# Seawater temperature in St. John, USVI, 1992-2008 (MCR LTER project, St. John LTREB project)

**Website**: https://www.bco-dmo.org/dataset/523676
**Version**: 2014-08-19

**Project**
» Moorea Coral Reef Long-Term Ecological Research site (MCR LTER)
» LTREB Long-term coral reef community dynamics in St. John, USVI: 1987-2019 (St. John LTREB)

**Program**
» Long Term Ecological Research network (LTER)

| Contributors | Affiliation | Role |
|---|---|---|
| Edmunds, Peter J. | California State University Northridge (CSUN) | Principal Investigator |
| Brown, Darren J | California State University Northridge (CSUN) | Student |
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## 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).

**Data Processing Description**

**BCO-DMO Processing Notes:**

- original file: Millepora_long_term _metadata copy.xlsx
- added conventional header with dataset name, PI name, version date
- moved columns so that date is first
- added year, month, day in order to display by year month
- reformated date from mm/dd/yyyy to yyyy/mm/dd
- replaced blank cells with 'nd'

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## Data Files

| File | |
|---|---|
| **Millepora_long_term%20_for_2013_JEMBE_BCODMO**<br>filename: Millepora_long_term%20_for_2013_JEMBE_BCODMO.xlsx<br>Original excel file for dataset 523648, 523691, 523637, 523676, 523661. File has also been reworked and submitted in the bco-dmo system. | (ZIP Archive (ZIP), 253.02 KB)<br>MD5:143d67e2a1ff133345c314cb8e9a9db7 |
| **temps.csv**<br>Primary data file for dataset ID 523676 | (Comma Separated Values (.csv), 162.64 KB)<br>MD5:e4bd2d451781180eec47aef03b447c47 |

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## 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*

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## 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) **Millepora coral cover, seawater temperature and storm intensity 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/523691 [view at BCO-DMO]
*Relationship Description: Millepora coral cover, seawater temperature and storm intensity 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: Millepora coral cover on shallow reefs in St. John, USVI, 1992-2008*

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## Parameters

| Parameter | Description | Units |
|---|---|---|
| year | year | YYYY |
| month_local | month; local time | MM |
| day_local | day; local time | DD |
| date_local | local date | YYYY/MM/DD |
| temp | average daily seawater temperature | degrees Celsius |

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## 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). |

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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

**Moorea Coral Reef Long-Term Ecological Research site (MCR LTER)**

**Website**: http://mcr.lternet.edu/

**Coverage**: Island of Moorea, French Polynesia

**NSF Award Abstract:**

Coral reefs provide important benefits to society, from food to exceptional biodiversity to shoreline protection and recreation, but they are threatened by natural perturbations and human activities, including those causing global-scale changes. These pressures increasingly are causing coral reefs to undergo large, often abrupt, ecological changes where corals are being replaced by seaweeds or other undesirable organisms. Historically, the major agent of disturbance to coral reefs has been powerful storms, but in recent decades, episodes of mass coral bleaching from marine heat waves have become more frequent and severe as the temperature of ocean surface waters continues to rise. Coral reefs are further stressed by local human activities that cause nutrient pollution and deplete herbivorous fishes that control growth of seaweeds. Studying how coral reefs respond to these two types of disturbance under different levels of nutrient pollution and fishing provides essential information on what affects the ability of coral reefs to buffer environmental change and disturbances without collapsing to a persistent, degraded condition. The fundamental goals of the Moorea Coral Reef Long Term Ecological Research program (MCR LTER) are to understand how and why coral reefs change over time, to assess the consequences of these changes, and to contribute scientific knowledge needed to sustain coral reef ecosystems and the important societal services they provide. This research improves understanding and management of coral reefs, which benefits all groups concerned with the welfare of this ecologically, economically and culturally important ecosystem. In addition to academic communities, scientific findings are communicated to interested individuals, non-governmental organizations, island communities and governmental entities. These findings also are integrated into K-12, undergraduate, graduate and public education activities through a multi-pronged program that includes inquiry-based curricula, interactive and media-based public education programs, and internet-based resources. MCR?s research, training, education and outreach efforts all emphasize broadening participation in STEM fields and strengthening STEM literacy.

New research activities build on MCR LTER?s powerful foundation of long-term observations and broad ecological understanding of oceanic coral reefs to address the following core issues: How is the changing disturbance regime (recurrent heat waves in addition to cyclonic storms) altering the resilience of coral reefs, and what are the ecological consequences of altered resilience? Research activities are organized around a unifying framework that explicitly addresses how reef communities are affected by the nature and history of coral-killing disturbances, and how those responses to disturbance are influenced by the pattern of local human stressors. New studies answer three focal questions: (1) How do different disturbance types, which either remove (storms) or retain (heat waves) dead coral skeletons, affect community dynamics, abrupt changes in ecological state, and resilience? (2) How do local stressors interact with new disturbance regimes to create spatial heterogeneity in community dynamics, ecosystem processes, and spatial resilience? And (3) What attributes of coral and coral reef communities influence their capacity to remain resilient under current and future environmental conditions? These questions provide an unparalleled opportunity to test hypotheses and advance theory regarding ecological resilience and the causes and consequences of abrupt ecological change, which is broadly relevant across aquatic and terrestrial ecosystems.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

**From http://www.lternet.edu/sites/mcr/ and http://mcr.lternet.edu/**:
The Moorea Coral Reef LTER site encompasses the coral reef complex that surrounds the island of Moorea, French Polynesia (17°30'S, 149°50'W). Moorea is a small, triangular volcanic island 20 km west of Tahiti in the Society Islands of French Polynesia. An offshore barrier reef forms a system of shallow (mean depth ~ 5-7 m), narrow (~0.8-1.5 km wide) lagoons around the 60 km perimeter of Moorea. All major coral reef types (e.g., fringing reef, lagoon patch reefs, back reef, barrier reef and fore reef) are present and accessible by small boat.

The MCR LTER was established in 2004 by the US National Science Foundation (NSF) and is a partnership between the University of California Santa Barbara and California State University, Northridge. MCR researchers include marine scientists from the UC Santa Barbara, CSU Northridge, UC Davis, UC Santa Cruz, UC San Diego, CSU San Marcos, Duke University and the University of Hawaii. Field operations are conducted from the UC Berkeley Richard B. Gump South Pacific Research Station on the island of Moorea, French Polynesia.

**MCR LTER Data:** The Moorea Coral Reef (MCR) LTER data are managed by and available directly from the MCR project data site URL shown above. The datasets listed below were collected at or near the MCR LTER sampling locations, and funded by NSF OCE as ancillary projects related to the MCR LTER core research themes.

**This project is supported by continuing grants with slight name variations:**

- LTER: Long-Term Dynamics of a Coral Reef Ecosystem
- LTER: MCR II - Long-Term Dynamics of a Coral Reef Ecosystem
- LTER: MCR IIB: Long-Term Dynamics of a Coral Reef Ecosystem
- LTER: MCR III: Long-Term Dynamics of a Coral Reef Ecosystem
- LTER: MCR IV: Long-Term Dynamics of a Coral Reef Ecosystem

**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.

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## Program Information

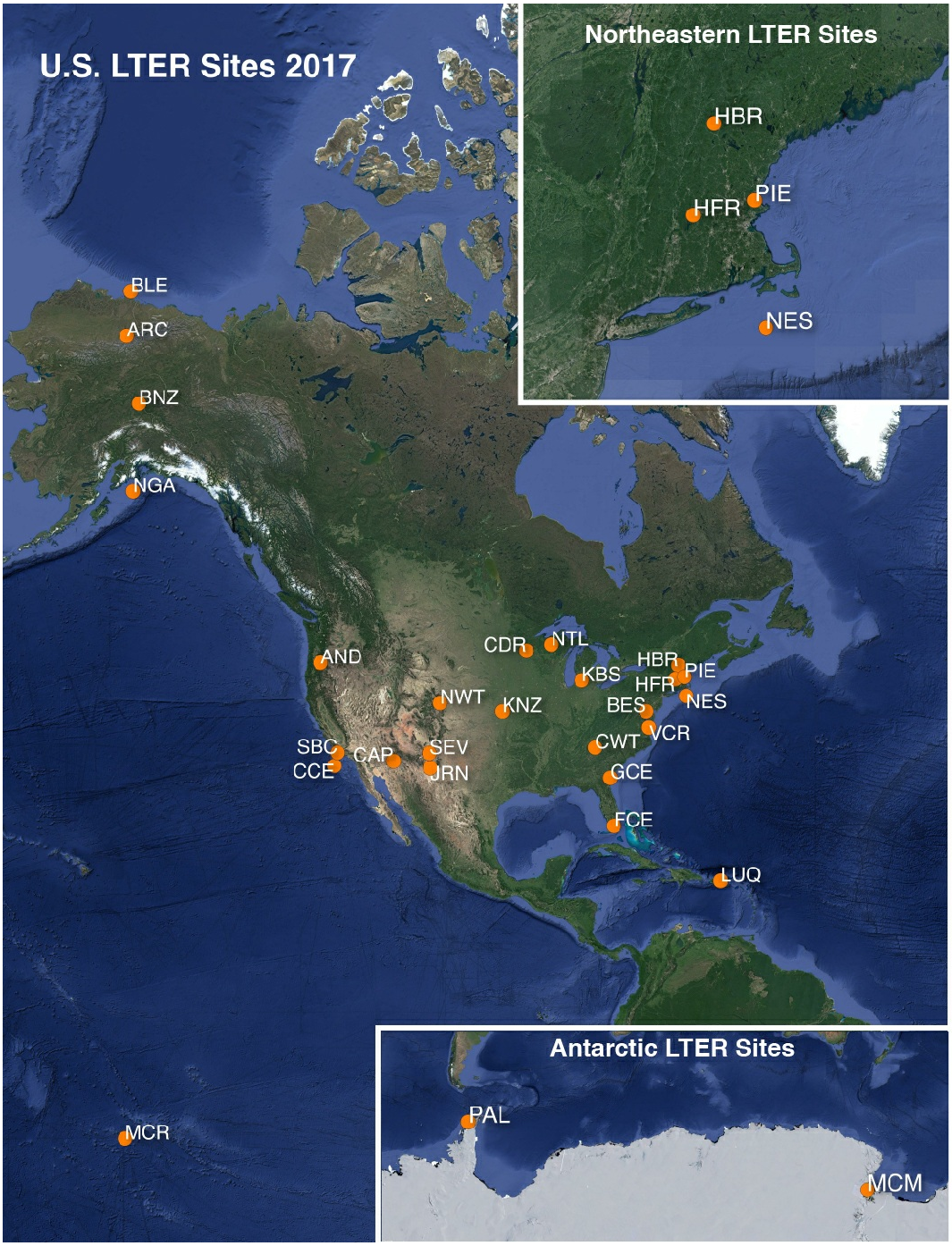
**Long Term Ecological Research network (LTER)**

**Website**: http://www.lternet.edu/

**Coverage**: United States

**adapted from http://www.lternet.edu/**

The National Science Foundation established the LTER program in 1980 to support research on long-term ecological phenomena in the United States. The Long Term Ecological Research (LTER) Network is a collaborative effort involving more than 1800 scientists and students investigating ecological processes over long temporal and broad spatial scales. The LTER Network promotes synthesis and comparative research across sites and ecosystems and among other related national and international research programs. The LTER research sites represent diverse ecosystems with emphasis on different research themes, and cross-site communication, network publications, and research-planning activities are coordinated through the LTER Network Office.




2017 LTER research site map obtained from https://lternet.edu/site/lter-network/

### Site Codes

| | |
|---|---|
| AND | Andrews Forest LTER |
| ARC | Arctic LTER |
| BES | Baltimore Ecosystem Stu |
| BLE | Beaufort Lagoon Ecosystems LTER |
| BNZ | Bonanza Creek LTER |
| CCE | California Current Ecosystem LTER |
| CDR | Cedar Creek Ecosystem Science Reserve |
| CAP | Central Arizona-Phoenix LTER |
| CWT | Coweeta LTER |
| FCE | Florida Coastal Everglades LTER |
| GCE | Georgia Coastal Ecosystems LTER |
| HFR | Harvard Forest LTER |
| HBR | Hubbard Brook LTER |
| JRN | Jornada Basin LTER |
| KBS | Kellogg Biological Station LTER |
| KNZ | Konza Prairie LTER |
| LUQ | Luquillo LTER |
| MCM | McMurdo Dry Valleys LT |
| MCR | Moorea Coral Reef LTEF |
| NWT | Niwot Ridge LTER |
| NTL | North Temperate Lakes I |
| NES | Northeast U.S. Shelf LTE |
| NGA | Northern Gulf of Alaska I |
| PAL | Palmer Antarctica LTER |
| PIE | Plum Island Ecosystems LTER |
| SBC | Santa Barbara Coastal L |
| SEV | Sevilleta LTER |
| VCR | Virginia Coast Reserve L |

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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-0343570 |


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