Experimental results describing the tenacity of byssal threads produced by mussels analyzed at Hopkins Marine Station during 2014 (Experiments in a Model Ecosystem project)

Website: https://www.bco-dmo.org/dataset/632647
Data Type: experimental
Version: 2016-01-14

Project
» Environmental Variability, Functional Redundancy, and the Maintenance of Ecological Processes: Experiments in a Model Ecosystem (Experiments in a Model Ecosystem)

Contributors	Affiliation	Role
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Dataset Description

This dataset includes the number and attachment sites of byssal threads produced by individual mussels.

Related Reference:

Cole, A. and Denny MW. (2014) United we fail: group versus individual strength in the ribbed mussel *Mytilus californianus*. *Biol. Bull.* 227: 61-67.

These data are also available at the Stanford Digital Repository: http://purl.stanford.edu/ph942zz5524

Related Datasets:

mussel size vs. byssal count
mussel size vs. byssal width
mussel dislodgement data

Methods & Sampling

Field measurements were performed in three separate beds of the California sea mussel, Mytilus californianus, in the rocky intertidal zone adjacent to Hopkins Marine Station, Pacific Grove, California. The beds comprised two layers of mussels: a basal layer attached to the rock and a surface layer attached to the basal layer. Measurements were conducted in summer and early autumn of 2008.

Tenacity measurements:
We used the method of Denny (1987) to measure the attachment strength of individual bed mussels in the

surface layer. We attached a recording spring scale to a mussel by placing a hook through a hole drilled in the exposed posterior lip of the shell. We then pulled the mussel evenly and swiftly perpendicular to the substratum (i.e., in the direction of lift) until it was dislodged. We divided the recorded force by the mussel's planform area to calculate tenacity. Planform areas were estimated using shell height and width as the axes of an ellipse, which closely approximated the shape of mussels' cross section. We measured shell height and width to the nearest millimeter using calipers. Sampled mussels were separated by at least 10 cm to ensure that each sample had no effect on subsequent samples.

We also tested groups of contiguous mussels in the surface layer. To pull multiple mussels simultaneously, we implemented an expansion of the procedure used to measure individuals. We attached groups of 2-6 contiguous mussels to a spring scale via hooks and lines, and adjusted line lengths so that each mussel was in approximately equal tension when the group was subsequently dislodged. Due to the increased force required to dislodge several mussels at once, we used a rigid, robust aluminum tripod to support the spring scale, and a winch to apply the normal force, FG, required to dislodge the group. We measured the width and height of the individuals within each group, calculated their planform areas, and summed these areas for use in calculating whole-group tenacity:
TG(n)=FG(n)/sum(Ai)
We repeated each measurement 20 times; that is, we sampled 20 individual bed mussels, 20 groups of two mussels, 20 groups of three mussels, etc.

Data Processing Description

BCO-DMO Processing:

- added conventional header with dataset name, PI name, version date
- renamed parameters to BCO-DMO standard
- replaced blank cells with nd (no data)

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Data Files

File
muss_tenacity.csv (Comma Separated Values (.csv), 2.25 KB) MD5:3feaaeafbf4106a1de1a8cd6b86e1d59 Primary data file for dataset ID 632647

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Parameters

Parameter	Description	Units
num_muss	number of mussels in group	mussels
tenacity	tenacity or strength of threads: combined resistance of the area of bed occupied by a mussel all threads in the byssus divided by the area of bed occupied by a mussel	newtons/mm2
comment	whether record is a single tenacity measurement; the mean; standard deviation; count; or standard error	unitless

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Deployments

Denny_2014

Website	https://www.bco-dmo.org/deployment/630162
Platform	Hopkins Marine Station
Start Date	2014-01-01
End Date	2014-12-31
Description	mussel studies

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Project Information

Environmental Variability, Functional Redundancy, and the Maintenance of Ecological Processes: Experiments in a Model Ecosystem (Experiments in a Model Ecosystem)

Coverage: Rocky intertidal zone; Hopkins Marine Station, Pacific Grove, CA USA

From NSF award abstract:
Functional traits of species are those that determine either species-specific responses to environmental conditions or their influence on ecological processes. Current theory suggests that communities with many species that perform a given function in a similar way but have different sensitivities to environmental conditions will exhibit greater temporal stability of ecosystem properties. So-called functional redundancy should lead to compensation among species, as some will do better when others do worse in response to environmental variability. Anthropogenic global warming is a major driver of current and anticipated changes in population dynamics, species interactions, and community structure from local to global scales. Resulting changes in biodiversity therefore have the potential to significantly alter important ecosystem properties such as productivity, nutrient cycling, and resistance to disturbance or invasion. Although ecologists have typically emphasized the response of populations and communities to changing climatic averages (e.g., increasing temperature and rainfall), global circulation models also predict significant increases in the intensity, frequency and duration of extreme weather and climate events in many parts of the world; that is, increases in the variability of the physical environment. Unfortunately, our current knowledge about the effects of increasing climatic variation on natural ecosystems is generally quite poor. Predicting how communities will likely respond to changing environmental variability has therefore been recognized as a critical research priority.

This project will advance our understanding of how projected changes in temperature variability will affect the behavior, demography, and interactions of key taxa on rocky shores, a model system for testing theoretical ecological predictions with field experiments. Environmental temperatures strongly influence the physiology, behavior, and demography of most organisms, and changes in average temperature have already been implicated in geographic range shifts of many species. A novel manipulative technique will be used to test the effects of changes in thermal variability on performance by a guild of congeneric grazing limpets, the productivity of their benthic microalgal food, and the resulting interaction strengths between the two taxa. Energy transfer among trophic levels is a key ecosystem process linked to local food-web support and rates of nutrient cycling. This research will evaluate not only species-specific effects of thermal variability on limpet survival, growth, and grazing activity, but also the potential for functional redundancy among limpet species to maintain that ecosystem function over time as environmental variability increases. Data generated from this study will provide a framework for future investigations of the consequences of climate change in this diverse and productive habitat.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1131038
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