Data describing individual aquatic respiration rates for limpets in trials conducted at the Hopkins Marine Station in 2013 (Experiments in a Model Ecosystem project)

Website: https://www.bco-dmo.org/dataset/630089
Data Type: experimental
Version: 2016-01-13

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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Table of Contents

Dataset Description

Growth data for animals on experimental plates in the field during 2013 was collected monthly via digital photographs and measured using ImageJ software. Respiration of limpets collected from the field during summer 2013 was measured in air or seawater at a range of temperatures for one hour or two hours.

Related Reference:

Miller, L.P., B.J. Allen, F.A. King, D.R. Chilin, V.M. Reynoso and M.W. Denny (2015). Warm microhabitats drive both increased respiration and growth rates of intertidal consumers. Marine Ecology Progress Series 522: 127-143 doi: http://dx.doi.org/10.3354/meps11117

Related Datasets:

limpet aerial respiration
limpet mass and body volume
limpet R-code and images

These data are also available at the Stanford Digital Repository: https://purl.stanford.edu/mz343tz6255

Methods & Sampling

Oxygen measurements taken using Ocean Optics FOXY fluorescence-based optode. Limpet mass data for all measured animals is included. Detailed methodology is available in Miller et al (2015).

Data Processing Description

Growth measurements were made by analyzing limpet shell projected area in ImageJ. Limpet respiration time series were used to estimate oxygen consumption rate. Complete analysis for size measurements and derived respiration rates are provided in the attached R code.

BCO-DMO Processing:

- added conventional header with dataset name, PI name, version date
- renamed parameters to BCO-DMO standard
- replaced space with underscore

Data Files

File
aquatic_resp_sort.csv(Comma Separated Values (.csv), 17.45 KB) MD5:28be260d6ac6e91e0461b6398c83553f Primary data file for dataset ID 630089

Parameters

Parameter	Description	Units
species	Lottia species name	unitless
limpet	unique identifying label for each limpet consisting of a 3-character species name abbreviation and a 3 or 4 digit number: lim = Lottia limatula; dig = L. austrodigitalis; sca = L. scabra; pel = L. pelta	unitless
well	record of the individual respiration chamber well the limpet was in; values can be 1-15	unitless
temp	temperature of the water bath (and respiration chamber)	degrees Celsius
dry_wt_limpet_g	limpet tissue dry mass after drying in the oven for 48hrs; the tissue was dissected from the shell	grams
rate_blank	average rate of change of oxygen concentration in the 3 blank chamber wells used in each trial. The same value is used to correct the respiration rates for all limpets in a trial run.	umol oxygen/hour

rate_raw	raw uncorrected oxygen consumption rate of the limpet. Originally derived by fitting a linear regression to the individual time points for which oxygen was measured in the chamber during the run; converted to umol O2. NOTE: negative values indicate oxygen consumption and lower numbers indicate faster consumption. The sign is reversed for the corrected rate in the following column.	umol oxygen/hour
rate_corr	corrected oxygen consumption rate of the limpet; corrected using the averaged rate of the blank chambers for that trial run. NOTE: the sign of the rate has been reversed here so that faster consumption rates are larger positive values instead of lower negative values.	umol oxygen/hour
r_squared	the R-squared value of the straight-line regression fit to the oxygen consumption data used to derive the raw oxygen consumption rate given above. Provided as a goodness-of-fit metric of the regression used to calculate oxygen consumption rate.	unitless
resid_var	the variance of the residuals around the straight-line regression fit of the oxygen consumption data versus time. Provided as a metric of the goodness-of-fit of the regression used to calculate oxygen consumption rate.	unitless
rate_mass_specific_O2	oxygen consumption rate divided by the dry tissue mass of the limpet.	umol oxygen/hour/gram dry tissue.
date_trial	Date of the trial run. All limpets were collected between 2 and 7 days prior to the trial date on which they were used.	mm/dd/yyyy

Instruments

Dataset-specific Instrument Name	ruthenium sensor spots
Generic Instrument Name	Oxygen Sensor
Dataset-specific Description	SP-PSt3-NAU-D5-YOP, PreSens Precision Sensing
Generic Instrument Description	An electronic device that measures the proportion of oxygen (O2) in the gas or liquid being analyzed

Dataset-specific Instrument Name	
Generic Instrument Name	Water Temperature Sensor
Dataset-specific Description	iButton temperature logger (DS1921G, Maxim Integrated)
Generic Instrument Description	General term for an instrument that measures the temperature of the water with which it is in contact (thermometer).

[|]

Deployments

Denny_2013

Website	https://www.bco-dmo.org/deployment/630067
Platform	Hopkins Marine Station
Start Date	2013-01-01
End Date	2013-12-31
Description	Limpet growth and respiration 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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