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Effects of Urbanization on Wild Small Mammal Species Richness in the Bronx Zoo

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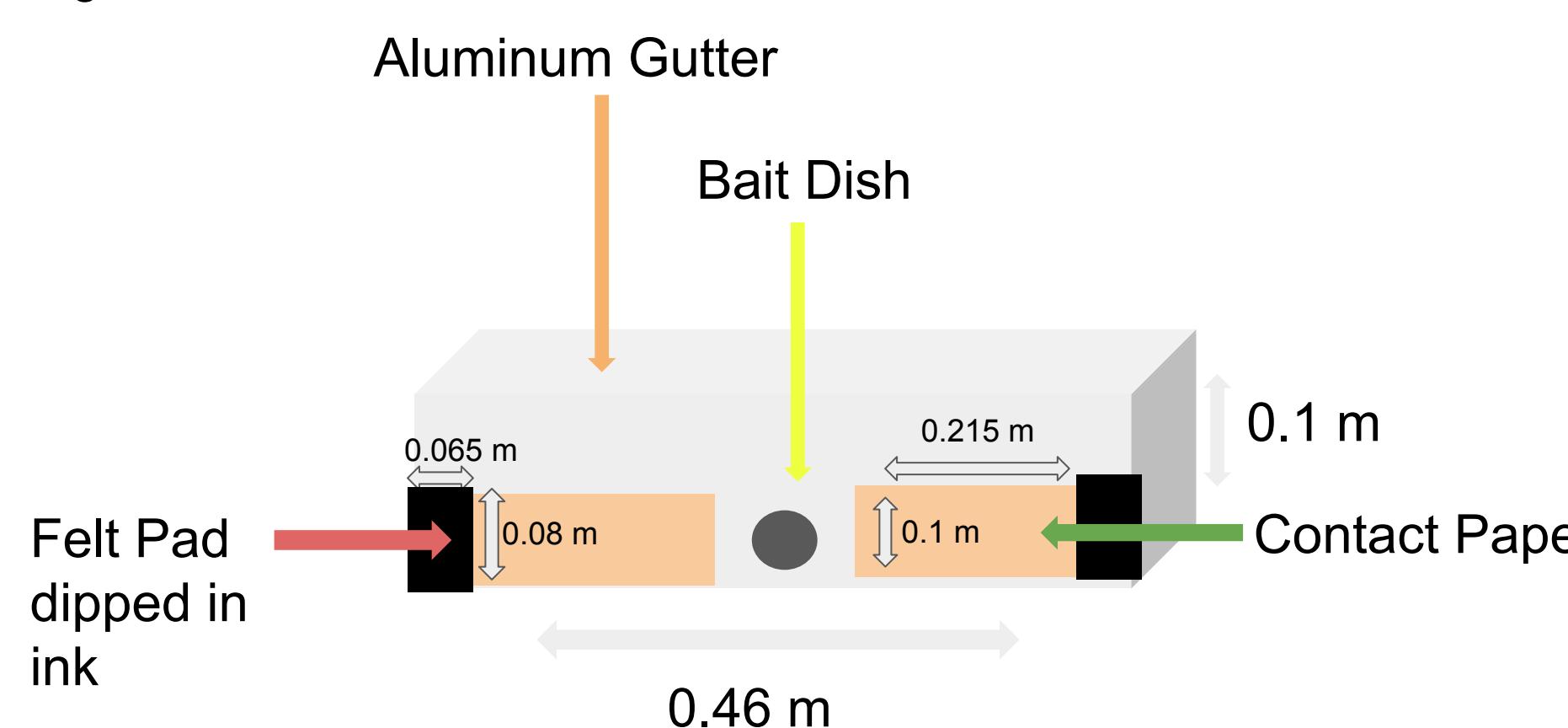
INTRODUCTION

- Small mammals are crucial components of both urban and natural environments. Their roles include seed dispersal, seed predation, maintaining balance in an ecosystem by regulating insect and plant populations, and supporting other species as prey (Hull Seig, 1987).
- Increases in construction of impervious surfaces due to urbanization may result in habitat loss and fragmentation for small mammal species (Mckinney, 2008). However, urbanization can increase biodiversity through the importation of nonnative species and provides additional food sources (Mckinney, 2008).
- In areas with moderate levels of urbanization studies on species richness have shown inconclusive results for vertebrates (Mckinney, 2008). Other studies have shown that species richness decreased with an increasing amount of human disturbance and increased with high levels of vegetation (Mahan & O'Connell, 2005).
- We used track tubes to study the small mammal species richness in habitats across the Bronx Zoo in Northern New York City (Fig 1). Track tubes are a good way to measure species richness because they are inexpensive, non-invasive, and can reduce risk of disease exposure to researchers (Glennon et al., 2002).

METHODS

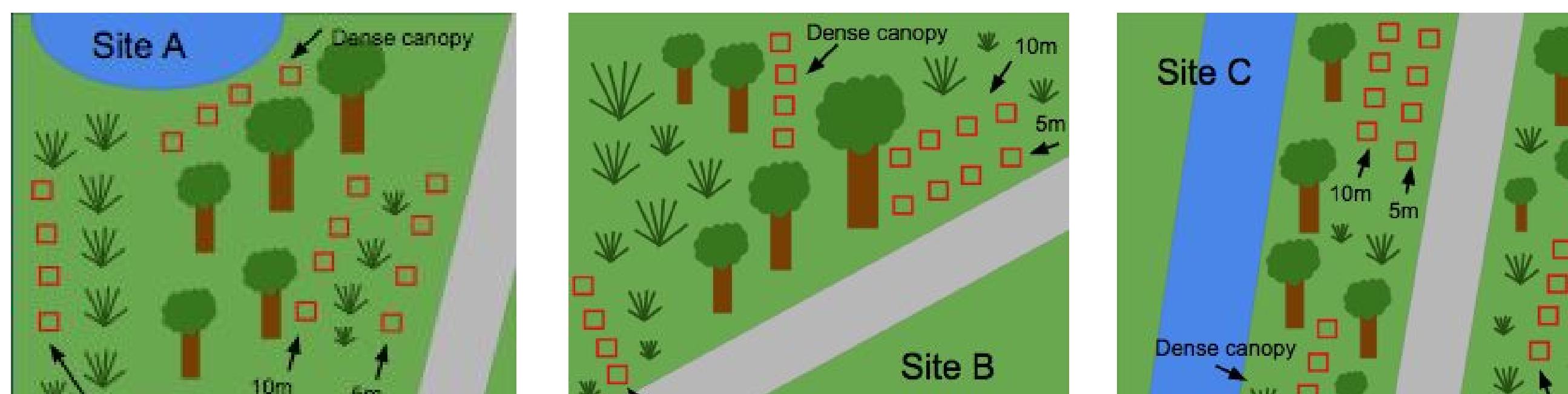
- We placed four track tubes under the open canopy at each site and four track tubes under the dense canopy at each site (Fig 2). Additionally, we placed four track tubes 5 meters from a road at each site and four track tubes 10 meters from a road at each site. Track tubes were spaced 2 meters apart. We put out track tubes on July 13, 2016 and collected track every two days for 17 days.

Figure 2. Track tube construction



- We used two kinds of bait: peanut butter/oatmeal and birdseed. Approximately one teaspoon of bait was placed in a container in the center of each track tube. Baits were used alternatively at each site.
- We used a spherical densitometer to measure canopy cover. We defined an open canopy as a canopy that had 20% or less canopy coverage and dense canopy cover as a canopy that had 80% or more canopy coverage.
- We identified the tracks using Elbroch (2003), Murie & Elbroch (2005), and Halfpenny (2008). In assessing richness and encountered species we did not count species that we deemed to be unidentifiable as not to double count for already found species in a given track tube. We counted unknown species when calculating species detection.

Figure 1. Habitat descriptions, Bronx Zoo

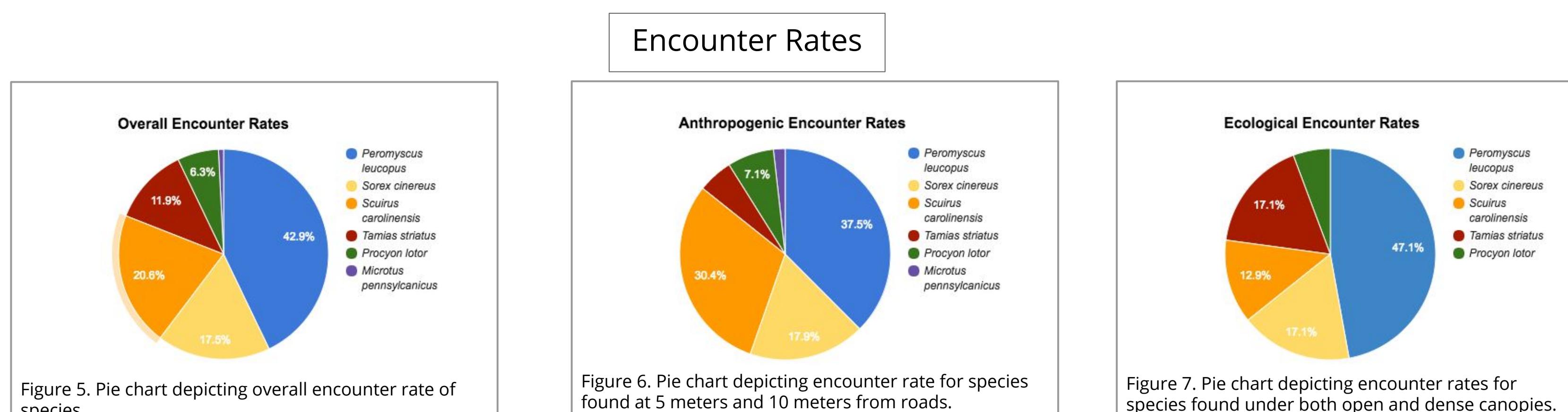
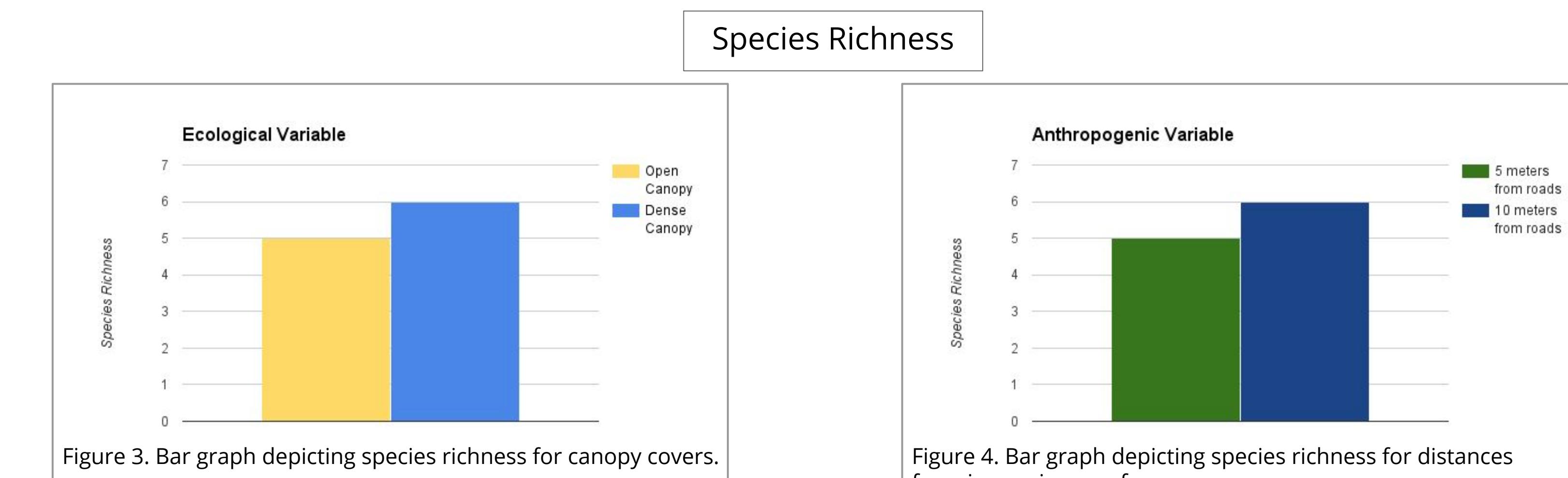
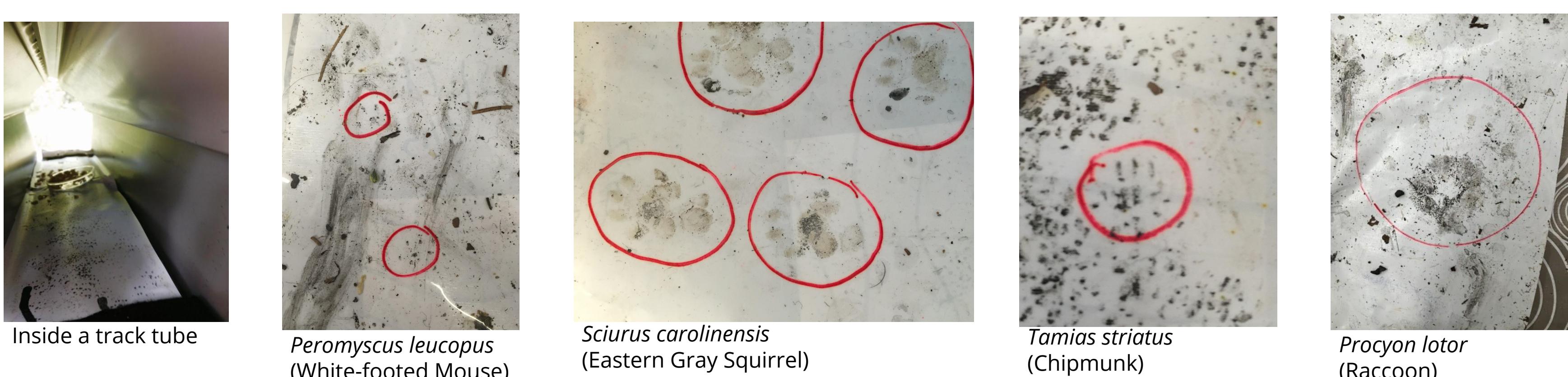


- Are ecological characteristics, particularly different types of canopy cover, associated with mammal species richness?
- Do anthropogenic characteristics (distances from roads) influence small mammal species richness?
- Do different bait types influence track tube success?
- Which small mammal species are most commonly encountered in habitats across the zoo?

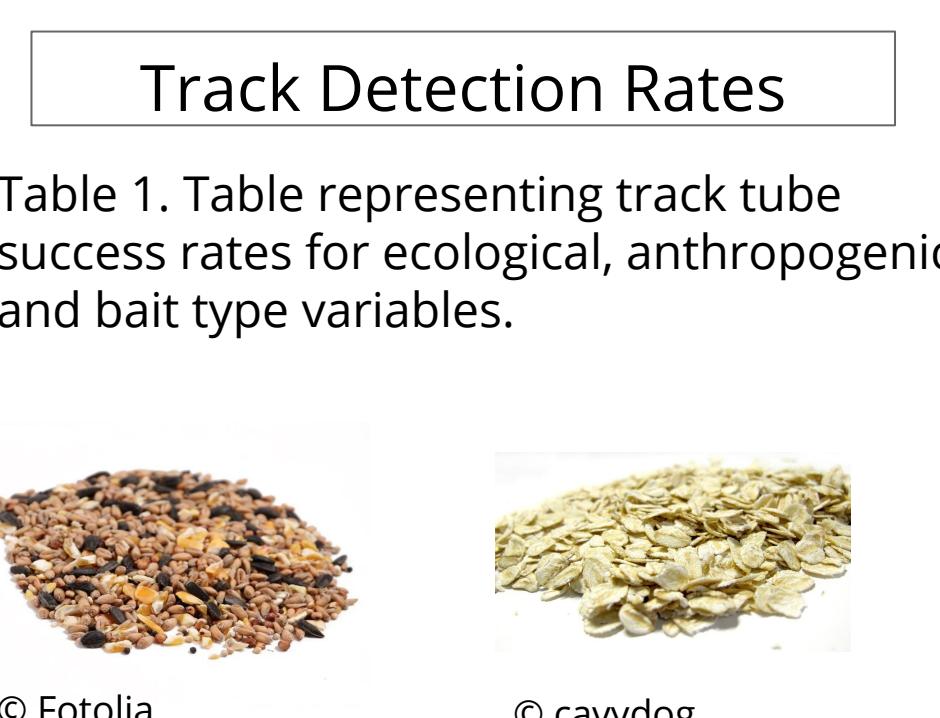
Hypothesis: We hypothesized that there will be greater species richness under dense canopies. We also hypothesized that there would be greater species richness 10 meters away from roads and that there will be greater detection rates when peanut butter and oats were used as bait. We hypothesized that we would most often encounter *T. striatus* (chipmunk).

RESULTS

We found tracks of *P. leucopus* (White-footed Mouse), *S. cinereus* (Shrew), *S. carolinensis* (Eastern Gray Squirrel), *T. striatus* (Chipmunk), *P. lotor* (Raccoon), *M. pennsylvanicus* (Meadow Vole) at all three sites. Species richness at open canopy sites was five while at dense canopy sites it was six species (Fig 3). Five meters from roads yielded a species richness of five while 10 meters yielded six species (Fig 4). There was no change in species richness between anthropogenic and ecological variables. In total, *Peromyscus leucopus* was the most common species encountered throughout the whole experiment (Figs 5-7). Species detection was highest for our ecological variable (96%) while anthropogenic was lower (80.3%) (Table 1). Species detection was highest when peanut butter and oats was used as bait rather than birdseed.

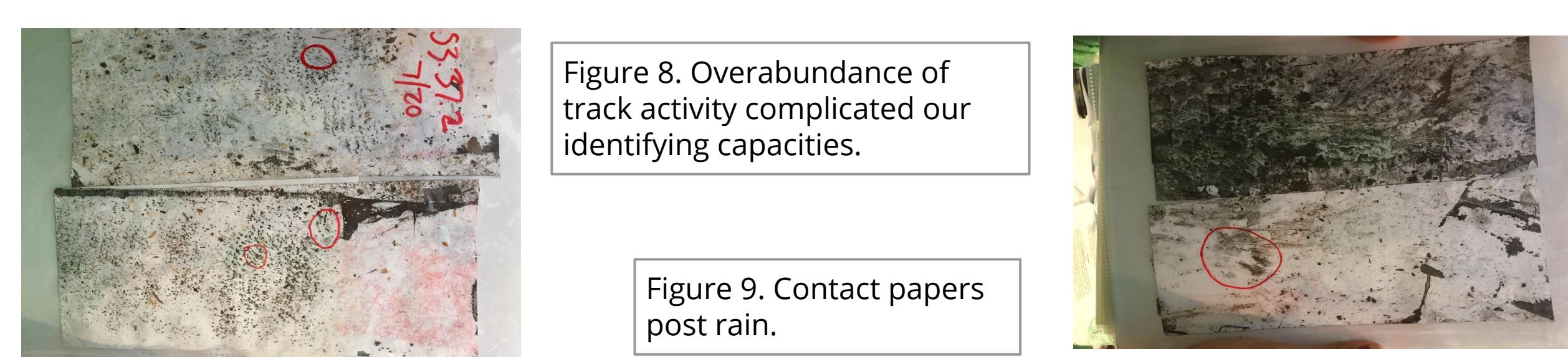


	Open Canopy	Dense Canopy	5 meters	10 meters	Birdseed	Peanut Butter & Oats
Track Success	25/25	24/25	22/28	23/28	18/29	76/79
Track Success Rate	100%	96%	78.5%	82.1%	62%	96%
Overall Success Rate	98%		80.3%			



DISCUSSION

- We predicted that we would find greater species richness under dense canopies and our findings were consistent with this hypothesis. Our results showed that species richness was greater in dense canopy cover than under open canopy cover. Carey and Johnson (1995) suggest that shrub and canopy covers are key determinants for small mammal abundance.
- We predicted that we would find greater species richness 10 meters away from roads and our findings were parallel to our hypothesis. This may be due to habitat fragmentation after impervious surface construction which may result in a decrease in species richness near these areas (McKinney, 2008).
- These results suggest that both ecological and anthropogenic factors significantly affect small mammal species richness in urban nature preserves.
- Other anthropogenic factors that may affect small mammal distributions in urban areas may be the presence of food resources provided by human activity. We predicted that we would have higher species encounters with peanut butter and oats and our results were consistent with this hypothesis. Small mammals in the Bronx Zoo may be accustomed to a diet of processed and sweet foods provided by the high levels of human activity and littering. Small mammals may be attracted to peanut butter and oats due to its pungent smell.
- We predicted that *T. striatus* would be the animal most encountered, but we found that *P. leucopus* was most common. High levels of urbanization and human activity may decrease numbers of medium sized predators therefore increasing the number of white-footed mice (Allan et al., 2003, Rosenblatt et al., 1999). A trend like this is highly likely in an urbanized area such as the Bronx Zoo.
- We encountered weather issues and constraints that limited our ability to identify tracks accurately (Fig 8 & 9).



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