Fall 12-15-2012

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2012

BY

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BIOLOGY

Submitted in Partial Fulfillment of the

Requirements for the Degree of Bachelor of Science

In the Honors Program at

Coastal Carolina University

December 2012

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Abstract:

The northern mockingbird (*Mimus polyglottos*) is a common bird species found in North America that in the past 150 years has expanded its distribution north. It is now commonly seen in urban and suburban areas were at one point, it was rarely seen outside of rural and forested areas. For the study, I observed northern mockingbirds at nine different sites over a period of a month between September and October 2012. After the study, I determined that there is a negative relationship between the number of people in the surrounding area and the distance when the birds flew away.

Introduction:

Northern mockingbirds are very common in the continental United States (Droege and Sauer, 1990; Pardieck and Sauer, 2007.) This species has successfully adapted to urbanization (Wright, 1921); for example, there are large populations of northern mockingbirds in Washington D.C. (Hadidian et al., 1997) and cities in Florida (Cox, 1987). Being able to adapt to urban environments requires the birds to acclimate to the presence of people and noises produced by cars and other machinery. It has been shown that northern mockingbirds are taking advantage of these noises by incorporating them into their songs, which improves their chances of attracting mates (Clark and Howard, 2001). Northern mockingbirds have been shown to remember perceived threats from other birds (Reichard and Price, 2008) and they remember particular people who have threatened them in the past (Levy et al., 2008).

Populations of northern mockingbirds seem to increase in size in response to human development. Early reports of this species in the northern parts of the continent were so uncommon

that people regarded them as “accidental visitors” to the region; it was believed that the northern mockingbird couldn’t expand its range past Massachusetts (Wright, 1921). By the 1920’s however, there were reports of the northern mockingbird nesting in coastal Maine (Wright, 1921). That range expanded from the coast towards Quebec (David et al., 1990) and central North America (Droege and Sauer, 1990; Pardieck and Sauer, 2007). The range expansion of northern mockingbirds seems to follow urban development due to increases in human populations in Florida (Cox, 1987) and in the Central and Western regions of the United States (Pardieck and Sauer, 2007).

Mockingbirds have three primary methods of responding to perceived threats- fleeing, attacking, or wing-flashing. Wing-flashing is where the mockingbird will raise it wings above its head; this has been proposed as an anti-predator defense (Dhondt and Kemink, 2008). Northern mockingbirds have demonstrated their ability to distinguish a threat posed by one individual out of a group of people (Levy et al., 2008). This behavior was demonstrated by having the same people disturb the same mockingbird nests and by the end of the experiment, the mockingbirds were recognizing the human attackers from a group of people. The mockingbirds would then begin to attack the people that had disturbed the nests.

Unlike many other birds, northern mockingbirds don’t migrate in the winter (except for populations in very northern ranges) (David et al., 1990). Northern mockingbirds will establish a territory in the fall and defend it until the breeding season (Logan, 1987).The mockingbird will use the territory to scavenge for food during the winter (Safina and Utter, 1989). These territories are guarded fiercely, with reports of mockingbirds violently attacking any bird that wanders to near to the territory (Hendrick and Woody, 1983). Sometimes, mated pairs of mockingbirds will defend the same territory together. By working together, the winter territory will shrink in size a little if at all (Breitswich et al.,

1986). Even mockingbirds of the same gender will help each other by not attacking one another due to the fact that mockingbirds can actually recognize individual mockingbird songs (Botero et al., 2006)

The purpose of my project is to determine if there is a negative correlation between levels of human activity and acclimation levels of northern mockingbirds. It already has been determined that northern mockingbirds have the ability to recognize individuals who pose a threat (Levy et al., 2008). What my project will determine is how flush distance of the northern mockingbirds is affected by the number of people in the nearby area. My hypothesis is that there is a negative correlation between human activity and mockingbird acclimation levels. Using the results from my project, a method of measuring the effect of human encroachment on the behavior of related bird species could be developed.

Materials/Methods:

I conducted my study on and around the Coastal Carolina University campus in Conway, South Carolina. I first found areas where northern mockingbirds had established a territory. I used nine different areas for the study. Using a random number table, I visited each site on randomly selected days at various times during the daylight hours and recorded how many people passed within three meters of the mockingbird's territory during a three minute period. I also recorded the behavior of the mockingbirds during these visits. Base on the preliminary studies, the data which is not shown, I determined the mockingbirds to be most active between 10 am to 2pm; I also determined that the human population levels were at their highest between 10:30 am to 12:30 pm. . I categorized the sites into three different types- high human activity (more than 15 people/ minute), medium human activity (5-15 people/minute), and a low human activity (less than 5 people/minute In the later days of the experiment, I approached each mockingbird and when the mockingbird flew away, I recorded how far

away I was when the mockingbird was flushed using a measuring wheel. I repeated my measurements on random days at the height of human activity so as not to acclimate the mockingbird to my presence.

To analyze my data, I first entered the data in Microsoft Excel. In Excel I found the average number of people and flush distance for each site. I also calculated the averages for each category. I then performed a natural log transformation of the distance values. Doing so allowed me to create an exponential model from the data I had collected.

I then began to compare the variances between sites and the variance of visits to sites. I did this by entering the number of people and the natural log of the distance values into SPSS (SPSS 13.0, IBM) An R^2 value was calculated from the comparison between the number of people and the flush distance. At the same time, another R^2 value was calculated from the comparison between the number of people and the natural log transformations of the flush distances by using Excel. These values were placed into a mixed model in SPSS in order to create a linear model from the exponential model I had created in Excel. After the model was made, the variances between sites were compared against the variance of the visits to the sites.

Results:

Human activity at the nine sites ranged from zero to 45 people per three minutes ($\bar{x}$=11.9, S.D..=10.45). Flush distances varied from 17.6 m. to .7 m. ($\bar{x}$=7.8 m, S.D.= 5.52). The data describes a pattern that as the number of people in the area increased, the flush distance decreased; at areas with low people activity, the average distance the mockingbirds were flushed was much larger than the average flush distance of the high people activity areas ($\bar{x}$=14.6 m, $\bar{x}$=3.3 m, respectively). As seen in Figure 1, the data forms a downward, negative slope that eventually levels out to form an exponential curve. This curve shows that there is a strong negative correlation (R^2 =.8359). Figure 2 shows the same correlation occurs when flush distance underwent natural log transformation (R^2 = .8359). Figure 2 is

meant to reinforce the correlation that was created in Figure 1. The variances, or difference, of the site visits was lower than the variance between the sites themselves (ICC=.895). This means that the each visit to a site was similar to other visits to the same location with little change.

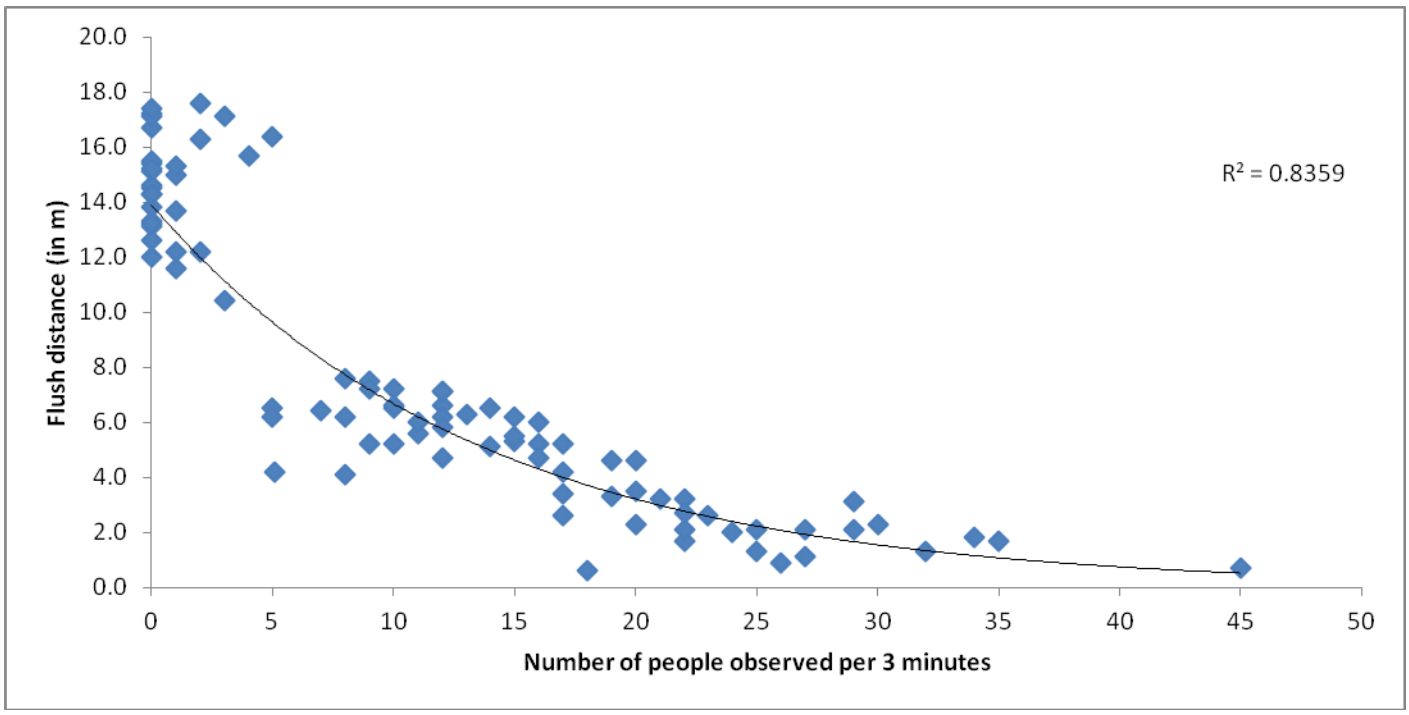

Figure 1: A X Y scatterplot comparing number of people to flush distance.

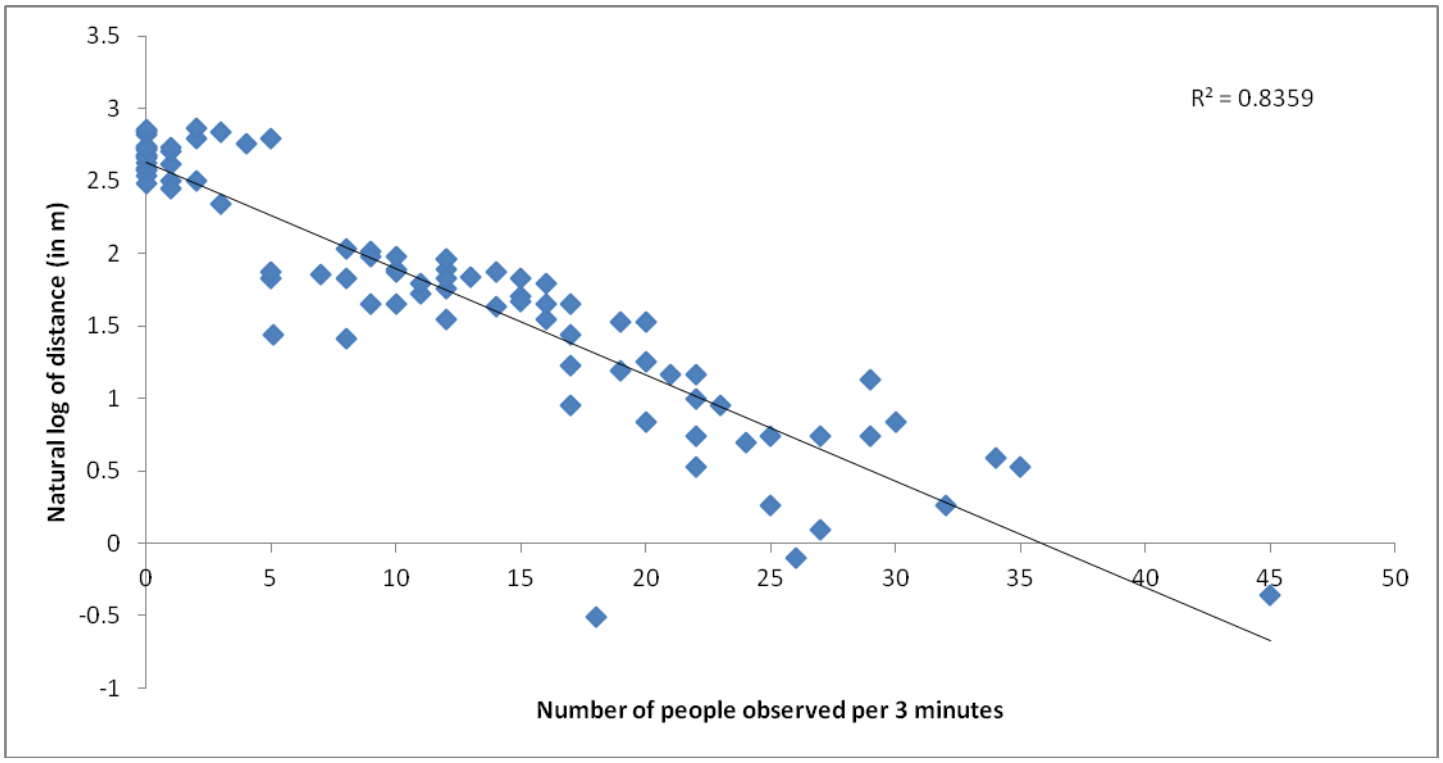

Figure 2: A linear model of number of people versus natural log of distance.

Discussion:

These results support my hypothesis about the negative correlation between the number of people in the nearby area and the flush distance; the data shows that as the number of people increased, the mockingbirds grew more accustomed to the people and flush distance decreased. It makes sense that the data would form an exponential curve instead of a straight line because no matter how comfortable a wild mockingbird may be to people, there will never come a point where a person could walk over to the bird and be able to pick it up; if that were possible, the mockingbird would have essentially be a tame mockingbird and no longer a wild mockingbird.

The curve having a good tight fit is unusual; normally animal behavior tends to have lower R^2 values, somewhere near the .3-.5 range instead of being .8359. I attribute this to the construction

around the Coastal Carolina University campus. Areas that once were forested or open with shrubs are now being built upon. While there is still plenty of food for the mockingbirds on campus, the limited amount of nesting space forced the mockingbirds to move to areas that would have put them in closer proximity to people. Being closer to people would force the mockingbirds to either acclimate to people or find a new nesting area.

Many animals have been shown to slowly acclimate to human encroachment but the mockingbird is one of the few species that not only adapts but actually thrives off of human expansion. An ideal northern mockingbird habitat is a short, grassy area with shrubbery (Breitswich and Derrickson. 1992). This describes the average lawn in most suburbs and this is why people often see northern mockingbirds in suburban and urban environments.

Another benefit to the species heading towards suburban and urban area is because of ornamental plants. Many urban and suburban areas have low plant species richness due to people planting ornamental plants (McKinney, 2002). Northern mockingbirds have been shown to favor some ornamental species such as *Ardisia crenata* (Meisenburg, 2007) and *Lonicera maaki* (Pennington, 2003). Because of ornamental plants being so numerous, the fruit the plants grow is also be abundant and this can attract northern mockingbirds; the northern mockingbirds are attracted to the areas because finding food is much easier. In order to be successful in suburban and urban environments, where there is a much higher chance of interacting with humans when compared to more rural areas, mockingbirds must be able to adapt and acclimate to people being very close to mockingbird territories.

Acknowledgements:

I wouldn't have been able to finish my study without the help of the people around me. I would like to thank Dr. Chris Hill, my thesis advisor, for his time and equipment, without it I probably wouldn't have been able to adequately present my results. I would also thank Dr. Deborah Hutchinson, my

Honors 499 teacher, for answering any questions I had throughout this entire process. One last thanks goes to my friends and family who gave me moral support and kept me going when I was most frustrated.

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