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Assessing the Thermotolerance of Coral Recruits Fused in Early Settlement in Two Species of Caribbean Corals

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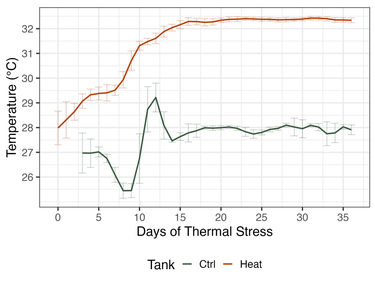
Introduction

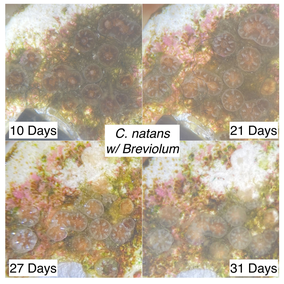
The settlement and survival of reef-building, Scleractinian coral recruits is important to maintain coral reef resilience in our changing climate. Coral recruits are more vulnerable to stressors like high temperatures until they exceed a "size-escape threshold"[2]. However, they have demonstrated longer endurance and higher survival rates under thermal stress when settled in clusters or as fused individuals when compared to individual recruits[3]. This could be due to higher collective size and pooled genetic diversity.

Fused coral recruits may have unique responses to heat stress when compared to individual recruits. This study compared the survival rates of fused and individual coral recruits under thermal stress for two Caribbean brain coral species: ***Colpophyllia natans*** and ***Pseudodiploria strigosa***

Methodology

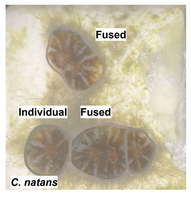
- Coral larvae were born from parent colonies at Florida Aquarium and settled into two algal symbiont inoculation treatments, *Breviolum minutum* and *Durusdinium trenchii*
- Conducted month long thermal stress exposure when recruits were four months of age from December 2022- January 2023

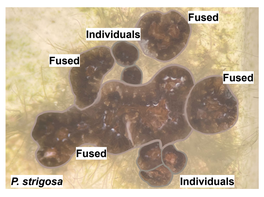




Data Collection:

- Measured photochemical health through Imaging Pulse Amplitude Modulated (IPAM) fluorometry
- Assessed visual degree of bleaching
- Observed size and extent of tissue regression (ImageJ)



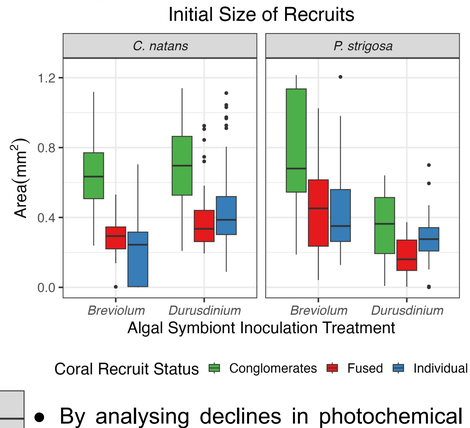


Fusion identification was species specific, but both species exhibited fusion through close proximity and the absence of a skeletal border between coral recruits.

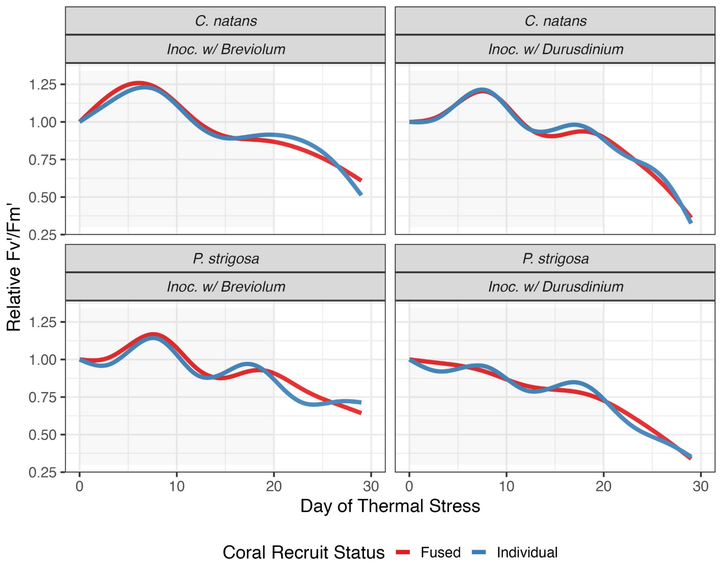
Results

Fusion Status and Initial Size at Four Months of Age

- 384 recruits of *C. natans* and 158 recruits of *P. strigosa* were assessed for fusion status, initial size, status after thermal stress, and photochemical health throughout thermal stress
  - 31% of *C. natans* recruits and 34% of *P. strigosa* recruits demonstrated signs of fusion.
- Fusion status had a significant effect on initial measurements of photochemical health (Fv'/Fm') (ANOVA, p = 0.0238), most notably in *C. natans* recruits hosting *Durusdinium*
- When assessed individually, fusion status did not have a significant effect on initial size (ANOVA, p = 0.274), with the significant driving factor being symbiont inoculation treatment (p = 4.32e-05). However, when multiple fused recruits were measured as a single entity, these coral conglomerates were significantly larger than their individual conspecifics (p <2e-16).

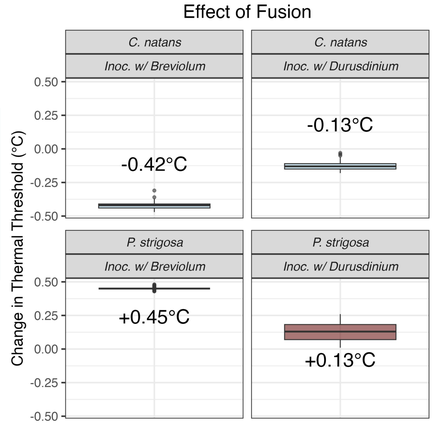


Response to Long-Term Thermal Stress at 32.2°C



P. strigosa demonstrated higher thermal tolerance when recruits were fused, however, *C. natans* demonstrated higher thermotolerance when recruits were individual.

- Negative results reflect a demonstrated advantage of individual corals over fused corals, and positive results reflect a demonstrated advantage of fused corals over individual.
- By analysing declines in photochemical health (Fv'/Fm') relative to accumulated heat stress, we compared the photochemical health of fused vs. individual recruits through use of a dose response curve.
- Fusion status demonstrated a significant effect in later heat stress (>20 days) (ANOVA, p = 0.002)
- Aligning the degree and timing of declines for each comparison produced an algebraic adjustment: the calculated change in thermal threshold attributable to fusion status.



Discussion

- We hypothesized fused coral recruits would have a higher thermotolerance than individual recruits in both *C. natans* and *P. strigosa*, due to literature on non-Caribbean coral species.
- **Our results indicate a species-specific response. This effect of differentiation was significant only in coral recruits inoculated with *Breviolum* when compared to those with *Durusdinium*.**
  - We hypothesize that the higher observed bleaching resistance of *Durusdinium* when compared to *Breviolum* outweighed the potential effect of coral fusion status.
- In early ontogeny, fusion can benefit recruits through successful long-term feeding and occupying a larger territory. However, these benefits may only extend to initial survivorship. Rejection is common (up to 53%) after transitory fusion[1].
- This temporal trade-off may explain why only one of the two study species demonstrated a significant benefit of fusion.

Future Directions

- Given mixed results, it would be valuable to study the rate of rejection among fused coral recruits after ontogeny to assess how long these potential benefits would remain relevant.
- Continuing to investigate differential response in other coral host species with *Breviolum*. Determining which species benefit from coral fusion in early development and prioritizing or discouraging these settlement behaviors could be a valuable intervention in coral reef conservation efforts.

References

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2. Doropoulos C, Ward S, Marshell A, Diaz-Pulido G, Mumby PJ (2012) Interactions among chronic and acute impacts on coral recruits: the importance of size-escape thresholds. Ecology 93:2131–2138
3. Huffmyer AS, Drury C, Majerová E, Lemus JD, Gates RD (2021) Tissue fusion and enhanced genotypic diversity support the survival of Pocillopora acuta coral recruits under thermal stress. Coral Reefs 40:447–458

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