Thermal buffering potential of mussels across latitude from a study on the West coast of the United States from June to October of 2012 and 2013.

Website: https://www.bco-dmo.org/dataset/869374
Data Type: Other Field Results
Version: 1
Version Date: 2022-02-28

Project
» Trophic consequences of ocean acidification: Intertidal sea star predators and their grazer prey (BOAR Trophic)

Contributors	Affiliation	Role
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Abstract
This datasets represent a study of thermal buffering potential of mussels across latitude on the West coast of the United States from June - October of 2012 and 2013. We measured marine intertidal habitat temperatures on horizontal surfaces in experimentally formed rock clearings and inside two different biogenic habitats dominated by the foundation species Mytilus californianus Conrad 1837, the California mussel, and the turf-forming ‘black pine’ alga, Neorhodomela larix (Turner) Masuda, 1982.

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Coverage

Spatial Extent: **N**:48 **E**:-117 **S**:34 **W**:-120
Temporal Extent: 2012-06-03 - 2013-10-20

Acquisition Description

This dataset represents measured marine intertidal habitat temperatures from June to October of 2012 and 2013 on horizontal surfaces in experimentally formed rock clearings and inside two different biogenic habitats dominated by the foundation species *Mytilus californianus* Conrad 1837, the California mussel, and the turf-forming ‘black pine’ alga, *Neorhodomela larix* (Turner) Masuda, 1982.

Study sites were embedded within three regions: a high-heat ‘hot spot’ for adult invertebrates living directly on rock surfaces (48° N, Washington, USA), a cooler mid-region (38° N, northern California), and a warm, lower latitude region (34° N, southern California). To account for potentially appreciable variation at the site level, we replicated measurements at two sites within each region that differed in wave exposure, directional orientation,

and bedrock type. At each site, we measured habitat temperatures every 30 minutes for roughly 20 weeks in 2012 (June 3–October 15; 135 days) and 2013 (May 27–October 20; 147 days) with small temperature loggers placed in M. californianus beds (4–6 centimeters (cm) deep), *N. larix* turfs (2–6 cm deep) and in bare rock clearings scraped of biota (N = 4 loggers per habitat per site).

To compare how latitude, shore elevation, and habitat influence the occurrence of stressful high temperatures on rocky shores, we used ecologically relevant assays of physiological stress in intertidal invertebrates that occupy biogenic habitats. We used published studies and experiments to select two temperature thresholds beyond which lethal and sub-lethal stresses were highly likely for multiple rocky shore taxa. We then determined lethal thresholds experimentally for sample populations of a subset of invertebrates commonly found in the relevant habitats: juvenile mussels, Mytilus californianus; the predatory whelks *Acanthinucella spirata* Blainville, 1832 and *Nucella ostrina* Gould, 1852; and the herbivorous chink snail, *Lacuna vincta* Montagu, 1803.

We analyzed patterns in the duration of exposure to habitat temperatures over 35 °C and 26 °C thresholds by latitude, shore elevation, and habitat type. We calculated this response metric as the cumulative hours that habitat temperatures exceeded each threshold over the duration of temperature measurements. For analysis, we used the total hours per 30 days of measurement that habitat temperatures exceeded each threshold.

Data are summarized from files extracted from individual temperature loggers (Maxim thermochron iButtons) deployed in each associated location, as described in Materials and Methods.

Reading counts are different due to differences in hours and days deployed by year (due to shifts in the timing of low tides between years, which affected the dates we affixed and retrieved instruments in the study locations)

For further details see: Jurgens & Gaylord (2018).

Processing Description

BCO-DMO Processing:
- Adjusted field/parameter names to comply with BCO-DMO naming conventions
- Added a conventional header with dataset name, PI names, version date

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Related Publications

Jurgens, & Gaylord, B. (2018). Physical effects of habitat-forming species override latitudinal trends in temperature. Ecology Letters, 21(2), 190–196. Portico. https://doi.org/10.1111/ele.12881
Methods

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Related Datasets

IsRelatedTo

Ninokawa, A. T., Gaylord, B. (2022) **Average conditions and chemical fluxes during mussel bed experiments at the Bodega Marine Laboratory, University of California, Davis in 2017.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2022-02-24 http://lod.bco-dmo.org/id/dataset/869361 [view at BCO-DMO]

Ninokawa, A. T., Gaylord, B. (2022) **Vertical profiles of chemistry within and above a mussel bed established in a laboratory flow tunnel at the Bodega Marine Laboratory, CA in 2017.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2022-02-23 http://lod.bco-dmo.org/id/dataset/866304 [view at BCO-DMO]

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Parameters

Parameter	Description	Units
region	Region in which temperature logger was deployed, abbreviated as either "OLY" indicating the Olympic coast of Washington, USA; "SRI" denoting Santa Rosa Island of south-central California; or "NCA" indicating northern coastal California.	unitless
year	Year in which instruments collected associated data	unitless
site	Site location of deployment, abbreviated as in Table S1 (Jurgens & Gaylord 2018)	unitless
hab	Habitat type in which instrument was deployed; R=rock clearing, M=within a mussel bed, N=within a bed of the common alga Neorhodomela larix	unitless
elev	Relative elevational zone in which data was recorded. H=upper quartile of the vertical extent of mussel beds at the site; L=lower quartile of the vertical extent of mussel beds at the site	unitless
repl	Assigned replicate number (1 through 4) of the instrument from which data were extracted	unitless
max_T	The maximum temperature recorded by the logger	degrees celsius (°C)
h25	Cumulative hours over 25°C recorded by the logger	unitless
h26	Cumulative hours over 26°C recorded by the logger	unitless
h28	Cumulative hours over 28°C recorded by the logger	unitless
h30	Cumulative hours over 30°C recorded by the logger	unitless
h33	Cumulative hours over 33°C recorded by the logger	unitless
h35	Cumulative hours over 35°C recorded by the logger	unitless
h37	Cumulative hours over 37°C recorded by the logger	unitless
days_deployed	Count of number of days the logger was deployed in a given location in a given year	unitless
hours_deployed	Count of number of hours the logger was deployed in a given location in a given year	unitless
readings_count	Count of total temperature readings logged by the instrument in the given location in the given year	unitless

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Instruments

Dataset-specific Instrument Name	Maxim_ DS-1922L iButtons
Generic Instrument Name	Temperature Logger
Generic Instrument Description	Records temperature data over a period of time.

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Project Information

Trophic consequences of ocean acidification: Intertidal sea star predators and their grazer prey (BOAR Trophic)

Coverage: Central California coast, USA

NSF Award Abstract:
The absorption of human-produced carbon dioxide into the world's oceans is altering the chemistry of seawater, including decreasing its pH. Such changes, collectively called "ocean acidification", are expected to influence numerous types of sea creatures. This project examines how shifts in ocean pH affect animal behavior and thus interactions among species. It uses a case study system that involves sea star predators, snail grazers that they eat, and seaweeds consumed by the latter. The rocky-shore habitats where these organisms live have a long history of attention, and new findings from this work will further extend an already-large body of marine ecological knowledge. The project provides support for graduate and undergraduate students, including underrepresented students from a nearby community college. The project underpins the development of a new educational module for local K-12 schools. Findings will moreover be communicated to the public through the use of short film documentaries, as well as through established relationships with policy, management, and industry groups, and contacts with the media.

Ocean acidification is a global-scale perturbation. Most research on the topic, however, has examined effects on single species operating in isolation, leaving interactions among species underexplored. This project confronts this knowledge gap by considering how ocean acidification may shift predator-prey relationships through altered behavior. It targets as a model system sea stars, their gastropod grazer prey, and macoalgae consumed by the latter, via four lines of inquiry. 1) The project examines the functional response of the focal taxa to altered seawater chemistry, using experiments that target up to 16 discrete levels of pH. This experimental design is essential for identifying nonlinearities and tipping points. 2) The project addresses both consumptive and non-consumptive components of direct and indirect species interactions. The capacity of ocean acidification to influence such links is poorly known, and better understanding of this issue is a recognized priority. 3) The project combines controlled laboratory experiments with field trials that exploit tide pools and their unique pH signatures as natural mesocosms. Field tests of ocean acidification effects are relatively rare and are sorely needed. 4) A final research phase expands upon the above three components to address effects of ocean acidification on multiple additional taxa that interact in rocky intertidal systems, to provide a broad database that may have utility for future experiments or modeling.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1636191

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