Chemical and physical measurements in coral tanks from Moorea, French Polynesia in 2010 (OA Corals project)

Website: https://www.bco-dmo.org/dataset/640148
Data Type: experimental
Version: 2016-03-10

Project
» RUI: Ocean Acidification- Category 1- The effects of ocean acidification on the organismic biology and community ecology of corals, calcified algae, and coral reefs (OA_Corals)

Program
» Science, Engineering and Education for Sustainability NSF-Wide Investment (SEES): Ocean Acidification (formerly CRI-OA) (SEES-OA)

Contributors	Affiliation	Role
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Dataset Description

Two laboratory experiments were completed using Porites lutea and Montipora aequituberculata from back and fringing reef habitats. First, in Moorea, French Polynesia, we evaluated the efficacy of linear extension as a dependent variable characterizing the response of corals in competitive encounters, as well as a means to test for an effect of elevated pCO2 on linear extension. Second, at Sesoko Island, Okinawa, we applied the techniques developed in Moorea to test the effects of elevated pCO2 on the ability of corals to compete with one another for space.

Temperature, pH, pCO2, total alkalinity, and the aragonite saturation state (omega) were measured daily in the tanks.

Related Reference:
Evensen, Nicolas R., Peter J. Edmunds, Kazuhiko Sakai. Effects of pCO2 on spatial competition between the corals Montipora aequituberculata and Porites lutea. MEPS 541:123-134 (2015) doi:10.3354/meps11512.

Related Datasets:
MEPS 2015: field survey
MEPS 2015: linear extension

Methods & Sampling

The ecological relevance of interactions between M. aequituberculata and P. lutea lies in the common occurrence of these corals in shallow reef habitats, and the frequency with which they encounter one another, as observed during preliminary field observations. To quantify these effects, we evaluated coral community structure in the back reef of Moorea along the East and West shores that are sampled annually as part of the Moorea Coral Reef LTER (Edmunds 2013). Photoquadrats recorded in the back reef of these shores (at LTER sites 3 and 6) in 2010, and analyzed for coral cover using Coral Point Count [CPCe] software [Kohler & Gill 2006]), were used to quantify the abundance of Montipora and massive Porites. These images were also used for an additional analysis in which colonies of Porites and Montipora were scored for contact with one another. All colonies of Porites and Montipora were evaluated for contact, with contact scored when colonies were < 5 mm from one another, and these points of contact inferred to be sites of interspecific competition. The number of colonies of each taxon involved in interspecific competition was expressed as a percentage of the total number of colonies in each taxon that were present in all the photoquadrats evaluated. It was however not possible to determine the outcome (i.e., which colony was dominant versus subordinate) of most competitive encounters in the planar photographs.

For further details, see Evenson et al (2015)

Data Processing Description

Chemical conditions in the tanks were compared among tanks with a 2-way ANOVA, with treatment as a fixed effect, and tank a random factor nested in each treatment. The tank effect was dropped from the analyses when not significant at p = 0.250 (Quinn & Keough 2002). Competitive pairings in both experiments were used in a split-plot ANOVA with one between-plot effect (pCO2), one within-plot effect (type of pairing), and replicate tanks (treated as plots, with 3 in Moorea and 4 in Okinawa) nested in each pCO2 treatment. Treatment effects were assessed after 24 d in Moorea and after 21 d in Okinawa using linear extension as the dependent variable. Planned comparisons of differences between control and interspecific pairings in both the ambient and elevated CO2 treatments, for M. aequituberculata in Moorea and both corals in Okinawa, were selected to test explicitly for an effect of OA on the growth of corals engaged in interspecific competition. Planned comparisons were completed following Sokal & Rohlf (1995). The assumptions of normality and homosce - dasticity required for the ANOVAs were evaluated through graphical analyses of residuals. SYSTAT 11 running on a Windows operating system was used for all analyses.

BCO-DMO Processing:

- added conventional header with dataset name, PI name, version date, reference information
- renamed parameters to BCO-DMO standard
- reformatted date from m/d/yyyy to yyyy-mm-dd
- added lat and lon columns

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Data Files

File
chemistry.csv (Comma Separated Values (.csv), 36.93 KB) MD5:737d18992d791f83ce2895abc208cb11 Primary data file for dataset ID 640148

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Parameters

Parameter	Description	Units
measure_type	seawater parameter: temperature pH pCO2 Total Alkalinity Aragonite saturation state	text
units	units for the seawater parameter measured	text
location	survey location	unitless
lat	latitude; north is positive	decimal degrees
lon	longitude; east is positive	decimal degrees
date	sampling date	yyyy-mm-dd
tank_1	measurement in tank 1	degrees Celsius
tank_2	measurement in tank 2	degrees Celsius
tank_3	measurement in tank 3	degrees Celsius
tank_4	measurement in tank 4	degrees Celsius
tank_5	measurement in tank 5	degrees Celsius
tank_6	measurement in tank 6	degrees Celsius
tank_7	measurement in tank 7	degrees Celsius
tank_8	measurement in tank 8	degrees Celsius
tank_9	measurement in tank 9	degrees Celsius

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	Automatic titrator
Dataset-specific Description	In Moorea, an automatic titrator (Model T50, Mettler-Toledo) was used.,br /> In Okinawa, an AT titration analyzer (Kimoto ATT-05).
Generic Instrument Description	Instruments that incrementally add quantified aliquots of a reagent to a sample until the end-point of a chemical reaction is reached.

Dataset-specific Instrument Name	
Generic Instrument Name	pH Sensor
Dataset-specific Description	Orion, 3-stars mobile coupled with a Mettler DG 115-SC pH electrode
Generic Instrument Description	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+).

Dataset-specific Instrument Name	
Generic Instrument Name	Water Temperature Sensor
Generic Instrument Description	General term for an instrument that measures the temperature of the water with which it is in contact (thermometer).

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Deployments

MCR_Edmunds

Website	https://www.bco-dmo.org/deployment/640059
Platform	Richard B Gump Research Station - Moorea LTER
Start Date	2010-01-01
End Date	2016-12-31
Description	Ongoing studies on corals

Edmunds_TBRC_Okinawa

Website	https://www.bco-dmo.org/deployment/640067
Platform	TBRC_Sesoko_Is_Okinawa
Start Date	2010-01-01
End Date	2016-12-31
Description	Ongoing studies on corals

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Project Information

RUI: Ocean Acidification- Category 1- The effects of ocean acidification on the organismic biology and community ecology of corals, calcified algae, and coral reefs (OA_Corals)

Coverage: Moorea, French Polynesia

While coral reefs have undergone unprecedented changes in community structure in the past 50 y, they now may be exposed to their gravest threat since the Triassic. This threat is increasing atmospheric CO2, which equilibrates with seawater and causes ocean acidification (OA). In the marine environment, the resulting decline in carbonate saturation state (Omega) makes it energetically less feasible for calcifying taxa to mineralize; this is a major concern for coral reefs. It is possible that the scleractinian architects of reefs will cease to exist as a mineralized taxon within a century, and that calcifying algae will be severely impaired. While there is a rush to understand these effects and make recommendations leading to their mitigation, these efforts are influenced strongly by the notion that the impacts of pCO2 (which causes Omega to change) on calcifying taxa, and the mechanisms that drive them, are well-known. The investigators believe that many of the key processes of mineralization on reefs that are potentially affected by OA are only poorly known and that current knowledge is inadequate to support the scaling of OA effects to the community level. It is vital to measure organismal-scale calcification of key taxa, elucidate the mechanistic bases of these responses, evaluate community scale calcification, and finally, to conduct focused experiments to describe the functional relationships between these scales of mineralization.

This project is a 4-y effort focused on the effects of Ocean Acidification (OA) on coral reefs at multiple spatial and functional scales. The project focuses on the corals, calcified algae, and coral reefs of Moorea, French Polynesia, establishes baseline community-wide calcification data for the detection of OA effects on a decadal-scale, and builds on the research context and climate change focus of the Moorea Coral Reef LTER.

This project is a hypothesis-driven approach to compare the effects of OA on reef taxa and coral reefs in Moorea. The PIs will utilize microcosms to address the impacts and mechanisms of OA on biological processes, as well as the ecological processes shaping community structure. Additionally, studies of reef-wide metabolism will be used to evaluate the impacts of OA on intact reef ecosystems, to provide a context within which the experimental investigations can be scaled to the real world, and critically, to provide a much needed reference against which future changes can be gauged.

Datasets listed in the "Dataset Collection" section include references to results journal publications published as part of this project.

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Program Information

Science, Engineering and Education for Sustainability NSF-Wide Investment (SEES): Ocean Acidification (formerly CRI-OA) (SEES-OA)

Website: https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503477

Coverage: global

NSF Climate Research Investment (CRI) activities that were initiated in 2010 are now included under Science, Engineering and Education for Sustainability NSF-Wide Investment (SEES). SEES is a portfolio of activities that highlights NSF's unique role in helping society address the challenge(s) of achieving sustainability. Detailed information about the SEES program is available from NSF (https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504707).

In recognition of the need for basic research concerning the nature, extent and impact of ocean acidification on oceanic environments in the past, present and future, the goal of the SEES: OA program is to understand (a) the chemistry and physical chemistry of ocean acidification; (b) how ocean acidification interacts with processes at the organismal level; and (c) how the earth system history informs our understanding of the effects of ocean acidification on the present day and future ocean.

Solicitations issued under this program:
NSF 10-530, FY 2010-FY2011
NSF 12-500, FY 2012
NSF 12-600, FY 2013
NSF 13-586, FY 2014
NSF 13-586 was the final solicitation that will be released for this program.

PI Meetings:
1st U.S. Ocean Acidification PI Meeting(March 22-24, 2011, Woods Hole, MA)
2nd U.S. Ocean Acidification PI Meeting(Sept. 18-20, 2013, Washington, DC)
3rd U.S. Ocean Acidification PI Meeting (June 9-11, 2015, Woods Hole, MA – Tentative)

NSF media releases for the Ocean Acidification Program:

Press Release 10-186 NSF Awards Grants to Study Effects of Ocean Acidification

Discovery Blue Mussels "Hang On" Along Rocky Shores: For How Long?

Discovery nsf.gov - National Science Foundation (NSF) Discoveries - Trouble in Paradise: Ocean Acidification This Way Comes - US National Science Foundation (NSF)

Press Release 12-179 nsf.gov - National Science Foundation (NSF) News - Ocean Acidification: Finding New Answers Through National Science Foundation Research Grants - US National Science Foundation (NSF)

Press Release 13-102 World Oceans Month Brings Mixed News for Oysters

Press Release 13-108 nsf.gov - National Science Foundation (NSF) News - Natural Underwater Springs Show How Coral Reefs Respond to Ocean Acidification - US National Science Foundation (NSF)

Press Release 13-148 Ocean acidification: Making new discoveries through National Science Foundation research grants

Press Release 13-148 - Video nsf.gov - News - Video - NSF Ocean Sciences Division Director David Conover answers questions about ocean acidification. - US National Science Foundation (NSF)

Press Release 14-010 nsf.gov - National Science Foundation (NSF) News - Palau's coral reefs surprisingly resistant to ocean acidification - US National Science Foundation (NSF)

Press Release 14-116 nsf.gov - National Science Foundation (NSF) News - Ocean Acidification: NSF awards $11.4 million in new grants to study effects on marine ecosystems - US National Science Foundation (NSF)

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1041270
NSF Division of Ocean Sciences (NSF OCE)	OCE-1236905

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