pH measurements from larval rearing jars used in an experiment on behavioral effects of ocean acidification on sand dollar larvae (Dendraster excentricus), July 2017

Website: https://www.bco-dmo.org/dataset/752999
Data Type: experimental
Version: 1
Version Date: 2019-01-14

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 datasets includes pH data measures from larval rearing jars as part of a laboratory experiment to investigate the behavioral effects of ocean acidification on sand dollar larvae (Dendraster excentricus) in July 2017.

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Coverage

Temporal Extent: 2017-07-18 - 2017-07-21

Dataset Description

This datasets includes pH data measures from larval rearing jars as part of a laboratory experiment to investigate the behavioral effects of ocean acidification on sand dollar larvae (*Dendraster excentricus*) in July 2017.

Methods & Sampling

We conducted two behavioral experiments; one when the larvae were 4-arm pleutei and one when the larvae were 6-armed pleutei.

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 PercollTM GE Healthcare (Podolsky & 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.

Columns were positioned in a randomized order along the table of a walk-in incubator set to 12°C. Once columns were in position and treatments were established, 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. Larvae were given 10 minutes in darkness to acclimate before we counted the vertical distribution of larvae in each water column. Using a small hand-held flashlight, we counted by eye the number of larvae occupying each centimeter of the water column beginning at the bottom and moving up to the top. We did these counts in the dark, so only one column received direct light from our small flashlight at a time to reduce the influence of light on the larvae's behavior.

At the end of the experiment we collected water from bottom layer (1-2cm above bottom), top layer (18-20cm from the bottom), and the transition point (visually determined based on color of where two water layers met) and measured pH with a pH probe.

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 column, and at the transition layer where the top and bottom layers of water met, which 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

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Data Files

File	
Dendraster_pH_OA_Expt2017.csv	(Comma Separated Values (.csv), 10.84 KB) MD5:085a8ace3d58a4abda81f40c270edd0a
Primary data file for dataset ID 752999	

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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

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Parameters

Parameter	Description	Units
date	Date of trial formatted as yyyy-mm-dd	unitless
larvae_stage	Stage of Dendraster excentricus larvae used in the experiment: 4-arm or 6-arm stage plutei	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
larvae_treatment	Indicates the pCO2 treatment condition larvae were reared in from the time of spawning to the time of the experiment. "Acidic" condition was treatment water maintained at 1500ppm and "neutral" condition was treatment water maintained at 400ppm.	unitless
column_treatment	Identifies the experimental treatment of the water column larvae were placed into. The first word indicates the pCO2 condition of the water layer at the top of the column and the second word indicates the pCO2 condition of the water layer at the bottom of the column. "Acidic" water was bubbled to be 1500ppm and the "Neutral" water was bubbled to be 400ppm.	unitless
column_name	Code for (1) tThe pCO2 treatment of the water in the top of the column (A or N); (2) the pCO2 treatment the larvae were reared within (A or N); (3) the pCO2 treatment of the water in the bottom of the column (A or N); and (4) the replicate number. "A"= acidic water that was bubbled to be 1500 pCO2; "N" = neutral water that was bubbled to be 400 pCO2	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

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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 Scientific Orion 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.

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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.

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Funding

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

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