

# Exploring the Effects of Urbanization on Small Mammals

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## Introduction

- Rapid urbanization is a force that is changing the composition of the NYC mammal community. As urbanization increases in an area, mammal diversity decreases. This is largely because urbanization results in loss of vegetation, degradation, fragmentation of habitats, and exposes mammals to a higher degree of human interaction than they are used to.<sup>1</sup>
- The important ecosystem roles of small mammals include pollinators and seed dispersers, which increases plant diversity, in addition to supporting forest regeneration, and maintaining insect populations. In the long run, small mammals are also indicators of climate, biodiversity, and ecosystem change.<sup>2</sup>
- Flight initiation distance (FID) is a helpful tool for urbanization research because it indicates an animal's, in this case a squirrel's, level of habituation to humans.<sup>3</sup>
- Population growth, which is intertwined with urbanization, is a major cause of pollution. Water pollution, in particular, increases the nitrate and phosphate content in the water, which disrupts the food and habitat resources of mammals in the environment.<sup>4</sup>
- Our project, in which we observe these mammals' environments and their responses to urban factors, is an important indicator of the prominent impacts of urbanization on mammal life.

## Research Questions & Hypotheses

**Research Question: What are the effects of urbanization on the behavior and species richness of small mammals?**

**Hypothesis:** Growing urbanization has made urban mammals less sensitive to human presence and decreases species richness.

**Does high adjacent population density have negative effects on water quality in NYC parks?**  
**Hypothesis:** An area with higher adjacent population density will have higher pollution runoff into water sources, and, therefore, lower water quality.

**How is water quality correlated with the mammal species richness of an area?**

**Hypothesis:** As quality of water sources increases, an area will have higher species richness.

**How does urbanization affect the flight distance of squirrels?**

**Hypothesis:** Flight distance will be lower in more urban parks and higher in less urban parks.

**How does urbanization affect the distance a squirrel flees to a refuge after flushing?**

**Hypothesis:** In less urban parks, squirrels will seek refuge farther away than in more urban parks.

**What is the effect of ambient sounds on the flight distance of squirrels?**

**Hypothesis:** Ambient sound will increase flight distance in squirrels.

## Methods

### Urbanization Gradient

- We selected five NYC parks according to their adjacent population density.<sup>5</sup>
- Most to least urban: Riverside Park, Central Park, Highbridge Park, Inwood Hill Park, and Pelham Bay Park.

### Track tubes

- We placed two track tubes at each site.
- We baited with oats and left the track tubes for a maximum of 48 hours before collection and analysis.
- We used a track ID book to identify species.

### Camera Traps

- We placed motion-sensored camera traps at each site baited with peanut butter and oats.

### Water Quality

- We used Lamotte kits to measure phosphates, nitrates, and pH.



Fig. 2: Student measuring flight initiation distance

### Flight Distance

- We walked steadily toward squirrels with hands behind our backs until squirrels flushed.
- We then recorded the distance at which the squirrel flushed and the distance to the refuge to which the squirrel ran.
- For a subset of squirrels we projected various sounds using a handheld speaker behind the observer's back.



Fig. 1: Map of NYC sites

## Results



Fig. 3: Raccoon destroying track tube (Inwood Hill Park)

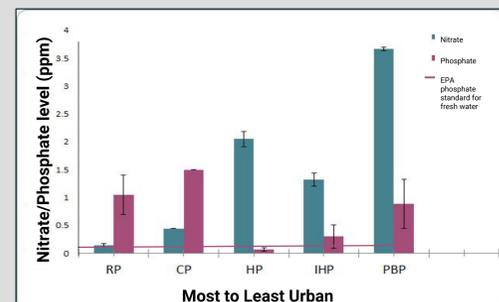


Fig. 5: Relationship of nitrate and phosphate levels to urbanization gradient. Error bars are standard error.

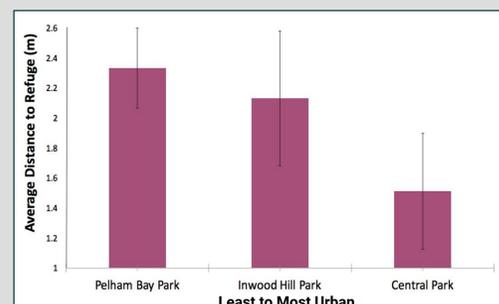


Fig. 7: Relationship of distance to refuge to urbanization gradient. A negative correlation between urbanization and flight distance was observed. Error bars are standard error.

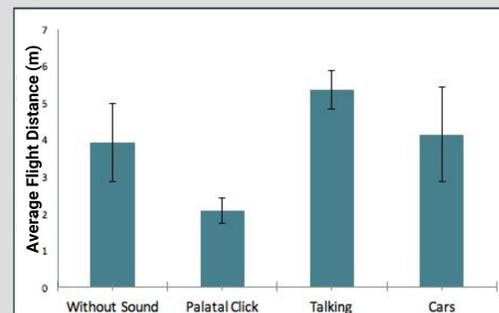


Fig. 9: Relationship of ambient sound to flight distance. FID without sound was observed to have to lowest average flight distance, except for the palatal click. Error bars are standard error.



Fig. 11: Eastern Gray Squirrel (Riverside Park)



Fig. 12: Possum (Inwood Hill Park)



Fig. 13: Skunk (Inwood Hill Park)



Fig. 4: Deer (Pelham Bay Park)

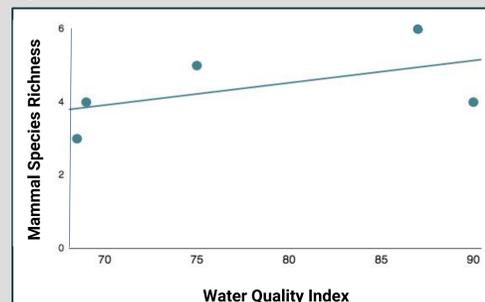


Fig. 6: Relationship of mammal species richness to water quality index.<sup>6</sup> A weak positive correlation is shown between the two variables;  $R^2 = 0.29$ .

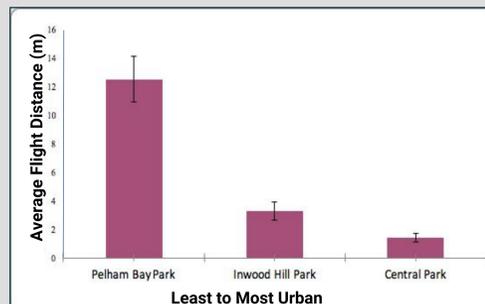


Fig. 8: Relationship of flight distance to urbanization gradient. A negative correlation between urbanization and flight initiation distance was observed. Error bars are standard error.

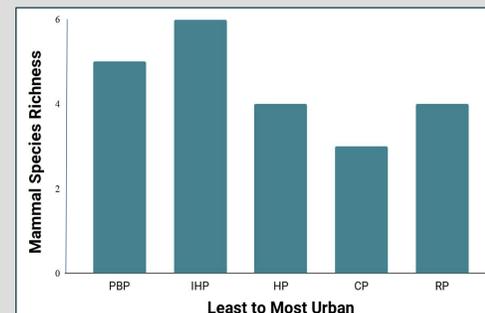


Fig. 10: Relationship of mammal species richness to levels of urbanization. Overall, a negative trend was observed between growing urbanization and mammal species richness.

## Conclusion

### Water Quality:

The nitrate content in the water generally increased as the parks became less urban, which **did not support our hypothesis**. The phosphate content in the water generally decreased as the parks became less urban, which **did support our hypothesis** (Fig. 5). The EPA water quality criteria states that phosphates should not exceed .076 mg/l to control algal growth.<sup>7</sup> The phosphate levels at Riverside, Central, Inwood Hill, and Pelham Bay parks all surpass this level by large amounts. In addition, there is a weak positive correlation between species richness and water quality (Fig. 6), **supporting our hypothesis**, and showing that an area with better water quality supports a larger variety of mammals, and is therefore beneficial to the ecosystem overall.

### Flight Distance:

Between the three parks where FID trials were conducted, as urbanization increased the flight distance of squirrels and distance to refuge decreased, which **supported our hypothesis** (Fig. 7 & 8). In Central Park, the most urban site, squirrels had the lowest FID and traveled the least for refuge. In Inwood Hill Park, two locations were observed. The exterior location, which was more heavily traveled, had squirrels with lower FID than inside the forested areas, which supports our claim that human presence can influence mammal behavior. Pelham Bay Park was the least urban on our gradient and the FID and refuge were significantly higher. Our data indicates that growing urbanization may impact mammal behavior by increasing their habituation to humans.

The average flight distance was observed to increase with the use of ambient sound, which **supported our hypothesis** (Fig. 9). In addition, the car noise had only a slight increase in flight distance compared to trials without sound. This supports the idea that urbanization is affecting mammal behavior, as urban squirrels are less startled by the loud noise of cars. Our data showed that squirrels in Pelham Bay and the forested areas of Inwood Hill Park are less accustomed to the sound of people. However, both of these sites are near major roadways where car sounds are likely to be heard. The palatal click showed the lowest flight distance when compared to trials of other sounds and no sound. This sound, which humans often make at animals as they approach them, further supported the influence of urbanization on mammal behavior. The squirrels were shown to not be as startled during these trials and paid more attention to the observer, potentially awaiting a reward of food in highly urbanized parks such as Central Park.

### Mammal Species Richness:

When comparing mammal species richness along an increasing urbanization gradient, a negative correlation was observed, which **supported our hypothesis**. This shows that there are less mammal species in environments surrounded by a higher density of people. This may be because humans are depleting needed aspects of mammals' habitats, which leaves only a few species able to adapt to an urban world. As urbanization continues to increase, this could be limiting to more mammal species and cause the endangerment of a higher number of New York City's mammals.

## Future Research



Fig. 14: Common Gray Fox<sup>8</sup>

Future research could observe other aspects of these mammals' environments, including the surrounding trees and soil. It's also important to note the size of their habitats, and determine if these parks are a large enough area for these mammals. Research can also look into the predator-prey relationships of various mammal species in these parks. Research like this is the first step in taking measures to help protect mammals in urban parks.

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