Environmental, sensory data (temperature, light intensity, salinity, pH, dissolved oxygen, depth) sampled in August 2019 in Carrie Bow Caye, Belize

Website: https://www.bco-dmo.org/dataset/781862
Data Type: Other Field Results
Version: 1
Version Date: 2019-11-18

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
Baums, Iliana B.	Pennsylvania State University (PSU)	Co-Principal Investigator
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Abstract
Environmental, sensory data (temperature, light intensity, salinity, pH, dissolved oxygen, depth) sampled in August 2019 in Carrie Bow Caye, Belize

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Coverage

Spatial Extent: **N**:16.80155 **E**:-88.07777 **S**:16.75145 **W**:-88.0822
Temporal Extent: 2019-08-19 - 2019-08-26

Dataset Description

Environmental, sensory data (temperature, light intensity, salinity, pH, dissolved oxygen, depth) sampled in August 2019 in Carrie Bow Caye, Belize

Methods & Sampling

Hobos were deployed at depth specified by attaching a logger with a cable tie to the line of a subsurface buoy. Water quality measurements were collected 0.5 m below the surface using a YSI except for pH, which was collected in a small bucket at 0.5m and measurements were immediately collected within the bucket.

Data Processing Description

BCO-DMO processing notes:

- converted coordinates from degrees decimal minutes to decimal degrees
- Added ISO_DateTime_UTC to the table, ISO_DateTime_Local has been preserved
- Adjusted column headers names to meet database requirements

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Data Files

File
environmental_variables.csv (Comma Separated Values (.csv), 51.69 KB) MD5:ab45e728910e46f45ac0249e9917854a Primary data file for dataset ID 781862

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Parameters

Parameter	Description	Units
Site	Site - local name	unitless
Latitude	Latitude - South is negative	decimal degrees
Longitude	Longitude - West is negative	decimal degrees
ISO_DateTime_Local	Local Date/Time (GMT-04:00) in ISO format: YYYY-MM-DDTHH:MM:SS	unitless
ISO_DateTime_UTC	UTC Date/Time in ISO format: YYYY-MM-DDTHH:MM:SS	yyyy-MM-dd'T'HH:mm:ss'Z'
Temperature	Water temperature	degrees Celcius (°C)
Light_Intensity	Light Intensity	lux (lx)
Instrument	Collection equipment	unitless
Depth	Depth below surface	meter (m)
Salinity	Water salinity	parts per thousand
Dissolved_Oxygen	Dissolved oxygen concentration	milligram per liter (mg/l)
pH	Water pH	molar concentrations of H ions

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Instruments

Dataset-specific Instrument Name	YSI ProDSS Conductivity sensor
Generic Instrument Name	Conductivity Meter
Dataset-specific Description	YSI ProDSS Handheld Conductivity sensor (626903) ±1.0% of reading or ±0.1 ppt, whichever is greater
Generic Instrument Description	Conductivity Meter - An electrical conductivity meter (EC meter) measures the electrical conductivity in a solution. Commonly used in hydroponics, aquaculture and freshwater systems to monitor the amount of nutrients, salts or impurities in the water.

Dataset-specific Instrument Name	Onset Hobo Pendant data logger
Generic Instrument Name	Data Logger
Dataset-specific Description	Onset Hobo Pendant data loggers UA-002-64; accuracy ± 0.53°C from 0° to 50°C (± 0.95°F from 32° to 122°F)
Generic Instrument Description	Electronic devices that record data over time or in relation to location either with a built-in instrument or sensor or via external instruments and sensors.

Dataset-specific Instrument Name	YSI ProDSS Handheld Optical Dissolved Oxygen Sensor
Generic Instrument Name	Oxygen Sensor
Dataset-specific Description	YSI ProDSS Handheld Optical Dissolved Oxygen Sensor (626900) 0 to 20 mg/L: ±0.1 mg/L or 1% of reading, whichever is greater
Generic Instrument Description	An electronic device that measures the proportion of oxygen (O2) in the gas or liquid being analyzed

Dataset-specific Instrument Name	Orion ROSS Ultra pH / ATC Triode double-junction combination electrode
Generic Instrument Name	pH Sensor
Dataset-specific Description	(Orion ROSS Ultra pH / ATC Triode double-junction combination electrode, 8157BNUMD, accuracy ±0.02 units)
Generic Instrument Description	An instrument that measures the hydrogen ion activity in solutions. The overall concentration of hydrogen ions is inversely related to its pH. The pH scale ranges from 0 to 14 and indicates whether acidic (more H+) or basic (less H+).

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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-1929979

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