Rates of photosynthesis and respiration by Ulva exposed to different average and variability of pCO2 (Seaweed OA Resilience project)

Website: https://www.bco-dmo.org/dataset/732625
Data Type: experimental
Version: 1
Version Date: 2018-03-26

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
Dudgeon, Steve	California State University Northridge (CSUN)	Co-Principal Investigator
Copley, Nancy	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
This dataset includes rates of photosynthesis and respiration by Ulva during culture experiments grown at 15 degrees C under various pCO2 levels, during May through July 2015.

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Coverage

Spatial Extent: **N**:34 **E**:-118 **S**:33 **W**:-119
Temporal Extent: 2015-05-11 - 2015-07-27

Dataset Description

This dataset includes rates of photosynthesis and respiration by Ulva during culture experiments grown at 15 degrees C under various pCO2 levels, during May through July 2015.

Related Datasets:
Ulva: Carbonate chemistry pCO2: Carbonate chemistry of Ulva lactuca culture pots testing the effects of pCO2 variability (Seaweed OA Resilience project)
Ulva: Chl a: Chlorophyll a per unit biomass in Ulva lactuca under ocean acidification (OA) conditions (Seaweed OA Resilience project)
Ulva: CHN and stable isotopes: Stable isotope ratios and mass of carbon and nitrogen in Ulva cells under ocean acidification conditions (Seaweed OA Resilience project)
Ulva: Growth: Growth rates of Ulva exposed to different average and variability of pCO2 (Seaweed OA

Resilience project)
Ulva: pH and temperature time-series: Time-series at 10 minute sampling interval of pH and temperature in Ulva culture pots (Seaweed OA Resilience project)
Ulva: pH Drift: Carbonate chemistry over a time course with Ulva in pH drift experiments (Seaweed OA Resilience project)
Ulva: seawater delta13C: Stable isotope ratio and concentration of carbon in seawater from Ulva OA experiments (Seaweed OA Resilience project)

Methods & Sampling

Measurements of photosynthesis and respiration of Ulva lactuca occurred at the end of 3 weeks of acclimation to various levels of ocean acidification at 15°C. Small circular sections of U. lactuca thalli used for measurements were sampled with a cork borer the evening before measurement and returned to culture conditions overnight to allow for wound healing. Plant sections used to estimate rates of photosynthesis and respiration from oxygen exchange measurements were placed in small white, mesh threaded bags designed to fit the diameter of the cuvette chamber so that the plant material was oriented perpendicularly to the light source provided in the Qubit Systems Dissolved Oxygen package. Prior to introducing plants to the cuvette chamber, oxygen exchange between the stirred seawater and electrode system (i.e., oxygen consumption by the electrode) was monitored to adjust for its effect on subsequent measurements in the presence of plant material. Sections were transferred to the cuvette containing a magnetic stirring bar and 3 ml of seawater corresponding to the average pCO2 level in their particular culture pot and placed in darkness for 10-15 minutes prior to beginning measurement. Once measurements began, output of oxygen exchange was monitored until a steady state of oxygen exchange was attained (typically within 10 minutes) in either darkness or light. Photosynthesis and respiration were measured at 15°C and ~550, and 0, µmole photons m-2 s-1, respectively; the same temperature and light conditions as in growth culture. Respiration was measured both following a ≥10 minute acclimation period in darkness prior to light exposure (dark respiration) and again in darkness immediately following exposure to the saturating light intensity (as an estimate of respiration that occurs in the light). Following these measurements in seawater at their culture pCO2 level, the seawater in the cuvette was replaced with standard air-saturated seawater at 15°C and the measurement process described above was repeated for measurements of respiration in the dark and 'light' and photosynthesis. After measurements of gas exchange, the mass of plant tissue was measured on an analytical balance.

Note: Trial 1 was a pilot test of culture system and methodological procedures so was not used for data collection.

Data Processing Description

BCO-DMO Processing Notes:
- added a conventional header with dataset name and description, PI names, version date

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Data Files

File	
Ulva_PS_Resp_Cult_AirSat.csv	(Comma Separated Values (.csv), 9.27 KB) MD5:8ab5ddbe21978320411395180abf4aa5
Primary data file for dataset ID 732625	

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Parameters

Parameter	Description	Units
Label	sample identifier formatted as: trial-culture pot.plant replicate numbers	unitless
pCO2_avg	Average pCO2 partial pressure in seawater tanks	microatmospheres (µatm)
pCO2_sd	Variability of pCO2 partial pressure - standard deviation	microatmospheres (µatm)
Off1C	slope of oxygen exchange during first dark period in pCO2 culture seawater	milligrams O2/liter/second (mg L-1 s-1)
OnC	slope of oxygen exchange during light period in pCO2 culture seawater	milligrams O2/liter/second (mg L-1 s-1)
Off2C	slope of oxygen exchange during second dark period in pCO2 culture seawater	milligrams O2/liter/second (mg L-1 s-1)
Off1A	slope of oxygen exchange during first dark period in aerated standard seawater	milligrams O2/liter/second (mg L-1 s-1)
OnA	slope of oxygen exchange during light period in aerated standard seawater	milligrams O2/liter/second (mg L-1 s-1)
Off2A	slope of oxygen exchange during second dark period in aerated standard seawater	milligrams O2/liter/second (mg L-1 s-1)
Fresh_Weight	Mass of tissue sample	grams
DRespC	Dark respiration rate during first dark period in pCO2 culture seawater	mol O2/g/min NA
PmaxC	Maximum rate of photosynthesis in pCO2 culture seawater	mol O2/g/min NA
LRespC	Estimated respiration in the light in pCO2 culture seawater	mol O2/g/min NA
DRespA	Dark respiration rate during first dark period in aerated standard seawater	mol O2/g/min NA
PmaxA	Maximum rate of photosynthesis in aerated standard seawater	mol O2/g/min NA
LRespA	Estimated respiration in the light in aerated standard seawater	mol O2/g/min NA

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Instruments

Dataset-specific Instrument Name	Qubit Systems Dissolved Oxygen package (Q-box OX1LP)
Generic Instrument Name	Oxygen Sensor
Dataset-specific Description	Used to measure oxygen, photosynthesis, and respiration.http://www.qubitbiology.com/ox1lp-dissolved-oxygen/
Generic Instrument Description	An electronic device that measures the proportion of oxygen (O2) in the gas or liquid being analyzed

Dataset-specific Instrument Name	Mettler Toledo AG204 Delta Range Analytical Balance
Generic Instrument Name	scale
Generic Instrument Description	An instrument used to measure weight or mass.

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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

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