DEPRECATED: Optical properties of Orbicella faveoalta fragments (chl-a, Symbiodinium density, absorbance, and absorbance efficiency) from Rosaria and Varadero reef sites, Colombia, 2016 and 2017 (Varadero Reef project)

Website: https://www.bco-dmo.org/dataset/719349
Data Type: experimental
Version: 2
Version Date: 2018-03-05

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

Contributors	Affiliation	Role
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Abstract
This dataset has been deprecated. Please see https://www.bco-dmo.org/dataset/719161 for updated data. This dataset contains the results of the preliminary analysis of the optical descriptors calculated for each coral fragment of the species Orbicella faveolata used in the transplant experiment between three sites: Varadero (10°18'23.3"N, 75°35'08.0"W), Rosario (10°11'12.1"N, 75°44'43.0"W) and Abanico (10°18'5.80"N, 75°34'37.10"W). The tag number/color of each fragment, the date of data collection, and the sites of origin and destination are specified.

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Coverage

Spatial Extent: **Lat**:10.3028 **Lon**:-75.5819
Temporal Extent: 2016-10 - 2017-05

Dataset Description

DEPRECATED: This dataset has been resubmitted and combined with data originally in dataset https://www.bco-dmo.org/dataset/719161. Please see https://www.bco-dmo.org/dataset/719161 for updated data.

This dataset contains the chlorophyll-a concentration, Symbiodinium density, absorbance, and absorbance efficiency of pigments extracted from coral Orbicella faveolata fragments collected at Rosaria and Varadero reef sites, Colombia, October 2016 and May 2017.

Related Reference:
Pizarro V, Rodríguez SC, López-Victoria M, Zapata FA, Zea S, Galindo-Martínez CT, Iglesias-Prieto R, Pollock J, Medina M. (2017) Unraveling the structure and composition of Varadero Reef, an improbable and imperiled coral reef in the Colombian Caribbean. PeerJ 5:e4119 https://doi.org/10.7717/peerj.4119

Methods & Sampling

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. 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. The depth of the particular transplant site in Varadero is 3.5m, while at Rosario, a site inside a marine protected area located south-west with relatively high coral cover, is 3m and 12m.

These are results of the preliminary analysis of the optical descriptors calculated from the raw data for each coral fragment:
- The average (AVG) and standard deviation (SD) of Chlorophyll a density (mg Chl a m-2),
- Estimated absorbance at 675 nm (D 675nm),
- The specific absorption coefficient per unit of pigment (aChl a*, m2 mg Chla -1) and per symbiont (aSymb*, m2 cell-1),
- Symbiodinium density (cell-cm2), and pigment content per symbiont (Ci) (pg Chl a cell-1).
- Coral fragments area (cm2) was calculated using the aluminum foil technique (Marsh 1970).
- Chlorophyll a concentration (mg Chl a cm-2)
- The specific absorption coefficient (a*)

Chlorophyll a concentration was estimated spectrophotometrically after extraction from symbiont cells in acetone/dimethyl sulfoxide (95:5, Vol:Vol; Iglesias-Prieto et al. 1992), using the equations of Jeffrey and Humphrey (1975). Cell numbers were estimated from preserved samples (40 µml Lugol's iodine) by direct count using a hemocytometer. Coral tissue area was estimated with the aluminum foil technique (Marsh, 1970). Reflectance (R) spectra of coral samples were measured between 400 and 750 nm (5 scans to average per measurement, boxcar width of 1.65 nm). Reflectance is expressed as the ratio of the radiance measured from the coral tissue surface, relative to the radiance obtained from the reference standard, a bleached O. faveolata skeleton. Absorbance (D) spectra were calculated as D=log (1/R), assuming that transmission through the skeleton is negligible. Optical determinations were estimated following Shibata (1969) and Enríquez et al. (2005).

The spectroscopy analyses were performed with a Flame mini-spectrophotometer (Ocean Optics Inc, Florida, USA). Cell counting was performed using a phase hemocytometer (Hausser Scientific, Horsham, USA) .

OceanView 1.6.7 was the software used for processing the tasks of the Flame spectrophotometer.

Methodology References:

- Iglesias-Prieto, R., Matta, J.L., Robins, W.A. and R.K. Trench. 1992. Photosynthetic response to elevated temperature in the symbiotic dinoflagellate Symbiodinium microadriaticum in culture. Proc Natl Acad Sci U S A. 89:10302-10305. Full text pdf: http://www.pnas.org/content/89/21/10302.full.pdf.
- Jeffrey, S.W. and G.F. Humphrey. 1975. New spectrophotometric equations for determining chlorophylls a, b, c1 and c2 in higher plants, algae and natural phytoplankton. Biochem. Physiol. Pflanzen 167: 191-194. DOI:10.1016/S0015-3796(17)30778-3
- Marsh, J. A. 1970. Primary productivity of reef-building calcareous red algae. Ecology 51: 255–265. DOI: 10.2307/1933661.
- Shibata, K. 1969. Pigments and a UV-absorbing substance in corals and a blue-green alga living in the Great Barrier Reef. Plant Cell Physiol. 10: 325–335. DOI: 10.1093/oxfordjournals.pcp.a074411
- Enríquez, S., E.R. Méndez and R. Iglesias-Prieto. 2005. Multiple scattering on coral skeletons enhances light absorption by symbiotic algae. Limnol. Oceanogr., 50(4), 2005, 1025–1032. DOI: 10.4319/lo.2005.50.4.1025

Data 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

- blank values were replaced with no data value 'nd'
- corrected spelling of Orbicella faveoalta to Orbicella faveolata

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Data Files

File
optical_compiled_all_v2.csv (Comma Separated Values (.csv), 9.21 KB) MD5:4b843919f018e6f8697c5b114d916315 Primary data file for dataset ID 719349

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Related Publications

Enríquez, S., Méndez, E. R., & -Prieto, R. I. (2005). Multiple scattering on coral skeletons enhances light absorption by symbiotic algae. Limnology and Oceanography, 50(4), 1025–1032. doi:10.4319/lo.2005.50.4.1025
Methods

Iglesias-Prieto, R., Matta, J.L., Robins, W.A. & R.K. Trench. 1992. Photosynthetic response to elevated temperature in the symbiotic dinoflagellate Symbiodinium microadriaticum in culture. Proc Natl Acad Sci U S A. 89:10302-10305. http://www.pnas.org/content/89/21/10302.full.pdf
Methods

Jeffrey, S. W., & Humphrey, G. F. (1975). New spectrophotometric equations for determining chlorophylls a, b, c1 and c2 in higher plants, algae and natural phytoplankton. Biochemie Und Physiologie Der Pflanzen, 167(2), 191–194. doi:10.1016/s0015-3796(17)30778-3 https://doi.org/10.1016/S0015-3796(17)30778-3
Methods

Johnson, M. D., Price, N. N., & Smith, J. E. (2014). Contrasting effects of ocean acidification on tropical fleshy and calcareous algae. PeerJ, 2, e411. doi:10.7717/peerj.411
Related Research

Marsh, J. A. (1970). Primary Productivity of Reef-Building Calcareous Red Algae. Ecology, 51(2), 255–263. doi:10.2307/1933661
Methods

Pigments and a UV-absorbing substance in corals and a blue-green alga living in the Great Barrier Reef1. (1969). Plant and Cell Physiology. doi:10.1093/oxfordjournals.pcp.a074411
Methods

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Related Datasets

Replaced By New Versions

Medina, M., Iglesias-Prieto, R. (2018) **Photosynthesic parameters (calculated alpha, Pmax, Respiration, Ek and Ec) for each P-E curve for coral Orbicella faveolata from Rosaria and Varadero reef sites and Cartagena Bay, Colombia, 2016 and 2017.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 3) Version Date 2018-03-05 doi:10.1575/1912/bco-dmo.719161.3 [view at BCO-DMO]

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Parameters

Parameter	Description	Units
Species	taxonomic species name	unitless
Parent_Colony_id	parent colony number	unitless
Parent_tag_color	parent colony tag color	unitless
Fragment_id	fragment number	unitless
Fragment_tag_color	fragment tag color	unitless
Date_collected	date collected	unitless
Transplanted_from	location coral fragment was transplanted from	unitless
Transplanted_to	location coral fragment was transplanted to	unitless
Area_cm2	area of coral fragment	centimeters^2
AVG_Chl_a	average chlorophyll-a concentration	milligrams Chla/meter^2
SD_Chl_a	standard deviation of chlorophyll-a concentration	milligrams Chla/meter^2
absorbance_D_675nm	estimated absorbance at 675 nm	unitless
absorp_coeff_pigm_unit	the specific absorption coefficient (a*) per unit of pigment	meters^2/mg Chla
Symb_density	Symbiodinium density	cells/centimeter^2
pigment_Symb_Ci	pigment content per symbiont (Ci)	pigment Chl-a/cell
absorp_coeff_aSymb	the specific absorption coefficient per symbiont (absorption of symbiont * m2 cell-1)	meters^2/cell

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Instruments

Dataset-specific Instrument Name	phase hemocytometer (Hausser Scientific, Horsham, USA)
Generic Instrument Name	Hemocytometer
Dataset-specific Description	Used for cell counting
Generic Instrument Description	A hemocytometer is a small glass chamber, resembling a thick microscope slide, used for determining the number of cells per unit volume of a suspension. Originally used for performing blood cell counts, a hemocytometer can be used to count a variety of cell types in the laboratory. Also spelled as "haemocytometer". Description from: http://hlsweb.dmu.ac.uk/ahs/elearning/RITA/Haem1/Haem1.html.

Dataset-specific Instrument Name	mini spectrophotometer (Ocean Optics USB4000)
Generic Instrument Name	Spectrophotometer
Generic Instrument Description	An instrument used to measure the relative absorption of electromagnetic radiation of different wavelengths in the near infra-red, visible and ultraviolet wavebands by samples.

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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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