Symbiont Density, Chlorophyll a, and Color Intensity of Aposymbiotic and Symbiotic Colonies of the Temperate Coral *Oculina arbuscula* on the N.C. Coast

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Question

How does the symbiont density, chlorophyll *a* content per symbiont, and color intensity of coral vary between symbiotic and aposymbiotic colonies, and how might these variables change across seasons?

Background

Corals are the foundation of reef ecosystems that are instrumental to the health and abundance of a vast diversity of marine life. Anthropogenic increases in atmospheric carbon dioxide have led to rising ocean temperatures, which are correlated with decreasing symbiont density and chlorophyll *a* (chl*a*) levels. Extreme levels of temperature stress can cause coral bleaching or complete loss of symbionts. Facultatively symbiotic corals, like *Oculina arbuscula*, can survive without symbionts by relying more on heterotrophic carbon and are thus useful models to study the physiological effects of coral bleaching. This study measured the natural variation in color intensity, symbiont density, and chl*a* content between symbiotic and aposymbiotic colonies of the temperate coral *Oculina arbuscula*.

Radio Island, N.C.

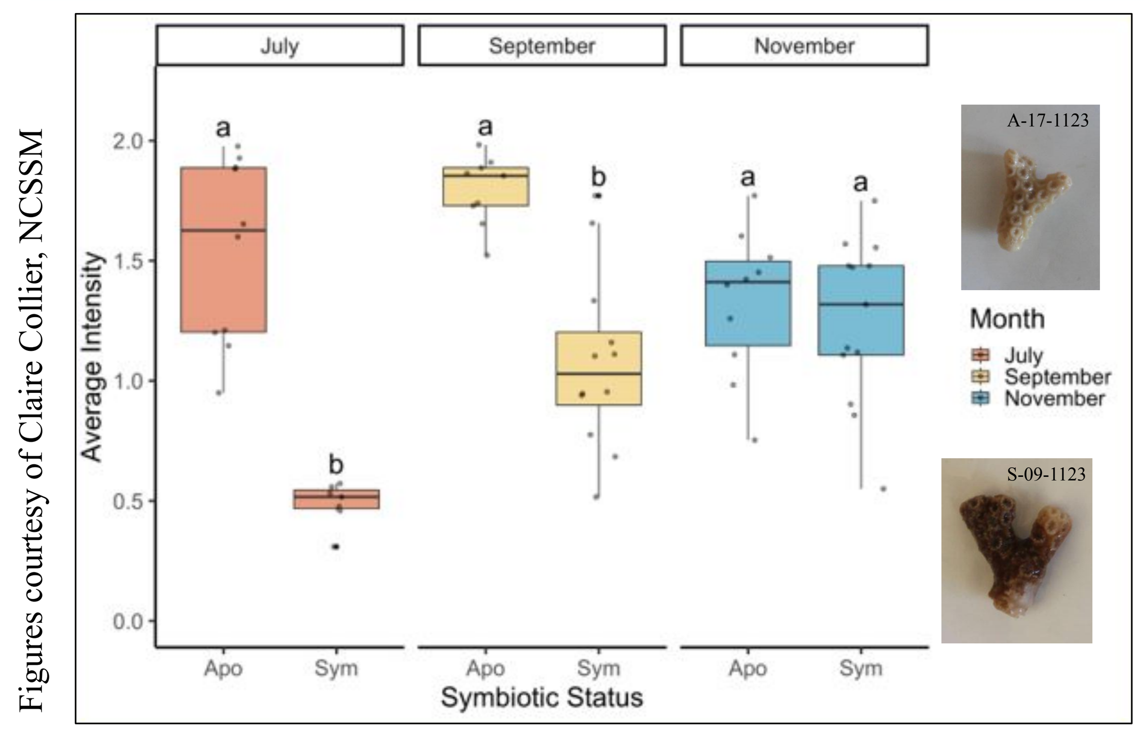
Mixed symbiosis

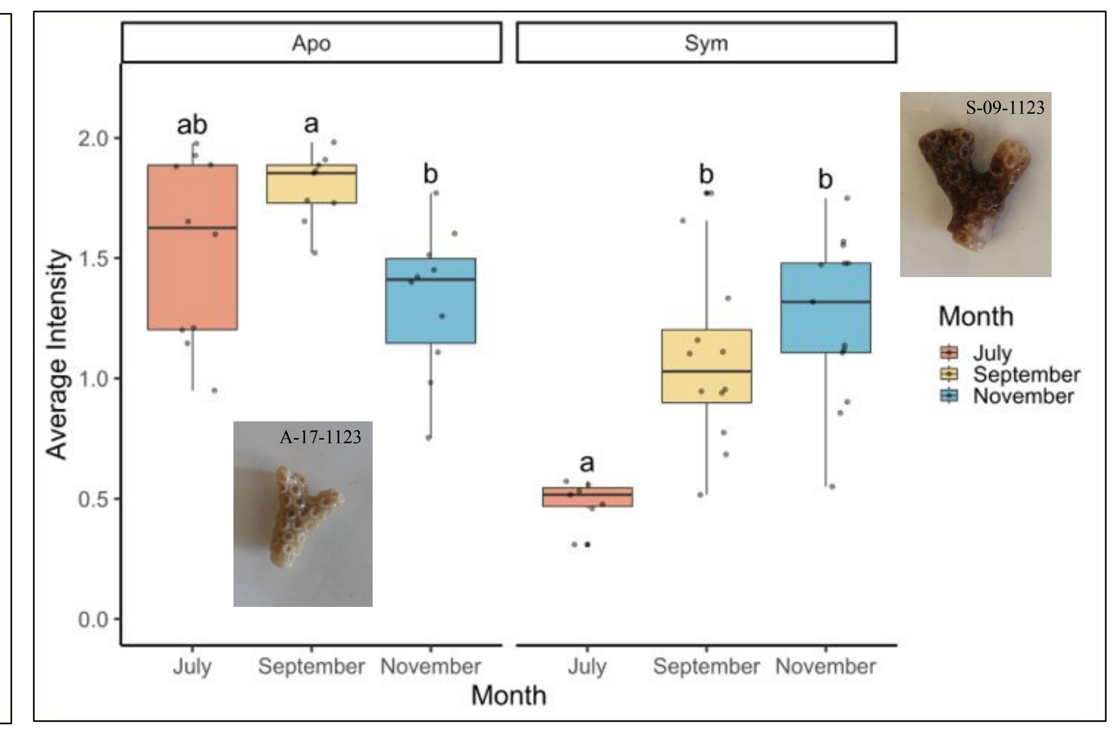
Methods

- **Color analysis**: measure brightness of coral fragment photos
- **Symbiont density**: count symbiont cells, normalize to surface area
- **Chlorophyll *a***: measure fluorescence to find chlorophyll *a* pigment concentration, normalize to surface area and to symbiont density

Results

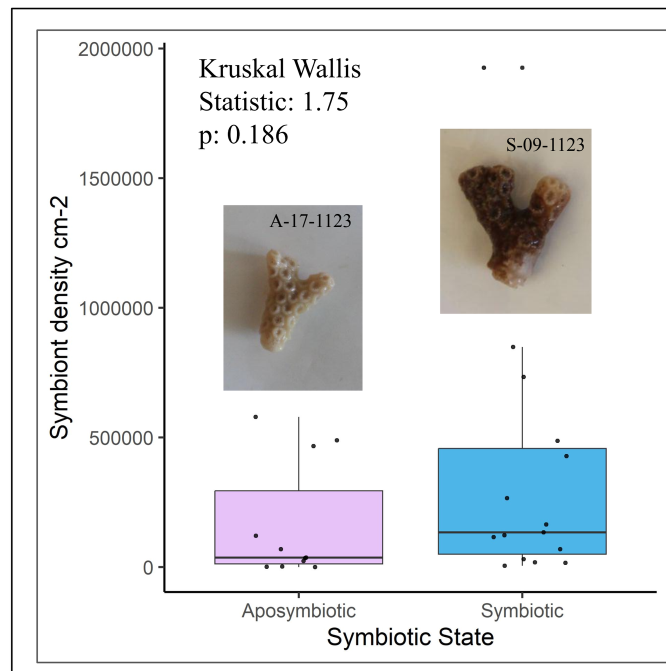
Color Intensity





Apo. and sym. colonies have significantly different intensity in July and Sept., but not Nov. This could partly be due to a storm event that occurred and caused high turbidity levels prior to November collection. Sym. colonies are much darker in the summer and become lighter in the fall and winter, whereas apo. colonies maintain lightness.

Symbiont density cm^{-2}, Chla cm^{-2} & Chla per symbiont (November)

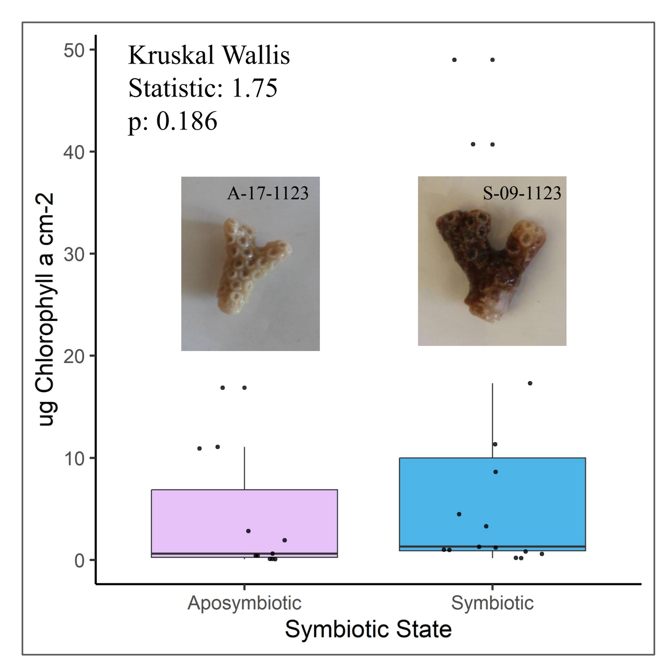


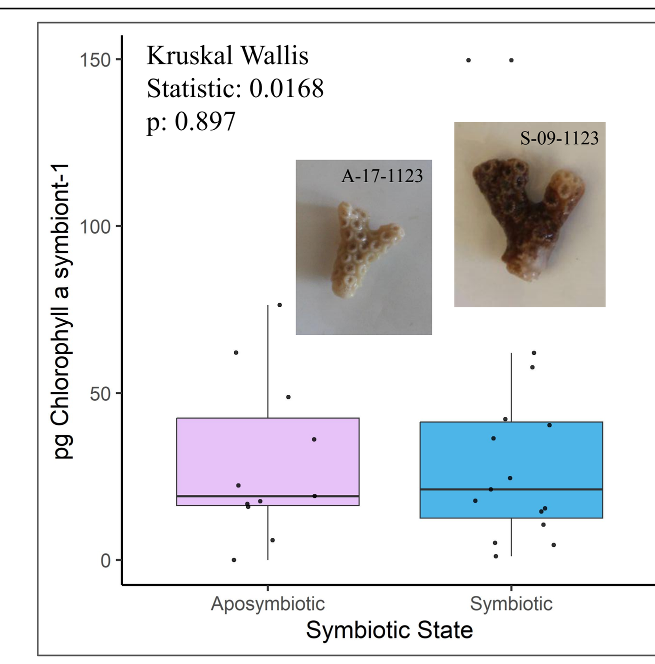
Symbiont Density cm^{-2}

Symbiont density was not significantly varied between apo. and sym. colonies in November. There were several outliers among the symbiotic colonies that had a much greater density of symbionts.

µg chlorophyll *a* cm^{-2}

Chlorophyll *a* content was also not varied between apo. and sym. colonies. Again several symbiotic outliers were present for this month.





pg chlorophyll *a* symbiont^{-1}

Chl*a* per symbiont was not significantly different between apo. and sym. colonies. This is predicted to change across seasons and both the amount of chla per symbiont and the difference between apo. and sym. will be interesting to observe at other seasonal timepoints.

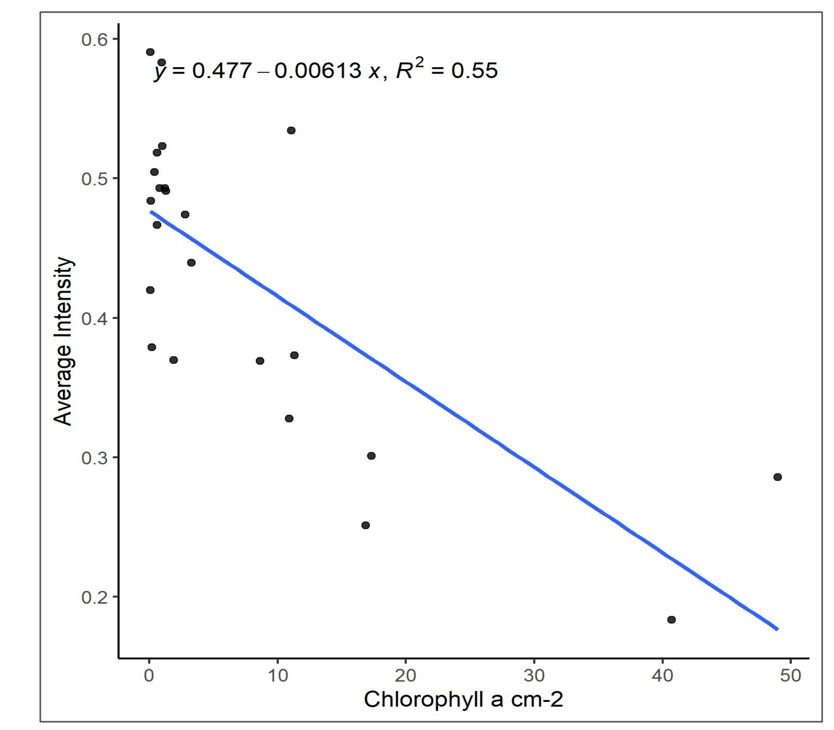
Conclusions

- **Color intensity** varied across seasons, and showed distinct differences between apo. and sym. during summer and fall.
- **Symbiont density**, **chlorophyll *a*, and color intensity** were the same between apo. and sym. colonies during the winter and after a storm event (Nov.)
- **Chl*a*** is more correlated with **color intensity** than symbiont density, but both show a negative relationship with average color intensity.

Method Comparison

The **chl*a* cm^{-2}** and **sym cm^{-2}** data were compared to **color intensity** to see which is a better match. When plotted against the average of color intensities, chl*a* had a slightly better correlation (R^2=0.55) than symbiont density (R^2=0.52).

As both the **chl*a* cm^{-2}** and **symbionts cm^{-2}** increase, the average color intensity decreases (is darker).



Future Directions

- More **data timepoints** will be analyzed to see whether the observed color intensity trend continues or changes across seasons.
- Similarly, **symbiont density, chl*a* content,** and **chl*a* per symbiont** from future timepoints will be analyzed to determine seasonal patterns of these parameters.
- Further study is needed to observe patterns in these physiological aspects in response to **natural seasonal fluctuations**, with potential implications for mitigating the effects of climate change on coral reefs.

Acknowledgments

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