Water chemistry during mesocosm study of trophic interactions under ocean acidification in Bodega Bay, CA.

Website: https://www.bco-dmo.org/dataset/869110
Data Type: experimental
Version: 1
Version Date: 2022-03-09

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

Contributors	Affiliation	Role
Gaylord, Brian	University of California-Davis (UC Davis-BML)	Principal Investigator
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Abstract
This dataset provides water chemistry data during a mesocosm study of trophic interactions among intertidal sea stars (Leptasterias hexactis), snails (Tegula funebralis), and macroalgae (Mazzaella flaccida) under ocean acidification in Bodega Bay, CA.

Table of Contents

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 centimeter (cm) of refuge space for snails above the waterline. Mesocosms were held within a seawater table under constant flow to maintain consistent temperatures.

Temperature, salinity, dissolved oxygen, and pH were measured using a YSI ProPlus Sensor.

Total pH was measured using a Sunburst SAMI spectrophotometric unit modified for benchtop use.

Total alkalinity was measured via Gran titration (Riebesell et al. 2010) standardized using certified reference material (A. Dickson, Scripps Institution of Oceanography) using a Metrohm 855 autotitrator.

Values of total pH for each container were measured using a YSI ProPlus Sensor and calibrated to the total scale using daily samples run on a Sunburst SAMI spectrophotometric unit modified for benchtop use.

Data Processing Description

pCO2 was calculated from daily alkalinity and pH using the seacarb package in R assuming the default dissociation constants.

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

[table of contents | back to top]

Data Files

File	
mesocosm_study_-_seawater_chemistry.csv	(Comma Separated Values (.csv), 86.86 KB) MD5:6514617f46d4d8c9314bf6ac61840470
Primary data file for dataset ID 869110	

[table of contents | back to top]

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

R Core Team (2018) R: A language and environment for statistical computing (R Foundation for Statistical Computing, Vienna, Austria). https://www.R-project.org
Software

[table of contents | back to top]

Related Datasets

IsRelatedTo

Jellison, B., Gaylord, B. (2022) **Mesocosm study of trophic interactions under ocean acidification, focusing on sea star behavior in Bodega Bay, CA.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2022-03-16 doi:10.26008/1912/bco-dmo.866365.1 [view at BCO-DMO]

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]

[table of contents | back to top]

Parameters

Parameter	Description	Units
Container	Container number	unitless
Phase	pH treatment level of the container; Low pH ~ 7.0 total pH, Ambient pH ~7.9 total pH	unitless
Trophic_Treatment	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
pH	pH Exposure = 5 day exposure phase before the mesocosm component in which animals were held separately and exposed to ambient and low pH, mesocosm = 7 day mesocosm component of the experimnet in which sea stars, snails and macroalgae were held together under 4 trophic treatments and exposed to the same pH level as they were during the pH exposure phase of the experiment.	unitless
Day	Day number within the experiment	day number
Water_Change	Whether water quality measurements were taken before or after daily complete water changes	unitless
Conductivity	Conductivity measured by a YSI ProPlus sensor	mS/cm
Salinity	Salinity measured by a YSI ProPlus sensor	ppt
Dissolved_Oxygen	Dissolved Oxygen measured by a YSI ProPlus sensor	mg/L
pH_mV	pH millivolts measured by a YSI ProPlus sensor	mV
Temperature	Temperature measured by a YSI ProPlus sensor	degrees Celsius
Total_pH	Total pH values for each container were processed using measurements from a YSI ProPlus Sensor and calibrated to the total scale using daily samples run on a Sunburst SAMI	pH units
Alkalinity	Total alkalinity was measured via Gran titration (Riebesell et al.2010) standardized using certified reference material (A. Dickson, Scripps Institution of Oceanography) using a Metrohm 855 autotitrator	µmol/kgSW
pCO2	pCO2 was calculated from daily alkalinity and pH using the seacarb package in R assuming the default dissociation constants.	ppm
SAMI_total_pH	Total pH was measured using a Sunburst SAMI spectrophotometric unit modified for benchtop use	pH units

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	Metrohm 855 autotitrator
Generic Instrument Name	Automatic titrator
Generic Instrument Description	Instruments that incrementally add quantified aliquots of a reagent to a sample until the end-point of a chemical reaction is reached.

Dataset-specific Instrument Name	Sunburst SAMI spectrophotometric unit
Generic Instrument Name	Benchtop pH Meter
Generic Instrument Description	An instrument consisting of an electronic voltmeter and pH-responsive electrode that gives a direct conversion of voltage differences to differences of pH at the measurement temperature. (McGraw-Hill Dictionary of Scientific and Technical Terms) This instrument does not map to the NERC instrument vocabulary term for 'pH Sensor' which measures values in the water column. Benchtop models are typically employed for stationary lab applications.

Dataset-specific Instrument Name	YSI ProPlus Sensor
Generic Instrument Name	YSI Professional Plus Multi-Parameter Probe
Generic Instrument Description	The YSI Professional Plus handheld multiparameter meter provides for the measurement of a variety of combinations for dissolved oxygen, conductivity, specific conductance, salinity, resistivity, total dissolved solids (TDS), pH, ORP, pH/ORP combination, ammonium (ammonia), nitrate, chloride and temperature. More information from the manufacturer.

[table of contents | back to top]

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.

[table of contents | back to top]

Funding

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

[table of contents | back to top]