BURMESE PYTHON RANGE DELIMITATION USING ENVIRONMENTAL DNA SURVEYS IN THE GREATER EVERGLADES ECOSYSTEM

Margaret E. Hunter, *U.S. Geological Survey, Wetland and Aquatic Research Center, Gainesville FL, USA, 32653*
Caitlin E. Beaver, *U.S. Geological Survey, Wetland and Aquatic Research Center, Gainesville FL, USA, 32653*

U.S. Department of the Interior
U.S. Geological Survey

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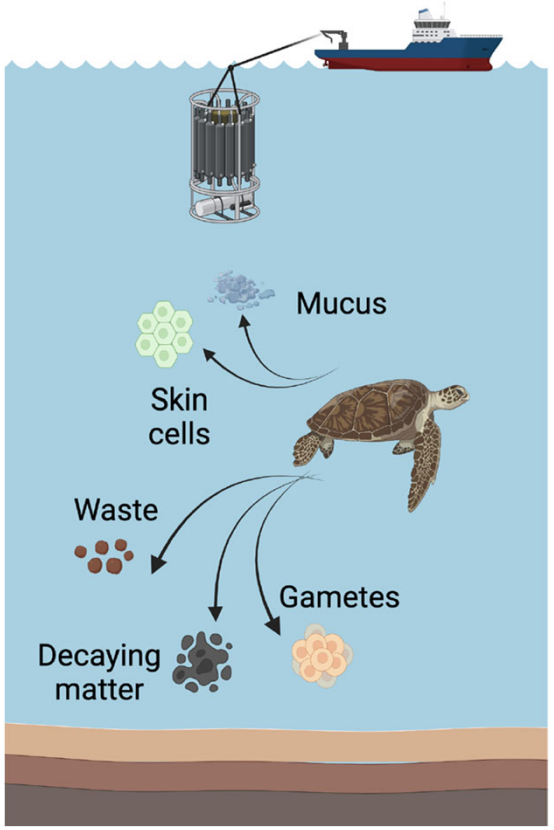
USGS Wetland and Aquatic Research Center
WARC Conservation Genetics Laboratory

This project is funded by USGS's Greater Everglades Priority Ecosystems Science (GEPES) Program

ENVIRONMENTAL DNA SOURCES



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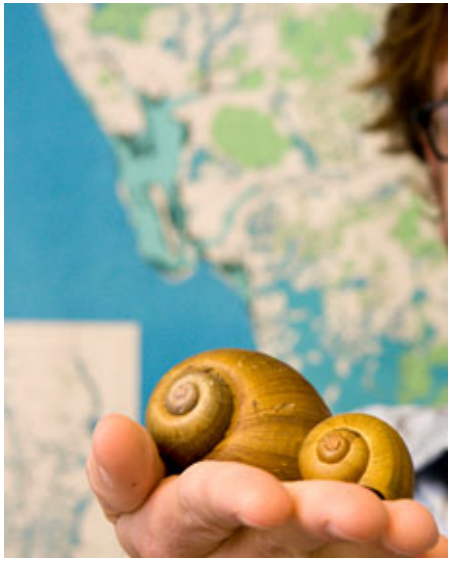
DETECTION OF EDNA MOLECULES, NOT THE SPECIES ITSELF

SUSIE THEROUX, SCCWRP



ENVIRONMENTAL DNA METHODS

- Non-invasive sampling
- Sensitive and specific
- High catch-per-unit

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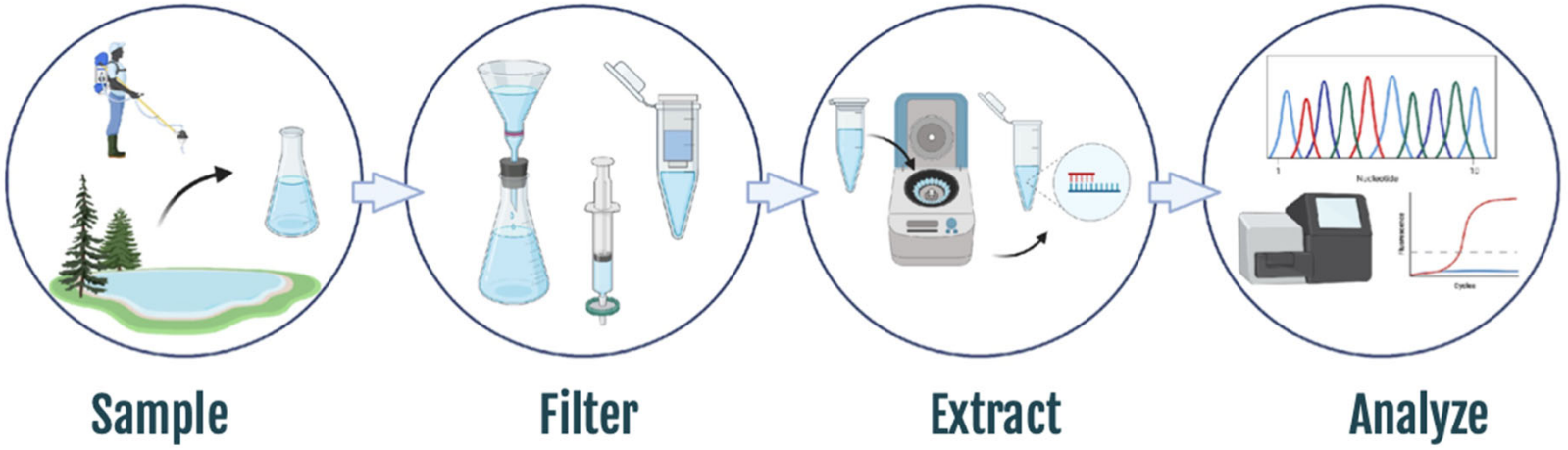
eDNA ANALYSIS PROCESS



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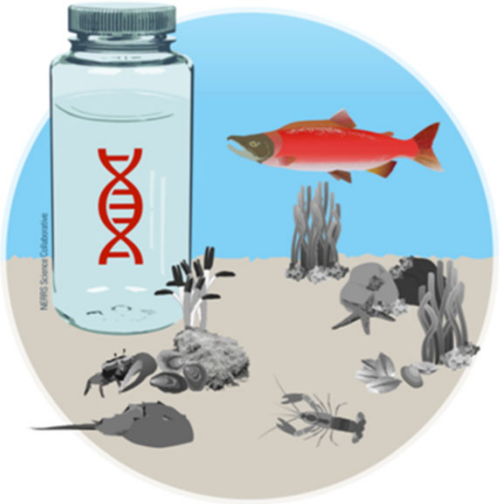
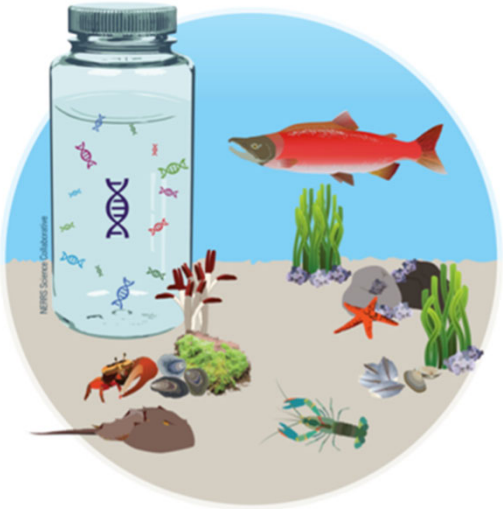
SUSIE THEROUX, SCCWRP

TWO PRIMARY eDNA DETECTION METHODS

Targeted:
Single species or genera



Metabarcoding: Community assessment



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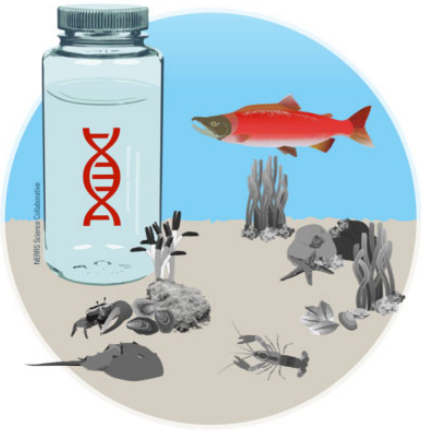
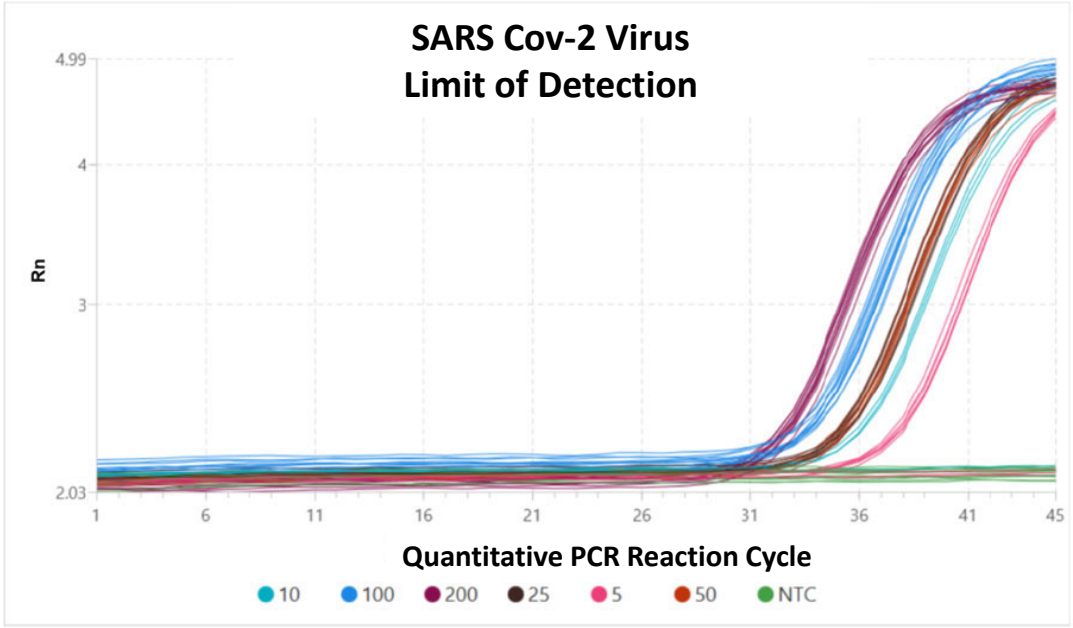
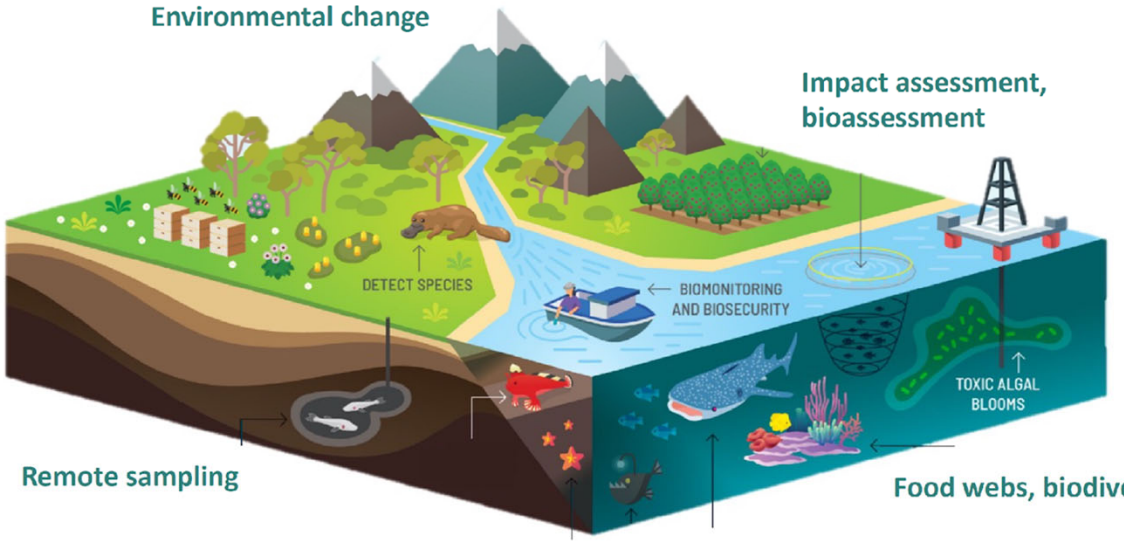
Targeted eDNA

- Species-specific
- Sensitive
- Detection/non-detection of eDNA
- Occurrence and detection rates





eDNA applications



Modified from Berry et al., 2020 Environmental DNA

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INVASIVE SPECIES eDNA APPLICATIONS

- Inform EDRR efforts
- Monitor control or eradication measures
- Inform invasion fronts, pathways or hot spot areas
- Occupancy estimates
- Food web analyses

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IMPERILED SPECIES eDNA APPLICATIONS

- Species range/habitat delimitation
- Travel corridors
- Monitor recovery efforts (increasing occupancy)
- Assist with extinction determinations

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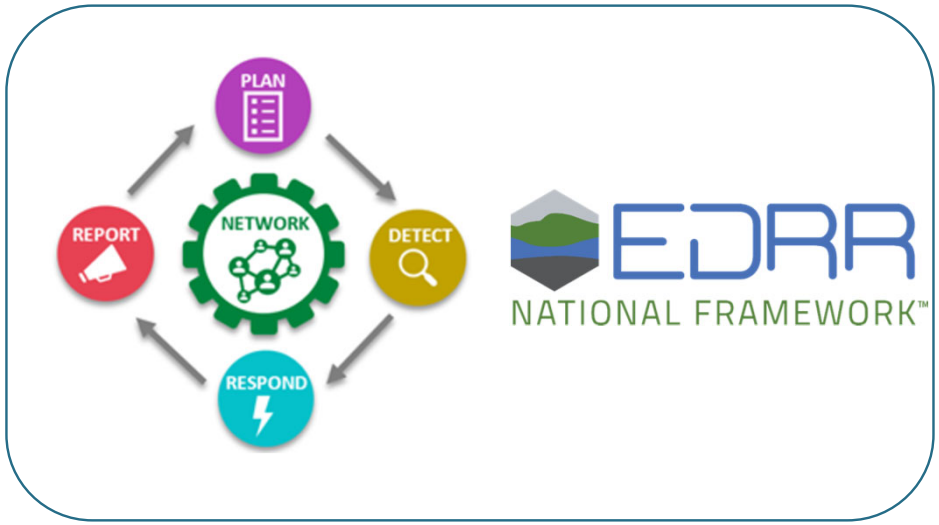
U.S. NATIONAL AQUATIC EDNA STRATEGY

The White House Office of Science and Technology Policy (OSTP)

National Science and Technology Council (NSTC)
Biodiversity Working Group, eDNA Task Team

Harnessing the power of eDNA to explore, map, monitor, and better understand aquatic life to sustain and restore biological resources into the future

NATIONAL eDNA ACTIVITIES



- Bipartisan Infrastructure Law Funds
- Early Detection Rapid Response (EDRR) National Framework
  - Molecular Lab Network
  - NAS database eDNA reporting
  - READI-Net (robotic sampling and data standards)

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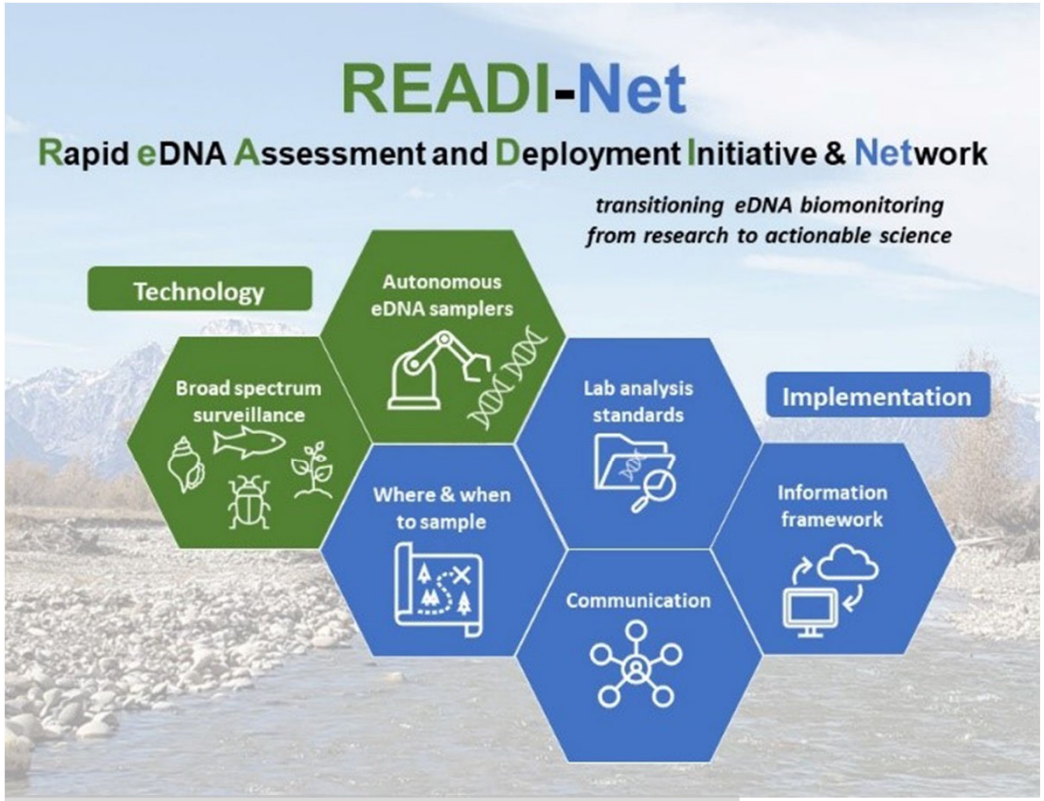

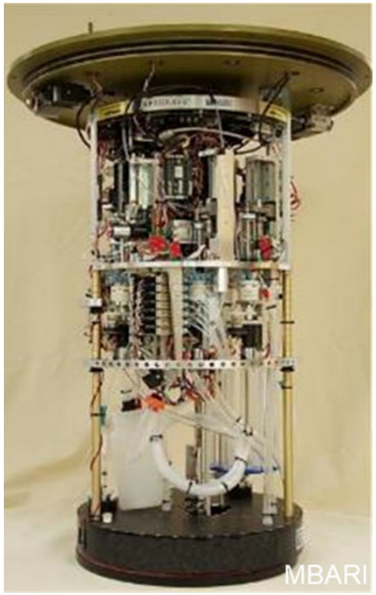

- Adam Sepulveda, USGS

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SOUTHEAST eDNA STUDIES

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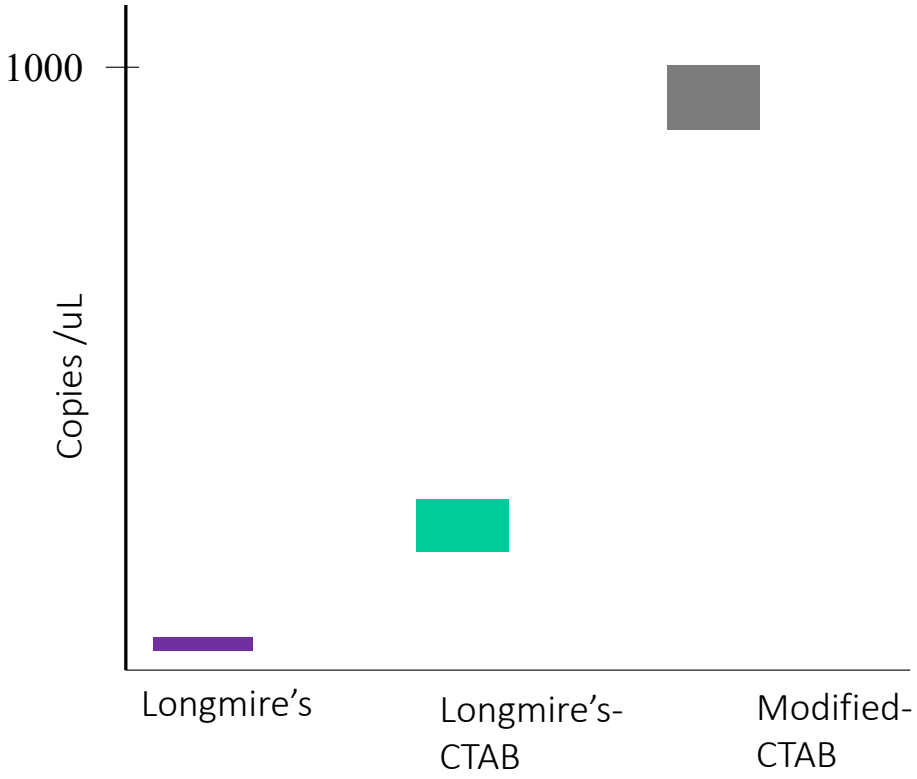
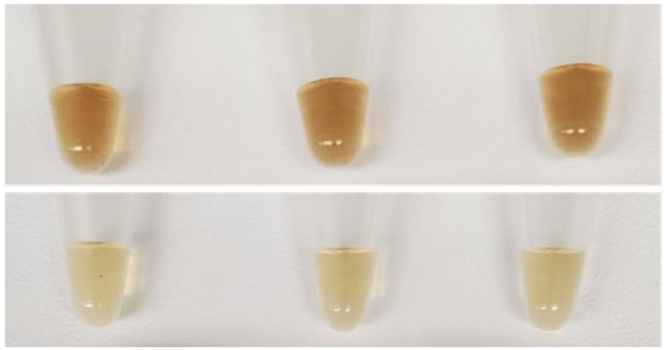
Descriptions in Hunter et al. (2019)

SOUTHEAST eDNA STUDIES: PCR Inhibitors





DNA extract

IRK (Zymo)

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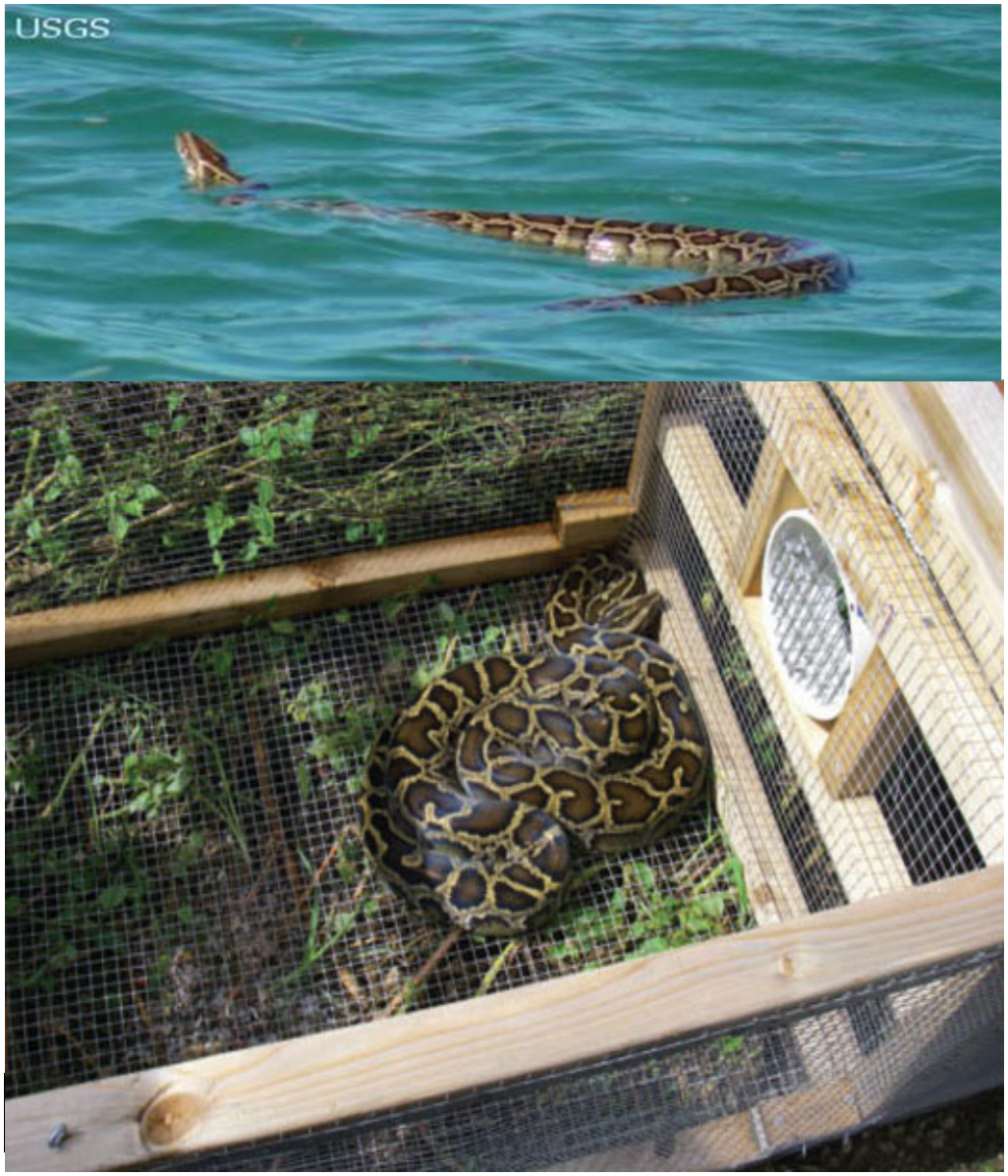
DESCRIPTIONS IN HUNTER ET AL. (2019)

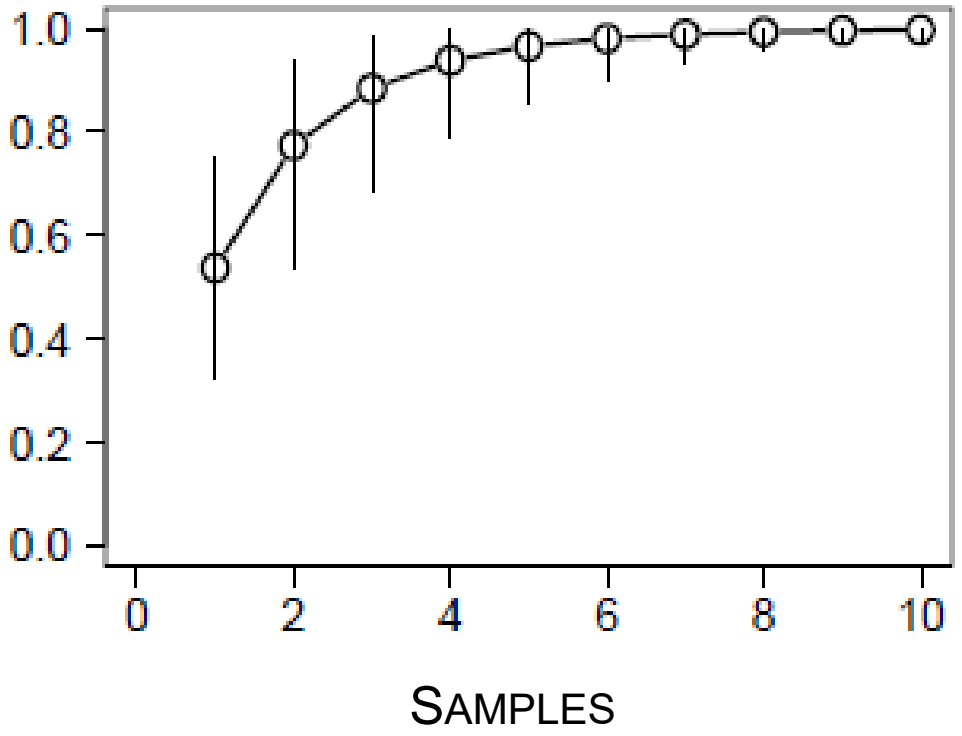
Invasive Burmese python

- Hindering restoration efforts
- Semi-aquatic, cryptic
- Visual sighting and Trapping rate is < 1%



- Visual sighting and trapping capture < 1%

- eDNA detection is <40-100%



- Occupancy analyses
  - Probability of occurrence

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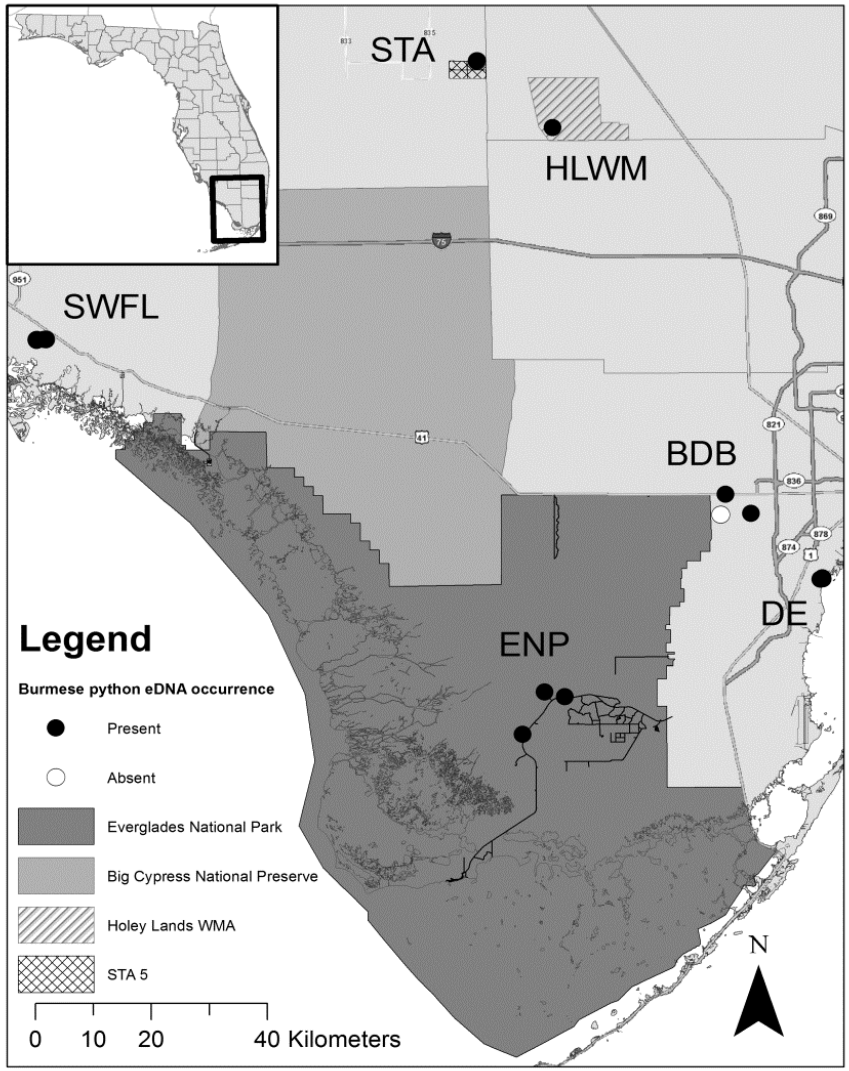
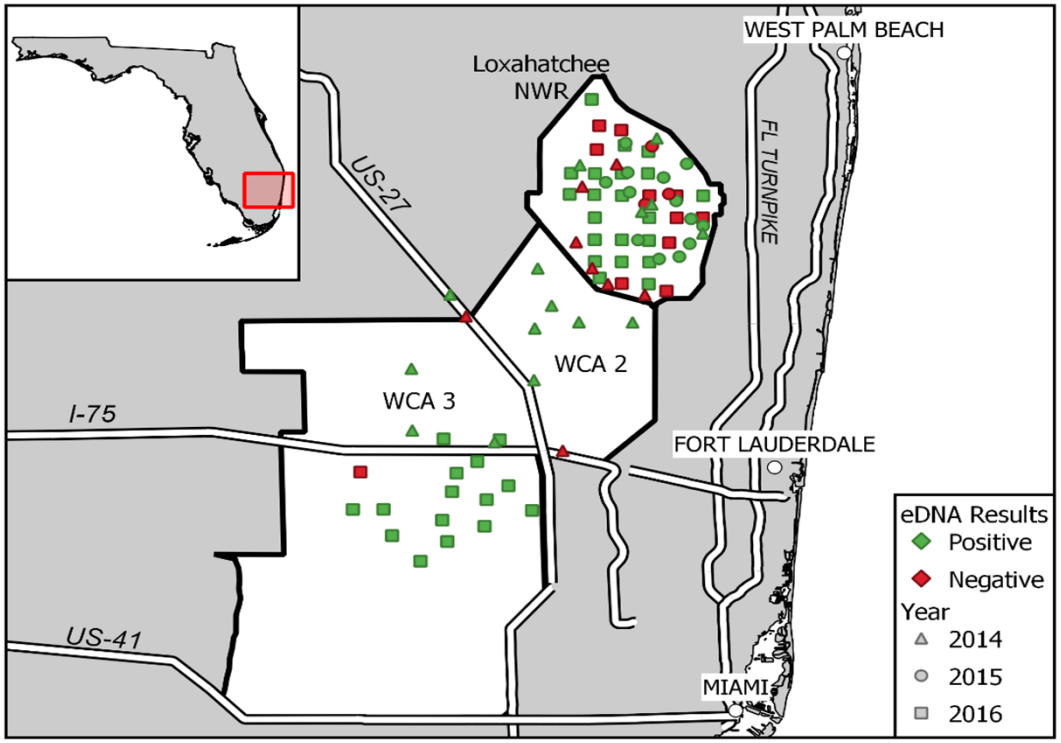
BURMESE PYTHON eDNA DETECTIONS: 37 OF 63 SAMPLES



HUNTER ET AL., PLOS ONE 2015

eDNA detections in Loxahatchee National Wildlife Refuge



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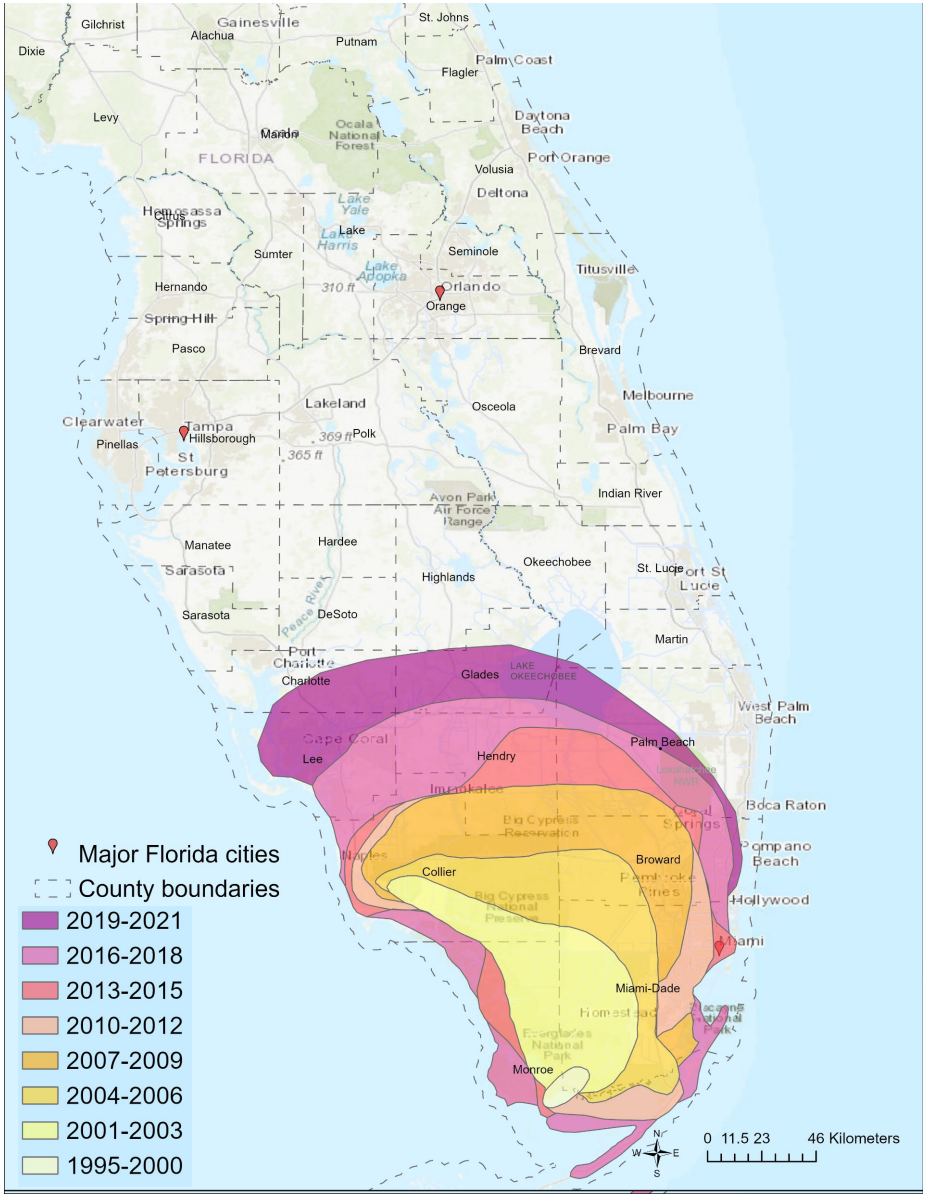
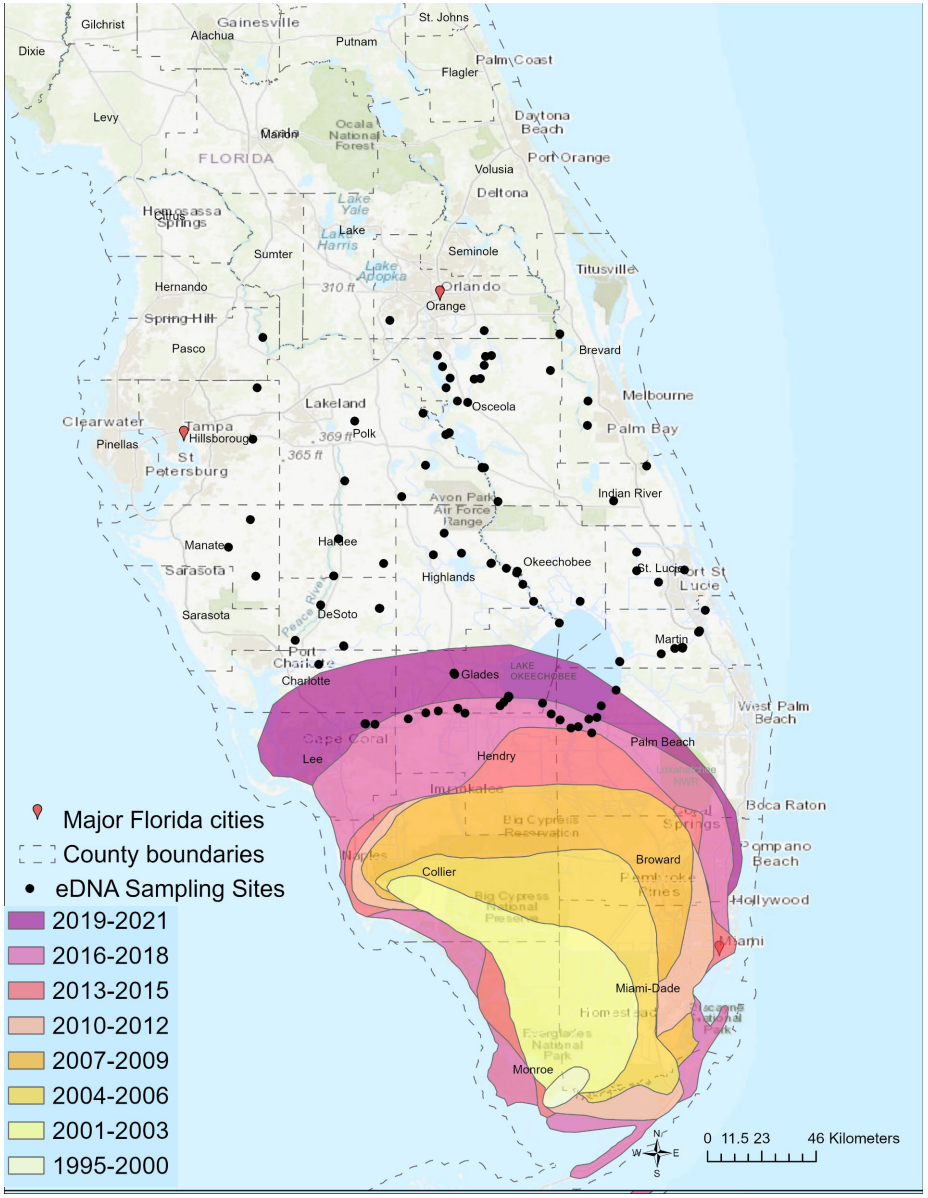
HUNTER ET AL. (2019) ECOLOGICAL INDICATORS

CURRENT ESTIMATION OF INVASION FRONT



Polygons from Guzy et al. (2023)

TOTAL PROJECT EFFORT



2019-2023
Total sampled sites = 141
Sites resampled = 26

Preliminary Information-Subject to Revision. Not for Citation or Distribution.

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Polygons from Guzy et al. (2023)

ALL SAMPLES
2019-2023

Preliminary Information-Subject to Revision. Not for Citation or Distribution.

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2023

DISCUSSION

- Likely detecting a population up to south Orlando
  - Not all recent releases
- The population may extend beyond our detections
- Evidence for more detections on the western side of the peninsula
  - Possibly indicating a corridor north

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Priority areas for further sampling?

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THANK YOU!

- Special thanks to John Stechly, Alexis Tays, Dr. Jason Ferrante, Stephanie Katircioglu, Dr. Maite de Maria, Maggie Parrish, Garet Dicks, Chelicia Espinoza, India Sander-Nazario for all the help in the lab and field.

- *We are grateful for the support by USGS's Greater Everglades Priority Ecosystems Science (GEPES) Program*

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- Hunter, M. E., Meigs-Friend, G., Ferrante, J. A., Smith, B. J., & Hart, K. M. (2019b). Efficacy of eDNA as an early detection indicator for Burmese pythons in the ARM Loxahatchee National Wildlife Refuge in the greater Everglades ecosystem. *Ecological Indicators*, *102*, 617-622.

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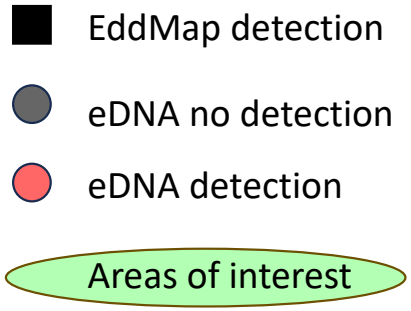
2022 eDNA RESULTS AND EDDMAPS DETECTIONS



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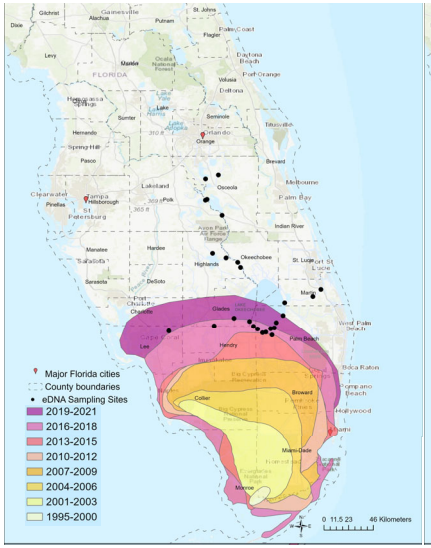
Preliminary Information-Subject to Revision. Not for Citation or Distribution.

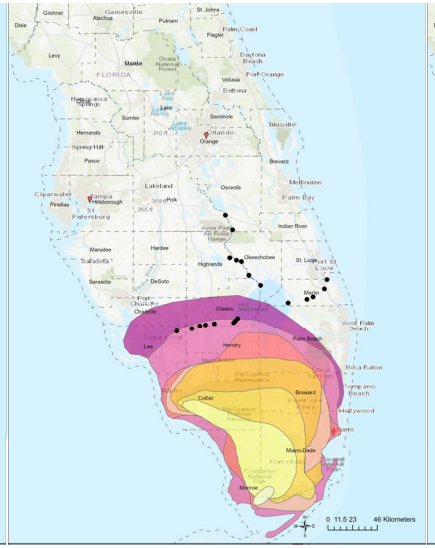
SAMPLING DESIGN BY YEAR

Fall 2019



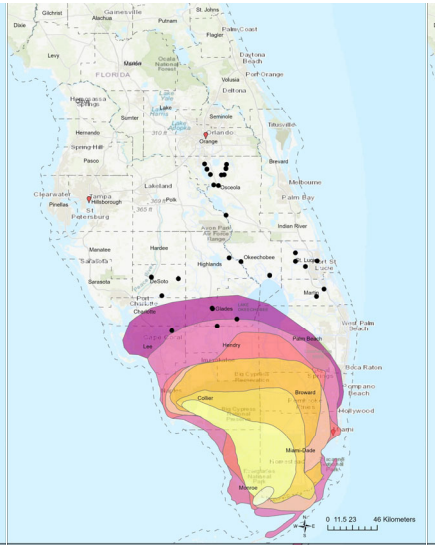
N = 26

Fall 2020



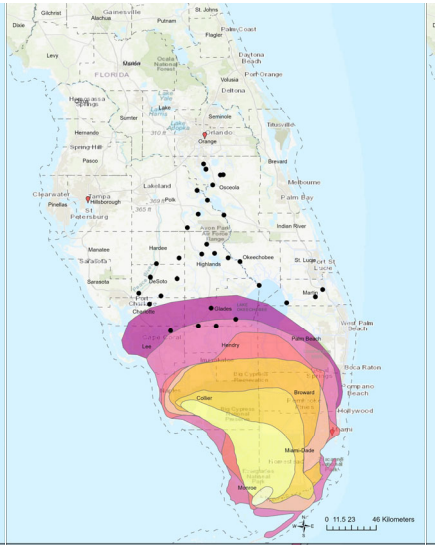
N = 20

Spring/Fall 2021



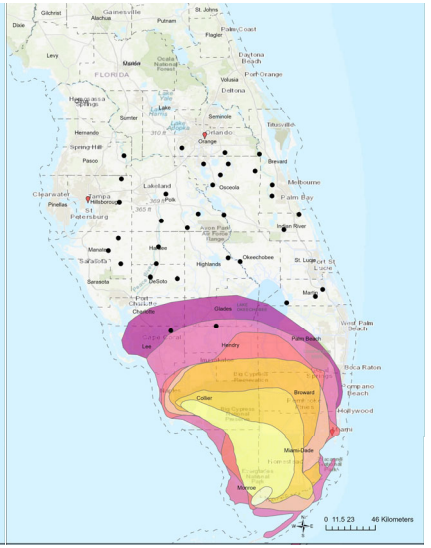
N = 28

Spring 2022



N = 31

Spring 2023



N = 34

CHALLENGES WITH EDNA METHODS

- EDNA METHODS DO NOT DETECT THE SPECIES ITSELF
- MULTIPHASE FIELD AND LAB PROCESS, SENSITIVE DATA INTERPRETATIONS
- EACH SPECIES AND HABITAT REQUIRES UNIQUE METHODS

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ALL SAMPLE SITES AND DETECTIONS

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DETECTIONS BY YEAR

2019 | 2020 | 2021 | 2022 | 2023

N = 26 | N = 20 | N = 28 | N = 31 | N = 34

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