Sampling information and presence/absence of stress bands (in 1998 and 2010) in Porites cf. lobata coral at Palau's Rock Islands

Website: https://www.bco-dmo.org/dataset/894894
Data Type: Other Field Results
Version: 1
Version Date: 2023-04-27

Project
» The Biophysics of Coral Reef Resilience: hydrodynamic and ecological drivers of coral survival under extreme heat (Biophysics of Coral Reef Resilience)

Contributors	Affiliation	Role
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Abstract
Ocean warming is killing corals, but heat-tolerant populations exist; if protected, they could replenish affected reefs naturally or through restoration. Palau's Rock Islands experience consistently higher temperatures and extreme heatwaves, yet their diverse coral communities bleach less than those on Palau's cooler outer reefs. Here, we combined genetic analyses, bleaching histories, and growth rates of Porites cf. lobata colonies to identify thermally tolerant genotypes, map their distribution, and investigate potential growth trade-offs. We identified four genetic lineages of P. cf. lobata. On Palau's outer reefs, a thermally sensitive lineage dominates. The Rock Islands harbor two lineages with enhanced thermal tolerance; one of which shows no consistent growth trade-off and also occurs on several outer reefs. This suggests that the Rock Islands provide naturally tolerant larvae to neighboring areas. Finding and protecting such sources of thermally-tolerant corals is key to reef survival under 21st century climate change. This dataset contains sampling location information for each sample, depth, and diameter of colonies, and presence/absence of stress bands in 1998 and 2010.

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Coverage

Spatial Extent: **N**:8.03909 **E**:134.691 **S**:2.85707 **W**:131.738
Temporal Extent: 2011-04-11 - 2018-10-07

Methods & Sampling

Samples were collected from coral reefs of Palau's Rock Islands. Coral cores (N = 121) were taken using an underwater pneumatic drill equipped with a diamond-tipped drill bit powered by compressed air from a SCUBA tank. Cores ranged from 10 to 204 centimeters (cm) long, covering years from 1970 to 2014. Cores were dried in an oven and imaged using a Volume Zoom Helical Computerized Tomography (CT) Scanner at Woods

Hole Oceanographic Institution. Scans were analyzed using an automated computer program. Cores that displayed high levels of bioerosion, inconsistent banding patterns, partial mortality, or other deformities preventing accurate identification of annual growth bands, and as a result, correct identification of years corresponding to bleaching events, were excluded from analysis (N = 42). Of the remaining 80 cores, 11 had unsuccessful DNA extractions or failed other downstream genetic data filters, leaving 69 corals for final analyses. Coral samples were imported to the U.S. under CITES permit numbers: PW14-163, PW15-022, PW18-121. RAD-sequencing data are available in the National Center for Biotechnology Information (NCBI) Sequence Read Archive (SRA) under accession number PRJNA801929. Additional input data are available in the GitHub repository of H. Rivera at https://github.com/hrivera28/Palau_porites (DOI: 10.5281/ZENODO.7953614).

Data Processing Description

Data Processing:
Growth metrics (extension and calcification rates and density) were calculated for each core by averaging the yearly growth during the years 1999 to 2009, in order to avoid bleaching years that might influence growth patterns. See related BCO-DMO dataset https://www.bco-dmo.org/dataset/894930 for the growth data. Stress bands were defined as a region of the core at least 1 millimeter (mm) thick in which density and the change in density gradient exceeded two standard deviations above each individual whole core average density and gradient.

BCO-DMO Processing:
- converted dates to YYYY-MM-DD format.

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Data Files

File
stress_bands.csv (Comma Separated Values (.csv), 36.68 KB) MD5:c8acccf94d53d2648d0e20f26cc52b53
Primary data file for dataset ID 894894.

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Related Publications

Rivera, H. (2023). hrivera28/Palau_porites: Creating permanent DOI for repo (DOI_repo) [Computer software]. Zenodo. https://doi.org/10.5281/ZENODO.7953614
Software

Rivera, H. E., Cohen, A. L., Thompson, J. R., Baums, I. B., Fox, M. D., & Meyer-Kaiser, K. S. (2022). Palau's warmest reefs harbor thermally tolerant corals that thrive across different habitats. Communications Biology, 5(1). https://doi.org/10.1038/s42003-022-04315-7
Results

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Related Datasets

IsRelatedTo

Cohen, A. L., Rivera, H. (2023) **Average yearly extension rate, calcification rate, and density for each core sample from Porites cf. lobata coral at Palau's Rock Islands.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-04-27 doi:10.26008/1912/bco-dmo.894930.1 [view at BCO-DMO]

Woods Hole Oceanographic Institution. Single digest RAD-sequencing of Porites lobata from Palau. 2022/01. In: BioProject [Internet]. Bethesda, MD: National Library of Medicine (US), National Center for Biotechnology Information; 2011-. Available from: http://www.ncbi.nlm.nih.gov/bioproject/PRJNA801929. NCBI:BioProject: PRJNA801929.

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Parameters

Parameter	Description	Units
Sample	Identifier code for sample	unitless
Cohort	whether the coral colony the sample was taken from was considered an adult or juvenile size coral	unitless
Site	The name of the reef at which the sample was taken	unitless
Region	Whether the reef was an Outer reef or Rock Island reef (see publication for distinction)	unitless
Lat	latitude of location	decimal degrees North
Long	longitude of location	decimal degrees East
Date	Date of sample collection	unitless
Depth_m	Approximate depth of colony in meters	meters (m)
Diam_m	Approximate diameter of colony in meters	meters (m)
SB_98	Binary designation of whether the core of the colony was deemed to have a stress band during the 1998 year of growth. 1 = stress band present, 0 = no stress band, NA = data not available for that sample (no core taken)	unitless
SB_10	Binary designation of whether the core of the colony was deemed to have a stress band during the 2010 year of growth. 1 = stress band present, 0 = no stress band, NA = data not available for that sample (no core taken)	unitless

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Instruments

Dataset-specific Instrument Name	Volume Zoom Helical Computerized Tomography (CT) Scanner
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.

Dataset-specific Instrument Name	underwater pneumatic drill
Generic Instrument Name	Drill
Generic Instrument Description	A drill is a tool used for making round holes or driving fasteners. There are many types of drills: some are powered manually, and others use electricity (electric drill) or compressed air as the motive power. Drills with a percussive action (hammer drills) are mostly used in hard materials such as masonry (brick, concrete, and stone) or rock. Some types of hand-held drills are also used to drive screws and other fasteners.

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Project Information

The Biophysics of Coral Reef Resilience: hydrodynamic and ecological drivers of coral survival under extreme heat (Biophysics of Coral Reef Resilience)

Website: http://www2.whoi.edu/site/cohenlab/

Coverage: Central Tropical Pacific

NSF Award Abstract:
Coral reefs are among the most diverse ecosystems on the planet and support the livelihoods of hundreds of millions of people around the world. Ocean warming and intensifying heatwaves are killing coral reefs and there are urgent efforts underway to identify and protect those capable of surviving future warming. Coral reefs in the central equatorial Pacific have experienced three extreme heat events over the last two decades. Initial observational data obtained by the investigators show that coral mortality during each event was spatially variable, implying that some coral communities have developed resilience to thermal stress. In this study, the investigators are examining the role of fine-scale variations in reef temperature and water flow in promoting coral resilience by providing opportunities for genetic adaptation, by protectively cooling corals through upwelling or internal waves, or by enhancing food supply. Results will provide novel insights into the mechanisms by which coral communities survive extreme heat and a new tool that allows scientists and coral reef managers to identify resilient reefs for protection. Additionally, this project is supporting an early-career scientist, graduate and undergraduate research, opportunities for high school students in the United States to participate in research, as well as participation by Kanton high school students. Outreach will be conducted through presentations and a variety of media, including film. The hydrodynamic model output will be made publicly available, and project outcomes will contribute to a universal map of coral thermal thresholds currently under development by the scientific community.

Ocean warming and intensifying heatwaves are devastating coral reefs across the global tropics. Consequently, a coordinated effort is underway to identify and protect coral communities that can survive these changes. This interdisciplinary team of investigators is combining oceanographic observations, 3-dimensional fine-scale hydrodynamic model simulations, benthic surveys, and biological assays to investigate the role of reef hydrodynamics in facilitating coral resilience to thermal stress on Kanton Island in the central equatorial Pacific. The investigators are testing the hypothesis that oceanographic and atmospheric forcing interact with reef bathymetry to induce predictable fine-scale heterogeneity in water temperature and flow across the reef. They are also testing the hypothesis that environmental heterogeneity, in turn, facilitates coral survival of extreme heat by providing opportunities for genetic adaptation, protective cooling, and/or enhanced food supply. Results will provide insights into the biophysical mechanisms underpinning reef resilience and a new tool with which to predict resilience across a broad range of coral reef ecosystems.

This project is supported with funds from the Biological and Physical Oceanography Programs.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-2049567

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