Dataset: Calcification Rates and Biomass of 4 Coral Species, 2 Temperatures and 2 pCO2 Levels from Experiments at LTER site in Moorea, French Polynesia, 2011 (OA_Corals project)

Project(s): The effects of ocean acidification on the organismic biology and community ecology of corals, calcified algae, and coral reefs (OA_Corals)

Abstract: This dataset contains area-normalized calcification (mg cm-2 d-1) and biomass normalized calcification (mg mg-1) for Pocillopora meandrina, massive Porites spp., Acropora pulchra and Millepora platyphylla, as a function of pCO2 (408 µatm versus 913 µatm) and temperature (28.0 °C and 30.1 °C), collected and measured in Moorea in 2011. These data were published in Brown & Edmunds (2016) Marine Biology, Fig. 1. For a complete list of measurements, refer to the supplemental document 'Field_names.pdf', and a full dataset description is included in the supplemental file 'Dataset_description.pdf'. The most current version of this dataset is available at: http://www.bco-dmo.org/dataset/641479

Description: Coral biomass and calicification rate at 2 temperatures and 2 pCO2 levels

Area-normalized calcification (mg cm-2 d-1) and biomass normalized calcification (mg mg-1) for *Pocillopora meandrina*, massive *Porites* spp., *Acropora pulchra* and *Millepora platyphylla*, as a function of pCO2 (408 µatm versus 913 µatm) and temperature (28.0 °C and 30.1 °C), collected in Moorea 2011.

Related Reference:
Darren Brown, Peter J. Edmunds. Differences in the responses of three scleractinians and the hydrocoral Millepora platyphylla to ocean acidification. Marine Biology, 2016 (in press).

Related Dataset:
MarBio. 2016: tank conditions

Acquisition Description: Calcifying cnidarians were collected from the back reef (~ 4 m depth) on the north shore of Moorea, French Polynesia, during January and April 2011. Fragments of Acropora pulchra, Pocillopora meandrina, massive Porites spp. (15% P. lobata and 85% P. lutea [Edmunds 2009]), and Millepora platyphylla were used to evaluate the effect of pCO2 and temperature on calcification. Massive Porites spp. and M. platyphylla were sampled using a pneumatic drill (McMaster-Carr, part #27755A17) fitted with a 4.1 cm diamond tip hole saw (McMaster-Carr, part #6930A43). The hole saw was used to remove cores ~ 4 cm diameter and ~ 3.8 cm long from adult colonies, and the holes were filled with non-toxic modeling clay (Van Aken Part #10117). To increase the likelihood that cores were genetically distinct, one core was taken from each colony, with sampled colonies distributed over 3 km of reef.

Freshly collected cores were placed in bags filled with seawater and transported to the Richard B. Gump South Pacific Research Station where they were immersed in tanks supplied with a constant flow of seawater from Cook's Bay. Cores were prepared by removing excess skeleton extending > 1.5 cm below the living tissue, and attaching the cores to numbered polyvinyl chloride (PVC) pipes (4.4 cm diameter and 2.0 cm long) with epoxy (Z Spar, #A788). To eliminate the possibility of fouling organisms accessing freshly cut skeleton, bare skeleton was covered in epoxy. A plastic screw was epoxied to the bottom of each core that was later used to attach them upright in racks placed in the tanks used for incubations. Following preparation, cores were returned to ~ 4 m depth in the back reef, where they were left to recover for 6 weeks. Recovery was evaluated from the presence of healthy c 124 oral tissue covering the formerly damaged edge of the skeleton.

Single branches of A. pulchra and P. meandrina were cut from colonies using bone shears, with each colony sampled once. Sampled colonies were ~ 10 m apart to increase the likelihood that they were genetically distinct. Branches were transported to the Richard B. Gump South Pacific Research Station where they were immersed in flowing seawater. Similar to the methods used for coral cores, branches of A. pulchra and P. meandrina were attached using epoxy to pieces of PVC pipe to make nubbins (Birkeland 1976). Care was taken to cover freshly fractured skeleton with epoxy, and to avoid damaging coral tissue during preparation. A plastic screw was attached to the base of the nubbins and used to hold them upright in plastic racks. Prior to beginning the treatments, coral cores and nubbins were placed in 150 L tanks under ambient conditions of 28.0 °C, 370 micro-atm pCO2 and where illuminated with 400 W metal halide lamps (True 10,000K Hamilton Technology, Gardena, CA to an irradiance of ~ 600 micro-mol quanta m2 s-1 (measured with a 4p LI-193 quantum sensor and a LiCor LI-1400 meter) for 5 d to recover from the preparation procedure. The sampling method limited tissue damage to A. pulchra and P. meandrina, and therefore a shorter acclimation period was needed in comparison to massive Porites spp. and M. platyphylla.

Experimental conditions and maintenance

Treatments were created in 8 tanks (Aqua Logic, San Diego), each holding 150 L of seawater and regulated independently for temperature, light, and pCO2. Tanks were operated as closed146 circuit systems with filtered seawater (50 micro-m) from Cook's Bay, with circulation provided by a pump (Rio 8HF, 2,082 L h-1). Light was supplied 147 by 400 W metal halide lamps (True 10,000K Hamilton Technology, Gardena, CA) at ~ 560 micro-mol quanta m-2s-1 (measured with a 4p LI-193 quantum sensor and a LiCor LI-1400 meter) in the range of

photosynthetically active radiation (PAR, 400-700 nm). Lights were operated on a 12hr light-12hr dark photoperiod, beginning at 06:00 hrs and ending at 18:00 hrs. Temperatures were maintained at 28.0 °C, which corresponded to the ambient seawater temperature in the back reef when the study was conducted, and 30.1 °C which is close to the maximum temperature in this habitat (Putnam and Edmunds 2011). pCO2 treatments contrasted ambient conditions (~ 408 micro-atm) and 913 micro-atm pCO2, with the elevated value expected to occur within 100 y under the "stabilization without overshoot" representative concentration pathway (RCP 6.0) (van Vuuren et al. 2011). pCO2 treatments were created by bubbling ambient air or a mixture of ambient air and pure CO2 that was blended continually and monitored using an infrared gas analyzer (IRGA model S151, Qubit Systems). A solenoid-controlled, gas regulation system (Model A352, Qubit Systems, Ontario, Canada) regulated the flow of CO2 and air, with pCO2 logged on a PC running LabPro software (Vemier Software and Technology). Ambient air and the elevated pCO2 mixture were supplied at ~ 10-15 L min-1 to treatment tanks using pumps (Gast pump DOA-P704-AA, see Edmunds 2011).

The temperatures and pCO2 levels created four treatments with two tanks treatment-1: ambient temperature-ambient pCO2 (AT-ACO2), ambient temperature-high pCO2 (AT-HCO2), high temperature-ambient pCO2 (HT-ACO2) and high temperature-high pCO2 (HT-HCO2). Treatment conditions were monitored daily, with temperature measured at 08:00, 12:00 and 18:00 hrs using a digital thermometer (Fisher Scientific model #150778, ± 0.05 °C), and light intensities at 12:00 hrs using a Li-Cor LI-193 sensor attached t 170 o a LI-1400 meter. Seawater within each tank was replaced at 200 ml/min with filtered seawater (50 micro-m) pumped from Cook's Bay.

Processing Description:

BCO-DMO Processing:

- added conventional header with dataset name, PI name, version date, reference information
- renamed parameters to BCO-DMO standard
- added location, lat and lon columns

Deployment Information

Deployment description for Richard B Gump Research Station - Moorea LTER MCR_Edmunds

Ongoing studies on corals

Instrument Information

Instrument	
Description	4p LI-193 quantum sensor
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).

Instrument	
Description	150 L tanks
Generic Instrument Name	In-situ incubator
Generic Instrument Description	A device on shipboard or in the laboratory that holds water samples under controlled conditions of temperature and possibly illumination.

Instrument	
Description	*local description not specified*
Generic Instrument Name	Water Temperature Sensor
Generic Instrument	General term for an instrument that measures the temperature of the water

Description	with which it is in contact (thermometer).

Instrument	
Description	Open cell potentiometric titrator (Model T50, Mettler-Toledo, Columbus, OH) fitted with a DG115-SC pH probe (Mettler-Toledo, Columbus, OH)
Generic Instrument Name	Automatic titrator
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.

Instrument	
Description	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)

Instrument	
Description	YSI 3100 conductivity meter
Generic Instrument Name	Conductivity Meter
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.

Instrument	
Description	Ultrasonic dismembrator (Fisher model 216 15-338-550; fitted with a 3.2

	mm diameter probe, Fisher 15-338-67)
Generic Instrument Name	ultrasonic cell disrupter
Generic Instrument Description	Instrument that applies sound energy to agitate particles in a sample.