Percent growth and tissue mortality of corals in experimental plots on Fringing reef (Coral Biodiversity project)

Website: https://www.bco-dmo.org/dataset/867137
Data Type: Other Field Results
Version: 1
Version Date: 2021-01-11

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

Contributors	Affiliation	Role
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Coverage

Spatial Extent: **Lat**:-17.476944 **Lon**:-149.839167

Methods & Sampling

Methodology:

We conducted an experiment that incorporated a greater range of coral species richness to better assess the role of coral diversity per se, evaluate changes in the shape of this relationship with increasing species richness, and lessen the potentially confounding effects of species identity when evaluated across only three species. Forty-eight experimental plots were deployed within a back reef lagoon on Mo'orea (17°29′19″S 149°52′54″W). Treatments consisted of one, three, six, or nine common coral species drawn at random for each plot from a pool of nine coral species: *P. rus*, *P. lobata*, *S. pistillata*, *P. damicornis*, *P. verrucosa*, *P. cactus*, *A. hyacinthus*, *A. pulchra*, and *A. cytherea* (12 plots per treatment; 864 corals total). Individual corals were randomly embedded within each plot, and differences in growth and tissue mortality were assessed at three and seven months with permutation ANOVA and a post hoc permutation test for multiple comparisons using the R package predictmeans. Six and 27 coral replicates that became dislodged from their epoxy base were excluded from our analyses at three and seven months (0.7 and 3.1% of replicates), respectively. At both time points, we also excluded 18 corals from a nine-species plot that was colonized by damselfish (the only plot where this occurred). In instances where significant differences among treatments were detected (i.e., growth at three and seven months and tissue mortality at three months), we also conducted separate analyses comparing growth and tissue mortality among treatments for each of the nine species used in our manipulations. Macroalgal cover was absent among plots across all treatments.

Sampling and analytical procedures:

We used permutation-based, LME models in the R package predictmeans to compare differences in the percentage mass change and tissue mortality of corals in each treatment. In each analysis, plot type (e.g., 3 species) was treated as a fixed factor, and individual replicate plots were treated as a random effect nested within plot type.

Data Processing Description

BCO-DMO Processing Notes:

- Concatenated month 3 and month 7 data from two different data sources

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Related Publications

Clements, C. S., & Hay, M. E. (2021). Biodiversity has a positive but saturating effect on imperiled coral reefs. Science Advances, 7(42). doi:10.1126/sciadv.abi8592
Results

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Parameters

Parameter	Description	Units
Plot	The unique ID number of the plot.	units
ID	The unique ID number of corals within each plot.	units
Species	The species present within the plot. Polyculture plots contain all three species (Porites rus, Pocillopora verrucosa, Acropora hyacinthus).	units
Treatment	The experimental treatment of the plot. Live polycultures contained three species: Pocillopora verrucosa, Acropora hyacinthus, and Porites rus.	units
Mass_Change_Percentage	The percent change in mass from T0 to T1.	units
Tissue_Mortality_Percentage	The percent tissue mortality of the coral.	units
Experiment_month	Month of growth and tissue mortality assessment.	months

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Instruments

Dataset-specific Instrument Name	OHAUS SP-2001 Scout Pro Balance
Generic Instrument Name	scale or balance
Dataset-specific Description	In instances where significant differences among treatments were detected (i.e., growth at three and seven months and tissue mortality at three months), we also conducted separate analyses comparing growth and tissue mortality among treatments for each of the nine species used in our manipulations.
Generic Instrument Description	Devices that determine the mass or weight of a sample.

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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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