

Macrophytes' amelioration of seawater acidity: Comparison among species in the Gulf of Maine from June-July 2015

Website: <https://www.bco-dmo.org/dataset/922818>

Data Type: Other Field Results

Version: 1

Version Date: 2024-05-21

Project

» [REU Site: Bigelow Laboratory for Ocean Sciences - Undergraduate Research Experience in the Gulf of Maine and the World Ocean](#) (Bigelow REU GOM)

Contributors	Affiliation	Role
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Abstract

This dataset includes data from experiment 1, comparison among species, described in the manuscript: Optimizing marine macrophyte capacity to locally ameliorate ocean acidification under variable light and flow regimes: Insights from an experimental approach (2023). An experiment examining the effects of increased CO₂ concentrations upon the capacity of the different species of marine macrophytes to ameliorate seawater acidity via several assays in enclosed well-mixed, airtight chambers with no headspace, was conducted indoors at the Bigelow Laboratory for Ocean Sciences (Maine, USA), in June-July 2015. We explored the individual capacities of four species of marine macrophytes (*Ulva lactuca*, *Zostera marina*, *Fucus vesiculosus* and *Saccharina latissima*) to ameliorate seawater acidity in experimentally elevated pCO₂. Data from experiment 2, residence time and irradiance, is available through BCO-DMO at <https://www.bco-dmo.org/dataset/922819>.

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Coverage

Location: Gulf of Maine, US

Spatial Extent: N:43.860556 E:-69.57825 S:43.749075 W:-70.193742

Temporal Extent: 2015-06 - 2015-07

Methods & Sampling

Methodology summary: The experiment in aquaria measured changes in dissolved oxygen, pH, and total alkalinity, and derived resultant changes to dissolved inorganic carbon (DIC) and calcium carbonate saturation state (Ω).

Values of temperature, salinity, oxygen and pH were recorded in all the chambers using a multiparameter meter (HQ40D, Hach Lange) calibrated before measurements with TRIS buffer, from A. Dickson laboratory,

with an accuracy of 0.01 pH units. Discrete water samples were acquired from three representative chambers from each CO₂ level per species for analysis of total alkalinity (AT). Seawater AT was measured using open-cell titration with triplicate samples (Metrohm 855 Robotic Titrosampler, Metrohm, USA) using 0.1 N HCl (Fisher Chemical) diluted to a nominal concentration of 0.0125 M. Acid was calibrated by analyzing Certified Reference Material (CRM Batch 138) from A. Dickson's laboratory. For each set of triplicate analyses, the median value was considered. Instrumental precision was within 5 μmol kg⁻¹.

See detailed methodology in Ricart AM, Honisch B, Fachon E, Hunt CW, Salisbury J, Arnold SN, Price NN. Optimizing marine macrophyte capacity to locally ameliorate ocean acidification under variable light and flow regimes: Insights from an experimental approach. PLoS One. 2023 Oct 11;18(10):e0288548. doi: 10.1371/journal.pone.0288548. PMID: 37819926; PMCID: PMC10566731.

Data Processing Description

DIC and Ω, as aragonite saturation state, were calculated from pH and AT.

Carbonate system calculations were performed using the seacarb R package and assuming published values for constants K₁ and K₂, K_F, and K_S. Uncertainties of the derived parameters (DIC, pCO₂, and Ω) were quantified using a Monte Carlo analysis (100 simulations). For each simulation, normally distributed errors were introduced into pH (± 0.01) and AT (± 5 μmol kg⁻¹). The overall uncertainties of the derived parameters were calculated as one standard deviation of the simulations. On average, uncertainties for DIC were 0.28 %, for pCO₂ were 2.5 % and for Ω 0.01 %. For pCO₂, uncertainty is higher at lower pCO₂, whereas uncertainty is lower for Ω at lower Ω. The uncertainty for DIC was similar to the uncertainty in AT, that is ± 5 μmol kg⁻¹.

BCO-DMO Processing Description

The first column of the dataset does not have a parameter name, so this was named ID.

Removed units from the parameter names since these units will be noted in the parameters section of the dataset page.

Renamed *Ulva* to *U. lactuca* to match the pattern of the other species entries.

Renamed *Z.marina* to *Z. marina* to match the format of the other species entries in the dataset.

Joined a metadata table created by the data manager to the submitted dataset on the parameter name Species. The metadata table has columns of Species, lat, and lon and after the join, lat and lon are part of the dataset file.

Reordered the parameters so that the metadata is at the front of the dataset.

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Related Publications

Ricart, A. M., Honisch, B., Fachon, E., Hunt, C. W., Salisbury, J., Arnold, S. N., & Price, N. N. (2023). Optimizing marine macrophyte capacity to locally ameliorate ocean acidification under variable light and flow regimes: Insights from an experimental approach. PLOS ONE, 18(10), e0288548.

<https://doi.org/10.1371/journal.pone.0288548>

Results

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Related Datasets

IsRelatedTo

Ricart, A. M., Price, N. N., Honisch, B. (2024) **Macrophytes' amelioration of seawater acidity: Residence time and irradiance in the Gulf of Maine on 2018-11-01**. Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2024-05-21 <http://lod.bco-dmo.org/id/dataset/922819> [[view at BCO-DMO](#)]

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Parameters

Parameter	Description	Units
ID	Row id	unitless
Sample	Chamber ID	unitless
Species	A taxonomic binomial that consists of a genus name followed by the species name. Scientific name of the macrophyte species used and the control chambers.	unitless
lat	Sampling location latitude, south is negative	decimal degrees
lon	Sampling location longitude, west is negative	decimal degrees
Treatment	pCO ₂ level during incubation	microatmospheres
Liters	volume of incubation chamber	liters (L)
Hours	total duration of incubation	unitless
Dry_Weight	dry biomass of macrophyte inside the chamber	grams (g)
Salinity	salinity of seawater	unitless
Temperature	temperature of seawater	degrees (C)
Initial_Dissolved_Oxygen	Initial dissolved oxygen	micromolar per liter (uM/L)
Initial_pH	initial pH	total scale
Initial_ALK	initial total alkalinity	micromolar per kilogram (uM/kg)
Initial_pCO ₂	initial pCO ₂	microatmospheres
delta_DO_norm	The difference in dissolved oxygen before and after the incubations normalized	micromolar per liter (uM/l)
delta_DIC_norm	The difference in dissolved inorganic carbon before and after the incubations normalized	unitless
delta_pH_norm	The difference in pH before and after the incubations normalized	total scale
delta_omega_norm	The difference in omega before and after the incubations normalized. Omega is the saturation state of calcium carbonate (CaCO ₃), the degree to which seawater is saturated with CaCO ₃ . This essentially is a measure of carbonate ion concentration.	unitless

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Instruments

Dataset-specific Instrument Name	Metrohm 855 Robotic Titrosampler, Metrohm, USA
Generic Instrument Name	Automatic titrator
Dataset-specific Description	Basic model for setting up customer-specific automation in the titration.
Generic Instrument Description	Instruments that incrementally add quantified aliquots of a reagent to a sample until the end-point of a chemical reaction is reached.

Dataset-specific Instrument Name	multiparameter meter (HQ40D, Hach Lange)
Generic Instrument Name	Multi Parameter Portable Meter
Dataset-specific Description	Designed for water quality applications measuring pH, Conductivity, TDS, Salinity, Dissolved Oxygen (DO), ORP and ISE, the Hach HQ40D portable multi meter is a two channels advanced handheld digital meter.
Generic Instrument Description	An analytical instrument that can measure multiple parameters, such as pH, EC, TDS, DO and temperature with one device and is portable or hand-held.

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Project Information

REU Site: Bigelow Laboratory for Ocean Sciences - Undergraduate Research Experience in the Gulf of Maine and the World Ocean (Bigelow REU GOM)

Coverage: Gulf of Maine, US

NSF Award Abstract:

Bigelow Laboratory for Ocean Sciences, in West Boothbay Harbor - Maine, plans to implement an REU site that will support 10 students each year, for the next 5 years. This REU program will combine group learning and guided individual research to help students address societal issues concerning the oceans. The goals of this REU Program are i) to provide undergraduate students from around the United States mentoring and access to high quality, hands on research opportunities in Oceanography and the opportunity to understand its interdisciplinary nature, ii) improve the capability and confidence of students to learn independently, iii) help to prepare undergraduates for their professional careers, and iv) increase the participation of underrepresented minorities in marine science careers. REU students will be incorporated into research groups consisting of technicians, post-docs, and junior and senior scientists, gaining exposure to the suite of activities and personalities involved in a science career. The recruitment goal is to engage students from all groups underrepresented in ocean sciences, such that cohorts are ~ 40% underrepresented students (including 1st generation college students). To achieve the recruitment goals, the principal investigator will work with partner organizations, like the Institute for Broadening Participation and Maine Community College System. Program content and delivery will continually be refined based on feedback from students and mentors in the form of pre-program, midpoint and final evaluations.

As a group, students will participate in a sampling cruise on the local estuary, and attend weekly meetings to learn the fundamentals of the scientific process, such as how to form testable hypotheses, critically evaluate data, and present information in a scientific manner to their peers and to the public. Students will attend an ethics in science discussion, a laboratory safety course with risk assessment training and a concept mapping workshop during the early stages of their project. Students participate in and become familiar with public outreach through attendance at Bigelow's weekly Café Scientifique talks (for the general public), participation in

the Lab's Open House and frequent public tours.

Continuing Award

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Funding

Funding Source	Award
NSF Division of Earth Sciences (NSF EAR)	EAR-1460861
NSF Division of Ocean Sciences (NSF OCE)	OCE-1156740

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