Temperature and light intensity measured at each transplant site during a reciprocal transplant experiment conducted at three sites in Turneffe Atoll, Belize from February to July 2022

Website: https://www.bco-dmo.org/dataset/927918
Data Type: Other Field Results
Version: 1
Version Date: 2024-05-28

Project
» OCE-PRF: Drivers of phenotypic diversity and adaptation in asexually propagating coral populations (Adaptation in asexual coral populations)

Contributors	Affiliation	Role
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Abstract
We sought to investigate the role of genetic, intra-clonal, and environmental variation in driving variation in fitness-related traits in the Caribbean thin finger coral, Porites divaricata (Taxonomy ID: 262287). We conducted a reciprocal transplant experiment whereby fragments from individual coral colonies of known genetic background were transplanted to three sites from February to July 2022. These sites included two mangrove sites and one reef site at Calabash Caye, Turneffe Atoll, Belize. Prior to and post-transplanting, fragments were measured to determine growth rate over this time. Coral fragments were also photographed to determine red channel intensity, which serves as a proxy for chlorophyll density. This dataset contains environmental information about each transplanted site over this time period, based on loggers that recorded temperature and light levels. This data was collected by scientists at the University of Texas at Austin and the University of Belize. A related dataset contains the measures of these two coral traits (coral fragment growth and chlorophyll density (red channel intensity)) for each coral individual and also contains metadata about the genotype, origin site, transplanted site, rope at transplanted site, and age.

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Coverage

Location: Turneffe Atoll, Belize
Spatial Extent: **N**:17.288681 **E**:-87.81111 **S**:17.28717 **W**:-87.815167
Temporal Extent: 2022-02-11 - 2022-07-20

Methods & Sampling

Reciprocal transplant experiment:
In February 2022, 32 colonies (subclone/ramet) of the Caribbean thin finger coral, *Porites divaricata* (Taxonomy ID: 262287) were identified. 3 to 9 branch fragments were collected from every subclone

(colony/ramet). 1 to 3 fragments from each ramet were moved to three designated sites: M1 (mangrove site 1), M2 (mangrove site 2), and R (reef site). 7 to 9 adjacent ropes were deployed at each site (seven ropes at M1 and R, and nine ropes at M2). Following a six-month period (February 2022 - July 2022), two traits were measured for each fragment: length change and red channel intensity, which serves as an inverse indicator of chlorophyll pigment density (Winters, Holzman, Blekhman, Beer, & Loya, 2009).

Environmental Measurements:
Four Onset HOBO Pendant data loggers (Onset Corporation, Bourne, MA) were deployed at the time of transplant to record both temperature (°C) and light intensity (lux) every two hours and remained there over the duration of the experiment. Lux was converted to photosynthetic photon flux density (PPFD: micromoles per square meter per second (µmol m-2 s-1)) with a standard sunlight conversion factor of 0.018.

See 'Related Datasets' for the coral trait variation data.

BCO-DMO Processing Description

- Imported original file "EnvironmentalSite_Data.xlsx" into the BCO-DMO system.
- Converted the date and time columns to ISO 8601 format in both (CST/CDT) and UTC time zones.
- Added columns for the site latitude and longitude.
- Removed the original date and time columns.
- Saved the final file as "927918_v1_coral_transplant_site_environmental_data.csv".

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Data Files

File	
927918_v1_coral_transplant_site_environmental_data.csv	(Comma Separated Values (.csv), 607.20 KB) MD5:38d07ce269a508816d7d632a65957404
Primary data file for dataset ID 927918, version 1	

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Related Publications

Winters, G., Holzman, R., Blekhman, A., Beer, S., & Loya, Y. (2009). Photographic assessment of coral chlorophyll contents: Implications for ecophysiological studies and coral monitoring. Journal of Experimental Marine Biology and Ecology, 380(1–2), 25–35. https://doi.org/10.1016/j.jembe.2009.09.004
Methods

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Related Datasets

IsRelatedTo

Scavo Lord, K. (2024) **Growth and chlorophyll density of individual fragments of the coral Porites divaricata measured during a reciprocal transplant experiment conducted at three sites in Turneffe Atoll, Belize from February to July 2022.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2024-05-20 doi:10.26008/1912/bco-dmo.927890.1 [view at BCO-DMO]

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Parameters

Parameter	Description	Units
Logger	Description of site location where logger was placed: channel, island, or reef (two loggers were placed at the reef - reef_1 and reef_2)	unitless
Site	Site where logger was placed: M2 = mangrove site 2, M1= mangrove site 1, and R = reef (two loggers were placed at R- R_1 and R_2)	unitless
ISO_DateTime_Local	Date and time when the data were collected in ISO 8601 format; local time zone = CDT/CST	unitless
ISO_DateTime_UTC	Date and time when the data were collected in ISO 8601 format; UTC time zone	unitless
Temp	Temperature of seawater at logging point	degrees Celsius
Light	Light intensity at depth at logging point	photosynthetic photon flux density (PPFD)
Site_Lat	General latitude of the site (not necessarily the exact latitude where the logger was placed within the site); positive values = North	decimal degrees
Site_Lon	General longitude of the site (not necessarily the exact longitude where the logger was placed within the site); negative values = West	decimal degrees

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Instruments

Dataset-specific Instrument Name	Onset HOBO (UA-002-64) Data Logger
Generic Instrument Name	Onset HOBO Pendant Temperature/Light Data Logger
Dataset-specific Description	The environmental data (temperature and light intensity) was measured by the following instrument: Onset HOBO (UA-002-64) Data Logger Measuring Temperature and Light Intensity.
Generic Instrument Description	The Onset HOBO (model numbers UA-002-64 or UA-001-64) is an in-situ instrument for wet or underwater applications. It supports light intensity, soil temperature, temperature, and water temperature. A two-channel logger with 10-bit resolution can record up to approximately 28,000 combined temperature and light measurements with 64K bytes memory. It has a polypropylene housing case. Uses an optical USB to transmit data. A solar radiation shield is used for measurement in sunlight. Temperature measurement range: -20 deg C to 70 deg C (temperature). Light measurement range: 0 to 320,000 lux. Temperature accuracy: +/- 0.53 deg C from 0 deg C to 50 deg C. Light accuracy: Designed for measurement of relative light levels. Water depth rating: 30 m.

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Project Information

OCE-PRF: Drivers of phenotypic diversity and adaptation in asexually propagating coral populations (Adaptation in asexual coral populations)

Coverage: Caribbean

NSF Award Abstract:
This award is funded in whole or in part under the American Rescue Plan Act of 2021 (Public Law 117-2).

In this era of rapid environmental change and degradation, the survival of marine organisms will depend largely upon their ability to tolerate increasing environmental stress. However, the processes that drive resilience (e.g., the relative contribution of genetic versus environmental factors) remain largely a mystery. Corals are a major focus of current studies on organismal resilience because they are undergoing a worldwide decline, and they are so important for both the health of the oceans and the welfare of coastal communities. Corals often occupy and build habitats through asexual reproduction (production of clones), and it is widely assumed that such asexual populations may lack sufficient genetic diversity to respond to diverse environmental stressors. However, few previous studies have quantified the effects of asexual reproduction on the ability of corals to respond to environmental change. This research explores the different mechanisms that contribute to differences in coral stress response among two predominately clonal populations of the Caribbean thin finger coral (*Porites divaricata*) dwelling in distinct habitat types (mangroves vs. reef). This research will illuminate the drivers of organismal resilience, potentially impacting ongoing coral conservation and restoration efforts. It will also broaden the participation of underrepresented groups by encouraging active participation by local community members, students and scientists at the University of Belize, as well as providing unique training opportunities for next-generation scientists at the interface of field marine ecology and genomics. Importantly, these results will be communicated to a wide audience through diverse venues, including technical reports and management recommendations provided for government agencies and non-profit Belizean conservation organizations, popular articles and curricular materials for the community at large, and peer-reviewed manuscripts and presentations targeted to the scientific community.

Among conservation biologists and ecologists, there is an urgent effort underway to understand the causes of diversity in traits impacting organismal survival and reproduction. If we are to understand how natural populations will respond to environmental change, it is critical to understand how genetic, epigenetic, and environmental factors impact resilience. Such studies have advanced significantly in many plant species, but they are only just beginning to be applied to animals like corals. As in many plants, the model species used here - Caribbean thin finger coral (*Porites divaricata*) - reproduces primarily asexually, allowing us to compare the

performance of clones in different environments and isolate the effects of genotype, epigenetics (namely DNA methylation), environment, and somatic mutations on variation in stress-related coral traits. Specially, combining fully-crossed reciprocally transplanted coral ramets across mangrove and reef sites with genomic and methylation sequencing data, this research will evaluate 1) the role of intra-genet variation accumulated during asexual reproduction in facilitating adaptation in the mangrove population, relative to roles of between-genet variation and phenotypic plasticity, 2) assess the role of new DNA methylation states, and 3) measure the rate of accumulation of new DNA methylation marks and base-changes during asexual reproduction. Results from this research effort will advance our understanding of the role of mechanisms like DNA methylation and somatic mutations in driving phenotypic variation in critical stress-response traits and how these mutations accumulate over time, provide insight into how such mechanisms are generated and inherited across asexual generations, build upon the sparse understanding of the role of novel habitat types, i.e. mangroves, in coral ecology and evolution; and generate novel molecular resources including the first reference genome assembly for the non-model coral, *P. divaricata*.

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-2126612

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