REGENERATION IN FOREST GAP UNDERSTORY AT THE NEW YORK BOTANICAL GARDEN AFTER HURRICANE SANDY

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ABSTRACT

Tree fall gaps created by Hurricane Sandy were chosen as areas of study at the Thain Family Forest at the New York Botanical Garden in the Bronx. Vegetation surveys, light meter, soil moisture, leaf litter, and densitometer measurements were performed in the summers of 2013 and 2014. Soil samples from seed banks were collected east and west of selected plots in both north and south directions. The analysis for of each gap were combined and placed in a greenhouse for germination. The seed bank and the understory had few species in common, with species in each gap except for the dominating *Aralia elata*. The seed bank and understory shared nine common species. Invasive species displayed an increasing presence in the forest with a total record of 137 nonnative seedlings in 2013 and 222 nonnative seedlings in 2014 in all plots. Further studies for Thain forest regeneration might be a continuation of this vegetation survey with more focus on the mortality rate of plants.

INTRODUCTION

Hurricane Sandy (2012) topped over 167 trees in the New York Botanical Garden.

A natural seed banks stores seeds that are distributed through natural occurrences, such as seed rain (dispersal by wind etc.).

- Seed bank studies often look into the composition and density of seeds located in a selected plot of soil.
- Seed bank composition is often significantly different from its surrounding trees. Seed banks are an important aspects of study in order to predict future forest composition and maintenance of the forest.

Forest gaps allow more sunlight to reach the ground, and the nutrients from the fallen trees help promote the growth of new plants.

The Thain Family Forest was originally categorized as a hemlock forest.

- The hemlock population has declined in recent years, mainly due to wooly adelgids, an insect infestation.
- Decline facilitated the rise of the invasive species population.

Invasive species are often imported by New York Botanical Garden; many for ornamental purposes. Major concerns includes *Aralia elata* and *Phellodendron amurense*.

Hypotheses:

- The seed bank would be mainly composed of perennial plants
- The aboveground vegetation will have little correspondence with the composition of the seed bank
- Regeneration in the understory is expected to increase with the distance away from the gap.

MATERIALS & METHODS

The summer after Hurricane Sandy, ten gaps were chosen for the study; eleven square meter plots running north-south in each gap (Figure 1).

Understory Survey: identification was in three categories: woody seedlings under a year old; woody plants over a year but less than a meter in height with herbs; tree saplings over a meter

- Light meter readings (μ mol): center of each plot
- Leaf litter depth (cm): measured at the corner of each plot
- Spherical densiometer readings: at the center, N10, S10, N edge, and S edge plots.
- Soil moisture (%): collected at five points in each plot; Campbell Scientific Hydrosense II.

Seed Bank Sampling: A three meter line was extended to the east and the west of the center. Two core samples with a volume of 63π cm^3 were collected from each side with an auger. The leaf litter was removed. Soil samples from the same gap were combined into one sample bag.

Seed Bank Culture: sterilized soil was layered in the soil trays before spreading out the core samples on top. Five control groups contain six centimeters of sterilized soil.

Data Collection: Seedlings were identified as soon as true leaves were evident. Once identified, the seedlings were removed.

RESULTS

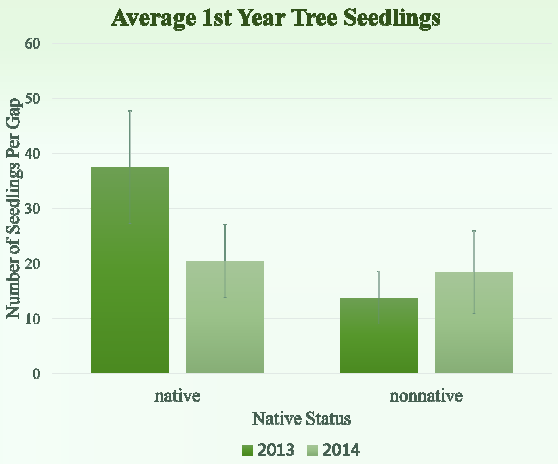

Figure 2. Average Number of 1st Year Seedlings. From 2013 to 2014, natives decreased and nonnatives increased. Error bars are standard deviation.

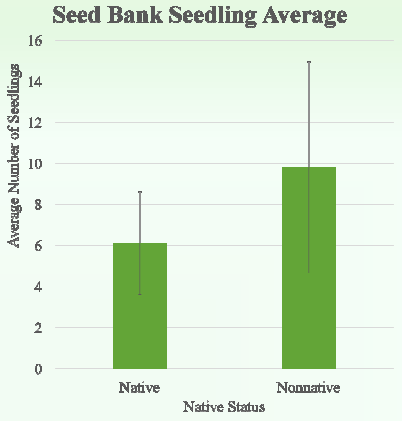

Figure 3. Seed Bank Seedling Average. The average number of seedlings that emerged in the seed banks for each gap is divided into native and non-native species. While there was great variation, on average almost twice as many non-native plants emerged as natives.

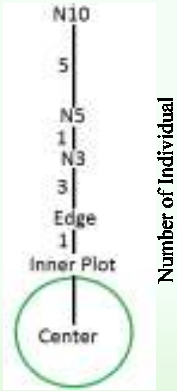

Figure 1. Plot along transect. The gap is represented by the green circle, and the numbers next to the line indicates the distance between each plot.

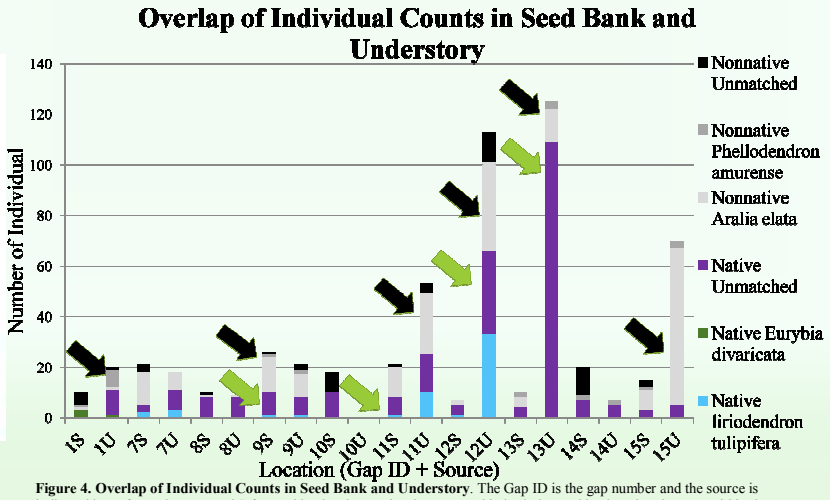

Figure 4. Overlap of Individual Counts in Seed Bank and Understory. The Gap ID is the gap number and the source is indicated by U for understory and S for seed bank. The species that emerged in both the seed bank and understory within the same gap are indicated. Only four specie were found in both seed bank and understory: *Aralia elata, Phellodendron amurense, Eurybia divaricate, Liriodendron tulipifera*. The black arrows indicates the nonnative sections and the green indicates the native section. There are more native plants than nonnative overall, but the nonnatives are more likely to be found in the two sources.

DISCUSSION

The Understory was mainly made up of herbaceous plants, followed by graminoids.

- *Maianthemum canadense* had the most emergents.
- The trees have a wider range of species in terms of diversity
- The most dominant tree species is an invasive – *Aralia elata.* (Figure 4.)
- There was a general decrease in seedling emergence in the understory during the second year, which could have been caused by the increase in competition from the previous year or from a harsh winter. (Figure 2.)

The Seed bank was overwhelmingly dominated by perennial species. It was composed of mainly tree species (60% of the total emergents)

Seed Bank and Understory:

- Most of the similar species between the seed banks and the understory composition were nonnatives
- Sixty two percent of the seed bank species were not shared by the understory.
- *A. elata* and *P. amurense* were the only nonnative species overlaps between the seed bank and understory.
- *Liriodendron tulipifera* was the only species to overlap in all the gaps, (except for gap 1, which ~~only~~ had only *Eurybia divaricate* in both ~~the~~ seed bank and understory).

Invasive species dominated the seed bank. The seedling with the most emergents in 2014 was *A. elata.*

- The center and inner plots have a higher average of invasive species emergence than the edge and outer plots.

A Gap effect was observed to have increased the average amount of invasive individuals that emerged within the gap.

Applications:

Management should focused more on getting rid of *A. elata* inside the gap because there will be a greater concentration with the increase in seedlings. More weeding should be done within these gaps as well as a concentrated use of pesticide, mostly during the pollination season for *A. elata.*

Future Research:

The forest is an ever changing environment with a vast amount of factors that have yet to be investigated.

- Research can be extended for years, with an annual survey of the plot to expand on the general trajectory of the forest
- Seed banks can also be saved for another growing season to see what else emerges.
- Forest characteristics can also be enhanced with more data collection, such as more leaf litter and light meter data collection points within one plot.
- Mortality can be kept track by adding a new section to the data survey - second year seedlings – and studying the gap effect on the mortality of seedlings.
- Seed Rain can be studied through the collection of dispersed seeds and the patterns may indicate how the gap effect might interferes with the distribution of seeds.

Conclusions:

The Thain Family Forest has a growing population of invasive species. The seed bank and understory has little correlation, just as the other seed bank studies have shown, except for the dominant presence of invasive species. There are fewer species in the seed bank than the understory.

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