

Seriatopora bleaching expt: water pH and carbonate chemistry, Taiwan 2010 (MCR LTER project, Climate_Coral_Larvae project)

Website: <https://www.bco-dmo.org/dataset/522631>

Version: 2014-08-12

Project

» [Moorea Coral Reef Long-Term Ecological Research site](#) (MCR LTER)

» [The ecophysiological basis of the response of coral larvae and early life history stages to global climate change](#) (Climate_Coral_Larvae)

Program

» [Long Term Ecological Research network](#) (LTER)

Contributors	Affiliation	Role
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Dataset Description

We hypothesized that ocean acidification would cause bleaching as defined by decreased photochemical efficiency, reduced photosynthetic capacity and efficiency, depressed chlorophyll a content, and lowered *Symbiodinium* densities and that these effects would be exacerbated with high temperature.

Related Datasets:

[Symbiodinium_Seriatopora photosynthesis](#)

[Symbiodinium_Seriatopora PI curve](#)

[Symbiodinium_Seriatopora temp-salinity-light](#)

These data were published in C. B. Wall, T.-Y. Fan, P. J. Edmunds (2014) Ocean acidification has no effect on thermal bleaching in the coral. *Coral Reefs* 33:119-13. doi: <http://dx.doi.org/10.1007/s00338-013-1085-2>.

[Download complete data for this publication \(Excel file\)](#)

Methods & Sampling

Experimental design

Four treatments contrasted high and low temperature and pCO₂:

Ambient temperature = 27.5 °C

Ambient pCO₂ = 39.0 Pa

High temperature = 30.5 °C

High pCO₂ = 86 Pa

Juvenile *Seriatopora calandrum* were collected from Hobihu Reef, Nanwan Bay, Taiwan, and kept at the National Museum of Marine Biology and Aquarium (NMMA), where they were placed randomly into the treatment tanks for incubations lasting 14 days. Corals were exposed to treatments in 8 tanks filled with filtered seawater. Treatments were maintained at a salinity of 33 and were monitored daily for temperature, salinity, irradiance, pH and carbonate chemistry.

Photochemical efficiency: The effects of temperature and pCO₂ on photochemical efficiency were tested by measuring the maximum photochemical efficiency of open RCII (Type II reaction centers) in the dark (F_v/F_m) and the effective photochemical efficiency of RCII in the light (deltaF/F_m) using pulse amplitude modulation (PAM) fluorometry.

Photosynthesis-irradiance (P/I) curves: To test for the effects of pCO₂ and temperature on the ability for *Symbiodinium* to utilize light and perform photosynthesis, net photosynthesis (P^{net}), determined from changes in O₂ concentrations in seawater, was measured under different irradiances using three corals selected randomly from each treatment tank.

Chlorophyll-a concentration and *Symbiodinium* density: Chlorophyll-a concentration and *Symbiodinium* density were determined.

Relevant References:

For full details see [Methodology](#), from C. B. Wall, T.-Y. Fan, P. J. Edmunds (2014) Ocean acidification has no effect on thermal bleaching in the coral. *Coral Reefs* 33:119-13

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Data Files

File
Symbiodinium_water_chem.csv (Comma Separated Values (.csv), 9.57 KB) MD5:ab8deb3a54993bb61714791cd4275def
Primary data file for dataset ID 522631

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Parameters

Parameter	Description	Units
lab	site of experiments	unitless
lat	latitude; north is positive	decimal degrees
lon	longitude; east is positive	decimal degrees
date_local	measurement date	yyyy/mm/dd
pCO2_trt	partial pressure of carbon dioxide for each treatment; CO2 treatments are ambient vs. elevated (45 vs 85 Pa pCO2)	Pascals
temp_trt	temperature treatments are ambient vs. elevated (27.7 vs 30.5 C)	degrees Celsius
tank	tanks are replicate treatments (n=2 per treatment)	unitless
pH	pH: The measure of the acidity or basicity of an aqueous solution	0-14
pCO2	partial pressure of carbon dioxide	Pascals
TA	total alkalinity	mol kg-1
HCO3	concentration of bicarbonate ion ([HCO3-]) in seawater	mol kg-1
CO3	concentration of carbonate ion ([CO3]2-) in seawater	mol kg-1
omega_ar	aragonite saturation state	unitless

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Instruments

Dataset-specific Instrument Name	Aquarium chiller
Generic Instrument Name	Aquarium chiller
Dataset-specific Description	Aquatek, Aquasystems, Taiwan
Generic Instrument Description	Immersible or in-line liquid cooling device, usually with temperature control.

Dataset-specific Instrument Name	Automatic titrator
Generic Instrument Name	Automatic titrator
Dataset-specific Description	Open-cell autotitrator (Model DL50, Mettler-Toledo, USA) filled with certified acid titrant (from A. Dickson, Scripps Institution of Oceanography) and equipped with a DG115-SC pH probe (Mettler-Toledo).
Generic Instrument Description	Instruments that incrementally add quantified aliquots of a reagent to a sample until the end-point of a chemical reaction is reached.

Dataset-specific Instrument Name	Conductivity Meter
Generic Instrument Name	Conductivity Meter
Dataset-specific Description	YSI 3100 Conductivity Meter, YSI Inc., USA
Generic Instrument Description	Conductivity Meter - An electrical conductivity meter (EC meter) measures the electrical conductivity in a solution. Commonly used in hydroponics, aquaculture and freshwater systems to monitor the amount of nutrients, salts or impurities in the water.

Dataset-specific Instrument Name	Fluorometer
Generic Instrument Name	Fluorometer
Dataset-specific Description	Diving-PAM (Waltz, GmbH, Effeltrich, Germany)
Generic Instrument Description	A fluorometer or fluorimeter is a device used to measure parameters of fluorescence: its intensity and wavelength distribution of emission spectrum after excitation by a certain spectrum of light. The instrument is designed to measure the amount of stimulated electromagnetic radiation produced by pulses of electromagnetic radiation emitted into a water sample or in situ.

Dataset-specific Instrument Name	Gas Analyzer
Generic Instrument Name	Gas Analyzer
Dataset-specific Description	Infrared (IR) gas analyzer (S151, Qubit Systems), calibrated against certified reference gas (1,793 ppm CO2, San Ying Gas Co., Taiwan).
Generic Instrument Description	Gas Analyzers - Instruments for determining the qualitative and quantitative composition of gas mixtures.

Dataset-specific Instrument Name	Homogenizer
Generic Instrument Name	Homogenizer
Dataset-specific Description	Polytron PT2100, Kinematica, USA
Generic Instrument Description	A homogenizer is a piece of laboratory equipment used for the homogenization of various types of material, such as tissue, plant, food, soil, and many others.

Dataset-specific Instrument Name	Immersion heater
Generic Instrument Name	Immersion heater
Dataset-specific Description	300 watts, Taikong Corp.
Generic Instrument Description	Submersible heating element for water tanks and aquaria.

Dataset-specific Instrument Name	LI-COR LI-193 PAR
Generic Instrument Name	LI-COR LI-193 PAR Sensor
Generic Instrument Description	The LI-193 Underwater Spherical Quantum Sensor uses a Silicon Photodiode and glass filters encased in a waterproof housing to measure PAR (in the 400 to 700 nm waveband) in aquatic environments. Typical output is in micromol s ⁻¹ m ⁻² . The LI-193 Sensor gives an added dimension to underwater PAR measurements as it measures photon flux from all directions. This measurement is referred to as Photosynthetic Photon Flux Fluence Rate (PPFFR) or Quantum Scalar Irradiance. This is important, for example, when studying phytoplankton, which utilize radiation from all directions for photosynthesis. LI-COR began producing Spherical Quantum Sensors in 1979; serial numbers for the LI-193 begin with SPQA-XXXXX (licor.com).

Dataset-specific Instrument Name	MFC
Generic Instrument Name	Mass Flow Controller
Dataset-specific Description	A350 Gas Concentration Controller (Qubit); solenoid-controlled
Generic Instrument Description	Mass Flow Controller (MFC) - A device used to measure and control the flow of fluids and gases

Dataset-specific Instrument Name	pump
Generic Instrument Name	Pump
Dataset-specific Description	To mix water in tanks
Generic Instrument Description	A pump is a device that moves fluids (liquids or gases), or sometimes slurries, by mechanical action. Pumps can be classified into three major groups according to the method they use to move the fluid: direct lift, displacement, and gravity pumps

Dataset-specific Instrument Name	Water Temp Sensor
Generic Instrument Name	Water Temperature Sensor
Dataset-specific Description	1. Microsensor-based temperature regulators (AquaController, Neptune Systems, USA) 2. Certified digital thermometer (Fisher Scientific 15-077-8, ± 0.05 C)
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

lab Edmunds_NMMBA

Website	https://www.bco-dmo.org/deployment/58892
Platform	Natl Museum Mar. Bio. and Aquar. Taiwan
Start Date	2010-03-18
End Date	2010-03-24
Description	Experiments related to the research project: 'RUI- The ecophysiological basis of the response of coral larvae and early life history stages to global climate change' were conducted at the laboratories of the National Museum of Marine Biology and Aquarium in Southern Taiwan.

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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

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

The ecophysiological basis of the response of coral larvae and early life history stages to global climate change (Climate_Coral_Larvae)

Coverage: Moorea, French Polynesia; Southern Taiwan; California State University Northridge

Tropical coral reefs face a suite of environmental assaults ranging from anchor damage to the effects of global climate change (GCC). The consequences are evident throughout the tropics, where many coral reefs have lost a substantial fraction of their coral cover in a few decades. Notwithstanding the importance of reducing the impacts of environmental stresses, the only means by which these ecosystems can recover (or simply persist) is through the recruitment of scleractinians, which is a function of successful larval development, delivery, settlement, metamorphosis, and post-settlement events. Despite wide recognition of the importance of these processes, there are few pertinent empirical data, and virtually none that address the mechanisms mediating the success of early coral life stages in a physical environment varying at multiple spatio-temporal scales.

The objective of this research is to complete one of the first comprehensive ecophysiological analyses of the early life stages of corals through a description of: (1) their functionality under 'normal' conditions, and (2) their response to the main drivers of GCC. These analyses will be completed for 2 species representative of a brooding life history strategy, and the experiments will be completed in two locations, one (Taiwan) that provides unrivalled experience in coral reproductive biology, and superb microcosm facilities, and the other (Moorea), with access to a relatively pristine environment, a well described ecological and oceanographic context (through the MCR-LTER), and the capacity to bring a strong biogeographic contrast to the project. The results of the study will be integrated through modeling to explore the effects of GCC on coral community structure over the next century.

The following publications and data resulted from this project:

2013 Wall CB, Fan TY, Edmunds PJ. Ocean acidification has no effect on thermal bleaching in the coral *Seriatopora calandrum*. Coral Reefs 33: 119-130.

[Symbiodinium_Seriatopora_photosynthesis](#)
[Symbiodinium_Seriatopora_PI_curve](#)
[Symbiodinium_Seriatopora_temp-salinity-light](#)
[Symbiodinium_Seriatopora_water_chemistry](#)
- [Download complete data for this publication \(Excel file\)](#)

2013 Wall CB, Edmunds PJ. *In situ* effects of low pH and elevated HCO₃⁻ on juvenile *Porites* spp. in Moorea, French Polynesia. Biological Bulletin 225:92-101.

Data at MCR and PANGAEA: [doi:10.1594/PANGAEA.833913](https://doi.org/10.1594/PANGAEA.833913)
- [Download complete data for this publication \(Excel file\)](#)

2013 Vivian R Cumbo, Peter J Edmunds, Christopher B Wall, Tung-Yung Fan. Brooded coral larvae differ in their response to high temperature and elevated pCO₂ depending on the day of release. Marine Biology DOI 10.1007/s00227-013-2280-y.

Data also at PANGAEA: [doi:10.1594/PANGAEA.831612](https://doi.org/10.1594/PANGAEA.831612)
[brooded coral larvae 2 - carbonate chemistry](#)
[brooded coral larvae 2 - larval release March 2003-2008](#)
[brooded coral larvae 2 - respiration_photosynth_mortality](#)
- [Download complete data for this publication \(Excel file\)](#)

2013 Edmunds PJ, Cumbo VR, Fan TY. Metabolic costs of larval settlement and metamorphosis in the coral *Seriatopora calandrum* under ambient and elevated pCO₂. Journal Experimental Marine Biology and Ecology 443: 33-38 Data also at PANGAEA: [doi:10.1594/PANGAEA.821644](https://doi.org/10.1594/PANGAEA.821644)

[Coral post-settlement physiology](#)
- [Download complete data for this publication \(Excel file\)](#)

2013 Aaron M Dufault, Aaron Ninokawa, Lorenzo Bramanti, Vivian R Cumbo, Tung-Yung Fan, Peter J Edmunds. The role of light in mediating the effects of ocean acidification on coral calcification. Journal of Experimental Biology 216: 1570-1577.

[coral-light expt.- PAR](#)
[coral-light expt.- carbonate chemistry](#)
[coral-light expt.- temp_salinity](#)
[coral-light expt.- growth](#)
[coral-light expt.- protein](#)
[coral-light expt.- survival](#)
- [Download complete data for this publication \(Excel file\)](#)

2012 Cumbo, VR, Fan TY, Edmunds PJ. Effects of exposure duration on the response of *Pocillopora damicornis* larvae to elevated temperature and high pCO₂. J Exp Mar Biol Ecol 439: 100-107.

Data is also at PANGAEA: [doi:10.1594/PANGAEA.823582](https://doi.org/10.1594/PANGAEA.823582)
[brooded coral larvae 3 - carbonate chemistry](#)
[brooded coral larvae 3 - light](#)
[brooded coral larvae 3 - mortality](#)
[brooded coral larvae 3 - protein](#)
[brooded coral larvae 3 - respiration and protein](#)
[brooded coral larvae 3 - respiration raw data](#)
[brooded coral larvae 3 - symbiont density](#)
[brooded coral larvae 3 - tank temperature](#)
- [Download part 1 of data for this publication \(Excel file\)](#)
- [Download tank parameters data for this publication \(Excel file\)](#)

2012 Cumbo, VR, Fan TY, Edmunds PJ. Physiological development of brooded larvae from two pocilloporid corals in Taiwan. Marine Biology 159: 2853-2866.

[brooded coral - carbonate chemistry](#)
[brooded coral - release](#)
[brooded coral - respiration](#)
[brooded coral - settlement competency](#)
[brooded coral - size July](#)
[brooded coral - size protein symbionts_photosynth](#)
- [Download complete data for this publication \(Excel file\)](#)

2012 Dufault, Aaron M; Vivian R Cumbo; Tung-Yung Fan; Peter J Edmunds. Effects of diurnally oscillating pCO₂ on the calcification and survival of coral recruits. Royal Society of London (B) 279: 2951-2958. doi:10.1098/rspb.2011.2545

Data is also at PANGAEA: [doi:10.1594/PANGAEA.830185](https://doi.org/10.1594/PANGAEA.830185)
[recruit_growth_area](#)
[recruit_growth_weight](#)
[recruit_seawater_chemistry](#)
[recruit_survival](#)
- [Download complete data for this publication \(Excel file\)](#)

2011 Edmunds PJ, Cumbo V, Fan TY. Effects of temperature on the respiration of brooded larvae from tropical reef corals. Journal of Experimental Biology 214: 2783-2790.

[Corallarvae_comparison_respir](#)
[Corallarvae_release](#)
[Corallarvae_respir](#)
[Corallarvae_size](#)
- [Download complete data for this publication \(Excel file\)](#)

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Program Information

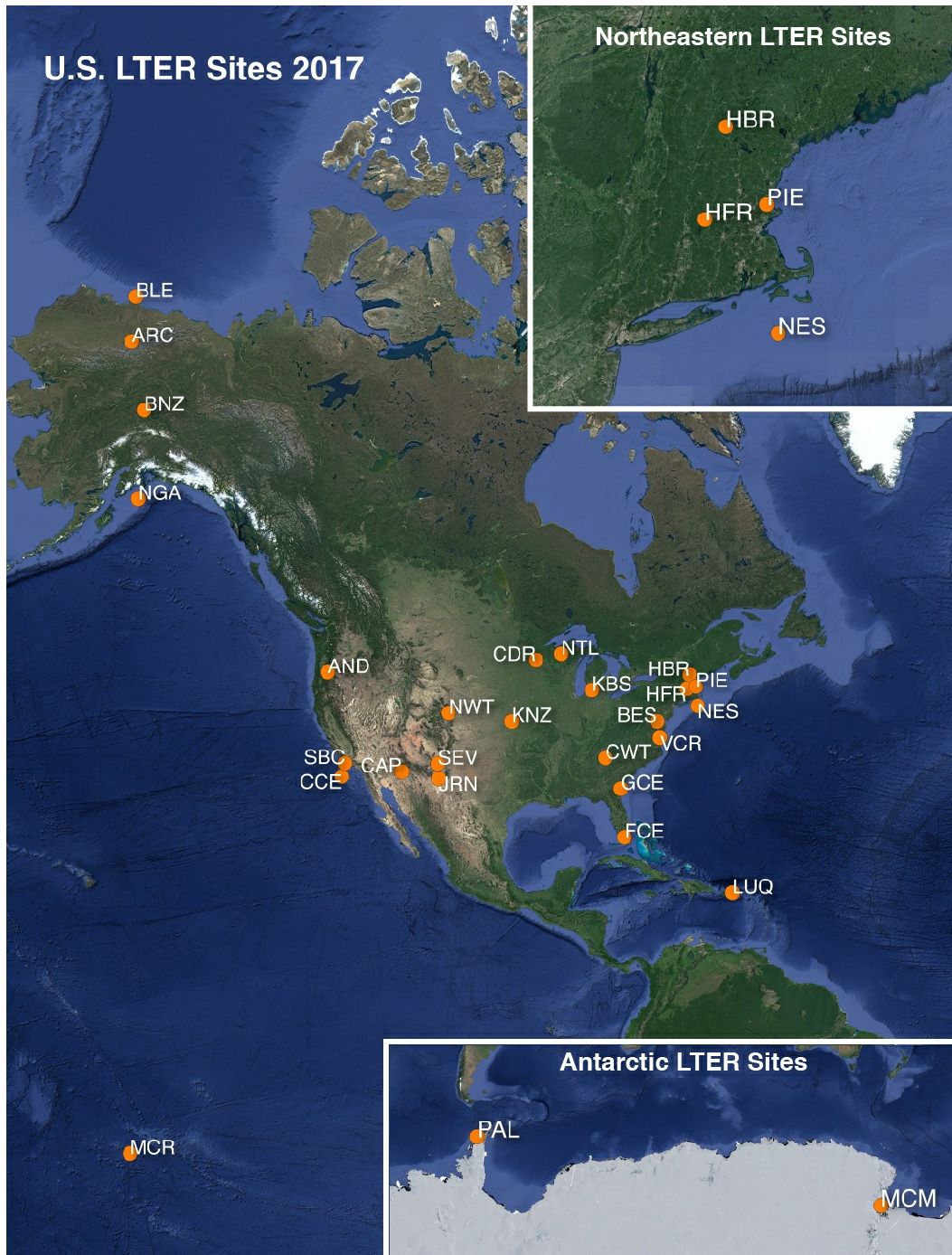
Long Term Ecological Research network (LTER)

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.



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

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

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-0844785

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