

Experimental results of seawater chemistry for coral recruits in variable CO₂ collected 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/516783>

Version: 2014-06-13

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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Table of Contents

- [Dataset Description](#)
 - [Methods & Sampling](#)
 - [Data Processing Description](#)
- [Data Files](#)
- [Related Publications](#)
- [Parameters](#)
- [Instruments](#)
- [Deployments](#)
- [Project Information](#)
- [Program Information](#)
- [Funding](#)

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 seawater chemistry data are published in Dufault et al. (2012), Proc. R. Soc. B. doi:10.1098/rspb.2011.2545, Table 1.

Related Datasets:

[recruit_growth_weight](#)

[recruit_growth_area](#)

[recruit_survival](#)

Methods & Sampling

Larvae were obtained from brooding colonies coral *S. callendrum* 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.

The DIC content of seawater was manipulated by bubbling premixed gas of a known pCO₂ or by bubbling unmodified air for the ambient treatment. To mix the gas for the high pCO₂ treatments, a system employing a variable-timed solenoid valve was used, which controlled the flow of air and CO₂ into a mixing chamber to reach the target pCO₂ of 650 matm in experiment I. This target value was selected to provide a conservative estimate for the atmospheric pCO₂ by 2100 following the business as usual emission scenario A1 [30]. In experiment II, pCO₂ levels were increased to 800 matm to test the effects of diurnally oscillating pCO₂ levels that exceeded what is found at Hobihu reef. The solenoid valve was connected to an infrared gas analyser (S151, Qubit Systems, Ontario Canada), which monitored the output gas and provided dynamic control of the duty cycle of the solenoid, thereby providing a consistent concentration of mixed gas to the treatment tanks. Refer to the electronic supplementary material for seawater chemistry and field sampling methods.

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

Data Processing Description

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

[[table of contents](#) | [back to top](#)]

Data Files

File
CoralRecruit_seawater_chem.csv (Comma Separated Values (.csv), 7.36 KB) MD5:11da594cc1545f8c0a1baaaae489d8ff
Primary data file for dataset ID 516783

[[table of contents](#) | [back to top](#)]

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](https://doi.org/10.1098/rspb.2011.2545)
Results

[[table of contents](#) | [back to top](#)]

Parameters

Parameter	Description	Units
laboratory	Laboratory where experiments were conducted.	unitless
lat	Latitude component of geographic position where experiments were conducted.	decimal degrees
lon	Longitude component of geographic position where experiments were conducted.	decimal degrees
date	Date of tank water sampling.	MMDDYYYY
yrday	Year day of tank water sampling.	
experiment	Experiment identifier: Experiment I treatments consisted of steady ambient pCO ₂ , steady high pCO ₂ and diurnally oscillating pCO ₂ on a natural phase. Experiment II treatments consisted of a diurnally oscillating pCO ₂ on a reverse phase.	dimensionless
tank_XX	Experimental tank number, where XX is equivalent to 1, 3, 8, 10, 12, 13, 14, 15 for experiment I, and 1, 2, 7, 8, 10, 14, 15, 16 for experiment II.	dimensionless
temp_X	Water temperature of experimental tank on day of measurement, where X is equivalent to I for experiment I or II for experiment II.	degrees Celsius
sal_X	Salinity of experimental tank on day of measurement, where X is equal to I for experiment I and II for experiment II.	PSU
TA_X	Total alkalinity of experimental tank on day of measurement, where X is equal to I for experiment I and II for experiment II.	umol per kilogram
pH_X	pH (total scale) of experimental tank on day of measurement, where X is equal to I for experiment I and II for experiment II.	
pCO ₂ _X	Partial pressure of CO ₂ for experimental tank on day of measurement, where X is equal to I for experiment I and II for experiment II.	microatmospheres
omega_X	Aragonite saturation state of experimental tank on day of measurement, where X is equal to I for experiment I and II for experiment II.	dimensionless

[[table of contents](#) | [back to top](#)]

Instruments

Dataset-specific Instrument Name	infrared gas analyser
Generic Instrument Name	Gas Analyzer
Dataset-specific Description	An infrared gas analyser (S151, Qubit Systems, Ontario Canada) was used to provide consistent gas mixture.
Generic Instrument Description	Gas Analyzers - Instruments for determining the qualitative and quantitative composition of gas mixtures.

[[table of contents](#) | [back to top](#)]

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.

[[table of contents](#) | [back to top](#)]

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 \(Excel file\)](#)

[[table of contents](#) | [back to top](#)]

Program Information

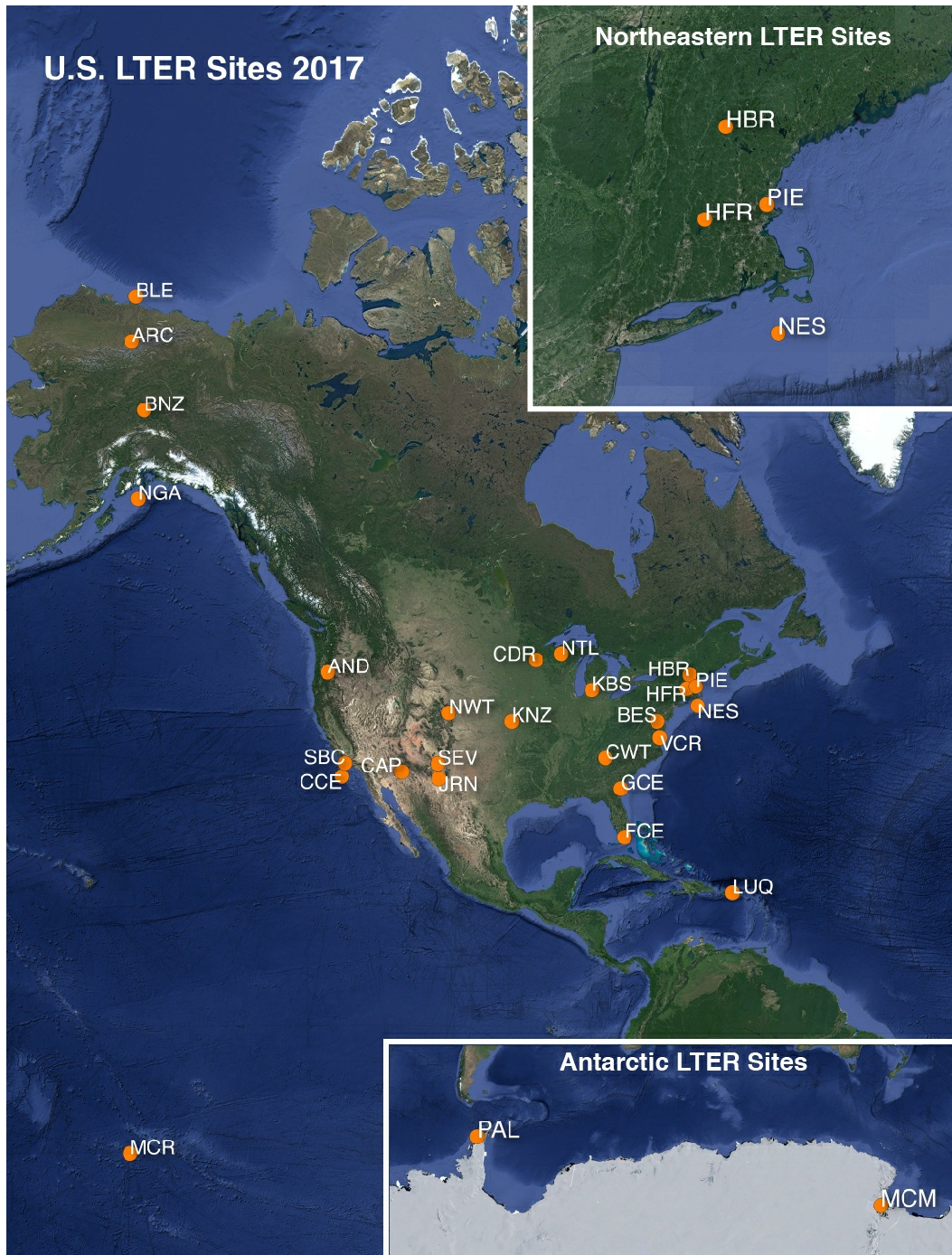
Long Term Ecological Research network (LTER)

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/>

[[table of contents](#) | [back to top](#)]

Funding

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

[[table of contents](#) | [back to top](#)]