Results from mesocosm experiments measuring how temperature affects predation rates by whelks on barnacles

Website: https://www.bco-dmo.org/dataset/894148
Data Type: experimental
Version: 1
Version Date: 2024-05-17

Project
» The Role of Temperature in Regulating Herbivory and Algal Biomass in Upwelling Systems (Temperature and Herbivory)

Contributors	Affiliation	Role
Bruno, John	University of North Carolina at Chapel Hill (UNC-Chapel Hill)	Principal Investigator
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Abstract
These data contain results from mesocosm experiments measuring how temperature affects predation rates by whelks on barnacles. These results include barnacles eaten and whelk movements under warm and cold conditions. The experiments were done in the Galapagos Science Center in San Cristobal, Galapagos. Estimates of how temperature modifies activity and predation rates will help understand and predict changes in marine communities under future climate change scenarios.

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Coverage

Spatial Extent: **Lat**:-0.67136 **Lon**:-89.2651
Temporal Extent: 2021-07-22 - 2021-08-13

Methods & Sampling

Trials were conducted to test the hypothesis that carnivory increases with temperature. Eight aquariums were used as "cold treatment" (16 degrees Celsius) and the remaining as "warm treatment" (26 degrees Celsius). Each aquarium was divided in two using a plastic mesh. Randomly selected whelk (12 to 16 centimeters in length) were put in one half of the aquarium. Four to seven barnacles were previously glued to a small rock using epoxy (Splash zone compound A788 HG) and put in both sides of the aquarium. Each day the mesocosm room was visited two times (at 7:30 am and 7:30 pm) to assess predator position in each tank and to count the number of barnacles consumed. This experiment ran for 20 days.

Experiments were conducted in the Galapagos Science Center on San Cristobal Island in the Galapagos Archipelago. Whelks and barnacles were collected in La Barcaza, a rocky reef located on the North of the Island (coordinates: -0.67136 N, -89.2651E).

BCO-DMO Processing Description

- Imported original file "PredationExperiment_WhelkBarnacles_2021_Updated.xlsx" into the BCO-DMO system.
- Created date-time fields in ISO8601 format (both Local and UTC); removed original date/time fields
- Saved final file as "894148_v1_whelk_barnacle_expts.csv".

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Data Files

File
894148_v1_whelk_barnacle_expts.csv (Comma Separated Values (.csv), 59.53 KB) MD5:1f1903074f928938ad75501f4ee5af68 Primary data file for dataset ID 894148, version 1

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Parameters

Parameter	Description	Units
Day_of_Week	Day of the week	unitless
ISO_DateTime_Local	Date and time when aquarium was observed in ISO 8601 format; local time zone of GMT-6:00	unitless
ISO_DateTime_UTC	Date and time when aquarium was observed in ISO 8601 format; UTC time zone	unitless
Aquarium	Aquarium ID number	unitless
Treatment	Description of the treatment (Cold, Warm, Extra, or NA); See metadata for description of "Cold" and "Warm". "Extra" were additional individuals (whelks) that were kept in case any of the individuals in the treatements had to be changed (i.e., any of the experimental whelks were overly stressed or died).	unitless
Temperature	Temperature of the aquarium	degrees Celsius
Position_of_Whelk	Description of the position of the whelk in the aquarium (Front, Back, AF(L), or NA). Note: Aquariums were divided in half. One side had a whelk and barnacles and the other side only had extra barnacles. Position_of_whelk means in which side of the aquarium the whelk was (in the front or the back).	unitless
WhelkPosition	Description of the position of the whelk in the aquarium (Front, Back, AF(L), or NA). Refers to where the whelk was each time investigators checked on the aquariums and took notes regarding predation on barnacles (morning and night). WhelkPosition was used to measured how much the whelks moved during the experiment.	unitless
DeadControl	Number of dead barnacle in control treatment	unitless
DeadPrey	Number of dead barnacle dead in predation treatment but without evidence of predation	unitless
PreyEaten	Number of barnacle eaten (evidence of predation)	unitless
Note	Notes or comments	unitless

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Instruments

Dataset-specific Instrument Name	Aquariums
Generic Instrument Name	Aquarium
Generic Instrument Description	Aquarium - a vivarium consisting of at least one transparent side in which water-dwelling plants or animals are kept

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Project Information

The Role of Temperature in Regulating Herbivory and Algal Biomass in Upwelling Systems (Temperature and Herbivory)

Website: http://github.com/johnfbruno/Galapagos_NSF.git

NSF Award Abstract:
A well-known pattern in coastal marine systems is a positive association between the biomass of primary producers and the occurrence or intensity of upwelling. This is assumed to be caused by the increase in nutrient concentration associated with upwelling, enabling higher primary production and thus greater standing algal biomass. However, upwelling also causes large, rapid declines in water temperature. Because the metabolism of fish and invertebrate herbivores is temperature-dependent, cooler upwelled water could reduce consumer metabolism and grazing intensity. This could in turn lead to increased standing algal biomass. Thus upwelling could influence both bottom-up and top-down control of populations and communities of primary producers. The purpose of this study is to test the hypothesis that grazing intensity and algal biomass are, in part, regulated by temperature via the temperature-dependence of metabolic rates. Broader impacts include the training and retention of minority students through UNC's Course Based Undergraduate Research program, support of undergraduate research, teacher training, and various outreach activities.

The investigators will take advantage of the uniquely strong spatiotemporal variance in water temperature in the Galápagos Islands to compare grazing intensity and primary production across a natural temperature gradient. They will combine field monitoring, statistical modeling, grazing assays, populations-specific metabolic measurements, and in situ herbivore exclusion and nutrient addition to measure the effects of temperature on pattern and process in shallow subtidal communities. The researchers will also test the hypothesis that grazer populations at warmer sites and/or during warmer seasons are less thermally sensitive, potentially due to acclimatization or adaptation. Finally, the investigators will perform a series of mesocosm experiments to measure the effect of near-future temperatures on herbivores, algae, and herbivory. This work could change the way we view upwelling systems, particularly how primary production is regulated and the temperature-dependence of energy transfer across trophic levels.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1737071

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