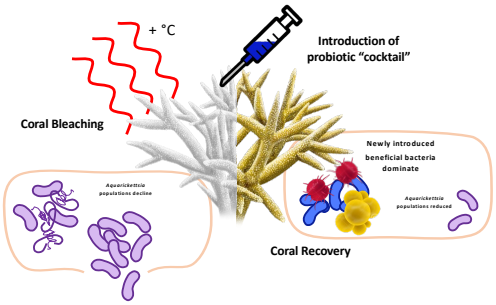
Microbiome Manipulation: Using Beneficial Microorganisms of Corals to Increase Disease Resilience

Cory J. Krediet[1], Grace Klinges[2,3], Marina Villoch[2], Jayden Kuhn[1], Erinn Muller[2]

[1]Department of Marine Science, Eckerd College, St. Petersburg, FL
[2]Coral Health and Disease Program, Mote Marine Laboratory, Sarasota, FL, USA
[3]Center for Global Discovery and Conservation Science, Arizona State University, Hilo, HI, USA

Background

- Certain genotypes of the coral *Acropora cervicornis* are naturally resilient against disease.
- The objectives of this study were to induce bleaching in *A. cervicornis* while avoiding coral mortality, and subsequently introduce beneficial microbes of corals (BMCs) to replace the dominant coral parasite, *Aquarickettsia.*



Methods

- Potentially beneficial microbes were isolated from disease resistant *A. cervicornis* genotypes and characterized.
- *A. cervicornis* fragments in aquaria were bleached using menthol or temperature shock.
- Coral food was inoculated with a cocktail of BMCs and then fed to the coral fragments during the first week of the experiment.
- 16S sequences were obtained using Illumina Sequencing from samples pre-inoculation, and 1 day, 7 days, and 30 days post-inoculation.
- The sequences were filtered, clustered to form ASVs, and analyzed for alpha diversity, beta diversity, relative abundance, and differential abundance using RStudio.

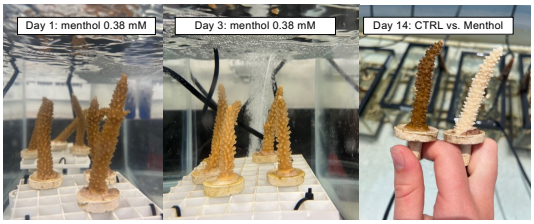


Figure 2. Outcome of menthol bleaching on *A. cervicornis*.

Results

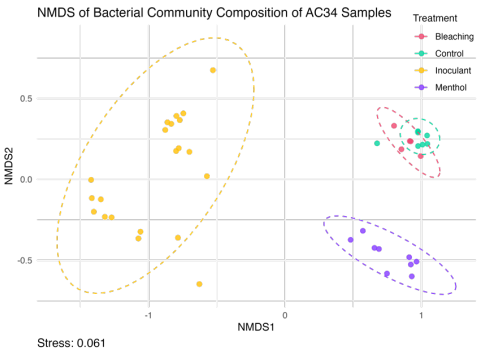


Figure 3. NMDS plot of AC34 samples 1 week after inoculation and all inoculant samples (n=44). Data was rarefied to a sampling depth of 13985.

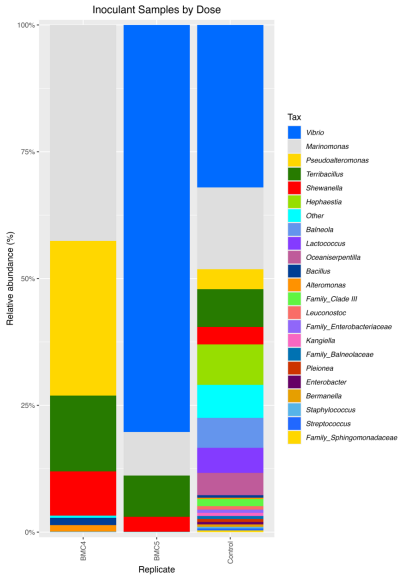


Figure 4. Relative abundance plot of inoculant samples averaged across each dose (n=21).

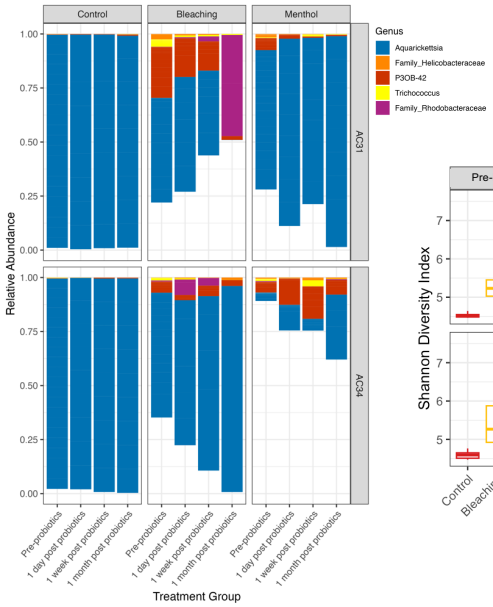


Figure 5. Relative abundance plot of samples from both genotypes across all bleaching treatments and timepoints (n=252).

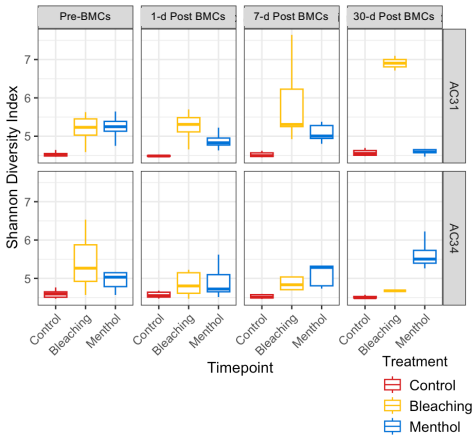


Figure 6. Boxplot of Shannon Diversity Index for each genotype, treatment group, and timepoint (n=252).

Conclusions

- Menthol-induced bleaching is a quick and effective method to significantly reduce both *Aquarickettsia* and algal symbiont densities (Klinges et al. in review at PeerJ)
- Both bleaching treatments significantly reduced *Aquarickettsia* populations, and produced shifts towards more diverse microbiomes.
- The menthol treatment was more effective in reducing the abundance of *Aquarickettsia* in corals with the AC34 genotype than the AC31 genotype.
- The corals did not robustly uptake the BMCs from the cocktails.
- BMC inoculation may be more successful with younger or juvenile corals, which may uptake microbes more readily. We are currently exploring this strategy with the BMC cocktails.

Acknowledgements

- Student support was provided by the Eckerd College Natural Sciences Summer Research Program (NSSRP.
- Research funding for this work was provided by the Florida Protect Our Reefs Program administered by Mote Marine Laboratory and the Eppley Foundation.
- We also thank Mote Marine Laboratory and Eckerd College interns Cara DeLacluyse, Connor Dempsey, Maia Erbes, and Roger Wilder for their assistance with coral husbandry and lab assistance.