Mangrove freeze resistance and resilience across a tropical-temperate transitional zone

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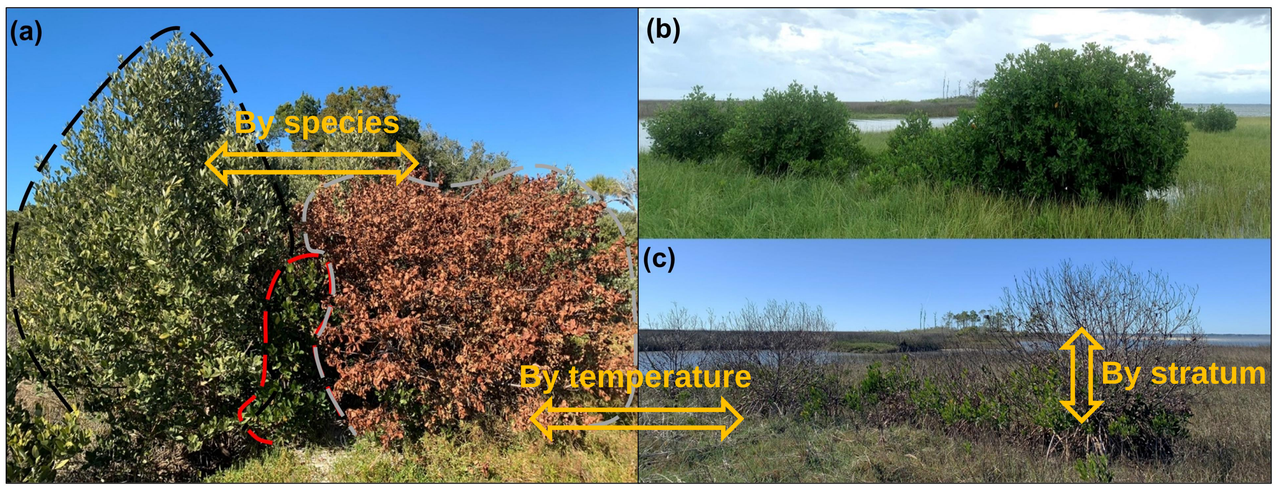
Introduction

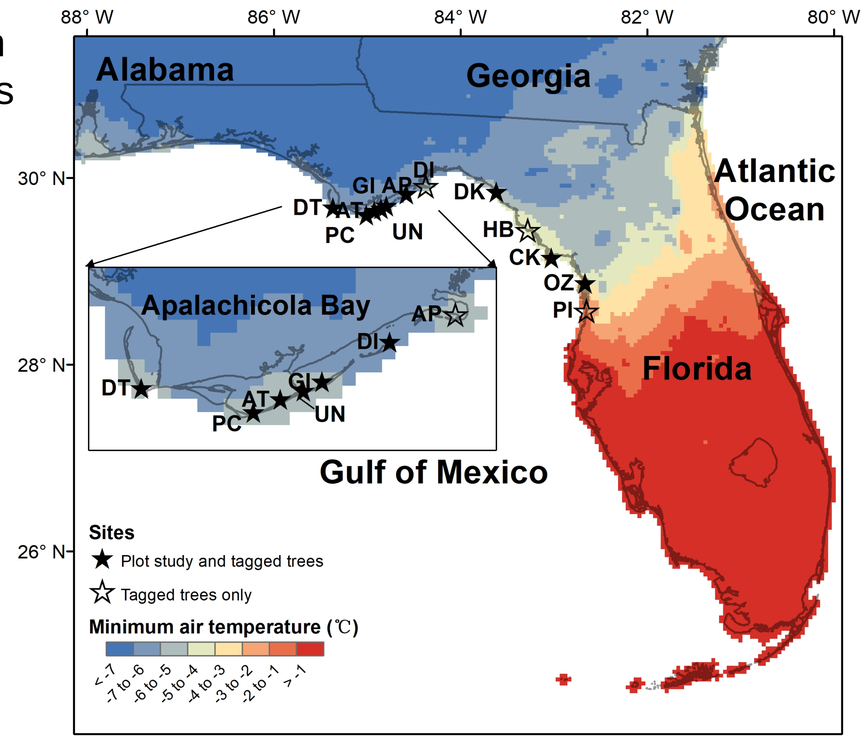
- Alleviated freeze stress induced by the warming climate has resulted in range expansion of mangroves[1].
- Understanding **how mangroves respond to freezing by temperature, species, and stratum** is critical for predicting future coastal wetlands transformation[2, 3].



Mangroves in (a) Cedar Key and (b, c) Goose Island, FL before and after the freeze event in 2022. Photo credit: Yiyang Kang

Methods

- Gradient study with 12 field sites across northern Florida's Gulf of Mexico coast
- Plot study: Freeze response by temperature, species, and stratum
- Tagged trees: Low temperature thresholds by species

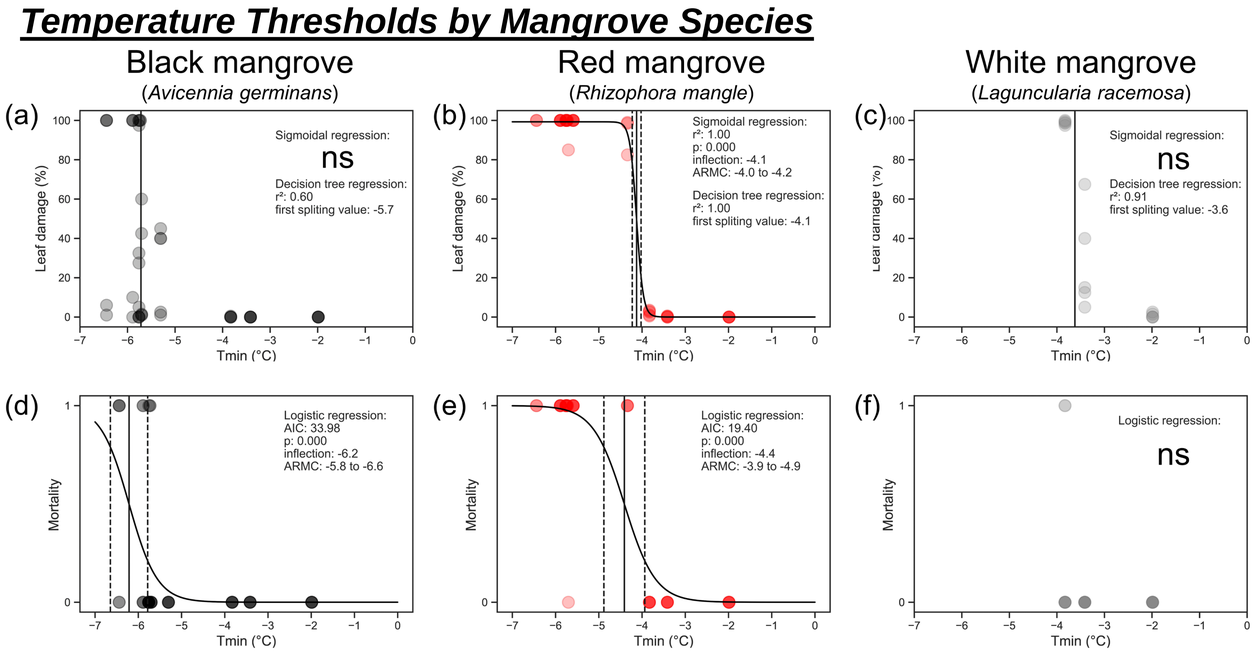


Freeze event (Dec 2022)

Baseline assessment (Jul 2022) — **Damage assessment (Jan 2023)** — **Recovery assessment (Nov 2023)**

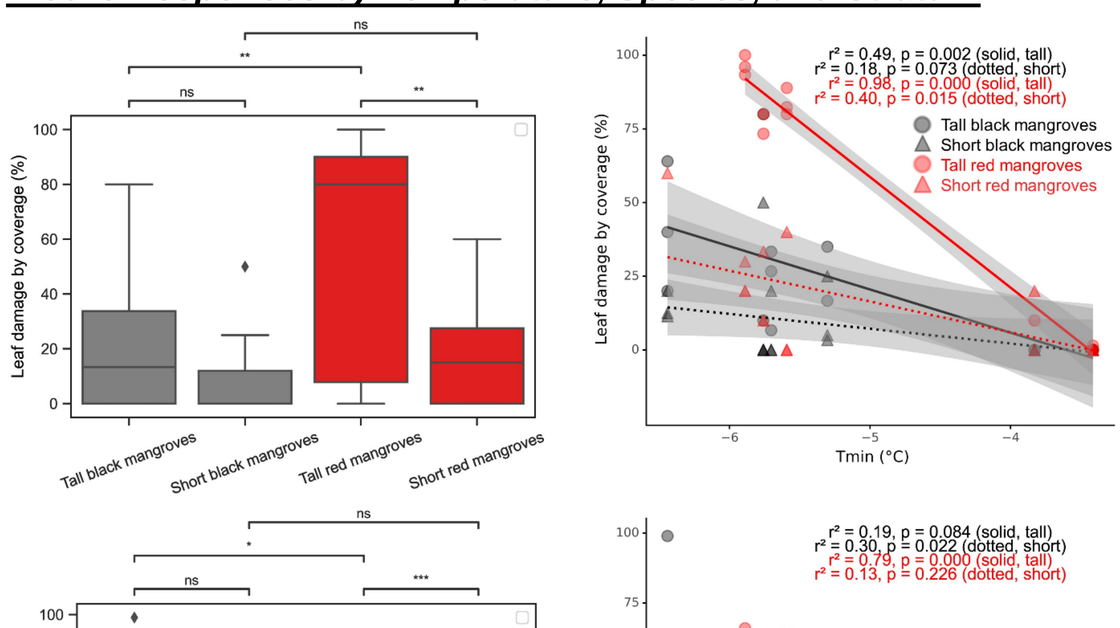
Results

Temperature Thresholds by Mangrove Species



- Leaf damage thresholds were **-5.7 ℃** for black mangrove, **-4.1 ℃** for red mangrove, and **-3.6 ℃** for white mangrove.
- Mortality thresholds were **-6.2 ℃** for black mangrove, **-4.4 ℃** for red mangrove, and <u>may</u> occur below **-3.8 ℃** for white mangrove.

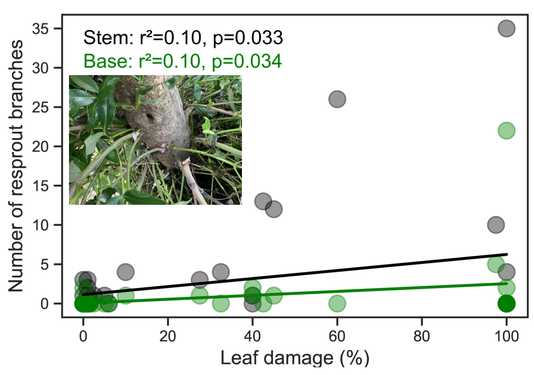
Freeze Responses by Temperature, Species, and Stratum



- Mortality rate and leaf damage of red mangroves were higher in tall stratum than short stratum, while no difference were found between black mangroves strata.
- Mortality rate and leaf damage of tall red mangrove significantly decreased with temperature.

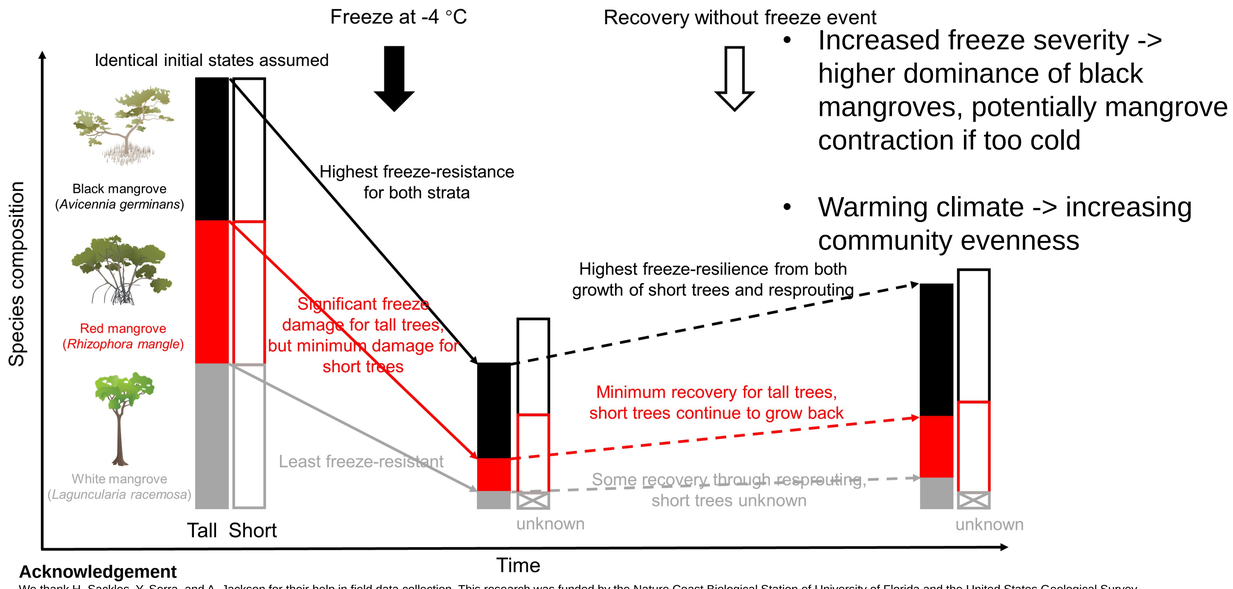
Recovery of Black Mangroves

- Resprout branches of surviving black mangroves, from both stem and base, were positively correlated with leaf damage.
- Resprout was activated at a temperature threshold of **-5.3 ℃**.



Conclusion

- Temperature thresholds for freeze resistance were quantified for three mangrove species; black mangroves were the most resistant, followed by red and white mangroves.
- All three mangrove species resprouted after freeze damage, with black mangroves being most freeze-resilient.
- Population recovery of red mangroves may primarily depend on growing of well-preserved short trees, despite high freeze mortality and little resprout in tall red mangroves.



- Increased freeze severity -> higher dominance of black mangroves, potentially mangrove contraction if too cold
- Warming climate -> increasing community evenness

References

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