

Growth and survival of mature *Sargassum polycystum* fronds in crowded and isolated habitats

Website: <https://www.bco-dmo.org/dataset/644062>

Data Type: experimental

Version:

Version Date: 2016-05-02

Project

» [Killer Seaweeds: Allelopathy against Fijian Corals](#) (Killer Seaweeds)

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Coverage

Spatial Extent: Lat:-18.208 Lon:177.7

Temporal Extent: 2013-03-01 - 2015-05-31

Dataset Description

Raw data on the growth of mature *Sargassum polycystum* fronds transplanted into or outside *Sargassum* beds, crowded and isolated conditions respectively, in a non-protected area in Fiji. Growth was obtained using the initial height measurement from each ramet and subtracting it from its final height, meaning the ramets that died were recorded as negative change. Details in Dell et al. 2016 Plos One.

Related Reference:

Dell, C., Longo, G.O., Hay, M.E. (2016) Positive feedbacks enhance macroalgal resilience on Degraded Coral Reefs. Plos One.

Related Datasets:

[Sargassum mature growth - figure 2](#)

[Sargassum recruit-sized survival - figure 3](#)

[Sargassum recruit-sized growth and survival with conspecifics - figures 5 and 6](#)

Methods & Sampling

[Reference cited below are from Dell et al (2016) Plos One.]

Study site and species:

This study was conducted between January and May in 2013 and 2015 on the coral coast of Fiji's main island, Viti Levu, in the villages of Votua and Vatu-o-lailai (18°12'32S, 177°42'00E and 18°12'13S, 177°41'29E respectively; Fig 1). These villages are ~3km apart and each has jurisdiction over their stretch of reef flat; a

habitat ranging between ~1.5 and 3m deep at high tide and between ~0 and 1.5m deep at low tide. In 2002, these villages established small areas (0.8km² in Votua and 0.5 km² in Vatu-o-lailai; Fig 1) as no-take MPAs [25]. Though MPA and non-MPA areas were initially similar in coral and macroalgal cover (33-42% macroalgal cover; 3-12% coral cover [25]), MPAs now differ significantly from the adjacent non-MPAs in benthic cover and fish diversity and abundance. MPAs now have ~56% live coral cover on hard substrate, ~2% macroalgal cover, ~8 fold higher biomass of herbivorous fishes, and higher recruitment of both fishes and corals than the non-MPAs [5,22]. Meanwhile the non-MPAs have lower fish biomass, 5-16% live coral cover on hard substrates and 51-92% macroalgal cover, the majority of which is comprised by Phaeophytes (primarily *Sargassum polycystum* C. Agardh [22]). In the MPAs, macroalgal cover is restricted to the shallowest, most shoreward areas (where access by herbivorous fishes appears limited), whereas macroalgal cover in the non-MPAs extends throughout the habitat. Thus, over distances of only a few hundred metres, there are dramatic differences in community composition that may impact the efficacy of factors controlling macroalgal populations, without the confounding factors of great differences in space or time.

Effect of conspecifics on survival and growth of mature fronds

To assess whether conspecific density might facilitate the survival and growth of mature fronds, we transplanted mature fronds into the centre of *Sargassum* beds and into nearby exposed habitats where they were isolated from others. Growth and duration of survival were measured over a two week period. Due to logistical constraints, this experiment was only conducted in Votua's non-MPA where *Sargassum* beds were extensive and thus many separate patches were available for use.

Eight 10cm fronds of *S. polycystum* were removed from the centre of one holdfast, assuring genetic uniformity. Four were threaded through a three-strand rope (secured 5cm apart and 10cm from each end of the rope), and returned to the centre of the *Sargassum* bed (crowded condition) ~75m from shore at a depth of ~1m at low tide. The other four were threaded through a separate rope and tied in an area devoid of *Sargassum* two to four metres away (isolated condition). The ends of the rope were tied to the substrate to hold the rope in place. Twenty such rope pairs were set up with a total of 80 *S. polycystum* pieces in each of the crowded and isolated treatments. After two weeks the ropes were collected, the number of remaining fronds was counted and their length was measured. The initial length was subtracted from the final so that fronds that had been grazed in excess of growth were recorded as negative change.

Data Processing Description

Grazing was either complete (such that none of the frond remained except the section of thallus held between strands of the rope) or absent (such that the entire frond remained including the apical meristem); there were no fronds with portions missing that might indicate partial grazing. Thus, fronds that were grazed or ungrazed could be easily identified. Consequently, we also calculated an estimate of growth from only the ungrazed fronds that had retained their apical meristems and survived the experiment. This permitted a comparison of growth between the crowded and isolated conditions when herbivory appeared to be absent. Once again, the initial length was subtracted from the final length of each ungrazed frond and an average change in length per rope was calculated. As all fronds were completely grazed on four ropes, those pairs were excluded leaving n=16 in this dataset. Difference scores satisfied the assumption of normality (p=0.161; Shapiro-Wilk) so data were analysed by a paired t-test. Both analyses were run in SPSS version 16.0 with $\alpha=0.05$.

BCO-DMO Processing:

- added conventional header with dataset name, PI name, version date
- renamed parameters to BCO-DMO standard
- corrected longitude from West to East degrees

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Data Files

File
mat_growth_conspec.csv (Comma Separated Values (.csv), 1.03 KB) MD5:80fbb2e15bf2fddc86df4b23b123cbb3
Primary data file for dataset ID 644062

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Parameters

Parameter	Description	Units
lat	latitude; north is positive	decimal degrees
lon	longitude; east is positive	decimal degrees
all_isolated	growth of all Sargassum fronds transplanted to an area isolated from conspecifics	cm
all_crowded	growth of all Sargassum fronds transplanted to an area crowded with conspecifics	cm
all_difference	difference between the growth of all Sargassum fronds in isolated and crowded conditions	cm
survivors_isolated	growth of Sargassum fronds that were transplanted to an area isolated from conspecifics and survived for the entire experiment range (two weeks)	cm
survivors_crowded	growth of Sargassum fronds that were transplanted to an area crowded with conspecifics and survived for the entire experiment range (two weeks)	cm
survivors_difference	difference between the growth of Sargassum fronds transplanted to isolated and crowded conditions and survived for the entire experiment range (two weeks)	cm

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	scale or balance
Generic Instrument Description	Devices that determine the mass or weight of a sample.

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Deployments

Fiji_2013

Website	https://www.bco-dmo.org/deployment/564474
Platform	Hay_GaTech
Start Date	2013-08-13
End Date	2013-10-09
Description	Studies of corals and seaweed were conducted on reef flats within no-take marine protected areas (MPAs) adjacent to Votua, Vatuo-lailai, and Namada villages along the Coral Coast of Viti Levu, Fiji in 2013.

Fiji_2015

Website	https://www.bco-dmo.org/deployment/643921
Platform	Hay_GaTech
Start Date	2015-01-01
End Date	2015-05-31
Description	A study of seaweeds was conducted on reef flats within no-take marine protected areas (MPAs) and non-MPAs adjacent to Votua, Vatuo-lailai, and Namada villages along the Coral Coast of Viti Levu, Fiji in 2013.

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Project Information

Killer Seaweeds: Allelopathy against Fijian Corals (Killer Seaweeds)

Coverage: Viti Levu, Fiji (18°13.049'S, 177°42.968'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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