Rainfall and seawater temperature in St. John, USVI in 1987–2013 (St. John LTREB project, VI Octocorals project).

Website: https://www.bco-dmo.org/dataset/664254
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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Table of Contents

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

Temperature and rainfall data for St. John USVI.

Methods & Sampling

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

Physical environmental conditions were characterized using three features that are well-known to affect coral reef community dynamics (described in Glynn 1993, Rogers 1993, Fabricius et al. 2005): seawater temperature, rainfall, and hurricane intensity. Together, these were used to generate seven dependent variables describing physical environmental features. Seawater temperature was recorded at each site every 15-30 min using a variety of logging sensors (see Edmunds 2006 for detailed information on the temperature measurement regime). Seawater temperature was characterized using five dependent variables calculated for each calendar year: mean temperature, maximum temperature, and minimum temperature (all averaged by day and month for each year), as well as the number of days hotter than 29.3 deg C (“hot days”), and the number of days with temperatures greater than or equal to 26.0 deg C (“cold days”). The temperature defining "hot days" was determined by the coral bleaching threshold for St. John (http://www.coral.noaa.gov/research/climate-change/coral-bleaching.html), and the temperature defining "cold days" was taken as 26.0 deg C which marks the lower 12th percentile of all daily temperatures between 1989 and 2005 (Edmunds, 2006). The upper temperature limit was defined by the local bleaching threshold, and the lower limit defined the 12th percentile of local seawater temperature records (see Edmunds 2006 for details). Rainfall was measured at various locations around St. John (see http://www.sercc.com) but often on the north shore (courtesy of R. Boulon) (see Edmunds and Gray 2014). To assess the influence of hurricanes, a categorical index of local hurricane impact was employed, with the index based on qualitative estimates of wave impacts in Great Lameshur Bay as a function of wind speed, wind direction, and distance of the nearest approach of each hurricane to the study area (see Gross and Edmunds 2015). Index values of 0 were assigned to years with no hurricanes, 0.5 to hurricanes with low impacts, and 1 for hurricanes with high impacts, and years were characterized by the sum of their hurricane index values.

Data Processing Description

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

Temporal trends of physical parameters were tested through linear regression using 3-year centered moving averages to address the lag of response of benthic community structure to environmental conditions (resulting in the loss of 2 y from the dataset).

Question 2. The seven physical environmental variables were tested for collinearity by screening variables by pairwise linear correlation. This procedure identified four variables that were independent, and these were used for subsequent analyses: hurricane index (Hindex), mean seawater temperature (deg C), rainfall (cm), and minimum seawater temperature (deg C). The physical variables were transformed using 3-year, centered moving averages of each dependent variable to smooth short-term fluctuations arising from stochastic effects, and to address delayed effects of environmental conditions on the communities. As physical conditions were measured on different scales, they were z-score standardized prior to analysis (Sokal and Rohlf 2012), and expressed as resemblance matrix based on Euclidean distances.

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]).

BCO-DMO Processing Notes:

-Reformatted column names to comply with BCO-DMO standards.
-Replaced "no data" with "nd"

[table of contents | back to top]

Data Files

File
physical_data.csv (Comma Separated Values (.csv), 994 bytes) MD5:dea18b155d0f6a356381aed9e74ba2db Primary data file for dataset ID 664254

[table of contents | back to top]

Related Publications

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

Edmunds, P. J. (2006). Temperature-mediated transitions between isometry and allometry in a colonial,

modular invertebrate. Proceedings of the Royal Society B: Biological Sciences, 273(1599), 2275–2281. doi:10.1098/rspb.2006.3589
Methods

Edmunds, P. J., & Gray, S. C. (2014). The effects of storms, heavy rain, and sedimentation on the shallow coral reefs of St. John, US Virgin Islands. Hydrobiologia, 734(1), 143–158. doi:10.1007/s10750-014-1876-7
Methods

Fabricius, K. E. (2005). Effects of terrestrial runoff on the ecology of corals and coral reefs: review and synthesis. Marine Pollution Bulletin, 50(2), 125–146. doi:10.1016/j.marpolbul.2004.11.028
Methods

Glynn, P. W. (1993). Coral reef bleaching: ecological perspectives. Coral Reefs, 12(1), 1–17. doi:10.1007/bf00303779 https://doi.org/10.1007/BF00303779
Methods

Gross, K., & Edmunds, P. J. (2015). Stability of Caribbean coral communities quantified by long-term monitoring and autoregression models. Ecology, 96(7), 1812–1822. doi:10.1890/14-0941.1
Methods

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

Rogers, C. S. (1993). Hurricanes and coral reefs: The intermediate disturbance hypothesis revisited. Coral Reefs, 12(3-4), 127–137. doi:10.1007/bf00334471 https://doi.org/10.1007/BF00334471
Methods

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

[table of contents | back to top]

Parameters

Parameter	Description	Units
year	Year in which photoquadrats were recorded; YYYY	unitless
rainfall	Annual precipitation recorded at http://www.sercc.com	centimeters
temp_seawaterSurface	Mean temperature (averaged by day and month for each year)	celsius
temp_min	Minimum temperature (averaged by day and month for each year)	celsius
temp_max	Maximum temperature (averaged by day and month for each year)	celsius
hotDays_num	Number of days per year with temperatures less than 29.3 deg C	count
coldDays_num	Number of days per year with temperatures greater than or equal to 26.0 deg C	count

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	Precipitation gauge
Generic Instrument Name	Precipitation Gauge
Dataset-specific Description	Measured rainfall
Generic Instrument Description	measures rain or snow precipitation

Dataset-specific Instrument Name	Temperature logger
Generic Instrument Name	Temperature Logger
Dataset-specific Description	Measured seawater temperature
Generic Instrument Description	Records temperature data over a period of time.

[table of contents | back to top]

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

[table of contents | back to top]

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

[table of contents | back to top]

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

[table of contents | back to top]