

Site locations for coral thermal response study at Belize Mesoamerican Barrier Reef System (MBRS), 2003-2015

Website: <https://www.bco-dmo.org/dataset/733680>

Data Type: Other Field Results

Version: 1

Version Date: 2018-04-16

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

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Table of Contents

- [Coverage](#)
 - [Dataset Description](#)
 - [Acquisition Description](#)
 - [Processing Description](#)
 - [Related Publications](#)
 - [Parameters](#)
 - [Instruments](#)
 - [Project Information](#)
 - [Funding](#)
-

Coverage

Spatial Extent: N:17.82413 E:-88.00196 S:16.13013 W:-88.62943

Temporal Extent: 2002 - 2015

Dataset Description

This dataset contains site names and locations of sampling areas for coral thermal response study.

Related Reference: Baumann et al. (2016). <https://doi.org/10.1371/journal.pone.0162098>.

Acquisition Description

Site Classification: Multiple thermal parameters were calculated at different temporal resolutions and examined across thirteen lagoonal reef sites. Lagoonal reefs are located between the barrier reef's crest and the mainland, and therefore do not include the seaward facing fore-reef. Instead, lagoonal reefs include nearshore reefs, patch reefs, and the back reef. Four thermal parameters produced distinct environments for the reef sites across the Belize MBRS: average annual maximum temperature, average annual temperature range, average annual number of days above the regional bleaching threshold of 29.7°C, and average annual consecutive days above the regional bleaching threshold (i.e., longest potential thermal stress events). A metric that combined all four thermal parameters was generated using ArcGIS in order to assess thermal environments across the Belize MBRS. Data from each of the four parameters in the metric were divided into 8–10 bins (0.5 standard deviations (SD) of the mean) and overlaid on a map of the Belize MBRS. Reefs were not present in areas where the value of any single variable was <1 SD below or >2 SD above the mean (across the entire data set from 2003–2012). For all four parameters, areas that were classified in bins ≥ 1 SD above the mean were designated high temperature parameter (highTP) sites. Moderate temperature parameter (modTP) sites were classified as areas where all values were 0.5 to 1 SD above the average annual temperature range and the average annual maximum temperature, and within 1 SD of the average annual consecutive days and the average annual number of days above the regional bleaching threshold. Low temperature parameter (lowTP) sites were classified as bins that were 0.5 SD above the average to 2 SD below the average for annual temperature range and annual maximum temperature, and below the average for consecutive and annual days above the regional bleaching threshold. Using the metric presented in Fig. 1, Baumann et al (2016), fifteen sites were identified, thirteen of which were visited and surveyed in November 2014 (the two northernmost highTP sites were not surveyed as corals were not located within the marked geographic area).

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
- changed longitude to negative values, default for degrees West.

[[table of contents](#) | [back to top](#)]

Related Publications

Baumann, J. H., Townsend, J. E., Courtney, T. A., Aichelman, H. E., Davies, S. W., Lima, F. P., & Castillo, K. D. (2016). Temperature Regimes Impact Coral Assemblages along Environmental Gradients on Lagoonal Reefs in Belize. PLOS ONE, 11(9), e0162098.
doi:[10.1371/journal.pone.0162098](https://doi.org/10.1371/journal.pone.0162098)

[[table of contents](#) | [back to top](#)]

Parameters

Parameter	Description	Units
site	site identifier	unitless
description	site description: nearby city name and low; moderate; or high temperature parameter	unitless
lat	latitude; north is positive	decimal degrees
lon	longitude; east is positive	decimal degrees
comments	comments pertaining to site locations	unitless

[[table of contents](#) | [back to top](#)]

Instruments

Dataset-specific Instrument Name	GPS
Generic Instrument Name	GPS receiver
Dataset-specific Description	Used to obtain site locations.
Generic Instrument Description	Acquires satellite signals and tracks your location.

[[table of contents](#) | [back to top](#)]

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.

[[table of contents](#) | [back to top](#)]

Funding

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

[[table of contents](#) | [back to top](#)]