Temperature/light data collected using Onset HOBO Pendant data loggers at two sites in Massachusetts, USA in 2019

Website: https://www.bco-dmo.org/dataset/846963
Data Type: Other Field Results
Version: 1
Version Date: 2021-04-01

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 included temperature/light data collected using Onset HOBO Pendant data loggers at two sites in Massachusetts, USA in 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).

Table of Contents

Coverage

Spatial Extent: **N**:42.55921 **E**:-70.80578 **S**:42.42009 **W**:-70.91553
Temporal Extent: 2019-05-13 - 2019-08-22

Methods & Sampling

We deployed three Onset HOBO Pendant® Waterproof Temperature/Light Data Loggers in both the shallow and deep zone at each site. 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). The shallow and deep zones were defined as being along the respective edges of the eelgrass beds. The exact depths of the zones varied from bed to bed.

Each logger was changed once over the course of the dataset. Loggers were deployed on May 14 and swapped out on June 26 at Curlew Beach and deployed on May 15 and swapped out on June 27 at West Beach.

Data Processing Description

Data Processing:
Light and temperature data from Curlew Beach and West Beach were analyzed separately using a linear regression with site, depth, and time (week) as fixed effects and including all possible interactions. Both data

sets were analyzed using daily averages taken from May 13th through August 20th for Curlew Beach, and through August 22nd for West Beach.

Statistical analyses were conducted using R Statistical Software v. 3.6.0 (R Core Team 224 2019). Linear models were done using the lme4 and lmerTest packages (Bates et al. 2015; Kuznetsova et al. 2017). 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.

[table of contents | back to top]

Data Files

File
temp_light.csv (Comma Separated Values (.csv), 5.85 MB) MD5:12289ad45f22cc9e1c408944713dafce Primary data file for dataset ID 846963

[table of contents | back to top]

Related Publications

Bates, D., Mächler, M., Bolker, B., & Walker, S. (2015). Fitting Linear Mixed-Effects Models Usinglme4. Journal of Statistical Software, 67(1). doi:10.18637/jss.v067.i01
Methods

Kuznetsova, A., Brockhoff, P. B., & Christensen, R. H. B. (2017). lmerTest Package: Tests in Linear Mixed Effects Models. Journal of Statistical Software, 82(13). doi:10.18637/jss.v082.i13
Methods

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

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

[table of contents | back to top]

Parameters

Parameter	Description	Units
Date	The date that a data point was taken; format: YYYY-MM-DD	unitless
Week	The week of data collection (corresponding with our field surveys)	unitless
Temp1	Temperature data from the first HOBO logger.	degrees Celsius
Intensity1	Light data from the first HOBO logger.	lux
Temp2	Temperature data from the second HOBO logger.	degrees Celsius
Intensity2	Light data from the second HOBO logger.	lux
Temp3	Temperature data from the third HOBO logger.	degrees Celsius
Intensity3	Light data from the third HOBO logger.	lux
Avg_Temp	The average of Temp 1, 2, and 3.	degrees Celsius
Avg_Intensity	The average of Intensity 1, 2, and 3.	lux
Site	The site of data collection. Either West (West Beach, Beverly, MA) or Dorothy (Curlew Beach, Nahant, MA).	unitless
Depth	SH (shallow zone) or DP (deep zone).	unitless

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	Onset HOBO Pendant® Waterproof Temperature/Light Data Loggers
Generic Instrument Name	Onset HOBO Pendant Temperature/Light Data Logger
Generic Instrument Description	The Onset HOBO (model numbers UA-002-64 or UA-001-64) is an in-situ instrument for wet or underwater applications. It supports light intensity, soil temperature, temperature, and water temperature. A two-channel logger with 10-bit resolution can record up to approximately 28,000 combined temperature and light measurements with 64K bytes memory. It has a polypropylene housing case. Uses an optical USB to transmit data. A solar radiation shield is used for measurement in sunlight. Temperature measurement range: -20 deg C to 70 deg C (temperature). Light measurement range: 0 to 320,000 lux. Temperature accuracy: +/- 0.53 deg C from 0 deg C to 50 deg C. Light accuracy: Designed for measurement of relative light levels. Water depth rating: 30 m.

[table of contents | back to top]

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.

[table of contents | back to top]

Funding

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

[table of contents | back to top]