



Effects of Water Motion and Substrate Characteristics on Invertebrate Settlement

Josh Mode, Michael O'Neal, Zack Kephart, Biology Department, College of Charleston, Charleston



Abstract

The main goal of this experiment was to gain a basic understanding of the recruitment of larvae onto different substrates. Two locations were chosen: Grice Cove and off Battery Point in the harbor. Settling plates were constructed and then dropped at these locations for approximately 3 weeks each. Afterwards we recorded what settled on each plate via a dissecting scope. From these results we were able to determine relationships between fast and slow currents as well as different substrate types.

Introduction

The water velocity throughout Charleston harbor varies depending on the location compared to the surrounding structures. If the location is in the middle of the harbor it will be faster than a location that is in a cove or near the outer edge of the harbor. The purpose of this experiment is to get a basic understanding of the recruitment of invertebrate larvae onto different substrates at different current velocities. The first part of the question was done by having five different types of substrates to see if any of the settling invertebrate larvae preferred to settle on one type of substrate more than the other. The five different types of substrate plates were: wood, Plexi glass, Lego (plastic), oyster shells, and pitted silicone. Each plate was made out of plexi glass with the different type of substrate attached on each side with silicone. The reason for using pitted silicone as one of the substrates was because of a technicality. The rocks that we placed on the silicone fell off, leaving pits in the silicone. To answer the second question, we placed the settlement plates at two different locations (figure 1) which were known to already have either a fast or a slow moving water velocity. The two locations picked were Grice cove (slow) and in the middle of the harbor located right off of battery point (fast).

Figure 2



This figure shows a comparison between the slow and fast moving water settlement on the plates placed in Charleston Harbor. The top row are plates from site 1 (fast moving water) and the bottom row is from site 2 (slow moving water). A) pitted silicone B) Oyster shell C) Wood D) Lego E) Plexi glass.

Figure 1



This is a map of Charleston, SC. The enlarged view to the right shows the 2 locations that the instruments (figure 4) were deployed. Site 1 was placed in a fast moving current and site 2 was placed in Grice Cove which has little or no moving current.

Figure 3

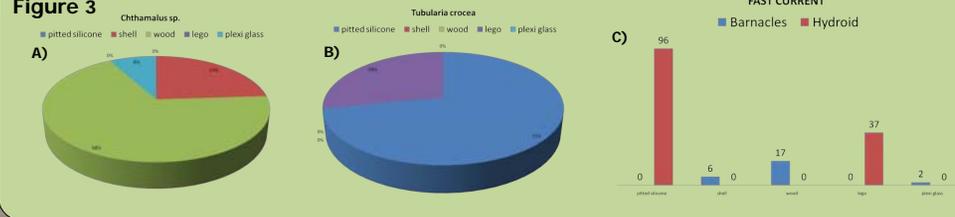
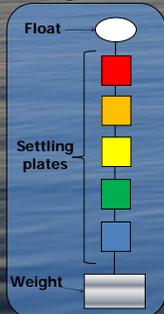


Figure 3 A) is the percentage of barnacles that settled on all of the plates in fast moving water. B) is the percentage of hydroids that settled on all of the plates in fast moving water. C) is the table that shows the data that was collected from the plates. We did not find any settlement on the plates that were placed in slow moving water. That is why we did not make any graphs for the slow moving water plates.

Figure 4



Methods

- Each instrument was made up of 5 plates with a float on the top and a cinder block used as a weight (figure 4) if it was placed in the harbor (site 2)
- For site 1 in Grice Cove the instrument was tied to the side of the cove instead of using a weight and float.
- At each of the two sites the instruments were placed in the harbor for 3 weeks.
- After three weeks, the instruments were taken out of the water and placed in 10% formaldehyde for 3 days and then placed in 70% ethanol until we looked at them under a dissecting microscope.

Every instrument had a randomized order of plates. Between each plate was a 10cm gap. The total length of the instrument was designed for the place that it was placed.

Results

- From an analysis of the plates it seems that substrate in slow moving currents don't facilitate settlement as well as faster currents.
- We found no settlement of any organisms on the plates set out in the slow moving area of Grice Cove.
- Algae cover may have hindered some settlement on the plates out in the harbor.
- We did take note of a few arthropod zooplankton. We did not however add these into our data for settling because they are pelagic and were most likely grazing in the algae and not settling onto the plate.
- From the data we discovered that the hydroids settled on the pitted silicone and Lego plates whereas the barnacles settled on the wood, shell, and plexi glass plates. From the sheer numbers counted it seems that the hydroids preferred the plastic type substrates whereas the barnacles preferred the natural wood/shell substrate.

References

Abelson A., Denny M., Settlement of Marine Organisms in Flow. Annual Review of Ecological Systems. 1997 28. 317-39
Crisp P., The Behavior of Barnacle Cyprids in Relation to Water Movement over a Surface. Journal of Experimental Biology. 1955. 32,569-590

Ideas for the future...

Instead of hanging the plates vertically where sunlight would be able to hit both sides, they should be hung horizontally so that sunlight will only be able to affect one side and would not allow algae growth to inhibit invertebrate settlement. Another change would be the use of a different adhesive, one that would stand up to many days in the water.

Conclusion

As made evident by the data, it was found that slow current areas do not facilitate settlement as well as fast moving current areas. This could be due to the fact that higher volumes of water flow by the plate, giving more organisms the chance to settle onto the plate. In a study done by Abelson and Denny, they showed that the flow of the water sometimes gives cues to the invertebrates that are settling in the water. Also in fast currents any structure that protrudes from the substrate will make eddies behind it. In an experiment done by Crisp, these eddies are what helped the barnacles settle in fast moving currents. Likewise the lack of current in the slower moving areas may not have allowed for as much settlement chance by the same organisms. One problem that we faced was the algae coverage on the plates in the harbor. We hypothesize that the large amount of algae coverage could have hindered the settlement of more organisms on the plates. An example of this can be seen in the Lego plate, where there was immense algae coverage and very little invertebrate settlement of any kind.

Acknowledgements

We would like to thank Sam for his in-depth help with getting ideas to get started. Also, "the boat guy" for helping us deploy the instruments, and my friend Gates for lending us kayaks to retrieve the instruments.