

Stress band counts from coral cores taken in the central equatorial Pacific between 1982 and 2015

Website: <https://www.bco-dmo.org/dataset/773896>

Data Type: Other Field Results

Version: 1

Version Date: 2019-07-31

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
Mollica, Nathaniel	Woods Hole Oceanographic Institution (WHOI)	Co-Principal Investigator
Soenen, Karen	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract

Coral cores were collected in the central equatorial Pacific (Central Pacific Coral reefs, -5 to 5 latitude, Dongsha Atoll, Curacao, Barbados, Martinique coral reefs) between March 1982 and June 2015. Stress bands were identified in the CT scan images of each core and quantified.

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Coverage

Spatial Extent: N:6.4 E:-176.6183 S:-4.6779 W:173

Temporal Extent: 1982-03 - 2015-06

Dataset Description

Coral cores were collected in the central equatorial Pacific (Central Pacific Coral reefs, -5 to 5 latitude, Dongsha Atoll, Curacao, Barbados, Martinique coral reefs) between March 1982 and June 2015. Stress bands were identified in the CT scan images of each core and quantified.

Methods & Sampling

These data were published in Mollica *et al.*, 2019

All cores were collected and analyzed using the same methods. Only live colonies were cored, establishing the top age, vertically i.e., parallel to the upward growth axis, and using either a pneumatic drill fitted with 3-cm diameter diamond tip coring bit or an hydraulic drill fitted with an 8-cm diameter bit. Core holes were sealed with a cement cap and underwater epoxy, secured flush with the colony surface to facilitate overgrowth of tissue and wound closure (e.g. Matson 2011), a 6 to 36-month process depending on the rate of coral growth and diameter of core. All cores were first air dried in the field, then oven dried at 60 °C, and CT scanned intact,

together with density standards, on the Siemens Volume Zoom Helical Computerized Tomography (CT) Scanner at Woods Hole Oceanographic Institution or the Siemens Biograph mCT scanner at the Biomedical Research Imaging Center (BRIC) at the University of North Carolina (protocol as per Barkley et al. 2015; DeCarlo et al. 2015).

Location: Central Pacific Coral reefs, -5 to 5 latitude, Dongsha Atoll, Curacao, Barbados, Martinique coral reefs.

Data Processing Description

Stress bands and annual growth bands were identified in the CT scan images of each core and quantified using the automated code coralCT for MATLAB which traces the density of individual corallites within the 3 dimensional core (DeCarlo and Cohen 2016). Revisions to version 1.1 of coralCT, which was designed primarily for *Porites* spp., were made to accommodate the skeletal architecture of the Atlantic corals which have more prominent thecal walls than *Porites*. Specifically, a linear quadratic estimation algorithm (i.e. Kalman Filtering) improved polyp tracing along the core axis. The code was also revised to enable automated identification of stress bands (Barkley et al. 2018). Specifically, the density time-series for all corallites in the core (see DeCarlo et al. 2015, Data Repository Figure DR2) were averaged to create an "ensemble" mean density time series for all traceable corallites. The averaged density profile time-series was then detrended to account for shifts in mean density that may occur over time.

Regions where skeletal density exceeded 2 standard deviations above the whole-core mean, a threshold chosen to account for the range in natural seasonal and inter-annual density variability, were identified as stress bands. To exclude fine-scale density anomalies such as worm borings, stress bands were defined as having a minimum width of 1 mm. Each CT scan was visually inspected to validate the presence and location of stress bands identified by the automated program.

BCO-DMO Processing Notes:

- Modified parameter names to conform with BCO-DMO naming conventions
- converted year/month format to yyyy-mm

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Data Files

File
stress_bands.csv (Comma Separated Values (.csv), 2.89 KB) MD5:ab667e895ccf07a0aaa3f2cdb1e47e57
Primary data file for dataset ID 773896

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Related Publications

Barkley, H. C., Cohen, A. L., Golbuu, Y., Starczak, V. R., DeCarlo, T. M., & Shamberger, K. E. F. (2015). Changes in coral reef communities across a natural gradient in seawater pH. *Science Advances*, 1(5), e1500328–e1500328. doi:[10.1126/sciadv.1500328](https://doi.org/10.1126/sciadv.1500328)

Methods

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](https://doi.org/10.1038/s42003-018-0183-7)

Methods

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

DeCarlo, T. M., Cohen, A. L., Barkley, H. C., Cobban, Q., Young, C., Shamberger, K. E., Brainard R.E., Golbuu, Y. (2015). Coral macrobioerosion is accelerated by ocean acidification and nutrients. *Geology*, 43(1), 7-10.

doi:10.1130/g36147.1 <https://doi.org/10.1130/G36147.1>

Methods

Matson, E.G. (2011). Core Plugs. In Hopley, D. (Ed.), *Encyclopedia of Modern Coral Reefs* (pp.294-296)Dordrecht: Springer. DOI:10.1007/978-90-481-2639-2

Methods

Mollica, N. R., Cohen, A. L., Alpert, A. E., Barkley, H. C., Brainard, R. E., Carilli, J. E., ... Young, C. W. (2019).

Skeletal records of bleaching reveal different thermal thresholds of Pacific coral reef assemblages. *Coral Reefs*.

doi:[10.1007/s00338-019-01803-x](https://doi.org/10.1007/s00338-019-01803-x)

Results

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Parameters

Parameter	Description	Units
Island	Island of coral sampling	unitless
Latitude	Latitude - south is negative	decimal degrees
Longitude	Longitude - west is negative	decimal degrees
Stress_Bands	Stress bands	percentage (%)
Number_of_Cores	Number of cores	unitless
Year_Month	Year and month of samples (format: yyyy-mm)	unitless

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	Computerized Tomography (CT) Scanner
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.

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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

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