Effect of a winter freeze event on red and black mangroves at an expanding range limit in Northern, Florida

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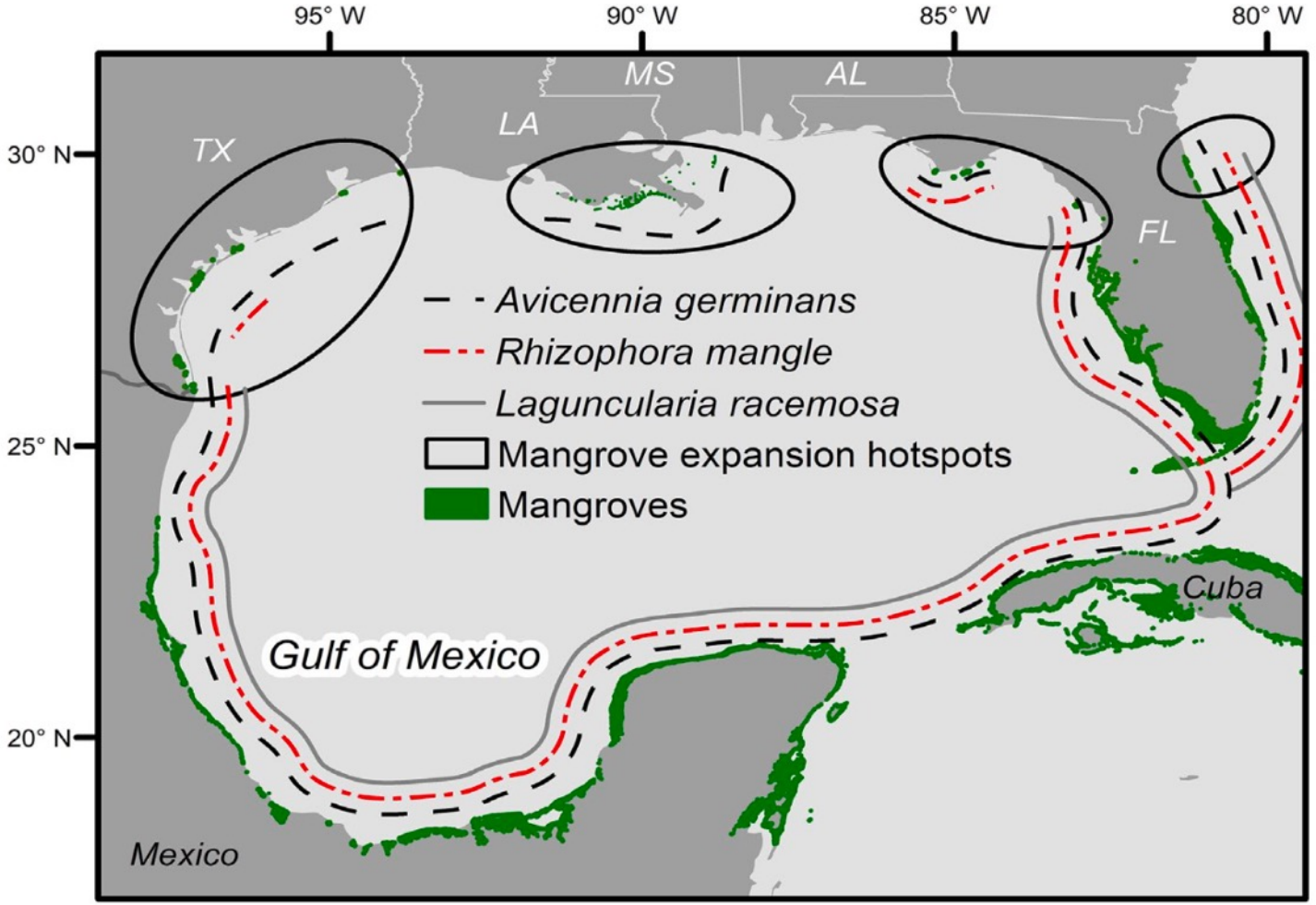
Mangrove Range Expansion

- Study located in Northwestern Florida that includes the northern range limits of *A. germinans* and *R. mangle* along the Gulf of Mexico.



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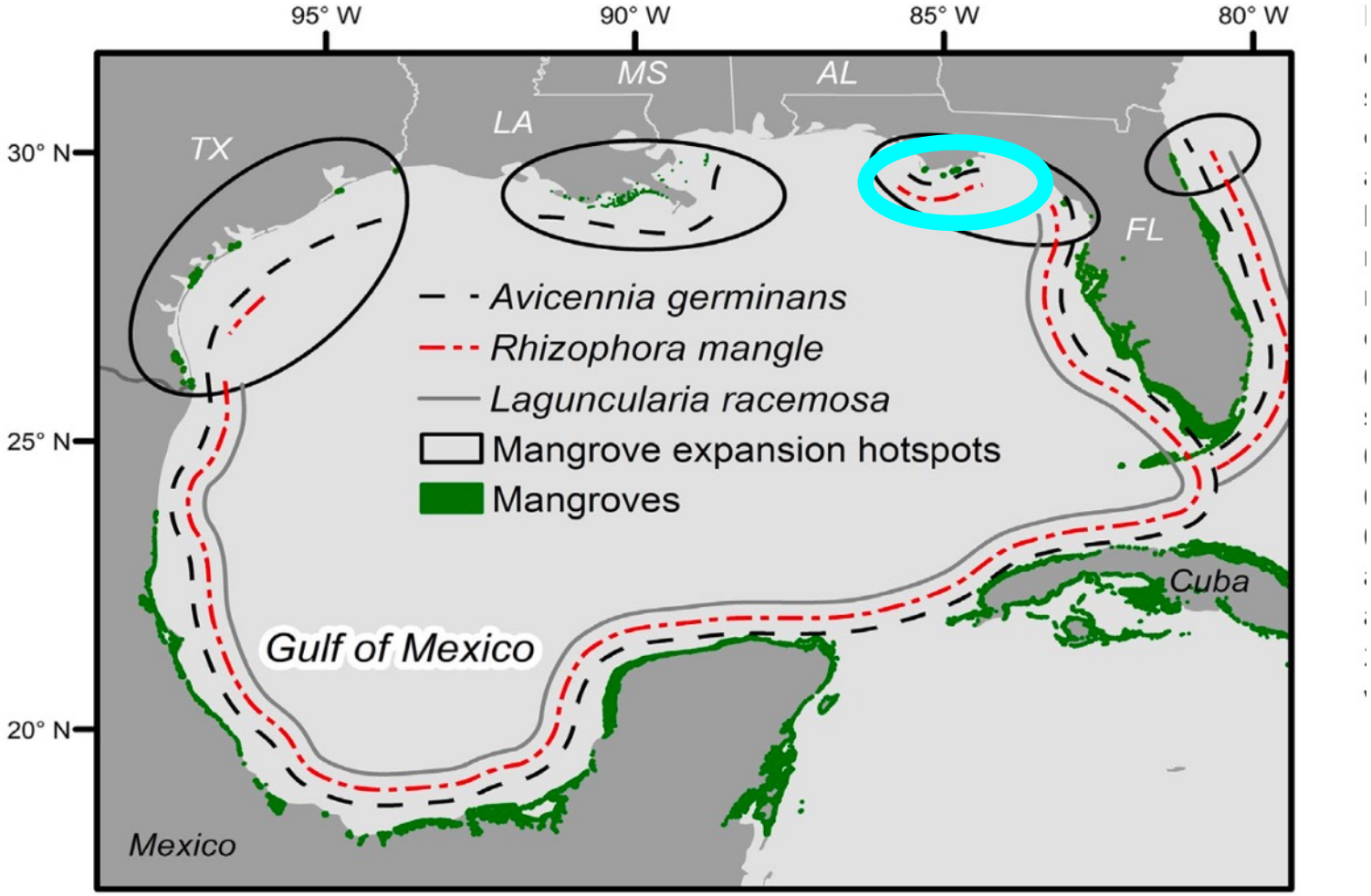

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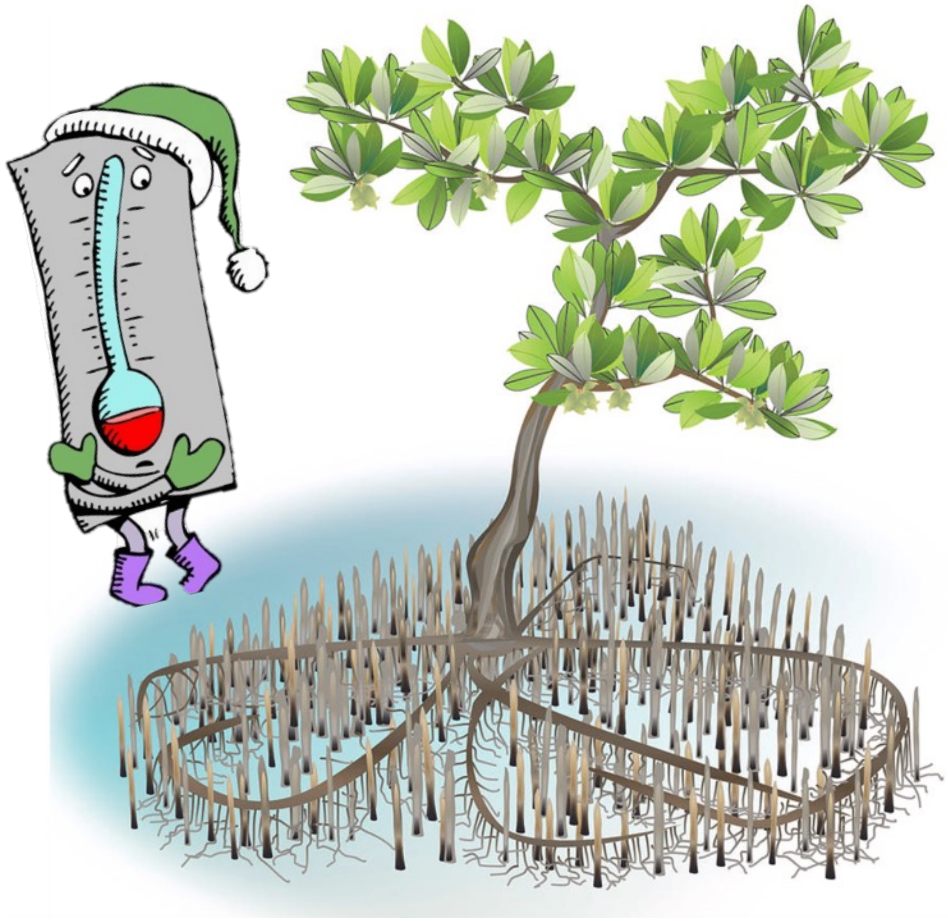
What is Known: Black Mangrove Threshold

- Field observations of *A. germinans* indicated survival but leaf damage as low as **-4 ° C,** but mature trees suffer near-total mortality at temperatures below **-6.7 ° C** (Stevens et al., 2006).



Knowledge Gaps

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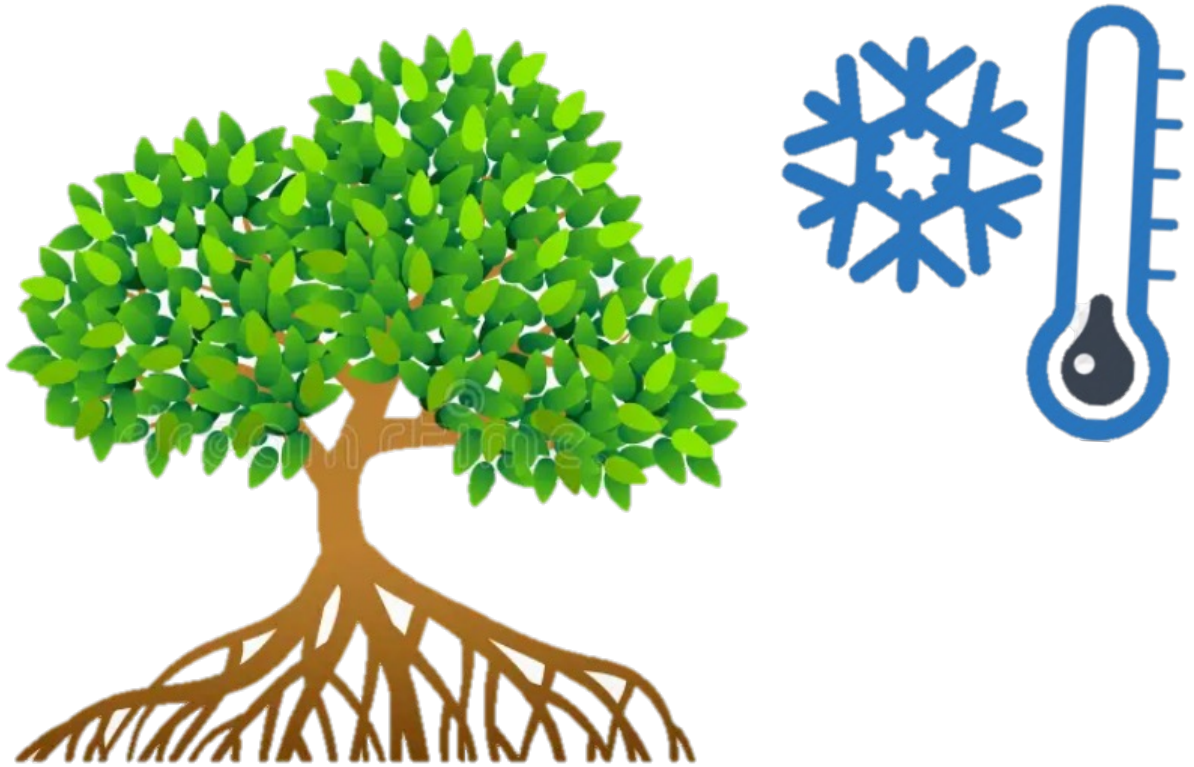

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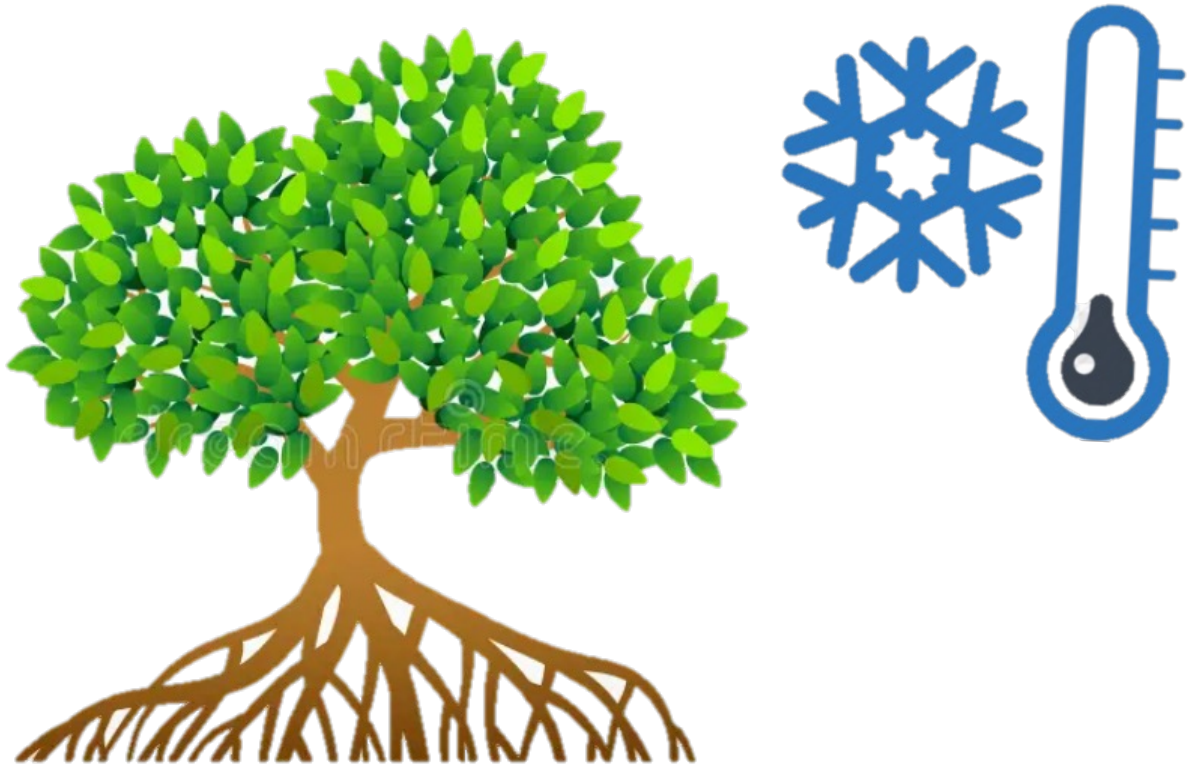

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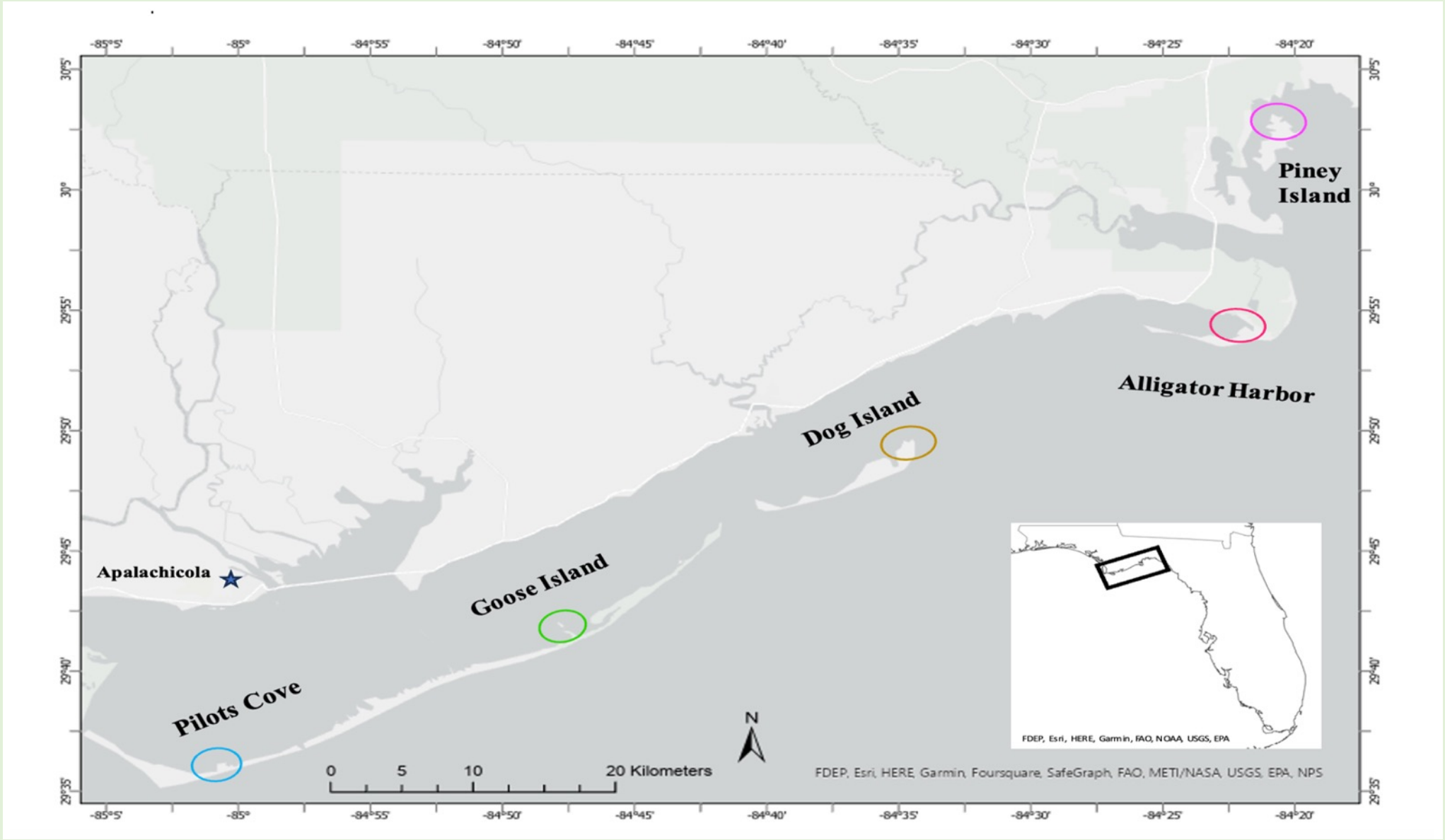

Study sites across 1°of latitude

atitude

-85°5'
-84°30'
-84°25'
-84°20'
30°5'
30°
29°55'
29°50'
29°45'
29°40'
29°35'
Piney
Island
Alligator Harbor
Ap
FDEP, Esri, HERE, Garmin, FAO, NOAA, USGS, EPA
Garmin, Foursquare, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS

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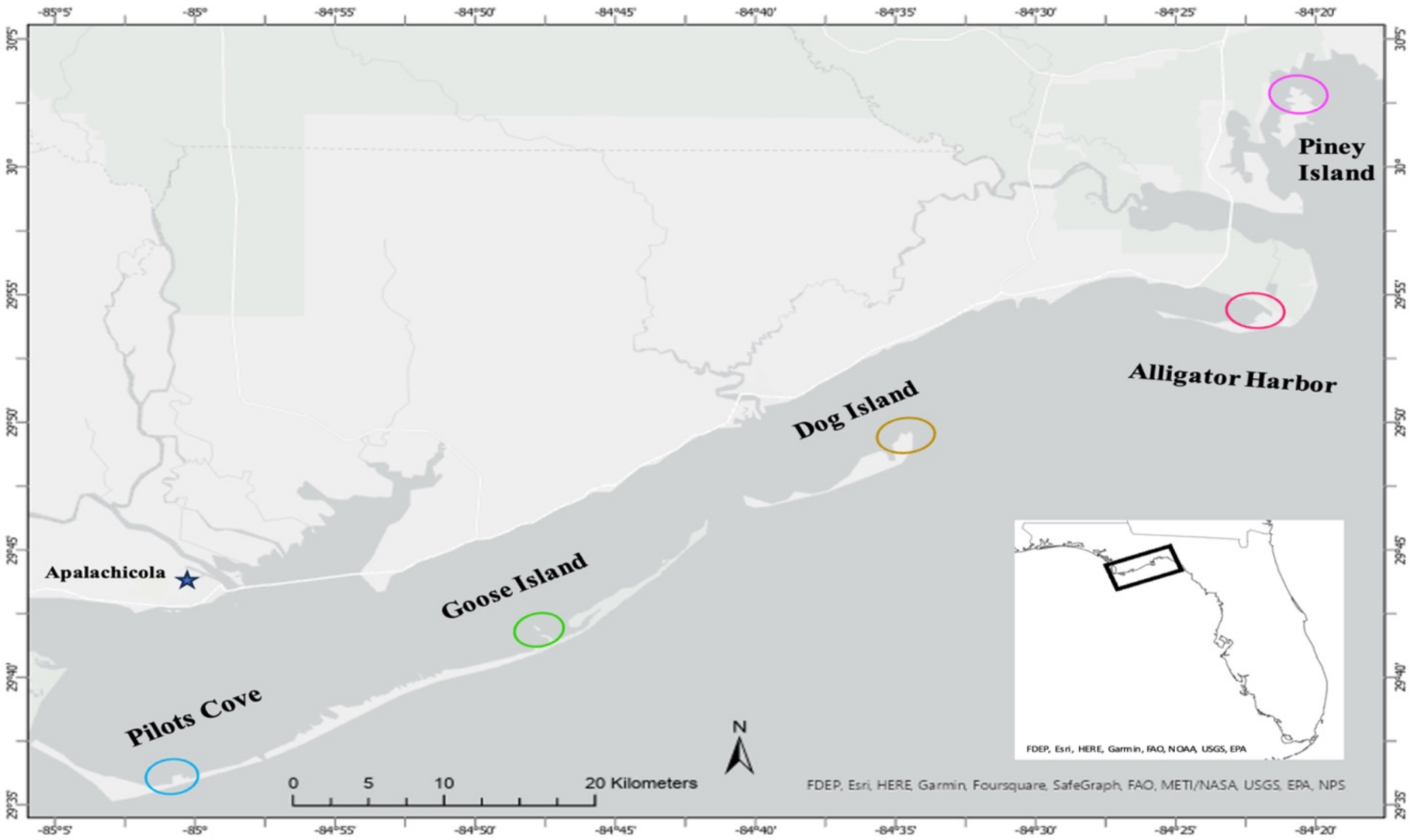

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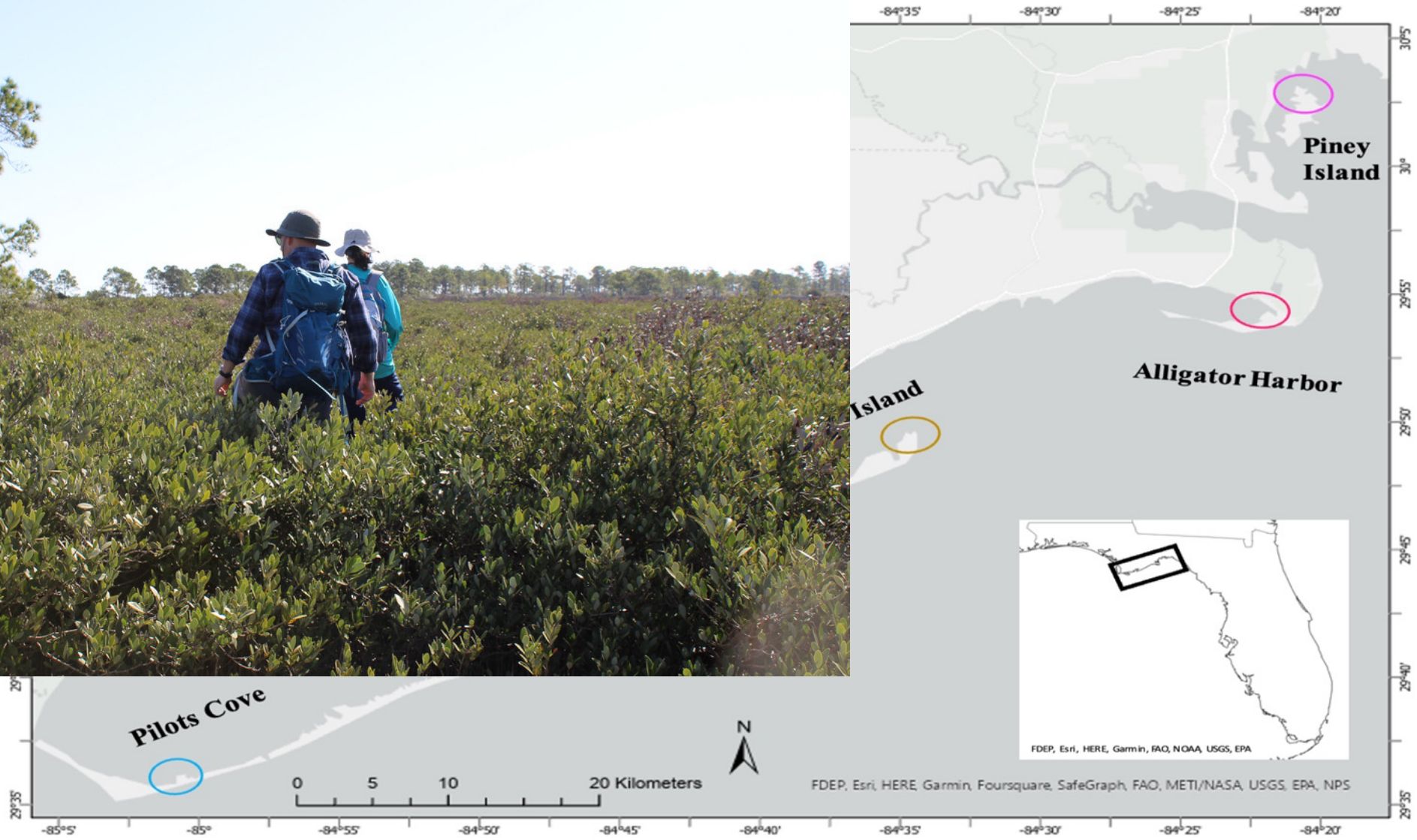

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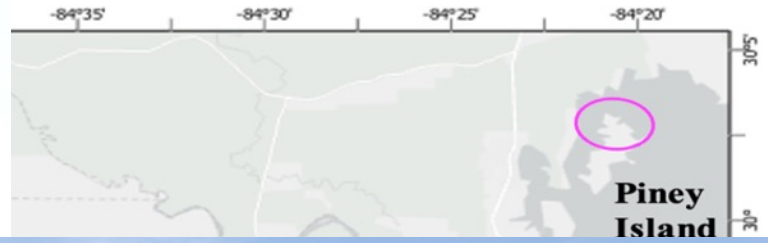

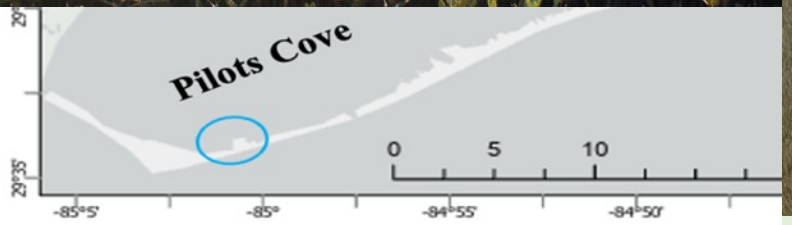

Photo Credit: Jen Bueno

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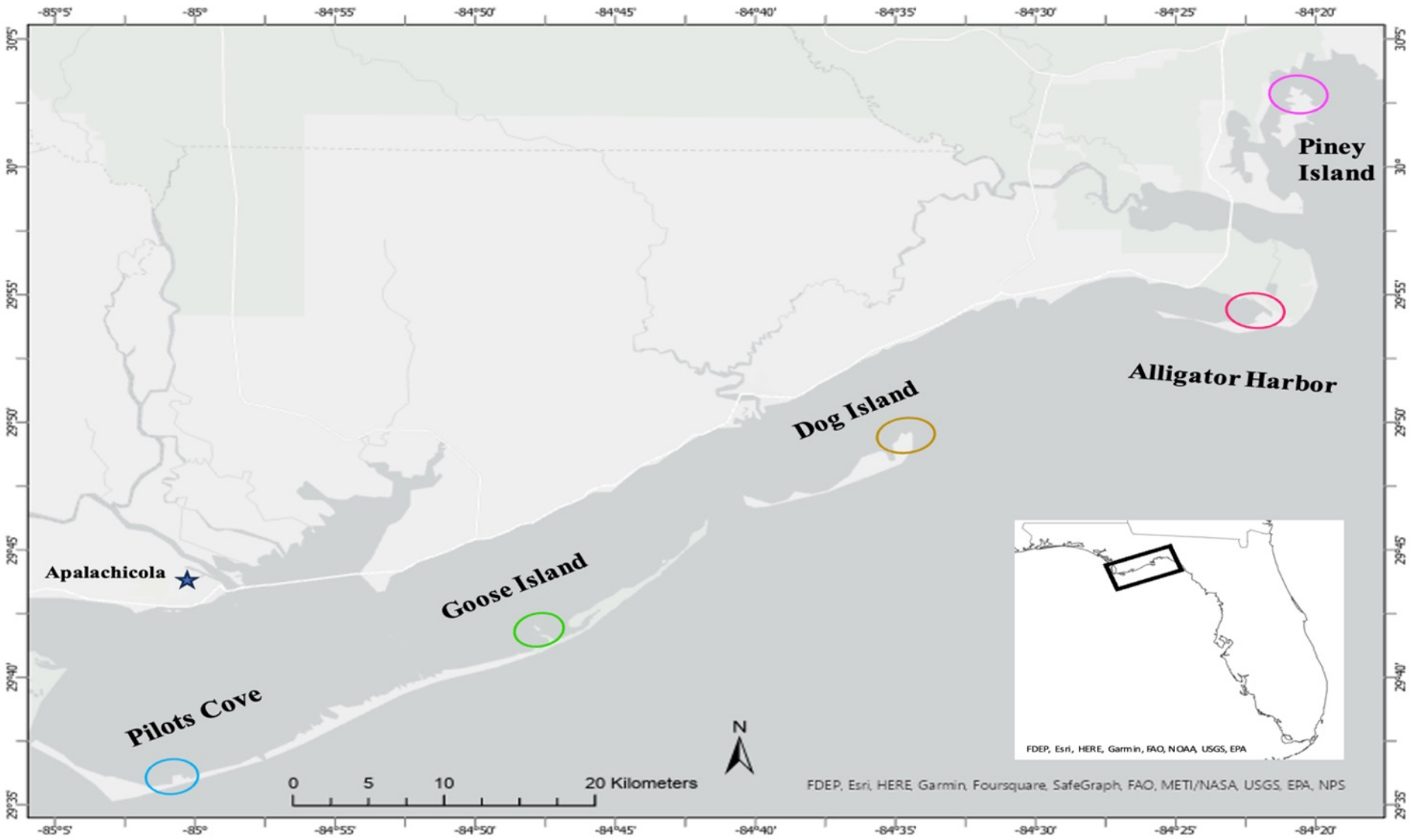

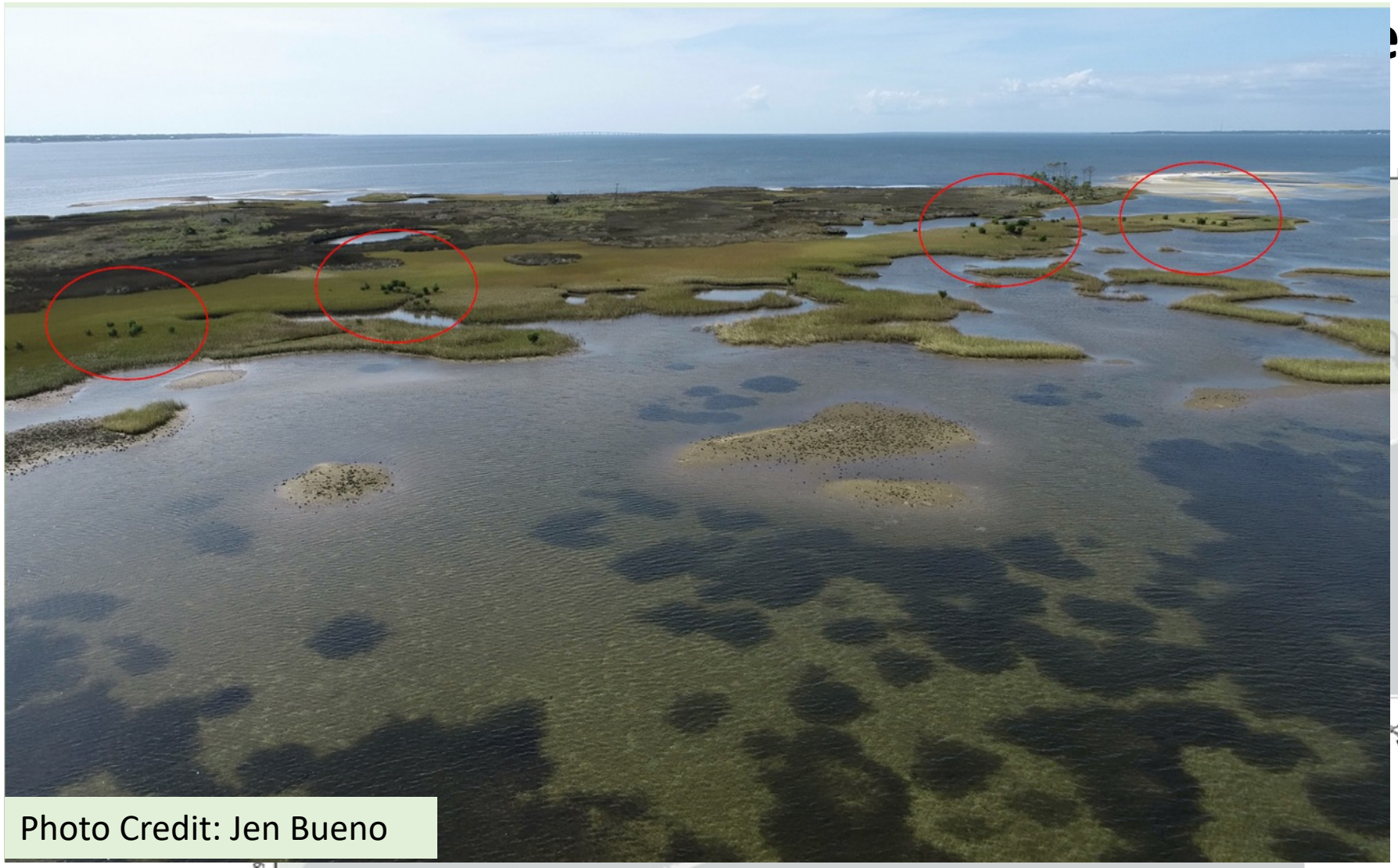

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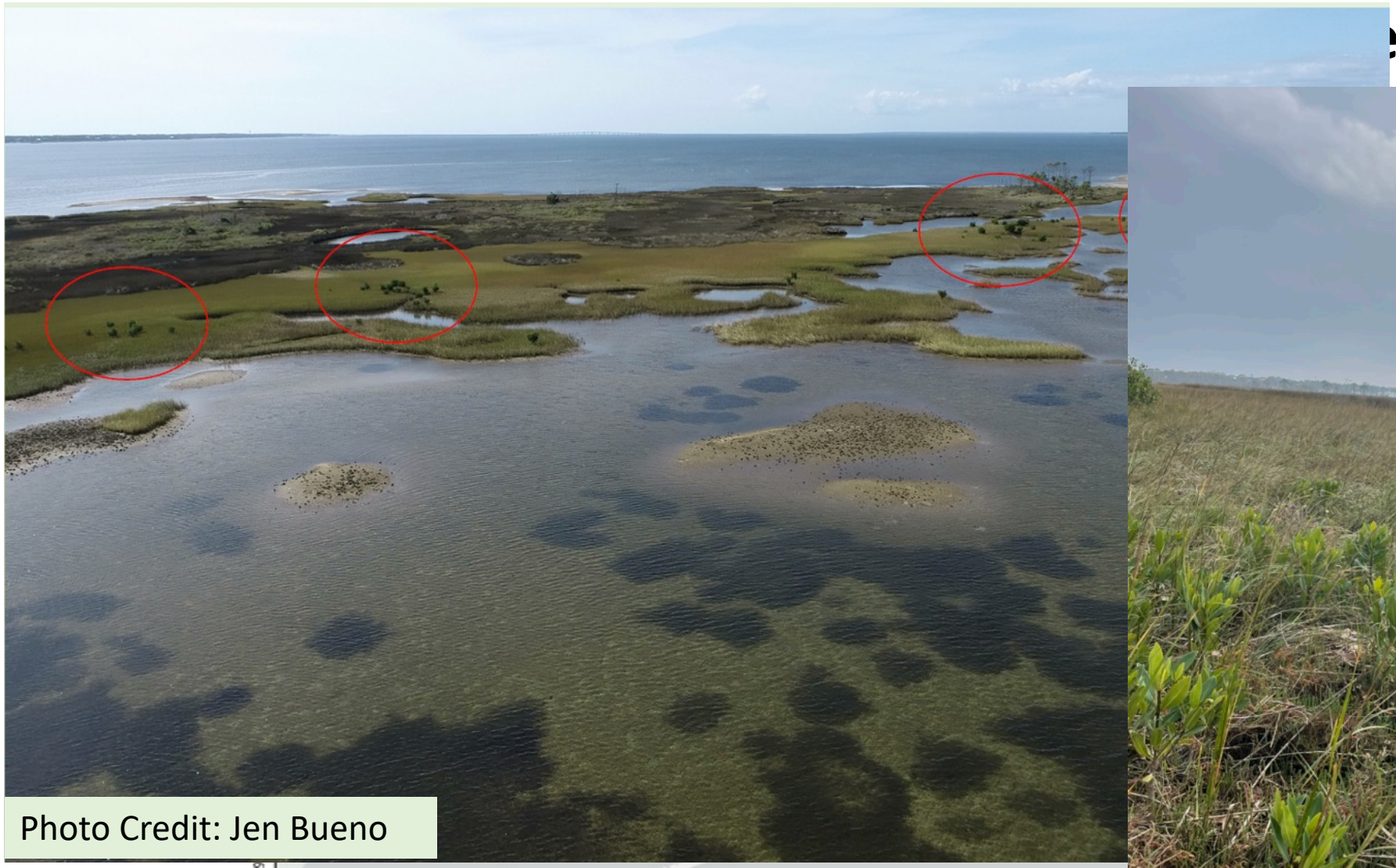

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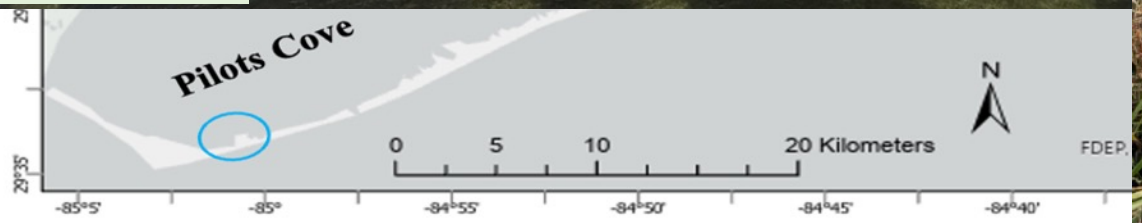

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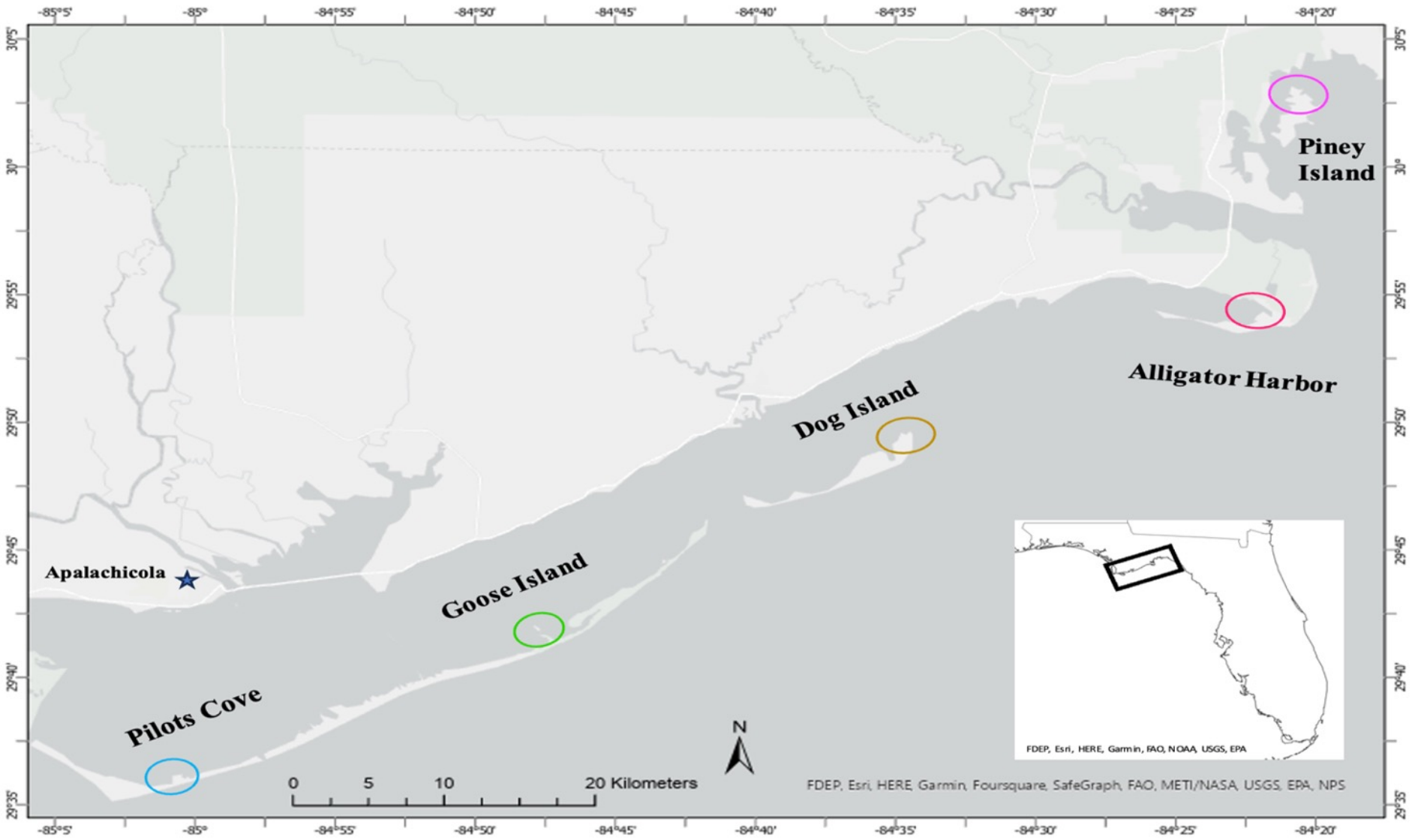

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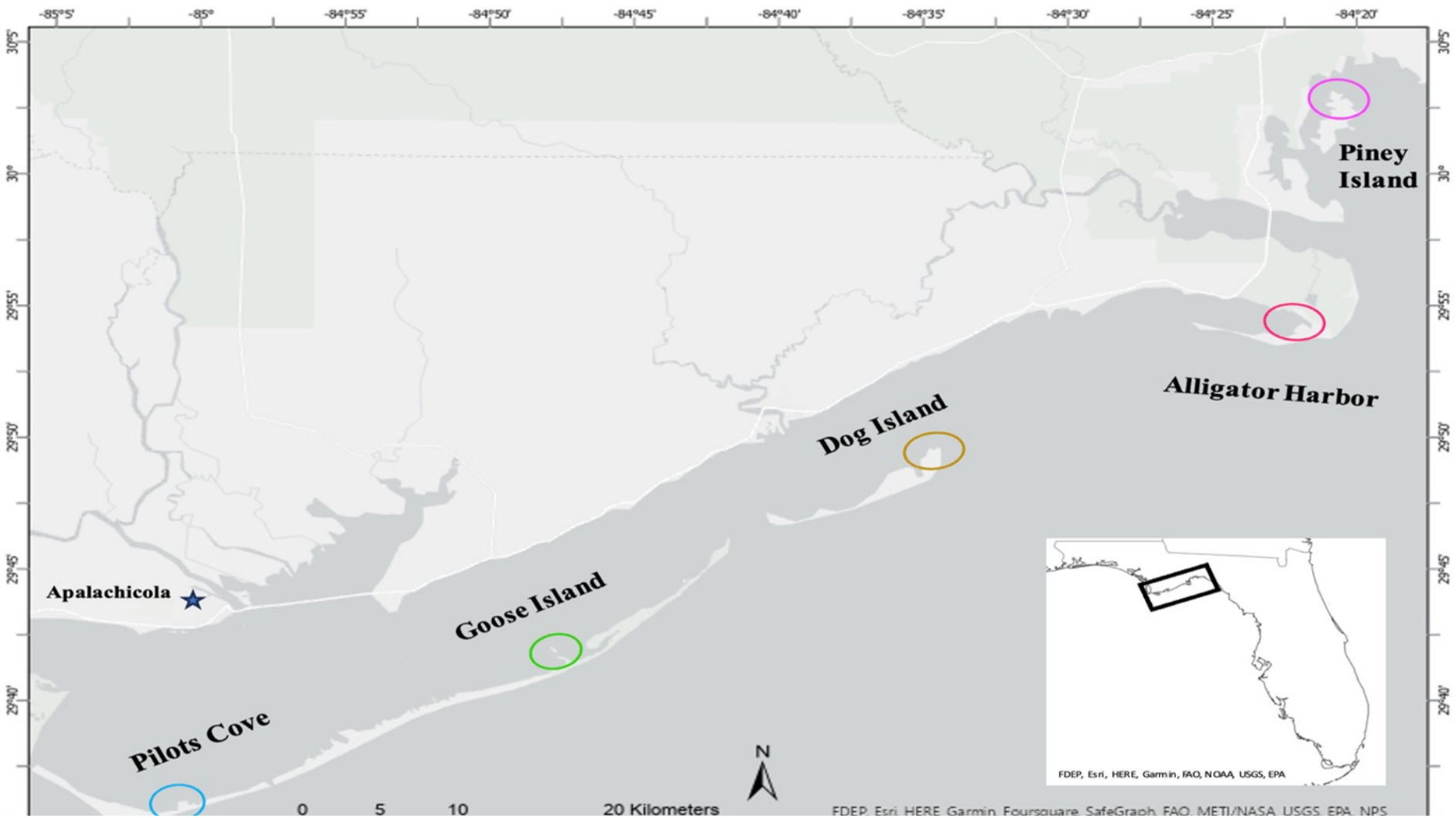


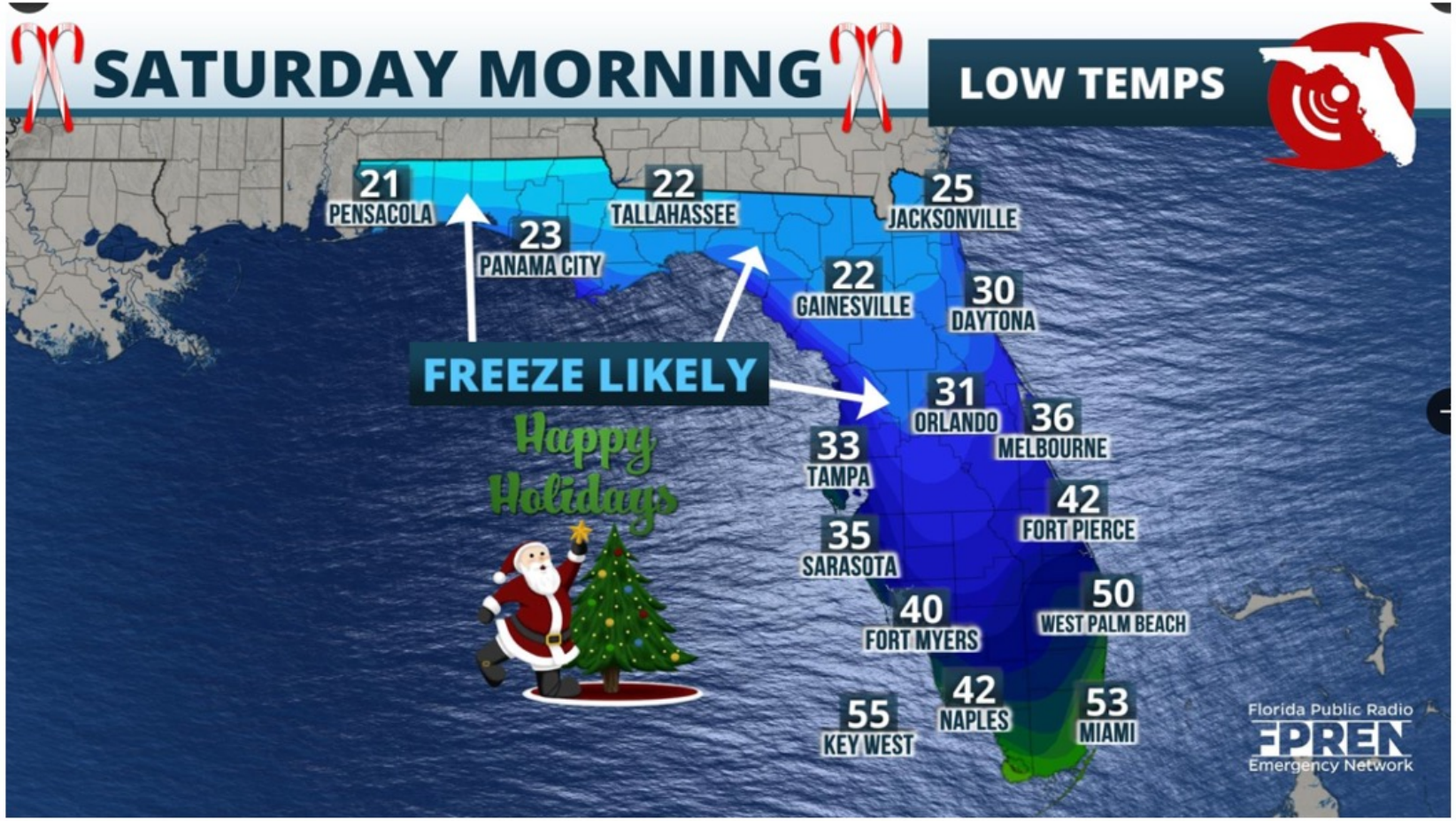
Research Question: Does winter air temperature affect the population structure seen across the latitudinal gradient? (i.e warmer in southernmost site (PC) and coldest in north (PI).

Air Temperature Field Methods

- iButton air temperature loggers were deployed in mangrove canopies at the fringe edge and interior section of the islands. Loggers were deployed on PVC poles in *Spartina alterniflora & Juncus roemerianus*

December 2022 Freeze Event

- From December 24th to 26th, minimum daily temperatures dropped below -4°C



https://www.jacksonville.com/story/weather/severe/2022/12/22/florida-cold-front-freezing-temperatures-warnings-christmas-holiday-travel/69749957007/

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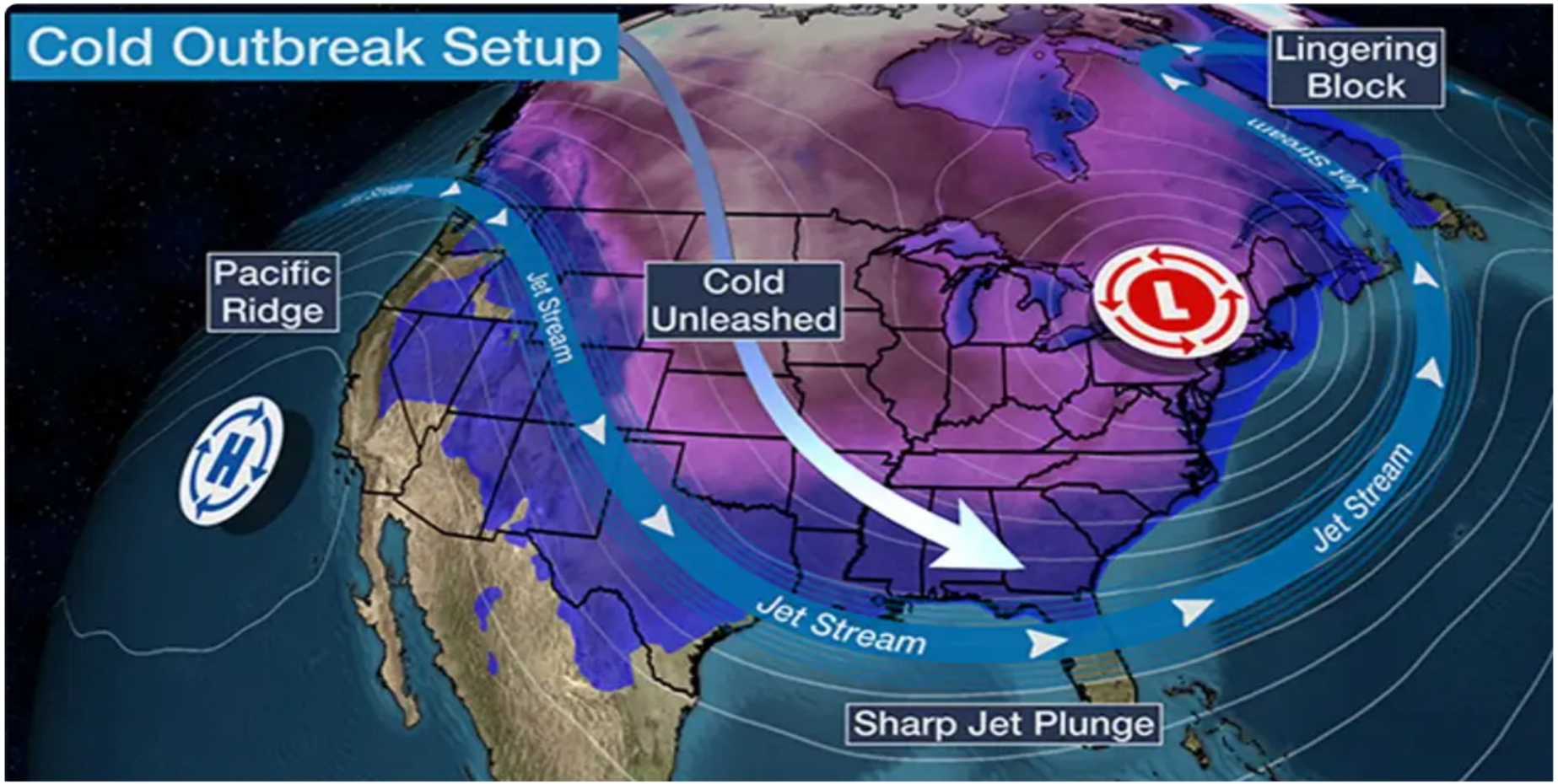
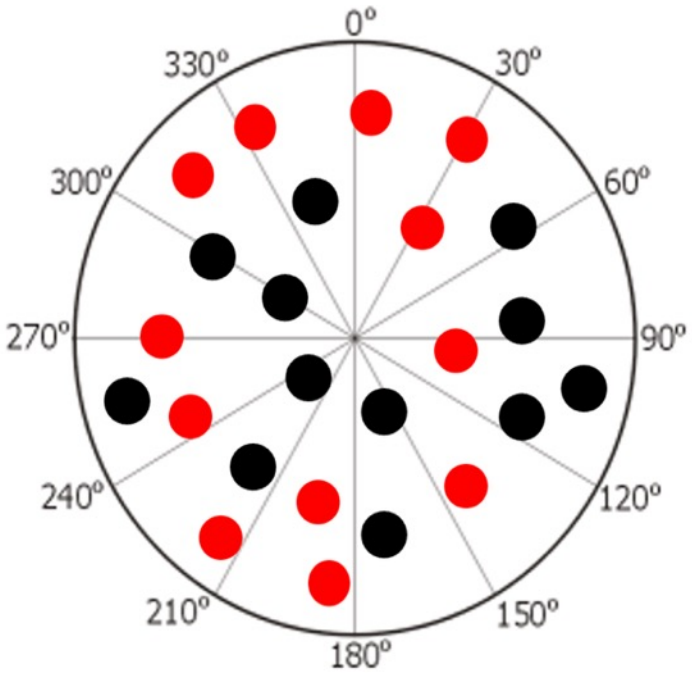


https://weather.com/storms/winter/news/2022-12-15-major-arctic-cold-outbreak-plains-midwest-south-christmas-week

Freeze Burn & Mortality Field Methods

Freeze Burn Plot:
-tall (>50cm)
-short(<50cm)



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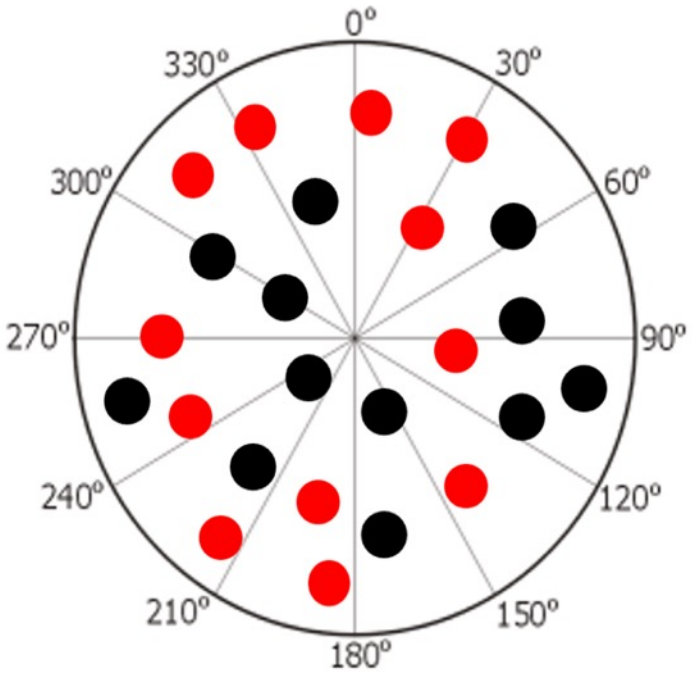

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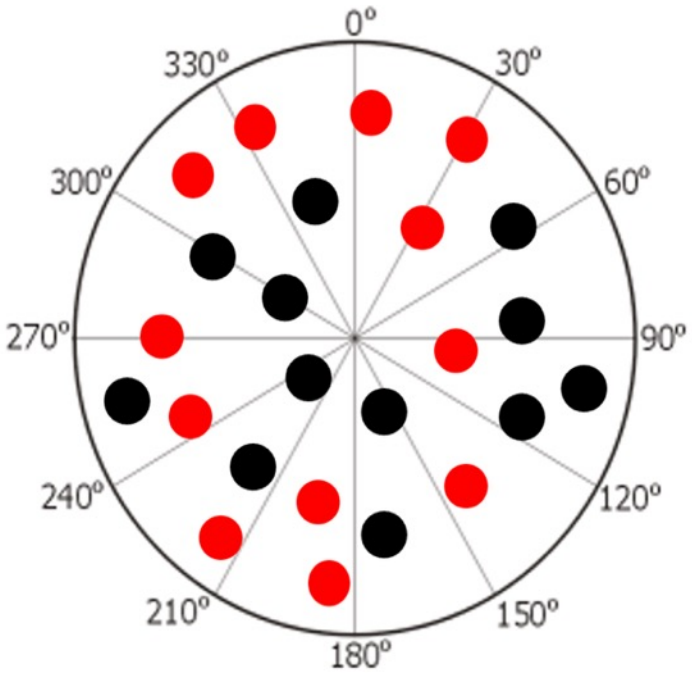
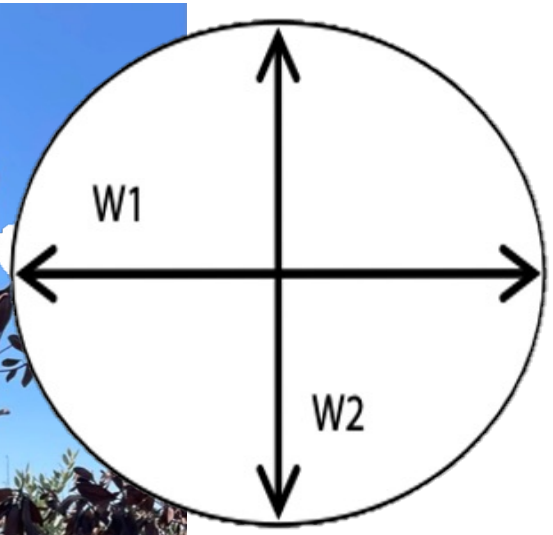


1) Height (cm)



2) Two perpendicular crown widths (cm)

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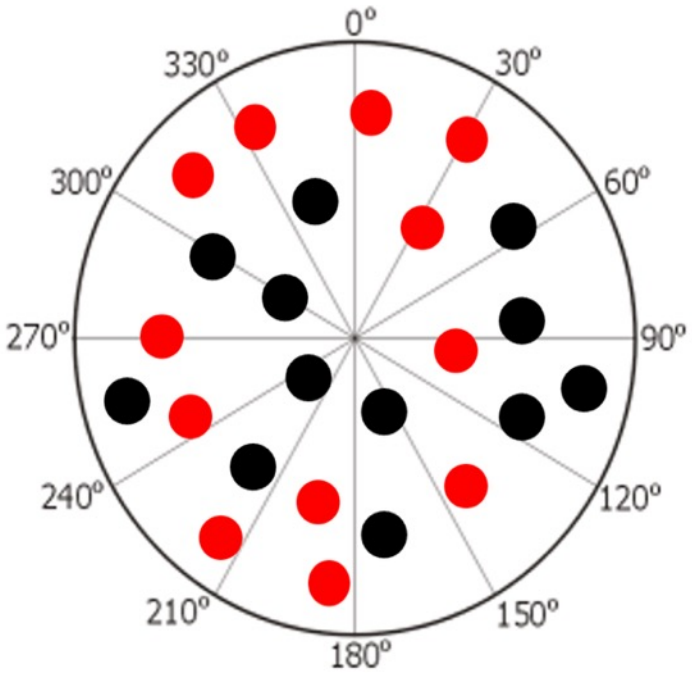

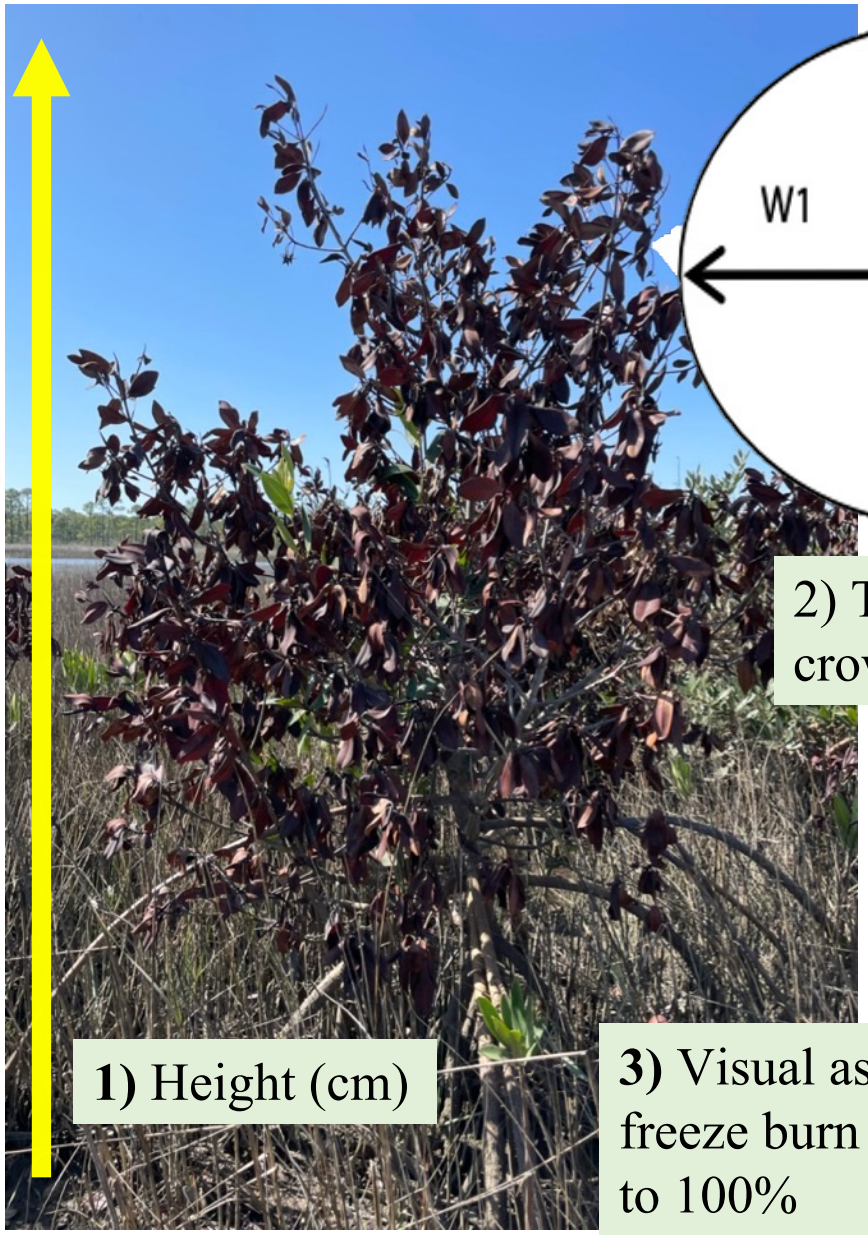

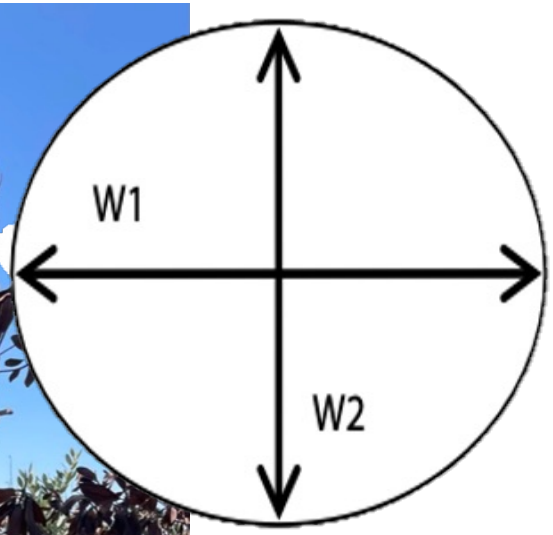

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3) Visual assessment of freeze burn ranging from 0 to 100%

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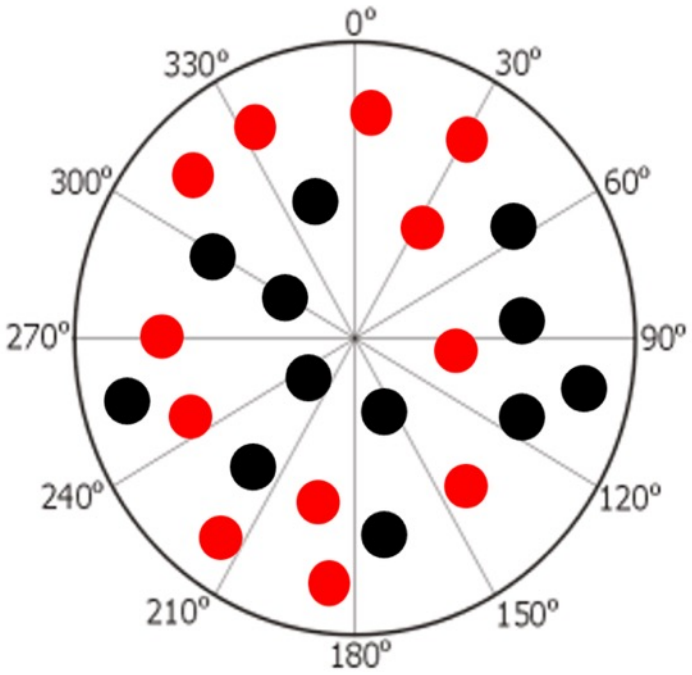

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Mangroves > 1 m
-Species
-Height (cm)
-Mortality status (Dead or Alive) with percent burn

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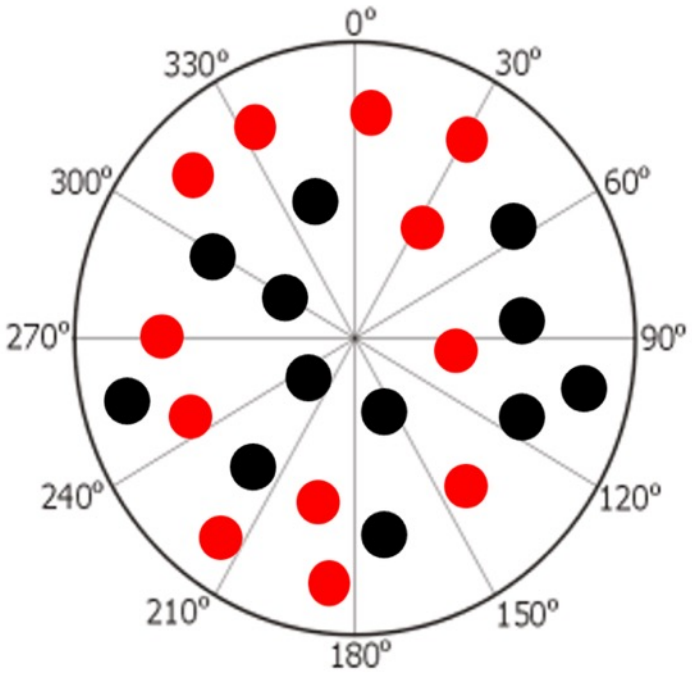

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Pre and Post Winter Freeze Pictures

Piney Island

December 13th, 2022

January 18th, 2023

Pre and Post Winter Freeze Pictures

Pilots Cove

December 12th, 2022

January 23rd, 2023

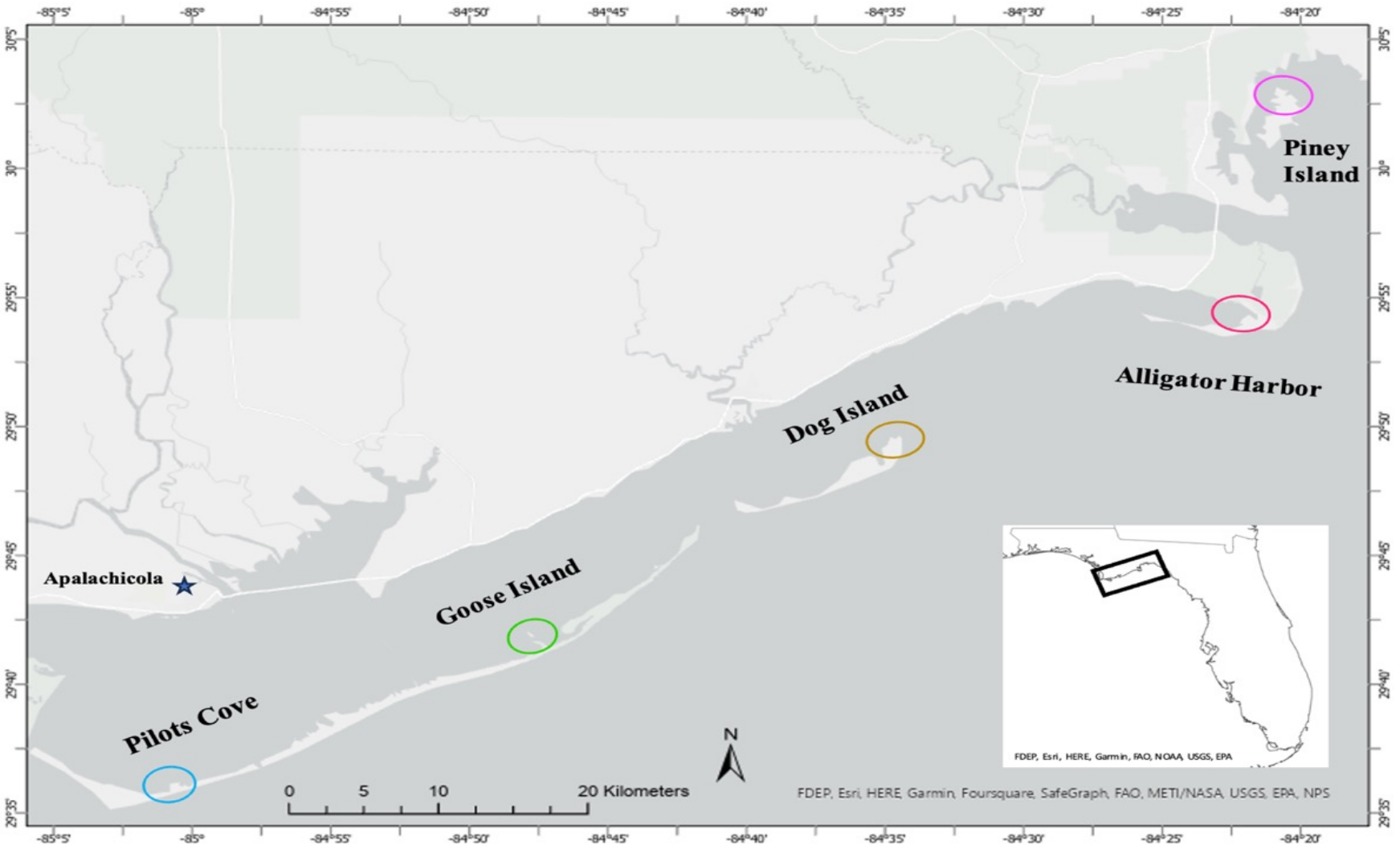
Pre and Post Winter Freeze Pictures

Goose Island, March 1st, 2023

Pre and Post Winter Pictures

Temperature Results

- ***A. germinans*** freeze damage threshold: **-5.1 °C to -6.35 °C** *(22.8 °F – 20.6 °F).*
- ***R. mangle*** freeze damage threshold: **-4.10 °C to -4.95 °C** *(24.6 °F – 23 °F)*



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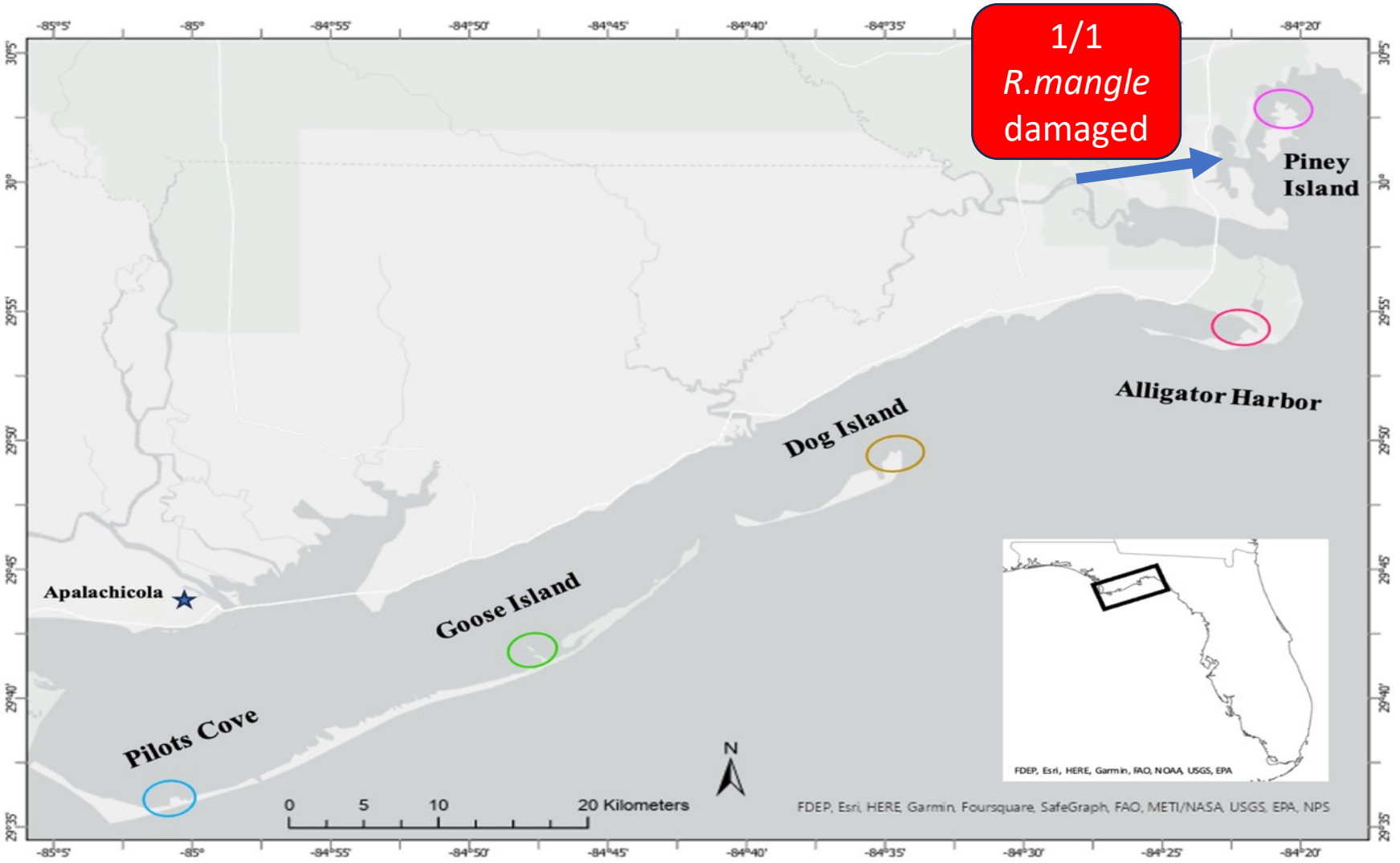

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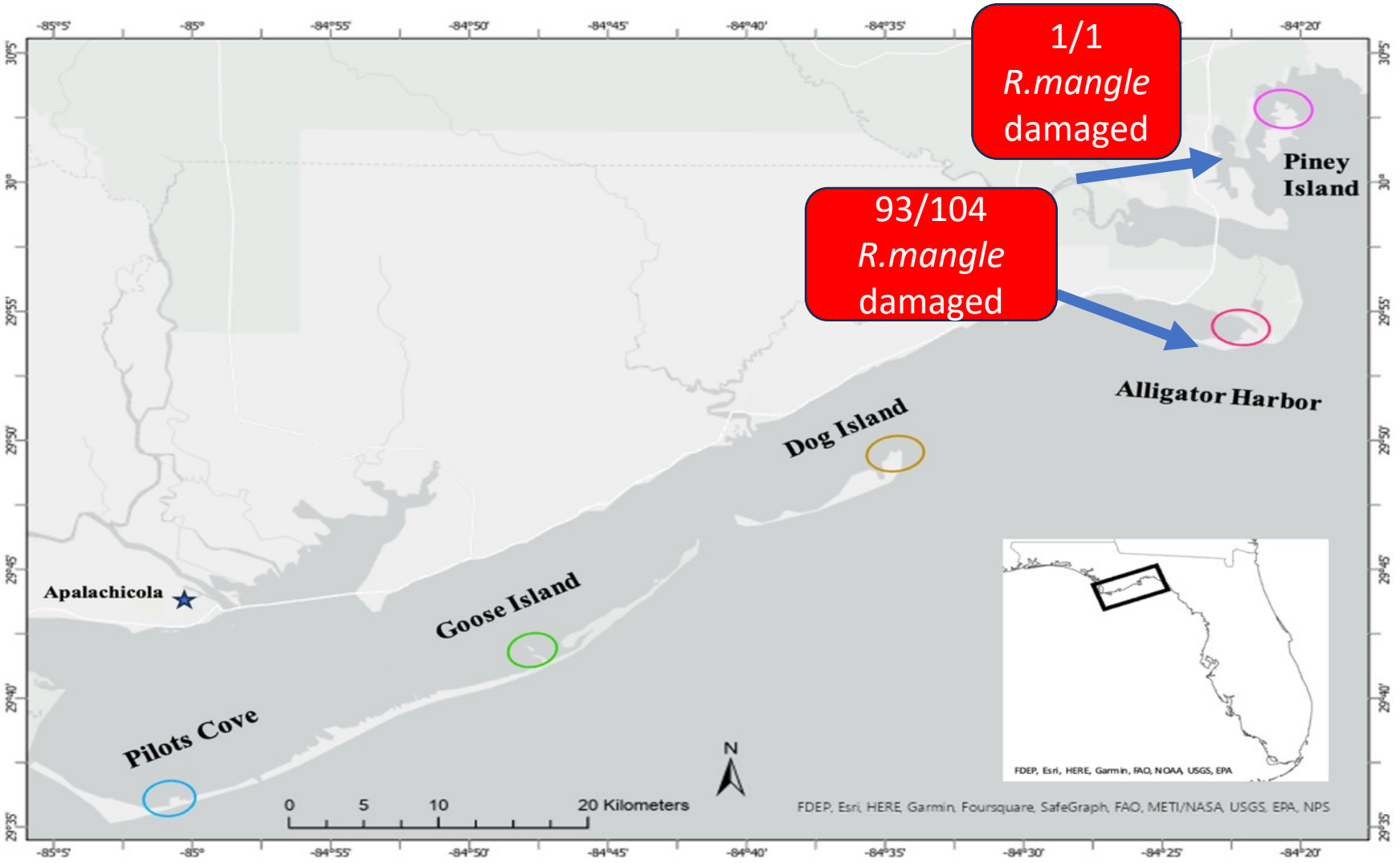

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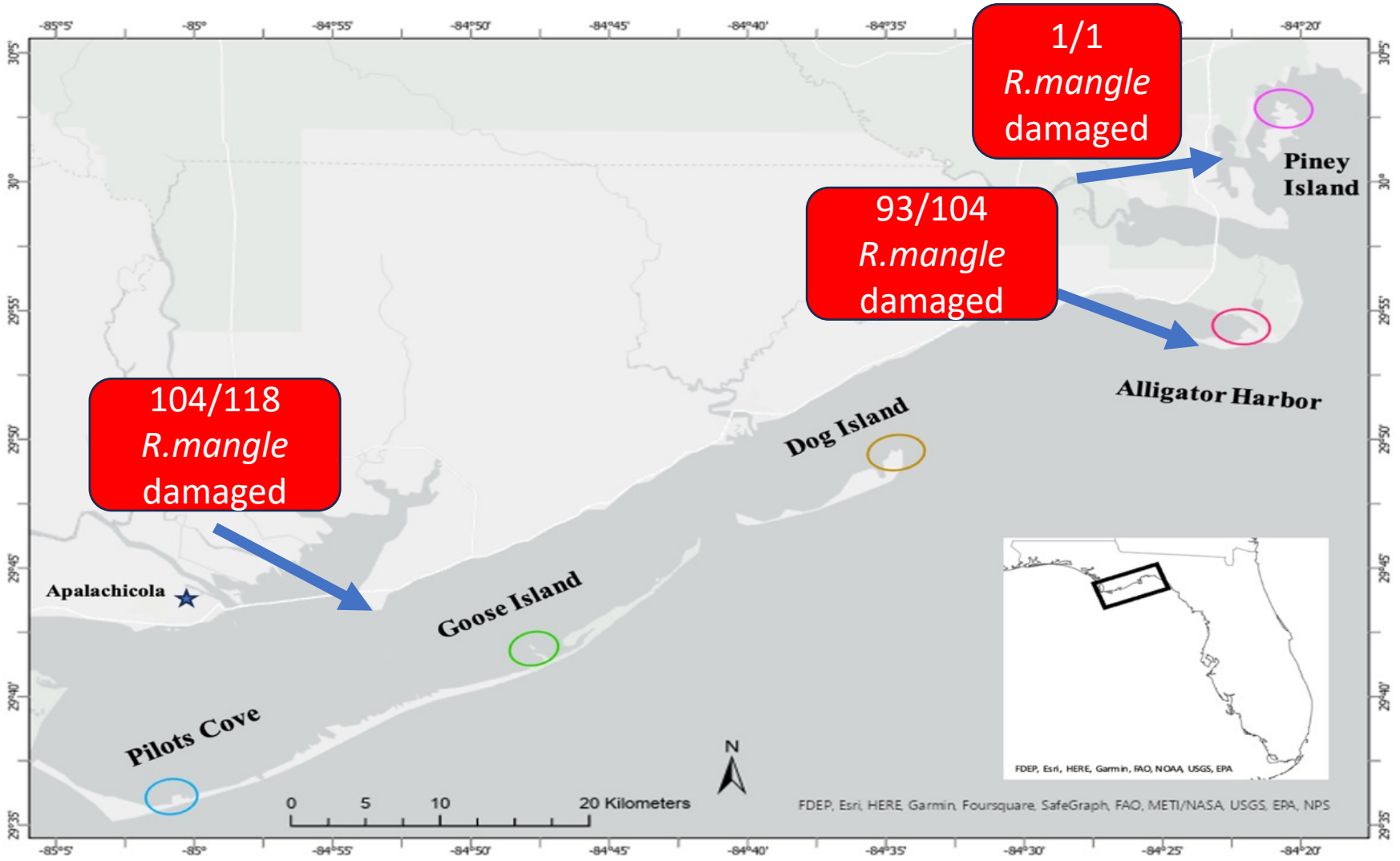

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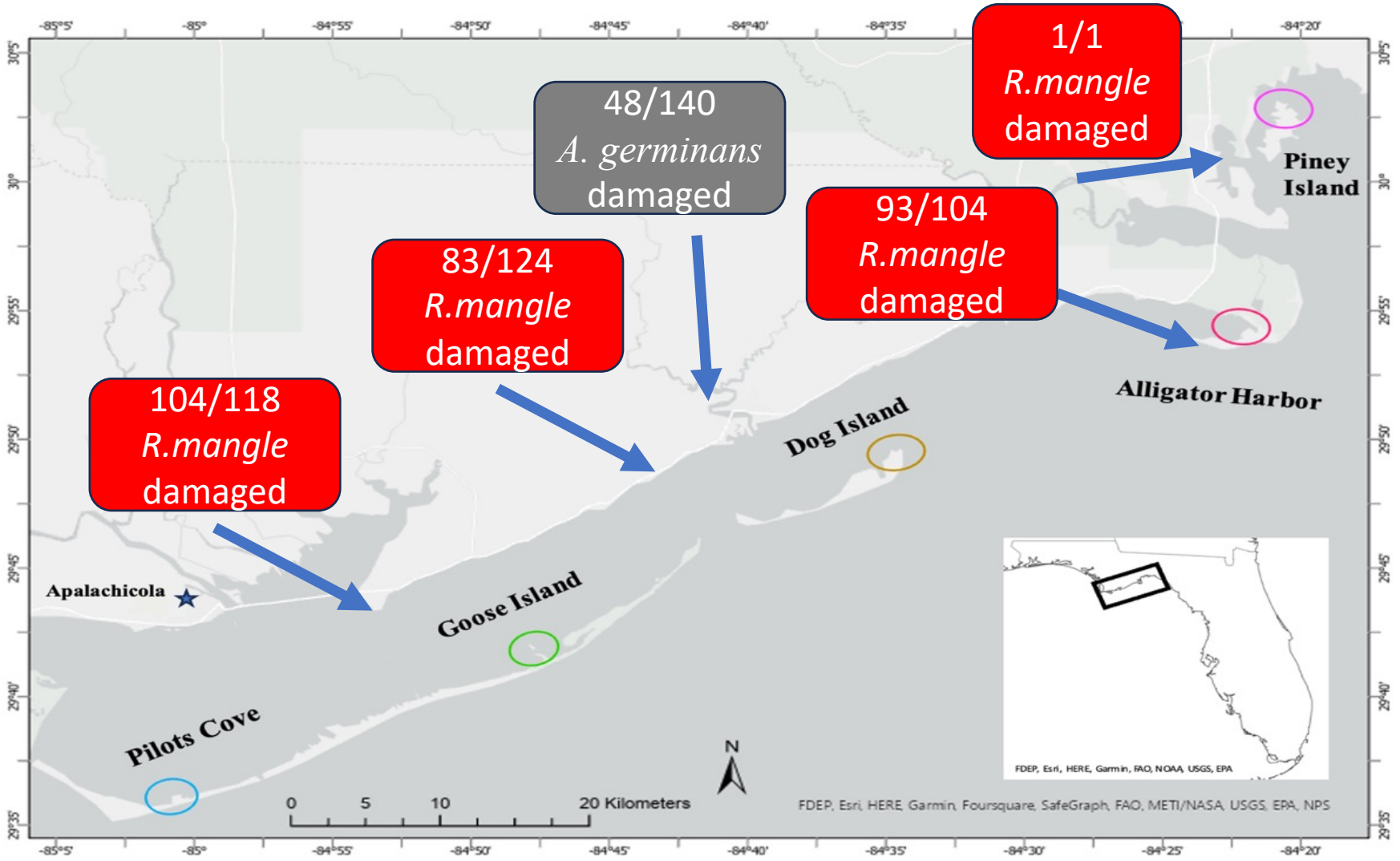
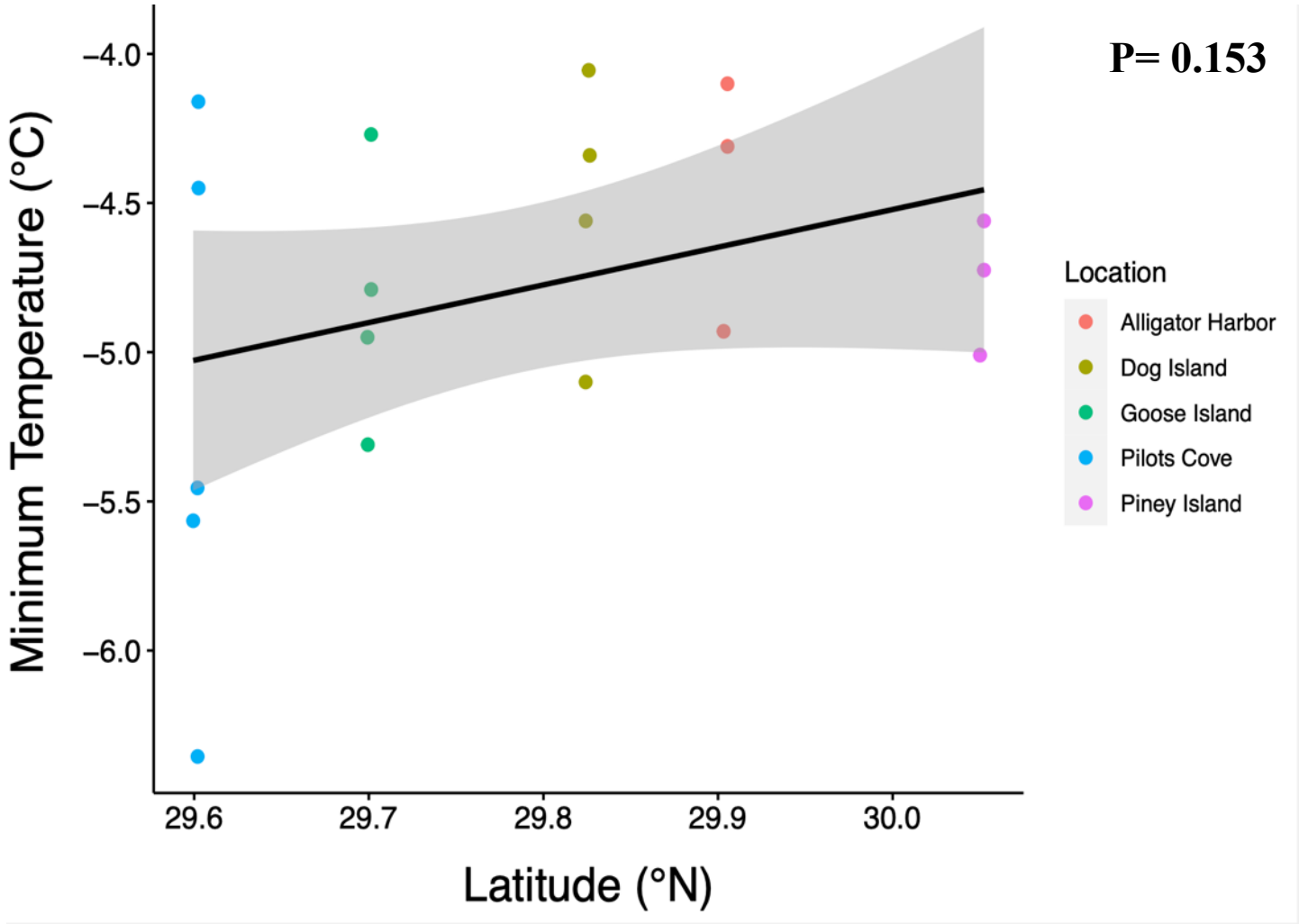


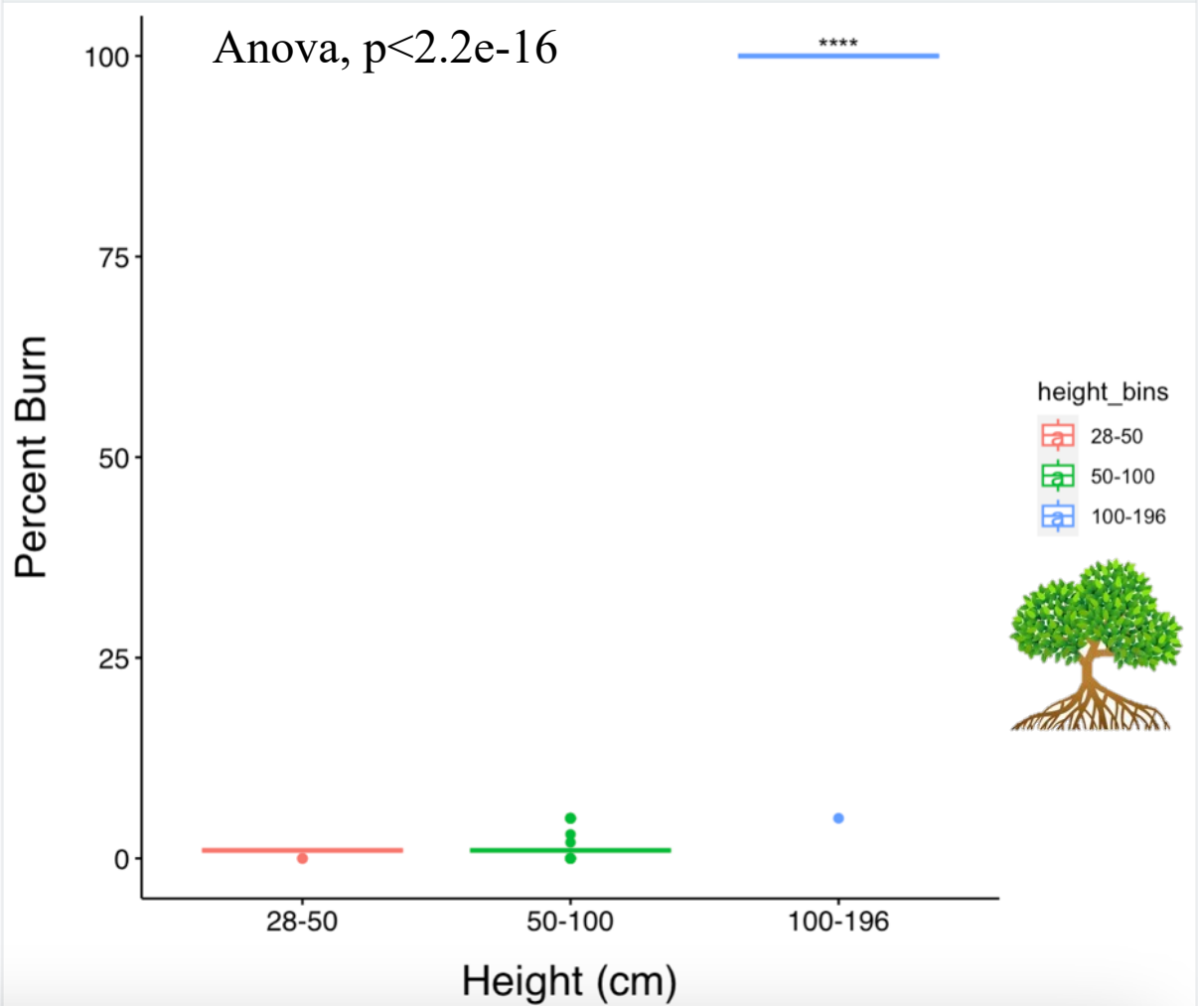
Air Temperature Logger Results

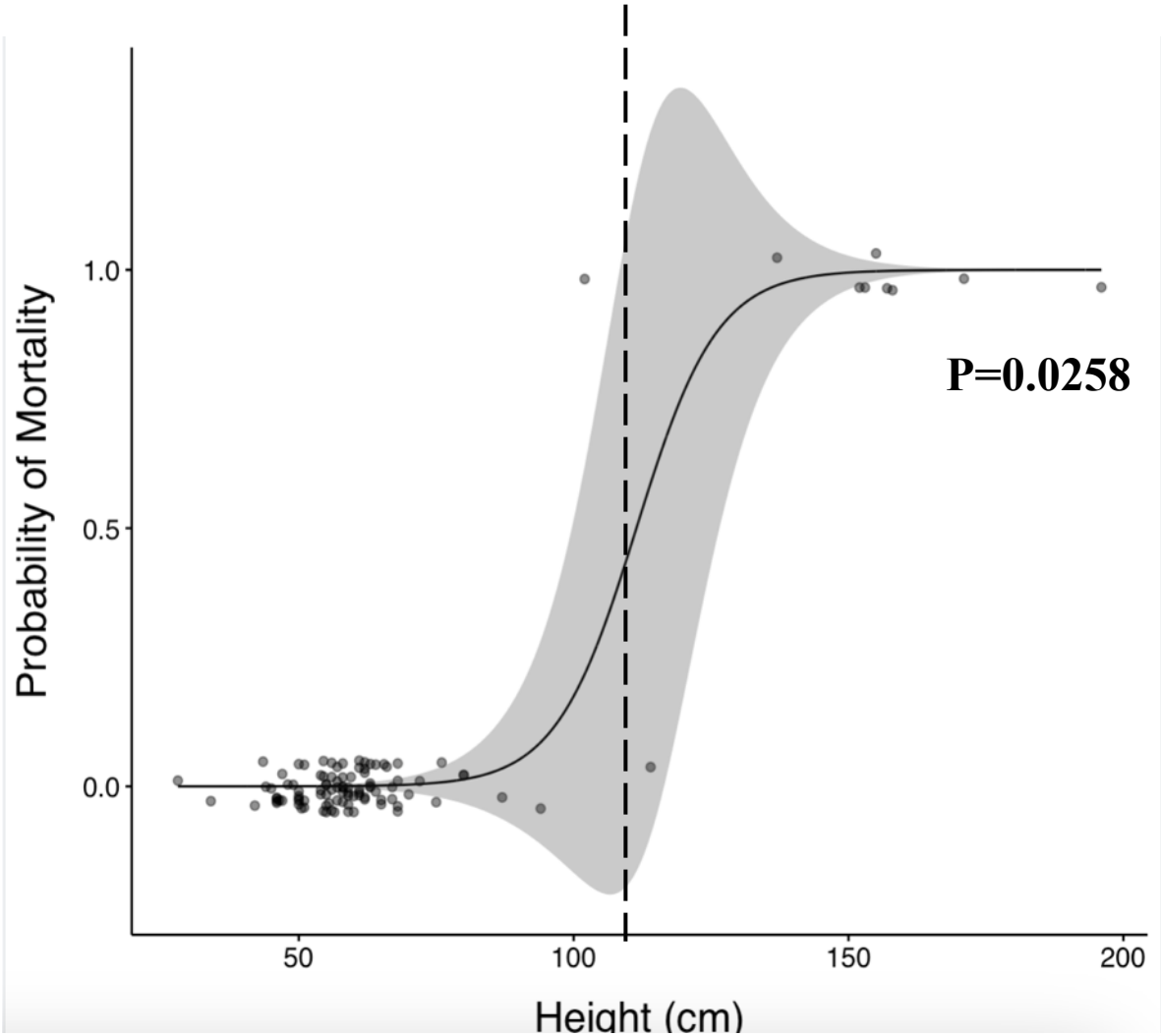
- Contrary to expectations, loggers did not record warmer temperatures in the south compared to the north; instead there was a non-significant trend in the opposite direction.



Alligator Harbor Results

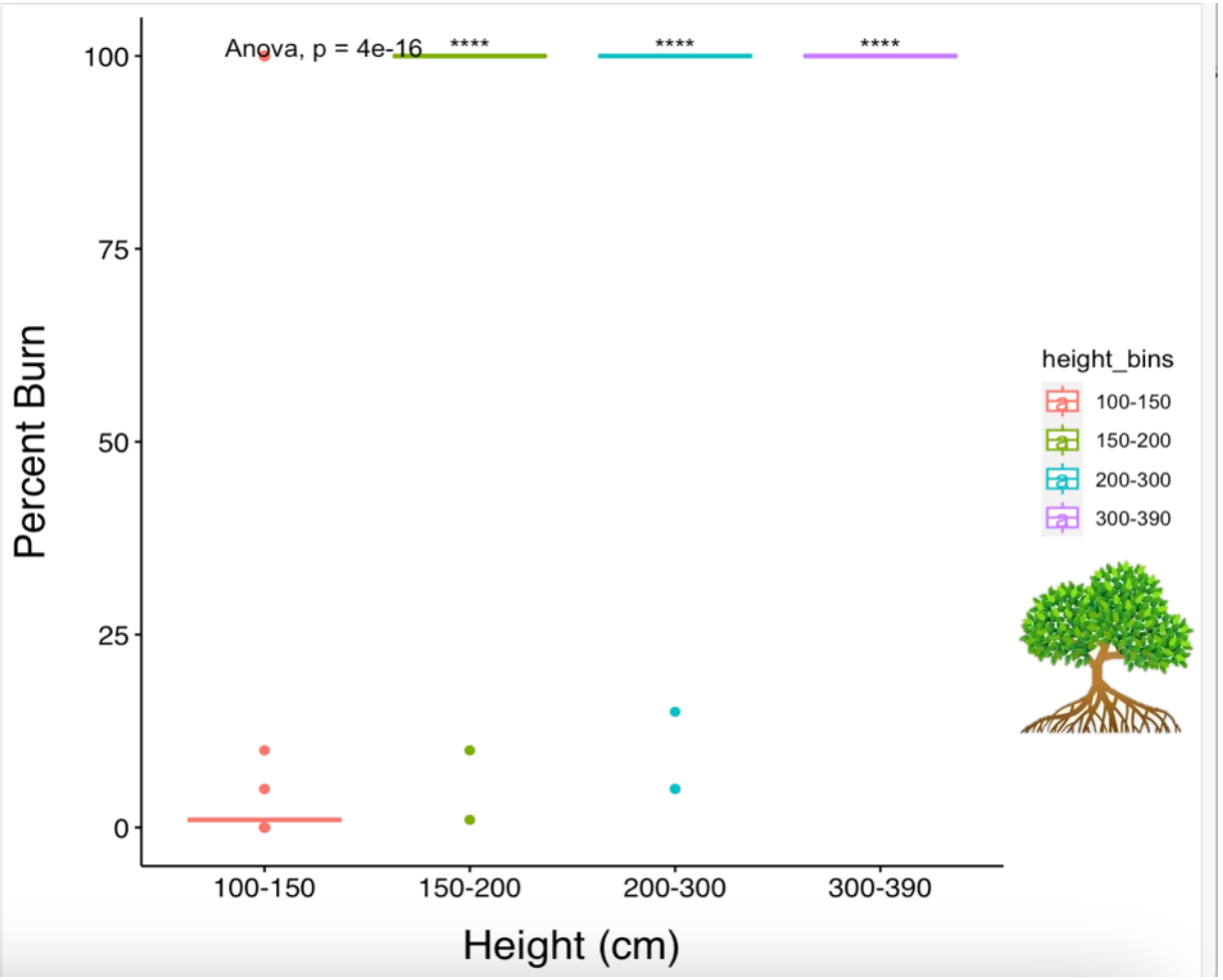
- Significant differences in freeze burn as a function of height for *R. mangle*, with taller individuals exhibiting higher freeze damage. The observed mortality threshold was around **111.5 cm**

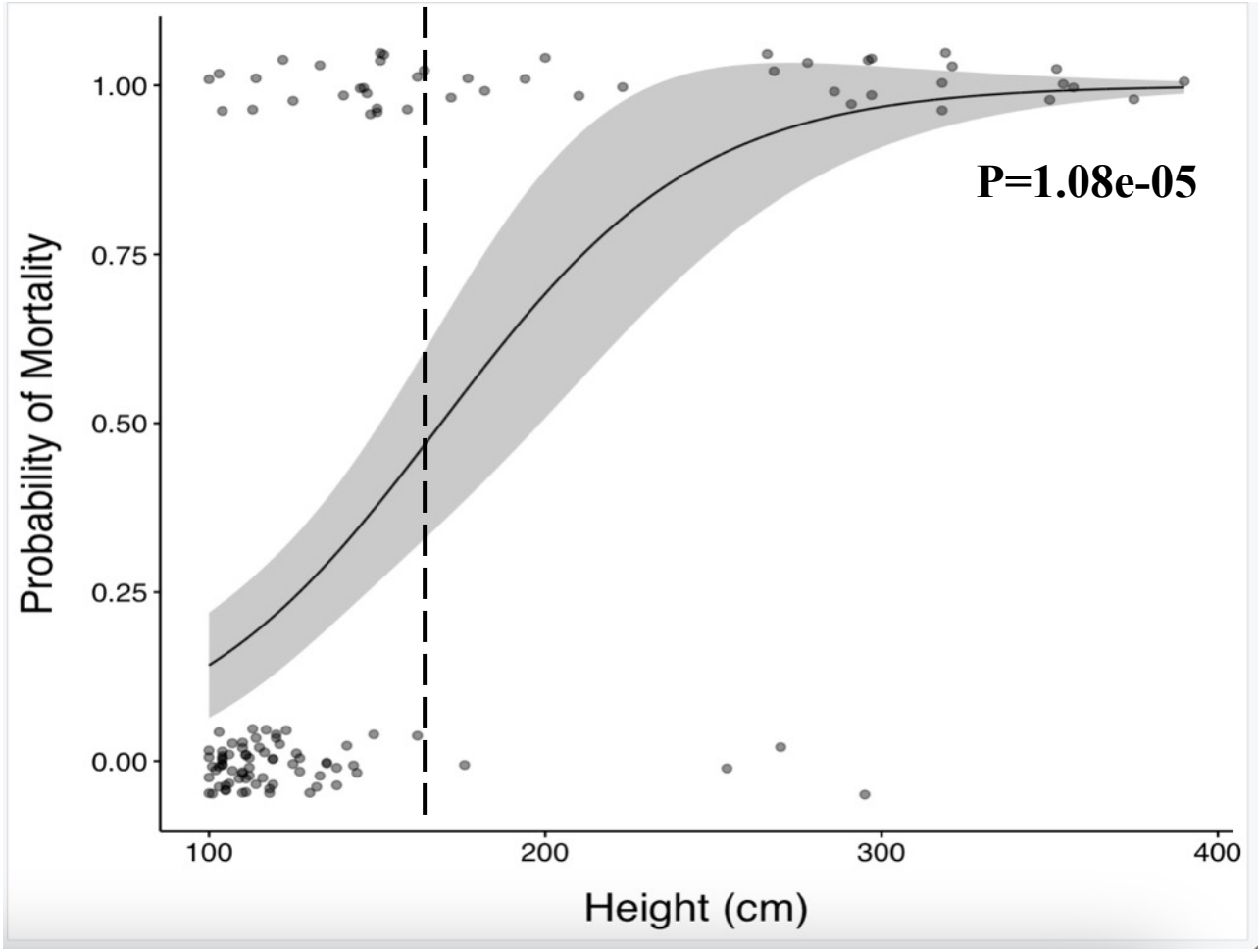




Goose Island Results

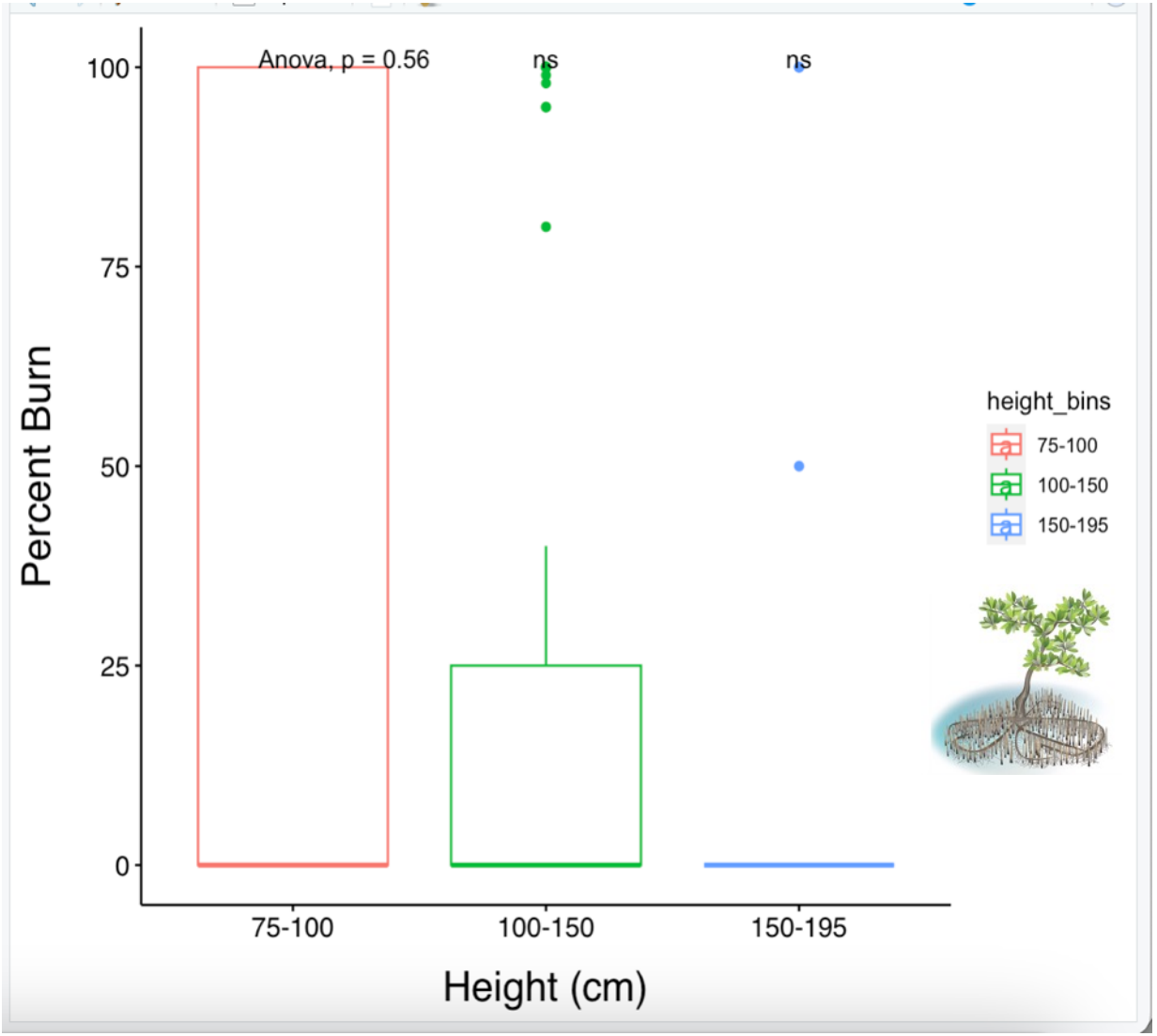
- Significant difference as height increases, individuals above 150 cm had much higher freeze damage. Mortality height threshold was about **169 cm.**

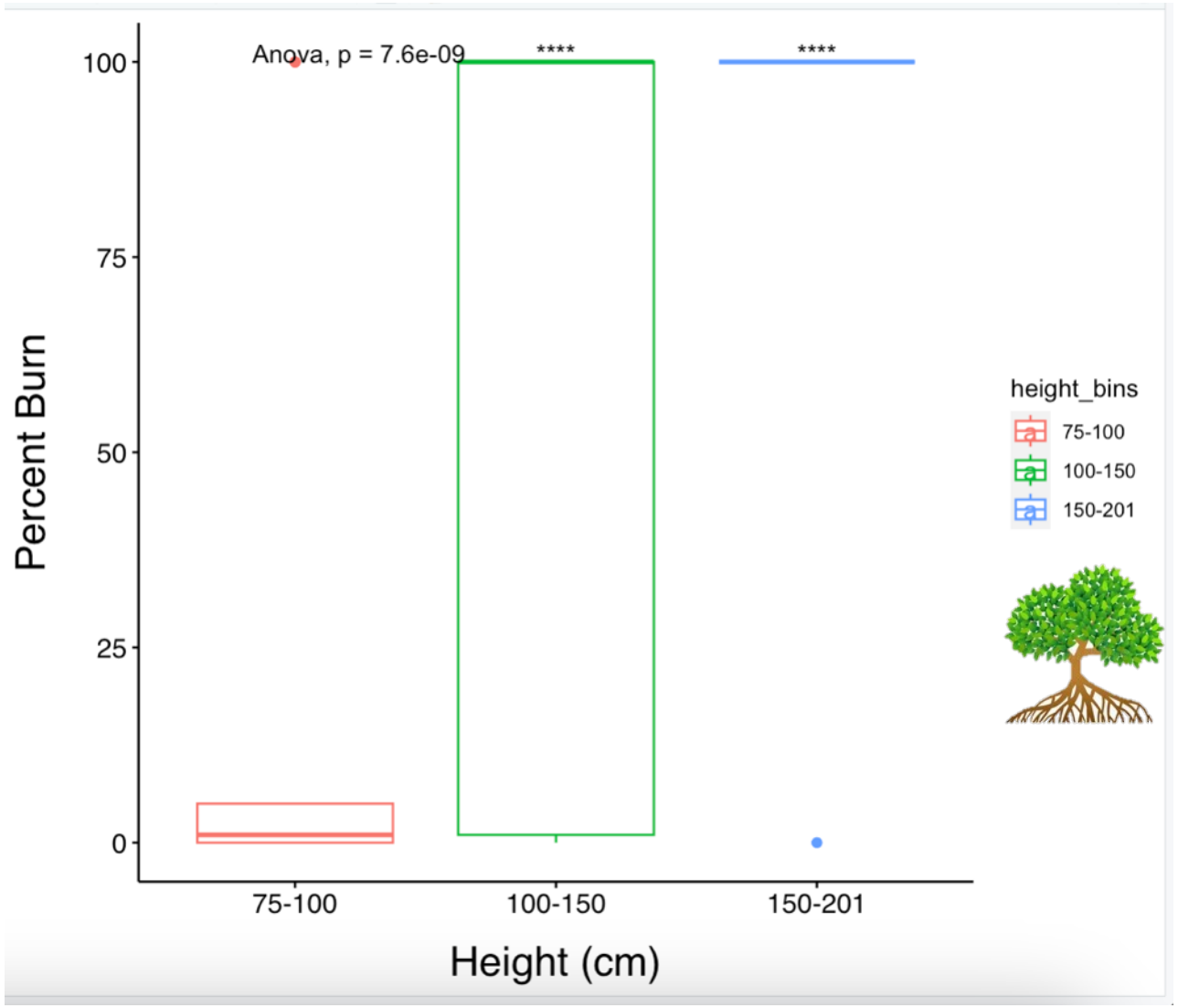




Dog Island Freeze Burn Results

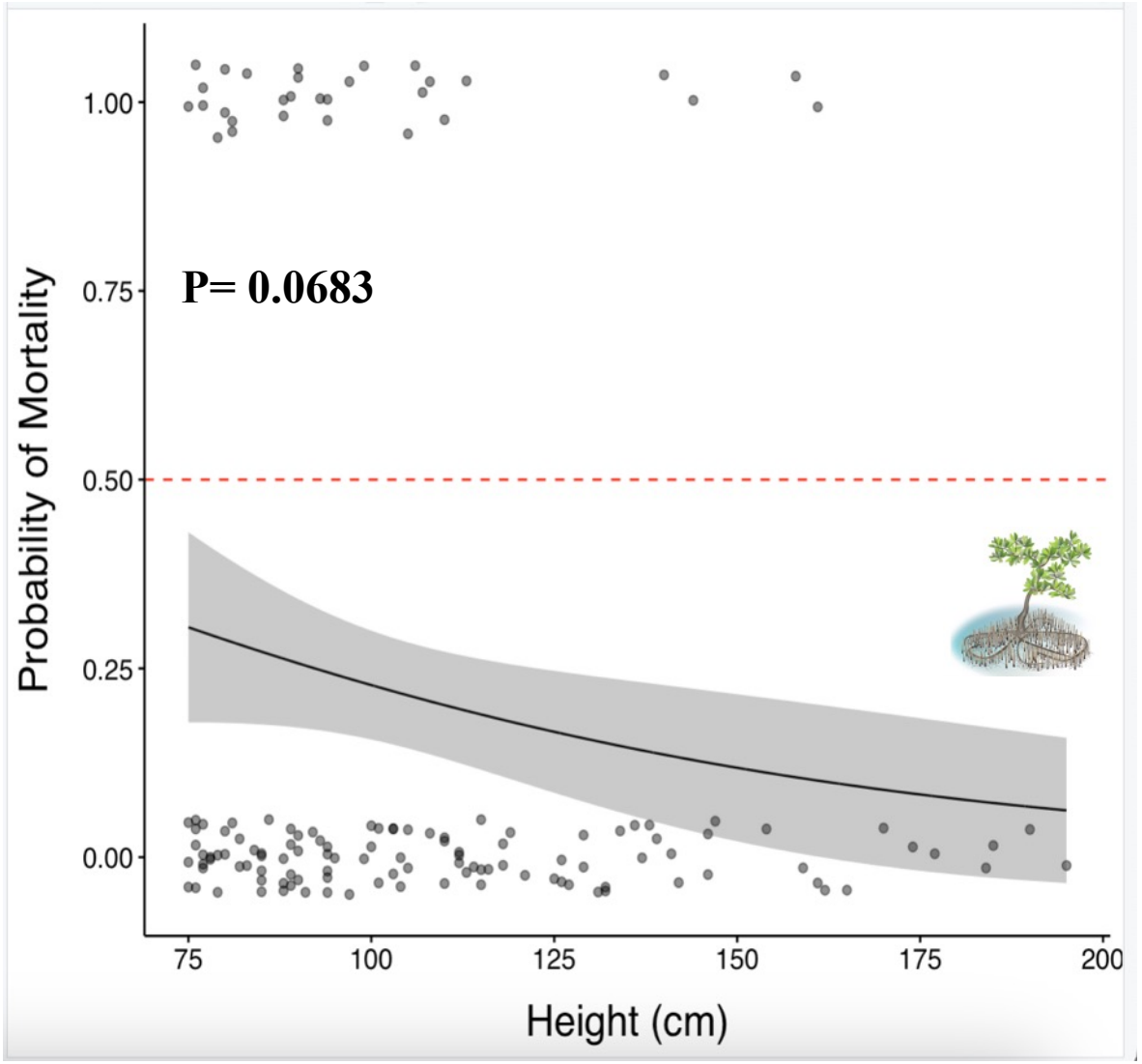
- General trend shows that as height increases for **black** mangroves, individuals exhibited lower freeze damage. Taller **red** mangroves exhibited higher freeze damage.

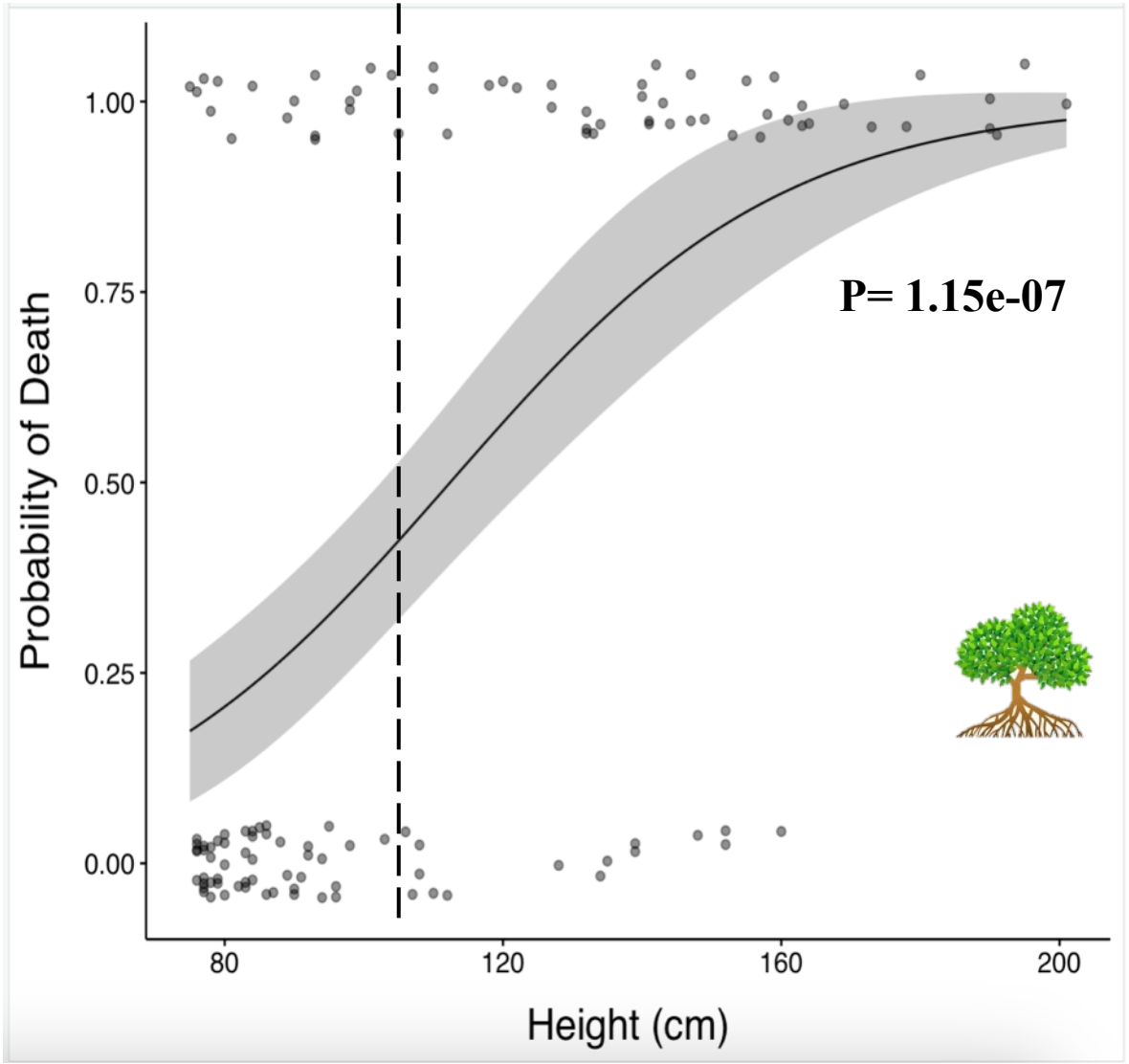




Dog Island Mortality Results

- Might be other factors influencing **black** mangrove mortality. **Red** mangrove mortality threshold was around **112.5 cm**.





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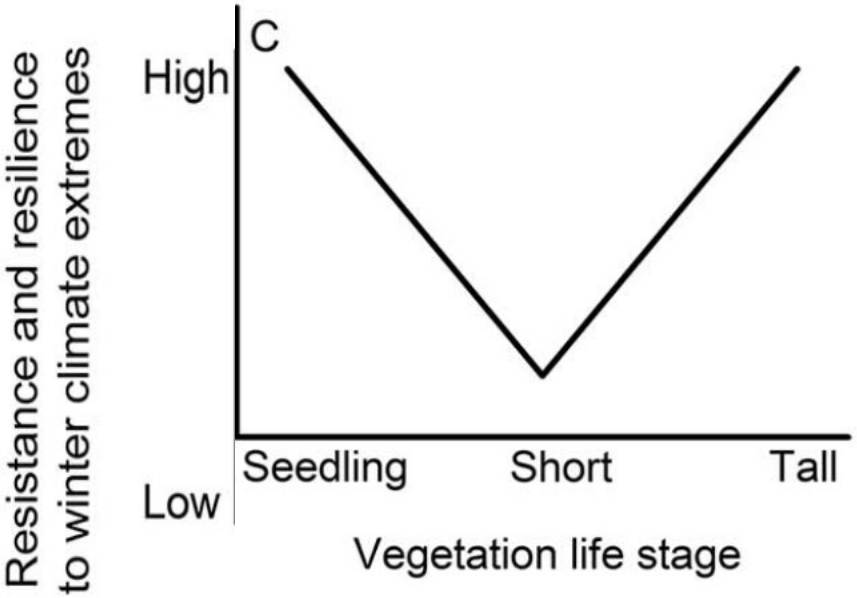

Osland et al. 2015

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Thank you!

- Breithaupt Lab Members; Kevin Engelbert, Erin Tilly, Jenny Bueno, Jayna Hankin, Selma Squafi and Jake Renner
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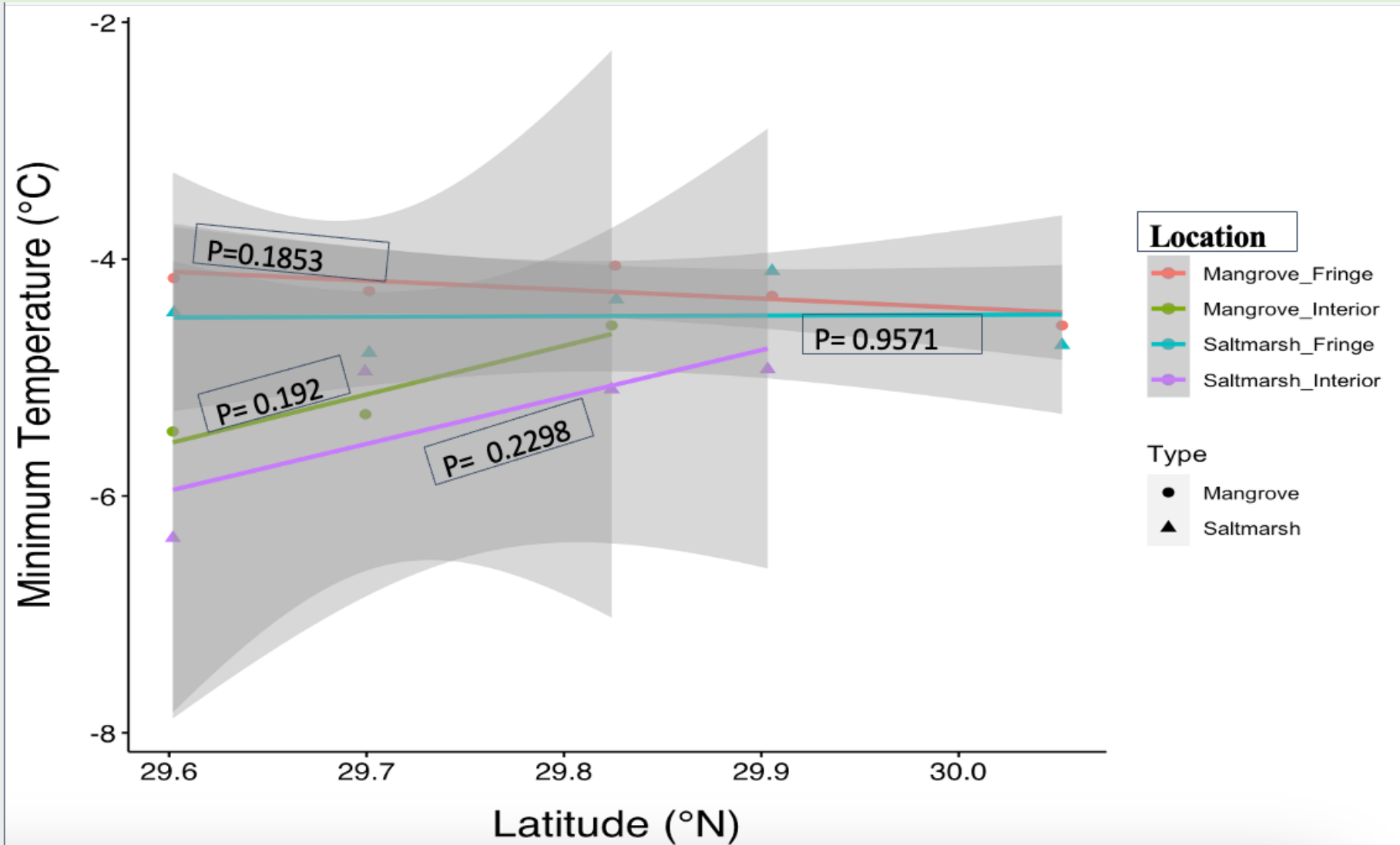
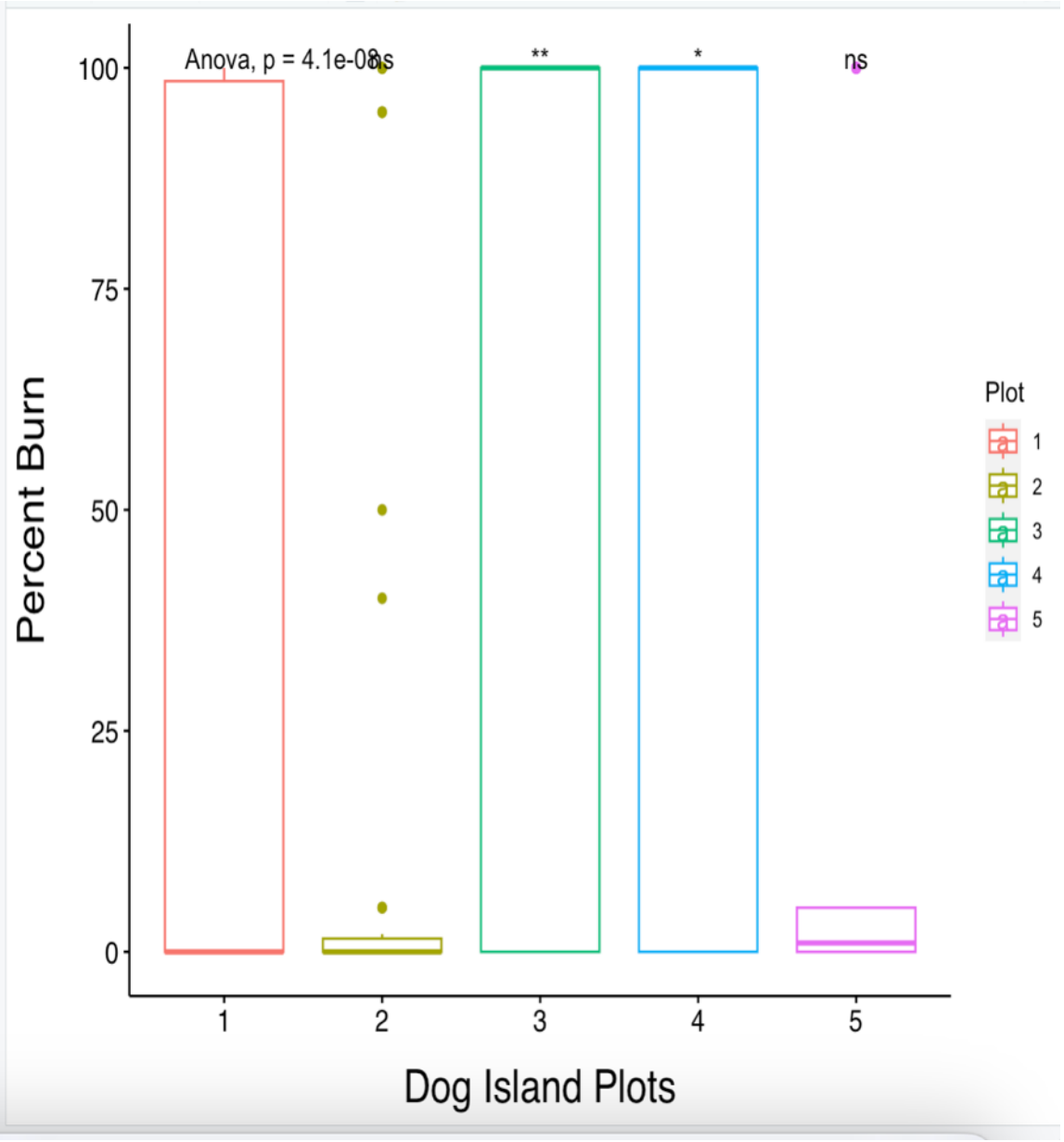
General trends indicate decrease in chilling temperature for both mangroves and saltmarsh at the fringe from low to high latitude. Vegetation type in the interior of the islands, showed a general trend in increased temperatures from low to high latitude.




Anova, p = 4.1e-08
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