Measurements of respiration, net photosynthesis, and gross photosynthesis of five different genotypes of Symbiodinium microadriaticum in culture at three different temperatures

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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
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Abstract
This dataset includes measurements of respiration, net photosynthesis, and gross photosynthesis of five different genotypes of Symbiodinium microadriaticum in culture at three different temperatures. This study was conducted in laboratory growth chambers in Los Angeles, California, USA in October 2019.

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Coverage

Temporal Extent: 2019-10 - 2019-10

Methods & Sampling

To investigate the physiological responses of isolated symbiont genotypes to temperature, we grew replicate cultures of each of the five genotypes in growth chambers set to 26°C, 30°C, and 32°C. The mean temperatures (+/- 1 s.d.) in the three chambers were 25.5°C (+/- 0.5), 30.1°C (+/- 0.3), and 31.6°C (+/- 0.2). We initiated 12 replicate cultures of each genotype in sterile flasks with 75 milliliters (mL) of sterile f/2 media with 750,000 cells (10,000 cells/mL) from the appropriate stock culture. Replicate cultures of each genotype were randomly distributed among three identical growth chambers (Percival I-36LLVL) set to each of the three temperatures (n=4 replicate cultures of each genotype at each temperature). We systematically rotated the position of cultures in the growth chamber daily to minimize the effect of any small differences in light and temperature within the chamber. Lights were set on a 12:12 day:night cycle, with an average illumination during the day of 4533 (+/- 456) Lux. We performed this experiment in October 2019.

We measured respiration and photosynthetic rate using a SDR SensorDish Reader (Loligo Systems, Viborg, Denmark). We filled two wells with 2 mL sampled from each culture and filled two wells with DI water as

controls. We placed plates in each of the three growth chambers set to 26°, 30°, and 32° C and dark-acclimated plates for five minutes before measuring oxygen concentration every 15 seconds for 15 minutes in the dark. We then turned on the lights in each growth chamber and measured oxygen concentration again in the same way. We also quantified algal density using the average of four replicate hemocytometer counts.

Data Processing Description

Data Processing:
We calculated respiration rates for each well as the slope of the best-fit line to the decline in oxygen concentration over time in the dark. We subtracted the slope of the same fit in the control wells to account for any background noise. We averaged the two replicate wells for each culture and standardized respiration by cell number. We determined net photosynthesis in the same manner, using the slope of the best-fit line to the increase in oxygen concentration over time. Finally, we calculated gross photosynthesis by adding the absolute value of respiration to net photosynthesis for each culture. We used multiple general linear models with type III SS to test for the effects of algal genotype, temperature, and their interaction on respiration, gross photosynthesis, and net photosynthesis. All variables were transformed to meet assumptions of normality and homoscedasticity (respiration: cube root; gross and net photosynthesis: fourth root).

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

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Data Files

File
culture_data.csv (Comma Separated Values (.csv), 4.20 KB) MD5:5b8cc171ba482ac303ad05a0f72bad36 Primary data file for dataset ID 874597

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Parameters

Parameter	Description	Units
Temperature	Growth temperature	degrees celsius
Genotype	One of five algal genotypes	unitless
Flask	Flask number	unitless
CellsPermL	Number of cells per milliliter	cells per mL
Respiration	Total respiration	micromoles of oxygen per minute (umolO2/min)
NetPhoto	Net photosynthesis	micromoles of oxygen per minute (umolO2/min)
GrossPhoto	Gross photosynthesis	micromoles of oxygen per minute (umolO2/min)
RespPer1000	Respiration per 1000 cells	micromoles of oxygen per minute per 1000 cells (umolO2/min/1000cells)
NetPhotoPer1000	Net photosynthesis per 1000 cells	micromoles of oxygen per minute per 1000 cells (umolO2/min/1000cells)
GrossPhotoPer1000	Gross photosynthesis per 1000 cells	micromoles of oxygen per minute per 1000 cells (umolO2/min/1000cells)

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Instruments

Dataset-specific Instrument Name	SDR SensorDish Reader (Loligo Systems, Viborg, Denmark)
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.

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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.

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Funding

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

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