Presence of Algae in NYC Bodies of Water: Its Correlation with Wildlife

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Abstract

Nearly all organisms in an ecosystem are linked together via the symbiotic relationships they share. The types of symbiotic relationships between certain species of fish and particular species of algae vary greatly. Nonetheless, these relationships are vital in maintaining a healthy and harmonious aquatic ecosystem. In this project, our team set out to research if these relationships between certain species of algae and fish are sustained throughout different locations in New York City. Our focus was not on the types of relationships themselves, but if, for example, the presence of a certain species of bass always correlated with the presence of a certain species of green algae; and if such correlation existed in different bodies of water throughout New York City, which contained the same species. We hypothesized that the presence of certain fish will correlate with the presence of a certain algae, or at least a very similar species, and vice versa. Utilizing 50 mL tubes, our team collected samples of water and vegetation, non-invasively, in and around different bodies of water throughout Central Park and the East River.

Introduction

Algae itself is a crucial element of ecosystems worldwide, as they play an instrumental role in food chain. Its appearance can range from large seaweeds to microalgae, including various forms of cyanobacteria. The autotrophic nature and ability to grow in brackish conditions allow it to survive in areas otherwise unfavorable toward vegetative growth. Although many types of algae sustain smaller fish and maintain the ecosystem healthy, other types are damaging towards the environment and the organisms that surround them. Our team set out to find if the symbiotic relationships between certain fish and algae were necessary to their survival. In such cases, we expected to find that specific species of algae and fish were always present together. In order to accomplish this, we collected water samples at different bodies of water in Central Park and then extracted and sequenced the DNA of the algae found in the water. Using existing data of the wildlife that inhabit each body of water, we can analyze the correlation, or lack thereof, of the presence certain algae and fish. Due to the nature's tendency of harmonious relationships, we hypothesized that the presence of certain fish will correlate with the presence of a certain algae, or at least a very similar species. If such correlations are established, we hope that our research proves valuable to the discussion of wildlife relationships and ecological conservation, especially in New York City.

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Materials & Methods

Our team collected a variety of samples throughout the borough of Manhattan, specifically in the East River and Central Park. Given its large area and high biodiversity, when it comes to the different bodies of water, Central Park became an immediate sampling hotspot. Additionally, the bordering rivers of Manhattan served as a great site to compare the species of algae between bodies of water in the city. The following were sites that our samples were collected from: East River, Turtle Pond, The Pond, The Lake, The Loch, Harlem Meer. Our sampling, in its entirety, was conducted in a non-invasive manner and served in the best interest of protecting the ecosystems within the parks. We utilized the Polymerase Chain Reaction (PCR) techniques in order to extract DNA from our samples. For plants, we used the conventional rbcL primer, and with water samples we utilized both ITS primers and Tuf A primers. Tuf A was used in an attempt to target algae cells specifically, and ITS was used in an attempt to detect anything in the water.

Process

Preparation
We began our research by brainstorming which locations would be optimal for collecting water and vegetation samples. We finally settled on Central Park, due to its large volume and high biodiversity, and the East River.

Permits
Once our sites were marked for sampling, our team applied for a research permit via the NYC Parks and Recreation Department to legally obtain samples. The efficiency of the Parks and Recreation Department allowed for them to grant us our permit in about sixty days, which greatly hindered the timeline of our project.

Collection
At each site, our team obtained, at maximum, two 50 mL tubes of water and three samples of vegetation, in or around the body of water. Samples were then stored conventionally, in an environment of 20°C

Extraction
After properly documenting and clipping smaller samples of our plants for extraction, we centrifuged all water samples in order to separate the millions of algae from the water. We used the common PCR method for extracting DNA, which entails the use of primers, incubators and DNA binding chemicals.

Sequencing
After completing the PCR process, we utilized the gel electrophoresis method in order to check our now-extracted DNA samples for the presence of actual DNA. Although only thirteen of our samples tested positive for DNA, we continued to move forward and sent them out to a third party lab for sequencing.

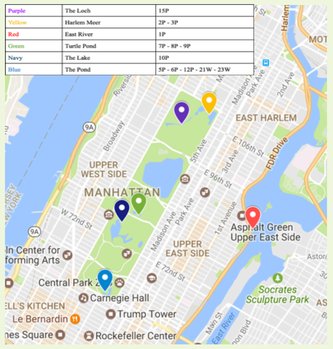
Results & Analysis
After sequencing, we accessed our results and successfully identified the species of each of our samples. We then organized the information and complied a list of the species present in each of the bodies of water we sampled at, using existing information. After gathering the all information necessary, we cross-referenced algae and fish species in search of a correlation in presence.

Results

After extracting DNA from our samples using the PCR technique, we used the process of gel electrophoresis in order to test for the presence of DNA in the extractions. Only thirteen of twenty-nine samples tested positive for DNA, and unfortunately only three of such proved to be species of algae. Below is the information we received as a result of DNA sequencing.

Sample #:	Sample Type	Location:	Best Species Match:	Correlation of Wildlife:
1P	Plant	East River	Gloeotilopsis planctonica	Striped Bass, Bluefish, Weakfish, Tautog/Blackfish, Scup/Porgy, Black Sea Bass, Winter Flounder, Summer Flounder, Striped Sea Robin, American Eel, Little Skate, Spiny Dogfish
2P	Plant	Harlem Meer	Potamogeton zosteriformis	Black Crappie, Bluegill, Brown Bullhead, Common Carp, Golden Shiner, Green Sunfish, Largemouth Bass, Pumpkinseed
3P	Plant	Harlem Meer	Potamogeton zosteriformis	
5P	Plant	The Pond	Hygroamblystegium tenax	Turtles, ducks and small fish; no specific information
12P	Plant	The Pond	Iris versicolor	
6P	Plant	The Pond	Ligustrum vulgare	
21W	Water	The Pond	Cyclotella meneghiniana	
23W	Water	The Pond	Skeletonema costatum	
7P	Plant	Turtle Pond	Acorus calamus	Red Eared Slider
8P	Plant	Turtle Pond	Acorus calamus	
9P	Plant	Turtle Pond	Symphyotrichum novae-angliae	
10P	Plant	The Lake	Symphyotrichum novae-angliae	Largemouth Bass, Black Crappie, Yellow Perch, Bluegill, Pumpkinseed, Carp, Brown Bullhead, Golden Shiner, Common Shiner
15P	Plant	The Loch	Prunus pensylvanica	N/A

Purple	The Loch	15P
Yellow	Harlem Meer	2P - 3P
Red	East River	1P
Green	Turtle Pond	7P - 8P - 9P
Navy	The Lake	10P
Blue	The Pond	5P - 6P - 12P - 21W - 23W



Discussion

Overall, the extraction process proved to be a mixed bag of both positive and negative results. Plant samples that were collected were strong enough so that the species could be determined, however only a couple of water samples possessed enough algae cells to be sequenced. The lack of samples yielding positive DNA results led to our sample pool being very limited, and negatively affected our results. Although it is highly probably that fish and algae share a symbiotic relationships, we could not identify a correlation between the presence of a certain species of algae and a certain species of fish across multiple bodies of water. While these results do not constitute enough to make any strong conclusions, we do believe that within favorable conditions, our research would have found a greater number of positive samples. A key turning point of our project was the time period in which our team waited to hear back on our sampling permit. At the time, the weather began its wintry cycle, and the possibility of collecting anything during this season was deemed impossible. One particular team member visited the same site four times and found that due to the seasonal changes, Turtle Pond had been barricaded for weeks. This, along with the time constraints already holding the process down, lead to a rushed sampling period. In turn, it found our DNA extraction process also strapped for time. With the expected timeline, our team would have most definitely been able to alter the processes of sampling and extraction to strive for better results. However, given the great amount of stress and obstacles our team overcame, we believe the results obtained were the best possible.

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