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ater flow reduces bleaching and thermal stress on photosystem function in the coral *Porites divaricata*

Porites divaricata on Old Sweat Bank, Florida Bay

Bleached *Porites divaricata*

Abstract

al reefs are exceptionally important ecosystems ioeconomically and ecologically. Much of the world's ulation is distributed along tropical coastlines and millions of ple depend on healthy coral reef ecosystems for a variety of ds. Coral bleaching is a severe global threat that is expected ncrease in frequency and intensity over the next several ades as a result of climate change, yet not much is known ut how to reduce bleaching. The branching coral *Porites aricata* is often found in very shallow areas with high solar diance, temperature, and water velocity. High temperature solar irradiance contribute to coral bleaching and there is dence that water motion may alleviate these affects. The othesis that increased water motion reduces bleaching (loss ooxanthellae cells from the coral) and bleaching stress in *P. aricata* was tested using paired flume experiments with erent water velocities under conditions of high temperature high solar irradiance. One measure of bleaching stress, rease in photochemical efficiency of Photosystem II (F_v/F_m), is ater in "slow flow" (2-3 cm s^{-1}) compared to "fast flow" (14-21 s^{-1}) after one day of exposure to bleaching conditions. otochemical efficiency was also significantly affected by water perature. Bleaching was significantly greater in corals in the v flow treatment. **These results support the hypothesis that reased water motion alleviates bleaching and the effects hermal bleaching stress on photosystem function in the al *Porites divaricata*.**

Environmental Issue

In this research I examine factors that influence coral bleaching and how bleaching might be alleviated.

Introduction

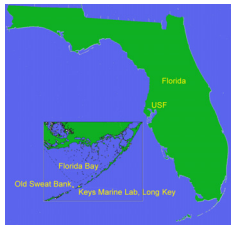
- There is evidence of a negative relationship between water motion and the severity of bleaching.
- If bleaching is affected by water motion, it may be due to enhanced transport of dissolved chemicals into or out of coral tissue.
  - Reactive oxygen species – cause cell damage
  - Nutrients – affect cell stress level

Hypothesis

Water flow reduces bleaching in *Porites divaricata*

Methods

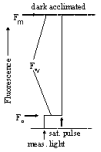
- *Porites divaricata* were collected from Old Sweat Bank in the Florida Bay.
- Experiments were conducted at Keys Marine Lab, Long Key, Florida.



Paired flume experiments

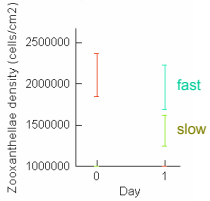
- Bleaching conditions: full sunlight, high temperature
- All conditions identical except velocity
- 2–3 cm s^{-1} (slow flow) vs. 14–21 cm s^{-1} (fast flow)
- Six corals per experiment, ten experiments

- Bleaching was measured as decrease in zooxanthellae density (cells cm^{-2}).
- Thermal stress on photosystem function was measured as decrease in photochemical efficiency (F_v/F_m) using a **pulse-amplitude modulated (PAM) fluorometer**.
  - F_o – Initial dark-acclimated fluorescence
  - F_m – Maximum dark-acclimated fluorescence
  - F_v/F_m – Photochemical efficiency (which is known to decrease in bleached corals)



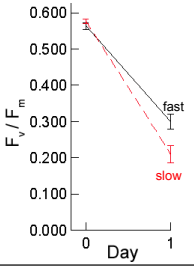
Results

Bleaching is reduced in fast flow



Mean zooxanthellae density decreased in 2-3 cm s^{-1} flow ($p = 0.02$, $N = 15$), but did not decrease in 14-21 cm s-1 flow ($p = 0.43$, $N = 15$).

Thermal stress on photosystem function is reduced in fast flow



F_v/F_m decreased during one day exposure to bleaching conditions ($P < 0.001$, $n = 60$)

F_v/F_m decreased more in slow flow than fast flow ($P < 0.001$, $n = 60$)

Impact

This research demonstrates that water flow reduces bleaching stress in corals, aiding managers in identification of habitats most critical for conservation.

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