Investigating *Thalassia hemprichii's* impact on coral calcification rates in the presence of ocean warming

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Background

- *Thalassia hemprichii* is a species of seagrass native to the tropical Indo-West Pacific Region (Sickle seagrass, wildsingapore.com). This seagrass has a unique heat stress response which allows it to survive under more extreme conditions of heat (and acidification) than what most marine species can survive under. *Thalassia hemprichii* has been shown to express antioxidant enzymes and heat shock proteins in response to heat stress (Purnama, P., & Purnobasuki, H), and scientists have observed that coral reef mesocosms respond better to heat stress and acidification when *Thalassia hemprichii* is present (Pi-Jen Liu, Shin-Jing Ang, et al.). *Thalassia Hemprichii* is also unique in that the adult plants can survive for extended periods of time disconnected from substrate, allowing them to float over long distances and potentially colonize new areas (Wu Chen & Soong). This makes *Thalassia hemprichii* a good migrator and a good candidate for purposeful introduction into new areas

Motivation

- Rising ocean temperatures, more commonly referred to as "ocean warming", is one of the many byproducts of rising carbon levels in the atmosphere. Ocean warming threatens some of the most important marine ecosystems, and thus, the health of our planet. This is why it is crucial for any potential strategy of mitigation to be studied thoroughly. The issue must be attacked from multiple angles and disciplines of knowledge, and one of these angles could be through the use of *Thalassia Hemprichii*. The ability to use this seagrass to buffer the negative impacts of ocean warming would be hugely beneficial for the health of the ecosystems in which they already reside or are newly implemented into.

Hypothesis

- We hypothesize that there is a positive relationship between the amount of the seagrass *Thalassia hemprichii* present and the calcification rates of coral reef mesocosms exposed to ocean warming.

Predictions

- If our hypothesis is correct, and the presence of *Thalassia Hemprichii* increases the calcification rates of the coral reef mesocosms, we predict that *Thalassia Hemprichii* could be introduced (and managed carefully) to real coral reef ecosystems to mitigate the impacts of ocean warming.

Figure 1: Photograph of The Great Barrier Reef

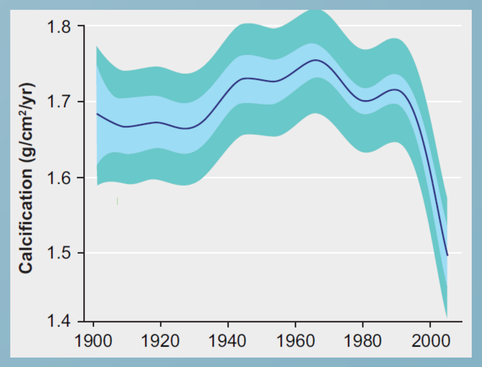

Figure 2: Calcification vs. Time, The Great Barrier Reef.

This graph (from eatlas.org/au) shows declining coral calcification rates in the Great Barrier Reef. This is an issue of major concern, as the reef is a hotspot for biodiversity and is already sensitive from previous mass bleaching events (Robertson).

Study Design

- By using mesocosms, outdoor experimental systems that examine the natural environment under controlled conditions, we were able to carry out a manipulative experiment that functions as a hybrid between a lab experiment and a field experiment. This allows for a broad scope of inference, meaning our findings are applicable to real coral reef ecosystems in the wild.
- 8 coral reef mesocosms were created, each containing equal amounts of coral, but different amounts of *Thalassia Hemprichii* (Mesocosm 1 has none, mesocosm 8 has a lot).
- Each mesocosm began at 25 degrees Celcius, and temperature was raised by 3 degrees Celcius every two weeks, for a period of 8 weeks.
- Coral calcification rates were measured throughout each time period, within each mesocosm by using chemical titrations and sensors to measure calcium levels in the water.

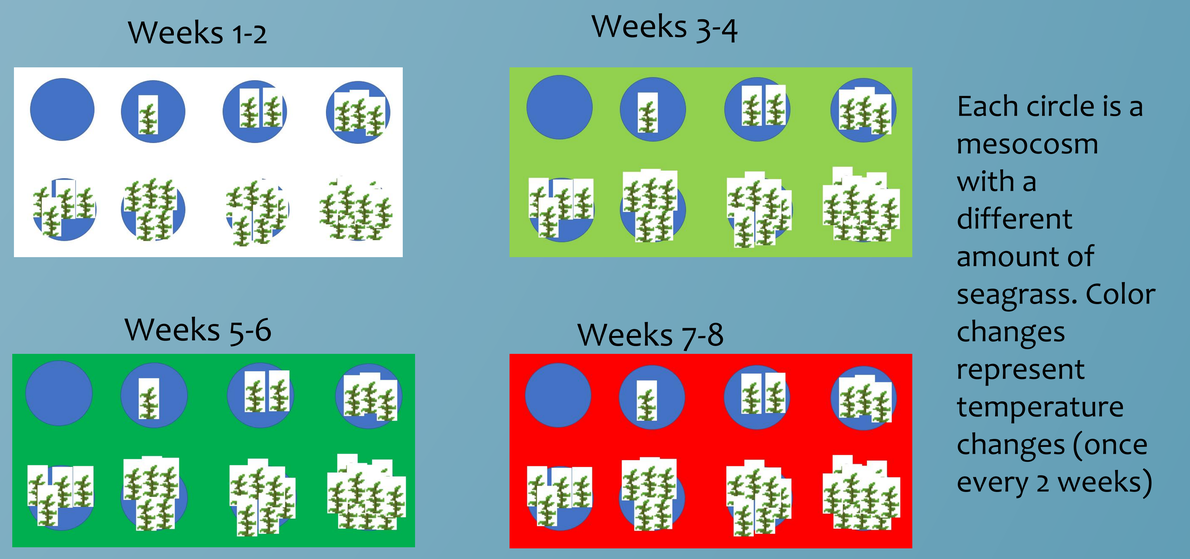

Figure 3: Mesocosm Diagrams

- *Expected Benefits/management implications*

With a better understanding of how *Thalassia hemprichii* impacts calcification, *Thalassia hemprichii* populations near or within coral reef ecosystems can be managed in ways that maximize calcification rates. This could help save fragile coral reef systems burdened by ocean warming and other threats to marine life.

- *Moving Forwards*

If *Thalassia Hemprichii* can effectively be used in natural settings to increase coral calcification rates, it must first be determined how to safely and effectively manage existing populations and how to safely introduce *Thalassia hemprichii* to new coral reef ecosystems without causing disruption. To do this, an experiment could be done in which coral reef mesocosms are created and maintained without *Thalassia hemprichii present*, and then *Thalassia hemprichii* would be introduced and managed differently in each mesocosm to observe the different impacts of different management strategies

Intended Analysis: Calcification rates were studied at each temperature for each mesocosm and were analyzed in relation to each other. Within each mesocosm, calcification rates dropped as temperature rose, which is to be expected with ocean warming. Mesocosms with more *Thalassia hemprichii*, however, showed more resistance to increased temperatures. (Legend shows mesocosm numbers… mesocosm 1 had no *Thalassia hemprichii* and mesocosm 8 had the most)

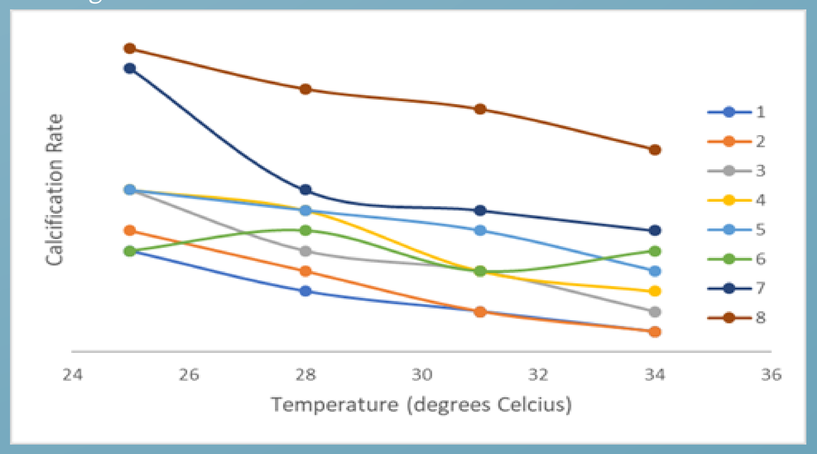

Figure 4: Calcification vs Temperature for 8 coral reef mesocosms exposed to different amounts of *Thalassia Hemprichii*

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