Coral mortality and tissue loss from experiments at Pickles Reef, Florida Keys National Marine Sanctuary, 2009-2012 (HERBVRE project)

Website: https://www.bco-dmo.org/dataset/674416
Data Type: experimental
Version: 1
Version Date: 2017-01-10

Project
» Cascading interactions of herbivore loss and nutrient enrichment on coral reef macroalgae, corals, and microbial dynamics (HERBVRE)

Contributors	Affiliation	Role
Burkepile, Deron	Florida International University (FIU)	Principal Investigator
Vega Thurber, Rebecca	Florida International University (FIU)	Co-Principal Investigator
Copley, Nancy	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
This dataset contains data on coral mortality and tissue loss during enclosure experiments at Pickles Reef, Florida Keys National Marine Sanctuary. Published in Nature Communications (2016) doi:10.1038/ncomms11833, Supplementary Data 5a.

Table of Contents

- Coverage
- Dataset Description
  - Methods & Sampling
  - Data Processing Description
- Data Files
- Related Publications
- Parameters
- Deployments
- Project Information
- Funding

Coverage

Spatial Extent: **Lat**:24.9943 **Lon**:-80.4065

Dataset Description

This dataset contains data on coral mortality and tissue loss during enclosure experiments at Pickles Reef, Florida Keys National Marine Sanctuary. Published in Nature Communications (2016) doi:10.1038/ncomms11833, Supplementary Data 5a.

Natural history of the study site:
This experiment was conducted in the area of Pickles Reef (24.99430, -80.40650), located east of Key Largo, Florida in the United States. The Florida Keys reef tract consists of a large bank reef system located approximately 8 km offshore of the Florida Keys, USA, and paralleling the island chain. Our study reef is a 5-6 m deep spur and groove reef system within this reef tract. The reefs of the Florida Keys have robust herbivorous fish populations and are relatively oligotrophic. Coral cover on most reefs in the Florida Keys, including our site, is 5-10%, while macroalgal cover averages ~15%, but ranges from 0-70% depending on location and season. Parrotfishes (*Scaridae*) and surgeonfishes (*Acanthuridae*) are the dominant herbivores on these reefs as fishing for them was banned in 1981. The other important herbivore on Caribbean reefs, the urchin *Diadema antillarum*, remains at low densities across the Florida Keys following the mass mortality event

in 1982-3.

Related Reference:
Zaneveld, J.R., D.E. Burkepile, A.A. Shantz, C. Pritchard, R. McMinds, J. Payet, R. Welsh, A.M.S. Correa, N.P. Lemoine, S. Rosales, C.E. Fuchs, and R. Vega Thurber (2016) Overfishing, nutrient pollution, and temperature interact to disrupt coral reefs down to microbial scales. Nature Communications 7:11833 doi:10.1038/ncomms11833 Supplementary Information

Methods & Sampling

Coral tissue growth or loss analyses:
At the beginning of the experiment, we mapped each coral colony in the experimental plots that were >2 cm in diameter and took close-up photographs of these corals in situ. Subsequently, we photographed each of these corals every ~16 weeks throughout the experiment for a photographic record of changes in coral colony health. In each picture a ruler or object of known size was placed next to the coral to provide scale. In total, we tracked the fate of 226 individual corals spread across each of the treatments for over 3 years. The most common corals were Porites porites (41.1 % of corals), Agaricia spp. (17.7 % of corals), Siderastrea siderea (15.5 % of corals) and P. astreoides (11.5 % of corals).

These corals allowed us to evaluate the impact of the different treatments on coral growth or tissue loss across the time course of the experiment. We scored growth or tissue loss on a 12-point scale, with bins corresponding to amounts of tissue loss that could be readily observed in photographs (for example, −2=10–25% tissue loss). We scored the tissue loss or gain of each coral over the course of the experiment on the following scale: −6=100% tissue loss, −5=75–90% loss, −4=50–75% loss, −3=25–50% loss, −2=10–25% loss, −1=0–10% loss, 0=0% loss/gain, 1=0–10% gain, 2=10–25% gain, 3=25–50% gain, 4=50–75% gain, 5=75–90% gain and 6>100% gain. We then converted these scores to mean loss/gain by averaging the range corresponding to that score. For example, a coral with a −3 score would be converted to a −37% tissue loss value. Only nine corals grew >100% (score=6) over the course of the experiment. For these corals, we estimated the growth for each coral at 100–500% at 50% intervals (for example, 100, 150, 200% and so on). Statistical analyses were conducted based on the raw tissue gain/loss scores, but converted to percentages in the presentation for ease of interpretation. Further, at each time point we scored each coral for: (1) algal competition as measured by direct contact with algal competitors (and the identification of that algal competitor), (2) the presence of overlying sediment on the coral, (3) predation scars from parrotfishes and invertebrate corallivores (only the former were observed at appreciable levels), and (4) signs of bleaching or disease. The primary coral disease observed was DSS (see ref. 52 for additional discussion). (Zaneveld, 2016)

Data Processing Description

Percent coral mortality per treatment and coral tissue loss were analysed using similar mixed models to algal cover. For growth measures, corals were nested within ambient or enriched plots, but we did not incorporate season as we only analysed change in tissue for corals at the end of the experiment. We calculated tissue loss statistics either excluding or including corals that suffered total colony mortality. Corals that died suffered total colony mortality and therefore 100% loss of live tissue area. Including these corals in coral growth analyses resulted in non-normal distributions that could not be corrected via transformations. Therefore, we analysed coral growth both excluding the corals that died, which satisfied normality requirements for the analyses, and including the corals that died. Both analyses produced relatively consistent results (Supplementary Data 5), with the exception that only the interaction of herbivory × nutrient loading was significant in Porites corals (rather than each factor also being individually significant) when total colony mortality was excluded. We used a $\chi 2$-test to determine if coral mortality was higher or lower than expected across different seasons given the null hypothesis that coral mortality would be distributed evenly across seasons (25% of total mortality per season). (Zaneveld, 2016)

BCO-DMO Processing:
- added conventional header with dataset name, PI name, version date, reference information
- renamed parameters to BCO-DMO standard
- reduced decimal places from 9 to 2
- changed N/A to nd (no data)

[table of contents | back to top]

Data Files

File
S5a_coral_mort.csv (Comma Separated Values (.csv), 699 bytes) MD5:8fc7e41c3f1e5700c34bc826fb86be80 Primary data file for dataset ID 674416

[table of contents | back to top]

Related Publications

Zaneveld, J. R., Burkepile, D. E., Shantz, A. A., Pritchard, C. E., McMinds, R., Payet, J. P., ... Thurber, R. V. (2016). Overfishing and nutrient pollution interact with temperature to disrupt coral reefs down to microbial scales. Nature Communications, 7(1). doi:10.1038/ncomms11833
Results

[table of contents | back to top]

Parameters

Parameter	Description	Units
plot	plot number	unitless
treatment	treatment	unitless
num_corals	number of corals	corals
num_dead	number dead	corals
tissue_change_score	tissue change score	unitless
dead_pcent	percent dead	dimensionless
tissue_change_pcent_high_max	tissue change (% high max)	dimensionless

[table of contents | back to top]

Deployments

Burkepile_FL_Keys

Website	https://www.bco-dmo.org/deployment/639486
Platform	Florida Keys National Marine Sanctuary
Start Date	2009-06-01
End Date	2012-08-31
Description	Herbivore effects on reef algae

[table of contents | back to top]

Project Information

Cascading interactions of herbivore loss and nutrient enrichment on coral reef macroalgae, corals, and microbial dynamics (HERBVRE)

Coverage: Key Largo, Florida Keys, USA; N 24.99430, W 080.40650

Description from NSF award abstract:
Coral reefs in the Caribbean Sea are undergoing unprecedented declines in coral cover due in large part to climate change, pollution, and reductions in fish biodiversity and abundance. Macroalgae have become abundant on reefs, probably due to decreases in herbivory (e.g., through overfishing) and increases in anthropogenic inputs of nutrients. The spread of macroalgae has negative feedbacks on reef recovery because algae are often superior competitors and suppress growth of both adult and juvenile corals. A majority of reef studies to date have focused on how stressors affect macroorganisms, while relatively few have investigated how these stressors and the resultant algal-dominated states affect microorganisms. Yet, coral reef-associated microbes play significant roles in coral reef ecosystems through biogeochemical cycling and disease. Since microbes are important mutualists of corals as well as potential pathogens, it is important to understand the mechanisms that control their taxonomic and functional diversity.

The goal of this proposal is to quantify how alterations of top-down (removal of herbivorous fish) and bottom-up (inorganic nutrient addition) forces alter macrobial as well as microbial dynamics on coral reefs in order to understand the mechanisms that reinforce coral-depauperate reef systems. This work asks two main questions:

Q1. How do nutrient enrichment and herbivore removal interact to affect benthic algal abundance, coral-algal interactions, and coral survivorship and growth?

Q2. How do nutrient enrichment and herbivore removal affect bacterial abundance, taxonomic diversity, and functional diversity on and within corals?

The proposed research will directly and empirically address many of the current hypotheses about how bottom-up and top-down forces alter reef dynamics. The PIs will investigate: (1) the impact of multiple stressors over several years; (2) impacts on multiple levels of biological organization (from fishes to algae to microbes); and (3) the mechanisms underlying changes in algal-coral microbe interactions. Significantly, the approach will provide the statistical power necessary to distinguish between seasonal- and stress-induced changes in macro- and microbial diversity.

Resulting Publication:
Zaneveld, J.R., D.E. Burkepile, A.A. Shantz, C. Pritchard, R. McMinds, J. Payet, R. Welsh, A.M.S. Correa, N.P. Lemoine, S. Rosales, C.E. Fuchs, and R. Vega Thurber (2016) Overfishing, nutrient pollution, and temperature interact to disrupt coral reefs down to microbial scales. Nature Communications 7:11833 doi:10.1038/ncomms11833.
Access to data via Supplementary Information.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1130786

[table of contents | back to top]