Experimental results on the response of Diopatra final size to Gracilaria abundance after four weeks in 2013 (Gracilaria effects project)

Website: https://www.bco-dmo.org/dataset/641680
Data Type: experimental
Version:
Version Date: 2016-04-07

Project
» Cascading effects of an invasive seaweed on estuarine food webs of the southeastern US (Gracilaria effects)

Contributors	Affiliation	Role
Byers, James E.	University of Georgia (UGA)	Co-Principal Investigator
Sotka, Erik	College of Charleston (CofC)	Co-Principal Investigator
Kollars, Nicole M.	College of Charleston (CofC)	Student, Contact
Copley, Nancy	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Table of Contents

Coverage

Spatial Extent: **N**:32.75253 **E**:-79.90142 **S**:31.96012 **W**:-81.01223
Temporal Extent: 2013-03-01 - 2013-10-31

Methods & Sampling

Field experiments
To quantify the effect of Gracilaria on Diopatra growth and survivorship in the field, we manipulated Gracilaria density and predator access to Diopatra in a fully factorial and blocked field experiment over 4 wk in June 2012. We prepared worms in plastic tubes as above and out-planted them along a transect parallel to the shore at ~+0.15 m MLLW in one of 4 treatments: ambient control, Gracilaria addition, Gracilaria addition and predator exclusion cage, and cage only. Two worms were added per plot and 10 plots were generated per treatment. We report the final body masses of surviving worms (if both survived we used the average of the 2 worms). Treatments of a given replicate block were within 1 m of each other and blocks were separated by at least 1 m. We added Gracilaria to a plot by weaving 50.00 g (± 0.05 g, acceptable range of variation) blotted wet mass of the seaweed through 30 cm of 0.76 cm 3- strand rope and placing the rope in the plot center. A pre-experimental survey indicated that the maximum seaweed biomass on a Diopatra individual in the field was ~25.0 g wet mass (data not shown). Cages were 0.5 m wide by 0.3 m tall, constructed with PVC-coated chicken wire (2.5 cm mesh size) and embedded ~10 cm into the sediment. Plots without cages were marked with 3 PVC posts extending <10 cm out of the sediment and separated by ~30 cm. After 4 wk, we removed the worms and severed the regenerated tissue from the rest of the body (see photo graph in Supplement 1B at http://www.int-res.com/articles/suppl/m545p135_supp/) using a razor blade. We dried and measured the original body mass and regenerated tissue mass at 60°C until no change in mass occurred (see Supplement

1B for details). We collected all Gracilaria biomass within the plot, defaunated it, measured its wet mass and dry mass, and counted the number of whole, epifaunal amphipods.

To assess spatial and temporal variation in the effect of Gracilaria on Diopatra, we manipulated Gracilaria density in replicated field experiments in June 2013 at 2 sites near Charleston, SC (Fort Johnson, Stono River) and 2 sites near Savannah, GA (Priest's Landing and Bull's River). The 2013 experiments did not include a cage treatment be cause we did not detect a predator-exclusion effect in 2012 (see 'Results'). Relative to the 2012 experiment, the 2013 experiments used only one worm per plot, had 30 replicates per treatment, and we reduced the initial level of Gracilaria biomass in the addition treatment from 50 g down to 25 g wet mass. We randomly distributed plots 1 m apart along a transect parallel to the shore at approx. +0.09 m MLLW. In addition, we attached the seaweed-embedded ropes to PVC posts using zip-ties and pushed the posts into the mudflat to in crease seaweed stability (see Supplement 1A). Plots where we did not add Gracilaria still contained a PVC post and empty rope. After 4 wk, we processed the worms, seaweed, and epifauna as in the 2012 experiment. Because of logistical constraints, we counted epifauna for only 2 of the 4 sites (Fort Johnson and Priest's Landing) used in 2013.

Related Reference:
Kollars, N.M., J.E. Byers and E.E. Sotka (2016) Invasive decor: an association between a native decorator worm and a non-native seaweed can be mutualistic. Marine Ecology Progress Series (DOI: 10.3354/meps11602)

Related Datasets:
MEPS_2016: Fig.2A - survey
MEPS_2016: Fig.2B - Gracilaria growth rate
MEPS_2016: Fig.3 - growth rate and depth
MEPS_2016: Fig.4A - worm growth
MEPS_2016: Fig.4B - stable isotopes
MEPS_2016: Fig.5A - field expt 2012

Data Processing Description

We analyzed survivorship of Diopatra as a function of treatment (Gracilaria addition and presence or absence of cage [2012 only]) using a Chi^2 test. Because we did not measure Gracilaria final density for treatments in which worms died, we cannot pursue a logistic regression. For growth analyses, we excluded worms with evidence of sublethal predation on Diopatra (c.f. Berke et al. 2009; seen only in 2013 and in GA; 5 of 239 worms removed) and worms that were damaged during collection and processing (2 damaged worms out of 80 in June 2012; 15 damaged worms out of 239 in June 2013). Although the Gracilaria manipulation was initially designed as a categorical variable, we treated Gracilaria final biomass as an independent, continuous variable in our growth analysis because plots gained or lost Gracilaria biomass from Diopatra decoration activity, Gracilaria growth, and Gracilaria detachment. Moreover, epifauna abundance - an important proxy for Diopatra growth in the laboratory growth assay - scales positively with Gracilaria abundance (Supplement 1C at http://www.int-res.com/articles/suppl/m545p135_supp/, Byers et al. 2012). The response of Diopatra final size (as well as other growth metrics, Supplement 1B) was analyzed using ANCOVA with Gracilaria density as a covariate and cage presence as a categorical variable for the 2012 experiment, and Gracilaria density as a covariate and site as a categorical variable for the 2013 experiment. To assess the potential for Gracilaria as an indirect food source in the field (i.e. an attractor of prey species for Diopatra), we examined the relationship between counts of epifaunal amphipods and Gracilaria biomass using a generalized linear model with a quasi-Poisson distribution (Zuur et al. 2009). Finally, we used ANCOVA to examine the relationship between Diopatra size and the count of epifaunal amphipods.

BCO-DMO Processing:
- added conventional header with dataset name, PI name, version date, reference information
- renamed parameters to BCO-DMO standard
- replaced NA with nd
- reduced excess number of digits after decimal for growth
- added lat and lon columns for mapping purposes

[table of contents | back to top]

Data Files

File
Kollars_fig5B.csv(Comma Separated Values (.csv), 10.90 KB) MD5:70bb064aec346fdf814e41d35344fd6d Primary data file for dataset ID 641680

[table of contents | back to top]

Parameters

Parameter	Description	Units
site	position in Charleston Harbor SC: FJ= Fort Johnson; ST=Stono River; and Savannah Georgia (GA): PL=Priest's Landing; BR=Bull's River	unitless
lat	latitude; north is positive	decimal degrees
lon	longitude; east is positive	decimal degrees
plot	unique plot identification	unitless
treatment	treatment assignment: worm = no Gracilaria added; wormgrac = Gracilaria added	unitless
om_dry	dry mass of the original tissue	grams
rt_dry	dry mass of the regenerated tissue	grams
final_size	om_dry + rt_dry	grams
growth	Diopatra growth rate per day	percent per day
grac	final dry mass of Gracilaria in the plot	grams
pods	number of epifaunal amphipods present on the Gracilaria	unitless

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	scale
Generic Instrument Description	An instrument used to measure weight or mass.

[table of contents | back to top]

Deployments

Sotka_2013

Website	https://www.bco-dmo.org/deployment/641612
Platform	Coll_Charleston
Start Date	2012-01-01
End Date	2013-12-31
Description	Benthic interactions of polychaetes and macroalgae

[table of contents | back to top]

Project Information

Cascading effects of an invasive seaweed on estuarine food webs of the southeastern US (Gracilaria effects)

Coverage: Georgia and South Carolina coasts

Description from NSF award abstract:
During the last decade, the Asian seaweed, *Gracilaria vermiculophylla*, has proliferated along high-salinity mudflats in several Georgia and South Carolina estuaries. The invasion is noteworthy because the mudflats in these estuaries were historically devoid of macrophyte-based primary production and structure. *Gracilaria* has few native analogues in these mudflat environments, and thus represents an opportunity to examine the ecosystem consequences of an invasion within an historically-unexploited niche. In theory, *Gracilaria* affects populations of species that are directly dependent on the invader for structure and food, as well as altering community- and ecosystem-level processes such as detrital production and food web structure. Through a combination of manipulative field experiments, laboratory assays and stable isotope analysis, the investigators will test three mechanisms by which *Gracilaria* influences native community structure. The novel structure and primary production generated by *Gracilaria vermiculophylla* may be 1) increasing rates of secondary production, 2) increasing levels of mudflat microbial production through leeching of dissolved nutrients, and 3) increasing detrital input to microbial and macrobial food webs.

This project will provide a mechanistic understanding of the multiple cascading impacts of an invasive species within the estuarine community. Species invasions that alter ecosystem functions are usually the most profound. These alterations are often generated by a small number of invaders that create physical structure, including important biogenic habitat, de novo. By altering physical structure, these non-native ecosystem engineers alter local abiotic conditions, interactions between species, and species composition. Highly influential invaders may also change food web structure and trophic flow of energy and materials. Such substantive food web changes can occur when an influential invader provides nutrients or resources that are different in quality, quantity or both. An invasive species that both provisions new physical structure and fundamentally alters food web structure could exert an overwhelming influence on native communities when these mechanisms act in synergy.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1057707
NSF Division of Ocean Sciences (NSF OCE)	OCE-1057713