



CLICKBAIT: A SURVEY OF MAMMAL DIVERSITY AND DETECTION RATE IN A LARGE URBAN PARK

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Introduction

As cities drastically alter the environment, they present new challenges and opportunities for wildlife. Compared to their rural counterparts, some urban species are able to exploit the niches and resources provided by humans and a relative scarcity of predators. The continuing fragmentation of landscapes caused by urbanization may shift mammal distribution patterns, as animals that thrive in urban settings develop a selective advantage over other species.^[1] Along an urbanization gradient, overall species diversity or variety decrease as urbanization levels increase, however the profusion of species that are well-adapted to urban environments, such as raccoons and squirrels, increase because they have learned to live alongside humans.^[2] In this study, we sought to understand how the detection rate and species diversity of mammals in an urban context is influenced by naturally occurring factors and anthropogenic pressures, which we defined as factors resulting from human activities. Animals naturally select patches that have the greatest concentration of prey/food or that are most lucrative to them.^[3] We also conducted tests to see if the use and type of bait used at camera trap sites had an impact on the frequency with which mammal species were detected.

All studies were conducted across three sites/patches in the Bronx Zoo. We defined a site as a piece of land surrounded by some sort of natural or man-made boundary. Site 1 is a forested patch located in the south-east portion of the Zoo, near an animal exhibit and a swamp. Site 4 is surrounded with several human interactions like paths, trash cans, buildings, a dam, etc. Site 7 is our largest site located in the Riverwalk just outside the zoo. Since it is the largest, we divided it into 3 sections named 7A, 7B and 7C. Site 7 has the least human interactions. Understanding the factors that affect an urban mammal's selection of patch may be useful in addressing human-mammal interactions in urban environments and estimating mammal behavior related to space utilization. By doing so, several human-mammal conflicts resulting from the exponential growth of urbanization may be avoided, and more natural spaces may be preserved for urban mammals.



Methods

Camera Trap Procedure: Camera traps were utilized to investigate our hypothesis since they are a non-intrusive technique for gathering data that usually result in little to no disturbance to the target species. Furthermore, camera traps can be left unattended in the field for several days, and thus are ideally suited for studying shy, nocturnal or crepuscular animals that avoid humans or that are otherwise difficult to study (e.g. animals with large home ranges, low abundance or secretive habits).^[5] Five infrared camera traps were placed across 3 different locations within and near the Bronx Zoo. Camera traps were installed out of public view, and affixed to a tree at ground level. Camera traps were set to capture three consecutive photos in response to motion and were left undisturbed for 24-72 hours. Footage was then retrieved after this and camera traps were reset to their original position.

Track Tube and Bait Procedure: Track Tubes were used to assist us in identifying the mammals that were lured in by the bait via the footprints they leave behind. Two out of the three camera traps received bait treatments: one was treated with sardines, and the other was treated with an oat and peanut butter mixture. All bait was placed in a mesh trap directly in front of the camera trap. Track tubes were only installed at two camera trap sites in the Riverwalk during the second and third weeks of data collection. Track tubes were placed directly in the line of sight of the camera traps; after 24 hours, they were photographed, bait was replaced and the procedure was repeated for two weeks.

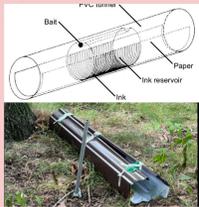


Photo Analysis Procedure: For every photo of interest, the mammal species were identified, and the number of occurrences of each species was counted. Image name, date and time of image capture, the site it was captured in and whether or not bait was present were recorded.

Measuring Environmental Variables: Average canopy cover of each habitat patch was measured using a spherical densiometer and by following procedures outlined by Strickler, 1959.^[4] The boundaries, perimeter, and area of each patch was determined using Google Maps. To establish how much of the habitat perimeter was influenced by anthropogenic elements, the length of boundaries surrounded by man-made things to natural factors was computed.

Estimating Human Food Waste: The amount of human food waste accessible at each habitat patch was estimated by measuring the distance to the nearest human "food hub" (an area where food is sold or has a higher density of trash cans and/or a certain amount of seating space).



Research Questions & Hypotheses

- Does the area of a habitat patch affect the species diversity and detection rate of mammals at different sites?**
 - Hypothesis 1 - Sites with a larger area will show both a higher diversity in species and detection rate of mammals compared to sites with a smaller area.
- Does the length of anthropogenic boundary versus natural boundary surrounding a habitat patch affect the diversity and detection rate of mammals at different sites?**
 - Hypothesis 2 - Sites with lower levels of anthropogenic boundaries will have higher levels of mammal diversity and detection rate, and more occurrences of tertiary consumers (such as red foxes and eastern coyotes) than sites with higher levels of anthropogenic boundaries.
- Does the use of bait and the type of bait used affect the detection rates of wild mammals that visit camera traps in a forested area in an urban park?**
 - Hypothesis 3 - Baited camera traps will have higher detection rates of mammals than non-baited (control) camera traps.
 - Hypothesis 4 - Oats and Peanut Butter will attract more primary consumers and sardines will attract secondary and tertiary consumers.

Results

Table 1	Area (sq m)	Perimeter (m)	Percent Habitat Boundary (%)	Percent Non habitat Boundary (%)	Percent Canopy Cover (%)	Distance to Nearest Food Hub (m)
4	8286.18	425.06	0	100	91.67	104.83
7	20313.03	786.51	57.5	42.4	84.6	432.81
1	4157.77	276.01	38.3	61.7	81.55	391.55

Table 1 summarizes the total perimeter of each habitat patch, the area, and the percentage of perimeter surrounded by anthropogenic (such as paths, parking lots, and fencing) vs. natural (such as rivers and adjacent habitat) boundaries.

Figure 1



Figure 1 depicts some footprints of the mammals detected at site 7 when track tubes were placed and baited.

Figure 2



Figure 2 shows images of some of the mammals detected on camera traps after bait was introduced.

Figure 3

Total Mammal Detections Across all Sites

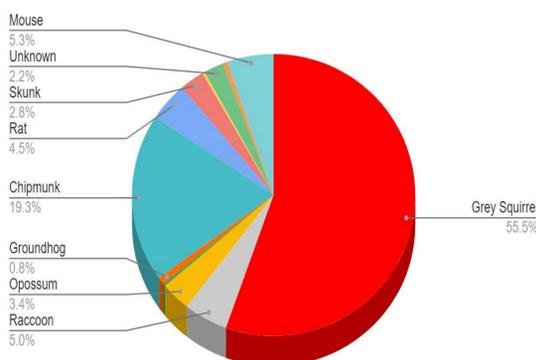


Figure 3 portrays the total diversity and detection rate of all mammals detected at all sites

Figure 4

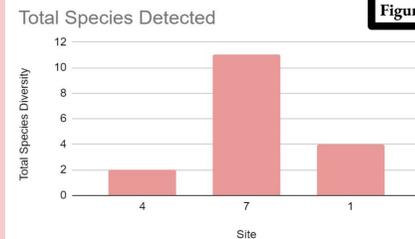


Figure 4 shows species diversity at each site

Figure 5

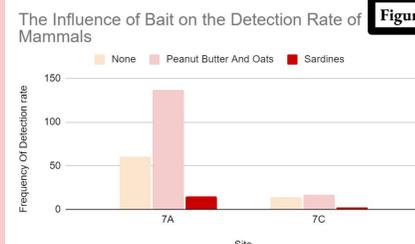


Figure 5 illustrates the changes in mammals diversity when different types of bait was introduced at Site 7

Analysis

As predicted, we found that urban mammals prefer to live in habitat patches that are characterized with both a large area and a significant amount of natural factors. As depicted in **Figure 3**, 64.7% of all the species that were detected were found at Site 7 likely because this habitat patch reflected these attributes. However, even with a vast area and several natural features, the amount of human disturbance at a site can also influence the presence of a mammal species. For example, Site 4 is our second largest patch, with a 91.67% canopy cover, making it the site with the most forest cover. Nevertheless, this patch is also completely surrounded by anthropogenic boundaries including an animal exhibit, a dam, human paths/roads, and other human disturbances such as loud speakers, lights, and tours. We think these are the main factors explaining why only two out of the eleven total mammal species were detected here. On the other hand, we detected four out of the eleven mammal species at Site 1, despite it being the smallest site. We believe that since Site 1 was surrounded by 38.3% natural boundaries, it was more favorable for mammals than Site 4. All in all, our hypothesis that sites with larger areas will be positively correlated with the detection rate of mammals was supported, but we also learned that the amount of human interaction at each site also influence the detection rates of mammals despite the size of the patch. Meaning that our second hypothesis that sites with lower levels of anthropogenic boundaries will be negatively correlated with the detection rate of mammals at each site was fully supported.



A map of all our study sites

Over the course of this research project, only sites 7A and 7C were baited; 7B was left undisturbed as our control. In the second week of our data collection, we placed a peanut butter and oat mixture at site 7A, and a frozen-and-thawed sardine at Site 7C in order to investigate if different types of bait influence mammal diversity in an urban environment. On the third week of data collection, the bait treatments at each site were switched. We found that the sites treated with peanut butter and oats attracted more mammals, both in number of detections and number of different species, compared to sites treated with sardines. While site 7 already proved to have a higher level of species diversity, the detection rate of mammals at this site increased 124.9% when peanut butter and oats were introduced. Conversely, the detection rate of mammals decreased 111.28% at each subsite when they were treated with sardines. The mammal species diversity mainly remained the same at the control site, 7B.

Discussion

Our research leads us to the conclusion that urban mammals prefer habitat patches that allow them to live separately from humans, despite the fact that they may be dependent on certain human resources for survival. We can also draw the conclusion that urban mammals move across sites in search of elements that are advantageous to them, such as preferable food options.

If we were to provide more natural spaces in heavily urbanized areas, the interaction between humans and mammals would most likely decrease. This could help avoid negative interactions between humans and pest animals, decrease the risk of zoonotic disease transfer, and minimize human disturbance on wild mammal populations. An increase in suitable habitat in urban areas would provide shelter and more food resources for mammals living in urban environments. In our study we noticed that at our site at the Riverwalk (site 7), we caught a higher mammal diversity than we did in the other sites that lie within the zoo. From this, we can predict that mammals will select the larger, more uninterrupted spaces over other patches, like the sites in the zoo that are a product of low habitat connectivity and a high amount of human interactions.

A suggestion for future research is to investigate how urban mammal behaviors are influenced by their choice of habitat patch, if the diversity of medium-sized carnivorous and omnivorous mammals differ among sites with varying levels of human food waste, and if there is a difference between the functional diversity of mammals at different sites of the Bronx Zoo based on shade cover and habitat connectivity.

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