Photosystem II (PSII) photochemical efficiency (Yield PSII) recorded at noon (ΔF/Fm') and at dusk (Fv/Fm) on corals from the species Orbicella faveolata, transplanted from Varadero and Rosario reefs, Colombia, May 2017

Website: https://www.bco-dmo.org/dataset/786485
Data Type: Other Field Results
Version: 1
Version Date: 2020-01-08

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

Contributors	Affiliation	Role
Medina, Mónica	Pennsylvania State University (PSU)	Principal Investigator
Iglesias-Prieto, Roberto	Pennsylvania State University (PSU)	Co-Principal Investigator
Lopez Lodoño, Tomás	Pennsylvania State University (PSU)	Contact
Copley, Nancy	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
Photosystem II (PSII) photochemical efficiency (Yield PSII) recorded at noon (ΔF/Fm') and at dusk (Fv/Fm) on corals from the species Orbicella faveolata. Coral fragments were transplanted from Varadero and Rosario reefs to Varadero reef, Rosario reef, or Cartagena Bay, Colombia, May 2017.

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Coverage

Spatial Extent: **N**:10.3065 **E**:-75.577 **S**:10.1867 **W**:-75.7453
Temporal Extent: 2017-05-20 - 2017-05-27

Dataset Description

These are primary data of the PSII photochemical efficiency (Yield PSII) recorded at noon (ΔF/Fm') and at dusk (Fv/Fm) in a reciprocal transplant experiment and on random colonies. The data reported here were obtained from coral fragments used in a transplant experiment.

The Varadero Reef is located south-west of the Cartagena Bay close to the southern strait that connects the Bay to the Caribbean Sea in Colombia (10°18’23.3”N, 75°35’08.0”W). The Bay is a receiving estuary from the Magdalena River through the Canal del Dique, a man-made channel whose construction and operation dates back almost a century. Three study sites with contrasting light regimes were considered in order to evaluate the role of the light-environment perturbation associated with the Dique channel freshwater plume on the photosynthetic performance of corals from Varadero: 1) Varadero reef at 3.5m depth close to the Dique channel mouth (10°18’23.3”N, 75°35’08.0”W), 2) Rosario reef at 12m depth as clear-control site 21 km southwest from Varadero (10°11'12.1"N, 75°44'43.0"W), and 3) Cartagena Bay at 3m depth, the closest site to the Dique channel mouth and most turbid among the three sites (10°18'5.80"N, 75°34'37.10"W).

These data were used in the manuscript “Degradation of the underwater light environment: physiological and ecological consequences for reef corals” submitted to the Journal Nature Communications Biology. [under review. 2019-12-28]

Acquisition Description

The Photosystem II (PSII) photochemical efficiency (Yield PSII) was recorded at noon (ΔF/Fm') and at dusk (Fv/Fm) on corals from the species Orbicella faveolata.

Measurements were recorded on corals used in a reciprocal transplant experiment and on random colonies. Data from three study sites are reported: Varadero at 3.5m depth (10°18’23.3”N, 75°35’08.0”W); Rosario at 12m depth (10°11'12.1"N, 75°44'43.0"W); and Cartagena Bay at 3m depth (10°18'5.80"N, 75°34'37.10"W). Varadero and Rosario were both source and destination sites; Cartagena Bay was only a destination site.

The maximum quantum yield of PSII (Fv/Fm) was recorded at dusk and the effective quantum yield of PSII (ΔF/Fm') at local noon during peak of sunlight exposure. Measurements were performed with a submergible Pulse Amplitud Modulated fluorometer (diving-PAM, Walz, Germany) on fragments used in a reciprocal transplant experiment and on colonies randomly distributed at similar depths compared to the transplant experiment. Three study sites with contrasting exposure to the Dique channel freshwater plume were considered: 1) Varadero reef at 3.5m depth close to the Dique channel mouth (10°18'23.3"N, 75°35'08.0"W), 2) Rosario reef at 12m depth as clear-control site located 21 km southwest of Varadero (10°11'12.1"N, 75°44'43.0"W), and 3) Cartagena Bay at 3m depth, the closest site to the Dique channel mouth (10°18'5.80"N, 75°34'37.10"W).

The software WinControl-3 was used to operate and download the data from the diving-PAM.

Processing Description

BCO-DMO Processing Notes:
- added conventional header with dataset name, PI name, version date
- modified parameter names to conform with BCO-DMO naming conventions
- reformatted date from m/d/yy to yyyy-mm-dd
- added ISO_DateTime_UTC column
- changed delta symbol (Δ) to text 'delta'

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Parameters

Parameter	Description	Units
Date	sampling date	unitless
Time	sampling time	unitless
Type	type of measurement: ?F/Fm' (effective photochemical efficiency of Photosystem II measured at noon); Fv/Fm (maximum potochemical efficiency of Photosystem II measured at dusk)	unitless
Frag	coral fragment identifier	unitless
Tag_color	color of fragment tag	unitless
Source_site	location of coral source	unitless
Destination_site	location of coral destination	unitless
F	minimal Chl a fluorescence yield	unitless
Fm_prime	maximal Chl a fluorescence yield (= Fm when measured at dusk and Fm' when measured at noon)	unitless
Yield_PSII	maximum or effective photochemical efficiency of Photosystem II when measurement takes place at dusk (Fv/Fm) or at noon (?F/Fm') respectively	unitless
Depth	sampling depth	meters
ISO_DateTime_UTC	date and time formatted is ISO: yyyy-mm-ddTHH:MM:SSZ	unitless

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Instruments

Dataset-specific Instrument Name	diving-PAM, Walz, Germany
Generic Instrument Name	Fluorometer
Dataset-specific Description	An underwater Pulse Amplitude Modulated fluorometer (diving-PAM, Walz, Germany) was used to measure the PSII photochemical efficiency.
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

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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Funding

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

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