Imaging pulse amplitude modulator fluorometer data collected from Acropora cervicornis under different pH and temperature treatments from experiments at Summerland Key, Florida from July to September 2017

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Project
» CAREER: Applying phenotypic variability to identify resilient Acropora cervicornis genotypes in the Florida Keys (Resilient Acerv)

Contributors	Affiliation	Role
Muller, Erinn	Mote Marine Laboratory (Mote)	Principal Investigator
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
Imaging pulse amplitude modulator fluorometer data collected from Acropora cervicornis under different pH and temperature treatments from experiments at Summerland Key, Florida (24.6616,-81.4538) from July to September 2017.

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Dataset Description

Imaging pulse amplitude modulator fluorometer data collected from *Acropora cervicornis* under different pH and temperature treatments from experiments at Summerland Key, Florida (24.6616,-81.4538) from July to September 2017.

Acquisition Description

Corals from different treatment scenarios were IPAMed every month for the duration of the two-month long experiment. All fragments were subjected to a light curve where the initial pulse represents the max Yield after dark acclimation and the subsequent electron transport rate (ETR) values are recorded after the corals were exposed to increasing light intensities over time.

Processing Description

We derived three key parameters from the PAM photophysiology data set: maximum yield (mY), maximum

electron transport rate (mETR), and the initial slope of the ETR curve (alpha).

PAM dataset parameters: Maximum electron transport rate (mETR) was estimated using a linear search algorithm that used the slopes between adjacent (PAR, ETR) data points to determine the first local critical point (maximum or plateau). The algorithm first searches for three data points between which the slope changes sign. If no sign change is detected, the algorithm then looks for the largest set of two data points between which the slope is less than a user-defined threshold (default is 0.1). In the former case, the middle point is chosen as the (mETR) coordinate, while in the later case the second endpoint is used. If neither search yields a solution, the threshold is increased by 0.01 and the two linear searches are repeated until a solution is found. The slope alpha is calculated with a similar algorithm that searches all PAR levels x such that min(PAR) = 55 < x < mPAR for pairs of points between which the ratio of the local slope to the initial slope (slope between (0,0) and first non-zero datapoint) is less than a user-defined threshold (default is 0.1). If no solution is found, the threshold is increased by 0.01 and the search is repeated. Once a pair of points *i* and *i+1* have been identified, all data points with PAR levels less than that of point *i* are used to calculate the slope. If the threshold increases to greater than 0.25, the algorithm terminates by returning the slope of all points with PAR < mPAR. Both algorithms return NA when given zero vectors and are both implemented in R.

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Parameters

Parameter	Description	Units
Tank	identifies the tank number that held the particular coral fragment	unitless
Genotype	identifies the genotype number of the coral animal for each fragment	unitless
pH	identifies the treatment pH level: Ambient = 8.1 pH; High CO2 = 7.7 pH	unitless
Temp	identifies the treatment temperature level: High = 31.5C; Ambient = 27C	unitless
mYield	change in photosynthetic yield between July and September 2017 after dark acclimation (unitless, but represents the proportion of electrons being used for photosynthesis, potential values range from 0 - 1)	unitless
mETR	change in the maximum level of electron transport rate between July and September 2017	umol electrons m−2 s−1
alpha	change in the slope of the electron transport rate between July and September 2017; units represent the change in ETR (umol electrons m−2 s−1) over increasing values of PAR	change in ETR over increasing values of PAR

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Instruments

Dataset-specific Instrument Name	Imaging pulse amplitude modulator (IPAM) fluorometer
Generic Instrument Name	Fluorometer
Generic Instrument Description	A fluorometer or fluorimeter is a device used to measure parameters of fluorescence: its intensity and wavelength distribution of emission spectrum after excitation by a certain spectrum of light. The instrument is designed to measure the amount of stimulated electromagnetic radiation produced by pulses of electromagnetic radiation emitted into a water sample or in situ.

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Project Information

CAREER: Applying phenotypic variability to identify resilient Acropora cervicornis genotypes in the Florida Keys (Resilient Acerv)

Coverage: Florida Keys, Summerland Key, FL 24.563595°, -81.278572°

Caribbean staghorn coral was one of the most common corals within reefs of the Florida Keys several decades ago. Over the last 40 years disease, bleaching, overfishing and habitat degradation caused a 95% reduction of the population. Staghorn coral is now listed as threatened under the U.S. Endangered Species Act of 1973. Within the past few years, millions of dollars have been invested for the purpose of restoring the population of staghorn coral within Florida and the U.S. Virgin Islands. Significant effort has been placed on maintaining and propagating corals of known genotypes within coral nurseries for the purpose of outplanting. However, little is known about the individual genotypes that are currently being outplanted from nurseries onto coral reefs. Are the genotypes being used for outplanting resilient enough to survive the three major stressors affecting the population in the Florida Keys: disease, high water temperatures, and ocean acidification? The research within the present study will be the first step in answering this critically important question. The funded project will additionally develop a research-based afterschool program with K-12 students in the Florida Keys and U.S. Virgin Islands that emphasizes an inquiry-based curriculum, STEM research activities, and peer-to-peer mentoring. The information from the present study will help scientists predict the likelihood of species persistence within the lower Florida Keys under future climate-change and ocean-acidification scenarios. Results of this research will also help guide restoration efforts throughout Florida and the Caribbean, and lead to more informative, science-based restoration activities. Acropora cervicornis dominated shallow-water reefs within the Florida Keys for at least the last half a million years, but the population has recently declined due to multiple stressors. Understanding the current population level of resilience to three major threats - disease outbreaks, high water temperatures, and ocean acidification conditions - is critical for the preservation of this threatened species. Results from the present study will answer the primary research question: will representative genotypes from the lower Florida Keys provide enough phenotypic variation for this threatened species to survive in the future? The present proposal will couple controlled laboratory challenge experiments with field data and modeling applications, and collaborate with local educators to fulfill five objectives: 1) identify A. cervicornis genotypes resistant to disease, 2) identify A. cervicornis genotypes resilient to high water temperature and ocean acidification conditions, 3) quantify how high water temperature and ocean acidification conditions impact disease dynamics on A. cervicornis; 4) determine tradeoffs in life-history traits because of resilience factors; and 5) apply a trait-based model, which will predict genotypic structure of a population under different environmental scenarios.

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Funding

Funding Source	Award
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