Distribution of octocoral colonies from long-term sampling sites in St. John, USVI.

Website: https://www.bco-dmo.org/dataset/745666
Data Type: Other Field Results
Version: 1
Version Date: 2018-09-06

Project
» LTREB Long-term coral reef community dynamics in St. John, USVI: 1987-2019 (St. John LTREB)
» Collaborative research: Ecology and functional biology of octocoral communities (VI Octocorals)
» RUI-LTREB Renewal: Three decades of coral reef community dynamics in St. John, USVI: 2014-2019 (RUI-LTREB)

Contributors	Affiliation	Role
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Table of Contents

Coverage

Spatial Extent: **Lat**:18.32 **Lon**:-64.723
Temporal Extent: 2014 - 2015

Dataset Description

Data published in JEMBE paper entitled “*Octocoral distribution is associated with substratum orientation on coral reefs in St. John, U.S. Virgin Islands*".

Methods & Sampling

Methodology from DOI: 10.1016/j.jembe.2017.12.015

Study sites and microhabitat characterization:

The distribution of octocorals was evaluated in July and August 2015, and July 2016, using surveys completed on shallow fringing reefs (8–10-m depth) at White Point, Europa Bay, Yawzi Point, Tektite reef, and East Cabritte (Fig. 1). Hard substrata composed of igneous rock, dead scleractinian colonies, or crustose coralline algae were codified in a categorical scheme identifying three types of microhabitats based on the predominant orientation of their surface: vertical (~ 80–110°, relative to horizontal), inclined (~ 35–60°), and horizontal (~ 0–20°). Octocoral distribution was evaluated among these microhabitats, with microhabitat location of the colonies determined by the position of their holdfast (Fig. 2). Surfaces of live scleractinians were excluded from these analyses, as octocorals were not found attached to live coral tissue, and therefore, we inferred that scleractinian tissue was not a suitable substratum for settlement by octocorals.

Octocoral distribution:

The spatial distribution of octocorals on benthic surfaces can be affected by multiple mechanisms, including microhabitat availability, substratum selection by larvae (Lasker and Coffroth, 1983), and post-settlement success (Lasker and Kim, 1996). To evaluate the role of microhabitat availability in determining the distribution of octocorals, the abundances of vertical, inclined, and horizontal microhabitats were quantified using 20-m transects placed at 8–10-m depth at sites where octocorals are common (Rogers and Teytaud, 1988, Lenz et al., 2015). Quadrats (0.25 m2) subdivided into 25 equal sub-squares (each 0.01 m2) were placed at random positions along each transect, and each sub-square was evaluated from multiple perspectives for the dominant type of non-living substrata composing vertical, inclined, or horizontal surfaces.

The analyses for microhabitat availability were constrained to hard, non-living substrata because octocorals do not settle on sediments. Shallow habitats along this portion of the coast of St. John typically have scleractinian cover of ~ 4% (as in 2012 [Edmunds, 2013]), which is equivalent to one sub-square of the subdivided quadrats used for the present analysis. When such low coral cover was divided among all 25 sub-squares in the 0.5 × 0.5 m quadrat, it was rare for a sub-square to be scored as dominated by live scleractinians. The dominant orientation of non-living surfaces was determined based on the qualitative abundance of hard, non-living substrata in each microhabitat category, but the results were scored by planar area with a resolution of 4% (i.e., one sub-square). With this scheme, a sub-square could be scored as dominated by vertical surfaces if the estimated three-dimensional area of the vertical surface was larger than the estimated three-dimensional area of horizontal and inclined surfaces, even though vertical surfaces were not always fully visible in planar view. It was not possible to quantify the limitations of this estimation procedure, as actual three-dimensional area could not be measured, and the relative bias in the technique is unique to each quadrat and dependent on the absolute area of vertical, horizontal, and inclined surfaces. Emerging technologies like structure-from-motion (Leon et al., 2015) offer potential to refine this approach.

The distribution of arborescent octocorals among microhabitats was evaluated using band transects (2 × 20 m) placed haphazardly along a constant isobath (8–10 m) at each site, within which octocorals were scored for microhabitat based on the surface to which their holdfasts were attached. The focus was placed on arborescent species because these are the most common octocorals in the region (Williams et al., 2015, Lenz et al., 2015). Octocorals were identified to species (Gorgonia ventalina), or genus (Eunicea spp., Pseudoplexaura spp., Muricea spp., Plexaurella spp., Antillogorgia spp., Plexaura spp., and Pterogorgia spp.), and colonies were summed by taxon within each microhabitat. To test the hypothesis of non-random octocoral distribution among microhabitats, the observed distribution among microhabitats was compared with the distribution expected based on the proportional abundance of each microhabitat. These analyses were completed first, for all octocorals (i.e., pooled among taxa), and second, for the most common taxa. Observed and expected abundances were compared with $\chi 2$ tests, and where minimum expected frequency for this analysis was not achieved (i.e., 5 [Yates et al., 1999]), taxa were pooled into a single category.

Nearest neighbor distances:

The distances between nearest arborescent octocoral colonies were measured in each microhabitat to evaluate crowding among octocorals. Nearest neighbor distances were measured by haphazardly selecting one octocoral colony (the focal colony) in each microhabitat, and then recording the shortest straight-line distance to the nearest neighboring octocoral. The size class for this analysis was defined as ≤ 6-cm height based on three criteria. First, we selected the smallest colonies at which genus level identification was possible. Second, small colonies allowed the identification of nearest neighbors by proximity of any portion of their holdfasts. The detection of nearest neighbors became ambiguous as colonies grew larger (i.e., > 6-cm height), which caused their holdfasts to meet and coalesce. Third, the focus on small colonies provided a balance between a tractable sample size and a sampling of an early life stage that is more likely to reflect the effects of substratum choice rather than post-settlement mortality. Limiting our analysis in this portion of the study to small colonies also had the advantage of reducing the likelihood of colony size affecting nearest neighbor distance, as it appears to do when nearest neighbors are evaluated by proximity of their branches (Gambrel and Lasker, 2016). Distances between nearest neighboring octocorals were compared among microhabitats using one-way ANOVA for each taxon.

Colony size:

To test for fitness-related consequences of octocoral distribution, the sizes of colonies of Gorgonia ventalina were compared among microhabitats. This species was selected because it is common on shallow reefs around St. John (Lenz et al., 2015), and its two-dimensional morphology is tractable to quantification through planar area (cm2). Colonies of G. ventalina with holdfasts in one of the three microhabitats were haphazardly selected (n = 15 colonies microhabitat− 1) at 10-m depth, and their planar area measured using photographs (Sony Cyber-shot Exmor R camera with 18.2-megapixel resolution). Each photograph included a scale bar, and the colonies were gently held against a flat plastic mesh to obtain a complete planar image. Photographs were analyzed using ImageJ 1.48v software (Schneider et al., 2012) and colony sizes were compared among microhabitats using one-way ANOVA.

All statistical analyses were conducted in RStudio version 3.2.4 (R Core Team, 2016), and the statistical assumptions of ANOVA (for normality and homoscedasticity) were tested through graphical analyses of the residuals.

Data Processing Description

BCO-DMO Data Processing Notes:

-Reformatted column names to comply with BCO-DMO standards
-Replaced blank cells with nd

[table of contents | back to top]

Data Files

File
distribution.csv (Comma Separated Values (.csv), 1.99 KB) MD5:294c1b252c9017d139a2740525f9e094 Primary data file for dataset ID 745666

[table of contents | back to top]

Related Publications

Al-Marayati, M., & Edmunds, P. J. (2018). Octocoral distribution is associated with substratum orientation on coral reefs in St. John, U.S. Virgin Islands. Journal of Experimental Marine Biology and Ecology, 500, 55–62. doi:10.1016/j.jembe.2017.12.015
Results
,
Methods

[table of contents | back to top]

Parameters

Parameter	Description	Units
Transect	20 m x 2 m area where distribution was surveyed	unitless
Location	Name of shallow reef where survey was conducted	unitless
substratum_vertical	Number of colonies found with holdfasts settled on verticle microhabitats	count
substratum_horizontal	Number of colonies found with holdfasts settled on horizontal microhabitats	count
substratum_inclined	Number of colonies found with holdfasts settle on inclined microhabitats	count
Gorgonia_ventalina_vertical	Number of colonies found with holdfasts settled on verticle microhabitats	count

Gorgonia_ventalina_horizontal	Number of colonies found with holdfasts settled on horizontal microhabitats	count
Gorgonia_ventalina_inclined	Number of colonies found with holdfasts settle on inclined microhabitats	count
Pseudoplexaura_spp_vertical	Number of colonies found with holdfasts settled on verticle microhabitats	count
Pseudoplexaura_spp_horizontal	Number of colonies found with holdfasts settled on horizontal microhabitats	count
Pseudoplexaura_spp_inclined	Number of colonies found with holdfasts settle on inclined microhabitats	count
Eunicea_spp_vertical	Number of colonies found with holdfasts settled on verticle microhabitats	count
Eunicea_spp_horizontal	Number of colonies found with holdfasts settled on horizontal microhabitats	count
Eunicea_spp_inclined	Number of colonies found with holdfasts settle on inclined microhabitats	count
Muricea_spp_vertical	Number of colonies found with holdfasts settled on verticle microhabitats	count
Muricea_spp_horizontal	Number of colonies found with holdfasts settled on horizontal microhabitats	count
Muricea_spp_inclined	Number of colonies found with holdfasts settle on inclined microhabitats	count
Plexaurella_spp_vertical	Number of colonies found with holdfasts settled on verticle microhabitats	count
Plexaurella_spp_horizontal	Number of colonies found with holdfasts settled on horizontal microhabitats	count
Plexaurella_spp_inclined	Number of colonies found with holdfasts settle on inclined microhabitats	count
Antillogorgia_spp_vertical	Number of colonies found with holdfasts settled on verticle microhabitats	count
Antillogorgia_spp_horizontal	Number of colonies found with holdfasts settled on horizontal microhabitats	count
Antillogorgia_spp_inclined	Number of colonies found with holdfasts settle on inclined microhabitats	count
Plexaura_spp_vertical	Number of colonies found with holdfasts settled on verticle microhabitats	count
Plexaura_spp_horizontal	Number of colonies found with holdfasts settled on horizontal microhabitats	count
Plexaura_spp_inclined	Number of colonies found with holdfasts settle on inclined microhabitats	count
Pterogorgia_spp_vertical	Number of colonies found with holdfasts settled on verticle microhabitats	count
Pterogorgia_spp_horizontal	Number of colonies found with holdfasts settled on horizontal microhabitats	count
Pterogorgia_spp_inclined	Number of colonies found with holdfasts settle on inclined microhabitats	count

[table of contents | back to top]

Project Information

LTREB Long-term coral reef community dynamics in St. John, USVI: 1987-2019 (St. John LTREB)

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

Coverage: St. John, U.S. Virgin Islands; California State University Northridge

Long Term Research in Environmental Biology (LTREB) in US Virgin Islands:

From the NSF award abstract:
In an era of growing human pressures on natural resources, there is a critical need to understand how major ecosystems will respond, the extent to which resource management can lessen the implications of these responses, and the likely state of these ecosystems in the future. Time-series analyses of community structure provide a vital tool in meeting these needs and promise a profound understanding of community change. This study focuses on coral reef ecosystems; an existing time-series analysis of the coral community structure on the reefs of St. John, US Virgin Islands, will be expanded to 27 years of continuous data in annual increments. Expansion of the core time-series data will be used to address five questions: (1) To what extent is the ecology at a small spatial scale (1-2 km) representative of regional scale events (10's of km)? (2) What are the effects of declining coral cover in modifying the genetic population structure of the coral host and its algal symbionts? (3) What are the roles of pre- versus post-settlement events in determining the population dynamics of small corals? (4) What role do physical forcing agents (other than temperature) play in driving the population dynamics of juvenile corals? and (5) How are populations of other, non-coral invertebrates responding to decadal-scale declines in coral cover? Ecological methods identical to those used over the last two decades will be supplemented by molecular genetic tools to understand the extent to which declining coral cover is affecting the genetic diversity of the corals remaining. An information management program will be implemented to create broad access by the scientific community to the entire data set.

The importance of this study lies in the extreme longevity of the data describing coral reefs in a unique ecological context, and the immense potential that these data possess for understanding both the patterns of comprehensive community change (i.e., involving corals, other invertebrates, and genetic diversity), and the processes driving them. Importantly, as this project is closely integrated with resource management within the VI National Park, as well as larger efforts to study coral reefs in the US through the NSF Moorea Coral Reef LTER, it has a strong potential to have scientific and management implications that extend further than the location of the study.

Collaborative research: Ecology and functional biology of octocoral communities (VI Octocorals)

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

Coverage: St. John, US Virgin Islands: 18.3185, 64.7242

The recent past has not been good for coral reefs, and journals have been filled with examples of declining coral cover, crashing fish populations, rising cover of macroalgae, and a future potentially filled with slime. However, reefs are more than the corals and fishes for which they are known best, and their biodiversity is affected strongly by other groups of organisms. The non-coral fauna of reefs is being neglected in the rush to evaluate the loss of corals and fishes, and this project will add on to an on-going long term ecological study by studying soft corals. This project will be focused on the ecology of soft corals on reefs in St. John, USVI to understand the Past, Present and the Future community structure of soft corals in a changing world. For the Past, the principal investigators will complete a retrospective analysis of octocoral abundance in St. John between 1992 and the present, as well as Caribbean-wide since the 1960's. For the Present, they will: (i) evaluate spatio-temporal changes between soft corals and corals, (ii) test for the role of competition with macroalgae and between soft corals and corals as processes driving the rising abundance of soft corals, and (iii) explore the role of soft corals as "animal forests" in modifying physical conditions beneath their canopy, thereby modulating recruitment dynamics. For the Future the project will conduct demographic analyses on key soft corals to evaluate annual variation in population processes and project populations into a future impacted by global climate change.

This project was funded to provide and independent "overlay" to the ongoing LTREB award (DEB-1350146, cofunded by OCE, PI Edmunds) focused on the long-term dynamics of coral reefs in St. John.

Note: This project is closely associated with the project "RAPID: Resilience of Caribbean octocorals following Hurricanes Irma and Maria". See: https://www.bco-dmo.org/project/749653.

The following publications and data resulted from this project:
2017 Tsounis, G., and P. J. Edmunds. Three decades of coral reef community dynamics in St. John, USVI: a contrast of scleractinians and octocorals. Ecosphere 8(1):e01646. DOI: 10.1002/ecs2.1646
Rainfall and temperature data
Coral and macroalgae abundance and distribution
Descriptions of hurricanes affecting St. John

2016 Gambrel, B. and Lasker, H.R. Marine Ecology Progress Series 546: 85–95, DOI: 10.3354/meps11670
Colony to colony interactions
Eunicea flexuosa interactions
Gorgonia ventalina asymmetry
Nearest neighbor surveys

2015 Lenz EA, Bramanti L, Lasker HR, Edmunds PJ. Long-term variation of octocoral populations in St. John, US Virgin Islands. Coral Reefs DOI 10.1007/s00338-015-1315-x
octocoral survey - densities
octocoral counts - photoquadrats vs. insitu survey
octocoral literature review
Download complete data for this publication (Excel file)

2015 Privitera-Johnson, K., et al., Density-associated recruitment in octocoral communities in St. John, US Virgin Islands, J.Exp. Mar. Biol. Ecol. DOI: 10.1016/j.jembe.2015.08.006
octocoral density dependence
Download complete data for this publication (Excel file)

Other datasets related to this project:
octocoral transects - adult colony height

RUI-LTREB Renewal: Three decades of coral reef community dynamics in St. John, USVI: 2014-2019 (RUI-LTREB)

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

Coverage: USVI

Describing how ecosystems like coral reefs are changing is at the forefront of efforts to evaluate the biological consequences of global climate change and ocean acidification. Coral reefs have become the poster child of these efforts. Amid concern that they could become ecologically extinct within a century, describing what has been lost, what is left, and what is at risk, is of paramount importance. This project exploits an unrivalled legacy of information beginning in 1987 to evaluate the form in which reefs will persist, and the extent to which they will be able to resist further onslaughts of environmental challenges. This long-term project continues a 27-year study of Caribbean coral reefs. The diverse data collected will allow the investigators to determine the roles of local and global disturbances in reef degradation. The data will also reveal the structure and function of reefs in a future with more human disturbances, when corals may no longer dominate tropical reefs.

The broad societal impacts of this project include advancing understanding of an ecosystem that has long been held emblematic of the beauty, diversity, and delicacy of the biological world. Proposed research will expose new generations of undergraduate and graduate students to natural history and the quantitative assessment of the ways in which our planet is changing. This training will lead to a more profound understanding of contemporary ecology at the same time that it promotes excellence in STEM careers and supports technology infrastructure in the United States. Partnerships will be established between universities and high schools to bring university faculty and students in contact with k-12 educators and their students, allow teachers to carry out research in inspiring coral reef locations, and motivate children to pursue STEM careers. Open access to decades of legacy data will stimulate further research and teaching.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1332915
NSF Division of Environmental Biology (NSF DEB)	DEB-1350146

[table of contents | back to top]