Serpula vermicularis

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Introduction

S. vermicularis is a sedentary polychaete worm that secretes a calcareous tube where it lives as an adult. The polychaete is a suspension feeder and therefore can populate areas with little water movement by creating its own feeding current. *S. vermicularis* is usually a solitary polychaete; however there have been some instances where the worm is found in small clusters forming reefs. Reef formation is a rare event only observed on the west coast of Scotland in Loch Crean (Poloczanska 2004). These aggregations are initially encrusting and then grow upwards to form "bush – like" reefs as more larvae settle on or near the aggregation. These aggregations are mostly found at depths between six and ten meters in muddy/sandy sea beds (Poloczanska 2004). Poloczanska suggests the reason for reef formation is to shorten the mean hiding time (withdrawing into their tubes) the worm exhibits when disturbed or when there are sudden drops in light intensity. Spending time hiding means the polychaete is unable to feed and respire, both of which are important for survival. Besides a decrease in hiding

time, other aggregation advantages could be increased vigilance, predator confusion, and dilution of predator risk (Poloczanska 2004). The major disadvantage to reef formation is the increase in competition for resources. It seems however that these aggregating worms find ways around this disadvantage by arranging their tubes so that there is no interference between adjacent crowns (www.ukmarinesac.org).

S. vermicularis is gonochoristic and free spawning. There are three larval forms before metamorphosis occurs. The larval forms are the trochophore, the metatrochophore, and the nectochaete. Once the embryos hatch they are called a trochophore larva and are planktotrophic. According to a developmental time table done by Young and Chia, after about three days of hatching the trocophore begins to develop the right ocellus (a simple eye). About day 28 the trocophore develops the left ocellus and is called a metatrocophore. It is also around this time that the larvae become benthic after the second ocellus is developed. The benthic larval form is called a nectochaete until about day 50 when settlement occurs and metamorphosis begins.

Young and Chia found that polychaete trochophore larvae are sensitive to light between 350 nm and 600 nm. This strong photosensitive reaction occurs as soon as the ocellus develops in the trochophore. When the larvae are in the dark and then are subjected to low intensities of light, the larvae swim towards the light until they are adapted to it (Young and Chia 1982). Early trochophores lacking the photoreceptor organs are insensitive to light. In metatrochophores there is a negative phototaxis response which Young and Chia suggest could help the metatrochophore locate the bottom, and there was no phototactic response found in nectochaete larvae. It is thought that the reason for the latter response in nectochaete larvae is due to the juvenile shadow

response (Young and Chia 1982). This is when the worm withdraws into its tube in response to an abrupt decrease in light levels. The juvenile shadow response begins shortly after the primary tube is secreted. Furthermore it implies that nectocheates do not pay attention to light levels until they find a suitable substratum to settle upon and during settlement, larvae use light as a cue to orient their tubes towards the dark (Young and Chia 1982).

Another study on polychaete larvae found that *S. vermicularis*, as well as other polychaete larval species, were associated with marine snow (Shanks et al. 1997). Shanks found that plankton is not randomly distributed in the water column but rather macroscopic aggregations of detritus and microbes (marine snow) allows for a "benthic-like micro-habitat" within the water column. Larval polycheates were also found not to be randomly distributed in the water column since there tended to be a higher concentration of polychaete larvae in marine snow compared with non-aggregate areas (Shanks et al. 1997). Polychaete larvae, both pre-competent and competent, were found to be significantly associated with these microbial aggregations, although there are a significantly lower percentage of pre-competent larvae within these environments. When larvae hit the marine snow, the larvae stop swimming and begin to move around the external surface of the aggregate or the larvae begins to enter the aggregate and crawl within it (Shanks et al. 1997). Once associated with the aggregate the pre-competent larvae were observed to stay for about two minutes before swimming off again into the water column. The association between polychaete larvae and marine snow has a few hypotheses. The simplest is that the larvae are feeding on the detritus and microbes that make up the marine snow. Another thought is that the larvae are investigating the

aggregate as a potential area for settlement since the aggregate is similar to the benthic layer and therefore the larvae could mistake the marine snow for benthos (Shanks et al. 1997). This latter idea is further supported by the fact that there are periods of mass phytoplankton aggregations. Therefore there is a significant aggregate deposition on the bottom of the ocean, which occurs at the same time as high concentrations of polychaete larval settlement (Shanks et al. 1997).

Materials and Methods

The collection of *S. vermicularis* was done at the Charleston docks on May 1, 2007. Pairs of Embryology students scraped *S. vermicularis* off the side of the docks with a chisel and caught them in large Ziploc bags. When *S. vermicularis* feels intensely threatened (being taken from its calcareous tube) it begins to release its gametes. In the lab the polychaetes were put into individual finger bowls with filtered seawater to obtain concentrated eggs and sperm for fertilization. When male and female polycheates were identified, a clean finger bowl with filtered seawater was acquired and a pipette was used to place a monolayer of eggs on the bottom. Sperm was then added. The bowl was set aside to allow fertilization to occur. Once there was a significant amount of fertilized eggs (seen through observation under the compound microscope) the finger bowl was reverse filtered using a 75-micron mesh filtering cup and sucking a large pipette. The bowl was refilled with filtered seawater and placed in the water table to keep cool. The culture water was changed every 2 to 3 days in the same manner using the reverse filter technique and filtered seawater. Once the embryos hatched, two different kinds of algae, *R. lens* and *D. tertrolecta*, were spun down using a centrifuge to get rid of all the bacteria

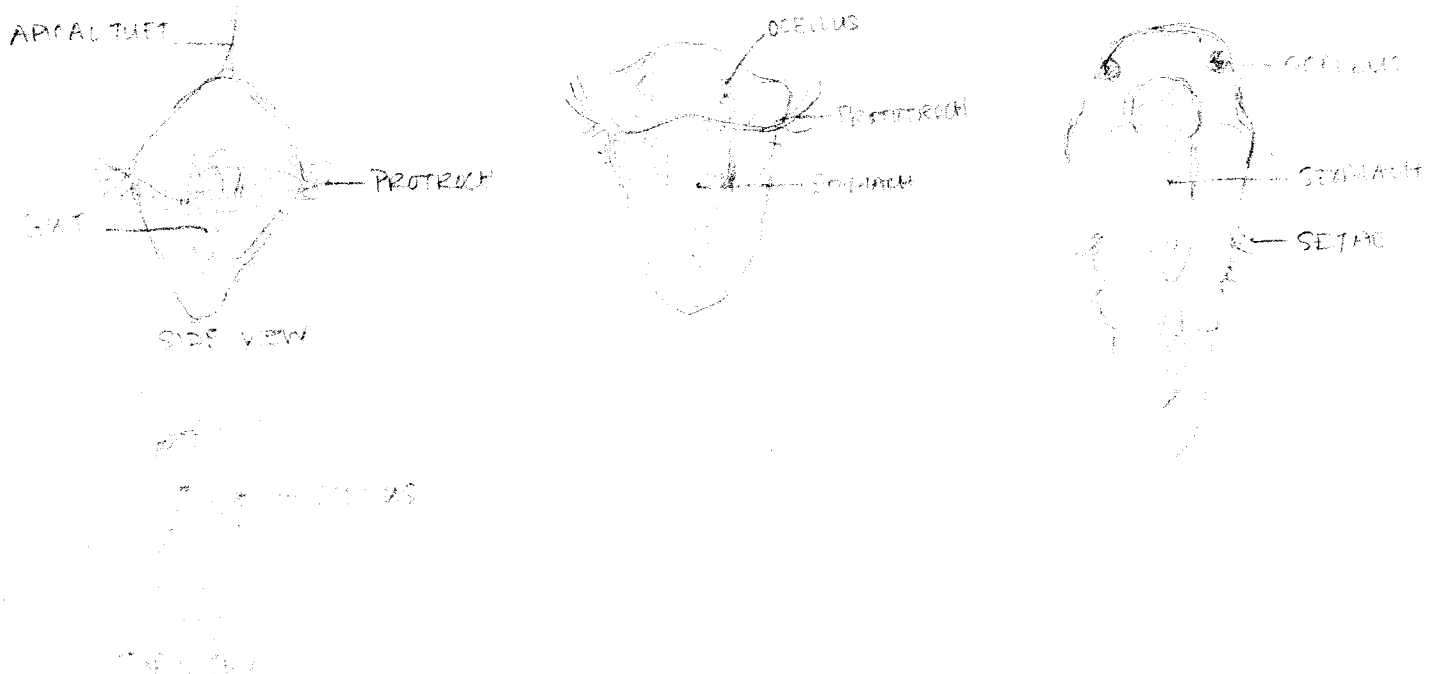
and other microbes. The algae were re-suspended in filtered seawater and fed to the *S. vermicularis* larvae. This procedure followed every seawater change. The progression of larval growth was captured through hand drawings and photographs using a digital camera attached to a compound microscope.

Results

My culture of *S. vermicularis* was a success, meaning I was able to maintain a few specimens through the entirety of the larval cycle, from fertilization to settlement. The following is a developmental diagram of my polychaete culture as well as a time table recorded by Young and Chia.

Larval Stage	My Culture	Young and Chia
Fertilization	Day 0	Day 0
Trochophore	Day 2	Day 1
Metatrochophore	Day 10	Day 20 – 27
Nectochaete	Day 20	Day 28
Settlement	Day 31	Day 41

Trochophore Metatrochophore Nectochaete



Discussion

The developmental time chart that Young and Chia discussed in their paper does not match the one I observed in my own culture. My culture settled quicker in development by about 10 to 20 days. I have a few guesses why my culture developed faster than Young and Chia's, but I am only hypothesizing. Although both my culture and Young and Chia's cultures were reared in the lab, my culture was much less comparable to the natural habitat of *S. vermicularis*. Therefore, I could have fed my larvae at a higher density, which would have sped up their developmental rate giving them maximal growth opportunities. Young and Chia noted that the larger the larvae the quicker the growth, where most of the smaller larvae don't make it to metamorphosis. It could be possible that the larvae I tracked were a little bigger in size than the larvae that Young and Chia reared and therefore would settle in less time. My last hypothesis for the differences in developmental rate is that I only observed one culture, which developed at a certain rate. Many cultures, like Young and Chia handled, all developed at different rates and the average could then be taken among the cultures. This would be a better representation of the amount of time needed to get to certain larval stages.

After reading about the juvenile shadow response I tested it on my settled larvae. I allowed the worms to become accustomed to the light and then covered the light with my hands abruptly decreasing the light intensity. At first I notice no difference, but after testing the response a few times I noticed that the worms would move quickly down into their tubes and then slowly come back out when I removed my hands from the light. I imagine this response is very useful to escape from overhead predators.

I did not notice any particular pattern in the way the crowns of the tubes were oriented, such as being turned away from the light. However, I did notice that the tubes were spaced apart so that the crowns were not interfering with each other and they were spread out across the bottom of the bowl, not in aggregations. The tubes themselves were almost microscopic and slightly transparent allowing the worm to be seen within the tube.

If I were to raise *S. vermicularis* again I would put some kind of film that can easily be removed on the bottom of the finger bowl. Therefore it would be easier to look at the settled larvae in more detail under the compound microscope instead of scraping them off the bottom and placing them on a slide, which destroys their tube. Putting some sort of removable surface on the bottom of the dish could also allow the *S. vermicularis* to be put back into their natural habitat instead of killing them by washing out the finger bowl. They may not survive in the real ocean though unless there was a way to adhere the removable surface to the docks or something, but maybe they could live in the sea tables or in a larger tank.

References

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