Stress bands in coral cores collected at Jarvis Island between 2008 and 2016

Website: https://www.bco-dmo.org/dataset/775828
Data Type: Other Field Results
Version: 1
Version Date: 2019-08-22

Project
» Skeletal Records of Coral Reef Bleaching in the Central Equatorial Pacific (Coral Bleaching Skeletal Records)

Contributors	Affiliation	Role
Cohen, Anne L.	Woods Hole Oceanographic Institution (WHOI)	Principal Investigator
Soenen, Karen	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
The dataset contains historical coral reef bleaching events on Jarvis Island reconstructed from stress bands in Porites coral cores. Samples are collected between 2008 and 2016.

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Coverage

Spatial Extent: **N**:0.376 **E**:160.014 **S**:0.369 **W**:159.982
Temporal Extent: 2010-04 - 2016-05

Dataset Description

These data were published in Barkley *et al.,* 2018 (Figure 5).

The dataset contains historical coral reef bleaching events on Jarvis Island reconstructed from stress bands in Porites coral cores. Samples are collected between 2010 and 2016.

Methods & Sampling

Skeletal cores were collected from *Porites* coral colonies in April 2010 (n = 4), May 2012 (n = 3), September 2012 (n = 6), November 2015 (n = 16), and May 2016 (n = 1). All cores were collected from colonies at 3-17 m depth using pneumatic or hydraulic drills with diamond drill bits. Cores collected in 2010 and 2012 were sampled from healthy colonies and were between 50 and 200 cm in length. In 2015, cores were collected from bleached *Porites* colonies, and were limited to 5-10 cm length in accordance with United States Fish and Wildlife Service permitting restrictions. The core collected in May 2016 was collected from a recently dead portion of a massive colony that experienced significant tissue mortality during the 2015-16 bleaching event. Core holes left

in the coral colonies were filled with cement plugs, sealed with underwater epoxy, and secured flush with the existing colony surface. Visual inspections of coral colonies several years after coring demonstrated full recovery and complete tissue overgrowth of the cement plug.

Coral skeletal cores, ecological survey data, seawater samples, and in situ instrument time series were collected during expeditions aboard:

- NOAA ship Hi'ialakai (2–4 April 2010, 3–5 May 2012)
- Pangaea Exploration S/V Sea Dragon (13–16 September 2012)
- R/V Machias (12–15 November 2015)
- NOAA ship Oscar Elton Sette (17–23 May 2016)

Research activities and sample collection were conducted under U.S. Fish and Wildlife Service Pacific Reefs National Wildlife Refuge Complex Research and Monitoring Special Use Permits:

- 12521-10001 (effective date: 15 Jan 2010; expiration date: 30 May 2010)
- 12521-12001 (effective date: 7 Feb 2012; expiration date: 31 Dec 2012)
- 12521-12005 (effective date: 29 Aug 2012; expiration date: 30 June 2014)
- 12521-14001 (effective date: 1 Jan 2015; expiration date: 31 Dec 2015)
- 12513-15001 (effective date: 11 Nov 2015; expiration date: 31 Dec 2015)

and in compliance with Presidential Proclamation 8336.

Data Processing Description

Coral cores were oven-dried and scanned with a Siemens Volume Zoom Helical Computerized Tomography (CT) Scanner at WHOI and at the University of North Carolina Biomedical Research Imaging Facility. Density banding and stress band presence was evaluated in 3-D CT scans of coral cores using the automated coralCT software (DeCarlo and Cohen 2016). Density time series were extracted and averaged from individual polyp growth tracks, which accounts for the different ages of skeleton in horizontal cross sections due to uneven growth geometry, in 0.1 mm increments from the top of the skeletal core up to 70 cm down core. Density values were converted to Z-scores by subtracting the long-term core mean density from each raw density value and dividing by the long-term standard deviation. High-density stress bands were defined as bands greater than 1 mm thick that spread across the entire width of the core where density values exceeded two standard deviations of the whole core density mean (i.e. a Z-score greater than 2). Stress bands that formed prior to 2010 were identified based on density banding patterns counted downward from the core top. Stress bands that were forming in 2015-16 were dated based on their location at the very top of the core (indicating that they were forming during the time of collection).

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Data Files

File
cores_stress_bands.csv(Comma Separated Values (.csv), 2.06 KB) MD5:30516a2141101c5ae71799268cc76362
Primary data file for dataset ID 775828

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Related Publications

Barkley, H. C., Cohen, A. L., Mollica, N. R., Brainard, R. E., Rivera, H. E., DeCarlo, T. M., … Luu, V. H. (2018). Repeat bleaching of a central Pacific coral reef over the past six decades (1960–2016). Communications Biology, 1(1). doi:10.1038/s42003-018-0183-7
Results

DeCarlo, T. M., & Cohen, A. L. (2016, July 14). Coralct: Software Tool To Analyze Computerized Tomography

(Ct) Scans Of Coral Skeletal Cores For Calcification And Bioerosion Rates (Version 1.1). Zenodo. https://doi.org/10.5281/zenodo.57855

Methods

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Parameters

Parameter	Description	Units
core_id	Unique identifier for each coral core	unitless
date_collected	Month and year of core collection	unitless
latitude	Latitude of coral core; north = positive	decimal degrees
longitude	Longitude of coral core; east = positive	decimal degrees
depth	Depth of coral core	meters
sb_1965_1966	Presence of stress band in 1965-1996; yes = stress band present; no = no stress band present; blank = no data	unitless
sb_1972_1973	Presence of stress band in 1972-1973; yes = stress band present; no = no stress band present; blank = no data	unitless
sb_1975_1976	Presence of stress band in 1975-1976; yes = stress band present; no = no stress band present; blank = no data	unitless
sb_1982_1983	Presence of stress band in 1982-1983; yes = stress band present; no = no stress band present; blank = no data	unitless
sb_1987_1988	Presence of stress band in 1987-1988; yes = stress band present; no = no stress band present; blank = no data	unitless
sb_1992_1993	Presence of stress band in 1992-1993; yes = stress band present; no = no stress band present; blank = no data	unitless
sb_1997_1998	Presence of stress band in 1997-1998; yes = stress band present; no = no stress band present; blank = no data	unitless
sb_2002_2003	Presence of stress band in 2002-2003; yes = stress band present; no = no stress band present; blank = no data	unitless
sb_2009_2010	Presence of stress band in 2009-2010; yes = stress band present; no = no stress band present; blank = no data	unitless
sb_2015_2016	Presence of stress band in 2015-2016; yes = stress band present; no = no stress band present; blank = no data	unitless

Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	Computerized Tomography (CT) Scanner
Dataset-specific Description	Density banding and stress band presence was evaluated in 3-D CT scans of coral cores using a Matlab automated coralCT software from DeCarlo, T. & Cohen (2016)
Generic Instrument Description	A CT scan makes use of computer-processed combinations of many X-ray measurements taken from different angles to produce cross-sectional (tomographic) images (virtual "slices") of specific areas of a scanned object.

Deployments

HA1001-03

Website	https://www.bco-dmo.org/deployment/780536
Platform	R/V Hi'ialakai
Start Date	2010-03-27
End Date	2010-04-24
Description	HA1001, Leg 3

HA1201-04

Website	https://www.bco-dmo.org/deployment/780539
Platform	R/V Hi'ialakai
Start Date	2012-04-27
End Date	2012-05-24
Description	HA1201, Leg 4

SeaDragon-2012

Website	https://www.bco-dmo.org/deployment/780663
Platform	Sea Dragon
Start Date	2012-09-13
End Date	2012-10-02

Machias_2015

Website	https://www.bco-dmo.org/deployment/780708
Platform	R/V Machias
Start Date	2015-11-12
End Date	2015-11-15

SE1602-02

Website	https://www.bco-dmo.org/deployment/780633
Platform	NOAA Ship Oscar Elton Sette
Start Date	2016-05-11
End Date	2016-05-31
Description	SE1602, Leg 2

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Project Information

Skeletal Records of Coral Reef Bleaching in the Central Equatorial Pacific (Coral Bleaching Skeletal Records)

Coverage: Central Equatorial Pacific

NSF Award Abstract:
Ocean warming kills corals and efforts are underway to identify and protect coral reefs that may withstand the projected 21st century rise in tropical ocean temperatures. Coral reefs in the central equatorial Pacific (CEP) have been exposed to episodes of extreme warmth every 3-7 years for centuries, if not millennia, yet remain highly productive ecosystems. Initial data obtained by the investigator from stress signatures archived in the skeletons of long lived coral species, suggests that CEP reefs lose their symbiotic algae or bleach, sometimes severely, during warm episodes. The observation that CEP reefs bleach repetitively yet remain productive implies uncommon resilience to ocean warming. The investigator will use laboratory experiments and field observations to validate skeletal records of historical bleaching. A successful outcome will provide novel and valuable insights into the resilience of the CEP reefs and a new tool with which to identify thermally tolerant coral reef ecosystems across the tropics. Additionally, this project includes mentorship of a postdoc and six undergraduate or high school students, outreach through presentations and media, and expansion of publically available software for coral stress band analysis.

Ocean warming projections indicate severe impacts to coral reefs will occur on an annual basis within the next few decades. Consequently, a coordinated effort is underway to identify reefs that might survive these changes. The investigator will test the hypothesis that such reefs exist at the epicenter of influence of the El Niño-Southern Oscillation (ENSO), where strong inter-annual temperature variability creates conditions conducive for the development of thermal resilience. The project uses laboratory-based bleaching experiments and actual stress signatures accreted by wild corals during the 2015 El Niño to validate signatures of historical bleaching archived in the skeletons of massive reef building corals. In addition the investigator will use new, long cores from the CEP to build a robust dataset of historical bleaching back to the 1800's. A successful outcome will increase confidence in the interpretation of skeletal stress bands as quantitative bleaching proxies and enable the reconstruction of the history of coral reef bleaching and recovery in the CEP.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1737311