Mesocosm study of trophic interactions under ocean acidification, focusing on sea star behavior in Bodega Bay, CA.

Website: https://www.bco-dmo.org/dataset/866365
Data Type: experimental
Version: 1
Version Date: 2022-03-16

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 dataset represents a mesocosm study of trophic interactions under ocean acidification, focusing on sea star behavior in Bodega Bay, California. This study is part of a larger experiment to investigate how pH influences trophic links between intertidal sea stars (Leptasterias hexactis), snails (Tegula funebralis), and macroalgae (Mazzaella flaccida).

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Coverage

Spatial Extent: **Lat**:38.33325 **Lon**:-123.04805
Temporal Extent: 2015-07-11 - 2015-07-21

Methods & Sampling

This dataset is part of a larger experiment to investigate how pH influences trophic links between intertidal sea stars (*Leptasterias hexactis*), snails (*Tegula funebralis*), and macroalgae (*Mazzaella flaccida)*. Organisms were placed for 7 days in mesocosms containing seawater at either ambient (~7.9) or low pH (~7.0). The pH was modified using equimolar additions of sodium bicarbonate (NaHCO3) and hydrochloric acid (HCl). The water in each container was changed daily. The mesocosm array consisted of 40, 13-liter (L) circular plastic containers with a mesh barrier down the center to separate predator, prey, and/or basal resource but allowing for passage of waterborne cue. Mesocosms were filled halfway with seawater, allowing 10 centimeters (cm) of refuge space for snails above the waterline. Mesocosms were held within a seawater table under constant flow to maintain consistent temperatures.

Each mesocosm was assigned to one of four trophic treatments and one of two pH levels, resulting in five

replicates per treatment and pH (4 trophic × 2 pH × 5 replicates = 40 mesocosms). The first trophic treatment was a “no-predator” configuration, composed of four snails and four 3-cm-diameter circular pieces of *Mazzaella* macroalgae cut out of blades (four pieces = 0.33 g ± 0.03 in total, with each piece standardized to have similar initial mass), both placed on one side of the central barrier of the mesocosm. The second trophic treatment was a “cue only” treatment in which one sea star was housed on one side of the barrier with four snails and macroalgae on the other side. The third was a “complete interaction” treatment in which one sea star, four snails, and macroalgae were all located on the same side of the barrier. The final trophic treatment was a “no prey/no grazing” configuration, for which one sea star was placed on one side of the barrier with the macroalgae on the other.

Consequences of pH for the predatory behavior of sea stars was quantified using image analysis (ImageJ) of photographs of animal position recorded every 2 min for 16 min daily starting immediately after the organisms were placed into the mesocosms. The behaviors were also stable through time and were, therefore, quantified only over the first 4 days of the experiment, following each water change. Sea star foraging behavior was evaluated through their tendency to move and the distance that they traveled (cm) during the assessment period.

See Jellison, B.M. & Gaylord, B. Oecologia (2019).

Data Processing Description

Distance traveled by sea stars was calculated using image analysis (ImageJ) of the sum net linear distance between sea star position coordinates in each consecutive picture.

BCO-DMO processing description:
- Adjusted field/parameter names to comply with BCO-DMO naming conventions
- Replaced blank values with "nd" (no data)
- Rounded column "Distance_cm" to 1 decimal place
- Added a conventional header with dataset name, PI names, version date

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Data Files

File	
mesocosm_study_-_seastar_behavior.csv	(Comma Separated Values (.csv), 3.78 KB) MD5:6ee651e8e2271c79ba43e7f5d103c0ce
Primary data file for dataset ID 866365	

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Related Publications

Jellison, B. M., & Gaylord, B. (2019). Shifts in seawater chemistry disrupt trophic links within a simple shoreline food web. Oecologia, 190(4), 955–967. doi:10.1007/s00442-019-04459-0
Results

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Related Datasets

IsRelatedTo

Jellison, B., Gaylord, B. (2022) **Mesocosm study of trophic interactions under ocean acidification, focusing on snail responses Bodega Bay, CA.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2022-03-09 doi:10.26008/1912/bco-dmo.869148.1 [view at BCO-

DMO]

Jellison, B., Gaylord, B. (2022) **Mesocosm study of trophic interactions under ocean acidification, focusing on the consumption of algae by snails in Bodega Bay, California.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2022-03-09 doi:10.26008/1912/bco-dmo.866359.1 [view at BCO-DMO]

Jellison, B., Gaylord, B. (2022) **Mesocosm study of trophic interactions under ocean acidification, focusing on the consumption of snails by sea stars in Bodega Bay, CA.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2022-03-09 doi:10.26008/1912/bco-dmo.869189.1 [view at BCO-DMO]

Jellison, B., Gaylord, B. (2022) **Water chemistry during mesocosm study of trophic interactions under ocean acidification in Bodega Bay, CA.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2022-03-09 doi:10.26008/1912/bco-dmo.869110.1 [view at BCO-DMO]

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Parameters

Parameter	Description	Units
Container	Container number	unitless
Trophic_Treatment	pH treatment level of the container; Low pH ~ 7.0 total pH, Ambient pH ~7.9 total pH	unitless
pH	Trophic treatment condition; “no-predator” = four snails and four circular pieces of macroalgae on one side of the barrier, “cue only" = one sea star was housed on one side of the barrier with four snails and macroalgae on the other side, "complete interaction" = one sea star, four snails, and macroalgae all placed on one side of the barrier together, “no prey/no grazing” = one sea star was placed on one side of the barrier with the macroalgae on the other.	unitless
Seastar_ID	Sea star number	unitless
Day	Day number within the seven day experiment	Day number
Move	1= sea star moved during the 16 minute assessment, 0 = the sea star did not move during the assessment period	unitless
No_move	0= sea star moved during the 16 minute assessment, 1 = the sea star did not move during the assessment period	unitless
Distance_cm	Net distance travelled (cm) by a sea star during the assessment period	cm

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Instruments

Dataset-specific Instrument Name	Single lense reflex (SLR)
Generic Instrument Name	Camera
Generic Instrument Description	All types of photographic equipment including stills, video, film and digital systems.

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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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