Coral tissue mortality as a function of presence or absence of sea cucumbers and coral outplant type in cage experiments in the lagoonal habitat of Palmyra Atoll in Nov and Dec of 2022 (Coral Biodiversity project)

Website: https://www.bco-dmo.org/dataset/920233
Data Type: Other Field Results, experimental
Version: 1
Version Date: 2024-02-12

Project
» Positive Effects of Coral Biodiversity on Coral Performance: Patterns, Processes, and Dynamics (Coral Biodiversity)

Contributors	Affiliation	Role
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Abstract
Coral reefs are in global decline with coral diseases playing a significant role. Coral diseases are commonly sediment-associated and could be exacerbated by overharvest of sediment-feeding sea cucumbers. These data include visual assessments of coral (Acropora nasuta) tissue mortality among corals outplanted in 50 x 50 cm cages in sandy lagoonal areas of Palmyra Atoll (5°52'42.6"N, 162°04'09.8"W). Zero or two Stichopus chloronotus sea cucumbers (n = 15 cages per treatment) were placed within each cage, and two outplants of the coral Acropora nasuta were also placed in each cage; one outplant was placed in contact with benthic sediment and the other was elevated 2-3 cm above benthic sediment. Percent tissue mortality of A. nasuta was assessed daily for 14 days (November-December 2022). All coral tissue mortality data were collected by Dr. Cody Clements of the Georgia Institute of Technology.

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Coverage

Location: Lagoonal habitat of Palmyra Atoll (5°52'42.6"N 162°04'09.8"W); depth 2-3m
Spatial Extent: **N**:5.8786 **E**:-162.069 **S**:5.8785 **W**:-162.069
Temporal Extent: 2022-11 - 2022-12

Methods & Sampling

In the lagoon on Palmyra Atoll (5°52'42.6"N 162°04'09.8"W), we conducted an experiment with a goal of determining the effects of a common sea cucumber (Stichopus chloronotus) on coral (Acropora nasuta) health. but enclosed or excluded the locally abundant sea cucumber Stichopus chloronotus and assessed impact on the coral Acropora nasuta. Within an area of about 160 m2, we erected thirty 50 x 50 x 12 cm cages constructed of plastic 1 cm2 mesh, planted two A. nasuta either in contact with or elevated 2-3 cm above benthic sediment into each cage, and randomly assigned cages to contain either zero or two S. chloronotus sea cucumbers (n = 15 for each treatment). Coral portions for the experiment were collected

from 15 A. nasuta colonies in the East Lagoon of Palmyra Atoll where our experimental cages were located. Cages and coral tissue death were monitored daily for 14 days, with data from the final day used to contrast effects of sea cucumber presence and sediment contact on coral condition.

Organism identifiers: Coral: Acropora nasuta, LSID (urn:lsid:marinespecies.org:taxname:207009) Cucumber: Stichopus chloronotus, LSID (urn:lsid:marinespecies.org:taxname:149789)

BCO-DMO Processing Description

- Converted latitude and longitude fields from degree, minute, second format to decimal degree format
- Rounded latitude and longitude fields to 6 degrees of precision
- Removed spaces from column names and replaced with underscores ("_")
- Removed special characters from column names (# -> "Percentage" and # -> "Count")

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Data Files

File
920233_v1_sea_cucumber_enclosure_experiments_palmyra_atoll.csv (Comma Separated Values (.csv), 2.79 KB) MD5:b0a7c040c06ffc3723c86aed891a03a3 Primary data file for dataset ID 920233, version 1

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Related Datasets

IsRelatedTo

Clements, C. (2024) **Coral tissue mortality as a function of the presence or absence of sea cucumbers and coral outplant type in cage experiments in lagoonal habitat of Mo'orea, French Polynesia in April and May of 2020.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2024-02-12 doi:10.26008/1912/bco-dmo.920209.1 [view at BCO-DMO]

Clements, C. (2024) **Coral tissue mortality in sand patches with vs. without sea cucumber removal in lagoonal habitat of Mo'orea, French Polynesia from June to August of 2021 (Coral Biodiversity project).** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2024-02-12 doi:10.26008/1912/bco-dmo.920201.1 [view at BCO-DMO]

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Parameters

Parameter	Description	Units
Cage	Cage ID in the experiment	unitless
ID	The unique ID of each coral outplant	unitless
Sediment_Contact	Describes whether corals were either (1) directly contacting cage sediments or (2) elevated and not contacting sediments	unitless
Stichopus_chloronotus_Count	The number of Stichopus chloronotus per cage	individuals
Mortality_Percentage	The percentage of tissue mortality of each coral outplant at 14 days	unitless
Latitude	Latitude of the experiment site; a positive value indicates a Northern coordinate	decimal degrees
Longitude	Longitude of the experiment site in decimal degrees; a negative value indicates a Western coordinate	decimal degrees

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Project Information

Positive Effects of Coral Biodiversity on Coral Performance: Patterns, Processes, and Dynamics (Coral Biodiversity)

Coverage: Moorea, French Polynesia, South Pacific Ocean (17º32’S 149º50’W)

NSF Award Abstract:
Coral reefs are extremely diverse, supply critical ecosystem services, and are collapsing at an alarming rate, with 80% coral loss in the Caribbean and >50% in the Pacific in recent decades. Previous studies emphasized negative interactions (competition, predation) as structuring reef systems, but positive interactions in such species-rich systems could be of equal importance in maintaining ecosystem function. If foundation species like corals depend on positive interactions, then their fitness may decline with the loss of surrounding species, creating a biodiversity meltdown where loss of one coral causes losses of others. This project conducts manipulative field experiments to understand the role of coral biodiversity in facilitating coral growth, survival, resilience, and retention of these foundation species and the critical ecosystem services they provide in shallow tropical seas. This project is committed to: 1) Educating and exciting influential business and civic leaders about conservation and restoration of coastal marine systems before these systems lose ecological function and value. This will involve influential Rotary clubs within North Georgia/Atlanta (the major economic engine of the southeastern US) as an initial focus. 2) Using the Research News and Institute Communications Office at Georgia Tech and well-developed contacts with science writers to produce popular press pieces on important ocean ecology discoveries emerging from these studies. (3) Organizing a public workshop of internationally prominent scientists focused on Maintaining Marine Biodiversity as a Strategy to Sustain Ecosystem Services and Coastal Cultures and Economies. A previous effort like this, organized by the investigators, attracted about 200 attendees and was webcast to numerous high schools in Georgia and to foreign investigators in less developed countries that could not attend. Speakers also conducted in-person video interviews with local high school classes. Due to that success, this model will be repeated. 4) Working with an association of educators and cultural leaders in French Polynesia to produce electronic format presentations on our work and on reef conservation that are appropriate for use by both teachers and leaders within Polynesian culture.

Ecologists have excelled at demonstrating the importance of direct (often negative) interactions among species pairs. However, when these interactions occur in a complex context among thousands of other species in the field, the sum of the many, poorly-known, indirect interactions can counterbalance, or even reverse, the better-known direct interactions, generating diffuse mutualisms instead of agonistic outcomes. In a proof-of-concept initial experiment, coral growth and survivorship were greater in coral polycultures than monocultures, especially during early stages of community development. Processes generating this outcome are unclear but understanding these is of critical importance as diversity and function of reefs decline and as humans need to predict and adapt to changing environments. This interdisciplinary investigation merges expertise in experimental field ecology, chemical ecology, and the ecology of microbiomes to investigate the functional role of biodiversity in coral reef ecosystems. Experiments use a novel coral transplantation method and field manipulations to assess: 1) whether greater coral species diversity enhances coral community performance, as well as growth and survivorship of individual corals, 2) whether greater genotypic diversity enhances coral performance within a species, 3) whether greater diversity of seaweed competitors further suppresses corals and enhances seaweed performance, and 4) the processes driving the patterns documented above, including the roles of disease, intraspecific versus interspecific competition, predators, mutualists, and differential access to, or use of, resources. The research investigates the relationship between biodiversity and ecosystem function across dimensions of coral taxonomic diversity, from species to genotypes, and creates a series of experiments elucidating general principles underlying ecosystem dynamics. Filling these knowledge gaps advances our fundamental understanding of how biodiversity influences ecosystem function at multiple scales and provides insight into the processes promoting coral coexistence in these species-rich ecosystems. Findings will have practical implications for coral management and restoration and may improve predictions regarding coral reef resilience and recovery in the face of changing climate.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1947522

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