Seawater temperature data from Carrie Bow Caye, Belize recorded from January to December 2017

Website: https://www.bco-dmo.org/dataset/846912
Data Type: Other Field Results
Version: 1
Version Date: 2021-04-14

Project
» Collaborative research: Is hybridization among threatened Caribbean coral species the key to their survival or the harbinger of their extinction? (Coral Hybridization)

Contributors	Affiliation	Role
Fogarty, Nicole	University of North Carolina - Wilmington (UNC-Wilmington)	Principal Investigator
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Abstract
This dataset includes seawater temperature data from Carrie Bow Caye, Belize recorded from January to December 2017. These data were used in Pitts et al. 2020 (doi:10.1007/s00338-019-01888-4). Further details on the larger dataset from which these data came can be found in Helmuth et al. 2020 (doi:10.1038/s41597-020-00733-6).

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Coverage

Spatial Extent: **Lat**:16.79972 **Lon**:-88.07863
Temporal Extent: 2017-01-23 - 2017-12-13

Methods & Sampling

Data collection using an Onset Hobo Water Temp Pro UA-002-64 (accuracy ± 0.2°C) began on January 23, 2017 and ended on December 13, 2017. The temperature logger was deployed on a buoy and suspended 1m above benthos at Carrie Bow Caye, Belize (N 16° 47.983', W 088° 04.718').

Data Processing Description

Monthly average temperatures were calculated and are provided in the Supplemental File, "Carrie_Bow_Caye_Temp_Monthly_Avg" (PDF).

BCO-DMO Processing:
- changed date/time format to ISO8601;
- added date/time in UTC;
- renamed fields to comply with BCO-DMO naming conventions.

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Data Files

File
Carrie_Bow_Caye_Temp_2017.csv (Comma Separated Values (.csv), 1.10 MB) MD5:40e98fd2a14c9c8f4876df09443f8b77 Primary data file for dataset ID 846912

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Supplemental Files

File
Carrie_Bow_Caye_Temp_Monthly_Avg.pdf (Portable Document Format (.pdf), 210.20 KB) MD5:1de703854462ec897af6b06c889b14f5 Monthly average water temperature (in degrees Celsius), standard deviation, and standard error from Carrie Bow Cay from 2017-01-23 to 2017-12-13.

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Related Publications

Helmuth, B., Leichter, J. J., Rotjan, R. D., Castillo, K. D., Fieseler, C., Jones, S., & Choi, F. (2020). High resolution spatiotemporal patterns of seawater temperatures across the Belize Mesoamerican Barrier Reef. Scientific Data, 7(1). doi:10.1038/s41597-020-00733-6
Results

Pitts, K. A., Campbell, J. E., Figueiredo, J., & Fogarty, N. D. (2020). Ocean acidification partially mitigates the negative effects of warming on the recruitment of the coral, Orbicella faveolata. Coral Reefs, 39(2), 281–292. doi:10.1007/s00338-019-01888-4
Results

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Parameters

Parameter	Description	Units
ISO_DateTime_Local	Date and time of data collection in local time zone (GMT-6:00); in ISO8601 format: YYYY-MM-DDThh:mm	unitless
ISO_DateTime_UTC	Date and time of data collection (UTC); in ISO8601 format: YYYY-MM-DDThh:mmZ	unitless
Temp	Water temperature	degrees Celsius

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Instruments

Dataset-specific Instrument Name	Onset Hobo Water Temp Pro UA-002-64
Generic Instrument Name	Temperature Logger
Generic Instrument Description	Records temperature data over a period of time.

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Project Information

Collaborative research: Is hybridization among threatened Caribbean coral species the key to their survival or the harbinger of their extinction? (Coral Hybridization)

Coverage: Caribbean and North-West Atlantic

NSF Award Abstract:
Reef-building acroporid corals form the foundation of shallow tropical coral communities throughout the Caribbean. Yet, the once dominant staghorn coral (Acropora cervicornis) and the elkhorn coral (A. palmata) have decreased by more than 90% since the 1980s, primarily from disease. Their continuing decline jeopardizes the ability of coral reefs to provide numerous societal and ecological benefits, including economic revenue from seafood harvesting and tourism and shoreline protection from extreme wave events caused by storms and hurricanes. Despite their protection under the U.S. Endangered Species Act since 2006, threats to the survival of reef-building acroporid corals remain pervasive and include disease and warming ocean temperatures that may lead to further large-scale mortality. However, hybridization among these closely related species is increasing and may provide an avenue for adaptation to a changing environment. While hybrids were rare in the past, they are now thriving in shallow habitats with extreme temperatures and irradiance and are expanding into the parental species habitats. Additional evidence suggests that the hybrid is more disease resistant than at least one of the parental species. Hybridization may therefore have the potential to rescue the threatened parental species from extinction through the transfer of adapted genes via hybrids mating with both parental species, but extensive gene flow may alter the evolutionary trajectory of the parental species and drive one or both to extinction. This collaborative project is to collect genetic and ecological data in order to understand the mechanisms underlying increasing hybrid abundance. The knowledge gained from this research will help facilitate more strategic management of coral populations under current and emerging threats to their survival. This project includes integrated research and educational opportunities for high school, undergraduate and graduate students, and a postdoctoral researcher. Students in the United States Virgin Islands will take part in coral spawning research and resource managers will receive training on acroporid reproduction to apply to coral restoration techniques.

Current models predict the demise of reefs in the next 200 years due to increasing sea surface temperatures and ocean acidification. It is thus essential to identify habitats, taxa and evolutionary mechanisms that will allow some coral species to maintain their role as foundation fauna. Hybridization can provide an avenue for adaptation to changing conditions. Corals hybridize with some frequency and results may range from the introduction of a few alleles into existing parent species via introgression, to the birth of a new, perhaps better adapted genetic lineage. The only widely accepted coral hybrid system consists of the once dominant but now threatened Caribbean species, Acropora cervicornis and A. palmata. In the past, hybrid colonies originating from natural crosses between elkhorn and staghorn corals were rare, and evidence of hybrid reproduction was limited to infrequent matings with the staghorn coral. Recent field observations suggest that the hybrid is increasing and its ecological role is changing throughout the Caribbean. These hybrids appear to be less affected by the disease that led to the mass mortality of their parental species in recent decades. Hybrids are also found thriving in shallow habitats with high temperatures and irradiance suggesting they may be less susceptible to future warming scenarios. At the same time, they are expanding into the deeper parental species habitats. Preliminary genetic data indicate that hybrids are now mating with each other, demonstrating the potential for the formation of a new species. Further, hybrids appear to be capable of mating with both staghorn and elkhorn coral, perhaps leading to gene flow between the parent species via the hybrid. Research

is proposed to address how the increase in hybridization and perhaps subsequent introgression will affect the current ecological role and the future evolutionary trajectory of Caribbean acroporids. Specifically, this collaborative project aims to answer the following questions: 1) What is the historic rate, direction, and degree of introgression across species ranges and genomes? Linkage block analysis based on genome-wide SNP genotyping across three replicate hybrid zones will answer this question. 2) What is the current extent and future potential of later generation hybrid formation? Morphometric and genetic analyses combined with in vitro fertilization assays will be used. 3) What mechanisms allow hybrids to thrive in hot, shallow waters? A series of manipulative in situ and ex situ experiments will determine whether biotic or abiotic factors favor hybrid survival in shallow waters. 4) Are hybrids more disease resistant than the parentals species? Disease transmission assays in reciprocal transplant experiments and histological analysis to determine the extent of disease will be conducted. A multidisciplinary approach will be taken that combines traditional and cutting edge technology to provide a detailed analysis of the evolutionary ecology of Caribbean corals.

Note: PI Nicole Fogarty's original award OCE-1538469 was issued while at Nova Southeastern University. This was replaced by OCE-1929979 upon moving to the University of North Carolina Wilmington.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1538469
NSF Division of Ocean Sciences (NSF OCE)	OCE-1929979

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