A STUDY OF *GORGONIAN FLABELLUM* IN ST. GEORGE'S BERMUDA: THE RELATIONSHIP BETWEEN SIZE, DEPTH, AND WATER INTERACTION

Emily Claire Braun

Department of Biology, Clark University, Worcester, MA 01610
(ebraun@clarku.edu)

Abstract Gorgonians are found on reefs throughout the world's oceans. They are located at a large variety of depths within the water column. The species *Gorgonian flabellum* are seen in different sizes throughout reefs. Previous studies have shown that there is a relationship between the orientation of gorgonians and their size. As the ocean's water moves, the gorgonians are pushed back and forth by the water's force. This study looks at both depth and width of *Gorgonian flabellum* and wave interaction, as reflected in oscillation rates, to determine if there is a correlation between the two.

Key Words: Gorgonian*; orientation; oscillation*

Introduction

Gorgonian flabellum are commonly known as purple sea fans. These organisms are formed of polyps. The polyps form a colony that takes on the fan-like shape. *Gorgonian flabellum* is a filter feeder that captures small organic matter, such as plankton, in the organism's clusters of polyps. The structure of a gorgonian is maintained by a strong, larger, mother branch, that grows by adding smaller daughter branches (Sanchez et. al., 2004). This allows gorgonians to become "multi-branched treelike networks" that can grow up to several meters tall (Sanchez et. al.). This network of branches forms the "fan-like" shape of the *Gorgonian flabellum* colonies*.* The main support branch of the colony is smaller than the holdfast, which connects the fan to the substratum rock (Muzik and Wainwright, 1977). This creates a sturdier base than the fan shaped colony itself, allowing for the colony to oscillate according to water movement, while maintaining the strong connection of the holdfast to the rock. The sturdier base allows for the fans to maintain their orientation, even when the roughness of the water increases (Muzik and Wainwright).

Several studies have researched the link between gorgonian shape and orientation. These studies have led to the theory that gorgonian fans orient at right angles to the dominant flow of the ocean's current. This placement is due to the mechanical forces caused by the water's movement (Grigg, 1972). As there is movement throughout the water channel, the forces act upon the gorgonian fan. Water motion also appears to have an effect on a fan's size. In shallower waters, the strength of the wave force that acts upon the gorgonian seems to be associated with branch diameter (Grigg, 1972).

The purpose of this study was to determine if there is a correlation between orientation and size of *Gorgonian flabellum.* This study specifically examines the depth, orientation, and size of *Gorgonian flabellums* found in St. George's, Bermuda. In addition to size and depth, I have also tested for a relationship between water motion/wave interaction and the size of the gorgonian.

Materials and Methods

The study sites that were used were Tobacco Bay and Whalebone Bay, located in St. George's Bermuda. Fifty percent of the data were collected at each of the locations. Whalebone Bay and Tobacco Bay both had areas that received higher levels of wave interaction, as well as well-protected sections of the reefs. Both orientation types were selected for this study.

Gorgonian flabellum organisms at Tobacco Bay and Whalebone Bay were randomly selected to sample. Once located by snorkeling, researchers measured the width of the fan, with a tape measure, in what appeared to be the widest part. Figure 1 demonstrates how the widest part of the gorgonian was determined and where the researchers measured for the width. Depth was then measured by using a weight that was attached to a string with measurements marked along it. One researcher held the top, as close as possible, directly above fan. The second researcher aligned the bottom of the measuring string with the weight to where the holdfast of the *Gorgonian flabellum* met with the rock. This was repeated for ten measurements at Tobacco Bay and ten measurements at Whalebone Bay.

Figure 1: *Gorgonian flabellum,* line represents where the measurements were made.

To determine if there is a relationship between wave interaction and the width or the depth of the *Gorgonian flabellum* the purple sea fans were video recorded for 30-seconds. For each *Gorgonian* videoed, an oscillation tally number, the number of times that the fan moved in one direction or the other, was recorded. This was done by observing the 30-second video, twice; if the oscillation numbers differed between viewings, then a third viewing was done.

Correlation coefficients were then calculated for all of the data (depth, width, and oscillation) and tested for significance.

Results and Discussion

Figure 2 shows the positive correlation between depth and width of the measured gorgonians purple sea fan, which is highly significant (t_{18}=5.12, p<0.001). The overall trend shows that as the depth of a purple sea fan increases, then the width of the widest part of the fan also increases. The data support the hypothesis that if a *Gorgonian flabellum* is located in deeper waters, then it is likely to be larger than those in shallower waters.

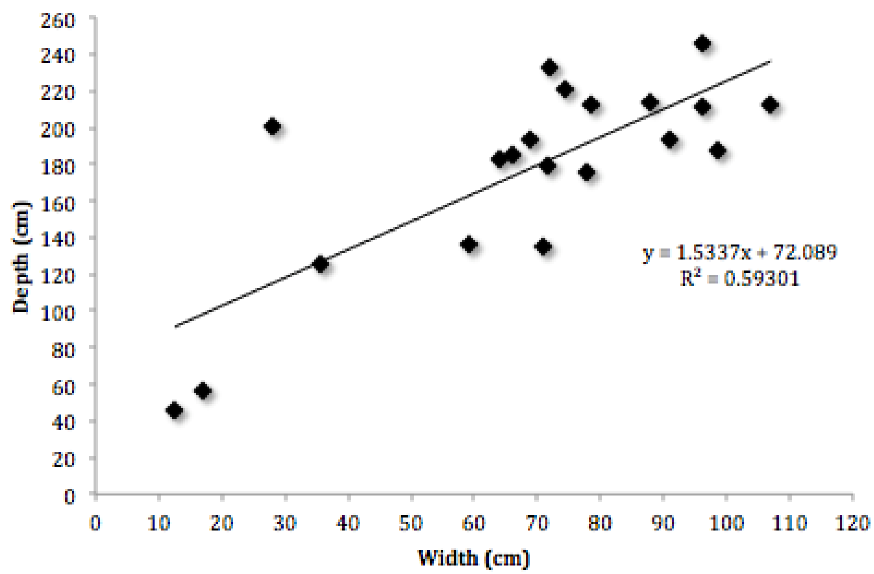

Figure 2: The width of *Gorgonian flabellum* compared to depth at Whalebone Bay and Tobacco Bay, in St. George's Bermuda, October 10^{th} – 12^{th} 2012.

Figures 3 and 4 depict the oscillation rates of the purple sea fans depending on width and depth. Figure 3 shows the relationship between the purple sea fan's number of times oscillated within 30 seconds and its depth. The slope of the line shows that there is no significant relationship between number of oscillations and the depth of the gorgonian. The fan depth did not affect the number of oscillations. The correlation coefficient is not significant (t_8=0.00, p=1.00). Figure 4 shows the relationship between the *Gorgonian flabellum's* number of times oscillated within 30 seconds and its width. While the slope of the regression suggests some relationship between oscillation and depth, the relationship is not significant (t_8=0.06, p=0.95).

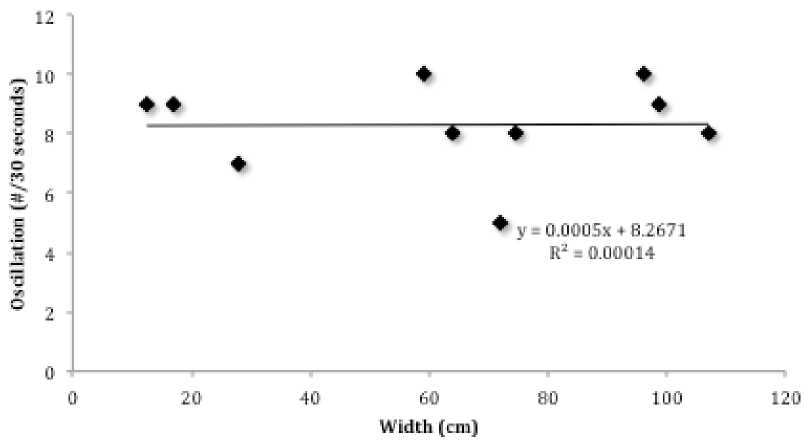

Figure 3: Width of *Gorgonian flabellum* compared to wave interaction. Whalebone Bay and Tobacco Bay, St. George's, Bermuda, October 10th – 12th 2012.

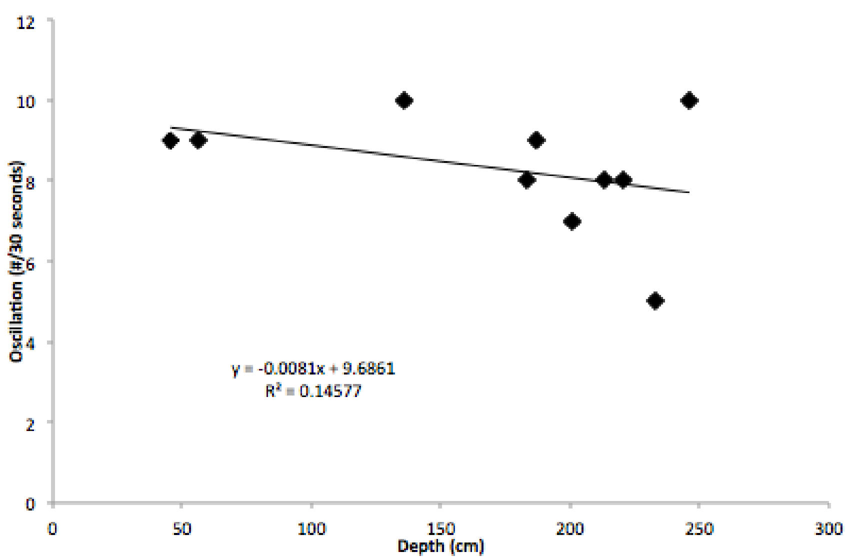

Figure 4: Depth of *Gorgonian flabellum* compared to wave interaction. Whalebone Bay and Tobacco Bay, St. George's, Bermuda, October 10th – 12th 2012.

Some options for further research on this topic would to obtain a larger sample. This could help further investigate the current hypothesis of the apparent positive correlation between *Gorgonian* depth and size. A possible change in the study methodology to help expand the sample size and further evaluate this hypothesis would be to use scuba to collect data. This will allow for a larger variety of depths of *Gorgonians*, as well as facilitate measurements of width and depth. The measurements may have been affected by human error. Because of the lung capacity of the researchers, some measurements may have been rushed while collecting. This issue could be resolved by using scuba as a means of research, rather than snorkeling. Another change to this study that would be helpful for further research is to use a computer graphics program to measure the fans. This would allow for possibly more accurate data of the measurements.

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