Vertical profiles of chemistry within and above a mussel bed established in a laboratory flow tunnel at the Bodega Marine Laboratory, CA in 2017.

Website: https://www.bco-dmo.org/dataset/866304
Data Type: experimental
Version: 1
Version Date: 2022-02-23

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 vertical profiles of chemistry within and above a mussel bed established in a laboratory flow tunnel at the Bodega Marine Laboratory, University of California, Davis in 2017. Alkalinity profiles using pH and O2 profiles were used to calculate calcification and respiration rates of mussel beds.

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Coverage

Spatial Extent: **Lat**:38.33325 **Lon**:-123.04805
Temporal Extent: 2017-01-27 - 2017-02-14

Methods & Sampling

These data were generated by establishing a mussel bed in a laboratory flow tunnel. Each profile represents a period where chemistry (pH and O2) was measured at defined heights within and above the mussel bed. These profiles occurred at two places in the mussel bed. Alkalinity at the top of each profile was determined with bottle samples and interpolated to each time point. Alkalinity profiles were generated by calculating the change in alkalinity using the pH and O2 profiles. These chemical profiles were used to calculate calcification and respiration rates of the mussel bed.

Known Issues: No oxygen data was collected for profiles 1-7. This also prohibits the calculation of alkalinity profiles.

Methods described in detail in Ninokawa et al. (2020).

Data Processing Description

Data Processing:
All data analyses were performed with R Statistical Software. The seacarb package was used for carbonate chemistry calculations and the marelac package was used for estimating oxygen flux out of the surface of the flow tunnel.

BCO-DMO Processing:
- Adjusted field/parameter names to comply with BCO-DMO naming conventions
- Missing data identifier ‘NA’ replaced with 'nd' (BCO-DMO's default missing data identifier)
- Converted date/time field to ISO8601 format (YYYY-MM-DDThh:mm)
- Added date/time field in UTC time zone
- Added a conventional header with dataset name, PI names, version date

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Data Files

File
profiles.csv (Comma Separated Values (.csv), 45.23 KB) MD5:faaf96b8f840c23ea27fb4d41c6ce4a3 Primary data file for dataset ID 866304

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Related Publications

Barnes, D. J. (1983). Profiling coral reef productivity and calcification using pH and oxygen electrodes. Journal of Experimental Marine Biology and Ecology, 66(2), 149–161. https://doi.org/10.1016/0022-0981(83)90036-9
Methods

Ninokawa, A., Takeshita, Y., Jellison, B. M., Jurgens, L. J., & Gaylord, B. (2019). Biological modification of seawater chemistry by an ecosystem engineer, the California mussel, Mytilus californianus. Limnology and Oceanography, 65(1), 157–172. doi:10.1002/lno.11258
Methods

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Related Datasets

IsRelatedTo

Jurgens, L., Gaylord, B. (2022) **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.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2022-02-28 doi:10.26008/1912/bco-dmo.869374.1 [view at BCO-DMO]

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 doi:10.26008/1912/bco-dmo.869361.1 [view at BCO-DMO]

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Parameters

Parameter	Description	Units
profile	profile identifier	unitless
ISO_DateTime_Local	date and time of measurement in Pacific time zone in format: YYYY-MM-DDTHH:MM	unitless
ISO_DateTime_UTC	date and time of measurement in UTC in format: YYYY-MM-DDThh:mmZ	unitless
ph_height	height of profiling pH sensors above the substrate	centimeters (cm)
ph_position	location of pH sensor in the bed, 1=95 cm downstream of leading edge, 2=145 cm downstream of leading edge	unitless
top_ph	pH measured by the top pH sensor	unitless
prof_ph	pH measured by the profiling pH sensor	unitless
diff_ph	pH difference between the profiling pH and top pH sensors (diff.ph=prof.ph-top.ph)	unitless
top_temp	temperature measured by the top temperature sensor	degrees celsius
prof_temp	temperature measured by the profiling temperature sensor	degrees celsius
salinity	salinity measured by the top salinity meter	PSU
o2_height	height of O2 profiling sensor above the substrate	centimeters (cm)
o2_position	location of pH sensor in the bed, 1=95 cm downstream of leading edge, 2=145 cm downstream of leading edge	unitless
top_o2	oxygen concentration measured by the top O2 sensor	µmol kg-1
prof_o2	oxygen concentration measured by the profiling O2 sensor	µmol kg-1

diff_o2	oxygen concentration difference between the profiling O2 and top O2 sensors (diff.o2=prof.o2-top.o2)	µmol kg-1
top_TA	alkalinity at the top of the profiles measured with bottle samples	µmol kg-1
prof_TA	alkalinity measured at the profiler height by combining the top alkalinity and alkalinity change values (prof.TA = top.TA+del.TA)	µmol kg-1
del_TA	alkalinty change profiles calculated by the combination of pH and O2 profiles (Barnes, 1983)	µmol kg-1

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Instruments

Dataset-specific Instrument Name	Nortek acoustic doppler profiler
Generic Instrument Name	Acoustic Doppler Current Profiler
Dataset-specific Description	Freestream velocity and u* were extracted from velocity profiles. A relationship between flow tunnel speed setting and freestream velocity and u* was used during period the ADP lacked sufficient particles in the water for accurate velocity measurements.
Generic Instrument Description	The ADCP measures water currents with sound, using a principle of sound waves called the Doppler effect. A sound wave has a higher frequency, or pitch, when it moves to you than when it moves away. You hear the Doppler effect in action when a car speeds past with a characteristic building of sound that fades when the car passes. The ADCP works by transmitting "pings" of sound at a constant frequency into the water. (The pings are so highly pitched that humans and even dolphins can't hear them.) As the sound waves travel, they ricochet off particles suspended in the moving water, and reflect back to the instrument. Due to the Doppler effect, sound waves bounced back from a particle moving away from the profiler have a slightly lowered frequency when they return. Particles moving toward the instrument send back higher frequency waves. The difference in frequency between the waves the profiler sends out and the waves it receives is called the Doppler shift. The instrument uses this shift to calculate how fast the particle and the water around it are moving. Sound waves that hit particles far from the profiler take longer to come back than waves that strike close by. By measuring the time it takes for the waves to bounce back and the Doppler shift, the profiler can measure current speed at many different depths with each series of pings. (More from WHOI instruments listing).

Dataset-specific Instrument Name	Presens Microx 4 Profiling O2 and temperature sensor
Generic Instrument Name	Oxygen Microelectrode Sensor
Dataset-specific Description	Presens Microx 4 with needle-type microsensor. O2 and temperature calibrate by the manufacturer. O2 calibration verified in seawater equilibrated with atmospheric O2 and sensors deviating from 100% were replaced.
Generic Instrument Description	Any microelectrode sensor that measures oxygen.

Dataset-specific Instrument Name	Honeywell Durafet III combination electrode
Generic Instrument Name	pH Sensor
Dataset-specific Description	Top pH sensor: Honeywell Durafet III combination electrode calibrated to total scale with spectrophotometric pH determination on discrete water samples Profiling pH sensor: Honeywell Durafet III combination electrode calibrated to total scale by holding adjacent to the top pH sensor
Generic Instrument Description	An instrument that measures the hydrogen ion activity in solutions. The overall concentration of hydrogen ions is inversely related to its pH. The pH scale ranges from 0 to 14 and indicates whether acidic (more H+) or basic (less H+).

Dataset-specific Instrument Name	Yellow Springs Instruments 6920 Multiparameter Sonde.
Generic Instrument Name	YSI Sonde 6-Series
Dataset-specific Description	Top O2, salinity, and temperature sensor: Yellow Springs Instruments 6920 Multiparameter Sonde. O2 calibrated by holding adjacent to the profiling O2 sensor. Salinity calibrated with YSI 50 uS/cm Conductivity Standard. Temperature calibrated by manufacturer.
Generic Instrument Description	YSI 6-Series water quality sondes and sensors are instruments for environmental monitoring and long-term deployments. YSI datasondes accept multiple water quality sensors (i.e., they are multiparameter sondes). Sondes can measure temperature, conductivity, dissolved oxygen, depth, turbidity, and other water quality parameters. The 6-Series includes several models. More from YSI.

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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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