Vegetative and flowering density of Zostera marina determined from from weekly-biweekly surveys in shallow and deep zones at two sites in Massachusetts, USA in 2019

Website: https://www.bco-dmo.org/dataset/847023
Data Type: Other Field Results
Version: 1
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Project
» RUI: Collaborative Research: Trait differentiation and local adaptation to depth within meadows of the foundation seagrass Zostera marina (ZosMarLA)

Contributors	Affiliation	Role
Hughes, A. Randall	Northeastern University	Principal Investigator
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Abstract
This dataset includes vegetative and flowering density of Zostera marina determined from from weekly-biweekly surveys in shallow and deep zones at two sites in Massachusetts, USA in 2019. Eleven surveys of two different eelgrass beds were conducted every 1-2 weeks starting June 4th and ending August 27th during the summer of 2019. The two sites were West Beach in Beverly (N 42.55921, W 70.80578) and Curlew Beach in Nahant (N 42.42009, W 70.91553).

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Coverage

Spatial Extent: **N**:42.55921 **E**:-70.80578 **S**:42.42009 **W**:-70.91553
Temporal Extent: 2019-06-04 - 2019-08-27

Methods & Sampling

We conducted eleven surveys of two different eelgrass beds in Massachusetts every 1-2 weeks starting June 4th and ending August 27th during the summer of 2019. The two sites were West Beach in Beverly (N 42.55921, W 70.80578) and Curlew Beach in Nahant (N 42.42009, W 70.91553). Each survey consisted of a 20 m transect being laid out parallel to shore in both the shallow and deep zone. These zones were defined as being along the respective edges of the eelgrass beds. The exact depths of the zones varied from bed to bed.

During each survey we counted the number of both flowering and vegetative shoots in a 0.25 m^2 quadrat every 2 meters along the transect. If a quadrat had no shoots, an additional quadrat was added at the end of the transect. A few weeks we sampled more than 10 quadrats per depth.

Data Processing Description

Data Processing:
We analyzed the number of vegetative shoots per 0.25 m^2 quadrat using a generalized linear model (GLM) with a negative binomial regression and site, depth, and time (week) as fixed effects and including all possible interactions. We did the same for the density of flowering shoots and the density of all shoots (total density). We analyzed the proportion of flowering shoots (% flowering by density) using a GLM with a quasi binomial distribution and logit link function with site, depth, and time (week) as our fixed effects and including all possible interactions. For all of these analyses, week was treated as a categorical factor.

Statistical analyses were conducted using R Statistical Software v. 3.6.0 (R Core Team 2019). Negative binomial regressions were done using the glm.nb function in the MASS package (Venables and Ripley 2002). We used a significance level of $\alpha = 0.05$ for all of our analyses.

BCO-DMO Processing:
- changed date format to YYYY-MM-DD;
- renamed fields to conform with BCO-DMO naming conventions;
- replaced "NA" with "nd" to indicate "no data".

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Data Files

File	
flowering_survey_density.csv	(Comma Separated Values (.csv), 19.37 KB) MD5:cd106add96829f7f3b84b85abe89e5ff
Primary data file for dataset ID 847023	

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Related Publications

R Core Team (2019). R: A language and environment for statistical computing. R v3.6.0. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/
Software

Venables, W. N., & Ripley, B. D. (2002). Modern applied statistics with S (4th ed., Ser. Statistics and computing). Springer. URL: http://www.stats.ox.ac.uk/pub/MASS4 https://isbnsearch.org/isbn/0-387-95457-0
Methods

Von Staats, D. A., Hanley, T. C., Hays, C. G., Madden, S. R., Sotka, E. E., & Hughes, A. R. (2020). Intra-Meadow Variation in Seagrass Flowering Phenology Across Depths. Estuaries and Coasts, 44(2), 325–338. doi:10.1007/s12237-020-00814-0
Results

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Parameters

Parameter	Description	Units
Date	The date of sample collection; format: YYYY-MM-DD	unitless
Week	The assigned collection week number. Numbers start at 1 for the first week of collection and go up 1 each collection week.	unitless
Site	The site of collection. Either West (West Beach, Beverly, MA) or Dorothy (Curlew Beach, Nahant, MA).	unitless
Depth	SH (shallow zone) or DP (deep zone).	unitless
Quadrat	For each transect, quadrats will be in order with 1 being the first quadrat of each transect at 2m and 10 being the last at 20m. Some weeks go higher than 10 quadrats if we sampled more or had empty quadrats. Week 4 quadrat numbers do not correspond to transect position/sampling order.	unitless
Vegetative_Density	The number of vegetative shoots in each quadrat.	number of shoots per quadrat
Flowering_Density	The number of flowering shoots in each quadrat.	number of shoots per quadrat
Total_Density	The number of vegetative AND flowering shoots found in each quadrat.	number of shoots per quadrat
Pcnt_Flowering_by_Density	(flowering density)/(total density) * 100. The percent of shoots in each quadrat which are flowering.	unitless (percent)

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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-1851043

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