

INCREASED TOLERANCE OF HUMAN PRESENCE OBSERVED IN URBAN COMPARED TO RURAL EASTERN GRAY SQUIRRELS

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ABSTRACT

As urbanization spreads in a world with drastically increasing human population, wildlife are forced to adapt or face the reality of anthropogenic caused extinction. According to data collected at SUNY Purchase College in Westchester County, New York, urban squirrels have adapted to increase their tolerance of human presence due to frequent anthropogenic disturbances and habitat fragmentation. We sampled 20 squirrels total with 10 sampled from an urban site and 10 sampled at a rural site. We observed that urban squirrels tolerated more distance moved towards them by humans than rural squirrels tolerated. Eastern gray squirrels show promising ability to adapt their behaviors to better survive in these urban environments, as observed in this study as the loss of fear to some extent represented by the increased amount of human presence that was tolerated by the urban squirrels.

Keywords: Habitat Fragmentation; Urban; Rural; Tolerance; Squirrels.

INTRODUCTION

The reality of the world we live in is that human overpopulation is a huge problem, resulting in widespread distress across ecosystems that had maintained their ecological functions for thousands of years before. The exponential growth of human population size is the root of a variety of some of the world's most complex ecological issues (Bavel 2013). One of the main factors in the damage that is being done by the expansion of mankind is the huge amount of habitat fragmentation that is occurring. Urbanization is causing habitats all over the world to become isolated from one another, barricaded by anthropogenic walls (Austin et al. 2015). Urbanization and habitat fragmentation have a direct relationship meaning as one increases, the other does as well (Liu et al. 2016). Habitat fragmentation causes a decrease in available natural habitat in the environment for organisms to utilize, and has been a leading cause of habit loss throughout the eastern United States (Austin et al. 2015). With the increasing global temperature limiting the habitat range of mammals, fragmentation can prove to be detrimental to wildlife.

Many mammals are negatively impacted by habitat fragmentation. Habitat fragmentation can be defined as the reduction and isolation of natural environments (Franklin et al. 2002). On the Purchase

College campus, fragmentation includes roads, paths, and building structures that separate the vegetative plots of land from each other. Fragmented land often leads to displacement and loss of habitat depending on the range size of the animal. However, some animals have the ability to adapt to their surroundings despite the urbanization of their environment, altering it from its natural state. By adjusting food preferences, changing their foraging and anti-predator behaviors, extending the length of their reproduction season, and other adaptive techniques, animals are able to maximize the benefits that they receive from urbanization (Jokimäki et al. 2011).

The eastern gray squirrel originated from the eastern United States and was introduced throughout the world between the late 1800's and early 1900's (Palmer and Koprowski 2007). They are typically known for their aggressive behavior towards humans and other animals, their spread of dangerous diseases, and their destruction of trees and property. The eastern gray squirrel seems to have better adapted to the increase of urbanization. As predation pressure decreases, the squirrels have a higher chance of accumulating in fragmented areas. As a result, the squirrels are able to adapt very quickly to their environment (Koprowski 2005). We have begun to see changes in squirrel behavior based on their location notably for squirrels living in urban environments (Bertolino et al. 2016). Human activity is thought to be a driver of behavioral changes in eastern gray squirrels.

In contrast to the urban adapted squirrels, rural squirrels tend to be more wary of human interactions being that they face the pressures of potential threat and predation. This is observed through behavioral responses including tail flagging. Tail flagging is a warning for other nearby squirrels that danger is present and is one advantage of group living that squirrels experience (Fulmer et al. 2010).

We hypothesized that the urban squirrels would tolerate more movement towards them by the human researcher than the rural squirrels would.

METHODS

Field Site. The location of both of the field sites were on the property of SUNY Purchase College in Westchester, New York. We collected data on 20 squirrels total. The 10 rural squirrels were surveyed in the old growth forest behind Alumni Village and the 10 urban squirrels were surveyed behind and to the west side of the dance building, a frequently utilized area on campus.

Data Collection. We collected data on October 18, 24, and 25, 2018. These days were chosen on the basis of having similar weather conditions to preserve consistency. Using meter tape, we measured the distance tolerated that the researcher was allowed to move towards the subject before it fled the area. We accomplished this by using a three person system. The three of us stood in one spot and wait for a squirrel to be insight and in our direct line of view. Then, one designated person cautiously approached the squirrel and paid careful attention to keep their pace constant. The person with the stopwatch stood next to the designated approacher and signaled when to begin moving toward the squirrel. When the squirrel displayed distress, either by tail flagging or fleeing the area, the approacher signaled to stop the timer and remained where they stopped. The third person then measured the distance tolerated with the meter tape. We measured from the starting point of the approacher, determined by the time-keeper, to the point where

the approacher signaled to stop. We then imputed our data into Microsoft Excel and analyzed it in graph form.

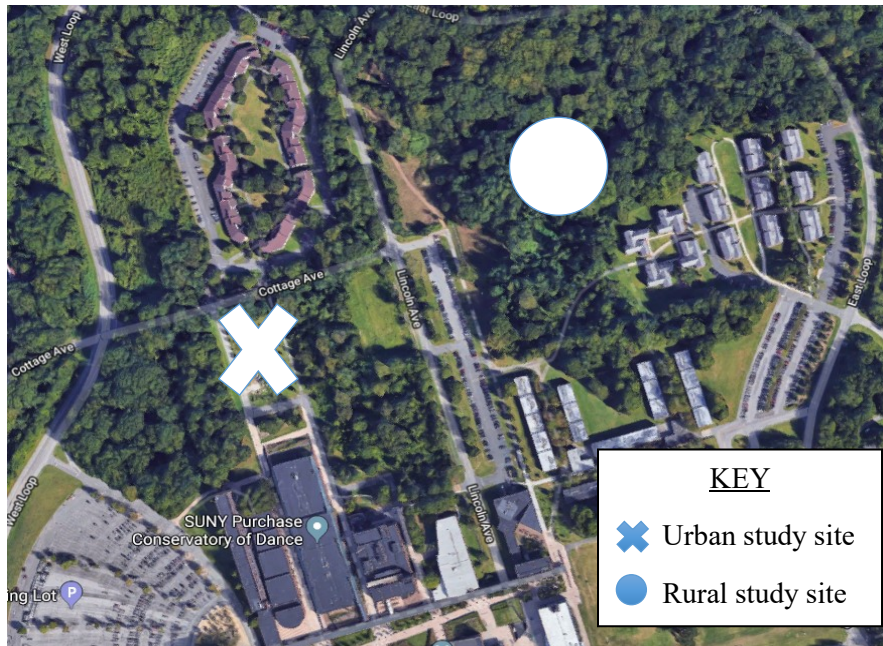


Figure 1. Study Area on Purchase College Campus (Aerial photo courtesy of Google Maps 2018)

RESULTS

Throughout our experiment, 20 squirrels in total were surveyed. Ten of which were found in a rural environment, and the remainder were surveyed in an urban setting. All of the areas chosen were found on the north side of Purchase College campus. We measured the average distance travelled by the approacher tolerated by squirrels in each environment (Figure 4) and the time it took for the squirrel to react to the approacher (Figure 5). Figures 2 and 3 display the detailed results of each individual squirrel that was surveyed for each site.

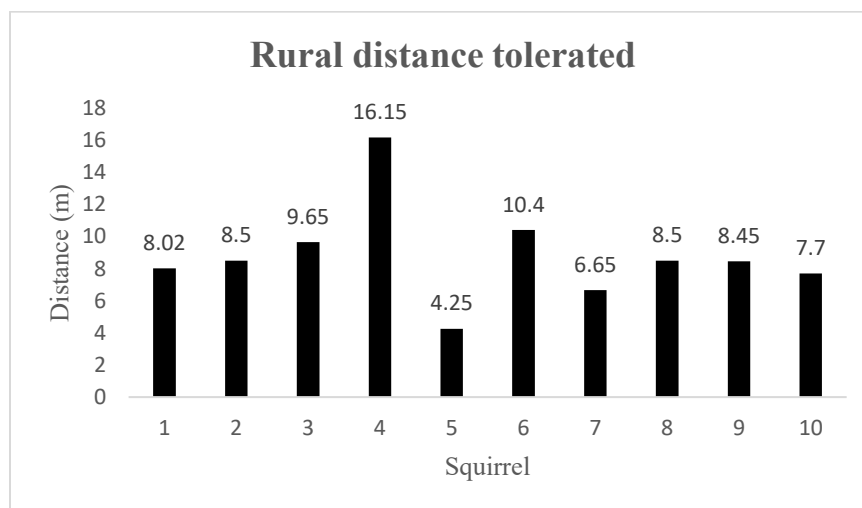


Figure 2. Rural distance tolerated for each individual squirrel

Figure 2 is a graph that shows the distance tolerated in meters for each individual squirrel sampled in the rural setting. We observed that the greatest distance allowed was 16.15 meters by squirrel number 4, and the least tolerated was 4.25 meters by squirrel number 5.

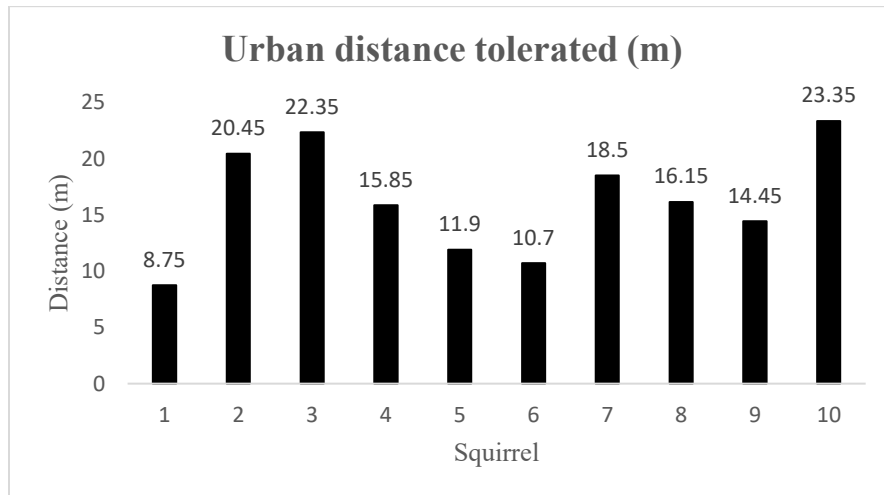


Figure 3. Urban distance tolerated for each individual squirrel

In figure 3, the distances tolerated by each individual urban squirrel sampled is represented. The highest distance tolerated was 23.35 meters tolerated by squirrel number 10. The least distance tolerated was 8.76 meters by squirrel number 1.

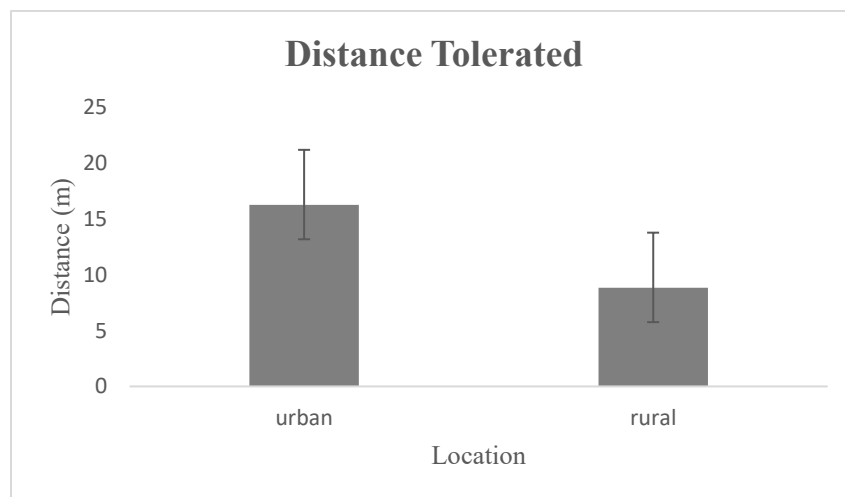


Figure 4. Average distance tolerated

Figure 4 represents the average distance in meters that was tolerated by squirrels in the urban survey site as well as the rural survey site. The standard deviation of both is represented by error bars. We observed that the urban squirrels tolerated humans to move further distances towards them before displaying defensive behaviors than the rural squirrels did. The average distance tolerated by the urban squirrels was 16.2 meters, which is greater than the average distance tolerated for rural squirrels, which

was 8.8 meters. The standard deviation for the urban survey sample group is 4.9 meters, and the standard deviation for the rural survey sample group is 6.6 meters.

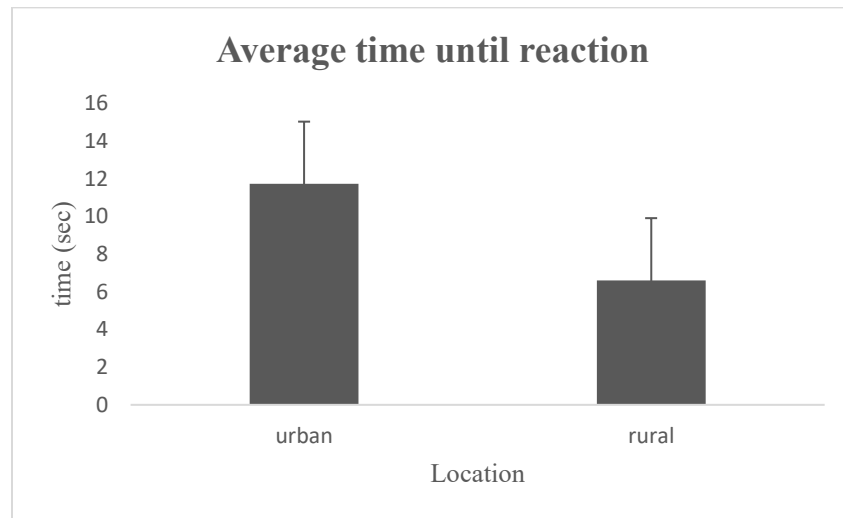


Figure 5. Average time until reaction

As represented in figure 5, our data showed that urban squirrels tolerated a longer average time before they displayed a behavioral reaction due to a human's motion towards it. The standard deviation of the urban and rural squirrels reaction times are represented by this figure as well. The average time until reaction for the urban squirrels sampled was 11.7 seconds, which is greater than the average time for the rural squirrels which was 6.6 seconds. The standard deviation for the urban survey sample group is 3.3 seconds, and the standard deviation for the rural survey samples sample is 2.9 seconds.

DISCUSSION

We hypothesized that the urban squirrels would tolerate more movement towards them by the human researcher than the rural squirrels would, which was supported by our data. Based on our research, we see that urban squirrels had a much higher tolerance for human presence than rural squirrels. Urbanized mammals tend to no longer display the same fear for humans as rural animals do. They have adapted to coexist with humans due to the pressures of habitat fragmentation and edge effects by utilizing alternative food sources (Jessen et al. 2018). Throughout our data collection, we witnessed many instances where urbanized squirrels were rummaging through trash cans in search of food near the dance building. These alternate food sources as well as the lack of predators in urban environments are both beneficial to squirrels (Jokimäki et al. 2016). Due to the vast opportunity for foraging, as well as the limitations posed by fragmentation, urbanized squirrels have tolerated increased interaction with human populations over time, causing them to lose some fear of humans. Similar studies have been done with marmots, which are in the same family as squirrels. These studies showed that increased human presence caused increased antipredator responses from the marmots (Griffin et al. 2007, Neuhaus and Mainini 1998).

Depending on human activity levels, eastern gray squirrels display different behaviors based on their environment. There have been studies that display eastern gray squirrels in areas with high human density showing increased antipredator behaviors when compared to squirrels in areas with lower human population densities. However, the opposite hypothesis was supported by our data. A notable variation

between the study that we conducted and the study described in Cooper et al. (2008) was that the survey site for urban squirrels contained only few trees, where our urbanized site still had many trees present. Researchers in the 2008 study determined that due to the lack of trees, squirrels displayed an increased fear of humans, explaining why we did not obtain the same results (Cooper et al. 2008).

As we began our experiment, we faced a few problems with data collection. The most ideal way to record squirrel behavioral response would be to measure how close the approacher from the same start line each time, and also record its corresponding time measurement. Particularly for the rural sample group, data would have been almost impossible to achieve by those means. This is another possible reasons why our results strayed from the data collected by Cooper et al. (2008). In that study, they measured the distance between the approacher and the initial sighting point of the squirrel, which could result in inconsistencies since there is no viable way to record the exact spot the squirrel fled from. That being said, we had to work out a different strategy. That is when we came up with the concept of measuring the distance travelled by the approacher to standardize our data, rather than measuring the distance between the approacher and the site that the squirrel fled from. To ensure consistency, the approaching was done by the same person each time, with a walking pace that was as constant as possible for each of the trials. Another issue is that squirrels have a fairly large range and many urbanized squirrels retreat at times into the rural areas nearby, causing some overlap in data that we did not take into account. If future researchers were to replicate this experiment, it would be advised to sample a rural area that is very far from any urbanization, a difficult task for many locations. One way of achieving this would be to sample within a large preserved area that has little human interference. This would ensure that there would not be urban squirrels mixed into the rural sample set. Additionally, it would benefit the study to increase the sample size for each group surveyed.

Fear of predation is important in prey animals as it has a significant effect on their reproductive rates and emigration, through the “landscape of fear.” The landscape of fear is a term used to describe the predation risk perceived by the prey population. This is determined by the social response of the prey animal (Croft et al. 2017). When a predator is introduced into a prey population, the prey itself will either retreat from the area overtime, adapt to live with their predators or die due to predation (Forrester et al. 2017).

Although squirrels are capable of adapting to urbanized environment, increased urbanization can lead to reduced overall biodiversity across many taxa. The alteration of native habitats can have detrimental effects on species (Franklin et al. 2002). Habitat fragmentation and edge habitat can reduce the quality of nesting areas for birds and lead to increased nest predation. Additionally, birds cannot get the necessary nutrients and supplies for nesting in these fragmented areas due to decreased vegetative complexity and degradation of habitat (Marzluff 2001).

CONCLUSION

In an increasingly anthropogenic world, it is important to acknowledge that the actions of humans are having a vast and exponential impact on the behaviors of animals, in this case eastern gray squirrels. The overpopulation of humans and increasing urbanization is resulting in habitat fragmentation that is changing the way that the squirrels react to humans from their natural responses. This is represented in this study by the increased distance moved towards the squirrel by the researcher seen in the urban site, as opposed to the lesser tolerance to the approaching researcher observed in the rural squirrels.

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