

Is There a Relationship Between PM 2.5 Air Pollution and Species Diversity of Birds?

Kaitlyn Duran, Tony Christopher, Sakura Smith, Yasmeen Muthana

Introduction

Air pollution can negatively impact many aspects of the environment, including biodiversity of birds. Generally, air pollution can negatively impact reproductive output and survival of birds, as well as cause damage to DNA (Barton et al. 2023), and this holds true in ecosystems across the eastern United States (Lovett et al. 2009). Other negative impacts of air pollution on the health of birds include respiratory distress and illness, increased detoxification effort, elevated stress levels, immunosuppression, and behavioral changes (Sanderfoot and Holloway 2017). Air pollution can also reduce population density, species diversity, and species richness of birds, but the correlation between air pollution and biodiversity remains understudied (Sanderfoot and Holloway 2017) and is not considered in biodiversity management (Lovett et al. 2009).

PM 2.5, which is fine particulate matter with an aerodynamic diameter equal to or less than 2.5 micrometers (La Sorte et al. 2022), is an air pollutant that is present in New York City. This pollutant can enter the respiratory and cardiovascular system of birds and cause a number of negative health effects (La Sorte et al. 2022).

In this study, we will observe the number of species present in different community districts in New York City and compare this to PM 2.5 pollution present in these districts in order to see if there is a relationship between species richness of birds and PM 2.5 pollution.

Methods

We utilized iNaturalist as our primary source for bird species data and the New York City Department of Health, in collaboration with Queens College (CUNY), for PM 2.5 pollution data. iNaturalist serves as a valuable resource due to its extensive user-contributed observations, creating a rich dataset for bird species in various locations. In addition, the NYC Department of Health provided us with reliable PM 2.5 pollution data through the NYC Community Air Survey. The pollution data examined in this study is recent, from the year 2022. Data collection for this study took about two weeks to understand the correlation between bird species and PM 2.5 pollution. By combining iNaturalist and NYC Department of Health data, our study aimed to provide a thorough analysis of the relationship between air pollution and bird species richness in New York City community districts.

Utilizing Google Sheets, we plotted the number of bird species against the mean concentration of PM 2.5 recorded in the NYC Community Air Survey for each district. A scatterplot was created, depicting the distribution of data points. In addition, a best fit line was generated to assess the trend and potential correlation between the two variables. The scatter plot showed that variations in PM 2.5 concentration are not strongly associated with the number of bird species in the studied districts.

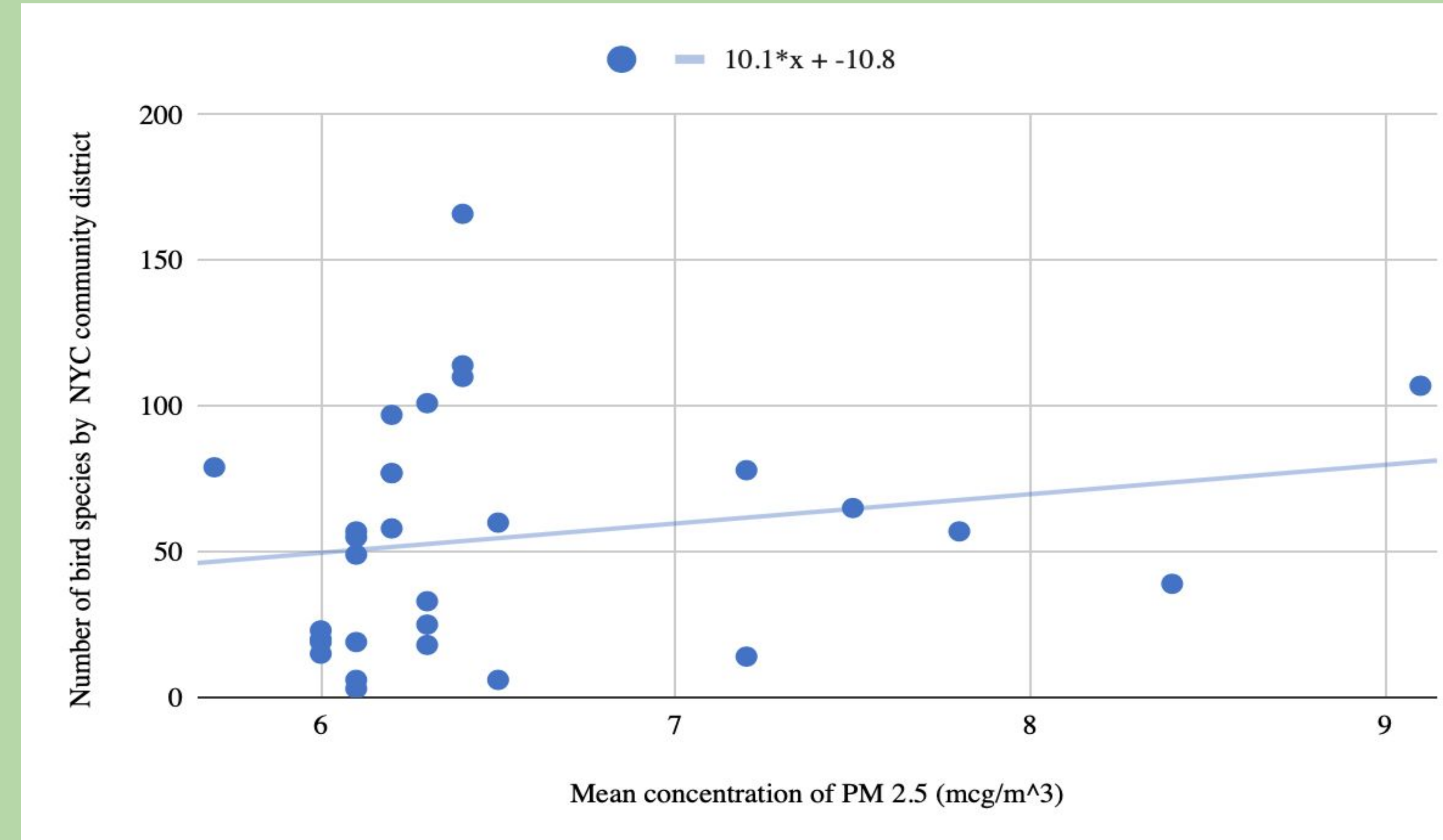


Figure 1. The Number of bird species in each NYC community district was compared with the mean concentration of PM 2.5 in each district recorded in the NYC Community Air Survey. While the model generated showed a direct relationship, the R value is approximately 0.194, which shows that there is little to no correlation between PM 2.5 concentration and number of bird species.

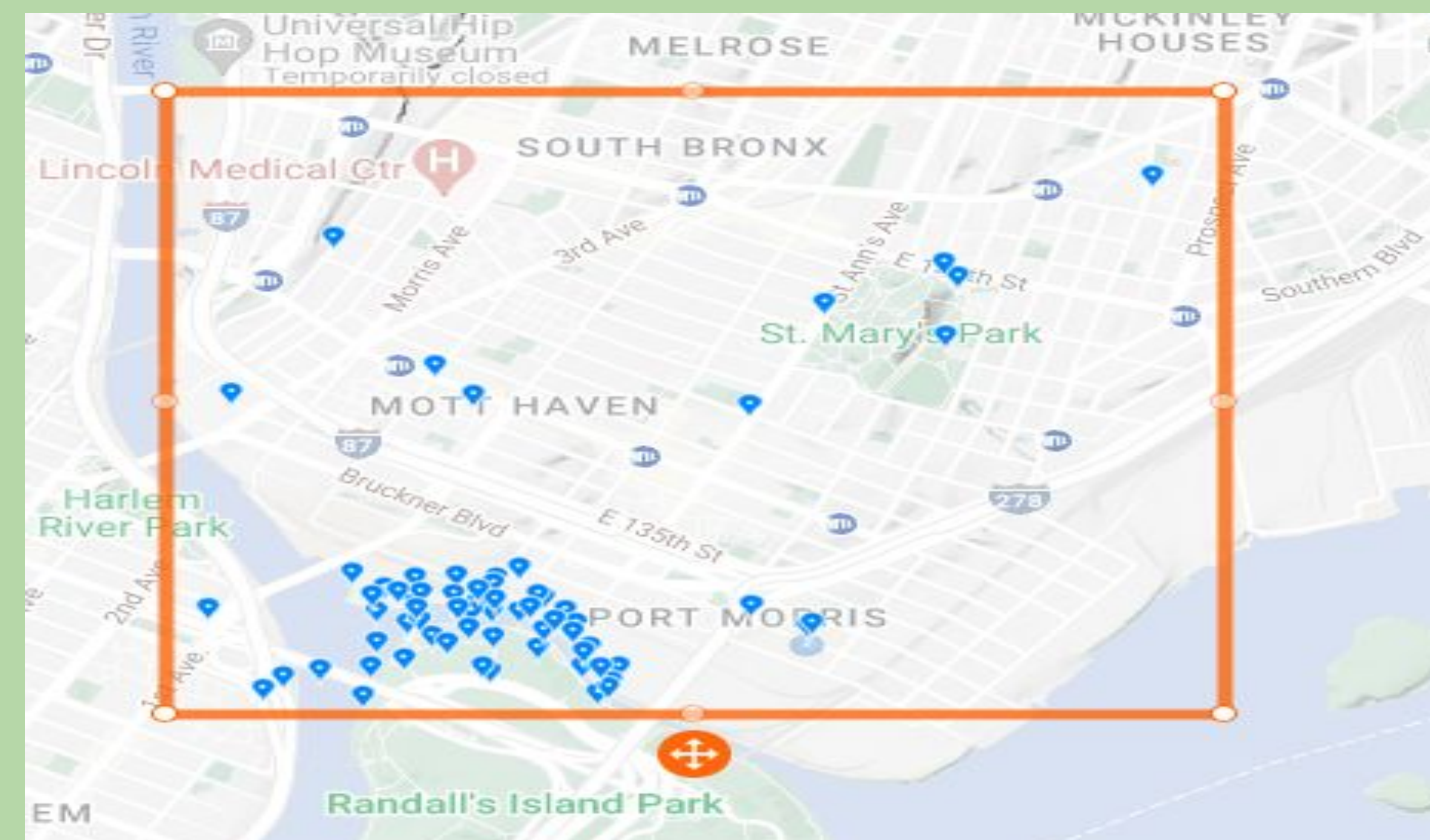


Figure 2. Example of iNaturalist interface. Custom boundary generated by iNaturalist around Mott Haven.

Results

There is little to no correlation ($R = \sim 0.194$) between species richness of birds in NYC Community Districts and PM 2.5 pollution.

Conclusion

We uncovered a lack of correlation between the number of bird species in various community districts and the mean concentration of PM 2.5. Our research attempted to shed light on the adverse effects of air pollution on bird populations. While acknowledging this graph, our model, with an R value of 0.194, suggests that the relationship lacks the strength to fully explain the variation in the number of bird species observed. Unfortunately these findings don't demonstrate the relationship between air pollution and avian biodiversity possibly due to the limitations of the community districts not being the same size and the iNaturalist data in that the bounds for neighborhoods were not as exact as desired, and there is no control variable of the citizens who were documenting these bird species, but still they still highlight the need for additional research in this less-explored domain.

Future Work

In light of our findings revealing no significant relationship between PM 2.5 concentration and bird species in NYC, it would be valuable to delve deeper into the connections between air pollution, notably PM 2.5, and the biodiversity of birds, because although this study did not provide conclusive results about the effect of air pollution on the avian species, air pollution does still have a definitive health effect on birds. Further studies that aim to more strongly demonstrate the correlation searched for in this study should look to account for bounds of districts, size of districts, more accurate documentation of bird species, and accounting for parks that act as more habitable species for avian species.

Works Cited

- Lovett, G.M., Tear, T.H., Evers, D.C., Findlay, S.E.G., Cosby, B.J., Dunscomb, J.K., Driscoll, C.T. and Weathers, K.C. (2009), Effects of Air Pollution on Ecosystems and Biological Diversity in the Eastern United States. *Annals of the New York Academy of Sciences*, 1162: 99-135.
- Barton, M. G., Henderson, I., Border, J. A., & Siriwardena, G. (2023, February 10). *A review of the impacts of air pollution on terrestrial birds*. Science of The Total Environment.
- Sanderfoot, O. V., & Holloway, T. (2017). Air pollution impacts on avian species via inhalation exposure and associated outcomes. *Environmental Research Letters*, 12(8), 083002.
- La Sorte, F. A., Aronson, M. F. J., Lepczyk, C. A., & Horton, K. G. (2022). Assessing the combined threats of artificial light at night and air pollution for the world's nocturnally migrating birds. *Global Ecology and Biogeography*, 31, 912–924.