Trajectories and velocities of Crepidula fornicata larvae swimming under various food cues from experiments conducted at Woods Hole Oceanographic Institution in July, 2018

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Data Type: experimental
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Project
» Larval Response to Turbulence During Dispersal and Settlement (Larvae in turbulence)

Contributors	Affiliation	Role
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Abstract
Trajectories and velocities of Crepidula fornicata larvae swimming under various food cues from experiments conducted at Woods Hole Oceanographic Institution in July, 2018. These data were published in DiBenedetto et al. (2020).

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Coverage

Temporal Extent: 2018-07

Methods & Sampling

Trajectory data of Crepidula fornicata larvae swimming in 65mL still water flasks, analyzed from video footage. Two experimental controls were varied, resulting in four experiment types. Larvae were either previous fed or starved (Fed/St), and either in the presence of food or not in the presence of food (F/0). Five replicates (1-5) were conducted for each of the four conditions, resulting in 20 individual datasets. Further description and analysis of the data is published in DiBenedetto et al., 2020 (https://doi.org/10.1242/jeb.239178).

Data Processing Description

Video footage was processed in MATLAB. The centroids of the larvae were identified in each image. The centroids were linked to form trajectories using a predictive tracking algorithm. Linear and angular velocities were calculated along each trajectory, as described in DiBenedetto et al. 2020.

BCO-DMO Data Manager Processing notes:
* 20 csv files containing larvae tracks combined into one data table with added column to capture information in the file name(treatment variables, replication information).
* Numbers with 15 decimal places rounded to 5 decimal places.
* Original missing data identifier "NaN" is converted to compatible missing data identifers based on file type (matlab, netcdf, etc). 'nd' meaning "no data" is the default missing data identifier at BCO-DMO.

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Data Files

File
tracks.csv(Comma Separated Values (.csv), 63.92 MB) MD5:cafa72519d1232417a24bf79411ed6a8 Primary data file for dataset ID 834221

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Related Publications

DiBenedetto, M. H., Meyer-Kaiser, K. S., Torjman, B., Wheeler, J. D., & Mullineaux, L. S. (2020). Departures from isotropy: the kinematics of a larval snail in response to food. The Journal of Experimental Biology, jeb.239178. doi:10.1242/jeb.239178
Results

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Parameters

Parameter	Description	Units
Exp_name	Name for the experimental run composed of treatment information (Previously_Fed, Food_Presence,Replicate).	unitless
Prevously_Fed	Whether larvae were either previously fed ('Fed') or starved ('St').	unitless
Food_Presence	Whether larvae were in the presence of food ('F') or not in the presence of food ('0').	unitless
Replicate	Replicate number	unitless
track	Larva track number	unitless
T	Time (seconds) elapsed since the start of the experiment.	seconds (sec)
X	Horizontal position	centimeters (cm)
Y	Vertical position	centimeters (cm)
U	Horizontal velocity	centimeters per second (cm/s)
V	Vertical velocity	centimeters per second (cm/s)
Theta	Angular velocity	radians per second (rad/s)

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Project Information

Larval Response to Turbulence During Dispersal and Settlement (Larvae in turbulence)

Coverage: Laboratory studies at Woods Hole Oceanographic Institution

Description from NSF award abstract:
The planktonic larval stage of benthic marine invertebrates provides a mechanism for exchange of individuals between remote populations. Dispersal is affected by swimming behaviors, particularly those that alter the larva's vertical position in the water. Larvae of some species change their vertical positions in response to turbulence by ceasing to swim and sinking downward (diving). By doing so, they can alter their horizontal transport in currents and increase their supply to the seafloor. The main objectives of this study are to investigate behavioral responses of oyster (*Crassostrea virginica*) larvae to turbulence in the water column and at the seafloor, and to determine how these behaviors affect settlement. The investigators hypothesize that diving behavior enhances settlement into suitable habitat, even where mean bed shear stress is high. They expect that once larvae approach the bottom, they can take advantage of temporal and spatial refuges (such as turbulent lulls in the lee of roughness elements) to settle in otherwise harsh conditions. Investigating larval responses to turbulence is a challenge because it requires simultaneous measurement of time-variant flows and larval behaviors. The investigators will modify a conventional particle image velocimetry (PIV) approach so it can be used to track larval motions and fluid velocities simultaneously. PIV provides information on flow kinematics (e.g., rotation and strain rate) in the immediate vicinity of a larva, as well as bulk dissipation rates and measures of Taylor and integral length scales that likely influence larval acceleration. When these measurements are coupled with a larval trajectory, they provide a history of the fluid environment a larva experiences, and can be used to determine what characteristic of turbulence triggers the diving behavior. They also make it possible to calculate the bottom shear stress an individual larva experiences when it encounters the bottom and attempts to settle. The investigators will examine turbulence effects on larval behaviors in the water column using a grid-stirred tank. They will use a racetrack flume to test the hypothesis that larval settlement success depends on the frequency of lulls of sufficient duration for larval attachment.

Laboratory experiments will provide a mechanistic understanding of larval behavior that can be used in general theoretical models exploring how behavior influences dispersal and population connectivity. The quantified swimming responses of oysters are critical input for coupled bio-physical models of dispersal in the field. An understanding of larval behavior contributes to our ability to predict the effects of natural and anthropogenic perturbations (some of which are linked to global climate change) on benthic communities in coastal ecosystems where turbulence and habitat suitability vary spatially. This information is critical for informed decision making on shellfish management and design of marine reserves. The technique developed for simultaneous PIV and larval tracking will open new questions in larval ecology and be broadly applicable to studies of plankton interactions with turbulence.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-0850419

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