THE SIZE AND DEPTH OF *CONDYLACTIS GIGANTEA*

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Abstract The relative size that a sessile marine organism is able to attain and its position in the ecosystem are very important characteristics for understanding key aspects of its biology. At Tobacco Bay on the island of Bermuda, I tested for a relationship between size and depth of the sea anemone *Condylactis gigantea*. A random sample of sea anemones across this environment were observed, measured, and photographed. Sea anemones found at greater depths were significantly larger than those found in shallower waters. Possible causes for this relationship are discussed, including the life cycle of *C. gigantea,* the distribution of offspring or mutualistic relationships.
Key Words: Condylactis gigantea - *sessile - Tobacco Bay*

Introduction

Sessile marine organisms occur at a variety of locations throughout the ocean. These types of organisms range from barnacles, mussels, and seaweed to more extravagant species such as sea fans and sea anemones. Sea anemones are located on almost any type of substrate, at various depths in the ocean, and in great abundance or in seclusion (Zahra 2012, Jennison 1981). This is due to the type of reproduction that the sea anemone goes through. For example, *Bartholomea annulata* are able to self-fertilize, or go through asexual reproduction. These mechanisms result in clustered offspring (Jennison 1981). In contrast, species such as *Condylactis gigantea* predominantly go through sexual reproduction, resulting in widely dispersed offspring over a larger area (Jennison 1981). By growing in relative isolation from conspecifics, *C. gigantea* are able to grow quite large relative to the size that can be achieved within a cluster (Jennison 1981). This reproductive pattern places these sea anemones all over the ocean floor, and on rocks and corals at different depths. A study on the sea anemone *Anthopleura elegantissima* found a correlation between size and depth, in which smaller individuals are found closer to the surface of the water while larger species were found at greater depths (Sebens 1983). This study tests for a size-depth relationship with *C. gigantea*. I hypothesized that there would be a sea anemone size gradient and the sea anemones found in deeper water would be larger than sea anemones found in shallow water.

Materials and Methods

Study Organism. Condylactis gigantea (Fig. 1) is an organism mostly comprised of tentacles that vary from green to brown in color; these anemones may have pink to purple tips, or no colored tips at all (Zahra 2012). After sexual reproduction the larvae are widely dispersed over a great array of sites (Hensley et al. 2012). Larvae attach to the first hard surface they can adhere to, which also explains why *C. gigantea* can be found in so many different places throughout the ocean and at varying depths (Russo et al. 1994). These sea anemones maintain their position on the substrate by attachment with their pedal disk. However, *C. gigantea* are not completely sessile organisms, and can move through the use of their pedal disk, depending on the amount of food that is available, or if they sense danger from predator cues (Hensley et al. 2012).

Figure 1

A photograph taken of *Condylactis gigantea* highlighting the purple tips located on the top of the tentacles.

Study Site. This study was conducted at Tobacco Bay, Bermuda (Fig. 2). The bay had many rock structures throughout the shallow and deep waters, with an array of marine organisms.

Figure 2

A photograph of the study site Tobacco Bay, Bermuda.

Experimental/Observational Methods. The data for this experiment were collected between October 10th, and October 12th 2012. This bay had many rock structures throughout the shallow shores, with *Condylactis gigantea* distributed throughout the entire area. The locations of individual *C. gigantea* in Tobacco Bay were determined by snorkeling around the entire area and marking rocks associated with sea anemones with marking tape. Once six *C. gigantea* individuals were found, the depths of each sea anemone was measured using a rope (with meter increments marked) wrapped around a Styrofoam block with a dive weight at one end. After the depth of each sea anemone was recorded, the diameter of each sea anemone was measured using a meter stick while the tentacles were fully extended. The marking tape was then removed from each rock in order to avoid littering. This process was repeated for two days in different areas of Tobacco Bay, and a total of 17 anemones were observed.

Results and Discussion

A significant positive correlation was found between the depth and the size of *Condylactis gigantean* ($t_{15}=2.59$, $p=0.02$). It can be noted that as the overall depth of the sea anemone increased, the size of the sea anemone also increased. Thus, a sea anemone growth gradient does exist (Fig. 3).

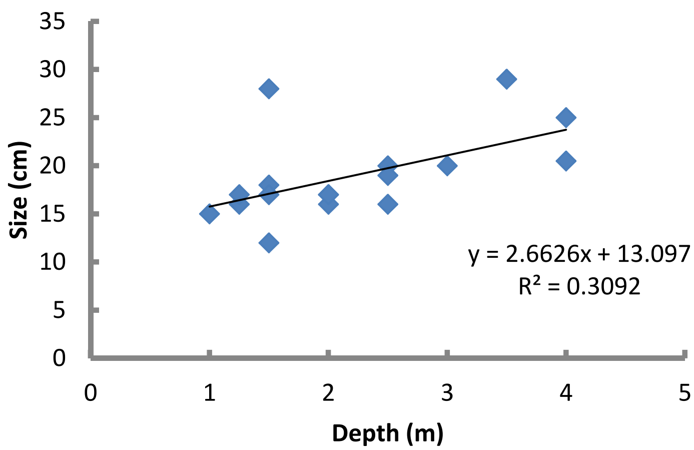

Figure 3

This graph shows the relationship between the depth and size of Purple Tipped Sea Anemones (*Condylactis gigantea*) found at Tobacco Bay in Bermuda. An increasing growth gradient can be seen on the positive line of best fit.

It seems likely that a sea anemone's depth cannot be the only factor that determines its size. *C. gigantea* is a dioecious species with a 1:1 male to female ratio, and primarily goes through sexual reproduction (Jennison 1981). *C. gigantea* lay eggs, which are then fertilized, and the larvae hatching fertilized eggs move freely in the water in their planktonic phase with a food supply in the yolk sac (Jennison 1981). Because of these properties *C. gigantea* can end up attaching to almost any solid surface, and start to grow. With this wide distribution of offspring *C. gigantea* usually grow up in solitude and do not need to compete for resources, thus making them able to grow to such large sizes (Jennison 1981). Overall, this reclusiveness and the distribution of species allow *C. gigantea* to grow to great sizes.

Sea anemones are known to harbor fish and shrimp through mutualistic relationships (Holbrook 2004). These relationships were initially thought to be commensal, in which only one species benefits while the other species is not affected (Holbrook 2004). In more recent studies it has been found that sea anemones harboring fish had greater growth and fission rates than sea anemones that lacked fish (Holbrook 2004). *C. gigantea* that allowed shrimp to live in their tentacles were found to be able to take up greater amounts of external nitrogen, which is beneficial to the sea anemone by supporting photosynthetic zooxanthellae (Holbrook 2004). This characteristic of *C. gigantea* further enhances the idea that sea anemones that are in a mutualistic relationship with either fish or shrimp, which promotes growth and viability in the sea anemone.
Reasons for this size-depth correlation remain to be explored. Possible factors that may contribute to size include age specific depth preferences, related to larval settling behavior as well as movement of the settled anemone, and the presence of cleaning symbionts at different depths. Other factors may contribute to size, including the type of substrate that the sea anemone is growing on and the availability of food at different depths.

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