Thermal Tolerance of *Nannochloropsis:* A Colony Recovery Model In Relation to Coral Bleaching

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Abstract

Zooxanthellae spp. are mixotrophic organisms that partake in a symbiotic relationship with reef-building corals in the Family *Acroporidae* and *Merulinidae*. When water temperatures rise above or drop below certain levels *Zooxanthellae* spp. cease to produce food, and are expelled from the coral, as they no longer provide it with the nutrients required to survive (Zooxanthellae). It is vital to marine life that coral reefs thrive as they are common mating and feeding grounds to many species. Our research was based on the intentions of investigating the thermal tolerance of *Nannochloropsis* spp. as a model for *Zooxanthellae* spp. in relation to colony recovery and coral bleaching. *Nannochloropsis* provides a primary model for *Zooxanthellae* spp. as its optimal growth temperature, 30℃, falls within the optimal thermal window of *Zooxanthellae* spp., 18-33℃. This investigation will provide vital insight as to how temperature is directly affecting colony recovery, and if there are temperatures too high or low that risk chances of irreversible damage (Conroy). For this project we will be investigating culturing rates of the algae at different temperatures ranging from 24-36 ℃. The model demonstrated that photosynthetic organisms such as *Zooxanthellae* spp. and *Nannochloropsis* are affected by drastic changes in temperature throughout short periods of time more so than the temperatures themselves, as the lowest point in culture numbers was as temperatures we're increasing. Levels peaked at different points throughout the samples, but each peak was somewhere within the time periods of stable temperature.

<u>Purpose</u>: Investigate and analyze the effect of varying temperatures on coral bleaching and colony recovery of algae using *Nannochloropsis* spp. as a model organism.

<u>Hypothesis</u>: Temperature groups below the ideal culturing temperature will have higher chances of colony recover than groups held at higher temperatures.

<u>Research Question</u>: How do varying water temperatures affect development and colony size of *Nannochloropsis* spp.?

References and Acknowledgements

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Results and Discussion

We analyzed our data using Microsoft Excel, taking the average colony size for each group was analyzed individually before being averaged and formatted into a graph. Through this analysis we found that *Nannochloropsis* spp. are affected by changes in temperature throughout more so than the temperatures themselves, as the lowest point in culture numbers occurred while temperatures were increasing. Levels peaked at different points throughout the samples, but each peak was somewhere within the six day time period of stable temperature. According to Sukenik et al. (2009) cultivating *Nannochloropsis* spp. in high temperature conditions causes a reduction in photosynthesis. This results in colony collapse, and decreases the amount of nutrients the algae produces. In the case of the symbiotic algae and coral, this causes the coral to expel the algae resulting in the coral bleaching phenomena associated with climate change.

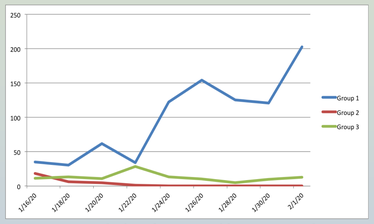

Figure 1: Growth chart for *Nannochlorpsis* spp. cultures that reached 24 ℃.

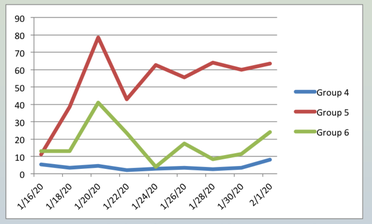

Figure 2: Growth chart for *Nannochlorpsis* spp. cultures that reached 27 ℃.

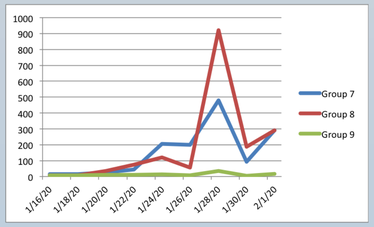

Figure 3: Growth chart for *Nannochlorpsis* spp. cultures that reached 30 ℃. Control group.

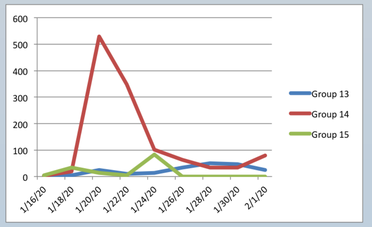

Figure 4: Growth chart for *Nannochlorpsis* spp. cultures that reached 33 ℃.

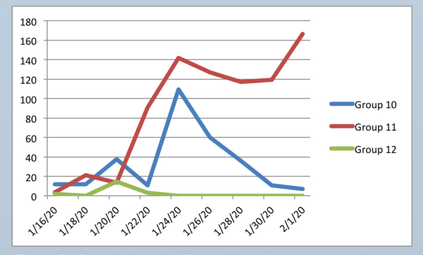

Figure 5: Growth chart for *Nannochlorpsis* spp. cultures that reached 36 ℃.

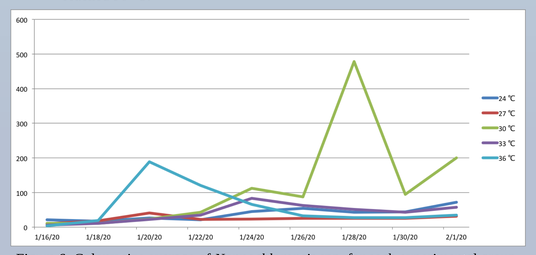

Figure 6: Colony size average of *Nannochloropsis* spp. for each experimental group.

Introduction

- *Nannochloropsis* is a genus of microalgae species that has a similar optimal growth temperature to *Zooxanthellae* spp., which makes it a good model species.
- *Zooxanthellae* produce and distribute vital nutrients to coral in exchange for shelter. This symbiosis is important as it creates coral reefs that provide spawning and feeding grounds for many marine species.
- Rising ocean temperatures are hypothesized to be the leading cause of coral bleaching. This is because when water temperatures rise *Zooxanthellae* is expelled from the corals pores.
- The greenhouse effect traps heat inside of the earths atmosphere, and most of this heat is absorbed by ocean water, causing ocean temperatures to rise.

Methods

- Thermal barriers made from foam insulation were used to keep each experimental group unaffected by adjacent heat lamps.
- Two holes were drilled into the lids of each pint mason jar; one hole was for a five inch section of 3/16 inch tubing filled at the end with cotton to prevent evaporation but allow the algae to respire. The second hole was for 3/16 inch tubing that connected to a 60 gallon bubbler to provide algae with oxygen.
- 125 Watt heat lamps were connected to thermostats to keep the algae at their specified temperature
- A fourth mason jar filled with growth medium was added to each group so the thermostat would receive accurate temperatures.
- Algae cultures were counted every other day using a hemocytometer, glass cover slip, microscope, and one drop from a 3ml pipette
- Hemocytometers were cleaned using rubbing alcohol and a cotton swab between each sample.