Measurements of fluorescence of photosystem II in Plocamium cartilagineum under various and pCO2 and temperature conditions

Website: https://www.bco-dmo.org/dataset/733238
Data Type: experimental
Version: 1
Version Date: 2018-04-11

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 photosynthetic pigment concentrations in Plocamium cartilagineum grown under various temperatures and CO2 levels, from July 2014 to February 2015. The parameters reported are: the concentrations of Chlorophyll a, Phycoerythrin, Phycocyanin, Allophycocyanin, and total Phycobiliprotein, and the ratio of total Phycobiliprotein to Chlorophyll A.

Table of Contents

- Coverage
- Dataset Description
  - Methods & Sampling
  - Data Processing Description
- Data Files
- Supplemental Files
- Parameters
- Instruments
- Project Information
- Program Information
- Funding

Coverage

Spatial Extent: **N**:34 **E**:-118 **S**:33 **W**:-119
Temporal Extent: 2014-06-26 - 2015-02-12

Dataset Description

This dataset includes photosynthetic pigment concentrations in Plocamium cartilagineum grown under various temperatures and CO2 levels, from July 2014 to February 2015. The parameters reported are: the concentrations of Chlorophyll a, Phycoerythrin, Phycocyanin, Allophycocyanin, and total Phycobiliprotein, and the ratio of total Phycobiliprotein to Chlorophyll A.

Related Datasets:
Plocamium carbon nitrogen and stable isotopes: Plocamium carbon and nitrogen content and stable isotope values, 2014-2015 (Seaweed OA Resilience project)

Plocamium culture carbonate chemistry: Carbonate chemistry in experimental cultures of Plocamium cartilagineum cultured at different temperatures and pCO2 levels (Seaweed OA Resilience project)

Plocamium culture: seawater delta13C: Stable isotope ratio and concentration of carbon in seawater during Plocamium culture experiments, 2014-2015 (Seaweed OA Resilience project)

Plocamium cultures pH and temperature: Plocamium culture pot pH and temperature time-series at 10 minute sampling intervals from 2014-2015 (Seaweed OA Resilience project)

Plocamium exptl treatments summary: Summary of pCO2 and temperature treatment combinations for each culture pot and experimental trial (Seaweed OA Resilience project)

Plocamium growth and biomass: Experimental results of Plocamium cartilagineum growth and biomass as a function of pCO2 and temperature (Seaweed OA Resilience project)

Plocamium: pH drift: Carbonate chemistry over a time-course in pH drift experiments with Plocamium growth collected at Catalina Island, 2014-2015 (Seaweed OA Resilience project)

Methods & Sampling

Plocamium cartilagineum was collected from Catalina Island in June - Nov. 2014 and Jan. 2015.

Culture pots were placed in large thermally insulated coolers in a temperature-controlled water bath at either 15 or 20°C under saturating illumination of ~150 µmoles photons/m^2/s. pCO2 treatments were supplied to closed culture pots by use of a gas mixing system combining Nitrogen, Oxygen and Carbon Dioxide to specific CO2 partial pressures, 20.9% oxygen and the balance being Nitrogen.

Measurements of chlorophyll fluorescence of photosystem II were made using a pulse amplitude modulated (PAM) fluorometer in situ in culture pots. All samples were dark-adapted prior to measurement by placing a leaf clip in the closed position over the area to be sampled for 5 minutes prior to measurement. For fluorescence measurements, the fiber optic probe was placed directly on the leaf clip perpendicular to the sample. The leaf clip was then opened and a rapid light curve program function was initiated to measure fluorescence at each of 9 photon flux densities (PFD's). PFD's of the light curve generated by the fluorometer were calibrated using an external LiCor light meter. Following measurement, the leaf clip was removed and the sample remained in the culture chamber.

Data were downloaded from the Diving PAM using WinControl version 3 software for Diving PAM.

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

See Supplemental Files for a table of culture conditions for each of the 8 trials (pdf).

Data Processing Description

BCO-DMO Processing Notes:
- added conventional header with dataset name, PI name, version date
- modified parameter names to conform with BCO-DMO naming conventions
- re-formatted date from dd.mm.yy to yyyy-mm-dd
- reordered columns to correspond with good database practices

[table of contents | back to top]

Data Files

File
RLC_PAM.csv (Comma Separated Values (.csv), 500.10 KB) MD5:28511621764b1616f2e73fced4acc66d Primary data file for dataset ID 733238

[table of contents | back to top]

Supplemental Files

File
Table of culture conditions for each of the 8 trials filename: Dudgeon_seaweed_trial_meta_2018-01.pdf (Portable Document Format (.pdf), 429.04 KB) MD5:5a4a9cbd3cb5092a419b4883c96979b8 Notes: Trial 1 was a pilot test of culture system and methodological procedures so was not used for data collection in the testing of hypotheses. In each culture pot, pCO2 was set by the supply rate of CO2 in the corresponding mass-flow controlled gas mixing system to be within a target range of either near ambient, moderately elevated or highly elevated in each trial. The near-ambient range was narrower than the other target ranges (set points typically ~380 - 390 micro-atm) as it served as the control range in each trial. However, actual pCO2 in solution in each culture pot varied slightly from constant target values on a diurnal cycle associated with the metabolic activities of the algae contained within each pot. Unique average values of pCO2 in each culture pot based on different set values for each mass-flow controlled mixer within the qualitative ranges of ambient, moderate and highly increased pCO2 levels that were replicated in each trial of the experiment enabled a more powerful regression-type experimental design. With a regression type approach we could estimate the functional relationship between response variables and pCO2, which was not possible with a simple categorical treatment design.

[table of contents | back to top]

Parameters

Parameter	Description	Units
Trial	Trial number of the experiment	unitless
Tank_ID	Identifying number of culture pot	unitless
Plant_ID	Plant ID number in culture pot	unitless
pCO2	Partial pressure of CO2 in solution in culture pot	atm
Temp	Temperature of seawater in culture pot	degrees Celsius (°C)
date	date of data collection formatted as yyyy-mm-dd	unitless
Week	Week number of given trial	unitless
ID	Unique identifier for every sample; concatenation of trial_tank ID_plant ID_week	unitless
light	Photosynthetically active radiation (PAR)	micromole photons/meter^2/second (µmole photons . m^-2 . s^-1)
F	Relative fluorescence of photosystem II	unitless
Fm	Maximum fluorescence	unitless
Yield	Effective (or Optimal if dark-adapted) quantum yield. Calculated as Yield = (Fm - F)/Fm	unitless
rETR	Relative Electron Transport Rate	unitless
qP	Photochemical quenching	unitless
qN	Non-photochemical quenching expressed as a fraction of difference between Fm and minimum F	unitless
NPQ	Non-photochemical quenching normalized to Fm measured in the light	unitless

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	Walz Underwater fluorometer - Diving-PAM, Heinz Walz, Effeltrich, Germany
Generic Instrument Name	Fluorometer
Dataset-specific Description	Used to measure chlorophyll fluorescence
Generic Instrument Description	A fluorometer or fluorimeter is a device used to measure parameters of fluorescence: its intensity and wavelength distribution of emission spectrum after excitation by a certain spectrum of light. The instrument is designed to measure the amount of stimulated electromagnetic radiation produced by pulses of electromagnetic radiation emitted into a water sample or in situ.

[table of contents | back to top]

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.

[table of contents | back to top]

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)

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1316198

[table of contents | back to top]