

# Analyzing and Barcoding the DNA of Seaweed on Long Island

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## Abstract

Seaweeds are marine algae that are important primary producers. The purpose of this experiment is to examine the seaweed species currently inhabiting the beaches and to catalogue species in order to analyze biodiversity and determine whether they are unknown, invasive, or native. Twenty samples of seaweed from various beaches on Long Island (Jones Beach, North Hempstead Beach Park, Captree State Park, Theodore Roosevelt Memorial Park, and Harbor Road, Huntington) were photographed and collected in tubes, and the GPS coordinates of where each sample was found were recorded using the Coordinates app. Each sample's DNA was extracted, isolated, and then amplified through PCR using either algae primer or plant primer. The PCR products were analyzed with the use of gel electrophoresis. The information and pictures of the gel electrophoresis and the samples were uploaded onto the Barcode Project Sample Database and samples 1, 9 and 10 were approved for DNA sequencing.

## Introduction

Seaweeds are marine algae that are important for the ecosystem of the Long Island Sound. They are primary producers that undergo the process of photosynthesis and provide energy for the rest of the food web. Seaweeds are categorized into three classes based on color: green, brown, and red (Guiry). Most species of seaweed require rigid surfaces to grow on, but some may grow in sandy or muddy areas. There are species of seaweed on Long Island that are non-native, some of which are considered to be invasive. Seaweed can cover an extensive area which then becomes a habitat for marine animals.

In addition to its beneficial role as a primary producer, seaweed has economic potential as well. Seaweed is used as an ingredient in makeup, paints, toothpaste, fertilizer, and animal feed. It is also used as a biofuel because of its high nutrient density. Sugar kelp, or *Laminaria saccharina*, is a seaweed that is part of the sea vegetable industry of Long Island (Yarish).

Seaweed can also be used to improve water quality by nutrient reduction. There have been experiments that show growing seaweed near fish farms can remove the potentially harmful excess of nutrients. An excess of nutrients such as nitrogenous compounds from fish production can cause eutrophication, but if seaweed is grown nearby it will absorb the excess (Cummings, 1999). The presence of seagrass in an estuarine system is usually regarded as an indicator of ecological health (Tyler, 2010).

Currently, there are studies involving seaweed in bioextraction and preliminary evaluation. There are also studies researching possible bioactive compounds found in seaweed that may manage diseases like diabetes (Sharifuddin, 2015).

However, seaweed also has harmful effects. For example, rotting seaweed is a source of hydrogen sulfide which is a highly toxic gas. Hydrogen sulfide causes vomiting and diarrhea in humans.

It is estimated that 5,000 to 6,000 species of seaweed exist worldwide (Cornell, 2012). Further cataloguing of seaweed is necessary in order to discover new species of seaweed and to analyze the biodiversity of seaweed on Long Island, as well as determine whether they are unknown, invasive, or native species and to research their impact on the environment.

## Materials and Methods

In order to explore the biodiversity of Long Island, it was decided that picking beaches located in various locations on the north and south shores of Long Island would be the most beneficial for this project. The beaches picked were Jones Beach, North Hempstead Beach Park, Captree State Park, Theodore Roosevelt Memorial Park, and Harbor Road, Huntington.

For this project, whole samples of seaweed were not collected. Only seaweeds that had washed ashore or were near the shore and that were not part of the rooted, original plant were collected. In some cases, such as on rocky beaches where there was not much vegetation, team members waded deeper into the water and cut off a small section of a seaweed plant (2 inches at most) using a pair of scissors. Before the samples were collected, pictures of each seaweed sample in its natural habitat were taken using a smartphone. Twenty samples of seaweed were collected in all and put into test tubes. The test tubes were filled with seawater to keep the samples fresh. GPS coordinates of the specific areas where the seaweeds were collected were taken down using the Coordinates app on a smartphone. The label on each tube consisted of the sample number, name of the beach, the GPS coordinates, and the date the sample was collected.

In order to extract and isolate the DNA from the samples, amplify the DNA, and to perform gel electrophoresis, the protocols provided by Cold Spring Harbor Laboratory were used ("Isolating DNA"). The amplification protocol was applied to two sets of tubes-- one set of tubes contained the DNA from each seaweed sample and the plant primer (rbcLaF/ rbcLa rev) and the other set of tubes contained the DNA from the same samples of seaweed and algae primer. This was done because seaweeds have many plant-like qualities and are marine algae, so both the plant primer and the algae primer were applicable. The gel electrophoresis was viewed using UV transillumination and photographed using a digital camera ("Analyze PCR Products by Gel Electrophoresis"). The pictures were uploaded onto the Barcode Project Sample Database.

## Results

Samples 1, 9 and 10 were approved for DNA sequencing from the gel electrophoresis images.

Fig. 1

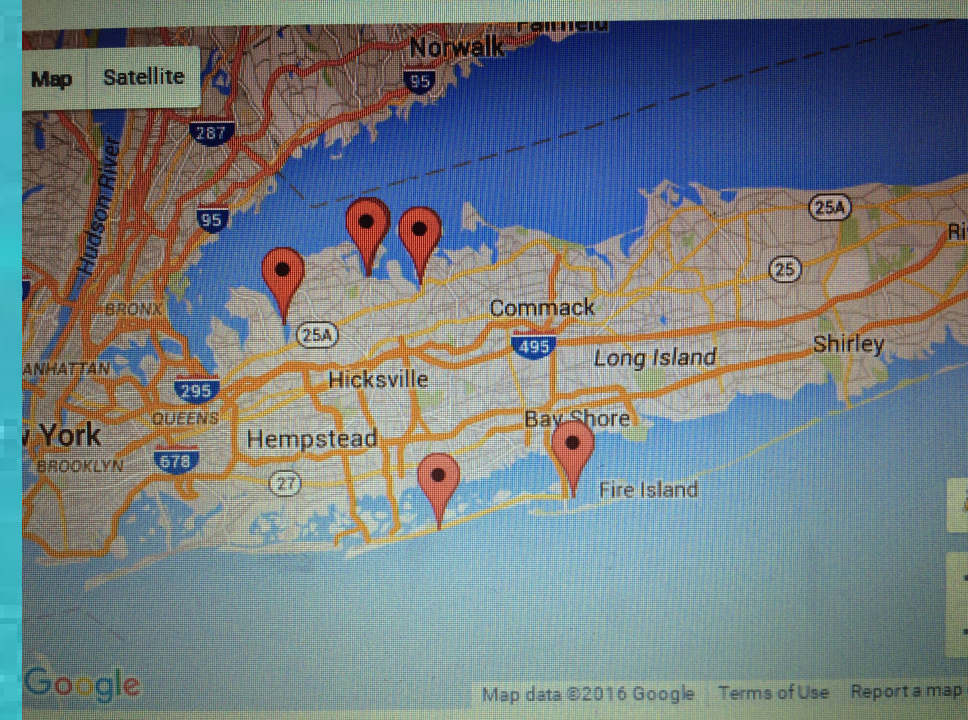


Fig. 1 Beaches from which seaweed was collected: Jones Beach, North Hempstead Beach Park, Captree State Park, Theodore Roosevelt Memorial Park, and Harbor Road, Huntington

Fig. 2



Fig. 2 Seaweed sample FSM-002 was collected from North Hempstead Beach Park, Nassau County.

Fig. 3



Fig. 3 Seaweed sample FSM-009 collected from Jones Beach, Nassau County.

Fig. 4



Fig. 4 Seaweed sample FSM-005 collected from Captree State Park, Nassau County.

Fig. 5



Fig. 5 Habitat at Theodore Roosevelt Memorial Park.

## Discussion

The method that was used for the collection of seaweed samples allowed for sources of error. Due to the fact that some samples were collected as they drifted by on the beach, it is possible that those samples did not originate from that beach, and were carried from their original locations by the waves. Furthermore, since only three of the twenty samples were approved, it will be difficult to analyze the biodiversity of seaweed on Long Island. The low percentage of acceptance demonstrated that both the algae and plant primers were not as effective as they could potentially be. For future work, we plan to search for or to develop a primer that will work effectively in helping to identify species of seaweed.

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