Macroalgal biomass data (Preburn, Postburn, and Ash-Free Dry Weight) collected in the nearshore shallow subtidal during six field experiments conducted at Cerro Mundo Bay in the Galapagos Islands between July 2021 and May 2022

Website: https://www.bco-dmo.org/dataset/894169
Data Type: experimental, Other Field Results
Version: 1
Version Date: 2023-04-18

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

Contributors	Affiliation	Role
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Abstract
Increased standing macroalgal biomass in upwelling zones is generally assumed to be the result of higher nutrient flux due to upwelled waters. However, other factors can strongly impact macroalgal communities. For example, herbivory and temperature, via their effects on primary producers and the metabolic demands of consumers, can also influence macroalgal biomass and productivity, respectively. Although there are a fair number of studies looking at the interactive effects of herbivores and nutrients in both tropical and temperate regions, there is a lack of studies looking at these effects in tropical or subtropical upwelling regions. The purpose of this study was to measure the effects that herbivores, temperature, and nutrient availability have on standing macroalgal biomass. We manipulated nutrient availability and herbivory in six field experiments during contrasting productivity and thermal regimes (cool-upwelling and warm, non-upwelling season) on a subtidal nearshore rocky reef. Here, we present the macroalgal biomass raw data (Preburn, Postburn, and Ash-Free Dry Weight) collected in the nearshore shallow subtidal during the six field experiments.

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Coverage

Location: Cerro Mundo, San Cristobal Island, Galapagos, Ecuador (0.87044°S, 89.58189°W)
Spatial Extent: **Lat**:-0.87044 **Lon**:-89.58189
Temporal Extent: 2021-07 - 2022-05

Methods & Sampling

Macroalgae accumulated in exclusion and open cages (deployed on the seafloor) was scraped and vacuumed into independent collection mesh bags after four-week trials between July 2021 and May 2022. Ash-free dry weight (AFDW) of the macroalgae samples was determined by drying each sample in an oven for 24 hours at 60° Celsius (C) and then burning it in a muffle furnace for 4 hours at 500°C.

The six field experiments were conducted in Cerro Mundo Bay, a shallow (~10 meters deep) rocky reef off the west side of San Cristobal Island, Galapagos, Ecuador (0.87044°S, 89.58189°W).

Data Processing Description

Note:
In the data file, 0 indicates there was no growth of macroalgae for that specific replicate. NA indicates that the macroalgae sample was not recovered at the end of the trial (e.g. collection mesh bag got lost).

BCO-DMO Processing Description

BCO-DMO Processing:
- Imported original file "AFDW.xlsx" into the BCO-DMO system.
- Concatenated the data from separate Excel sheets (one per trial) into one data file.
- Renamed fields to comply with BCO-DMO naming conventions.
- Saved the final file as "algal_ash-free_dry_weight_cerro_mundo.csv".

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Data Files

File	
algal_ash-free_dry_weight_cerro_mundo.csv	(Comma Separated Values (.csv), 24.62 KB) MD5:30fdfa77d27df9e9d8e1c4fa32c4ae0b
Primary data file for dataset ID 894169.	

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Parameters

Parameter	Description	Units
Trial	Month and year of the experiment	unitless
Cage	Replicate number	unitless
Treatment	Four types of experimental treatments were used: (All Present) Open with full access to all grazers. (Urchins Only) Urchin inclusions, where two pencil urchins remained caged throughout the duration of each trial to maintain the identity and density of our herbivore of interest constant. (None Present) Full exclusions, preventing access to all macro-herbivores such as sea urchins, fishes, iguanas, and turtles, but not to meso-herbivores such as amphipods. These cages are covered with a top. (Procedural) Procedural control that included partial sides, designed to affect flow and light to a similar degree as other cages to test for experimental artifacts of the herbivore manipulation.	unitless
N	Nutrient category: N+= elevated nutrients; No N= ambient nutrients.	unitless
Algae_Type	Algae type: RF = Red filamentous; cca = Crustose Coralline algae; D = Dictyota; P = Padina; Ulva = Ulva; RA = Red algae.	unitless
Foil_cup_weight	Weight (in grams) of only the aluminum foil cup before placing the wet algae sample	grams (g)
Sample_and_foil_cup_weight	Weight (in grams) of algae sample and aluminum foil after the sample was dried in the drying oven	grams (g)
Preburn_weight	Subtraction of "Foil_cup_weight" from "Sample_and_foil_cup_weight"	grams (g)
Ceramic_cup_weight	Weight (in grams) of only the ceramic melting pot before placing the dried algae sample	grams (g)
Sample_and_ceramic_cup_weight	Weight of algae sample and ceramic melting pot after the sample was burned in the muffle furnace	grams (g)
Postburn_weight	Subtraction of "Ceramic_cup_weight" from "Sample_and_ceramic_cup_weight"	grams (g)
AFDW	Ash-free dry weight; subtraction of "Preburn_weight" from "Postburn_weight"	grams (g)

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Instruments

Dataset-specific Instrument Name	Memmert UFE 400 Sterilizer Laboratory Oven
Generic Instrument Name	Drying Oven
Generic Instrument Description	a heated chamber for drying

Dataset-specific Instrument Name	Optic Ivymen System Laboratory Furnace 8.2/1100
Generic Instrument Name	muffle furnace
Generic Instrument Description	A muffle furnace or muffle oven (sometimes retort furnace in historical usage) is a furnace in which the subject material is isolated from the fuel and all of the products of combustion, including gases and flying ash. A type of jacketed enclosure that is used to heat a material to significantly high temperatures while keeping it contained and fully isolated from external contaminants, chemicals or substances. Muffle furnaces are usually lined with stainless steel, making them largely corrosion-resistant.

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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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