Percent growth of corals in experimental plots for month 4 and month 16

Website: https://www.bco-dmo.org/dataset/756532
Version: 0
Version Date: 2019-02-21

Project
» Killer Seaweeds: Allelopathy against Fijian Corals (Killer Seaweeds)

Contributors	Affiliation	Role
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Coverage

Spatial Extent: **Lat**:-18 **Lon**:177

Dataset Description

To assess coral growth in each plot, corals and their epoxy/bottle-top base were unscrewed from their respective bottle cap and wet-weighed in the field using an electronic scale (OHAUS Scout Pro) enclosed within a plastic container mounted to a tripod holding it above the water surface. Some 24–48 h before weighing, each coral's epoxy/bottle-top base was brushed clean of fouling organisms. Before weighing, each coral was gently shaken 30 times to remove excess water, weighed, immediately placed back into the water and reattached to its respective bottle cap. At the end of the experiment (16 months), each coral was separated from its epoxy/bottle-top base, and each coral and base were weighed separately. We could then determine, via subtraction, the coral mass and thus the percentage growth throughout the experimental period.

These data was also funded through:
National Institutes of Health (2 U19 TW007401-10)
Teasley Endowment to the Georgia Institute of Technology

Methods & Sampling

Corals and their epoxy/bottle-top base were unscrewed from their respective bottle cap and wet-weighed in the field using an electronic scale (OHAUS Scout Pro). At the end of the experiment (16 months), each coral was separated from its epoxy/bottle-top base, and each coral and base were weighed separately. We could then determine, via subtraction, the coral mass and thus the percentage growth throughout the experimental period.
We used linear mixed-effects (LME) models in the R (version 3.3.2) package nlme (version 3.1–130) to assess

differences in the percentage mass change at 16 months between conspecific corals in monocultures and polycultures. We also used LME models to compare the combined percentage mass change of all species in polycultures with that of all species in monocultures, as well as the percentage mass change of corals in polycultures compared with the most productive monocultures (that is, A. millepora). Individual corals within plots that had been completely broken off from their bottle-top base were excluded from the dataset and subsequent analyses; this occurred for only 23 of our 864 corals (2.6%) at 4 months and 143 corals at 16 months (16.6%), did not vary significantly with treatment ($P \geq 0.478$; permutation analysis of variance (ANOVA); 5,000 permutations) and in some observed instances was due to human trampling. Models were fitted using restricted maximum likelihood, with plot type (that is, monoculture and polyculture) as a fixed factor and individual replicate plots treated as a random effect nested within plot type. When individual models did not meet assumptions of homogeneous variance and normally distributed errors, we re-ran the analysis and specified the variance structure using the varIdent function in nlme.

These data are depicted in Figure 1 e-g of the following publication:
Clements CS, Hay ME (2019) Biodiversity enhances coral growth, tissue survivorship and suppression of macroalgae. Nature Ecology & Evolution [Epub ahead of print]

Data Processing Description

BCO-DMO Processing Notes:
- combined Month 4 and Month 16 together into one dataset
- added conventional header with dataset name, PI name, version date
- modified parameter names to conform with BCO-DMO naming conventions

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Related Publications

Clements, C. S., & Hay, M. E. (2019). Biodiversity enhances coral growth, tissue survivorship and suppression of macroalgae. Nature Ecology & Evolution, 3(2), 178–182. doi:10.1038/s41559-018-0752-7
Results

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Parameters

Parameter	Description	Units
Plot	The unique ID number of the plot	unitless
ID	The unique ID number of corals within each plot	unitless
Species	The species present within the plot. Polyculture plots contain all three species (Porites cylindrica; Pocillopora damicornis; Acropora millepora)	unitless
Treatment	The experimental treatment of the plot	unitless
Mass_Change_Month_4	The percent change in mass from T0 to T1 (month 4)	percent
Mass_Change_Month_16	The percent change in mass from T0 to T1 (month 16)	percent
lat	latitude with North values positive, negative denotes South	decimal degrees
lon	longitude with East values positive, negative denotes West	decimal degrees

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Instruments

Dataset-specific Instrument Name	snorkel
Generic Instrument Name	Diving Mask and Snorkel
Dataset-specific Description	These data were collected near shore via snorkel.
Generic Instrument Description	A diving mask (also half mask, dive mask or scuba mask) is an item of diving equipment that allows underwater divers, including, scuba divers, free-divers, and snorkelers to see clearly underwater. Snorkel: A breathing apparatus for swimmers and surface divers that allows swimming or continuous use of a face mask without lifting the head to breathe, consisting of a tube that curves out of the mouth and extends above the surface of the water.

Dataset-specific Instrument Name	OHAUS SP-2001 Scout Pro Balance
Generic Instrument Name	scale
Dataset-specific Description	OHAUS SP-2001 Scout Pro Balance
Generic Instrument Description	An instrument used to measure weight or mass.

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Project Information

Killer Seaweeds: Allelopathy against Fijian Corals (Killer Seaweeds)

Coverage: Viti Levu, Fiji (18º13.049’S, 177º42.968’E)

Extracted from the NSF award abstract:

Coral reefs are in dramatic global decline, with reefs commonly converting from species-rich and topographically-complex communities dominated by corals to species- poor and topographically-simplified communities dominated by seaweeds. These phase-shifts result in fundamental loss of ecosystem function. Despite debate about whether coral-to-algal transitions are commonly a primary cause, or simply a consequence, of coral mortality, rigorous field investigation of seaweed-coral competition has received limited attention. There is limited information on how the outcome of seaweed-coral competition varies among species or the relative importance of different competitive mechanisms in facilitating seaweed dominance. In an effort to address this topic, the PI will conduct field experiments in the tropical South Pacific (Fiji) to determine the effects of seaweeds on corals when in direct contact, which seaweeds are most damaging to corals, the role allelopathic lipids that are transferred via contact in producing these effects, the identity and surface concentrations of these metabolites, and the dynamic nature of seaweed metabolite production and coral response following contact. The herbivorous fishes most responsible for controlling allelopathic seaweeds will be identified, the roles of seaweed metabolites in allelopathy vs herbivore deterrence will be studied, and the potential for better managing and conserving critical reef herbivores so as to slow or reverse conversion of coral reef to seaweed meadows will be examined.

Preliminary results indicate that seaweeds may commonly damage corals via lipid- soluble allelochemicals. Such chemically-mediated interactions could kill or damage adult corals and produce the suppression of coral fecundity and recruitment noted by previous investigators and could precipitate positive feedback mechanisms making reef recovery increasingly unlikely as seaweed abundance increases. Chemically-mediated seaweed-coral competition may play a critical role in the degradation of present-day coral reefs. Increasing information on which seaweeds are most aggressive to corals and which herbivores best limit these seaweeds may prove useful in better managing reefs to facilitate resilience and possible recovery despite threats of global-scale stresses. Fiji is well positioned to rapidly use findings from this project for better management of reef resources because it has already erected >260 MPAs, Fijian villagers have already bought-in to the value of

MPAs, and the Fiji Locally-Managed Marine Area (FLMMA) Network is well organized to get information to villagers in a culturally sensitive and useful manner.

The broader impacts of this project are far reaching. The project provides training opportunities for 2-2.5 Ph.D students and 1 undergraduate student each year in the interdisciplinary areas of marine ecology, marine conservation, and marine chemical ecology. Findings from this project will be immediately integrated into classes at Ga Tech and made available throughout Fiji via a foundation and web site that have already set-up to support marine conservation efforts in Fiji and marine education efforts both within Fiji and internationally. Business and community leaders from Atlanta (via Rotary International Service efforts) have been recruited to help organize and fund community service and outreach projects in Fiji -- several of which are likely to involve marine conservation and education based in part on these efforts there. Media outlets (National Geographic, NPR, Animal Planet, Audubon Magazine, etc.) and local Rotary clubs will be used to better disseminate these discoveries to the public.

PUBLICATIONS PRODUCED AS A RESULT OF THIS RESEARCH

Rasher DB, Stout EP, Engel S, Kubanek J, and ME Hay. "Macroalgal terpenes function as allelopathic agents against reef corals", Proceedings of the National Academy of Sciences, v. 108, 2011, p. 17726.

Beattie AJ, ME Hay, B Magnusson, R de Nys, J Smeathers, JFV Vincent. "Ecology and bioprospecting," Austral Ecology, v.36, 2011, p. 341.

Rasher DB and ME Hay. "Seaweed allelopathy degrades the resilience and function of coral reefs," Communicative and Integrative Biology, v.3, 2010.

Hay ME, Rasher DB. "Corals in crisis," The Scientist, v.24, 2010, p. 42.

Hay ME and DB Rasher. "Coral reefs in crisis: reversing the biotic death spiral," Faculty 1000 Biology Reports 2010, v.2, 2010.

Rasher DB and ME Hay. "Chemically rich seaweeds poison corals when not controlled by herbivores", Proceedings of the National Academy of Sciences, v.107, 2010, p. 9683.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-0929119

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