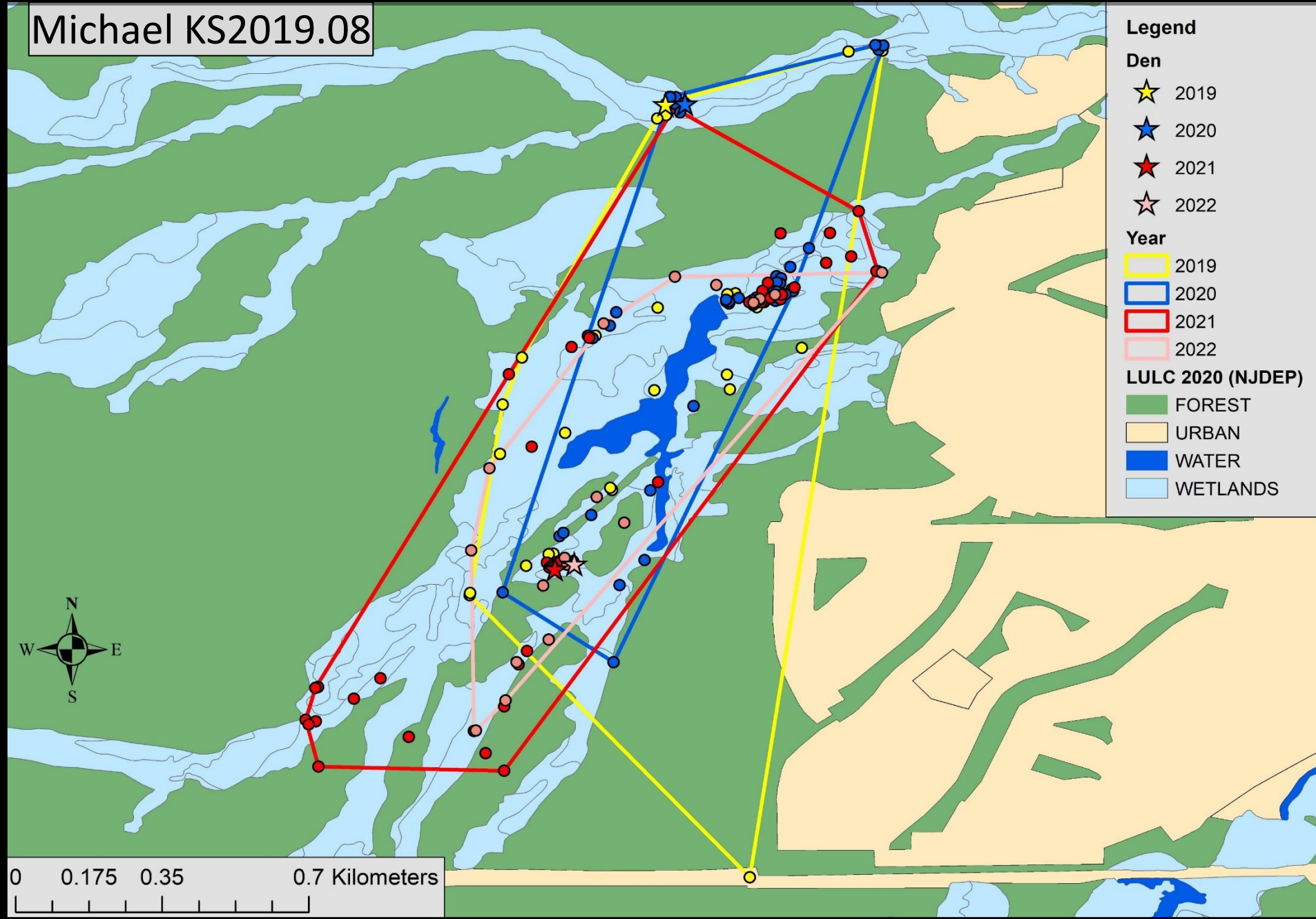


# EASTERN KING SNAKE STUDY

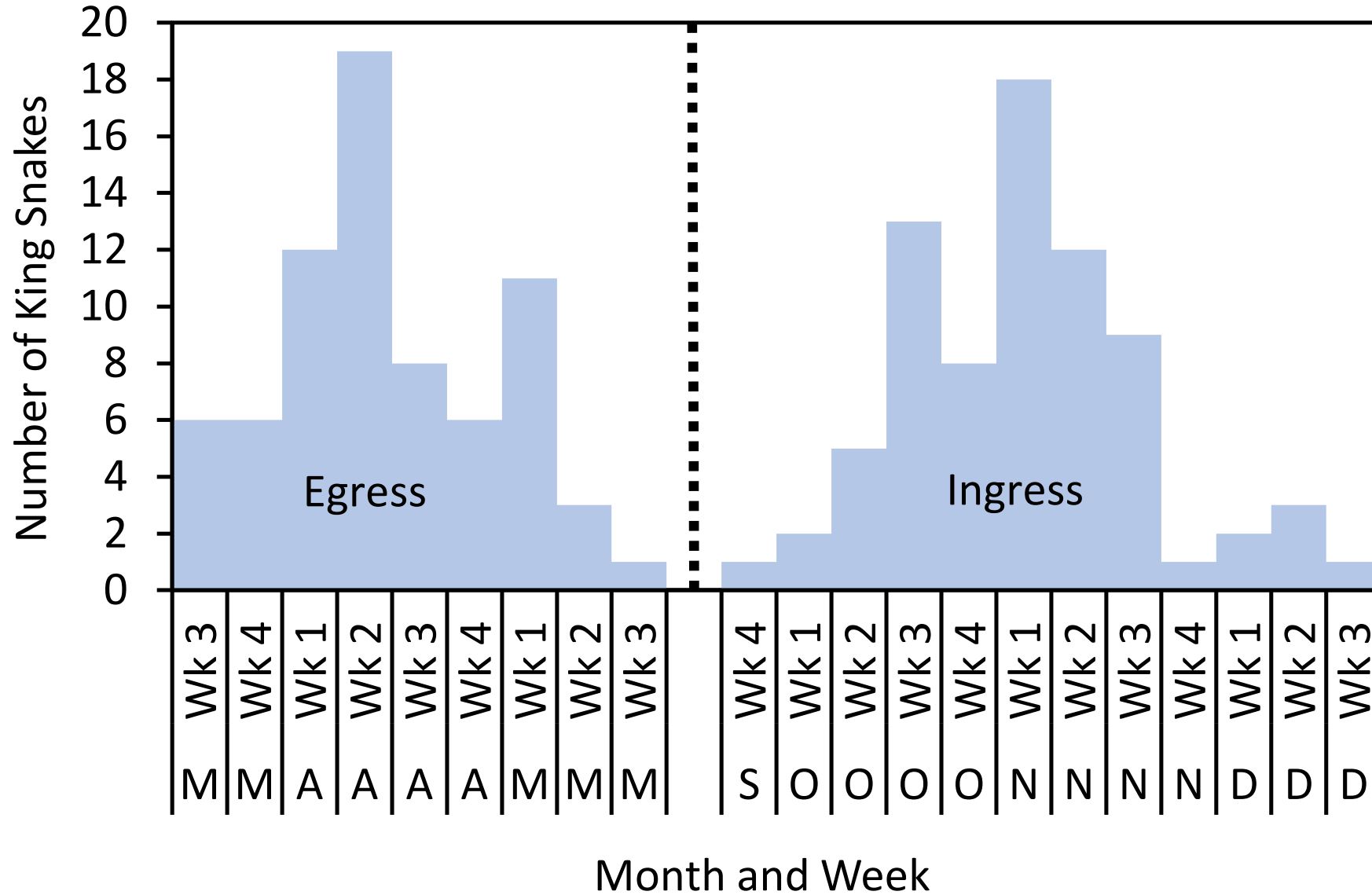
Michael KS2019.08



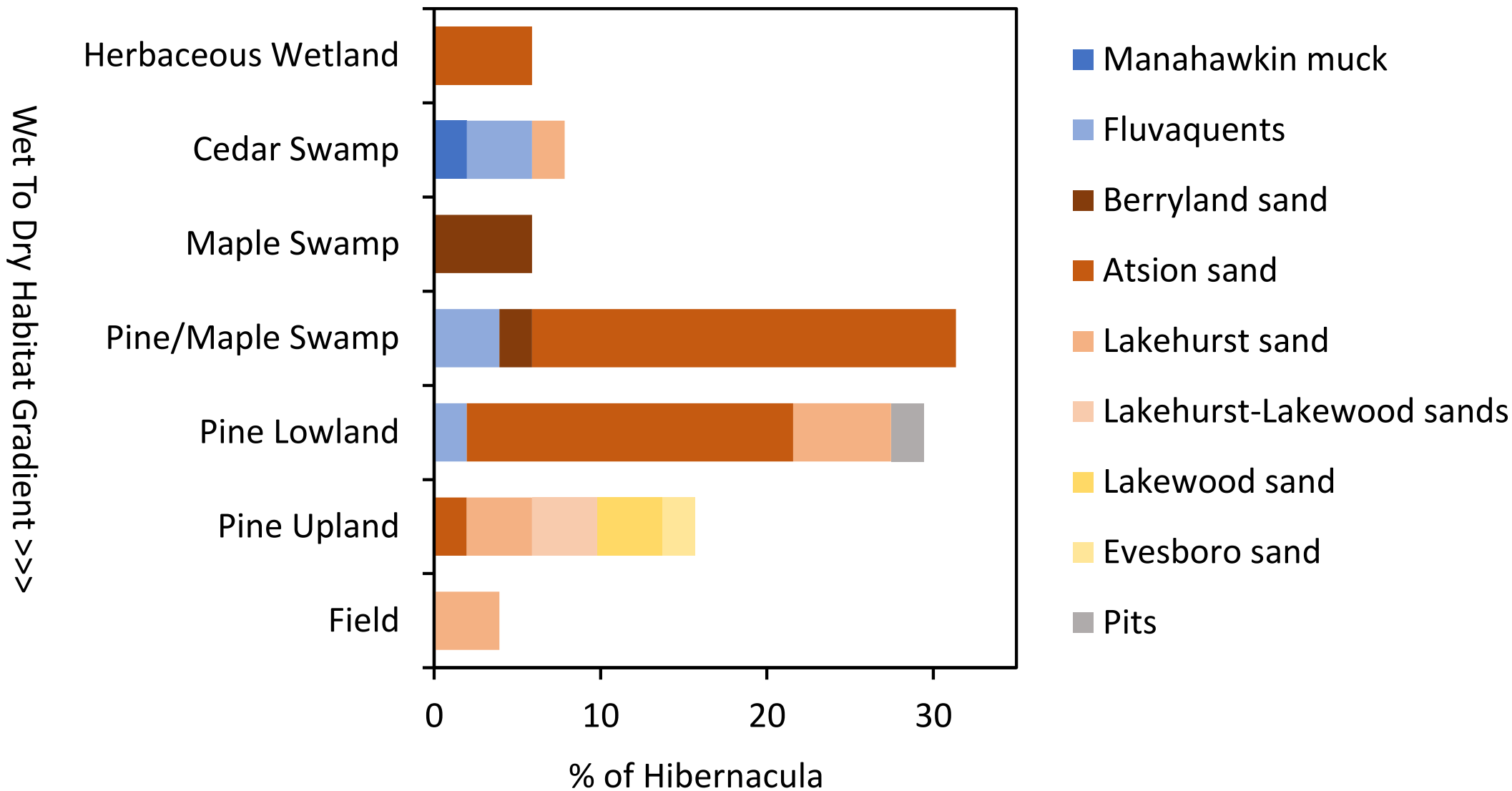
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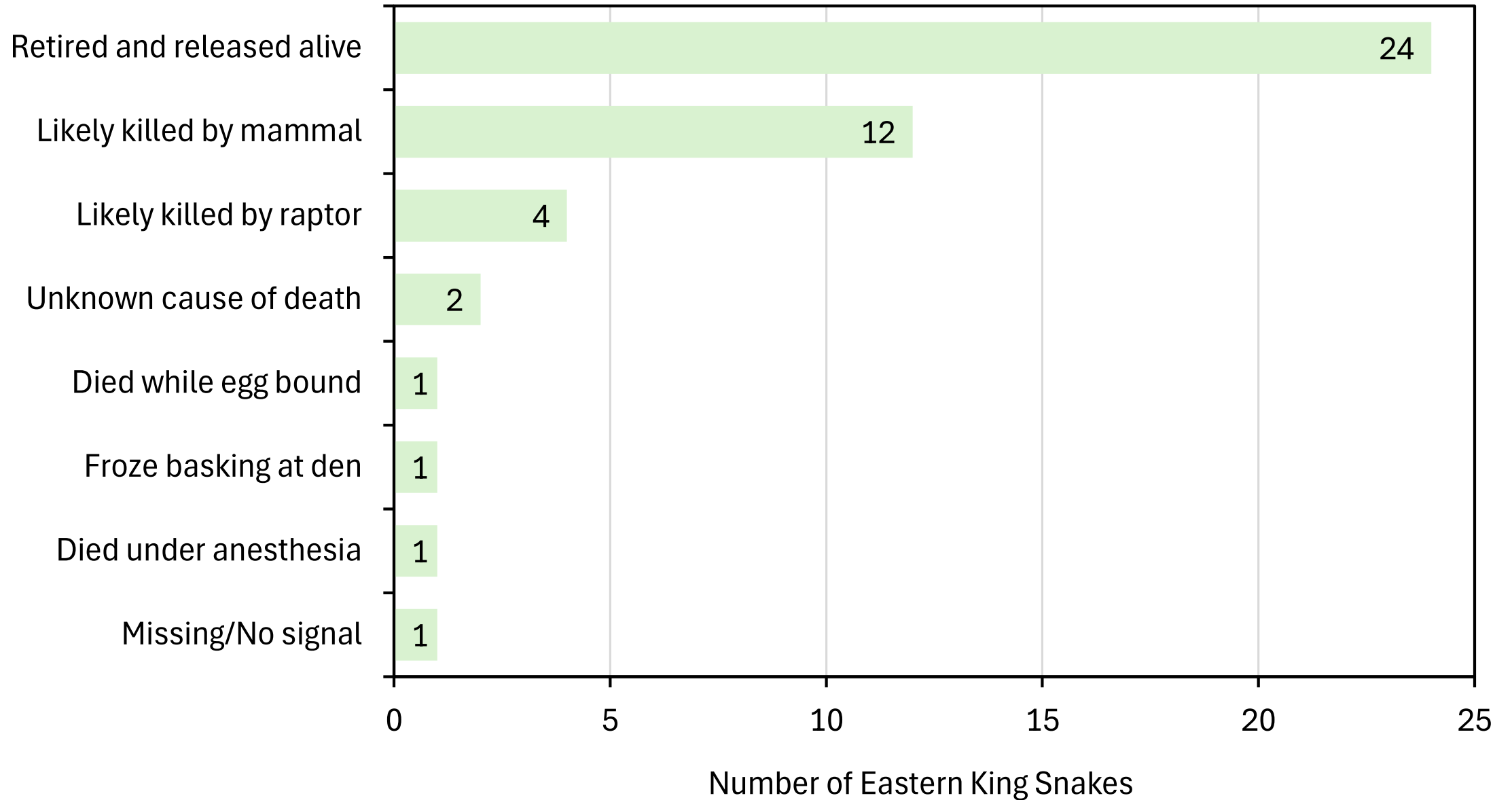
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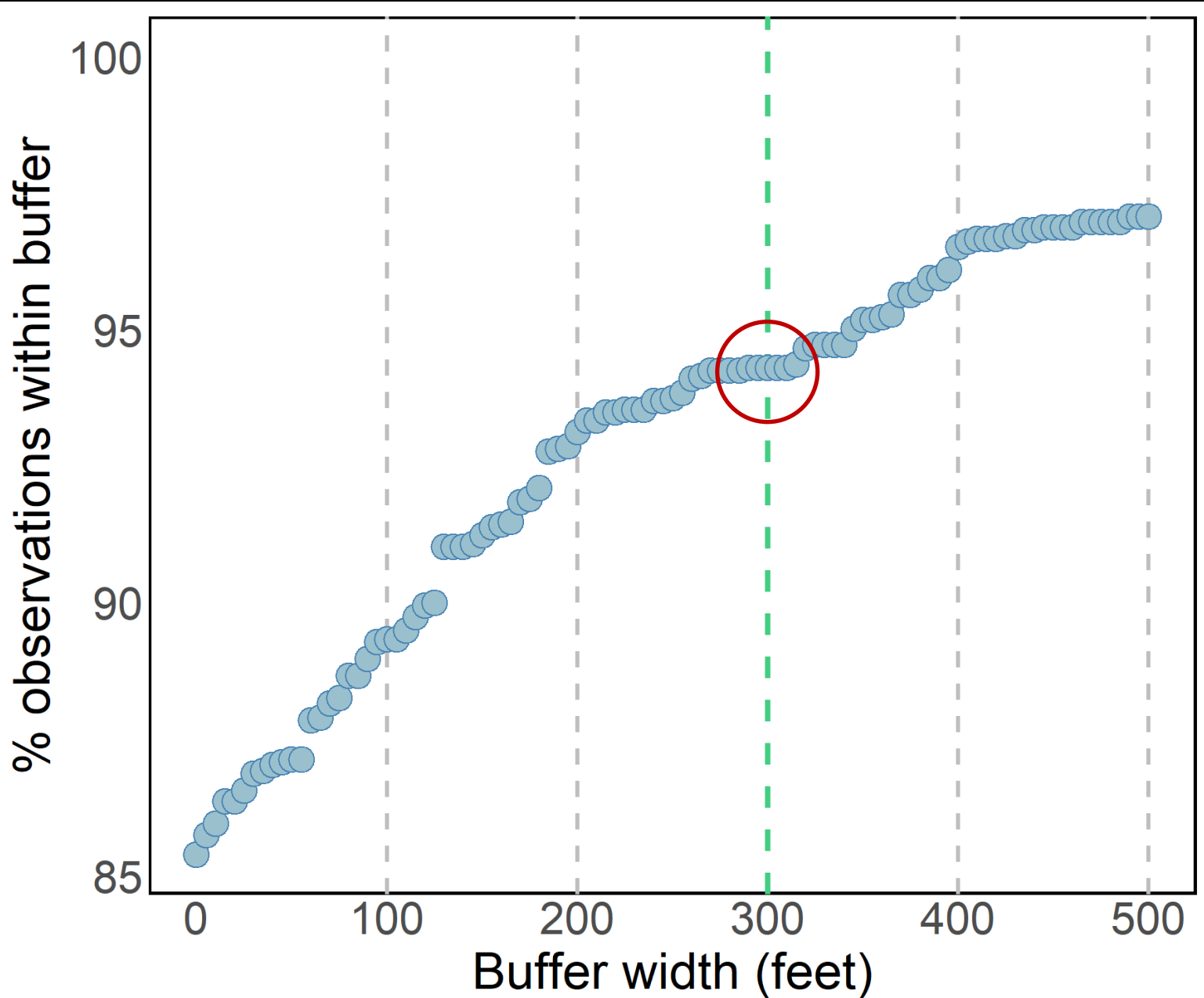
# EASTERN KING SNAKE STUDY



# EASTERN KING SNAKE STUDY



# EASTERN KING SNAKE STUDY



**1,839 king snake relocations  
from snakes with complete  
active seasons**

**85% of relocations  
were within wetlands**

**94% of telemetry relocations  
were within a 300-foot  
buffer to wetlands**

# EASTERN KING SNAKE STUDY



Currently analyzing  
the data and writing  
a final report for EPA

# EASTERN BOX TURTLE STUDY



## WHY?

Listed as Special  
Concern in NJ

Threatened by  
habitat loss,  
collection, mowers,  
motor vehicles,...

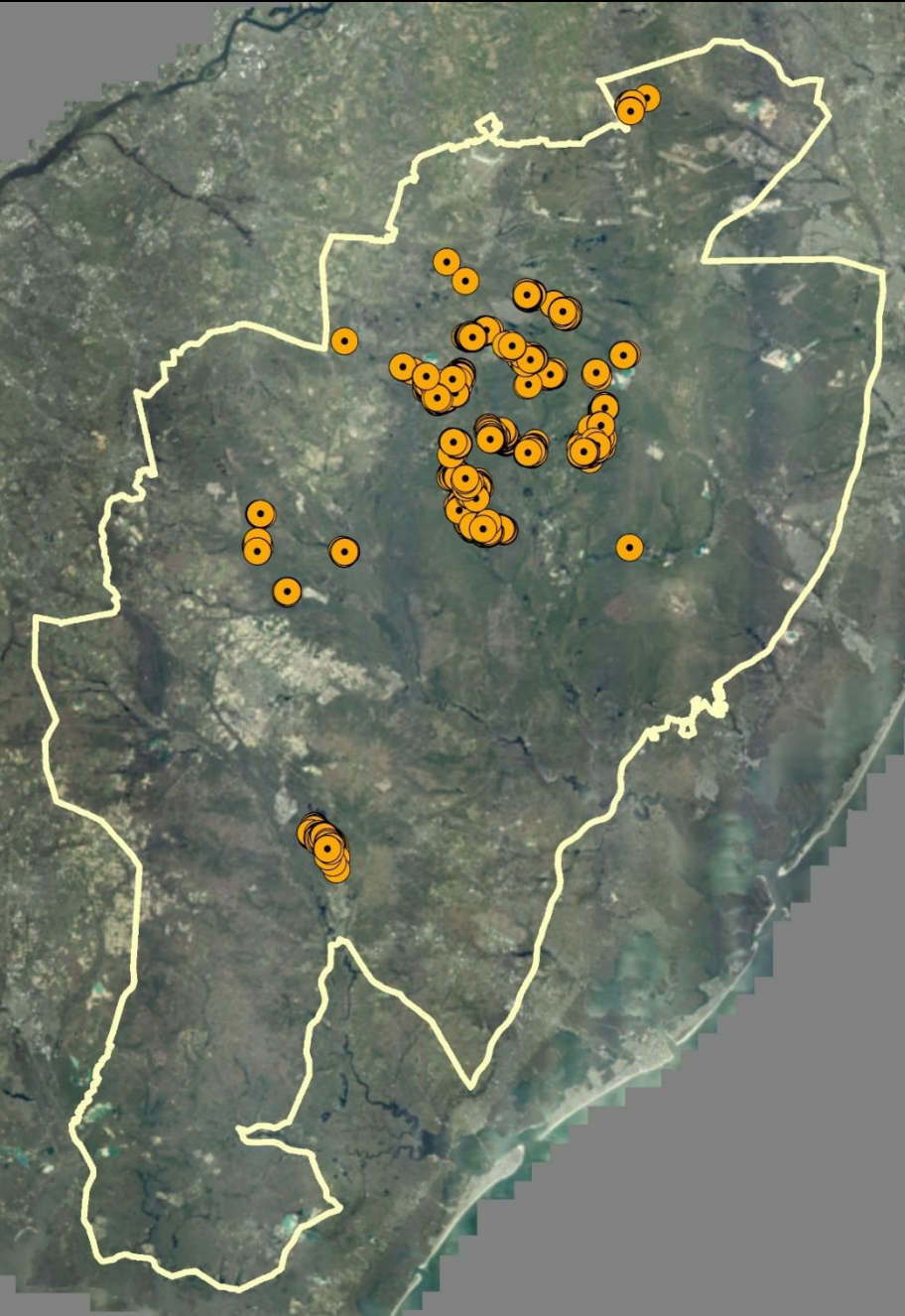
Declining in the  
northeast states

Unknown  
status in NJ

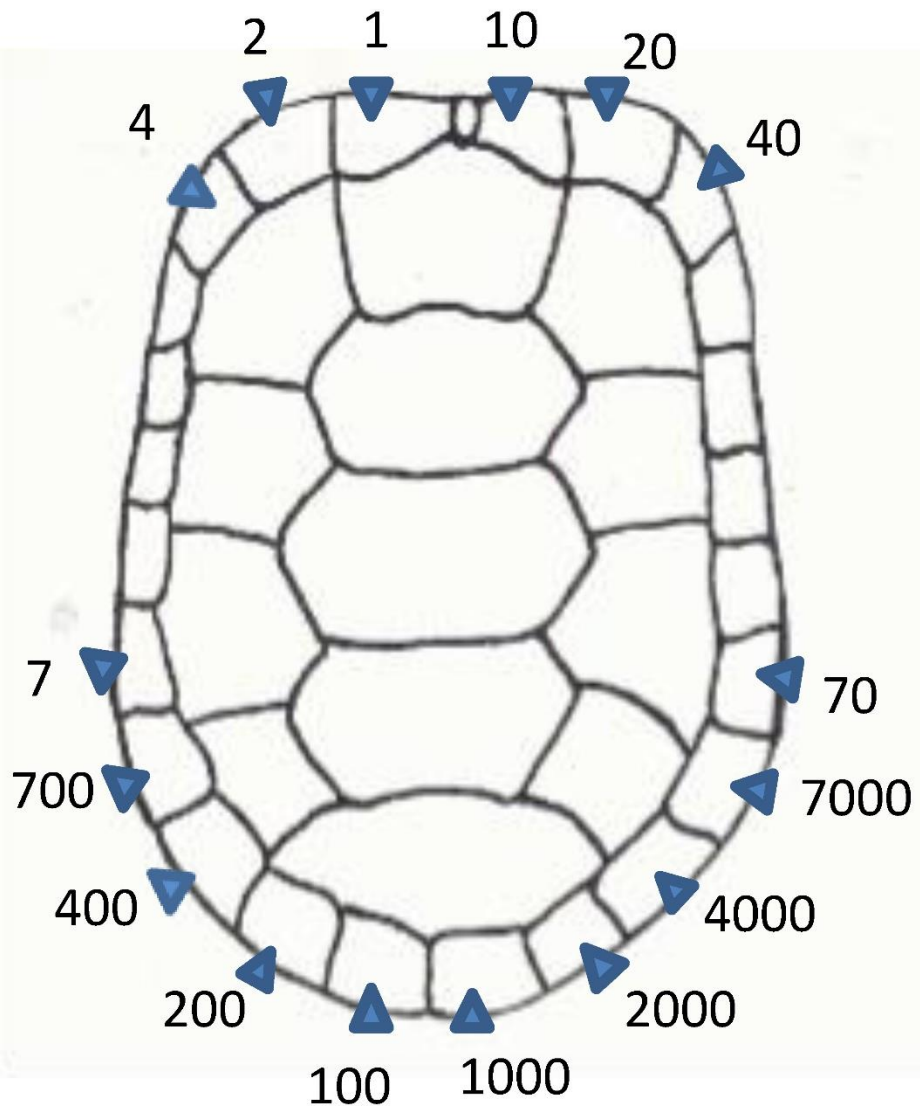
# EASTERN BOX TURTLE STUDY

Wharton, Brendan Byrne, Makepeace, Colliers Mills

Parker Preserve, Huber Preserve, South Park  
Gun Club, Cutts Brothers, Pine Island



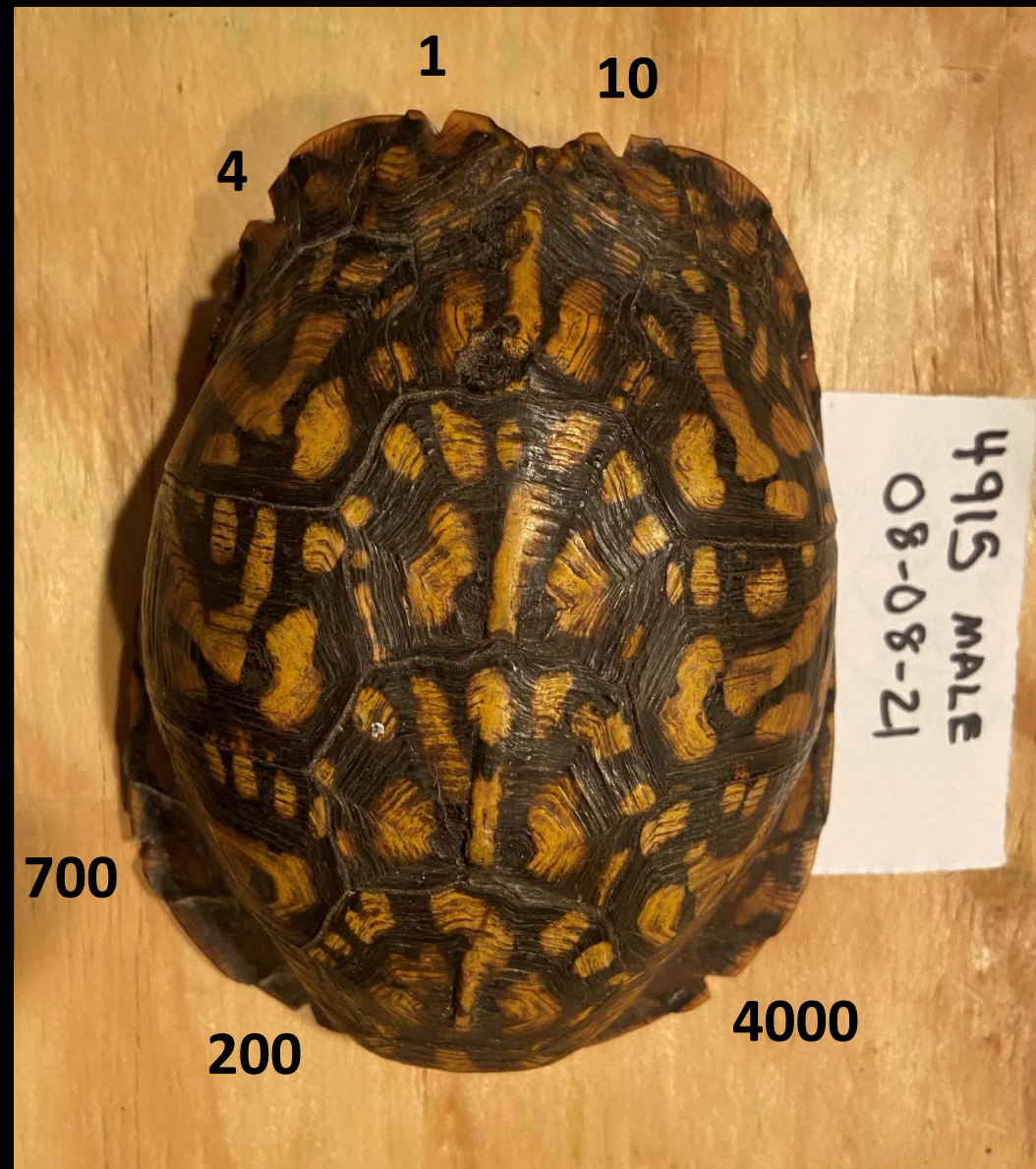
# EASTERN BOX TURTLE STUDY



**Weigh,  
measure, and  
sex them**

**Shell formation,  
damage, and  
health**

**Notch the shell  
with a file for  
permanent  
identification**



# EASTERN BOX TURTLE STUDY



**2021 – 2025,  
captured 143 turtles**

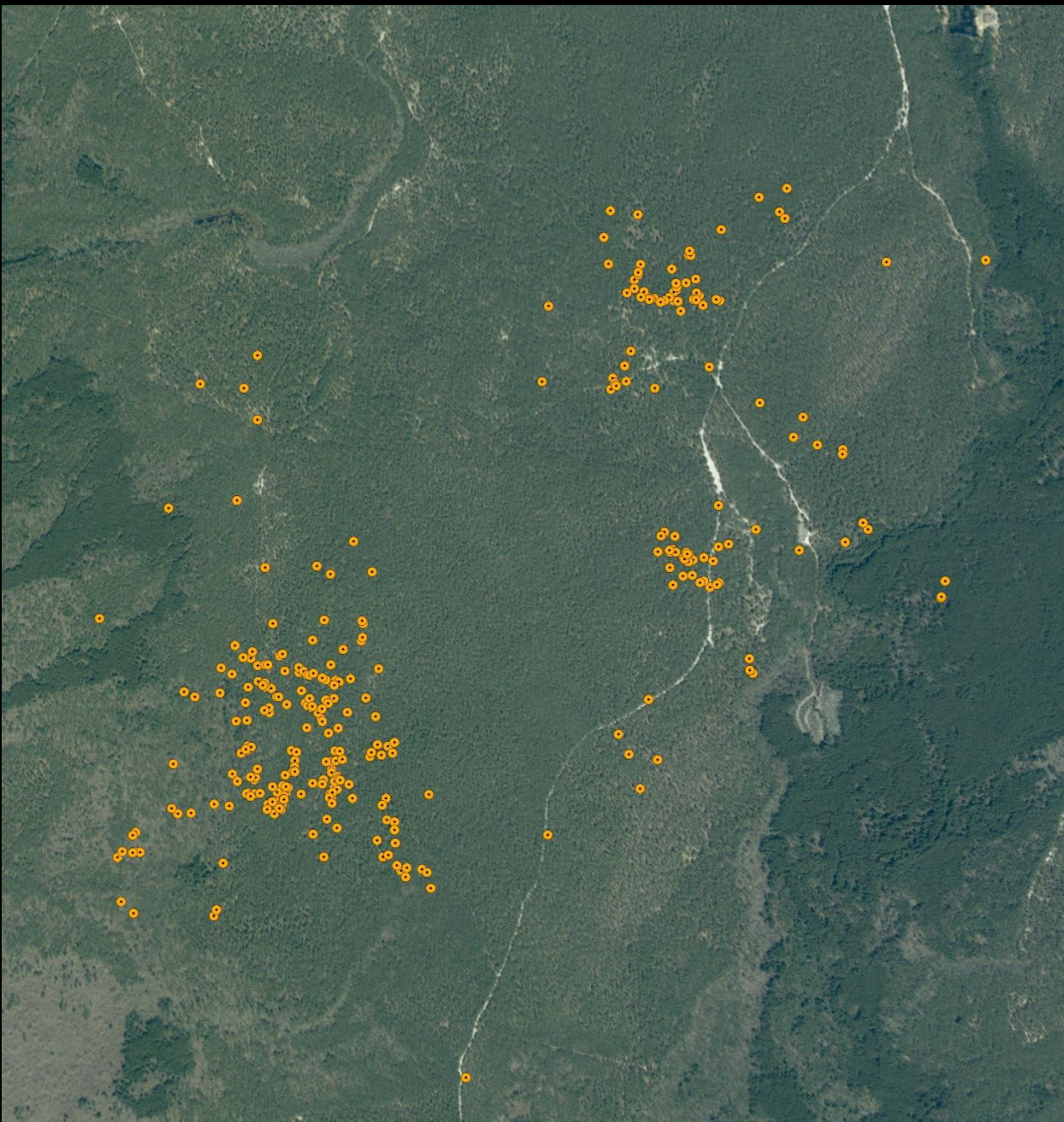
**Glued radio  
transmitters to the  
back of shell**

**Currently tracking  
101 turtles**

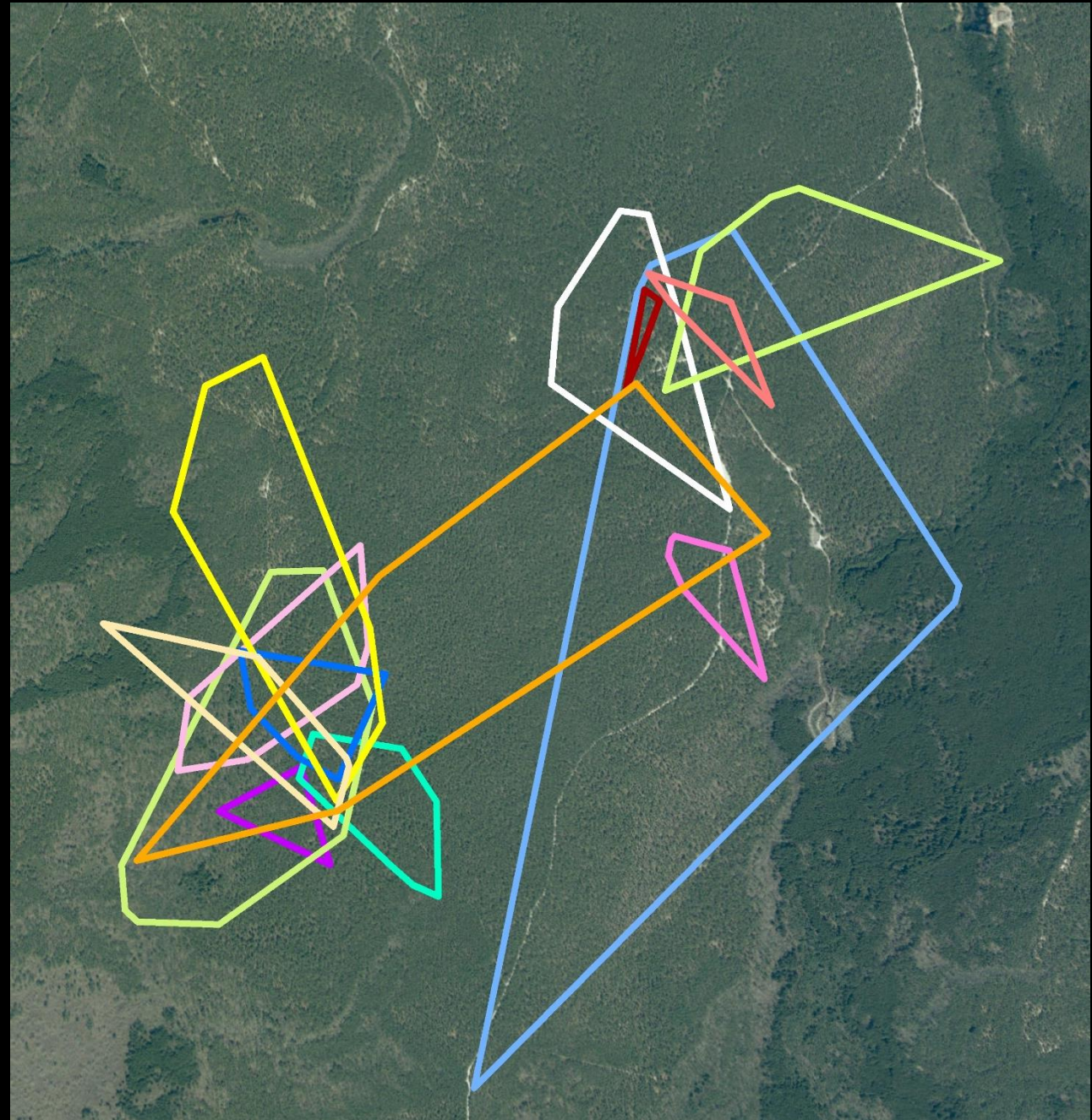
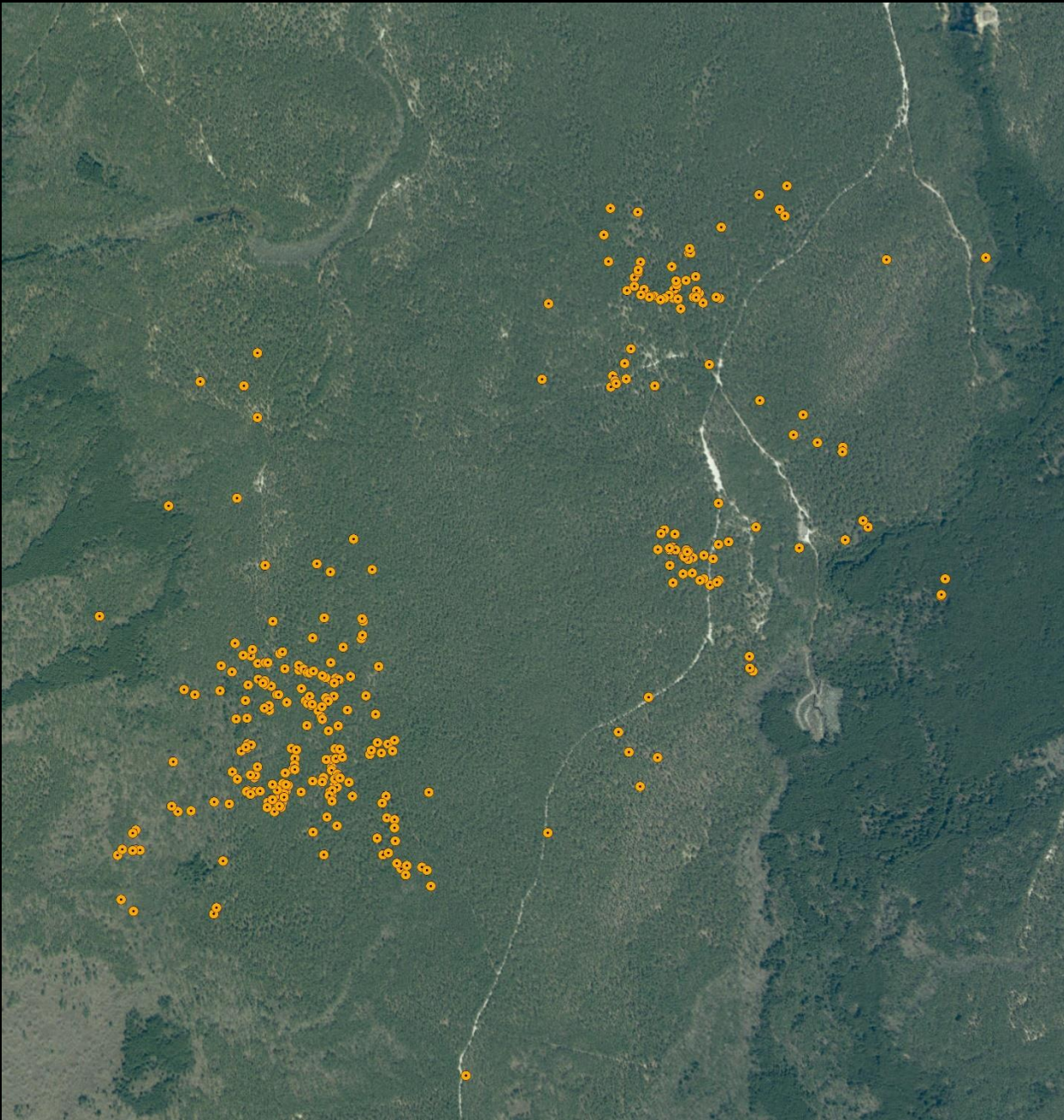
**Activity range,  
habitat use, and  
hibernacula**

**Relationship  
with fire**

# EASTERN BOX TURTLE STUDY



# EASTERN BOX TURTLE STUDY



# EASTERN BOX TURTLE STUDY

## Upland habitat types

Old field



Upland pine



Upland oak



Upland pine-oak



# EASTERN BOX TURTLE STUDY

## Wetland habitat types

Shrub wetland



Herbaceous wetland



Maple swamp

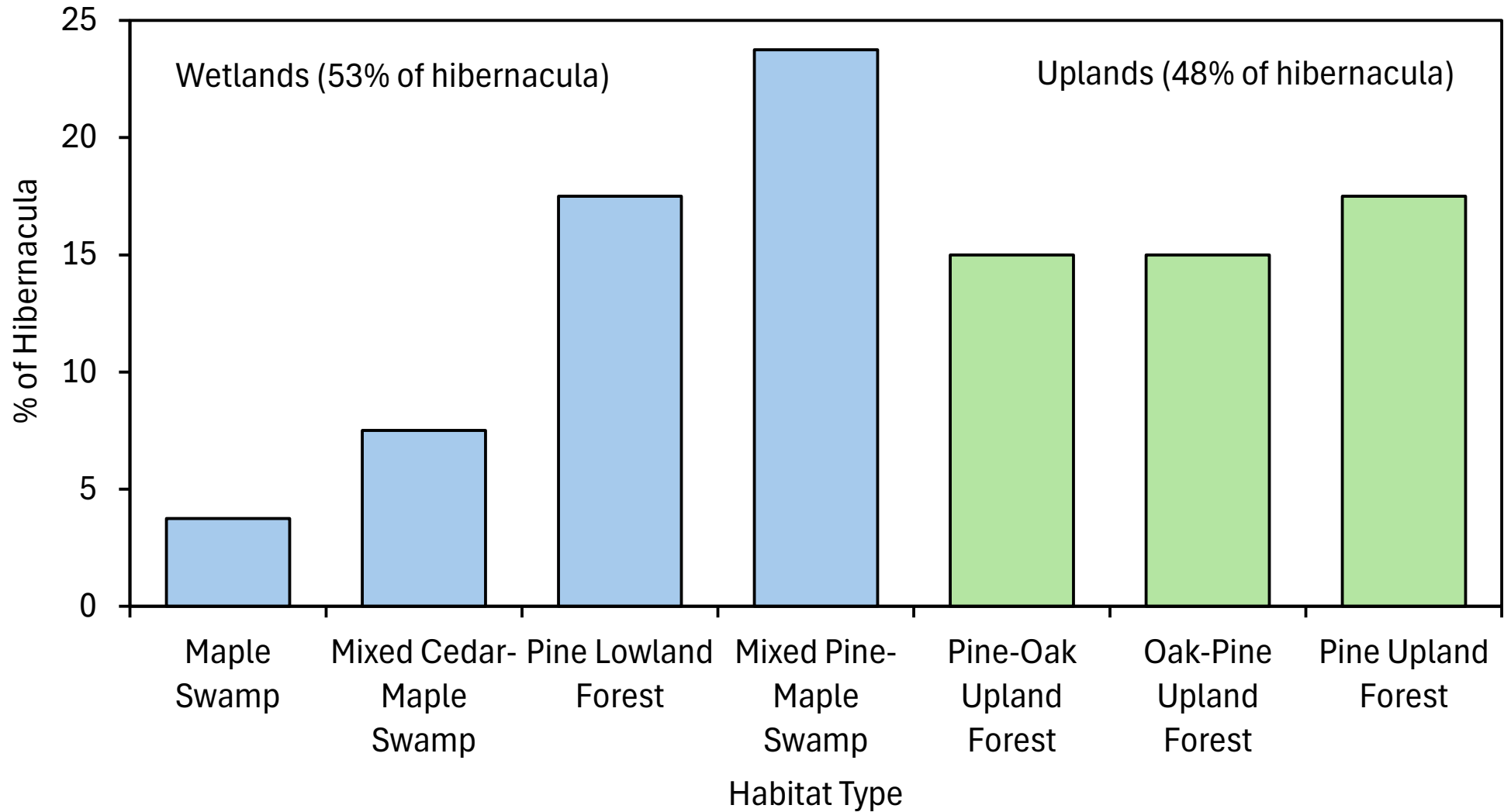


Cedar swamp

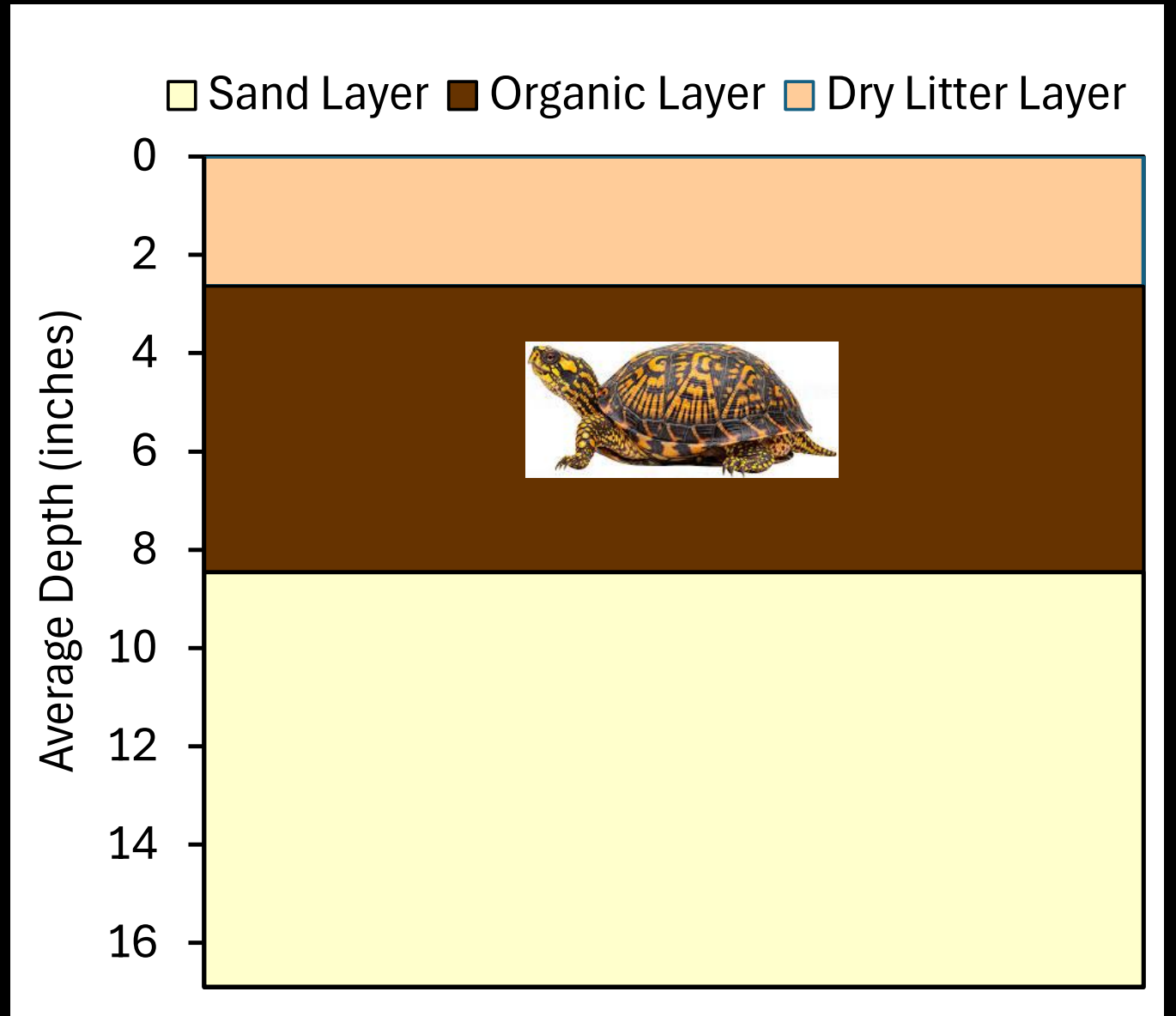


# EASTERN BOX TURTLE STUDY

## Hibernacula



# EASTERN BOX TURTLE STUDY



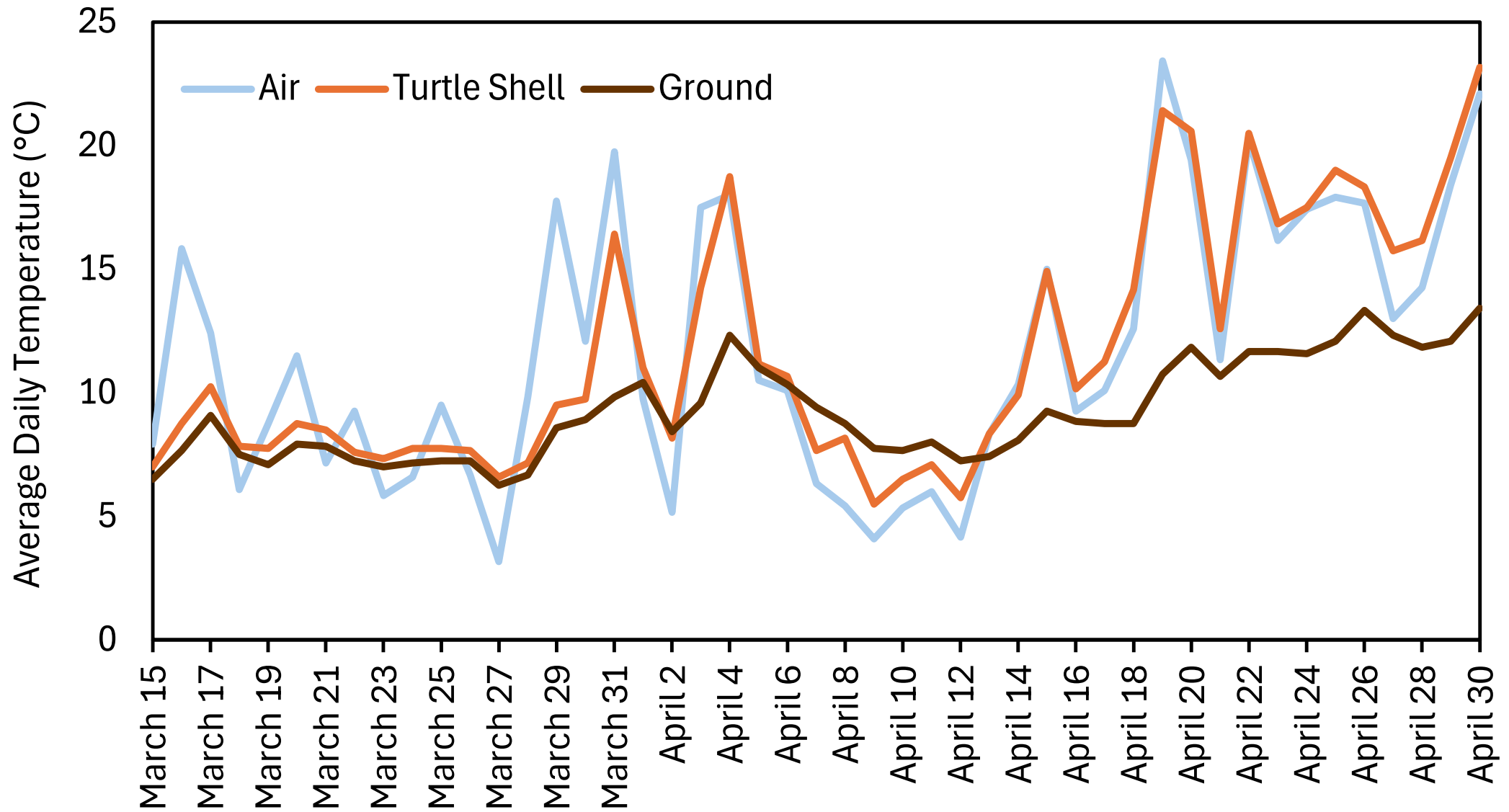
# EASTERN BOX TURTLE STUDY



iButtons for temperature logging



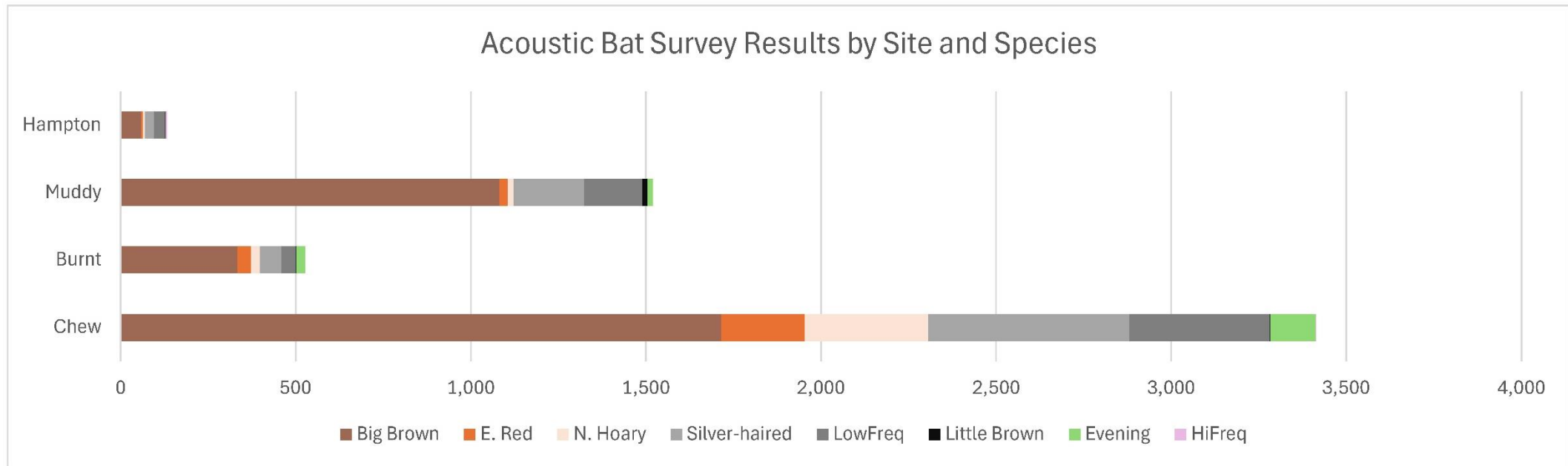
# EASTERN BOX TURTLE STUDY



# RARE BAT SURVEYS



**Collaborated with NJDEP ENSP staff**  
**Acoustic surveys at LTEM ponds for rare bats**  
**Targets: Northern long-eared bat and Tricolor bat**



# TIMBER RATTLESNAKE MONITORING

Capture gravid females to give birth in captivity  
Weigh, measure, and PIT tag females and neonates  
Swab adults and neonates for SFD



# TIMBER RATTLESNAKE MONITORING

Attach external transmitters to females to find their dens  
Corral the dens for long-term population monitoring



QUESTIONS?

