Translocating Long-spined Sea Urchins to Reduce Macroalgae on Coral Reefs
Abby Rolle, Juliet Morse, Keeley Brooks, Nico Simons, and Norah Van Vranken

Advisors: Casey Harris & Kennedy Wall

INTRODUCTION

Long-spined sea urchins (Diadema antillarum) are important herbivores that effectively reduce macroalgae on coral reefs, enhancing coral growth and increasing space for new coral recruits (Fig 1). However, in 1983-84, this sea urchin species suffered mass mortality throughout the Caribbean. The exact cause of this mortality event is still unknown, but researchers believe it was due to a waterborne pathogen spread over long distances through ocean currents. The effects of this die-off on the reef ecology were immediate and combined with overfishing and other stressors, reefs transitioned from coral-dominated to algal-dominated communities, a process known as a phase shift.

The purpose of our study was to test if restoring D. antillarum to coral reefs was an effective tool to decrease competition of fleshy green macroalgae, such as Acropora palmata, on coral colonies (Fig 2). The long-term goal of this study is to improve the health and resilience of coral reef ecosystems off South Eleuthera, and combine this method with coral gardening techniques.

RESULTS

During the study, 70 D. antillarum were collected from the Cape Eleuthera Marina (collection site) and kept at the Cape Eleuthera Institute wetlab (Fig 5). The D. antillarum were fed macroalgae twice a week before being translocated to patch reefs at Tunnel Rock (translocation site) (Fig 5). Using a spatula, tongs, and puncture proof gloves, the D. antillarum were translocated to selected patch reefs off South Eleuthera, Bahamas. Six patch reefs were used in this study: three experimental and three control reefs. The D. antillarum were translocated to three experimental reefs at densities of two individuals per square meter. At the translocation site, our team descended on SCUBA with D. antillarum and corks and carefully placed them onto the experimental patch reefs (Fig 6). Fish surveys were performed using slates to note the abundance of D. antillarum predators and herbivores on patch reefs. Survivorship and retention rate of D. antillarum was monitored daily after they were translocated. To do so, the experimental reefs were thoroughly observed with flashlights to locate remaining D. antillarum. Additionally, we studied examined reef rugosity and how this impacts the survivorship of the D. antillarum. Reef rugosity was collected by laying a transect tape on the reef and carefully placing a 4-meter lightweight chain to measure the surface structure of the reef.

DISCUSSION

Coral reefs in the Bahamas are dominated by macroalgae, mainly due to the loss of herbivorous grazers, such as D. antillarum. Our study aimed to reintroduce this urchin species to the reef to reduce algal competition on corals.

When translocating D. antillarum to coral reefs, our study showed that high reef rugosity is important to D. antillarum survivorship. ER2 had the highest rugosity compared to ER1 & ER3. (Fig 7). High reef rugosity supports a greater diversity of fish predators. Fish predators increased immediately after D. antillarum were translocated to patch reefs and were translocated to patch reefs and closer to their pre die-off densities (4 individuals per sq. m) and protection from predators. This finding indicates that the survivorship and recovery of D. antillarum could be greatly impacted by climate change, as coral reefs in the Caribbean are becoming less structurally complex due to ocean acidification and hurricanes.

The reefs around South Eleuthera are dominated by fleshy green macroalgae, mainly M. marinum. Our study and field observations, we found that D. antillarum actively grazes M. marinum, which was not previously documented before this study. Due to high predation on translocated D. antillarum, the benthic composition did not change between experimental and control reefs. However, signs of local grazing were observed on a small scale.

Through our fish surveys, we observed a lack of herbivorous fishes on and around patch reefs. The majority of herbivorous fishes observed were juvenile, which had little impact on the benthic composition changing. D. antillarum this predators increased immediately after D. antillarum were translocated to patch reefs and were translocated to patch reefs and closer to their pre die-off densities (4 individuals per sq. m) and protection from predators. This finding indicates that the survivorship and recovery of D. antillarum could be greatly impacted by climate change, as coral reefs in the Caribbean are becoming less structurally complex due to ocean acidification and hurricanes.

ACKNOWLEDGEMENTS

We would like to thank the whole Island School community and CEI for constant support throughout this research project. As well as Blair and Alex for overseeing all of our scientific data. Theo Walsh for his early contributions, Jacob and Lily for their assistance, and our parents for their love and support. Lastly, to our helpful and encouraging advisors Casey and Kennedy for making Team Diadema so special.

LITERATURE CITED


