Red and Black Mangroves Defoliation Responses Post-Freeze Event Using Drone Imagery

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BACKGROUND

- Mangroves are intertidal trees, primarily found in tropical and subtropical zones due to lower temperatures in higher latitudes that can cause damage and/or mortality[1]
- Climate change is causing mangroves to expand their ranges by decreasing the frequency and intensity of winter temperatures[2]
- This phenomenon is occurring in the Gulf of Mexico across Texas, Louisiana, Mississippi, and Florida[3]
- Florida is the only state in the Gulf of Mexico where we are seeing both the *Avicennia germinans*, or the black mangrove, and the *Rhizophora mangle*, or the red mangrove, expanding their ranges[3,4] (**Figure 1**)
- The black mangrove is the most freeze tolerant, with a mortality threshold of approximately **-6.5° C**
- Over the last 50-60 years, **infrequent** freeze events have occurred with temperatures below the black mangrove mortality threshold[4] (**Figure 2**)
- Understanding species differences is important for predicting continued mangrove expansion in this region
- Therefore, this study assesses red and black mangrove responses to freeze events using high-resolution drone imagery
- Interior refers to areas within the saltmarsh that are further away from the water's edge, while fringe indicates the outer edge of the marsh directly bordering the water.

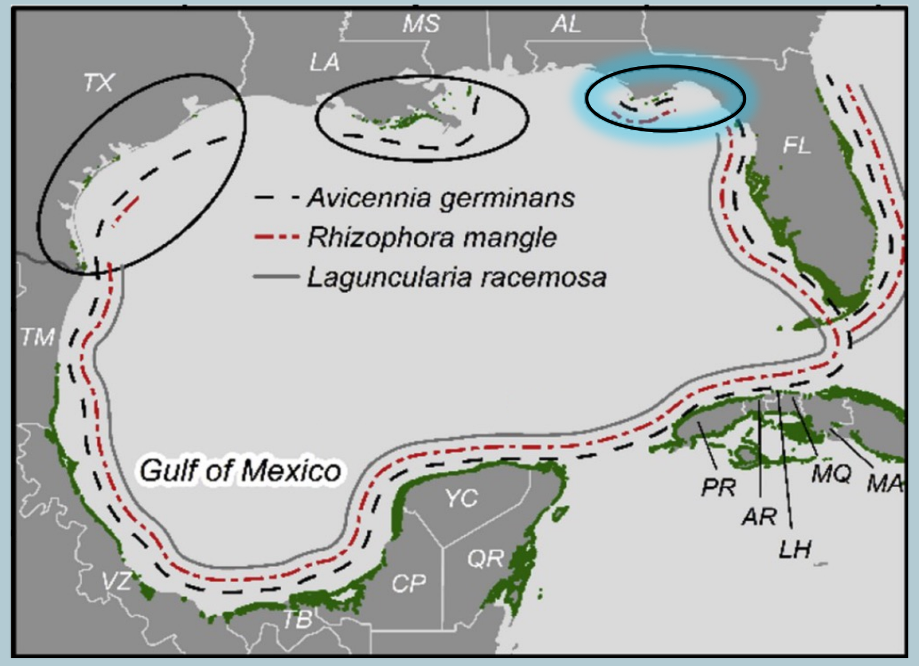

Figure 1: Map of the distribution of mangrove species along the coast of the Gulf of Mexico [3], highlighted region indicates area of interest

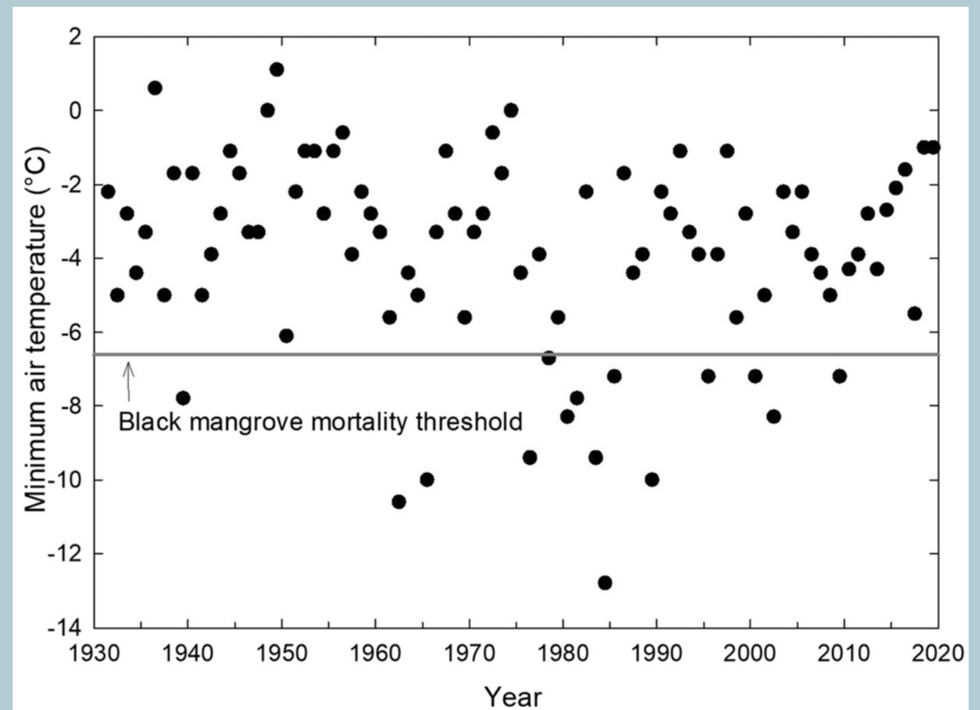

Figure 2: Annual minimum temperatures from 1931 to 2020, depicting multiple freeze events across this period [4]

METHODS

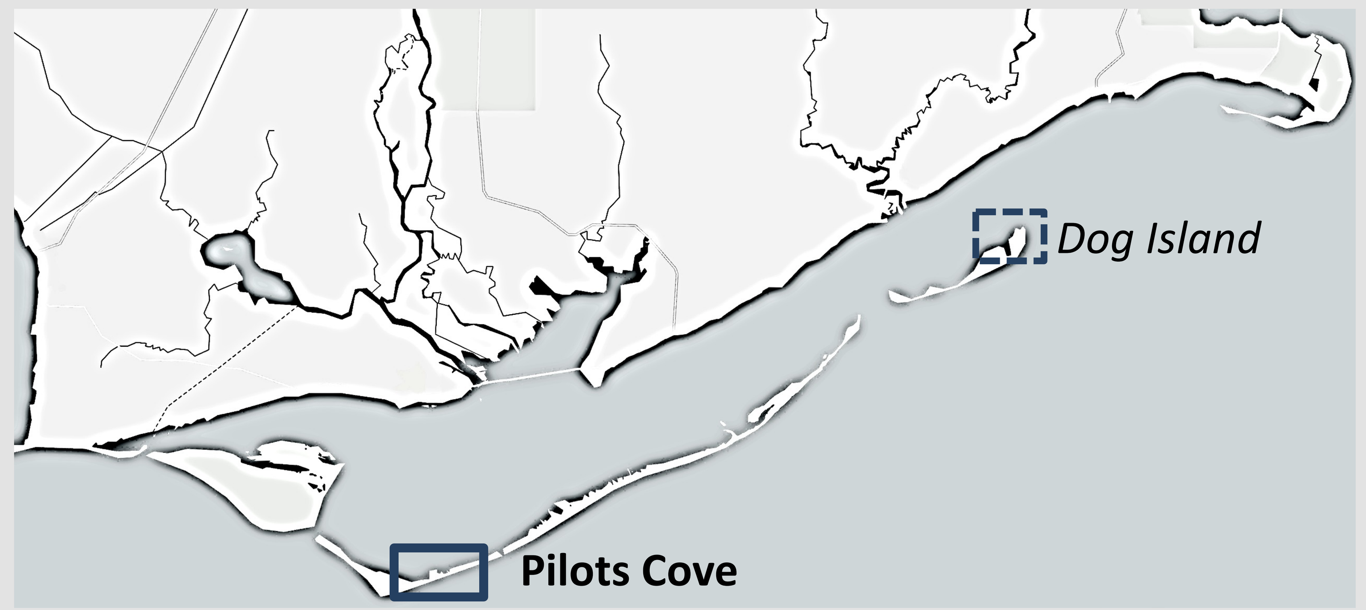

Figure 3: Map of Apalachicola Bay, FL with rectangles around area of interest.

- Drone imagery was collected in 2021 and 2023 at Pilot's Cove in Apalachicola Bay (**Figure 3**)
- The drone imagery was processed to create an orthomosaic, or a stitched georeferenced mosaic

Figure 4: Images of a red mangrove (left) and a black mangrove (right)

- Red and black mangroves were manually identified on the 2021 orthomosaic using visual differences, such as yellow leaves on red mangroves (**Figure 4**)

Figure 5: Zoomed in section of an orthomosaic at Pilot's cove, depicting a red mangrove, outlined in red, before and after a freeze event, showing foliation on the left and defoliation on the right

- Mangroves identified in the 2021 orthomosaics were assessed in the 2023 orthomosaic, through observation and comparison, and determined if each tree was foliated, defoliated, or partially defoliated (**Figure 5**)

RESULTS

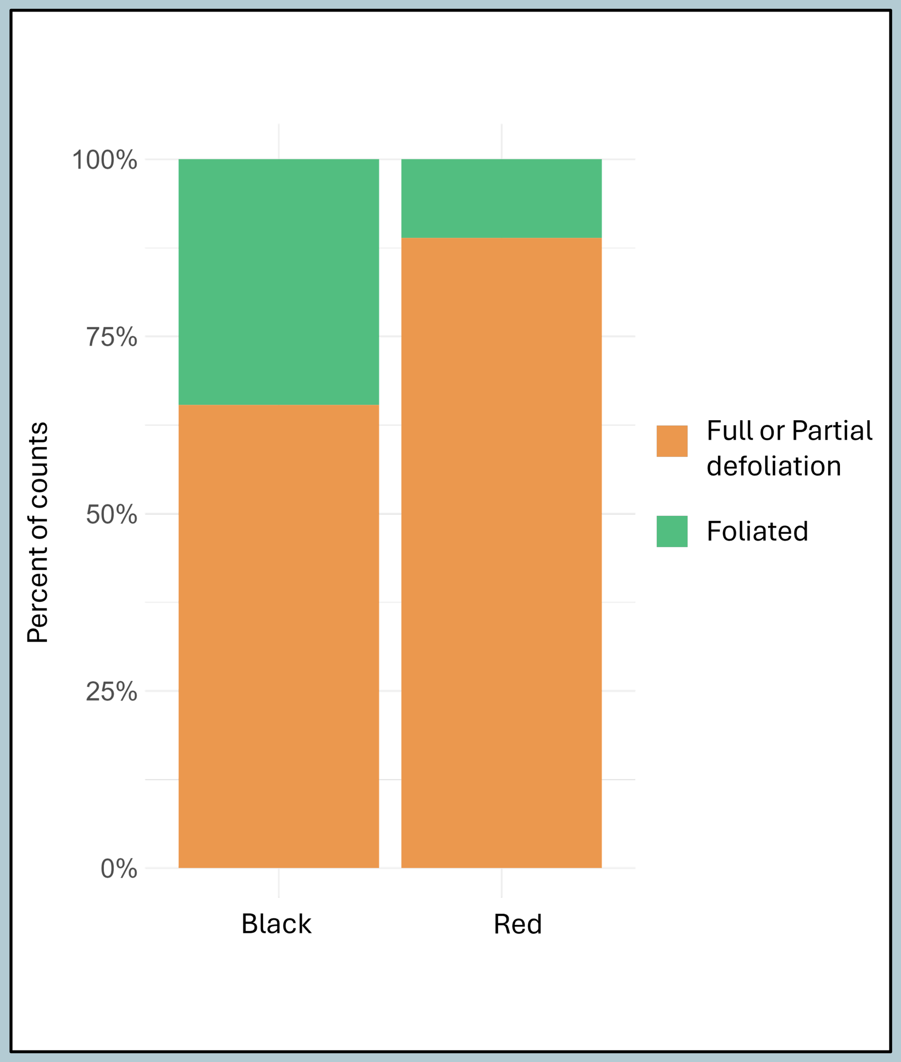

Figure 6: Bar chart depicting each species of mangrove and the proportion of trees defoliated

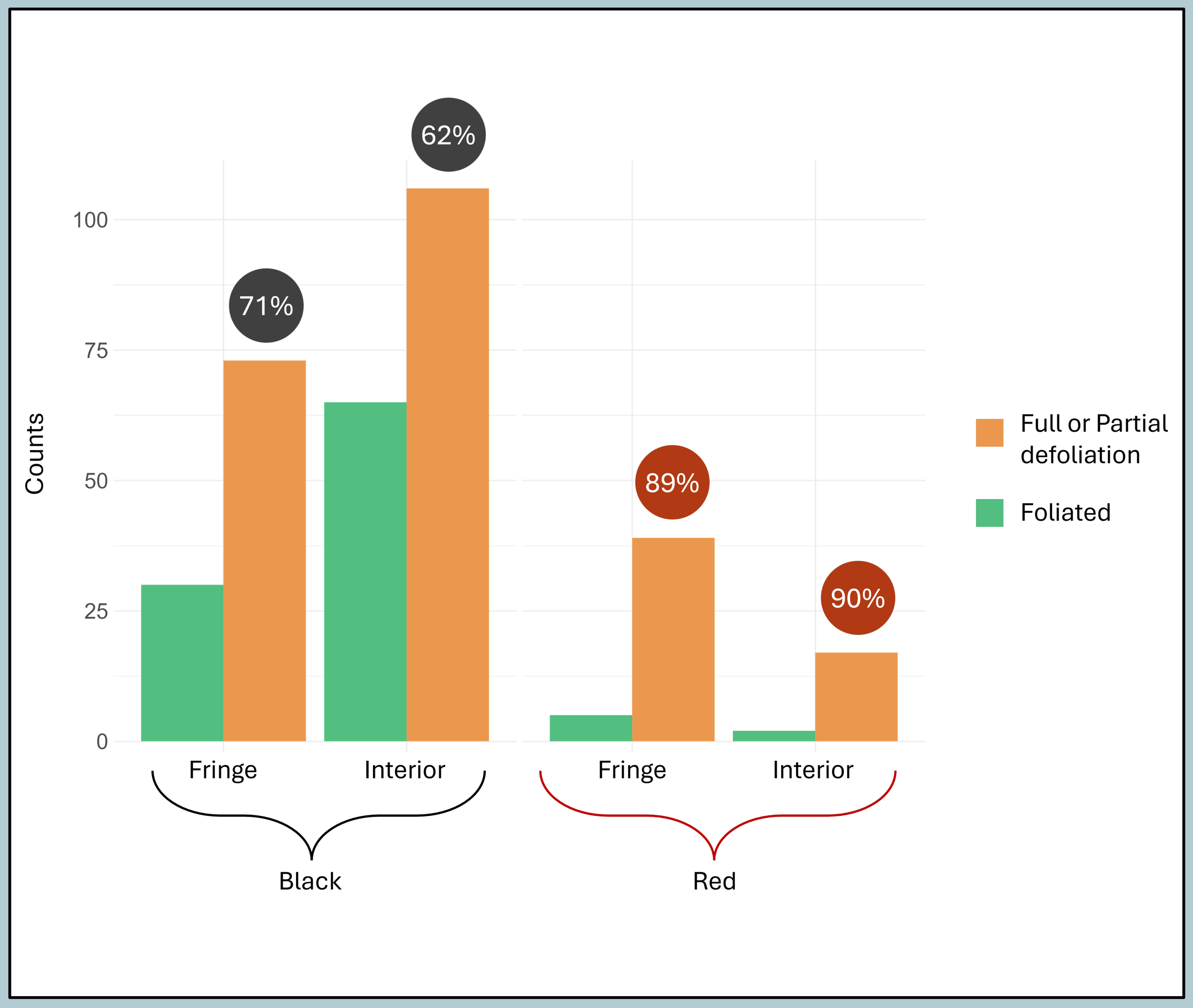

Figure 7: Bar chart depicting each species of mangrove and the proportion of trees defoliated, separated by fringe/interior

CONCLUSION

- The red mangrove showed a higher percentage of defoliation than the black mangrove (Figure 6)
- The higher defoliation percentage of the red mangrove did not show that it was a function of its location; defoliation percentages at the fringe and interior were similar (Figure 7)
- The higher defoliation of the black mangrove may be a function of its location; the black mangroves located on the fringe showed a higher percent of defoliation than those at the interior (Figure 7)

FUTURE CONSIDERATIONS

- Assess accuracy of the red/black mangrove identification on the orthomosaics with ground surveys collected in 2023
- Statistically assess if differences of mangrove responses are significant
- Consider other variables such as tree height and type of salt marsh vegetation present
  - Smaller trees may be more vulnerable or may have been more protected by specific salt marsh vegetation
- Assess data from Dog Island (Figure 3) to determine if species respond differently by site
- Compile temperature differences across sites
- Collect drone imagery in 2024 to assess mangrove recovery
- Determine how this information can be used to predict mangrove responses to freeze events and improve understanding of the factors affecting mangrove survival

REFERENCES

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