

EFFECTS OF URBANIZATION ON NORTHEASTERN MAMMAL SPECIES: DUMPSTERS AS A FOOD SOURCE FOR NOCTURNAL OMNIVORES

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ABSTRACT

*The Purchase College Campus is home to a wide variety of species, all of which have adapted behaviors that developed over time with the increase of urbanization and habitat fragmentation in the Northeast United States. In particular, many species have not only learned to coexist with humans, but benefit from their presence as well, seeking anthropogenic food sources in garbage cans and dumpsters. In this article, we sought out 3 dumpster locations of which one might expect to find differing species and determined from these three locations the diversity of species as well as the individual count of animals that visited these sites. In six observation sessions spread out over the span of two weeks, we went out between the hours of 11:00 pm to 12:00 am and observed the sites, noting any animals that visited the dumpsters. Through this data collection, we found that 5 animals visited the Fort Awesome site, 10 visited The Hub site, and 6 visited The Olde site. The three observed species were the common raccoon (*Procyon lotor*), the striped skunk (*Mephitis mephitis*), and the Virginia opossum (*Didelphis virginiana*). We found that only raccoons and skunks visited For Awesome, all three species visited The Hub, and only skunks and opossums visited The Olde. After comparing this information, we concluded that more animals and a wider diversity of species gathered at The Hub due to the higher abundance of food available and the low levels of civilian traffic in the area.*

Keywords: Biodiversity, Dumpsters, Habitat Fragmentation, Nocturnal Species, Omnivore Populations, Purchase College, Species Adaptation, Urbanization.

INTRODUCTION

Over the past few centuries, humans have advanced to a degree that allowed their global population to grow at an unprecedented rate. Advances in science and medicine enabled mankind to spread across the globe resulting in deleterious effects on the world's ecosystems. Compared to other

habitat destruction directly manipulated by human interaction, the conversion of wildlife habitat into human settlements results in a permanent change (McKinney 2002). The Northeastern region of the United States in particular is the second most developed region in the country. This development comes at a cost as urbanization leads not only to direct habitat loss, but is also a precursor to the issues of habitat fragmentation.

Habitat fragmentation poses a huge threat to biodiversity and overall species health. The splitting of habitat connectivity into smaller, more isolated remnant-regions brings harm to all aspects of an ecosystem (Gibb et al. 2001). The equilibrium theory of island biogeography ties into this point as it proposes that a species living the mainland will be more successful than a species in an insular environment as it will have more open access to resources than an island can provide. The species richness of an insular environment relies heavily on the immigration and emigration of individuals from the mainland (MacArthur et al. 1963). The biodiversity patterns within fragmented urban environments show little interaction between individuals of these fragments therefore decreasing genetic diversity and overall population health (Gomes et al. 2011).

The Northeastern United States was once rich with a multiplicity of species that could potentially thrive in the varying environments of the region. When European colonists began exploiting the land for resources, they hunted the local wildlife, cleared forests, and displaced entire tribes of Native Americans (Ray 2000). This resulted in the extirpation of species such as cougars, wolves, and elk. Additionally, species that have been reduced significantly in the region include moose, lynx, and black bears (Merkle 2013). While this is the case for some, other species have adapted in response to human settlements. Specifically, some species including raccoons, skunks, opossums, coyotes, and bears have become adept at exploiting anthropogenic food sources. Most of these species are opportunistic generalists which can utilize food items left by humans in garbage dumps or other places like parking lots (DeStefano et al. 2003). Omnivorous and nocturnal lifestyles have proven successful to some species making it easier to acquire food by rummaging through dumpsters and trash cans at night, avoiding direct confrontation with humans while benefitting from their presence (Gehring 2003).

Purchase College was once rural, used mostly for farmland, before which it was a forest. Only in recent years has the land become a college campus (“Campus History to 1900”). This transition has resulted in the creation of many small, isolated forest habitats located around the campus’ center. The animals that occupy these forests have adapted due to human development, learning how to avoid contact, but benefit from the presence of humans. In suburban towns located near edge habitats or habitat fragments it is common for people to put cat food or bird seed outside of their house. In many cases however, this can draw unwanted attention in the form of striped skunks and common raccoons (Theimer et al. 2015). Another, unavoidable draw for these animals is the trash that people leave out before it is moved to a landfill. Many Northeastern mesopredator species have learned to scavenge for food from anthropogenic garbage sources (DeStefano et al. 2003).

The Purchase College campus is surrounded with small forest habitat fragments which are home to few mesopredator species observed in this study including, striped skunks, Virginia opossums, and common raccoons. This study sought to discover which dumpster out of three sites, Fort Awesome, The Hub, and The Olde, all of which differing in civilian traffic and trash composition, attracted the most animals and the greatest diversity of species. It was hypothesized that The Hub site would attract the greatest number and diversity of animals due to a perceived abundance of food in the area and the lack of human traffic between the edge of the habitat and the dumpster. It is important to know this information when approaching the complexities of conservation. While these species are viewed as pests, they are key to the ecosystems that they live and it is important for people to know why animals have gained certain behaviors in the presence of urbanization and habitat fragmentation when looking to the future.

METHODS

The entirety of the data collection was conducted through an observational study, requiring very few additional materials. Six observation sessions were spread out over a two-week period, from the 15th to the 29th of October 2017. The three sites had two, hour-long observation sessions over the two-week period, with one session at each site per week. The observation sessions lasted exactly 1 hour and were always conducted from 11:00 pm to 12:00 am. During a session, it was important to be situated in a location far enough away from the observation site as to not potentially frighten any nearby animals and deter them but also have clear visibility of the site. After recording our observations, we compared and developed graphs for our data using Microsoft Excel

Field Sites. The first site was the dumpster near the Olde apartment complex. This site appeared to have a lower concentration of food composition, however, it also has less human traffic possibly making it desirable. Site two was at a dumpster near Fort Awesome, here there was more estimated activity due to the dumpsters close proximity to a large living area and a Starbucks, the waste produced would add up to a steady supply of food for the animals. The Hub was the third and final site, due to the site being the dumpster for a dining area, it was estimated that there would be a wider variety of species due to an abundance of food waste supplied from the dumpster and the composter. This supply would almost certainly attract creatures looking for an easy meal (Prange 2004).



	Fort Awesome
	The Hub
	The Olde

Figure 1. Map of the Purchase College Campus marked with the locations of each field site.

Statistical Analysis. When recording and evaluating our data, we used Microsoft Excel, creating a table displaying the species that we found on each particular site during each observation session. To compare the collected data, we derived a bar graph which presents the differing abundance and diversity of animals based off of site location and week of each sighting.

Species Studied. The common raccoon (*Procyon lotor*) is a medium sized mammal characterized by its brownish-grey coloration and a patch of black fur surrounding both eyes forming a “mask”. They can reach up to thirty pounds, have large territories, and are known to be an aggressive species, capable of severely wounding humans and dogs (Owen et al 2017). They are a common site in suburban areas where they can utilize their high intelligence and manipulative hands to access food sources provided by humans (Prange et al 2004).

The striped skunk (*Mephitis mephitis*) is a small mammal of the *Mephitidae* family, which includes all other skunk species. Its black and white fur serves as warning coloration to ward off potential predators. It uses its anal scent glands to release a foul smelling gas when it feels threatened as an extra defense mechanism. Similar to raccoons it is commonplace to see them travelling through neighborhoods and backyards looking for food (Rudd et al).

The Virginia opossum (*Didelphis virginiana*) is the only marsupial native to the United States and like its Australian cousins it rears its young in a pouch. These cat-sized mammals are opportunistic omnivores that eat anything from seeds to bird eggs, making them highly adaptable in urban and suburban environments. However they require a natural water source to flourish (Fidino et al 2016). Despite their adaptability opossums are not considered an intelligent species and they do not have many defense mechanisms beyond playing dead. With a max lifespan of four years, opossums are enigmatic in their ability to compete with more well-adapted species like skunks and raccoons (Fidino et al 2016).

RESULTS

For the two weeks we studied, we only saw three species visit each site: the common raccoon (*Procyon lotor*), the striped skunk (*Mephitis mephitis*), and the Virginia opossum (*Didelphis virginiana*). At the Olde three skunks were spotted during week one and two skunks accompanied by a single opossum were spotted during week two. At Fort Awesome two raccoons were observed during week one, during the second week we observed one raccoon and two skunks. At the Hub we noted three raccoons, two skunks, and one opossum during the first week, during the second week we saw one raccoon, one skunk, and two opossums.

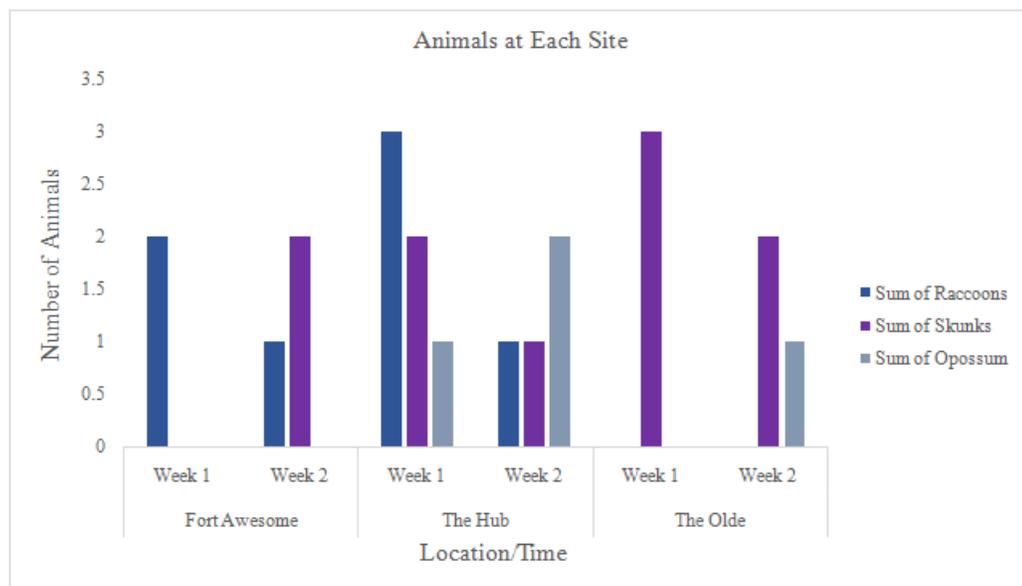


Figure 2: This graph shows the different species encountered and the number of individuals for each species that were observed during each week, at each location.

DISCUSSION

The purpose of this study was to determine the species diversity and abundance of nocturnal animals living in or near the Purchase College campus and what factors attract them to the school. Three study sites were chosen to best summarize the differing areas of the campus. These locations were based off of the amount of civilian traffic moving through the area and the possible food content that would likely be found in each area's respective dumpster (Prange et al. 2004). Based off of the data in *Figure 2.*, the Hub appears to have both the highest number individuals and the most diversity out of the three sites. The Olde had the next highest individual count and both The Olde and Fort Awesome had only two observed species.

Overall, the two main factors that seemed to influence species diversity and abundance the most were the compositions of the dumpsters and the levels of civilian traffic moving through the area. Fort Awesome was located close the edge of a habitat, but between the animals and the dumpsters is a path that is frequently passed through by students living in Fort Awesome. While observing this site, the raccoons and skunks seemed to be very weary of this and crossed the path individually while the others waited for their turn to go at the edge of the forest. There were no opossums observed at this site, suggesting that perhaps this species is less comfortable being under stress in a highly human populated area (Fidino et al. 2016). Opossums were spotted at the other sites, which were situated in areas less visited by humans. At The Olde site, there were no observed skunks. This site is much closer to a forest edge habitat, but the composition of the garbage would have a lower proportion of food giving that the other two sites were located near dining commons. This suggest that while skunks may be more comfortable with humans, their diet may be more specialized requiring substances not found in this location (Gehring et al. 2003). All species were found at The Hub site. This site is further from the forest edge and located near a path, but during late hours it was observed that very few individuals pass through the area. Animals would make their way from the forest, down the grass next to the path and walk through the open gates to the dumpsters. The diversity of food supplied, the easy access, and the low numbers of humans make this spot the most appealing to these species. It was also noted that while species would go to the sites together, there was never more than one species at a dumpster at a time. This suggests that these species may try to avoid competing with each other by waiting for the dumpsters to be clear of competitors and to avoid confrontation (Crooks 2002).

From the data we have collected over the course of this study, it seems that more animals congregated by the Hub likely due to an abundance of food readily available to them. We also noticed how the fauna on campus differed based on location. For example, there were a higher number of skunks at the Olde while no raccoons were present in the area. This may have been due to the ability of skunks to drive competitors away with their warning coloration and defense mechanisms (Theimer et al. 2015). Opossums appear to be relatively scarce on campus when compared to skunks and raccoons. This is likely due to their perceived lower intelligence, solitary nature, lack of defenses, and specific requirements for water sources (Fidino et al. 2016). These reasons would likely make them more wary of the more aggressive and intelligent skunks and raccoons as to avoid directly competing with them.

Throughout this study several errors occurred during observations. One major factor that interrupted observations was the weather. When precipitation occurred it was difficult to make clear observations, coupled with the fact that many animals prefer to seek shelter during rain storms meant that they would not leave their burrows (DeStefano et al. 2003). Animals would sometimes not appear for an extended period of time possibly due to the presence of humans making them apprehensive.

Further research can be done to improve our overall understanding of the nocturnal populations living on and around the Purchase College campus. Given more time it would be helpful to run similar observational experiments at different times of the year to compare the activity during particular seasons. Equipment also plays a very important role in this research. Given the time and resources, cameras could be set up at every dumpster on campus. This additional information would not only give us a larger pool

of data to work from, but it would also round out our conclusions and add a greater understanding of the nocturnal life on the Purchase College campus.

CONCLUSIONS

In our study we observed three dumpster sites on the Purchase College campus to determine what areas have the most diversity of nocturnal mammals and which areas attracted the most animals in general. Our results illustrate how urban environments have impacted animal behavior and how some have adapted to human society by exploiting anthropogenic food sources.

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