Exploring patterns of thermal acclimation of leaf respiration in a marsh-mangrove ecotone

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Introduction

Vegetated coastal ecosystems (saltmarsh, mangroves) make a large contribution to global net primary productivity and **C** cycling despite covering a small proportion of the earth's surface. Respiration (*R*) is a key parameter for global models that predict climate carbon cycle interactions. At the global scale, respiration is the second largest flux of **C** (behind photosynthesis), and ~50% of respiration comes from leaves. Yet respiratory responses to temperature in marsh and mangrove species remain uncertain (potential responses shown in **Figure 1**).

In this study we are testing **1)** whether marsh grasses and mangroves show similar acclimation of leaf respiration to seasonal temperature changes, and **2)** whether acclimation is consistent between plants grown under ambient and warmed conditions.

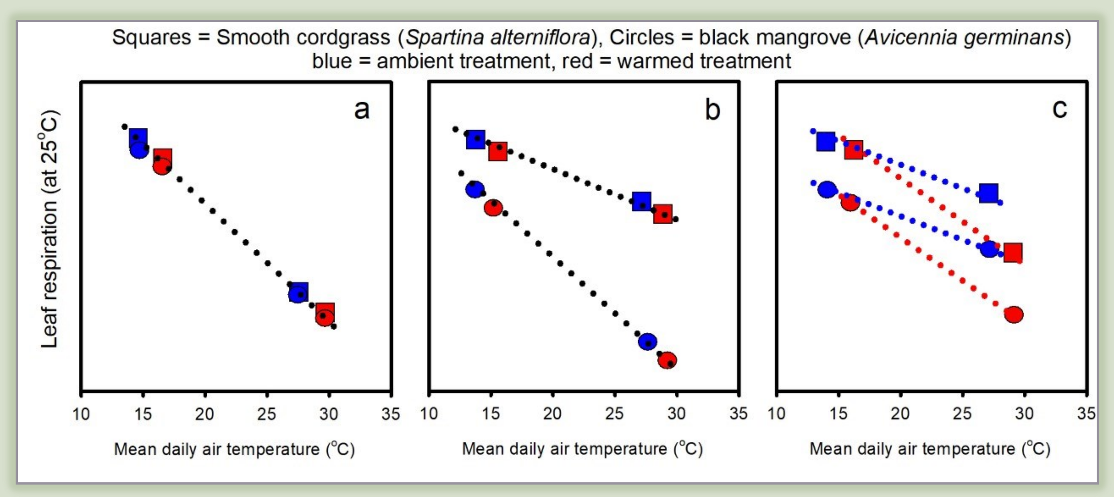


Figure 1. Conceptual figure showing three potential patterns of thermal acclimation of leaf respiration in marsh and mangrove species.

Approach

- In this study we repeatedly measured short-term temperature responses of leaf respiration in a **C4** marsh grass species (*Spartina alterniflora*) and a **C3** mangrove species (*Avicennia germinans*) growing under **ambient temperatures** and **experimental warming** at two sites in Florida (see **Figure 2**).
- **Experimental warming** (~2-3 °C above ambient) is imposed using passive warming chambers (see **Figure 4b.**)
- Short-term temperature response curves of leaf respiration are generated by sealing leaves in a Walz GFS-3000 temperature-controlled chamber connected to a LI-6400xt gas analyzer.

Walz GFS-3000

- This system allows us to increase the temperature of the leaf from 20-40°C at a rate of 1°C per minute while continuously measuring rates of leaf *R* as the rate of leaf CO_2 efflux per unit leaf area.

Study Sites

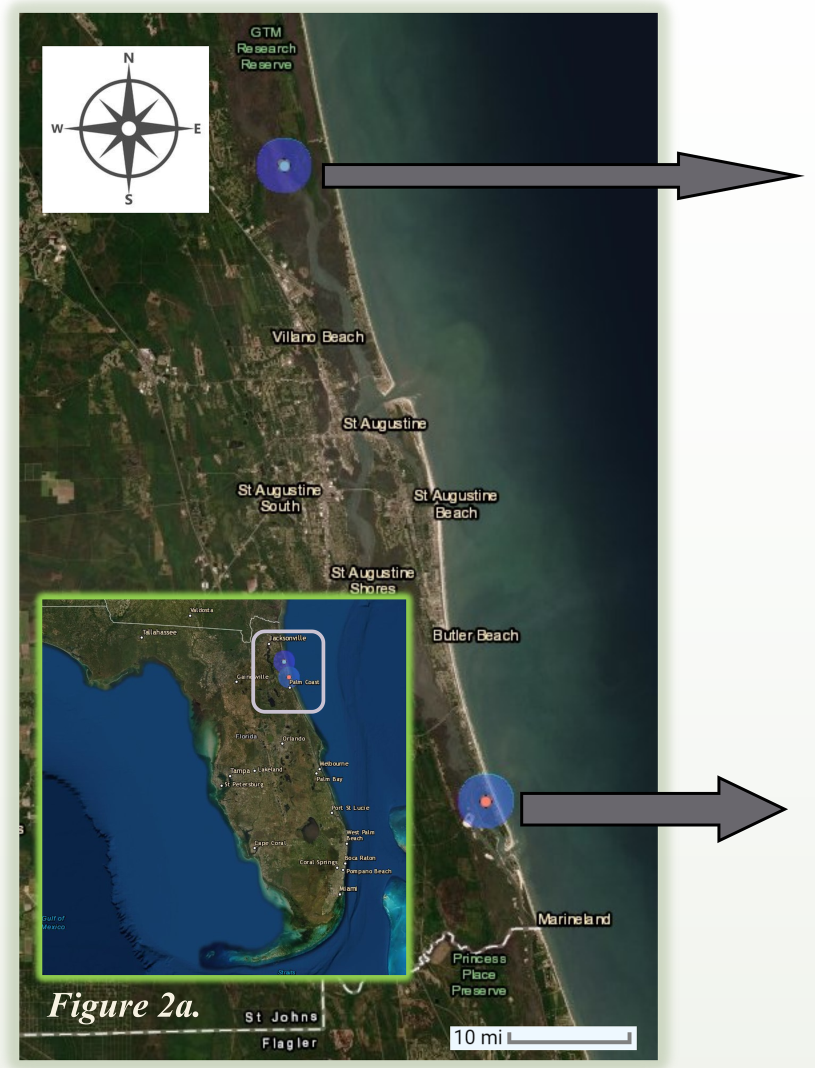


Figure 2a. A Map of the northeast coast of Florida with arrows pointing to the corresponding sites.

Figure 2b. Big Mama, north site

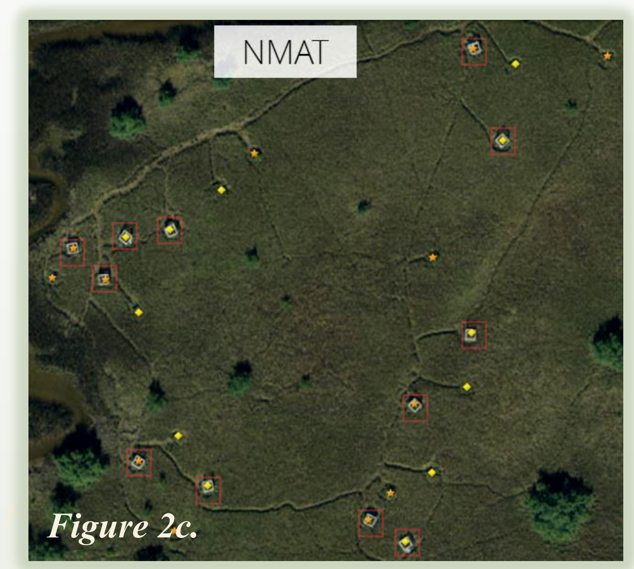
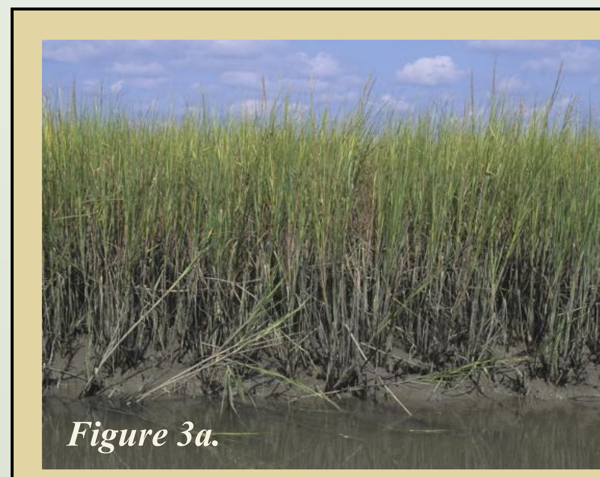


Figure 2c. NMAT, South site

Species



Spartina alterniflora (smooth cordgrass)

Avicennia germinans (black mangrove)

Treatments

Ambient temperature control plot

Passive warming chamber plot

Preliminary results and discussion

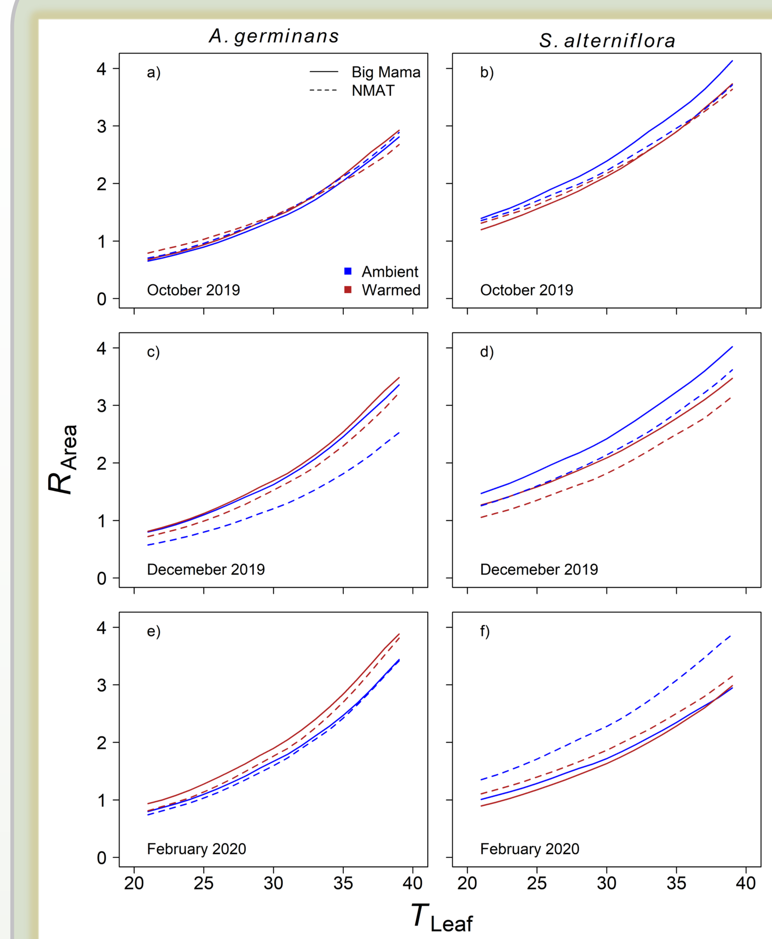


Figure 5. Each curve illustrates the average *R* response to temperature for each treatment combination.

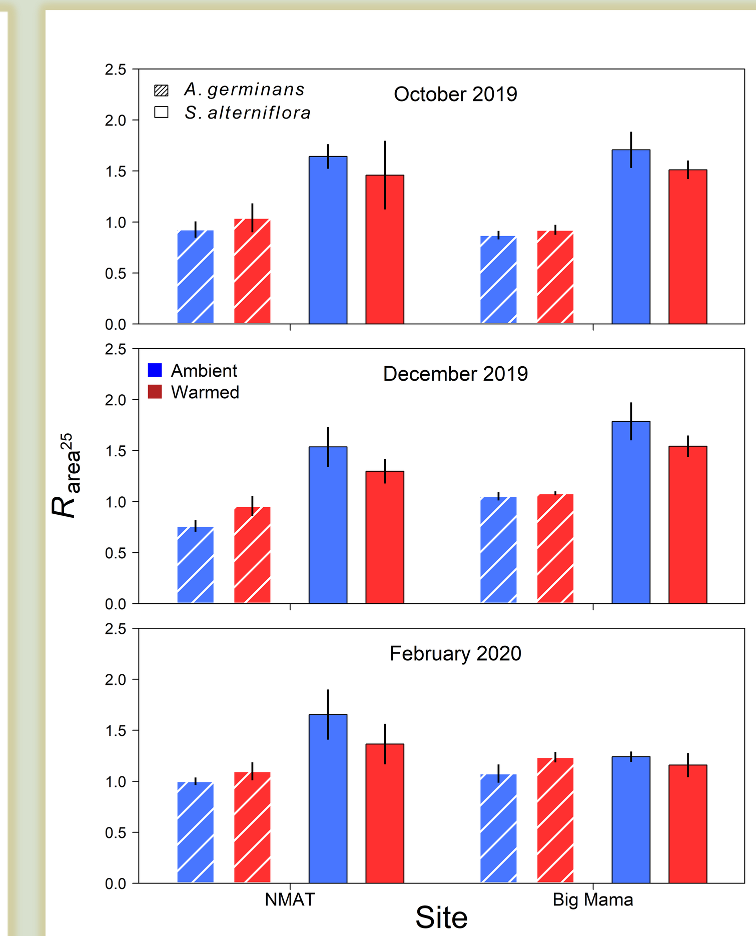


Figure 6. Illustrates the differences of *R* at 25°C between timepoints, species, sites, and treatments. Red bars signify warmed treatment, blue bars signify ambient. Striped bars are black mangrove (*Avicennia germinans*), and solid bars are smooth cordgrass (*Spartina alterniflora*).

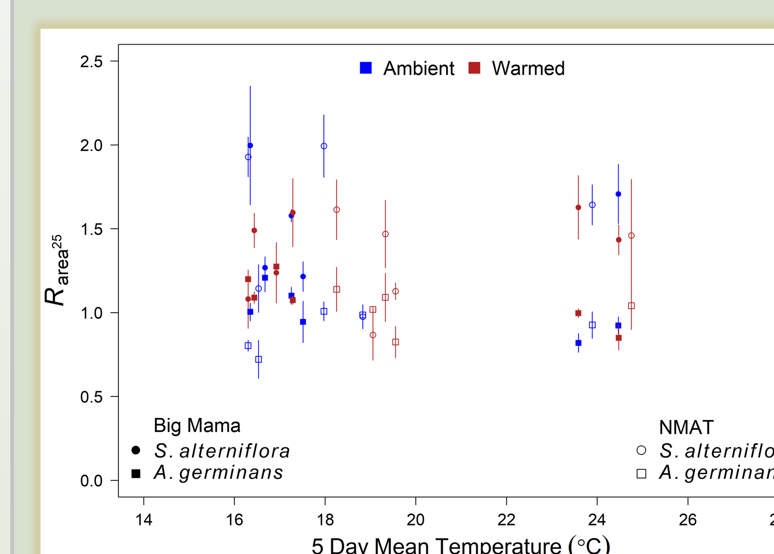


Figure 7. Illustrates *R* at 25°C for each treatment combination (Site, Temperature, Species) plotted at the mean temperature of the 5 preceding days of sampling.

Takeaways

- *Spartina* shows evidence for potential thermal acclimation of leaf *R*.
- *Avicenna* shows little evidence of thermal acclimation of leaf *R* in response to seasonal temperature changes and warming.
- These results indicate that thermal acclimation might reduce respiratory **C** fluxes from marsh grasses in response to warming.
- Our data suggests that under future climate warming scenarios mangroves will not acclimate their respiratory response to increased temperatures.

Going forward...

These results indicate that thermal acclimation might reduce respiratory **C** fluxes in response to warming for C_4 marsh grasses. We expect the resolution of our data to improve as mean temperatures increase through spring and summer. Our results provide new data that may improve predictions of carbon cycling processes in vegetated coastal ecosystems over space and time.

Acknowledgments

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