Foraging for Birds: How Habitat Characteristics Impact Avian Communites in the Bronx Zoo

Chris Acevedo, Kimora Nixon, Marinnel Velasco, Sajia Uddin, Naima Hossain
NYCSRMC Summer Research Symposium | August 2025

Abstract

Urban green spaces provide crucial habitats for birds, although small-scale habitat characteristics may influence abundance, diversity, and behavior of such birds. This study examined how habitat characteristics such as vegetation cover, noise levels, and human disturbance affect bird communities across four sites in the Bronx Zoo. Point counts and behavioral observations were conducted over 11 surveys per site during July-August 2025. Measurements of vegetation density, noise pollution and human activity were also taken. Results revealed that the River site, which has moderate vegetation and minimal disturbance, has the highest abundance (555 individuals) and species richness (34 species). The Bison Walkway, with higher disturbance and moderate vegetation, showed lower diversity and more aggressive interactions. Sites with greater vegetation cover and lower disturbance typically supported more foraging and neutral behaviors, while disturbed sites showed more competitive interactions. Findings of this study aid in the understanding of the role of small-scale habitat characteristics on bird diversity and behavioral patterns in urban green spaces.

Introduction

Birds are a vital part of an ecosystem; they provide crucial ecosystem services to the environment, such as seed distribution and pollination. (Whelan et al., 2008). These roles don't disappear in urban areas, but urbanization often disrupts them. The spread of buildings and roads can fragment habitats and create barriers for birds. This can then lead to population declines or even local extinction as environments change and biodiversity ultimately decreases (Tietze, 2018). However, habitat fragmentation in urban environments can be beneficial to birds and vice versa. (Murgui & Hedblom, 2017). For example, urban landscapes are beneficial stopover sites for birds to refuel and rest during long-distance migration (Seewagen & Slayton et al. 2008). Moreover, birds in return provide us fertile soils, ample wildlife, and the natural resources that we rely on, specifically economic developments.(The State of the Birds, 2009). Because of this urban green spaces, parks, gardens, green roofs, and zoos, can play a critical role in supporting avian biodiversity, specifically wild birds. This is especially important for urban avoider bird species who may not benefit as much as species like *Passer domesticus* (house sparrows) or *Columba livia* (rock pigeons) who are seen more commonly in areas with more human intervention (Silva-Ortega et al., 2023). For example, a study shows that urbanization can cause more difficulty to urban avoiders with forgoing than urban exploiters (*Habitat Selection in Birds: The Roles of Vegetation Structure, Competitors, and Productivity*, 1981). Because not much is known about how microhabitat variations within urban green space affects bird interactions, studies like this can help fill knowledge gaps.

This study took place at the Bronx Zoo, a 260-acre facility with natural forest and riparian habitat within the larger Bronx Park system. In places like the Bronx Zoo, wild birds often take advantage of the trees, water, and remote corners that offer shelter and food in the middle of the city (Tóth et al., 2019). However, not all parts of the zoo are equally suitable or welcoming for birds. Factors like vegetation, noise, and the level of human activity may influence which species show up or how many stay, or how they interact with each other. This can then show that certain habitat features either limit or support bird presence and behaviors in urban green spaces. Because not much is known about how microhabitat variations within urban green space affects birds, studies like this can help fill knowledge gaps. By comparing patterns across the zoo, we hope to better understand how the Bronx Zoo functions as an urban green space offering ecological refuges for wild birds, influenced by urban development.

Methodology

Study Sites
Four sites were selected due to their variation in habitat characteristics and location in the Bronx Zoo.

Point Count and Ethogram
One 30-meter plot was measured within each site. Fixed-radius point counts were conducted by two or three observers at the center of these plots. Point counts were conducted for 30 minutes, during which all birds observed within the radius were identified and recorded. Birds were identified by visual and auditory cues using the Merlin app, an application by the Cornell Lab of Ornithology. Bird behavior was identified using an ethogram (Fig. 3).

11 surveys were conducted at each site across five weeks in July and August 2025. Counts were done between the hours of 10 a.m. and 12 p.m. which allowed the observation of birds at different times throughout the day with variations in noise and human disturbance. Double counting was prevented by not counting the bird if it was still present in the same or general area, or if the bird flew away. Moreover, birds seen outside of the 30-meter radius were not recorded.

Sound Level Measurement
Noise pollution was measured using the Extech Digital Sound Level Meter. During the 30-minute point counts, the sound meter was turned on every 5 minutes and calibrated for 15 seconds before recording the noise levels in decibels (dB). Since there was only one sound meter available, sound level was recorded for 2 point counts alternating sites.

Human Disturbance and Vegetation Measurement
At each site, human disturbance was recorded every five minutes by counting individuals present (excluding observers) and scoring on a 0-4 scale (0= no people seen; 4= more than 15 individuals). Vegetation density within the 30-meter point count plot was estimated on a 0-4 scale, where 0= bare/grassy areas and 4= dense forest cover.

Research Questions & Hypotheses

Question 1: How do variations in habitat characteristics such as vegetation density, noise pollution, and human activity influence avian diversity and abundance?
Question 2: How do these same habitat features affect observed behaviors such as foraging or chasing across the sites?
Hypotheses:
#1. Sites with greater vegetation cover and lower human disturbance will show higher bird species richness and abundance.
#2. Higher levels of noise and human activity will negatively correlate with species diversity and total bird abundance.
#3. Bird species in less-disturbed and vegetation rich sites will exhibit more neutral interactions such as foraging, while competitive or aggressive behaviors will increase in sites that are highly disturbed and have lower levels of vegetation.

Results & Figures

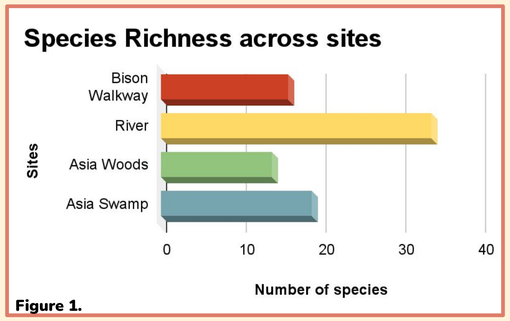
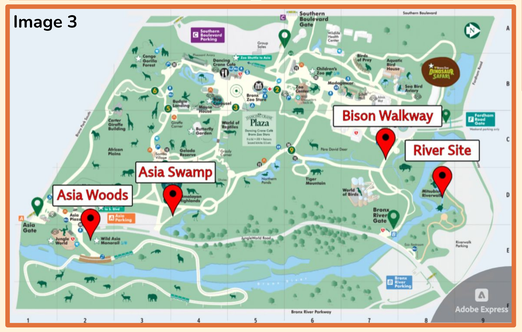


Figure 1.

Figure 2.

Sites	River	Asia Woods	Asia Swamp	Bison Walkway
Noise Pollution(dB)	56.8	51.2	52.2	56.3
Vegetation level	3	4	3	2
Human Disturbance	0.7	2.5	1.3	2.3
Abundance #	555	201	165	291



These four sites were selected to ensure variation in vegetation and average human disturbance level:
Image 1: Asia Swamp
Image 2: River Site
Image 3: Map of the Bronx Zoo with each site location

Behavior Code	Behavior	Description
CH	Chasing	One bird pursuing another aggressively or defensively
F	Foraging	Pecking, probing, gleaning, searching for food
FI	Fighting	Displaying, posturing, or attacking by flying at each other
FL	Flocking	Birds moving/feeding together in a loose group
MO	Mobbing	Group harassment of predator/intruder (chasing, loud calls)
R	Resting/Perching	Stationary, not engaged in other listed behaviors
S	Singing/Calling	Vocalizations (song, call, alarm, etc.)
O	Other	Any behavior not captured above (add a note)

Figure 3.

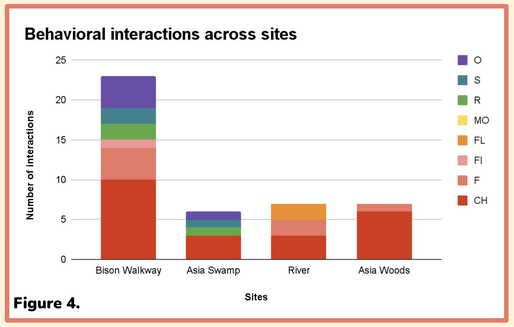


Figure 4.

Figure 1. Graph of species richness among the sites.
Figure 2. Table with averages of noise pollution, vegetation level, human disturbance, and abundance.
Figure 3. Ethogram table specifying bird behavior.
Figure 4. Graph of behavioral interactions of birds across four sites with the use of an ethogram.

Analysis

Across the Bronx Zoo's four study sites, bird abundance, diversity, and behavior varied noticeably with habitat conditions. The River site, with its moderate vegetation (3) and very low human disturbance, hosted the highest number of birds of over 555 individuals recorded and greatest species richness of 34. Asia Woods also supported high numbers (201 individuals) as this site was the most densely vegetated (level 4) and lowest in noise levels (51.2 dB) but had only 14 species. Moreover, Asia Swamp despite having similar vegetation levels to the River site (level 3) and low human disturbance. This site however had the fewest individuals of 165 and species richness of 19. In contrast, the Bison Walkway had moderate vegetation (level 3) and high human activity but had low species richness of 15 and 291 individuals.

Behavioral observations also varied by site. The River site had high frequency neutral behaviors such as foraging and flocking. While, more aggressive behaviors like chasing and fighting were more frequent at the Bison Walkway, Asia Woods, and Swamp.

Discussion

These results partially support the hypothesis that sites with greater vegetation cover and lower human disturbance would have higher bird abundance. The River site demonstrated both the highest abundance and species richness, aligning with our hypotheses. These results are consistent with other studies where they found higher diversity and abundance with lower levels of human disturbance and vegetation complexity. (Minor, et al.2015). However, Asia Woods, despite having the densest vegetation and lowest noise levels, had fewer total individuals and species richness than the River site. This suggests that vegetation alone does not always determine where and how many bird species can be found (Cody, 1981).
The hypothesis that higher human activity and noise would negatively correlate with species richness was also supported. The Bison Walkway had the highest human disturbance and relatively low species richness and abundance. Other studies have gotten similar results and found that noise pollution has been a factor that's been associated with declining bird densities(Francis et al., 2009).

Finally, behavioral data supported the hypothesis that less disturbed and vegetation-rich sites would show more neutral interactions such as foraging. The River site and Asia Woods both displayed frequent foraging and resting behaviors. On the other hand, the Bison Walkway exhibited more chasing and fighting. This aligns with studies showing that increased disturbance can alter species interactions and even indirectly affect a wide-range of organisms and processes (Francis et al., 2009).

This project had a few limitations that occurred during field work. This included the missing sound meter during site rotations, since only one of the devices could be used at a time. Also, was the possibility of double counting the birds we may have already marked down. Moreover, the challenges of finding birds that were heard and not seen. With this it could've caused inflated data. The last limitation was starting some counts at different times, causing it to affect our consistency.

These results suggest that the variation in microhabitats within the Bronx Zoo significantly impacts avian diversity, abundance, and social interactions. This highlights the importance of preserving green spaces to maintain urban bird communities. Future research can look into how wild birds in the Bronx Zoo interacts with the broader environment in regards to varying habitat characteristics including foraging space and potential food sources.

Acknowledgements

We would like to thank Fordham University, the Pinkerton Foundation, the Wildlife Conservation Society, Max Falkenberg, Lowell Iporac, and Brian Saville for providing space for this program.

References

Animal Keepers' Forum (Vol. 46). (2019). In The Journal of the American Association of Zoo Keepers. https://www.aazk.org/wp-content/uploads/Songbird-2019.pdf#page=29
Ferrarini, A., Bagni, L., & Gustin, M. (2025). Bird richness and Abundance in Urban Areas: Simulation-Based Conservation Strategies for an Italian Town. *Biology*, *14*(1), 37. https://doi.org/10.3390/biology14010037
Francis, C. D., Ortega, C. P., & Cruz, A. (2009). Noise pollution changes avian communities and species interactions. *Current Biology*, *19*(16), 1415–1419. https://doi.org/10.1016/j.cub.2009.06.052
Gray, A., Doyle, S., Doyle, C., Young, J. C., & McMahon, B. J. (2023). Birds and human health: Pathways for a positive relationship and improved integration. *Ibis*, *166*(3), 761–779. https://doi.org/10.1111/ibi.13290
Habitat selection in birds: the roles of vegetation structure, competitors, and productivity. (1981, February 2). https://academic.oup.com/bioscience/article-abstract/31/2/107/223759
Silva-Ortega, M., Muñoz-Pacheco, C. B., & Villaseñor, N. R. (2023). Abundance of Non-Native Birds in the City: Spatial Variation and Relationship with Socioeconomics in a South American City. *Animals*, *13*(11), 1737. https://doi.org/10.3390/ani13111737
Stevens, T. K., Hale, A. M., & Williams, D. A. (2023). Environmental and anthropogenic variables influence the distribution of a habitat specialist (Sylvilagus aquaticus) in a large urban forest. *Conservation Science and Practice*, *5*(2). https://doi.org/10.1111/csp2.12882
Tietze, D. T. (Ed.). (2018). Bird species: How they arise, modify and vanish. In Natural History Museum Basel, *Fascinating Life Sciences*. https://library.oapen.org/bitstream/handle/20.500.12657/22941/1007220.pdf#page=240
WHO Regional Office for Europe. (n.d.). *Urban green spaces: a brief for action*. https://iris.who.int/bitstream/handle/10665/344116/9789289052498-eng.pdf?sequence=1