

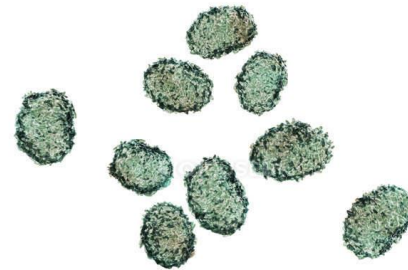
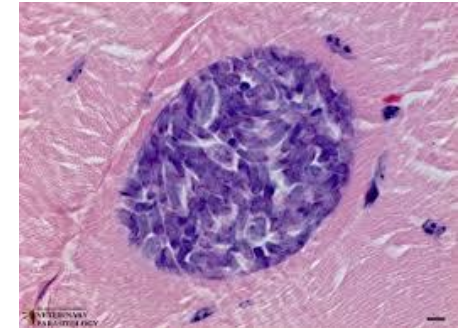
Emerging Infectious Diseases of Invasive Reptiles

*What we know, what we need to
know, and what we can do*

Melissa Miller

UF/IFAS Fort Lauderdale Research
and Education Center

melissamiller@ufl.edu



Collaborative presentation – showcasing amazing work from many co-authors and collaborators!



**Frank Ridgley,
DVM, Ph.D.**



**Nathan Burkett-
Cadena, Ph.D.**



**Madison
Harman, M.Sc.**



**Robert Ossiboff,
DVM, Ph.D.**



**Michael Cove,
Ph.D.**



Biological invasions provide a pathway for spread of nonnative species and their pathogens



Invasive Reptiles in Florida

- Florida is a hotspot of biological invasions with more introduced species of reptiles breeding in the wild than anywhere else in the world
- At least 54 species of nonnative reptiles are established in FL
- Includes 27% of all established nonnative reptile species known to occur globally
- Invasive reptiles can be a source of emerging infectious diseases



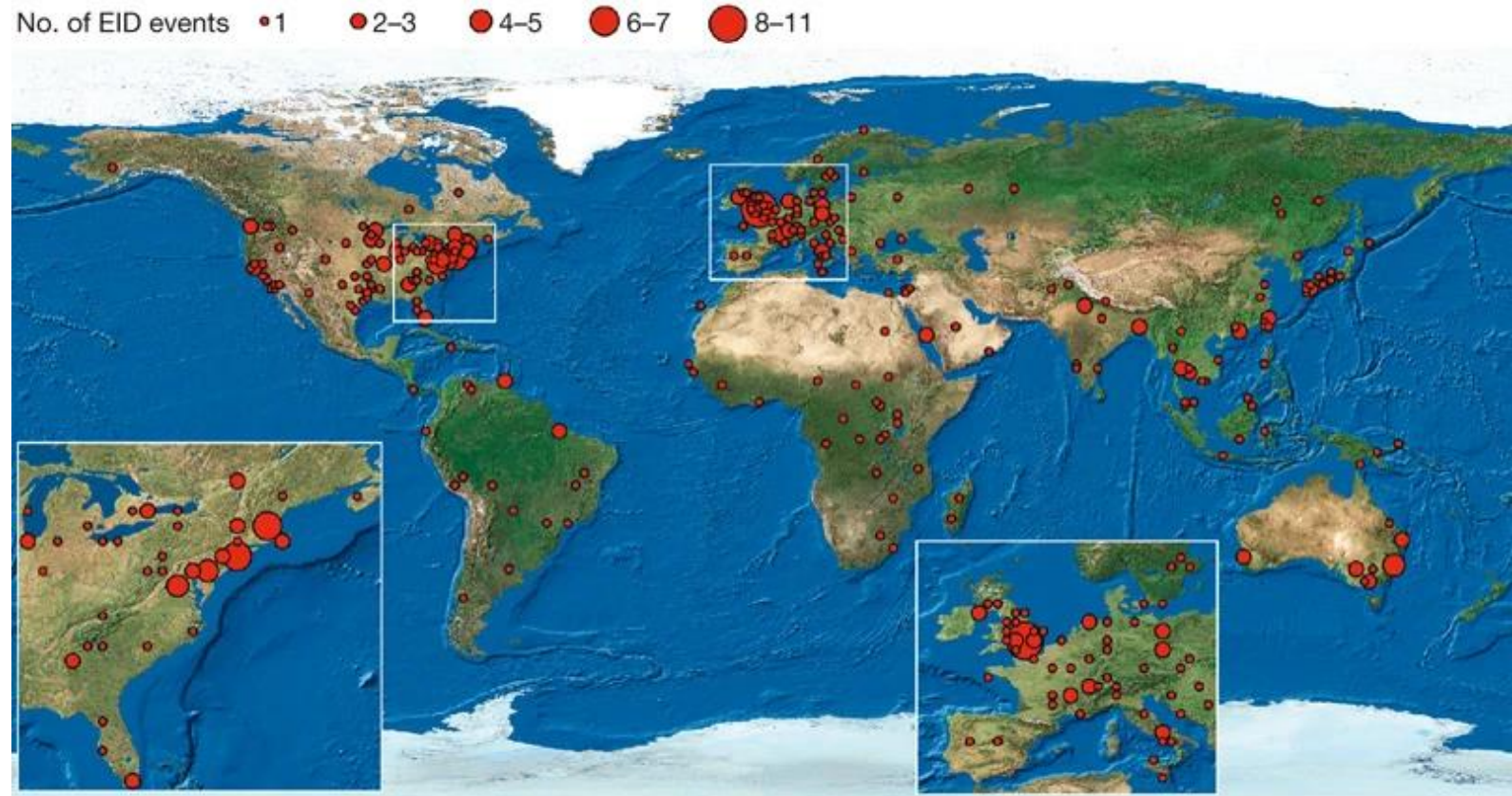
(Capinha et al. 2017)



Emerging Infectious Diseases (EIDs)

- EIDs: Disease-causing agents that are rapidly increasing in geographic range, host range, or prevalence.
- Can impact people, agriculture, and wildlife.
- Wildlife EIDs pose a substantial threat to conservation of global diversity.

Global richness map of the geographic origins of EID events from 1940 to 2004

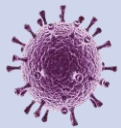


EIDs of invasive reptiles in Florida



Parasites

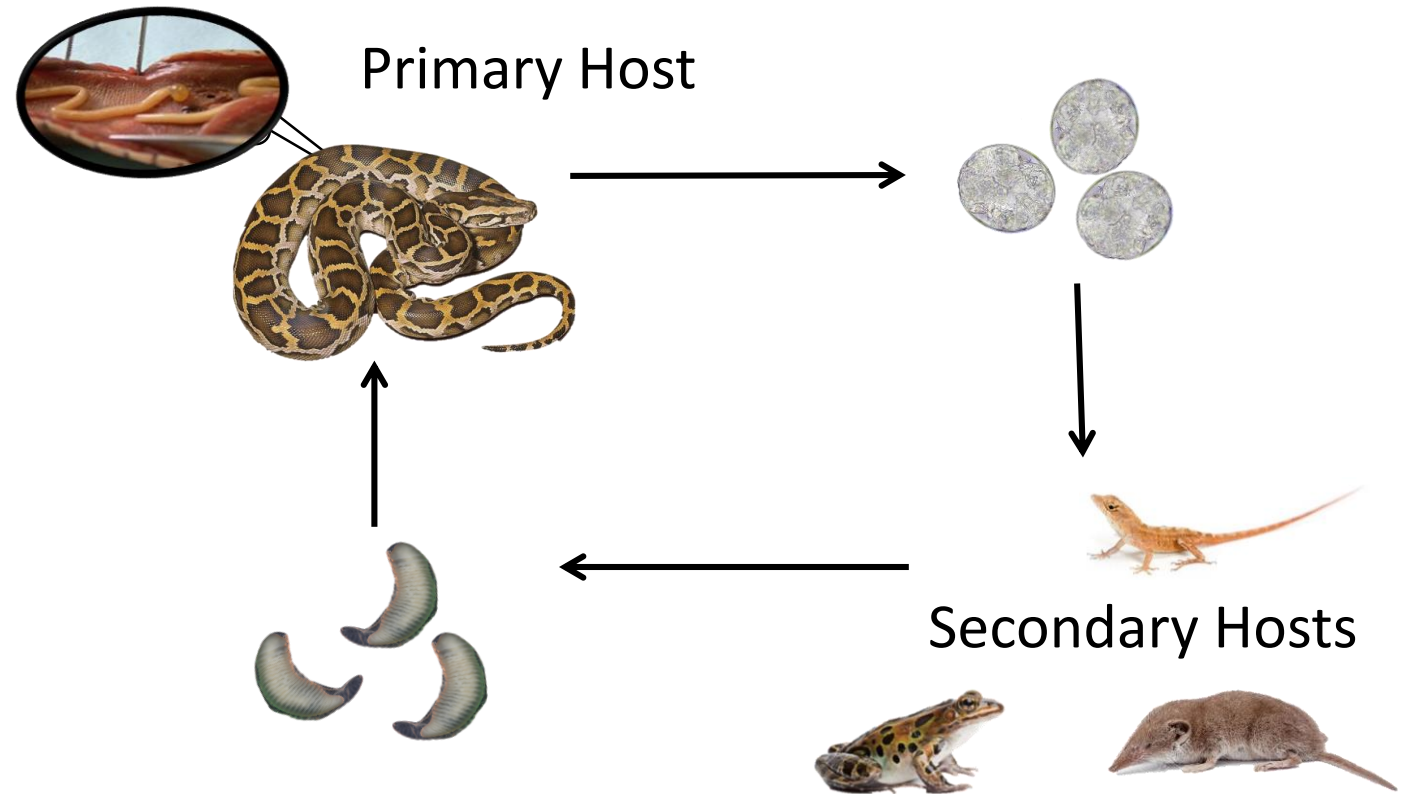
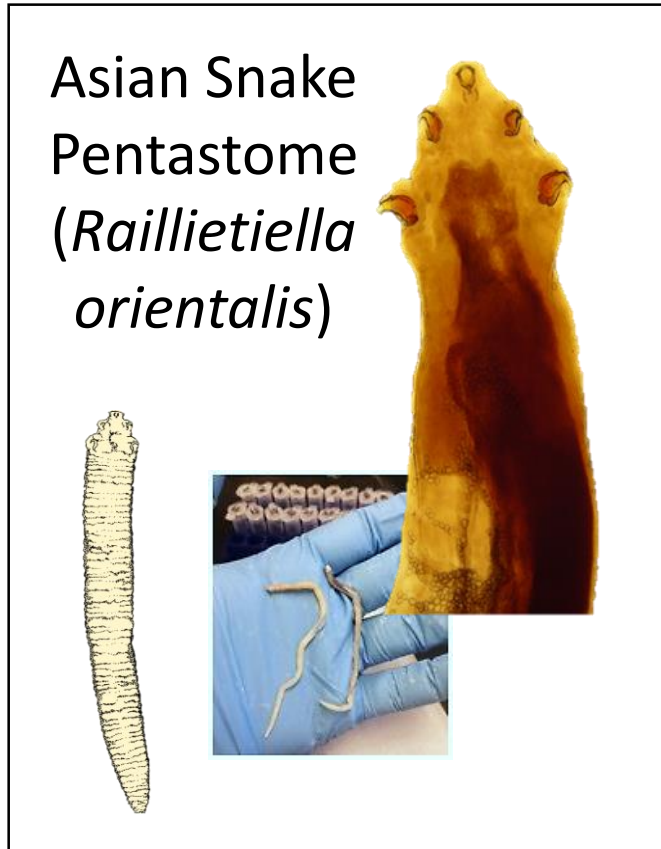
Pentastomes, *Sarcocystis*



Viruses

Serpentovirus, Invasive-reptile mediated mosquito-borne pathogen transmission

Asian snake pentastome



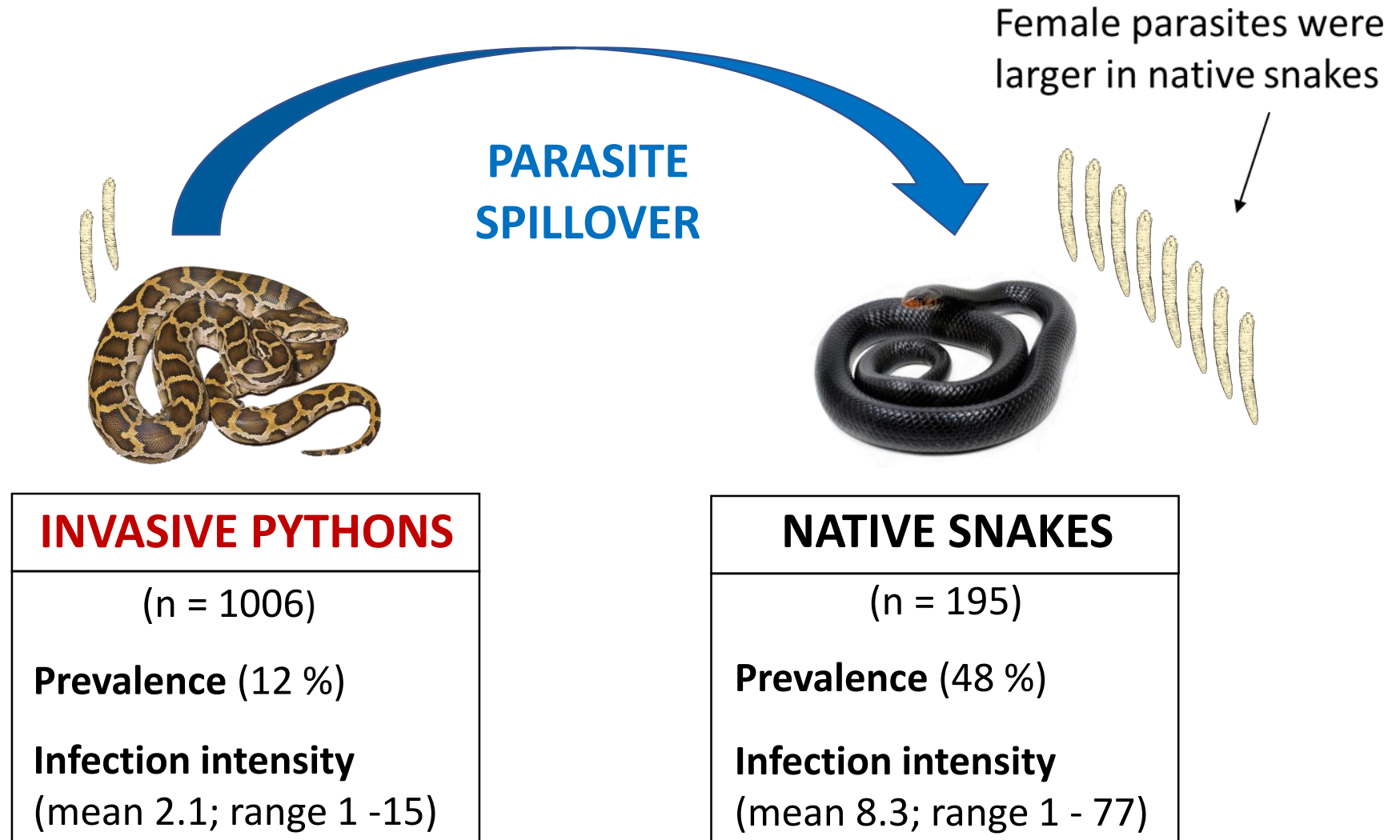
Has parasite spillover occurred?

Yes!



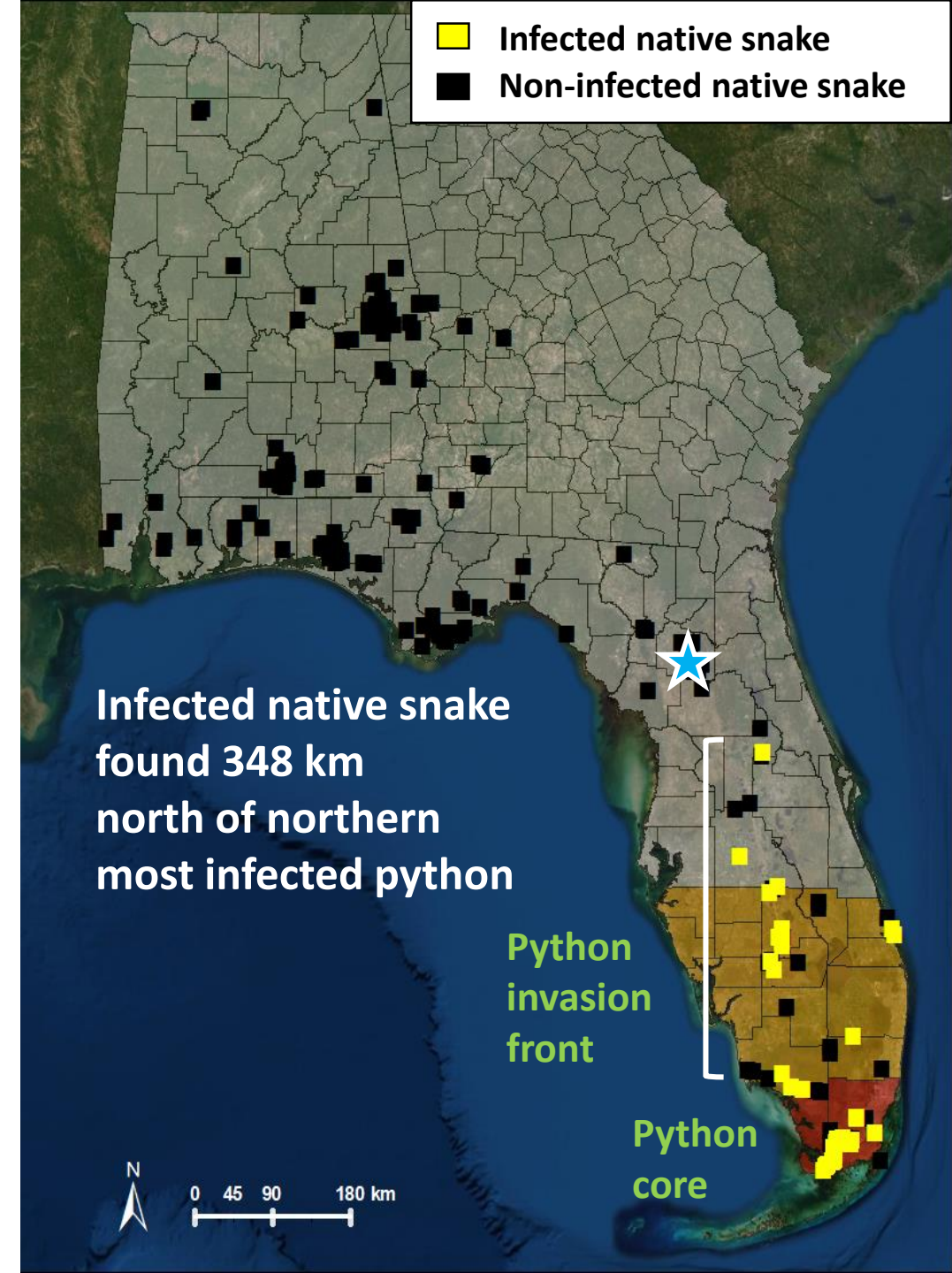
Miller et al. 2018; Miller et al. 2020

Asian Snake Pentastome



Asian Snake Pentastome

- Ro can spread independent of its python host.
 - Native snakes are highly competent hosts
 - Intermediate hosts are common and widespread
- Conservation concern for native snakes
 - Need to know physiological impact of Ro infection on native snake hosts
 - Assess if population declines are occurring in native snakes (preliminary results suggest yes for some species – see James Whelpley’s poster!)



Asian snake pentastome

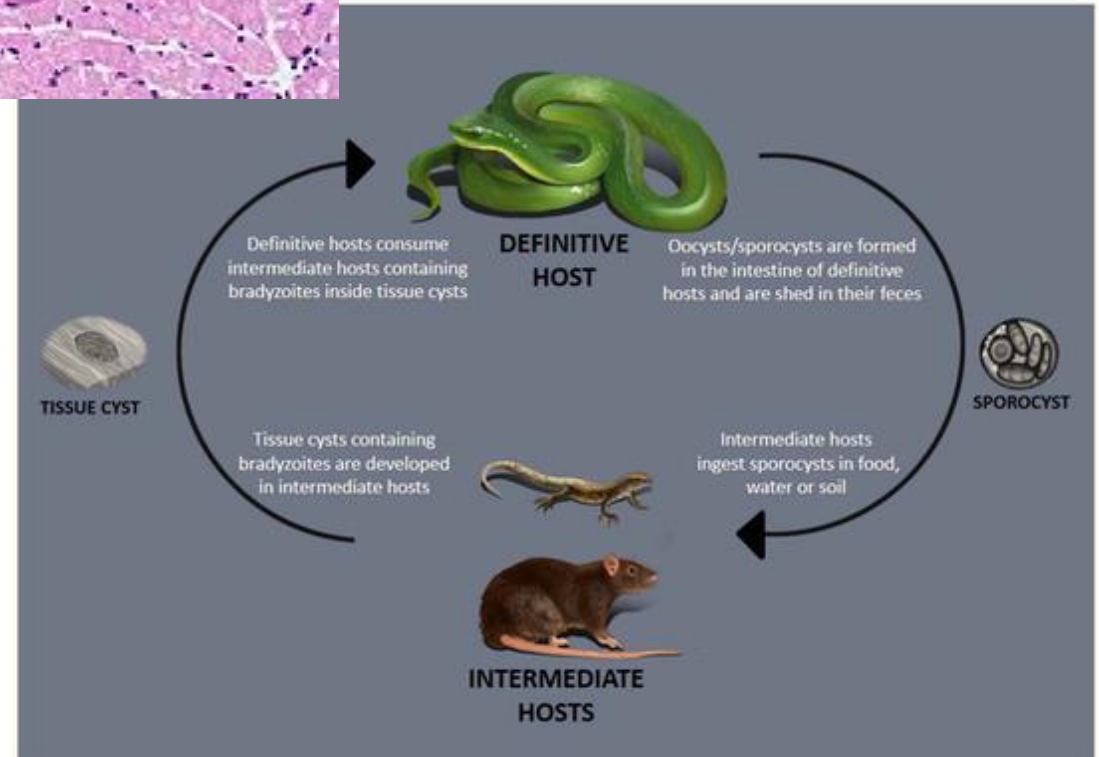
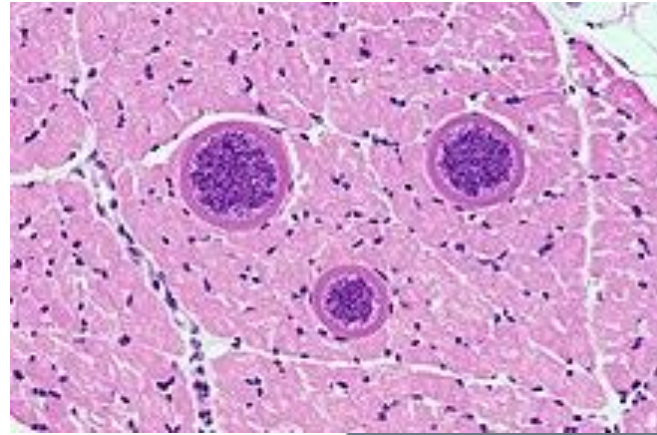
Ro has been documented to infect other reptiles including:

- Boa constrictors (Ridgley et al., in prep)
- Argentine black and white tegus
- Tokay geckos
- Giant tortoise (Ossiboff et al., in prep)



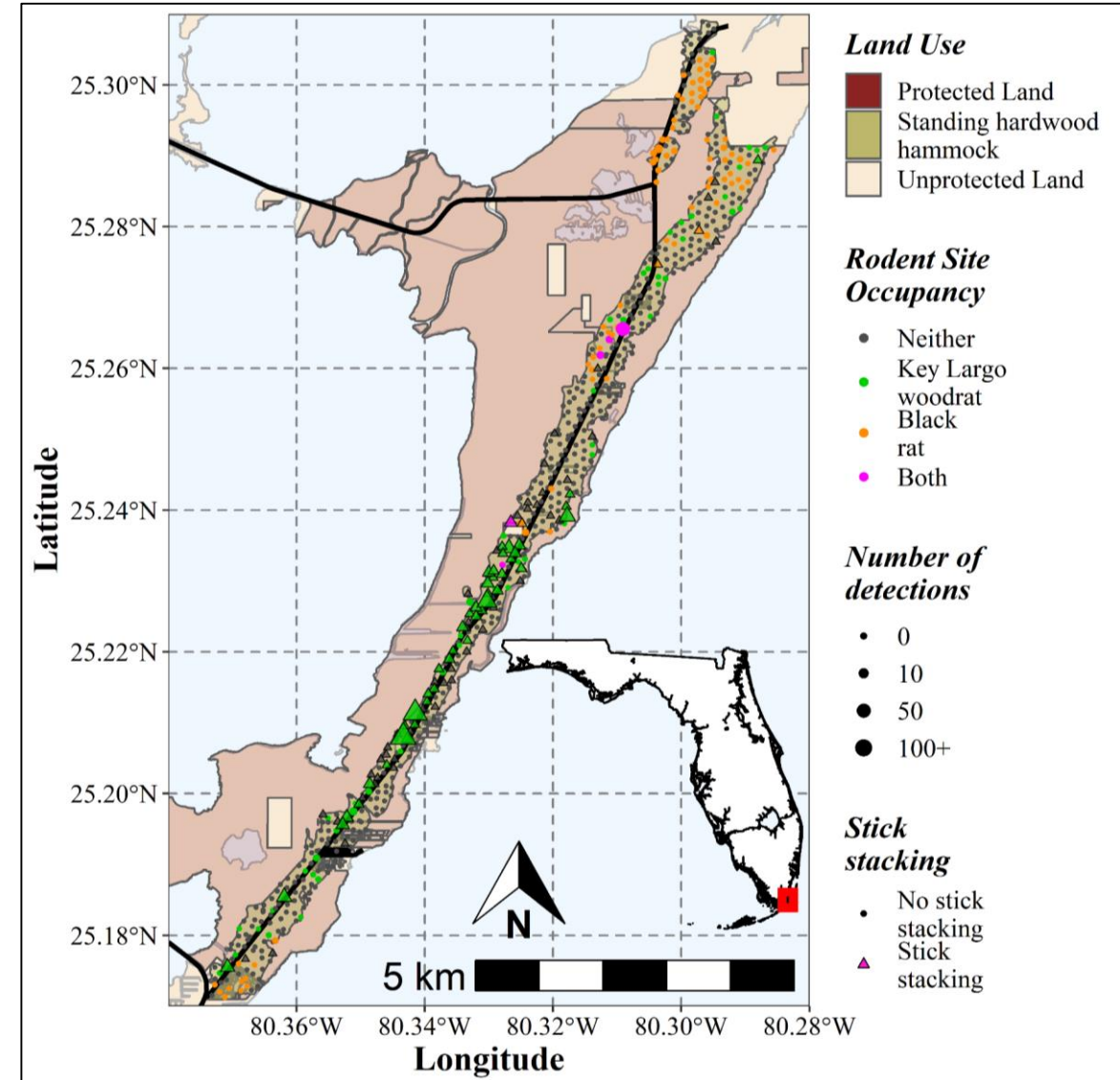
Sarcocystis

- Protozoan cyst-forming parasites (phylum Apicomplexa) that infects mammals, reptiles, and birds
- Indirect life cycle (definitive and intermediate hosts)
- Can cause weakness, neurologic signs, respiratory difficulty, loss of appetite



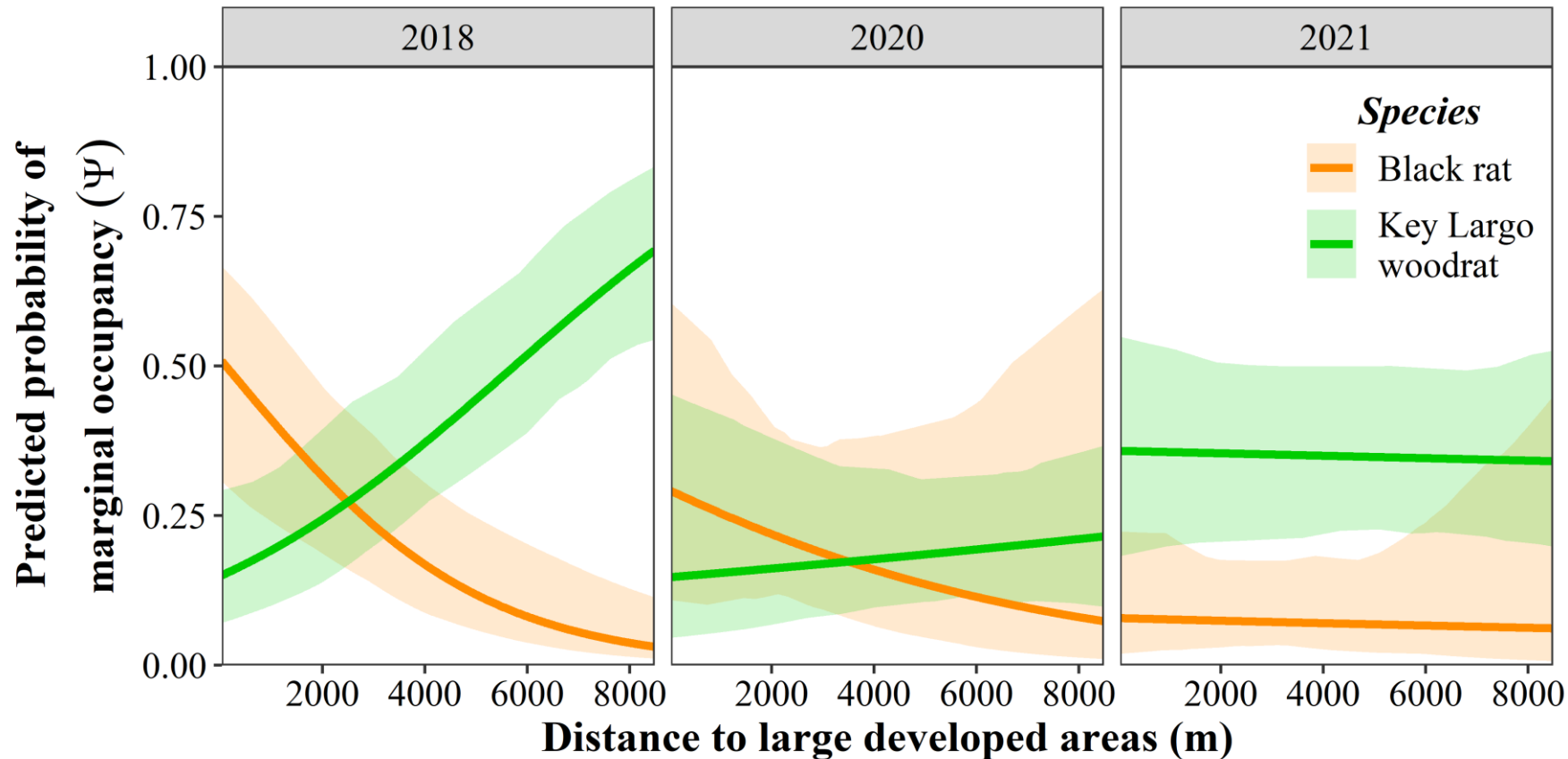
Sarcocystis in Key Largo

- Distribution of KLWR and Black Rats in 2018 prior to collapse of black rats in 2020-21.
- Brandon McDonald's (UF) thesis work; from McDonald, Lashley, and Cove (*In review*).



Sarcocystis - Enigmatic Declines of *Rattus*

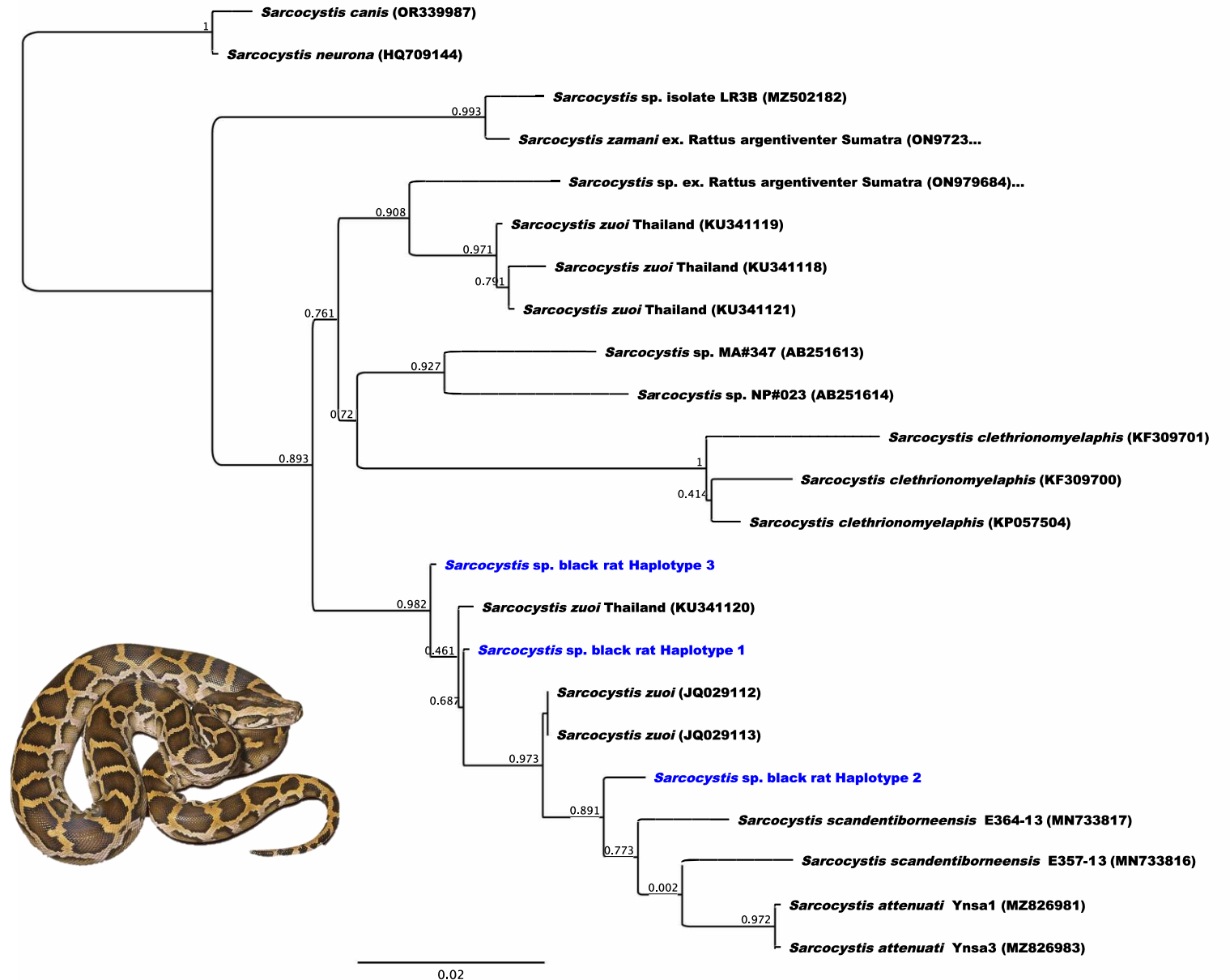
- Apparent collapse of *Rattus* releases KLWR
- High Prevalence of *Sarcocystis* (~94% inds)



Association between KLWR and human development disappeared as black rats were gone from the system

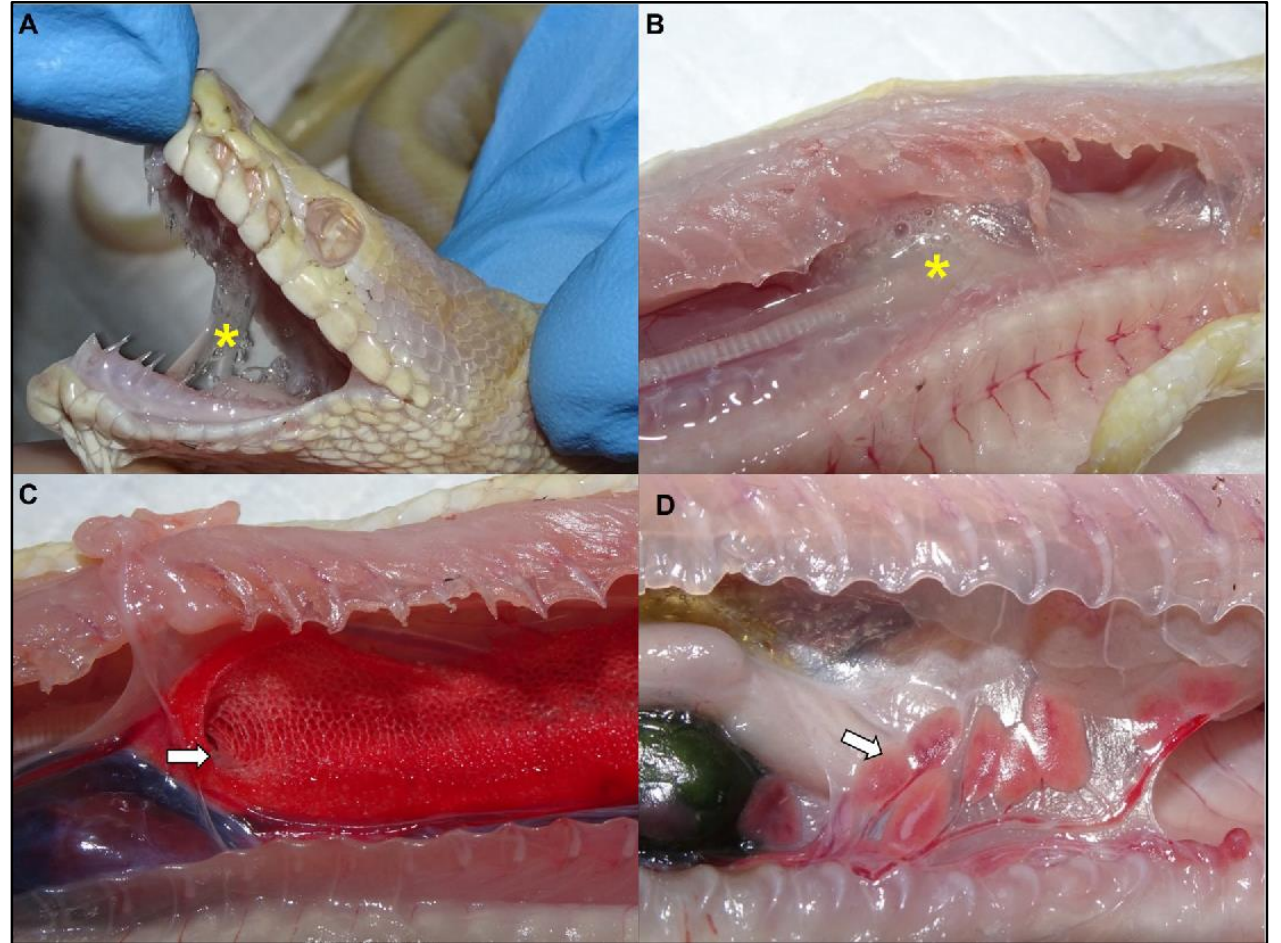
Rise of *Sarcocystis* sp.

- Clade showing the 3 haplotypes from Key Largo supporting *Sarcocystis* from an Asian snake definitive host.
- Likely definitive host: Burmese pythons



Serpentoviruses

- Respiratory virus of pythons and boas, often lethal
- Serpentoviruses belong to the same order as coronaviruses (rapid spread, inflammation of respiratory and gastrointestinal tract)

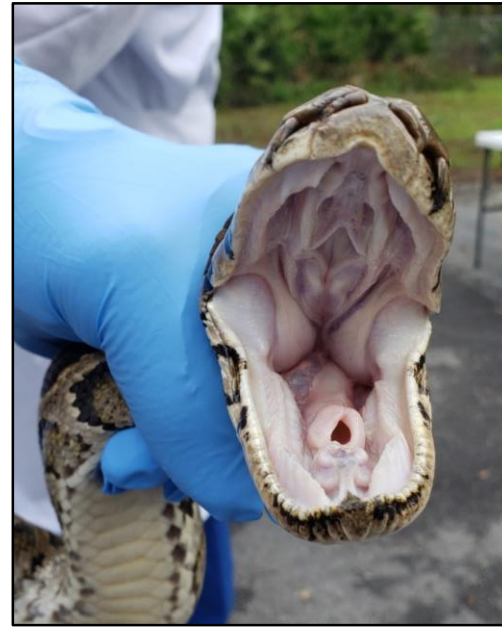


Li et al. 2020

Serpentoviruses

- Found in captive snakes and recently in wild invasive Burmese pythons in FL (Tillis et al. 2022)
- Native reptiles tested positive for serpentoviruses, but viruses were not the same as viruses found in pythons
- Potential for spillover from pythons to native reptiles should be further examined

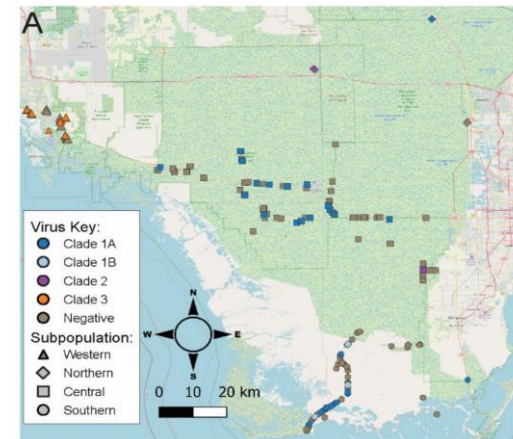
(Tillis et al. 2022)



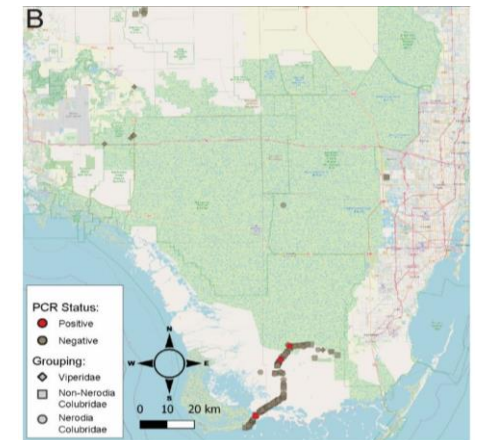
Non-infected



Infected



Pythons



Native Snakes

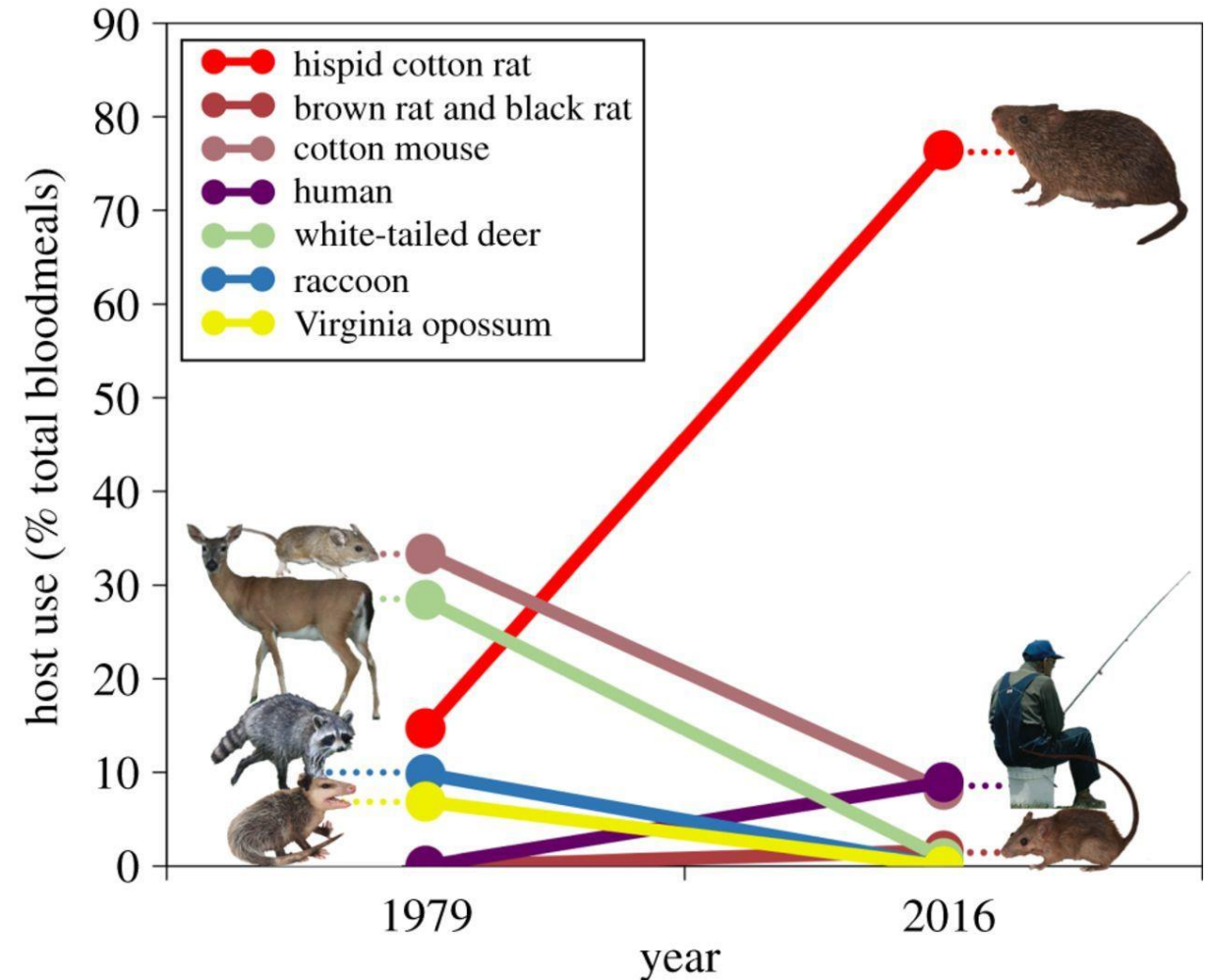
Invasive reptile-mediated risk of mosquito-borne pathogen transmission

- Everglades virus: Zoonotic pathogen endemic to South Florida transmitted by mosquitos feeding on amplifying host.
- Symptoms include headache, muscle aches, sore throat, fever, and neurological manifestations.



Invasive reptile-mediated risk of mosquito-borne pathogen transmission

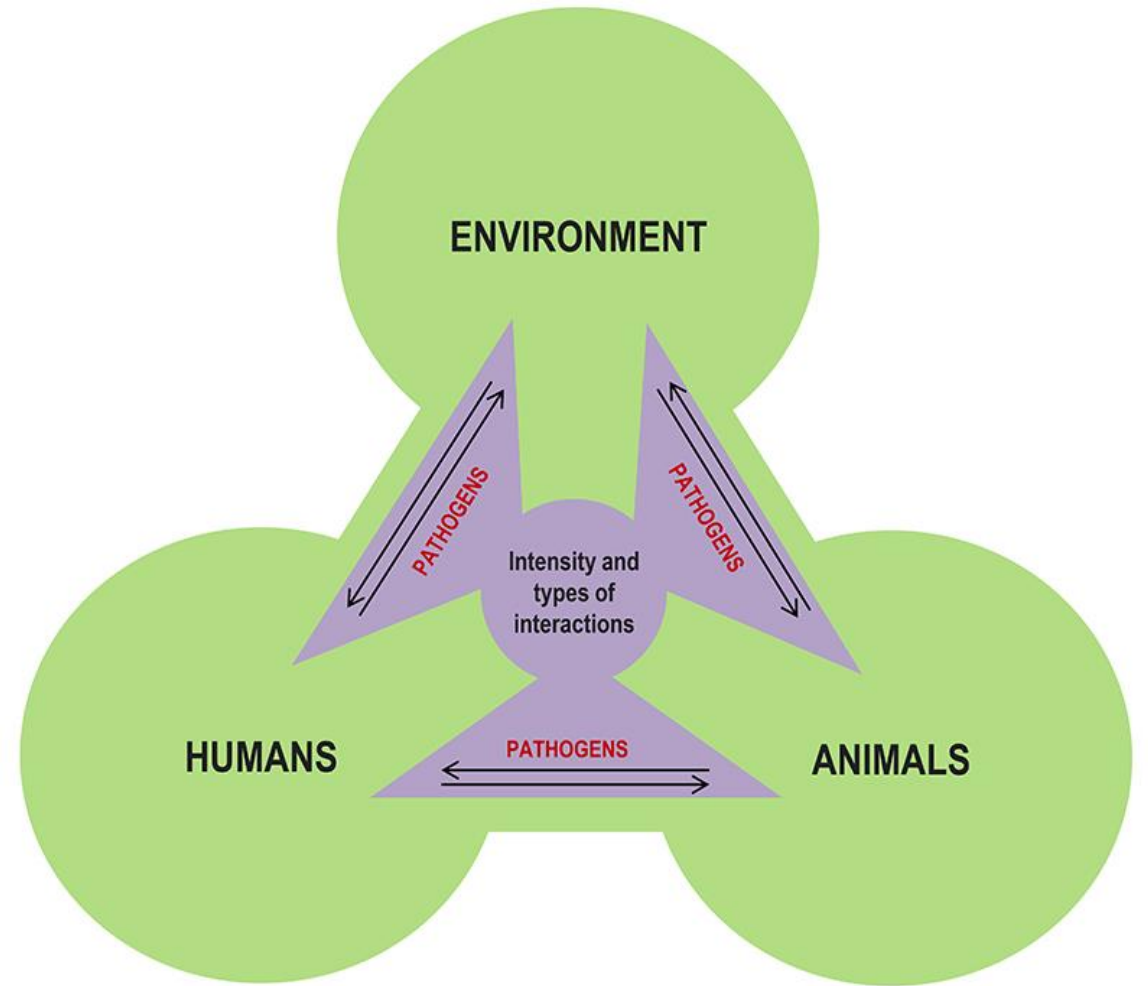
- Increased transmission of Everglades virus attributed to python predation
- Decline in mammal diversity resulted in shift of mosquito vector use of primary reservoir host (cotton rat)
- Potential for increased transmission and increased risk to humans



What can we do about EIDs?

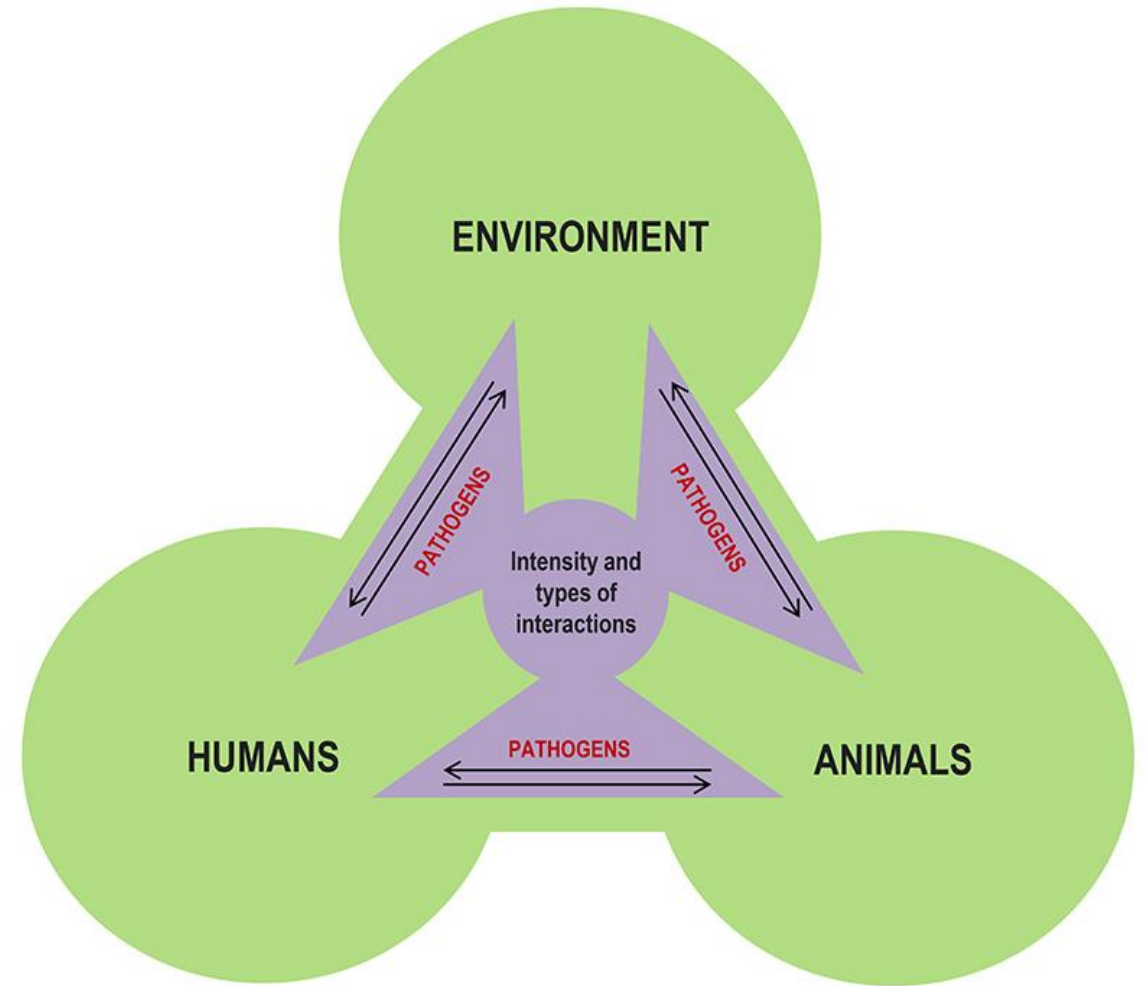
The intensity and types of interactions between humans, animals, and the environment determine the circulation of pathogens between these three actors.

Therefore, these interactions can control infectious diseases or facilitate the emergence of outbreaks and epidemics, depending on how humans interact with the environment and other animals.



What can we do about EIDs?

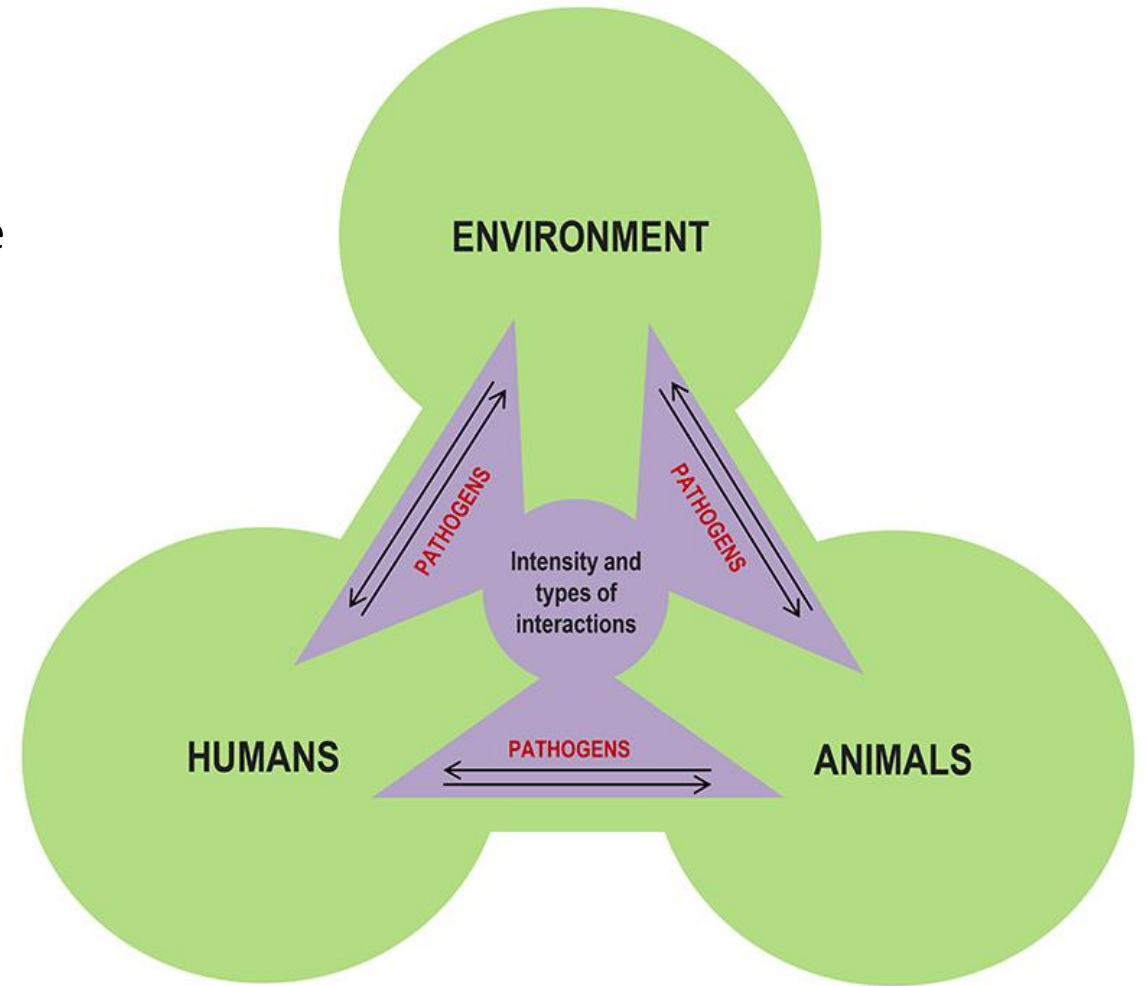
- **Surveillance** of EID “hot spots” (identify where transmission is likely to occur and monitor animals in those areas)
- **Report** sick or diseased animals (FWC Wildlife Alert Hotline (888) 404-3922)
- **Reduce contact** (minimize or avoid contact with species known to be infected)
- **Sanitation** (washing hands, sanitizing equipment and gear, use PPE)



One Health Perspective

What can we do about EIDs?

- **Regulate wildlife trade** (legal and illegal wildlife trade)
- **EDRR and control** (detection and removal of nonnative species)
- **Educate** (increase awareness and identification)
- **Coordinate efforts** (leverage resources)
- **Research** (support research examining wildlife pathogens and long-term monitoring of native wildlife populations)
- **Establish an advisory committee** (ECISMA Disease Task Force coming soon!)



One Health Perspective



Melissa Miller
melissamiller@ufl.edu

UF | IFAS
UNIVERSITY of FLORIDA