Microbiome Manipulation: Using Beneficial Microbes of Coral to Increase Disease Resilience

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The Coral Holobiont

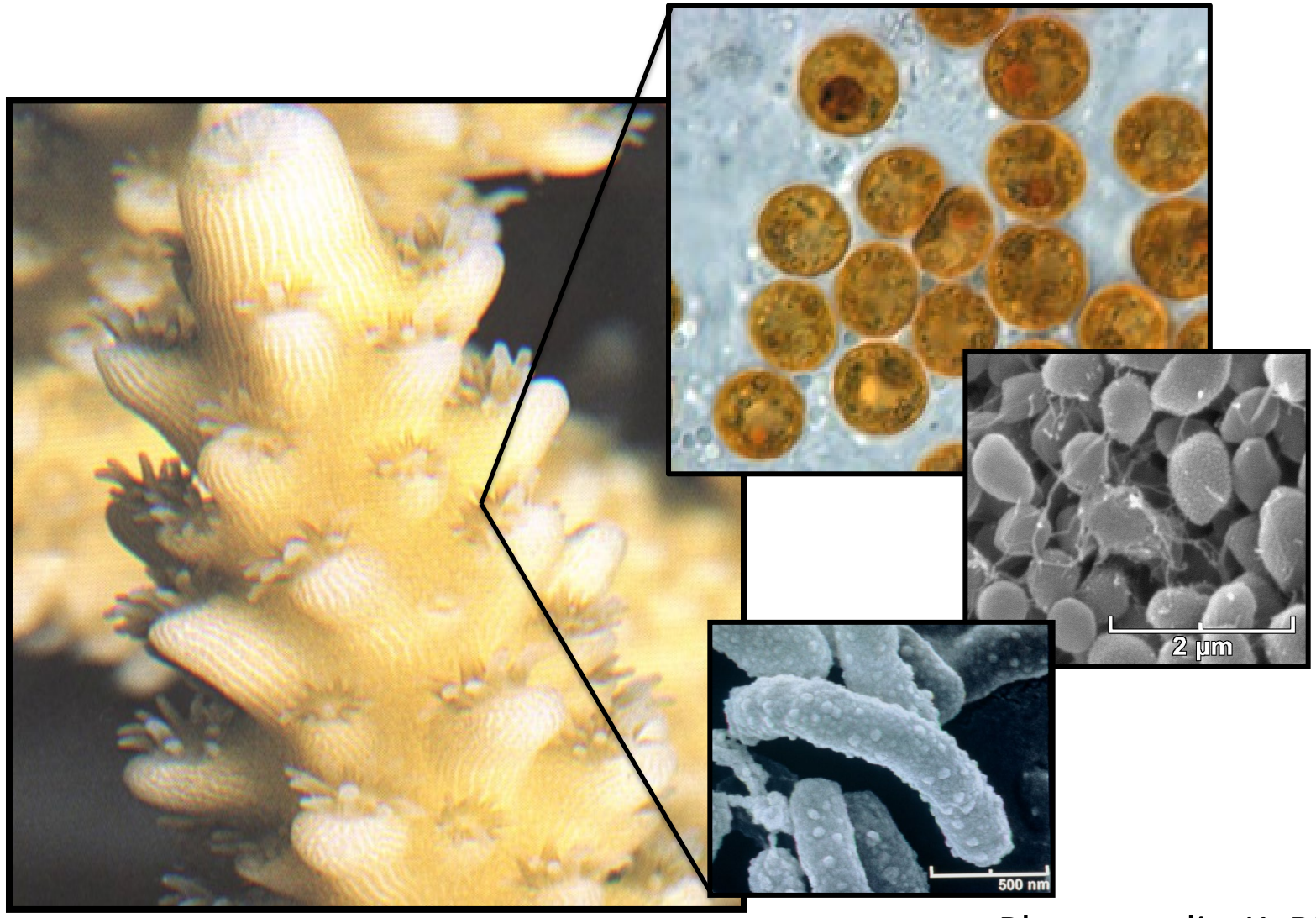


Photo credit: K. Ritchie

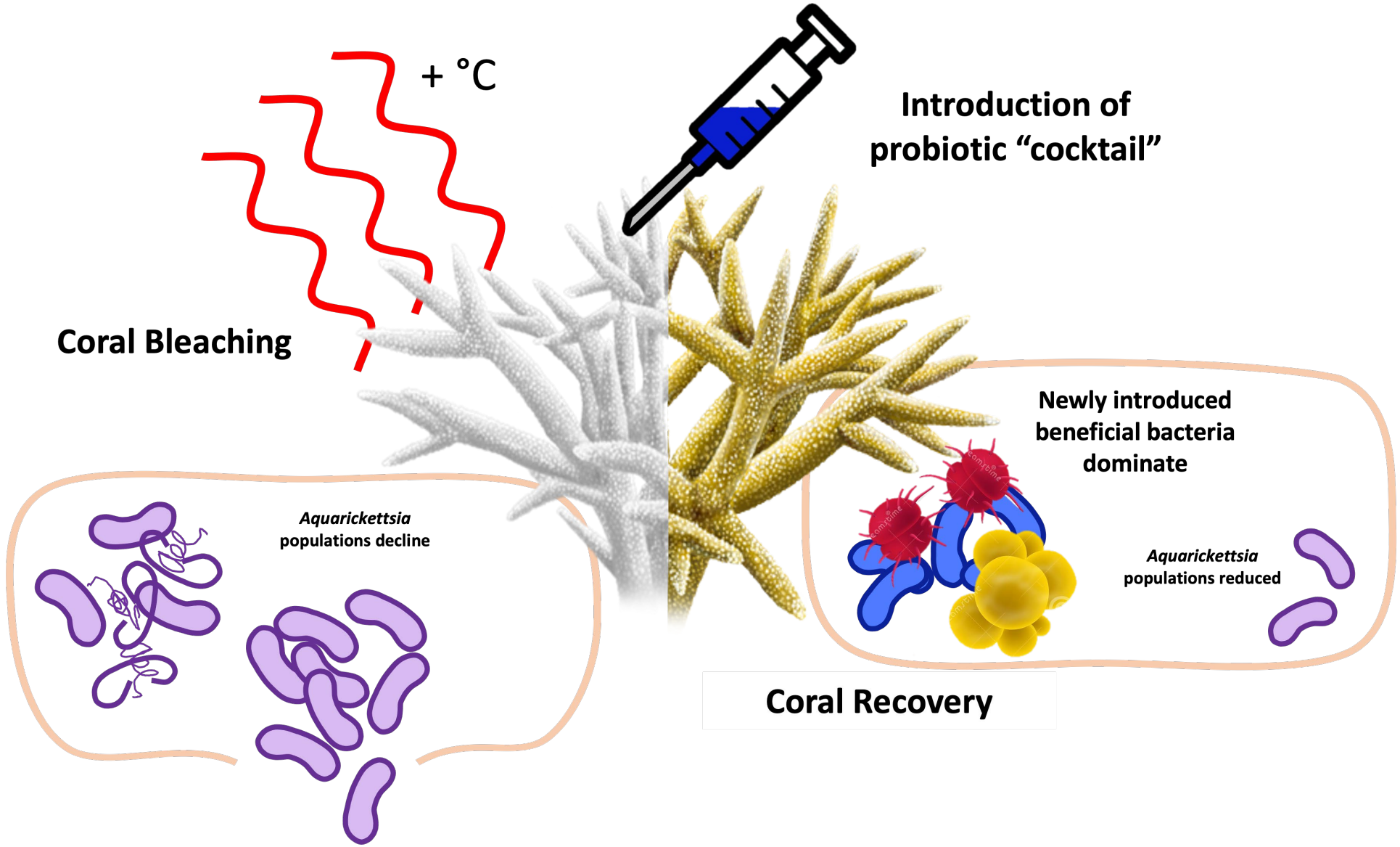
Beneficial Microbes of Coral (BMCs)

- Question: Can coral-associated microbes lead to increased resilience in *Acropora cervicornis* used in restoration in the FL Keys?

- Objective 1: *Isolate, identify, and characterize coral-associated strains of bacteria from the resilient genotypes and develop a library of potential isolates for probiotic capabilities.*

- Objective 2: *Introduce potential BMCs to susceptible genotypes of corals to manipulate their microbiomes.*

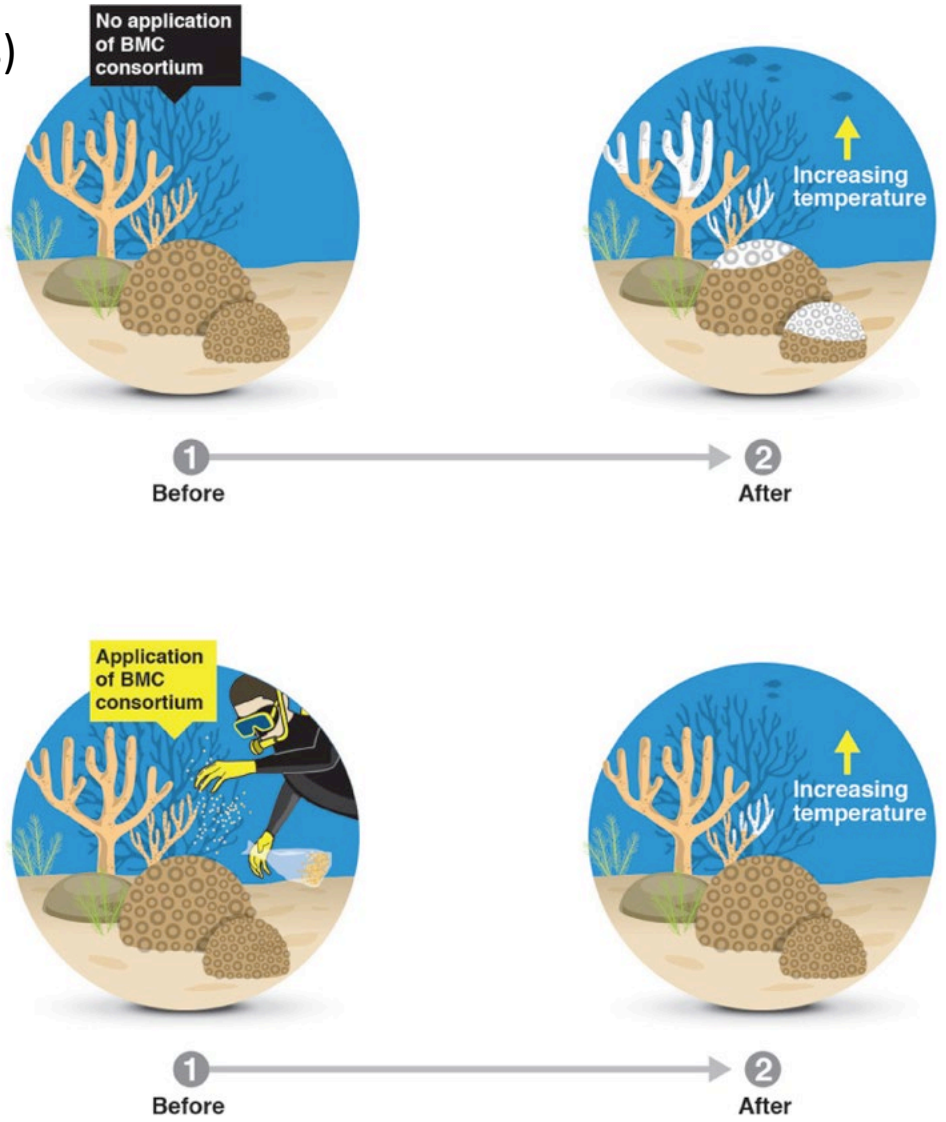
Beneficial Microbes of Coral (BMCs)



The Approach in the FL Keys – Summer 2023

Credit: Penh Alicandro

Beneficial Microorganisms of Coral (BMCs)



Peixoto et al. 2017

Results from bacterial characterizations

Coral Genotype	Isolates Identified	Swarming Inhibitory	β-galactosidase Inhibitory*	Total Screened (swarming)
#3	80	35	6	95
#7	64	31	0	91

Over 700 isolates in culture from four genotypes

Over 250 isolates identified by 16S rRNA sequencing

Dominated by *Vibrio*, *Photobacterium*, and *Pseudoalteromonas* strains

From the resistant genotypes:

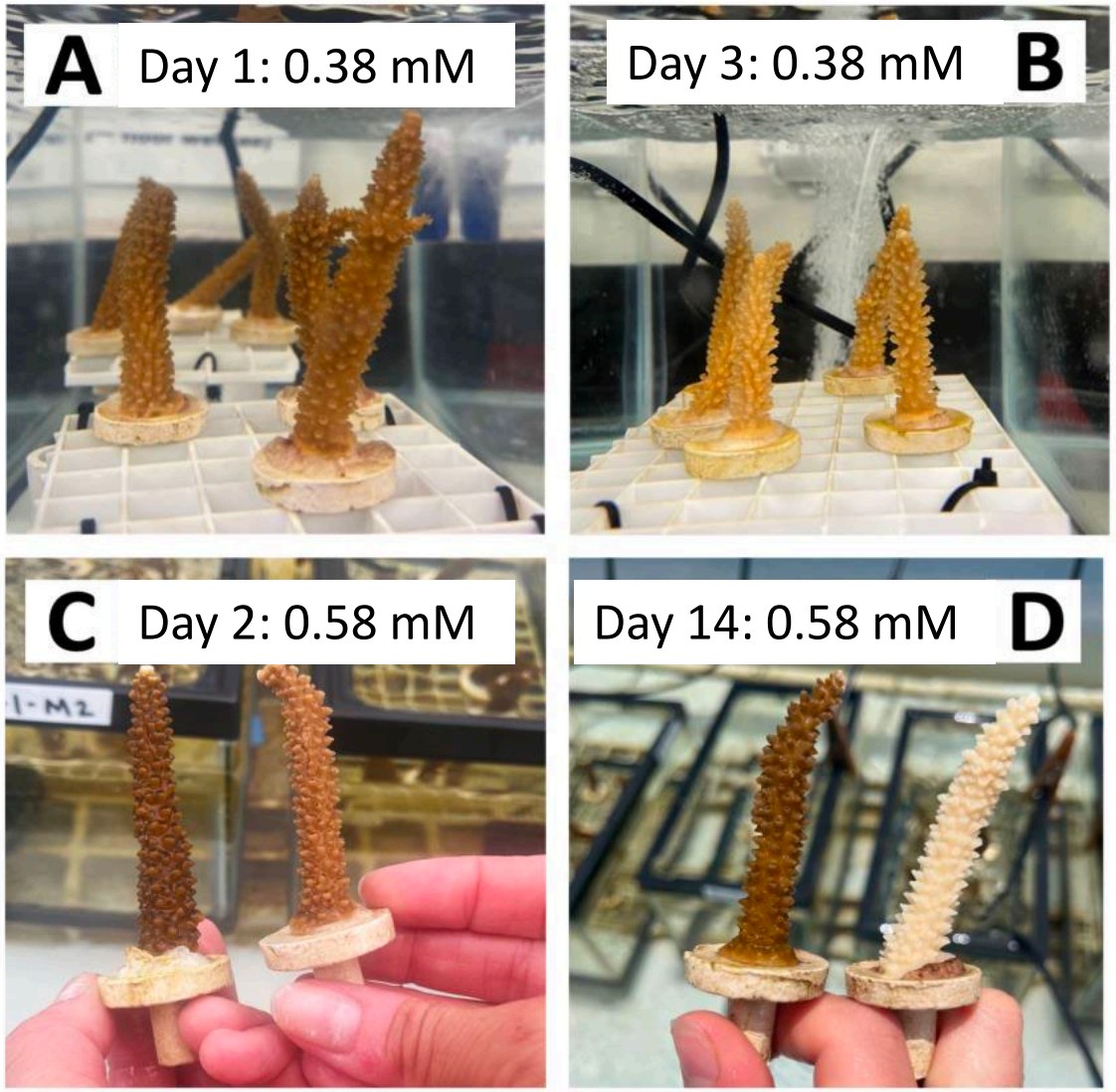
72 isolates show either swarming and/or B-gal* inhibition

BMCs of Disease-Resistant *A. cervicornis*

Strain Name	Best BLAST hit with 16S rRNA gene
P1A3	*Alteromonas macleodii*
P1B9	*Vibrio rotiferianus*
P1D7	*Vibrio alginolyticus / Vibrio owensii*
P1G7	*Vibrio harveyi*
P2B9	*Pseudoaltermonas shioyasakiensis*
P2C11	*Mariomonas* spp.
P2D4	*Vibrio coralliilyticus*
P2E2	*Vibrio ponticus*
P2F1	*Shewanella* sp. 49WBP
P2F6	*Vibrio orientalis*

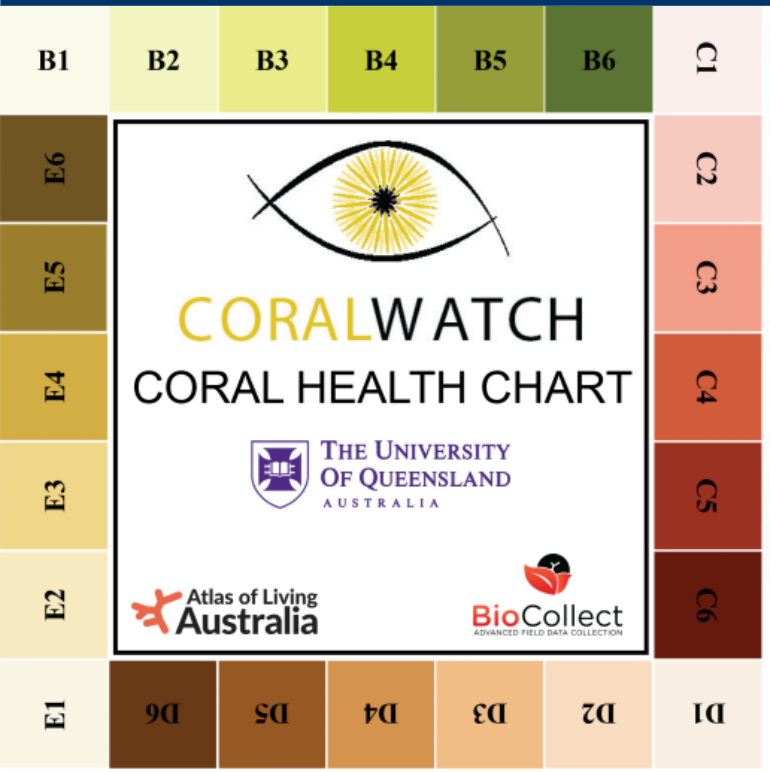
Menthol-Induced Bleaching of *A. cervicornis*

- Menthol-Induced Bleaching Protocol
  - Three doses:
    - 0.19 mM, 0.38 mM, 0.58 mM
    - Incubation for 6 hours daily for up to two weeks
- Thermal-Induced Bleaching
  - 31°C after ramp from 27°C

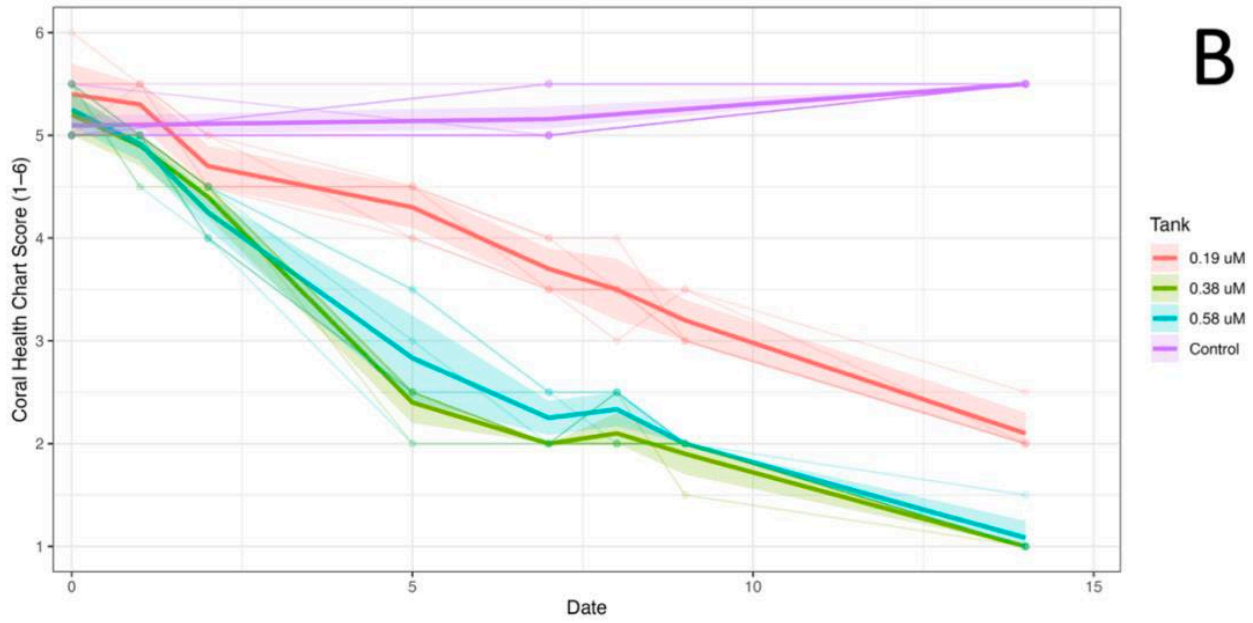


Klinges et al. *in review at PeerJ*

Monitoring Bleaching by CoralWatch Coral Health Chart

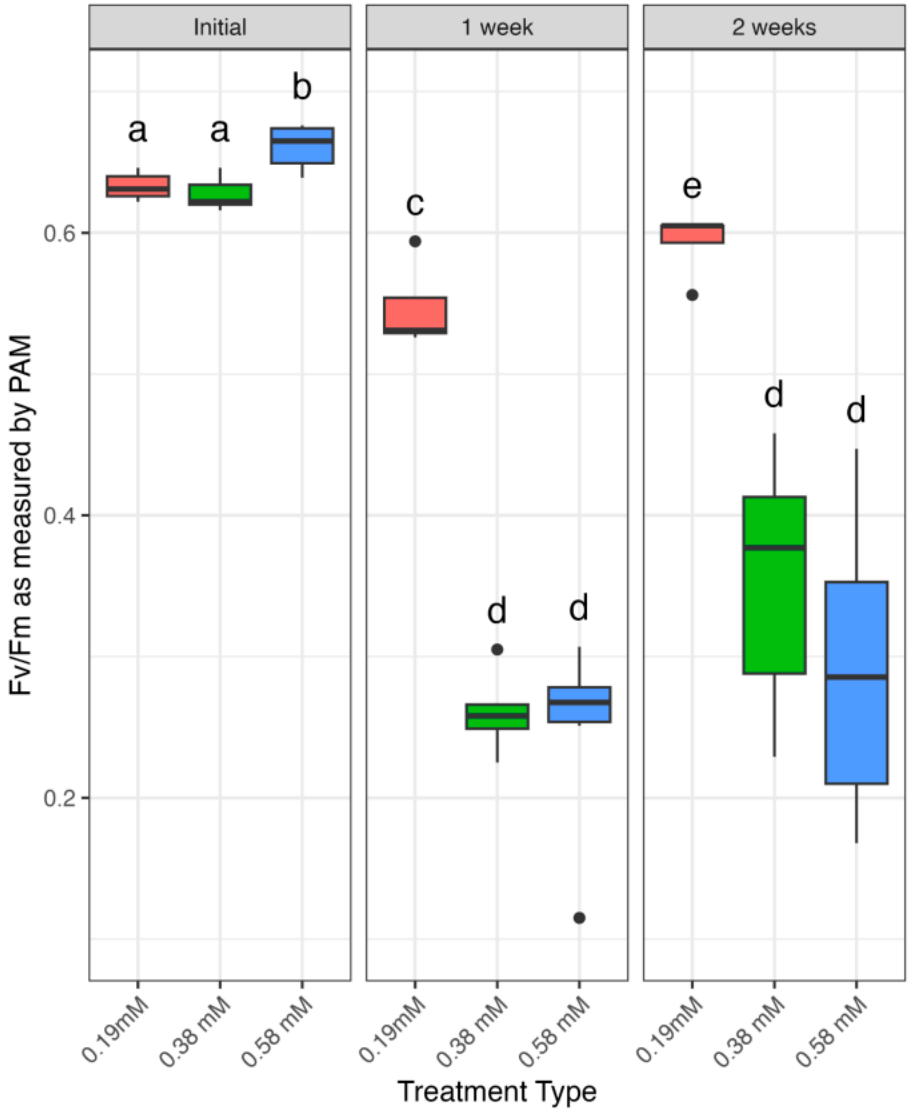


https://coralwatch.org/product/coral-health-chart/

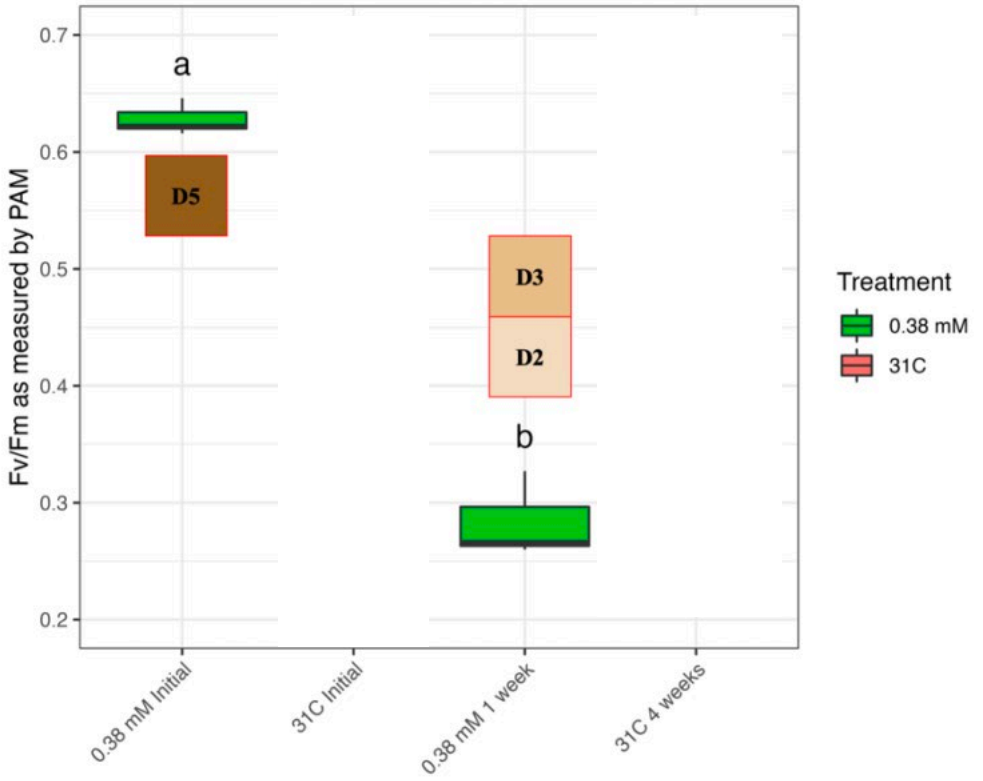


Klinges et al. *in review at PeerJ*

Monitoring Bleaching by Photophysiology (Fv/Fm)



Menthol at 0.38 mM and 0.58 mM were not significantly different, but did bleach significantly more than 0.19 mM.



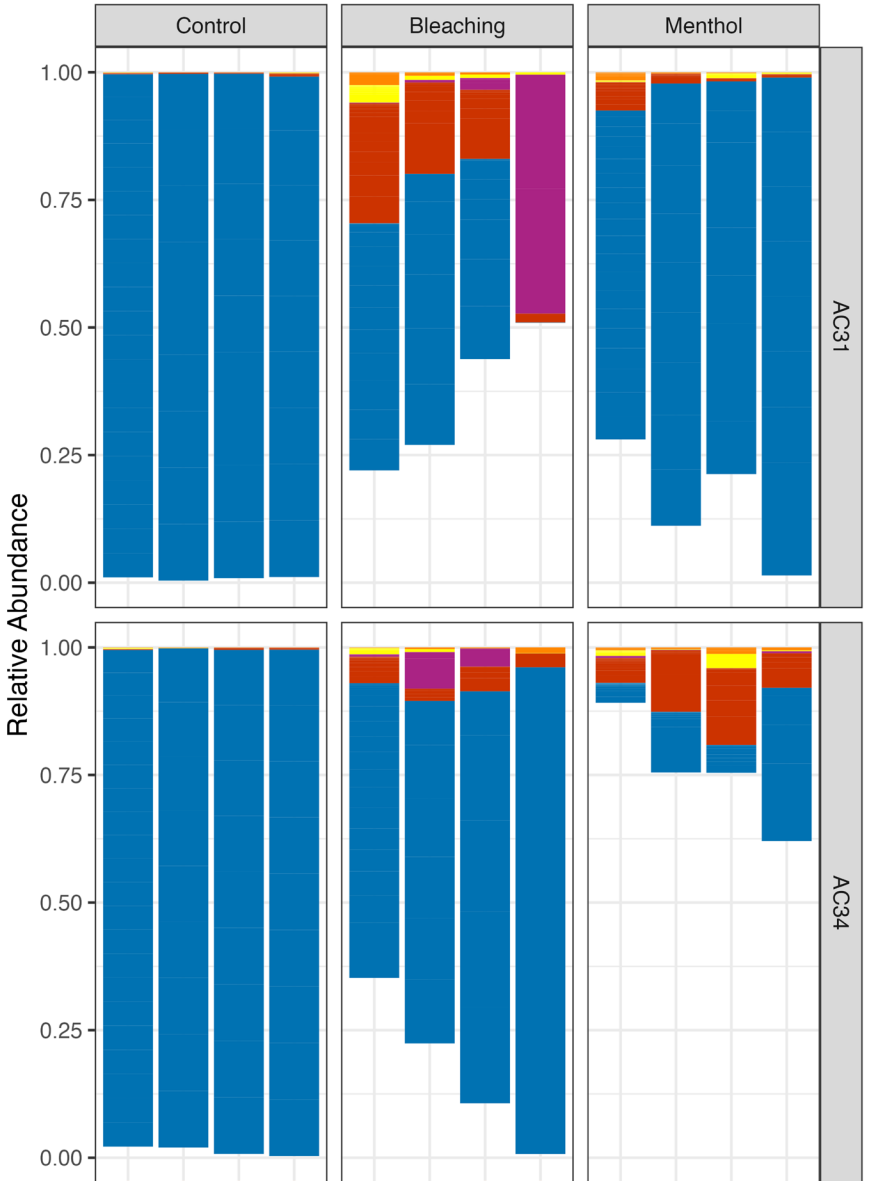
Klinges et al. *in review at PeerJ*

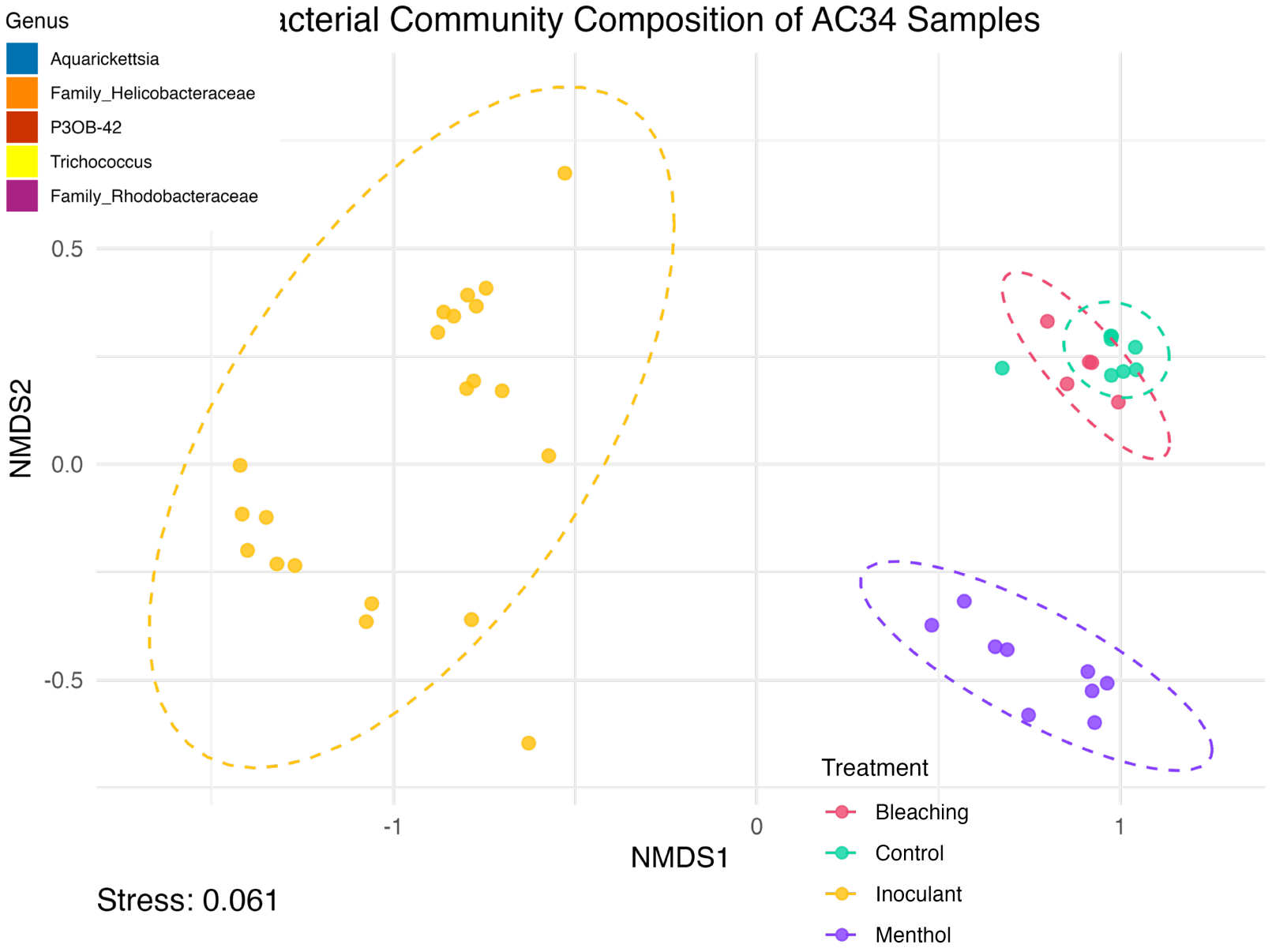
Inoculation of BMCs onto Acer Fragments

- *A. cervicornis* fragments in aquaria were bleached using menthol or thermal stress.
- 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.

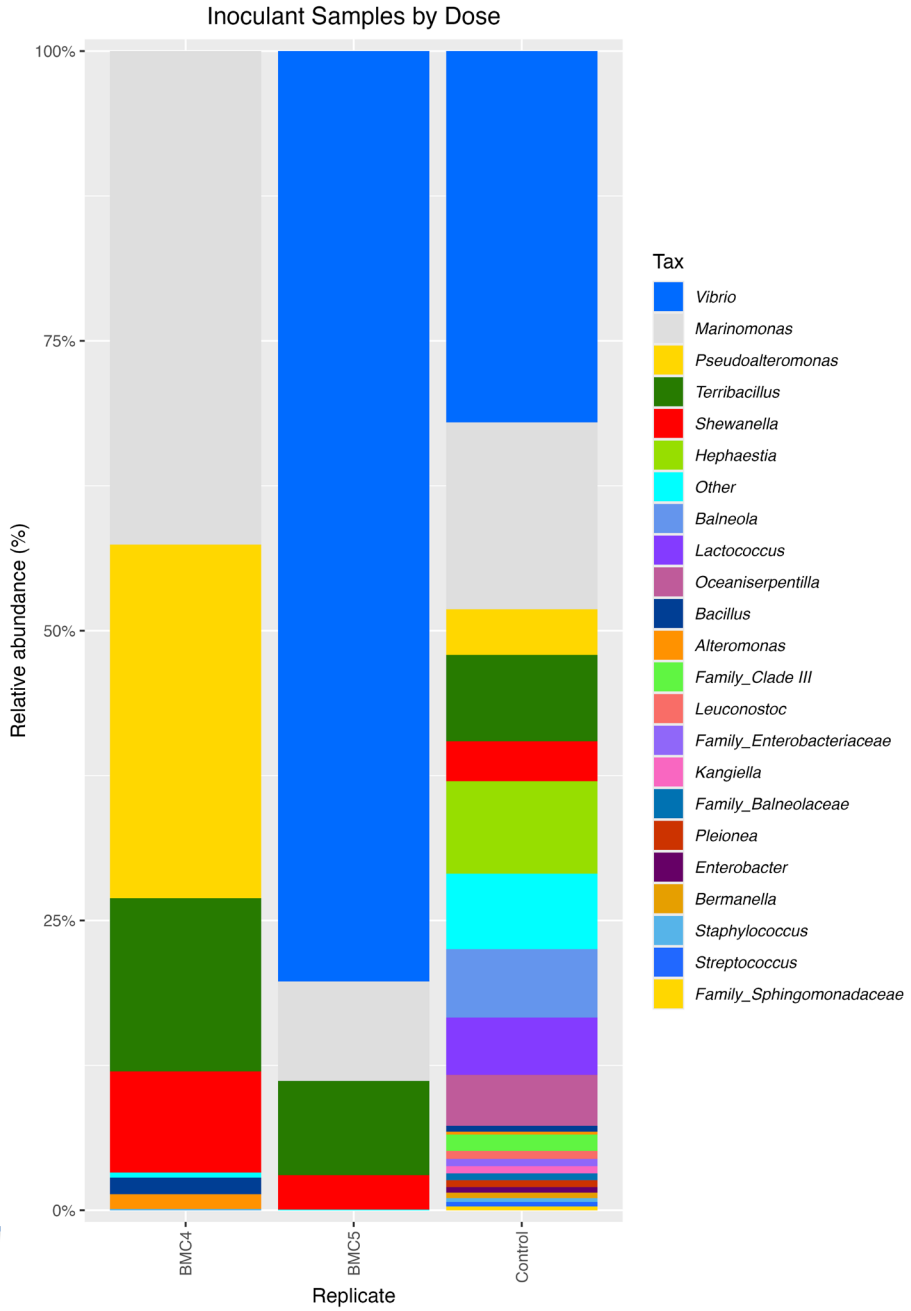
Effect of Bleaching and BMCs on Acer Microbiomes

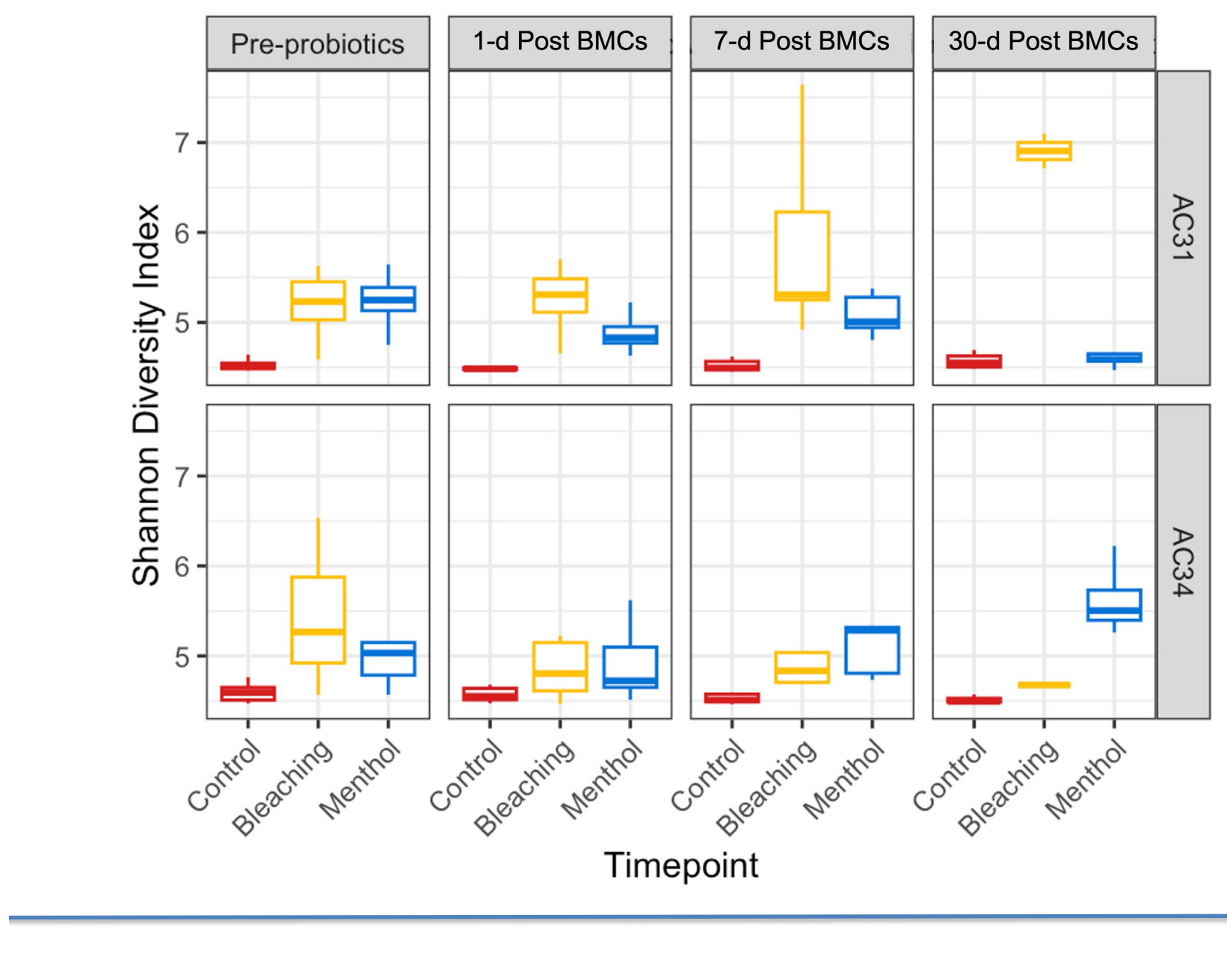




Time ⟶

Effect of Bleaching and BMCs on Acer Microbiomes

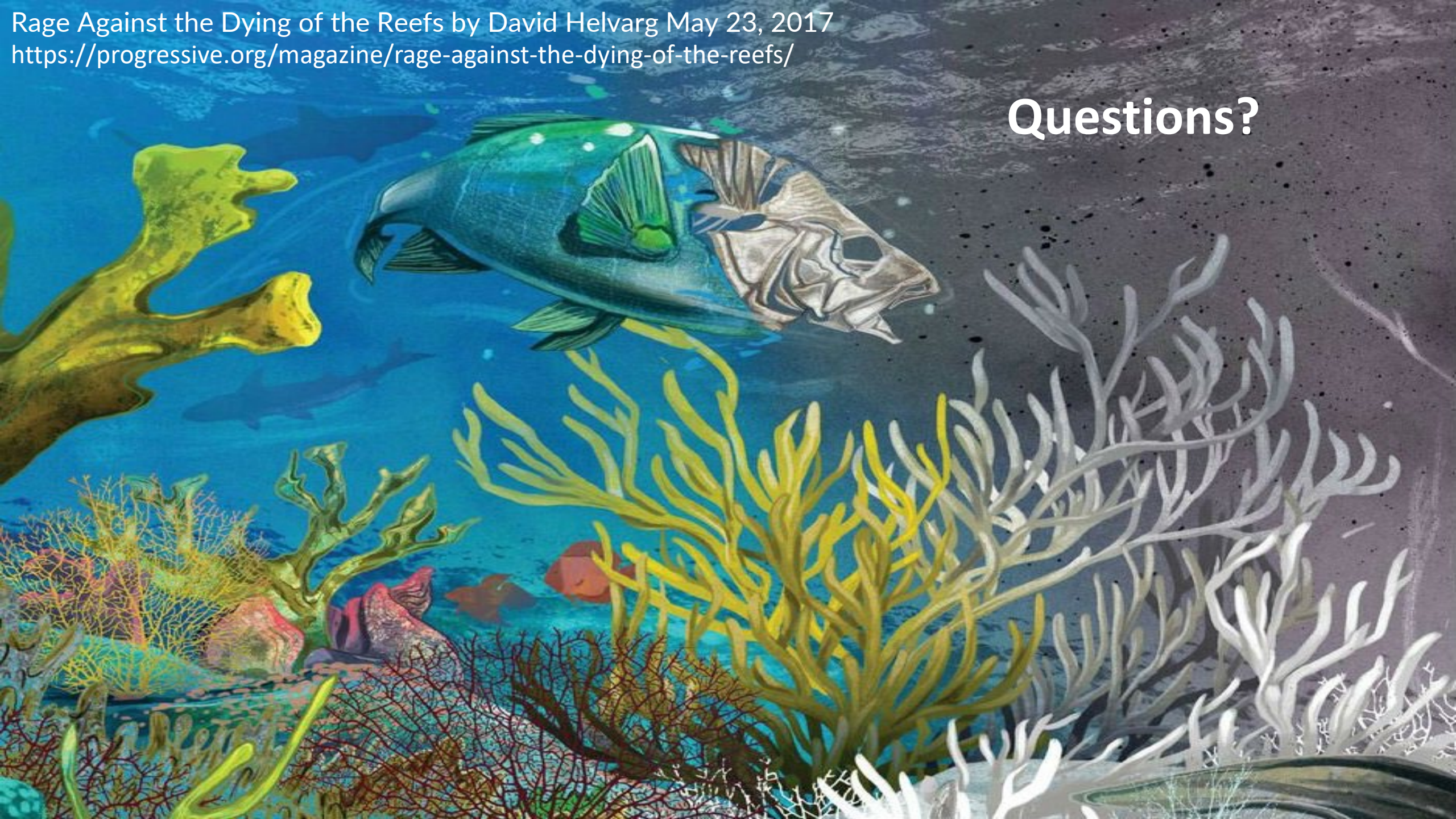




Some Final Thoughts…

- Menthol-induced bleaching is a quick and reliable method to bleach genotypes of Acer to reduce both algal and bacterial symbionts.
- Acer fragments did not robustly take up BMCs in this study.
- Beneficial microorganisms of corals (BMCs) could help to increase resilience of corals to current and future environmental stressors
- Next steps:
  - Optimize application of BMCs on recent sexual recruits
    - Current project underway at Mote's IC2R3

Rage Against the Dying of the Reefs by David Helvarg May 23, 2017
https://progressive.org/magazine/rage-against-the-dying-of-the-reefs/



Questions?