Water column nutrients for ambient nutrient conditions from Pickles Reef in Upper Florida Keys, 2009-2012 (HERBVRE project)

Website: https://www.bco-dmo.org/dataset/639563
Data Type: Other Field Results
Version: 1
Version Date: 2016-03-01

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

Contributors	Affiliation	Role
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Abstract
This dataset contains summary percent cover data for algal species and other encrusting invertebrates found in the study plots.

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Coverage

Spatial Extent: **Lat**:24.9943 **Lon**:-80.4065
Temporal Extent: 2009-06 - 2012-08

Methods & Sampling

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

Exclosure and nutrient enrichment experimental design details

In order to simulate the effects of overfishing, nutrient loading, or the combination of these stressors, we conducted a three-year field experiment. Four pairs of 9m^2 plots were established. One member of each of these pairs was enriched with nitrogen and phosphorous, while the other remained at ambient nutrient levels. These plots were >10 m from each other in all cases. Each 9 m^2 plot was delineated into nine 1 m^2 subplots with metal nails driven into the reef at the corners and center of each plot. The locations of the plots were selected such that initial variation in rugosity and algal cover within each subplot was minimal. Within each plot, two randomly-selected subplots were enclosed with herbivore exclosures, while two other random subplots were selected as exclosure controls. Exclosure controls were fitted with open-topped exclosures. These controls allowed access by herbivorous fishes but acted as controls for other potential artifacts of the cages.

All exclosures were made of plastic-coated wire mesh with 2.5 cm diameter holes. This diameter mesh generally excludes most fishes >10 cm total length. Smaller or juvenile herbivorous fishes are able to enter the exclosures, but these smaller herbivores generally contribute little to overall grazing rates on reefs and have minimal impacts on the algal communities. Additionally, access by smaller herbivores reflects patterns seen under intensive fishing, in which larger fish species are preferentially harvested while leaving smaller size classes of fish. We scrubbed both exclosures and exclosure controls every 4-6 weeks to remove fouling organisms.

Nutrient pollution was simulated using slow-release fertilizer diffusers applied to each nutrient enrichment plot. Each diffuser was a 15 cm diameter PVC tube, perforated with six 1.5 cm holes. The open ends of the PVC tube were wrapped in fine plastic mesh to keep fertilizer pellets inside, but allow diffusion of soluble nutrients. 175 g of Osmocote® (19-6-12, N-P-K) slow-release fertilizer was loaded into each diffuser. PVC enrichment tubes were attached to each metal nail within the 9m^2 enrichment plots for a total of 25 enrichment tubes per enrichment plot. Nutrients were replaced every 30-40 days to ensure continued delivery of N and P. Previous studies have shown Osmocote delivery using similar methods to be an effective way of enriching water column nutrients in benthic systems.

Quantification of Water Column Nutrients
Nitrogen and phosphorus levels were assessed in the water column above each control plot. Divers used 60 ml syringes to slowly draw water from ~3 cm above the benthos. Immediately after collection, samples were filtered (GF/F) into acid-washed bottles, placed on ice, returned to the laboratory, and frozen until analyzed. Dissolved inorganic nitrogen (DIN = ammonium and nitrite + nitrate) and soluble reactive phosphorus (SRP) concentrations were determined via autoanalyzer. Here, we only report data from the ambient nutrient treatment and not data from the enrichment treatment to avoid confusion about the natural nutrient concentrations at our field site.

Data Processing Description

BCO-DMO Processing:
- added conventional header with dataset name, PI name, version date, reference information
- renamed parameters to BCO-DMO standard
- added site, lab, lat, lon columns
- reformatted date from m/d/yyyy to yyyy-mm-dd

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Data Files

File
nutrients.csv (Comma Separated Values (.csv), 6.82 KB) MD5:0add96311c6b86d78ce497717c0d0fcd Primary data file for dataset ID 639563

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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

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Related Datasets

IsRelatedTo

Burkepile, D., Vega Thurber, R. (2021) **Algal cover from herbivore exclusion and nutrient enrichment experiments conducted in the Florida Keys National Marine Sanctuary during 2009-2012.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2016-03-02 doi:10.26008/1912/bco-dmo.639509.1 [view at BCO-DMO]

Burkepile, D., Vega Thurber, R. (2021) **Algal species ID from herbivore exclusion and nutrient enrichment experiments conducted in the Florida Keys National Marine Sanctuary during 2009-2012 (HERBVRE project).** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2016-12-19 doi:10.26008/1912/bco-dmo.639480.1 [view at BCO-DMO]

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Parameters

Parameter	Description	Units
site	study site	unitless
lat	latitude; north is positive	decimal degrees
lon	longitude; east is positive	decimal degrees
date	sampling date	yyyy-mm-dd
SRP	Soluble reactive phosphorus	microMoles
NO3	Nitrate concentration	microMoles
NH4	Ammonium concentration	microMoles
DIN	Dissolved inorganic nitrogen concentration	microMoles

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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

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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.

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Funding

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

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