Ocean Acidification in the Florida Keys

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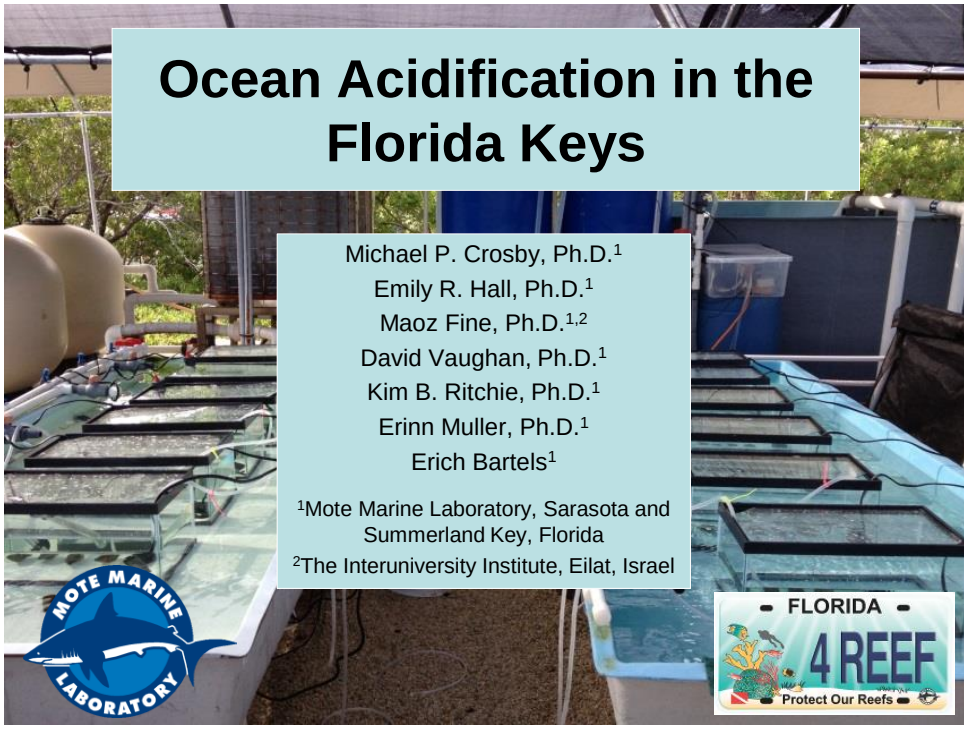
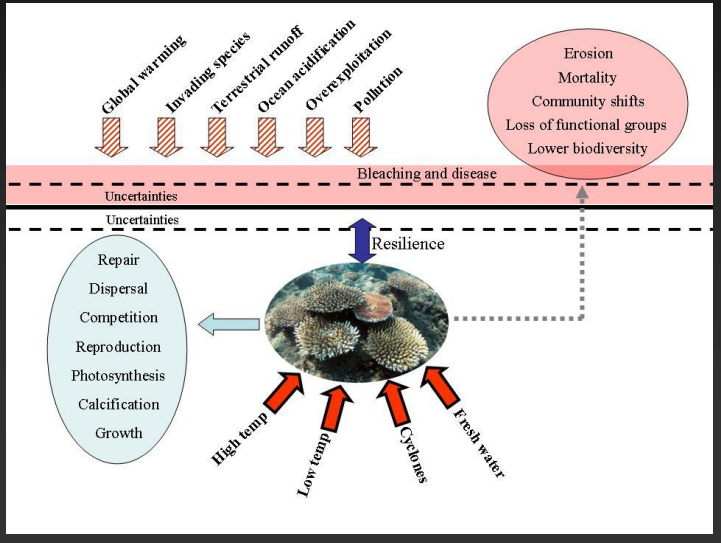
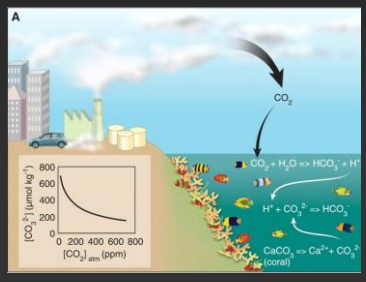


How will environmental stress shape future coral reefs?



Big Picture for Florida Keys



Species composition, habitat, and water quality influence coral bleaching in southern Florida

Daniel E. Wagner[1,*], Philip Kramer[2], Robert van Woesik[1]

Is proximity to land-based sources of coral stressors an appropriate measure of risk to coral reefs? An example from the Florida Reef Tract

Diego Lirman [a,*], Peggy Fong [b]

ScienceDirect

Impacts of nutrient enrichment on coral reefs: new perspectives and implications for coastal management and reef survival☆

Cecilia D'Angelo[1] and Jörg Wiedenmann[1,2]

GEOPHYSICAL RESEARCH LETTERS, VOL. 31, L15307, doi:10.1029/2004GL020182, 2004

Linkages between coastal runoff and the Florida Keys ecosystem: A study of a dark plume event

Chuanmin Hu,[1] Frank E. Muller-Karger,[1] Gabriel A. Vargo,[1] Merrie Beth Neely,[1] and Elizabeth Johns[2]

Coral Reefs © Springer-Verlag 1996

Water column and sediment nitrogen and phosphorus distribution patterns in the Florida Keys, USA

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OA Questions in the Florida Keys

1. Understand the natural variability of ocean acidification within the FL Keys coral reef ecosystem
2. Predict the impacts of ocean acidification and climate change of FL Keys coral reef ecosystem through space and time
3. Understand the additive, synergistic, or antagonistic impacts of multiple stressors on coral reef organisms and ecosystems
4. Utilize our understanding of the impacts from ocean acidification on coral reef restoration

Integrated Network of Ongoing Monitoring

1. NOAA
2. FL Keys National Marine Sanctuary Program (NOAA)
3. Coral Reef Conservation Program (NOAA)
4. USGS
5. The Nature Conservancy
6. FL Fish and Wildlife Research Institute Coral Reef Ecosystem Monitoring Program (CREMP)
7. EPA Florida Keys Coral Reef Monitoring Program
8. Mote Marine Laboratory
9. FIO

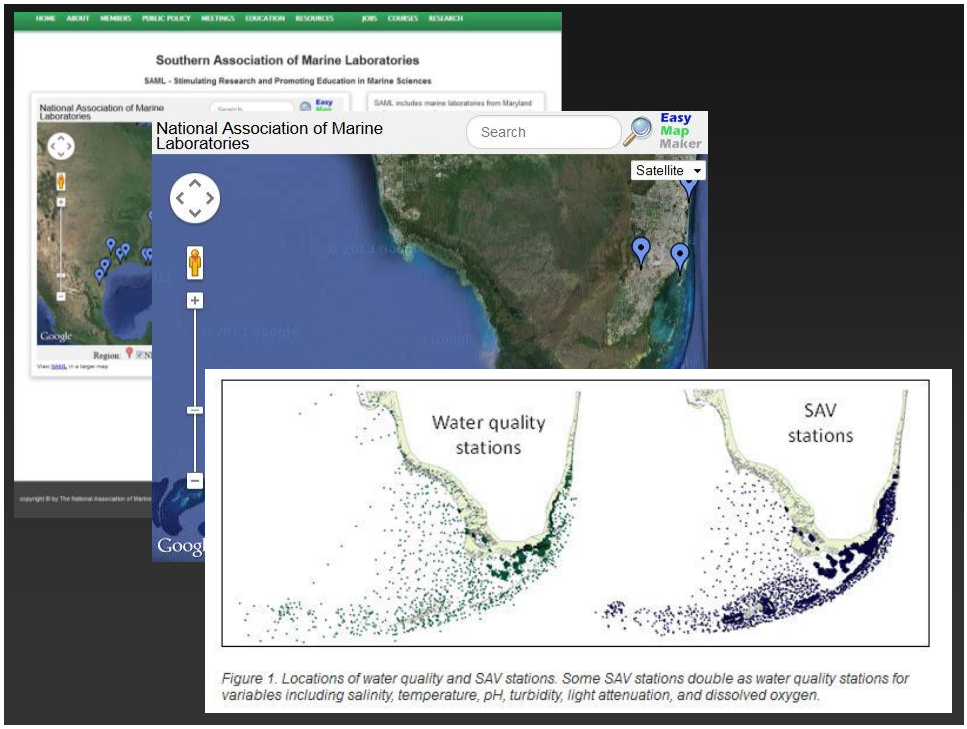
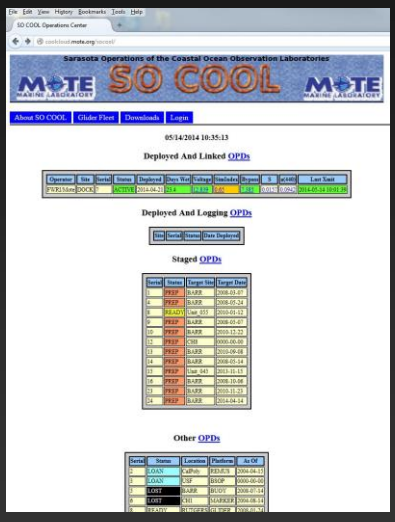


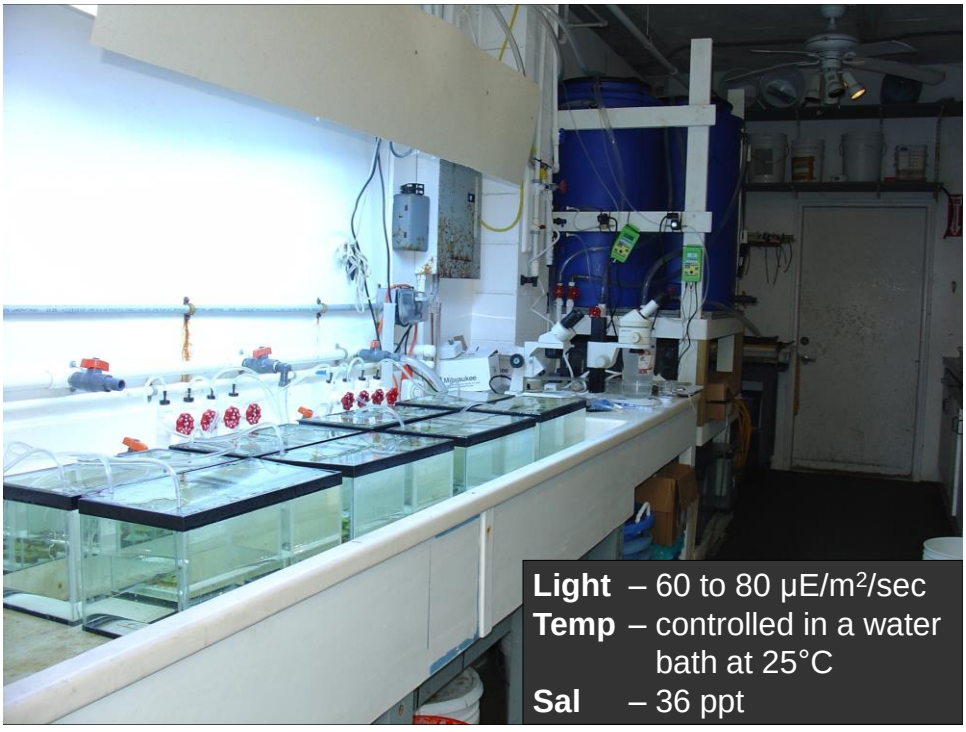
Figure 1. Locations of water quality and SAV stations. Some SAV stations double as water quality stations for variables including salinity, temperature, pH, turbidity, light attenuation, and dissolved oxygen.

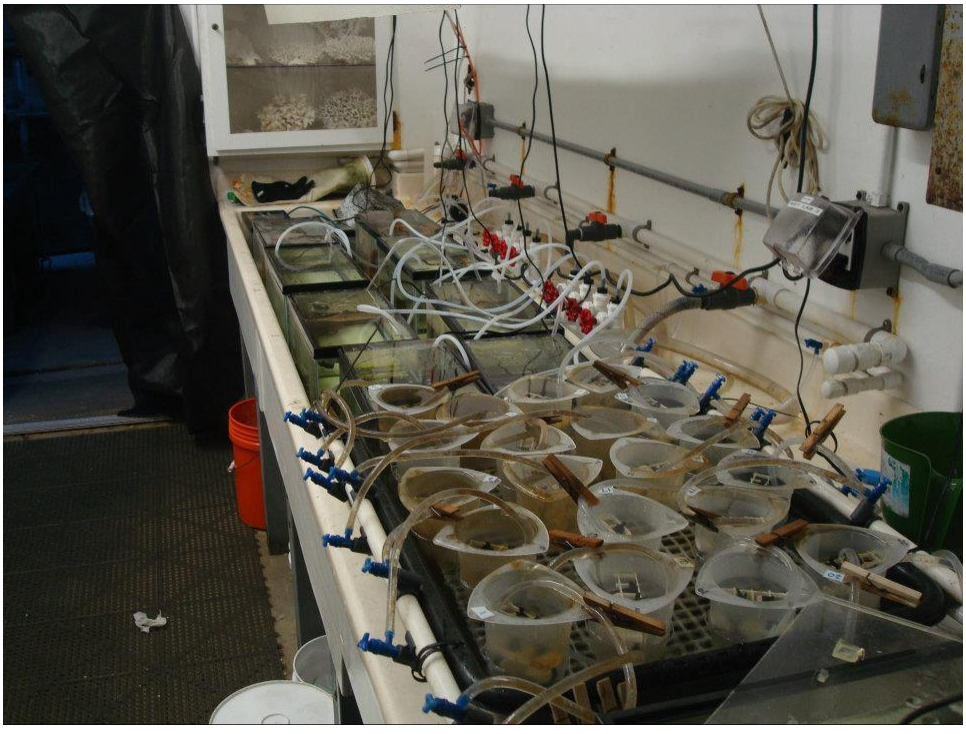
Mote Monitoring

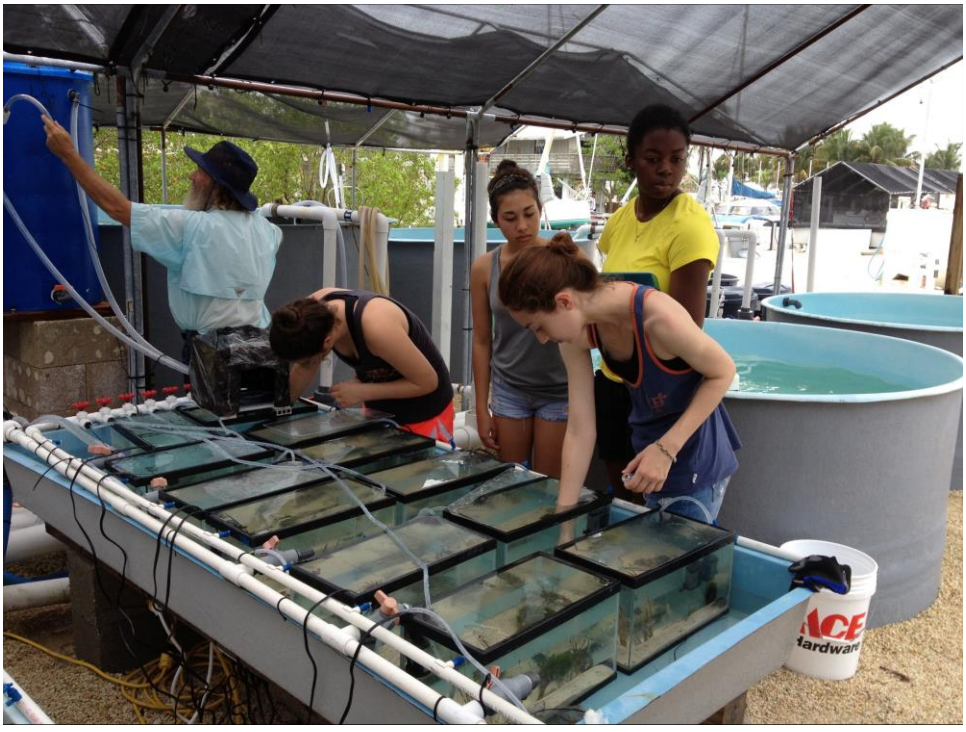


Carbonate Parameters
Nutrients
Surveys

EVOLUTION OF OAFTERU (Ocean Acidification Flow Through Experimental Raceway Units):


Light – 60 to 80 µE/m²/sec
Temp – controlled in a water bath at 25°C
Sal – 36 ppt






MOTE MARINE
ABORATORY
WELCOME
CORAL AND
OCEAN
ACIDIFICATION
RESEARCHERS
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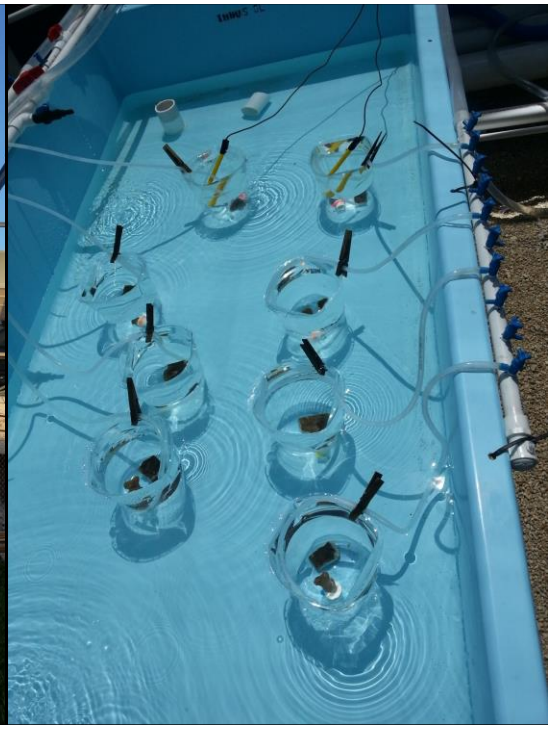
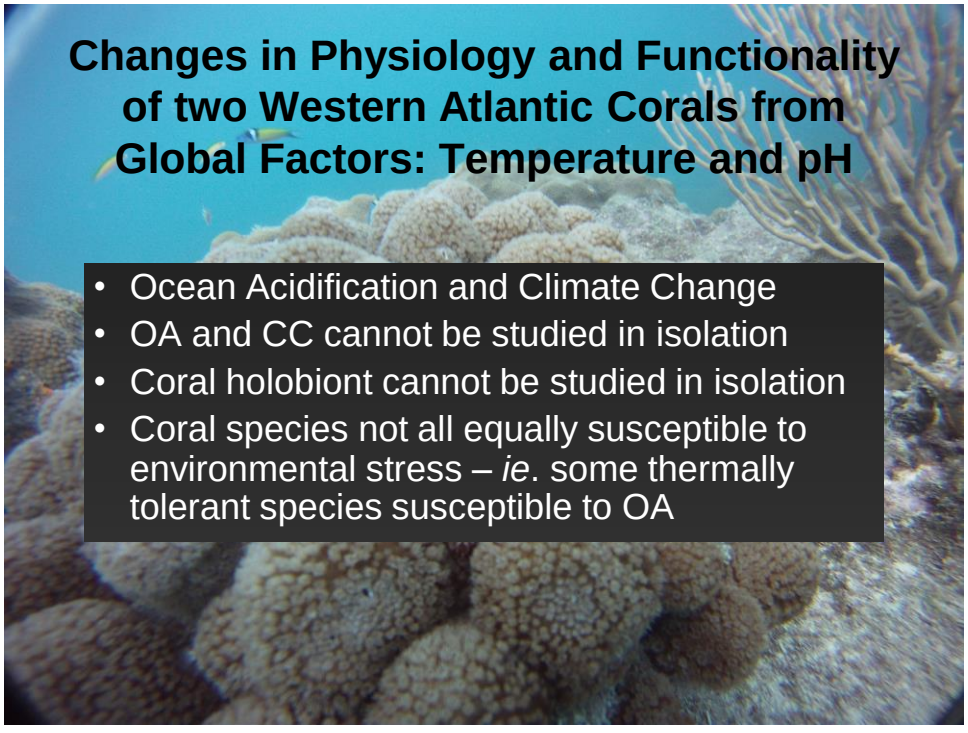


Current and Future Planned Projects using OAFTERU

Effects of OA and CC on:

- Embryonic development and larval morphology in commercially important stone crabs and spiny lobsters (Gravinese - FIT)
- Settling disks and larvae of *P. astreoides* (Paul and Sneed - Smithsonian)
- Coral disease in the Florida Keys (Muller, et al. - MML)
- Growth and early life stages of *Diadema* larvae (Vaughan - MML)
- Bacterial community of Florida Keys coral species (Ritchie, et al. - MML)
- Holobiont of *Porites spp*. in the Florida Keys (Hall, et al. – MML)
- Coral larvae (Ross – UNF)
- "Mini" cosms of Florida Keys ecosystem (Hall et al. – Booker High School Students
- Coral adaptation (Merseiles – FAU)



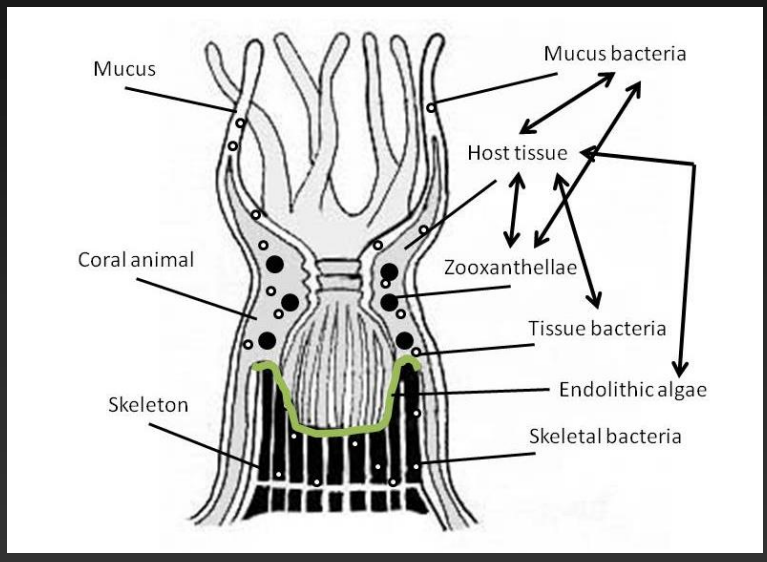
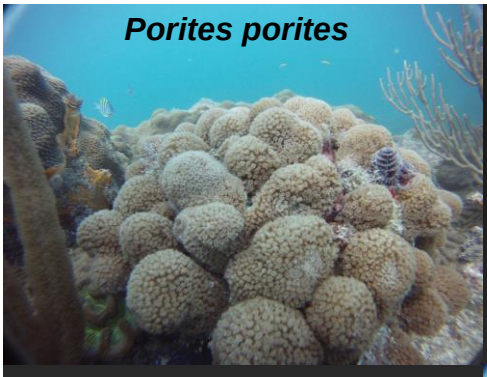


Diagram adjusted from w3.shorecrest.org

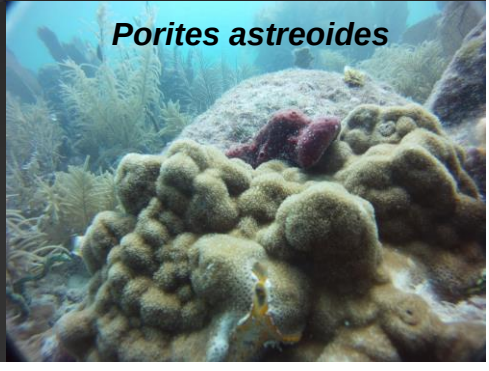
Arrows designate known trophic competitive or pathogenic interactions



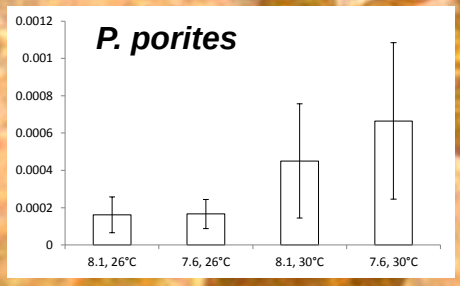
Both species collected and acclimated for 1 month prior to initial analyses

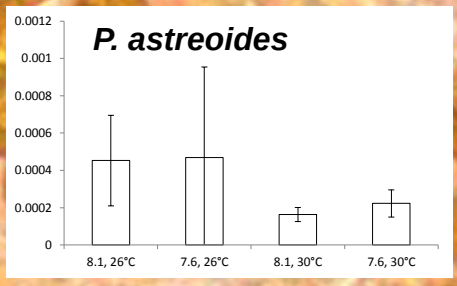
Both species typically thermally resistant, but different morphologies.

PA is massive and is expected to be very resilient (maybe more resilient than the branching PP?)



Chlorophyll *a*/zoox (µg/cell)

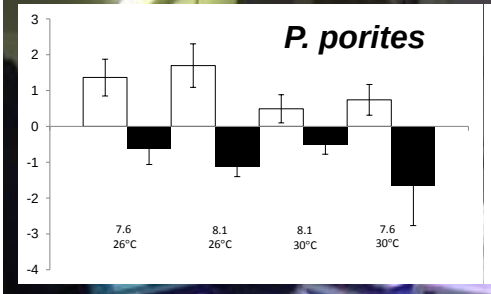


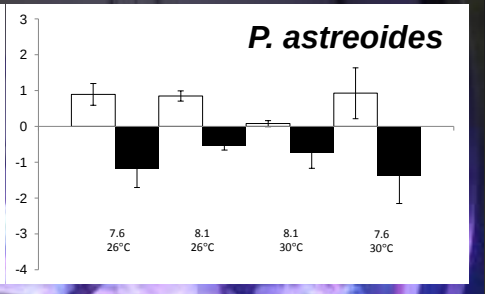


pH 0.47
Temp 0.015*
pH:Temp 0.76

pH 0.78
Temp 0.027*
pH:Temp 0.43

Photosynthesis and Respiration





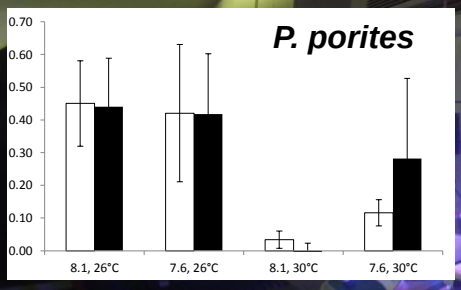
Pn (white)
pH 0.9
Temp 0.008 **
pH:Temp 0.3

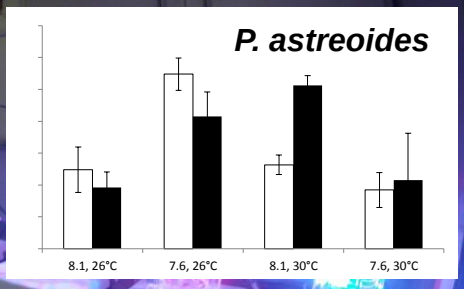
Rd (black)
pH 0.35
Temp 0.9
pH:Temp 0.008**

Pn (white)
pH 0.03 *
Temp 0.06
pH:Temp 0.047*

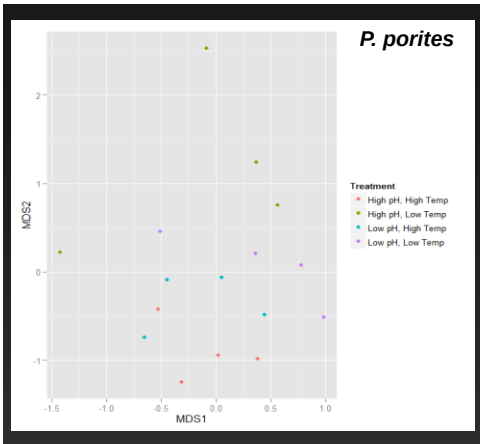
Rd (black)
pH 0.049 *
Temp 0.5
pH:Temp 0.96

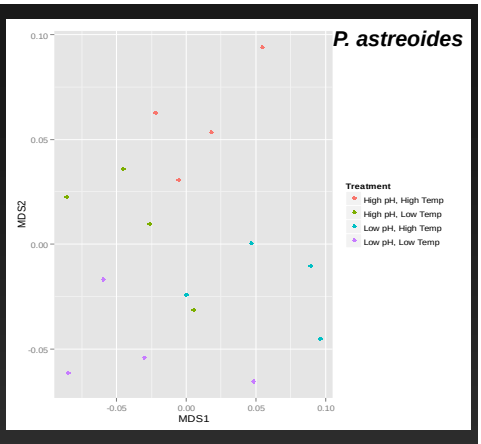
Calcification



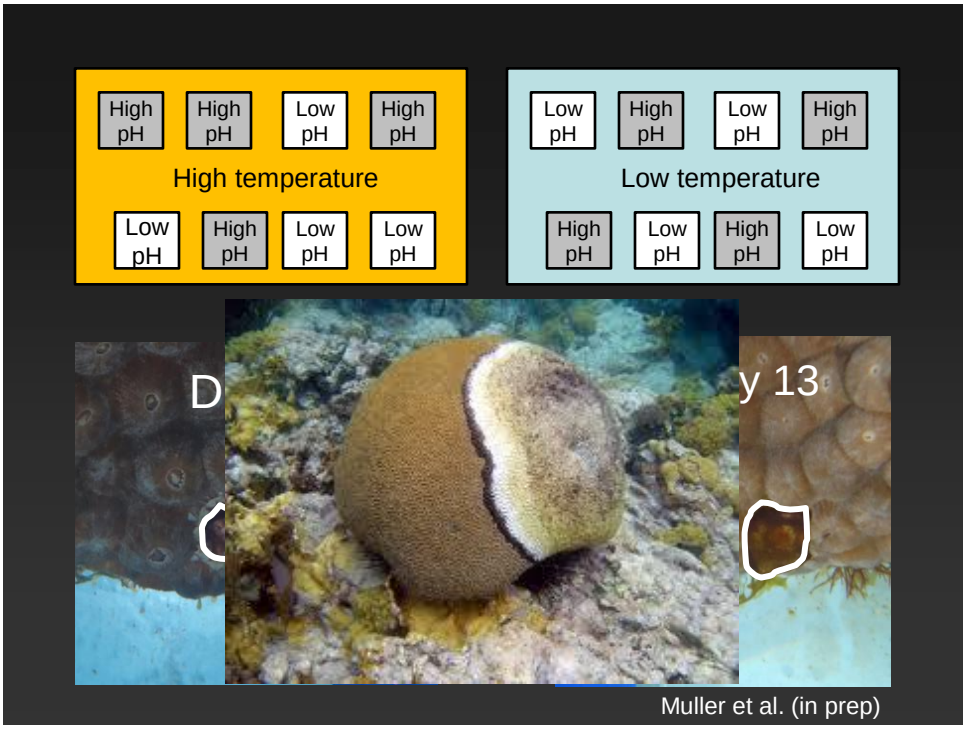


Light	Dark	Light	Dark
pH 0.7	pH 0.2	pH 0.08	pH 0.41
Temp 0.006 ***	Temp 0.02*	Temp 0.001 **	Temp 0.2
pH:Temp 0.44	pH:Temp 0.14	pH:Temp 0.0004***	pH:Temp 0.00028***





Synergistic shifts in microbial communities of two Caribbean coral species exposed to temperature and pH. **HH** (high pH, high temp); **HL** (high pH, low temp); **LH** (low pH, high temp); **LL** (low pH, low temp);. Microbial shifts were measured via metabolic differences in carbon source utilization via Biolog ECO plates (Biolog, INC).


High pH
High pH
Low pH
High pH
High temperature
Low pH
High pH
Low pH
Low pH
Low pH
High pH
Low pH
High pH
Low temperature
High pH
Low pH
High pH
Low pH
D
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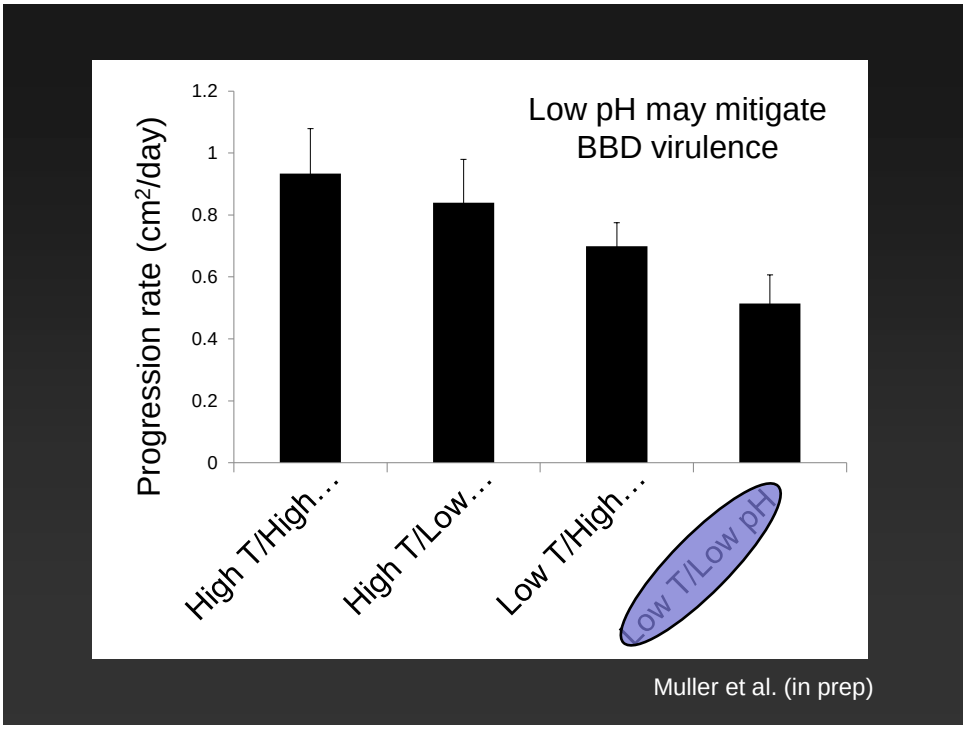
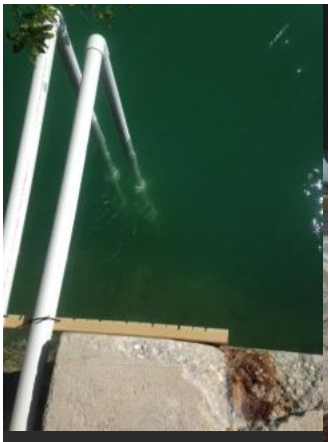
Muller et al. (in prep)


Low pH may mitigate BBD virulence
Progression rate (cm²/day)
1.2
1
0.8
0.6
0.4
0.2
0
High T/High…
High T/Low…
Low T/High…
Low T/Low pH
Muller et al. (in prep)

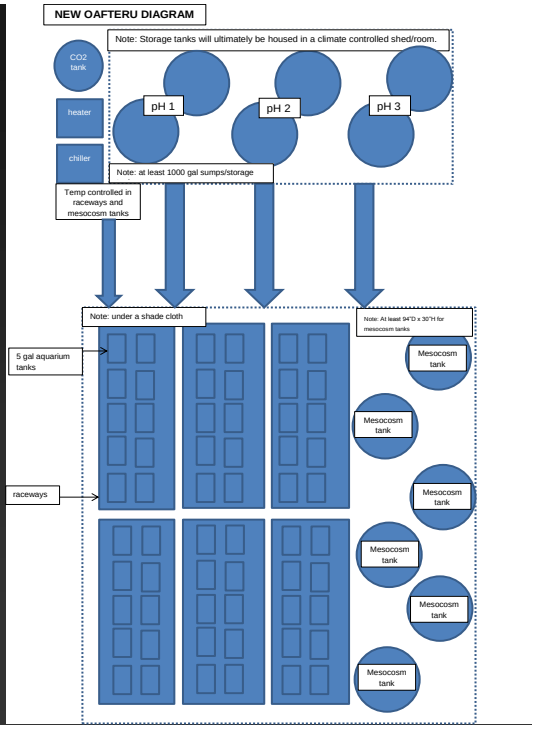
Series of special workshops to envision the "ideal" infrastructure at Mote TRL to support broader research community needs for lab based and *in situ* trans-disciplinary and multi-institutional studies on impacts of OA on coral reef ecosystems



New Source of Seawater

Needs Upgraded Temperature and pH Control

The Proposed Future of the OA and CC System at Mote TRL



Development of an International Center for Climate Change and Ocean Acidification

1. State-of-the-art water chemistry and infrastructure capabilities will position it as an international center for CC and OA research on the Florida Keys reef ecosystem
2. Transformative primary research on CC and OA for work at Mote TRL that compliments ongoing monitoring programs toward ***protection and restoration*** and will more effectively guide policy decisions for how financial resources should be directed to ***protection and restoration*** of coral reef ecosystems specific to the Florida Keys
3. Philanthropic donations and NSF Facilities