Quadrat-based measurements of eelgrass shoot density and above-ground biomass for plants growing in shallow and deep zones at four coastal sites in Massachusetts, USA in 2019

Website: https://www.bco-dmo.org/dataset/939467
Data Type: Other Field Results
Version: 1
Version Date: 2024-10-03

Project
» RUI: Collaborative Research: Trait differentiation and local adaptation to depth within meadows of the foundation seagrass Zostera marina (ZosMarLA)

Contributors	Affiliation	Role
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Abstract
This dataset includes quadrat-based measurements of eelgrass shoot density and above-ground biomass for plants growing in shallow and deep zones at four different sites in Massachusetts, USA in 2019. The four sites were West Beach in Beverly (N 42.55921, W 70.80578), Curlew Beach in Nahant (N 42.42009, W 70.91553), Lynch Park in Beverly (N 42.54488, W 70.85842), and Niles Beach in Gloucester (N 42.59711, W 70.65592). Like many marine foundation species, eelgrass often spans strong environmental gradients over relatively small spatial scales - this data set provides information on phenotypic differentiation across the depth gradient at multiple sites in the Gulf of Maine.

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Coverage

Location: coastal sites in the Gulf of Maine, USA
Spatial Extent: **N**:42.59711 **E**:-70.65592 **S**:42.42009 **W**:-70.91553
Temporal Extent: 2019-06-26 - 2019-07-01

Methods & Sampling

Location description: Four coastal sites in the Gulf of Maine, USA, that sustain continuous eelgrass meadows across a depth gradient of ~1-2 m below MLLW to ~4-5.5 m below MLLW (see Supplemental File "Site List" for site codes used in this dataset and coordinates (lat,lon)).

We conducted a field survey in the shallow and deep zone of the meadow at each site, with zones defined by proximity to the respective edges of the eelgrass beds. Divers on SCUBA harvested all above-ground eelgrass biomass within in 5-7 0.25 x 0.25 m quadrats set in each of three previously established permanent quadrats per depth per site (N = 15-21 quadrats per depth per site). Shoots were transferred to the lab on ice, where we counted the number of vegetative and flowering shoots in each sample; then we dried the plants at 60 degrees C and recorded aboveground biomass to the nearest milligram.

Organism:
eelgrass, Zostera marina, urn:lsid:marinespecies.org:taxname:495077

BCO-DMO Processing Description

* Data from "perm.quad.density.2019.csv" was imported into the BCO-DMO data system for this dataset. Values "NA" imported as missing data values.
** Missing data values are displayed differently based on the file format you download. They are blank in csv files, "NaN" in MatLab files, etc.

* A Site list was extracted from metadata and added as a supplemental file.

* The site code was used to join the lat and lon for each site into the primary data table for this dataset (939467_v1_eelgrass-shoot-density-and-biomass.csv) from the supplemental site list.

* Coordinate for Lynch Park in Beverly corrected from (42.42009,-70.91553) to (42.54488,-70.85842). New coordinate was provided by the data submitter.

Problem Description

Note: Duplicate rows in this data table are correct and intentional entries of separate measurements, not redundant rows.

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Data Files

File	
939467_v1_eelgrass-shoot-density-and-biomass.csv	(Comma Separated Values (.csv), 7.32 KB) MD5:50a26aee47a930b04534421f8f5ca614
Primary data file for dataset ID 939467, version 1	

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Supplemental Files

File	
Site List filename: site_list.csv	(Comma Separated Values (.csv), 234 bytes) MD5:0cba40568ee8de4c0b6b7bc23e1745a3
Site list containing columns: Site_Code, Site code as used in Data File for this dataset Site_Description, Site description lat, latitude, decimal degrees lon, longitude, decimal degrees.	

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Related Publications

Sotka, EE, Hughes, AR, Hanley, TC, and CG Hays (n.d.). Restricted dispersal and phenotypic response to water depth in a foundation seagrass. In review, Molecular Ecology.
Results

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Related Datasets

IsRelatedTo

Hughes, A. R. (2021) **Vegetative density data from two surveys of eelgrass flowering in shallow and deep zones at four different sites in Massachusetts, USA in 2019.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2021-03-30 doi:10.26008/1912/bco-dmo.847062.1 [view at BCO-DMO]
Relationship Description: These datasets all contain results from the same sampling effort (end of June/early July of 2019). Dataset "Permanent plot vegetative density" (847062) also contains additional results from an additional sampling effort in August of 2019.

Sotka, E., Hughes, A. R., Hanley, T. C., Hays, C. (2024) **Eelgrass shoot lengths measured at two depths within each of four coastal sites in Massachusetts, USA in 2019.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2024-10-03 doi:10.26008/1912/bco-dmo.939440.1 [view at BCO-DMO]
Relationship Description: These datasets all contain results from the same sampling effort (end of June/early July of 2019). Dataset "Permanent plot vegetative density" (847062) also contains additional results from an additional sampling effort in August of 2019.

Sotka, E., Hughes, A. R., Hanley, T. C., Hays, C. (2024) **Number and mass of eelgrass seeds collected from sediment cores in shallow and deep zones at four coastal sites in Massachusetts, USA in 2019.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2024-10-03 doi:10.26008/1912/bco-dmo.939488.1 [view at BCO-DMO]
Relationship Description: Data from the same locations as part of the same eelgrass study in 2019.

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Parameters

Parameter	Description	Units
Date	The date of sample collection	unitless
Site	Site Code (see supplemental file "Site List" for more details)	unitless
lat	Site latitude	decimal degrees
lon	Site longitude	decimal degrees
Depth	Nominal depth=SH (shallow zone) or DP (deep zone)	unitless
Permanent_Quadrat	The permanent quadrat identifier the sample came from, three per depth per site.	unitless
Vegetative_Density	The number of vegetative shoots in each quadrat.	number/0.25m^2
Flowering_Density	The number of flowering shoots in each quadrat.	number/0.25m^2
Total_Density	The sum total of vegetative and flowering shoots in each quadrat.	number/0.25m^2
Biomass	The dry mass of all above-ground biomass, to the nearest 0.001 g	grams (g)

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Project Information

RUI: Collaborative Research: Trait differentiation and local adaptation to depth within meadows of the foundation seagrass Zostera marina (ZosMarLA)

Coverage: Massachusetts, USA

NSF Award Abstract:
Understanding how species cope with spatial variation in their environment (e.g. gradients in light and temperature) is necessary for informed management as well as for predicting how they may respond to change. This project will examine how key traits vary with depth in common eelgrass (Zostera marina), one of the most important foundation species in temperate nearshore ecosystems worldwide. The investigators will use a combination of experiments in the field and lab, paired with fine-scale molecular analyses, to determine the genetic and environmental components of seagrass trait variation. This work will provide important information on the microevolutionary mechanisms that allow a foundation species to persist in a variable environment, and thus to drive the ecological function of whole nearshore communities. The Northeastern University graduate and Keene State College (KSC) undergraduate students supported by this project will receive training in state-of-the-art molecular techniques, as well as mentorship and experience in scientific communication and outreach. A significant portion of KSC students are from groups under-represented in science. Key findings of the research will be incorporated into undergraduate courses and outreach programs for high school students from under-represented groups, and presented at local and national meetings of scientists and stakeholders.

Local adaptation, the superior performance of "home" versus "foreign" genotypes in a local environment, is a powerful demonstration of how natural selection can overcome gene flow and drift to shape phenotypes to match their environment. The classic test for local adaptation is a reciprocal transplant. However, such experiments often fail to capture critical aspects of the immigration process that may mediate realized gene flow in natural systems. For example, reciprocal transplant experiments typically test local and non-local phenotypes at the same (often adult) life history stage, and at the same abundance or density, which does not mirror how dispersal actually occurs for most species. In real populations, migrants (non-local) often arrive at low numbers compared to residents (local), and relative frequency itself can impact fitness. In particular, rare phenotypes may experience reduced competition for resources, or relative release from specialized pathogens. Such negative frequency dependent selection can reduce fitness differences between migrants and residents due to local adaptation, and magnify effective gene flow, thus maintaining greater within-population genetic diversity. The investigators will combine spatially paired sampling and fine-scale molecular analyses to link seed/seedling trait variation across the depth gradient at six meadows to key factors that may drive these patterns: local environmental conditions, population demography, and gene flow across depths. The team will then experimentally test the outcome of cross-gradient dispersal in an ecologically relevant context, by reciprocally out-planting seeds from different depths and manipulating relative frequency in relation to both adults and other seedling lineages. The possible interaction between local adaptation and frequency-dependence is particularly relevant for Zostera marina, which represents one of the best documented examples of the ecological effects of genetic diversity and identity. Further, a better understanding of seagrass trait differentiation is not simply a matter of academic interest, but critical to successful seagrass restoration and conservation.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1851432
NSF Division of Ocean Sciences (NSF OCE)	OCE-1851262
NSF Division of Ocean Sciences (NSF OCE)	OCE-1851043

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