

# Seawater chemistry measured parameters from Crab-Oyster Behavior study from laboratory results from UNC from data collected at the Sapodilla Caye, Belize starting 2010 ((OA - Ocean Acidification and Warming Impact on Calcification project)

**Website:** <https://www.bco-dmo.org/dataset/563268>

**Version:** 28 July 2015

**Version Date:** 2015-07-28

## Project

» [Investigation of the Effects of CaCO<sub>3</sub> Saturation State and Temperature on the Calcification Rate and Skeletal Properties of Benthic Marine Calcifiers](#) (OA - Ocean Acidification and Warming Impact on Calcification)

## Program

» [Ocean Carbon and Biogeochemistry](#) (OCB)

Contributors	Affiliation	Role
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## Dataset Description

Impacts of OA on Crab-Oyster Behavior - Seawater Chemistry - Measured Parameters

Seawater chemistry and predatory behavior observations

## Methods & Sampling

Experiments were conducted at University of North Carolina at Chapel Hill. Organisms studied are present across much of the US Atlantic and Gulf coasts.

See manuscript: [Ocean acidification impairs crab foraging behaviour](#)

## Data Processing Description

See manuscript: [Ocean acidification impairs crab foraging behaviour](#)

## BCO-DMO Processing Notes

- Generated from original files "Behavioral data for archive.xlsx, Sheet: Seawater Chemistry" contributed by Luke Dodd
- Parameter names edited to conform to BCO-DMO naming convention found at [Choosing Parameter Name](#)
- "nd" (no data) inserted into blank cells
- names of some calculated parameters modified for ASCII text o/p

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## Data Files

File
<b>OC_Behavior_SWChem_Meas.csv</b> (Comma Separated Values (.csv), 610 bytes) MD5:03b5b3d8faf2e3df41fbd969a632cd06 Primary data file for dataset ID 563268

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## Parameters

Parameter	Description	Units
Parameter	Calculated parameter	text
Units_Data	Units or Data measured calculated for parameter	text
Control_pCO2	Measured value at control pCO2 treatment level	text
Moderate_pCO2	Measured value at moderate pCO2 treatment level	text
High_pCO2	Measured value at high pCO2 treatment level	text

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## Instruments

<b>Dataset-specific Instrument Name</b>	Isolated 34 l tanks
<b>Generic Instrument Name</b>	Aquarium
<b>Dataset-specific Description</b>	Crabs and oysters were raised in isolated 34 l tanks for 71 days in seawater
<b>Generic Instrument Description</b>	Aquarium - a vivarium consisting of at least one transparent side in which water-dwelling plants or animals are kept

<b>Dataset-specific Instrument Name</b>	UIC 5400
<b>Generic Instrument Name</b>	CO2 Coulometer
<b>Dataset-specific Description</b>	The temperature within experimental tanks was measured every other day with a NIST-calibrated partial-immersion organic- filled glass thermometer (precision + 0.3%, accuracy + 0.4%). Salinity was measured every other day with a YSI 3200 conductivity meter with a YSI 3440 cell (K 1/4 10) that was calibrated with seawater standards of known salinity provided by the laboratory of Prof. A. Dickson of Scripps Institute of Oceanography. Seawater pH was measured every other day with a Thermo Scientific Orion 2 Star benchtop pH meter with an Orion 9156BNWP pH probe, calibrated with 7.00 and 10.01 Orion NBS buffers traceable to NIST standard reference material (for slope of the calibration curve) and with seawater standards of known pH also provided by Prof. Dickson's laboratory (for y-intercept of the calibration curve). Seawater DIC was measured via coulometry (UIC 5400) and TA was measured via closed-cell potentiometric Gran titration calibrated with certified Dickson TA/DIC standards. Measurement of DIC and TA of the certified reference materials (CRMs) were consistently within 0.3% of certified values. Differences between the measured and certified TA and DIC values of the CRMs were used to correct measurements of experimental seawater solutions.
<b>Generic Instrument Description</b>	A CO2 coulometer semi-automatically controls the sample handling and extraction of CO2 from seawater samples. Samples are acidified and the CO2 gas is bubbled into a titration cell where CO2 is converted to hydroxyethylcarbonic acid which is then automatically titrated with a coulometrically-generated base to a colorimetric endpoint.

<b>Dataset-specific Instrument Name</b>	Thermo Scientific Orion 2 Star benchtop pH meter with an Orion 9156BNWP pH probe
<b>Generic Instrument Name</b>	pH Sensor
<b>Dataset-specific Description</b>	The temperature within experimental tanks was measured every other day with a NIST-calibrated partial-immersion organic- filled glass thermometer (precision + 0.3%, accuracy + 0.4%). Salinity was measured every other day with a YSI 3200 conductivity meter with a YSI 3440 cell (K 1/4 10) that was calibrated with seawater standards of known salinity provided by the laboratory of Prof. A. Dickson of Scripps Institute of Oceanography. Seawater pH was measured every other day with a Thermo Scientific Orion 2 Star benchtop pH meter with an Orion 9156BNWP pH probe, calibrated with 7.00 and 10.01 Orion NBS buffers traceable to NIST standard reference material (for slope of the calibration curve) and with seawater standards of known pH also provided by Prof. Dickson's laboratory (for y-intercept of the calibration curve). Seawater DIC was measured via coulometry (UIC 5400) and TA was measured via closed-cell potentiometric Gran titration calibrated with certified Dickson TA/DIC standards. Measurement of DIC and TA of the certified reference materials (CRMs) were consistently within 0.3% of certified values. Differences between the measured and certified TA and DIC values of the CRMs were used to correct measurements of experimental seawater solutions.
<b>Generic Instrument Description</b>	An instrument that measures the hydrogen ion activity in solutions. The overall concentration of hydrogen ions is inversely related to its pH. The pH scale ranges from 0 to 14 and indicates whether acidic (more H+) or basic (less H+).

<b>Dataset-specific Instrument Name</b>	Closed-cell potentiometric Gran titration
<b>Generic Instrument Name</b>	Titration
<b>Dataset-specific Description</b>	The temperature within experimental tanks was measured every other day with a NIST-calibrated partial-immersion organic-filled glass thermometer (precision + 0.3%, accuracy + 0.4%). Salinity was measured every other day with a YSI 3200 conductivity meter with a YSI 3440 cell (K 1/4 10) that was calibrated with seawater standards of known salinity provided by the laboratory of Prof. A. Dickson of Scripps Institute of Oceanography. Seawater pH was measured every other day with a Thermo Scientific Orion 2 Star benchtop pH meter with an Orion 9156BNWP pH probe, calibrated with 7.00 and 10.01 Orion NBS buffers traceable to NIST standard reference material (for slope of the calibration curve) and with seawater standards of known pH also provided by Prof. Dickson's laboratory (for y-intercept of the calibration curve). Seawater DIC was measured via coulometry (UIC 5400) and TA was measured via closed-cell potentiometric Gran titration calibrated with certified Dickson TA/DIC standards. Measurement of DIC and TA of the certified reference materials (CRMs) were consistently within 0.3% of certified values. Differences between the measured and certified TA and DIC values of the CRMs were used to correct measurements of experimental seawater solutions.
<b>Generic Instrument Description</b>	Titration is an instrument that incrementally adds quantified aliquots of a reagent to a sample until the end-point of a chemical reaction is reached.

<b>Dataset-specific Instrument Name</b>	NIST-calibrated partial immersion organic-filled glass thermometer
<b>Generic Instrument Name</b>	Water Temperature Sensor
<b>Dataset-specific Description</b>	The temperature within experimental tanks was measured every other day with a NIST-calibrated partial-immersion organic-filled glass thermometer (precision + 0.3%, accuracy + 0.4%). Salinity was measured every other day with a YSI 3200 conductivity meter with a YSI 3440 cell (K 1/4 10) that was calibrated with seawater standards of known salinity provided by the laboratory of Prof. A. Dickson of Scripps Institute of Oceanography. Seawater pH was measured every other day with a Thermo Scientific Orion 2 Star benchtop pH meter with an Orion 9156BNWP pH probe, calibrated with 7.00 and 10.01 Orion NBS buffers traceable to NIST standard reference material (for slope of the calibration curve) and with seawater standards of known pH also provided by Prof. Dickson's laboratory (for y-intercept of the calibration curve). Seawater DIC was measured via coulometry (UIC 5400) and TA was measured via closed-cell potentiometric Gran titration calibrated with certified Dickson TA/DIC standards. Measurement of DIC and TA of the certified reference materials (CRMs) were consistently within 0.3% of certified values. Differences between the measured and certified TA and DIC values of the CRMs were used to correct measurements of experimental seawater solutions.
<b>Generic Instrument Description</b>	General term for an instrument that measures the temperature of the water with which it is in contact (thermometer).

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## Deployments

lab\_Ries UNC Chapel Hill

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/58723">https://www.bco-dmo.org/deployment/58723</a>
<b>Platform</b>	Ries
<b>Report</b>	<a href="http://www.unc.edu/~jries/index.html">http://www.unc.edu/~jries/index.html</a>
<b>Start Date</b>	2010-09-01
<b>End Date</b>	2099-01-01
<b>Description</b>	The Ries Lab

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## Project Information

### Investigation of the Effects of CaCO<sub>3</sub> Saturation State and Temperature on the Calcification Rate and Skeletal Properties of Benthic Marine Calcifiers (OA - Ocean Acidification and Warming Impact on Calcification)

**Website:** <http://www.unc.edu/~jries/index.html>

**Coverage:** Chapel Hill, North Carolina (lab) and Mesoamerican Barrier Reef System - Sapodilla Caye, Belize (16.2 N 88.5 W)

#### *Description from NSF award abstract:*

Anthropogenic elevation of atmospheric pCO<sub>2</sub> is increasing the acidity of the oceans, thereby reducing the saturation state of seawater with respect to calcium carbonate (CaCO<sub>3</sub>). Of mounting concern is the potential impact of these changes on the ability of calcifying organisms to form their shells and skeletons. Recent studies, including pilot work conducted by investigator Ries and his colleagues on a suite of benthic marine calcifiers spanning broad taxonomic, mineralogical, and ecological ranges, have revealed that marine organisms exhibit a wide range of calcification responses to CO<sub>2</sub>-induced ocean acidification, including positive, negative, parabolic, threshold, and neutral responses. Marine calcifiers build their shells and skeletons from various forms (polymorphs) of CaCO<sub>3</sub>, most commonly aragonite, high-Mg calcite, and low-Mg calcite. These polymorphs differ greatly in their solubility in seawater and, therefore, in their potential response to CO<sub>2</sub>-induced ocean acidification. X-ray diffraction analysis of shells secreted by the organisms investigated in the pilot study reveals that the proportion of calcite (the less soluble form of CaCO<sub>3</sub>) to aragonite (the more soluble form) within their shells increases under elevated pCO<sub>2</sub>, while the Mg:Ca ratio of their calcite declines. These observations suggested that some marine calcifiers may partially adapt to a declining CaCO<sub>3</sub> saturation state by accreting a greater proportion of the less-soluble form of CaCO<sub>3</sub> (low-Mg calcite) at the expense of the more soluble forms (aragonite, high-Mg calcite). However, it is likely that such mineralogical and compositional changes in the shells and skeletons of marine organisms would alter their structural and biomechanical properties.

The project seeks to build upon the results of a pilot study by rearing a suite of benthic marine calcifiers under past (280 ppm), present (385 ppm), and predicted future (540, 840 ppm) pCO<sub>2</sub> and under three distinct temperatures to investigate changes in: (1) their rates of calcification and linear extension; (2) the relative abundance and micron-scale distribution of the various CaCO<sub>3</sub> polymorphs within their shells/skeletons; (3) the ultrastructure and crystal morphology of their shells/skeletons; and (4) their biomechanical properties. The research also builds upon the pilot experiments by utilizing a more thoroughly replicated study design, by more precisely constraining the chemical parameters of the experimental seawater treatments, by investigating calcification responses under 3 different temperature regimes, and by employing a "pre-industrial" pCO<sub>2</sub> level (280 ppm). The results of the proposed research should advance our understanding of how benthic marine calcifiers shall respond to future CO<sub>2</sub>-induced changes in seawater temperature and CaCO<sub>3</sub> saturation state. By investigating the response of organisms over the range of atmospheric pCO<sub>2</sub> that has occurred since late Paleozoic time, this research should inform our understanding of the putative links between atmospheric pCO<sub>2</sub>, mass extinction events, and secular variation in the polymorph mineralogy of marine calcifiers throughout geologic time. Finally, comparison of the observed biological responses to variable pCO<sub>2</sub>-T scenarios with that already established for abiogenic carbonates will advance our understanding of the very mechanisms by which marine calcifiers build their shells and skeletons.

Results of this research project will inform the decisions of policy makers and legislators working to mitigate the impacts of CO<sub>2</sub>-induced warming and ocean acidification by establishing pCO<sub>2</sub>-T tolerances for a range of marine calcifiers.

**Note (02 Oct 2014):** Funding for this project has transferred from award OCE-1031995 to OCE-1357665, coincident with Principal Investigator's affiliation change from University of North Carolina at Chapel Hill to Northeastern University.

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## Program Information

### Ocean Carbon and Biogeochemistry (OCB)

**Website:** <http://us-ocb.org/>

**Coverage:** Global

The Ocean Carbon and Biogeochemistry (OCB) program focuses on the ocean's role as a component of the global Earth system, bringing together research in geochemistry, ocean physics, and ecology that inform on and advance our understanding of ocean biogeochemistry. The overall program goals are to promote, plan, and coordinate collaborative, multidisciplinary research opportunities within the U.S. research community and with international partners. Important OCB-related activities currently include: the Ocean Carbon and Climate Change (OCCC) and the North American Carbon Program (NACP); U.S. contributions to IMBER, SOLAS, CARBOOCEAN; and numerous U.S. single-investigator and medium-size research projects funded by U.S. federal agencies including NASA, NOAA, and NSF.

The scientific mission of OCB is to study the evolving role of the ocean in the global carbon cycle, in the face of environmental variability and change through studies of marine biogeochemical cycles and associated ecosystems.

The overarching OCB science themes include improved understanding and prediction of: 1) oceanic uptake and release of atmospheric CO<sub>2</sub> and other greenhouse gases and 2) environmental sensitivities of biogeochemical cycles, marine ecosystems, and interactions between the two.

The OCB Research Priorities (updated January 2012) include: ocean acidification; terrestrial/coastal carbon fluxes and exchanges; climate sensitivities of and change in ecosystem structure and associated impacts on biogeochemical cycles; mesopelagic ecological and biogeochemical interactions; benthic-pelagic feedbacks on biogeochemical cycles; ocean carbon uptake and storage; and expanding low-oxygen conditions in the coastal and open oceans.

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## Funding

Funding Source	Award
<a href="#">NSF Division of Ocean Sciences (NSF OCE)</a>	<a href="#">OCE-1031995</a>
<a href="#">NSF Division of Ocean Sciences (NSF OCE)</a>	<a href="#">OCE-1357665</a>

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