

Shell Concentrations from an adult Eastern oyster ocean acidification exposure experiment on adult Eastern oysters from Plum Island Sound in 2017

Website: <https://www.bco-dmo.org/dataset/888902>

Data Type: Other Field Results

Version: 1

Version Date: 2023-02-02

Project

» [Collaborative Research: Does ocean acidification induce a methylation response that affects the fitness of the next generation in oysters?](#) (Epigenetics to Ocean)

Contributors	Affiliation	Role
Lotterhos, Katie	Northeastern University	Principal Investigator
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Abstract

Trace, minor, and major element data from adult Eastern oyster ocean acidification exposure experiments were conducted at the Ries Lab at the Northeastern University Marine Science Center on samples from Plum Island Sound in 2017. This dataset represents shell Concentrations of the adult eastern oyster (*Crassostrea virginica*) exposed to experimental ocean acidification (OA) over 80 days.

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Coverage

Spatial Extent: Lat:42.751636 Lon:-70.837023

Temporal Extent: 2017-04 - 2017-04

Acquisition Description

This dataset represents *Crassostrea virginica* shell samples analyzed for trace and minor elements in adult Eastern oyster ocean acidification exposure experiments at the Ries Lab at the Northeastern University Marine Science Center on samples from Plum Island Sound in 2017.

The collection and culturing of *C. virginica* specimens are detailed in Downey-Wall, A.M., L.P. Cameron, B.M. Ford, E.M. McNally, Y.R. Venkataraman, S.B. Roberts, J.B. Ries, and K.E. Lotterhos. 2020. Ocean acidification induces subtle shifts in gene expression and DNA methylation in the mantle tissue of the Eastern oyster

(*Crassostrea virginica*). *Frontiers in Marine Science* doi: 10.3389/fmars.2020.566419.

Shells were cleaned thoroughly in 90 percent ethanol (Fisher Reagent Alcohol CAS: 64-17-5). Cleaned shells were dried at room temperature for 48 hours and stored in sealed plastic bags. The inner (lamellar) layer of oyster shells was sampled for elemental analysis. Shells were sampled by gently moving a Shiyang-III dental drill outfitted with a round bit across the low-Mg calcite surfaces of the interior shell. The powdered shell was placed in 15-milliliter (mL) polypropylene centrifuge tubes leached in 5 percent ultra-pure nitric acid solution (Fisher TraceMetal Grade Nitric Acid UN2031).

Elemental analysis

Shell samples were analyzed for trace and minor elements by inductively coupled plasma mass spectrometry (ICPMS). Shell samples were also acidified with ultra-pure nitric acid for analysis. Shell samples were analyzed for a suite of 57 elements (including Ca) by ActLabs, Ontario, Canada using the ActLabs ICPMS Ultratrace 4 method.

Processing Description

Concentration data were received from ActLabs:

<https://actlabs.com/geochemistry/exploration-geochemistry/4-acid-near-total-digestion/>

Concentration data were negative-corrected (i.e., for intercept correction of the calibration) by adding the lowest negative value along with a de minimis constant (0.000001) to each sample for each element that exhibited negative concentration values.

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Data Files

File	Version
shell_concentrationdata.csv filename: shell_concentrationdata.csv (Comma Separated Values (.csv), 46.11 KB) MD5:4d2c4777b507ddf4f060f11dc7518915 <i>Primary data file for dataset 888902, version 1.</i>	1

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Related Publications

Downey-Wall, A. M., Cameron, L. P., Ford, B. M., McNally, E. M., Venkataraman, Y. R., Roberts, S. B., Ries, J. B., & Lotterhos, K. E. (2020). Ocean Acidification Induces Subtle Shifts in Gene Expression and DNA Methylation in Mantle Tissue of the Eastern Oyster (*Crassostrea virginica*). *Frontiers in Marine Science*, 7.

<https://doi.org/10.3389/fmars.2020.566419>

IsRelatedTo

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Related Datasets

IsRelatedTo

Downey-Wall, A., Lotterhos, K., Ries, J. B., Cameron, L. (2023) **Phenotypic responses of Eastern oyster in response to variable length OA exposure conducted in summer 2017 with oysters sampled in Plum Island.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-01-20 <http://lod.bco-dmo.org/id//887553> [[view at BCO-DMO](#)]

Lotterhos, K., Ries, J. B. (2023) **Molar Ratios from an adult Eastern oyster ocean acidification exposure experiment at the Northeastern University Marine Science Center in 2017.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-02-02 <http://lod.bco-dmo.org/id//888911> [[view at BCO-DMO](#)]

McNally, E., Lotterhos, K., Ries, J. B. (2023) **Seawater concentration data from an ocean acidification exposure experiment on adult Eastern oysters from Plum Island Sound in 2017.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-02-02 doi:10.26008/1912/bco-dmo.888887.1 [[view at BCO-DMO](#)]

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Parameters

Parameter	Description	Units
RunID	Unique id for analysis run	unitless
SampleID	Unique identifier for the sample	unitless
OystID	Unique identifier for the bivalve used when sample ID was just labelled as shell	unitless
Species	sample shell type; M = mantle R = repair AM = above mud UM = under mud	unitless
SampleType	species that the shell sample was taken from	unitless
Ag_ppm	measured concentration of silver	parts per million
Al_perc	measured concentration of aluminum	percent
As_ppm	measured concentration of arsenic	parts per million
Au_ppb	measured concentration of gold	parts per billion
B_ppm	measured concentration of boron	parts per million
Ba_ppm	measured concentration of barium	parts per million
Be_ppm	measured concentration of beryllium	parts per million
Bi_ppm	measured concentration of bismuth	parts per million
Ca_perc	measured concentration of calcium	percent
Cd_ppm	measured concentration of cadmium	parts per million
Ce_ppm	measured concentration of Cerium	parts per million
Co_ppm	measured concentration of cobalt	parts per million
Cr_ppm	measured concentration of chromium	parts per million
Cs_ppm	measured concentration of cesium	parts per million
Cu_ppm	measured concentration of copper	parts per million
Dy_ppm	measured concentration of dysprosium	parts per million
Er_ppm	measured concentration of erbium	parts per million
Eu_ppm	measured concentration of europium	parts per million
Fe_perc	measured concentration of iron	percent

Ga_ppm	measured concentration of gallium	parts per million
Gd_ppm	measured concentration of gadolinium	parts per million
Ge_ppm	measured concentration of germanium	parts per million
Hf_ppm	measured concentration of hafnium	parts per million
Hg_ppb	measured concentration of mercury	parts per billion
Ho_ppm	measured concentration of holmium	parts per million
In_ppm	measured concentration of indium	parts per million
K_perc	measured concentration of potassium	percent
La_ppm	measured concentration of lanthanum	parts per million
Li_ppm	measured concentration of lithium	parts per million
Lu_ppm	measured concentration of lutetium	parts per million
Mg_perc	measured concentration of magnesium	percent
Mn_ppm	measured concentration of manganese	parts per million
Mo_ppm	measured concentration of molybdenum	parts per million
Na_perc	measured concentration of sodium	percent
Nb_ppm	measured concentration of niobium	parts per million
Nd_ppm	measured concentration of neodymium	parts per million
Ni_ppm	measured concentration of nickel	parts per million
P_perc	measured concentration of phosphorus	percent
Pb_ppm	measured concentration of lead	parts per million
Pr_ppm	measured concentration of praseodymium	parts per million
Rb_ppm	measured concentration of rubidium	parts per million
Re_ppm	measured concentration of rhenium	parts per million
S_perc	measured concentration of sulfur	percent
Sb_ppm	measured concentration of antimony	parts per million
Sc_ppm	measured concentration of scandium	parts per million
Se_ppm	measured concentration of selenium	parts per million
Sm_ppm	measured concentration of samarium	parts per million
Sn_ppm	measured concentration of tin	parts per million
Sr_ppm	measured concentration of strontium	parts per million
Ta_ppm	measured concentration of tantalum	parts per million
Tb_ppm	measured concentration of terbium	parts per million
Te_ppm	measured concentration of tellurium	parts per million
Th_ppm	measured concentration of thorium	parts per million
Ti_perc	measured concentration of titanium	percent
Tl_ppm	measured concentration of thallium	parts per million
Tm_ppm	measured concentration of thulium	parts per million
U_ppm	measured concentration of uranium	parts per million
V_ppm	measured concentration of vanadium	parts per million
W_ppm	measured concentration of tungsten	parts per million
Y_ppm	measured concentration of yttrium	parts per million

Yb_ppm	measured concentration of ytterbium	parts per million
Zn_ppm	measured concentration of zinc	parts per million
Zr_ppm	measured concentration of zirconium	parts per million

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	Inductively Coupled Plasma Mass Spectrometer
Generic Instrument Description	An ICP Mass Spec is an instrument that passes nebulized samples into an inductively-coupled gas plasma (8-10000 K) where they are atomized and ionized. Ions of specific mass-to-charge ratios are quantified in a quadrupole mass spectrometer.

Dataset-specific Instrument Name	Mettler Toledo scale
Generic Instrument Name	Scale
Dataset-specific Description	Mettler Toledo scale (precision = 0.001g)
Generic Instrument Description	An instrument used to measure weight or mass.

Dataset-specific Instrument Name	Shiyang-III dental drill
Generic Instrument Name	Drill
Generic Instrument Description	A drill is a tool used for making round holes or driving fasteners. There are many types of drills: some are powered manually, and others use electricity (electric drill) or compressed air as the motive power. Drills with a percussive action (hammer drills) are mostly used in hard materials such as masonry (brick, concrete, and stone) or rock. Some types of hand-held drills are also used to drive screws and other fasteners.

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Project Information

Collaborative Research: Does ocean acidification induce a methylation response that affects the fitness of the next generation in oysters? (Epigenetics to Ocean)

Coverage: Coastal Massachusetts near Nahant: 42°25'06"N 70°54'14"W

NSF Award Abstract:

Marine ecosystems worldwide are threatened by ocean acidification, a process caused by the unprecedented rate at which carbon dioxide is increasing in the atmosphere. Since ocean change is predicted to be rapid, extreme, and widespread, marine species may face an "adapt-or-die" scenario. However, modifications to the DNA sequence may be induced in response to a stress like ocean acidification and then inherited. Such

"epigenetic" modifications may hold the key to population viability under global climate change, but they have been understudied. The aim of this research is to characterize the role of DNA methylation, a heritable epigenetic system, in the response of Eastern oysters (*Crassostrea virginica*) to ocean acidification. The intellectual merit lies in the integrative approach, which will characterize the role of DNA methylation in the intergenerational response of oysters to ocean acidification. These interdisciplinary data, spanning from molecular to organismal levels, will provide insight into mechanisms that underlie the capacity of marine invertebrates to respond to ocean acidification and lay the foundation for future transgenerational studies. Ocean acidification currently threatens marine species worldwide and has already caused significant losses in aquaculture, especially in *Crassostrea* species. This research has broader impacts for breeding, aquaculture, and the economy. Under the investigators' "Epigenetics to Ocean" (E2O) training program, the investigators will build STEM talent in bioinformatics and biogeochemistry, expose girls in low-income school districts to careers in genomics, and advance the field through open science and reproducibility.

This research will specifically test if intermittent exposure to low pH induces a methylation response with downstream beneficial effects for biomineralization. These methylation states could be inherited and confer a fitness advantage to larvae that possess them. Phase 1 of the project will use an exposure experiment to determine the degree to which DNA methylation is altered and regulates the response to OA. Data from this experiment will be used to test the hypotheses that (i) DNA methylation, induced in the tissue of shell formation (i.e., mantle tissue), is correlated with changes in transcription and regulation of pallial fluid pH (calcifying fluid pH, measured by microelectrode), and (ii) that methylation changes induced in the mantle tissue are also induced in the germline --indicating that such changes are potentially heritable. Phase 2 of the project will use a pair-mated cross experiment to test the hypothesis that parental exposure to OA alters larval traits (calcification rate, shell structure, and polymorph mineralogy). Larvae will be generated from parents exposed to OA or control seawater, and then raised under control or OA conditions. Results will be used to (i) characterize inheritance of induced methylation states, (ii) estimate the variance in larval traits explained by genotype, non-genetic maternal/paternal effects, adult OA exposure, larval OA exposure, and parental methylome, and (iii) test the hypothesis that adult exposure alters the heritability (a quantity that predicts evolutionary response) of larval traits. Since the effects of epigenetic phenomena on estimates of heritability are highly debated, the results would advance understanding of this important issue. Because the investigators could discover that DNA methylation is a mechanism for heritable plastic responses to OA, knowledge of this mechanism would significantly improve and potentially transform predictive models for how organisms respond to global change.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1635423

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