Coral cover in St. John, US Virgin Islands from 2007-2016

Website: https://www.bco-dmo.org/dataset/750676
Data Type: Other Field Results
Version: 1
Version Date: 2018-12-06

Project
» 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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Coverage

Spatial Extent: **Lat**:18.32 **Lon**:-64.723
Temporal Extent: 2007 - 2016

Dataset Description

This study was carried out on shallow reefs along the south coast of St. John, which have been monitored since 1987, and studied since the 1950's. Three aspects of the time-series analyses are utilized, and the study period exploited concurrent sampling of coral cover, coral recruitment, and the dynamics of small corals (colonies ≤ 40-mm diameter). These aspects of community structure were studied at 5–6 sites at 5–9-m depth between Cabritte Horn and White Point (Figs. 1, S1), and each was added to the study as the project evolved, mostly for purposes other than the one described herein. The longevity and breadth of this study created opportunities for analyses that rarely have been considered in ecological investigations of coral reefs, but the ad hoc evolution of the study resulted in an imperfect match among the components, notably in the 4-m depth range over which the three aspects of community structure were studied. This depth range is ecologically relevant for corals, and interpretation of the present analysis therefore must be constrained by the assumption that temporal variation in coral recruitment, dynamics of small corals, and coral cover is similar between 5 and 9 m depth. Apart from the first two years over which recruitment was measured every ~ 6 months, annual surveys were completed in July and August. Throughout this analysis, study sites, and mean values by site, are treated as statistical replicates of the fringing reefs of St. John.

The entire Excel Workbook, which contains the additional datasets listed below, can be downloaded using the following link: https://datadocs.bco-dmo.org/docs/302/St_John_LTREB/data_docs/Data_for_P...

Coral mortality and growth in St. John, US Virgin Islands from 2006-2016: https://www.bco-dmo.org/dataset/750710
Coral cover, density, and recruits averages per site in St. John, US Virgin Islands from 2007-2016: https://www.bco-dmo.org/dataset/750740
Coral cover, density, and recruits averages per year in St. John, US Virgin Islands from 2007-2016:

https://www.bco-dmo.org/dataset/750771
Mean monthly seawater temperatures in St. John, US Virgin Islands from 1989-2016: https://www.bco-dmo.org/dataset/750049

Methods & Sampling

Coral cover
Coral cover was evaluated using photoquadrats (0.5 × 0.5 m) placed at random positions along 40 m, permanently marked transects at six sites at 7–9-m depth; these sites were randomly selected in 1992. The positions of photoquadrats were re-randomized at each sampling, and they were recorded using digital cameras (Nikon SLRs, with 6–36 Megapixel resolution) fitted with a zoom lens (Nikon DX 18–70 mm or FX 18–35 mm) and placed in a waterproof housing (Ikelite). Cameras were attached to two strobes (Nikon SB105) and mounted on a framer that held them perpendicular to the reef.
Photoquadrats were analyzed for benthic community structure by overlaying images with 200 randomly located dots and identifying the benthos beneath each dot. The full analysis resolved corals to species, macroalgae, and a combination category of crustose coralline algae, algal turf, and bare space (CTB). In the present analysis, coral cover is presented on a percentage scale, and was averaged by sites and year.

Coral recruitment
Coral recruitment was measured using unglazed terra cotta tiles (15 × 15 × 1 cm) that were individually attached to the benthos in approximately horizontal orientations using a stainless steel stud epoxied into non-living carbonate rock. Tiles were seasoned for several months in seawater prior to each deployment, and were secured, rough surface down, with a ~ 1 cm gap beneath to create a cryptic habitat favored for coral settlement. In the initial design, each tile was an independent replicate, and in the first year (2006-2007), 10 tiles were deployed at 5-m depth at each of five sites in August 2006, and at each site were placed in a cluster with tiles ~ 25-cm apart. The first tiles were immersed for ~ 6 months, and were replaced in January 2007. When tiles were replaced in August 2007, the sample size was increased to 15 tiles site-1, and over the following year, the tiles were changed every ~ 6 months (January 2008 and August 2008). Thereafter, tiles were replaced annually in July or August.

Retrieved tiles were cleaned in dilute bleach, air dried, and screened for coral recruits using a dissecting microscope (40 x). Recruits were identified to family using field guides, keys and advice from colleagues, and were resolved to Poritidae, Faviidae, Agaricidae, Siderastreidae, and “others”. Following scoring, tiles were cleaned in ~ 10% HCl, rinsed, and stored in seawater beneath the dock until the next deployment. The number of recruits on each tile was standardized among tile surfaces (top + bottom + sides) as recruits tile-1, and the results averaged by site. To compare recruit densities in the first two years with results obtained in the following years, annual recruitment in 2007 and 2008 at each site was estimated by summing mean recruitment by site in January and August of each year. Recruitment was compared among years using sites as replicates.

Small corals
Small corals were ≤ 40-mm diameter, and while many were juveniles based on the age of inferred sexual maturity, others were sexually mature, for example, based on analyses of Soong (1993) for Favia fragum (Esper, 1795), and Siderastrea radians (Pallas, 1766) and the recent study by Gelais et al. (2016) of S. siderea (Ellis & Solander, 1786). Small corals were counted at six sites, five at 5-m and one at 9-m depth, and separate sampling schemes were used to quantify density and dynamics (i.e., growth and mortality). The density of small corals was determined using 40 m, permanently marked transects placed along the isobath at each site, along which 40 quadrats (0.5 × 0.5 m) were randomly placed. Small corals in each quadrat were counted by genus, using calipers to ensure corals were in the desired size class, and densities were expressed at colonies 0.25 m-2, and averaged by site. Densities of small corals were compared among years using sites as replicates.

The growth and mortality of small corals was determined by marking corals with numbered aluminum tags that were epoxied to the substratum. Corals were tagged as encountered within an area ± 3 m of the first 10 m of the transects used to evaluate density (described above). All corals were tagged regardless of taxon, with some as small as ~ 2-mm diameter, but none > 40-mm diameter. Tagged corals were identified to species (or genus where the identity was uncertain), and their size measured as the mean of two planar diameters using calipers (± 1 mm). The following year, tags were relocated using a metal detector (Surfmaster PI Pro, White’s Electronics, Sweet Home, OR, or VibraProbe 580, Treasure Products Inc., Simi Valley, CA), and the marked coral located and evaluated for conditions (alive or dead) and, if alive, measured. Missing corals were assumed to have died, and their tags were removed. Additional tags were deployed annually to mark new corals that were added to replace those that died, but the number of corals tagged at each site varied among years depending on the time available for this task. Growth rates were expressed as mm y-1, and mortality as % y-1, and were averaged by site for all corals. Limited sample sizes prevented analyses with site as a replicate and taxon a factor as was used for cover and density.

Statistical analyses
Coral cover, recruitment, and density of small corals were compared among times using repeated measures (RM) PERMANOVA. For each demographic domain, the first analysis was completed with sites as replicate, time the RM factor, and abundance (i.e., cover or density of corals, pooled among taxa) the dependent variable. In the second analysis, sites were replicates, time the RM factor, and genus (for small corals: Porites, Agaricia, Favia, and Siderastrea) or family (for coral recruits: Poritidae, Agaricidae, Faviidae, and Siderastreidae) a between subjects fixed effect. PERMANOVAs were conducted using resemblance matrices prepared using square root-transformed data and Bray Curtis dissimilarities, and these were tested for differences among times. Where time was significant, multiple contrasts were conducted using pairwise t-tests in a permutational framework. The mortality and growth of small corals were compared over time with one way ANOVA, but they were not separated by site and taxon due to unequal representation (including missing data) at levels of these factors. Temporal trends in abundance, mortality, and growth also were analyzed using least squares linear regression, in which the dependent variables were averaged among sites; only significant regressions are reported.
Multivariate community structure in each domain was visualized with 2-D ordination using non-metric multidimensional scaling (nMDS) based on sites as replicates and resemblance matrices prepared using square-root transformed data and Bray-Curtis dissimilarities. Ordinations were based on results by genus (small corals) or family (recruits), and vectors were used to display the influence of dependent variables on separation along each nMDS axis as evaluated by Pearson correlations. PERMANOVA was used to test for multivariate variation in community structure over time, using an RM design with sites as replicates and time the repeated factor. Parametric statistics were completed using Systat 13 (Systat Software, Inc., San Jose, CA), and assumptions of normality and equal variance were tested through graphical analysis of residuals. nMDS and PERMANOVA were conducted using Primer-E 6.0 with PERMANOVA+ add-on (Quest Research, Ltd., Auckland, NZ).

Data Processing Description

BCO-DMO Processing Notes:

- Combined all tables with coral cover data
- Modified header to include detailed information
- replaced spaces with underscores
- added conventional header with dataset name, PI name, version date

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Data Files

File
fig2_coral_cover.csv (Comma Separated Values (.csv), 1.76 KB) MD5:51bc9ce018fe8f66bbe5380da4434732 Primary data file for dataset ID 750676

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Related Publications

Edmunds, P. J. (2018). The hidden dynamics of low coral cover communities. Hydrobiologia, 818(1), 193–209. doi:10.1007/s10750-018-3609-9
Results

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Parameters

Parameter	Description	Units
Year	year of measurement in YYYY format	unitless
Coral_Cover_Cabritte	coral cover mean at Cabritte	percent
Coral_Cover_Neptune	coral cover mean at Neptune	percent
Coral_Cover_E_TKT	coral cover mean at E TKT	percent
Coral_Cover_WLL	coral cover mean at WLL	percent
Coral_Cover_Europa	coral cover mean at Europa	percent
Coral_Cover_White	coral cover mean at While	percent
Coral_Cover_Mean	coral cover mean at all sites	percent
Coral_Cover_SE	coral cover standard error of all sites	percent
Small_corals_all_taxa_West_Tektite	Density of small corals (≤ 4 cm diameter) at West_Tektite	per 0.25 meter squared
Small_corals_all_taxa_Donkey_Bite	Density of small corals (≤ 4 cm diameter) at Donkey Bite	per 0.25 meter squared
Small_corals_all_taxa_Yawzi_Point	Density of small corals (≤ 4 cm diameter) at Yawzi Point	per 0.25 meter squared
Small_corals_all_taxa_White_Point	Density of small corals (≤ 4 cm diameter) at White Point	per 0.25 meter squared
Small_corals_all_taxa_Tektite_East	Density of small corals (≤ 4 cm diameter) at Taktite East	per 0.25 meter squared
Small_corals_all_taxa_Cabritte	Density of small corals (≤ 4 cm diameter) at Cabritte	per 0.25 meter squared
Small_corals_all_taxa_Mean	Mean density of small corals (≤ 4 cm diameter) at all sites	per 0.25 meter squared
Small_corals_all_taxa_SE	Standard error of density of small corals (≤ 4 cm diameter) at all sites	per 0.25 meter squared
Coral_recruits_to_tiles_Cabritte	Coral recuits on settlement tiles (15 x 15 x 1 cm) at Cabritte	recruits per tile
Coral_recruits_to_tiles_Europa	Coral recuits on settlement tiles (15 x 15 x 1 cm) at Europa	recruits per tile
Coral_recruits_to_tiles_Tektite	Coral recuits on settlement tiles (15 x 15 x 1 cm) at Tektite	recruits per tile
Coral_recruits_to_tiles_White	Coral recuits on settlement tiles (15 x 15 x 1 cm) at White	recruits per tile
Coral_recruits_to_tiles_Yawzi	Coral recuits on settlement tiles (15 x 15 x 1 cm) at Yawzi	recruits per tile
Coral_recruits_to_tiles_Mean	Mean of coral recuits on settlement tiles (15 x 15 x 1 cm) at all sites	recruits per tile
Coral_recruits_to_tiles_SE	Standard error of coral recuits on settlement tiles (15 x 15 x 1 cm) at all sites	recruits per tile

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Instruments

Dataset-specific Instrument Name	digital cameras
Generic Instrument Name	Camera
Dataset-specific Description	The positions of photoquadrats were re-randomized at each sampling, and they were recorded using digital cameras (Nikon SLRs, with 6–36 Megapixel resolution) fitted with a zoom lens (Nikon DX 18–70 mm or FX 18–35 mm) and placed in a waterproof housing (Ikelite).
Generic Instrument Description	All types of photographic equipment including stills, video, film and digital systems.

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Project Information

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.

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Funding

Funding Source	Award
NSF Division of Environmental Biology (NSF DEB)	DEB-0841441
NSF Division of Environmental Biology (NSF DEB)	DEB-1350146

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