

# **SCIENCE OFFICE RESEARCH**

**ANNUAL UPDATE**

**February 9, 2024**

**Pinelands Commission Meeting**

# SCIENCE OFFICE PERSONNEL

John Bunnell (34 years)  
Kim Laidig (31 years)  
Patrick Burritt (16 years)  
Jeff Dragon (5 years)  
Chris Jeitner (<1 year)

# **PAST RESEARCH**

**Water Quality**

**Wastewater Treatment**

**Upland and Wetland Forests**

**Ponds and Stormwater Basins**

**Stream and Wetland Hydrology**

**Pesticides and Endocrine Disruptors**

**Aquatic and Wetland Plants and Animals**

**Threatened and Endangered Species**

**Ecological Integrity Assessment**

**Landscape Assessments**

**Cranberry Agriculture**

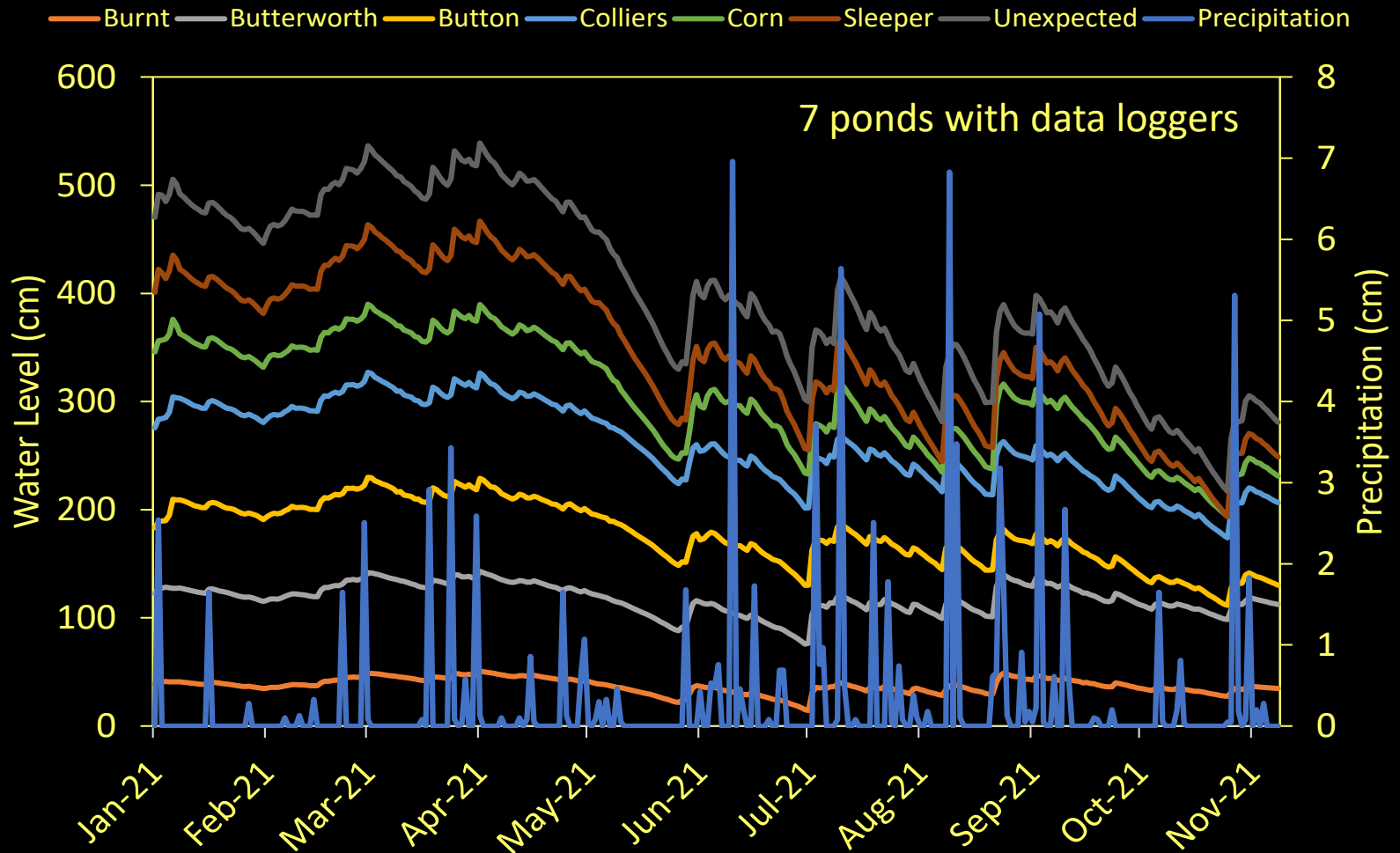
**Utility Rights-of-way**

# CURRENT RESEARCH

Water Level Monitoring  
Pinelands-wide WQ Monitoring  
Frog and Toad Monitoring  
Joint Corn Snake Study  
Rare Snake Monitoring  
King Snake Study  
Snake Fungal Disease Monitoring  
Box Turtle Study  
Future Possibilities

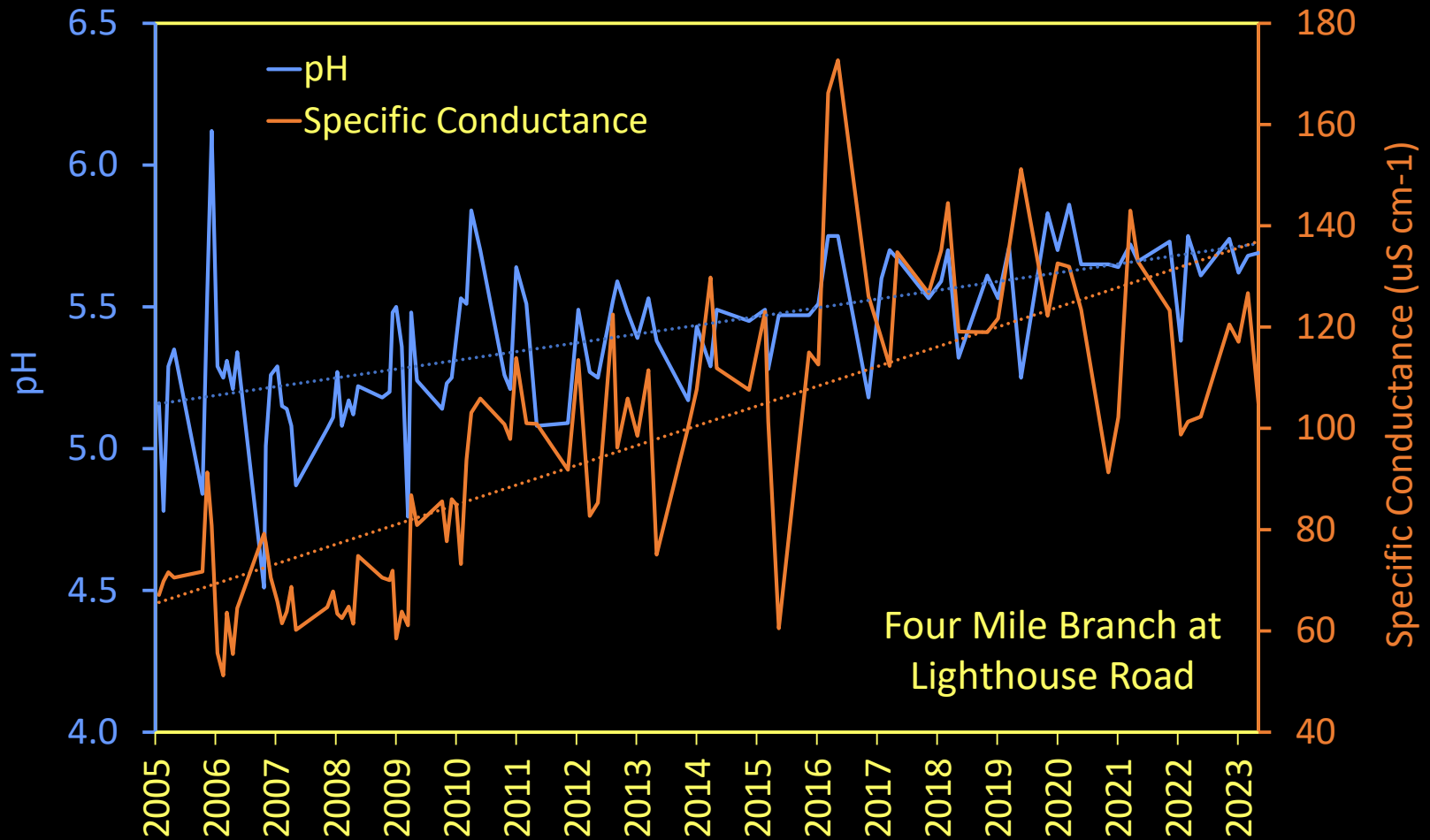
# WATER LEVEL MONITORING

NPS funded ongoing environmental monitoring  
Monitor 33 forest plots manually + 1 plot with data logger  
Monitor 30 ponds manually + 7 ponds with data loggers



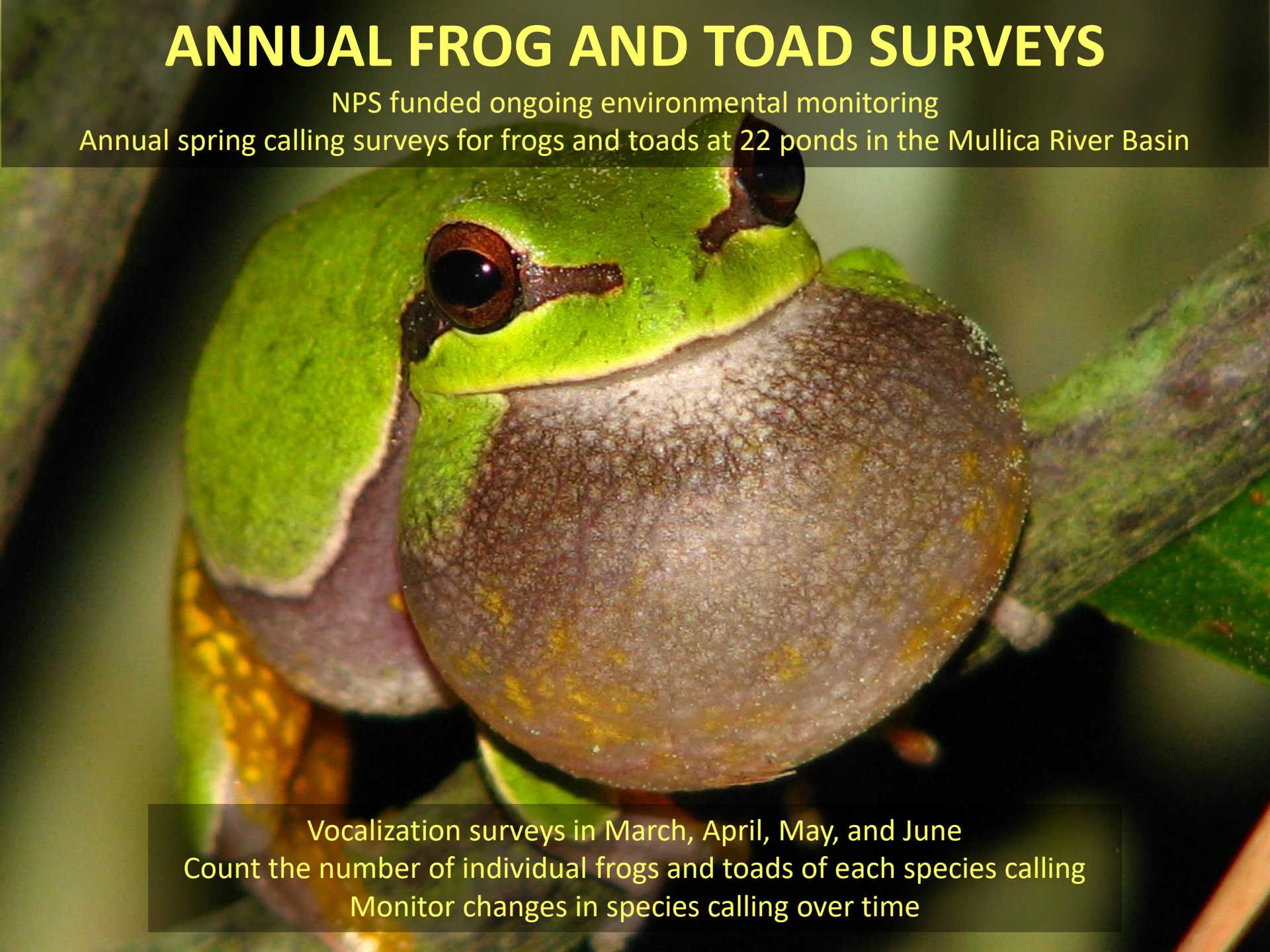
# PINELANDS WIDE WQ MONITORING

NPS funded ongoing environmental monitoring  
47 stream sites sampled every year in April, June, August, and October  
Monitor changes in pH and specific conductance



# ANNUAL FROG AND TOAD SURVEYS

NPS funded ongoing environmental monitoring  
Annual spring calling surveys for frogs and toads at 22 ponds in the Mullica River Basin



Vocalization surveys in March, April, May, and June  
Count the number of individual frogs and toads of each species calling  
Monitor changes in species calling over time

# JOINT CORN SNAKE STUDY

PCF funded collaboration between PC, HA, TCNJ, and ENSP

1. Radio telemetry
2. Head started vs cold released
3. Drift fence study
4. Locate critical habitats





# 1. RADIO TELEMETRY

Capture snakes and surgically implant radio transmitters  
Surgeries are done by Patrick Burritt and Jeff Dragon  
Trained by Dr. Howard Reinert



# 1. RADIO TELEMETRY



Located snakes 2 – 3x  
per week in 2017 – 2019

Environmental, habitat,  
and behavioral data

Activity range  
and habitats used

Timing of nesting,  
shedding, and denning

Location of dens, nests,  
and shed sites

Analyze data in 2024

## 2. HEAD STARTED VS COLD RELEASED



Collected females or eggs from nest areas and hatched at HA

Cold released group released back to nest area

Head started group kept over winter, fed, and released following spring

Head starting was done 2016 – 2019 and 2022

Goal is to compare growth, survivorship, time to reproduction, dispersal, etc., of the two groups

# 3. DRIFT FENCE STUDY



4 Drift fences:

1,800 ft

800 ft

255x255 ft

150x225 ft

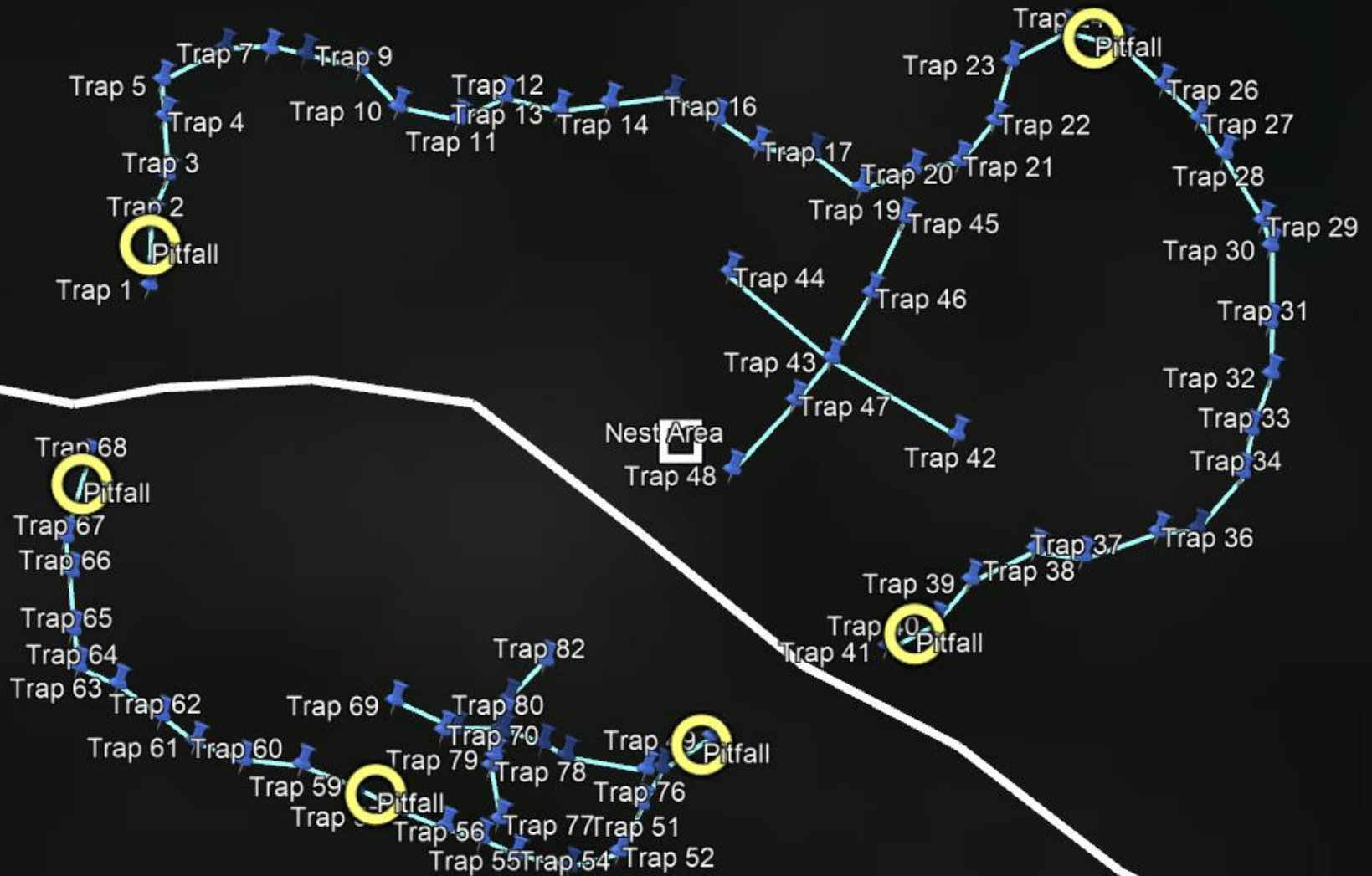
Spring – Fall

2019 – 2022

82 box traps, 82  
plywood, 82 metal,  
added 12 pitfall traps

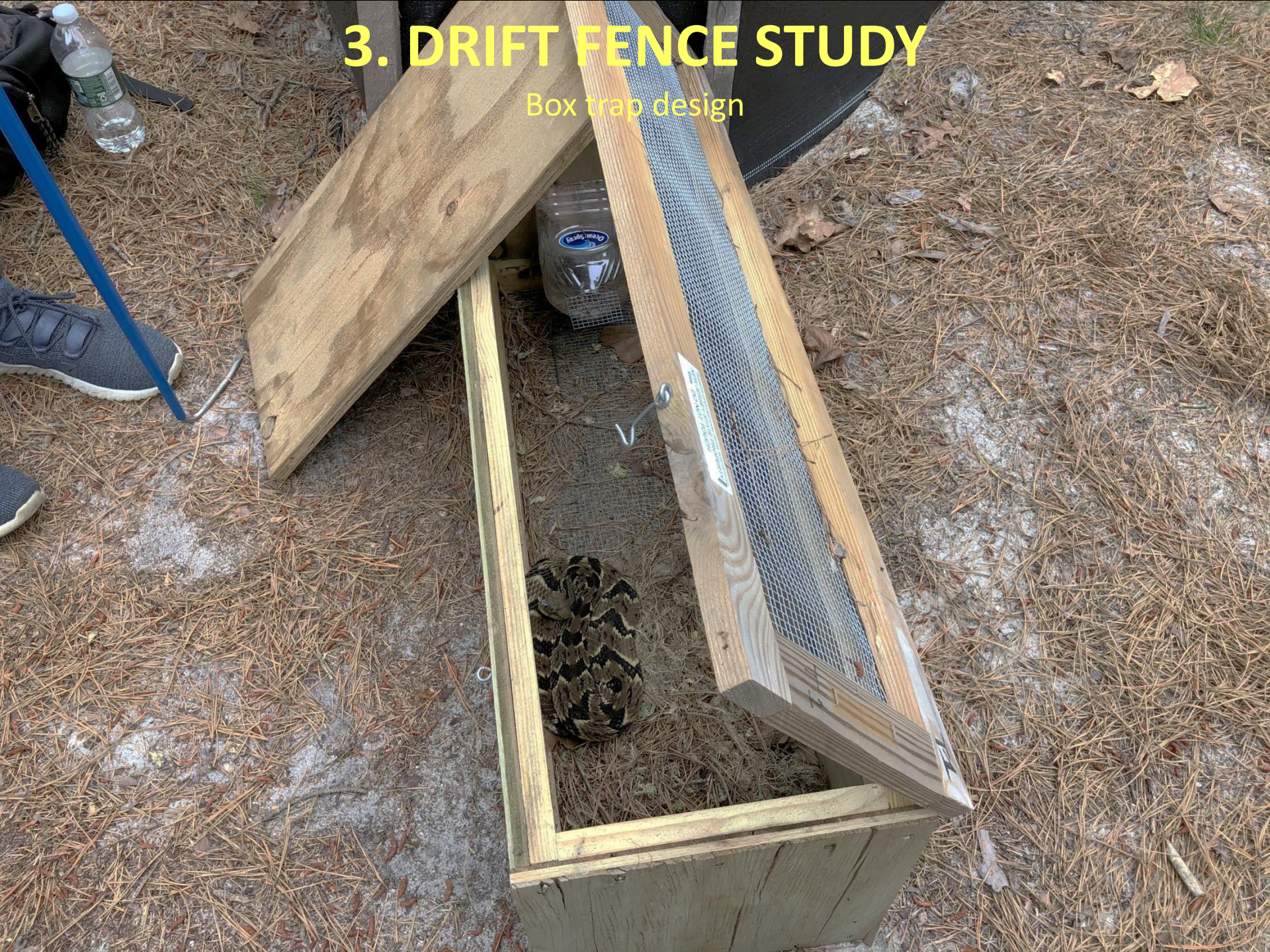
Goal: capture  
hatchlings and assess  
survey methods

# 3. DRIFT FENCE STUDY



# 3. DRIFT FENCE STUDY

Box trap design



### 3. DRIFT FENCE STUDY



Added 12 pitfall traps in 2021 and removed in early 2022

# 3. DRIFT FENCE STUDY



**PRELIMINARY  
DATA**

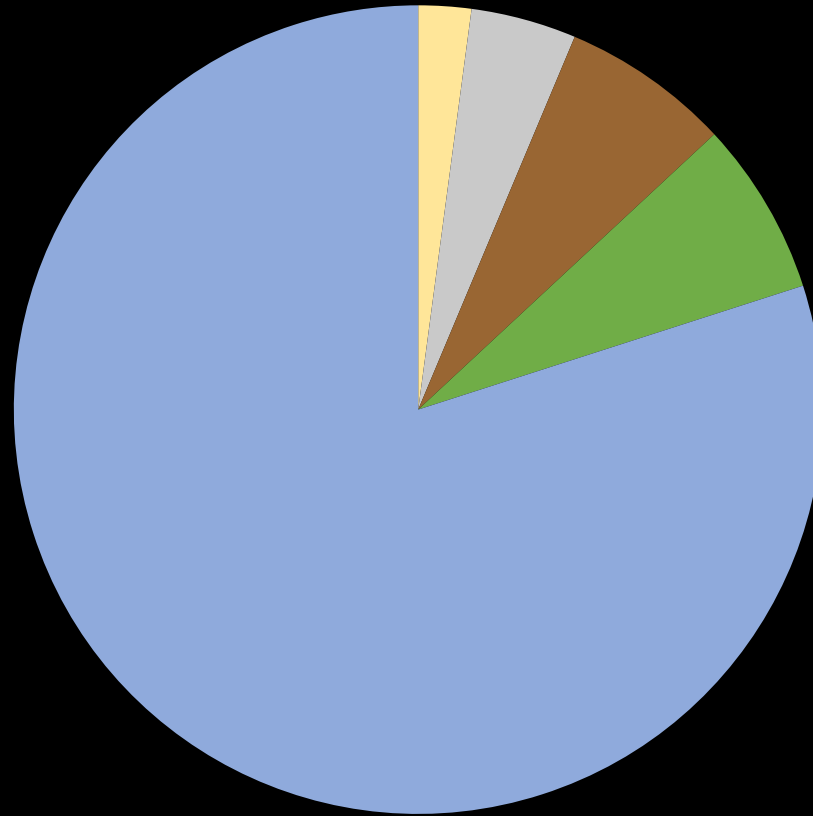
Total of 7,644  
animals

37 different  
animal species



# 3. DRIFT FENCE STUDY

Distribution of all animals observed at drift fence array



■ Pitfall ■ Metal ■ Board ■ Forest ■ Box trap

# 3. DRIFT FENCE STUDY

**DRAFT** Number of individuals observed at the drift fenced array  
 (\* = threatened species and \*\* = endangered species)

Species	Pitfall	Metal	Board	Forest	Box trap	# individuals
Eastern king snake					1	1
Northern brown snake					1	1
Northern scarlet snake					1	1
Eastern worm snake		1			2	3
Timber rattlesnake**		1			2	3
Eastern hognose snake		1		1	7	9
Northern pine snake*			1		8	9
Eastern garter snake		1		2	16	19
Northern water snake	1			1	21	23
Eastern ribbon snake	1			2	29	32
Rough green snake			1	18	23	42
Northern black racer		1	7	6	48	62
Corn snake**	4	15	22	3	23	67
Southern ringneck snake	3		1		72	76
Northern redbelly snake	1				125	126
Total # of individuals	10	20	32	33	379	474

15 species  
of snakes

### 3. DRIFT FENCE STUDY

Fence arrays with box traps can capture large and small snakes

Corn snakes can crawl over a 3-foot drift fence

No doubt pine snakes can climb over a 3-foot drift fence

Artificial cover worked well for corn snakes, but not for pine snakes

#### Recommendations

Drift fence arrays should be installed properly

Fence height should be 4-foot rather than 3-foot

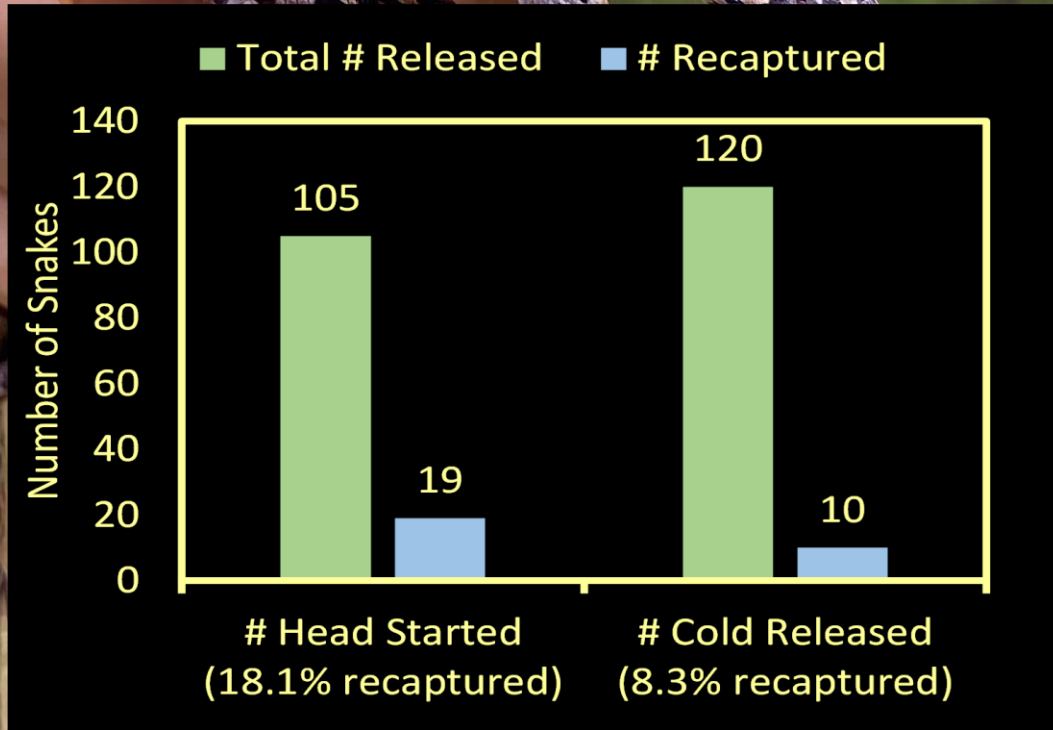
Drift fence arrays should be maintained at all times

Corn snakes should be surveyed during pine snake surveys

Cover boards should be required with drift fence surveys

Drift fences should be inspected randomly by regulators

# 3. DRIFT FENCE STUDY



# 4. LOCATE CRITICAL HABITATS

## Hibernacula

- Identify hibernacula and corral them when possible
- Snakes usually maintain fidelity to hibernacula or hibernacula cluster
- Critical habitats (dens, nests and shed sites) are often communal
- Camera monitoring network for security

## 4. LOCATE CRITICAL HABITATS

Hibernacula



Modified den  
corral for near  
roads and trails

# 4. LOCATE CRITICAL HABITATS

Shed sites



Found numerous shed stations

Many are communal shed stations

Built 2 shed tree corrals, but are removing them due to the inability to check them frequently

# 4. LOCATE CRITICAL HABITATS

Nest areas



18 corn  
snake nest  
areas  
discovered  
to date



# 4. LOCATE CRITICAL HABITATS

Nest areas

12 corn snake nest areas are communal and used by multiple snakes

# RARE SNAKE MONITORING



Little data exists on rare snake trends in the Pinelands

Corrals are a non-invasive method to census snakes

No physical disturbance to dens or hibernating snakes

# RARE SNAKE MONITORING



# RARE SNAKE MONITORING

2016 - 2023

Species	Total	Non-hatchlings	Hatchings	Recaptured
Eastern ribbon snake	1	1		
Northern water snake	1	1		
Northern scarlet snake	2	2		
Rough green snake	5	5		1
Timber rattlesnake	5	5		
Black rat snake	6	6		
Eastern garter snake	14	14		3
Eastern milk snake	19	19		4
Eastern hognose snake	86	29	57	2
Northern black racer	137	130	7	19
Eastern king snake	192	91	101	43
Northern pine snake	513	286	227	67
Corn snake	1,159	475	684	204
<b>Grand Total</b>	<b>2,140</b>	<b>1,064</b>	<b>1,076</b>	<b>343</b>

# KING SNAKE STUDY

EPA funded collaboration with PC, HA, and TCNJ

Listed as SC for threats,  
declines, unknown NJ status

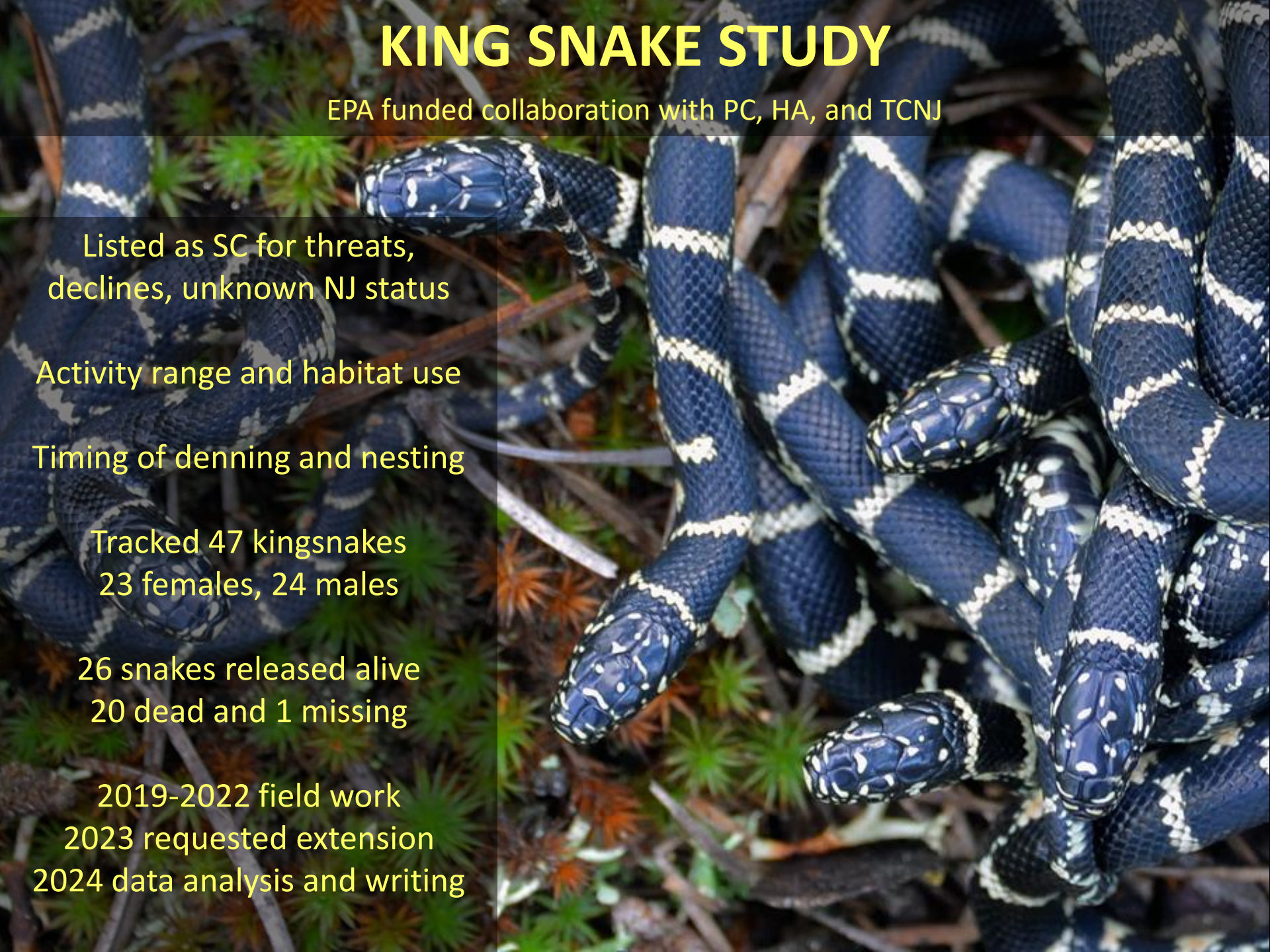
Activity range and habitat use

Timing of denning and nesting

Tracked 47 kingsnakes  
23 females, 24 males

26 snakes released alive  
20 dead and 1 missing

2019-2022 field work  
2023 requested extension  
2024 data analysis and writing



# KING SNAKE STUDY

Party Girl KS2019.06

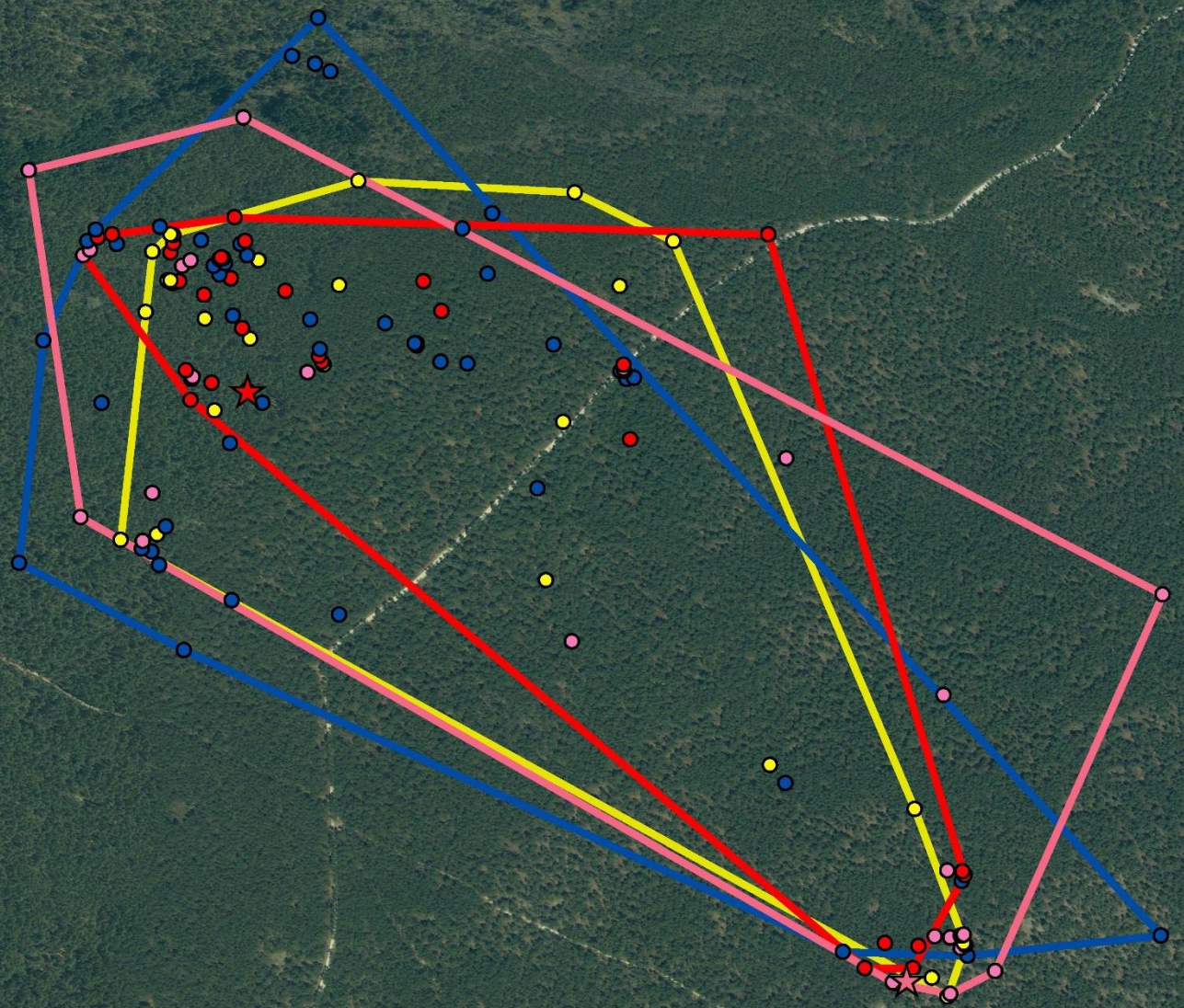
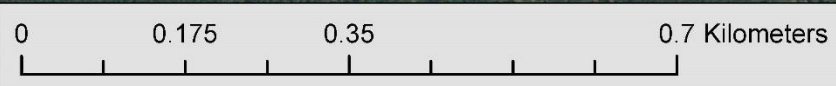
**Legend**

**Den**

- ★ 2019, 2020, 2021
- ★ 2022

**Year**

- 2019
- 2020
- 2021
- 2022



# KING SNAKE STUDY

Party Girl KS2019.06

## Legend

### Den

★ 2019, 2020, 2021

★ 2022

### Year

□ 2019

□ 2020

□ 2021

□ 2022

### LULC 2020 (NJDEP)

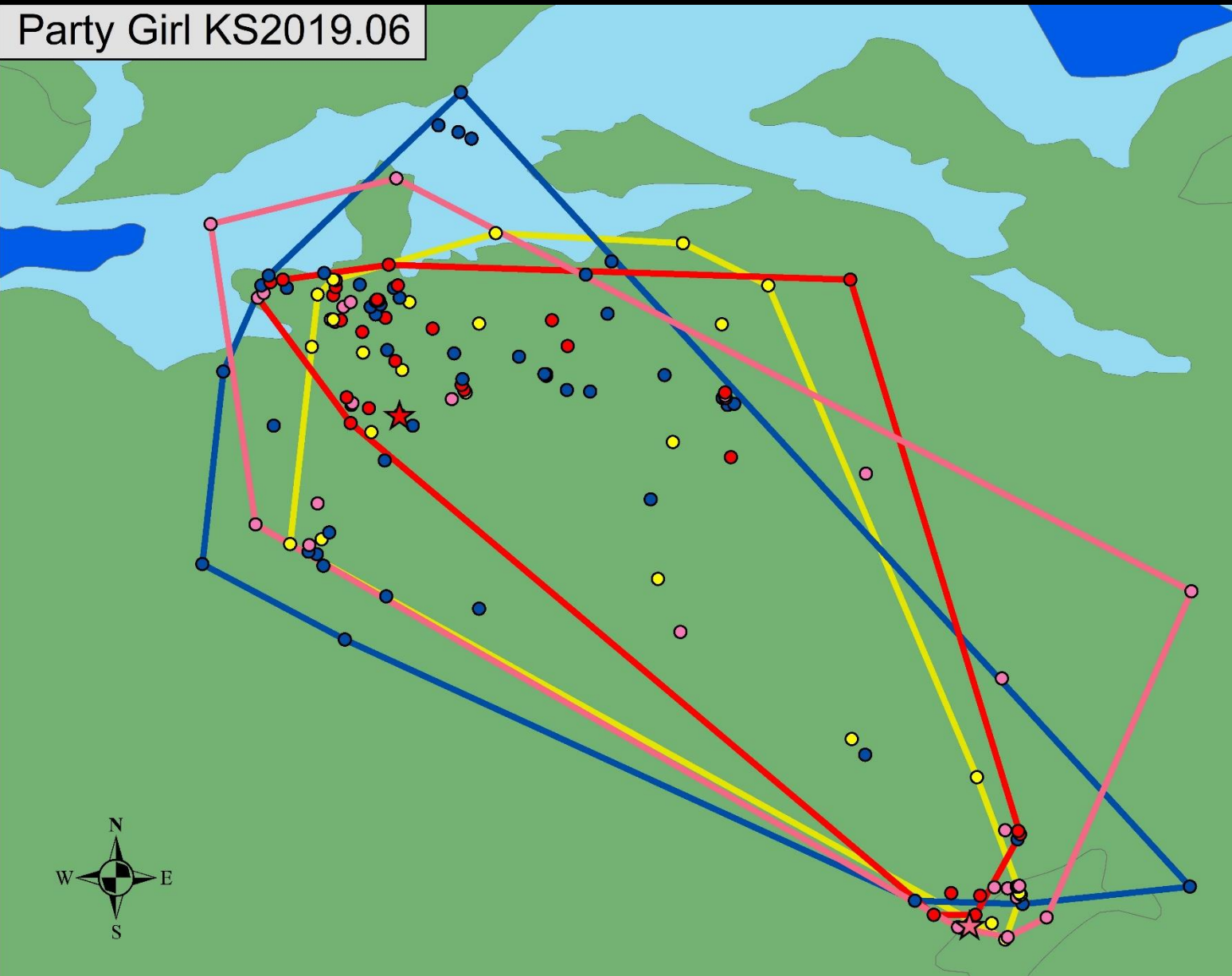
■ FOREST

■ WATER

■ WETLANDS



0 0.175 0.35 0.7 Kilometers



# KING SNAKE STUDY

Michael KS2019.08

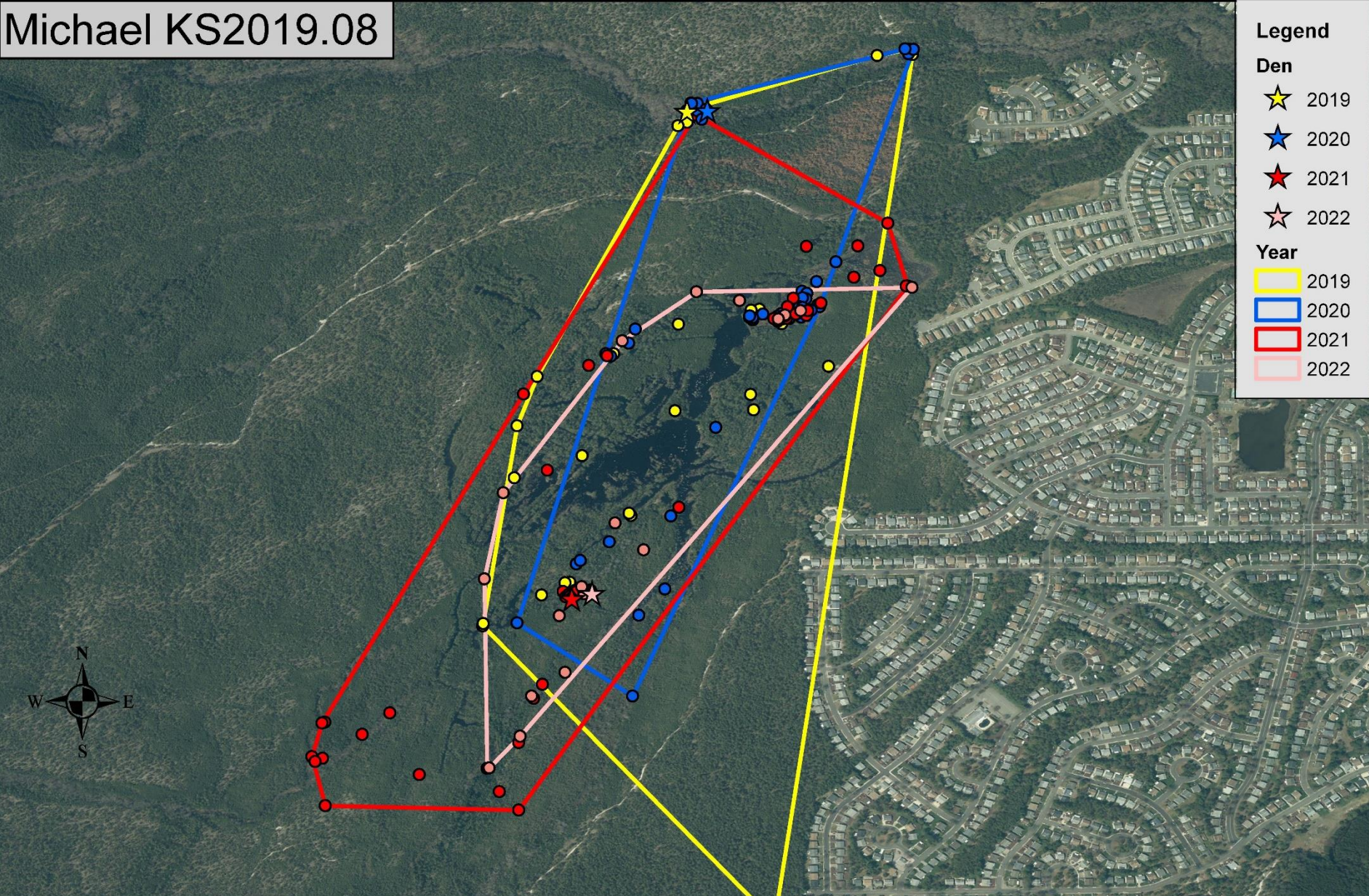
## Legend

### Den

- ★ 2019
- ★ 2020
- ★ 2021
- ★ 2022

### Year

- 2019
- 2020
- 2021
- 2022





# KING SNAKE STUDY

Michael KS2019.08

## Legend

### Den

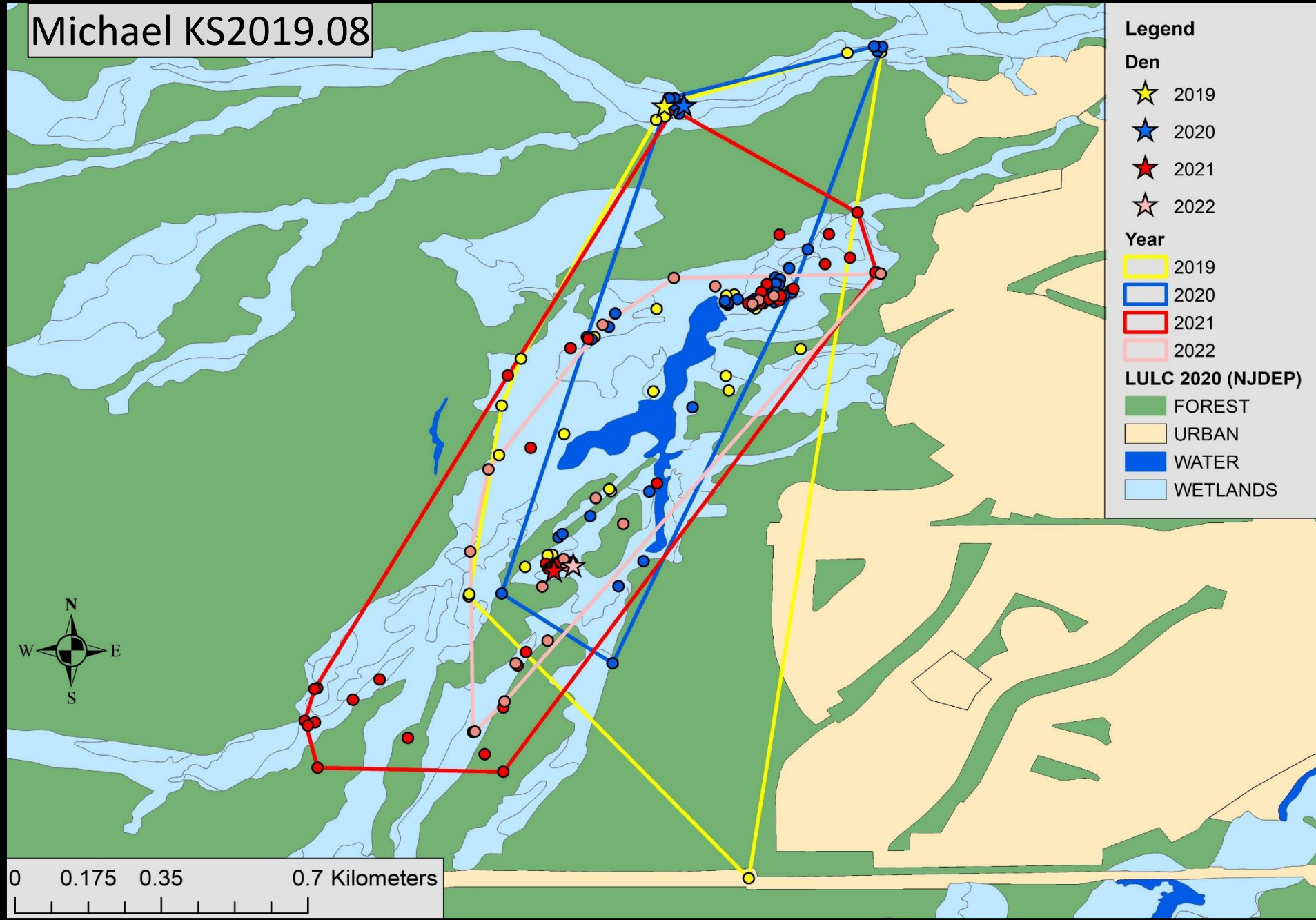
- ★ 2019
- ★ 2020
- ★ 2021
- ★ 2022

### Year

- 2019
- 2020
- 2021
- 2022

### LULC 2020 (NJDEP)

- FOREST
- URBAN
- WATER
- WETLANDS



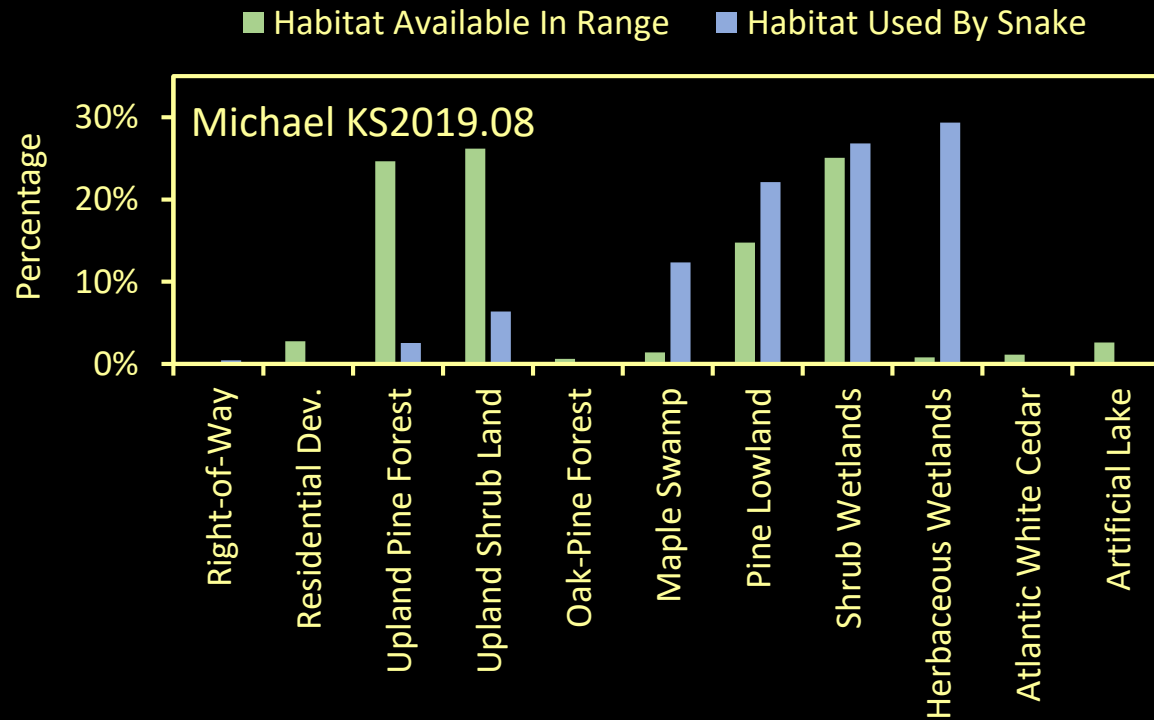
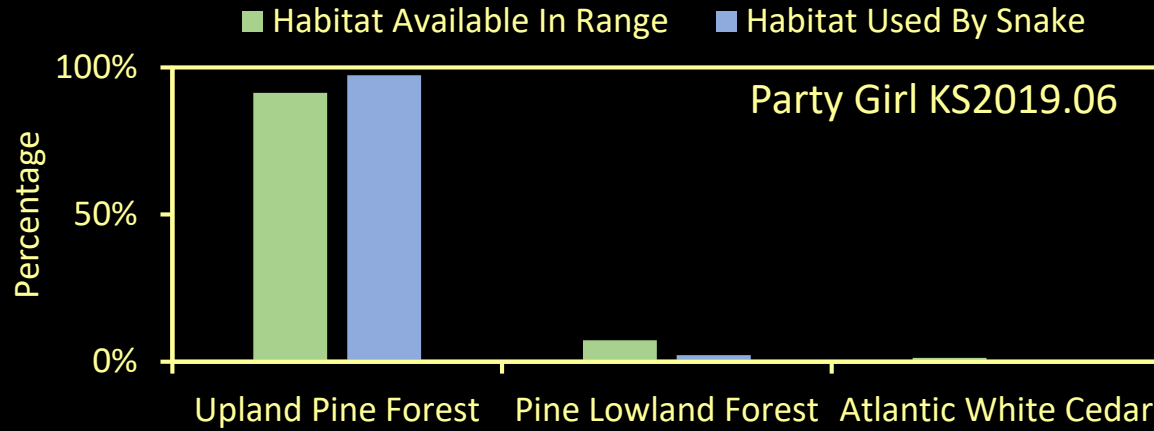
# KING SNAKE STUDY

## Telemetry statistics for 2 king snakes

### Telemetry data for Eastern King Snakes radio tracked 2019 - 2022

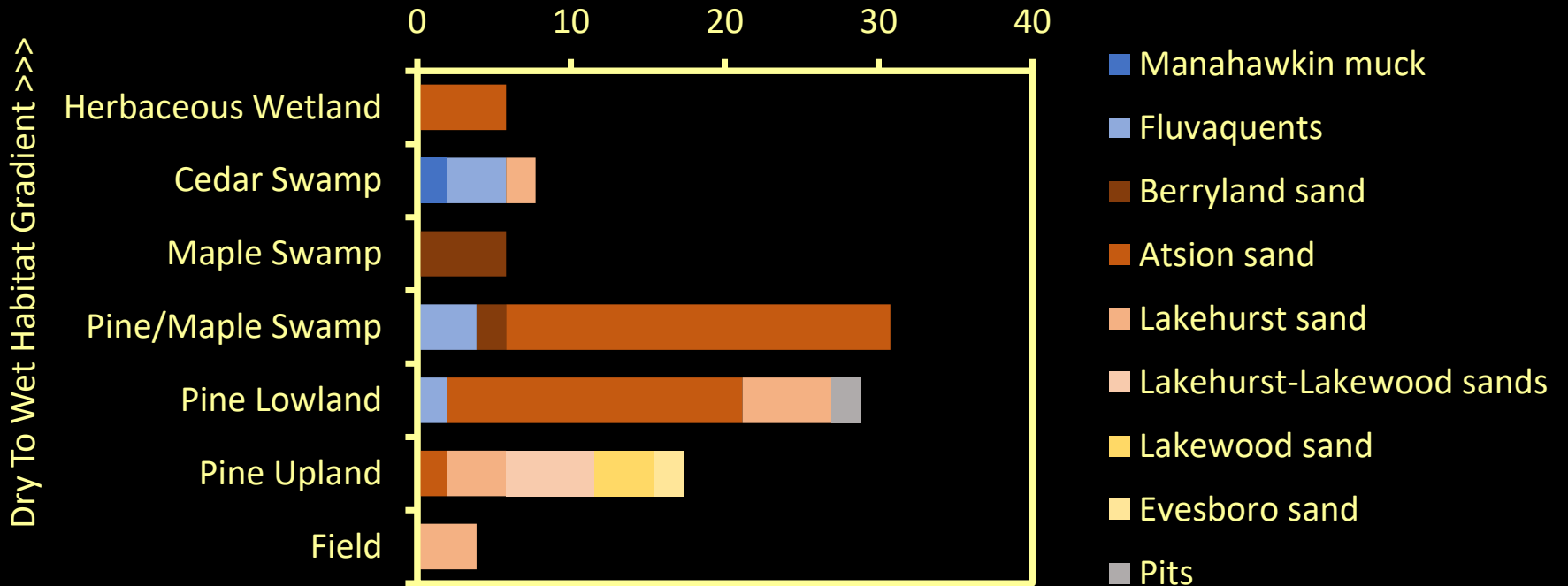
Snake Name	Sex	Year	Number of Relocations	Active Period	Days in Hibernaculum	Total Distance Traveled (mi)	Mean Dist./Day (ft)	Convex Polygon (ac)	Range Length (mi)	Max Distance from Hibernaculum (mi)
Michael	M	2019	35	6/9/19-11/4/19	180	4.4	157	213	1.25	---
		2020	65	5/2/20-10/22/20	170	6.5	197	106	0.97	0.84
		2021	86	4/10/21-11/19/21	147	6.9	163	178	1.08	1.08
		2022	48	4/15/22-11/3/22	162	5.4	142	82	0.83	0.58
Party Girl	F	2019	42	6/2/19-11/6/19	177	3.9	131	94	0.70	---
		2020	68	5/1/20-11/4/20	168	5.3	150	121	0.81	0.64
		2021	54	4/21/21-10/25/21	183	3.5	99	84	0.70	0.61
		2022	43	4/26/22-11/9/22	146	4.9	130	128	0.79	0.59

# KING SNAKE STUDY



# KING SNAKE STUDY

Percentage of 52 King Snake Hibernacula Associated with Habitat Types and Soils



# SNAKE FUNGAL DISEASE MONITORING

NPS funded ongoing environmental monitoring  
Sample for SFD in long-term pine snake dens  
Collaboration between Rutgers, HA, USGS, and PC

Emerging fungal disease in snakes

*Ophidiomyces ophiodiicola* (O.o.)

Excavating same dens for 35+ years

Opportunity to sample inside dens

2018 pilot sampling, all snakes 2019-2022

3 published studies so far

O.o. grows in den soils

Males = 82% positive

Females = 62% positive

Soil under positive snake = 70% positive

Hatchlings = 0% before 75% after hibernation

Researchers not good at predicting SFD

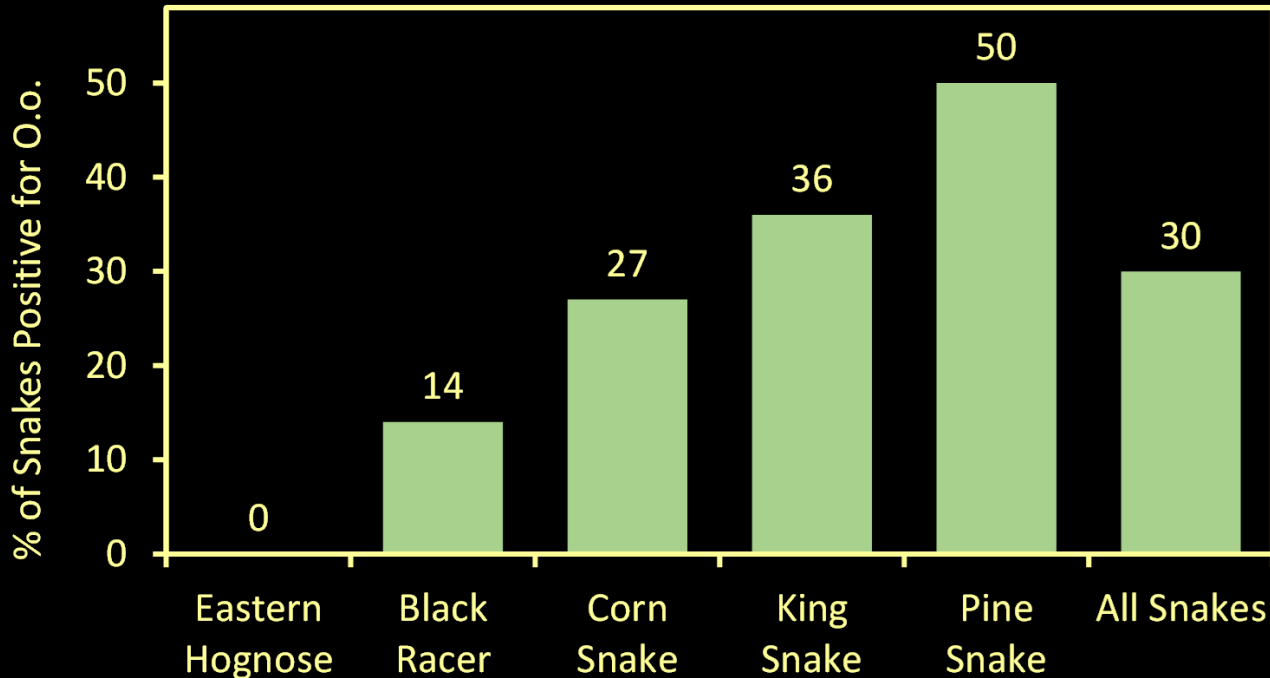
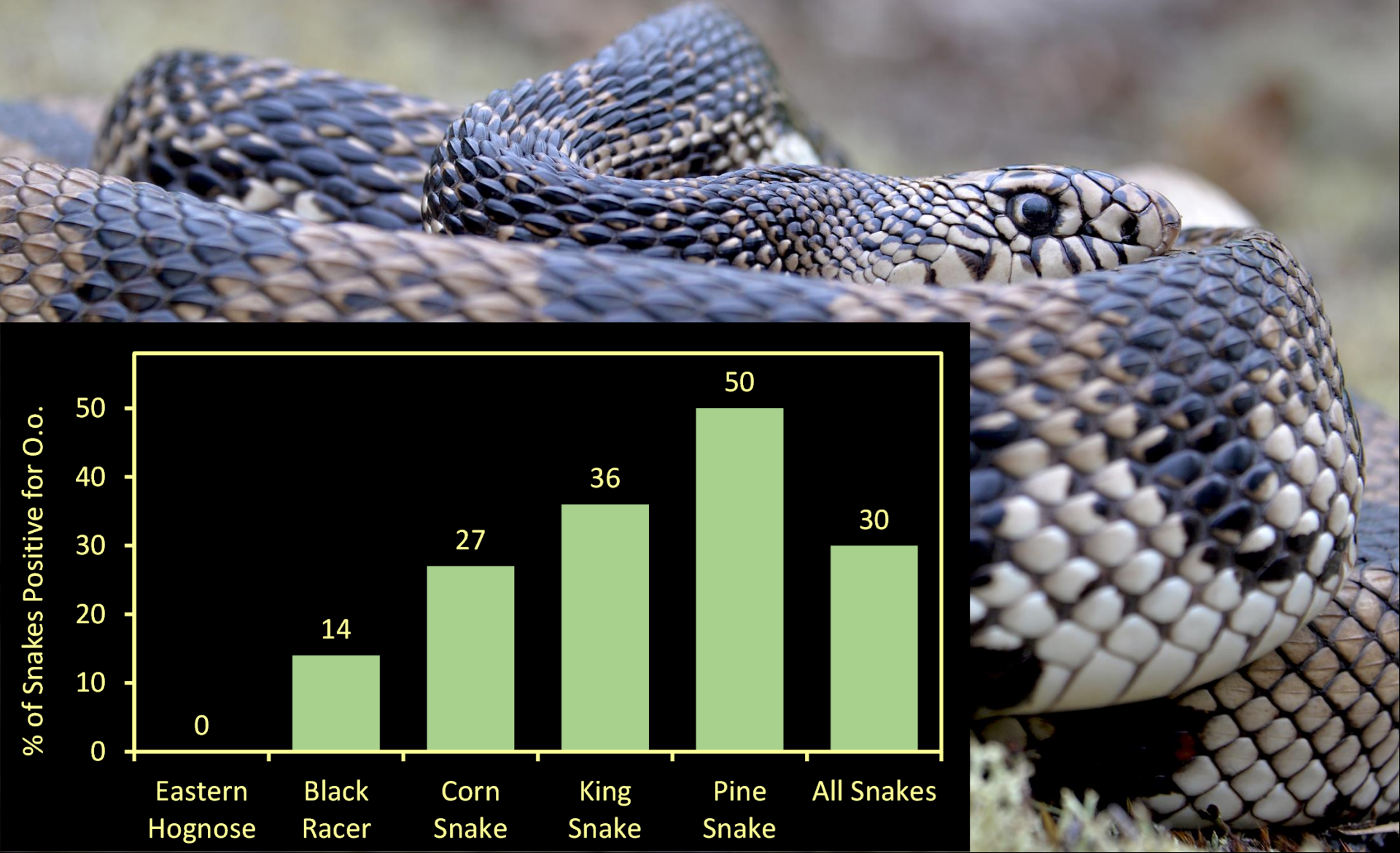
# SNAKE FUNGAL DISEASE MONITORING

NPS funded ongoing environmental monitoring  
Sample for SFD on all snakes found in 2023  
Collaboration between Virginia Tech and PC



# SNAKE FUNGAL DISEASE MONITORING

Sampled 164 snakes so far  
Results below are for the first 80 snakes sampled



# EASTERN BOX TURTLE STUDY

A close-up photograph of an Eastern Box Turtle. The turtle is the central focus, with its head and front legs visible. It has a dark, patterned shell and a head with orange and black markings. The background is a soft-focus natural setting with thin, light-colored branches and green foliage.

Listed as SC for threats,  
declines, and  
unknown NJ status

PCF & DEP funding

Activity range, behavior,  
habitat use, nesting  
sites, and dens

Monitor turtles in  
burned and unburned  
areas

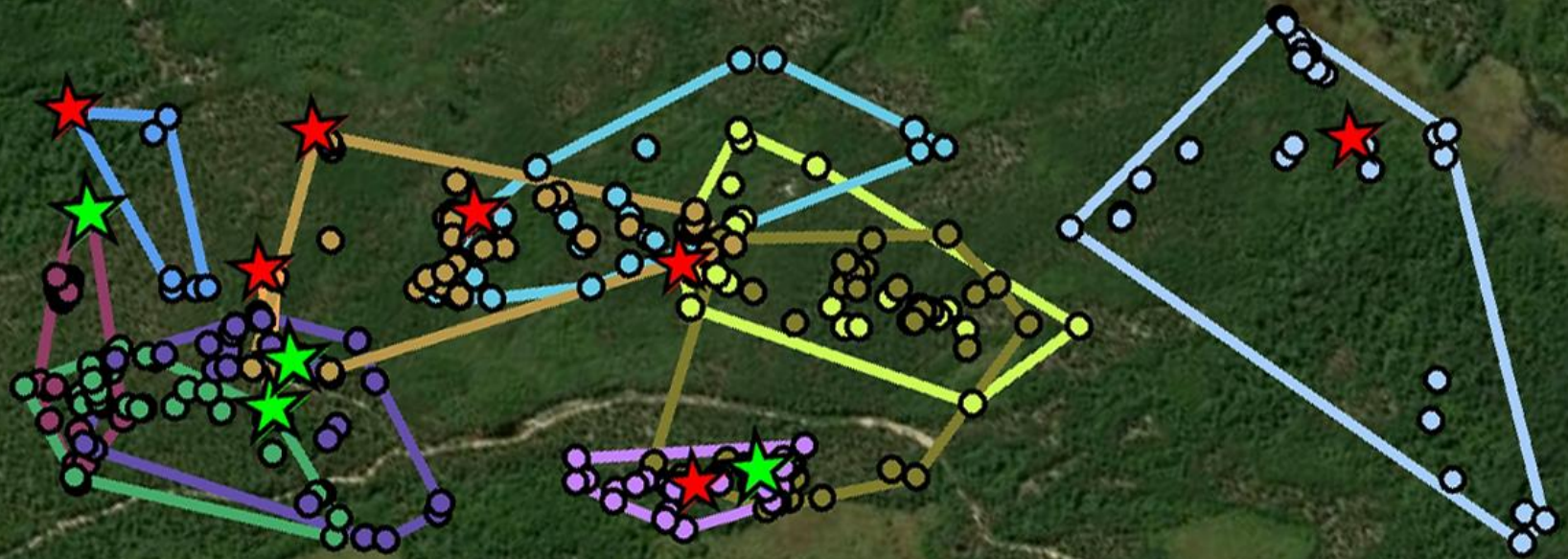
Tracked turtles  
in 2021-2023

Tracking 68 turtles  
currently



# EASTERN BOX TURTLE STUDY

Activity ranges and hibernacula for 11 radio tracked turtles  
Monitoring hibernation and emergence temperature with ibuttons



Stars = hibernacula  
Green stars = ibuttons  
Red stars = no ibutton

# NEW GRANT PROPOSAL

“Protecting Wetlands, Monitoring Climate Change, Reducing Wildfire, and Educating the Public”

Proposal to EPA in October 2023

Supposed to hear back from EPA in March 2024

## 1. Protecting Wetlands:

Use box turtle data to value uplands and wetlands in the NJDEP Landscape Project

## 2. Monitoring Climate Change:

Establish climate stations at 5 ponds where we already monitor water levels

## 3. Reducing Wildfire:

Direct prescribed burns to areas with tracked box turtles

## 4. Educating the Public:

Target disadvantaged communities for education events

QUESTIONS?

