Observed survival of coral fragments throughout a 93-day ocean acidification and warming experiment

Website: https://www.bco-dmo.org/dataset/735609
Data Type: experimental
Version: 1
Version Date: 2018-05-09

Project
» Investigating the influence of thermal history on coral growth response to recent and predicted end-of-century ocean warming across a cascade of ecological scales (Thermal History and Coral Growth)

Contributors	Affiliation	Role
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Abstract
This dataset includes the observed survival of four species of Caribbean reef-building corals (Siderastrea siderea, Pseudodiploria strigosa, Porites astreoides, and Undaria tenuifolia) throughout a 93-day ocean acidification (280-3200 µatm) and warming (28°C and 31°C) experiment. Survival was assessed every 30 days during the experiment. After the experiment, these data were analysed to evaluate the effects of ocean acidification and warming on the survivorship of the four corals species.

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Coverage

Spatial Extent: **N**:16.1899 **E**:-88.2614 **S**:16.1167 **W**:-88.5728
Temporal Extent: 2015-06 - 2015-12

Acquisition Description

Coral colonies were collected from inshore reefs (Port Honduras Marine Reserve; 16°11'23.5314"N, 88°34'21.9360"W) and from offshore reefs (Sapodilla Cayes Marine Reserve; 16°07'00.0114"N, 88°15'41.1834"W) along the Belize Mesoamerican Barrier Reef System (MBRS) in June 2015. The experiment was carried out from September 2015-December 2015 (recovery and acclimation June 2015-September 2015).

Coral fragments were considered dead when no living tissue remained and were quantified at each 30-day interval.

Data were analyzed using the survival package (2.39-5) and coxme package (2.2-5) in R (3.3.2).

Processing Description

BCO-DMO Processing Notes:
- added conventional header with dataset name, PI name, version date
- modified parameter names to conform with BCO-DMO naming conventions

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Related Publications

Therneau, T. (2012). coxme: mixed effects Cox models. R package version 2.2-3. Vienna, Austria: R Foundation for Statistical Computing.

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Parameters

Parameter	Description	Units
coral	Unique coral fragment ID	unitless
treatment	Experimental treatment fragment was in: first number represents target pCO2 value; second is the temperature treatment	unitless
tank	Tank ID fragment was in	unitless
temp	Measured average experimental temperature	degrees Celsius
pCO2	Measured average experimental pCO2	micro-atmospheres
pCO2_label	pCO2 treatment label: pre = pre-industrial (280); cur = current (400); eoc = end-of-century (700); ext = extreme (2800)	unitless
temp_target	Temperature treatment factor label	degrees Celsius
species_code	Species code: S = S. siderea; P = P. strigosa; A = P. astreoides; T = U. tenuifolia	unitless
reefzone	Collection reef zone of each fragment: N = inshore; F = offshore	unitless
colony	ID of the coral colony	unitless
tod	Time of death: number represents the day fragment was observed to be dead (fragments surviving through the duration of the experiment contain 90-92)	days
dead	Represents state of fragment: 0 = surviving; 1 = dead	unitless

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Instruments

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).

Dataset-specific Instrument Name	
Generic Instrument Name	pCO2 Sensor
Generic Instrument Description	A sensor that measures the partial pressure of CO2 in water (pCO2)

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Project Information

Investigating the influence of thermal history on coral growth response to recent and predicted end-of-century ocean warming across a cascade of ecological scales (Thermal History and Coral Growth)

Website: http://www.unc.edu/~kdcastil/research.html

Coverage: Western Caribbean

Description from NSF award abstract: Rising global ocean surface temperatures have reduced coral growth rates, thereby negatively impacting the health of coral reef ecosystems worldwide. Recent studies on tropical reef building corals reveal that corals' growth in response to ocean warming may be influenced by their previous seawater temperature exposure - their thermal history. Although these recent findings highlight significant variability in coral growth in response to climate change, uncertainty remains as to the spatial scale at which corals' thermal history influences how they have responded to ocean warming and how they will likely respond to predicted future increases in ocean temperature. This study investigates the influence of thermal history on coral growth in response to recent and predicted seawater temperatures increases across four ecologically relevant spatial scales ranging from reef ecosystems, to reef communities, to reef populations, to an individual coral colony. By understanding how corals have responded in the past across a range of ecological scales, the

Principal Investigator will be able to improve the ability to predict their susceptibility and resilience, which could then be applied to coral reef conservation in the face of climate change. This research project will broaden the participation of undergraduates from underrepresented groups and educate public radio listeners using minority voices and narratives. The scientist will leverage current and new partnerships to recruit and train minority undergraduates, thus allowing them to engage high school students near field sites in Florida, Belize, and Panama. Through peer advising, undergraduates will document this research on a digital news site for dissemination to the public. The voice of the undergraduates and scientist will ground the production of a public radio feature exploring the topic of acclimatization and resilience - a capacity for stress tolerance within coral reef ecosystems. This project will provide a postdoctoral researcher and several graduate students with opportunities for field and laboratory research training, teaching and mentoring, and professional development. The results will allow policy makers from Florida, the Mesoamerican Barrier Reef System countries, and several Central American countries to benefit from Caribbean-scale inferences that incorporate corals' physiological abilities, thereby improving coral reef management for the region. Coral reefs are at significant risk due to a variety of local and global scale anthropogenic stressors. Although various stressors contribute to the observed decline in coral reef health, recent studies highlight rising seawater temperatures due to increasing atmospheric carbon dioxide concentration as one of the most significant stressors influencing coral growth rates. However, there is increasing recognition of problems of scale since a coral's growth response to an environmental stressor may be conditional on the scale of description. This research will investigate the following research questions: (1) How has seawater temperature on reef ecosystems (Florida Keys Reef Tract, USA; Belize Barrier Reef System, Belize; and Bocas Del Toro Reef Complex, Panama), reef communities (inshore and offshore reefs), reef populations (individual reefs), and near reef colonies (individual colonies), varied in the past? (2) How has seawater temperature influenced rates of coral growth and how does the seawater temperature-coral growth relationship vary across these four ecological spatial scales? (3) Does the seawater temperature-coral growth relationship forecast rates of coral growth under predicted end-of-century ocean warming at the four ecological spatial scales? Long term sea surface temperature records and small-scale high-resolution in situ seawater temperature measurements will be compared with growth chronologies for the reef building corals Siderastrea siderea and Orbicella faveolata, two keystone species ubiquitously distributed throughout the Caribbean Sea. Nutrients and irradiance will be quantified via satellite-derived observations, in situ measurements, and established colorimetric protocols. Field and laboratory experiments will be combined to examine seawater temperature-coral growth relationships under recent and predicted end-of-century ocean warming at four ecologically relevant spatial scales. The findings of this study will help us bridge the temperature-coral growth response gap across ecologically relevant spatial scales and thus improve our understanding of how corals have responded to recent warming. This will lead to more meaningful predictions about future coral growth response to climate change.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1459522

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