The Biodiversity of Marine Epiphytes on *Zostera marina*

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SEPA Science Education Partnership Award. Supported by the National Institutes of Health

Abstract

Marine epiphytes are commonly found on the leaves of seagrass plants. In marine ecosystems, these "organisms" can include, but are not limited to plants. Epiphytes are any sessile, or immobile organisms, that remain permanently attached to a plant. Epiphytes in marine ecosystems often include: algae (micro and macro), bacteria, fungi, sponges, bryozoans, tunicates, protozoa, hydroids, crustaceans and mollusks. Populations of epiphytes were analyzed on the zostera plants and barcoded to determine the number of different species on the marine plant samples that were taken.

Introduction

Epiphyte comes from the word "epi" meaning upon and the word "phyton" meaning plant (Welch 2007). Epiphytes are organisms that grow on other plants but are not parasitic. Examples of epiphytes that grow on other plants includes numerous different species of algae, bacteria, fungi, sponges, crustaceans, mollusks, and larval stages of invertebrates. These can all grow on seagrass. Seagrass is able to grow in harsh environments due to their roots constantly being in the air. Epiphytes and the plants they reside on, live in symbiosis, so the organisms benefit from each other. For example, the seagrass benefits from being nourished by the epiphytes but once the seagrass die, they provide the epiphytes with nutrients to survive (Act for Libraries).

Marine epiphytes serve important roles as indicators for biodiversity, which is decreasing due to anthropogenic factors. It is important to manage the landscape in marine ecosystems in ways that will minimize negative effects on biodiversity. For example, epiphytic lichens are indicators of air quality. They are used for this in the U.S. Forest Service in the National Lichens and Air Quality Database & Clearinghouse and the Forest Health Monitoring Program. Furthermore, epiphyte biomass, as biomass per unit, can be the most effective epiphyte indicator (USDI BRD Forest and Range Ecosystem Science Center). To estimate future possible thresholds for environmental concerns, an analysis of epiphytes responses versus seagrass responses were taken. Results showed that density and productivity are proposed as potential thresholds, with a 25% and 50% reduction in seagrass biomass (Nelson 2016). This prior research is useful because it shows how epiphytes could potentially affect biodiversity moving forward. By providing an area for organisms to hide from their predators, seagrass serves as a three dimensional canopy which helps increase biodiversity.

Seagrass meadows play a vital role in marine habitats by providing shelter to numerous organisms and acting as a food source, they also benefit human health by improving the quality of water. A study found that the percentage of bacterial pathogens was significantly lower in areas where seagrass meadows were present, compared to areas without seagrass meadows (Lamb et al., 2017). However, an overgrowth of epiphytes on seagrass can prevent the prosperity and growth of these seagrass plants (Lamb et al., 2017).

This project was completed to answer the following questions: Are the effects of marine epiphytes on zostera leaves and biodiversity positive or negative? The hypothesis of this research is that there is great biodiversity among marine epiphytes found on the beach and these epiphytes can have an effect on the seagrass on which they are found. Barcoding is a method of identification of species based on DNA which is more reliable and precise than identification based on phenotype.

Methodology

Twenty samples were taken from the Venetian Shore, Tanner Park, and Crab Meadow Beach from Long Island, NY. The process of DNA extraction and isolation then began with lysis solution, incubating, wash buffer, and silica resin for the samples. At this point, gel electrophoresis was used to separate the DNA by size and charge. After being placed under a UV light, pictures of the gel were taken and uploaded to the sample database. The DNA was then able to be sent to Gene Wiz for sequencing. Finally, with the help of DNA Subway, cladograms and DNA barcodes were created.

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Tables & Figures

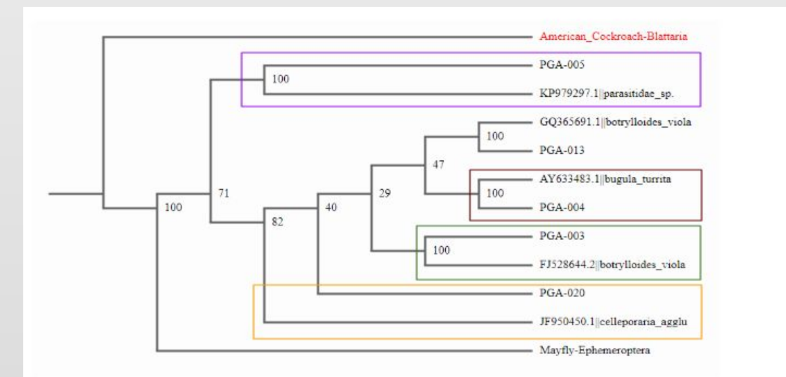


Figure 1: A phylogenetic tree demonstrates the similar ancestry of the samples and their closest match on DNA Subway. The data indicates that 75% of the samples that were collected have a 100 bootstrap indicating the most recent common ancestor.

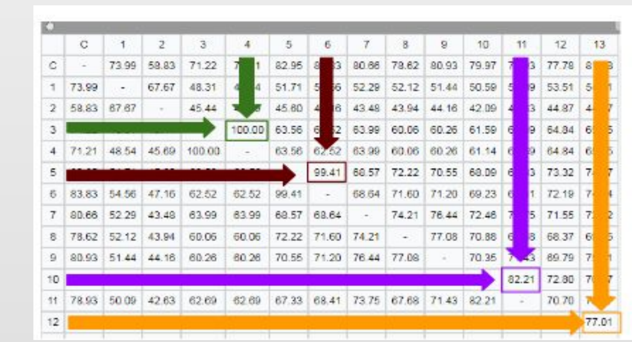
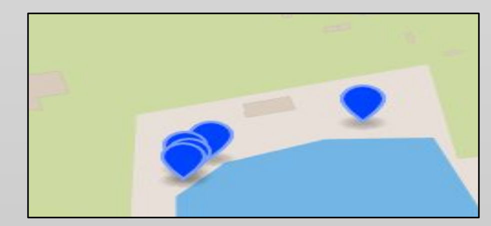


Figure 2A: This chart demonstrates the percentage similarity between each sample and its closest match on DNA Subway. Approximately 95% similarity or higher is indicative of a species match. Therefore 50% of the samples collected can be identified using DNA Barcoding.

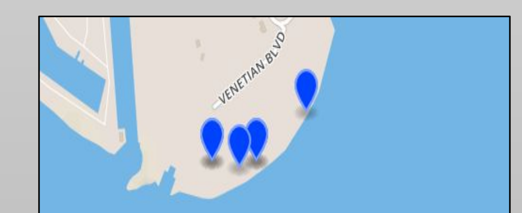
Figure 2B: This demonstrates a DNA Barcode for the epiphytic samples and their match on DNA Subway. The data indicates that samples PGA-003 and PGA-004 both have a very similar barcode to their matches, Botrylloides violaceum and Bulga turrita respectively.

Long Island



Tanner Park

Venetian Shore



Crab Meadow Beach

Figure 3: These maps refer to the locations that samples were collected from.

Figure 4: *Zostera marina* is a species of eel grass that is commonly found on Long Island. This creates a third dimensional canopy that organisms such as juvenile scallops use as a nursery which in turn increases biodiversity.

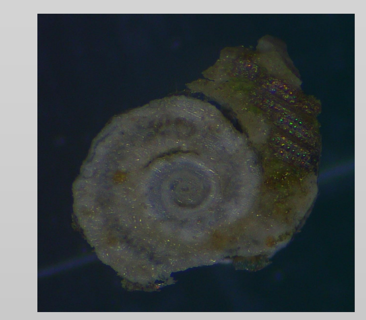


Figure 5A: This is a picture of sample PGA-001

Figure 5B: This is a picture of the genus Amphiscapha

Results

Phenotypic identification was difficult due to the physical size of each sample. DNA Barcoding was used and is shown in Figure 2A and Figure 2B. Figure 2A shows the percent similarities between the samples, and Figure 2B shows the DNA barcode for the experimental samples and their closest matches on DNA Subway. The dark and light grey areas representing no DNA sequences, and colored areas representing similar DNA sequences. Figure 5A the most prominent epiphytic organism (sample PGA-001) found amongst the *Zostera* leaves resembles a species of Gastropoda. Phenotypically, this corresponds to an *Amphiscapha*, shown in Figure 5B. However, the DNA from this sample was not successfully amplified.

Discussion & Conclusion

The hypothesis of great biodiversity among marine epiphytes and the effect they have on the seagrass itself, was supported because based on the phenotypes and genotypes of the epiphytes there appears to be a lot of biodiversity among the epiphytes and a negative effect on the seagrass. Prior research has been done on epiphytes and their impact on their environment, species of seagrasses and eelgrasses. This research shows that the seagrass population is declining and it is likely due to a large biomass of marine epiphytes within the seagrass (Hughes, Stachowicz, 2009). It can be inferred, based on this prior research, that among this large population of epiphytes there is great biodiversity, as well. This defends our results because based on the samples that we found and those that had clear DNA sequences, no two samples were the same therefore, there is also high biodiversity. This can then later be used to obtain more information about what may cause the the increase of marine epiphytes and the decline of the seagrass and eelgrass.

Acknowledgements

This research was made feasible by the following :
Cold Spring Harbor Laboratory's DNA Learning Center, Stony Brook STEP, Dr. Veloso, Ms. Swiss, Ms. Victoria Hernandez, Mrs. Dorys Johnson, Mrs. Edwina Branch-Smith, Ms. Lizsaura Gonzalez, Mr. Daniel Owusu, Ms. Demetra Catalano, Dr. Rebecca Grella from Brentwood High School, Brentwood High School, Half Hollow Hills High School East, and Long Island Lutheran Middle & High School.