Biomass and diversity measurements in eelgrass (Zostera marina) habitat from 16 sites across the Northern Hemisphere, 2011 (ZEN project)

Website: https://www.bco-dmo.org/dataset/659737
Data Type: Other Field Results
Version: 1
Version Date: 2016-09-26

Project
» Zostera Experimental Network (ZEN)

Contributors	Affiliation	Role
Duffy, J. Emmett	Virginia Institute of Marine Science (VIMS)	Principal Investigator
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Abstract
This dataset includes biomass and diversity measurements of eelgrass communities from 16 sites across the Northern Hemisphere: Japan (2), USA (8), Canada (2), Norway (1), Sweden (1), Finland (1), Portugal (1). The purpose was to study the plant and animal responses to top-down and bottom-up manipulations in eelgrass (Zostera marina) habitat.

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Coverage

Spatial Extent: **N**:67 **E**:1 **S**:32.71 **W**:135
Temporal Extent: 2011 - 2011

Methods & Sampling

Methodology is available from: J. Emmett Duffy, et al. Biodiversity mediates top-down control in eelgrass ecosystems: A global comparative-experimental approach. Ecology Letters 18:7 (696–705). DOI: 10.1111/ele.12448.

Table S1. Codes and locations of sites

Code	Site	Latitude	Longitude	Principal Investigator
AK	Kachemak Bay, Alaska, USA	59.648	-151.436	Iken
BB	Bodega Bay, California, USA	38.317	-123.033	Stachowicz
BC	Vancouver, British Columbia, Canada	49.000	-123.100	O'Connor
FI	Ängsö Island, Finland	60.100	21.700	Boström
JN	Akkeshi-Ko Estuary, Hokkaido, Japan	43.060	144.911	Nakaoka
JS	Akiwan Bay, Hiroshima, Japan	34.178	132.550	Hori
MA	Nahant, Massachusetts, USA	42.426	-70.919	Douglass
NC	Beaufort, North Carolina, USA	34.683	-76.600	Reynolds, Sotka
NN	Misvaerfjord, Bodø, Norway	67.233	15.200	Olsen, Eriksson, Horeau
PO	Ria Formosa Lagoon, Portugal	36.997	-7.829	Engelen
QU	Pointe-Lebel, Quebec, Canada	49.113	68.179	Cusson
SD	San Diego Bay, CA, USA	32.714	-117.226	Hovel
SW	Gullmar Fjord, Sweden	58.314	11.548	Moksnes/Fredriksen
VA	Goodwin Islands, Gloucester Point, Virginia	37.217	-76.383	Duffy/Reynolds
WA	Willapa Bay, Washington, USA	46.500	-124.000	Ruesink

Data Processing Description

Data have been QA/QC'd for accuracy. Irrelevant/incorrect values have been removed.

BCO-DMO Processing:
- added conventional header with dataset name, PI name, version date, reference information
- renamed some parameters to BCO-DMO standard
- reformatted date from m/d/y to yyyy-mm-dd
- reduced digits to right of decimal

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Data Files

File
ZEN.csv (Comma Separated Values (.csv), 60.98 KB) MD5:d265e6306a20a1fc0c6477b44bfdf467 Primary data file for dataset ID 659737

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Related Publications

Duffy, J. E., P.-O. Moksnes, and A. R. Hughes. (2013). Ecology of Seagrass Communities. Pages 271–297 in M. D. Bertness, J. F. Bruno, B. R. Silliman, and J. J. Stachowicz, editors. "Marine Community Ecology and Conservation". Sinauer Associates, Sunderland, Massachusetts. https://isbnsearch.org/isbn/978-1605352282
Results

Duffy, J. E., Reynolds, P. L., Boström, C., Coyer, J. A., Cusson, M., Donadi, S., … Stachowicz, J. J. (2015). Biodiversity mediates top-down control in eelgrass ecosystems: a global comparative-experimental approach. Ecology Letters, 18(7), 696–705. https://doi.org/10.1111/ele.12448
Results

Reynolds, P. L., Richardson, J. P., & Duffy, J. E. (2014). Field experimental evidence that grazers mediate transition between microalgal and seagrass dominance. Limnology and Oceanography, 59(3), 1053–1064. https://doi.org/10.4319/lo.2014.59.3.1053
Results

Whalen, M. A., Duffy, J. E., & Grace, J. B. (2013). Temporal shifts in top-down vs. bottom-up control of epiphytic algae in a seagrass ecosystem. Ecology, 94(2), 510–520. https://doi.org/10.1890/12-0156.1
Results

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Parameters

Parameter	Description	Units
site_code	Code: VA (Virginia); NC (North Carolina); MA (Massachusettes); QU (Quebec); AK (Alaska); BC (British Columbia);WA (Washington); BB (Bodega Bay); SD (San Diego); JN (Northern Japan); JS (Southern Japan); NN (Norway); SW (Sweden);FI (Finland); PO (Portugal)	unitless
plot	unique plot number within a site	unitless
unique_plot_id	unique idenitifier; concatenated from site code and plot number	unitless
treatment	D refers to deterrent; N refers to nutrient addition; and +/- refer to presence or absence; respectively.	unitless
grazer_bmass_per_g	Total biomass of all mesograzers sampled from the plot; estimatred using Edgar's (1990) size-class equations	grams
crustacean_bmass_per_g	Total biomass of all crustacean mesograzers sampled from the plot; estimatred using Edgar's (1990) size-class equations	grams
gammarid_bmass_per_g	Total biomass of all gammaridean mesograzers sampled from the plot; estimatred using Edgar's (1990) size-class equations	grams
caprellid_bmass_per_g	Total biomass of all caprellid mesograzers sampled from the plot; estimatred using Edgar's (1990) size-class equations	grams
isopod_bmass_per_g	Total biomass of all isopod mesograzers sampled from the plot; estimatred using Edgar's (1990) size-class equations	grams
decapod_bmass_per_g	Total biomass of all decapod mesograzers sampled from the plot; estimatred using Edgar's (1990) size-class equations	grams
gastropod_bmass_per_g	Total biomass of all gastropod mesograzers sampled from the plot; estimatred using Edgar's (1990) size-class equations	grams
grazer_richness_plot	Total number of mesograzer taxa (usually species) recorded from the plot	taxa
chla_per_Zostera	Algal chlorophyll-a attached to eelgrass blades; expressed as micrograms chl a per g eelgrass blade tissue	micrograms chl a per g (ug/g)

latitude	Latitude in decimal degrees	decimal degrees
longitude	Longitude in decimal degrees	decimal degrees
temp_avg	Water temperature in degrees Celsius; mean of measurements made during the experiment	degrees Celsius
sal	Salinity in parts per thousand	PPT
N_mean_pcent	Elemental nitrogen as % of eelgrass dry mass	unitless
genotype_richness_standardized	Total number of eelgrass multilocus genotypes recorded from the site; divided by the maximum number recorded from any site (thus; scale = 0 - 1)	unitless
grazer_richness_site	Total number of mesograzer taxa (usually species) recorded from all 40 plots at the site	taxa
ocean	Atlantic (including Baltic Sea); Pacific	unitless

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	Automated DNA Sequencer
Generic Instrument Description	A DNA sequencer is an instrument that determines the order of deoxynucleotides in deoxyribonucleic acid sequences.

Dataset-specific Instrument Name	
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.

Dataset-specific Instrument Name	
Generic Instrument Name	Refractometer
Dataset-specific Description	Used to measure salinity
Generic Instrument Description	A refractometer is a laboratory or field device for the measurement of an index of refraction (refractometry). The index of refraction is calculated from Snell's law and can be calculated from the composition of the material using the Gladstone-Dale relation. In optics the refractive index (or index of refraction) n of a substance (optical medium) is a dimensionless number that describes how light, or any other radiation, propagates through that medium.

Dataset-specific Instrument Name	
Generic Instrument Name	Temperature Logger
Dataset-specific Description	HOBO Pendant temperature loggers
Generic Instrument Description	Records temperature data over a period of time.

Dataset-specific Instrument Name	
Generic Instrument Name	Thermal Cycler
Generic Instrument Description	A thermal cycler or "thermocycler" is a general term for a type of laboratory apparatus, commonly used for performing polymerase chain reaction (PCR), that is capable of repeatedly altering and maintaining specific temperatures for defined periods of time. The device has a thermal block with holes where tubes with the PCR reaction mixtures can be inserted. The cycler then raises and lowers the temperature of the block in discrete, pre-programmed steps. They can also be used to facilitate other temperature-sensitive reactions, including restriction enzyme digestion or rapid diagnostics. (adapted from http://serc.carleton.edu/microbelife/research_methods/genomics/pcr.html)

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Deployments

ZEN_2011

Website	https://www.bco-dmo.org/deployment/659867
Platform	eelgrass_beds_global
Start Date	2011-06-01
End Date	2011-08-31
Description	eelgrass community studies

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Project Information

Zostera Experimental Network (ZEN)

Website: http://zenscience.org

Coverage: Northern Hemisphere

NSF Project Title:
"Biodiversity and Complex Forcing of Ecosystem Functioning in the Marine Foundation Species, Eelgrass: A Global Experimental Network"

Description from NSF award abstract:
This project will develop a global collaborative network of field experiments to quantify how resources and grazing interactively affect biomass, production, and trophic transfer along natural gradients in biodiversity and abiotic forcing. It focuses on a key mutualism between invertebrate mesograzers and the globally distributed eelgrass (*Zostera marina*), as a model system and as the foundation of important but threatened coastal ecosystems worldwide. This interaction provided a model for influential experiments linking biodiversity to functioning (BEF) of multitrophic ecosystems. Yet, seagrass ecology has historically focused almost exclusively on bottom-up forcing, and impacts of these ubiquitous animals in the field are nearly unknown.The research program will address three questions:
(1) What role do crustacean mesograzers, the benthic equivalents of grazing copepods, play in regulating vegetated coastal ecosystem functioning and buffering effects of eutrophication?
(2) Are generalizations derived from 15 years of BEF experiments consistent with variation in ecosystem properties along natural diversity gradients in complex, open marine systems?
(3) Do relative influences and interactions of resource supply, grazing pressure, and biodiversity on ecological processes vary systematically with climate and abiotic environmental drivers?

Methods will include two novel approaches. First, a new technique that excludes crustacean mesograzers without cage artifacts will rigorously test their long-suspected role in fostering macrophyte dominance. The project assembles experienced collaborators who will conduct identical factorial experiments manipulating grazers and nutrient loading at each of 12 sites spanning the sub-global range of eelgrass, across concomitant gradients in diversity and abiotic forcing variables. Second, Structural Equation Models (SEM), designed specifically to quantify relative importance and interactions among variables in complex systems, will tease apart effects of resource supply, grazer biomass, species composition, and richness, and several abiotic variables on eelgrass and algal biomass, production, and trophic transfer. Small-scale experiments with synthesized communities show that biodiversity generally enhances production and resource use in a range of ecosystems, but the importance of diversity relative to other well-documented forcing factors remains poorly understood. Intriguingly, BEF relationships in the few studies from wild ecosystems often saturate at much higher richness than in experiments, suggesting that prior work may underestimate rather than overestimate functional effects of diversity. Yet few large-scale data sets are available to evaluate this conjecture. This research will do so on a global scale in eelgrass beds, one of the few community types in which such a test is possible.

This project will initiate a lasting, and open, collaborative network of researchers studying the functioning of multitrophic marine vegetation ecosystems. It leverages a wealth of globally distributed collaborator expertise, person power, and experience with multinational partnerships including a new network of marine plant-herbivore ecologists funded by the Australian Research Council; the Census of Marine Life's NaGISA project; and key partners in MarBEF's BIOFUSE project. It will thus catalyze integration of several formerly independent research efforts.

Data:
Data are expected to be submitted in 2014. Data will include plant and animal responses to top-down and bottom-up manipulations in eelgrass (*Zostera marina*) habitat from 16 sites across the northern hemisphere (in Japan, USA, Canada, Norway, Sweden, Finland, and Portugal).

Publications produced as a result of this research:
Poore AGB, Campbell AH, Coleman RA, Edgar GJ, Jormalainen V, Reynolds PL, Sotka EE, Stachowicz JJ, Taylor RB, Vanderklift MA, Duffy JE. 2012. Global patterns in the impact of marine herbivores on benthic primary producers. Ecology Letters. DOI: 10.1111/j.1461-0248.2012.01804.x
Naeem S, Duffy JE, Zavaleta E. 2012. The Functions of Biological Diversity in an Age of Extinction. Science, v.336, p. 1401. DOI: 10.1126/science.1215855
Cardinale BJ, Duffy JE, Gonzalez A, Hooper DU, Perrings C, Venail P, Narwani A, Mace GM, Tilman D, Wardle DA, Kinzig AP, Daily GC, Loreau M, Grace JB, Larigauderie A, Srivastava D, Naeem S. 2012. Biodiversity loss and

its impact on humanity. Nature, v.486, 2012, p. 59. DOI: 10.1038/nature11148
Hooper DU, Adair EC, Cardinale BJ, Byrnes JEK, Hungate BA, Matulich KL, Gonzalez A, Duffy JE, Gamfeldt L, O'Connor MI. 2012. A global synthesis reveals biodiversity loss as a major driver of ecosystem change. Nature, v.486, p. 10. DOI: 10.1038/nature11118

Additional publications produced as a result of this research:

Duffy, J. E., P. L. Reynolds, C. Boström, J. A. Coyer, M. Cusson, S. Donadi, J. G. Douglass, J. S. Eklöf, A. H. Engelen, B. K. Eriksson, S. Fredriksen, L. Gamfeldt, C. Gustafsson, G. Hoarau, M. Hori, K. Hovel, K. Iken, J. S. Lefcheck, P.-O. Moksnes, M. Nakaoka, M. I. O'Connor, J. L. Olsen, J. P. Richardson, J. L. Ruesink, E. E. Sotka, J. Thormar, M. A. Whalen, and J. J. Stachowicz. 2015. Biodiversity mediates top-down control in eelgrass ecosystems: a global comparative-experimental approach. Ecology Letters 18:696–705.

Reynolds, P. L., J. Paul Richardson, and J. Emmett Duffy. 2014. Field experimental evidence that grazers mediate transition between microalgal and seagrass dominance. LIMNOLOGY AND OCEANOGRAPHY 59:1053–1064.

Duffy, J. E., P.-O. Moksnes, and A. R. Hughes. 2013. Ecology of Seagrass Communities. Pages 271–297 in M. D. Bertness, J. F. Bruno, B. R. Silliman, and J. J. Stachowicz, editors. "Marine Community Ecology and Conservation". Sinauer Associates, Sunderland, Massachusetts.

Whalen, M. A., J. E. Duffy, and J. B. Grace. 2013. Temporal shifts in top-down versus bottom-up control of epiphytic algae in a seagrass ecosystem. Ecology 94:510–520.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1031061

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