

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.

Website: <https://www.bco-dmo.org/dataset/884208>

Data Type: experimental

Version: 1

Version Date: 2022-11-23

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
Strand, Emma	University of Rhode Island (URI)	Student
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Abstract

Two common reef-building corals, *Montipora capitata* and *Pocillopora acuta*, were subjected to an extended heatwave scenario. 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. Throughout the entire four-month experiment, photos of the coral individuals were taken to extract a "color score". This dataset contains the processed data to calculate "color score" values.

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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 Liliupuna.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.

To assess tissue color change over time, each fragment was photographed once a week (16 timepoints in 4 month experimental setup) with a red, blue, green color standard ruler.

Data Processing Description

ImageJ® (version 1.51) was used to extract the mean blue, green, and red color score for each coral fragment and these values were normalized to the mean of the red, blue, and green color standards. The color score was quantified as Principal Component 1 from principal component analysis (PCA) sensu (Edmunds, Gates and Gleason, 2003).

BCO-DMO Processing Notes:

* Added latitude and longitude of reef locations to the dataset

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Data Files

File
heatwave_colorscore.csv (Comma Separated Values (.csv), 373.61 KB) MD5:b332370404806dff43249e9ae62b81eb Primary data file for dataset ID 884208

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Supplemental Files

File
Heatwave_Color_Score_Images.zip filename: Heatwave_Color_Score_Images_Emma_Strand.zip (ZIP Archive (ZIP), 1.27 GB) MD5:0d52fe0ccdaecffe5edf35971aacba51 Pictures of coral during a heatwave experiment where physiology color score has been extracted from using ImageJ.

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Related Publications

Edmunds, P. J., Gates, R. D., & Gleason, D. F. (2003). The tissue composition of *Montastraea franksi* during a natural bleaching event in the Florida Keys. *Coral Reefs*, 22(1), 54–62. <https://doi.org/10.1007/s00338-003-0278-5>

Methods

Schneider, C. A., Rasband, W. S., ... (n.d.). ImageJ. US National Institutes of Health, Bethesda, MD, USA. Available from <https://imagej.nih.gov/ij/>
Software

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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'ohē 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'ohē 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 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'ohē 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 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'ohē 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 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'ohē 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'ohē 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 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'ohē 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 same experiment.

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Parameters

Parameter	Description	Units
Number	Record number	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
Plug_ID	The individual coral fragment ID number	unitless
Species	Coral host species: Montipora capitata or Pocillopora acuta	unitless
ANALYSIS	Physiology for all entries indicating that fragment was sampled for physiology	unitless
Timepoint	The sampling time point; at what point during the experiment was that fragment sampled	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
Bleaching_Score	Calculated PC1 value from Principal Components Analysis used as a "Bleaching Score" or "Color Score"	unitless
Blch_Time	Time point for this measurement.	unitless

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Instruments

Dataset-specific Instrument Name	Ruler with three red, blue, and green colored bands
Generic Instrument Name	ruler
Dataset-specific Description	Ruler with three red, blue, and green colored bands
Generic Instrument Description	A device used for measuring or for drawing straight lines, consisting of an elongated piece of rigid or semi-rigid material marked with units for measurement. Device that allows one or more physical dimensions of a sample or specimen to be determined by visible comparison against marked graduations in units of measurement of dimension length.

Dataset-specific Instrument Name	
Generic Instrument Name	Underwater Camera
Generic Instrument Description	All types of photographic equipment that may be deployed underwater including stills, video, film and digital systems.

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.

Funding

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

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