Experimental results of tethered amphipod and isopod survival in global eelgrass habitats, summer 2015 (Zostera Experimental Network 2; ZEN2)

Website: https://www.bco-dmo.org/dataset/724015
Data Type: experimental, Other Field Results
Version: 2
Version Date: 2018-01-24

Project
» Global biodiversity and functioning of eelgrass ecosystems (Zostera Experimental Network 2) (ZEN 2)

Contributors	Affiliation	Role
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Stachowicz, John J.	University of California-Davis (UC Davis)	Co-Principal Investigator
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Abstract
This dataset includes survival of tethered amphipods and isopods in eelgrass plots, and the biomass of other organisms in the plots. The eelgrass beds were located globally.

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Coverage

Spatial Extent: **N**:60.1084 **E**:0.001 **S**:31.753 **W**:135
Temporal Extent: 2013-05-01

Methods & Sampling

In the summer of 2015 we quantified predation risk for mesograzers using identical experiments conducted at 17 sites spread across North America, Europe, and Asia (see Table 1 at end of this document). In each experiment, we used tethering to determine relative predation risk for locally collected organisms along patch edges and in patch interiors under three levels of simulated eelgrass degradation (0, 50, and 80% shoot loss) in a crossed design. Epifauna selected for tethering were small (approximately 2 – 20 mm in length) mesograzers (gammarid amphipods and isopods) that are commonly found in the guts of small fishes (Table 1). Tethering measures the relative mortality rate of prey among different treatments, and because tethered prey cannot flee from predators, represents the relative mortality rate for prey that are readily available to predators (Aronson & Heck 1995). Though organisms used in tethering experiments differed in species and sizes among sites, we only used taxa of sizes that are commonly found in the guts of predators at each site.

To set up experiments, at each site we first selected a large eelgrass bed (typically > 5,000 m2) in shallow water (0.5 – 1.5 m water depth at low tide) with a distinct edge formed by an abrupt transition from eelgrass to unvegetated sand or mud. Edge habitat was defined as being within eelgrass but within 1 m of the transition from eelgrass to unvegetated sediment, and interior habitat was > 5 m from this transition. We chose these distances because in seagrass habitat edge effects on mortality and abundance of small epifauna typically occur within 1 m from patch edges (Tanner 2005, MacReadie et al. 2010). Patch vegetation consisted exclusively of eelgrass, except for epibionts or sparse drift algae. At each site, we created 21 experimental blocks along the edge and 21 experimental blocks within the interior of the eelgrass bed. Each block consisted of two 1 m x 1 m eelgrass plots separated by a distance of 30 cm. One randomly selected plot in each block was designated for tethering mesograzers, and the other plot was used to tether larger organisms in a companion experiment (data are not listed for this companion experiment). We randomly selected seven of the 21 blocks at the edge and in the interior, and after obtaining shoot counts within these plots, haphazardly pulled shoots by hand to thin each plot to 50% of its ambient shoot density, creating 50% shoot loss plots. Another randomly selected seven blocks were thinned to 20% ambient shoot density (80% shoot loss plots), and the remaining seven remained at ambient shoot density.

To conduct experimental trials, we affixed locally collected mesograzers to 10 cm pieces of monofilament (Fireline™; dia. 0.13 mm) tied near the top of 40 cm clear acrylic rods. After being tethered in the lab, each mesograzer was held in seawater overnight before being deployed to the center of a randomly chosen plot, 15 cm above the sediment surface, between 0800 – 1100 h the next morning. Trials lasted 24 h, at which time we retrieved acrylic rods and scored each individual as alive, eaten (fragments of the carapace remaining on the tether), missing, or molted (entire carapace remaining on the tether). We considered organisms that went missing to have been consumed by predators because no organisms tethered in predator-free controls at three sites (n = 20 mesograzers at Bodega Bay, Finland, and San Diego) fell off tethers after 48 h. Few animals molted on tethers, and any that did were removed from the analysis. Four trials of the experiment were conducted over a 7 – 10 day period at each site (N = 7 individuals per treatment per trial * 6 treatments * 4 trials = 168 organisms tethered per site).

Immediately after trials concluded at a site we sampled plots in which mesograzers were tethered for epibiont biomass and epifaunal biomass. Epibiont biomass represented the degree to which eelgrass shoots were colonized by epiphytic algae and sessile epifauna such as bryozoans; these organisms contribute to variability in structural complexity at very small scales. We used the biomass of mobile crustacean epifauna as a proxy for prey density. To quantify epibiont biomass, three shoots near the center of each plot were haphazardly selected and removed from the plot, and returned to the laboratory where all epibionts were scraped from shoots, dried, and weighed. Scraped shoots also were dried and weighed to calculate epibiont biomass per unit eelgrass biomass. Epifauna were sampled by placing a 500 m mesh bag with a 20 cm diameter opening over eelgrass in a haphazardly selected area of each plot. This method targets small mobile mesograzers, but not larger mesopredators. Captured organisms were removed from eelgrass blades in the laboratory, separated into crustaceans vs. others taxa (primarily gastropods), and weighed. Eelgrass collected in the bag was dried and weighed to standardize epifaunal biomass per unit eelgrass biomass.

Instruments: Experiments were conducted individually at each site, so instrumentation varied among sites. At each site, a balance was used to measure biomass of organisms collected in plots. In the field, sampling of organisms was performed by collecting organisms in mesh bags or by clipping shoots. Shoot counts were made using PVC or wire rings laid over plots.

Table 1. (A) Sites used in the tethering experiment, their locations, and principle investigators involved in the study. (B) Taxa used for the tethering experiment at each site.

(B) Taxa used for the tethering experiment at each site.

Data Processing Description

Data were submitted to the PI from each site in the form of Microsoft Excel 2013 spreadsheets. The final collated data set is available as a Microsoft Excel spreadsheet.

BCO-DMO Processing Notes:
- added conventional header with dataset name, PI name, version date
- modified parameter names to conform with BCO-DMO naming conventions
- Data version 2018-01-24 replaced version 2018-01-17: longitudes were corrected for sites VA and GA.

Code	Site	Principle Investigator	Latitude	Longitude
BB	Bodega Bay, California, USA	J. Stachowicz	38.379	-123.053
CR	Posejarje, Adriatic Sea, Croatia	C. Kruschel	44.211	15.491
FI	Angso Island, Baltic Sea, Finland	C. Boström	60.108	21.711
FR	Bouzigues, Mediterranean Sea, France	F. Rossi	43.446	3.661
JN	Shinryu, Hokkaido, Japan	M. Nakaoka	43.052	144.842
JS	Akiwan Bay, Hiroshima, Japan	M. Hori	34.294	132.915
KO_A	Dong-dae Bay, Korea	K-S Lee	34.894	128.017
KO_B	Koje Bay, Korea	K-S Lee	34.800	128.583
MX	Punt Banda Estuary, Baja, Mexico	C. Hereu, P. Jorgensen	31.752	-116.626
NC	Back Sound, North Carolina, USA	J. Fodrie	34.671	-76.573
NI	Greyabbey, Irish Sea, Northern Ireland	N. O'Connor	54.519	5.562
OR	Sally's Bend, Oregon, USA	F. Nash	44.613	-124.013
QU	Point-Lebel, Quebec, Canada	M. Cusson	49.081	-68.311
SD	San Diego Bay, California, USA	K. Hovel	32.714	-117.171
SF	San Francisco Bay, California, USA	K. Boyer	37.940	-122.409
VA	Chesapeake Bay, Virginia, USA	E. Duffy	37.220	-37.254
WA	Willapa Bay, Washington, USA	J. Ruesink	46.497	-124.025

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Data Files

File
crustacean_survival.csv (Comma Separated Values (.csv), 241.90 KB) MD5:8f101fb9b4f1da944827e3edc7df5e06 Primary data file for dataset ID 724015

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Parameters

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Parameter	Description	Units
Taxon	type of organism tethered: 0 = alive; 1 = dead	unitless
Site	one of 17 unique sites	unitless
Basin	Atlantic or Pacific	unitless
Latitude	latitude of the site; north is positive	decimal degrees
Longitude	longitude of the site; east is positive	decimal degrees
Patch_location	whether organism was tethered at patch edge or in patch interior: edge or interior	unitless
Shoot_reduction	one of 3 levels of shoot reduction: ambient = no reduction; fifty = 50% shoot reduction; eighty = 80% shoot reduction	unitless
Tether_no	unique number for each tethered organism	unitless
Size_mm	size of the tethered organism in mm	millimeters (mm)
Crust_biomass	biomass of all crustaceans captured in samples taken in the plot in which this organism was tethered.	grams per shoot
Other_biomass	biomass of all non-crustaceans captured in samples taken in the plot in which this organism was tethered.	grams per shoot
Total_biomass	biomass of all organisms captured in samples taken in the plot in which this organism was tethered.	grams per shoot
Epiphyte_biomass	biomass of all organisms living on eelgrass leaves in samples taken in the plot in which this organism was tethered.	grams per shoot
Starting_shoot_dens	shoot density of the plot in which this organism was tethered; before any shoot reduction.	shoots per square meter
Calc_shoot_dens	shoot density of the plot after shoot reduction.	shoots per square meter
Status	status of the tethered organism after a 24 hour deployment: 0 = alive and 1 = eaten	unitless

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Instruments

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

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Deployments

ZEN2_2014

Website	https://www.bco-dmo.org/deployment/659814
Platform	eelgrass_beds_global
Start Date	2014-05-16
End Date	2014-09-29
Description	eelgrass community studies

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Project Information

Global biodiversity and functioning of eelgrass ecosystems (Zostera Experimental Network 2) (ZEN 2)

Website: http://zenscience.org

Coverage: 20+ sites located throughout the northern hemisphere

Description from NSF award abstract:
This research will produce the second generation of a global collaborative research project, the Zostera Experimental Network (ZEN), to quantify the interacting influences of environmental forcing, biodiversity, and food-web perturbations on structure and functioning of eelgrass (*Zostera marina*) beds, the foundation of important but threatened coastal ecosystems worldwide. Partners at 40 sites in 14 countries will conduct parallel, standardized field sampling of producer and consumer biomass and diversity, and measure grazing and predation rates, to produce a global map of biodiversity, biomass distribution among trophic levels, and ecosystem processes in eelgrass habitats. Partners at a subset of core sites will conduct factorial experiments to characterize the interaction of nutrient loading, predator loss, and biogenic habitat structure (eelgrass density) in mediating producer growth and trophic processes in eelgrass. Finally, guided by the results from mechanistic experiments, the global field data will be used to test specific hypotheses about impacts of climate warming, nutrient loading, and declining biodiversity on eelgrass ecosystems via structural equation modeling, a uniquely powerful approach to dissecting complex interacting networks of causality. The proposed research will characterize in unprecedented detail how environmental forcing, biodiversity, and food-web processes interact to mediate functioning of a coastal ecosystem on a global scale. There are four general objectives:

1. Quantify linkages between eelgrass genetic diversity, growth, and provision of animal habitat;

2. Quantify the influence of eelgrass habitat structure on consumer-prey interactions, secondary production, and trophic transfer;

3. Identify mechanisms for the influence of grazer diversity on algal control;

4. Develop a global map of grazing and predation intensity to assess the relative importance of bottom-up and top-down forcing in eelgrass beds.

This program's integrated characterization of biodiversity, ecosystem state variables, and process rates across the globe is arguably unique in any marine system. It builds on promising results from the first generation of ZEN to allow for the first time a rigorous analysis of links between biodiversity and ecosystem functioning in a natural system on a global scale. As part of this analysis, the proposed research will provide the most comprehensive analysis yet of the controversial question of the relative importance of bottom-up and top-down forcing in seagrass ecosystems, an issue of fundamental importance to management and conservation.

Seagrasses and the many ecosystem services they provide are declining worldwide. This project's data on higher trophic levels and food-web interactions will provide a valuable and overdue complement to the many monitoring programs around the world that focus primarily on seagrasses and water quality, and will ultimately be made available to parameterize and test models of threatened seagrass ecosystems at a higher level of resolution ecological reality than previously possible. The success of the Zostera Experimental Network (ZEN) is evidenced by the continuation of all but one partner in the second generation (ZEN 2), and recruitment of nearly the same number of new partners to this global collaboration. This research will solidify and expand this network by more than doubling the number of participating sites, collaborating with parallel European Union and Japanese efforts, and integrating the world's largest and most successful seagrass restoration project at the Virginia Coast LTER site.

Note: This is an NSF-funded Collaborative Research project.

Also see: ZEN project BCO-DMO page.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1336905

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