Experiment testing the temperature dependence of urchin grazing at the Galapagos Science Center on San Cristobal Island from February to March 2018

Website: https://www.bco-dmo.org/dataset/775500
Data Type: experimental
Version: 1
Version Date: 2019-08-20

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
This study was conducted from February to March 2018 at the Galapagos Science Center on San Cristobal Island. The rate of Ulva sp. consumption by the two sea urchins, Lytechinus semituberculatus and Eucidaris galapagensis was measured at 10 temperatures: 14°, 16°, 18°, 20°, 22°, 24°, 26°, 28°, 30°, 32°C. L. semituberculatus (green urchin), E. galapaguensis (pencil urchin) and T. depressus (white urchin) are the three most common species in the Galapagos Islands and together make up 91% of the sea urchin biomass. Ulva sp. was used as the prey item because it is one of the most abundant macroalgal species, together with turf, encrusting coralline algae and Sargassum near the Galapagos and coast and because it is highly palatable for herbivores.

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Coverage

Spatial Extent: **Lat**:-0.883 **Lon**:-89.608
Temporal Extent: 2018-02 - 2018-03

Dataset Description

This study was conducted from February to March 2018 at the Galapagos Science Center on San Cristobal Island. The rate of Ulva sp. consumption by the two sea urchins, Lytechinus semituberculatus and Eucidaris galapagensis was measured at 10 temperatures: 14°, 16°, 18°, 20°, 22°, 24°, 26°, 28°, 30°, 32°C. L. semituberculatus (green urchin), E. galapaguensis (pencil urchin) and T. depressus (white urchin) are the three most common species in the Galapagos Islands and together make up 91% of the sea urchin biomass. Ulva sp. was used as the prey item because it is one of the most abundant macroalgal species, together with turf, encrusting coralline algae and Sargassum near the Galapagos and coast and because it is highly palatable for herbivores.

Methods & Sampling

For each temperature run (i.e., each experimental level) eight urchins of each species were collected from Cerro Tijieretas cove (0°53’16.78”S, 89°36’29.18”W) at an average depth of 4 m. Urchins were transported in plastic containers filled with sea water to the UNC/USFQ Galapagos Science Center.

Each individual, whose volume has been calculated using a beaker (ie, via water displacement), was randomly assigned to a numbered mesocosm: green and pencil urchins were placed in 21x11x9 cm and 42x9 cm (circumference x depth), respectively, with 5g (wet weight) of fresh Ulva sp. each taken from the Cerro Tijieretas site. Ulva sp. was weighed after excess water was removed using a salad spinner that was cycled twice for 20 repetitions. The 16 mesocosms were then placed randomly within a large water bath of 130x60x35 dimensions at the temperature to be tested randomly. A chiller and two heaters, paired with an Apex aquarium thermostat, were used to control the water temperature inside the water bath. Each mesocosm closed with a wire mesh top so that the water temperature inside the mesocosm was the same as that in the aquarium and water could be exchanged freely. Before the test, the individuals were left to fast for 24 hours in basins with oxygenators. The water inside the basins was changed approximately every 12 hours with new sea water at an ambient temperature of ~23°C. This procedure was repeated for every temperature tested.

Data Processing Description

BCO-DMO Processing Notes:
- added conventional header with dataset name, PI name, version date

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Data Files

File
urch_graz.csv (Comma Separated Values (.csv), 2.78 KB) MD5:d8d12d5f58b701d4ba5ea9c9a095739a Primary data file for dataset ID 775500

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Parameters

Parameter	Description	Units
Mesocosm	mesocosm identifier	unitless
Species	Species of sea urchin	unitless
Temperature	water temperature	degrees Celsius
Grazing	volume of Ulva app eater (g) divided by the urchin volume; I.e. size normalized grazing rate.	unitless

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Instruments

Dataset-specific Instrument Name	aquarium
Generic Instrument Name	Aquarium
Dataset-specific Description	Each mesocosm closed with a wire mesh top so that the water temperature inside the mesocosm was the same as that in the aquarium and water could be exchanged freely.
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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