

# Pterosiphonia bipinnata and Corallina vancouveriensis final experiment shear and percent remaining at Deadman Bay on San Juan Island, Washington

**Website:** <https://www.bco-dmo.org/dataset/778426>

**Data Type:** experimental

**Version:** 1

**Version Date:** 2019-10-01

## Project

» [Effects of Ocean Acidification on Coastal Organisms: An Ecomaterials Perspective](#) (OA - Ecomaterials Perspective)

## Program

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

| Contributors                      | Affiliation   | Role                      |
|-----------------------------------|---|---------------------------|
| <a href="#">Carrington, Emily</a> | University of Washington (FHL)                      | Principal Investigator    |
| <a href="#">Martone, Patrick</a>  | University of British Columbia (UBC-Bot)            | Co-Principal Investigator |
| <a href="#">Guenther, Rebecca</a> | University of British Columbia (UBC-Bot)            | Contact                   |
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## Abstract

Pterosiphonia bipinnata and Corallina vancouveriensis final experiment shear and percent remaining at Deadman Bay on San Juan Island, Washington

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## Coverage

**Spatial Extent:** Lat:48.51359 Lon:-123.14893

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## Dataset Description

The effect of pH on the attachment of *Pterosiphonia bipinnata* and *Corallina vancouveriensis* spores.

## Acquisition Description

Sporophytic specimens of *Pterosiphonia bipinnata* and *Corallina vancouveriensis* were collected from the mid to low intertidal zone on San Juan Island, Washington (Deadman Bay: 48°30' 48.93"N, 123°8'56.14"W), immediately transported to Friday Harbor Laboratories (FHL), and maintained in an outdoor seawater table for up to one week before testing. Reproductive parent fronds were held at ambient levels of seawater pH/pCO<sub>2</sub> and were only exposed to experimental conditions while releasing spores. Spore release and settlement was performed in the Ocean Acidification Environmental Laboratory (OAEL) at FHL, allowing precise control of pH and temperature in a flow-through system. Two pH treatments were established by bubbling CO<sub>2</sub> (7.75, 7.30 total scale) at 11°C and confirmed with carbonate water chemistry analyses. Specifically, spectrophotometric pH was determined as per SOP6 and total alkalinity was measured using an open cell titrator as outlined in SOP3b (Dickson et al. 2007). Ambient pH values for the Salish Sea are approximately 7.8, and pH as low as 7.3 has been documented in nearshore environments in Washington.

The spore settlement apparatus consisted of a carriage system that slowly (1-2.5 cm/hr.) drove reproductive algal thalli across a glass settlement plate (0.6 x 7.6 x 60 cm), while releasing spores. The working section (14 x 1.5 cm) was defined at one end of the plate. Spores landing in the working section had a decreasing gradient of attachment time, determined by the rate parent thalli were driven across the plate and the time the plate was allowed to set. Error in attachment time was estimated to be 6-12 minutes given sinking rates of spores of comparable spore size (50-100 µm) and release height (5-10 cm).

The shear flume was designed to release a tall column of water that flushes quickly across the working section of the spore settlement plate. Water column height was varied to create a range of shear stresses. Shear stresses generated by each water column height were calculated according to Schultz et al. 2000, using the height of the channel (4.3 mm), the pressure gradient across the working section (measured with a manometer), and the length of the working section. Most spores were removed in the first 10 seconds of continuous exposure to shear and longer exposure times result in little additional detachment, so trials were limited to 15 seconds.

Prior to each test, the shear flume was fitted on the settlement plate with clamps and the released spores were photographed using a microscope (Steindorff SXC, New York Microscopes) connected to a camera (Nikon Coolpix S3300), using the lines drawn in the working section for reference. For the attachment time assay, a low shear stress (1 Pa) was applied and the remaining spores were photographed and counted.

For the attachment strength assay, spores were allowed to set in stationary water for 35-48 hours in *P. bipinnata* and for 5-10 hours in *C. vancouveriensis*, since maximum attachment of each species was found in these time frames using the logistic regression analyses of attachment time. For *P. bipinnata*, replication was achieved by repeating the experiment in time since one frond moved across the entire settlement plate in each run. Due to limitations with *C. vancouveriensis* spore release, several fronds were used to provide sufficient spores for this assay. In this case, each frond that released spores was considered a replicate, and this was repeated across several days. All spore releases were natural, as attempts to artificially induce spore release (osmotic, temperature, or light) were unsuccessful.

Attached spores were exposed to increasing shear stresses (1, 4, 7, 17 and 20 Pa). Shear stresses in the flume represented boundary layer velocities of 0.2 – 4 ms<sup>-1</sup>, similar to intertidal field conditions. At each position and at each shear stress applied, spores were counted through photo-analysis in ImageJ (version 1.48; U.S. National Institutes of Health, Bethesda, MD). With each successive application of shear stress, we expected an increasing percentage of spores to detach from the settlement plate, up to a maximum value assuming some spores would be stronger than our assay. The effect of shear stress on spore detachment in each species was tested using an exponential rise-to-maximum non-linear regression (SigmaPlot 11.0, R<sup>2</sup> = 0.84 - 0.99), which provided estimates of two parameters: the maximum percentage of spores detached and the initial dependence of detachment on shear stress. The first derivatives of fitted, non-linear regressions were plotted to estimate frequency distributions of spore attachment strength.

## **Processing Description**

## BCO-DMO Processing:

- added conventional header with dataset name, PI name, version date.
- modified parameter names to conform with BCO-DMO naming conventions.
- deleted date column as instructed by submitter
- added coordinate information to the data from the station information provided by the submitter.

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## Related Publications

Dickson, A.G., Sabine, C.L. and Christian, J.R. (Eds.) 2007. Guide to best practices for ocean CO<sub>2</sub> measurements. PICES Special Publication 3, 191 pp. ISBN: 1-897176-07-4. Handle: <http://hdl.handle.net/11329/249>. URL:

[https://www.nodc.noaa.gov/ocads/oceans/Handbook\\_2007.html](https://www.nodc.noaa.gov/ocads/oceans/Handbook_2007.html)

Guenther, R., Miklasz, K., Carrington, E., & Martone, P. T. (2018). Macroalgal spore dysfunction: ocean acidification delays and weakens adhesion. *Journal of Phycology*, 54(2), 153–158. doi:[10.1111/jpy.12614](https://doi.org/10.1111/jpy.12614)

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## Parameters

| Parameter        | Description                                    | Units           |
|------------------|--|-----------------|
| Treatment        | High (7.8) or Low (7.3) pH conditions          | unitless        |
| Shear            | Shear force applied                            | Pascals (Pa)    |
| PercentRemaining | Percentage of spores remaining after assay     | unitless        |
| Species          | Latin name of seaweed                          | unitless        |
| lat              | latitude with positive values indicating North | decimal degrees |
| lon              | longitude with negative values indicating West | decimal degrees |
| location         | name of the location                           | unitless        |

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## Instruments

|   |   |
|---|---|
| <b>Dataset-specific Instrument Name</b> | camera (Nikon Coolpix S3300)  |
| <b>Generic Instrument Name</b>          | Camera  |
| <b>Dataset-specific Description</b>     | Prior to each test, the shear flume was fitted on the settlement plate with clamps and the released spores were photographed using a microscope (Steindorff SXC, New York Microscopes) connected to a camera (Nikon Coolpix S3300), using the lines drawn in the working section for reference. |
| <b>Generic Instrument Description</b>   | All types of photographic equipment including stills, video, film and digital systems.  |

|   |  |
|---|--|
| <b>Dataset-specific Instrument Name</b> | manometer  |
| <b>Generic Instrument Name</b>          | Pressure Sensor  |
| <b>Dataset-specific Description</b>     | Pressure gradient across the working section (measured with a manometer).  |
| <b>Generic Instrument Description</b>   | A pressure sensor is a device used to measure absolute, differential, or gauge pressures. It is used only when detailed instrument documentation is not available. |

|   |  |
|---|--|
| <b>Dataset-specific Instrument Name</b> | Thermometer  |
| <b>Generic Instrument Name</b>          | Water Temperature Sensor   |
| <b>Dataset-specific Description</b>     | Specifically, spectrophotometric pH was determined as per SOP6 and total alkalinity was measured using an open cell titrator as outlined in SOP3b. As described in Dickson, A.G., Sabine, C.L. and Christian, J.R. (Eds.) 2007. Guide to Best Practices for Ocean CO2 Measurements. PICES Special Publication 3, 191 pp. |
| <b>Generic Instrument Description</b>   | General term for an instrument that measures the temperature of the water with which it is in contact (thermometer).   |

|   |   |
|---|---|
| <b>Dataset-specific Instrument Name</b> | pH meter  |
| <b>Generic Instrument Name</b>          | pH Sensor   |
| <b>Dataset-specific Description</b>     | Specifically, spectrophotometric pH was determined as per SOP6. As described in Dickson, A.G., Sabine, C.L. and Christian, J.R. (Eds.) 2007. Guide to Best Practices for Ocean CO2 Measurements. PICES Special Publication 3, 191 pp. |
| <b>Generic Instrument Description</b>   | General term for an instrument that measures the pH or how acidic or basic a solution is.   |

|   |   |
|---|---|
| <b>Dataset-specific Instrument Name</b> | microscope (Steindorff SXC, New York Microscopes)   |
| <b>Generic Instrument Name</b>          | Microscope-Optical  |
| <b>Dataset-specific Description</b>     | Prior to each test, the shear flume was fitted on the settlement plate with clamps and the released spores were photographed using a microscope (Steindorff SXC, New York Microscopes) connected to a camera (Nikon Coolpix S3300), using the lines drawn in the working section for reference. |
| <b>Generic Instrument Description</b>   | Instruments that generate enlarged images of samples using the phenomena of reflection and absorption of visible light. Includes conventional and inverted instruments. Also called a "light microscope".   |

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## Project Information

### Effects of Ocean Acidification on Coastal Organisms: An Ecomaterials Perspective (OA - Ecomaterials Perspective)

**Website:** <http://depts.washington.edu/fhl/oael.html>

**Coverage:** Friday Harbor, WA

Effects of Ocean Acidification on Coastal Organisms: An Ecomaterials Perspective This award will support researchers based at the University of Washington's Friday Harbor Laboratories. The overall focus of the project is to determine how ocean acidification affects the integrity of biomaterials and how these effects in turn alter interactions among members of marine communities. The research plan emphasizes an ecomaterial approach; a team of biomaterials and ecomechanics experts will apply their unique perspective to detail how different combinations of environmental conditions affect the structural integrity and ecological performance of organisms. The study targets a diversity of ecologically important taxa, including bivalves, snails, crustaceans, and seaweeds, thereby providing insight into the range of possible biological responses to future changes in climate conditions. The proposal will enhance our understanding of the ecological consequences of climate change, a significant

societal problem. Each of the study systems has broader impacts in fields beyond ecomechanics. Engineers are particularly interested in biomaterials and in each system there are materials with commercial potential. The project will integrate research and education by supporting doctoral student dissertation research, providing undergraduate research opportunities via three training programs at FHL, and summer internships for talented high school students, recruited from the FHL Science Outreach Program. The participation of underrepresented groups will be broadened by actively recruiting URM and female students. Results will be disseminated in a variety of forums, including peer-reviewed scientific publications, undergraduate and graduate course material, service learning activities in K-8 classrooms, demonstrations at FHL's annual Open House, and columns for a popular science magazine.

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## Program Information

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

**Website:** [http://www.nsf.gov/funding/pgm\\_summ.jsp?pims\\_id=503477](http://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 ([http://www.nsf.gov/funding/pgm\\_summ.jsp?pims\\_id=504707](http://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-1041213</a> |

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