The Abundance of Invasive Seaweed Species Along Barrier Beaches

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Abstract: Invasive seaweeds disrupt barrier beach environments, rob resources from native plants and suffocate and kill the populations of other marine life through hypoxia. It was predicted there would be more invasive species than native species across barrier beaches. Species and location data was collected for each sample, and Simpson's Index was calculated to indicate biodiversity. The genetic material was isolated through silica and rapid protocols and the rbcL region was amplified through PCR. DNA barcoding was then used to determine the species found at each beach. DNA barcoding was unsuccessful, but through morphological analysis it was determined that the samples were all native species. Influxes of invasive species occur between June and September, so future repeats of this experiment would ideally be done in that window.

Introduction: Seaweed plays a crucial role in Long Island's coastal ecosystem, from providing coastal protection, carbon storage, and helping to keep a balanced food chain. (Cotas J. et al. 2023) Without seaweed, coastal ecosystems could collapse. A particular threat to seaweed in Long Island's barrier islands are invasive species. Invasive species, such as *Dasysiphonia japonica*, can use up resources, leaving little to none left for native seaweeds that are essential to the environment. It is important to discern the abundance of invasive species of seaweed when determining how to best take care of our environment.

This experiment focuses on seaweed in the barrier beaches of Long Island. A barrier beach collects all the debris and pollution from exterior sources, preventing the wreckage from reaching the main island and its beaches. They also protect the mainland from strong waves, flooding, and erosion (Natural Heritage Resources Fact Sheet Barrier Beaches). Should native seaweed be removed from a barrier beach ecosystem, dunes that prevent flooding would diminish and therefore all sorts of debris and damage would be able to pass through the beach and inland.

In addition to the harm invasive seaweed can cause to its adopted habitat, seaweed can also cause brown tides, which is a specific high concentration of seaweed that forms what is known as a "bloom". Brown tides can cause damage to those who practice fishing and oystering (for both profit and pleasure), which are popular on Long Island, most notably in Great South Bay.

This project aimed to determine how large invasive populations actually are, through collecting samples of seaweeds on South Shore Beaches and performing rapid and silica isolations to determine their species. The project hoped to see how pressing the matter of invasive seaweed species on Barrier Beaches was by determining the abundance of invasive seaweeds on Long Island.

Figure 1: Annotated maps of collection sites: Jones Beach and Robert Moses

Materials and Methods: Seaweed samples were collected from Jones Beach State Park and Robert Moses State Park. 26 samples were collected on March 24, 2026 (Figures 1 and 2). Samples were photographed, stored in tubes with 95% ethanol, and then frozen in the freezer with caps left open for 36 hours to dry. Once dried, a dissection microscope was used to take magnified photos of our samples, and information was uploaded onto the DNALC Sample Database. To identify the samples, the Seaweeds of Long Island Sound field guide was used (Margaret Stewart Van Patten, 2009). Silica isolation did not result in many samples being amplified properly, so another round of isolations was done, this time using the rapid isolation protocol. The rbcL region was amplified, but with a similar success rate when gels were examined (Figure 3). After gel electrophoresis, 8 samples were sent over for sequencing, and were analyzed through BLAST to determine the species.

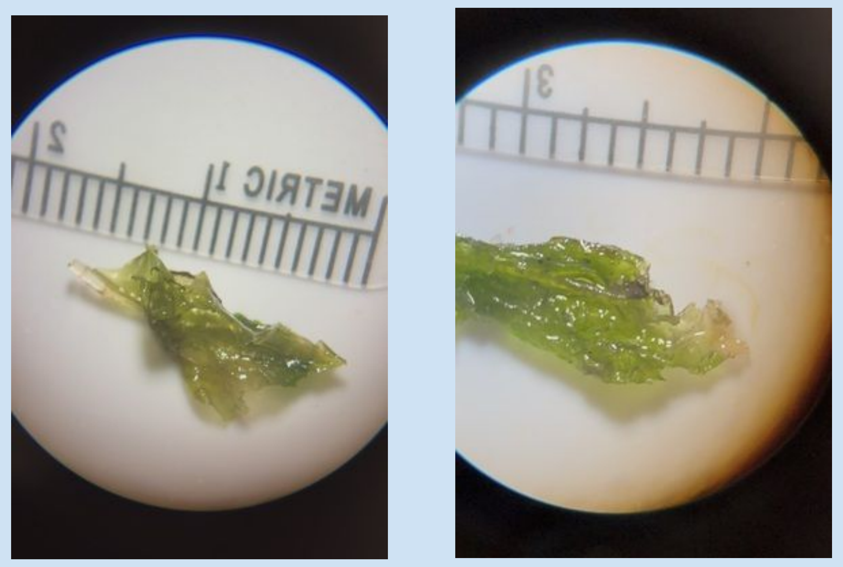

Figure 2: Samples DRE-002 and DRE-014 as Ulva linza and Ulva lactuca, respectively

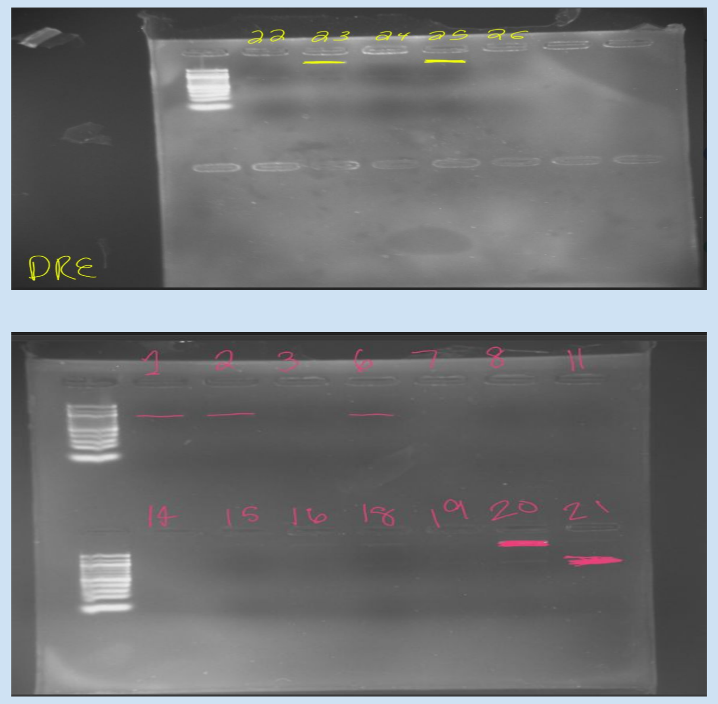

Figure 3: Results of gel electrophoresis

Results: Sequenced samples were identified as *Citrus maxima* (pomelo), *Paramignya confertifolia*, *Quercus robur* (English oak), *Tetramorium caespitum* (pavement ant), and *Solanum tuberosum* (potato). The samples were then morphologically identified as *Ulva lactuca* (sea lettuce), *Ulva linza* (mini sea lettuce), and *Ulva intestinalis* (gut lettuce). No species were identified as invasive. Simpson's Diversity Index was calculated to be 0.698 at Robert Moses and 0.133 at Jones Beach (Figures 4-7).

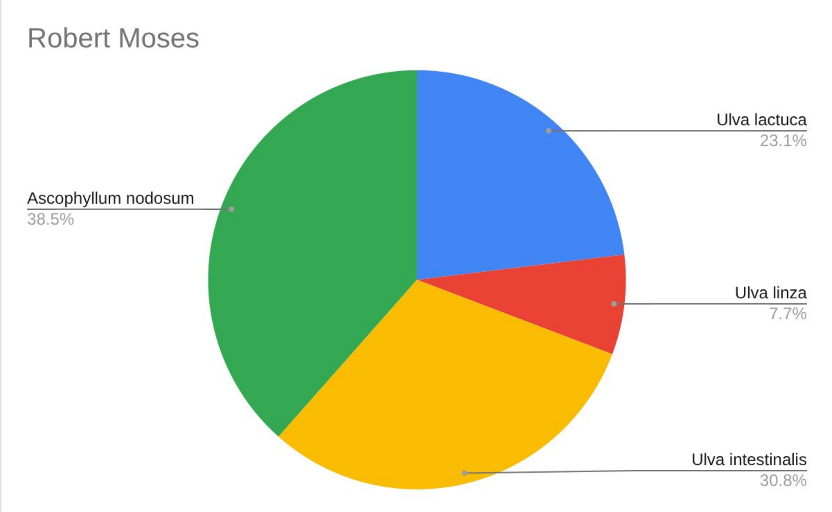

Figure 4: Pie chart: biodiversity of samples at Robert Moses based on morphology

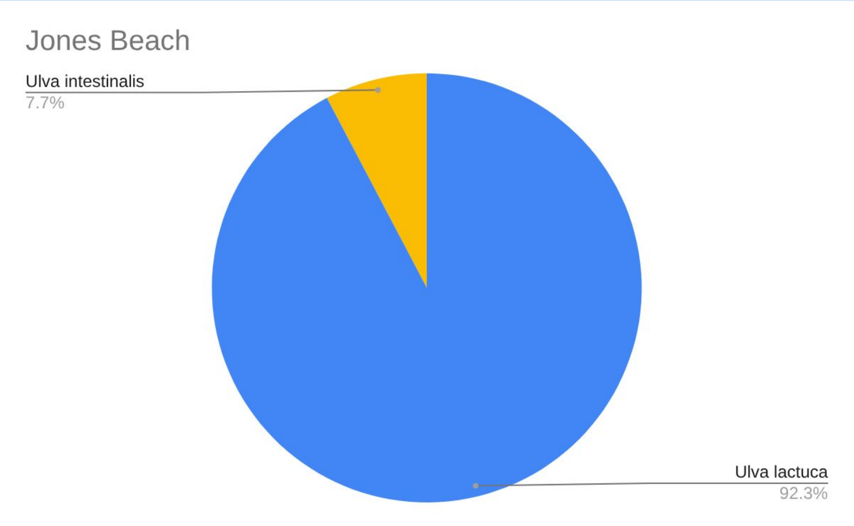

Figure 5: Pie chart: biodiversity of samples at Jones Beach based on morphology

Discussion: Our barcoding results identified our samples as Pomelo, English Oak, potatoes, and a pavement ant. Considering the morphological characteristics of the samples, this is impossible.

Further experiments should be done with caution utilizing other methods of identification, such as iNaturalist and guide books. Though morphological identification was useful in this case, it is important to consider human error. Many types of seaweed are hard to morphologically identify, whether it be the low morphological differences between species, or the plasticity of seaweed.

Given the errors that could result in morphological identification, it is more reliable to use DNA Barcoding. Though this is true, seaweed is incredibly complex to barcode and does not usually show fruitful results. For one, seaweed DNA is hard to preserve, especially for long periods of time. The isolation of DNA is extremely complex as well. Seaweed plant cells have cell walls that need to be broken to allow the DNA to be isolated. If this step isn't done correctly, isolation can not occur (Zuccarello and Paul 2020). Future studies could reattempt the unsuccessful samples with rapid and Silica isolation. Given that only 80 minutes a day were available to perform the isolations, the process was vulnerable to human error due to the constant needing to stop, rushing, and storage: impeding the process.

Basing results solely on morphology, no invasive species were found. Recently, researchers from Stony Brook University conducted an experiment on algae blooms on Long Island, however, and they found the largest influx of invasive species from June to September (SBU Study Shows Record Number of Dead Zones in LI Waters 2024). Conducting the experiment during this time period could yield a more accurate representation of both native and invasive species.

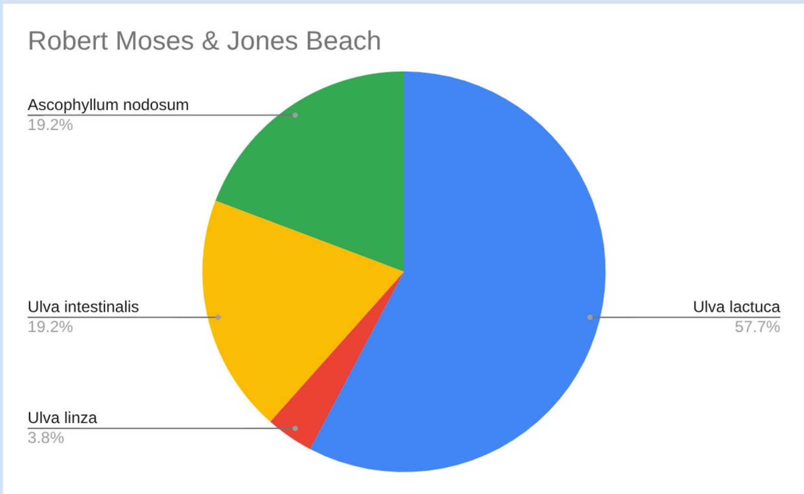

Figure 6: Biodiversity of samples considering both Robert Moses and Jones Beach based on morphology

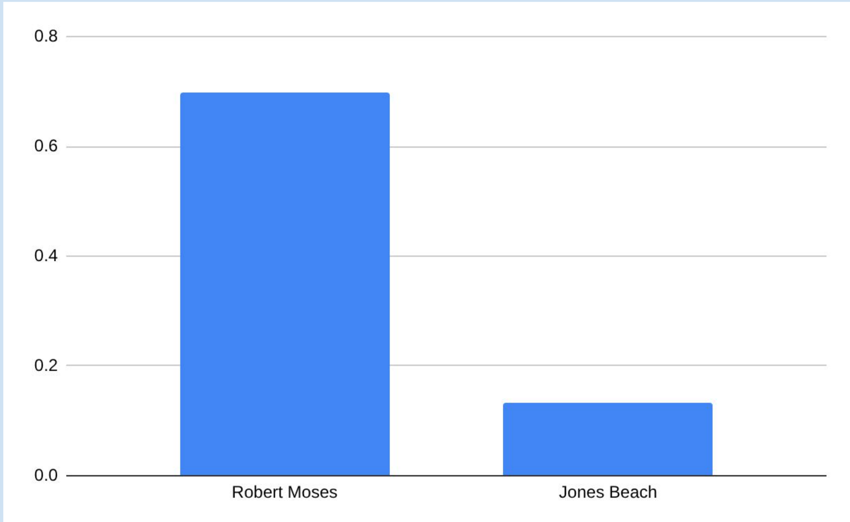

Figure 7: Formula & Bar Graph: Simpson's Index results based on morphology

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References: