Analyzing Correlation Between Plant Life Cycle and Habitat

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Abstract

Diversity of plant life differed significantly between Zones 2 and 5 in the New York Botanical Garden. One hypothesis to account for this discrepancy could be that Zone 5, a forested habitat, is more conducive to long-lived plants over Zone 2, a lakeside habitat. Plant type was also taken into consideration when grouping perennials, biennials, and annuals. Plant types were divided into three categories: tree, plant, or flower. We tested for possible correlations between the plant type, life-cycle duration and location (zone). Data from the 2014 MHC BioBlitz was analyzed and grouped into the three different plant life cycle durations (perennial, biennial, annual) based on zone. Analysis resulted in a rejection of the hypothesis.

Introduction

When the BioBlitz data was gathered for plants, there was a noticeable difference in plant diversity in each area of the garden. BioBlitz Plant Data was taken from 2 different zones in four different areas: Zone 2 (Twin Lakes) and Zone 5 (Forest North: Within forest, Thain Forest Center, Forest Edge). Both Zone 2 and Zone 5 are areas of the garden that have not had human interference and were allowed to naturally grow since 1895. To explain the natural diversity of plants in these four areas, we speculated that the duration of the plant lives may correlate to the specific location of each plant specie. A plant's life cycle can fall into one of three different categories: perennial, annual, and biennial. Perennial plants continuously live from one year to the next. Annual plants complete their entire life cycle in less than one year. Biennial plants complete their life cycle within 2 years. Because of these specific time requirements for certain plants, we speculated that perennial plants would thrive better by the Twin Lakes because it is closer to the water. Within the old growth forest, plants rely mainly on rainfall.

Purpose

Plants and trees are essential organisms that human beings must coexist with in order to survive. They play a vital role in the ecosystems for people as well as many other animals by providing oxygen, food, and shelter. Therefore, it is important to understand the lifespan of plants in relation to their diversity and environment, especially those that can be found in New York Botanical Gardens. Our in-depth analysis of how duration of plant life correlates to the location in which they are found is aimed to help explain why certain plants flourish in specific zones of the New York Botanical Gardens.

Hypothesis

There is a correlation between plant life cycle and their environment, or, stated differently, certain environments will better support long-lived versus shorter-lived plants. We aim to determine this relationship for the NYBG.

Results

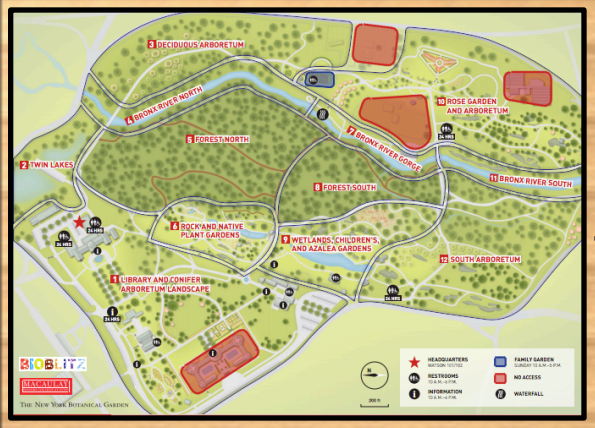


Figure 1: Zone Map of New York Botanical Garden

TREE	Zone 2	Zone 5	Thain Forest Center	Forest Edge	Duration Total
Tree	4	20	14	2	40
Plant	12	15	7	8	42
Flower	6	2	4	2	14

Table 1: Abundance of Plant Types in Four Locations

DURATION	Zone 2	Zone 5	Thain Forest Center	Forest Edge	Duration Total
Perennial	15	33	24	11	83
Biennial	3	0	0	0	3
Annual	4	4	2	2	12

Table 2: Duration of Plant Species in Relation to Location

Figure 2: Perennial Red Oak Tree

Figure 3: Orange Touch-Me-Not from NYBG

Figure 4: Porcelain berries from NYBG

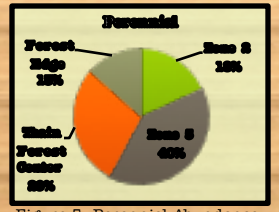


Figure 5: Perennial Abundance

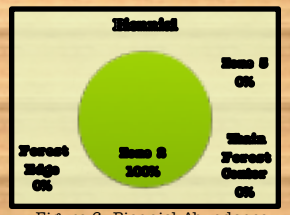


Figure 6: Biennial Abundance

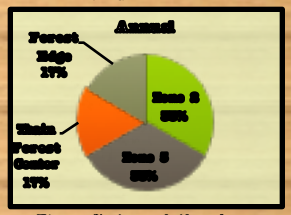
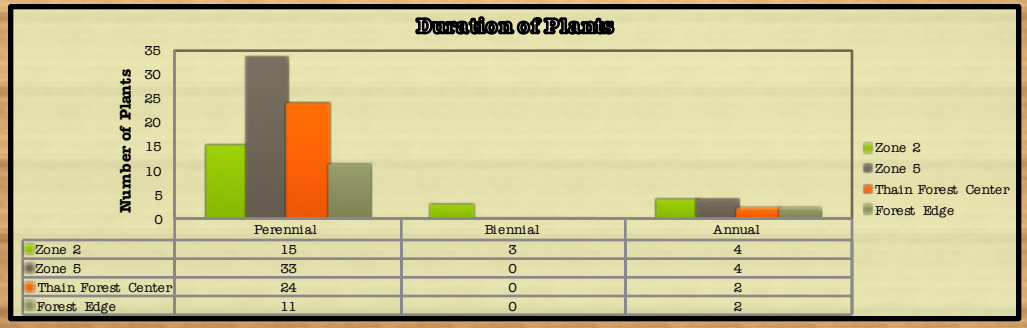


Figure 7: Annual Abundance



	Perennial	Biennial	Annual
Zone 2	15	3	4
Zone 5	33	0	4
Thain Forest Center	24	0	2
Forest Edge	11	0	2

Figure 8: Bar Graph Comparison of Plant Duration by Location

References

1. Welcome to the PLANTS Database | USDA PLANTS. Retrieved November 24, 2014, from http://plants.usda.gov/java/
2. Thain Family Forest | NYBG. Retrieved November 24, 2014, from http://www.nybg.org/gardens/thain-family-forest/

Methods

The plant data collected from BioBlitz 2014 at New York Botanical Garden were analyzed in terms of which species of plants were observed at distinct zones. Four areas were analyzed: Zone 5, Thain Forest Center (Zone 5), Forest Edge (Zone 5) , and Twin Lakes (Zone 2). The plants were first separated into their respective zones. The different plant species were then searched on http://plants.usda.gov/java/[1] to determine what their duration period would be. Each plant was also categorized into one of the three (plant, tree, flower) plant types.[2] Data was then summarized and analyzed. The Chi square test on GraphPad QuickCalcs was used to determine statistical significance as well.

Conclusions

Based on the results of our chi-square analysis, the null hypothesis that plant species composition is homogeneous across different zones is rejected; there is a significant difference between the number of perennial plants species in the studied areas. The analysis demonstrated that the difference between the observed number perennial species and expected distribution of perennial plant species in Zone 2, Zone 5, Thain Forest Center, and Forest Edge is statistically significant. The calculated Chi squared equals 15.249 with 7 degrees of freedom, and the two-tailed P value equals 0.0329. With a significance level of $P<.05$, the null hypothesis of no difference is rejected. When comparing the perennial plants of the four areas, Zone 5 seems to have the highest number of perennial plants with 40% of all the perennial plants in Zone 5. Thain Forest Center and Forest Edge are also part of Zone 5: with 29% and 13% of all perennial plants in these zones respectively. Zone 2 takes up a mere 18% of these plants. There is not enough data to accurately conclude whether one zone has more biennials than another.

However, one finding that seemed to be inconsistent was the number of biennial plants in the BioBlitz data. Out of all the plants, only 3 plants were biennials and they were all observed in Zone 2. One of the limitations of the chi-square test is a minimum of five observations per factor. Perhaps, there may be a correlation between biennial plants and their location by the water. Further research must be conducted in order to analyzed the soil types that each of the plants observed in the Twin Lakes, Forest North, Thain Forest Center, and Forest Edge in order to correlate the location and duration of plant life, in terms of differences in soil microbes. Although other students collected microbe data during the 2014 BioBlitz, the locations that were sampled were the Rose Garden, Native Plant Garden, and Decaying Forest. Therefore, they cannot be directly related to the plant data we analyzed. However, the microbe data revealed that the strains of bacteria vary from one type of soil to another based on the amount of human interaction in each area, so the diversity in soil microbes may be the reason why location is such an important factor for plant life duration.