# Experimental results of coral recruit growth as a function of corallite area change in variable CO2, from the Natl Museum Mar. Bio. and Aquar., Taiwan in 2010 (MCR LTER project, Climate_Coral_Larvae project)

**Website**: https://www.bco-dmo.org/dataset/514198
**Data Type**: experimental
**Version**: 2014-03-07
**Version Date**: 2014-03-20

**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 |
|---|---|---|
| Edmunds, Peter J. | California State University Northridge (CSUN) | Lead Principal Investigator |
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## Dataset Description

Manipulative studies have demonstrated that ocean acidification (OA) is a threat to coral reefs, yet no experiments have employed diurnal variations in pCO2 that are ecologically relevant to many shallow reefs. Two experiments were conducted to test the response of coral recruits (less than 6 days old) to diurnally oscillating pCO2; one exposing recruits for 3 days to ambient (440 uatm), high (663 uatm) and diurnally oscillating pCO2 on a natural phase (420–596 uatm), and another exposing recruits for 6 days to ambient (456 uatm), high (837 uatm) and diurnally oscillating pCO2 on either a natural or a reverse phase (448–845 uatm).

These data are published in Dufault et al. (2012), Proc. R. Soc. B. doi:10.1098/rspb.2011.2545

Related Datasets:

recruit_seawater_chemistry
recruit_growth_weight
recruit_suvival

### Methods & Sampling

Larvae were obtained from brooding colonies coral S. caliendrum collected from 5 to 7 m deep on Hobihu Reef, Nanwan Bay, in March and June of 2010, placed into individual flow-through seawater tanks. Overflow water from each tank passed through mesh-lined (110 mm) cups that captured larvae. Following collection, larvae were settled onto clean pre-weighed glass microscope coverslips. Coverslips with coral recruits (n=18: experiment I; n=36: experiment II) were assigned randomly to the pCO2 treatments.

In experiment I, treatments consisted of steady ambient pCO2, steady high pCO2 and diurnally oscillating pCO2 on a natural phase; this design was augmented in experiment II by including a diurnally oscillating pCO2 on a reverse phase.

To measure the area of the recruits, bleached and dried corallites were photographed (Nikon Coolpix 4500, 4.0 megapixel resolution) through a compound microscope (Zeiss Axiolab E, 40 magnification).

For detailed description of methods, see Dufault et al. (2012), Proc. R. Soc. B. doi:10.1098/rspb.2011.2545

### Data Processing Description

Images were analysed using the IMAGE J software (Wayne Rasband, v. 1.42q), with approximately 65 corallites in each treatment measured for experiment I, and approximately 33 in each treatment for experiment II. To obtain an unambiguous indication of area, only corallites that were not touching neighboring corallites were selected for analysis, and each corallite was treated as a statistical replicate.

For detailed description of processing see Dufault et al. (2012), Proc. R. Soc. B. doi:10.1098/rspb.2011.2545

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## Data Files

| File |
|---|
| **CoralRecruit_growth_area.csv** (Comma Separated Values (.csv), 23.89 KB) MD5:efe08f8d7a90b1d86fd5dfaf32c0ab43<br>Primary data file for dataset ID 514198 |

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## Related Publications


Dufault, A. M., Cumbo, V. R., Fan, T.-Y., & Edmunds, P. J. (2012). Effects of diurnally oscillating pCO2 on the calcification and survival of coral recruits. Proceedings of the Royal Society B: Biological Sciences, 279(1740), 2951–2958. doi:10.1098/rspb.2011.2545

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## Parameters

| Parameter | Description | Units |
|---|---|---|
| laboratory | Laboratory where experiments were conducted. | unitless |
| experiment | Experiment identifier: Experiment I treatments consisted of steady ambient pCO2, steady high pCO2 and diurnally oscillating pCO2 on a natural phase. Experiment II treatments consisted of a diurnally oscillating pCO2 on a reverse phase. | dimensionless |
| lat | Latitude component of geographic position where experiments were conducted. | decimal degrees |
| lon | Longitude component of geographic position where experiments were conducted. | decimal degrees |
| duration | Experiment duration: 3 (Exp I) or 6 days (Exp. II). | days |
| coverslip | Unique coverslip the coral was settled upon. | dim |
| treatment_CO2 | Individual CO2 treatment (A=ambient, H=High, D=Diurnal, DX=Reverse-phase Diurnal). Originally reported as "CO2". | dimensionless |
| tank | Unique tank the coverslips with settled corals were placed in (a decimal number represents 2 tanks used for the diurnal treatments - corals were placed in the first tank during the day (1st number) and into the second tank at night (2nd number), eg Tank 1.8= tank 1 during day, tank 8 at night). | dimensionless |
| month | Month of coral colony collection. | dimensionless |
| year | Year of coral colony collection. | |
| area | Area of corallite. | millimeters^2 |
| area_day | Area of corallite normalized to the duration of the experiment. | millimeters^2 per day |
| transformation | Square root transformation to address negative skewing in Experiment II. | unknown |

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## Instruments

| | |
|---|---|
| **Dataset-specific Instrument Name** | camera |
| **Generic Instrument Name** | Camera |
| **Dataset-specific Description** | A Nikon Coolpix 4500, 4.0 megapixel resolution camera was used to photograph recruit area. |
| **Generic Instrument Description** | All types of photographic equipment including stills, video, film and digital systems. |

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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 environmental 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 caliendrum*. 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 PANGEA: doi.pangaea.de/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 PANGEA: doi.pangaea.de/10.1594/PANGAEA.831612
brooded coral larvae 2 - carbonate chemistry
brooded coral larvae 2 - larval release March 2003-2008
brooded coral larvae 2 - respiration_photosyth_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 caliendrum* under ambient and elevated pCO2. Journal Experimental Marine Biology and Ecology 443: 33-38 Data also at PANGEA: doi: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 PANGEA: doi: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 PANGEA: doi: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

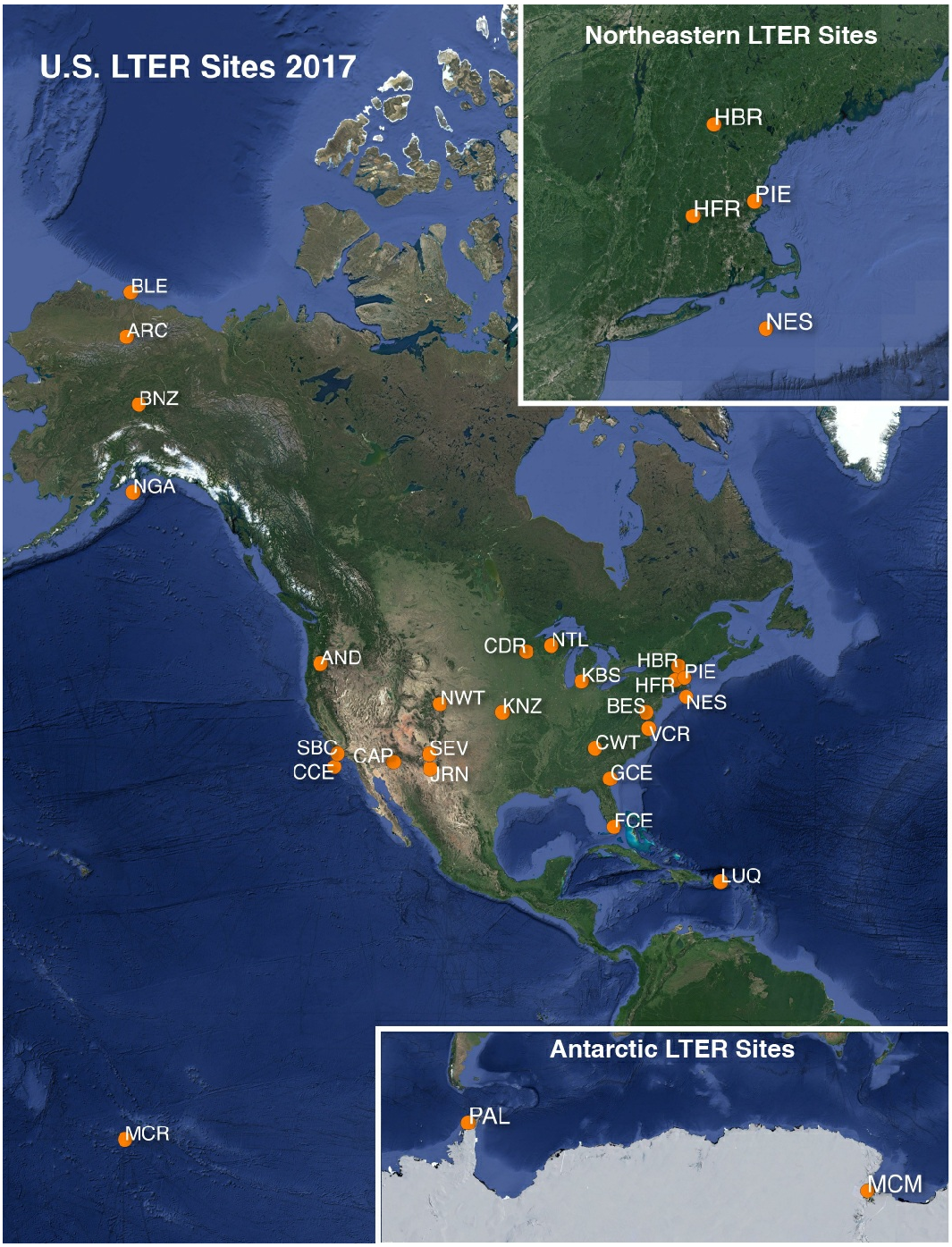
**Long Term Ecological Research network (LTER)**

**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 |