

Correlation Between Bird Composition and Noise Level

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RESEARCH QUESTION

How does anthropogenic noise affect bird diversity across the Bronx Zoo?
We hypothesize an inverse relationship between average noise level and average bird diversity across the sampling sites.
We also hypothesized an inverse relationship between average noise level and average bird richness across the sampling sites.

INTRODUCTION

Urbanization has resulted in an increase in acoustic masking—the process by which noise masks or reduces the distance that acoustic signals (noises made by animals) can travel (Parris and Schneider 2008). Birds use songs and calls to attract mates, defend territories, and keep from danger (Parris and Schneider 2008). Because birds communicate via acoustic signaling these animals are impacted by acoustic masking (Bayne et al. 2008, Goodwin and Shriver 2010, Parris and Schneider 2008). Goodwin and Shriver (2010) found that birds are less abundant in areas of high traffic noise (44-57 dB) and Parris and Schneider (2008) found that as traffic noise increases, the probability of detecting birds at a given site decreases due to loud noises interfering with the bird's ability to maintain its territory and attract mates.

We conducted our research at the Bronx Zoo campus in New York City. While the zoo is home to a number of bird exhibits like Birds of Prey and the Aquatic Bird House, the zoo is also similar to natural park areas in that there are wild birds such as the Red-winged Blackbird, the Great Egret, and the Canada Goose. All of our sampling sites were in the wild areas of the zoo, away from animal exhibits. The zoo campus (265 acres) is surrounded by urban neighborhoods and highways, which introduce anthropogenic noise that may affect wild bird distributions in the zoo. Our objective was to determine if there was a correlation between bird diversity and noise level at the Bronx Zoo.

METHODS

We conducted bird counts at seven sampling sites across the Bronx Zoo (Figure 4). At each sampling site, human conversations and vehicle traffic in the zoo could be heard. All sampling sites had dead leaf litter, high canopy trees, and a body of water. At each sampling site we conducted point counts following Bibby et al. (2000) with a 50-meter radius (Figure 3). We used field marks and vocalizations to identify birds. Point counts were 15 minutes long with a 5-minute wait period between time of arrival and the time the point count was started. During each point count we measured the maximum and minimum sound level with the Extech 407730 Sound Level Meter (Extech Instruments, Nashua, USA). To minimize an outlier effect of a random noise superfluously raising our maximum noise level, only the minimum noise level was taken into account during data analysis. Abiotic variables such as canopy cover, temperature and humidity were also collected, but they were not used in the data analysis. We varied the start time at each site so that by the fifth day, we had gone to each site both in the morning and in the afternoon. We collected data three days per week from July 13, 2016 through July 29, 2016. During our data analysis, we used the Simpson's Diversity Index to calculate the diversity of bird populations at each sampling site. The Simpson's Index of Diversity measures the probability that two individuals selected at random within the same site will belong to different species.

RESULTS

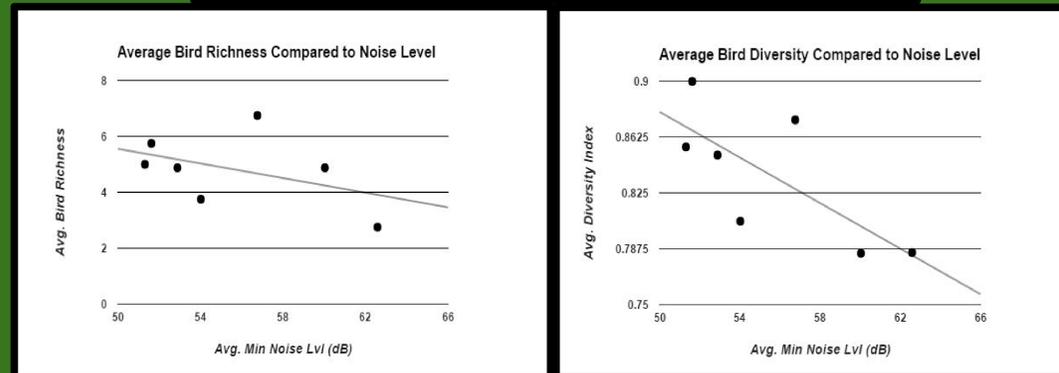


Figure 1. shows the inverse relationship between average bird richness and average minimum noise level in decibels (r=-0.4405).

Figure 2. shows the inverse relationship between the average diversity index and the average minimum noise level in decibels (r=-0.7369).

| Avg Noise Level (dB) | 51.63 | 51.31 | 52.89 | 54.03 | 62.59 | 56.76 | 60.04 |
|--------------------------|-------|-------|-------|-------|-------|-------|-------|
| Bird Species | B1A | B2A | B2B | B5A | B5B | B5D | B6A |
| American Robin | 15 | 7 | 8 | 18 | 5 | 13 | 33 |
| European Starling | 3 | 0 | 0 | 0 | 0 | 3 | 2 |
| Blue Jay | 15 | 2 | 10 | 3 | 4 | 12 | 14 |
| Red-winged Blackbird | 0 | 0 | 0 | 0 | 0 | 17 | 0 |
| House Sparrow | 10 | 0 | 2 | 1 | 0 | 22 | 4 |
| Common Grackle | 6 | 4 | 7 | 3 | 6 | 35 | 5 |
| Gray Cat Bird | 16 | 17 | 18 | 17 | 8 | 18 | 15 |
| Song Sparrow | 0 | 2 | 10 | 0 | 4 | 6 | 0 |
| Downy Woodpecker | 4 | 3 | 1 | 1 | 1 | 2 | 2 |
| Red Bellied Woodpecker | 1 | 0 | 1 | 1 | 0 | 0 | 2 |
| Spotted Sandpiper | 0 | 0 | 0 | 3 | 0 | 1 | 0 |
| White Breasted Nuthatch | 0 | 0 | 2 | 0 | 1 | 4 | 1 |
| Baltimore Oriole | 0 | 5 | 0 | 0 | 0 | 0 | 0 |
| Great Egret | 0 | 2 | 0 | 0 | 1 | 0 | 0 |
| Mallard | 1 | 5 | 1 | 4 | 2 | 0 | 0 |
| Peafowl | 5 | 5 | 2 | 1 | 0 | 0 | 0 |
| Cardinal | 11 | 0 | 0 | 0 | 0 | 1 | 2 |
| Mourning Dove | 0 | 0 | 0 | 0 | 1 | 5 | 0 |
| King Bird | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Great Blue Heron | 0 | 3 | 2 | 0 | 0 | 0 | 0 |
| Wood Duck | 0 | 1 | 6 | 0 | 0 | 3 | 0 |
| Double Crested Cormorant | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| Canada Goose | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| Scarlet Tanager | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Unidentified | 20 | 15 | 23 | 14 | 19 | 20 | 16 |
| Total | 107 | 73 | 93 | 67 | 53 | 162 | 96 |

Table 1: Bird Composition among sampling sites

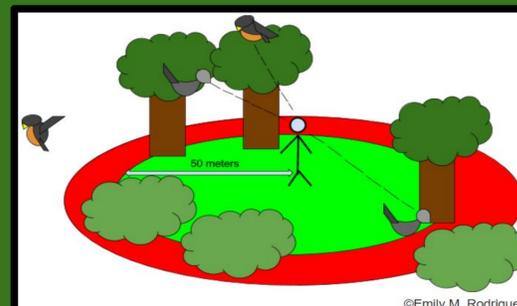


Figure 3: Example of the bird point count sampling structure



Figure 4: The Bronx Zoo with the seven point count locations (B1A, B2A, B2B, B5A, B5B, B5D, B6A)

DISCUSSION

In total we conducted eight point counts for each sampling site and identified a total of 24 species and observed a total of 651 Individuals (Table 1). The results indicate that the American Robin, Gray Catbird, Common Grackle and Blue Jay were fairly abundant at all noise levels at all sites. These birds may suffer less from acoustic masking or they may be better adapted to the anthropogenic noises at the Bronx Zoo. By contrast, the Baltimore Oriole, King Bird, and Great Blue Heron were only observed a few times and at sites with lower noise level which may mean that they suffer from acoustic masking (Table 1). We only found the Red-winged Blackbird at site B5D, suggesting that this may be its only nesting area at the zoo. It may also be because this site had high abundance and high diversity compared to other sites. Site B5D had the highest bird abundance, with a total of 162 birds and an average minimum noise level of 56.76 dB (Table 1). The noise level at the site was the third highest among all sampled sites. Sites B5B and B6A were the noisiest sites with 62.59 dB and 60.04 dB respectively. Site B5B was also the least abundant with only 53 bird identifications. We observed an inverse relationship between the average minimum noise level and the average bird diversity (Figure 2). We also observed inverse relationship between the average minimum noise level and the average bird richness (Figure 1). The findings supports the initial hypotheses that as noise level increases, so does bird richness and diversity. We conclude that as urbanization and anthropogenic noise increase, more acoustic masking occurs which forces more birds out of their native habitats.

REFERENCES

- Bayne, E. M., Habib, L., & Boutin, S. (2008). Impacts of chronic anthropogenic noise from energy-sector activity on abundance of songbirds in the boreal forest. *Conservation Biology*, 22(5), 1186-1193.
- Bibby, C. J., Burgess, N. D., Hill, D. A., & Mustoe, S. H. (2000). *Bird Census Techniques*. (Academic Press: San Diego, CA).
- Goodwin, S. E., & Shriver, W. G. (2011). Effects of traffic noise on occupancy patterns of forest birds. *Conservation Biology*, 25(2), 406-411.
- McKinney, M. L. (2002). Urbanization, biodiversity, and conservation the impacts of urbanization on native species are poorly studied, but educating a highly urbanized human population about these impacts can greatly improve species conservation in all ecosystems. *BioScience*, 52(10), 883-890.
- Parris, K. M., & Schneider, A. (2009). Impacts of traffic noise and traffic volume on birds of roadside habitats. *Ecology and society*, 14(1), 29.
- Rollfinke, B. F., & Yahner, R. H. (1990). Effects of time of day and season on winter bird counts. *Condor*, 215-219.

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