Seagrass ecosystems and environmental change: Effects of warming temperatures and tropicalization on plant-herbivore interactions

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Background

- Multiple stressors are occurring simultaneously in the Gulf of Mexico:
  - Temperatures predicted to rise by up to 3ºC this century.
  - Tropicalization: tropical herbivores (green turtles, emerald parrotfish, and manatees) are all increasing in abundance in the northern Gulf of Mexico.
- Effects of multiple stressors are hard to predict, and this is a novel combination of stressors.
- Understanding the response to these stressors can help predict future trends in seagrass structure and cover.

Methods: Mesocosm Experiment

Weeks

0 — ***Thalassia testudinum*** collected from Steinhatchee, FL and planted in mesocosm tanks at the Whitney Lab (St. Augustine, FL).

3 — Start experiment: apply temperature treatments.

5 — Apply grazing treatments.
- **Fully crossed temperature & grazing treatments** (fig. 1; n = 12).

7.5 — Breakdown mesocosms and conduct feeding trials.
- **Feeding trial**: Choice experiment using seagrass from the mesocosm experiment and the herbivore *Lytechinus variegatus* (sea urchin).

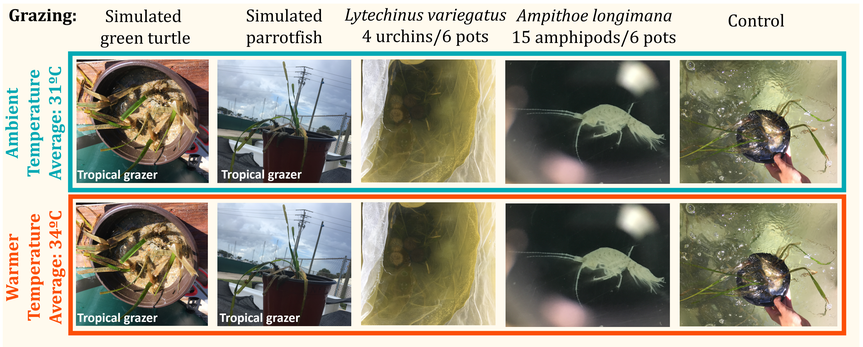
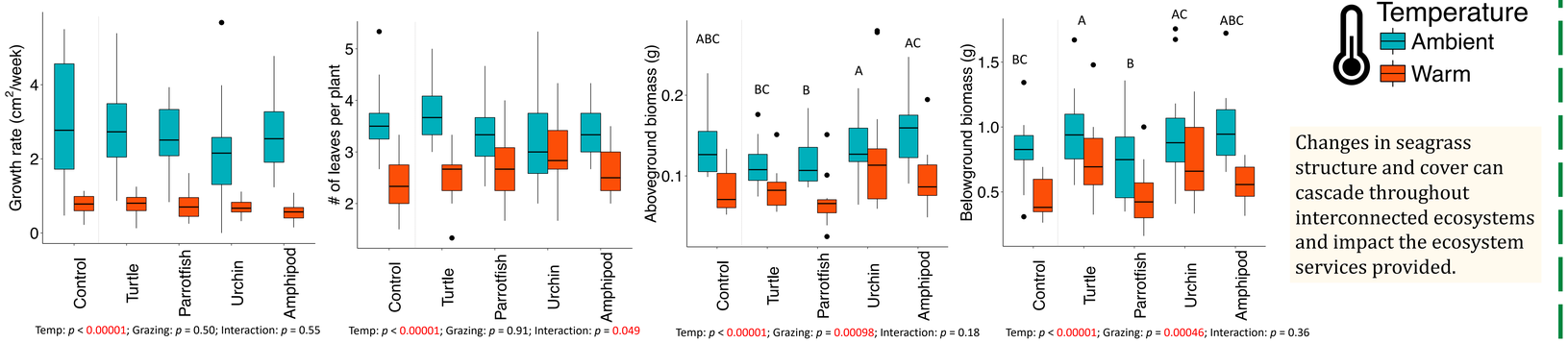


Figure 1. Experimental design

Connections!

For more information and access to youth education activities related to this research:

Figure 2. Stressors impact plant structure, cover, and productivity



Changes in seagrass structure and cover can cascade throughout interconnected ecosystems and impact the ecosystem services provided.

Figure 3. Stressors impact leaf chemistry and physical anti-herbivore defenses

Leaf tissue carbon content did not vary based on temperature or grazing. Changes in C:N and C:P were driven by altered N and P content.

These traits can influence grazing pressure and therefore plant persistence.

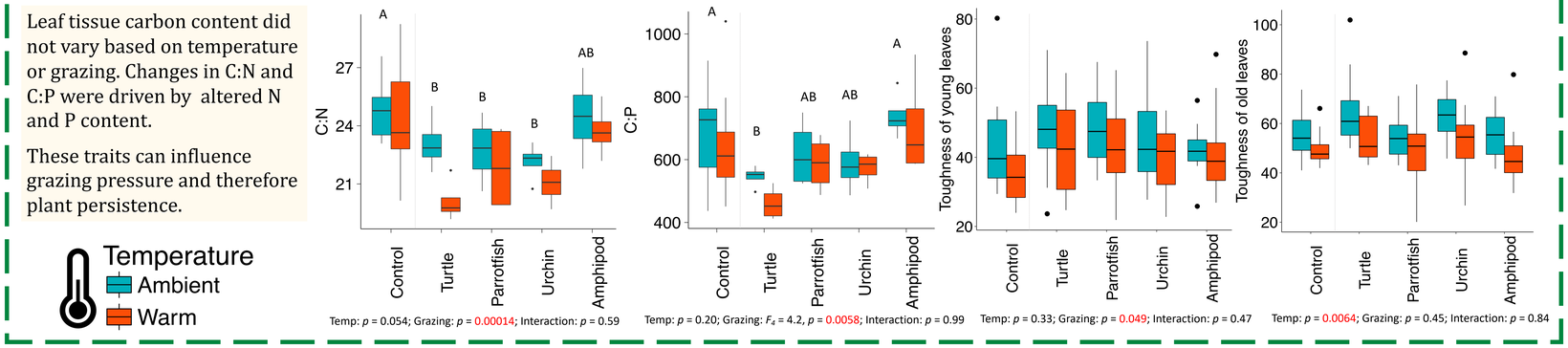
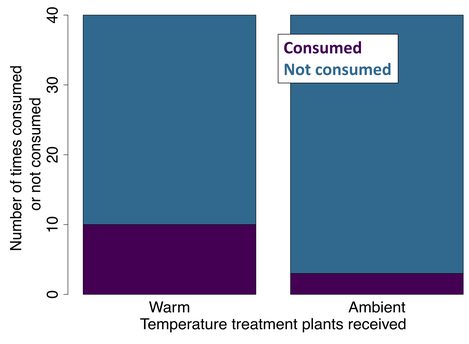


Figure 4. Feeding choice



Fisher's exact test: $p = 0.066$

Conclusions

- Complicated response to multiple stressors due to differing response to various grazers, interactions between stressors, and feedbacks between grazing pressure and plant response.
- Warming **directly reduced *T. testudinum* structure and cover** (fig. 2).
  - As a foundation species, **effects can cascade.**
- Warming might **increase susceptibility to herbivory** through reduced leaf tissue C:N ratio and leaf toughness (fig. 3).
  - Supported by feeding trials: sea urchins may prefer plants grown under warmer temperatures (fig. 4).
- Grazing by some herbivores influenced leaf tissue nutrients and toughness (fig. 3).
  - Can create **feedbacks** between grazing pressure and anti-herbivore defenses.

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