Aquatic Plant Diversity in Van Cortlandt Park

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Abstract

Aquatic plants are the basis of almost every aquatic ecosystem since they can photosynthesize and bring energy into their environment. Fertilizers, pesticides and herbicides drastically change aquatic environments. We compared the plant diversity in Tibbett's Brook and Van Cortlandt Lake to determine whether pollutants present in the golf course affect the aquatic plants in these ecosystems. To ascertain the aquatic plant biodiversity in these ecosystems, samples of aquatic plants were collected from each location and the DNA was sequenced. There was less biodiversity among the species collected from Tibbett's Brook than in the species from Van Cortlandt Lake. Pollutants in Tibbett's Brook from Van Cortlandt Park Golf Course may affect the aquatic plant biodiversity by limiting the number of species living in that environment.

Introduction

- Aquatic plants are the basis of almost every aquatic ecosystem
  - Primary producers
  - Photosynthesize to bring energy into ecosystems
- Different species indicate different water quality
- Fertilizers, pesticides and herbicides drastically change aquatic environments
  - Alter the nitrogen-phosphorus ratio in water[1]
  - Present on golf courses, including the Van Cortlandt Park Golf Course[2]
- Tibbett's Brook
  - Runs through the Van Cortlandt Park Golf Course and therefore is exposed to pesticides and fertilizers
  - Empties into Van Cortlandt Lake after draining through mud, grass and forest
- We measured the biodiversity of aquatic plants in Tibbett's Brook and Van Cortlandt Lake to see what effect chemicals from the golf course have on the health of this ecosystem

Aquatic plants at Van Cortlandt Lake

Results

Figure 1: Sample Locations in Van Cortlandt Park

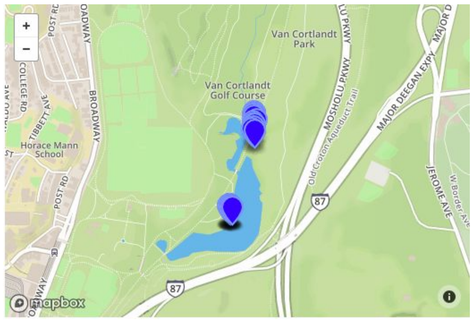

Figure 1. Map of Van Cortlandt Park indicating the locations of each of the collected samples. The northern group of location pins represents the samples taken from Tibbett's Brook, while the samples in the southern group were extracted from Van Cortlandt Lake.

Table 1: Species Found At Two Locations in Van Cortlandt Park

Van Cortlandt Lake	Tibbett's Brook
Wolfia sp.	*Zannichellia palustris*
Trapa natans	*Callitriche cophocarpa*
Nymphea alba	*Zannichellia major*
Landoltia punctata	*Trapa natans*
Nuphar lutea	*Landoltia punctata*
Potemogeton octandrus	

Table 1. These aquatic plant species were found in Van Cortlandt Park and identified by sequencing. All the species in Van Cortlandt Lake were identified once, but in Tibbett's Brook *Zannichellia palustris* was identified 3 times and *Landoltia punctata* was identified twice.

Table 2: Water Quality Data

Location	pH	Temperature °C	Dissolved O_2	Nitrates (ppm)	Phosphate (ppm)
Van Cortlandt Lake	6.61	17.33	35%	4.77	0.86
Tibbett's Brook	6.75	18	35%	0	0.46

Table 2. There were nine repetitions for the Van Cortlandt Lake tests and three repetitions for the Tibbett's Brook tests; this data is the mean.

Figure 3: Untrimmed Multiple Alignment Created By MUSCLE

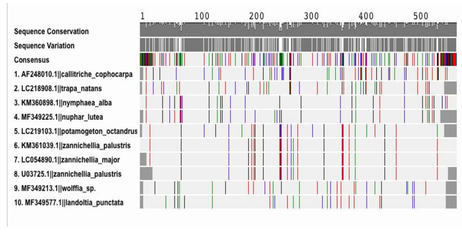

Figure 3. Sequencing results illustrated by the MUSCLE program. This image shows 500 bp of sequence conservation, with the colors representing different nucleotides. In both the sequence conservation bar and the sequence variation bar, conservation is represented by gray and variation by white.

Figure 4: Phylogenetic Tree of Sequencing Results

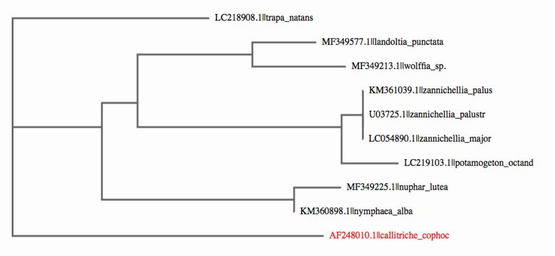

Figure 4. Maximum likelihood phylogenetic tree displaying the evolutionary relationships between the identified species. The species highlighted in red has the least genetic commonalities with the rest of the species.

Materials and Methods

- 27 algae and aquatic samples were collected
  - 14 samples from Tibbett's Brook
  - 13 samples from Van Cortlandt Lake
- LaMotte Estuary and Marine Monitoring Kit was used to test the water quality at each site
- DNA from the samples was isolated and amplified using PCR
- PCR products were analyzed using gel electrophoresis and 14 samples were sequenced

Discussion

- We hypothesized that aquatic plant samples extracted closer to the golf course would exhibit less diversity than samples taken further away from the pesticides, herbicides, and fertilizers used to maintain the grass on the course.
- Our hypothesis was supported by the DNA sequences showing that out of the six species collected from Van Cortlandt Lake, all six of the species were unique, whereas only five out of the eight sequences from Tibbett's Brook were unique.
- One error in our experiment was that the algae PCR primer did not work. Many of the samples collected were algae, and we could not determine the species of the samples of algae that we collected.
- Our results could have implications on the way that the Department of Parks and Recreation manages the Van Cortlandt Park golf course in order to continue their mission to preserve the natural beauty of the third largest park in New York City.
- In the future, it would be desirable to collect plant samples in the ponds on the golf course because the aquatic plants in those ponds are certainly affected by the products used to maintain the golf course. It would also be beneficial to collect more samples so our results could be more conclusive.

References

1. Bruun, Karl. "Algae can function as indicators of water pollution." *Washington State Lake Protection Association*, June 2012. Web. 10/23/17. www.walpa.org/waterline/june-2012/algae-can-function-as-indicators-of-water-pollution/

2. "Golf Course Pesticides FAQs." Northern Ohio Golf Course Superintendents Assoc. Accessed October 13, 2017. http://www.nogcsa.com/Golf-Course-Pesticides-FAQs-19C1.html?LayoutID=6.

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