Sponge density and morphology and percent cover of sponges and associated community at Virgin Islands Territorial Coral Reef Monitoring Program site, pre- and post-hurricane, 2015-2017

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Project
» RAPID: Collaborative Research: Sponge resilience in the face of multiple stressors (Sponge resilience)

Contributors	Affiliation	Role
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Abstract
Sponge density and morphology and percent cover of sponges and associated benthic community determined from videos of three transects at Virgin Islands Territorial Coral Reef Monitoring Program site, pre- and post-hurricane, 2015-2017.

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Coverage

Spatial Extent: **N**:18.3743 **E**:-64.8602 **S**:18.2786 **W**:-65.0823
Temporal Extent: 2015-08 - 2017-12

Dataset Description

This dataset includes sponge density and morphology and percent cover of sponges and associated benthic community determined from videos along transects at six sites at the Virgin Islands Territorial Coral Reef Monitoring Program site, pre- and post-hurricane, 2015-2017.

These data were published in Gochfeld et al (2020).

Methods & Sampling

Prior to the 2017 hurricanes, six shallow (8-15 m depth) reef sites had been selected from the Virgin Islands Territorial Coral Reef Monitoring Program's (TCRMP) permanent monitoring sites to study variation in sponge communities in St. Thomas. These sites included Black Point (N18° 20.665', W64° 59.107'), Coculus Rock (N18° 18.734', W64° 51.613'), and Magens Bay (N18° 22.459', W64° 56.077'), which are in embayments with heavily developed watersheds. Buck Island (N18° 16.717', W64° 53.925') and Savana Island (N18° 20.437', W65° 04.939') are located near undeveloped offshore cays. Botany Bay (N18° 21.433', W65° 02.071') is a nearshore site in a bay with a low level of watershed development. For this study, we used three randomly selected transects out of the six permanently established 10 m TCRMP transects at each site. The same three transects at each site were re-surveyed repeatedly in August 2015, August 2016 (pre-hurricanes) and December 2017 (10 weeks post-hurricanes).

Sponge assemblages were surveyed on each transect using multiple measures. Sponge density was quantified by a diver in situ by counting every sponge individual (i.e., ramet) within 0.5 m of each transect (resulting in 0.5 x 10 m belt transects) for all sites except Black Point, where 0.5 m on both sides of the transects (1 x 10 m belt transects) were surveyed. Density (sponges/m2) was calculated as the total number of individual sponges per transect, divided by the transect area (Gochfeld et al. 2020).

To determine whether different sponge morphologies were differentially affected by hurricanes, each sponge from each transect was assigned to a broad morphological category (sensu Wulff 2006). These categories included excavating sponges ("excavating"); low relief encrusting sponges ("encrusting"); thicker cushions, massive, tube, vase, or other amorphous shapes of medium relief ("massive"); and upright, branching and rope sponges ("upright"). These groupings differ slightly from those used by Wulff (2006), but represent the morphotypes found within our transects in St. Thomas. The percent of the entire sponge community represented by each morphological category was calculated as the number of individuals in each category divided by the total number of individuals for each transect and multiplied by 100 (Gochfeld et al. 2020).

Percent cover of sponges was determined from videos of the three transects at each site following established methods from the Virgin Islands Territorial Coral Reef Monitoring Program (Smith et al. 2016). A diver swam at uniform speed while videoing the substrata from a height of approximately 0.4 m (the height of a guide wand). Consecutive, non-overlapping images, each approximately 0.64 x 0.48 m in planar area, were captured for each transect, for an average of 21 images per transect. Twenty random points were superimposed on each image (average of 1282 points per site, per sampling period) and the benthic cover underneath each point was identified to the lowest identifiable taxonomic level and used in the calculation of percent cover by transect. Specific sponges were not identified in the benthic cover analysis and were instead grouped into the overarching category of "Sponge". The number of points per image required to adequately characterize the percent cover of each of the benthic categories (sponges, hard corals, macroalgae, epilithic algal community [EAC; i.e., diminutive turf algae and other low complexity filamentous algal communities; Smith et al. 2016], non-living substrata, calcareous algae, cyanobacterial mats, gorgonians, zoanthids and other/unknown living substrata) was determined by visual inspection of the running means. For all categories, the mean value stabilized at no more than 17 points per image per transect, indicating that the 20 points analyzed per image was sufficient to accurately reflect percent cover at these sites (Gochfeld et al. 2020).

Data Processing Description

To test for hurricane effects on various metrics of the sponge community, repeated measures analyses of variance (ANOVA) were performed on sponge density and sponge volume, with site as a random factor, using the lmer function in the lme4 package in R (Bates et al. 2015). Square-root transformations were performed to meet the assumptions of parametric analysis. For significant effects, post-hoc comparisons were performed using the lumens function with the Tukey correction specified in R. To characterize hurricane effects on sponges with differing morphologies, a repeated measures ANOVA was also performed on arcsine transformed proportions to test for the main effect of year, using site as a random factor, followed by least square means post-hoc tests where warranted (Gochfeld et al. 2020).

Sponges, hard corals, macroalgae, EAC and non-living substrata represented over 90% of the overall benthic substrata. Percent cover of these major benthic community constituents were compared individually among years using repeated measures ANOVAs as described above, following logarithmic or square root transformation if necessary. Post-hoc comparisons among years were performed using least square means as described above. Other benthic constituents were either of such low representation or did not meet the assumptions of parametric analysis even after transformation, and were not analyzed independently (Gochfeld

et al. 2020).

BCO-DMO Processing:
- added conventional header with dataset name, PI name, version date
- modified parameter names to conform with BCO-DMO naming conventions
- added lat, and lon columns
- joined tables of density, morphology, and benthos percent cover into single table
- changed calcareous_agale to calcareous_algae
- rounded percent cover values to 2 decimal places

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Data Files

File
sponge_density_morph_cover.csv (Comma Separated Values (.csv), 6.72 KB) MD5:5ce47ff1d24d615bf8fbf949e2979a83 Primary data file for dataset ID 814267

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Related Publications

Bates, D., Mächler, M., Bolker, B., & Walker, S. (2015). Fitting Linear Mixed-Effects Models Usinglme4. Journal of Statistical Software, 67(1). doi:10.18637/jss.v067.i01
Methods

Gochfeld, D. J., Olson, J. B., Chaves-Fonnegra, A., Smith, T. B., Ennis, R. S., & Brandt, M. E. (2020). Impacts of Hurricanes Irma and Maria on Coral Reef Sponge Communities in St. Thomas, U.S. Virgin Islands. Estuaries and Coasts, 43(5), 1235–1247. doi:10.1007/s12237-020-00694-4
Methods

Smith, T.B., R.S. Ennis, E. Kadison, R.S. Nemeth, and L. Henderson. (2016) The United States Virgin Islands Territorial Coral Reef Monitoring Program. 2016 Annual Report. University of the Virgin Islands, United States Virgin Islands. 286 pp.
Methods

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Parameters

Parameter	Description	Units
Year	sampling year	unitless
Site	sampling site identifier	unitless
site_name	name of sampling site	unitless
lat	latitude; north is positive	decimal degrees
lon	longitude; east is positive	decimal degrees

site_description	description of relative human development of site	unitless
Transect	transect number	unitless
Sponge_density	Number of sponges per unit area	sponges/meter^2
Encrusting_pcent	percent of encrusting sponges on the transect	percent (%)
Excavating_pcent	percent of excavating sponges on the transect	percent (%)
Massive_pcent	percent of massive sponges on the transect	percent (%)
Upright_pcent	percent of upright sponges on the transect	percent (%)
calcareous_algae	percent cover by calcareous algae along transect	percent (%)
coral	percent cover by coral along transect	percent (%)
cyanobacterial_mats	percent cover by cyanobacterial mats along transect	percent (%)
epilithic_algal_community	percent cover by epilithic algal community along transect	percent (%)
gorgonians	percent cover by gorgonians along transect	percent (%)
macroalgae	percent cover by macroalgae along transect	percent (%)
non_living	percent cover by non-living substrata along transect	percent (%)
other_unknown_living	percent cover by other or unknown living substrata along transect	percent (%)
zoanthids	percent cover by zoanthids along transect	percent (%)

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Instruments

Dataset-specific Instrument Name	high definition digital video recorder
Generic Instrument Name	Camera
Dataset-specific Description	Used to record bottom along transects for % cover analysis.
Generic Instrument Description	All types of photographic equipment including stills, video, film and digital systems.

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Project Information

RAPID: Collaborative Research: Sponge resilience in the face of multiple stressors (Sponge resilience)

Coverage: St. Thomas, U.S. Virgin Islands

NSF Award Abstract:
Over the past several decades, coral reefs worldwide have undergone a transition from being dominated by the corals themselves to being dominated by sponges or algae. The causes of these changes are complex, but they include both natural stressors, such as diseases and hurricanes, and impacts from human activities, such as coastal development and climate change. There are over 600 species of sponges on Caribbean coral reefs, and they serve many important ecological roles, including nutrient cycling, providing food and shelter for other reef animals, and producing a tremendous diversity of chemical compounds that are important for controlling species interactions on the reef, and may serve as potential new drugs. In spite of their importance on coral reefs, there are many aspects of sponge biology that remain unknown, including how they respond to different types of stressors. Coral reefs in St. Thomas, in the U.S. Virgin Islands, are exposed to different levels of man-made stressors, depending upon their proximity to coastal development, and the sponge assemblages on these reefs also vary with levels of human impacts. In September 2017, St. Thomas was devastated by two Category 5 hurricanes in a row. Since, unlike corals, virtually nothing is known about what happens to sponge communities in the aftermath of hurricanes, the research team will use a combination of field ecology and population genetics approaches to determine how sponge communities respond and recover from these devastating storms and whether prior exposure to land-based stressors affects their recovery. Researchers at the Universities of Mississippi, Alabama and the Virgin Islands will participate in this RAPID project, and will provide training opportunities for students and postdoctoral researchers, especially from underrepresented groups. Information will be provided to resource managers in the Virgin Islands, along with outreach programs to community groups in St. Thomas.

The goal of this project is to assess the impacts of single (e.g., hurricanes) versus multiple (e.g., hurricanes and land-based sources of pollution) stressors on the resilience, recovery, and recruitment of sponge communities in St. Thomas, U.S.V.I. Given the growing dominance of sponges on coral reefs worldwide, understanding the responses of sponges to natural and anthropogenic stressors is increasingly important. The investigators will leverage multiple years of data on sponge assemblages from several sites around the island of St. Thomas that varied in their levels of exposure to local land-based stressors prior to Hurricanes Irma and Maria, and evaluate changes to these diverse assemblages over time, beginning within 3 months of these devastating storms. Using a combination of natural and experimentally cleared plots, the investigators will assess the progress of sponge succession and whether the presence of algae interferes with sponge recruitment and recovery. Subsamples of recruits and nearby conspecifics will be collected to evaluate population genetic diversity and potential sources of new individuals. The data resulting from this project will provide critical insights into sponge resilience in response to hurricanes at sites previously exposed to land-based stressors, the initiation of succession within sponge communities, potential predictors of successional trajectory, and genetic diversity within sponge populations following a storm event. This information will help identify factors that inhibit coral recovery and potential approaches to enhance resilience of coral reefs.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1807807

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