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)

Website: https://www.bco-dmo.org/dataset/920201
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
Clements, Cody	Georgia Institute of Technology (GA Tech)	Principal Investigator, Contact
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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 pulchra) tissue mortality among corals outplanted in natural sand patches within lagoonal areas of Mo'orea, French Polynesia (17.4894° S, 149.8825° W) where sea cucumbers were either removed or left at natural densities (n = 10 patches per treatment). Five A. pulchra corals were outplanted into each sand patch, and percent tissue mortality of each coral was assessed daily for 45 days during June-August 2021. 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 Mo'orea, French Polynesia (17.4894° S, 149.8825° W); depth 2-3m
Spatial Extent: **N**:-17.4881 **E**:-149.882 **S**:-17.4892 **W**:-149.883
Temporal Extent: 2021-06 - 2021-08

Methods & Sampling

At the initiation of the experiment, sea cucumbers were removed daily (removals) or left in place (controls) for seven days to condition sand patches for subsequent coral planting, after which five A. pulchra outplants approximately 8-10 cm in length were embedded in the sediment of each patch, with % coral tissue mortality and outplant survival monitored at approximately 2-day intervals for 45 days (50 corals treatment-1, 100 corals total). The corals were initially fragmented from numerous A. pulchra thickets adjacent to our study area, individually embedded within the cutoff necks of inverted plastic bottles using Z-Spar Splash Zone epoxy (see 56) and screwed into upturned bottle caps attached to ~7 x 7cm pieces of metal gridded mesh that could be slid into the sediment to hold each coral upright. To prevent feeding by coral consumers, each coral was

caged within 1 cm2 metal screening. Corals were embedded within their sand patches so that living basal coral tissue was in direct contact with the sediment as would occur following natural fragmentation. Every other day for 45 days, we counted sea cucumbers, maintained removal treatments, cleaned cages, and quantified A. pulchra tissue mortality in each patch.

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BCO-DMO Processing Description

* Latitude and Longitude fields converted from degrees, minutes, seconds (DMS) to decimal degrees (DD)

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Data Files

File	
920201_v1_sea_patch_removal_cucumbers_moorea.csv	(Comma Separated Values (.csv), 6.35 KB) MD5:8c0eb84cc7171be0ef08044ec79ccd1a
Primary data file for dataset ID 920201, version 1	

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Related Datasets

IsRelatedTo

Clements, C. (2024) **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).** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2024-02-12 doi:10.26008/1912/bco-dmo.920233.1 [view at BCO-DMO]

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]

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Parameters

Parameter	Description	Units
Patch	Patch ID in experiment	unitless
Patch_Replicate	The number assigned to each coral outplant in a given patch	unitless
ID	The unique ID of each coral outplant (Patch and Platch_Replicate)	unitless
Treatment	Describes the treatments in experiment. Sea cucumbers were either removed or not removed from natural sand patches.	unitless
Censor_Days	The number of days that traspired until a coral outplant was either censored (100% mortality occurred) or not censored (100% mortality did not occur) before end of experiment	days
Censor_Status	Indicates where coral outplant experienced 100% mortality (1) or 100% mortality did not occur (0)	unitless
Mortality_Percentage	The percent tissue mortality of each outplant at 45 days	unitless
Latitude	Latitude of experimental patch in decimal degrees; a negative value indicates a Southern coordinate	decimal degrees
Longitude	Longitude of experimental patch 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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