Body characteristic measurements of sand dollar larvae (Dendraster excentricus) reared in different pCO2 conditions, July 2017

Website: https://www.bco-dmo.org/dataset/752974
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 dataset includes body characteristic measurements of sand dollar larvae (Dendraster excentricus) reared in different pCO2 conditions as part of a laboratory experiment to investigate the behavioral effects of ocean acidification on this species in July 2017.

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Coverage

Temporal Extent: 2017-07-21 - 2017-07-27

Dataset Description

This dataset includes body characteristic measurements of sand dollar larvae (Dendraster excentricus) reared in different pCO2 conditions as part of a laboratory experiment to investigate the behavioral effects of ocean acidification on this species in July 2017.

Methods & Sampling

We collected adult sand dollars (D. excentricus) from Semiahmoo Bay, WA, in July 2017 and maintained them in 14°C continuous flowing seawater at the Shannon Point Marine Center. We induced twelve individuals to spawn by injecting 1-mL of 0.5-M KCl into the coelom following methods outlined by Strathmann (1987). We then collected and mixed concentrated gametes of four males and four females for fertilization. We added five drops of sperm to 500-mL of filtered seawater and 5-mL of eggs. We placed the fertilized eggs in 12°C

incubator and bubbled them with ambient pCO2 condition for 12-hrs before dividing the embryos into pCO2 treatment conditions before gastrulation.

We reared D. excentricus larvae (2 individuals mL-1) at 12°C in eight 3-L jars that were individually bubbled with CO2 to achieve four replicates of ambient (400ppm) and acidic (1500ppm) pCO2 conditions. Daily we gave each larval jar a water change from pre-equilibrated ambient and acidic water and fed the larvae D. tertiolecta (6,000 cells ml-1).

We measured morphological characteristics of larvae from each rearing jar when larvae were in the 4- and 6-arm stages following diagrams in Chan et al. (2011) and Reitzel et al. (2004). Larvae were relaxed in 7% magnesium chloride, fixed in 3% formalin, imaged using a stereomicroscope equipped with a camera (Leica MC170 HD and Leica Application Suite, Leica, Wetzlar, Germany), and measured with ImageJ software. 4-arm larvae were fixed on 7/24/17 and 6-arm larvae were fixed on 7/28/18. The following morphological characteristics were measured: length of postoral arms (PO), anterolateral arms (AL), length of body midline, body width, and longitudinal length of stomach.

This dataset includes unprocessed data.

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
- changed year from 2018 to 2017

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Data Files

File	
Dendraster_Characters_OA_Expt2017.csv	(Comma Separated Values (.csv), 10.78 KB) MD5:4d57e5677f0f305a69324220aa2d9ad8
Primary data file for dataset ID 752974	

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Supplemental Files

File	
Fig. 1: Diagram showing body characteristics of D. excentriucs (Reitzel et al. 2004) filename: Reitzel_etal_2004_fig1.png (Reitzel et al. 2004)	(Portable Network Graphics (.png), 66.89 KB) MD5:f0b6de08164a59962fda2b8a454db9e1
Fig. 2: Diagram showing body characteristics of D. excentricus (Chan et al. 2011) filename: Chanetal_2011.jpg Chan et al. 2011	(JPEG Image (.jpg), 151.43 KB) MD5:db8e67472e6acf001ad1770b810f570e

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Related Publications

Chan, K. Y. K., Grünbaum, D., & O'Donnell, M. J. (2011). Effects of ocean-acidification-induced morphological changes on larval swimming and feeding. Journal of Experimental Biology, 214(22), 3857-3867. doi:10.1242/jeb.054809

Methods

Reitzel, A. M. (2004). Growth, development and condition of Dendraster excentricus (Eschscholtz) larvae reared on natural and laboratory diets. Journal of Plankton Research, 26(8), 901–908. doi:10.1093/plankt/fbh077
Methods

Strathmann, M. F. (2017). Reproduction and development of marine invertebrates of the northern Pacific coast: data and methods for the study of eggs, embryos, and larvae. University of Washington Press. https://isbnsearch.org/isbn/0-295-96523-1
Methods

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Parameters

Parameter	Description	Units
Date	Date larvae were fixed formatted as yyyy-mm-dd	unitless
rearing_condition	The pH condition of the water larvae were reared in; "acidic" water was bubbled to be 1500ppm and "ambient" water was bubbled to be 400ppm	unitless
jar_replicate	Jar replicate larvae were sampled from. There were four replicate jars per rearing condition.	unitless
PO_1	Postoral arm length; one of two	micrometers (um)
PO_2	Postoral arm length; one of two	micrometers (um)
AL_1	Anterolateral arm length; one of two	micrometers (um)
AL_2	Anterolateral arm length; one of two	micrometers (um)
Body_ML	Length of body midline	micrometers (um)
BW	Length of body width	micrometers (um)
PD_1	Posterodorsal arm length; one of two	micrometers (um)
PD_2	Posterodorsal arm length; one of two	micrometers (um)
Stomach	Longitudinal length of stomach	micrometers (um)

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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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