Size frequency of octocorals along long-term transects in St. John, USVI from 2014 to 2015.

Website: https://www.bco-dmo.org/dataset/745620
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)

Contributors	Affiliation	Role
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Coverage

Spatial Extent: **Lat**:18.32 **Lon**:-64.723
Temporal Extent: 2014-07-26 - 2014-08-10

Dataset Description

Data published in Marine Biology paper entitled "*Variability of size structure and species composition in Caribbean octocoral communities under contrasting environmental conditions".*

Methods & Sampling

Methodology from Tsounis, G., Edmunds, P.J., Bramanti, L. et al. Mar Biol (2018) 165: 29. https://doi.org/10.1007/s00227-018-3286-2

Surveys were conducted at East Cabritte and Europa Bay (Fig. 1) in July and August 2014, and March 2015. The sites represent contrasting exposure regimes, suggested by the exposure of East Cabritte to prevailing winds and swells, and the shelter of Europa Bay in the lee of Cabritte Horn. Measurements of physical environmental conditions (described below) were used to quantify these differences.

At each site, a 50 × 10 m study area was haphazardly established, within which aspects of the biota and the physical environment were measured. The long axes of the areas were parallel to the shore and ranged from 7.5- to 9.0-m depth at East Cabritte, and from 5.6- to 8.0-m depth at Europa Bay, and the short axes were perpendicular to the shore and crossed a depth gradient of 5.6–7.2 m at Europa Bay, and 7.5–9.0 m at East

Cabritte. The depth ranges of the study sites differed, because the reef at Europa did not extend into deeper water, while the reef at East Cabritte markedly steepened above 7 m. Five, 10-m transects were equally spaced along, and perpendicular to, the long axis of each study area. Octocoral community structure was compared between sites using octocoral diversity, size, and density in both multivariate and univariate statistics frameworks.

Physical environmental condition

Environmental conditions at each site were characterized in the summer of 2014 and the winter of 2014–2015 through measurements of water motion, benthic rugosity, sedimentation, and light intensity. Water motion was characterized using two methods, first, using the wave climate recorded by an NOAA buoy moored 7.8 km from the study site (CariCOOS Data Buoy C at Mooring VI-105), and second, through direct measurements of integrated water motion using clod cards (Doty 1971).

Hourly wave direction (degrees relative to north) from March 15th 2011, 17:00 h to March 2nd 2015, 21:00 h was obtained from the NOAA buoy VI-105 (http://www.caricoos.org/drupal/virgin_islands), with measurements averaged by hour from a sampling frequency of 2 Hz in 17 min bursts. To obtain hourly averages, a varying number of records were averaged depending on the coincidence of the 17-min sampling bursts with the 60-min averaging period. Using hourly averages, the proportion of time (i.e., percentages based on number of hours) when waves directly impacted each site was calculated based on the direction from which the waves originated. The two sites were impacted by waves originating from dissimilar, but partially overlapping directions, because the sites differed in orientation and location along the shore relative to the southerly projection of Cabritte Horn (Fig. 1). Europa Bay is exposed to waves from 135° to 250°, and East Cabritte to waves from 60° to 135°. To capture these effects, the number of hours describing mean wave directions corresponding to each of these directional bins was quantified, without considering wave refraction around Cabritte Horn. Wave height was not evaluated using data from this buoy, as its distance from our study sites made estimates of wave height unreliable.

Integrated water motion was measured in situ using clod cards (Doty 1971) that were prepared in a single batch for each deployment, dried to a constant weight at 50 °C, and weighed prior to use. Clod cards had similar initial weights [128 ± 2 g (mean ± SE, $n = 78$)], and were deployed in July and August 2014, and March 2015, and assigned to each site in a paired design (two clods per site). Clods were secured for 24–48 h to posts ~ 30 cm above the benthos at 9-m depth adjacent to, but outside of, the octocoral canopy. Following deployment, clods were dried to a constant weight at 50 °C, and integrated water motion was evaluated from the dissolution of plaster in units of g day^{-1}.

Sedimentation was measured with sediment traps in two deployments for 8 and 9 days in 2014 (to begin a new measurement when a storm at the end of the first deployment saturated the traps), and in a single deployment for 12 day in 2015. Both sites were monitored simultaneously. The traps consisted of PVC tubes (20 × 5 cm ID) that were deployed 60 cm above the benthos (Edmunds and Gray 2014). Traps were capped in situ, returned to the lab, and filtered through pre-weighed filters (Whatman #113). Filters and sediment were rinsed with freshwater to remove salt, dried to a constant weight at 50 °C, and weighed (± 1 mg). Sedimentation was normalized by catchment area of the traps, and time (mg cm^{-2} day^{-1}).

In situ light intensity was measured using two integrating submersible light meters (JFE-Advantech Compact-LW) fitted with a cosine-corrected collector sensitive to photosynthetically active radiation (PAR, 400–700 nm) and a wiper blade that cleaned the collector prior to each measurement. The meters were deployed in a paired design at the two sites for 8 days in 2014 (August 10–15th and August 18–19th) and 8 days in 2015 (March 3–13th). Each meter was attached to a post at 9-m depth adjacent to the octocoral community, but ~ 5 m from the nearest octocoral colony to avoid shading. Light intensity was recorded at 0.033 Hz, and data were used to generate two dependent variables, one recording the maximum daily intensity (µmol m^{-2} s^{-1}) and the other recording the intensity integrated over each 24-h period (units of mol m^{-2} day^{-1}).

Benthic rugosity was determined along the five transects at each study plot using a light chain (10-mm links) which was laid along each transect to conform to the reef surface. Rugosity was calculated as the quotient of the linear distance and the conformed length of the chain (Luckhurst and Luckhurst 1978).

The hypothesis that the sites differed in environmental parameters was tested with univariate ANOVA using R (R Development Core Team 2008). Sediment traps and clods cards were not deployed at both sites in synchronous deployments due to logistical constraints, and these data were compared between sites and times using a two way, Model I ANOVA. Light intensity differs among days, and, therefore, was compared between sites using a within-subject design in the aov function in R, accounting for variation over time by considering deployment day as a blocking factor. Substratum rugosity was compared between sites using one-way ANOVA. In all cases, the ANOVA assumptions of normality and homoscedasticity were tested through graphical analyses of residuals.

Octocoral community structure

Species richness:
Octocoral species richness was compared between sites based on 50 quadrats (1 × 1 m) that were sequentially placed along the five, 10 m transects that crossed the short axis of the study plots, and censused for octocoral presence. Surveys began in July and August 2014, and were concluded in February and March 2015 (i.e., two field trips were required). Octocoral diversity was determined using Pielou's Evenness Index (J´) (Pielou 1966), and the Shannon–Wiener Diversity index, H´ (Shannon 1948). This study considered adult octocorals, and excluded recruits (i.e., colonies ≤ 5 cm tall [HR Lasker, unpublished data]) from the surveys. However colonies ≤ 5 cm were censused if it was obvious that they had been larger adults that were reduced in size by predators. Octocorals were identified to the lowest taxonomic-level possible, as determined through voucher samples that were microscopically inspected for sclerites (after Bayer 1961). Preliminary sampling revealed 10 genera and 35 species at the two sites, but a small number (< 1.6%, n = 1290 colonies) could not be identified to species and were scored by genus (mostly Eunicea and Pseudoplexaura). Initial work indicated 39 nominal species (Edmunds and Lasker 2016), though subsequent analysis refined the species count to 35 (this study). We do, however, highlight the fact that the distinctions between Pseudoplexaura wagenaari and P. flagellosa, those between Plexaurella dichotoma and P. fusifera and and those between Eunicea laxispica, Eunicea mammosa and Eunicea succinea are difficult to make, especially in the field. For this study, we opted to distinguish between these species in our analyses, based on the best information available (spicule analysis), but acknowledge that this might not always be feasible in future studies, where pooling these pairs will facilitate consistent long-term data series analyses using multiple observers. Rarefaction curves (sensu Coleman et al. 1982) were used to evaluate the efficacy of the sampling regime (i.e., number of 1 m2 quadrats) in quantifying octocoral species abundance. At each site, the number of species as a function of sample size (number of quadrats) was analyzed using the specaccum option in the vegan package (version 2.3.2) for R [R Development Core Team 2008 (Oksanen et al. 2015)], and species abundance was evaluated by the asymptote of the curves against sample size.

Colony abundance:
To compare community structure of octocoral colonies between sites, we randomly subsampled 32 of the 50 quadrats (each 1 × 1 m) along the transects (described above) to remove the biases associated with uniform sampling (Sokal and Rohlf 1995). Densities (colonies m−2) by species were log(x) transformed and used to compute Bray–Curtis dissimilarity indices after applying a dummy value (+ 1) to account for paired observations of zero (Clarke et al. 2006). Dissimilarity indices were compared between sites using a one factor PERMANOVA with 999 permutations. Dissimilarity indices were produced using the vegdist function, and PERMANOVA was performed using the ADONIS function, both in the vegan package (version 2.3.2) for R [R Development Core Team 2008 (Oksanen et al. 2015)]. A similarity percentage analysis (SIMPER, Clarke 1993) was performed using the simper function in the vegan package (version 2.3.2) for R, and used to assess the contribution of individual species to the total dissimilarity between sites. Spatial variation in multivariate community structure was visualized using ordination plots generated by non-metric dimensional scaling (NMDS) that were based on Bray–Curtis dissimilarities (using the Vegan package in R).

Colony size:
The colony size–frequency distributions of the three most common octocorals that could be identified in the field (Antillogorgia americana, Eunicea flexuosa, and Gorgonia ventalina) were compared between sites. Colony heights were surveyed using 1-m-wide belt transects placed along the five transects dividing the study plots. Colonies were measured as encountered within these survey areas, with the objective of measuring 75–100 colonies of each species for each size class at each site. When too few colonies were found to meet the target sample size, additional non-overlapping belt transects were censused within the study plot to reach the target number of colonies. To test for differences in colony sizes for the three species between sites, one-way PERMANOVA with 999 permutations were performed (Anderson 2001) using the Adonis function in the vegan package (version 2.3.2) for the R software [R Development Core Team 2008 (Oksanen et al. 2015)]. Two-sample Kolmogorov–Smirnov tests using the R software were performed to compare the complete size–frequency distributions for each species between sites.

Community structure resolved by genus versus by species:
To evaluate the effect of taxonomic resolution on the differences in community structure detected between sites, multivariate analyses were conducted with genus- and species resolution, and the contribution of each genus or species (respectively) to total dissimilarity between sites was resolved using SIMPER.

Data Processing Description

BCO-DMO Data Processing Notes:

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

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Data Files

File
size_frequency.csv(Comma Separated Values (.csv), 15.49 KB) MD5:ca831e170c6eefd63c201e5335b87dfb Primary data file for dataset ID 745620

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Related Publications

Tsounis, G., Edmunds, P. J., Bramanti, L., Gambrel, B., & Lasker, H. R. (2018). Variability of size structure and species composition in Caribbean octocoral communities under contrasting environmental conditions. Marine Biology, 165(2). doi:10.1007/s00227-018-3286-2
Results
,
Methods

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Parameters

Parameter	Description	Units
Date	Calendar date	unitless
Site	Study site: Europa = Europa Bay; E_Cabritte = East Cabritte. Both in St. John, USVI.	unitless
Depth	Depth in meters	meters
Transect	Transect position, refering to the position within a 50x10m sampling area divided by 6 transects (0m, 10m, 20m, 30m, 40m, 50m), or random	unitless
Side	L= left side of transect line, R= right side of the transect line (orientation towards the nearest coast)	unitless
Quadrat_No	Distance in meters along the transect line, starting opposite of the shore side	meters
Num_of_Octocorals	Number of octocorals	count
Species	Octocoral species	unitless
size	Height in cm of cotcoroal colonies, measured from the base to the farthest tips	centimeters

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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, co-funded 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

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1332915

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