Coral (Porites rus) calcification and chemistry data from outdoor flumes at the UCB Gump Research Station Moorea, French Polynesia in April and March of 2012

Website: https://www.bco-dmo.org/dataset/754661
Data Type: Other Field Results
Version: 1
Version Date: 2020-11-30

Project
» Moorea Coral Reef Long-Term Ecological Research site (MCR LTER)
» RUI: Ocean Acidification- Category 1- The effects of ocean acidification on the organismic biology and community ecology of corals, calcified algae, and coral reefs (OA_Corals)

Programs
» Long Term Ecological Research network (LTER)
» Science, Engineering and Education for Sustainability NSF-Wide Investment (SEES): Ocean Acidification (formerly CRI-OA) (SEES-OA)

Contributors	Affiliation	Role
Carpenter, Robert	California State University Northridge (CSUN)	Principal Investigator
Comeau, Steeve	California State University Northridge (CSUN)	Co-Principal Investigator, Contact
Edmunds, Peter J.	California State University Northridge (CSUN)	Co-Principal Investigator
Srednick, Griffin	California State University Northridge (CSUN)	Technician
York, Amber D.	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
Coral calcification and chemistry data from outdoor flumes at the UCB Gump Research Station Moorea, French Polynesia in April and March of 2012. These data were collected as part of a study to assess the effects of feeding and light intensity on the response of the coral Porites rus to ocean acidification. See Comeau et al. (2013) for details of this study.

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Coverage

Spatial Extent: **Lat**:-17.490483 **Lon**:-149.826367
Temporal Extent: 2012-04-21 - 2012-05-05

Methods & Sampling

Methodology:

Calcification was estimated by measuring the change in buoyant weight (Davies 1989) based on an initial measurement of all the corals and subsequent measures on one-third of the corals after 1, 2, and 3 weeks of incubation in order to monitor the evolution of the treatment effects through time. The difference between initial and final buoyant weight was converted to dry weight increments using an aragonite density of 2.93 g cm-3 (Davies 1989) and standardized to the area of the corals as determined by the aluminum foil technique (Marsh 1970). Dry tissue weight of the organisms also was measured to normalize calcification to biomass to evaluate changes in biomass that might result from changes in the size of energy reserves attributed to the feeding regimes. To determine tissue dry weight, corals were fixed in 10 % formalin solution for 48 h, then the skeleton was dissolved by immersion in 5 % HCl that was replaced daily until the skeleton was dissolved (2–4 days). Tissues were rinsed in distilled water and dried for 48 h at 60 °C prior to weighing (±1 mg) and normalizing to area (mg cm-2).

pH was measured using an open-cell autotitrator (Model T50, Mettler-Toledo) calibrated every other day with Tris buffer provided by Dr. Andrew Dickson (Scripps Institution of Oceanography). Total alkalinity (AT) and salinity were measured daily during the first half of the incubation, and then every other day during the second half of the experiment based on the rationale that conditions were demonstrably stable. Seawater analyses were performed on the day of sampling using open-cell potentiometric titration with an automatic titrator (T50, Mettler-Toledo). Measurements were taken on 50-mL samples at *23 °C, and AT calculated after Dickson et al. (2007). Prior to each set of AT measurements, titrations of certified reference material (batch 108) provided by Dr. A. Dickson were performed and yielded values that were ±3 lmol kg-1 of certified values. Parameters of the carbonate system were calculated from salinity, temperature, AT, and pHT using the R package seacarb (Lavigne and Gattuso 2011).

See Comeau et al. (2013) for more details.

Data Processing Description

BCO-DMO Data Manager Processing Notes:
* Data submitted as sheet "data" in original excel file "comeau et al. 2013_data.xlsx" exported as csv with the formatting that was set in Excel.
* added a conventional header with dataset name, PI name, version date
* modified parameter names to conform with BCO-DMO naming conventions: only A-Za-z0-9 and underscore allowed. Can not start with a number. (spaces, +, and - changed to underscores).
* Duplicate column names given either suffix _1 or suffix _2. e.g. (DIC_1, DIC_2)
* blank values in this dataset are displayed as "nd" for "no data." nd is the default missing data identifier in the BCO-DMO system.
* Various date formats in Date column changed from to yyyy-mm-dd (e.g. 2015-11-13).

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Data Files

File
comeau2013_calcif.csv (Comma Separated Values (.csv), 37.88 KB) MD5:40472b3776f88bb860855a21f9878c44 Primary data file for dataset ID 754661

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Related Publications

Comeau, S., Carpenter, R. C., & Edmunds, P. J. (2013). Effects of feeding and light intensity on the response of the coral Porites rus to ocean acidification. Marine Biology, 160(5), 1127–1134. doi:10.1007/s00227-012-2165-5
Results

Davies, P.S. (1989). Short-term growth measurements of corals using an accurate buoyant weighing technique. Marine Biology, 101(3), 389–395. doi:10.1007/bf00428135 https://doi.org/10.1007/BF00428135
Methods

Dickson, A.G., Sabine, C.L. and Christian, J.R. (Eds.) 2007. Guide to Best Practices for Ocean CO2 Measurements. PICES Special Publication 3, 191 pp https://isbnsearch.org/isbn/1-897176-07-4
Methods

Lavigne H, Gattuso J-P. (2011). seacarb: seawater carbonate chemistry with R. R package version 2.4.1. http://CRAN.Rproject.org/package=seacarb
Software

Marsh, J. A. (1970). Primary Productivity of Reef-Building Calcareous Red Algae. Ecology, 51(2), 255–263. doi:10.2307/1933661
Methods

Nisumaa, A.-M., Pesant, S., Bellerby, R. G. J., Delille, B., Middelburg, J. J., Orr, J. C., … Gattuso, J.-P. (2010). EPOCA/EUR-OCEANS data compilation on the biological and biogeochemical responses to ocean acidification. Earth System Science Data, 2(2), 167–175. doi:10.5194/essd-2-167-2010
Methods

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Parameters

Parameter	Description	Units
Species	Species identification in format Genus species (coral).	unitless
Date	Date	unitless
Treat	Treatment	unitless
Sample_label	Sample code/label	unitless
E	Irradiance	umol/m2/s
Calc_rate_CaCO3_mg_cm2_day	Calcification rate of calcium carbonate (mg/cm2/day). Buoyant weighing technique (Davies, 1989).	mg/cm2/day
Calc_rate_CaCO3_mg_mg_day	Calcification rate of calcium carbonate (mg/mg/day). Buoyant weighing technique (Davies, 1989).	mg/mg/day
biomass	biomass	mg/cm2
Sal	Salinity	PSU
Temp	Temperature, water	degrees Celcius
pH	pH, Potentiometric.	total hydrogen ion scale (pHT)
CO2_1	Carbon dioxide. Calculated using seacarb (Lavigne and Gattuso, 2011).	umol/kg
pCO2water_SST_wet_1	Partial pressure of carbon dioxide (water) at sea surface temperature (wet air). Calculated using seacarb (Lavigne and Gattuso, 2011).	uatm
fCO2water_SST_wet_1	Fugacity of carbon dioxide (water) at sea surface temperature (wet air). Calculated using seacarb (Lavigne and Gattuso, 2011).	uatm
Bicarbonate_ion_1	Bicarbonate ion [HCO3]-. Calculated using seacarb (Lavigne and Gattuso, 2011).	umol/kg
Carbonate_ion_1	Carbonate ion [CO3]2-. Calculated using seacarb (Lavigne and Gattuso, 2011).	umol/kg
DIC_1	Carbon, inorganic, dissolved. Calculated using seacarb (Lavigne and Gattuso, 2011).	umol/kg
AT	Alkalinity, total. Potentiometric titration.	umol/kg
Omega_Arg_1	Aragonite saturation state. Calculated using seacarb (Lavigne and Gattuso, 2011).	omega aragonite (Ωa)
Omega_Cal_1	Calcite saturation state. Calculated using seacarb (Lavigne and Gattuso, 2011).	omega calcite (Ωcal)
CSC_flag	Carbonate system computation flag	unitless
CO2_2	Carbon dioxide. Calculated using seacarb (Lavigne and Gattuso, 2011) after Nisumaa et al. (2010).	umol/kg
pCO2water_SST_wet_2	Partial pressure of carbon dioxide (water) at sea surface temperature (wet air). Calculated using seacarb (Lavigne and Gattuso, 2011) after Nisumaa et al. (2010).	uatm
fCO2water_SST_wet_2	Fugacity of carbon dioxide (water) at sea surface temperature (wet air). Calculated using seacarb (Lavigne and Gattuso, 2011) after Nisumaa et al. (2010).	uatm
Bicarbonate_ion_2	Bicarbonate ion [HCO3]-. Calculated using seacarb (Lavigne and Gattuso, 2011) after Nisumaa et al. (2010).	umol/kg
Carbonate_ion_2	Carbonate ion [CO3]2-. Calculated using seacarb (Lavigne and Gattuso, 2011) after Nisumaa et al. (2010).	umol/kg
DIC_2	Carbon, inorganic, dissolved (DIC). Calculated using seacarb (Lavigne and Gattuso, 2011) after Nisumaa et al. (2010).	umol/kg
Omega_Arg_2	Aragonite saturation state. Calculated using seacarb (Lavigne and Gattuso, 2011) after Nisumaa et al. (2010).	omega aragonite (Ωa)
Omega_Cal_2	Calcite saturation state. Calculated using seacarb (Lavigne and Gattuso, 2011) after Nisumaa et al. (2010).	omega calcite (Ωcal)

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Instruments

Dataset-specific Instrument Name	Mettler Toledo T50
Generic Instrument Name	Automatic titrator
Dataset-specific Description	TA: Mettler Toledo T50
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	4p quantum sensor (LI-193) and a LiCor LI-1400 meter
Generic Instrument Name	Light Meter
Generic Instrument Description	Light meters are instruments that measure light intensity. Common units of measure for light intensity are umol/m2/s or uE/m2/s (micromoles per meter squared per second or microEinsteins per meter squared per second). (example: LI-COR 250A)

Dataset-specific Instrument Name	Orion 3-stars pH Meter fitted with a DG 115-SC pH probe
Generic Instrument Name	pH Sensor
Generic Instrument Description	An instrument that measures the hydrogen ion activity in solutions. The overall concentration of hydrogen ions is inversely related to its pH. The pH scale ranges from 0 to 14 and indicates whether acidic (more H+) or basic (less H+).

Dataset-specific Instrument Name	YSI 3100
Generic Instrument Name	Salinity Sensor
Generic Instrument Description	Category of instrument that simultaneously measures electrical conductivity and temperature in the water column to provide temperature and salinity data.

Dataset-specific Instrument Name	ThermoFisher Traceable
Generic Instrument Name	Water Temperature Sensor
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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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

RUI: Ocean Acidification- Category 1- The effects of ocean acidification on the organismic biology and community ecology of corals, calcified algae, and coral reefs (OA_Corals)

Coverage: Moorea, French Polynesia

While coral reefs have undergone unprecedented changes in community structure in the past 50 y, they now may be exposed to their gravest threat since the Triassic. This threat is increasing atmospheric CO2, which equilibrates with seawater and causes ocean acidification (OA). In the marine environment, the resulting decline in carbonate saturation state (Omega) makes it energetically less feasible for calcifying taxa to mineralize; this is a major concern for coral reefs. It is possible that the scleractinian architects of reefs will cease to exist as a mineralized taxon within a century, and that calcifying algae will be severely impaired. While there is a rush to understand these effects and make recommendations leading to their mitigation, these efforts are influenced strongly by the notion that the impacts of pCO2 (which causes Omega to change) on calcifying taxa, and the mechanisms that drive them, are well-known. The investigators believe that many of the key processes of mineralization on reefs that are potentially affected by OA are only poorly known and that current knowledge is inadequate to support the scaling of OA effects to the community level. It is vital to measure organismal-scale calcification of key taxa, elucidate the mechanistic bases of these responses, evaluate community scale calcification, and finally, to conduct focused experiments to describe the functional relationships between these scales of mineralization.

This project is a 4-y effort focused on the effects of Ocean Acidification (OA) on coral reefs at multiple spatial and functional scales. The project focuses on the corals, calcified algae, and coral reefs of Moorea, French Polynesia, establishes baseline community-wide calcification data for the detection of OA effects on a decadal-scale, and builds on the research context and climate change focus of the Moorea Coral Reef LTER.

This project is a hypothesis-driven approach to compare the effects of OA on reef taxa and coral reefs in Moorea. The PIs will utilize microcosms to address the impacts and mechanisms of OA on biological processes, as well as the ecological processes shaping community structure. Additionally, studies of reef-wide metabolism will be used to evaluate the impacts of OA on intact reef ecosystems, to provide a context within which the experimental investigations can be scaled to the real world, and critically, to provide a much needed reference against which future changes can be gauged.

Datasets listed in the "Dataset Collection" section include references to results journal publications published as part of this project.

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Program Information

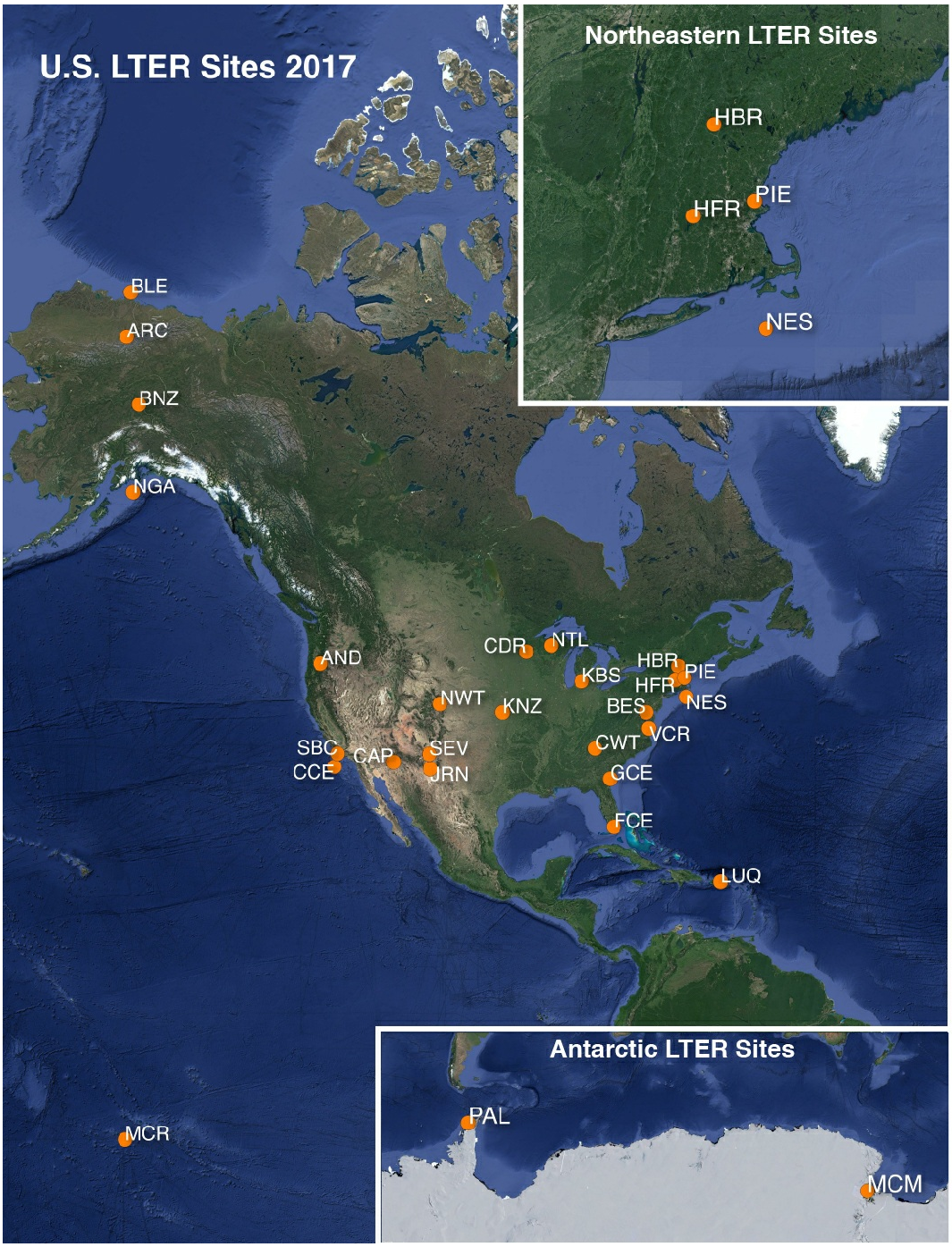
Long Term Ecological Research network (LTER)

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/

Science, Engineering and Education for Sustainability NSF-Wide Investment (SEES): Ocean Acidification (formerly CRI-OA) (SEES-OA)

Website: https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503477

Coverage: global

NSF Climate Research Investment (CRI) activities that were initiated in 2010 are now included under Science, Engineering and Education for Sustainability NSF-Wide Investment (SEES). SEES is a portfolio of activities that highlights NSF's unique role in helping society address the challenge(s) of achieving sustainability. Detailed information about the SEES program is available from NSF (https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504707).

In recognition of the need for basic research concerning the nature, extent and impact of ocean acidification on oceanic environments in the past, present and future, the goal of the SEES: OA program is to understand (a) the chemistry and physical chemistry of ocean acidification; (b) how ocean acidification interacts with processes at the organismal level; and (c) how the earth system history informs our understanding of the effects of ocean acidification on the present day and future ocean.

Solicitations issued under this program:

NSF 10-530, FY 2010-FY2011
NSF 12-500, FY 2012
NSF 12-600, FY 2013
NSF 13-586, FY 2014
NSF 13-586 was the final solicitation that will be released for this program.

PI Meetings:
1st U.S. Ocean Acidification PI Meeting(March 22-24, 2011, Woods Hole, MA)
2nd U.S. Ocean Acidification PI Meeting(Sept. 18-20, 2013, Washington, DC)
3rd U.S. Ocean Acidification PI Meeting (June 9-11, 2015, Woods Hole, MA – Tentative)

NSF media releases for the Ocean Acidification Program:

Press Release 10-186 NSF Awards Grants to Study Effects of Ocean Acidification

Discovery Blue Mussels "Hang On" Along Rocky Shores: For How Long?

Discovery nsf.gov - National Science Foundation (NSF) Discoveries - Trouble in Paradise: Ocean Acidification This Way Comes - US National Science Foundation (NSF)

Press Release 12-179 nsf.gov - National Science Foundation (NSF) News - Ocean Acidification: Finding New Answers Through National Science Foundation Research Grants - US National Science Foundation (NSF)

Press Release 13-102 World Oceans Month Brings Mixed News for Oysters

Press Release 13-108 nsf.gov - National Science Foundation (NSF) News - Natural Underwater Springs Show How Coral Reefs Respond to Ocean Acidification - US National Science Foundation (NSF)

Press Release 13-148 Ocean acidification: Making new discoveries through National Science Foundation research grants

Press Release 13-148 - Video nsf.gov - News - Video - NSF Ocean Sciences Division Director David Conover answers questions about ocean acidification. - US National Science Foundation (NSF)

Press Release 14-010 nsf.gov - National Science Foundation (NSF) News - Palau's coral reefs surprisingly resistant to ocean acidification - US National Science Foundation (NSF)

Press Release 14-116 nsf.gov - National Science Foundation (NSF) News - Ocean Acidification: NSF awards $11.4 million in new grants to study effects on marine ecosystems - US National Science Foundation (NSF)

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-0417412
NSF Division of Ocean Sciences (NSF OCE)	OCE-1041270
NSF Division of Ocean Sciences (NSF OCE)	OCE-1026851

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