

Bird Habitation and Species Diversity on UNCP's Campus

Honors Project

In fulfillment of the Requirements for

The Esther G. Maynor Honors College

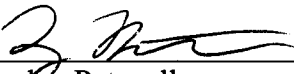
University of North Carolina at Pembroke

By

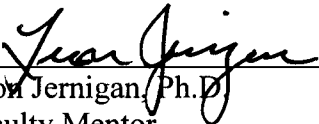
Kenley Patanella

Biology Department

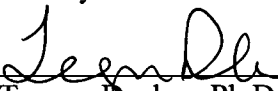
April 25, 2016

  
\_\_\_\_\_  
Kenley Patanella  
Honors College Scholar

4 - 28 - 16  
\_\_\_\_\_  
Date

  
\_\_\_\_\_  
Leon Jernigan, Ph.D.  
Faculty Mentor

4/28/16  
\_\_\_\_\_  
Date

  
\_\_\_\_\_  
Teagan Decker, Ph.D.  
Senior Project Coordinator

5/2/16  
\_\_\_\_\_  
Date

## Preface

I believe it is not typical for a scientific paper to have a preface, nor am I entirely sure what is supposed to be said in this (optional) preface. So one would think with that parenthetical clarification, I would simply delete this page—it is not for me, it is for other types of projects. However, I am also a creative writing minor (a pairing that has been equally questioned—“what are you going to do with a creative writing minor in biology?” [as if I have to do “something” with it beyond write]—and praised—“interdisciplinary stuff always looks good on a resume!” [and here I was just taking fiction classes because they were fun]), so I have decided to indulge myself.

In this paper, I focus on the science—the number of species I saw, their behaviors such as flocking, singing, and nesting—I avoided making any anthropomorphic descriptions; I avoided giving the birds personalities. I didn’t claim for them to be self-aware, to have thoughts, to see or feel the world the way we humans do. And I’m still not now. But with all of the research and data regarding birds’ responses to urban environments, for a moment I want to break away from the scientific writing and talk about what it was like watching them days on end in a way less so as a researcher and more as a birder.

Birdwatching is an interaction. It is not one-sided, and even when I would go out alone, I was not alone. The birds were there, and the many species I encountered reacted differently to my presence. I had Yellow-rumped Warblers and Golden Finches with bouts of curiosity—in a tree, they would hop down to a lower branch and look right at me, as if asking what I was doing. There was a Yellow-bellied Sapsucker that would play hide and seek, moving around to the back of a tree trunk and then stealthily flying to a nearby tree in hopes that I still thought it was on the back of the first one, only to peek its head out to see me, thus revealing itself again. I once had a Tufted Titmouse chirp at me consistently until I turned around to see it in the tree closest to me. I swear, the moment I acknowledged it, the bird looked at me, satisfied, quit chirping, and flew off to its companion several yards away. Another time, I was sitting at a picnic table, and the Northern Mockingbird I was observing would perch and sing for a few seconds, move a little ways to again perch and sing, thus making points of a circle around the table, as if to show me that I was in the middle of his territory. Now, I’m not claiming to know what the birds were thinking or feeling in those moments, if anything at all. What I am saying is that birdwatching is an active interaction, because birds are aware of and respond to their surroundings, and until I completed this project, I never realized that this included me.

Thanks to this project, I have formed the habit of noticing every bird I see. It’s almost like a sixth sense, practically involuntary—I’ll be going to class or taking my dog for a walk, my thoughts hazy and unfocused, when my eyes become fixed on a spot on the ground or in a tree, where there’s a robin, mockingbird, or chickadee. And I’ll watch it, flitting around, feeding, chirping, flying off, for as long as I can until I’ve passed it as I moved forward. The process of this research project came with doubts and frustrations, but those moments were balanced out by the moments of birdwatching, by the days when I’d add new species to the list or record interesting behaviors—when I would look at the birds and they’d look back.

## Acknowledgments

I would like to thank Dr. Decker and Dr. Jernigan for their guidance in the creation and completion of this project. I would also like to thank Dr. Ash, who helped me with the statistical data in my project. I also thank my roommate, Haley Bean, for tolerating my waking up at early hours, walking with me on occasion when she had free time during my observations, and finally, for making an impromptu photo-shoot of me with my binoculars for my poster.

## TABLE OF CONTENTS

|                   |    |
|-------------------|----|
| Abstract.....     | 1  |
| Introduction..... | 2  |
| Methods.....      | 3  |
| Results.....      | 7  |
| Discussion.....   | 11 |
| Conclusion.....   | 14 |
| References.....   | 15 |
| Appendix A.....   | 16 |

## List of Figures

|               |   |
|---------------|---|
| Figure 1..... | 3 |
| Figure 2..... | 7 |
| Figure 3..... | 8 |
| Figure 4..... | 8 |
| Figure 5..... | 8 |

## ABSTRACT

Birds are commonly seen in suburban and urban areas, such as Pembroke's campus. Observations were conducted for 9 weeks on UNCP's campus, noting species seen and their behaviors. The different areas of campus were considered and divided into 5 sites. A total of 29 species were seen throughout the sites, and the Old Main and Health Sciences ends of campus had the most species richness. All bird species seen were ones typically found in suburban areas and their behavior changed over the course of the months as it transitioned to spring.

BIRD HABITATION AND SPECIES DIVERSITY ON UNCP'S CAMPUS:

by,  
Kenley Patanella  
Bachelors of Science in Biology  
The University of North Carolina at Pembroke  
May 7, 2016

## **Introduction**

Urbanized environments, those dominated by humans and man-made structures, are not entirely void of wildlife. It is heavily acknowledged that as urban environments expand due to the growing human population, the original, natural habitats undergo changes that impact the species within them (Møller et al., 2012; Evans et al., 2009; La Sorte et al., 2014; Zuckerburg et al., 2011; Chamberlain et al., 2009; Miranda et al., 2013). When habitats are urbanized, the species that will have remaining populations in the area are abundant ones, which typically includes many avian species (as quoted in Møller et al., 2013). Birds, more than any other class of vertebrates, are ubiquitous within human environments. While they are commonly seen in human dominated areas, urbanization still causes a decrease in the number of species (i.e., species richness) that can survive in the changed habitat (as quoted in Evans et al., 2009). Species that can thrive in urban environments are typically generalists and able to adjust their behaviors in differing situations, whereas habitat specialists tend to suffer (Evans et al., 2009; Møller et al., 2013).

However, urbanized habitats can be diverse in structure, and they may have varying traits and features throughout them, some of which may be more susceptible to habitation for various bird species. According to Evans et al. (2009), “avian species richness typically peaks at intermediate levels of urbanization,” suggesting that many bird species can survive in human environments that still demonstrate a variety of traits such as vegetation diversity, variety in habitat structure, and large patch sizes with little isolation (20). The University of North Carolina at Pembroke’s campus consists of various types of landscaping such as gardens and lawns, athletic fields, and patches of remaining wooded areas. At UNCP, birds are active throughout the year, taking advantage of these areas of potential habitat in the urban environment of a university

campus. Avian species and their behaviors were observed to determine their habitat usage on UNCP's campus. While UNCP's campus is relatively small, it still is a good representation of a typical campus landscape, so observations should generally reflect the species and their behaviors for similar urbanized areas in the region.

## Methods

Observational data was collected for nine weeks during January, February, and March, three weeks per month. To complete observations throughout campus, five sites were determined and four standard walks were designed to survey these sites (Figure 1). These walks would take anywhere from 30 minutes to 75 minutes, depending on the amount of bird activity and time it would take to observe their behavior. Every walk was conducted on a weekly basis, and the time of day each path was taken interchanged between mornings (typically around 8:30) and afternoons (typically around 4:15) on a weekly basis.



Figure 1: The four walks throughout campus shown in red and each site shown as a blue number.

Observations recorded the species seen, the number of individuals of each species seen, and the behaviors of such individuals. Species identification was done on a visual basis, with binoculars and birdwatching field guides available as aids. Vocalizations were noted as behavior, and could be useful in sighting birds, but as the species were being recorded based on specific locations, a species would only be recorded if it was seen in the site.



The five different sites were determined based on location and type of landscape. These five sites are: the Old Main end of campus, the athletic fields, the UC and GPAC area, the Dial and Sampson area, and the Health Sciences end of campus. Each site had its own walk, except for the athletic fields—the football stadium and field were observed in the beginning of the walk for the UC and GPAC area, and the soccer and baseball fields on Braves Drive were observed during the Dial and Sampson walk. The acreage of each site was determined using a measurement tool in Google Maps, and a more detail description of size, vegetation, and vertical strata was given to each site:

### **1.) Old Main End of Campus**

This site has an area of about 9.6 acres. The vegetation and vertical strata of this area is quite varied. By the Education building, there is a line of tall hardwood trees, all uniform, and near the road there are some ornamental trees and shrubbery. North and West halls have mostly small, uniform, ornamental trees and shrubs, such as crepe myrtles and a type of small holly-like tree. Between West hall and the back of the Chancellor's residence, there is a small patch of unkempt woods that is a mix of pines and hardwoods such as sweetgum and oaks, with minimal shrubbery and herbaceous ground cover. There is also an area of grass in front of these woods, behind the Chancellor's residence. Down the path at Hickory Hall, a small area consists of varied strata: two tall longleaf pines close together, two tall hardwoods (one by the building, one alone in the center of the area), two medium sized live oaks by the road, some dogwoods and other smaller trees, and then ornamental bushes and herbaceous plants in a maintained garden area. Across the road, the vegetation and vertical strata by the library and Old Main is also varied. It consists of many crepe myrtles and ornamental shrubs/herbaceous plants, but also has many native trees such as the longleaf and loblolly pines, a few oak species, dogwoods, and two red

cedars close to the water feature. There are also large plots of lawn, bordered by the above mentioned trees.

## **2.) Athletic Fields**

The area of these sites totals to about 6.1 acres, and consists of the football field and stadium, and the soccer and baseball fields on Braves Drive. There is virtually no vegetation or vertical strata in the athletic fields. They are highly maintained lawns, and the only means of vertical strata are light posts, signs, and wire fences. These fields are also frequently in use, which limits bird activity and observations in these areas.

## **3.) UC and GPAC Area**

This site has an area of about 4.6 acres. The area in front of GPAC and by the Annex is fairly sparse for vegetation; there is one large hardwood, a magnolia, and some ornamental shrubs. There are two longleaf pine trees by the Annex, behind GPAC. In the area between the UC building and the gym, vegetation and vertical strata is relatively uniform. There is a line of red maples that follows the path on the gym side, with one sycamore in there as well, and some ornamental shrubs and herbaceous plants right by the gym building. The center of this area has an open lawn, with some trees—two pines close together and a few smaller hardwoods spread out from each other. The UC and Annex buildings also have some ornamental shrubs and herbaceous plants near them, like the gym building did.

## **4.) Dial and Sampson Area**

This site's area was about 3.7 acres. The vegetation and vertical strata was relatively varied. By Dial, most of the vegetation was close to the building. However, it still managed to consist of various strata from a handful of large hardwoods, to some small trees such a crepe myrtles, a live oak, and a magnolia, and there were some ornamental shrubs and herbaceous

plants in the gardens by the building as well. As for Sampson, the front and side of the building had uniform strata of young trees and some ornamental shrubs right next to the building. In the back of Sampson, by the gravel parking lot and main road, there was a patch of well-established trees, consisting of mostly tall hardwoods, a couple of tall pines, and a few smaller trees such as dogwood. The understory was mostly grass, and among the trees, there was a ditch that drained water from a pond across the road.

### **5.) Health Sciences End of Campus**

The area of this site is about 8.3 acres. The vegetation and vertical strata of this area is varied. In the forest-like area in front of Village apartments, it is composed of mostly tall, well-established trees, a mix of pines and hardwoods. There is some variance in the height of these trees, but they are mostly tall and there is not much of an understory of vegetation—it is simply pine needles and leaf litter. This area is cut off by a small pond, with a lawn next to it. Behind the Health Sciences building, one area of woods seems somewhat maintained, with pines and hardwoods, and the understory is grass—the vertical strata is mostly uniform due to the tall trees. Next to this area, and separated by a wire fence, is a less maintained wooded area. This area demonstrates much more variation in vertical strata, as there are tall hardwoods and pines, along with small trees such as dogwoods, and then a thicket-like understory of vines, shrubs, and herbaceous plants. There is a very similar area further down on the walk, past Cypress Hall and across the street from the varsity field. It is narrow and long, following the road, but has a variety of tall trees (a mix of pines and hardwoods) as well as a thicket understory, even thicker than the one by Health Sciences. This area has a pond right next to it. On the other side of the pond, there are some small young hardwoods that were planted along the side of the road. Across the street, there is the varsity field, and on a hill right before the field, there is a group of trees—two

longleaf pines and around seven hardwoods, with grass in between and under them. Then there is the actual field, a lawn surrounded by a fence and large light posts.

## Results

### Species Diversity and Richness

Statistically speaking, there was no significant difference in diversity between the different sites, with a P-value of 0.056. However, species richness varied greatly throughout the sites (Figure 2). A total of 29 species were observed on campus throughout the nine weeks (Appendix A). The Health Sciences end of campus had the highest richness, with 26 species observed over the nine weeks, and the Old Main end of campus had the next highest at 23 species. The athletic fields had the least, with only seven species observed, and the UC and GPAC site only had eight species observed.

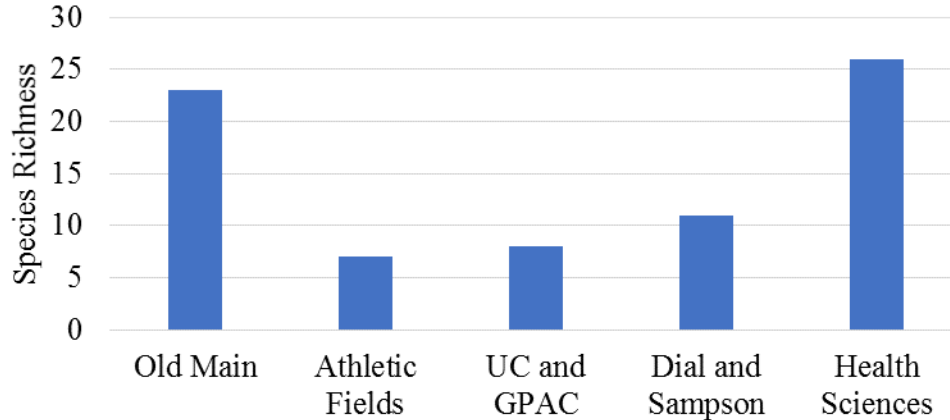


Figure 2

In an overall comparison of the sightings of each species, European Starlings and Dark-eyed Juncos were seen the most; House Finches, Mourning Doves, Northern Cardinals, Northern Mockingbirds, and Rock Pigeons were seen a moderate amount; the rest of the species were seen in low amounts. However, statistically, only European Starlings were seen significantly more than others. A list of all species seen on campus is in Appendix A.

## Seasonality

Seasonality was a large factor in the species observed throughout the months, as well as in the behaviors. Shown below are the sightings of three species on a monthly basis to show the differences between wintering species and permanent residents (Figures 3, 4, & 5).

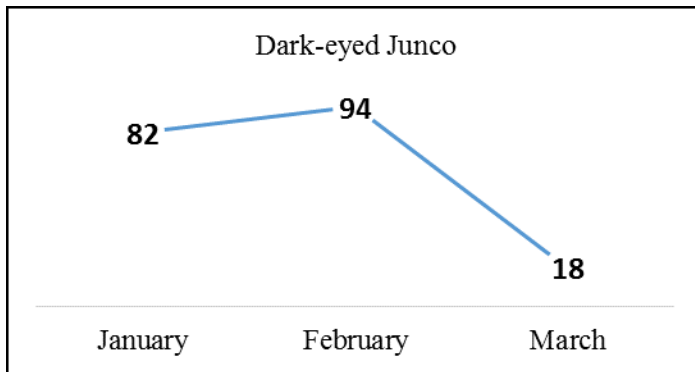


Figure 3: Monthly sighting of the Dark-eyed Junco, a winter resident of NC (Potter et al., 1980).

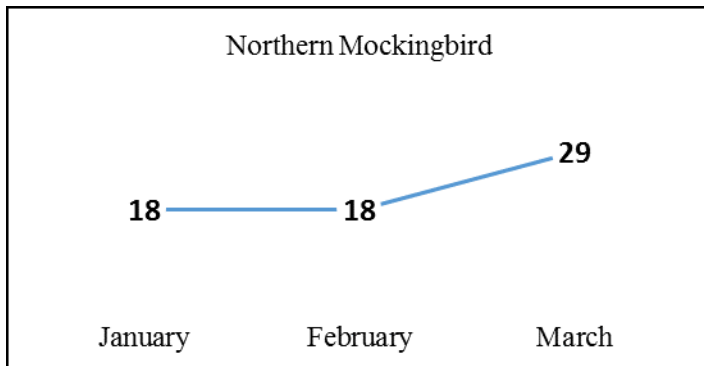


Figure 4: Monthly sightings of the Northern Mockingbird, a permanent year-round resident of NC (Potter et al., 1980).

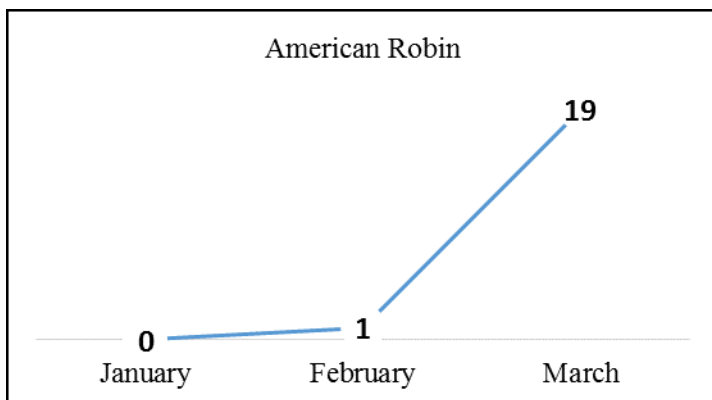


Figure 5: Monthly sightings of the American Robin, a breeding resident of NC (Potter et al., 1980).

The seasonality displayed in the sightings of these three species demonstrates that species richness and composition changes throughout the year. Since the Dark-eyed Junco is a winter resident, it was most frequently sighted in January and February, and sightings dropped off in March, with no sightings during the last week of the survey. Inversely, the American Robin breeds in suburban areas North Carolina, and sightings of this species did not begin until the last week of February, and increased greatly throughout March. Behavior also changes throughout the year, which is suggested in the increase of Northern Mockingbird sightings in March. Mockingbirds are typically very defensive of their territory, which is established in spring, through their singing on open perches. This made individuals easier to sight than in the winter months, when they were still around, but typically not as active or vocal.

### **Behavior and Habitat Use**

The birds on campus displayed many types of behavior throughout the different sites and months. In the winter, birds were often seen in flocks; common species who displayed uniform flocking behavior were Dark-eyed Juncos, Europeans Starlings, and House Finches, ranging from 8 to 30 individuals within one flock. Species were also sighted foraging in mixed flocks, as a January observation in the Old Main site noted, “2 bluebirds (males), 6 house finches, and 9 Juncos, all moving around the ground feeding and occasionally flying into the surrounding crepe myrtles, and some finches flew further off to a red cedar tree by the water feature, in which they still [were] feeding.” Foraging flocks were most commonly seen in the Old Main site, where the birds could easily fly between the lawns, shrubs, and trees of the area.

As it grew closer to spring, flocks became less frequent and birds started showing signs of territoriality. Throughout most sites, Northern Mockingbirds started perching in open places to

sing, and would not hesitate to show aggressive behavior if another individual was in their territory. For instance, on the morning of March 18<sup>th</sup> in the Dial and Sampson site, observations describe “one mockingbird acting very territorial: perched on [a] light post singing, would move to ground briefly, [then] perch in tree and sing, move to ground, perch on another light post and sing—virtually making a circle around the area, very alert.” American Robins were another species that began singing to establish territories. Other species also showed mating behavior, such as a group of cardinals in the Health Sciences site, where “the males were chasing each other aggressively, and they would occasionally chase the females as well, all of them chirping a lot.” Territoriality and mating behavior was common among the species that breed in North Carolina, while lingering winter residents, such as the Yellow-rumped Warbler, were still only observed foraging and feeding.

By the end of March, there was also some nesting behavior. A killdeer had a nest on the varsity field in the Health Sciences site, and the bird was described as “doing the act where it pretends to be injured” to draw potential dangers away from its nest. Eastern Bluebirds were also observed building a nest in the cavity of a tree in the Dial site, seen “moving around a group of branches, seemed like there might have been a cavity in one of the branches...[one bluebird] looked like it had pine needle/nest material in its beak.” If observations could have continued into later spring months, it is likely that more nesting behavior would have been seen.

While the birds all took advantage of the vegetation on campus, some species also seemed comfortable enough in the human setting to use the man-made features such as buildings, light posts, and fences. For example, there were several House Sparrows living inside the vents of the Annex building, and observations described the sparrows “hiding in the vents of the side of the Annex building, peeking their heads out to chirp.” Additionally, in the athletic

fields, European Starlings and Rock Pigeons were consistently using the large light posts to perch on, and throughout all of campus, Northern Mockingbirds would use anything from light posts to corners of buildings to electrical boxes as a perch from which to sing.

### **Discussion**

Virtually every species observed on UNCP's campus is recognized as either an abundant, common species, and/or has habitats or can be found in a variety of suburban areas (Dunne, 2006; Potter et al., 1980). The species most adjusted to a highly urban habitat are the European Starlings, House Sparrows, and Rock Pigeons; each of these species is described as urban and they are often viewed by the public as the feathered pests one can find in cities (Dunne, 2006). On campus, European Starlings were found virtually everywhere, and along with the sparrows and pigeons, commonly used man-made structures such as the light posts in athletic fields or nooks in buildings such as the Annex or football stadium. Møller et al. (2012) had found that abundant populations of birds were most likely to remain in urbanized habitats after conversion, and these three species are abundant, widespread species with a long history of adapting to urban areas.

Most of the remaining species, such as Dark-eyed Juncos, Eastern Bluebirds, Northern Cardinals, Yellow-rumped Warblers, etc., are found in habitats described as more suburban, such as gardens, parks, and yards. This description is reflective of the Old Main and Health Sciences sites, and explains why species richness was highest in these sites. In addition to the park-like atmosphere of these sites, Evans et al. (2009) found that "increased structural complexity of vegetation, and higher woody plant species richness can also promote higher avian species richness" (34). Both the Old Main site and the Health Sciences site had high diversity in trees and shrubs, including various oak species, longleaf and loblolly pines, maples, sweetgum,



dogwoods, and ornamentals such as crepe myrtles. These two sites had more tree species than the athletic fields, where there were none, and the UC and GPAC site, where there were only a handful of species and in less abundance. Evans et al. (2009) also found that larger habitat patches with little isolation and urban areas with mature vegetation tend to have high species richness. This could explain why the Health Sciences site had slightly more species richness than the Old Main site. The trees in the main areas of focus in the Health Sciences site were mature, well-established trees with a more forest-like structure, whereas the Old Main site had more young trees and garden-like structure.

The behaviors observed of the species on campus reflected their expected typical behaviors. For instance, Dunne (2006) describes the behavior of wintering Dark-eyed Juncos as social, vocal, and often foraging not far from cover in mixed flocks. In the observations of juncos in the survey, they were almost always in flocks, sometimes mixed, in areas like the Old Main site, where there was a balance of open lawn near gardens and shrubs for them to dart to when people walked by. Another example is that Northern Mockingbirds have the reputation for being very vocal and territorial, and mockingbirds, in every site, were seen singing (Dunne, 2006). Mockingbirds in the Old Main, UC and GPAC, and Dial and Sampson sites were seen also displaying aggressive behavior, such as fighting another mockingbird or chasing another species away from its territory. Nesting behavior was also consistent with the texts' descriptions. For instance, Eastern Bluebirds begin nesting in early March, and the observations of bluebirds building a nest in a cavity was on March 18<sup>th</sup> (Potter et al., 1980). Killdeer are also known to protect their nest by faking a broken wing, showing their bright orange feathers and flailing on the ground, which is exactly what happened with the killdeer on the varsity field in late March

(Dunne, 2006; Potter et al., 1980). These typical behaviors suggest that the UNCP campus consists of suitable habitat for the species that are used to urban and suburban areas.

As the survey was conducted in the months of January, February, and March, it mostly was able to represent the wintering birds of the region, with some insight into the transitory stage of the beginning of spring. According to La Sorte et al. (2014), bird species composition in temperate regions typically have 4 phases throughout a year: breeding, autumn migration, non-breeding, and spring migration. La Sorte et al. (2014) also describes that during spring migration, there is overlap of breeding and non-breeding species, as well as the possibility of migratory species at a stop over. During the nine week survey, species composition did change some in the transition to spring. For instance, the most notable winter residents, the Dark-eyed Junco and the House Finch, were seen in high numbers throughout January and February, but their numbers declined in March. There were no observations of the House Finch in all of March, and by the last week there were no juncos either. Conversely, the American Robin and the Chipping Sparrow were not sighted until March. The robin appeared in the last week of February, and then the number of individuals increased throughout March; the Chipping Sparrow did not even show up until the last week in March.

While the survey shows slight changes in the species composition throughout the months, it is only a small window into the year, and species composition will continue to change with the seasons. Only being able to make observations for 9 weeks was a limitation of the survey, and species richness and behavior could vary more throughout the year. However, La Sorte et al. (2014) did research on a full annual cycle of bird assemblages and found that urban environments have less species diversity throughout the year, stating that “seasonal variation in avian diversity...has probably been simplified by human activities” (1230). On campus

throughout the year, there may be some changes in species observed, as there were a few over the course of nine weeks, but the urban setting of campus perhaps limits the diversity of seasonal changes. Further research would need to be done to determine this.

Another limitation to the research was in determining diversity. Since observations were made over the course of nine weeks, the number of sightings were likely overlapping with the actual number of individuals. For instance, the Northern Mockingbird was sighted 65 times in total; however, as a territorial and permanent resident, it is likely that the same mockingbirds were being seen repeatedly throughout the weeks, but it is difficult to determine exactly how many individuals there really were. This affected the statistical analysis of the data, which is perhaps why there was little statistical significance found. To account for this flaw, species richness was considered more than overall diversity. Diversity consists of richness (number of species) and evenness (number of individuals of each species). Since the richness for each site on campus was determined with certainty, whereas the sightings to account for evenness were less valid, only species richness was used to compare the sites on campus.

### **Conclusion**

UNCP's campus consists of a variety of landscapes that serve as habitat to many avian species. In the months of January, February, and March, 29 species were observed on campus, with a higher richness in the park-like areas with a variety of vegetation and vertical strata. The urban species, European Starlings, was viewed the most; however, all species seen are common in suburban habitats. Further research could be done to determine the species richness over the course of a year, and another study could consider the evenness factor of diversity further. UNCP maintains the gardens and park-like atmosphere on campus, so it is likely that these bird species will remain common throughout the upcoming years.

## References

- Chamberlain, D. E., Cannon, A. R., Toms, M. P., Leech, D. I., Hatchwell, B. J., & Gaston, K. J. (2009). Avian productivity in urban landscapes: a review and meta-analysis. *Ibis*, *151*(1), 1-18. doi:10.1111/j.1474-919X.2008.00899.x
- Dunne, P. (2006). *Essential field guide companion: A comprehensive resource for identifying North American birds*. New York: Houghton Mifflin Company.
- Evans, K. L., Newson, S. E., & Gaston, K. J. (2009). Habitat influences on urban avian assemblages. *Ibis*, *151*(1), 19-39. doi:10.1111/j.1474-919X.2008.00898.x
- La Sorte, F. A., Tingley, M. W., & Hurlbert, A. H. (2014). The role of urban and agricultural areas during avian migration: an assessment of within-year temporal turnover. *Global Ecology & Biogeography*, *23*(11), 1225-1234. doi:10.1111/geb.12199
- Miranda, A. C., Schielzeth, H., Sonntag, T., & Partecke, J. (2013). Urbanization and its effects on personality traits: a result of microevolution or phenotypic plasticity? *Global Change Biology*, *19*(9), 2634-2644. doi:10.1111/gcb.12258
- Møller, A., Diaz, M., Flensted-Jensen, E., Grim, T., Ibáñez-Álamo, J., Jokimäki, J., & ... Tryjanowski, P. (2012). High urban population density of birds reflects their timing of urbanization. *Oecologia*, *170*(3), 867-875. doi:10.1007/s00442-012-2355-3
- Potter, E.F., Parnell, J.F., & Teulings, R.P. (1980). *Birds of the Carolinas*. Chapel Hill: The University of North Carolina Press.
- Zuckerberg, B., Bonter, D. N., Hochachka, W. M., Koenig, W. D., DeGaetano, A. T., & Dickinson, J. L. (2011). Climatic constraints on wintering bird distributions are modified by urbanization and weather. *Journal of Animal Ecology*, *80*(2), 403-413. doi:10.1111/j.1365-2656.2010.01780.x

## Appendix A

List of All Species Observed (in alphabetical order):

1. American Crow
2. American Goldfinch
3. American Robin
4. Blue Jay
5. Brown-headed Nuthatch
6. Carolina Chickadee
7. Carolina Wren
8. Chipping Sparrow
9. Common Grackle
10. Dark-eyed Junco
11. Eastern Bluebird
12. Eastern Phoebe
13. European Starling
14. House Finch
15. House Sparrow
16. Killdeer
17. Mourning Dove
18. Northern Cardinal
19. Northern Flicker
20. Northern Mockingbird
21. Red-bellied Woodpecker
22. Rock Pigeon
23. Ruby-crowned Kinglet
24. Song Sparrow
25. Tufted Titmouse
26. White-breasted Nuthatch
27. White-throated Sparrow
28. Yellow-bellied Sapsucker
29. Yellow-rumped Warbler