POR 2010-16

Development of Ocean Acidification Flow-Thru Experimental Raceway Units (OAFTERU): Simulating the Future Reefs in the Keys, Today

INTERIM REPORT

SUBMITTED TO:
MOTE MARINE LABORATORY – PROTECT OUR REEFS LICENSE PLATE
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Original Proposal:
We propose to develop this unique water system so that it can be used as an ocean acidification testing location for Florida Keys corals and other reef species. Once stability of the system is demonstrated, we will determine if water with different pH has an effect on different coral reef species. This will be developed and tested over the course of the year providing results that will potentially allow us to apply for future facilities grants and to establish the Summerland Keys Mote Marine facility as a permanent ocean acidification testing facility.

Objective 1. To demonstrate that the water system at the Mote facility in Summerland Key can provide a range of seawater pH values, making it suitable as a testing facility for ocean acidification.

Objective 2. To determine the effect of different pH concentrations from the system at the Mote facility in Summerland Key on a few different coral reef species (e.g. *Porites astreoides, Montastraea annularis, Oculina robusta*, or *Pseudopterogorgia americana*) including one to three hard corals, one soft coral species, and one other calcifying species (e.g. *Astraea sp.* snail) found on the reef or surrounding habitat.

Original Timeline:

May-July 2011:	Equipment purchase, experiment set-up and testing (Objective 1)
Aug 2011:	Water chemistry analysis
Sept-Nov 2011:	Experiment set-up and testing (Objective 2)
Oct 2011:	Interim report
Nov-Dec 2011:	Water chemistry analysis
Jan-March 2012:	Data collation and final report
April 2012:	Presentation at Protect our Reef Meeting

Accomplishments to Date:
System Setup:

Setup of the storage tanks and raceways has been completed (Figure 1). All materials have been purchased, including storage tanks, pH controllers, aquarium tanks, and water flow controllers. Multiple experiments with system setup have occurred including flow and pH tests with different size tanks (for the low and high pH seawater bulk tanks). We have determined that the experimental design will allow us to manipulate and control two pH treatments for this project. We have been able to stabilize the low pH tank at a pH of 7.4, and the high pH tank at a pH of 8.1. Larger volume tanks are being purchased (100 gallon tanks instead of 50 gallon tanks) to ensure a good differential is kept. Once these items are received, the system will run without organisms for a couple of weeks (with water chemistry analyses). Corals for this experiment will be collected on Tuesday, November 1 and will be introduced to the system approximately two weeks after that.

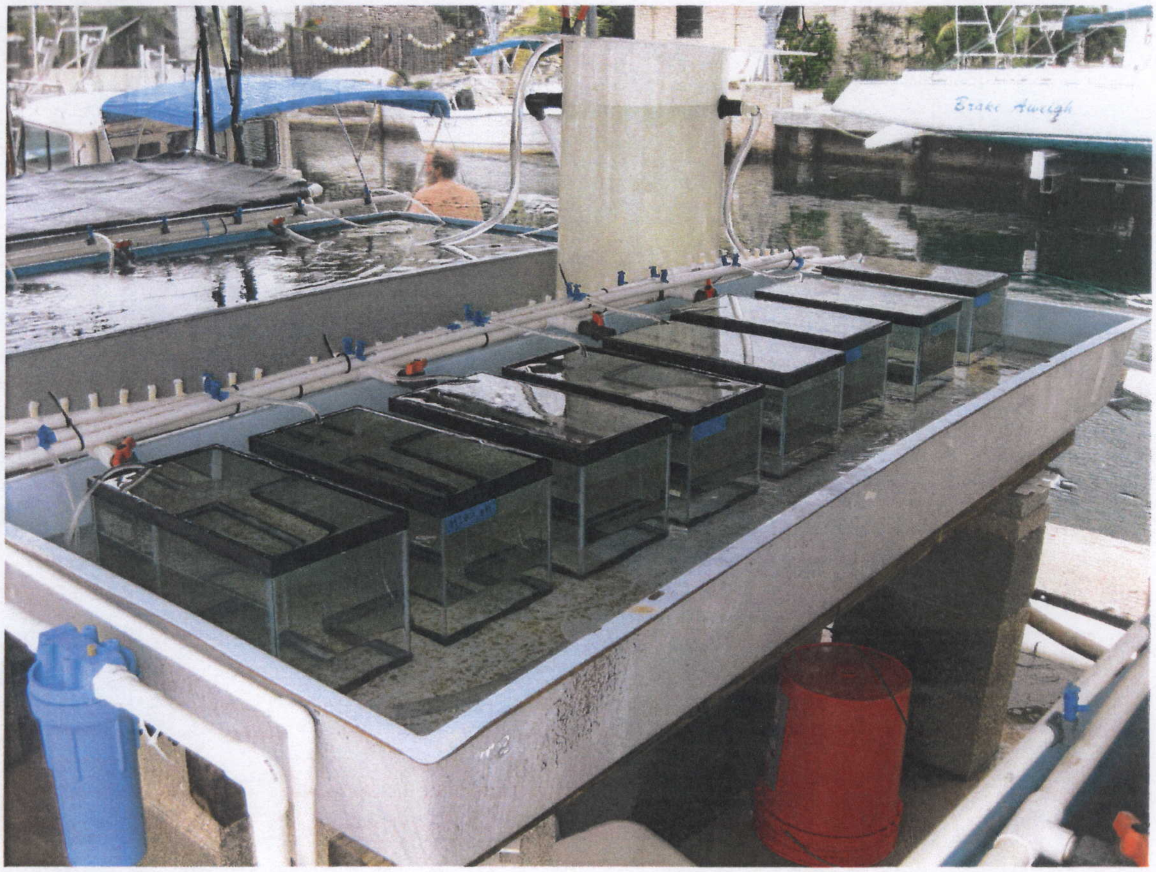

Figure 1. Outdoor raceway setup for the ocean acidification experiments at TRL.

One YSI 5200A with a newly developed dissolved CO_2 analyzer was purchased, however there has been delay in running the first experiment due to a non-functioning pH meter in the newly purchased YSI 5200A. The pH readings have not been holding standards when tested against other hand-held pH meters and standards. The instrument has been tested in the TRL laboratory according to manufacturer's instructions and after multiple failed tests, returned to the manufacturer for testing. It was determined that YSI had produced a faulty pH connection and would fix the instrument as soon as possible. The instrument was returned to TRL in August 2011, tested again, and continued to fail calibration specifications. There have been more than 15 email communication exchanges with YSI, as well as multiple phone calls concerning the instrument. The next step is to run two more tests via manufacturer's instruction and if continues to fail, ship back for a replacement box. If after that, the YSI 5200A continues to fail, then it will be determined by the PI, collaborators, and with permission from the POR committee, to run the experiment using pH controllers, pH meters, and chemical analyses. This decision will be made by the end of October 2011.

With the delay due to the failing YSI 5200A, the first testing experiment will occur in November 2011. The second experiment (indoor and outdoor raceways with live coral) will occur in November-February 2012. That will still allow enough time for data processing, analyses, and final report. A new Timeline is presented below:

NewTimeline:

May-July 2011:	Equipment purchase, experiment set-up and testing (Objective 1)
Aug-Oct 2011:	Experiment set-up and testing (YSI instrument tests)
Oct 2011:	Interim report
Oct 2011:	Experiment set-up and testing (Objective 1)
Nov 2011:	Water chemistry analysis
Nov-Feb 2010:	Experiment set-up and testing (Objective 2)
March 2012:	Water analyses, data collation and final report
April 2012:	Presentation at Protect our Reef Meeting

Finally, a free program available online called CO2Sys EXCEL Macro (Pierrot, 2007 using code from Lewis and Wallace, 1998) will be used to calculate concentrations of the inorganic carbon system in each tank. Input data from our experiment will include total alkalinity, pH, temperature, total phosphate, and salinity. Output for this program includes CO_2 parameters (total CO_2, partial pressure of CO_2, and fugacity of CO_2), contributions to the alkalinity, carbonate speciation, degree of saturation for calcite and aragonite, and Revelle Factor (Pierrot, 2007). This program will help determine the carbon chemistry in the deep well system at TRL.

References:

Lewis, E. and D.W.R. Wallace. 1998. Program developed for CO2 system calculations. ORNL/CDIAC-105. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tennessee.

Perriot, D. 2007. CO2Sys EXCEL Macro.