

# Chlorophyll a per unit biomass in *Ulva lactuca* under ocean acidification (OA) conditions (Seaweed OA Resilience project)

**Website:** <https://www.bco-dmo.org/dataset/732438>

**Data Type:** experimental

**Version:** 1

**Version Date:** 2018-03-22

## 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
<a href="#">Kubler, Janet E.</a>	California State University Northridge (CSUN)	Principal Investigator
<a href="#">Dudgeon, Steve</a>	California State University Northridge (CSUN)	Co-Principal Investigator
<a href="#">Copley, Nancy</a>	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

## Abstract

This dataset reports the chlorophyll a concentration per unit biomass of *Ulva lactuca* grown in closed culture pots at varying pCO<sub>2</sub> levels.

## Table of Contents

- [Coverage](#)
- [Dataset Description](#)
  - [Methods & Sampling](#)
  - [Data Processing Description](#)
- [Data Files](#)
- [Related Publications](#)
- [Parameters](#)
- [Instruments](#)
- [Project Information](#)
- [Program Information](#)
- [Funding](#)

## Coverage

**Spatial Extent:** N:34 E:-118 S:33 W:-119

**Temporal Extent:** 2015-05-11 - 2015-07-27

## Dataset Description

This dataset reports the chlorophyll a concentration per unit biomass of *Ulva lactuca* grown in closed culture pots at varying pCO<sub>2</sub> levels.

### Related Datasets:

[Ulva: Carbonate chemistry pCO<sub>2</sub>](#): Carbonate chemistry of *Ulva lactuca* culture pots testing the effects of pCO<sub>2</sub> variability (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 pCO<sub>2</sub> (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: Photosynthesis and respiration](#): Rates of photosynthesis and respiration by Ulva exposed to different average and variability of pCO<sub>2</sub> (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

Culture pots were placed in large thermally insulated coolers in a temperature-controlled water bath at 15° C under saturating illumination of ~550 μmoles photons/m<sup>2</sup>/s on a 12:12 L:D cycle. pCO<sub>2</sub> treatments were supplied to closed culture pots by use of a gas mixing system combining nitrogen, oxygen and carbon dioxide to specific CO<sub>2</sub> partial pressures, 20.9% oxygen and the balance being nitrogen.

Chlorophyll a was extracted from Ulva tissue following the procedure described in Duncan and Harrison (1982). Chlorophyll a concentrations were measured using a Shimadzu UV-2450 UV-visible spectrophotometer.

## Data Processing Description

### BCO-DMO Processing Notes:

- added a conventional header with dataset name and description, PI names, version date
- modified parameter names to conform with BCO-DMO naming conventions

[ [table of contents](#) | [back to top](#) ]

---

## Data Files

File
<b>Chl_a_Ulva.csv</b> (Comma Separated Values (.csv), 6.06 KB) MD5:13302458522a7c50790cb4247dfd48f0 Primary data file for dataset ID 732438

[ [table of contents](#) | [back to top](#) ]

---

## Related Publications

Duncan, M. J., & Harrison, P. J. (1982). Comparison of Solvents for Extracting Chlorophylls from Marine Macrophytes. *Botanica Marina*, 25(9). doi:[10.1515/botm.1982.25.9.445](https://doi.org/10.1515/botm.1982.25.9.445)  
*Methods*

[ [table of contents](#) | [back to top](#) ]

---

## Parameters

Parameter	Description	Units
Label	Trial number-pot number.frozen tissue replicate	unitless
pCO2_avg	Average pCO2 partial pressure in seawater tanks	microatmospheres (µatm)
pCO2_sd	Variability of pCO2 partial pressure - standard deviation	microatmospheres (µatm)
Fresh_Wt	Fresh weight of tissue sample prior to deep freeze	grams
DMSO_A665	Absorbance of light by ground Ulva tissue at 665nm in 1.25 ml of an 80% DMSO solution in water	unitless
Methanol_A668	Absorbance of light by ground Ulva tissue at 668nm in 6 ml methanol	unitless
Methanol_A635	Absorbance of light by ground Ulva tissue at 635nm in 6 ml methanol	unitless
DMSO_ext	Chlorophyll a extracted in DMSO	milligram/liter (mg/L)
Meth_ext	Chlorophyll a in pooled extracts of 12 ml of methanol	milligram/liter (mg/L)
Total_chl_mg	Total chlorophyll a extracted from ground tissue	milligrams (mg)
chl_a	Chlorophyll a concentration per unit biomass	milligrams/gram (mg/g)

[ [table of contents](#) | [back to top](#) ]

## Instruments

<b>Dataset-specific Instrument Name</b>	Shimadzu UV-2450 UV-visible spectrophotometer
<b>Generic Instrument Name</b>	UV Spectrophotometer-Shimadzu
<b>Dataset-specific Description</b>	Used to measure chlorophyll a concentration.
<b>Generic Instrument Description</b>	The Shimadzu UV Spectrophotometer is manufactured by Shimadzu Scientific Instruments (ssi.shimadzu.com). Shimadzu manufacturers several models of spectrophotometer; refer to dataset for make/model information.

[ [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 CO<sub>2</sub>, and populations of *Ulva* spp., which have an inducible concentrating mechanism (CCM). The investigators will culture these algae in media equilibrated at 8 different pCO<sub>2</sub> 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](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](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**

<b>Funding Source</b>	<b>Award</b>
<a href="#">NSF Division of Ocean Sciences (NSF OCE)</a>	<a href="#">OCE-1316198</a>

[ [table of contents](#) | [back to top](#) ]