Fecundity and oocyte sizes of Acropora cervicornis genotypes measured July 2020 at Mote Marine Lab

Website: https://www.bco-dmo.org/dataset/843067
Data Type: experimental, Other Field Results
Version: 1
Version Date: 2022-03-23

Project
» CAREER: Applying phenotypic variability to identify resilient Acropora cervicornis genotypes in the Florida Keys (Resilient Acerv)

Contributors	Affiliation	Role
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Abstract
Primary fecundity was assessed for Acropora cervicornis corals with known disease susceptibility. This dataset presents information on oocyte sizes from dissections of coral polyps from five adult colonies containing 12 genets held in Mote Marine Lab's spawning nurseries.

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Coverage

Spatial Extent: **N**:24.56257 **E**:-81.40009 **S**:24.45782 **W**:-81.88595
Temporal Extent: 2020-07-25

Dataset Description

This dataset is part of a larger study of *Acropora cervicornis* (staghorn) corals studied at Mote Marine Lab's Elizabeth Moore International Center for Coral Reef Research and Restoration. We present dissection information on the sizes of oocytes measured from five randomly chosen oocytes for each of five replicate polpys from three fragments of five colonies containing 12 different genets of *Acropora cervicornis* held in Mote Marine Laboratory's Sand Key spawing nursery.

The project's additional analyses are listed here, and links to other data from this study can be found in the Related Datasets section below.

Analyses undertaken include:

1. Total Population (Colony size dataset)
2. Morphometric Assessment (Colony size dataset)
3. Primary Fecundity Analysis (Colony size dataset's population subset, Polyps dataset)
4. Dissections (**this dataset;** plus Oocyte number dataset)
5. Secondary Fecundity Analysis (Gamete bundle dataset)

See Related Datasets section below for links to above mentioned datasets.

Methods & Sampling

Sampling of *Acropora cervicornis* coral genotypes took place at Mote Marine Lab's spawning nurseries at Sand Key (24.45782, -81.88595) and Looe Key (24.56257, -81.40009). Primary fecundity analysis involved sampling corals with known disease susceptibility and/or resistance, measuring their size, and counting and analyzing their oocytes.

Sampling for Primary Fecundity Analysis:
On July 3, 2020, from 5 colonies of every genet, 3 linear branches (~10 cm in length) were sampled using bone cutters from the central portion of each colony (N=180 branches). Using a ruler, the number of polyps per one square centimeter was recorded from every branch near the base of the fragment (Polyps per Area dataset, https://www.bco-dmo.org/dataset/868308). The top ~2 cm (sterile zone) of every branch was removed before placing into a 50 mL falcon tube with 10% formalin to fix tissues. After 2 days, the formalin solutions were replaced with a 5% HCl solution, with every branch and tube triple rinsed with DI water in between to remove excess formalin. After 3 days, the 5% HCl solution in every tube was replaced with 10% HCl and subsequently refreshed every 2-3 days until branches were completely decalcified. Once decalcified, samples were triple rinsed in DI water and returned to their tubes with 70% EtOH for storage until dissection.

Dissections (this dataset):
Under a dissecting microscope, every fragment was dissected using scalpel and forceps to haphazardly select 5 polyps per fragment (N = 900 polyps) to count the total number of oocytes within each polyp (Oocyte Number Dataset, https://www.bco-dmo.org/dataset/867314). From those, 5 oocytes were randomly selected to measure their size under a compound microscope using an ocular micrometer to record the maximum diameter (length, d1) and its perpendicular diameter (width, d2). The volume of oocytes was calculated using the formula for a prolate ellipsoid: V= (4/3)*pi*(d1/2)*(d2/2)^2

Calibration factor: Oocytes were measured using a 10x ocular micrometer and 4x objective (total 40X) and a calibration factor was applied using the formula: V= (4/3)*pi*((d1/2)*250)*((d2/2)*250)^2 and converted to the units, mm3, for final values.

Problem report:
Genet 31: In the time between when the parental colonies were morphometrically assessed/sampled in the Sand Key nursery for the primary fecundity analysis and brought into the lab for spawning/sampled for the secondary fecundity analysis, the entire tree for genet 31 snapped off from its anchor and went missing. As such, 5 colonies of genet 31 were brought in from a different spawning nursery and location (Looe Key Nursery: 24.56257, -81.40009). Thus, the fecundity data obtained from the fragments and gamete bundles come from different subpopulations (fragments from Sand Key and gamete bundles from Looe Key).

Data Processing Description

Data were compiled into Excel (Microsoft Office) and analyzed using R version 4.0.3 (2020-10-10) -- "Bunny-Wunnies Freak Out". Nonparametric statistical and correlation analyses were conducted.

BCO-DMO Processing:
- separated Latitude and Longitude into separate columns
- added conventional header with dataset name, PI name, version date
- modified parameter names to conform with BCO-DMO naming conventions

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Data Files

File
oocyte_size.csv (Comma Separated Values (.csv), 400.78 KB) MD5:1e7aca6e4e1673da81866cf18bc780db Primary data file for dataset ID 843067

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Supplemental Files

File
Disease_Susceptibility_Table filename: Disease_Susceptibility_Table.pdf (Portable Document Format (.pdf), 64.24 KB) MD5:b155930985bd0c9e954a1f0eeacc78a1 Acropora cervicornis genotypes and susceptibility to white-band disease

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Related Publications

Borger, J. L., & Colley, S. (2010). The effects of a coral disease on the reproductive output of Montastraea faveolata (Scleractinia: Faviidae). Revista de biologia tropical, 58 Suppl 3, 99–110.
Related Research

Foster, N., Box, S., & Mumby, P. (2008). Competitive effects of macroalgae on the fecundity of the reef-building coral Montastraea annularis. Marine Ecology Progress Series, 367, 143–152. https://doi.org/10.3354/meps07594
Related Research

Graham, J. E., & van Woesik, R. (2013). The effects of partial mortality on the fecundity of three common Caribbean corals. Marine Biology, 160(10), 2561–2565. doi:10.1007/s00227-013-2248-y
Related Research

Muller, E. M., Bartels, E., & Baums, I. B. (2018). Bleaching causes loss of disease resistance within the threatened coral species Acropora cervicornis. eLife, 7. doi:10.7554/elife.35066 https://doi.org/10.7554/eLife.35066
Methods

Okubo, N., Motokawa, T., & Omori, M. (2006). When fragmented coral spawn? Effect of size and timing on survivorship and fecundity of fragmentation in Acropora formosa. Marine Biology, 151(1), 353–363. doi:10.1007/s00227-006-0490-2
Related Research

Pratchett, M. S., Hoey, A. S., Tan, C.-H., Kuo, C.-Y., Bauman, A. G., Kumaraswamy, R., & Baird, A. H. (2019). Spatial and Temporal Variation in Fecundity of Acropora spp. in the Northern Great Barrier Reef. Diversity, 11(4), 60. doi:10.3390/d11040060
Related Research

R Core Team (2020). R: A language and environment for statistical computing. R v4.0.3. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/
Software

Smith, L.E., & Hughes, T.P. (1999). An experimental assessment of survival, re-attachment and fecundity of coral fragments. Journal of Experimental Marine Biology and Ecology, 235(1), 147–164. doi:10.1016/s0022-0981(98)00178-6 https://doi.org/10.1016/S0022-0981(98)00178-6
Related Research

Teo, A., Guest, J. R., Neo, M. L., Vicentuan, K., & Todd, P. A. (2016). Quantification of coral sperm collected during a synchronous spawning event. PeerJ, 4, e2180. doi:10.7717/peerj.2180
Related Research

Vargas-Ángel, B., Colley, S. B., Hoke, S. M., & Thomas, J. D. (2005). The reproductive seasonality and

gametogenic cycle of Acropora cervicornis off Broward County, Florida, USA. Coral Reefs, 25(1), 110–122. doi:10.1007/s00338-005-0070-9
Related Research

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Related Datasets

IsRelatedTo

Koch, H., Azu, Y., Bartels, E., Muller, E. (2022) **Colony sizes and morphometric assessments of Acropora cervicornis genotypes sampled July 2020 for fecundity analysis at Mote Marine Laboratory.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2021-03-23 doi:10.26008/1912/bco-dmo.843028.1 [view at BCO-DMO]
Relationship Description: Oocyte sizes were determined on a population subset (fragment sampled for fecundity) of the Colony Size dataset

Koch, H., Azu, Y., Bartels, E., Muller, E. (2022) **Fecundity and number of oocytes from Acropora cervicornis genotypes measured July 2020 at Mote Marine Lab.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2022-03-14 doi:10.26008/1912/bco-dmo.867314.1 [view at BCO-DMO]

Koch, H., Azu, Y., Bartels, E., Muller, E. (2022) **Fecundity assessment of Acropora cervicornis colonies from spawning observations and gamete bundle analysis in August 2020 at Mote Marine Laboratory.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2022-03-15 doi:10.26008/1912/bco-dmo.868493.1 [view at BCO-DMO]

Koch, H., Muller, E., Azu, Y., Bartels, E. (2022) **Assessment of polyps per area of Acropora cervicornis genotypes sampled July 2020 for fecundity analysis at Mote Marine Laboratory.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2022-03-16 doi:10.26008/1912/bco-dmo.868308.1 [view at BCO-DMO]

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Parameters

Parameter	Description	Units
Location	Location of coral sampling site	unitless
Latitude	Latitude of spawning nursery	decimal degrees
Longitude	Longitude of spawning nursery	decimal degrees
Date_measured	Date when measurements were taken (local time)	unitless
Genotype	Mote Marine Lab genet that was sampled (1, 3, 7, 13, 31, 34, 41, 44, 47, 50, 62, 63)	unitless
Phenotype	Phenotype that was sampled (S = white band disease susceptible, R = white band disease resistant)	unitless
Replicate_Colony	Which of the five replicate colonies of the genet was sampled for analysis	unitless
Replicate_Fragment	Which of the three replicate fragments per replicate colony was sampled for analysis	unitless
Replicate_Polyp	Which of the five polyps was randomly chosen to be dissected and counted for number of oocytes	unitless
Replicate_Oocyte	Which of the 5 oocytes per polyp that was randomly chosen for size measurement	unitless
Oocyte_Length_d1	Length of the oocyte’s longest axis	micrometers
Oocyte_Width_d2	Width perpendicular to the oocyte's longest axis	micrometers
Oocyte_Volume_micron	Oocyte volume calculated using a prolate ellipsoid (V= (4/3)*pi*(d1/2)*(d2/2)^2)	cubic micrometers
Oocyte_Vol_corrected	Oocyte volume with applied calibration factor using 10x ocular micrometer and 4x objective	cubic micrometers
Oocyte_Volume_mm3	Oocyte size converted to more commonly used unit of volume	cubic millimeters

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Instruments

Dataset-specific Instrument Name	Calcutta metal pliers
Generic Instrument Name	bone cutter
Dataset-specific Description	Each ramet was cut from the donor colony using metal pliers (Calcutta bone cutters).
Generic Instrument Description	A bone cutter is a surgical instrument used to cut bones or coral fragments.

Dataset-specific Instrument Name	AmScope compound microscope with ocular micrometer
Generic Instrument Name	Microscope - Optical
Dataset-specific Description	Oocyte size was measured under a compound microscope using an ocular micrometer to record the maximum diameter (length, d1) and its perpendicular diameter (width, d2).
Generic Instrument Description	Instruments that generate enlarged images of samples using the phenomena of reflection and absorption of visible light. Includes conventional and inverted instruments. Also called a "light microscope".

Dataset-specific Instrument Name	articulating dissecting microscope
Generic Instrument Name	Microscope - Optical
Dataset-specific Description	Under a dissecting microscope, every fragment was dissected using a scalpel and forceps and to count the total number of oocytes within each polyp.
Generic Instrument Description	Instruments that generate enlarged images of samples using the phenomena of reflection and absorption of visible light. Includes conventional and inverted instruments. Also called a "light microscope".

Dataset-specific Instrument Name	scalpel
Generic Instrument Name	scalpel
Dataset-specific Description	Every coral fragment was dissected using a scalpel and forceps
Generic Instrument Description	A scalpel, or lancet, or bistoury, is a small and extremely sharp bladed instrument used for dissection and surgery.

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Project Information

CAREER: Applying phenotypic variability to identify resilient Acropora cervicornis genotypes in the Florida Keys (Resilient Acerv)

Coverage: Florida Keys, Summerland Key, FL 24.563595°, -81.278572°

NSF Award Abstract:
Caribbean staghorn coral was one of the most common corals within reefs of the Florida Keys several decades ago. Over the last 40 years disease, bleaching, overfishing and habitat degradation caused a 95% reduction of the population. Staghorn coral is now listed as threatened under the U.S. Endangered Species Act of 1973. Within the past few years, millions of dollars have been invested for the purpose of restoring the population of staghorn coral within Florida and the U.S. Virgin Islands. Significant effort has been placed on maintaining and propagating corals of known genotypes within coral nurseries for the purpose of outplanting. However, little is known about the individual genotypes that are currently being outplanted from nurseries onto coral reefs. Are the genotypes being used for outplanting resilient enough to survive the three major stressors affecting the population in the Florida Keys: disease, high water temperatures, and ocean acidification? The research within the present study will be the first step in answering this critically important question. The funded project will additionally develop a research-based afterschool program with K-12 students in the Florida Keys and U.S. Virgin Islands that emphasizes an inquiry-based curriculum, STEM research activities, and peer-to-peer mentoring. The information from the present study will help scientists predict the likelihood of species persistence within the lower Florida Keys under future climate-change and ocean-acidification scenarios. Results of this research will also help guide restoration efforts throughout Florida and the Caribbean, and lead to more informative, science-based restoration activities.

Acropora cervicornis dominated shallow-water reefs within the Florida Keys for at least the last half a million years, but the population has recently declined due to multiple stressors. Understanding the current population level of resilience to three major threats - disease outbreaks, high water temperatures, and ocean acidification conditions - is critical for the preservation of this threatened species. Results from the present study will answer the primary research question: will representative genotypes from the lower Florida Keys provide enough phenotypic variation for this threatened species to survive in the future? The present proposal will couple controlled laboratory challenge experiments with field data and modeling applications, and collaborate with local educators to fulfill five objectives: 1) identify *A. cervicornis* genotypes resistant to disease, 2) identify *A. cervicornis* genotypes resilient to high water temperature and ocean acidification conditions, 3) quantify how high water temperature and ocean acidification conditions impact disease dynamics on *A. cervicornis*; 4) determine tradeoffs in life-history traits because of resilience factors; and 5) apply a trait-based model, which will predict genotypic structure of a population under different environmental scenarios.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1452538

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