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

Website: https://www.bco-dmo.org/dataset/884738
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
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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. HOBO loggers were placed in each tank and recorded temperature every ten minutes.

Table of Contents

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.

Experimental Tank Setup: Treatment conditions (n=3 tanks treatment-1) were randomly assigned to twelve outdoor mesocosm tanks (122 cm x 122 cm x 30 cm; 510 L). Flow rates, measured daily with a graduated cylinder and timer, averaged 84.36 ± 1.20 mL second-1 (n=826), providing full mesocosm tank turnover every ~2 hours. Mesocosm tanks were 60% shaded from full irradiance, and photosynthetically active radiation was measured continuously with the Apex cosine corrected PAR Sensor (accuracy = ± 5%) that was cross calibrated to the Li-Cor cosine corrected PAR sensor (LI-193). Additionally, light values (PAR) from six different positions in each tank were compared to determine spatial differences within each tank. There was no significant difference in light between positions in each tank (n=4 position-1 tank-1). Based on these results, light was measured in the center of the tank ~daily for the duration of the experiment using the Li-Cor 193 spherical underwater quantum sensor. To further reduce any potential position effects with respect to incoming water, heater position, or bubble stream, the positions of the coral fragments in the tank were changed weekly.

Experimental temperature conditions: Temperature treatment conditions were programmed to mimic the natural daily fluctuations (0.75 °C ± 0.06) of the environment at the collection sites in Kāne'ohe Bay, Hawai'i (NOAA Moku o Lo'e Buoy data from September 2018). Based on these data, high temperature treatment fluctuated between ~29-30°C to reflect previous marine heatwaves in Kāne'ohe Bay, Hawai'i (+2°C above ambient temperature). Temperature was monitored with Apex Extended Life Temperature Probes (accuracy = ± 0.05 °C, Neptune Systems) and temperature loggers (HOBO Water Temp Pro v2, accuracy = ±0.21°C, resolution = 0.02°C, Onset Computer Corp) that were placed in each tank at the same height as the coral fragments for the duration of the experiment and logged temperature at 10 minute intervals. Temperature was separately controlled by submersible heaters (ProHeat D-1500 Heater Controllers, precision ± 1°C) due to the electrical demand of the heaters. Ambient temperature treatments were not controlled, and thus reflected the natural conditions of Kāne'ohe Bay.

[table of contents | back to top]

Data Files

File
hobo_logger.csv (Comma Separated Values (.csv), 22.03 KB) MD5:0b12f3087d325290796465261a215aef Primary data file for dataset ID 884738

[table of contents | back to top]

Related Publications

Station MOKH1 https://www.ndbc.noaa.gov/station_page.php?station=mokh1
Methods

[table of contents | back to top]

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 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. Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-01-31 doi:10.26008/1912/bco-dmo.884530.1 [view at BCO-DMO]
Relationship Description: Dataset is part of the 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 of 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.

[table of contents | back to top]

Parameters

Parameter	Description	Units
Treatment	Tank treatment condition	units
Date	Date of measurement summary	units
N	Sample size for that date (Every 10 minutes in each tank; 3 tanks per treatment)	units
Temperature	date of measurement summary	degrees Celsius (°C)
sd	Standard deviation	degrees Celsius (°C)
se	Standard error	degrees Celsius (°C)
ci	Confidence Interval	degrees Celsius (°C)

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	HOBO Water Temp Pro v2 Onset Computer Corp
Generic Instrument Name	Onset HOBO Pro v2 temperature logger
Generic Instrument Description	The HOBO Water Temp Pro v2 temperature logger, manufactured by Onset Computer Corporation, has 12-bit resolution and a precision sensor for ±0.2°C accuracy over a wide temperature range. It is designed for extended deployment in fresh or salt water. Operation range: -40° to 70°C (-40° to 158°F) in air; maximum sustained temperature of 50°C (122°F) in water Accuracy: 0.2°C over 0° to 50°C (0.36°F over 32° to 122°F) Resolution: 0.02°C at 25°C (0.04°F at 77°F) Response time: (90%) 5 minutes in water; 12 minutes in air moving 2 m/sec (typical) Stability (drift): 0.1°C (0.18°F) per year Real-time clock: ± 1 minute per month 0° to 50°C (32° to 122°F) Additional information (http://www.onsetcomp.com/) Onset Computer Corporation 470 MacArthur Blvd Bourne, MA 02532

[table of contents | back to top]

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.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1756623

[table of contents | back to top]