# Brooded coral larval respiration (Cumbo, 2012) from Taiwan 2010 (MCR LTER project, Climate_Coral_Larvae project)

**Website**: https://www.bco-dmo.org/dataset/528695
**Version**: 2014-09-08

**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) | Principal Investigator |
| Cumbo, Vivian R | California State University Northridge (CSUN) | Scientist |
| Copley, Nancy | Woods Hole Oceanographic Institution (WHOI BCO-DMO) | BCO-DMO Data Manager |

## Table of Contents


- Dataset Description
  - Methods & Sampling
  - Data Processing Description
- Data Files
- Parameters
- Instruments
- Deployments
- Project Information
- Program Information
- Funding


## Dataset Description

The physiological development of brooded larvae from the pocilloporid corals *Pocillopora damicornis* and *Seriatopora caliendrum* in southern Taiwan was examined.

These data include larval respiration rates from experiments conducted in June and July, 2010.

**Related datasets:**
brooded coral - carbonate chemistry
brooded coral - release
brooded coral - settlement competency
brooded coral - size_July
brooded coral - size_protein_symbionts_photosynth

These data are published in Cumbo, VR, Fan TY, Edmunds PJ. (2012) Physiological development of brooded larvae from two pocilloporid corals in Taiwan. Marine Biology 159: 2853-2866. DOI 10.1007/s00227-012-2046-y. See Figs. 1d and 3e.

Download complete data for this publication (Excel file)

### Methods & Sampling

Dark respiration of larvae Larval respiration was measured as O2 uptake by a group of 6 swimming larvae in Wheaton vials (2 mL) that were incubated in darkness at the same temperature as the treatments (~28C) (Edmunds et al. 2011). O2 was measured using a ruthenium-based optrode (FOXY-R, 1.58 diameter, Ocean Optics) connected to a spectrophotometer (USB2000, Ocean Optics) and interfaced with a computer running Ocean Optics software (OOISensor, version 1.00.08). The optrode was two-point calibrated in a zero solution (sodium sulfite and 0.010 mol L-1 sodium tetraborate) and water-saturated air at the experimental temperature. At each sampling, four replicates of 6 larvae were placed in Wheaton vials filled with filtered seawater (1 lm, FSW) and sealed with Parafilm; these were accompanied by four control vials that were processed in an identical manner but without larvae. The O2 saturation of the water used to fill the vials was recorded using the optrode and again in each vial following incubations lasting 1.5-2.0 h. The incubations were completed in a temperature-regulated bath (±0.1C, Hipoint, models LC-06), and the vials were inverted prior to measuring O2 saturation; larval motility during the incubations prevented the formation of boundary layers. O2 saturation was converted to concentration using gas tables [N. Ramsing and J. Gundersen at http://www.unisense.com (based on Garcia and Gordon 1992)], and the temperature and salinity of the seawater, and the change in O2 concentration converted to nmol O2 min-1 larva-1 after adjusting for control O2 fluxes.

### Data Processing Description

**BCO-DMO processing notes:**

- added conventional header with dataset name, PI name, version date, reference information
- added lab, lat, lon, expt columns
- renamed parameters to BCO-DMO standard
- combined data from Figures 1d and 3e

[ table of contents | back to top ]

## Data Files

| File |
|---|
| **brood_respiration.csv**(Comma Separated Values (.csv), 18.87 KB) MD5:14605e477dd4ef5eb180996dd82376ca<br>Primary data file for dataset ID 528695 |

[ table of contents | back to top ]

## Parameters

| Parameter | Description | Units |
|---|---|---|
| expt | experiment id | unitless |
| lab | laboratory | unitless |
| lat | latitude; north is positive | decimal degrees |
| lon | longitude; east is positive | decimal degrees |
| date | local date of measurement | yyyy-mm-dd |
| lunar_day | lunar day of measurement | integer |
| treatment | whether tank contained larvae or not | unitless |
| tank | tank id number | integer |
| replicate | replicate id number | integer |
| release | larval release relative to full moon: early, peak, or late; N_A = not applicable | unitless |
| temp | seawater temperature | degrees Celsius |
| species | coral species name | unitless |
| num_larvae | number of larvae in respiration chamber | integer |
| vol_chamber | volume of respiration chamber | ml |
| duration | duration of respiration incubation | minutes |
| O2_sat_pcnt_start | oxygen saturation relative to air at start of incubation | percent |
| O2_sat_pcnt_final | oxygen saturation relative to air at end of incubation | percent |
| respiration | respiration rate (6 larvae/chamber) | umol O2/chamber/hr |

[ table of contents | back to top ]

## Instruments

| | |
|---|---|
| **Dataset-specific Instrument Name** | water bath |
| **Generic Instrument Name** | In-situ incubator |
| **Dataset-specific Description** | A temperature-regulated bath (±0.1C, Hipoint, models LC-06) |
| **Generic Instrument Description** | A device on a ship or in the laboratory that holds water samples under controlled conditions of temperature and possibly illumination. |

| | |
|---|---|
| **Dataset-specific Instrument Name** | optrode |
| **Generic Instrument Name** | Optode |
| **Dataset-specific Description** | A ruthenium-based optrode (FOXY-R, 1.58 diameter, Ocean Optics) connected to a spectrophotometer (USB2000, Ocean Optics) and interfaced with a computer running Ocean Optics software (OOISensor, version 1.00.08). |
| **Generic Instrument Description** | An optode or optrode is an optical sensor device that optically measures a specific substance usually with the aid of a chemical transducer. |

| | |
|---|---|
| **Dataset-specific Instrument Name** | spectrophotometer |
| **Generic Instrument Name** | Spectrophotometer |
| **Dataset-specific Description** | USB2000, Ocean Optics |
| **Generic Instrument Description** | An instrument used to measure the relative absorption of electromagnetic radiation of different wavelengths in the near infra-red, visible and ultraviolet wavebands by samples. |

[ 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

**NSF Award Abstract:**

Coral reefs provide important benefits to society, from food to exceptional biodiversity to shoreline protection and recreation, but they are threatened by natural perturbations and human activities, including those causing global-scale changes. These pressures increasingly are causing coral reefs to undergo large, often abrupt, ecological changes where corals are being replaced by seaweeds or other undesirable organisms. Historically, the major agent of disturbance to coral reefs has been powerful storms, but in recent decades, episodes of mass coral bleaching from marine heat waves have become more frequent and severe as the temperature of ocean surface waters continues to rise. Coral reefs are further stressed by local human activities that cause nutrient pollution and deplete herbivorous fishes that control growth of seaweeds. Studying how coral reefs respond to these two types of disturbance under different levels of nutrient pollution and fishing provides essential information on what affects the ability of coral reefs to buffer environmental change and disturbances without collapsing to a persistent, degraded condition. The fundamental goals of the Moorea Coral Reef Long Term Ecological Research program (MCR LTER) are to understand how and why coral reefs change over time, to assess the consequences of these changes, and to contribute scientific knowledge needed to sustain coral reef ecosystems and the important societal services they provide. This research improves understanding and management of coral reefs, which benefits all groups concerned with the welfare of this ecologically, economically and culturally important ecosystem. In addition to academic communities, scientific findings are communicated to interested individuals, non-governmental organizations, island communities and governmental entities. These findings also are integrated into K-12, undergraduate, graduate and public education activities through a multi-pronged program that includes inquiry-based curricula, interactive and media-based public education programs, and internet-based resources. MCR?s research, training, education and outreach efforts all emphasize broadening participation in STEM fields and strengthening STEM literacy.

New research activities build on MCR LTER?s powerful foundation of long-term observations and broad ecological understanding of oceanic coral reefs to address the following core issues: How is the changing disturbance regime (recurrent heat waves in addition to cyclonic storms) altering the resilience of coral reefs, and what are the ecological consequences of altered resilience? Research activities are organized around a unifying framework that explicitly addresses how reef communities are affected by the nature and history of coral-killing disturbances, and how those responses to disturbance are influenced by the pattern of local human stressors. New studies answer three focal questions: (1) How do different disturbance types, which either remove (storms) or retain (heat waves) dead coral skeletons, affect community dynamics, abrupt changes in ecological state, and resilience? (2) How do local stressors interact with new disturbance regimes to create spatial heterogeneity in community dynamics, ecosystem processes, and spatial resilience? And (3) What attributes of coral and coral reef communities influence their capacity to remain resilient under current and future environmental conditions? These questions provide an unparalleled opportunity to test hypotheses and advance theory regarding ecological resilience and the causes and consequences of abrupt ecological change, which is broadly relevant across aquatic and terrestrial ecosystems.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

**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)

[ table of contents | back to top ]

---

## Program Information

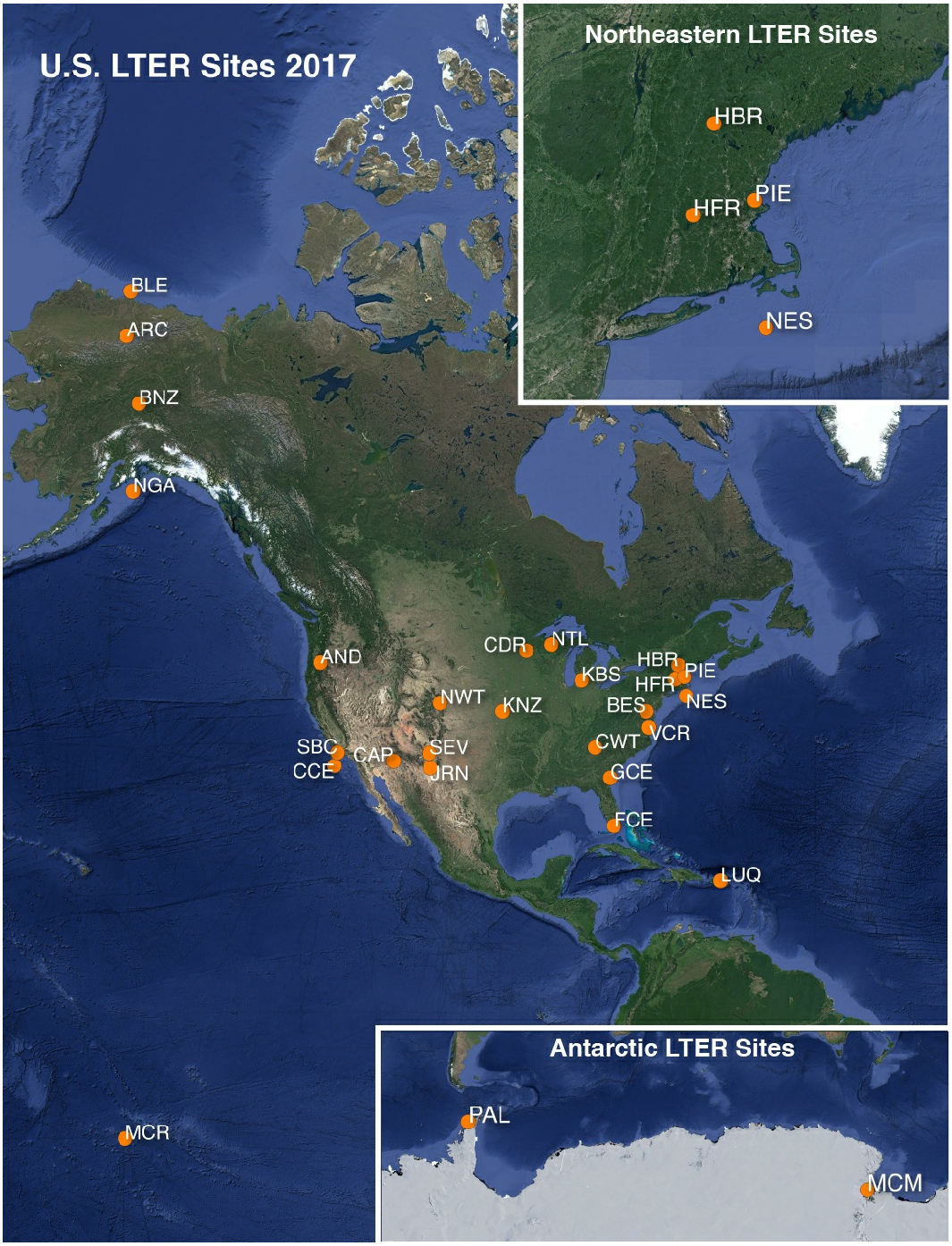
**Long Term Ecological Research network (LTER)**

**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.




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

### 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 |

[ 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 ]