Time-series of estimating pH in culture tanks of Ulva australis under ocean acidification (OA) and eutrophication (Seaweed OA Resilience project)

Website: https://www.bco-dmo.org/dataset/731339
Data Type: experimental
Version:
Version Date: 2018-03-21

Project
» Ocean Acidification: Scope for Resilience to Ocean Acidification in Macroalgae (Seaweed OA Resilience)

Program
» Science, Engineering and Education for Sustainability NSF-Wide Investment (SEES): Ocean Acidification (formerly CRI-OA) (SEES-OA)

Contributors	Affiliation	Role
Kubler, Janet E.	California State University Northridge (CSUN)	Principal Investigator
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Coverage

Spatial Extent: **Lat**:-42.998 **Lon**:147.33
Temporal Extent: 2015-07-31 - 2015-08-07

Dataset Description

This dataset includes estimates of the pH in cultures of Ulva australis under OA and eutrophication. The time-series lasted for a week from 2015-07-31 until 2015-08-07.

Related Datasets:

Ulva pCO2 - NH4 enrichment: Data on growth rates, and physiological parameters of Ulva australis under ocean acidification (OA) and eutrophication, from July 2015 (Seaweed OA Resilience project)

Ulva rapid light curves (RLC): Rapid light curves of Ulva australis based on PAM fluorometry under OA and eutrophication (Seaweed OA Resilience project)

Methods & Sampling

Ulva australis was collected from Blackmans Bay, Tasmania, Australia (approx. 42°59’56"S 147°19’8"E) in July 2015 (Austral winter). Three Ulva australis thalli were placed in chambers filled with sterile seawater and circulated with fresh seawater. The pHT of seawater pumped to each tank was maintained using an automated pH control system. Seawater was equilibrated using a membrane contactor where the appropriate mix of N2 and CO2 gas was achieved using three pairs of mass flow controllers (MFCs) set to pHTs of 8.05, 7.85, and 7.65.

Each of the three MFCs were randomly assigned to four ambient NH4+ and four enriched NH4+growth chambers for a total of 24 chambers. The pHT within each culture chamber was measured every 1.5–3 hours throughout the week-long experiment, monitoring the effect of U. australis photosynthesis and respiration on seawater pHT. The seaweed biomass: seawater volume ratio affected the pHT of the culture chambers so the average pHT of each chamber was denoted by measurements of pHT during the dark cycle throughout the entire experiment which resulted in a continuous range of pHTs (7.56–7.85) representative of future seawater pH conditions.

The ambient NH4+ concentration (n = 12) served as a control for the nutrient treatment and consisted of natural, UV-sterilized, filtered seawater. The enriched concentration of NH4+ (n = 12) was achieved using an auto-dosing peristaltic pump programmed to deliver 12 mL of a 1000 µM NH4Cl solution to growth chambers every two hours. Based on NH4+dosing rate, the NH4+ concentration in the enriched treatment was 20 µM. However, discrete measurements of seawater NH4+ concentrations on days 0, 3, and 6 showed that the average NH4+ concentration was 0.4 ± 0.3 µM in the ambient treatment and 38.0 ± 18.6 µM the enriched treatment.

A syringe pump and two 12-port rotary valves were used to sample seawater directly from each growth chamber. For each spectrophotometric pH measurement, a reference spectrum was acquired after flushing 25 mL of seawater through a 1 cm flow-through quartz cuvette. A spectrum (400–800 nm) was acquired using an LED light source and a UV-Vis spectrometer (BluLoop and USB2000+, Ocean Optics, USA). A dye + seawater spectrum was then obtained after mixing 200 µL of 2 mM metacresol purple sodium salt dye (211761-10G, Sigma Aldrich, Australia) with an additional 25 mL of seawater within the syringe pump. The two spectra were used to calculate an absorbance spectrum. pHT was calculated using the quadratic fits of the absorbance spectra between 429–439 nm, 573–583 nm and a background signal averaged between 750–760 nm. When compared to calculations based on a single wavelength, the quadratic fit approach leads to a three-fold improvement in measurement precision. Each recorded pHT was the average of four replicate measurements, which took approximately three minutes to obtain. The temperature of each sample was recorded with a PT100 temperature sensor and a high-precision data logger. All instrument control, spectra manipulations, and pHT calculations were done using LabVIEW 2014 (National Instruments, USA).

A complete description of methods for implementation and monitoring of experimental treatments, and sampling methods to estimate response variables provided in the following publication:

Related Reference:

Reidenbach LB, Fernandez PA, Leal PP, Noisette F, McGraw CM, Revill AT, et al. (2017). Growth, ammonium metabolism, and photosynthetic properties of Ulva australis (Chlorophyta) under decreasing pH and ammonium enrichment. PLoS ONE 12(11): e0188389. https://doi.org/10.1371/journal.pone.0188389

Data Processing Description

BCO-DMO Processing Notes:
- added a conventional header with dataset name, PI name, version date
- modified parameter names to conform with BCO-DMO naming conventions
- removed trailing blanks from a few date records and formatted all dates to yyyy-mm-dd (originally variable)
- added ISO_DateTime_Local column

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Data Files

File
pHT_Ulva_australis.csv (Comma Separated Values (.csv), 194.89 KB) MD5:386dcd644030ccfb367e9251c6d6a7fb Primary data file for dataset ID 731339

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Related Publications

Reidenbach, L. B., Fernandez, P. A., Leal, P. P., Noisette, F., McGraw, C. M., Revill, A. T., ... Kübler, J. E. (2017). Growth, ammonium metabolism, and photosynthetic properties of Ulva australis (Chlorophyta) under decreasing pH and ammonium enrichment. PLOS ONE, 12(11), e0188389. doi:10.1371/journal.pone.0188389 *Results*

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Parameters

Parameter	Description	Units
Tank_valve	Tank valve ID for culture treatment	unitless
MFC_ID	Mass-flow controller ID	unitless
NH4_Trt	Designated level of treatment of ammonium enrichment categorical descriptor	unitless
Date	Date formatted as yyyy-mm-dd	unitless
Time	Time formatted as HH:MM:SS	unitless
ISO_DateTime_Local	Date/Time (lcoal) ISO formatted based on ISO 8601:2004E. Format: yyyy-mm-ddTHH:MM:SS	unitless
Run	Water sample identifier from tank	unitless
pH	pH Total scale (average of 4 estimates)	unitless
pH_stdev	Standard deviation about pHT estimate	unitless
N	Number of samples at each time	samples
Spec_Temp	Sample temperature in spectrometer	degrees Celsius
Tank_Temp	Sample temperature in situ	degrees Celsius

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Instruments

Dataset-specific Instrument Name	high-precision data logger (PT-104, PICO Technology, UK)
Generic Instrument Name	Data Logger
Dataset-specific Description	Used to record temperature data during the time-series.
Generic Instrument Description	Electronic devices that record data over time or in relation to location either with a built-in instrument or sensor or via external instruments and sensors.

Dataset-specific Instrument Name	Omega Engineering, models FMA5418A and FMA545C
Generic Instrument Name	Mass Flow Controller
Dataset-specific Description	Three pairs of MFC's were used to achieve the appropriate mix of N2 and CO2 gas.
Generic Instrument Description	Mass Flow Controller (MFC) - A device used to measure and control the flow of fluids and gases

Dataset-specific Instrument Name	Peristaltic pumps - Omega Engineering, model FPU500; auto-dosing peristaltic pump (Jebao DP-4); syringe pump (V6 pump with valve 24090, Norgren, UK)
Generic Instrument Name	Pump
Dataset-specific Description	Peristaltic pumps (FPU500, Omega Engineering, USA) were used to provide fresh seawater to each of the 24 growth chambers at a rate of 6–8 mL/min. The elevated concentration of NH4+ (n = 12) was achieved using an auto-dosing peristaltic pump (Jebao DP-4) programmed to deliver 12 mL of a 1000 µM NH4Cl solution to growth chambers every two hours. A syringe pump (V6 pump with valve 24090, Norgren, UK) and two 12-port rotary valves (23425 valve driver with valve 24493, Norgren, UK) were used to sample seawater directly from each growth chamber for pH and alkalinity measurements.
Generic Instrument Description	A pump is a device that moves fluids (liquids or gases), or sometimes slurries, by mechanical action. Pumps can be classified into three major groups according to the method they use to move the fluid: direct lift, displacement, and gravity pumps

Dataset-specific Instrument Name	UV-vis Spectrometer - Ocean Optics, USA, BluLoop and USB2000+
Generic Instrument Name	Spectrometer
Dataset-specific Description	Used to measure pH and alkalinity.
Generic Instrument Description	A spectrometer is an optical instrument used to measure properties of light over a specific portion of the electromagnetic spectrum.

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Project Information

Ocean Acidification: Scope for Resilience to Ocean Acidification in Macroalgae (Seaweed OA Resilience)

Coverage: Temperate coastal waters of the USA (30 - 45 N latitude, -66 to -88 W and -117 to -125 W longitude)

Benthic macroalgae contribute to intensely productive near shore ecosystems and little is known about the potential effects of ocean acidification on non-calcifying macroalgae. Kübler and Dudgeon will test hypotheses about two macroalgae, *Ulva* spp. and *Plocamium cartilagineum*, which, for different reasons, are hypothesized to be more productive and undergo ecological expansions under predicted changes in ocean chemistry. They have designed laboratory culture-based experiments to quantify the scope for response to ocean acidification in *Plocamium*, which relies solely on diffusive uptake of CO2, and populations of *Ulva* spp., which have an inducible concentrating mechanism (CCM). The investigators will culture these algae in media equilibrated at 8 different pCO2 levels ranging from 380 to 940 ppm to address three key hypotheses. The first is that macroalgae (such as Plocamium cartilagineum) that are not able to acquire inorganic carbon in changed form will benefit, in terms of photosynthetic and growth rates, from ocean acidification. There is little existing data to support this common assumption. The second hypothesis is that enhanced growth of Ulva sp. under OA will result from the energetic savings from down regulating the CCM, rather than from enhanced photosynthesis per se. Their approach will detect existing genetic variation for adaptive plasticity. The third key hypothesis to be addressed in short-term culture experiments is that there will be a significant interaction between ocean acidification and nitrogen limited growth of *Ulva* spp., which are indicator species of eutrophication. Kübler and Dudgeon will be able to quantify the individual effects of ocean acidification and nitrogenous nutrient addition on *Ulva* spp. and also, the synergistic effects, which will inevitably apply in many highly productive, shallow coastal areas. The three hypotheses being addressed have been broadly identified as urgent needs in our growing understanding of the impacts of ocean acidification.

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Program Information

Science, Engineering and Education for Sustainability NSF-Wide Investment (SEES): Ocean Acidification (formerly CRI-OA) (SEES-OA)

Website: https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503477

Coverage: global

NSF Climate Research Investment (CRI) activities that were initiated in 2010 are now included under Science, Engineering and Education for Sustainability NSF-Wide Investment (SEES). SEES is a portfolio of activities that highlights NSF's unique role in helping society address the challenge(s) of achieving sustainability. Detailed information about the SEES program is available from NSF (https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504707).

In recognition of the need for basic research concerning the nature, extent and impact of ocean acidification on oceanic environments in the past, present and future, the goal of the SEES: OA program is to understand (a) the chemistry and physical chemistry of ocean acidification; (b) how ocean acidification interacts with processes at the organismal level; and (c) how the earth system history informs our understanding of the effects of ocean acidification on the present day and future ocean.

Solicitations issued under this program:
NSF 10-530, FY 2010-FY2011
NSF 12-500, FY 2012
NSF 12-600, FY 2013
NSF 13-586, FY 2014
NSF 13-586 was the final solicitation that will be released for this program.

PI Meetings:
1st U.S. Ocean Acidification PI Meeting(March 22-24, 2011, Woods Hole, MA)
2nd U.S. Ocean Acidification PI Meeting(Sept. 18-20, 2013, Washington, DC)
3rd U.S. Ocean Acidification PI Meeting (June 9-11, 2015, Woods Hole, MA – Tentative)

NSF media releases for the Ocean Acidification Program:

Press Release 10-186 NSF Awards Grants to Study Effects of Ocean Acidification

Discovery Blue Mussels "Hang On" Along Rocky Shores: For How Long?

Discovery nsf.gov - National Science Foundation (NSF) Discoveries - Trouble in Paradise: Ocean Acidification This Way Comes - US National Science Foundation (NSF)

Press Release 12-179 nsf.gov - National Science Foundation (NSF) News - Ocean Acidification: Finding New Answers Through National Science Foundation Research Grants - US National Science Foundation (NSF)

Press Release 13-102 World Oceans Month Brings Mixed News for Oysters

Press Release 13-108 nsf.gov - National Science Foundation (NSF) News - Natural Underwater Springs Show How Coral Reefs Respond to Ocean Acidification - US National Science Foundation (NSF)

Press Release 13-148 Ocean acidification: Making new discoveries through National Science Foundation research grants

Press Release 13-148 - Video nsf.gov - News - Video - NSF Ocean Sciences Division Director David Conover answers questions about ocean acidification. - US National Science Foundation (NSF)

Press Release 14-010 nsf.gov - National Science Foundation (NSF) News - Palau's coral reefs surprisingly resistant to ocean acidification - US National Science Foundation (NSF)

Press Release 14-116 nsf.gov - National Science Foundation (NSF) News - Ocean Acidification: NSF awards $11.4 million in new grants to study effects on marine ecosystems - US National Science Foundation (NSF)

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1316198
NSF Office of International Science and Engineering (NSF OISE)	OISE-1515267

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