Coral growth rate measured during a heatwave experiment done September to November 2018 using reef building corals collected in Kāne'ohe Bay, O'ahu, Hawai'i

Website: https://www.bco-dmo.org/dataset/884530
Data Type: experimental
Version: 1
Version Date: 2023-01-31

Project
» NSFOCE-BSF: COLLABORATIVE RESEARCH: Elucidating adaptive potential through coral holobiont functional integration (Holobiont Integration)

Contributors	Affiliation	Role
Putnam, Hollie	University of Rhode Island (URI)	Co-Principal Investigator
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Abstract
Two common reef-building corals, Montipora capitata and Pocillopora acuta, were collected from six sites in Kāne'ohe Bay, O'ahu, Hawai'i. Fragments were allowed to acclimate in experimental tanks for two weeks prior to exposure to one of the following four treatments: Ambient Temperature Ambient pCO2 (ATAC), Ambient Temperature High pCO2 (ATHC), High Temperature Ambient pCO2 (HTAC), and High Temperature High pCO2 (HTHC). The treatment period lasted for a two month period, starting on September 22nd, 2018 and lasting through November 17th, 2018. Following the stress period, coral fragments were exposed to a two-month recovery period in ambient conditions. Every two weeks, corals were measured for buoyant weight to calculate growth rates.

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Coverage

Spatial Extent: **N**:21.477194 **E**:-157.786861 **S**:21.429417 **W**:-157.833667
Temporal Extent: 2018-09-22 - 2018-11-17

Methods & Sampling

Corals sampled at six reefs within Kāne'ohe Bay, O'ahu, Hawai'i:

1.) USA: Hawaii HIMB: 21.436056, -157.786861
2.) USA: Hawaii Reef.11.13: 21.450806, -157.794944
3.) USA: Hawaii Reef.35.36: 21.473889, -157.833667
4.) USA: Hawaii Reef.18: 21.450806, -157.811139
5.) USA: Hawaii Lilipuna.Fringe: 21.429417, -157.791111

6.) USA: Hawaii Reef.42.43: 21.477194, -157.826889

Experiment conducted at the Hawai'i Institute of Marine Biology.

Data Processing Description

Growth over time was determined by the buoyant weight technique (Davies 1989; Jokiel and Maragos 1978), using air, freshwater, and saltwater standard temperature curves. Each coral fragment was weighed in its respective treatment temperature and pCO2 conditions. Wet buoyant weight was converted to dry mass using the aragonite density of 2.03 g cm-3 for *Montipora* spp. (Anthony and Hoegh-Guldberg 2003) and 2.93 g cm-3 for *P. acuta* (Jokiel and Maragos 1978). Rates were normalized to surface area and reported in units of mg CaCO3 cm-2 d-1.

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Data Files

File
heatwave_resultsgrowth.csv (Comma Separated Values (.csv), 101.46 KB) MD5:2d4455fd33adbc569f479f4ff9f5cba3
Primary data file for dataset ID 884530

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Related Publications

Anthony, K., & Hoegh-Guldberg, O. (2003). Kinetics of photoacclimation in corals. Oecologia, 134(1), 23–31. https://doi.org/10.1007/s00442-002-1095-1
Methods

Davies, P.S. (1989). Short-term growth measurements of corals using an accurate buoyant weighing technique. Marine Biology, 101(3), 389–395. doi:10.1007/bf00428135 https://doi.org/10.1007/BF00428135
Methods

Jokiel, P.L., Maragos, J.E., & Franzisket, L. (1978). Coral growth: buoyant weight technique. Coral Reefs: Research Methods.
Methods

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Related Datasets

IsRelatedTo

Strand, E., Putnam, H. (2023) **Carbonate Chemistry Parameters from a heatwave experiment done September to November 2018 using reef building corals collected in Kāne'ohe Bay, O'ahu, Hawai'i.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-01-31 doi:10.26008/1912/bco-dmo.884411.1 [view at BCO-DMO]
Relationship Description: Dataset is part of same experiment.

Strand, E., Putnam, H. (2023) **Coral physiology parameters acquired during a heatwave experiment done September to November 2018 using reef building corals collected in Kāne'ohe Bay, O'ahu, Hawai'i.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-01-31 doi:10.26008/1912/bco-dmo.884544.1 [view at BCO-DMO]
Relationship Description: Dataset is part of the same experiment.

Strand, E., Putnam, H. (2023) **Coral survivorship tracked during a heatwave experiment done September to November 2018 using reef building corals collected in Kāne'ohe Bay, O'ahu, Hawai'i.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-01-31 doi:10.26008/1912/bco-dmo.884551.1 [view at BCO-DMO]
Relationship Description: Dataset is part of the same experiment.

Strand, E., Putnam, H. (2023) **Experiment Tank Conditions from a heatwave experiment done September to November 2018 using reef building corals collected in Kāne'ohe Bay, O'ahu, Hawai'i.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-01-31 doi:10.26008/1912/bco-dmo.884417.1 [view at BCO-DMO]
Relationship Description: Dataset is part is same experiment.

Strand, E., Putnam, H. (2023) **Photosynthetic irradiance capacity of coral fragments measured during a heatwave experiment done September to November 2018 using reef building corals collected in Kāne'ohe Bay, O'ahu, Hawai'i.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-01-31 doi:10.26008/1912/bco-dmo.884537.1 [view at BCO-DMO]
Relationship Description: Dataset is part of the same experiment.

Strand, E., Putnam, H. (2023) **Physiology color score extracted from pictures taken during a heatwave experiment done September to November 2018 using reef building corals collected in Kāne'ohe Bay, O'ahu, Hawai'i.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2022-11-23 doi:10.26008/1912/bco-dmo.884208.1 [view at BCO-DMO]
Relationship Description: Dataset is part of same experiment.

Strand, E., Putnam, H. (2023) **Temperature data measured during a heatwave experiment done September to November 2018 using reef building corals collected in Kāne'ohe Bay, O'ahu, Hawai'i.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-01-31 doi:10.26008/1912/bco-dmo.884738.1 [view at BCO-DMO]
Relationship Description: Dataset is part of the same experiment.

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Parameters

Parameter	Description	Units
Plug_ID	The individual coral fragment ID number	unitless
Species	Coral host species: Montipora capitata or Pocillopora acuta	unitless
Treatment	Temperature and pCO2 treatment exposure indication. Ambient Temperature Ambient pCO2 (ATAC), Ambient Temperature High pCO2 (ATHC), High Temperature Ambient pCO2 (HTAC), or High Temperature High pCO2 (HTHC).	unitless
Tank	The tank number that coral fragment was sampled from (12 options; 3 tanks per treatment).	unitless
Temperature	Temperature treatment indication: high or ambient.	unitless
CO2	pCO2 treatment indication: high or ambient.	unitless
Site_Name	The reef location where that sample was collected (6 options total).	unitless
Site_Latitude	Latitude of coral sampling site, south is negative	decimal degrees
Site_Longitude	Longitude of coral sampling site, west is negative	decimal degrees
Timepoint	The sampling time point; at what point during the experiment was that fragment sampled (for multivariate physiology analyses)	units
Growth_Time	Buoyant weight time point (this was done weekly).	units
Growth_Rate	Calculated growth rate	units

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Instruments

Dataset-specific Instrument Name	Balance
Generic Instrument Name	scale
Generic Instrument Description	An instrument used to measure weight or mass.

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Project Information

NSFOCE-BSF: COLLABORATIVE RESEARCH: Elucidating adaptive potential through coral holobiont functional integration (Holobiont Integration)

Website: https://sites.rutgers.edu/coralbase/

Coverage: Hawaii, Rhode Island, New Jersey, Israel

NSF Abstract:

The remarkable success of coral reefs is explained by interactions of the coral animal with its symbiotic microbiome that is comprised of photosynthetic algae and bacteria. This total organism, or "holobiont", enables high ecosystem biodiversity and productivity in coral reefs. These ecosystems are, however, under threat from a rapidly changing environment. This project aims to integrate information from the cellular to organismal level to identify key mechanisms of adaptation and acclimatization to environmental stress. Specific areas to be investigated include the role of symbionts and of epigenetics (molecular "marks" on coral DNA that regulate gene expression). These aspects will be studied in Hawaiian corals to determine whether they explain why some individuals are sensitive or resistant to environmental perturbation. Results from the proposed project will also provide significant genomic resources that will contribute to fundamental understanding of how complex biological systems generate emergent (i.e., unexpected) properties when faced with fluctuating environments. Broader impacts will extend beyond scientific advancements to include postdoctoral and student training in Science, Technology, Engineering and Mathematics (STEM). Data generated in the project will be used to train university students and do public outreach through live videos of experimental work, and short stop-action animations for topics such as symbiosis, genomics, epigenetics, inheritance, and adaptation. The research approaches and results will be shared with the public in Hawaii through the Hawaii Institute of Marine Biology education department and presentations at Hawaiian hotels, as well as at Rutgers University through its 4-H Rutgerscience Saturdays and 4-H Rutgers Summer Science Programs.

Symbiosis is a complex and ecologically integrated interaction between organisms that provides emergent properties key to their survival. Such is the case for the relationship between reef-building corals and their microbiome, a meta-organism, where nutritional and biogeochemical recycling provide the necessary benefits that fuel high reef productivity and calcification. The rapid warming and acidification of our oceans threatens this symbiosis. This project addresses how relatively stress resistant and stress sensitive corals react to the environmental perturbations of increased temperature and reduced pH. It utilizes transcriptomic, epigenetic, and microbial profiling approaches, to elucidate how corals respond to environmental challenges. In addition to this profiling, work by the BSF Israeli partner will implement powerful analytical techniques such as network theory to detect key transcriptional hubs in meta-organisms and quantify biological integration. This work will generate a stress gene inventory for two ecologically important coral species and a (epi)genome and microbiome level of understanding of how they respond to the physical environment. Acknowledgment of a role for epigenetic mechanisms in corals overturns the paradigm of hardwired genetic control and highlights the interplay of genetic and epigenetic variation that may result in emergent evolutionary and ecologically relevant properties with implications for the future of reefs. Furthermore, clarifying the joint contribution of the microbiome and host in response to abiotic change will provide an important model in metazoan host-microbiome biotic interactions.

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-1756623

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