Physiological data from Breviolum antillogorgia genotypes grown in laboratory growth chambers in Los Angeles, CA in 2021.

Website: https://www.bco-dmo.org/dataset/874587
Data Type: experimental
Version: 1
Version Date: 2022-05-24

Project
» RUI: Collaborative Research: Genetic variation as a driver of host and symbiont response to increased temperature on coral reefs (Host Symbiont Temp Response)

Contributors	Affiliation	Role
terHorst, Casey	California State University Northridge (CSUN)	Principal Investigator, Contact
Coffroth, Mary Alice	State University of New York at Buffalo (SUNY Buffalo)	Co-Principal Investigator
Heyl, Taylor	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
Five genotypes of Breviolum Antillogorgia were grown at three temperatures where growth rate, carrying capacity, respiration, gross photosynthesis, and new photosynthesis were quantified. This work was conducted in laboratory growth chambers in Los Angeles, California, USA in 2021.

Table of Contents

- Coverage
- Dataset Description
  - Methods & Sampling
  - Data Processing Description
- Data Files
- Related Publications
- Parameters
- Instruments
- Project Information
- Funding

Coverage

Temporal Extent: 2021-03 - 2021-03

Methods & Sampling

We collected symbionts from octocoral colonies in the genus Antillogorgia from Elbow Reef and Pickles Reef in the Florida Keys in September 2016 (11-18 m depth). Details of collection and genotyping are available in Pelosi et al. (2021). Briefly, we recovered five unique genotypes of *Breviolum antillogorgium* from the heterogenous mixture of strains within the colonies. Three of these genotypes (G1, G2, G3) were isolated and reared at 26 C for five years (~650-700 generations) prior to the start of the experiment; the other two genotypes (G4, G5) were isolated and subsequently reared at 30 C for the same period of time. In March 2021, we initiated a laboratory experiment to measure population dynamics and physiology of each genotype at three different temperatures. Every three days, we removed 50 micrometers from each culture and performed four replicate

hemacytometer counts and used the mean as an estimate of cell density. On Day 27 of the experiment, we used microrespirometry plates to quantify changes in oxygen in the dark (respiration) and in the light (new photosynthesis).

We used the stock cultures of each genotype to initiate 15 new replicate 50 mL cultures at an initial density of 10,000 cells/mL. Five of these cultures of each genotype were maintained in a growth chamber set at 26 C (actual mean temperature +/- s.d. determined by HOBO Data Logger: 25.5 C +/- 0.51). Another five cultures of each genotype were grown in identical growth chambers set at 30 C (30.1 +/- 0.28) and 32 C (31.6 +/- 0.23). Lights were set on a 12:12 day:night cycle, with average day illumination of 4244 Lux (approximately 59 µmole m-2 s-1 based on a conversion of 1 lux = 0.014 µmole m-2 s-1). On Day 27 of the experiment, we removed two 2 mL from each culture grown at 26 C and used these samples to estimate rates of photosynthesis and respiration at each temperature. Replicate samples were placed in randomly assigned wells in a microrespirometry plate that quantified changes in oxygen concentrations over time (Loligo Systems, Viborg, Denmark) in the 26 C growth chamber. We also placed sterile f/2 samples in two wells in each plate to account for any background changes in oxygen concentration. Samples were dark-adapted for 10 min before measuring oxygen levels in each well every 15 sec for 10 min. Following this, we turned the lights on in the growth chambers, allowed samples two minutes to acclimate, and then again measured oxygen levels every 15 sec for 10 min. The microrespirometry plates were then moved to the 30 C growth chamber, and later the 32 C growth chamber, and allowed to acclimate for 15 minutes in each growth chamber before measurements were taken. We estimated respiration as the slope of a linear fit to declining oxygen levels over time in the dark, subtracting any background changes in oxygen. Similarly, we estimated net photosynthesis as the slope of a linear fit to increasing oxygen levels, accounting for background changes in oxygen in the light. We estimated gross productivity by adding the absolute value of respiration in each culture to net photosynthesis. We standardized respiration, net photosynthesis, and gross photosynthesis by the number of cells in each well, determined by replicate hemacytometer counts, as above.

Known Issues:
Genetic analyses revealed that genotype G3 was contaminated with cells of Genotype G1. The results from each genotype are presented here, but the results from G3 should be interpreted with caution.

Data Processing Description

Data Processing:
We used the time series data up to the time of maximum density in each culture to estimate per-capita growth rate (r) and carrying capacity (K) using the ‘growthrates’ package (Petzoldt 2019) in R v. 4.0.2 (R Core Team 2021). We used Analysis of Variance (ANOVA) to determine the fixed effects of temperature, algal genotype, and their interaction on maximum growth rate (r), carrying capacity (K), respiration, gross photosynthesis, and net photosynthesis in separate tests. All data were visually inspected for normality and heteroscedasticity using Q-Q plots and plots of residuals against fitted values. All data met the assumptions of ANOVA, except for r, which was log-transformed to meet assumptions. All analyses were conducted in the R Statistical Computing Platform (v. 4.0.2).

BCO-DMO Processing:
- Added a conventional header with dataset name, PI names, version date

[table of contents | back to top]

Data Files

File	
physiological_data.csv	(Comma Separated Values (.csv), 6.03 KB) MD5:edc784efd1e0e6967c1269f1a54b807a
Primary data file for dataset ID 874587	

[table of contents | back to top]

Related Publications

Pelosi, J. A., Bernal, M. A., Krabbenhoft, T. J., Galbo, S., Prada, C., Coffroth, M. A., & Lasker, H. (2021). Fine-scale morphological, genomic, reproductive, and symbiont differences delimit the Caribbean octocorals Plexaura homomalla and P. kükenthali. Coral Reefs. https://doi.org/10.1007/s00338-021-02175-x
Methods

[table of contents | back to top]

Parameters

Parameter	Description	Units
Flask	Replicate number	unitless
Genotype	One of five genotypes	unitless
Temp	Experimental growth temperature	degrees celsius
OriginTemp	Temperature at which algae were isolated	degrees celsius
GrowthRate	Per-capita population growth rate	cells per cell per day
CarryingCapacity	Estimated carrying capacity	cells
TotalResp	Decrease in oxygen over time	micromoles of oxygen per minute (umolO2/min)
TotalNetPhoto	Increase in oxygen over time	micromoles of oxygen per minute (umolO2/min)
TotalGrossPhoto	Gross photosynthesis	micromoles of oxygen per minute (umolO2/min)
CellspermL	Cell density	cells per milliliter (cells/mL)
RespperCell	Respiration per cell	micromoles of oxygen per minute per cell (umolO2/min/cell)
NetPhotoperCell	Net photosynthesis per cell	micromoles of oxygen per minute per cell (umolO2/min/cell)
GrossPhotoperCell	Gross photosynthesis per cell	micromoles of oxygen per minute per cell (umolO2/min/cell)

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	Loligo microrespirometry system
Generic Instrument Name	Respirometer
Generic Instrument Description	A device that measures the rate of respiration by a living organism or organic system by measuring its rate of exchange of oxygen and/or carbon dioxide.

[table of contents | back to top]

Project Information

RUI: Collaborative Research: Genetic variation as a driver of host and symbiont response to increased temperature on coral reefs (Host Symbiont Temp Response)

Coverage: Florida Keys, Caribbean

Description from NSF award abstract:
On coral reefs, mutualisms with single celled algae (Symbiodinium) and reef species literally and figuratively form the foundation of reef ecosystems. Coral reefs are among the most threatened ecosystems under a changing climate and are rapidly declining due to increasing levels of environmental stress, namely increased temperatures. Climate change is resulting in even warmer ocean temperatures that threaten associations between Symbiodinium and their hosts. In this project the investigators examine the genetic diversity of Symbiodinium and the potential for this important species to evolve in response to temperature. The project will also address whether the ecological and evolutionary dynamics of the Symbiodinium population affect the performance of their host. If so, this suggests that the evolution of microscopic organisms with short generation times could confer adaptation to longer-lived host species on ecologically and economically vital coral reefs. Given that diversity is already being lost on many reefs, considering how evolutionary changes in Symbiodinium will affect reef species is crucial for predicting the responses of reefs to future climate change. This project provides training for two graduate students and several undergraduates at a Hispanic-serving institution. This work includes outreach to the students and the general public through the Aquarium of Niagara, local K-12 schools, and web-based education modules.

The effects of evolution on contemporary ecological processes are at the forefront of research in evolutionary ecology. This project will answer the call for experiments elucidating the effects of genetic variation in Symbiodinium performance and the effect on the response of the holobiont (host and symbiont) to increased temperature. These experiments examine the effects of temperature through both ecological and evolutionary mechanisms and will determine the relative importance of adaptation and acclimatization in replicated experimental populations. The investigators will examine how genetic variation within a species (Symbiodinium antillogorgium) affects symbiont performance in culture and in the host and how this affects the response of the holobiont to increased temperature. Further, the project examines whether holobiont response to increased temperature associated with climate change depends on particular GxG host-symbiont combinations. Moreover, the investigators will examine the effects of symbiont history on mutualist hosts, which have been largely ignored in eco-evolutionary studies. These experiments provide a first step in predicting whether invertebrate hosts on coral reefs will respond to global change via adaptation of their symbionts.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1559105

[table of contents | back to top]