Water temperature measured at six coral reefs sites in Palau from 2021 to 2023

Website: https://www.bco-dmo.org/dataset/926498
Data Type: Other Field Results
Version: 1
Version Date: 2024-05-02

Project
» Collaborative Research: How do selection, plasticity, and dispersal interact to determine coral success in warmer and more variable environments? (Palau coral selection plasticity dispersal)

Contributors	Affiliation	Role
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Abstract
Water temperature was measured at six coral reef sites in Palau from 2021 to 2023. Loggers (Hobo Tidbit) were attached to threaded rods embedded in the reef using zip ties. Water temperature was measured every 30 minutes.

Table of Contents

Coverage

Location: Republic of Palau
Spatial Extent: **N**:7.36722 **E**:134.4766 **S**:7.16162 **W**:134.34697
Temporal Extent: 2021-11-02 - 2023-05-12

Methods & Sampling

Data were collected from 6 sites located in the Republic of Palau from November 2021 to May 2023. Stainless steel (316, 1/4-20 size) threaded rods were driven into dead coral or sand using a hammer or by hand. Duplicate loggers (Hobo Tidbit) were attached to threaded rods at each site and left in place between field seasons in 2021 to 2023. Loggers were changed in November 2022.

Data Processing Description

Temperature measurements from before and after the deployment were removed (i.e., temperature in the lab or on the boat). Temperatures measured by duplicate loggers were averaged for a given site.

BCO-DMO Processing Description

- Created a site locations table, "site_locations.csv", using the site latitudes and longitudes provided by PI by email.
- Converted latitude and longitude values from degrees and decimal minutes to decimal degrees, and rounded to 5 decimal places.
- Imported original file "Temp_all sites_2021-2023.csv" into the BCO-DMO system.
- Marked "NaN" as a missing data value (missing data are blank/empty in the final CSV file).
- Unpivoted the table to create a new column for "Site" and a column for "Temperature".
- Converted date/time field to ISO 8601 format (local).
- Created a date/time column for UTC.
- Added columns for Latitude and Longitude to the primary data table by joining to the site locations table.
- Sorted data by Site name and then date/time.
- Saved the final file as "926498_v1_temperature_palau_reefs.csv".

Problem Description

No loggers were recovered from the site Taoch in May 2023. Therefore, data are missing for Taoch from November 2022 to May 2023.

[table of contents | back to top]

Data Files

File	
926498_v1_temperature_palau_reefs.csv	(Comma Separated Values (.csv), 10.27 MB) MD5:7f844bfdb75c4bc8c77549b3abfc6342
Primary data file for dataset ID 926498, version 1	

[table of contents | back to top]

Related Publications

Meyer-Kaiser, KS, Bennett, M-J, Andres, MO, & Grupstra, CGB (2024) Early life-history bottlenecks shape coral community composition across classical and extreme reefs in Palau. Marine Ecology Progress Series, in review. *Results*

[table of contents | back to top]

Parameters

Parameter	Description	Units
ISO_DateTime_Local	Date and time of measurement in ISO 8601 format; time zone: GMT+09:00.	unitless
ISO_DateTime_UTC	Date and time of measurement in ISO 8601 format; time zone: UTC.	unitless
Site	Site name	unitless
Latitude	Site latitude; positive values = North	decimal degrees
Longitude	Site longitude; positive values = East	decimal degrees
Temperature	Water temperature	degrees Celsius

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	Hobo Tidbit temperature logger (Onset Corp., Wareham, MA, part number UTBI-001)
Generic Instrument Name	Onset HOBO TidbiT v2 (UTBI-001) temperature logger
Generic Instrument Description	A temperature logger that measures temperatures over a wide temperature range. It is designed for outdoor and underwater environments and is waterproof to 300 m. A solar radiation shield is required to obtain accurate air temperature measurements in sunlight (RS1 or M-RSA Solar Radiation Shield). With an operational temperature range between -20 degrees Celsius and +70 degrees Celsius, the TidbiT v2 has an accuracy of +/-0.21 and a resolution of 0.02 degrees Celsius.

[table of contents | back to top]

Project Information

Collaborative Research: How do selection, plasticity, and dispersal interact to determine coral success in warmer and more variable environments? (Palau coral selection plasticity dispersal)

Website: https://www.nsf.gov/awardsearch/showAward?AWD_ID=2048589&HistoricalAwards=false

Coverage: Palauan coral reefs

NSF Award Abstract:
Coral reefs host thousands of marine species, help protect coastlines from storm damage, generate tourism, and house fish used for human consumption. However, corals are vulnerable to increasing water temperatures, which can lead to coral death. One way for reefs to survive in warming oceans is for corals that are well-suited to warmer waters to repopulate reefs that have less temperature-tolerant individuals. For this strategy to succeed, however, the more temperature-tolerant corals need to be able to disperse to and survive in these different environments. This project takes advantage of reef systems in the Pacific nation of Palau that naturally experience a wide range in temperatures across short geographic distances. Using cutting-edge ecological and genomic techniques, the team of investigators is directly testing whether young corals from Palau's warmest reefs can successfully be carried by ocean currents to Palau's currently cooler reefs and subsequently survive and thrive in these habitats. Given the relevance of this research for the local ecology, the team is disseminating results to the Palauan government through a written report in conjunction with Palauan scientists who are interning with the team, and to the Palauan people through public presentations. As part of this work, the investigators are maintaining a blog and are organizing a music-lecture series combining dance, music, and science to promote awareness of the coral reef crisis across English and Spanish-speaking communities in the US. Results from this project are informing restoration and conservation practices of the Coral Conservation Consortium as well as other efforts worldwide.

A major question in evolutionary biology is how plasticity and adaptation interact to influence survival under novel environments. Understanding these processes is increasingly important as rising temperatures associated with climate change influence species globally. For marine organisms with pelagic larval phases, including reef-building corals, the post-settlement period constitutes a critical bottleneck for adaptation and plasticity, with the added complexity that the conditions experienced and time spent as larvae can incur carryover effects. This project leverages reefs in Palau that span a steep environmental gradient to study how environmental variation drives selection and plasticity and to examine if dispersal between reefs limits success across habitats due to carryover effects. The investigators are testing the overarching hypothesis that corals from warmer and more variable environments are adapted to warmer temperatures and exhibit increased

plasticity, but that dispersal between reefs incurs a fitness cost. The team integrates field and molecular techniques to: 1) investigate the degree of selection occurring on warmer and more variable reefs, 2) test whether corals transplanted to more variable environments improve their thermal tolerance through developmental plasticity, and 3) examine whether delays in metamorphosis required for dispersal across reefs comes at a fitness cost due to carryover effects.

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.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-2048678

[table of contents | back to top]