Scleractinia, macroalgae and octocoral surveys describing species abundance and distribution, in St. John, USVI in 1987–2013 (St. John LTREB project, VI Octocorals project).

Website: https://www.bco-dmo.org/dataset/664223
Data Type: Other Field Results
Version: Final
Version Date: 2016-11-08

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
Tsounis, Georgios	California State University Northridge (CSUN)	Co-Principal Investigator
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Coverage

Spatial Extent: **N**:-18.298056 **E**:64.803611 **S**:-18.376667 **W**:64.668056
Temporal Extent: 1987-06-01 - 2013-08-31

Dataset Description

Scleractinian, octocoral, and macroalgae abundance and percent cover.

Methods & Sampling

Based on Tsounis and Edmunds (In press), Ecosphere:

Analyses are based on ~ 1,600 photoquadrats recorded annually since 1987. Photoquadrats were recorded with a Nikonos V camera fitted with Kodachrome 64 slide film from 1987-1999, but from 2000, digital cameras were used (2000-2006: Nikon Coolpix 990, 3.3 megapixels; 2007: Nikon D70, 6.1 megapixels; 2011, Nikon D90, 12.3 megapixels; and 2012-2013, Nikon D7000, 16.2 megapixels). Cameras were fitted with a strobe (Nikonos SB105) and mounted on a quadrapod holding them perpendicular to the substratum (Edmunds 2002, 2013). The camera framer remained identical throughout the study and together with the cameras, resolved objects greater than or equal to 10-mm diameter in a 1 × 1 m framer. At each site, photoquadrats were recorded at ~ 10 contiguous locations along each of three transects that are parallel to one another at constant depth (+/- 2 meters), and 5-m apart (30 images y-1 at each site). The same transects were resampled every year. Sampling occurred in December 1987, March 1988, July 1988, December 1988, April 1989, October 1989, March 1991, May 1992, June 1993, August 1994, May 1995 to 1997, and July or August thereafter. Images are archived online (http://mcr.lternet.edu/vinp/overview/).

Images were analyzed for percentage cover of benthic organisms using CPCe version 3.6 software (Kohler and Gill 2006), or for abundance of octocoral colonies (number of colonies). First, percentage cover was determined using 200 dots randomly scattered on each image and scored by their occurrence on scleractinians, macroalgae (algae greater than or equal to 1 cm high, consisting mostly of *Halimeda, Lobophora, Padina,* and *Dictyota*), and CTB. Scleractinians were scored as a single functional group as the fauna was dominated by *O. annularis* (85 % at Yawzi; 58 % at Tektite, 1987), and resolution in the 1 x 1 m photoquadrats made it difficult to resolve small colonies such as those of Agaricia and juvenile *Porites spp*. Second, colony abundance of octocorals (individuals m-2) was quantified with annual resolution, and colonies were counted when their holdfasts were visible in the photoquadrats (Lenz et al. 2015). *Erythropodium spp*. and encrusting *Briareum spp*. were represented at low cover and abundance, and were quantified based on the number of discrete areas of colonies. Numerical abundance of octocorals was used at annual resolution. Cover data with 5-year resolution were included for comparison with other studies.

Octocorals are challenging to resolve to species underwater, because identification typically requires analysis of sclerites (Bayer 1961) in voucher specimens, the collection of which is restricted in the Virgin Islands National Park. Identification is even more challenging in photoquadrats where lighting and resolution can be limiting, and therefore our analysis focused on the 11 genera found at these sites: *Briareum, Erythropodium, Plexaura, Pseudoplexaura, Eunicea, Plexaurella, Muriceopsis, Antillogorgia,* and *Gorgonia*. Small colonies of *Eunicea*, *Plexaurella*, *Pseudoplexaura*, and *Plexaura spp*. were scored as “unknowns” as they could not be distinguished in the photographs. The height of small colonies could not be determined in planar images, but they were ~ 12 cm tall. *Pterogorgia* and *Muricea* were found in the region, and either were not detected in the sampling areas, or could not be resolved in the photographs.

References:

Edmunds, P. J. 2002. Long-term dynamics of coral reefs in St. John US Virgin 827 Islands. Coral Reefs 21:357−367.

Data Processing Description

Based on Tsounis and Edmunds (In press), Ecosphere:

Community structure was characterized for four assemblage constructs that employed annual means for dependent variables (cover or abundance). First, the scleractinian-focused assemblage was quantified using the percentage cover of scleractinians (pooled among taxa), macroalgae, and CTB. Second, the octocoral-focused assemblage was quantified using octocoral abundance (pooled among taxa) together with cover of macroalgae, and CTB. Third, the octocoral genus assemblage focused on octocoral abundance resolved to genus, or unknowns. Fourth, a complete assemblage was used, containing scleractinians (all taxa), octocorals (abundance by genus), macroalgae and CTB. Data for each benthic group were presented untransformed as means +/- SE by year on scatterplots.

All analyses of scleractinian-focused, octocoral-focused, octocoral genera, and complete assemblages were based on resemblance matrices using Bray-Curtis similarities. Data for the scleractinian-focused assemblage consisted of percent cover and were square root transformed; data for the octocoral-focused and complete assemblage consisted of both percent cover and numerical abundance, and therefore were z-score standardized (Sokal and Rohlf 2012); and data for the octocoral genera were z-score standardized to optimize the performance of PCoA for the zero-inflated data. A dummy value of 3 was added to z-score standardized data to create positive values that could analyzed in this statistical framework.

Non-metric multidimensional scaling (nMDS) was used to visualize multivariate trends in community structure for the four assemblages. To prepare nMDS plots, multiple restarts of 999 iterations were used until stress stabilized and ordinations were repeatable (after Clarke and Warwick 2001). In these plots, years were represented as circles scaled to scleractinian cover in the scleractinian-focused analysis, and to pooled abundance of octocorals in the octocoral focused and octocoral genera analyses. Sampling years were clustered using the SIMPROF routine in PRIMER-E, with 999 permutations and significant clusters identified at an alpha of 0.05. SIMPROF results were displayed as similarity contours on the respective nMDS plots visualizing hierarchical similarity among years (after Clarke and Warwick 2001). To evaluate similarities between two groupings of years that became apparent during initial analysis (as in Edmunds 2013; Edmunds and

Lasker 2016), we used an iterative procedure for each graph to determine the highest value of dissimilarity percentage that would describe the groups of years separated in nMDS state space. To identify the contribution of each benthic group to inter-annual variability, a principal coordinate analysis (PCoA) was performed using the cmdscale function in the R statistical package (R Development Core Team 2008). Loading scores were calculated as the Pearson correlations of each dependent variable (i.e., benthic group) against PCO1 and PCO2, and were displayed when significant (P less than 0.05) as vectors scaled to a maximum length of 1. The PCoA were based on Bray-Curtis similarities that were produced using the vegan package for R (Oksanen et al. 2015).

Question 1. To test whether the description of community dynamics differ when described with the four assemblages constructs, we used a multivariate correlation procedure with significance determined within a permutational framework using a Mantel test (Legendre and Legendre 1998). First we compared the scleractinian-focused assemblage with the octocoral-focused assemblage; second, we compared the scleractinian-focused assemblage with the octocoral genera assemblage; and third, we tested whether the scleractinian-focused assemblage differed from the complete assemblage. The Mantel test was performed using the Vegan package in R [Oksanen et al. 2015; R Development Core Team 2008]).

Each of the four assemblages was tested for associations with all combinations of the four measures of physical conditions, using Spearman rank correlation (Clarke and Ainsworth 1993). The Bioenv function (Clarke and Ainsworth 1993) was used for correlations, and was followed with a Mantel procedure (Legendre and Legendre 1998) to identify the set of physical variables most strongly associated with the biological variables, with significance evaluated in a permutational framework. The Bioenv function was performed using the vegan package for R (R Development Core Team 2008 [Oksanen et al. 2015]).

Analysis of general implications

To address general implications of our findings, the Yawzi Point versus Tektite contrast was interpreted as a comparison of a reef dominated by living *Orbicella annularis* (i.e., Tektite), with one dominated by antecedent (but dead) colonies of *O. annularis* with the decline in cover of this species having taken place since 1987. In this format, the contrast has utility in evaluating how the regional trend for declining cover of *O. annularis* (e.g., Hughes and Tanner 2000, Edmunds 2015) is likely to influence the community dynamics of octocorals. Central to this interpretation was an inferential test of octocoral community dynamics at Yawzi Point versus Tektite, and this was accomplished using the Mantel test to compare all four assemblages as described above.

BCO-DMO Processing Notes:

-Reformatted column names to comply with BCO-DMO standards.
-Replaced "no data" with "nd"
-Changed significant figures to reflect the accuracy of the measuring system.

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Data Files

File
biological_data.csv(Comma Separated Values (.csv), 6.38 KB) MD5:58c7e903454905542aa533798aefb023 Primary data file for dataset ID 664223

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Related Publications

Bayer, F. M. 1961. The shallow-water Octocorallia of the West Indian region. Studies on the Fauna of Curacao and other Caribbean Islands 12:1–373. http://www.repository.naturalis.nl/document/549850
Methods

Clarke, K., & Ainsworth, M. (1993). A method of linking multivariate community structure to environmental variables. Marine Ecology Progress Series, 92(3), 205-219.
Methods

Clarke, K., & Warwick, R. (2001). A further biodiversity index applicable to species lists: variation in taxonomic distinctness. Marine Ecology Progress Series, 216, 265–278. doi:10.3354/meps216265
Methods

Edmunds, P. (2013). Decadal-scale changes in the community structure of coral reefs of St. John, US Virgin Islands. Marine Ecology Progress Series, 489, 107–123. doi:10.3354/meps10424
Methods

Edmunds, P. J. (2015). A quarter-century demographic analysis of the Caribbean coral,Orbicella annularis, and projections of population size over the next century. Limnology and Oceanography, 60(3), 840–855. doi:10.1002/lno.10075
Methods

Edmunds, P., & Lasker, H. (2016). Cryptic regime shift in benthic community structure on shallow reefs in St. John, US Virgin Islands. Marine Ecology Progress Series, 559, 1–12. doi:10.3354/meps11900
Methods

Hughes, T. P., & Tanner, J. E. (2000). RECRUITMENT FAILURE, LIFE HISTORIES, AND LONG-TERM DECLINE OF CARIBBEAN CORALS. Ecology, 81(8), 2250–2263. doi:10.1890/0012-9658(2000)081[2250:rflhal]2.0.co;2 https://doi.org/10.1890/0012-9658(2000)081[2250:RFLHAL]2.0.CO;2
Methods

Kohler, K. E., & Gill, S. M. (2006). Coral Point Count with Excel extensions (CPCe): A Visual Basic program for the determination of coral and substrate coverage using random point count methodology. Computers & Geosciences, 32(9), 1259–1269. doi:10.1016/j.cageo.2005.11.009
Software

Legendre, P., and L. Legendre. 1998. Numerical Ecology. 2nd English 918 Edition. Elsevier.
Methods

Lenz, E. A., Bramanti, L., Lasker, H. R., & Edmunds, P. J. (2015). Long-term variation of octocoral populations in St. John, US Virgin Islands. Coral Reefs, 34(4), 1099–1109. doi:10.1007/s00338-015-1315-x
Methods

Oksanen, J., F. G. Blanchet, R. Kindt, P. Legendre, P. R. Minchin, R. B. O'Hara, G. L. Simpson, P. Solymos, M., H., H. Stevens, and H. Wagner. 2015. Vegan: Community Ecology Package. R package version 2.3-0. http://CRAN.R-project.org/package=vegan.
Software

R Development Core Team. 2008. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0, http://www.R-project.org.
Methods

Sokal, R. R., and F. J. Rohlf. 2012. Biometry Fourth Edition. Freeman, New York.
Methods

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Parameters

Parameter	Description	Units
site	Site at which data were collected: Yawzi Point or Tektite	unitless
year	Year in which photoquadrats were recorded	year
AntillogorgiaCover_mean	Mean relative surface percent cover of Antillogorgia	percent
AntillogorgiaCover_SE	Standard error of surface percent cover of Antillogoria	percent
GorgoniaCover_mean	Mean relative surface percent cover of Gorgonia	percent
GorgoniaCover_SE	Standard error of surface percent cover of Gorgonia	percent
PlexauraCover_mean	Mean relative surface percent cover of Plexaura	percent
PlexauraCover_SE	Standard error relative surface percent cover of Plexaura	percent
totalOctocoralCover_mean	Mean relative surface percent cover of all octocorals	percent
totalOctocoralCover_SE	Standard error for surface percent cover of all octocorals	percent
AntillogorgiaAbundance_mean	Mean abundance (individual octocoral colony as defined by ist holdfast in the 1x1 m photoquadrat) of Antillogorgia	count
AntillogorgiaAbundance_SE	Abundance standard error (individual octocoral colony as defined by ist holdfast in the 1x1 m photoquadrat) of Antillogorgia	count
GorgoniaAbundance_mean	Mean abundance (individual octocoral colony as defined by ist holdfast in the 1x1 m photoquadrat) of Gorgonia	count
GorgoniaAbundance_SE	Abundance standard error (individual octocoral colony as defined by ist holdfast in the 1x1 m photoquadrat) of Gorgonia	count
PlexauraAbundance_mean	Mean abundance (individual octocoral colony as defined by ist holdfast in the 1x1 m photoquadrat) of Plexaura	count
PlexauraAbundance_SE	Abundance standard error (individual octocoral colony as defined by ist holdfast in the 1x1 m photoquadrat) of Plexaura	count
totalAbundance_mean	Mean abundance (individual octocoral colony as defined by ist holdfast in the 1x1 m photoquadrat) of all octocoral genera	count
totalAbundance_SE	Abundance standard error (individual octocoral colony as defined by ist holdfast in the 1x1 m photoquadrat) of all octocoral genera	count
ScleractinianCover_mean	Mean relative surface percent cover of live scleractinian corals (all genera)	percent
ScleractinianCover_SE	Relative standard error surface percent cover of live scleractinian corals (all genera)	percent
MacroalgaeCover_mean	Mean relative surface percent cover of macroalgae (all genera) in quadrats algae greater than or equal to 1 cm height; Mostly Halimeda Lobopohra Padina and Dictyota	percent
MacroalgaeCover_SE	Relative standard error surface percent cover of macroalgae (all genera) in quadrats algae greater than or equal to 1 cm height mostly Halimeda Lobopohra Padina and Dictyota	percent
CTBcover_mean	Mean relative surface percent cover of crustose coralline algae algal turf and bare space combined	percent
CTBcover_SE	Relative standard error surface percent cover of crustose coralline algae algal turf and bare space combined	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

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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 Environmental Biology (NSF DEB)	DEB-0841441
NSF Division of Ocean Sciences (NSF OCE)	OCE-1332915
NSF Division of Environmental Biology (NSF DEB)	DEB-1350146

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