Canopy closure values from photographs taken within octocoral forestsalong the south shore of St. John, U.S. Virgin Islands in March of 2019

Website: https://www.bco-dmo.org/dataset/892323
Data Type: Other Field Results
Version: 1
Version Date: 2023-03-21

Project
» Collaborative Research: Pattern and process in the abundance and recruitment of Caribbean octocorals (Octocoral Community Dynamics)
» RUI: Pattern and process in four decades of change on Caribbean reefs (St John Coral Reefs)

Contributors	Affiliation	Role
Edmunds, Peter J.	California State University Northridge (CSUN)	Principal Investigator
Girard, John	California State University Northridge (CSUN)	Student
York, Amber D.	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
These data represent the determination of canopy closure values from photographs taken within octocoral forests along the south shore of St. John, U.S. Virgin Islands. Sampling was performed during March 2019 in quadrats (1m2) placed at ~8–9-m depth. These data were recorded in conjunction with light intensity measurements and used to investigate the relationship between octocoral canopy metrics and evidence of sunflecking in the understory environment. These data were collected as part of an NSF Coral Reef Time Series, Virgin Islands: Long-term coral reef community dynamics in the Virgin Islands National Park and were published in Girard and Edmunds (2023).

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Coverage

Spatial Extent: **N**:18.3154 **E**:-64.7186 **S**:18.3096 **W**:-64.7252
Temporal Extent: 2019-03-09 - 2019-03-11

Methods & Sampling

Location:
Yawzi Point and East Cabritte sites along the south shore of St. John, U.S. Virgin Islands at ~8–9-m depth
Research conducted from the University of the Virgin Islands Marine Station in Lameshur Bay during March 2019.

Methods & Sampling:

Canopy closure was quantified using a modified method from (Jennings et. al. 1999) whereby a GoPro Hero 3+ camera with a 130° field of view (manufacturer's specification, Go-Pro., Inc. San Mateo, CA) was used to record still images in the center, and at each of the four corners, of quadrats, with all five images quadrat-1 recorded within < 5 minutes. To avoid biases in estimating canopy closure caused by adjacent non-living substrata (e.g., boulders and rock walls), images were excluded when they included these features. Images were analyzed using ImageJ software (v1.52a, Schneider et al., 2012), in which 300 randomly located dots (~ 0.5 pixel in diameter) were superimposed on each image. The number of dots on the octocoral canopy were counted and expressed as a percentage of the dot population. This metric was used to quantify canopy closure, and the results from the five images quadrat-1 were averaged to characterize each quadrat.

Instruments:
PVC Quadrats (1 m2)
GoPro Hero 3+ camera

Data Processing Description

To calculate canopy closure images were analyzed using ImageJ software (v1.52a, Schneider et al., 2012), in which 300 randomly located dots (~ 0.5 pixel in diameter) were superimposed on each image. The number of dots on the octocoral canopy were counted and expressed as a proportion of the dot population. To aid in the quantification of dots a grid of twenty squares was superimposed on the image. Each "box" was scored for the number of points in it that fell on the octocoral canopy. All twenty boxes for each image were summed for the total points out of 300 falling on the octocoral canopy.

BCO-DMO Data Manager Processing Notes:
* File "St.John_Closure Analysis for Octocorals in Light Quadrats.csv" imported as the primary table for this dataset.
* Supplemental files shared with other related datasets also added here (site list, photo inventory, photos).
* Photo ID transformed to be uppercase in this data table to match the actual file names.
* lat lon values added into the table by joining with the site list.
* Proportion_Closed rounded to three decimal places.
* Column names adjusted to conform to BCO-DMO naming conventions designed to support broad re-use by a variety of research tools and scripting languages. [Only numbers, letters, and underscores. Can not start with a number]

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Data Files

File
canopy_closure.csv (Comma Separated Values (.csv), 1.31 KB) MD5:e6d2b9ac34bbc96aa4e86e96d5ba029b Primary data table for dataset 892323.

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Supplemental Files

File
Photo inventory filename: photo_inventory.csv (Comma Separated Values (.csv), 148.68 KB) MD5:2bdcfdff1945b4e75048f03870524b7b Photo inventory table for files within Girard_and_Edmunds_2023_supporting_photos.zip This table has columns: filename, file name relative_filepath, relative path inside the zip file filesize_bytes, filesize in bytes md5sum, checksum of image file Site, site name Quadrat_Num, quadrat number Transect_Num, transect number Year, year (YYYY) lat, site latitude in decimal degrees lon, site longitude in decimal degrees Category, description of survey type (Closure, Community, etc). The site, transect number and quadrat number correspond to the values in the main data table "Benthic Invertebrate Abundance."
Site List filename: site_list.csv (Comma Separated Values (.csv), 192 bytes) MD5:4415feb2d663fc251a671a2a7c5cac04 Site list for all dataset related to the results publication Girard and Edmunds (2023). Parameters (column names, descriptions, and units): Site, Site name used in dataset related to Girard and Edmunds (2023),unitless lat, Site latitude,decimal degrees lon,Site longitude,decimal degrees Alternate_name, Alternate name for the site,unitless
Supporting Photos for Girard and Edmunds (2023) filename: Girard_and_Edmunds_2023_supporting_photos.zip (ZIP Archive (ZIP), 3.77 GB) MD5:55008bec5933c4c2eefb45f7a7824d39 See "photo_inventory.csv" for a full file listing within this photo zip file. Photo inventory also includes site and quadrat information.

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Related Publications

Girard, J. F., & Edmunds, P. J. (2023). Effects of arborescent octocoral assemblages on the understory benthic communities of shallow Caribbean reefs. Journal of Experimental Marine Biology and Ecology, 561, 151870. https://doi.org/10.1016/j.jembe.2023.151870
Results

GoPro (2013). Hero 3 silver edition: user manual. 1–62. https://gopro.com/content/dam/help/hero3-silver-edition/manuals/HERO3_Silver_UM_ENG_RevC_web.pdf. Accessed: 21/Dec/2022
Methods

Jennings, S. (1999). Assessing forest canopies and understorey illumination: canopy closure, canopy cover and other measures. Forestry, 72(1), 59–74. https://doi.org/10.1093/forestry/72.1.59
Methods

Schneider, C. A., Rasband, W. S., & Eliceiri, K. W. (2012). NIH Image to ImageJ: 25 years of image analysis. Nature Methods, 9(7), 671–675. https://doi.org/10.1038/nmeth.2089
Software

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Related Datasets

IsRelatedTo

Girard, J., Edmunds, P. J. (2023) **Benthic invertebrate abundances associated with octocoral forests in St. John, US Virgin Islands from July 2019 to Jan 2020.** Biological and Chemical Oceanography Data

Management Office (BCO-DMO). (Version 1) Version Date 2023-03-21 doi:10.26008/1912/bco-dmo.892248.1 [view at BCO-DMO]
Relationship Description: Octocoral measurements and invertebrate counts were done in the same quadrats. Therefore, the quadrat IDs correspond to each other across community & canopy data sets.

Girard, J., Edmunds, P. J. (2023) **Canopy closure values from photographs taken within octocoral forests in Lameshur Bay St. John, U.S. Virgin Islands from July 2019 to Jan 2020.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-03-21 doi:10.26008/1912/bco-dmo.892258.1 [view at BCO-DMO]
Relationship Description: Octocoral measurements and invertebrate counts were done in the same quadrats. Therefore, the quadrat IDs correspond to each other across community & canopy data sets.

Girard, J., Edmunds, P. J. (2023) **Light intensity (lux) of downwelling light upon the benthos along differing conditions of octocoral canopy formation in East Cabritte, in Grootpan Bay, St. John U.S. Virgin Islands in March of 2019.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-03-21 doi:10.26008/1912/bco-dmo.892300.1 [view at BCO-DMO]
Relationship Description: Octocoral measurements and invertebrate counts were done in the same quadrats. Therefore, the quadrat IDs correspond to each other across community & canopy data sets.

Girard, J., Edmunds, P. J. (2023) **Light intensity (lux) of downwelling light upon the benthos along differing conditions of octocoral canopy formation in Lameshur Bay St. John, U.S. Virgin Islands in March of 2019.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-03-21 doi:10.26008/1912/bco-dmo.892272.1 [view at BCO-DMO]
Relationship Description: Octocoral measurements and invertebrate counts were done in the same quadrats. Therefore, the quadrat IDs correspond to each other across community & canopy data sets.

Girard, J., Edmunds, P. J. (2023) **Octocoral canopy metrics (mean height, density, and closure) in St. John, US Virgin Islands in March of 2019.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-03-21 doi:10.26008/1912/bco-dmo.892293.1 [view at BCO-DMO]
Relationship Description: Octocoral measurements and invertebrate counts were done in the same quadrats. Therefore, the quadrat IDs correspond to each other across community & canopy data sets.

Girard, J., Edmunds, P. J. (2023) **Octocoral height, density, and genera from in situ observations within octocoral forests in Lameshur Bay St. John, U.S. Virgin Islands from July 2019 to Jan 2020.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-03-21 doi:10.26008/1912/bco-dmo.892265.1 [view at BCO-DMO]
Relationship Description: Octocoral measurements and invertebrate counts were done in the same quadrats. Therefore, the quadrat IDs correspond to each other across community & canopy data sets.

Girard, J., Edmunds, P. J. (2023) **Pulse Amplitude Modulation (PAM) fluorometer measurements from Porites astreoides colonies in St. John, US Virgin Islands from July to August of 2019.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-03-21 doi:10.26008/1912/bco-dmo.892279.1 [view at BCO-DMO]
Relationship Description: Octocoral measurements and invertebrate counts were done in the same quadrats. Therefore, the quadrat IDs correspond to each other across community & canopy data sets.

Girard, J., Edmunds, P. J. (2023) **Simultaneous light intensity measurements from a HOBO light intensity logger and a cosine-corrected PAR sensor in Lameshur Bay, St. John, U.S. Virgin Islands in January of 2021.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-03-21 doi:10.26008/1912/bco-dmo.892308.1 [view at BCO-DMO]
Relationship Description: Octocoral measurements and invertebrate counts were done in the same quadrats. Therefore, the quadrat IDs correspond to each other across community & canopy data sets.

Girard, J., Edmunds, P. J. (2023) **Steady state photosynthesis (photosynthetic induction time) from Porites astreoides colonies in St. John, US Virgin Islands from July to August of 2019.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-03-21 doi:10.26008/1912/bco-dmo.892286.1 [view at BCO-DMO]
Relationship Description: Octocoral measurements and invertebrate counts were done in the same quadrats. Therefore, the quadrat IDs correspond to each other across community & canopy data sets.

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Parameters

Parameter	Description	Units

Date	Date of sampling	unitless
Site	Name of site	unitless
lat	Site latitude	decimal degrees
lon	Site longitude	decimal degrees
Closure_Photo_ID	Identification code given to the file of the photograph used for analysis (Filename without .JPG extension)	units
Box_1	Number of points in Box 1 of the grid superimposed on the closure photograph that fell on octocoral branches	points
Box_2	Number of points in Box 2 of the grid superimposed on the closure photograph that fell on octocoral branches	points
Box_3	Number of points in Box 3 of the grid superimposead on the closure photograph that fell on octocoral branches	points
Box_4	Number of points in Box 4 of the grid superimposed on the closure photograph that fell on octocoral branches	points
Box_5	Number of points in Box 5 of the grid superimposed on the closure photograph that fell on octocoral branches	points
Box_6	Number of points in Box 6 of the grid superimposed on the closure photograph that fell on octocoral branches	points
Box_7	Number of points in Box 7 of the grid superimposed on the closure photograph that fell on octocoral branches	points
Box_8	Number of points in Box 8 of the grid superimposed on the closure photograph that fell on octocoral branches	points
Box_9	Number of points in Box 9 of the grid superimposed on the closure photograph that fell on octocoral branches	points
Box_10	Number of points in Box 10 of the grid superimposed on the closure photograph that fell on octocoral branches	points
Box_11	Number of points in Box 11 of the grid superimposed on the closure photograph that fell on octocoral branches	points
Box_12	Number of points in Box 12 of the grid superimposed on the closure photograph that fell on octocoral branches	points
Box_13	Number of points in Box 13 of the grid superimposed on the closure photograph that fell on octocoral branches	points
Box_14	Number of points in Box 14 of the grid superimposed on the closure photograph that fell on octocoral branches	points
Box_15	Number of points in Box 15 of the grid superimposed on the closure photograph that fell on octocoral branches	points
Box_16	Number of points in Box 16 of the grid superimposed on the closure photograph that fell on octocoral branches	points
Box_17	Number of points in Box 17 of the grid superimposed on the closure photograph that fell on octocoral branches	points
Box_18	Number of points in Box 18 of the grid superimposed on the closure photograph that fell on octocoral branches	points
Box_19	Number of points in Box 19 of the grid superimposed on the closure photograph that fell on octocoral branches	points
Box_20	Number of points in Box 20 of the grid superimposed on the closure photograph that fell on octocoral branches	points

Total_Points_on_Canopy	Sum of the points counted as falling on octocoral branches from the twenty boxes superimposed on the photograph	points
Proportion_closed	Caclulated from the total canopy points divided by the total number of points, 300	unitless

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Instruments

Dataset-specific Instrument Name	GoPro Hero 3+ camera
Generic Instrument Name	Underwater Camera
Generic Instrument Description	All types of photographic equipment that may be deployed underwater including stills, video, film and digital systems.

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Project Information

Collaborative Research: Pattern and process in the abundance and recruitment of Caribbean octocorals (Octocoral Community Dynamics)

Coverage: St. John, US Virgin Islands

NSF Award Abstract:
Coral reefs are exposed to a diversity of natural and anthropogenic disturbances, and the consequences for ecosystem degradation have been widely publicized. However, the reported changes have been biased towards fishes and stony corals, and for Caribbean reefs, the most notable example of this bias are octocorals ("soft corals"). Although they are abundant and dominate many Caribbean reefs, they are rarely included in studies due to the difficulty of both identifying them and in quantifying their abundances. In some places there is compelling evidence that soft corals have increased in abundance, even while stony corals have become less common. This suggests that soft corals are more resilient than stony corals to the wide diversity of disturbances that have been impacting coral corals. The best coral reefs on which to study these changes are those that have been studied for decades and can provide a decadal context to more recent events, and in this regard the reefs of St. John, US Virgin Islands are unique. Stony corals on the reefs have been studied since 1987, and the soft corals from 2014. This provides unrivalled platform to evaluate patterns of octocoral abundance and recruitment; identify the patterns of change that are occurring on these reefs, and identify the processes responsible for the resilience of octocoral populations. The project will extend soft coral monitoring from 4 years to 8 years, and within this framework will examine the roles of baby corals, and their response to seafloor roughness, seawater flow, and seaweed, in determining the success of soft corals. The work will also assess whether the destructive effects of Hurricanes Irma and Maria have modified the pattern of change. In concert with these efforts the project will be closely integrated with local high schools at which the investigators will host marine biology clubs and provide independent study opportunities for their students and teachers. Unique training opportunities will be provided to undergraduate and graduate students, as well as a postdoctoral researcher, all of whom will study and work in St. John, and the investigators will train coral reef researchers to identify the species of soft corals through a hands-on workshop to be conducted in the Florida Keys.

Understanding how changing environmental conditions will affect the community structure of major biomes is the ecological objective defining the 21st century. The holistic effects of these conditions on coral reefs will be studied on shallow reefs within the Virgin Islands National Park in St. John, US Virgin Islands, which is the site of one of the longest-running, long-term studies of coral reef community dynamics in the region. With NSF-LTREB support, the investigators have been studying long-term changes in stony coral communities in this location since 1987, and in 2014 NSF-OCE support was used to build an octocoral "overlay" to this decadal perspective.

The present project extends from this unique history, which has been punctuated by the effects of Hurricanes Irma and Maria, to place octocoral synecology in a decadal context, and the investigators exploit a rich suite of legacy data to better understand the present and immediate future of Caribbean coral reefs. This four-year project will advance on two concurrent fronts: first, to extend time-series analyses of octocoral communities from four to eight years to characterize the pattern and pace of change in community structure, and second, to conduct a program of hypothesis-driven experiments focused on octocoral settlement that will uncover the mechanisms allowing octocorals to more effectively colonize substrata than scleractinian corals on present day reefs. Specifically, the investigators will conduct mensurative and manipulative experiments addressing four hypotheses focusing on the roles of: (1) habitat complexity in distinguishing between octocoral and scleractinian recruitment niches, (2) the recruitment niche in mediating post-settlement success, (3) competition in algal turf and macroalgae in determining the success of octocoral and scleractian recruits, and (4) role of octocoral canopies in modulating the flux of particles and larvae to the seafloor beneath. The results of this study will be integrated to evaluate the factors driving higher ecological resilience of octocorals versus scleractinians on present-day Caribbean reefs.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

RUI: Pattern and process in four decades of change on Caribbean reefs (St John Coral Reefs)

Website: http://coralreefs.csun.edu/

Coverage: United States Virgin Islands, St. John: 18.318, -64.7253

NSF Award Abstract:
The coral reef crisis refers to the high rates of death affecting tropical reef-building corals throughout the world, and the strong likelihood that coral reefs will become functionally extinct within the current century. Knowledge of these trends comes from the monitoring of coral reefs to evaluate their health over time, with the most informative projects providing high-resolution information extending over decades. Such projects describe both how reefs are changing, and answer questions addressing the causes of the changes and the form in which reefs will persist in the future. This project focuses on coral reefs in United States waters, specifically around St. John in the US Virgin Islands. These reefs are protected within the Virgin Islands National Park, and have been studied more consistently and in greater detail than most reefs anywhere in the world. Building from 33 years of research, this project extends monitoring of these habitats by another five years, and uses the emerging base of knowledge, and the biological laboratory created by the reefs of St. John, to address the causes and consequences of the bottleneck preventing baby corals from repopulating the reefs. The work is accomplished with annual expeditions, staffed by faculty, graduate students, undergraduates, and teachers, coupled with analyses of samples at California State University, Northridge, and Florida State University, Tallahassee. The students and teachers assist with the research goals at the center of this project, but also engage in independent study and integrate with the rich and diverse societal context and natural history of the Caribbean. The scope of the science agenda extends to schools in California, where students are introduced to the roles played by marine animals in ecosystem health, concepts of long-term change in the biological world, and the role of science engagement in promoting positive environmental outcomes. In addition to generating a wide spectrum of project deliverables focusing on scientific discovery, the project promotes STEM careers and train globally aware scientists and educators capable of supporting the science agenda of the United States in the 21st Century.

This project leverages one of the longest time-series analyses of Caribbean coral reefs to extend the time-series from 33 to 38 years, and it tests hypotheses addressing the causes and consequences of changing coral reef community structure. The project focuses on reefs within the Virgin Islands National Park (VINP) and along the shore of St. John, US Virgin Islands, and is integrated with stakeholders working in conservation (VINP) and local academia (University of the Virgin Islands). Beginning in 1987, the project has addressed detail-oriented analyses within a small spatial area that complements the large-scale analyses conducted by the VINP. The results of these efforts create an unrivaled context within which ecologically relevant hypotheses can be tested to elucidate mechanisms driving ecological change. Building from image- and survey- based analyses, 33 years of data reveal the extent to which these reefs have transitioned to a low-abundance coral state, and the importance of the bottleneck preventing coral recruits from contributing to adult size classes. The intellectual merits of this project leverage these discoveries to address eight hypotheses: (H1) long-term changes are defining a cryptic regime change, with the low coral abundance reinforced by, (H2) enhanced

community resilience, (H3) low post-settlement success, (H4) negative effects of peyssonnelid algal crusts (PAC) on juvenile corals, (H5) inability of juvenile corals to match their phenotypes to future conditions, (H6) impaired population growth caused by reduced genetic diversity, (H7) the premium placed on PAC-free halos around Diadema sea urchins for coral recruitment, and (H8) biotic homogenization occurring on a landscape-scale.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

Related Projects:

- Affiliated with MCR-LTER - https://www.bco-dmo.org/project/2222
- Serves as a new project that builds on NSF DEB-1350146 - RUI-LTREB Renewal: Three decades of coral reef community dynamics in St. John, USVI: 2014-2019 - https://www.bco-dmo.org/project/734983
- Overlaps with OCE 17-56678 (which focuses on soft corals with H. Lasker) - Collaborative Research: Pattern and process in the abundance and recruitment of Caribbean octocorals - https://www.bco-dmo.org/project/752508
- LTREB Long-term coral reef community dynamics in St. John, USVI: 1987-2019 - https://www.bco-dmo.org/project/2272
- RUI: Pattern and process in four decades of change on Caribbean reefs - https://www.bco-dmo.org/project/835192
- RAPID: Hurricane Irma: Effects of repeated severe storms on shallow Caribbean reefs and their changing ecological resilience - https://www.bco-dmo.org/project/722163

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1756678
NSF Division of Ocean Sciences (NSF OCE)	OCE-2019992

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