Fv/Fm for cultured Clade A & B Symbiodinium with 2 treatments measured over a range of temperatures

Website: https://www.bco-dmo.org/dataset/732890
Data Type: experimental
Version: 1
Version Date: 2018-03-26

Project
» Coevolution of scleractinian corals and their associated microorganisms (GCMB)
» RAPID: Coral robustness: lessons from an "improbable" reef (Varadero Reef)

Program
» Dimensions of Biodiversity (Dimensions of Biodiversity)

Contributors	Affiliation	Role
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Abstract
Coral photosynthetic endosymbionts (Symbiodinium) are phylogenetically very diverse, yet the extent of inter- and intraspecific functional variation within clades remains largely underexplored. Understanding this variability will be critical for future research on climate change mediated responses. A properly functioning thylakoid membrane is essential for optimal photosynthetic performance both in free-living and in hospite conditions. Here we analyze the thylakoid membrane melting points of 13 Symbiodinium strains from species in Clades B and A, grown at both control (26 °C) and high temperature (31 °C). We observed a broad range of responses to thermal stress regardless of taxonomic rank. Our results support and augment a growing body of literature demonstrating that functional differences among Symbiodinium spp. are as distinct at lower taxonomic levels (i.e. interspecific) as they are among major clades. These findings highlight the importance of assessing the variability of plastid traits across the Symbiodinium tree.

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Coverage

Temporal Extent: 2016-11 - 2017-01

Dataset Description

This dataset includes the maximum quantum yield (Fv/Fm) of clade A and B Symbiodinium cultures exposed to a range of temperatures.

These data are presented in Mansour et al., 2018.

Methods & Sampling

Symbiodinium culture preparation: Cultures were obtained from the LaJeunesse algal collection at Penn State University. Phylogenetic relationships of these strains are described in Parkinson et al., (2015). Symbiodinium cultures were grown and maintained in liquid media (ASPA-8A, Blank, 1987) at 26 ˚C with fluorescent lights delivering 80-100 µmol quanta m-2 s-1 (measured using a DIVING-PAM equipped with a flat cosine-corrected Fiber Quantum Sensor, Walz, Germany) on a 12:12 hours Light:Dark photoperiod in Innovator 44 incubators (New Brunswick, USA). Symbiodinium cultures of equal starting concentration (3 x 104 cells 126 mL-1) for each strain were grown for 7.5 days at 26 ˚C at logarithmic growth phase prior to experimentation. After 7.5 days of incubation at 26 ˚C, one culture of each strain was subjected to a high temperature treatment of 31 ˚C for two light cycles and one dark cycle (i.e., 1.5 d), whilst another was maintained at 26 ˚C.

Data collection: 100 µL aliquots (8.33 x 104 cells mL-1, calculated as the average of twelve independent hemocytometer measurements) of dark-adapted cultures were then subjected to 5 minutes of elevated temperatures in a thermocycler (Eppendorf Mastercycler Pro S).

Chlorophyll fluorescence parameters were measured immediately after the 5 min temperature exposure using a Fluorometer (see below). Measurements were performed at 25 temperatures (i.e. 26, 30.3, 30.5, 31, 31.7, 32.6, 33.7, 34.8, 35.9, 36.8, 37.6, 38.1, 38.3, 38.8, 38.9, 39.4, 40.1, 41,42, 43, 44, 44.9, 45.6, 46.1, 46.2 ˚C) and replicated three times per Symbiodinium strain per treatment. A modified protocol by Díaz-Almeyda et al., 2011 was used.

Fv/Fm was automatically calculated/determined by fitting each fluorescence transient to the bio-physical model of Kolber et al. (1998) using the FIREPRO software (Satlantic, Version 1.4.3) integrated with the FIRe system.

Reference excitation profile used by FIReView to normalize the variable fluorescence profile: EXCFOP.TXT
Column 1: incremental sample counter
Column 2: elapsed time measured in microSeconds (uS)
Column 3: reference excitation profile
Column 4: relative fluorescence profile normalized to the reference excitation, or the fluorescence yield
Calibration date: 1/ 1/2002
Time (in seconds) of day reading was taken = 79931

Methodology Reference:
Díaz-Almeyda, E., Thomé, P. E., Hafidi, M. El, and Iglesias-Prieto, R. (2011). Differential stability of photosynthetic membranes and fatty acid composition at elevated temperature in Symbiodinium. Coral Reefs, 30(1), 217–225. https://doi.org/10.1007/s00338-010-0691-5.

Data Processing Description

BCO-DMO Processing Notes:
- added a conventional header with dataset name and description, PI name, version date
- modified parameter names to conform with BCO-DMO naming conventions

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Data Files

File
Fv_Fm.csv (Comma Separated Values (.csv), 71.44 KB) MD5:32c3cf591ada75feba9651ad72d96deb Primary data file for dataset ID 732890

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Related Publications

Díaz-Almeyda, E., Thomé, P. E., El Hafidi, M., & Iglesias-Prieto, R. (2010). Differential stability of photosynthetic membranes and fatty acid composition at elevated temperature in Symbiodinium. Coral Reefs, 30(1), 217–225. doi:10.1007/s00338-010-0691-5
Methods

Mansour, J. S., Pollock, F. J., Díaz-Almeyda, E., Iglesias-Prieto, R., & Medina, M. (2018). Intra- and interspecific variation and phenotypic plasticity in thylakoid membrane properties across two Symbiodinium clades. Coral Reefs, 37(3), 841–850. doi:10.1007/s00338-018-1710-1
Results

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Parameters

Parameter	Description	Units
Strain	Symbiodinium strain	unitless
Species	Symbiodinium species	unitless
Treatment	relevant treatment (see methods): 26 = control temperature; 31 = high temperature treatment	unitless
Replicate	experimental repetition identifier	unitless
Temperature	measurement temperature	degrees Celsius
Fv_Fm	Max photochemical quantum efficiency	dimensionless

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Instruments

Dataset-specific Instrument Name	Fluorescence Induction and Relaxation (FIRe) Fluorometer system and fibre optic probe (Satlantic, Halifax, Nova Scotia, Canada)
Generic Instrument Name	Fluorometer
Dataset-specific Description	Used to measure fluorescence. Settings: default settings of the manufacturer with the following changes: Gain: 800; # of samples: 4; STF: 60 µs. See Exc profile,the reference excitation profile used by FIReView to normalize the variable fluorescence profile. See also: http://www.seabird.com/FIRe-System
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

Coevolution of scleractinian corals and their associated microorganisms (GCMB)

Website: http://oregonstate.edu/microbiology/vegathurberlab/global-coral-microbiome-project

Coverage: Circumtropical

Description from NSF award abstract:
Coral reefs are among the most biologically diverse marine ecosystems on the planet, and provide substantial economic and ecological benefits to coastal communities. Corals are composed of both the Cnidarian animal host and complex communities of unique and underexplored microbial organisms. Today these natural wonders are in global decline, threatened by the intersecting effects of multiple stressors including overfishing, pollution, and climate change. These stressors can alter coral microbial communities in ways that may contribute to the susceptibility of corals to disease or overgrowth by algae. Therefore, understanding the relationships between corals and their microbiota may be useful for efforts to understand coral disease and preserve reef ecosystems. The microbial diversity of coral species in many diverse and ancient groups of corals remains unexplored, but understanding these communities will help to extend the knowledge gained in well-studied corals to diverse reefs worldwide. This project aims to describe microbial diversity across all major groups of reef-building corals in each of several distinct ecosystems across the globe, to determine the genome sequences and metabolic capabilities of key coral bacteria, and to test whether the composition of coral microbial communities helps to explain the overall vulnerability or resistance of different coral species to stress or disease.

Coral species differ in their susceptibility to bleaching and disease, but these differences are only partially explained by coral phylogeny. Therefore this project will test the extent to which incorporating the microbiota (or their contributed genes) better predicts these and other traits. Recent technological advances have broadened understanding of how complex microbiomes shape the life history, physiology, and evolution of their multicellular hosts (e.g., the human microbiome). The use of newly developed DNA sequencing techniques will allow a more complete exploration of microbial diversity in corals than has previously been feasible, while advanced computational methods will help to maximize the value of sequenced bacterial genomes. Improved predictive models that incorporate both coral phylogeny and microbial function will help inform conservation strategies and yield predictive biomarkers for coral vulnerability to disease or bleaching. Relating the diversity of corals to the diversity of their microbes will also provide important insights into how intimate symbiotic associations with microorganisms arose and are maintained in diverse animals.

RAPID: Coral robustness: lessons from an "improbable" reef (Varadero Reef)

Coverage: Caribbean Sea (10°18’10”N, 75°34’ 55”W)

NSF Award Abstract:
Coral reefs provide invaluable services to coastal communities, but coral populations worldwide are in a state of unprecedented decline. Studying resilient reefs is of primary importance for coral conservation and restoration efforts. A unique natural experiment in coral resilience to stress has been playing out in Cartagena Bay, Colombia since the Spanish conquistadors diverted the Magadalena River into the Bay in 1582. Varadero Reef at the southern mouth of the Bay has survived centuries of environmental insults and changing conditions with up to 80% coral cover. This reef provides an ideal system to test biological robustness theory. Given that Varadero is a highly perturbed system, we hypothesize that while likely more robust to perturbation than nearby pristine reefs, it will be less physiologically efficient. Some of the large star coral colonies (Orbicella faveolata) at this site have existed since before the construction of the Canal del Dique. These coral specimens contain invaluable information regarding the conditions of the Magdalena River wathershed and its construction in the XIV century. Changes in turbidity of the plume associated with the urban industrial and agricultural

development of Colombia can be documented as variations in calcification rates and changes in the microstructure of the skeleton. The Colombian government has announced the approval for the construction of a shipping channel that will go right over this reef, with the goal to start dredging as early as Fall 2016 or early 2017. The RAPID funding mechanism would enable immediate collection of data and information of why this reef has survived centuries of environmental stress that can shed light on what genotype combinations of coral and its microbial constituents will fare better in similar conditions at other reef locations around the world. Coral reef conservation biology will benefit from this study by generating data for the development of stress diagnostic tools to identify resilient corals. This project will help broaden participation in science by training a diverse cohort of students to work effectively in the global arena while fostering productive collaborations with several Colombian researchers and educational institutions. Students will also gain cultural empathy and sensitivity through direct engagement with the members of society who are most directly impacted by coral reef degradation (e.g. fishermen). Student researchers from Penn State University will work alongside their Colombian counterparts to develop a series of bilingual blog posts to record the cultural and scientific aspects of this project's research expeditions. The blog postings will be submitted for wide dissemination to the Smithsonian's Ocean Portal where Penn State students have published in the past. An educational coral kit developed by the Medina Lab and extensively tested in schools in the US has been translated into Spanish and will be used in local schools in Cartagena and vicinities. All expedition data and metadata will be incorporated into the Global Coral Microbiome Project's interactive web portal, a responsive outreach tool allows researchers, students and/or teachers to access a wealth of information about every coral colony we sample and to virtually explore coral reefs around the world from any internet-enabled device.

This research will generate information to understand functional traits related to symbioses stability under different perturbation regimes. Comparative analyses of microbiome modifications generated during the reciprocal transplantation will allow us to document possible differential responses of the holobionts to acute and chronic stressors relative to corals not exposed to significant levels of perturbation. The development of local bio-optical models of coral calcification and the characterization of the coral holobiont will permit the distinction between the effects in calcification attributed to local turbidity from those that can be ;attributed to differences in host genotype and/or microbial community composition and function. The information recorded in coral skeletons can be used to reconstruct the rates of agricultural, industrial and urban development of Colombia through the last 5 centuries as changes in the turbidity of the effluent of the Magdalena River.

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Program Information

Dimensions of Biodiversity (Dimensions of Biodiversity)

Website: http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503446

Coverage: global

(adapted from the NSF Synopsis of Program)
Dimensions of Biodiversity is a program solicitation from the NSF Directorate for Biological Sciences. FY 2010 was year one of the program. [MORE from NSF]

The NSF Dimensions of Biodiversity program seeks to characterize biodiversity on Earth by using integrative, innovative approaches to fill rapidly the most substantial gaps in our understanding. The program will take a broad view of biodiversity, and in its initial phase will focus on the integration of genetic, taxonomic, and functional dimensions of biodiversity. Project investigators are encouraged to integrate these three dimensions to understand the interactions and feedbacks among them. While this focus complements several core NSF programs, it differs by requiring that multiple dimensions of biodiversity be addressed simultaneously, to understand the roles of biodiversity in critical ecological and evolutionary processes.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1442206
NSF Division of Ocean Sciences (NSF OCE)	OCE-1642311

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