

# Growth rates of *Ulva* exposed to different average and variability of pCO<sub>2</sub> (Seaweed OA Resilience project)

**Website:** <https://www.bco-dmo.org/dataset/732600>

**Data Type:** experimental

**Version:** 2

**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)

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## Abstract

This dataset includes growth rates of *Ulva* measured at three weekly intervals as well as integrated over the experimental trial grown in culture under various pCO<sub>2</sub> levels from 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 growth rates of *Ulva* measured at three weekly intervals as well as integrated over the experimental trial grown in culture under various pCO<sub>2</sub> levels from May through July 2015.

### 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: 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: 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

Growth rate was measured in batch culture by pooling all plant thalli and summing them to attain the datum for the culture pot. Hence, the culture pot is the unit of replication. Growth rate was measured by recording the fresh weight of living material approximately every 6 days. Plant tissue was lightly stacked and gently pressed between layers of Kimwipes. This method reduced handling time and removed superficial water prior to weighing. The stack was then weighed together to attain the fresh weight for the pot. Relative growth rate was then calculated following Lüning (1990):  $RGR(\% \cdot \text{day}^{-1}) = (100 \cdot \ln(W_2/W_1))/(t_2 - t_1)$ , where  $W_1$ ,  $W_2$ ,  $t_1$ ,  $t_2$  correspond to fresh weights at times 1 ( $t_1$ ) and 2 ( $t_2$ ), respectively. The weekly relative growth rates track the dynamics of growth and its variation during the experiment. In addition to growth rates estimated approximately weekly, estimates of overall net and absolute growth rates integrated across the 3-week experiment were also made using the initial and final starting masses. The difference between the overall net and absolute growth rate estimates is that the latter estimate includes small tissue fragments derived from whole thalli that occasionally appeared at the end of a weekly growth interval, but were thought to not be healthy viable fragments that would generate new growth in the subsequent interval so were discarded at the beginning of the next growth interval.

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
<b>Ulva_Growth_pCO2_var.csv</b> (Comma Separated Values (.csv), 3.55 KB) MD5:914ea098b2e5b3c7e8dc0450ee5257c2
Primary data file for dataset ID 732600

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## Related Publications

Lüning, K. (1990). Seaweeds: Their Environment, Biogeography, and Ecophysiology. John Wiley and Sons, Inc. [978-0471624349](#)  
*Methods*

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## Parameters

Parameter	Description	Units
Label	Trial and culture pot number	unitless
pCO2_avg	Average pCO2 partial pressure in seawater tanks	microatmospheres (µatm)
pCO2_sd	Variability of pCO2 partial pressure - standard deviation	microatmospheres (µatm)
GP1i	Pot biomass at the beginning of the first growth interval	grams
GP1f	Pot biomass at the end of the first growth interval	grams
GP2i	Pot biomass at the beginning of the second growth interval	grams
GP2f	Pot biomass at the end of the second growth interval	grams
GP3i	Pot biomass at the beginning of the third growth interval	grams
GP3f	Pot biomass at the end of the third growth interval	grams
RGR_GP1	Calculated relative growth rate for the 1st growth interval	%/day
RGR_GP2	Calculated relative growth rate for the 2nd growth interval	%/day
RGR_GP3	Calculated relative growth rate for the 3rd growth interval	%/day
RGR_GP1to3_Net	Calculated net growth integrated across experiment duration	%/day
added_mass	Summed biomass of small fragments from thalli in each growth interval	grams
RGR_GP1to3_Abs	Calculated absolute growth integrated across experiment duration	grams
Total_mass	Sum of GP3f and added_mass	grams

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## Instruments

<b>Dataset-specific Instrument Name</b>	Mettler Toledo AG204 Delta Range Analytical Balance
<b>Generic Instrument Name</b>	scale
<b>Generic Instrument Description</b>	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 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.

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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](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 \(NSF\)](#)

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## Funding

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

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