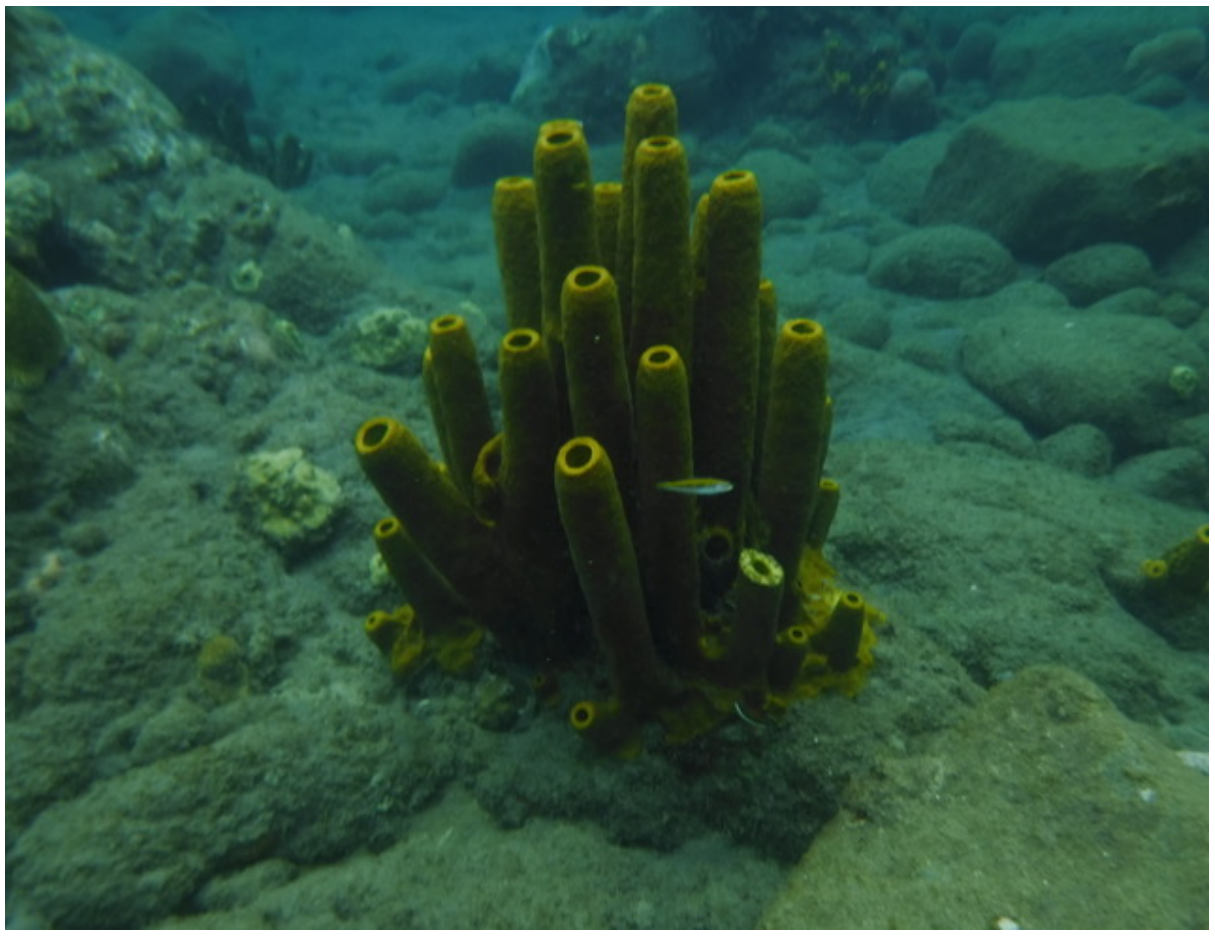
Survey of Live Coral at Champagne Bay and Scott's Head



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Abstract

The island of Dominica's Caribbean shores are home to many diverse coral reefs with an abundance of marine life. These coral reefs are suffering due to global warming and pollution. In our experiment, we studied the percentage of live coral at two different reefs on the island: Champagne Bay and Scott's Head Bay. We used a HOBO device to measure the daily temperature of the waters in each area. At each reef we took five transects each five meters long to make up our sample size. To keep our sample sizes consistent we took five pictures each 1 meter apart through a square grid. We observed that Scott's Head had a lower percentage of live coral compared to Champagne Bay. We also compared our data to data taken from the years 2014 and 2015. Through this comparison we concluded that coral health has declined and water temperature has increased since the last study was conducted.

Introduction

The island of Dominica is located in the Caribbean Sea south of Guadeloupe. Dominica is a small yet diverse island home to many different ecosystems. One ecosystem in particular that Dominica houses is coral reefs, which serve as an important source of food, shelter, and community for a vast amount of marine wildlife. Although Dominica has a relatively low amount of anthropogenic activity in comparison to other islands in the Caribbean, marine species diversity and abundance of the reefs are still impacted by the processes of coral bleaching (Camp et al. 2015).

Coral bleaching is the reduction of endosymbiotic dinoflagellates (zooxanthellae) on the coral due to the disruption of surrounding water temperatures (Lesser, 2011). This organism has a symbiotic relationship with coral, providing oxygen and nutrients to the coral, which enables it to flourish and produce its calcium carbonate exoskeleton in exchange for nutrients. When this symbiotic algae is lost due to increased exposure to high water temperatures, the coral dies and is essentially bleached because it turns white (Roberts, 1987). Other contributing factors to decreasing health of coral reefs include coastal development and the emission of greenhouse gases (Hughes, 1994). Although coral mortality can also be attributed to a number of natural causes, including hurricanes, earthquakes, and predator outbreaks, coral bleaching due to anthropogenic impact is an increasing concern (Hughes and Connell, 1999).

Two of Dominica's primary coral reefs, Champagne Reef and Scott's Head, were analyzed in previous studies conducted in both 2014 and 2015. They determined the health of the reef did not vary much between those two summers (Camp et al. 2015 and Encarnacion et al. 6). This study is designed to follow up on previous findings and determine which reef has the most live coral and if the health of either reef has declined.

Materials and Methods

In order to accurately survey the amount of coral present around Dominica, we decided to focus on two different locations: Scott's Head and Champagne Reef. These reefs are both located on the Southwest portion of the island and are popular tourist destinations in Dominica. They were chosen primarily because of their accessibility, species diversity, and potential for human

impact. Since studies similar to the one we conducted have been performed previously, we were interested to see how much the reefs had changed in the past three years.

At each site we tied a HOBO waterproof shuttle, which records temperature data every hour, to a buoy on the outer edge of the reef 1 meter below the water's surface. These temperature readings allowed us to compare current ocean conditions to the temperatures recorded from past studies. We allowed the HOBOs to remain in the water for several days so they would give us an accurate picture of temperature at both of the sites.

Areas of the reef used for analysis were chosen based on the abundance and diversity of coral present. A square quadrat was used to help facilitate an accurate size perception of the ocean floor. The quadrat was a 1x1 meter square made out of PVC pipe and divided using rope into 100 squares of 10 by 10 cm (see Figure 1). Fishing weights were attached to each corner to enable the quadrat sink and remain stable while in the water.

When an area was chosen for observation, a five meter transect rope with five loops, each tied one meter apart, was stretched out across the water's surface. The quadrat was attached to each loop individually with a carabiner and photos were taken of the grid using an underwater camera. At each sample site, we covered five one square meter rectangles. Multiple pictures were taken at each site to ensure the best quality picture for data analysis. At both locations, we took 5 different transects, which totaled to 25 square meters of ocean floor photographed at each site. Figure 1, found below, shows an example of the photographs taken at each section of the transect and what the quadrat looks like.

The saturation and contrast of the photos was increased in Adobe Lightroom so we could better identify the coral. We then analyzed all 100 sections in order to determine if live coral was

present or not. A section was given a score of 0 if there was no live coral present and a score of 1 if there was live coral present. The overall percentage of coral present in each quadrat was then calculated. This allowed us to compare reef health in each of the locations with each other and also allowed us to compare our numbers using the data they recorded in previous studies.

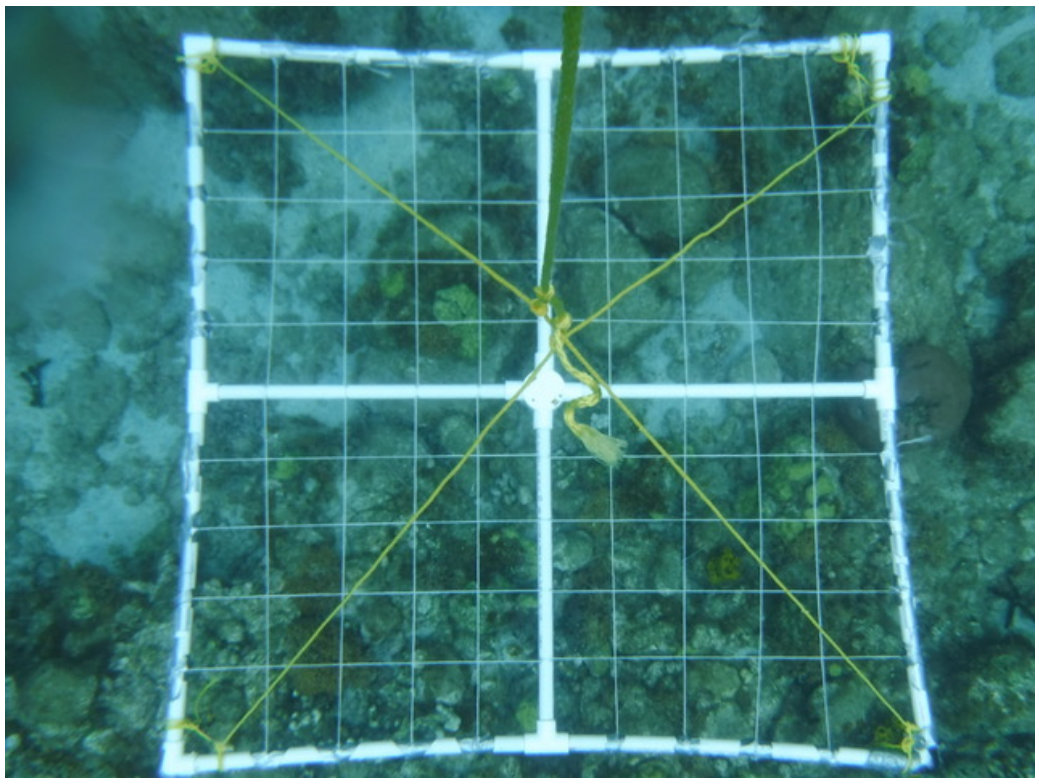

Figure 1. Quadrat used for transects.

Results

There were a total of 5 transects completed for both Champagne Bay and Scott's Head. The average percentage of live coral for all transects at Champagne Bay was 45% (Figure 2) and the average at Scott's Head was 17% (Figure 3). Water temperature was taken at both Champagne Bay and Scott's Head. Average temperature at Champagne Bay was 28.169 degrees Celsius (Figure 4), and the average at Scott's Head was 28.845 degrees Celsius (Figure 5).

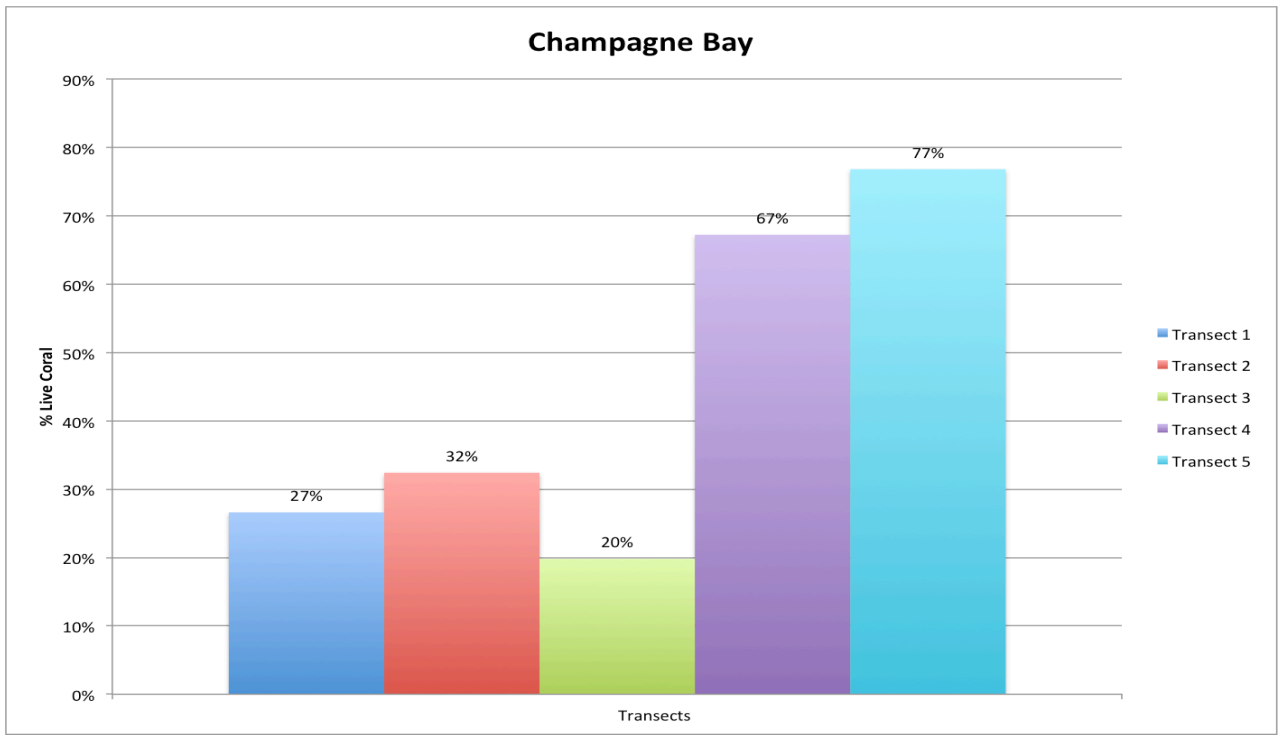

Figure 2. Average percentage of live coral at Champagne Bay. Each individual transect contained 5 pictures of quadrats. The percentage of live coral was calculated within each quadrat. This graph shows the average of the 5 quadrats per transect.

Figure 3. Average percentage of live coral at Scott's Head. Each individual transect contained 5 pictures of quadrats. The percentage of live coral was calculated within each quadrat. This graph shows the average of the 5 quadrats per transect.

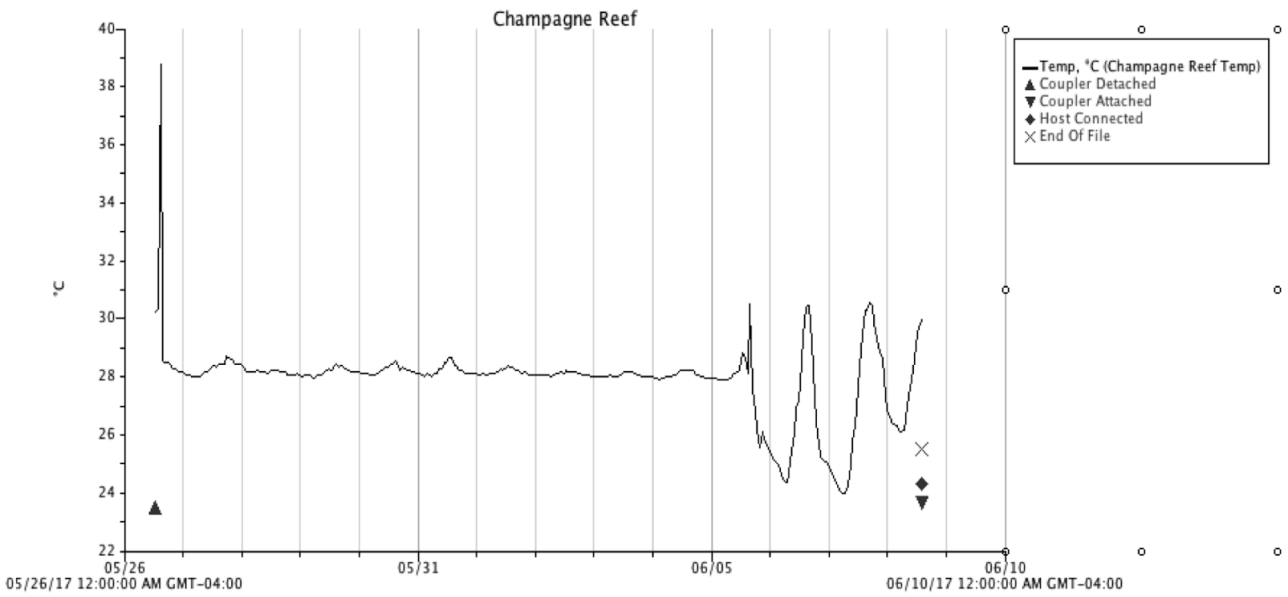

Figure 4. Temperature data at Champagne Bay. The HOBO was placed in the water at Champagne Bay mid-day on 5/26/17 and pulled from the water on 6/5/17. Rises in temperature can cause coral to expel zooxanthellae, which causes coral bleaching. The drastic fluctuations at the beginning and end of the graph are due to the device being outside of the water.

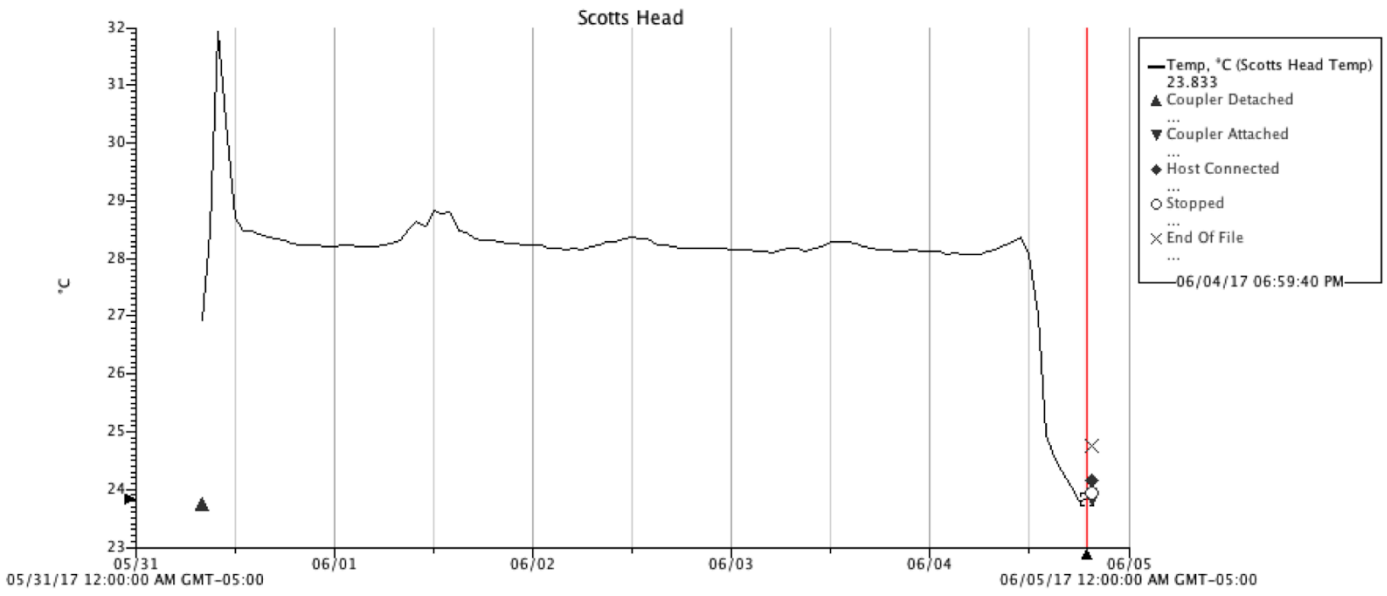

Figure 5. Temperature data at Scott's Head. The HOBO device was placed in the water at Scott's Head mid-day on 5/31/17 and pulled from the water mid-day on 6/4/17. Rises in temperature can cause coral to expel zooxanthellae, which causes coral bleaching. The drastic fluctuations at the beginning and end of the graph are due to the device being outside of the water.

Discussion

Based on the data presented, it was apparent that Champagne Bay had a higher percentage of live coral than Scott's Head Bay. We believe this is due to the proximity of the reef at Scott's Head to the town of Scott's Head. This causes there to be more pollution runoff into Scott's Head Bay, therefore creating more bleached coral. The percentage of live coral has dropped significantly since 2014 (Encarnacion et al. 6). In the 2014 study, an average of 61.03% live coral was observed in Champagne Bay and 31.17% live coral was observed in Scotts Head Bay (Figure 6). In only three years, the percentages have dropped to an average of 45% live coral in Champagne Bay and 17% live coral in Scotts Head Bay.

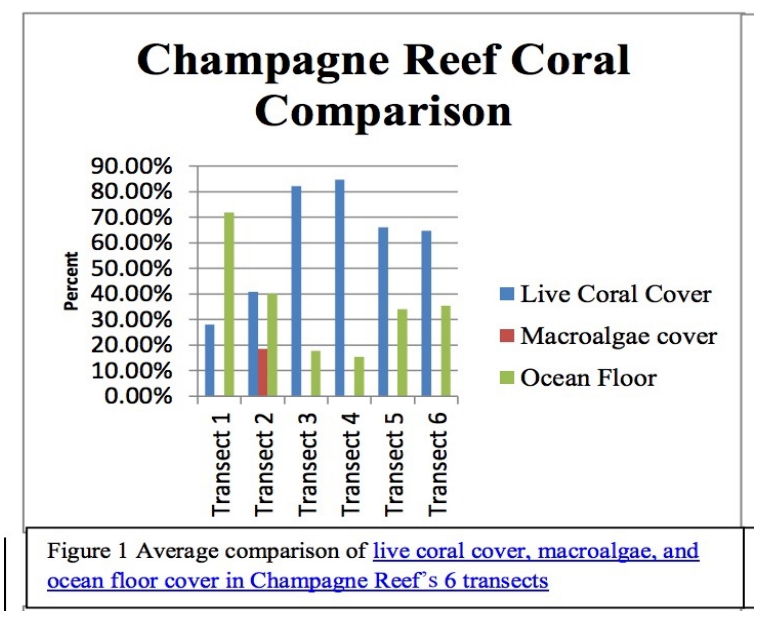

Figure 1 Average comparison of live coral cover, macroalgae, and ocean floor cover in Champagne Reef's 6 transects

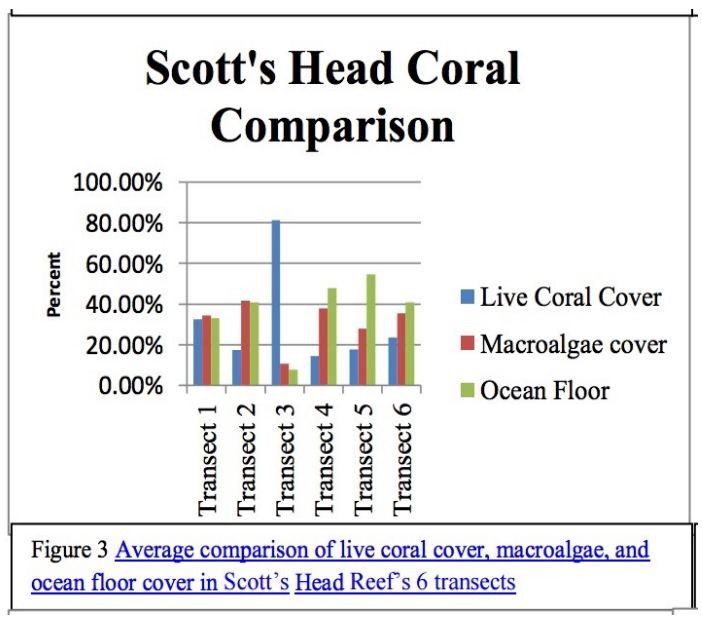

Figure 3 Average comparison of live coral cover, macroalgae, and ocean floor cover in Scott's Head Reef's 6 transects

Figure 6: Data taken from the paper "An Assessment and Comparison of Reef Health in Dominica" from 2014 (Encarnacion et al. 6). We are comparing their live coral percentage to ours.

The data taken from the HOBOs in Scott's Head Bay and Champagne Bay showed that their daily temperatures were approximately the same. Average temperature at Champagne Bay was 28.169 degrees Celsius (Figure 4), and the average at Scott's Head was 28.845 degrees Celsius (Figure 5). These data compared to the data taken in the 2015 study shows a definite

change in water temperature over the past two years (Camp et al. 2015). The average water temperature they calculated from Scott's Head was 27.80 degrees celsius and Champagne Bay's was 27.84 degrees celsius. This shows that the average temperature of the of the reefs at approximately the same time of year is rising. Because temperature was only measured for a short period of time, we cannot definitively say temperature is drastically rising but the numbers suggest a potential area for serious concern.

The increasing water temperatures and declining health of coral that we found at Scott's Head and Champagne Reef show trends that could devastate the fragile ecosystem found on the shores of Dominica. Because of this, water temperatures and coral health should be carefully monitored and serious action to preserve these reefs should be taken.

Acknowledgements

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