Fecundity assessment of Acropora cervicornis colonies from spawning observations and gamete bundle analysis in August 2020 at Mote Marine Laboratory

Website: https://www.bco-dmo.org/dataset/868493
Data Type: Other Field Results, experimental
Version: 1
Version Date: 2022-03-15

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
As a secondary assessment of fecundity, colonies of Acropora cerviconis (various genets) were taken to Mote Marine Laboratory in August 2020 for spawning and ex situ assisted sexual reproduction. From genets that spawned, forty random gamete bundles were collected during spawning and the total number of eggs and sperm per bundle were quantified.

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Coverage

Spatial Extent: **N**:24.56257 **E**:-81.40009 **S**:24.45782 **W**:-81.88814
Temporal Extent: 2020-07-31 - 2020-08-10

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. The different 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 (Population subset of Colony size dataset, plus Polyps dataset)
4. Dissections (Oocyte number dataset, Oocyte size dataset)
5. Secondary Fecundity Analysis (**this dataset of Gamete Bundles**)

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).

Sampling for Primary Fecundity Analysis was performed 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 (see Colony Size dataset, https://www.bco-dmo.org/dataset/843028). Using a ruler, the number of polyps per one square centimeter was recorded from every branch near the base of the fragment (see Polyps per Area dataset,https://www.bco-dmo.org/dataset/868308).

Treatments with formalin, DI, and HCl solution were done to preserve and decalcify the coral, which were then stored until dissection (see datasets Oocyte Size, https://www.bco-dmo.org/dataset/843067 and Oocyte Number, https://www.bco-dmo.org/dataset/867314).

Sampling for Secondary Fecundity Analysis (this dataset)
As a secondary assessment of fecundity, five replicate colonies of every genet were brought back to the lab on July 31, 2020 for spawning and ex situ assisted sexual reproduction. From every genet that spawned during August 4-10, 2020 (all of them), 40 random gamete bundles were collected during spawning using a transfer pipet and 50 mL falcon tube. Each gamete bundle was immediately placed into a 2 mL glass vial with 10% formalin for fixation and inverted several times to break up the bundle in each vial. Then, the total number of oocytes and sperm per bundle were counted. Eggs were counted by eye by two independent observers. Replicate sperm counts were recorded using a hemocytometer.

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).

Genet 41: From the primary fecundity analysis, it was determined that none of the colonies of genet 41 in the Sand Key nursery were gravid and therefore genet 41 was not included in the secondary fecundity analysis (Gamete Bundles Dataset).

Genets 62 + 63: Due to space limitations during transport of colonies from the field nursery to the lab, only 1 colony of genet 62 was brought in for assisted sexual reproduction and secondary fecundity analysis (Gamete Bundles Dataset).

Data Processing Description

Data processing:
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
gamete_bundles.csv (Comma Separated Values (.csv), 26.11 KB) MD5:4e53f12ca83570a217f300947e62c1f6 Primary data file for dataset ID 868493

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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]

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 and oocyte sizes of Acropora cervicornis genotypes measured July 2020 at Mote Marine Lab.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2022-03-23 doi:10.26008/1912/bco-dmo.843067.1 [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_start_collect	Start date of spawning	unitless
Date_end_collect	End date of spawning	unitless
Genotype	Mote Marine Lab genet that was sampled (1, 3, 7, 13, 31, 34, 44, 47, 50, 62)	unitless
Phenotype	Phenotype that was sampled (S = white band disease susceptible, R = white band disease resistant)	unitless
Replicate_Gamete_Bundle	Which of the 40 gamete bundles was analyzed and counted	unitless
Total_Sperm_per_bundle_in_millions	Total number (in millions) of sperm counted per gamete bundle	unitless
Total_Eggs_per_bundle	Total number of eggs counted per gamete bundle	unitless

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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	Neubauer hemocytometer
Generic Instrument Name	Hemocytometer
Dataset-specific Description	Replicate sperm counts were recorded using a hemocytometer
Generic Instrument Description	A hemocytometer is a small glass chamber, resembling a thick microscope slide, used for determining the number of cells per unit volume of a suspension. Originally used for performing blood cell counts, a hemocytometer can be used to count a variety of cell types in the laboratory. Also spelled as "haemocytometer". Description from: http://hlsweb.dmu.ac.uk/ahs/elearning/RITA/Haem1/Haem1.html.

Dataset-specific Instrument Name	AmScope compound microscope with ocular micrometer
Generic Instrument Name	Microscope - Optical
Dataset-specific Description	Eggs were counted by eye by 2 independent observers
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	Eggs were counted by eye by 2 independent observers
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".

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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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