

Abstract

The Bronx river is one of the few remaining freshwater systems in New York City and is a large melting pot of diverse riparian plants. The purpose of this study is to characterize the relationship between the river and riparian plants, and looking at how the different management zones have impacted the Bronx riparian community. To measure river health, pH, temperature, phosphorus, nitrogen, salinity, conductivity, temperature and velocity were collected at five different points in the river. All of the forest data was taken from previous years and collected by the Natural Areas Conservancy, and the New York Botanical Garden. A common trend seen in the Bronx River is that many of the river characteristics indicated an unhealthy water quality further south. The forest data taken showed a majority native overstory and midstory, with each vegetative site having their own distinct tree species composition. There were more invasive and introduced species in NYBG, the southern part of the river, which could have affected the health of the river, considering how interconnected the river and the riparian species are. Therefore, it would be beneficial for the river to have NYBG and the Bronx River Alliance to work together to restore and preserve the riparian ecosystem. These organizations should also work on managing the forests and rivers to maintain their quality health, and prevent any possibilities for invasives to threaten them. In the future, it would be helpful to increase the sites to sample in and to use more current forest data, or collect the data firsthand to get a more accurate representation of the riparian ecosystem.

Introduction

Riparian Communities are unique because they are the transition zone between terrestrial ecosystems and aquatic ecosystems (Nilsson and Svedmark, 2002). The combination of these two components creates a unique and interconnected ecosystem that contributes to their biodiversity, and they are often studied to find the relationship between the river and the adjacent areas and how management affects these communities (Rios and Bailey, 2006). The New York Botanical Garden (NYBG) and Bronx River Alliance (BxRA) are committed to preserving and protecting the planet's biodiversity, natural resources and improving human well-being through education. Since the Bronx River serves as a corridor between NYBG and the Bronx River Forest (which is managed by the BxRA) it is important to acknowledge the health of the river. Healthy phosphorus levels in a water quality tests range from 0.03mg/L and below. Natural nitrogen levels in the river should remain less than 1 mg/L. Any changes in the nutrient levels of the river, or any other factors such as flood patterns, can dramatically affect the surrounding organisms (Nilsson and Svedmark, 2002). Many modern problems threaten the stability of riparian ecosystems such as climate change (Baatrup-Pederson, *et al.*, 2018), and urbanization (Groffman *et al.*, 2003) because they can disturb the conditions of the river, and the ecosystem by extension. This study aims to investigate the relationship between the Bronx River's physical, chemical and biological characteristics with the riparian plant communities that surround it, and determine if there are any correlations between the two. Additionally, we hope to use our findings to assess the current management plans for the Bronx River that both the BxRA and NYBG follow, and provide suggestions that will improve the health of both the riparian plant communities and the Bronx River itself. We hope that our research will inspire other groups of scientists to pursue further research the river and aim for restoring, maintaining and improving the river conditions, along with its riparian communities.

Materials and Methods

- Five points were chosen along the Bronx River. Nitrogen, phosphorus, pH, conductivity, temperature, salinity and velocity were tested at each point.
- Nitrogen and phosphorus levels were collected by using a Hach Pocket Colorimeter.
- A YSI meter was able to collectively record pH, temperature, conductivity, and salinity.
- Finally, velocity was calculated by having two team members stand five meters apart from each other, in the center of the river, recording the amount of time a stick took to reach the other person.
- Three trials were conducted at each point.
- Pre-existing riparian community data was used. It was originally gathered by the Natural Areas Conservancy, and the New York Botanical Garden.

Assessing The Effects of The Bronx River's Water Quality on Riparian Plant Communities

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Figure 1. Vegetation and river health conditions of NYBG and Bronx River Forest.

Variables	R ² Values						
	pH	P	N	Salinity	Conductivity	Velocity	Temperature
pH		0.7582	0.5007	0.7345	0.662		
P	0.7582		0.6293	0.9308	0.837	0.0167	0.01
N	0.5007	0.6293		0.3849	0.2359	0.0358	0.2874
Salinity	0.7345	0.9308	0.3849		0.9457	0.0633	0.0076
Conductivity	0.662	0.837	0.2359	0.9457		0.0548	0.0649
Velocity		0.0167	0.0358	0.0633	0.0548		0.044
Temperature		0.01	0.2874	0.0076	0.0649	0.044	

Figure 2. Identifies whether a relationship exists between river qualities. (The closer to zero, the lesser the correlation, the closer to one the stronger the correlation).

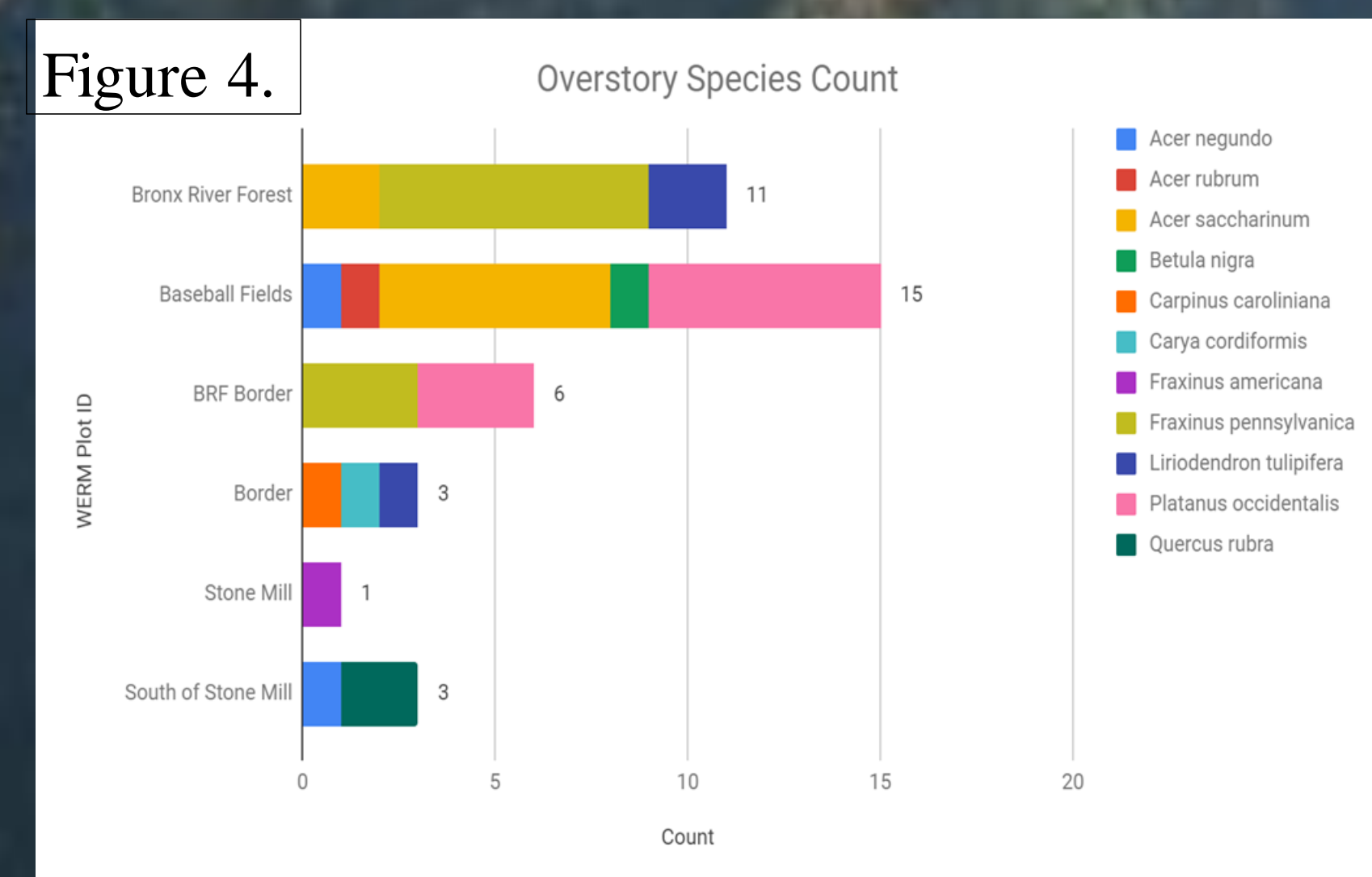


Figure 4. This figure represents how many of each overstory species is present, at each vegetation point.

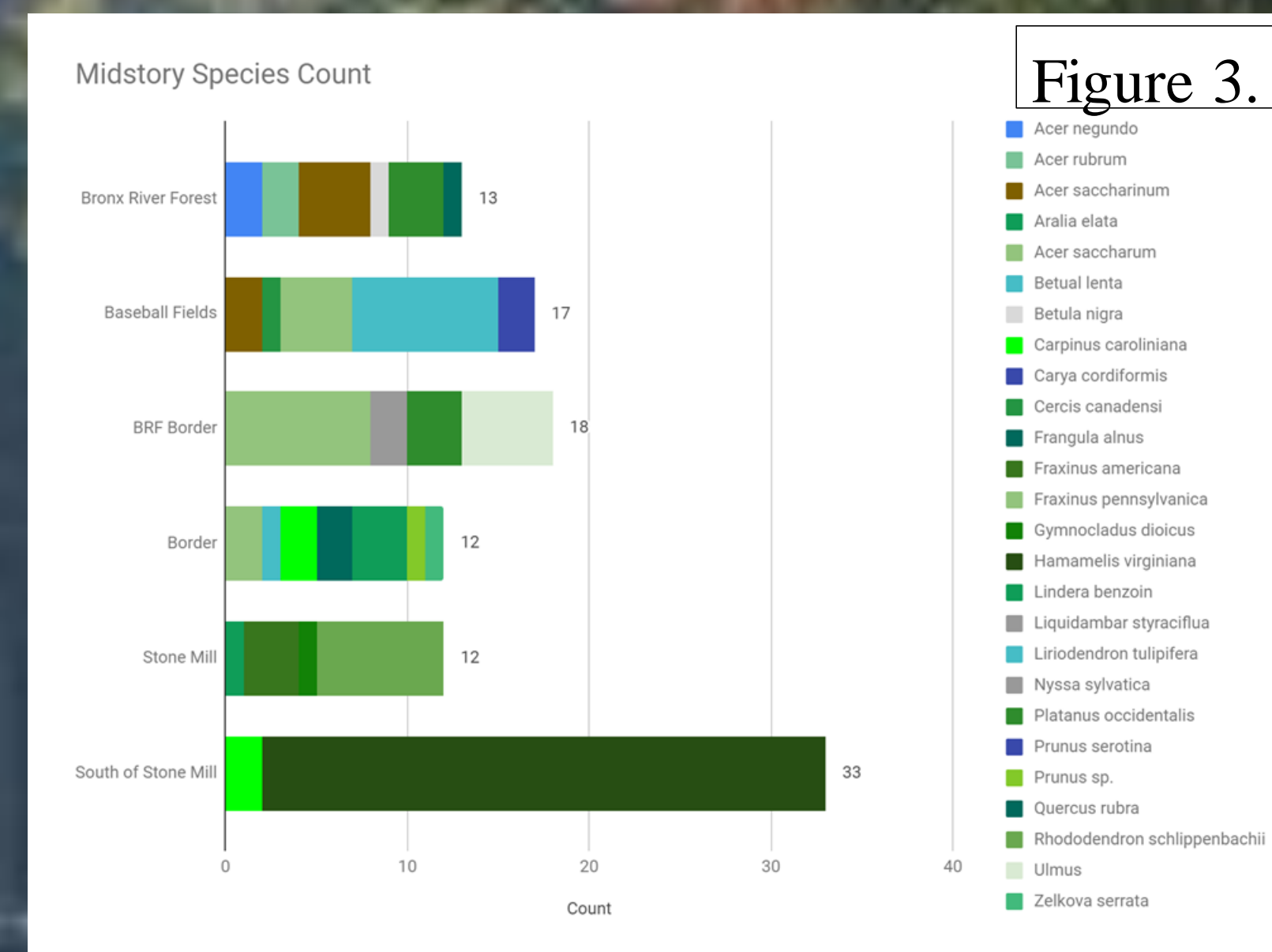


Figure 3. This figure shows how many midstory species are present at each vegetation point.

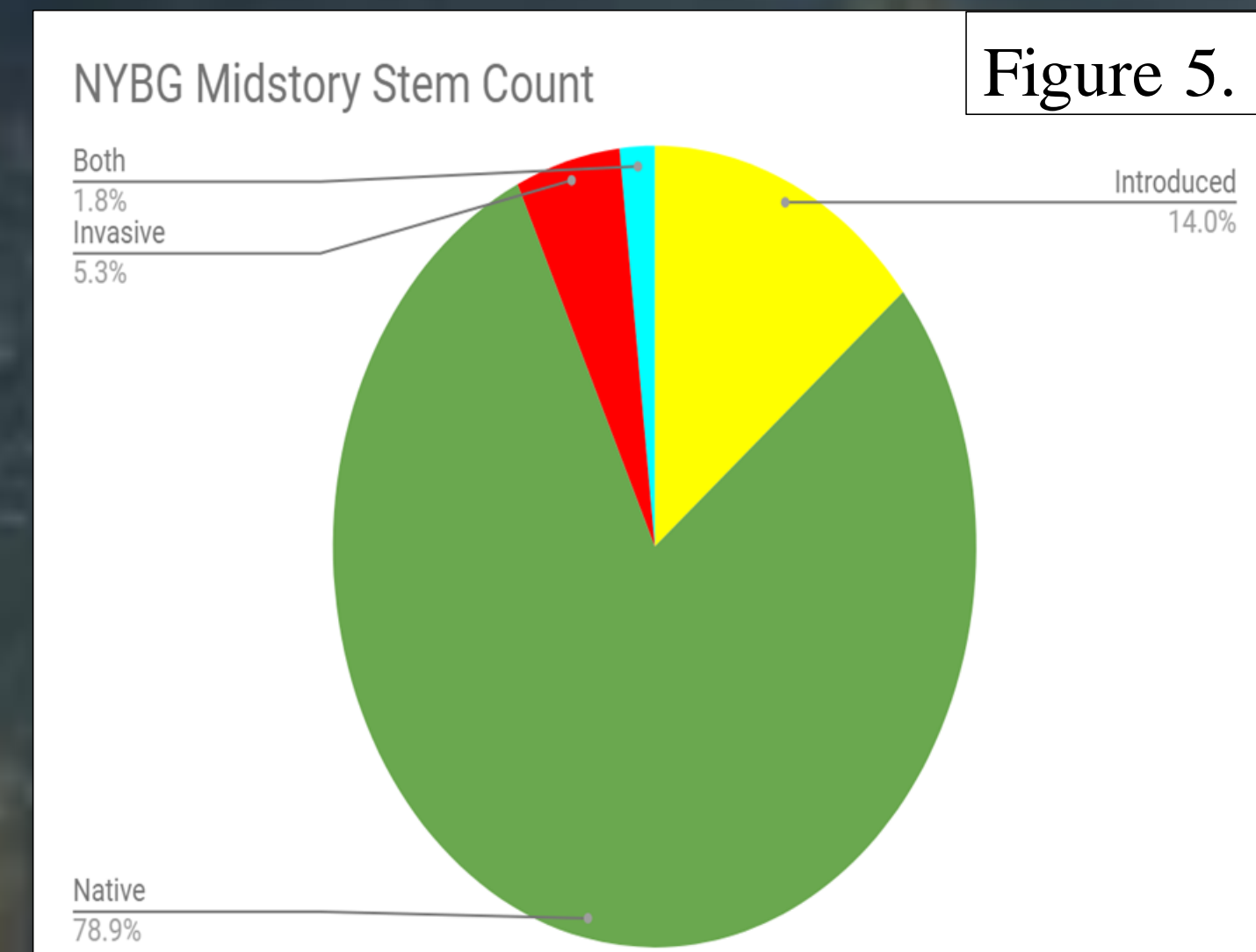


Figure 5. This figure breaks down the NYBG midstory stem count into invasives, introduced, both and natives.

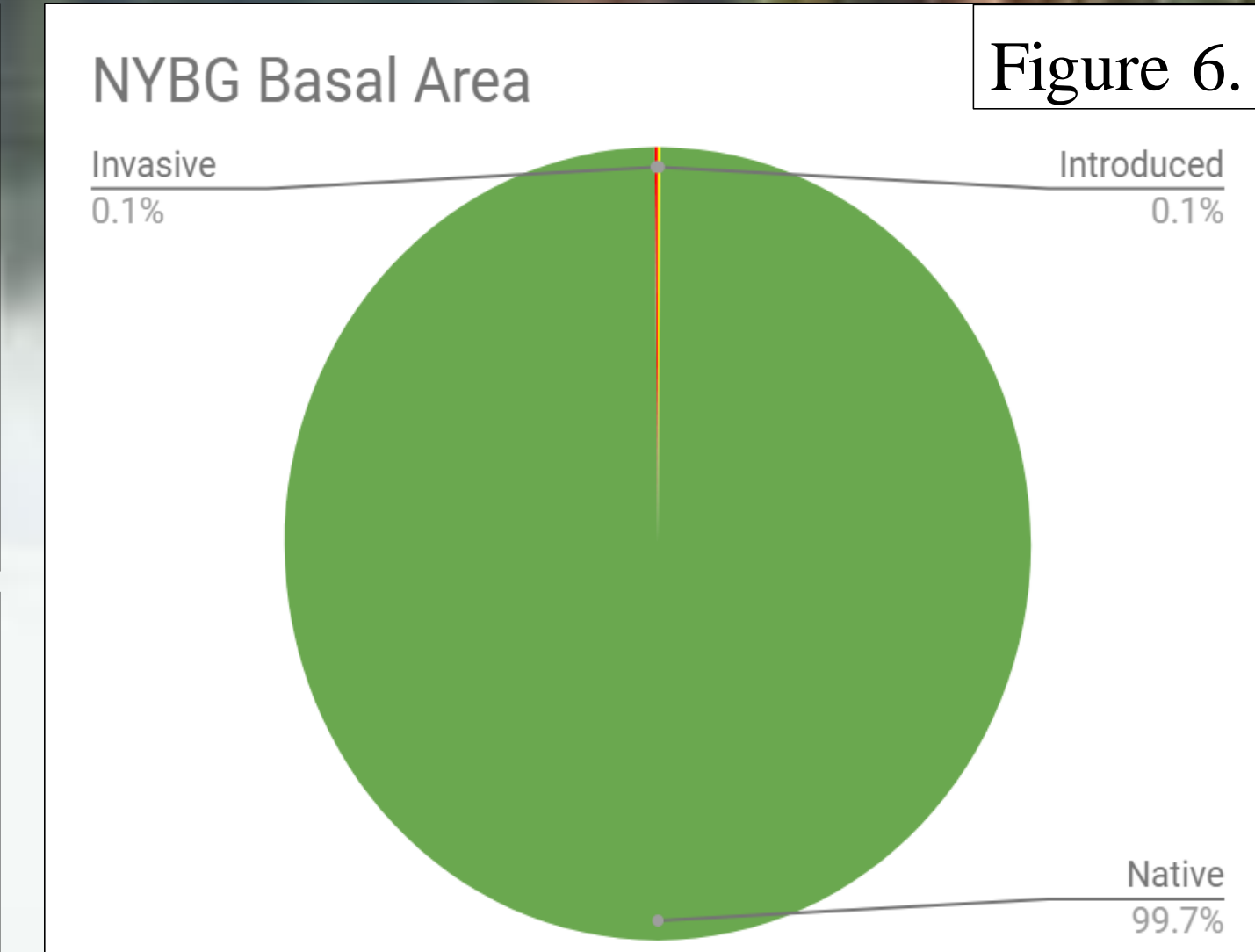


Figure 6. The basal area of the invasive, introduced and native plant species, in NYBG.

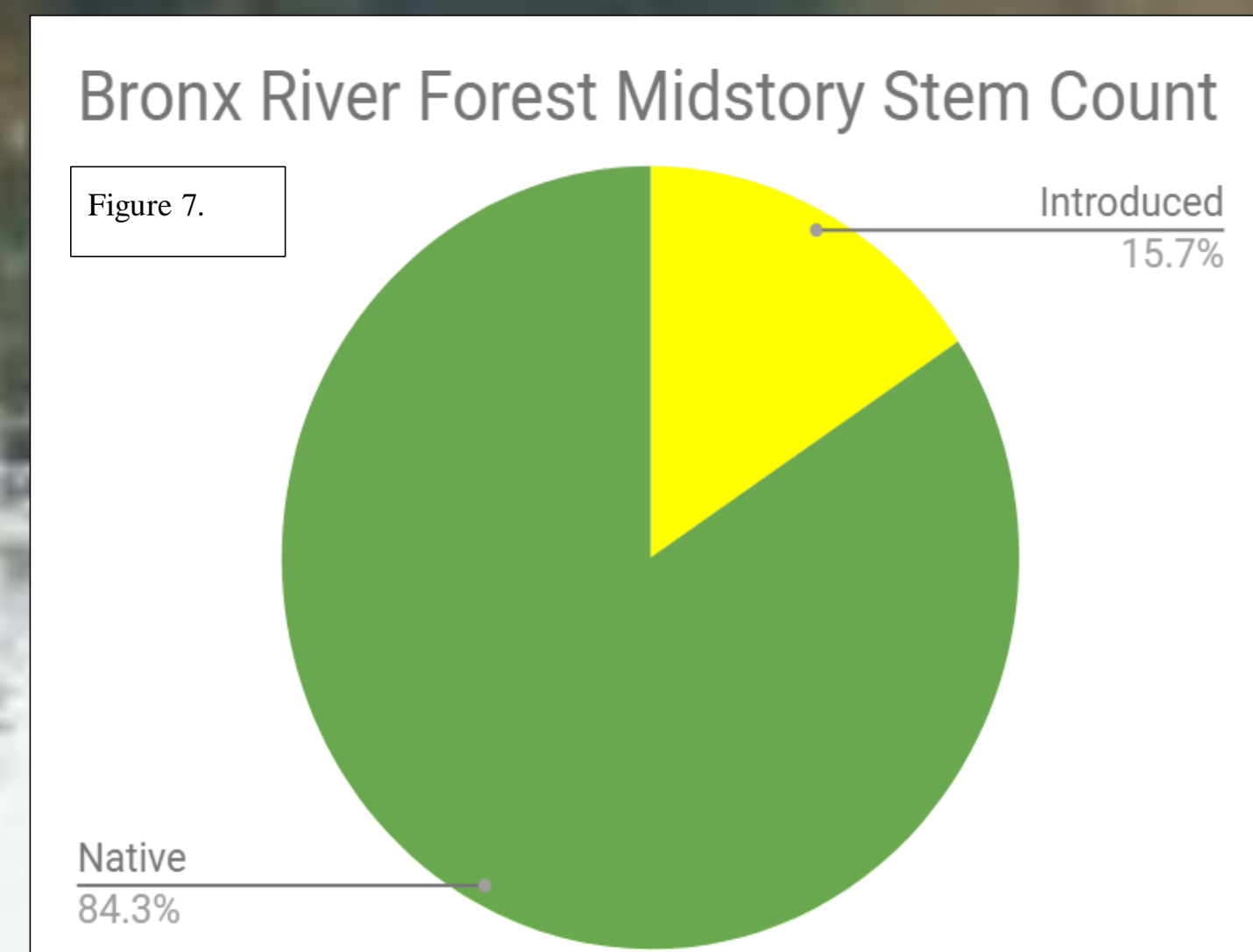


Figure 7. This figure breaks down the Bronx River midstory stem count into invasives, introduced, both and natives.

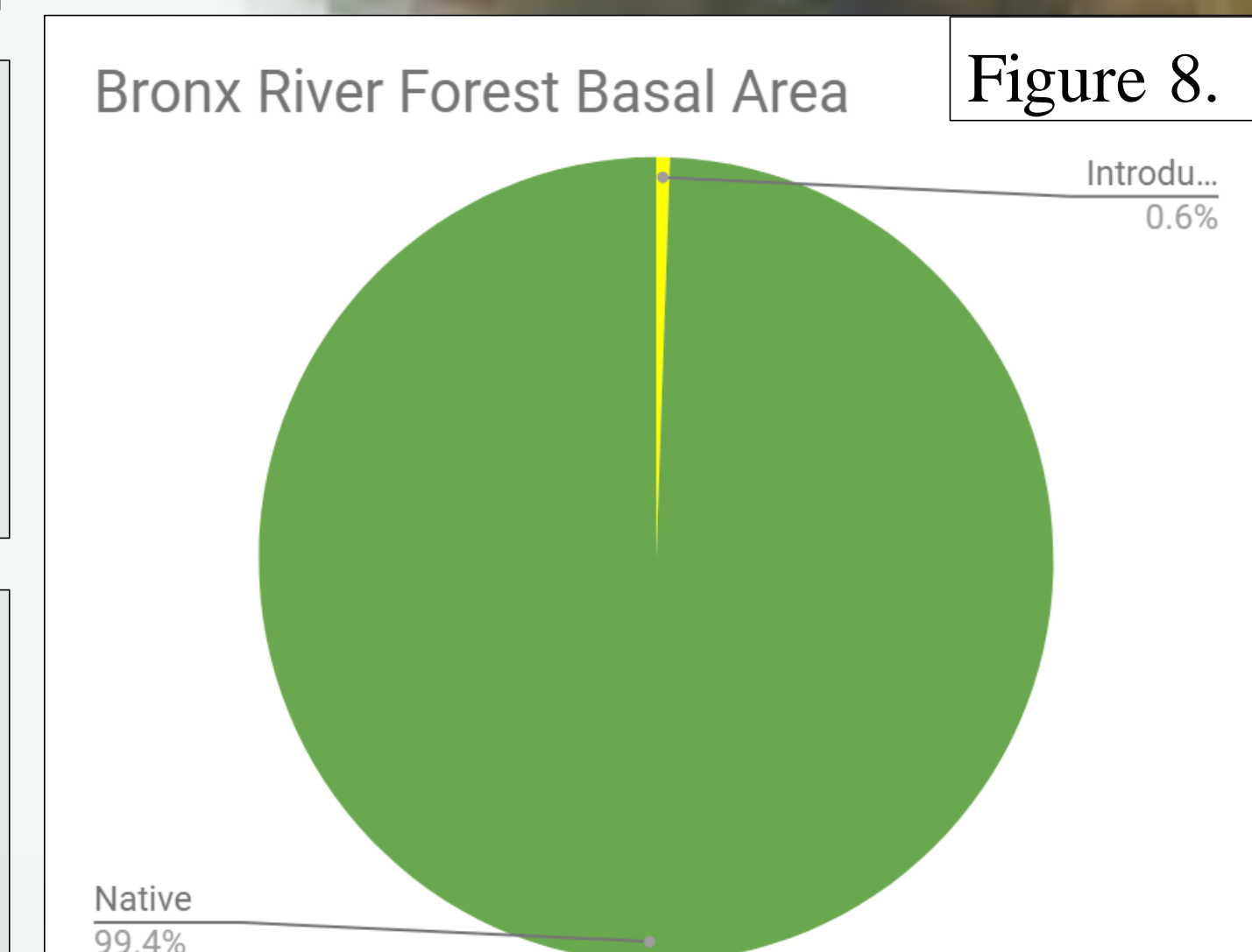


Figure 8. The basal area of the invasive, introduced and native plant species, in NYBG.

Discussion

A majority of the river is in good health, as seen in Figure 1, where a good portion of the river is in the green zone. As the river flows south, the water becomes more acidic and phosphorous, nitrogen, salinity, velocity and conductivity decrease, indicating a worsening in health. Figure 2 shows a correlation between the decrease of pH, phosphorus and nitrogen, and other river quality traits that are declining. There are many theories as to why this happens, such as changes in characteristics of the river between the two parks. The river bed sediment was sandier in NYBG than in the Bronx River Forest and the addition of a man made waterfall and dam in NYBG could have both changed the water health. Looking at Figure 5, NYBG also has a larger presence of non-native midstory trees, which could also affect the river and soil health through the roots of the trees. All of this is just speculation, and should be tested.

The Bronx River Forest and NYBG both possess an extremely healthy forest (Figure 6 and 8). The midstory in both parks is relatively healthy, with more introduced and invasive species than in the overstory. NYBG consists of more invasives and introduced species than the Bronx River Forest. This is most likely because NYBG has many non-native species in their garden, like ornamentals that could have easily spread into the forest. Additionally, the species composition seen in the midstory and overstory is healthy and diverse as a riparian community should be (Figure 3 and 4). Two T-Tests were also done in order to look at the significance between the river health of the Bronx River Forest and the river health of NYBG, and to look at the significance between the forest health of the Bronx River Forest and the forest health of NYBG. Although both of these p-values came out to be greater than 0.05 (insignificant), this is probably because of the small sample size, and some errors that happened during this experiment.

The aim of this project was to analyze both the data gathered in the Bronx River and the riparian communities and identify if there is any correlation. As a result of these findings, the areas of the river that are not as healthy were in NYBG and have a lower pH, lower phosphorus and nitrogen levels than recommended. NYBG also has more invasives in the midstory (Figure 5) compared to the Bronx River Forest, which has the healthier part of the river (Figure 7). As previously stated, the NYBG does have several ornamentals and foreign plant species on their property which may contribute to the invasives but, we also theorize that the invasives may be causing the drop in these river conditions. On the other side of the spectrum, most of the river is healthy and many of its characteristics fall within the proper ranges, which may have resulted in many of the vegetative areas being very healthy and having little to no invasive threats posed to them.

Another purpose of our project was to provide suggestions to NYBG and BxRA that they can use to improve river and vegetative health. We recommend that NYBG should implement more invasive and river management in the southern side of their property in order to regulate a healthy pH, phosphorus and nitrogen level. The BxRA should increase clean ups of the river in order to remove trash and oils that affect the river's health. We also suggest that the BxRA and NYBG work together in order to ensure that the Bronx River and its riparian communities remain healthy.

Literature/References

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