Developmental Biology of *Phoronopsis harmeri*

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Introduction

Phoronopsis harmeri are members of the phylum Phoronida, a small phylum with only twenty described species of marine worms that make up two genera, Phoronis and Phoronopsis. Phoronids are found in all oceans and most seas typically living from the intertidal zone to a depth of 70m although a few have been found at 400m. These worms live in chitinous tubes that they secrete and can be found in the mud or sand of the benthos, in colonies made of tubes resting on rocky substrate or they may burrow into rocks or shells to secrete their tubes.

These worms are crowned by a ring of ciliated tentacles that surrounds their mouth called a lophophore which they use for feeding. They are commonly called horseshoe worms because their gut makes a u-turn inside the body cavity and exits the tube near the mouth.

Phonopsis harmeri are dioecious and reproduce sexually but are capable of regenerating lost tissue. Spermatophores are packaged and released through the lophophore tentacles. Sperm enter the trunk coelom of a female by lysing through the body wall of the lophophore or stomach lining. Eggs are shed into the trunk coelom of the female where they will be fertilized then released to the water column. Fertilized eggs undergo planktotrophic development as actinotroch larva that will undergo what is described as "catastrophic" metamorphosis (Johnson and Zimmer 2006). When larva reach competency they search for settlement cues in their surroundings. Cesium ions and seawater conditioned with chemicals from commensal organisms induced settlement in the related species *Phoronis pallida* (Santagata 2004). When

metamorphosis occurs the metasomal sac of the organism is everted, the anus is pulled up near the mouth and the gut takes on the u-shaped form of the adult worm.

Methods and Materials

Specimens of *Phornopsis harmeri* were collected from the Portside mudflats of Charleston, Oregon shortly after low tide on May 21,2008. The worms were taken to the laboratory and gently removed from their tubes with forceps under the dissecting microscope. Individuals were identified as male or female. Sperm was collected from a male by cutting the worm into 5mm sections with a razor blade and milking out the sperm. Sperm was diluted with filtered seawater. Eggs were collected by cutting a female into sections with a razor blade and milking out the eggs. The eggs of this female were already fertilized when they were collected and had completed the first cell division. Fertilized eggs were added to a fingerbowl with filtered seawater. The fingerbowl was kept in the seatable with flowing seawater at 12°c. Water was changed every other day for the duration of the study. Larva were fed one milliliter of a preparation of the green alga *Dunaiella teriolecta* and one milliliter of a preparation of the red alga *Rhodomonas lens* after each water change. Cultures were observed by compound microscope several times during the first 24 hours after fertilization and checked at the time of each water change for the duration of this study.

Results

Completion of meiosis, germinal vesicle breakdown and fertilization of the egg occurred before the first observation. These worms demonstrate a pattern of radial cleavage that can be observed by the eight cell stage. Gastrulation occurs by invagination and is evident by day two. By day three the preoral hood tentacles and trunk were apparent. The larvae began to swim and were able to contract their preoral hood by day five. Figure 1 is a picture of an actinotroch larva. By day 15 the larva no longer looked healthy. No

larva were observed in the culture by day 19.

Discussion

Phoronopsis development is fascinating both because the larval form is beautiful and because the metamorphosis is dramatic. This investigation clearly demonstrated the early stages of phoronid development described in the literature (Johnson and Zimmer 2006). Regrettably the event of metamorphosis was not observed. For further studies a larger sample size would add to the possibility of continuing the culture through the settlement stage. Addition of settlement cues could also contribute to achieving metamorphosis.

Acknowledgements

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Literature Cited

Johnson, KB, Zimmer, RL 2006 Phylum Phoronida. In: Young CM (ed) Atlas of Marine Invertebrate Larva. Academic Press, Barcelona, Spain, pp 429 - 439.

Santagata,S. 2004. A Waterborne Behavioral Cue for the Actinotroch Larva of *Phoronis pallida* (Phornonida) Produced by *Upogebia puggettensis* (Decapoda: Thalassinidea). *Biol.Bull.* 207:103-115

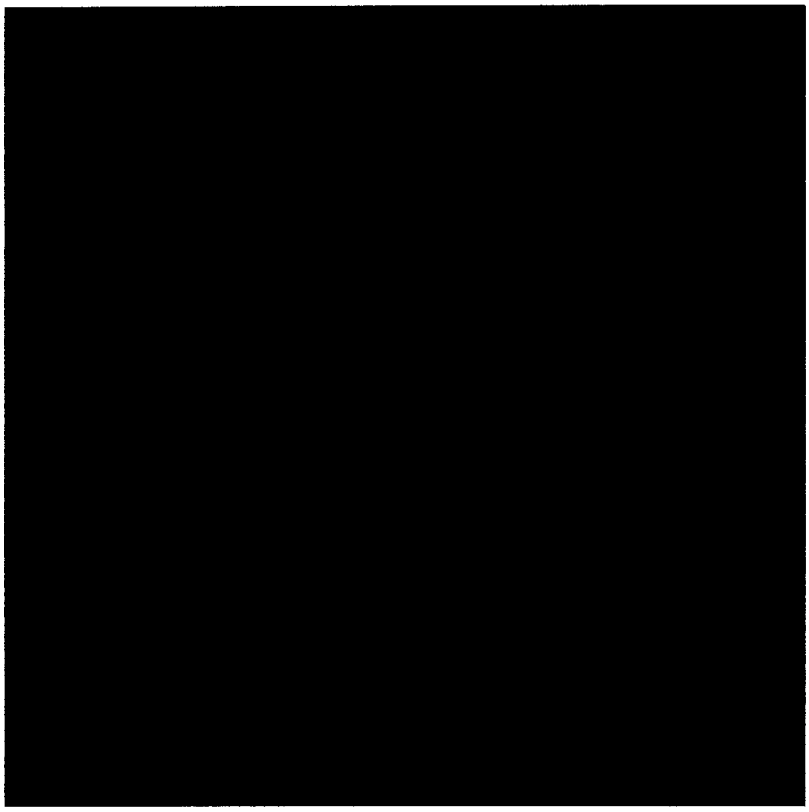

Figure 1. Actinotroch larva