Effects of iron on the heat tolerance of *Stylophora pistillata*

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Background & Objectives

- Rising seawater temperatures caused by global warming destabilizes the coral-algae mutualism (Mizerek et al., 2018)
- Fe is important on the growth of *Symbiodinium and* is utilized by superoxide dismutase (SOD) to regulate the level of reactive oxygen species (ROS) produced by photosynthesis (Rodriguez et al., 2016)
- *Stylophora pistillata* is a species of stony corals found in a range of coral reefs ecosystems providing homes to myriad of marine species in the underwater world (Sully et al., 2019)
- This project investigates corals' response to heat stress under varying concentrations of bioavailable iron through image analysis and algae's photosynthetic efficiency measurement

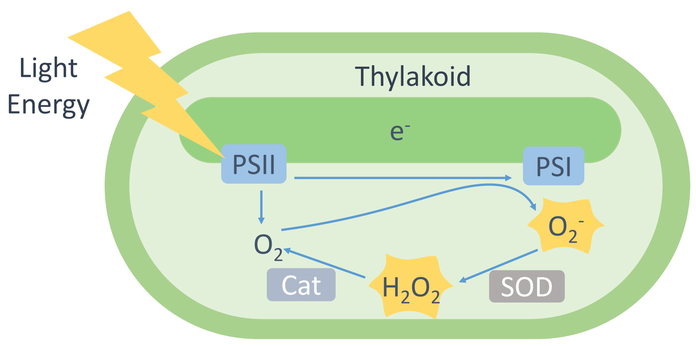


Figure 1. The important antioxidant defense of SOD inside a plant cell chloroplast

Methods

1. Develop a short-term heat stress assay following a modified Coral Bleaching Automated Stress System (CBASS) protocol (**Figure 2**)
2. Prepare trace-metal defined seawater from a modified YBC-II medium recipe for coral culturing
3. Compare the short-term effects of iron replete (500pM Fe') vs iron limiting (0pM Fe') condition on *Stylophora pistillata*
4. Measure the maximum quantum efficiency of photosystem II (Fv/Fm) with a Diving PAM and calculate RGB intensities of corals in MATLAB (**Figure 3**)
5. Utilize ICP-MS to determine iron and other trace-metal concentrations before and after the experiment

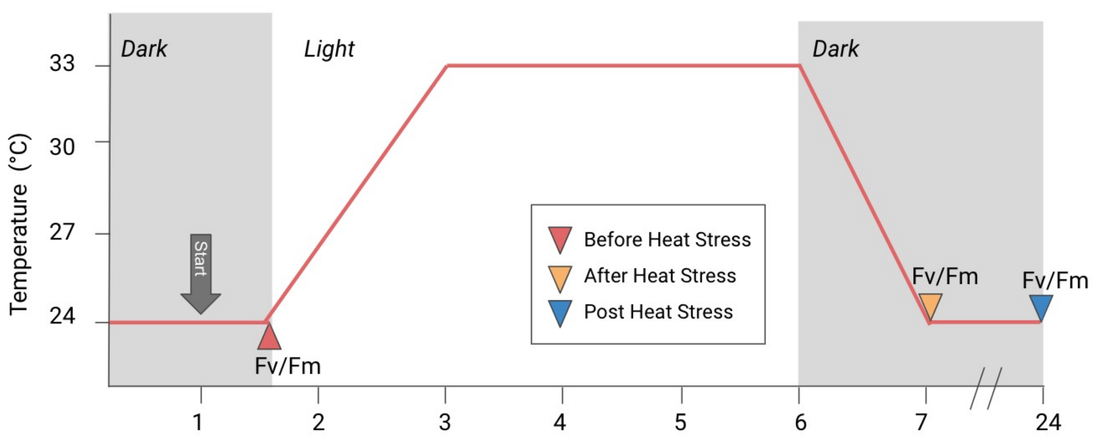


Figure 2. Modified CBASS protocol for coral short-term stress assays

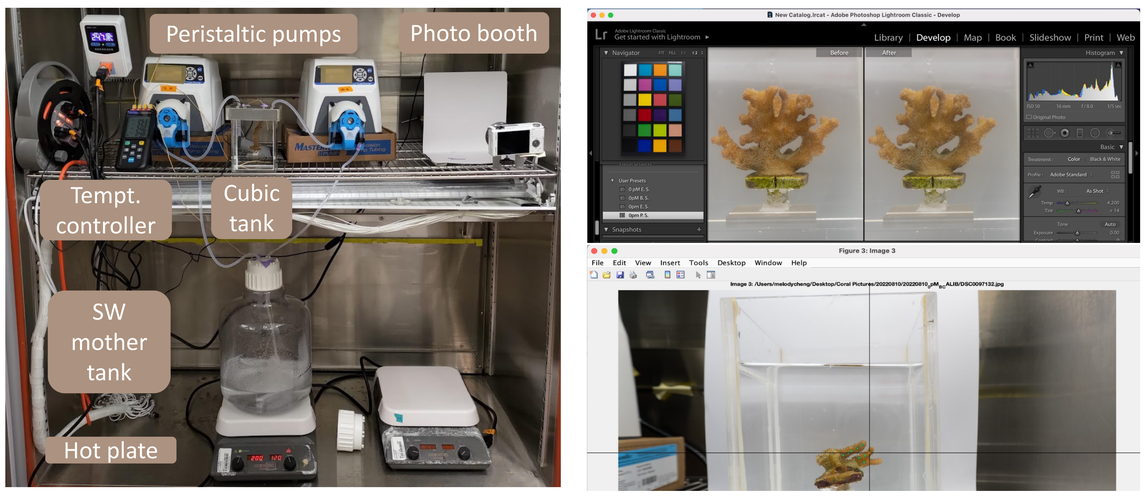
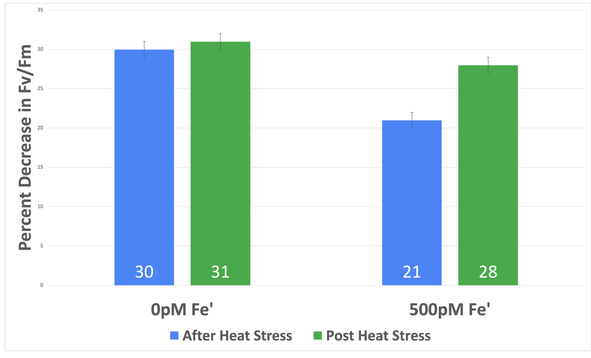


Figure 3. Experimental set up for coral culturing (*left*) and image analysis programs (*right*)

Results & Discussions



Measurement Timing	0 pM Fe′	500 pM Fe′
Before heat stress	0.68 ± 0.01	0.65 ± 0.01
After heat stress	0.47 ± 0.01	0.51 ± 0.01
Post heat stress	0.47 ± 0.02	0.47 ± 0.01

Figure 4. Bar graph demonstrating the percent decrease in Fv/Fm of corals after and post heat stress under varying Fe' concentrations (*left*). Comparison of Fv/Fm of corals measured for different Fe' concentrations (*right*). The error bars illustrate the standard deviation for each sample.

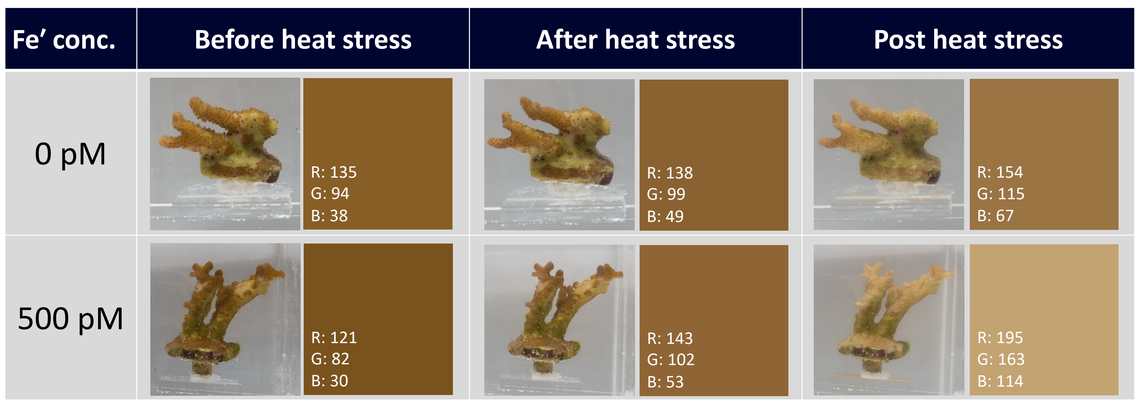


Figure 5. Color changes in RGB intensities under varying Fe' concentrations

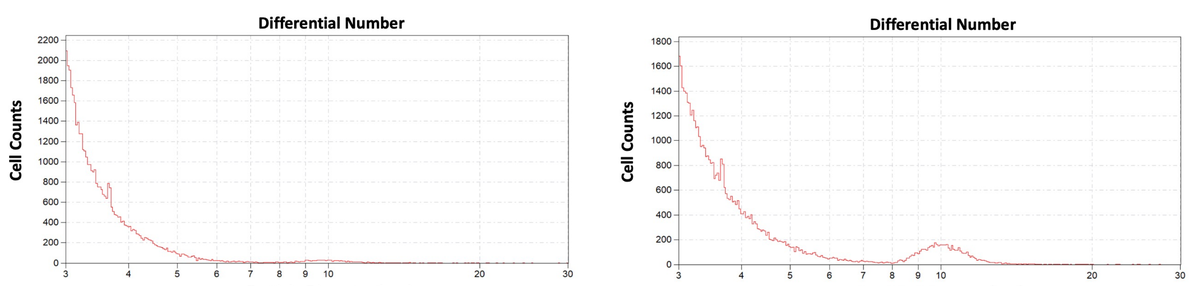


Figure 6. Cell counts from seawater sample collected after 0pM Fe' treatment (*left*) and 500pM Fe' treatment (*right*)

In both treatments, photosynthetic efficiency is reduced (**Figure 4**). In 500 pM Fe' treatment, corals experience a higher degree of stress, observed based on RGB analysis, (**Figure 5**) and expulsion of algae (**Figure 6**). Due to the limitation of experimental setup and small sample size, observations are made, and no conclusive statement can be made on the effects of Fe' concentration on corals' response to heat stress.

Conclusions

- Growing *Stylophora pistillata* under iron replete (500 pM Fe') and limiting (0 pM Fe') conditions is found to have reduced the maximum quantum yields (Fv/Fm) of photosystem II
- The degree of coral bleaching suffered the most in the iron replete treatment at the post heat stress stage. Further experimentation required to confirm the impact of increased iron on thermal resilience of corals

Future Directions

- Explore long-term effects of iron on corals and conduct heat stress assay with a chemostat flow-through water system
- Conduct SOD-activity assays on algae in corals to investigate further the Fe-SOD mechanism

Acknowledgements

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References

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Mizerek et al. (2018) *Coral Reefs*, *37*, 791-800. https://doi.org/10.1007/s00338-018-1702-1
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