Relationship Between Species Diversity and Acreage of Select NYC Parks

ABSTRACT: In this study, we investigated whether there exists a relationship between the species diversity of selected NYC parks and their acreage. Shannon-Wiener Diversity Indices were calculated for Central Park, Flushing Meadows Corona Park, Prospect Park, Randall's Island Park, and Van Cortlandt Park using iNaturalist data. New York City's Department of Parks and Recreation's website openly provides the acreage of each park. The diversity index values and acreage of each park was plotted to determine if any correlation exists. It was revealed that there is a weak, negative correlation between the species diversity and acreage of the select NYC parks. This study is subject to various limitations stemming from the methodology utilized to obtain species data. The community-driven nature of iNaturalist data and the differing time frames in which the data for each park was gathered potentially introduce bias. We recommend future research efforts that collect species data for all parks of interest within the same time frame so that perceptive comparisons can be made between them. Additionally, we recommend future investigations that consider the extent to which human disturbance and management practices impact the species diversity at the park, regardless of its acreage.

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Introduction

Urban parks in New York City tend to attract many visitors, and one may wonder whether their size relates to their diversity in any way. Following Macaulay Honors College's BioBlitz at Prospect Park, we compared the species diversity of Prospect Park to other urban parks in NYC such as: Randall's Island Park, Flushing Meadows Corona Park, Central Park, and Van Cortlandt Park. Then, by utilizing park acreage figures available at the New York City Department of Parks & Recreation website, we performed a correlation test between acreage and diversity for those parks.

To quantify the species diversity in each park, the Shannon-Wiener Diversity Index was used. Shannon-Wiener's Diversity Index provides a means to describe the species richness (number of species) and species abundance in a habitat. The equation for the Shannon-Wiener Diversity Index is:

$$H' = -\sum_{i=1}^{n} p_i * \ln(p_i)$$

Where n is refers to the number of species, and pi refers to the proportion of the species.

Intuitively, a positive correlation between park species diversity and park size is expected because bigger parks have more space to support a diverse range of species.

Methods

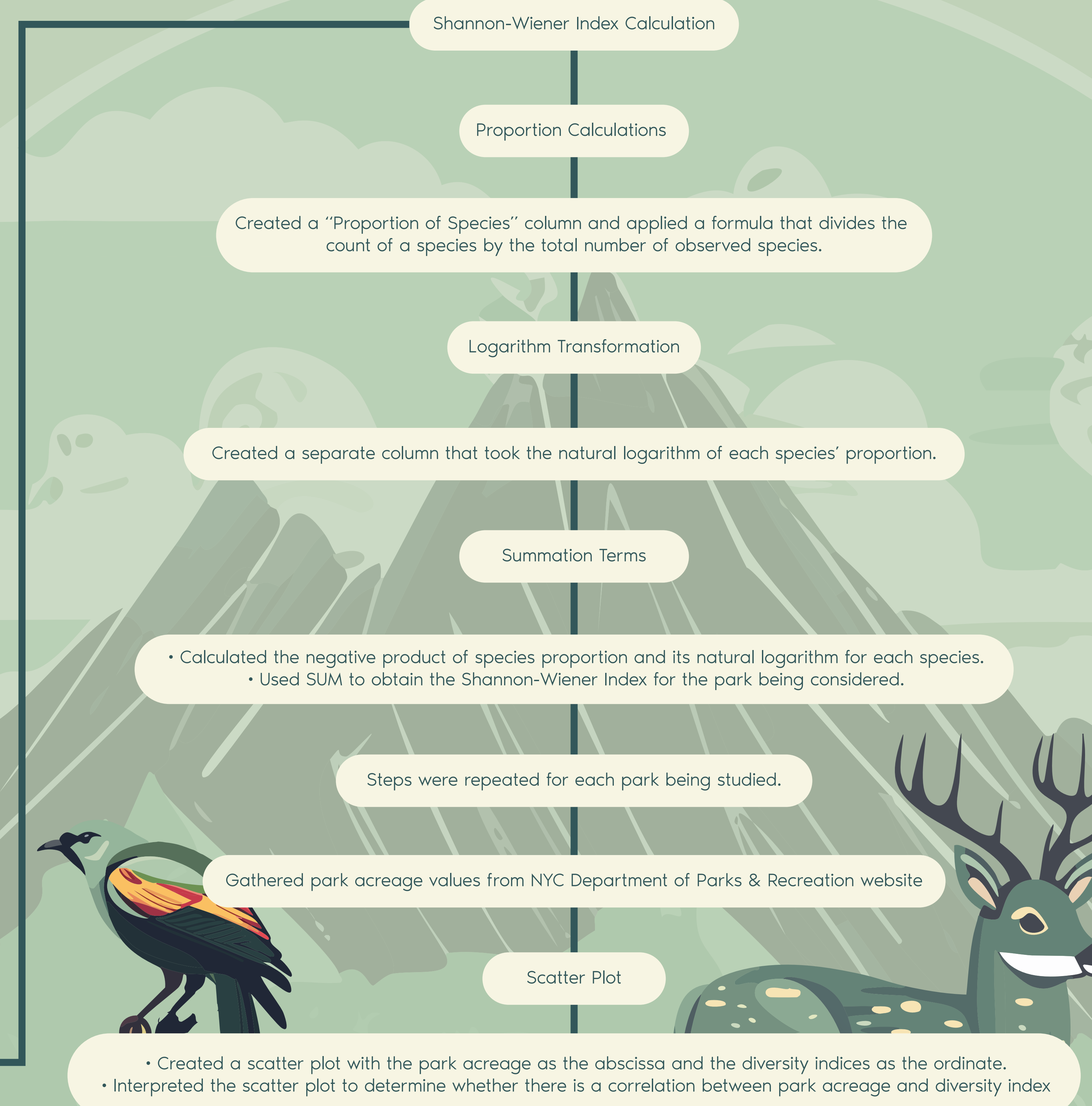Conducted searches on iNaturalist for regional parks.

Export Observations

- Used the "Export Observations" feature to acquire species data.
- Applied filters: any grade of observation allowed, export only scientific names.

Data Processing

- Sorted scientific names alphabetically.
- Created a unique species column using UNIQUE function to eliminate duplicates.
- Used COUNTIF to determine species frequency.
- Used SUM to find the total number of species observed

Shannon-Wiener Index Calculation

Proportion Calculations

Created a "Proportion of Species" column and applied a formula that divides the count of a species by the total number of observed species.

Logarithm Transformation

Created a separate column that took the natural logarithm of each species' proportion.

Summation Terms

- Calculated the negative product of species proportion and its natural logarithm for each species.
- Used SUM to obtain the Shannon-Wiener Index for the park being considered.

Steps were repeated for each park being studied.

Gathered park acreage values from NYC Department of Parks & Recreation website

Scatter Plot

- Created a scatter plot with the park acreage as the abscissa and the diversity indices as the ordinate.
- Interpreted the scatter plot to determine whether there is a correlation between park acreage and diversity index

Results

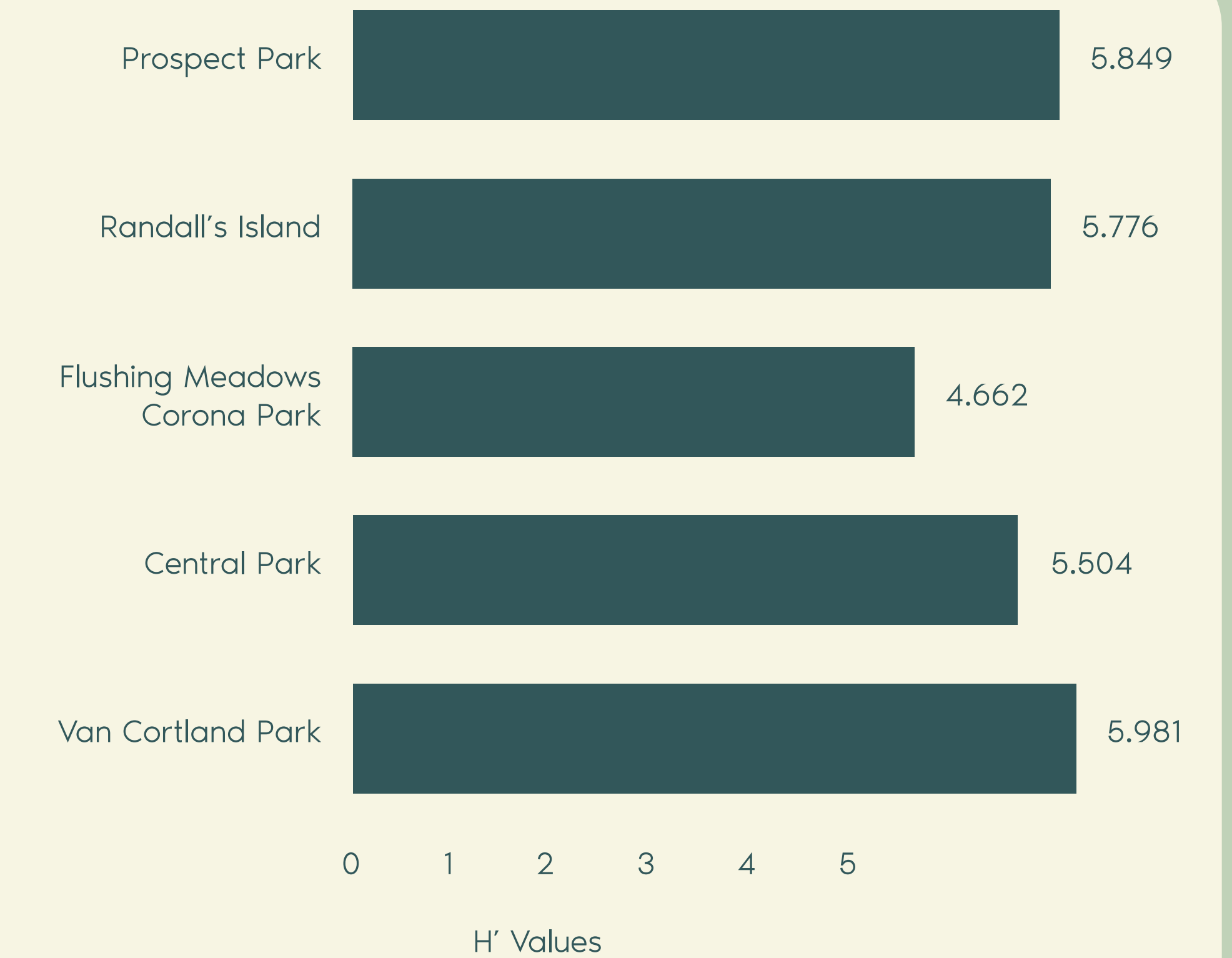| Park	H' Value
Prospect Park	5.849
Randall's Island	5.776
Flushing Meadows Corona Park	4.662
Central Park	5.504
Van Cortland Park	5.981

(H' Values axis: 0 1 2 3 4 5)

Figure 1 - Summary of Calculated Shannon-Wiener Index (H') Values.

Data shows that Prospect Park has the second highest species diversity, following Van Cortlandt Park.
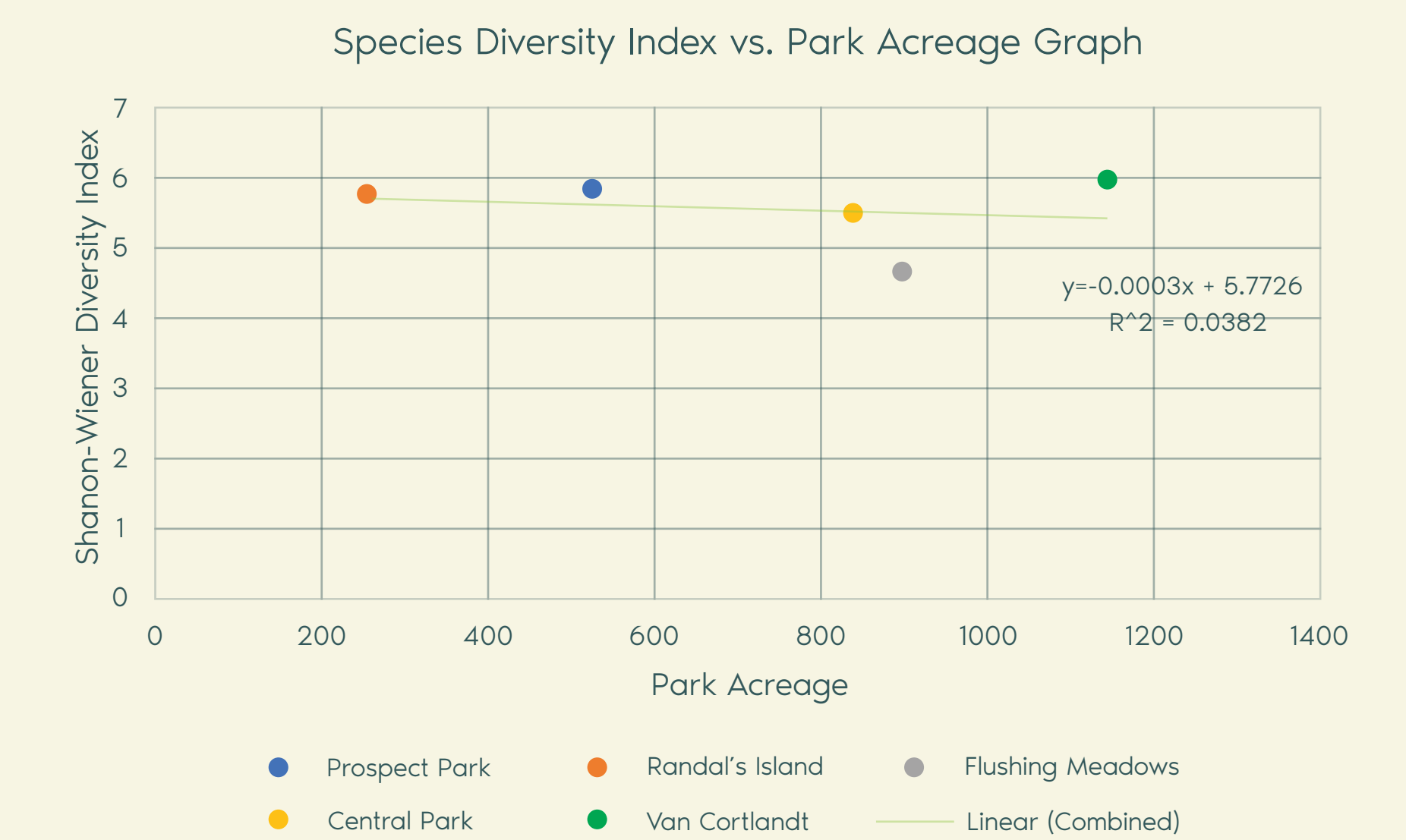
Species Diversity Index vs. Park Acreage Graph

$y = -0.0003x + 5.7726$
$R^2 = 0.0382$

(Legend: Prospect Park, Randal's Island, Flushing Meadows, Central Park, Van Cortlandt, Linear (Combined))

Figure 2 - Shannon-Wiener Diversity Index vs. Park Acreage Graph

Correlation coefficient (r) is approximately -0.195

Discussion & Conclusion

The least-squares regression line and the correlation coefficient of approximately -0.195 indicates that there is a weak, negative correlation between park acreage and species diversity. Delving into our data collection method reveals several challenges that are worth mentioning. Using iNaturalist data may create in an inherent bias due to its community-driven nature. Specifically, iNaturalist data may not completely capture the species composition of the parks. Some problems that arise when iNaturalist data is used include: incomplete data (e.g. missing species information), differences in the total number of observations between the parks leading to different sample sizes, observations not spanning across the area of the park, reporting of species that cover areas of land (e.g. plants and lichens) as an integer number of observations, etc.

Additionally, the chosen iNaturalist projects range different years. Species composition may be subject to change over time, influenced by various external factors. If projects occurred during different seasons, additional bias is introduced, as species diversity in a park can vary across seasons. For future considerations, we recommend the following: an alternate method of data collection that considers the space occupied by species that inherently cover areas, projects for species observation in parks that occur during the same time period (i.e. same season and same year), observations that span most of the park's area, and long-term monitoring of parks. These recommendations permit for more robust species diversity calculations, permitting researchers to obtain observations that are more reflective of the park's true species diversity. Additionally, these improvements may foster better comparisons between park acreage and species diversity.

In conclusion, the relationship between the Shannon-Wiener Diversity Index and acreage of a park was investigated. Although intuition dictates that a bigger park would have more space to support a diverse range of species, there are other factors that may contribute to species diversity other than the space available. Species diversity in a park may also be affected by the management of, and human activity in the park. All in all, we advocate for continued research that explores the contribution of different external factors on the species diversity of an urban park.

Refference

- "Shannon–Wiener Index." A Dictionary of Environment and Conservation, 3rd ed., Oxford University Press, 2017.
- New York City Department of Parks & Recreation. "Central Park." NYC Parks, www.nycgovparks.org/parks/central-park.
- ---. "Flushing Meadows Corona Park." NYC Parks, www.nycgovparks.org/parks/flushing-meadows-corona-park.
- ---. "Prospect Park." NYC Parks, www.nycgovparks.org/parks/B073/.
- ---. "Randall's Island Park." NYC Parks, www.nycgovparks.org/parks/randalls-island/.
- ---. "Van Cortland Park." NYC Parks, www.nycgovparks.org/parks/VanCortlandtPark.

Links to iNaturalist Data:
https://www.inaturalist.org/projects/2023-macaulay-honors-college-prospect-park-bioblitz
https://www.inaturalist.org/projects/2022-macaulay-honors-college-randall-s-island-park-bioblitz
https://www.inaturalist.org/projects/city-nature-challenge-2022-flushing-meadows-corona-park
https://www.inaturalist.org/projects/2013-macaulay-honors-college-central-park-bioblitz
https://www.inaturalist.org/projects/city-nature-challenge-2022-van-cortlandt-park?tab=species

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