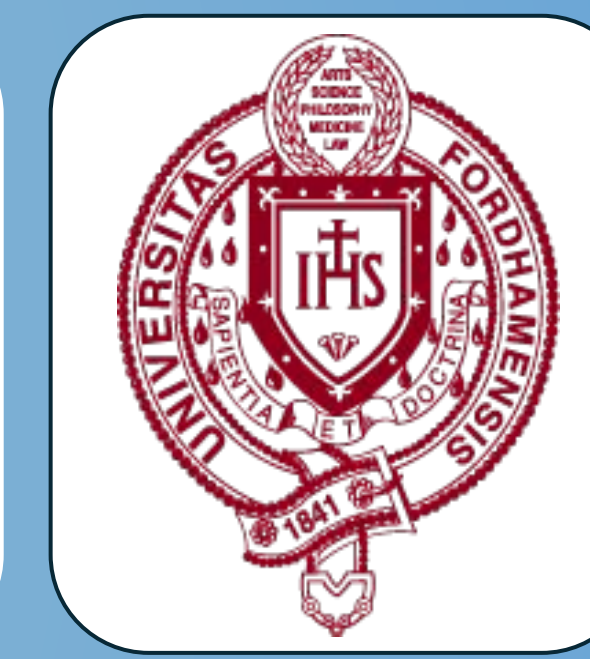


Birds in the Big Apple: Unraveling the Effects of Urbanization on Avian Populations

ANALISA BROWN-BEEBE
Fordham University



Introduction

Urbanization, the worldwide phenomenon of transitioning natural landscapes to metropolitan areas, creates continuous challenges for wildlife, especially birds. This process promotes habitat fragmentation, forcing bird communities to migrate to more suitable areas or adapt to new environmental spaces. Birds provide various essential ecosystem services: pest control, vital pollinators, and ecosystem engineering within ecosystems¹. Environmental disturbances, such as sound pollution and poor air quality, negatively affect urban bird populations. The excessive **sound pollution** caused by urbanization interferes with acoustic communication associated with mating, nesting, and defending territories, which elevates low species richness and abundance². In addition, **air pollution** is another critical factor harming birds by causing physiological stress, reduced abundance rates, and dangerous respiratory health problems due to exposure to PM 2.5, CO₂, and NO₂³. For example, the 2023 Canadian wildfires led to record-breaking levels of PM 2.5 in New York City. In such disturbances, community science platforms, eBird, are utilized to study the trends of bird abundance and bird species within environmental stressors like sound and air pollution. The integration of scientific databases, such as the Global Biodiversity Information (GBIF), allows the examination of bird abundance through the years in relation to urbanization. This is key to understanding the impacts of urbanization on birds in urban areas.



Key Takeaways

In the summer, our team explored the impact of sound pollution on bird species richness, abundance, and alteration in singing behavior in the five different sites in the Bronx Zoo, a critical urban green space for avian and local wildlife⁴. Data was collected through fixed-point count surveys and acoustic monitoring. Additionally, in the fall, two separate projects were conducted. The projects expanded on the topics of bird abundance and bird species richness from the original summer project in order to explore the effects of air pollution and evaluate the amount of woodpeckers and birds of prey around New York City.

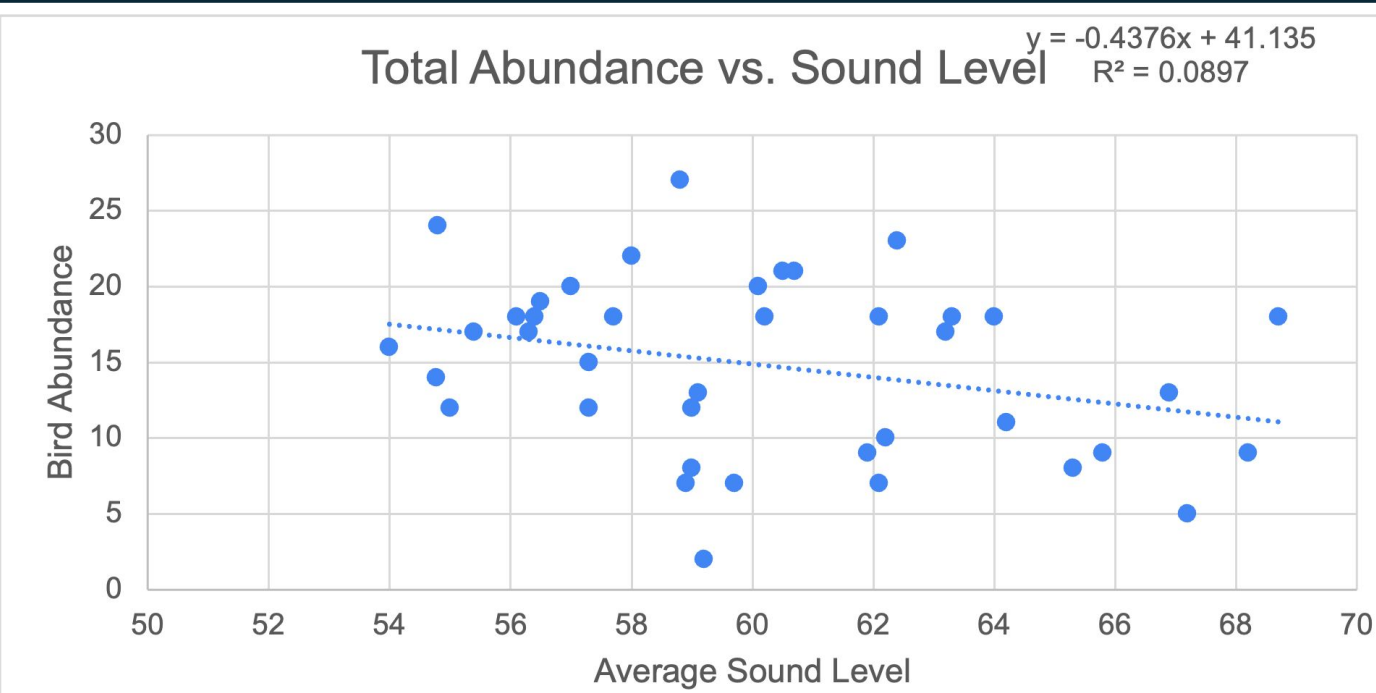


Figure 1 Higher sound levels was associated with the decreasing rates in the total abundance of birds.

Project Overviews

Each of the following projects builds on a prior summer research project exploring the effects of sound pollution on bird diversity, abundance, and singing behavior. Utilizing the methodologies and insights developed throughout the summer, the fall projects expanded into a complex layer between environmental disturbances and birds. The first fall project evaluates the abundance rates of two important functional groups: woodpeckers and birds of prey, within three different urban parks: Central Park, Bronx Zoo, and Prospect Park. However, the second research project amplified another serious environmental stressor, air pollution, to examine the correlation of poor air quality on bird abundance throughout the five boroughs throughout New York City. The projects incorporate data from citizen science platforms for a more comprehensive analysis and engage with more than 10,000 rows of data. These projects serve as valuable insights to assess the impacts of environmental interferences on the bird community.

Pecking the Trends: An Investigation of Woodpeckers and Raptors in NYC Parks By: Lala Diawara & Oscar Smith

Question 1: How have the abundance of woodpeckers and birds of prey in different New York City urban parks changed from 2018 - 2023?

Hypothesis 1: The abundance of both woodpeckers and birds of prey will be higher in larger public parks like Central Park, compared to smaller parks, like the Bronx Zoo and Prospect Park.



Feathers in the Fog: Assessing the Correlation between Air Quality and Bird Abundance By: Deylan Tavaréz

Question 1: From 2019 to 2023, how does air pollution impact bird abundance across urban green spaces in the 5 NYC boroughs?

Hypothesis 1: As air quality index increases, bird abundance will decrease.

Question 2: How does the Canada wildfire event correlate with bird abundance each of the NYC boroughs?

Hypothesis 2: During the 2023 Canada Wildfires, as air quality index increases, bird abundance will decrease



Acknowledgments

A special thanks to Max Falkenberg for his guidance through the course of the internship and his abundant knowledge of birds, Dr. Lowell Iporac, the Wildlife Conservation Society, Bronx Zoo, eBird, GBIF, Fordham University, our parents, and lastly the Pinkerton Foundation for their support of the program.

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Feathers in the Fog: Assessing the correlation between Air Quality and Bird Abundance

DEYLAN TAVAREZ
Belmont Preparatory High School



Introduction

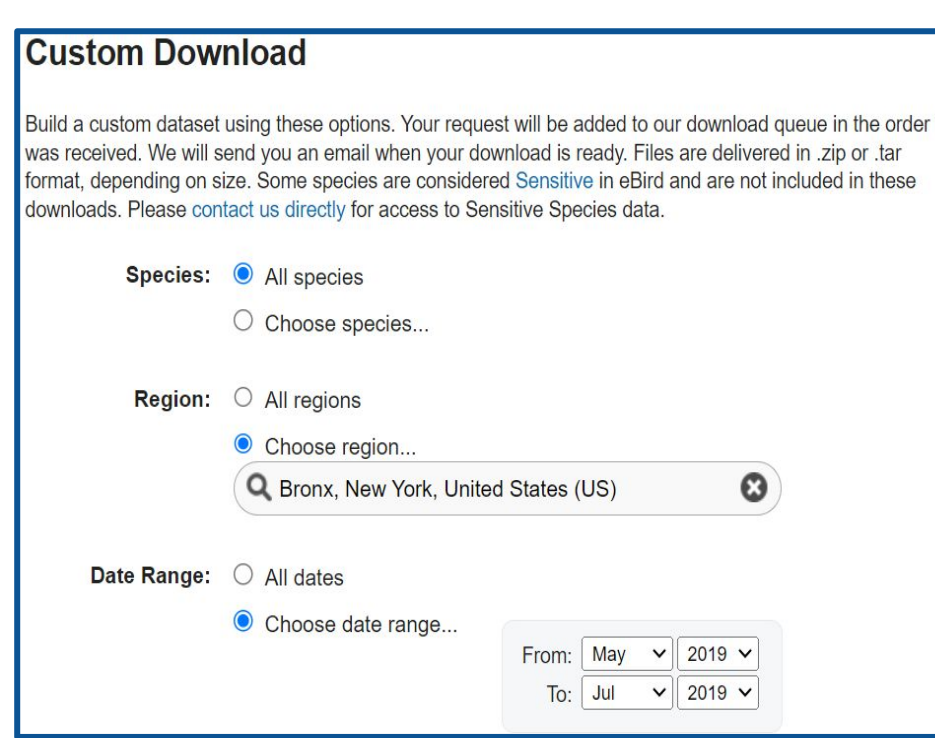
Urbanization transforms rural areas into metropolitan areas, significantly changing ecosystems and threatening wildlife¹. Due to the environmental consequences of urbanization, sound pollution has impacted birds. Birds play a vital role for ecosystems as they reflect the condition of their environment, minimize pest populations, are ecosystem engineers and pollinators². In the summer of 2024, the relationship between native bird abundance and sound pollution was examined to better understand how birds respond to auditory stimuli and disturbances within the Bronx Zoo. However, sound pollution isn't the only threat to birds in urban areas. Air pollution caused by Fine Particulate Matter (PM 2.5) and Carbon dioxide is another critical issue. It is a significant threat to birds as it can impact reproductive output, molecular damage, foraging behavior, plumage coloration, body size, and overall survival³.



In June 2023, the Canadian Wildfires in Quebec released high levels of PM 2.5, causing hazardous air quality all across the Northeastern coast of North America, raising concerns on the impact on bird diversity⁴. This research project investigates how air pollution affects bird abundance across the five boroughs of New York City, in relation to the Canadian wildfires of 2023.

Methodology

This study explored the relationship between Air Quality Index and bird abundance around New York City. Bird abundance data was collected from eBird, a citizen science platform developed by the Cornell Lab of Ornithology that allows anyone, whether a professional scientist or an amateur birder, to record bird sightings in their local area. Data for the months of May, June, and July from the years 2019 to 2023 were queried and downloaded from the eBird public database. Data included observation count of species names and observation counts grouped by borough and year.



The U.S. Environmental Protection Agency (EPA) was accessed to acquire Air Quality Index values, focusing on Fine Particulate Matter (PM2.5) for each time frame and borough. To manage the extensive datasets of more than 10,000 values, bird abundance and air quality data were separated into pivot tables for each borough and year based on the specific months. Each table included the observation date, common name, and observation count. Five separate graphs were made from these tables to find the relationship between AQI and species abundance.

Abstract

Anthropogenic activities have drastically changed natural habitats, directly impacting wildlife, particularly birds¹. Urbanization has amplified these changes, bringing with it various environmental disturbances such as air pollution. Most bird habitats within urban cities are constantly exposed to various forms of air pollution: car exhaust, burning of fossil fuels, and industrial activity. This study analyzes the relationship between air quality and bird abundance across New York City and explores the impact of Canadian wildfires from June 2023. Bird abundance data, spanning from 2019 - 2023 for May, June, and July, was collected on eBird, a citizen science platform. Air quality records were obtained by the United States Environmental Protection Agency. An increase in AQI due to higher levels of PM 2.5 correlated with a decrease in bird species abundance.

Research Questions & Hypotheses

- Research Question 1:** From 2019 to 2023, how does air pollution impact bird abundance across urban green spaces in the 5 NYC boroughs?
Hypothesis 1: As air quality index increases, bird abundance will decrease.
- Research Question 2:** How does the Canada wildfire event correlate with bird abundance each of the NYC boroughs?
Hypothesis 2: During the 2023 Canada Wildfires, as air quality index increases, bird abundance will decrease

Results & Figures

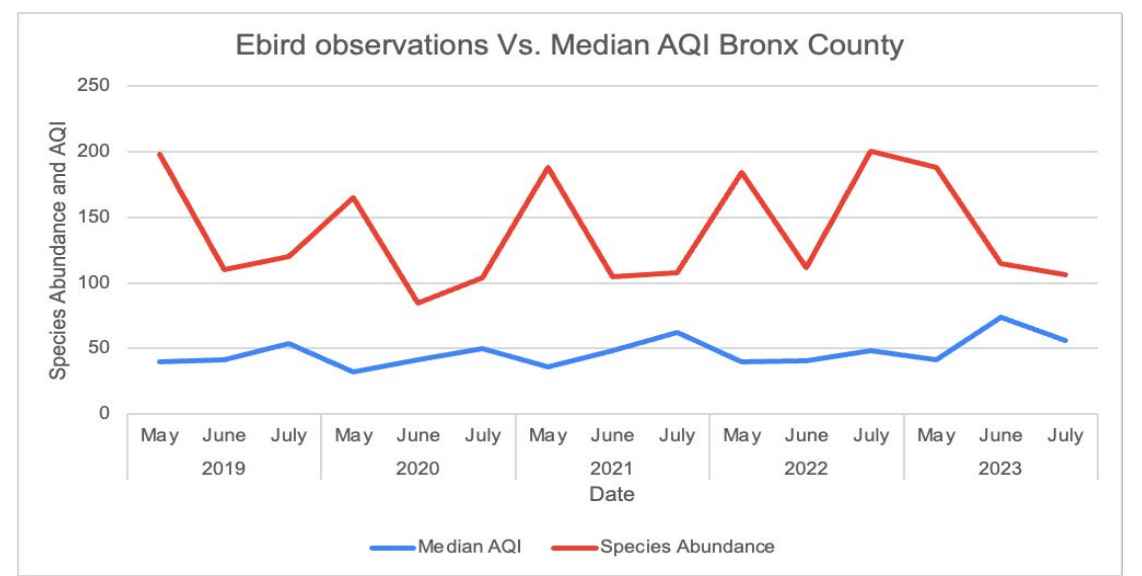


Figure 1. Median AQI increased, as eBird observations decreased

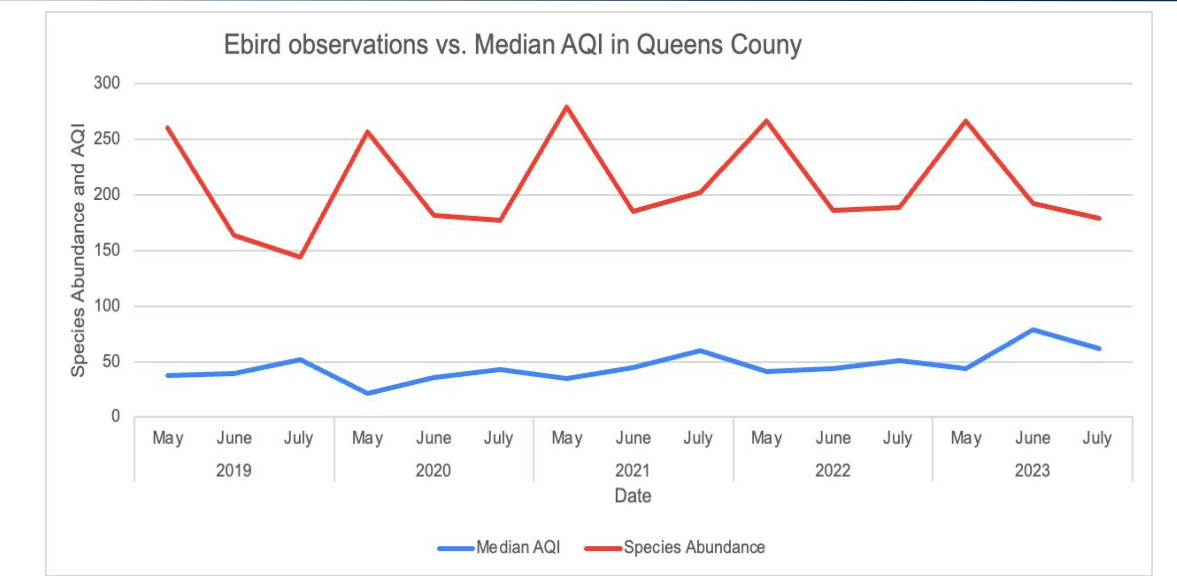


Figure 2. Higher abundance in relation to the low AQI

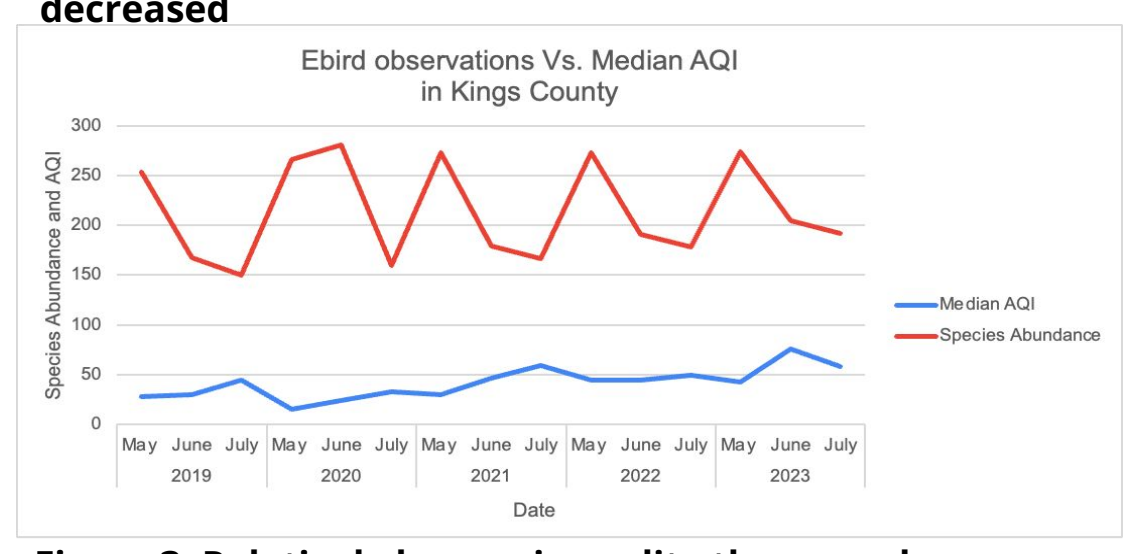


Figure 3. Relatively lower air quality than usual

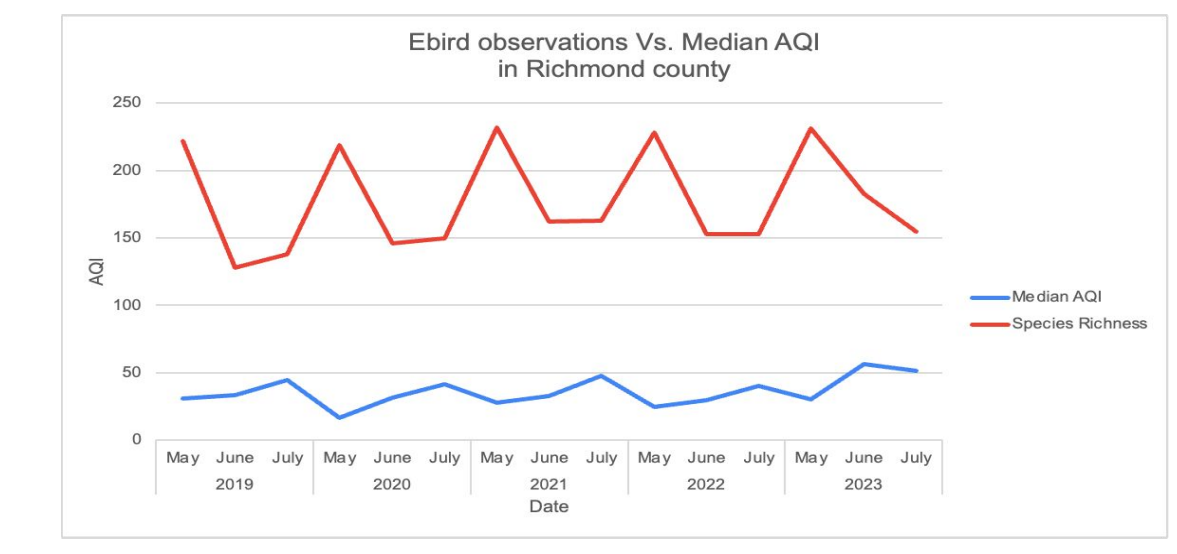


Figure 4. Constant amount of species in June and July 2021-2022

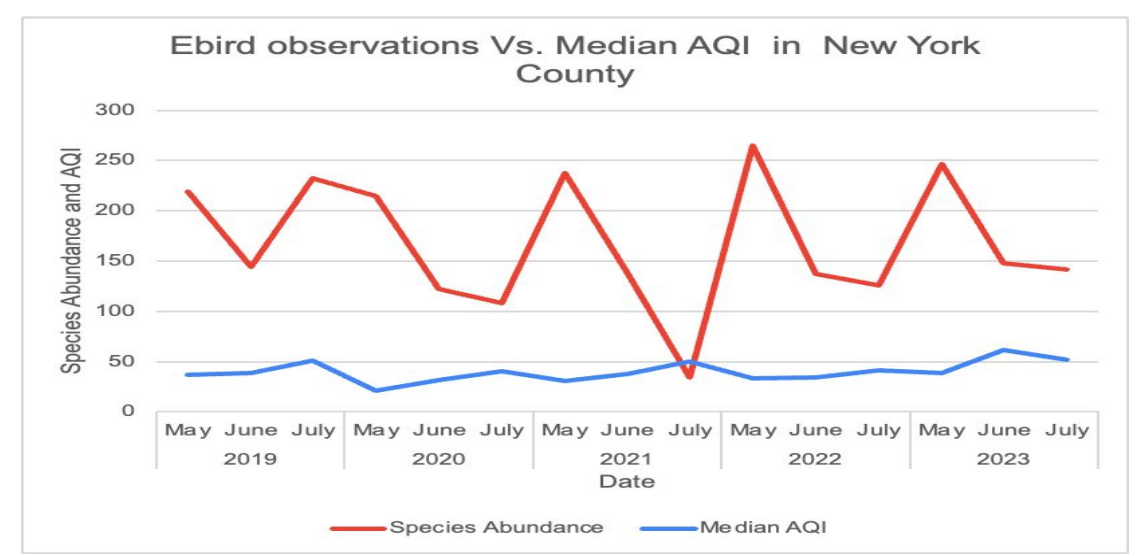


Figure 5. Major dip in abundance in July 2021



Figure 6. Map of each New York City Borough

Discussion

Birds are reliable species that can be categorized as vital indicators of environmental health. They display if there is a particular environment changing ecologically. However, the increase in the air quality index due to human activities has affected bird communities widely. This study examined the correlation between air quality and species abundance across New York City boroughs from 2019-2023 during the months of May to July. Results showed that as the median Air Quality Index (AQI) increased, eBird observations generally decreased. Distinctly, New York County (Fig. 3) exhibited a significant decrease in species richness and bird observations in June and July 2021, coinciding with an increase in PM 2.5 levels caused by smoke from the West Coast wildfires that traveled to the East Coast⁵. Additionally, to the fluctuations in air quality, the changes may be due to spontaneous fires throughout the city, vehicle usage, and wind patterns. Also, fewer eBird observations in 2020 and 2021 may be due to the COVID-19 pandemic, as people didn't go out as often, causing fewer reports. These findings suggest that poor air quality may drive birds to migrate to less polluted areas, contributing to the observed decline in abundance. This trend reflects reduced human activity and fewer eBird submissions during the periods of poor air quality. These results underscore the importance of monitoring air pollution's ecological effect. Future studies should focus on the limiting factors on this study by integrating additional citizen science platforms, such as iNaturalist, to cross-reference bird abundance data.

Acknowledgements

I would like to thank my supervisor Max Falkenburg for assisting me with editing this poster, Analisa Brown-Beebe for her hard work in assisting me with creating this poster, Dr. Lowell Iporac, the Wildlife Conservation Society, and Bronx Zoo, the Pinkerton Foundation, Cornell Ornithology Lab for eBird, the U.S. Environmental Protection Agency, Fordham University, and my parents for supporting me throughout this program.

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Pecking the Trends: An Investigation of Woodpeckers and Raptors in NYC Parks

OSCAR SMITH & LALA DIAWARA

Bronx Science and Frank McCourt High School



Introduction

Urbanization, where rural lands turn into cities, has a significant impact on bird species, as their habitats such as green spaces shrink and become fragmented. Woodpeckers are **keystone species**, meaning that they play an essential role in maintaining healthy ecosystems. Woodpeckers specifically from the family *picidae* includes species such as northern flickers, downy woodpeckers and red-bellied woodpeckers. These species, along with others found in the same family create tree cavities that serve as shelters for various smaller animals, such as birds, mammals, and insects, while aiding nutrient cycling by dispersing fungi and assisting in the decomposition of dead trees¹. Similarly to woodpeckers, birds of prey such as, hawks, eagles and falcons, are also keystone species. Birds of prey can be classified in different families. *Falconiformes* and *accipitriformes* were chosen to evaluate as they are predatory birds excluding vultures and birds that can be easily seen, excluding owls. Birds of prey act as top predators, regulating prey populations like rodents and small mammals. Through their hunting behaviors, they naturally control populations by removing weaker or sick individuals, helping maintain ecological balance and reduction of diseases². Our study evaluate these two groups of birds as they are both functional groups who have very different roles in ecosystems but are equally important bird groups.



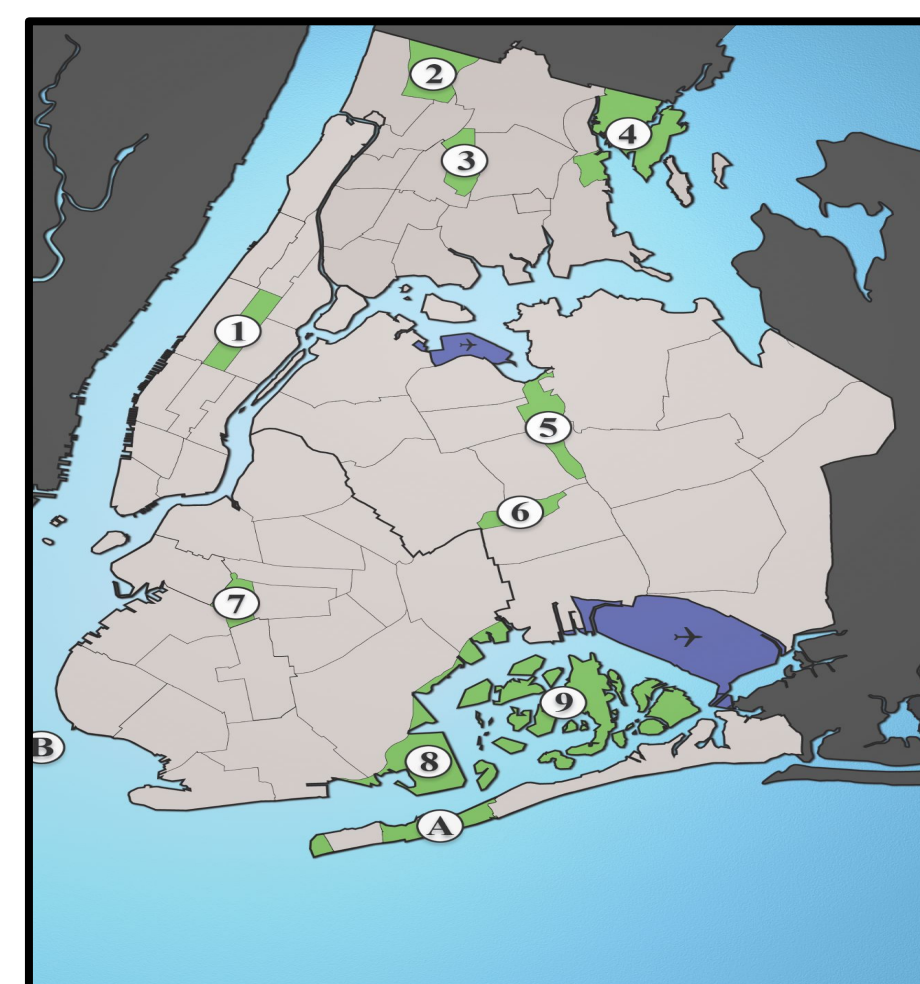
Over the summer of 2024, point count surveys were conducted at five Bronx Zoo sites to study the impact of sound pollution on bird species richness, abundance, and singing behavior. The study used fixed-radius surveys and singing ethograms to reveal how sound pollution influences bird diversity and vocalizations. The findings displayed significant amount of woodpeckers such as downy woodpeckers, and birds of prey such as hawks, which prompted the further evaluation of these populations. The purpose was to assess the bird abundance in green spaces beyond the Bronx Zoo, to observe if park size was a major factor.



Methodology

Within the study, the correlation between the species richness of woodpeckers and birds of prey, specifically *Falconiformes* and *Accipitriformes*, in New York City Parks was evaluated. Bird species richness was collected through an online platform named Global Biodiversity Information Facility (GBIF). This platform allows researchers to access a large collection of species observation records from across the world. Data from 2018 to 2023 were requested and downloaded from the GBIF database.

Data was gathered from GBIF, which included the location, observation count, and scientific names grouped by each borough: Manhattan, Bronx, and Brooklyn. To organize datasets over 20,000 rows, bird species richness was calculated through a pivot table. Each data table included the bird species, year, and grand total of woodpeckers and one for birds of prey across three urban parks: Bronx Zoo, Prospect Park, and Central Park. Three graphs were created to display the relationship between woodpecker richness within the parks, however, only one graph was made for birds of prey to compare bird species richness in each urban park.



Map of NYC green spaces. # 1,3,7 parks used in study

Abstract

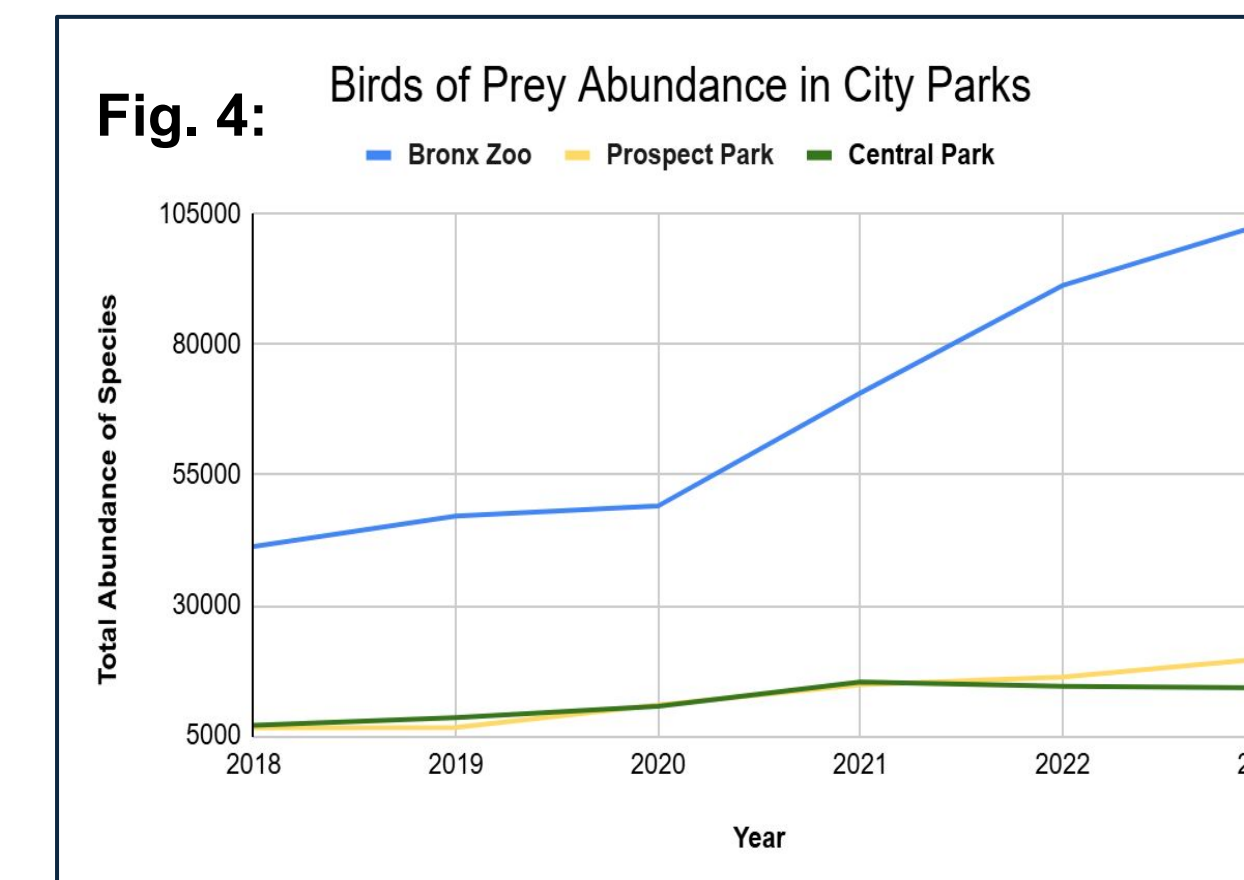
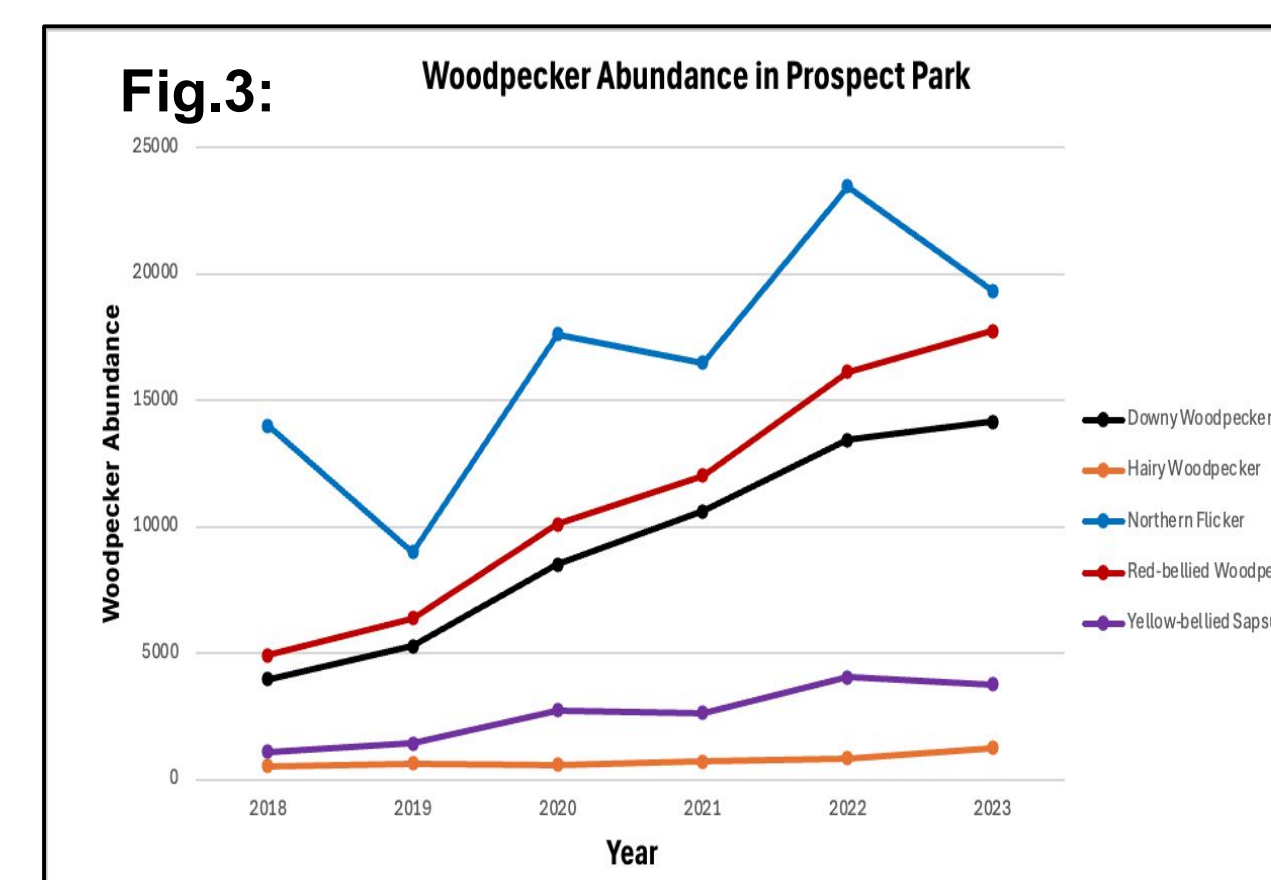
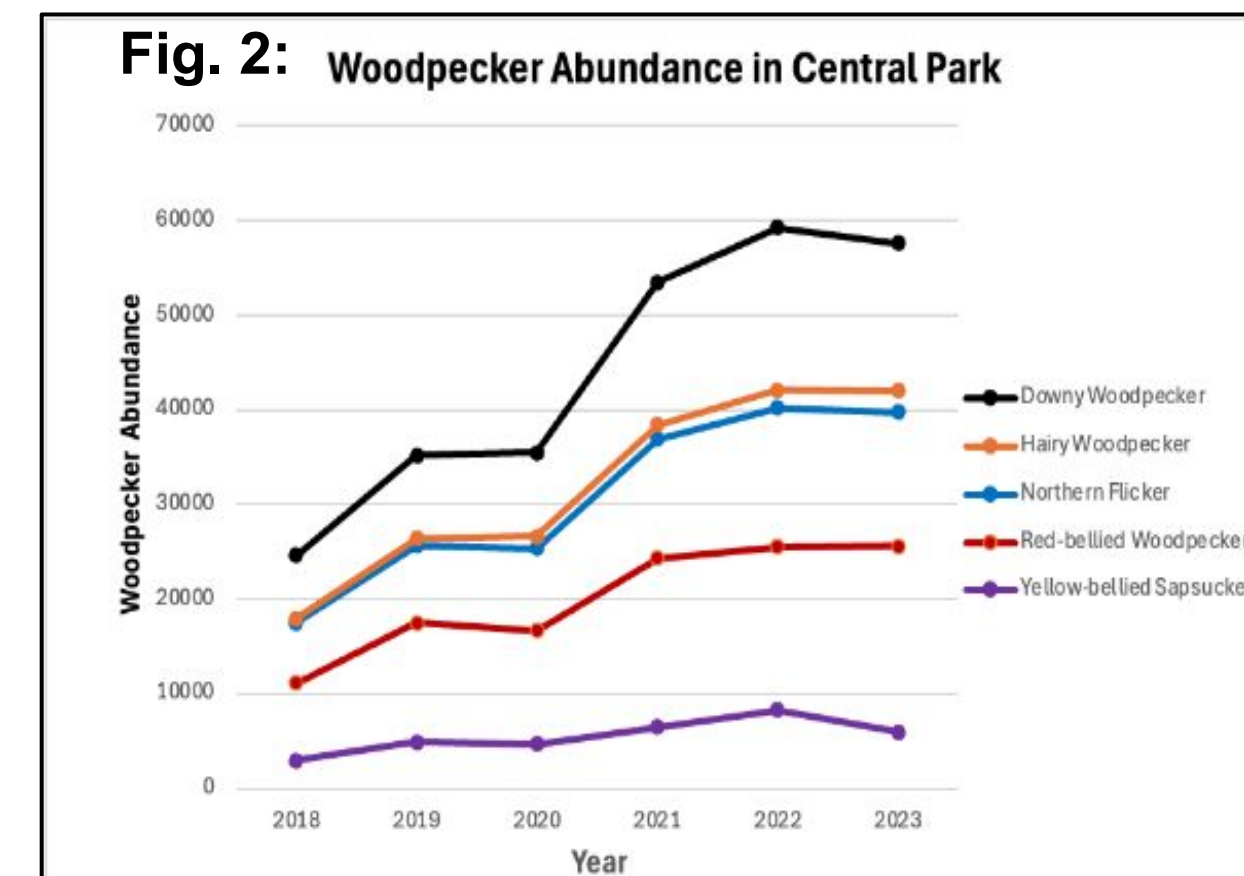
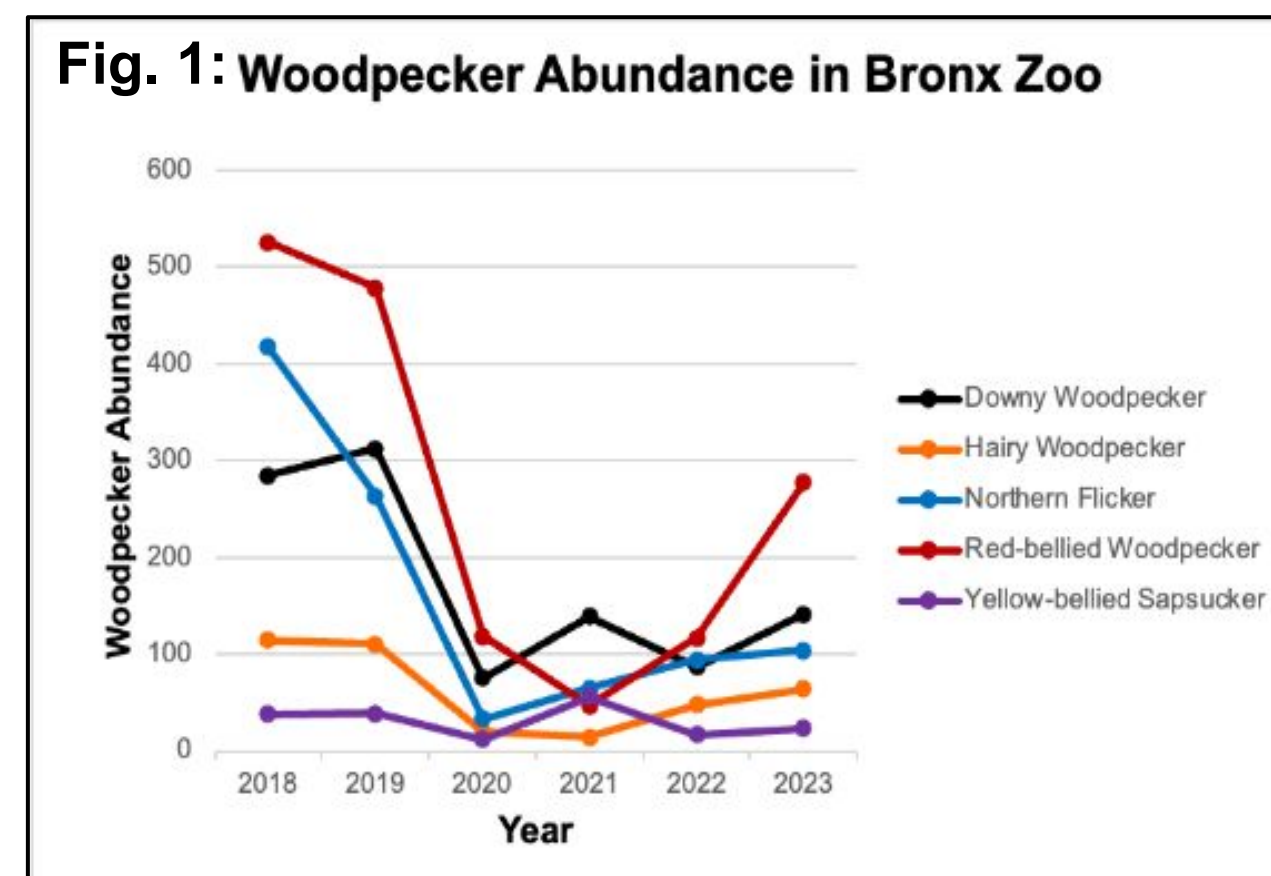
Urbanization has affected environments such as green spaces, significantly impacting bird populations, including species like woodpeckers and birds of prey. Woodpeckers contribute to ecosystem health by creating tree cavities for smaller species and aiding in nutrient cycling, while birds of prey regulate prey populations, creating ecological balance². This research was conducted to reveal the difference in woodpeckers and birds of prey abundance in green spaces that were different in size and location over the course of 6 years. Data from GBIF (human observations) revealed that Red-bellied woodpeckers were most abundant at the Bronx Zoo, downy woodpeckers in Central Park, and northern flickers in Prospect Park. This indicates there is no one dominant woodpecker species in NYC; they vary by park. The size of the park correlated to the amount of woodpeckers recorded within the park because Central Park had the greatest rate of abundance. As for raptors, they were consistently the most observed at the Bronx Zoo. The Bronx Zoo was the smallest park in size, but contained the greatest birds of prey abundance, while Central and Prospect Park, which are greater in size, had a smaller and very similar abundance of birds of prey throughout the years.

Research Questions & Hypotheses

Question 1: How have the abundance of woodpeckers and birds of prey in different New York City urban parks changed from 2018 - 2023?

Hypothesis 1: The abundance of both woodpeckers and birds of prey will be higher in larger public parks like Central Park, compared to smaller parks, like the Bronx Zoo and Prospect Park.

Figures



Results

Woodpeckers: The red-bellied woodpecker was shown to be most abundant at the Bronx Zoo on average. The pandemic led to a decline in all woodpecker reporting. On average, the yellow-bellied sapsucker is the least abundant (**Fig 1**). The downy woodpecker is by far the most abundant species in Central Park. The hairy and northern flicker are very similar in abundance. The yellow-bellied sapsucker is the least observed species across the years (**Fig 2**). The northern flicker was the most observed woodpecker within Prospect Park, displaying constant decreasing and increasing abundance rates by the year. As shown, red-bellied and downy woodpeckers are similar in abundance, increasing by the year (**Fig 3**). From 2018 to 2023, a total of 4,131 woodpeckers were observed at the Bronx Zoo, 243,536 in Prospect Park, and 265,700 in Central Park. The pandemic affected all data for 2020 as bird observations dropped.

Birds of Prey: Compared to Prospect and Central Park, the Bronx Zoo had the greatest number of raptors for the entire 2028–2023 period. Although it has risen over time, there was a notable increase from 2018 to 2023. A similar low number of raptors were observed in Bronx Zoo and Prospect Park, with only slight increases following the pandemic (**Fig 4**).

Discussion

We originally hypothesized that the abundance of woodpeckers and birds of prey would be higher in larger public parks like Central Park (842 acres), compared to smaller parks, like Prospect Park (526 acres) and the Bronx Zoo (265 acres). We were surprised that this was only partially true: supported with woodpeckers and refuted with birds of prey. It's important to consider that the abundance of woodpeckers observed by humans does not correlate to the amount of physical birds in nature, since not every bird can be visible to the public. We believe Central Park has the most woodpecker observation compared to other parks since more people visit this park each year, and there are many large forested areas for the woodpeckers. Central Park is also free to the public, the Bronx Zoo requires tickets to enter which influences number of observers. We believe raptors were most observed at the Bronx Zoo since they stand out more in a smaller zoo setting.

These observations do offer a rough estimate of the park prevalence for birds of prey and woodpeckers, indicating green spaces that support more of a bird species. If we had more time, we would've taken data from parks from all 5 boroughs (including Queens and Staten Island) to create more trends across woodpeckers and raptors. In a future study, we would look more into the vegetation diversity and tree canopy within the NYC parks to see how it correlates with woodpecker and raptor abundance.

Acknowledgements

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