

Average conditions and chemical fluxes during mussel bed experiments at the Bodega Marine Laboratory, University of California, Davis in 2017.

Website: <https://www.bco-dmo.org/dataset/869361>

Data Type: experimental

Version: 1

Version Date: 2022-02-24

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 average conditions and chemical fluxes during mussel bed experiments where chemistry (pH and O₂) was measured at defined heights within and above the mussel bed. These data describe average conditions outside of the mussel bed during each profile sampled at the Bodega Marine Laboratory, University of California, Davis in 2017.

Table of Contents

- [Coverage](#)
- [Dataset Description](#)
 - [Methods & Sampling](#)
 - [Data Processing Description](#)
- [Data Files](#)
- [Related Publications](#)
- [Related Datasets](#)
- [Parameters](#)
- [Instruments](#)
- [Project Information](#)
- [Funding](#)

Coverage

Spatial Extent: Lat:38.33325 Lon:-123.04805

Temporal Extent: 2017-01-27 - 2017-02-13

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. These data describe average conditions outside of the mussel bed during each profile. Freestream velocities and shear velocities were assumed constant during a profile.

Calcification and respiration rates were calculated as the fluxes of alkalinity and oxygen, respectively. Flux calculations were modified from McGillis et al, 2011 and Takeshita et al, 2016.

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

Known Issues: No oxygen data was collected for profiles 1-7. This also prohibits the calculation of alkalinity profiles, calcification rates, and respiration rates. Zero freestream velocities also prohibits the calculation of calcification and respiration rates due to the lack of sufficient turbulent mixing.

Data Processing Description

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)
- Added a conventional header with dataset name, PI names, version date

[[table of contents](#) | [back to top](#)]

Data Files

File
effects_of_mussels_on_seawater_chemistry_-_summary_data.csv (Comma Separated Values (.csv), 1.75 KB) MD5:96bf120f1a3f09064b53612789656455
Primary data file for dataset ID 869361

[[table of contents](#) | [back to top](#)]

Related Publications

McGillis, W. R., Langdon, C., Loose, B., Yates, K. K., & Corredor, J. (2011). Productivity of a coral reef using boundary layer and enclosure methods. *Geophysical Research Letters*, 38(3), n/a-n/a.

<https://doi.org/10.1029/2010gl046179> <https://doi.org/10.1029/2010GL046179>

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](https://doi.org/10.1002/lno.11258)

Methods

Takeshita, Y., Cyronak, T., Martz, T. R., Kindeberg, T., & Andersson, A. J. (2018). Coral Reef Carbonate Chemistry Variability at Different Functional Scales. *Frontiers in Marine Science*, 5.

<https://doi.org/10.3389/fmars.2018.00175>

Methods

[[table of contents](#) | [back to top](#)]

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](https://doi.org/10.26008/1912/bco-dmo.869374.1) [[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
doi:10.26008/1912/bco-dmo.866304.1 [[view at BCO-DMO](#)]

Results

Ninokawa, A., Takeshita, Y., Jellison, B. M., Jurgens, L. J., & Gaylord, B. (2020). *Seawater carbonate chemistry and mussel respiration and calcification rates* [Data set]. PANGAEA - Data Publisher for Earth & Environmental Science. <https://doi.org/10.1594/PANGAEA.915978>

[[table of contents](#) | [back to top](#)]

Parameters

Parameter	Description	Units
profile	profile identifier	unitless
date	date when the profile was measured in format: YYYY-MM-DD	unitless
freestream_velocity	freestream velocity held during the profile, calculated from a relationship with flow tunnel speed setting	m s-1
u_star	shear velocity during the profile, calculated from a relationship with flow tunnel speed setting	m s-1
bed_position	location of profile in the bed, 1=95 cm downstream of leading edge, 2=145 cm downstream of leading edge	unitless
temperature	average top temperature during the profile	degrees celsius (°C)
salinity	average top salinity during the profile	PSU
top_ph	average top pH during the profile	unitless
top_o2	average top oxygen concentration during the profile	μmol kg-1
max_diff_ph	maximum observed difference in pH during the profile	unitless
max_diff_o2	maximum observed difference in oxygen concentration during the profile	μmol kg-1
calcification_rate	bed calcification rate calculated for the mussel bed as the areal flux of alkalinity during the profile	mmol hr-1 m-2
respiration_rate	bed respiration rate calculated for the mussel bed as the areal flux of oxygen during the profile	mmol hr-1 m-2

[[table of contents](#) | [back to top](#)]

Instruments

Dataset-specific Instrument Name	Nortek acoustic doppler profiler (ADP)
Generic Instrument Name	Acoustic Doppler Current Profiler
Dataset-specific Description	Nortek acoustic doppler profiler (ADP). 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 with needle-type microsensors
Generic Instrument Name	Oxygen Microelectrode Sensor
Dataset-specific Description	O ₂ and temperature calibrate by the manufacturer. O ₂ calibration verified in seawater equilibrated with atmospheric O ₂ 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.

[[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 macroalgae 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](#)]