Egg sizes and macromere allocation for diverse annelids and molluscs

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Data Type: Other Field Results
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Project
» Feeding by the ciliated larvae of marine invertebrates: effects of diverse particle capture mechanisms on feeding performance (Ciliated Larvae Feeding)

Contributors	Affiliation	Role
Pernet, Bruno	California State University Long Beach (CSULB)	Principal Investigator
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
Egg sizes and macromere allocation for annelids and molluscs used in a comparative analysis of allocation of cytoplasm to macromeres. Many of these data were obtained from the literature, but some were obtained directly by the authors.

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Dataset Description

Egg sizes and macromere allocation for annelids and molluscs used in a comparative analysis of allocation of cytoplasm to macromeres. Many of these data were obtained from the literature, but some were obtained directly by the authors. For details on where and how data were obtained, please see the publication:

Jones, C., et al. 2016. Allocation of cytoplasm to macromeres in embryos of annelids and molluscs is positively correlated with egg size. Evolution & Development, 18:3, 156–170. doi:10.1111/ede.12189

Methods & Sampling

See complete methodolgy in:
Jones, C., et al. 2016. Allocation of cytoplasm to macromeres in embryos of annelids and molluscs is positively correlated with egg size. Evolution & Development, 18:3, 156–170. doi:10.1111/ede.12189

In brief (extracted from above):
Data on 43 specieswere obtained fromthe literature.We searched the online databases Web of Science, Biological Abstracts, and Zoological Record using one or more keywords (development, cleavage, macromeres, micromeres, or blastomeres) and taxonomic names (Spiralia, Gastropoda, Bivalvia, Annelida, or Polychaeta). We used studies that contained at least one clear micrograph or drawing of an embryo at the eight-cell stage, with boundaries of at least one micromere and macromere visible.

Embryos of an additional six species were imaged in our laboratory. For three species of gastropods in the

genus Crepidula, we could measure the dimensions of a specific isolated zygote, allow it to cleave, and then image it at the eightcell stage to obtain estimates of allocation to macromeres. We did this for Crepidula fornicata and C. plana (collected June 2014 from Cedar Beach, Bailey Island, Maine: 43.743730, -69.986991) and C. williamsi (collected several times in 2013 and 2014 from White Point, Rancho Palos Verde, California: 33.715604, -118.319490). For these species, capsules deposited in the laboratory were removed from females, and 8–10 embryos from each brood were imaged at the zygote and eight-cell stages. Eight-cell stages were imaged in animal-pole view using brightfield illumination.

For members of three additional species we could not follow the development of specific isolated zygotes, but instead imaged different zygotes and eight-cell embryos from the same or different broods, depending on the species. We collected aggregations of S. tribranchiata from floating docks at the Alamitos Bay Marina, Long Beach,California (33.754743,-118.111179) in May 2014. We broke open tubes until zygotes and eight-cell embryos were found. Ten zygotes and 10 eight-cell embryos (in animal-pole view) were imaged. Adults of the opisthobranch gastropod Haminoea vesicula were collected in May 2014 from the intertidal zone of Alamitos Bay, Long Beach, California (33.747227, -118.118773). Adults kept in mesh-sided containers in a recirculating seawater system deposited egg masses on the sides of the containers. We imaged 10 zygotes and 10 eight-cell embryos (in animal-pole view) fromone brood fromeach of three different parents.Wealso imaged zygotes and eight-cell embryos (in animal-pole view) of the poecilogonous opisthobranch gastropod Alderia willowi. Individual adults of this species deposit egg masses containing small zygotes (approx. 68mm diameter) or egg masses containing large zygotes (approx. 105mm) (Krug 2007). We collected adults of A. willowi in April and May 2014 from their host alga, Vaucheria longicaulis, from the intertidal zone of Golden Shore Marine Biological Reserve, Long Beach, California (33.763624, -118.202146). Pairs of adults were kept in small dishes in the laboratory until broods were deposited.We imaged 10 zygotes and 10 eight-cell embryos from each of three "small-egg" broods, and 10 zygotes and 10 eight-cell embryos from each of three "large-egg" broods, each deposited by a different adult.

We estimated the volumes of cytoplasm allocated to micromeres and macromeres at the eight-cell stage from images of eight-cell embryos.

Data Processing Description

BCO-DMO Processing:
- modified parameter names to conform with BCO-DMO naming conventions;
- rounded values to 4 decimal places;
- replaced spaces with underscores in species names.

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Data Files

File	
macromere_allocation.csv	(Comma Separated Values (.csv), 7.64 KB) MD5:7a14ccfb3f94631878486820488fca2
Primary data file for dataset ID 683186	

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Related Publications

Jones, C., Stankowich, T., & Pernet, B. (2016). Allocation of cytoplasm to macromeres in embryos of annelids and molluscs is positively correlated with egg size. Evolution & Development, 18(3), 156–170. doi:10.1111/ede.12189
General

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Parameters

Parameter	Description	Units
taxon	Broader taxonomic group	unitless
species	Species name	unitless
nutrition	Larval nutrition; 0=feeding, 1=nonfeeding	unitless
taxa	?	unitless
egg_diameter	Egg diameter	micrometers (um)
egg_volume	Egg volume	cubic micrometer (um3)
allocation	Macromere allocation: proportion of egg volume found in the four macromeres at 8-cell stage	unitless
alloc_pcnt	Macromere allocation expressed as a percentage	unitless
log_egg_diameter	Log of egg diameter	micrometers (um)
log_egg_volume	Log of egg volume	cubic micrometer (um3)
logit_allocation	Logit of allocation	unitless

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	Microscope - Optical
Generic Instrument Description	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

Feeding by the ciliated larvae of marine invertebrates: effects of diverse particle capture mechanisms on feeding performance (Ciliated Larvae Feeding)

Website: http://www.csulb.edu/colleges/cnsm/depts/biology/invertebrate_reproduction/

Coverage: coastal northeastern Pacific (California, Washington)

Description from NSF award abstract:
Many marine invertebrate larvae must feed to fuel development through metamorphosis to the juvenile stage. These feeding larvae capture suspended food particles in diverse ways. Laboratory evidence suggests that different larval feeding mechanisms may affect performance depending on particle types. For example, larvae of echinoderms feed by ciliary reversal, a mechanism that apparently limits clearance rates on small particles (<10 um diameter). In contrast, mollusk larvae feed using opposed bands of cilia, which limits clearance rates on larger particles (>10 um). Because the concentration of suspended food particles can constrain larval growth in natural waters, and because the size distribution of natural particles varies over space and time, maximum clearance rates imposed by a particular feeding mechanism may restrict larval growth rates and development. As a result, the planktonic period of suspension-feeding larvae would be extended and larval mortality (due to predation, or advection from suitable adult habitat) increased, leading to lower recruitment. In this way, performance constraints associated with particular larval feeding mechanisms could strongly affect population dynamics. Such effects are missing from population-dynamic models of benthic invertebrates, largely because they are not well understood. Toward this end, controlled comparisons are needed of the feeding capabilities of ciliated larvae that differ in feeding mechanism.

The present study will examine the feeding capabilities of larvae that gather food using one of three particle capture mechanisms (ciliary reversal, opposed band, or a "mixed" strategy of opposed band feeding and encounter feeding on large particles), and for larvae with distinct body forms (e.g., within opposed band feeding, trochophores vs. veligers). Three main hypotheses will be tested. (1) Larvae that differ in particle capture mechanisms/body form will also differ in either maximum clearance rates, or in the size spectrum of particles cleared at high rates. Laboratory experiments will involve artificial particles, varying only in size. (2) Hypothesized differences in (1) also hold for natural particles. Experiments will test semi-natural prey communities. (3) Larvae with different feeding mechanisms will perform best in specific feeding environments (e.g., those dominated by small particles versus large particles). Larval growth rates will be tested in experimentally manipulated, semi-natural food regimes.

Yielding explicit, planned comparisons of larval performance as a function of feeding mechanism, larval body form, and particle type, this research would improve understanding of the importance of larval feeding mechanism in the population dynamics of marine invertebrates. This study is relevant to many compelling questions in reproductive biology, ecology and evolution, such as: how do seasonal changes in the types of particulate food affect the performance of larvae with particular feeding mechanisms; how might such linkages be related to the evolution of seasonal reproductive patterns in various taxa of marine invertebrates; and how might human-mediated shifts in ocean temperature and chemistry (predicted to alter the size spectrum of potential food particles) affect performance of larvae with particular feeding mechanisms?

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1060801

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