Summary metrics of light and temperature at multiple sites and depths on the fore reef of Moorea, French Polynesia from 2005 to 2019

Website: https://www.bco-dmo.org/dataset/857017
Data Type: Other Field Results
Version: 1
Version Date: 2021-08-02

Project
» Collaborative research: Coral community resilience: testing the role of hidden diversity in pocilloporid corals at Moorea (Pocilloporid Coral Diversity)

Contributors	Affiliation	Role
Burgess, Scott	Florida State University (FSU)	Principal Investigator
Edmunds, Peter J.	California State University Northridge (CSUN)	Co-Principal Investigator
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
This dataset includes summary metrics of light and temperature at multiple sites and depths on the fore reef of Moorea, French Polynesia from 2005 to 2019. These data are published in Figures 1 and 4 of Johnston et al., 2021 (doi: 10.1007/s00338-021-02107-9).

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Coverage

Spatial Extent: **Lat**:-17.5333 **Lon**:-149.8333
Temporal Extent: 2005-01 - 2019-12

Methods & Sampling

The researchers derived seven environmental variables related to sea water temperature and light regimes at each site and depth:

1) the mean of the maximum daily sea water temperature from June to November ('Max Daily Temp (Jun-Nov)'),

2) the mean of the maximum daily sea water temperature from December to May ('Max Daily Temp (Dec-May)'),

3) the mean of the minimum daily sea water temperature from December to May ('Min Daily Temp'),

4) the mean of the daily sea water temperature variance from December to May ('Temp Variance [Mean]'),

5) the maximum of the daily sea water temperature variance from December to May ('Temp Variance [Max]'),

6) the mean photosynthetically active radiation (PAR) from December to February ('Mean Light'), and

7) the minimum PAR from December to February ('Min Light').

The sea water temperature regimes at 10 m and 20 m were quantified based on the *in situ* time series (2005 – 2019) collected at 2 min intervals as part of the MCR-LTER program (http://mcrlter.msi.ucsb.edu/data/variable/) using Seabird Electronics SBE39 and SBE56 temperature recorders (0.002 °C accuracy, 0.0001 °C resolution, < 10 s response time) mounted onto plates directly affixed to the reef surface. Sea water temperatures for 5 m depth, where there were no loggers, were derived for each site based on SST and the diurnal and semi-diurnal variance observed at 2-min intervals in the backreef at 2 m and the forereef at 10 m. Daily average sea water temperatures at 5 m were interpolated onto a 2-min grid and realistic variability superimposed based on the time series of semi-diurnal and diurnal variability observed at 2 m and 10 m at each site focusing on variations between 1 hr and the local inertial period of 40 hrs.

PAR was derived for each site and depth based on satellite estimates of surface PAR and the diffuse attenuation coefficient for PAR (K_d(PAR)) available from the European Space Agency GlobColour datasets over the period April 2016 to April 2020 (http://www.globcolour.info/). Daily PAR and K_d(PAR) values were obtained around Mo'orea at a 1/24° resolution (approximately 6 x 6 km), with site specific values based on the average of the nearest 4 pixels (approximately 12 x 12 km). Depth specific PAR values (PAR_z) were then determined at 5, 10, and 20 m water depths at each site based on the site-specific PAR and K_d(PAR): $PAR_z(Z) = PAR.e^{-Kd(PAR).z}$

A climatology was calculated for the time series of temperature and light at each site and depth, which closely resembled bimodal normal distributions corresponding to summer and winter seasons.

Data Processing Description

These data are published in Figures 1 and 4 of Johnston et al. (2021). The R scripts and data used to perform analyses and prepare figures are available from Dryad (doi: 10.5061/dryad.kwh70rz3p).

BCO-DMO Processing:
- renamed fields (columns) to conform with BCO-DMO naming conventions.

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Data Files

File	
physical_data_summaries.csv	(Comma Separated Values (.csv), 1.35 KB) MD5:cbdf9182fd5288db85a4d73ae967e2fb
Primary data file for dataset ID 857017	

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Related Publications

Johnston, E. C., Wyatt, A. S. J., Leichter, J. J., & Burgess, S. C. (2021). Niche differences in co-occurring cryptic coral species (Pocillopora spp.). Coral Reefs. doi:10.1007/s00338-021-02107-9
Results

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Related Datasets

Different Version

Johnston, E., Wyatt, A., Leichter, J., & Burgess, S. (2021). Niche differences in co-occurring cryptic coral species (Pocillopora spp.) (Version 2) [Data set]. Dryad. https://doi.org/10.5061/DRYAD.KWH70RZ3P https://doi.org/10.5061/dryad.kwh70rz3p

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Parameters

Parameter	Description	Units
Depth	Sampling depth in meters	meters (m)
Site	Sampling site label corresponds to the site used in the Moorea Coral Reef Long-Term Ecological Research (MCR-LTER) program	unitless
Temp_MaxDailyMean_DecMay	Mean of the maximum daily sea water temperature from December to May	degrees Celsius
Temp_MaxDailyMean_JunNov	Mean of the maximum daily sea water temperature from June to November	degrees Celsius
Temp_MinDailyMean_DecMay	Mean of the minimum daily sea water temperature from December to May	degrees Celsius
Temp_MinDailyMean_JunNov	Mean of the minimum daily sea water temperature from June to November	degrees Celsius
Temp_MeanDailyVariance_DecMay	Mean of the daily sea water temperature variance from December to May	degrees Celsius
Temp_MeanDailyVariance_JunNov	Mean of the daily sea water temperature variance from June to November	degrees Celsius
Temp_MaxDailyVariance_DecMay	Maximum of the daily sea water temperature variance from December to May	degrees Celsius
Temp_MaxDailyVariance_JunNov	Maximum of the daily sea water temperature variance from June to November	degrees Celsius
Light_Mean_Em2d_DecFeb	Mean photosynthetically active radiation (PAR) from December to February	Einsteins per square meter per day (E m-2 d-1)
Light_Mean_Em2d_JunAug	Mean photosynthetically active radiation (PAR) from June to August	Einsteins per square meter per day (E m-2 d-1)
Light_Min_Em2d_DecFeb	Minimum PAR from December to February	Einsteins per square meter per day (E m-2 d-1)
Light_Min_Em2d_JunAug	Minimum PAR from June to August	Einsteins per square meter per day (E m-2 d-1)
Light_Variance_DecFeb	Maximum PAR from December to February	Einsteins per square meter per day (E m-2 d-1)
Light_Variance_JunAug	Maximum PAR from June to August	Einsteins per square meter per day (E m-2 d-1)

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Instruments

Dataset-specific Instrument Name	Seabird Electronics SBE39
Generic Instrument Name	Sea-Bird SBE 39 temperature recorder
Dataset-specific Description	Temperature was recorded using Seabird Electronics SBE39 and SBE56 temperature recorders (0.002 °C accuracy, 0.0001 °C resolution, < 10 s response time).
Generic Instrument Description	A high-accuracy temperature recorder (pressure optional) with internal battery and non-volatile memory for deployment at depths up to 10500 meters. It is intended for moorings or other long-term, fixed-site applications, as well as shorter-term deployments on nets, towed vehicles, or ROVs. Calibration coefficients stored in EEPROM allow the SBE 39 to transmit data in engineering units. Typical drift is less than 0.002C per year. The SBE 39 communicates directly with a computer via a standard RA-232 interface. For more information see http://www.bodc.ac.uk/data/documents/nodb/108627/

Dataset-specific Instrument Name	SBE56 temperature recorder
Generic Instrument Name	Sea-Bird SBE 56 temperature recorder
Dataset-specific Description	Temperature was recorded using Seabird Electronics SBE39 and SBE56 temperature recorders (0.002 °C accuracy, 0.0001 °C resolution, < 10 s response time).
Generic Instrument Description	This is a small (30 cm by 2.54 cm diameter) high-accuracy, battery-powered temperature and time logger capable of sampling intervals from 0.5 seconds to 9 hours. Temperature is measured by a pressure-protected (1500m depth) thermistor. Initial accuracy is 0.002C and drift is typically less than 0.002C per year.

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Project Information

Collaborative research: Coral community resilience: testing the role of hidden diversity in pocilloporid corals at Moorea (Pocilloporid Coral Diversity)

Coverage: Moorea, French Polynesia

NSF Award Abstract:
While most coral reefs in the world are threatened by multiple disturbances that are driving coral cover downward, the coral reefs at Mo'orea, French Polynesia, provide a striking exception. However, it is not yet clear what makes the coral communities of Mo'orea an exception to the trend of global decline in coral cover, and what drives spatial variation in recovery patterns around the island. The most recent wave of recovery on the outer reefs is dominated by corals in the genus Pocillopora (the cauliflower coral). While the colonies of this coral all look similar to one another, they actually represent multiple 'hidden' species that are genetically divergent but visibly indistinguishable. The morphological similarity makes it hard to identify species in the field, and this often forces researchers to pool these corals into a single group, which has impeded a full understanding of coral recovery. The ecological differences among these hidden species remain poorly understood, but they may be a crucial factor keeping the ecosystem in a coral-dominated state. This project is

studying how 'hidden diversity' provides a form of 'ecological insurance' that provides reef-building coral communities around this island with ecological and evolutionary options that buffer reefs from unpredictable and unfavorable environmental conditions. If multiple cryptic species exhibit a diversity of responses to disturbance and stress, then it increases the ability of the community to recover and re-organize after impacts compared to that if all the species responded the same way. By studying the reefs at Mo'orea, this project provides unique, important, and transferable knowledge to better understand fundamental mechanism driving coral community recovery following catastrophic damage, and will provide much-needed information to better manage coral reefs and favor them remaining in a coral-dominated state. A PhD student and a postdoctoral researcher at Florida State University (FSU) are being supported and mentored during the project, and a program of professional growth is being provided for a technician who will work on the project. The investigators are working with science educators from Florida schools to introduce marine biology clubs that will provide outreach opportunities for FSU and California State University Northridge participants to engage high school students and teachers in the research themes at the core of this project.

This project will test the hypothesis that the presence of morphologically similar yet genetically divergent lineages of corals in the genus Pocillopora drives rapid recovery of coral communities dominated by Pocillopora on the outer reefs of Mo'orea, French Polynesia. By creating a diverse portfolio in the capacity of the Pocillopora community to recover and reorganize after disturbance, hidden ecological differences among coral lineages in their response to disturbance is expected to promote community resilience. A well-studied genetic marker will be used to distinguish coral colonies among different lineages. Field-based projects, co-located with Moorea Coral Reef-Long-Term Ecological Research (MCR-LTER) sites, will determine how pocilloporid lineages differ in their distribution and abundance, spatial and temporal patterns of annual recruitment, symbiont composition, and post-settlement growth and survival. These data will be used to build Integral Projection Models (IPMs) to compare population differences among lineages in their sensitivity to size-dependent perturbations, and their capacity for population growth following disturbance. Results from the field projects and IPMs will be synthesized to estimate response diversity as the multivariate dispersion of lineage dissimilarity, and to assess the extent to which it predicts variation among sites in the recovery rate of pocilloporid percent cover, estimated empirically from the MCR-LTER time series. The intellectual merits of this project lie in developing new and transferable understanding of: i) the ecological differences within an ecologically important coral genus, ii) why pocilloporids at Mo'orea are an exception to the global trend of declining coral cover, and iii) the potential for hidden response diversity to act as a fundamental mechanism determining the capacity for coral communities to reestablish and reorganize following disturbances.

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.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1829867

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