Francis Marion National Forest

Herpetofauna Diversity and Conservation

Francis Marion National Forest

- Over 260,000 acres of diverse habitat
- 8 distinct ecotypes
  - Longleaf pine, wet pine savannas, depressional wetlands, Carolina bays, and Pocosins
- Uniquely situated in the temperate coastal plain
- Broad diversity of both plants and animals

39 species of amphibians

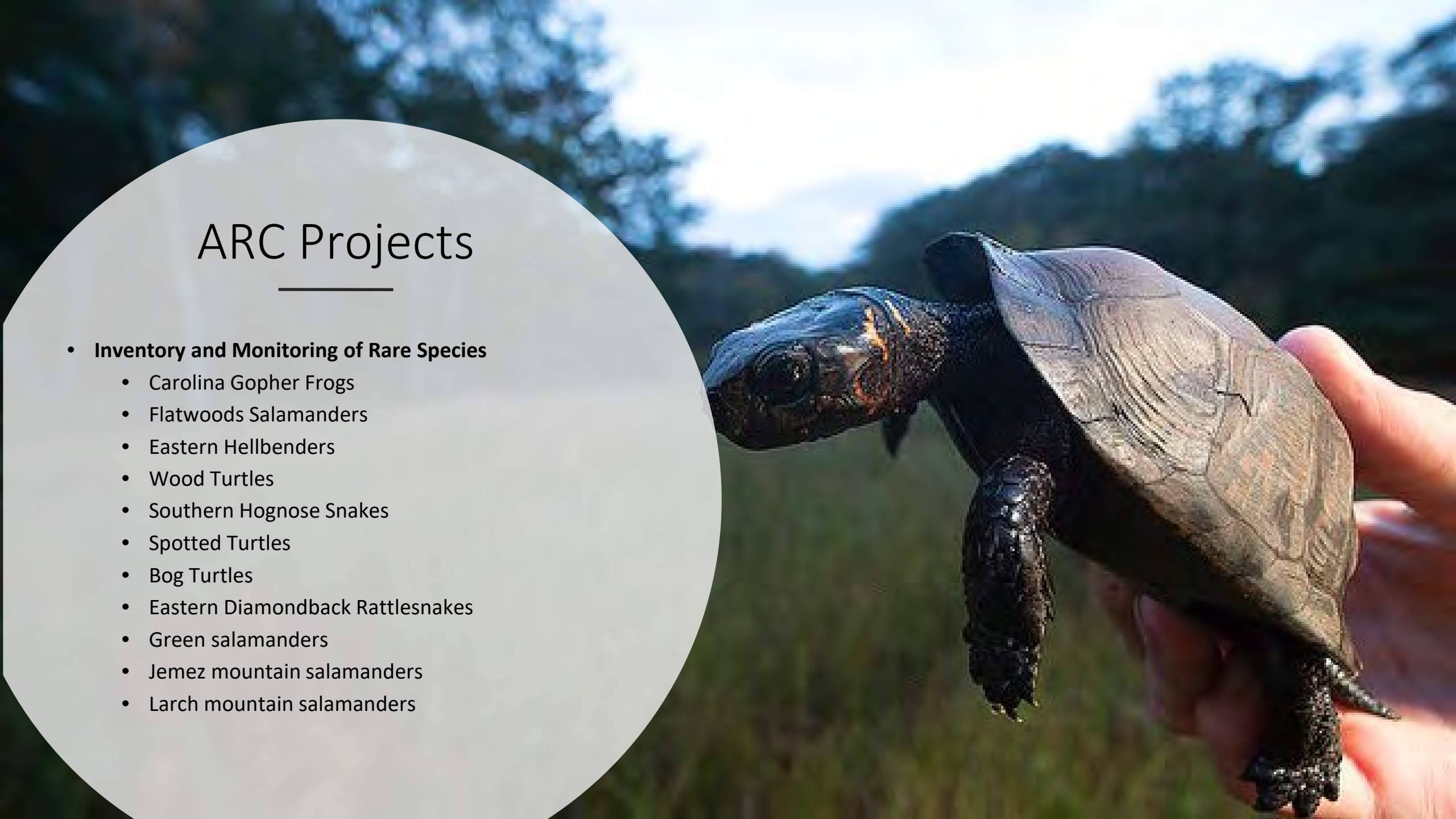
56 species of reptiles

Amphibian and Reptile Conservancy

A brief overview and introduction into ARC

ARC Projects

- **Inventory and Monitoring of Rare Species**
  - Carolina Gopher Frogs
  - Flatwoods Salamanders
  - Eastern Hellbenders
  - Wood Turtles
  - Southern Hognose Snakes
  - Spotted Turtles
  - Bog Turtles
  - Eastern Diamondback Rattlesnakes
  - Green salamanders
  - Jemez mountain salamanders
  - Larch mountain salamanders




FRANCIS MARION
National
Forest

Gopher Frog Life History

- Adults live mostly underground (hence the name)
- Emerge at night to feed on a variety of invertebrates and other frogs and toads
- Breeding occurs at night during or after heavy rainfall (late winter/early spring, sometimes fall)
- Mating call is a vibrating, deep, guttural snore

- Females attach a large egg mass to a rigid support of vegetation
- Contains ~1,200-2,500 eggs (up to 6,000)
- Tadpole stage lasts from 3 to 7 months
- May-July juvenile frogs disperse into drier uplands
- 2 years are required to attain minimum size for sexual maturity
- Can live up to 6 or 7 years

Habitat and Range

- Closely associated with underground refugia
- Fire-maintained habitats with open canopy
- Xeric uplands with sandy substrates
- Seasonal, isolated wetlands without predatory fish
- Open-canopied ponds with emergent graminaceous vegetation

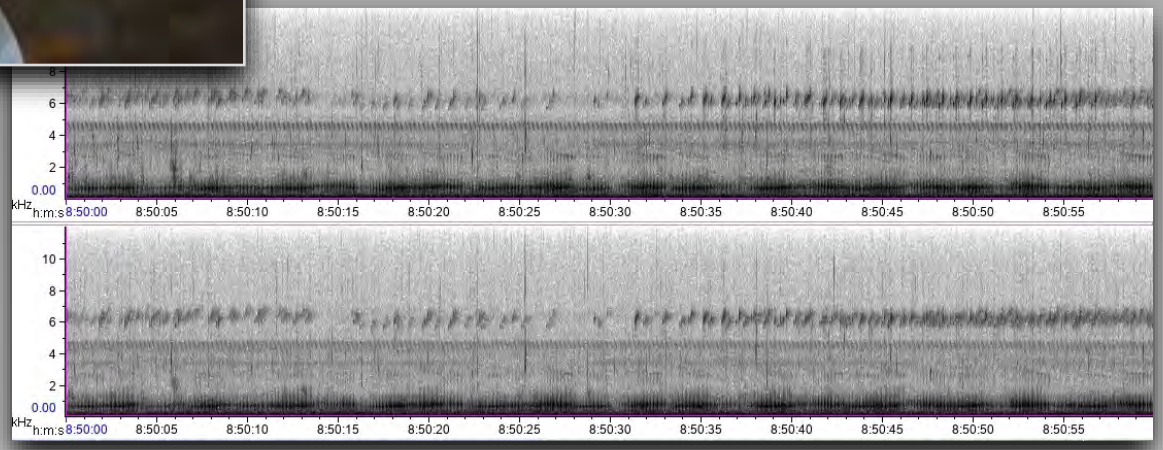
Status and Threats

- South Carolina - Listed as endangered
- USFWS currently reviewing status
- Population estimates suggest less than 10,000 individuals remain in the wild.
- Only a few known occurrences in SC
- Main threat is destruction of habitat, especially breeding ponds
- Exclusion and suppression of fire from wetlands degrades the quality of breeding ponds
- Reduced gopher tortoise populations

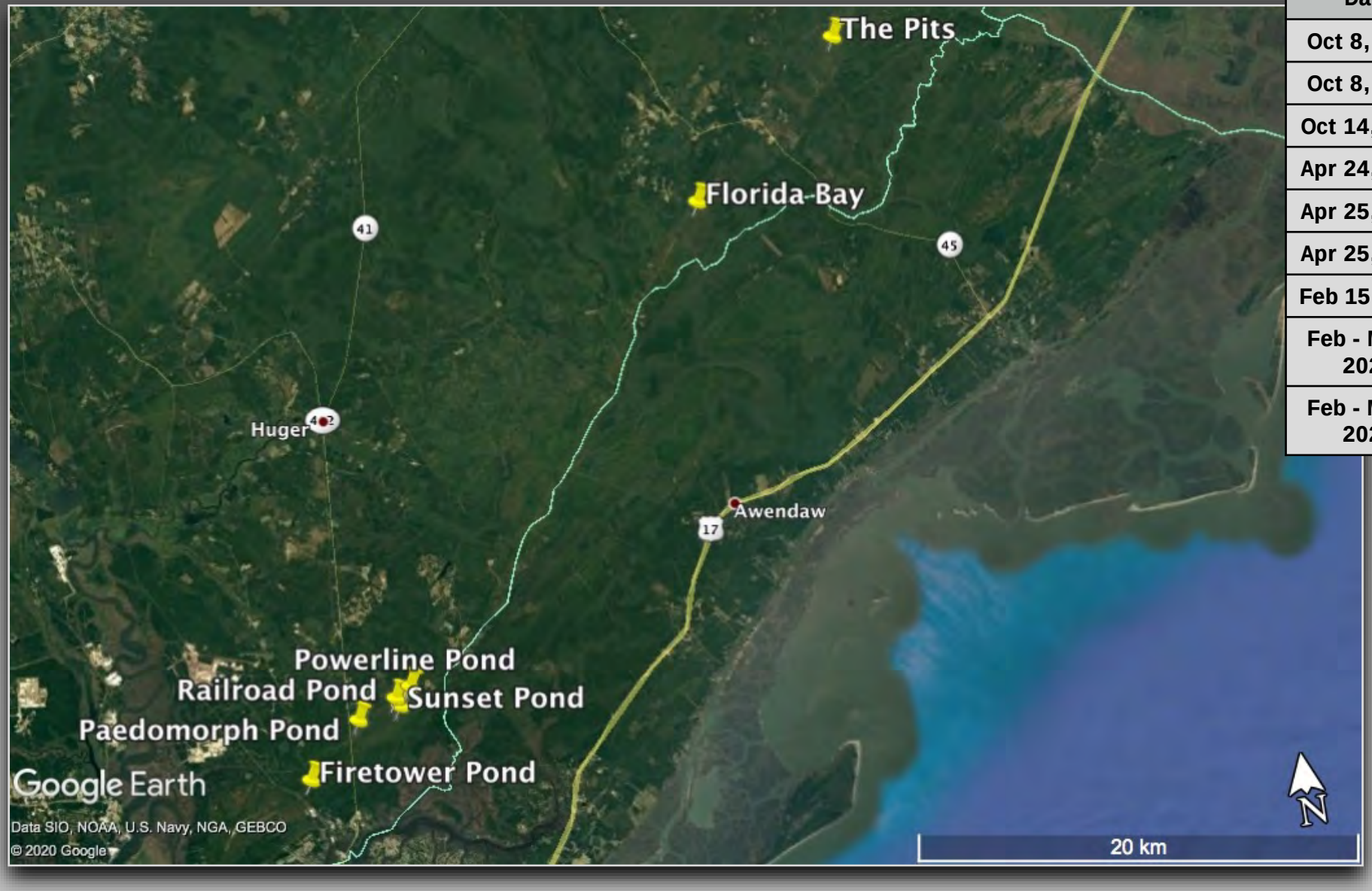
Conservation Efforts

Monitoring FMNF

- Call surveys, audio recorders (“frogloggers”)
- eDNA sampling
- Egg mass searches



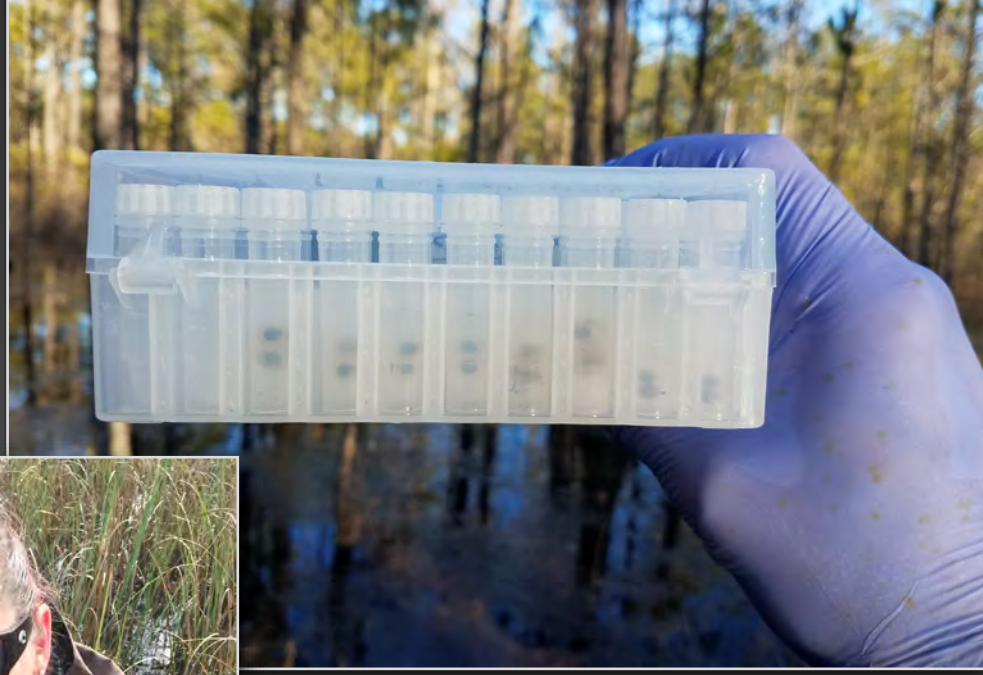
Locations of Ponds Where Gopher Frogs Have Been Detected



Total Egg Masses Detected		
Date	**Location**	**Total Egg Masses**
Oct 8, 2015	**Sunset Pond**	45
Oct 8, 2015	**Railroad Pond**	25
Oct 14, 2016	**Sunset Pond**	17
Apr 24, 2017	**Sunset Pond**	7
Apr 25, 2018	**Sunset Pond**	21
Apr 25, 2018	**Railroad Pond**	3
Feb 15, 2019	**Sunset Pond**	5
Feb - March 2021	**Sunset Pond**	41
Feb - March 2021	**Firetower Pond**	7

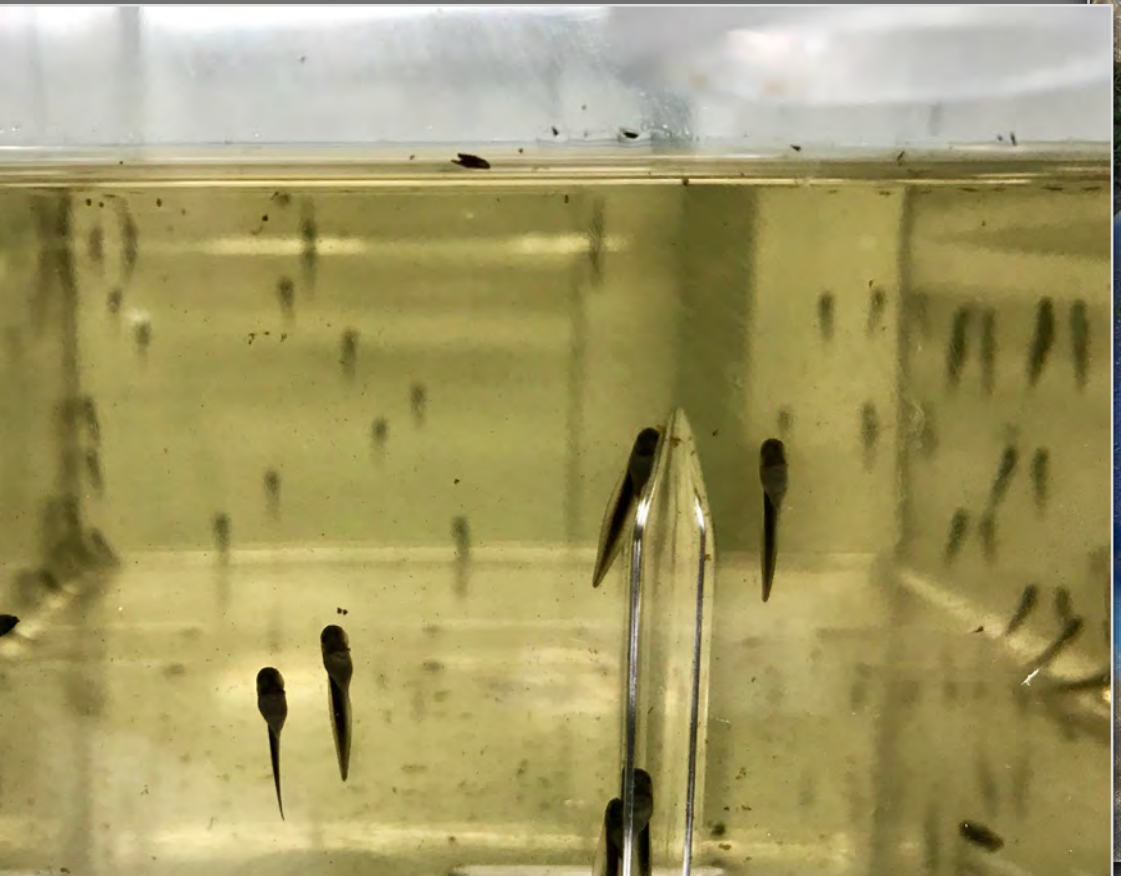
Population Management

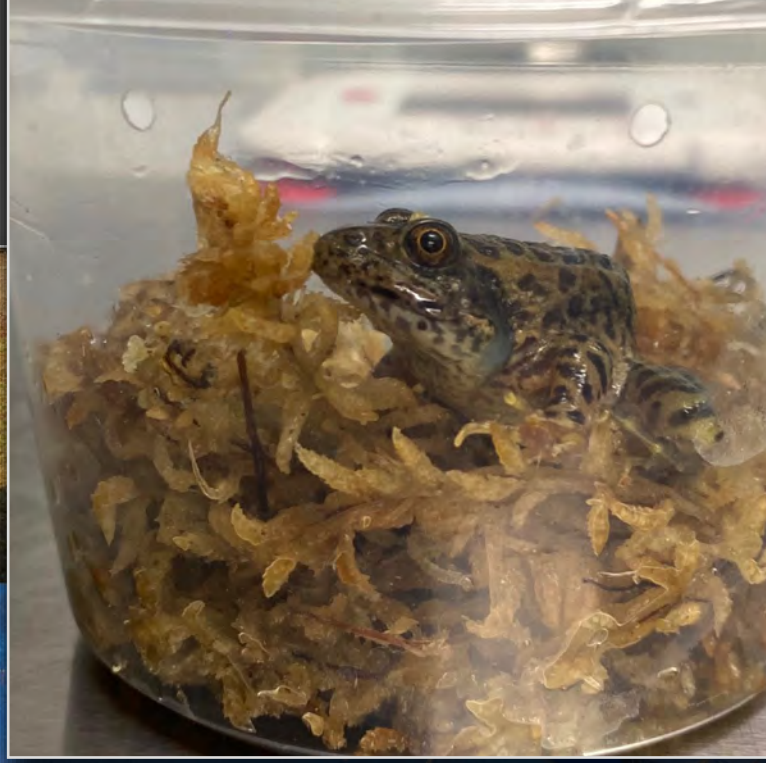
- Two eggs collected from every mass (genetic ID and DNA banking)
- Small portions of egg masses collected for head-starting



Bears Bluff Fish Hatchery

- Hatch tadpoles from eggs
- Raise tadpoles in mesocosms
- Collect and release froglets





Frogs Released

- 2019 - 243
- 2021 - 483

Looking Forward

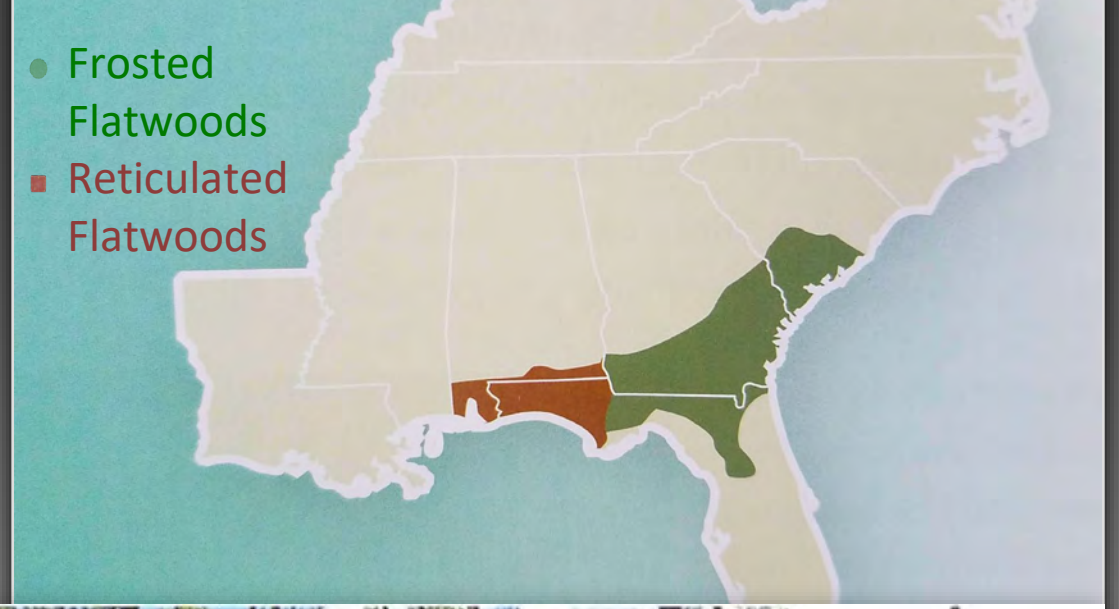
- Continue monitoring
- Enlarge head-starting program
- Improve and restore habitat

Frosted Flatwoods Salamander Life History

- Adults are terrestrial and live underground
- Breed in isolated ephemeral ponds
- Lay eggs in the dry pond basin and leave them
- Hatching occurs when rains inundate the eggs
- Unknown longevity, but sexually mature at 2 years

Habitat and Range

- Endemic to the lower Gulf and Atlantic coastal plains
- Occur in longleaf pine-wiregrass flatwoods and savannas
- Non-breeding sites are heavily fire-dependent



Status and Threats

- Listed as threatened under the Endangered Species Act
- Only at a small minority of formerly inhabited sites
- Many populations supported by a single breeding site
- At imminent risk of extinction in the next 5-10 years
- Small and localized surviving populations makes them highly vulnerable to habitat destruction, deterioration, and fragmentation
- Drought years exacerbate declines

Conservation Efforts

- Nocturnal breeding movement searches
- Diurnal searches for eggs
- Trapping and dipnetting for larvae at historically documented ponds
- eDNA sampling at historically documented ponds

- Despite substantial efforts, frosted flatwoods salamanders have not been detected
- Survey efforts will continue
- Many years may pass between detections
- Sampling conditions (e.g., water depth) since 2015 have seldom been ideal
- But the possibility of local extinction cannot be dismissed
- Habitat improvement/restoration is being implemented
- Captive reproduction efforts suggest the possibility of eventual reintroduction

Eastern Diamondback Rattlesnake Life History

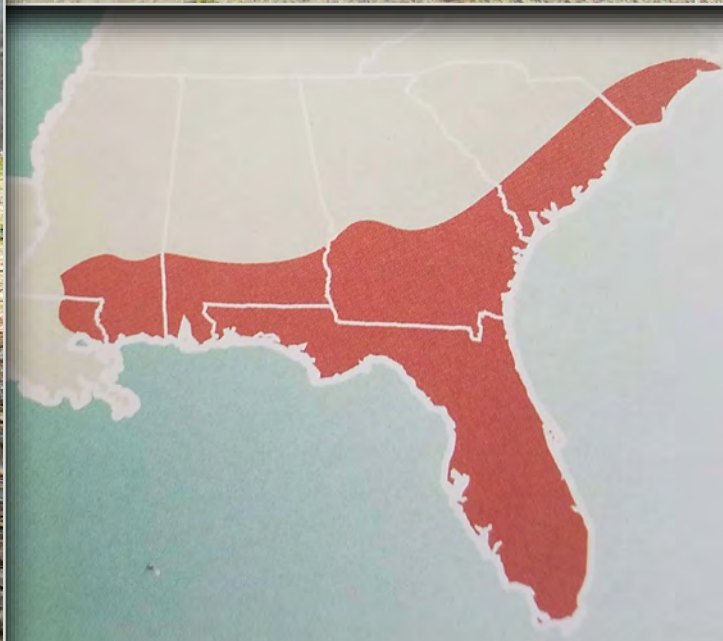
- Largest rattlesnake in the world
- <10 bites/year
- Ambushes prey (mostly rats and rabbits)
- Live 10-20 years

- Sexual maturity at 2-4 years
- Mating occurs in late summer/early fall
- One of the largest home ranges of any U.S. snake

- Males fight for territory rights in a "combat dance"
- Ovoviviparous (carry eggs inside their body)
- Don’t reproduce annually (~2-4 year intervals)
- 7-21 young

Habitat and Range

- Inhabit a variety of coastal plain habitat types
- Require large tracts of open-canopy habitats
- Shelters from fire and cold are important microhabitats
- Excellent swimmers, sometimes spotted miles from land



Status and Threats

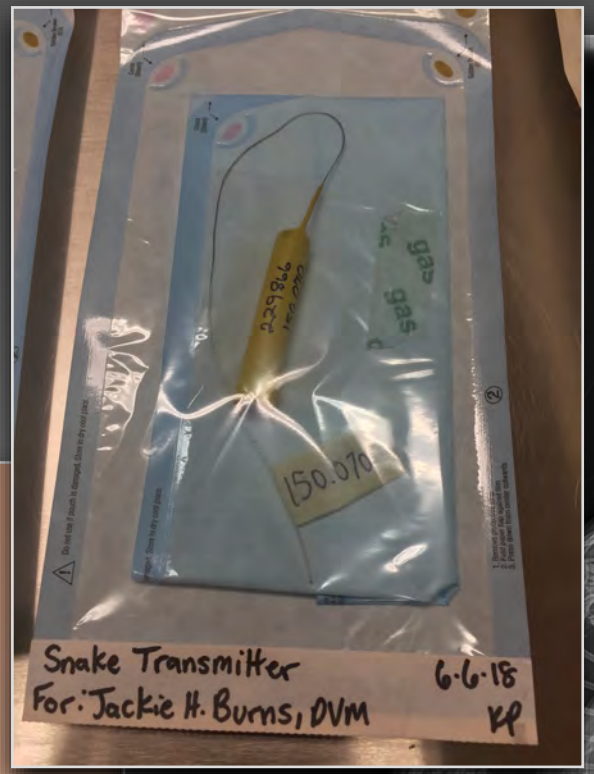
- Species of Concern in South Carolina
- Many populations are fragmented and/or extirpated
- Life history traits increase vulnerability
- Primary threat is habitat fragmentation and loss
- Mortality from automobiles
- Human persecution

Conservation Efforts

- Visual Encounter Surveys
- Burn searches during spring emergence
- Radio Telemetry
- Opportunistic (Road cruising, etc.)

- Morphometric data is recorded from captured snakes, DNA collected
- PIT tags inserted for mark-recapture
- Priority individuals receive radio transmitters

- Snakes of appropriate size and healthy body condition receive implant transmitters
- Surgeries performed only from May to September
- Implants have ~2 year battery life and long range



- Implant vs. external transmitters
- External “tie-ons” can be put on almost any snake
- Minimal animal stress
- Shorter battery life and smaller range
- Rattles sometimes come off

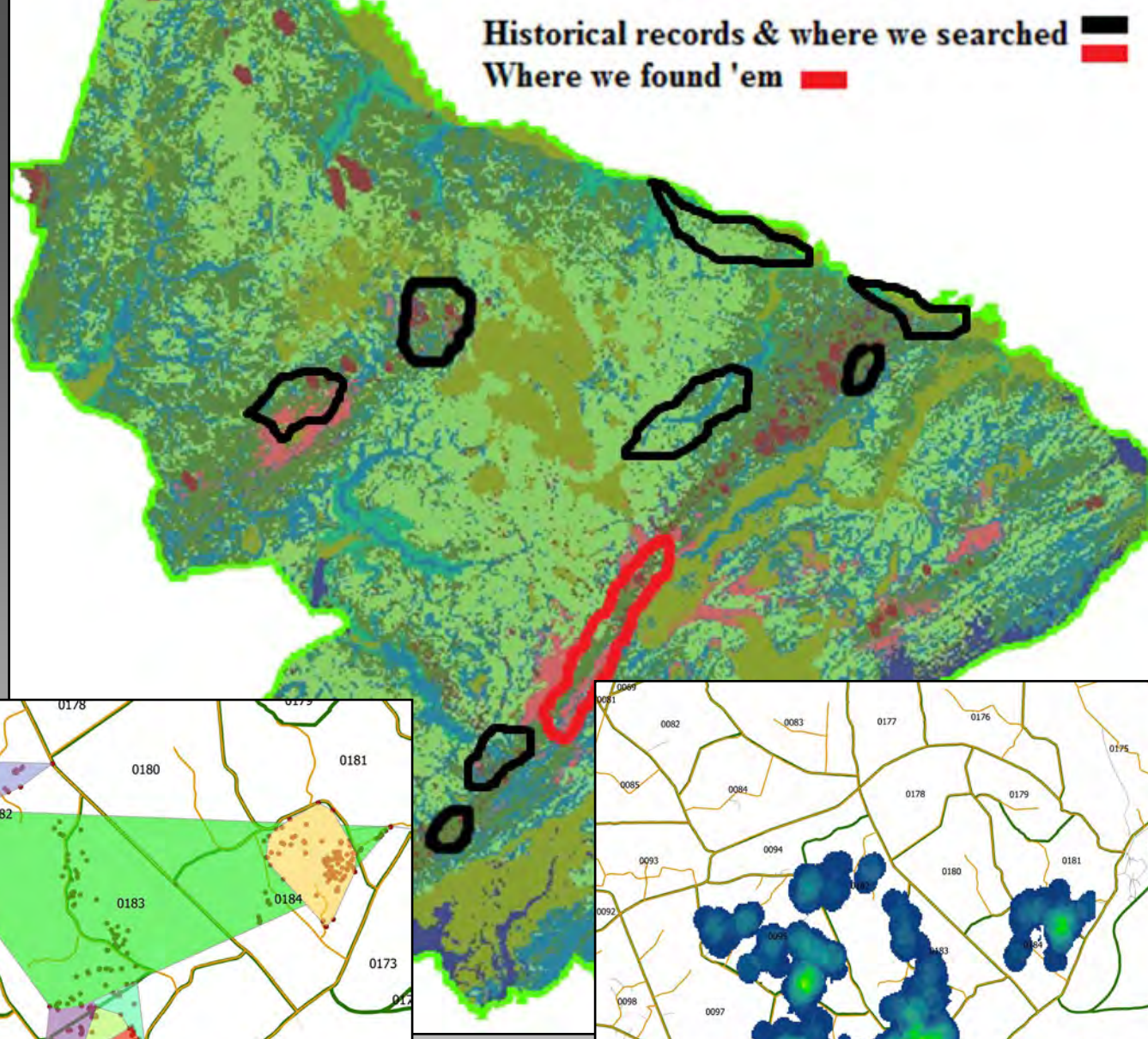
Radio-tagged snakes

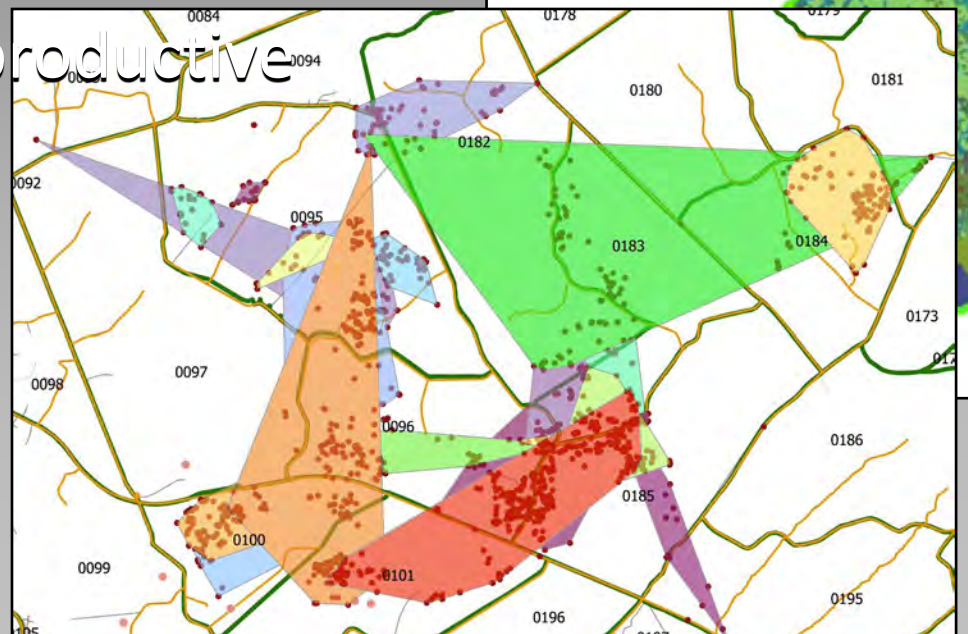
- Over 1,700 GPS locations from almost 60 EDBs—including ~40 radio-tracked individuals
- Behavior and habitat use noted
- Body conditions assessed

Status and Distribution

- Likely one remaining population
- No detections in over 15,000 search-hours in historic areas
- Fecundity and mortality remain poorly understood
- Many EDBs show poor body condition
- Low rate of female reproductive years

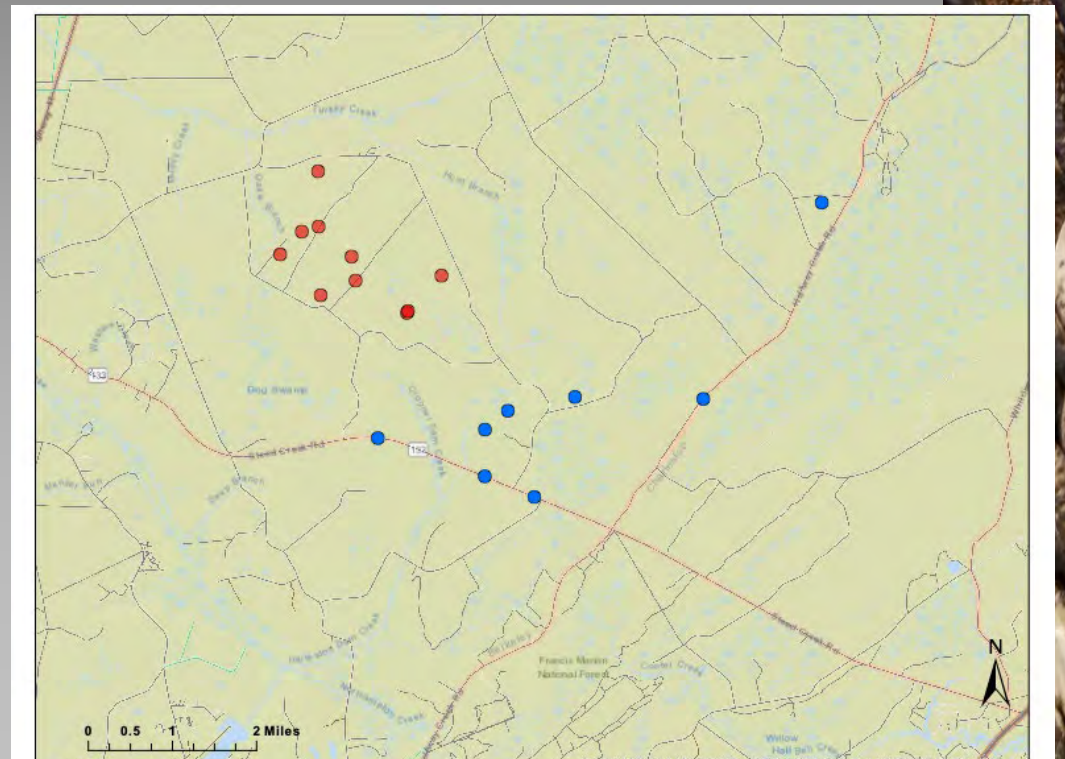
- Tentative models suggest remaining "core" population is unsustainable

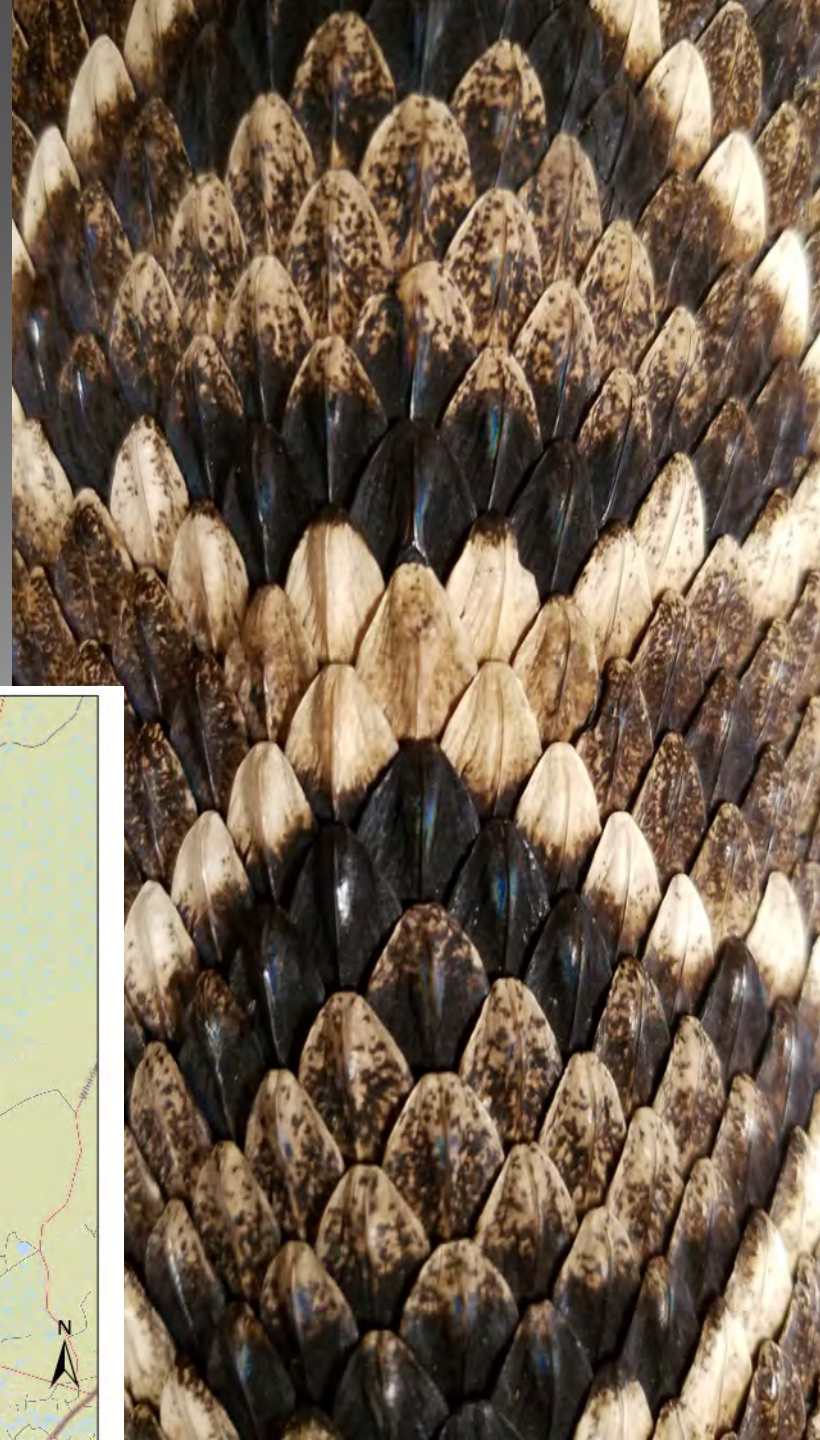




Genetic Analyses

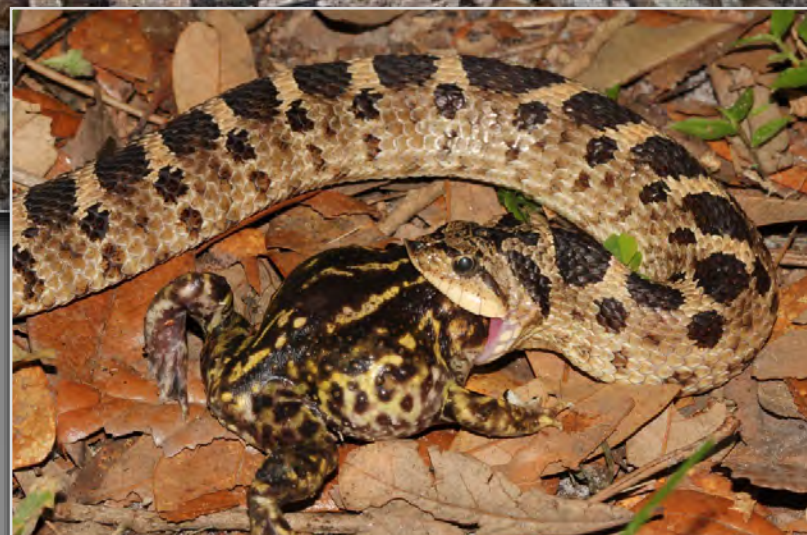
- Assess the genetic structure of EDBs in FMNF
- Assess the population genetic parameters
- 31 individuals were sequenced
- Distinct NW and SE populations
- Both populations show high levels of inbreeding
- What are the effects?
- Decreased juvenile survivorship-population persistence, and lower fecundity
- How to proceed?





Southern Hognose Snake Life History

- Highly fossorial
- Preys on toads and lizards
- Interesting defense mechanism
- Mate in spring
- Clutches of 6-14 eggs laid in fall
- Feed extensively in fall as they prepare for winter

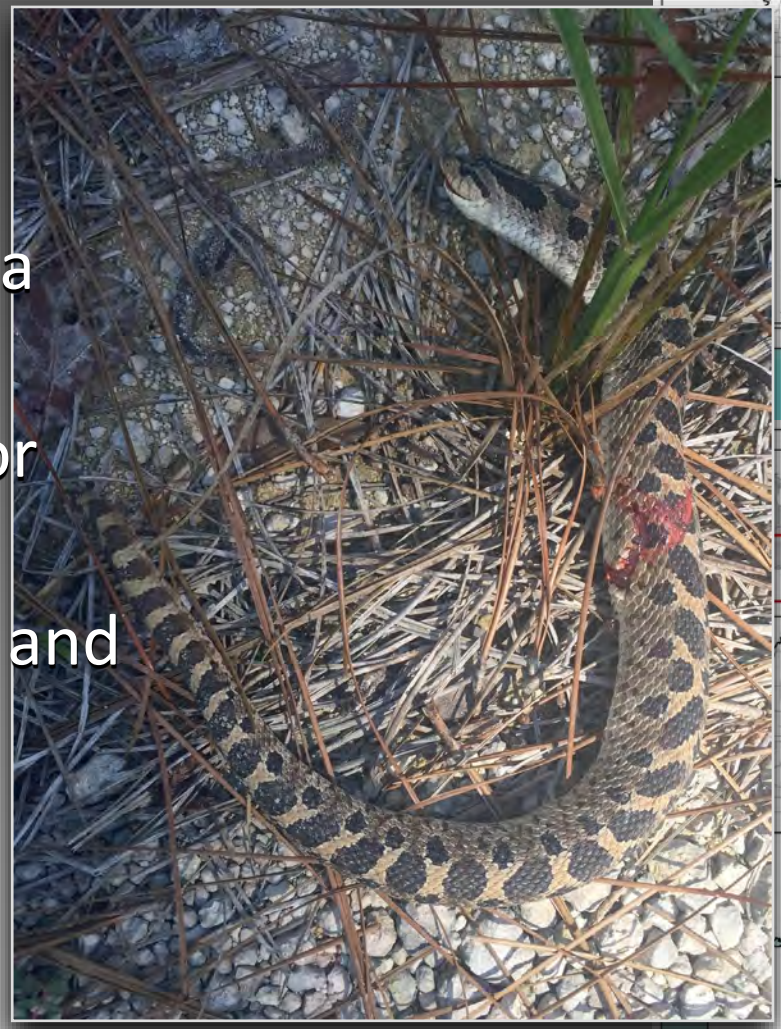


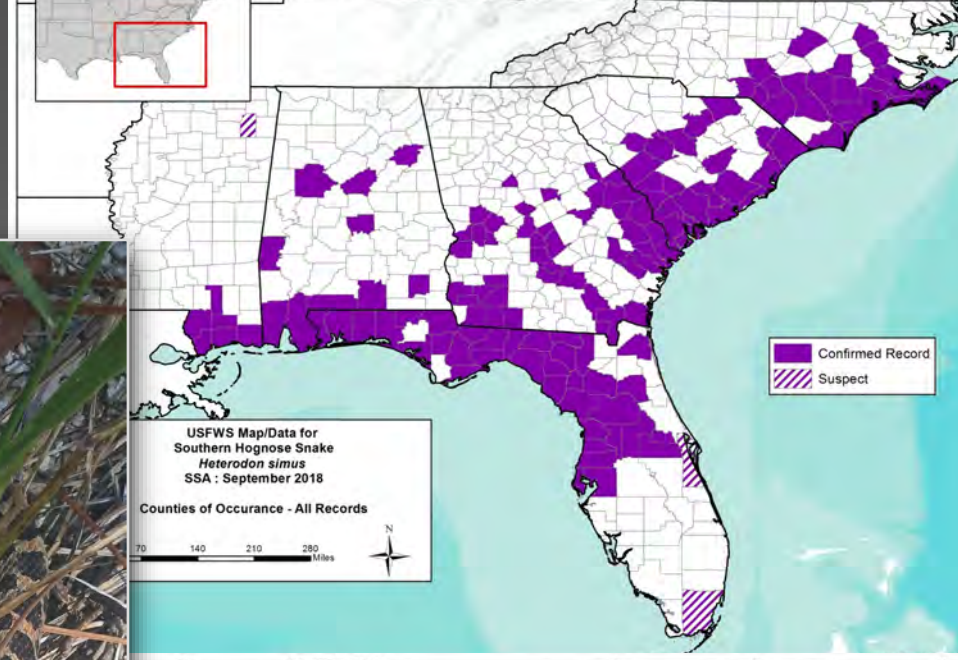
Habitat and Range

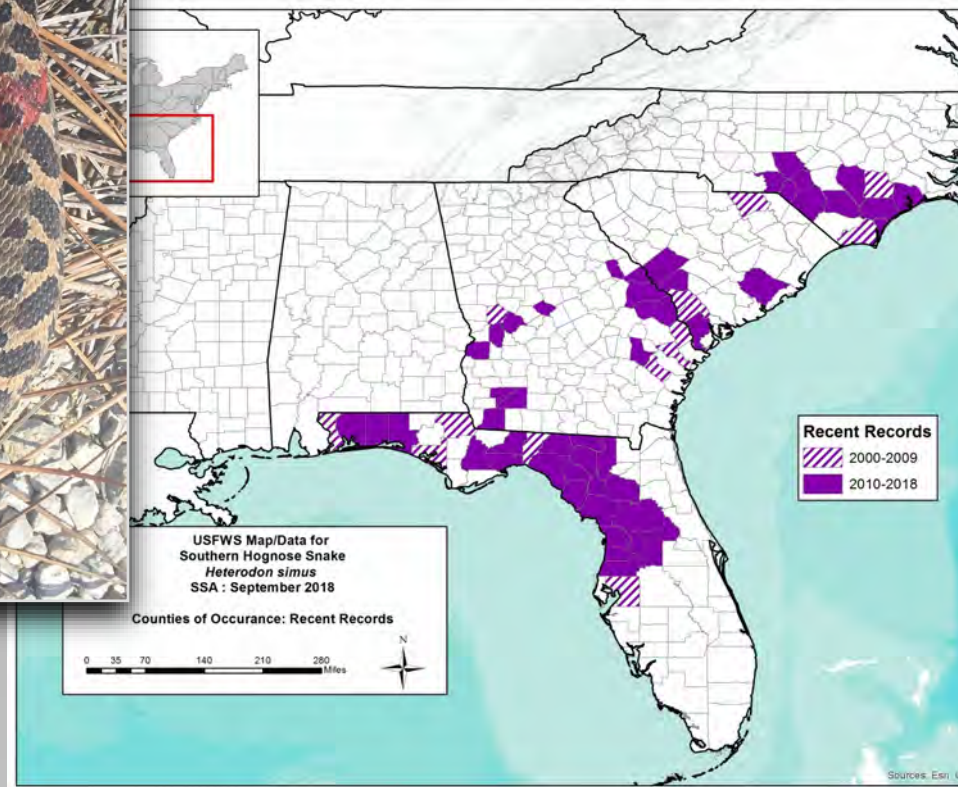
- Needs very dry upland habitat with well-drained, sandy soils
- Open canopy with a grassy understory
- Do not depend on underground refugia
- Historically found in the Coastal Plain from southern North Carolin to southern Mississippi
- Now only found in scattered locations in South Carolina, North Carolina, Georgia, and Florida.

Status and Threats

- Are of conservation concern throughout their range
- USFWS currently conducting a Species Status Assessment
- Not been found in Alabama or Mississippi since the 1970's
- Primary threat is habitat loss and fragmentation
- Road mortality
- Invasive fire ants
- Collection for pet trade

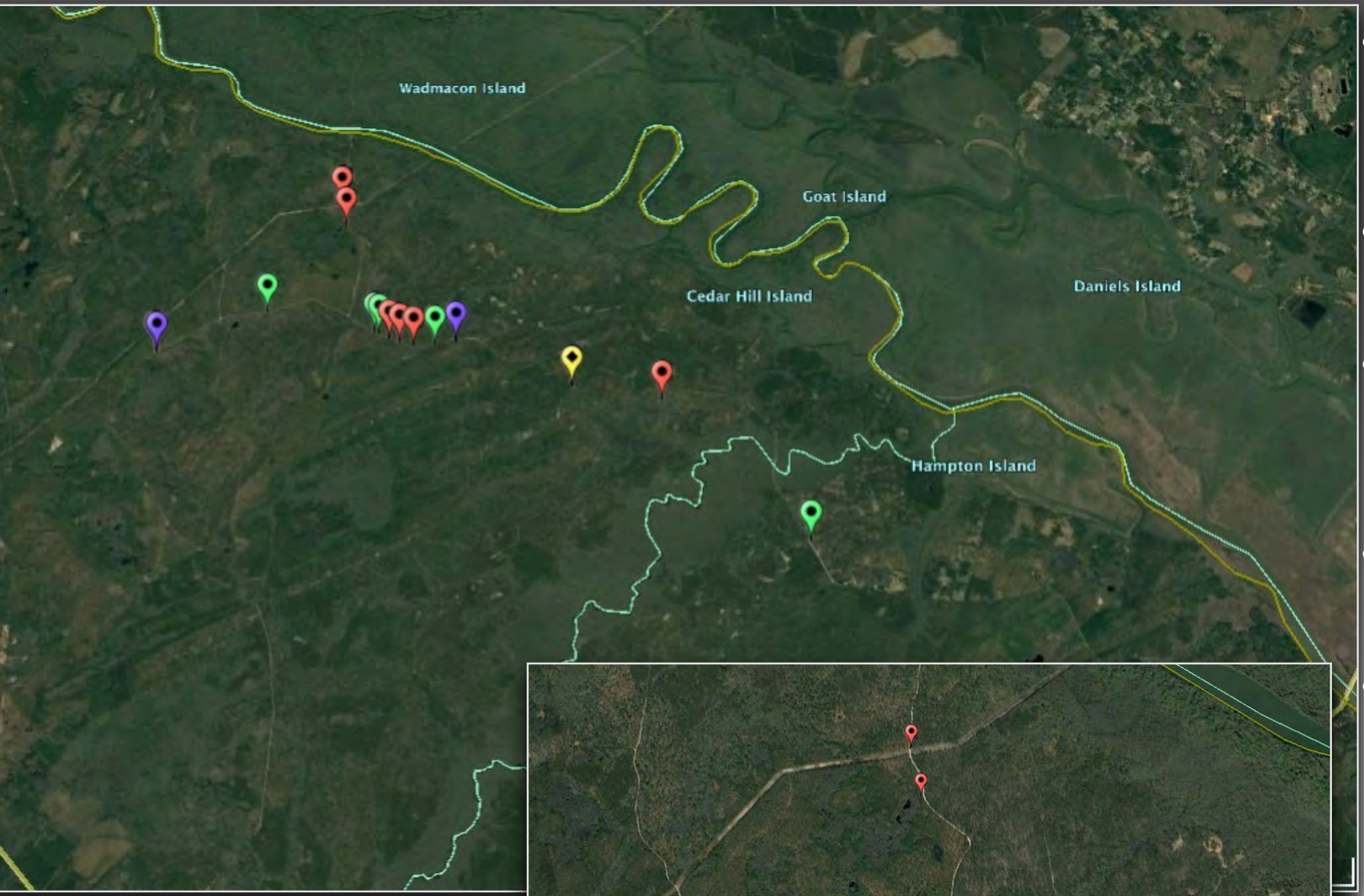






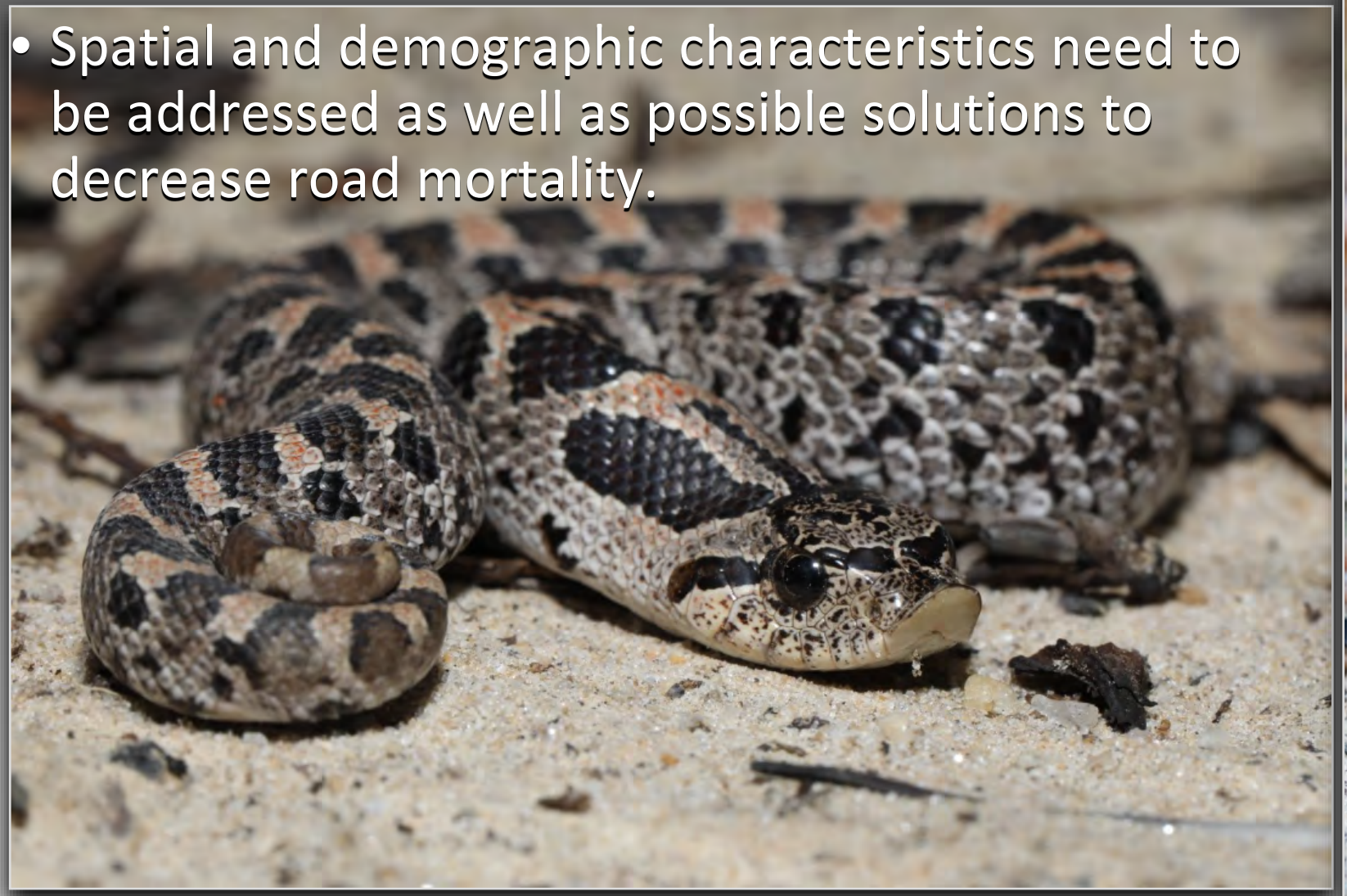
Conservation Efforts

- Monitoring via seasonal road surveys
- Collection of morphometric data and DNA collection
- Marking of individuals for mark-recapture



- Likely just one localized population in the Santee River sandhills
- Low detectability on some roads
- Almost half of all detections are road mortalities
- Many detections are neonates
- Fire ants are uncommon in the area and do not appear to be a significant threat

- Continue seasonal road surveys and mark recapture to monitor status
- Document survey effort for modeling
- Spatial and demographic characteristics need to be addressed as well as possible solutions to decrease road mortality.



Spotted Turtle Life History

- Second smallest North American turtle species, after the Bog Turtle
- Hatchling turtles have one spot per scute
- Adult spotting patterns are individually unique
- Sexually dimorphic
- Late sexual maturity at 7-14 years
- Small clutches of 2-4 eggs
- Longevity unknown, but may live over 100 years

Habitat and Range

- Prefer shallow waters with a soft bottom substrate and some submergent and emergent vegetation
- Require clean, slow-moving or still-water wetlands with accumulations of leaf litter
- Habitats include Carolina Bays, bogs, cypress swamps, sedge meadows, gum ponds, and slow streams

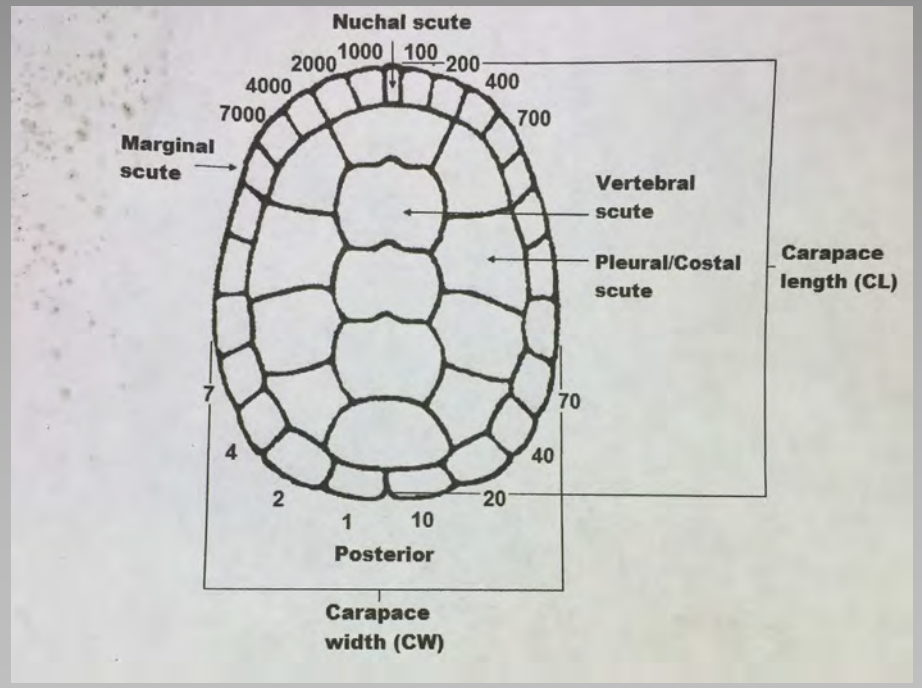
Status and Threats

- Half of all turtle species worldwide are in danger of extinction, including spotted turtles
- Life history traits increase vulnerablity (high egg-hatchling mortality, low reproductive potential, delayed sexual maturity)
- Require high annual survivorship of adults and juveniles to maintain population stability
- Loss of wetlands (drained, filled, polluted, or altered)
- Collection for pet trade

Conservation Efforts

- Late winter/early spring basking surveys
- Aquatic-trapping
- Opportunistic searches (road-cruising)
- Radio telemetry

- Morphometric data, DNA, photo IDs, unique shell notch code
- X-rays to determine gravid females, thread-trailing to lead to nest sites
- Trapping and mark-recapture to determine population demographics



Nine Spottie females were radio-tagged & available for X-ray. Two (upper left) are now known to have been gravid. For the others, coun the eggs.
20MAY21 cla

Other Conservation Efforts in FMN

- More at-risk target species added (Box turtle, kingsnake, ornate chorus frog, chicken turtle)
- Continue documenting observations of common species for baseline data and potential future use
- Continue educational and community outreach

Questions

- Thanks to ARC, SCDNR, USFWS and all our partners for their dedicated efforts and photos