Millepora coral cover, seawater temperature and storm intensity in St. John, USVI, 1992-2008 (St. John LTREB project)

Website: https://www.bco-dmo.org/dataset/523691
Version: 2014-08-19

Project
» LTREB Long-term coral reef community dynamics in St. John, USVI: 1987-2019 (St. John LTREB)

Contributors	Affiliation	Role
Edmunds, Peter J.	California State University Northridge (CSUN)	Principal Investigator
Brown, Darren J	California State University Northridge (CSUN)	Student
Copley, Nancy	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Table of Contents

- Coverage
- Dataset Description
  - Methods & Sampling
- Data Files
- Related Publications
- Related Datasets
- Parameters
- Instruments
- Deployments
- Project Information
- Funding

Coverage

Temporal Extent: 1992 - 2008

Dataset Description

The objective of this study was to describe how a rare, yet ecologically important invertebrate has changed in abundance over 16 years, and evaluate the extent to which the changes were associated with seawater temperature and storm intensity.

The study was conducted between Cabritte Horn and White Point in the protected Virgin Islands National Park (VINP). The abundance of Millepora spp. on shallow fringing reefs in St. John was quantified from 1992 to 2008 using photoquadrats. Average daily temperature and storm intensity is also reported.

These data were published in Brown and Edmunds 2013

Original submitted excel file in data file section.

Methods & Sampling

Monitoring began in 1992 using six sites selected at random to characterize the reef community using photoquadrats (0.5×0.5 m). For the present analysis, photoquadrats were pooled among sites to describe the abundance of Millepora spp. on shallow fringing reefs.

At each site, photoquadrats were scattered randomly along a single transect parallel to the 7-9 m depth contour. Prior to 2000, photoquadrats were recorded using Kodachrome 64 film and a Nikonos V camera fitted with a 28-mm lens and strobes. The camera was mounted on a frame that held it perpendicular to the

reef and was used to record ~18 photoquadrats along a 20-m transect. Starting in 2000, digital photography (with strobes and a framer) was introduced, first with a 3.3 megapixel camera (Nikon Coolpix 990), and from 2007, a 6.1 megapixel camera (Nikon D70). Digital photography allowed the sample size to increase to 40 photoquadrats site-1, with the additional photoquadrats scattered along a 20 m extension to the original transect. Both photographic techniques produced images in which objects >=10 mm diameter could be resolved, and the annual surveys (pooled among sites) provided ~102 photoquadrats y-1 prior to 2000, with 210-222 photoquadrats y-1 thereafter. Photoquadrats were recorded between July and August in all years except for 1992, 1993 and 1995-1997 when they were recorded between May and June. Slides were digitally scanned (at 3200 dpi) and together with digital images are archived at mcr.lternet.edu/vinp/data/.

Millepora spp. abundance
The population dynamics of Millepora spp. were quantified using three measures of abundance. Percent cover, colony size (planar area of colonies entirely within the photoquadrat), colonies and branches within each quadrat were counted to evaluate population size (number of colonies). Colonies were counted if they were entirely within the photoquadrat, or if present as encrusting bases located partially within the photoquadrat. These criteria overestimated population sizewhen colonies grewwithmultiple encrusting fronts that separately spread into the photoquadrats.

Temperature and storm intensity
To gain insight into the role of environmental factors in mediating changes in Millepora spp. populations, the associations between abundance and seawater temperature were evaluated using Pearson correlations with census years as replicates. Associations between abundance and storm intensity were evaluated using Spearman correlations as the intensity of storms was evaluated on a categorical scale.

Seawater temperature in Great Lameshur Bay was recorded using a Ryan Industries thermistor (±0.3 °C accuracy) at 11-m depth from January 1992 to April 1997, and from November 1997 to August 1999; an Optic Stowaway logger (±0.2 °C accuracy) at 9-m depth from May 1997 to October 1997, and from August 1999 to August 2001; and a Hobo Aquapro logger (±0.2 °C accuracy) at 9-m depth from August 2001 to August 2008. Loggers recorded temperature every 15-30 min. Temperature was averaged by day and used to calculate a mean for the ~12 months between samplings. Daily temperatures were used to categorize days as hot (>29.3 °C) or cold (<=26.0 °C), and the number of hot and cold days in each year was used to evaluate the association between thermally extreme days and Millepora spp. abundance. 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 °C which marks the lower 12th percentile of all daily temperatures between 1989 and 2005 (Edmunds, 2006).

To analyze the impacts of storms on Millepora spp., storms occurring between sampling intervals were ranked by their potential damaging effects, and the ranks summed over each sampling year to assess the annual impact on benthic taxa. The potential impacts of storms were evaluated from their greatest wind speeds on St. John, which were used as a proxy for the size ofwaves resulting from the closest passage to the south of the island. Wind speeds were used to rank storms on a four-step scale: 1 <= 25 km h-1, 25 kmh-1 < 2 <= 50 km h-1, 50 km h-1 < 3 <= 75 km h-1, and 4 > 75 km h-1.

Wind speeds in St. John were estimated using summaries of Atlantic hurricane seasons (http://www.nhc.noaa.gov/pastall.shtml), which provided the maximum wind speed of each storm at its closest proximity to St. John, and an exponential function to predict the extent to which the maximum wind speed decayed by the time it impacted the island. The exponential function had the form Sd=Sm e^(-lambda*d) where Sd is the local wind speed, Sm is the maximum wind speed at the closest distance (d) to the south coast of St. John, and lambda a constant. lambda was determined empirically for six storms (Hortense, Georges, Lenny, Jose, Debby, and Earl) for which wind speed was recorded at the Cyril E. King Airport, St. Thomas, 25-km west of Lameshur Bay; wind speed was best predicted with lambda=0.016 (r2=0.659, n=6). Wind speeds on the south coast of St. John resulting from the close passage of major storms were therefore predicted using Sd=Sme^(-0.016*d).

[table of contents | back to top]

Data Files

File	
coral_temps_storms.csv	(Comma Separated Values (.csv), 1.38 KB) MD5:ff2783c8730d146ff38de827e0f0f42a
Primary data file for dataset ID 523691	
Millepora_long_term%20_for_2013_JEMBE_BCODMO filename: Millepora_long_term%20_for_2013_JEMBE_BCODMO.xlsx	(ZIP Archive (ZIP), 253.02 KB) MD5:143d67e2a1ff133345c314cb8e9a9db7
Original excel file for dataset 523648, 523691, 523637, 523676, 523661. File has also been reworked and submitted in the bco-dmo system.	

[table of contents | back to top]

Related Publications

Brown, D., & Edmunds, P. J. (2013). Long-term changes in the population dynamics of the Caribbean hydrocoral Millepora spp. Journal of Experimental Marine Biology and Ecology, 441, 62–70. https://doi.org/10.1016/j.jembe.2013.01.013
Results

[table of contents | back to top]

Related Datasets

IsRelatedTo

Edmunds, P. J. (2014) **Millepora coral colony size on shallow reefs in St. John, USVI, 1992-2008 (St. John LTREB project).** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 2014-08-19) Version Date 2014-08-19 http://lod.bco-dmo.org/id/dataset/523648 [view at BCO-DMO]
Relationship Description: Millepora coral colony size on shallow reefs in St. John, USVI, 1992-2008

Edmunds, P. J. (2014) **Millepora coral cover on shallow reefs in St. John, USVI, 1992-2008 (St. John LTREB project).** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 2014-08-19) Version Date 2014-08-19 http://lod.bco-dmo.org/id/dataset/523637 [view at BCO-DMO]
Relationship Description: Millepora coral cover on shallow reefs in St. John, USVI, 1992-2008

Edmunds, P. J. (2014) **Seawater temperature in St. John, USVI, 1992-2008 (MCR LTER project, St. John LTREB project).** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 2014-08-19) Version Date 2014-08-19 http://lod.bco-dmo.org/id/dataset/523676 [view at BCO-DMO]
Relationship Description: Seawater temperature in St. John, USVI, 1992-2008

Edmunds, P. J. (2014) **Storm record from St. John, USVI, 1992-2008 (St. John LTREB project).** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 2014-08-19) Version Date 2014-08-19 http://lod.bco-dmo.org/id/dataset/523661 [view at BCO-DMO]
Relationship Description: Storm record from St. John, USVI, 1992-2008

[table of contents | back to top]

Parameters

Parameter	Description	Units
year	year	YYYY
pcent_cover	percent cover by Millepora	percent
cover_std_err_plus	percent cover standard error: upper asymmetric error bar calculated on arcsine transformed data that were bark transformed	percent
cover_std_err_minus	percent cover standard error: lower asymmetric error bar calculated on arcsine transformed data that were bark transformed	percent
colony_size	planar area of colonies entirely within the photoquadrat	cm^2
colony_size_se	colony size standard error	cm^2
branches_quad	number of attached and detached branches within the photoquadrats	number/0.25 m^2
branches_quad_se	number of branches standard error	number/0.25 m^2
colonies_quad	number of colonies within the photoquadrats	number/0.25 m^2
colonies_quad_se	number of colonies standard error	number/0.25 m^2
days_hot	number of hot days (>29.3 °C) in each year	days
days_cold	number of cold days (=26.0 °C) in each year	days
storm_strength	strength (Saffir-Simpson Scale)	1 to 5
temp_mean	average annual seawater temperature	degrees Celsius

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	camera
Generic Instrument Name	Camera
Dataset-specific Description	1992-1999: Nikonos V film camera using Kodachrome 64 film 2000-2006: Nikon Coolpix 990 - 3.3 megapixel digital camera 2007-2008: Nikon D70 - 6.1 megapixel digital camera
Generic Instrument Description	All types of photographic equipment including stills, video, film and digital systems.

Dataset-specific Instrument Name	Water Temp Sensor
Generic Instrument Name	Water Temperature Sensor
Dataset-specific Description	1992-1997: Ryan Industries thermistor (±0.3 °C accuracy) 1997: Optic Stowaway logger (±0.2 °C accuracy) 2001-2008: Hobo Aquapro logger (±0.2 °C accuracy
Generic Instrument Description	General term for an instrument that measures the temperature of the water with which it is in contact (thermometer).

[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.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Environmental Biology (NSF DEB)	DEB-0841441
NSF Division of Environmental Biology (NSF DEB)	DEB-0343570

[table of contents | back to top]