

# Control incubation data during *Mytilus californianus* calcification experiments from 2020 to 2022 (OA decoupling project)

**Website:** <https://www.bco-dmo.org/dataset/925714>

**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
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## Abstract

These data support Incubation data for *Mytilus californianus* calcification. These incubations did not contain mussels and demonstrate that background alkalinity changes during experimental modules were minor. These data support Incubation data for *Mytilus californianus* calcification. These data demonstrate that background alkalinity changes during experimental modules were minor.

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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:** 2020-01-12 - 2022-04-22

## Methods & Sampling

### Experiment details

We conducted additional incubations (n=87, between 3 and 9 per experiment day) without mussels throughout the trials as experimental blanks to determine background changes in alkalinity. We excluded from our analysis any experimental days where background alkalinity changes exceeded 5  $\mu\text{mol kg}^{-1}$ .

The mean of the absolute values of alkalinity change during the incubations of these experimental blanks was  $1.3 \pm 1.2 \mu\text{mol kg}^{-1}$  (n = 72).

## Data Processing Description

We performed all computations with R statistical software, version 4.1.0. We performed carbonate system calculations using the package *seacarb*, using equilibrium constants from Lueker *et al.* We computed linear mixed models using the *lmer* function in the *lmerTest* package in R and focused on assessing likely candidate parameters as fixed factors, and mussel collection date as a random intercept to account for natural seasonal differences between cohorts. Conditional R<sup>2</sup> was calculated with the package *MuMIn*. We determined parameters for non-linear fits employed to model dissolution rates by minimizing the sum of squares of model residuals using the *optim* function.

Colors for plots were chosen from color palettes in the *cmocean* package in R.

## BCO-DMO Processing Description

- Removed special characters (e.g., periods) from column names and replaced with underscores
- Replaced NAs with "" (blanks) to indicate no data values
- 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
- A column was added to the data file to represent the incubation start time in UTC, this new column is called ISO\_start\_DateTime\_UTC

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## Data Files

File
<b>925714_v1_control_incubation_data_during_calcification_experiments.csv</b> (Comma Separated Values (.csv), 15.00 KB) MD5:7dbd28d2f7f7056792422fd2138f1bacc
Primary data file for dataset ID 925714, version 1

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## Related Publications

Gazeau, F., Urbini, L., Cox, T., Alliouane, S., & Gattuso, J. (2015). Comparison of the alkalinity and calcium anomaly techniques to estimate rates of net calcification. *Marine Ecology Progress Series*, 527, 1-12.  
<https://doi.org/10.3354/meps11287>

*Methods*

Lueker, T. J., Dickson, A. G., & Keeling, C. D. (2000). Ocean pCO<sub>2</sub> calculated from dissolved inorganic carbon, alkalinity, and equations for K<sub>1</sub> and K<sub>2</sub>: validation based on laboratory measurements of CO<sub>2</sub> in gas and seawater at equilibrium. *Marine Chemistry*, 70(1-3), 105-119. doi:10.1016/S0304-4203(00)00022-0

[https://doi.org/10.1016/S0304-4203\(00\)00022-0](https://doi.org/10.1016/S0304-4203(00)00022-0)

*Methods*

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) **Allometric scaling of calcification data for *Mytilus californianus* from 2021-2022 (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.925689.1 [[view at BCO-DMO](#)]

*Relationship Description: Net calcification rates are calculated using the ammonia-corrected alkalinity anomaly technique, divided by incubation duration and mussel dry tissue mass raised by a factor of 0.72. Related dry tissue mass data is included in this linked dataset.*

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## Parameters

Parameter	Description	Units
species	Mussel species used in incubation.	units
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
date_local	Incubation date in Pacific Standard Time.	unitless
start_time_local	Start time of the incubation in Pacific Standard Time.	unitless
ISO_start_DateTime_UTC	Start time of the incubation in UTC.	unitless
duration	Duration of incubation in hours.	hours (h)
salinity	Incubation Salinity.	PSU
temperature	Incubation Temperature.	degrees Celcius (c)
TA	Mean alkalinity during incubation.	umol kg-1
ph	Mean pH during incubation, total scale.	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
pco2	Mean partial pressure of carbon dioxide during incubation.	uatm
dic	Mean dissolved inorganic carbon concentration, [CO <sub>2</sub> ] + [HCO <sub>3</sub> <sup>-</sup> ] + [CO <sub>3</sub> <sup>2-</sup> ], during the incubation.	umol kg-1
do	Mean dissolved oxygen concentration 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
delta_nh3	Measured change in ammonia concentration during incubation.	umol kg-1

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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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