Physiology color score extracted from pictures taken during a thermal stress experiment using reef building corals collected in Kāne'ohe Bay, O'ahu, Hawai'i.

Website: https://www.bco-dmo.org/dataset/884220
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
Understanding the response of the coral holobiont to environmental change is crucial to inform conservation efforts. The most pressing problem is “coral bleaching,” usually precipitated by prolonged thermal stress. This dataset spans a five week thermal stress experiment in which images were taken of coral individuals and analyzed for a "color score".

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Methods & Sampling

From the waters of Kāne‘ohe Bay, HI, four colonies of each coral species M. capitata and P. acuta were identified and collected under SAP 2019-60. Each of the four colonies for each species was fragmented into 30 pieces at the Hawai‘i Institute of Marine Biology, located on Moku o Lo‘e in Kāne‘ohe Bay, HI, and hot-glued to labeled plugs. (21N 157 W ; depth 1m).

Data Processing Description

Each sample was photographed using a digital camera with a red/blue/green color standard. Red/blue/green values that were extracted in ImageJ, version 1.51 (Schneider et al. 2012) from the coral were standardized to the color standards by dividing the experimental value observed in the coral against the corresponding actual recorded value from the color standards (Edmunds et al. 2003). Using the normalized intensity values from each color channel, a bleaching score was quantified as PC1 from principle components analysis of these data.

As stress is prolonged and bleaching becomes more pronounced, the red/blue/green color readings from the coral will equalize around the same number because white is an equal expression of all colors. All nubbins available at each time points were used for color assessment.

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Data Files

File
thermal_colorscore.csv (Comma Separated Values (.csv), 178.60 KB) MD5:b59e9683f571a8ddf7c3072834a54222 Primary data file for dataset ID 884220

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Supplemental Files

File
Thermal_Stress_Experiment_Color_Score_Images filename: Thermal_Stress_Experiment_Color_Score_Images_Emma_Strand.zip (ZIP Archive (ZIP), 286.59 MB) MD5:9dc5de3f06d3ae13b279e88e528b7fde Pictures of coral during a thermal stress 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., & Eliceiri, K. W. (2012). NIH Image to ImageJ: 25 years of image analysis. Nature Methods, 9(7), 671–675. https://doi.org/10.1038/nmeth.2089
Software

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) **Experiment Tank Conditions during a thermal stress experiment 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.886196.1 [view at BCO-DMO]
Relationship Description: Dataset is part of the same experiment.

Strand, E., Putnam, H. (2023) **Metabolomic data collected during a thermal stress experiment 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.886420.1 [view at BCO-DMO]
Relationship Description: Dataset is part of the same experiment.

Strand, E., Putnam, H. (2023) **Untargeted metabolomic data collected during a thermal stress experiment 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.886427.1 [view at BCO-DMO]
Relationship Description: Dataset is part of the same experiment.

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Parameters

Parameter	Description	Units
Date	Date of measurement (Month-Day-Year)	unitless
Timepoint	Categorical timepoint of experiment	unitless
PLUG_ID	Plug ID indicating coral ID	unitless
Genotype	Genotype ID	unitless
Species	Coral species	unitless
Photo_Number	ID of photograph taken	unitless
Tank	Tank ID	unitless
Treatment	Temperature treatment	unitless
Red_Standard	Color value of red standard, raw RGB values extracted from ImageJ.	pixels
Green_Standard	Color value of green standard, raw RGB values extracted from ImageJ.	pixels
Blue_Standard	Color value of blue standard, raw RGB values extracted from ImageJ.	pixels
Red_Coral	Red color in coral measurement, raw RGB values extracted from ImageJ.	pixels
Green_Coral	Green color in coral measurement, raw RGB values extracted from ImageJ.	pixels
Blue_Coral	Blue color in coral measurement, raw RGB values extracted from ImageJ.	pixels
Notes	Notes	units

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Instruments

Dataset-specific Instrument Name	Digital Camera
Generic Instrument Name	Camera
Generic Instrument Description	All types of photographic equipment including stills, video, film and digital systems.

Dataset-specific Instrument Name	Ruler with three red, blue, and green colored bands
Generic Instrument Name	ruler
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.

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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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