Above and below ground carbon, nitrogen, and phosphorus content by weight of seagrass near an artificial reef in the Bahamas (Fish and biogeochem hot spots project)

Website: https://www.bco-dmo.org/dataset/682675
Data Type: Other Field Results
Version:
Version Date: 2017-02-21

Project
» Fish aggregations and biogeochemical hot spots across regional environmental gradients (Fish and biogeochem hot spots)

Contributors	Affiliation	Role
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Coverage

Spatial Extent: **N**:26.6062 **E**:-73.6051 **S**:18.08719 **W**:-78.51647
Temporal Extent: 2013-12-01

Dataset Description

This dataset includes above and below ground carbon, nitrogen, and phosphorus content by weight of seagrass blades, roots, and rhizome near an artificial reef in The Bahamas in December 2013.

Related Reference:
Layman, C.A., Allgeier, J.E., and Montaña, C.G. 2016. The attraction-production debate viewed from the bottom-up: mechanistic evidence of increased production thresholds. Ecological Engineering. 95:574-579. http://dx.doi.org/10.1016/j.ecoleng.2016.06.109

Methods & Sampling

All raw values are based on the seagrass collected in a core with a area of 126cm^2.

Methods from Layman et al (2016) Ecol. Engr.:

This case study was based in the Bight of Old Robinson, Abaco, The Bahamas, a semi-enclosed bay that has a complex benthic mosaic comprised predominantly of sand, seagrass (primarily turtle grass Thalassia testudinum), and hard bottom/patch reef habitat. We sampled an artificial reef (N 26 20.549', W77 00.874') that had similar spatial patterns in aboveground seagrass traits as other patch reefs (both natural and artificial)

in seagrass beds of this area (Allgeier et al., 2013; Layman et al., 2013). This reef (dimensions ~1.2 m2 at base and ~1.2 m tall) was constructed in March 2009 using 40 cinder blocks arranged in pyramid fashion (Yeager et al., 2011). Samples (December 2013) were taken in spatially-explicit fashion on 3 transects radiating from each reef; transects were oriented ~120 degrees apart in random directions. Cores were taken with a 12.7 cm diameter pvc pipe at set distances (m) from the reef on each transect: 1, 2, 3, 4, 6, 10, 15, 100. The core was driven ~16 cm into the sediment and manually excavated, placing one hand under the bottom of the core as it was pulled out. Visual inspection demonstrated cores successfully remove all seagrass tissues from the sampled area. Water was drained from the cores and sand was rinsed off with seawater and then they were placed in individual plastic bags and immediately frozen.

In the laboratory, cores of seagrass biomass were thawed and separated into aboveground biomass (all attached green leaves of shoots) and belowground biomass (rhizomes and roots). Shoots were enumerated and morphology of blades (length and width) was measured. As a proxy for grazing intensity, we measured the total number of grazing scars on all blades in the core (Valentine and Duffy, 2006). Blades were gently scraped with a razor blade to remove epiphytes; belowground material was rinsed with deionized water. Tissues were dried for 72 h at a constant temperature of 65C and dry weight (to the nearest 0.01 g) was recorded. Dried samples were ground into a fine powder using a PRECELLYS-24 grinder and subsamples of each were analyzed for percent of carbon (C), nitrogen (N), and phosphorous (P). Percent C and N content were determined using a CHN Carlo-Erba elemental analyzer (Fison NA1500). Percent P was determined by dry oxidation acid hydrolysis extraction followed by colorimetric analysis (Fourqurean and Zieman, 1992).

To explore potential thresholds in allocation of resources between different tissue structures, we first partitioned total plant nutrients into the various tissues from which these measurements were obtained (n = 48 for each tissue type, n = 144 total). Partitions included: % blade nutrients to total (whole-plant) nutrients, % total belowground (root + rhizome) to total, % root to total, % rhizome to total, % roots to total belowground, and % rhizome to total belowground. Generalized additive models (gam) were then used to describe the relationship of these data with respect to distance from the reef. If the relationship was non-linear, a changepoint analysis, using the package "changepoint" in R, was used to determine the distance from the reef at which the threshold was reached. Relationships between belowground and aboveground traits were tested using least squares regression. Data were log transformed and satisfied model assumptions.

Data Processing Description

BCO-DMO Processing:
- added conventional header with dataset name, PI name, version date
- renamed parameters to BCO-DMO standard

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Data Files

File
seagrass_CNP.csv (Comma Separated Values (.csv), 6.17 KB) MD5:2666ec42154b325e184402643e727475
Primary data file for dataset ID 682675

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Parameters

Parameter	Description	Units
grass_part	partition of grass plant analysed: blade root or rhizome	unitless
sample	sample identifier: the '5' designates that this study was conducted at reef 5 in our array. The letters A B and C designate which of the three transects.	unitless
delta_15N_vs_air	difference between 15N:14N in sample relative to air	parts per thousand (per mil; 0/00)
delta_13C_vs_PDB	difference between 13C:12C in sample relative to PDB	parts per thousand (per mil; 0/00)
total_C_pcnt	The proportional contribution (by weight) of carbon	unitless
total_N_pcnt	The proportional contribution (by weight) of nitrogen	unitless
P_pcnt	The proportional contribution (by weight) of phosphorus	unitless
C_to_N	ratio of carbon to nitrogen by weight	unitless
C_to_P	ratio of carbon to phosphorous by weight	unitless
N_to_P	ratio of nitrogen to phosphorus by weight	unitless

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Instruments

Dataset-specific Instrument Name	CHN Carlo-Erba elemental analyzer (Fison NA1500)
Generic Instrument Name	CHN Elemental Analyzer
Generic Instrument Description	A CHN Elemental Analyzer is used for the determination of carbon, hydrogen, and nitrogen content in organic and other types of materials, including solids, liquids, volatile, and viscous samples.

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Deployments

Layman_2014

Website	https://www.bco-dmo.org/deployment/542786
Platform	Caribbean_nearshore
Start Date	2014-01-01
End Date	2014-11-30
Description	Coral reef surveys as part of the project "Fish aggregations and biogeochemical hot spots across regional environmental gradients".

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Project Information

Fish aggregations and biogeochemical hot spots across regional environmental gradients (Fish and biogeochem hot spots)

Coverage: Caribbean

Description from NSF award abstract:
Consumers in marine ecosystems have long been acknowledged for their role in top-down regulation of ecosystems, but their influence through bottom-up pathways such as nutrient supply is often underappreciated and has not been integrated into models of coastal ecosystem dynamics. Yet, nutrient supply from consumers may be a regulating factor when consumers aggregate, such as fishes around structurally complex habitat. Examining this bottom-up mechanistic pathway is essential for a more holistic understanding of seagrass ecosystems, which are important and threatened globally. This study will address the following questions: (1) Does concentrated nutrient supply from consumers result in distinct biogeochemical hot spots in seagrass beds? and (2) How do consumer effects on ecosystem processes vary across regional environmental contexts where nutrient availability and fishing pressure vary? The PIs will conduct experiments at multiple sites within three biogeographic regions in the Caribbean (The Bahamas, Hispaniola, and Grenada/St.Vincent/Grenadines). The experiments will utilize artificial reefs that mimic natural patch reef habitats that concentrate animals at high densities. Response variables reflecting ecosystem processes (e.g., seagrass nutrient content, seagrass biomass, primary producer diversity) will be measured at reef sites and compared with control sites (seagrass sites without reefs). The spatial extent over which ecosystem processes may be affected, i.e., distance from artificial reef, will be quantified and used to detect ecological thresholds in ecosystem responses. Predictor variables, including measures of ambient nutrient availability, fish densities and fish grazing rates, will be used to contextualize the relative importance of consumer-mediated nutrient supply. The hierarchical experimental design and two-pronged analysis will characterize relationships across environmental gradients found among and within the biogeographic regions, facilitating a conceptual framework needed to predict when, where, and why consumer-mediated nutrient supply is an important control of ecosystems processes in seagrass beds.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1405198

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