Eelgrass shoot lengths measured at two depths within each of four coastal sites in Massachusetts, USA in 2019

Website: https://www.bco-dmo.org/dataset/939440
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 eelgrass shoot lengths measured at two depths within each of four different sites in Massachusetts, USA in late June and early July 2019. 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 - 2019-06-28

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)).

Divers on SCUBA cored for dispersed eelgrass seeds at four different eelgrass beds in Massachusetts in September 2019, within the same permanent sampling grids established and sampled for shoot density and morphology earlier in the summer. 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 42.42009, W 70.91553), and Niles Beach in Gloucester (N 42.59711, W 70.65592), and cores were collected in permanent quadrats previously established in both the shallow and deep zone at each site, defined by proximity to the respective

edges of the eelgrass beds.

Each core was 10 cm in diameter and 10 cm in depth; divers collected cores at 3 locations within each grid at Curlew Beach, and at 4 locations within each grid at the other three field sites (n = 9 or 12 cores per depth). The sediment cores were bagged and kept cold (4ºC) until they could be processed; each core was hand-sieved for intact seeds within three days of collection. We counted all intact seeds encountered and assessed viability by firmness. Seeds that were deemed viable were individually weighed and stored in microfuge tubes and frozen at -80ºC until DNA extraction.

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

BCO-DMO Processing Description

* Data from "perm.quad.veg.ht.2019.csv" was imported into the BCO-DMO data system for this dataset.

* 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 (939440_v1_eelgrass-shoot-lengths.csv) from the supplemental site list.

Problem Description

A duplicate site location lat, lon coordinate in this dataset is being resolved by the data submitter.

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Related Datasets

IsRelatedTo

Hughes, A. R., Hanley, T. C., Sotka, E. (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 http://lod.bco-dmo.org/id/dataset/939488 [view at BCO-DMO]
Relationship Description: Data from the same locations as part of the same eelgrass study in 2019.

Hughes, A. R., Hanley, T. C., Sotka, E. (2024) **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.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2024-10-03 http://lod.bco-dmo.org/id/dataset/939467 [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
Sample_Quadrat	The 0.25m^2 quadrat identifier from which the shoot was harvested.	unitless
Height	Length of the shoot from meristem to tip of longest leaf, to nearest 0.5 cm.	centimeters (cm)

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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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