pH measurements from laboratory water column experiments on the behavioral effects of ocean acidification on Olympia oyster larvae (Ostrea lurida), July 2017

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Data Type: experimental
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Project
» RUI: Will climate change cause 'lazy larvae'? Effects of climate stressors on larval behavior and dispersal (Climate stressors on larvae)

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Abstract
This dataset contains pH measurements collected from a laboratory water column experiments to investigate the behavioral effects of ocean acidification on Olympia oyster larvae (Ostrea lurida).

Table of Contents

- Coverage
- Dataset Description
  - Methods & Sampling
  - Data Processing Description
- Data Files
- Related Publications
- Parameters
- Instruments
- Project Information
- Funding

Coverage

Temporal Extent: 2017-07-21 - 2017-08-03

Dataset Description

This dataset contains pH measurements collected from a laboratory water column experiments to investigate the behavioral effects of ocean acidification on Olympia oyster larvae (*Ostrea lurida*), July 2017.

Methods & Sampling

Collection & Larval Rearing

We collected adult Olympia oysters (*Ostrea lurida*) from Fidalgo Bay in June 2017 and maintained them in a sea table with continuous flowing seawater heated to 19-20°C at the Shannon Point Marine Center. We fed adult oysters were fed concentrated algae once a day (Shellfish Diet, Reed Mariculture) and utilized banjo-style filters (60-m) attached to the outflow pipes of the sea table to catch released *O. lurida* larvae. We then collected and reared larvae at 12°C in 3-L jars (2 individuals mL-1). Each jar of larvae received a 50% water change with 0.35-

m filtered sea water and were fed Isochrysis galbana algae (50,000 cells mL-1) daily.

Experimental Design

To measure the effect of pH conditions on the vertical distribution of larvae we established three experimental pycnocline treatments within clear plexiglass water columns (2.5cm x 2.5cm x 30cm): (1) ambient water (400ppm) in the top layer and acidic water in the bottom layer (1500ppm), (2) ambient water (400ppm) in both top and bottom layers, and (3) acidic water (1500ppm) in the top layer and ambient water (400ppm) in the bottom layer. Each water layer was 60-mL of water and filled the column 10-cm high, so when each experimental treatment was established it filled the column to 20-cm. We established the experimental treatments by increasing the density of seawater in the bottom layer by 0.003-0.005 g ml-1 using dialyzed Percoll (Mills 1984; Podolskey & Emlet 1993). Experimental treatment water was kept at 12°C and pre-equilibrated to the desired pCO2 level and density. We also included blue food coloring (1 drop per 100-mL) to the dense bottom layer to more easily visualize the density layers while establishing experimental treatments. We set-up four replicate columns for each experimental treatment making twelve columns total per experiment.

On the day of each experiment, we incubated the experimental treatment columns in clear plexiglass water baths connected to a Fisher Scientific Isotemp recirculating water bath to maintain treatment temperature at 12°C throughout the experiment. We carefully injected 150 larvae by syringe into the bottom 2-cm of each column with no more than 2-mL of their culture water. Olympia oyster larvae are highly phototactic (personal observations), so we gave the larvae 10 minutes to acclimate in darkness and then recorded their vertical position in the water columns under infrared light. We video recorded the larvae's vertical position in each column using an infrared uEye camera equipped with Edmund Optics VIS-NIR Lens mounted on a motorized stand. We later counted by eye the number of larvae per centimeter area of each column from the videos.

Sampling and analytical procedures:

Carefully collected water with a syringe and pipet from the top 1-3cm of the column, the bottom 1-3cm of the water column and right at the transition layer where the top and bottom layers of water met and was visible by the blue dye in the bottom layer of water. The water from the syringe was carefully transferred to a clean 2 ml microcentrifuge tube and pH was measured directly using a pH probe (Micro PerpHect Ross Ross® Combination pH electrode) and read with a Thermo Scientific Orion Star pH meter.

Data Processing Description

BCO-DMO Processing Notes:
- added conventional header with dataset name, PI name, version date
- reformatted date from m/d/yy to yyyy-mm-dd

[table of contents | back to top]

Data Files

File	
Ostrea_pH_OA_Expt2017.csv	(Comma Separated Values (.csv), 2.79 KB) MD5:e78d44fd1e77d0cdc52e09348030152b
Primary data file for dataset ID 753080	

[table of contents | back to top]

Related Publications

Mills, C. E. (1984). Density is altered in hydromedusae and ctenophores in response to changes in salinity. The Biological Bulletin, 166(1), 206-215. https://doi.org/10.2307/1541442
Related Research

Podolsky, R. D., & Emlet, R. B. (1993). Separating the effects of temperature and viscosity on swimming and

water movement by sand dollar larvae (Dendraster excentricus). Journal of Experimental Biology, 176(1), 207-222. http://jeb.biologists.org/content/176/1/207
Methods

[table of contents | back to top]

Parameters

Parameter	Description	Units
trial	Trial number	unitless
date	Date of trial formatted as yyyy-mm-dd	unitless
column_name	Identifies the experimental water column treatment and replicate #: AN-# = Acidic water at the top and Neutral water at the bottom ; NN-# = Neutral water at the top and Neutral water at the bottom; NA-# = Neutral water at the top and Acid water at the bottom	unitless
column_depth_cat	Water column depth category where the pH sample was collected. top = 18-20 cm from bottom of water column; bottom = 1-2 cm from the bottom of the water column; transition point = middle of the water column where two treatment waters meet	unitless
column_depth_cm	Water column depth in cm where the pH sample was collected.	centimeters (cm)
pH	pH of seawater in water column	standard pH units

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	Thermo Scientific Orion Star A214 pH/ISE meter with a Micro PerpHect Ross® Combination pH electrode
Generic Instrument Name	Benchtop pH Meter
Dataset-specific Description	The pH electrode was prepared before each set of measurements following instructions in the ROSS® Electrode User Guide (Thermo Fisher Scientific Inc.) and calibrated with a three-buffer calibration using Thermo ScientificTM OrionTM pH Buffer Individual Use Pouches.
Generic Instrument Description	An instrument consisting of an electronic voltmeter and pH-responsive electrode that gives a direct conversion of voltage differences to differences of pH at the measurement temperature. (McGraw-Hill Dictionary of Scientific and Technical Terms) This instrument does not map to the NERC instrument vocabulary term for 'pH Sensor' which measures values in the water column. Benchtop models are typically employed for stationary lab applications.

Dataset-specific Instrument Name	Fisher Scientific Isotemp Circulating Water Bath
Generic Instrument Name	In-situ incubator
Dataset-specific Description	Used to maintain treatment temperature during experiment
Generic Instrument Description	A device on a ship or in the laboratory that holds water samples under controlled conditions of temperature and possibly illumination.

[table of contents | back to top]

Project Information

RUI: Will climate change cause 'lazy larvae'? Effects of climate stressors on larval behavior and dispersal (Climate stressors on larvae)

Coverage: Coastal Pacific, USA

In the face of climate change, future distribution of animals will depend not only on whether they adjust to new conditions in their current habitat, but also on whether a species can spread to suitable locations in a changing habitat landscape. In the ocean, where most species have tiny drifting larval stages, dispersal between habitats is impacted by more than just ocean currents alone; the swimming behavior of larvae, the flow environment the larvae encounter, and the length of time the larvae spend in the water column all interact to impact the distance and direction of larval dispersal. The effects of climate change, especially ocean acidification, are already evident in shellfish species along the Pacific coast, where hatchery managers have noticed shellfish cultures with 'lazy larvae syndrome.' Under conditions of increased acidification, these 'lazy larvae' simply stop swimming; yet, larval swimming behavior is rarely incorporated into studies of ocean acidification. Furthermore, how ocean warming interacts with the effects of acidification on larvae and their swimming behaviors remains unexplored; indeed, warming could reverse 'lazy larvae syndrome.' This project uses a combination of manipulative laboratory experiments, computer modeling, and a real case study to examine whether the impacts of ocean warming and acidification on individual larvae may affect the distribution and restoration of populations of native oysters in the Salish Sea. The project will tightly couple research with undergraduate education at Western Washington University, a primarily undergraduate university, by employing student researchers, incorporating materials into undergraduate courses, and pairing marine science student interns with art student interns to develop art projects aimed at communicating the effects of climate change to public audiences

As studies of the effects of climate stress in the marine environment progress, impacts on individual-level performance must be placed in a larger ecological context. While future climate-induced circulation changes certainly will affect larval dispersal, the effects of climate-change stressors on individual larval traits alone may have equally important impacts, significantly altering larval transport and, ultimately, species distribution. This study will experimentally examine the relationship between combined climate stressors (warming and acidification) on planktonic larval duration, morphology, and swimming behavior; create models to generate testable hypotheses about the effects of these factors on larval dispersal that can be applied across systems; and, finally, use a bio-physically coupled larval transport model to examine whether climate-impacted larvae may affect the distribution and restoration of populations of native oysters in the Salish Sea.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1538626

[table of contents | back to top]