Octocorals, scleractinia, macroalgae surveys describing species abundance and distribution on St. John and St. Thomas, USVI in 2011 (St. John LTREB project, VI Octocorals project)

Website: https://www.bco-dmo.org/dataset/630404
Data Type: Other Field Results
Version: 1
Version Date: 2016-01-06

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
Edmunds, Peter J.	California State University Northridge (CSUN)	Principal Investigator
Lasker, Howard	State University of New York at Buffalo (SUNY Buffalo)	Co-Principal Investigator
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Abstract
Octocorals, scleractinia, macroalgae surveys describing species abundance and distribution on St. John and St. Thomas, USVI in 2011 (St. John LTREB project, VI Octocorals project)

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Coverage

Spatial Extent: **N**:18.3833 **E**:-64.6797 **S**:18.3023 **W**:-65.0343
Temporal Extent: 2011 - 2011

Dataset Description

Photoquadrats recorded in 2011 on north and south shores of St. John and St. Thomas, USVI, were used to quantify octocoral and scleractinian abundance with generic resolution.

Data used in Edmunds et al., 2015

Original submitted excel file in data file section.

Methods & Sampling

From Edmunds et al (2015) Hydrobiologia:

The study exploited six sites between Cabritte Horn and White Point on the south shore of St. John that have been censused since 1992, and augments data from these sites with 11 new sites sampled in 2011. The six original sites were collapsed to provide a single sampling between Cabritte Horn and White Point, and together with the 11 new sites, an experimental design was created with three sites in each level of a two island x two shore analysis (i.e., with 12 sites). The original sites are at 7-9 m depth on fringing reefs, and since 2000, they have been sampled using ~40 photoquadrats (0.5 x 0.5 m) scattered randomly along a 40 m transect running parallel to the depth contour. To facilitate a comparison among sites on the two islands with similar sampling effort at each site (described below), photoquadrats recorded at the six original sites in 2011 were pooled (n ~ 240 quadrats), and 40 photoquadrats randomly selected for inclusion in the present analysis as representative of the single site between White Point and Cabritte Horn. The advantage of this approach is that it supported a balanced statistical design with ~40 quadrats at each of the 12 sites. Repeated random selections of 40 photoquadrats from the photoquadrats pooled among the original sites did not appreciably alter the mean estimates of coral abundance (data not shown). The 11 new sites were selected haphazardly to sample habitats similar to those evaluated at the original sites, and to sample the north and south shores (i.e., a contrast of exposure) of St. John and St. Thomas at the largest spatial scale that was possible to capture using the small boats available for this project. Sites were not selected with prior knowledge of the benthic communities, and the 40 m transects were placed along the depth contour of the first reef encountered after entering the water. The additional sites are not permanently marked (although the original sites are), but the GPS coordinates are reported in Fig. 1.

Photoquadrats were recorded with a digital camera (Nikon D90, 6.8 megapixels) fitted with an 18-70 mm lens, and two strobes (Nikonos SB 105). The camera was mounted on a framer to hold it perpendicular to the reef, and pictures were taken at random positions along each transect (images archived at http://mcr. lternet.edu/vinp). For scleractinians, images were analyzed for percentage cover by genus using CPCe software (Kohler & Gill, 2006), with 200 dots (10 pixel diameter) randomly placed on each image with the substratum beneath identified and scored. With this technique, ~8000 decisions characterized each site (~96,000 decisions for this study), and here we report analyses including a brief treatment of the cover of scleractinians, macroalgae, and crustose coralline algae, turf, and bare space [combined as CTB (Aronson & Precht, 2000)].

Measurements of planar area is the most widely used means of assessing abundance of benthic organisms on tropical reefs, but the biological interpretation of this metric is equivocal for branching organisms such as arborescent octocorals. Their soft and flexible branches create a canopy whose planar area varies depending on orientation, flow conditions, and height of branches. While percentage cover for such taxa evaluates their impact on the benthos, cover will vary depending on the conditions under which it is recorded, as well as the morphological strategies of the component taxa (e.g., candelabra versus fans), and it is related only loosely to the number of colonies producing the canopy [i.e., substratum occupancy Jackson, 1979)]. To avoid these challenges, we quantified octocoral densities (i.e., colonies 0.25 m-2), with colonies defined by the presence of their holdfast in the photoquadrat (Lenz et al., 2015), or contiguous encrusting colonies (for Erythropodium and encrusting Briareum). Photoquadrats provide an imperfect tool for quantifying arborescent colonies, but we have found densities determined in situ to be correlated with densities determined from photoquadrats, although analyses by photoquadrats are downwardly biased for octocoral density, with this effect intensifying at high densities (Lenz et al., 2015).

Data Processing Description

Preliminary screening of the photoquadrats indicated that 16 scleractinian genera (Orbicella, Montastraea, Agaricia, Colpophyllia, Dendrogyra, Dichocoenia Diploria, Eusmilia, Favia, Madracis, Meandrina, Porites, Stephanocoenia, Siderastrea, Manicina, and Mycetophyllia), 12 octocoral categories consisting of 11 genera (Briareum, Erythropodium, Plexaura, Pseudoplexaura, Eunicea, Plexaurella, Muricea, Muriceopsis, Antillogorgia, Gorgonia,and Pterogorgia), and ‘‘unknown’’ colonies could be identified. Additionally, percentage cover of macroalgae and CTB from Edmunds (2014) was used to provide a more comprehensive analysis of overall community structure on the study reefs.

Site-specific descriptive statistics were calculated from raw data using photoquadrats as replicates (ESM). Overall differences in abundance (pooled genera within the Scleractinia and Octocorallia) between islands, shores, and sites were tested with three-way ANOVA in which islands and shores were fixed effects, and sites were nested in islands and shores. Prior to analyses, percentages were arcsine transformed, abundances transformed to stabilize variances when some of the observations are zero ([x + 3/8]^0.5 [Zar, 2010]), and the statistical assumptions of normality and homoscedasticity tested through graphical analyses of residuals.

Spatial similarity in community structure was visualized using principal coordinates analyses (PCO) and nonmetric multidimensional scaling (MDS). Site-specific means were used to prepare resemblance matrices prepared using Bray-Curtis similarities for three groups of data: (1) overall community structure (scleractinians by genus, octocorals by genus, macroalgae, and CTB), (2) scleractinians by genus, and (3) octocorals by genus. Data were square-root transformed (for scleractinians, macroalgae, and CTB) or fourth-root transformed (octocorals) to adjust for extreme values (the problem was more acute for the octocorals for which many observations were zero). In both cases, the least stringent transformations were applied having verified that the multivariate outcome was broadly robust to the use of more stringent transformations. A PCO was prepared from the resemblance matrix for the overall community structure and was displayed in an ordination plot based on the first two axes. The PCO was combined with vectors with lengths (B 1) revealing the strength of the association between each dependent variable and the PCO axes (defined by Spearman correlation coefficients). The common origin for these vectors was arbitrarily placed on the PCO plot, the terminus of each vectors reveals the form of the relationship with each PCO (either positive or negative relative to the origin of the vector), and together these tools reveal the dependent variables most influential in determining patterns of similarity among sites.

The resemblance matrices for scleractinians and octocorals (separately) were used to prepare MDS plots with similarity contours (70, 80, and 90% levels) determined through clustering by means of group averages, and sites displayed as bubbles scaled to the combined cover of scleractinians or the combined abundance of octocorals. For octocorals, an additional MDS was prepared without Erythropodium in order to evaluate the impact of this taxon on the similaritybased analyses. Erythropodium was treated this way because estimation of its abundance based on number of colonies was made difficult by the challenges of using photographs to discern the boundaries of small encrusting colonies on topographically complex substrata. The resemblance matrices also were used to prepare PCO plots for scleractinians and octocorals in which the first two axes captured the multivariate structure of the resemblance matrices. When combined with vectors displaying the association between dependent variables and PCOs (as described above), this tool was used to reveal the taxa most influential in determining patterns of similarity among sites, shores, and islands.

Resemblance matrices were also prepared using photoquadrats as replicates, in these cases with the addition of a dummy value (=1) to accommodate paired observations of zero abundance. Transformations and similarities were applied as above, and the resemblance matrices used for three analyses. These resemblance matrices were used in three way PERMANOVAs (one for each of the overall community structure, octocorals, and scleractinians) testing the effect of islands, shores, and sites on multivariate community structure. Site was nested in islands and shores, and the results (Pseudo-F) displayed following 1000 permutations with a probability of occurrence by chance alone (Pperm). The photoquadrat-based resemblance matrices for octocorals, and scleractinians were statistically compared using a Mantel-type test (‘‘RELATE’’ in PRIMER 6 software) in a permutational format (1000 permutations). This test evaluated the extent to which the two resemblance matrices described similar multivariate variation among shores, sites, and islands. Inferential tests involving octocorals were repeated using a resemblance matrix in which Erythropodium was excluded as described above. Univariate statistics were completed using Systat 11, and multivariate analyses were completed using PRIMER 6 (Clark & Gorley, 2006) with PERMANOVA + (Anderson et al., 2008).

BCO-DMO Processing Notes:

- original file: 'All Data_Gorgonians_Scleract.xlsx'
- added conventional header with dataset name, PI name, version date, reference
- renamed parameters to BCO-DMO standard
- reformatted data from columns to rows to conform with database practices
- added lat/lon and photo columns

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Data Files

File	
octocoral - sp. abundance and distribution filename: All_Data_Gorgonians_Scleract_Hydrobiol_2015.xlsx Original excel file for dataset 630404. This file has been reworked and put into the BCO-DMO system for improved interoperability.	(ZIP Archive (ZIP), 90.92 KB) MD5:d1832e54a421c7d33d6661dbd5712de2
hydrobio_2015.csv Primary data file for dataset ID 630404	(Comma Separated Values (.csv), 787.20 KB) MD5:3160f2f375dde5e9ffc8bf4e352fcdca

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Related Publications

Edmunds, P. J., Tsounis, G., & Lasker, H. R. (2015). Differential distribution of octocorals and scleractinians around St. John and St. Thomas, US Virgin Islands. Hydrobiologia, 767(1), 347–360. https://doi.org/10.1007/s10750-015-2555-z
Results

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Parameters

Parameter	Description	Units
site	sampling location	unitless
lat	latitude; north is positive	decimal degrees
lon	longitude; east is positive	decimal degrees
year	year of survey	yyyy
island	island of survey	unitless
shore	north or south shore of island	unitless
station_code	ST=St. Thomas; SJ=St. John; N=north; S=south	unitless
photo	randomly assigned number for photoquadrat	unitless
taxon	genus of organism; CTB=crustose coralline algae/algal turf/bare space combined	unitless
abund_or_pcent_cover	abundance of octocorals or percent cover of scleractinia and macroalgae	specimens/0.25 m^2 or percent

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Instruments

Dataset-specific Instrument Name	camera
Generic Instrument Name	Camera
Dataset-specific Description	Nikon D90 - 6.8 megapixel digital camera
Generic Instrument Description	All types of photographic equipment including stills, video, film and digital systems.

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Deployments

Edmunds_VINP

Website	https://www.bco-dmo.org/deployment/523357
Platform	Virgin Islands National Park
Start Date	1987-01-01
End Date	2016-09-01
Description	Studies of corals and hermit crabs

Edmunds_StThomas

Website	https://www.bco-dmo.org/deployment/630432
Platform	Virgin Islands
Start Date	2011-01-01
End Date	2015-03-17
Description	coral studies

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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
NSF Division of Ocean Sciences (NSF OCE)	OCE-1334052
NSF Division of Environmental Biology (NSF DEB)	DEB-1350146

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