

# Shell dissolution data for *Mytilus californianus* from March to July 2020 (OA decoupling project)

**Website:** <https://www.bco-dmo.org/dataset/925664>

**Data Type:** Other Field Results, experimental

**Version:** 1

**Version Date:** 2024-05-06

## Project

» [Invertebrate calcification and behavior in seawater of decoupled carbonate chemistry](#) (OA decoupling)

Contributors	Affiliation	Role
<a href="#">Gaylord, Brian</a>	University of California-Davis (UC Davis)	Principal Investigator
<a href="#">Ninokawa, Aaron Takeo</a>	University of California - Davis: Bodega Marine Laboratory (UC Davis-BML)	Student, Contact
<a href="#">Saley, Alisha</a>	University of California - Davis: Bodega Marine Laboratory (UC Davis-BML)	Student
<a href="#">Shalchi, Roya</a>	University of California - Davis: Bodega Marine Laboratory (UC Davis-BML)	Student
<a href="#">Newman, Sawyer</a>	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

## Abstract

This dataset supports the main incubation data. These data document shell dissolution rates for *Mytilus californianus* which were used to convert net calcification rates of mussels into gross calcification rates.

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## Coverage

**Location:** Laboratory experiments were conducted at the Bodega Marine Laboratory in Bodega Bay, CA, USA and specimens were collected from Carmet Beach

**Spatial Extent:** Lat:38.371361 Lon:-123.076306

**Temporal Extent:** 2020-03-05 - 2020-07-08

## Methods & Sampling

### Sampling collection details

We gathered naturally settled, adult California mussels (*M. californianus* between 30 and 80 mm in maximum shell length) by hand from the mid-intertidal zone of Carmet Beach, along the northern California coast. We cleaned mussels of all epibionts and external byssal threads, then transported them in buckets (< 0.5 hr

transit time) to Bodega Marine Laboratory, where we acclimated individuals for seven days in flow-through seawater tables prior to subsequent experiments.

## Experiment details

This experiment utilized separate incubations with de-fleshed mussel shells to quantify rates of abiotic dissolution, and we employed these dissolution rates to correct the alkalinity anomaly data to estimate gross calcification rates (gross calcification = net calcification + dissolution). The researchers dried and bleached shells ( $n = 60$ ) originating from live mussels at Carmet Beach, CA, and used 7.5% sodium hypochlorite to remove excess tissue and microbial communities, before incubating them in an analogous fashion to the calcification trials (Supplementary Figure S4 in Results paper Pomano de Orte et al. (2021)). Dissolution rate data was plotted against calcium carbonate saturation state, with an Arrhenius-derived dissolution equation of the form  $y = b0 - b1 \cdot e^{a \cdot \Omega}$  where  $y$  is the measured dissolution rate,  $b0$  is the asymptotic dissolution rate,  $b1$  is the y-intercept, and  $a$  is the rate of approaching the asymptote<sup>12</sup>. Dissolution corrections were applied prior to normalization by dry tissue weight.

## Data Processing Description

The researchers fit dissolution rate data, plotted against calcium carbonate saturation state, with an Arrhenius-derived dissolution equation of the form  $y = b0 - b1 \cdot e^{a \cdot \Omega}$  where  $y$  is the measured dissolution rate,  $b0$  is the asymptotic dissolution rate,  $b1$  is the y-intercept, and  $a$  is the rate of approaching the asymptote<sup>12</sup>. Dissolution corrections were applied prior to normalization by dry tissue weight.

## BCO-DMO Processing Description

- Removed special characters (e.g., periods) from column names and replaced with underscores
- Changed the presentation of species values from "mytilus\_californianus" to "Mytilus californianus" and added AphiaID and LSID to the data file
- All numeric float fields rounded to 2 degrees of precision

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## Data Files

File
<b>925664_v1_shell_dissolution_data_for_mytilus_californianus.csv</b> (Comma Separated Values (.csv), 13.78 KB) MD5:e23aebc267b644813bea0fffe1e7e1f2
Primary data file for dataset ID 925664, version 1

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## Related Publications

Romanó de Orte, M., Koweek, D. A., Cyronak, T., Takeshita, Y., Griffin, A., Wolfe, K., Szmant, A., Whitehead, R., Albright, R., & Caldeira, K. (2021). Unexpected role of communities colonizing dead coral substrate in the calcification of coral reefs. *Limnology and Oceanography*, 66(5), 1793–1803. Portico.

<https://doi.org/10.1002/lno.11722>

Results

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## Related Datasets

IsRelatedTo

Gaylord, B. (2024) **Incubation data for Mytilus californianus calcification from January to April 2022 (OA decoupling project)**. Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2024-05-06 doi:10.26008/1912/bco-dmo.925598.1 [[view at BCO-DMO](#)]  
*Relationship Description: Calcification rates are expressed as gross calcification where net calcification = gross calcification - dissolution. Net calcification rates were quantified separately and can be found in this related dataset.*

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Parameters

Parameter	Description	Units
species	Mussel species used in incubation, Mytilus californianus.	unitless
AphiaID	Unique identifier for the listed taxon in the Aphia database.	unitless
LSID	Life Science Identifier (LSID) for the listed taxon.	unitless
module	Experimental module corresponding to different mussel collection events.	unitless
datetime_local	Incubation datetime in Pacific Standard Time.	unitless
start_time_local	Start time of the incubation in Pacific Standard Time.	unitless
ISO_Start_DateTime_UTC	Start datetime of the incubation in UTC.	unitless
duration	Duration of incubation in hours.	hours
salinity	Incubation Salinity.	PSU
temperature	Incubation Temperature.	degrees Celcius
shell_mass	Dried mussel shell mass.	grams (g)
TA	Mean alkalinity during incubation.	umol kg-1
ph	Mean pH during incubation.	unitless
hco3	Mean bicarbonate ion concentration during incubation.	umol kg-1

co3	Mean carbonate ion concentration during incubation.	umol kg-1
omega	Mean aragonite saturation state during incubation, corrected for calcium concentration where calcium was modified.	unitless
co2	Mean carbon dioxide concentration, including dissolved carbon dioxide and carbonic acid concentrations during incubation.	umol kg-1
pco2	Mean partial pressure of carbon dioxide during incubation.	uatm
dic	Mean dissolved inorganic carbon concentration, [CO2] + [HCO3-] + [CO32-], during the incubation.	umol kg-1
incubation_water_mass	Mass of seawater in incubation vessel.	kilograms (kg)
delta_ta	Measured change in alkalinity during incubation.	umol kg-1
diss_rate	Dissolution rate during the incubation expressed as the change in alkalinity per gram of shell material.	umol hr-1 g-1

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## Instruments

<b>Dataset-specific Instrument Name</b>	Shimadzu spectrophotometer
<b>Generic Instrument Name</b>	UV Spectrophotometer-Shimadzu
<b>Dataset-specific Description</b>	A Shimadzu spectrophotometer was used to conduct spectrophotometric pH and ammonia analyses.
<b>Generic Instrument Description</b>	The Shimadzu UV Spectrophotometer is manufactured by Shimadzu Scientific Instruments (ssi.shimadzu.com). Shimadzu manufactures several models of spectrophotometer; refer to dataset for make/model information.

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## Project Information

**Invertebrate calcification and behavior in seawater of decoupled carbonate chemistry (OA decoupling)**

**Coverage:** California coast, USA

#### *NSF Award Abstract:*

This research is exploring the capacity of coastal organisms to cope with alterations in seawater chemistry driven by both freshwater inputs and absorption of carbon dioxide into the world's oceans (ocean acidification). The project focuses on calcification responses and behavioral impairments of shoreline animals under altered seawater chemistry, and forefronts a common mussel species (the California mussel), and a common snail (the black turban snail), each abundant on rocky shores along the west coast of North America. The target species operate as exemplar organisms for characterizing the responses of marine invertebrates more generally. Methods involve experimental decoupling of multiple components of the carbonate system of seawater to isolate drivers that are difficult to separate otherwise. Broader impacts include transfer of scientific information to policy-makers, including legislators, as well as training and skill-set development of future generations of scientists and citizens. One Ph.D. student is supported, as are UC Davis undergraduates conducting mentored research. The project also provides research internships for undergraduates from a local community college (Santa Rosa Junior College), many of whom are from underrepresented groups. The latter project component substantially bolsters an ongoing program at Bodega Marine Laboratory that includes efforts in diversity, equity, and inclusion. Data and interpretations from the project are feeding into an existing educational program that links to local K-12 schools and reaches ~10,000 members of the public each year.

Overall, the research of the project is dissecting drivers of calcification and behavioral disruption in key shoreline invertebrates, across present-day and future carbonate system conditions appropriate to coastal marine environments. Efforts are exploring the extent to which calcification depends on one versus multiple parameters of the seawater carbonate system. In particular, existing conceptual models emphasize the importance of calcium carbonate saturation state ( $\Omega$ ) and/or the ratio of bicarbonate to hydrogen ion concentrations ( $[\text{HCO}_3^-]/[\text{H}^+]$ ), and the project is examining these mechanisms as well as the possibility that more than one driver acts simultaneously. It is doing so both in bivalves and in gastropods to test for generality across mollusks. The project is additionally examining whether pH is the only carbonate system factor contributing to known patterns of behavioral impairment in marine invertebrates. Leading explanations for debilitating behaviors induced by ocean acidification involve altered ion channel function, but discussion in the literature continues, and studies that explicitly decouple the carbonate system are necessary.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

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## **Funding**

Funding Source	Award
<a href="#">NSF Division of Ocean Sciences (NSF OCE)</a>	<a href="#">OCE-2129942</a>

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