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Does Vegetation Density Affect Insect Populations? An Analysis of Insect Biodiversity on the Ouachita Baptist University Campus with essays: The Musings of a Wildlife Enthusiast

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SENIOR THESIS APPROVAL

This Honors thesis entitled

"Does Vegetation Density Affect Insect Populations? An Analysis of Insect Biodiversity on the Ouachita Baptist University Campus *with essays:* The Musings of a Wildlife Enthusiast"

written by

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and submitted in partial fulfillment of
the requirements for completion of
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meets the criteria for acceptance
and has been approved by the undersigned readers.

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Abstract

As insect populations continue to decrease worldwide, scientists are continuing to search for answers as to why their numbers have been decreasing for decades and how anthropogenic influences play a role. One possible deleterious effect is the clearing/removal of vegetation and overgrowth in environments where insect populations are high and may depend on said overgrowth for food and safety. This paper uses the data of a 2013 study conducted on the Ouachita Baptist University campus to compare how insect populations have changed from 2013 to 2024 in areas that have been cleared of overgrowth in between that time frame. Pitfall and pan traps were used and insects were identified to Order. The results of the study found that insect populations in the areas studied had decreased significantly in between studies (4,658 insects in 2013 compared to 1,446 in 2024). Diversity in insect Order had also decreased, as nine Orders present in 2013 were absent in 2024. These findings indicate that the clearing of overgrowth in the areas studied, as well as the passage of time, may have had a negative impact on the insect populations on campus.

Introduction

Insect populations are heavily dependent on surrounding vegetation, as it provides cover from the elements and predators as well as their source of food. In a study researching the species richness of insects in urban areas, Morpurgo et. al found that "…increasing vegetation density and plant richness led to higher insect diversity" (2024). The extent to which insects are dependent on specific vegetation availability varies, however. Many insects are monophagous, meaning they feed on only one species of plant. Bassi and Staude (2024) analyzed the relationship between insect population trends and their host-plant species and found that 16.4% of insects studied (bees, butterflies, sawflies, hoverflies, and moths) were monophagous.

Monophagous insects are more at risk of being affected by the clearing of vegetation and overgrowth because if their host plant is removed, they may be unable to feed on another plant left available.

This study is a continuation of a previous research study conducted at Ouachita Baptist University in 2013 by a student named Tyler Files. Files' research consisted of using pan traps and pitfall traps along Mill Creek, which runs through the Ouachita Baptist campus, and inside a ravine on campus grounds. Between the time Files' data was collected and this current study was conducted, the ravine on campus as well as a portion of Mill Creek was cleared of brush and cleaned out.

The research conducted by Files utilized pan traps (Styrofoam bowls) and pitfall traps (test tubes) to collect insects. Pitfall traps are a common method of insect trapping and are simple to set up and use. Pitfall traps consist of a cup or some other container dug into the ground so that the lip of the container is level with the ground or slightly below. Bait may be placed inside the container to increase the chances of collection, but none was used in File's study.

Files used 4-6 red and yellow pan traps along with 4 test tubes at each site. Pan traps are a popular means of insect collection as they remove collection bias and can be left out to collect samples for multiple days (Cane *et al.* 2000; Saunders *et al*. 2012). These traps are effective at capturing pollinating insects, especially when bowls are colored, as pollinators mistake the pan traps for flowers (Campbell and Hanula, 2007). González *et al*. (2019) found that a combination of pitfall and pan traps provided a more accurate representation of insect communities moving though forest-crop edges. While this study did not take place along forest-crop edges, traps were placed in areas where forest and walking paths and/or mowed fields intersected. As for what insects are most commonly found in pitfall and pan traps, in a 2018 study conducted in the

Mazumbai Forest Reserve in Tunisia by Emma Weisner, 61.34% of insects collected in yellow bowl pan traps were Hymenoptera and 23.19% were Diptera. As for pitfall traps, Coleoptera was the most abundant order collected, making up 32.56% of all insects collected in pitfall traps. A 2019 study conducted in Central Argentina found differing results from pan and pitfall traps. In this study, Coleoptera, Hemiptera, and Thysanoptera were best represented in pan traps, and Hymenoptera as well as some non-insect groups such as Araneae, Acari, and Collembola were best represented in pitfall traps (Gonzalez *et al*. 2019).

This study utilizes the same sites Files used as well as similar trapping methods to compare how insect biodiversity has changed since his 2013 study. The primary research questions of this study are as follows:

1. Has the clearing of vegetation in the ravine and a portion of the creek on campus, as well as the passage of time (approximately 10 years since the previous study) led to a decrease in the insect biodiversity on campus?
2. What is the general overview (identified to Order) of insect biodiversity on the Ouachita Baptist University campus?

Methods

Location Sampled

This study was conducted at Ouachita Baptist University in Arkadelphia, Arkansas from April 12, 2024, to May 17, 2024. Traps were placed at seven sites on campus, and the sites sampled were the same seven sites used in the 2013 study. GPS coordinates (Table 1) of the seven sites were available, and the sites were located using the IOS app “Coordinates” while cross-referencing the app with a map that had the sites marked. Three sites ran through a ravine located in the middle of the Ouachita Baptist University campus, and four sites were along Mill

Creek, which runs along a walking path on campus before continuing along near the practice football field. The first two sites along Mill Creek were next to a walking path, and the next two sites were in a secluded clearing near the practice football field.

Site A (Ravine)	Lat: 34.121616 Long: -93.05299
Site B (Ravine)	Lat: 34.12705 Long: -93.05084
Site C (Ravine)	Lat: 34.12755 Long: -93.05084
Site 1 (Mill Creek)	Lat: 34.13402 Long: -93.05703
Site 2 (Mill Creek)	Lat: 34.13545 Long: -93.05587
Site 3 (Mill Creek)	Lat: 34.13301 Long: -93.05298
Site 4 (Mill Creek)	Lat: 34.13129 Long: -93.05333

Table 1

Trapping

The traps used were chosen based on the traps used in the 2013 study. Pitfall traps and pan traps were used throughout the study. The pan traps consisted of Styrofoam bowls filled ¾ full with soapy water. Colored food dye was then added and mixed into the bowls. Two bowls were mixed with yellow food dye and two were mixed with red food dye. The pitfall traps were made using plastic cups dug into the ground with a trowel until the lip of the cups were flush with the ground, and a thin layer of soapy water was poured into the cups to kill insects that fell in.

At the Mill Creek sites (sites 1-4), four pan traps (two yellow and two red) and 3 pitfall traps were used at each site (*Figure 1*). At the ravine sites (sites A-C), four pan traps were used with the same specifications as the Mill Creek sites, and no pitfall traps were used due to the soil in the ravine being too rocky to effectively place pitfall traps.

Traps were set out and collected a total of six times over the course of the study. On average traps were left out for 5 to 6 days before being collected. When collected, insects were removed from the traps with a pair of forceps and placed in jars filled with 70% isopropyl alcohol. Jars were labeled with the name of the site they corresponded to and the date of collection.

Figure 1

Identification and Classification

The collected jars were later taken to the biology lab in the Harvey Jones Science Center at Ouachita Baptist University and collected insects were identified using a stereoscope. Insects were classified according to order, and the orders chosen were based on those used in the 2013 study. The one change made was the replacement of the order Dictyoptera with the order Blattodea. Dictyoptera is a super order which includes the orders Mantodea, Blattodea, and Isoptera. Isoptera was included separately along with Dictyoptera in the original study, thus Dictyoptera was replaced to avoid overlap.

Statistical Tests Conducted

Once the trapping was completed and all collected insects were identified, a two-sample t-test was performed to compare the number of insect orders between years. A one-way ANOVA was used to compare the number of insect orders among study sites used in 2024.The statistical

computing software R was used to perform these statistical analyses (R Core Team 2024). In order to determine if there was a significant difference in the orders sampled between the creek sites and ravine sites of this study, a chi-square goodness of fit test was run.

Results

Totals Collected

Throughout the duration of the study, 1,446 samples were collected consisting of 13 different orders (*Figure 2).* Of these 1,446, 520 samples were collected at the ravine sites and 926 from the creek sites. By contrast, the 2013 study had a total of 4,658 samples collected, with 1,486 samples from the ravine sites and 3,182 samples from the creek sites.

Figure 2

When comparing the 2024 data to the 2013 data, only the top 10 most abundant orders from each study were compared. A total of 9 shared orders were present in each study's top 10 most abundant orders, with the top 3 (Isopoda, Diptera, Hymenoptera) being the same for each

study (*Figure 3).* Evenness was calculated for both study's top 10 orders. E for 2024 was equal to 0.649, and E for 2013 was equal to 0.670.

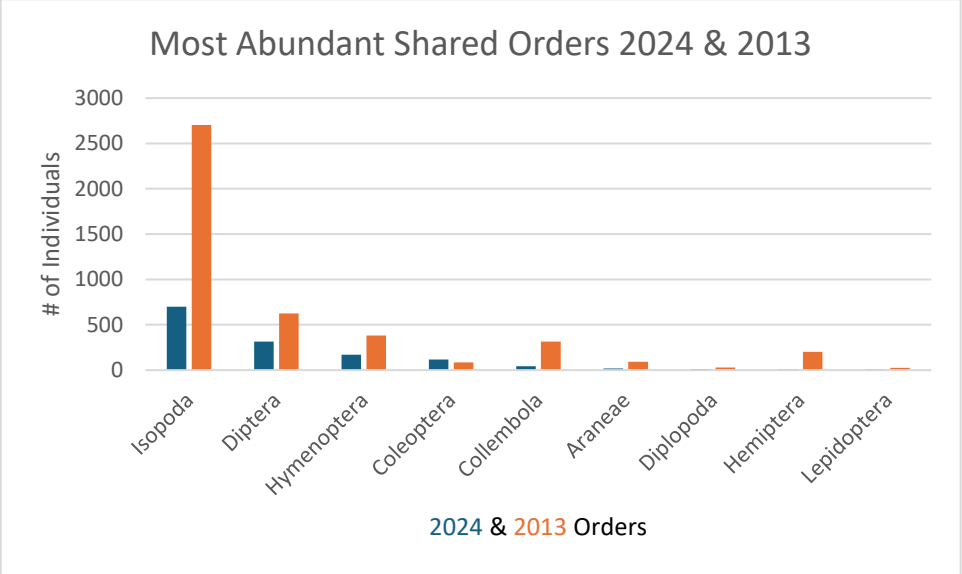

Figure 3

Chi Square Tests

The chi-square test used the number of shared orders between each site, with the two categories being "yes" for the number of orders shared between each site, and "no" for orders that were only present at one site. 9 Orders were shared between the two sites, and 3 were only found at one site. The chi-square test did not reveal a significant difference between the observed and expected numbers of shared orders between sites. $X^2 (1, n = 12) = 3, p = 0.083$.

A second chi-square test was conducted to compare the orders present in this study to the Orders present in the 2013 study. The two categories were once again "yes" and "no", with "yes" meaning an order was present in both studies and "no" meaning it was only present in one study. 12 orders were shared between the two studies, and 9 were only present in the 2013 study and not the 2024 study. The chi-square test did reveal a significant difference between the observed and expected numbers of shared orders between studies. $X^2 (1, n = 21) = .0429, p = 0.513$.

ANOVA Test

The one-way ANOVA compared the number of orders found at each site (sites A-C and 1-4) for the 2024 study (Figure 3). A significant difference among study sites was not found for the number of insect orders (F=1.10, df=6,33, P=0.38).

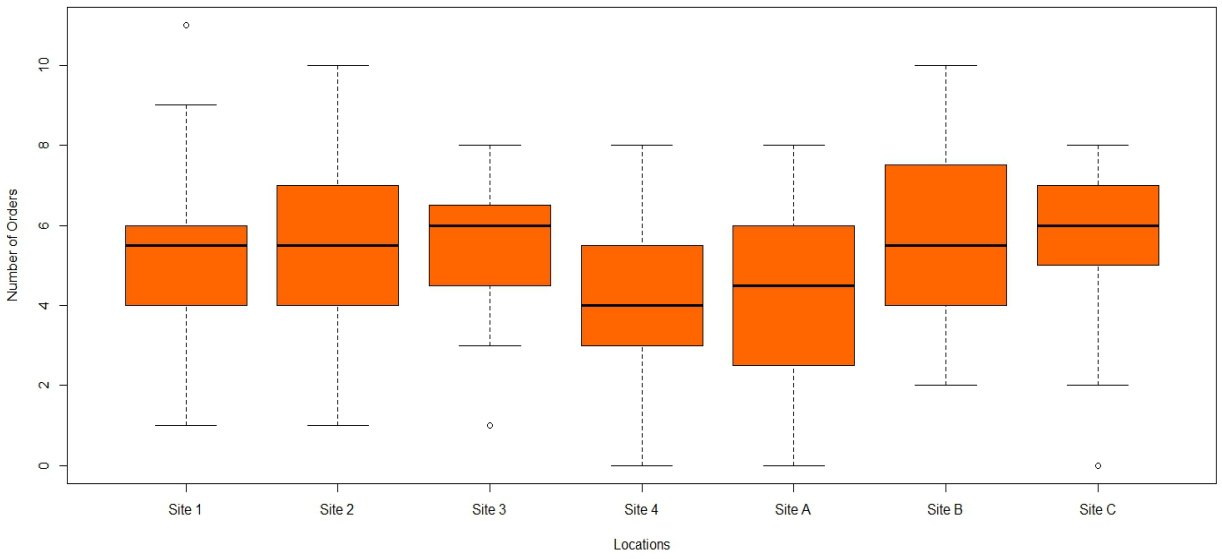

Figure 4

Two Sample T-Test

A Welch two-sample t-test comparing the number of insect orders among all sites in both the 2013 study and 2024 study was conducted (Figure 4). The mean for 2013 sites was 5.84 and the mean for 2024 sites was 4.05. There was a significant difference between years (t=4.73,

df=93.26, P<0.001).

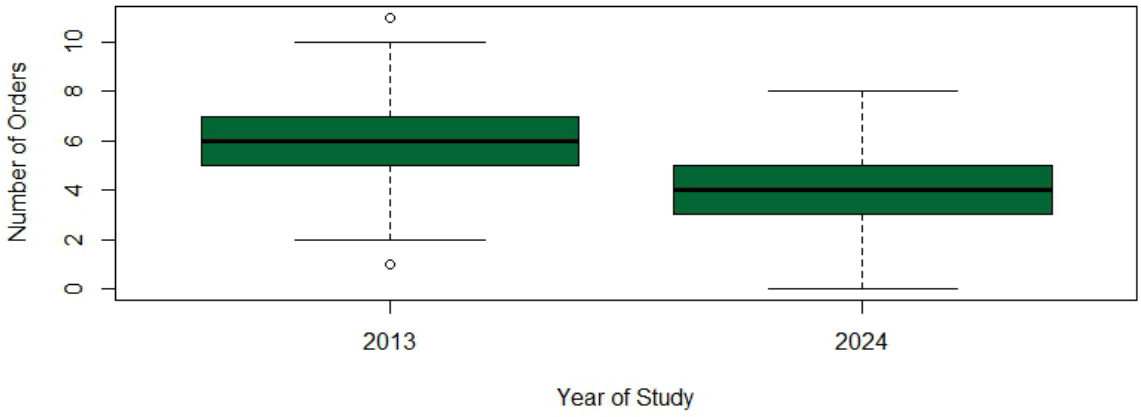

Figure 5

Discussion

Isopoda was the most abundant order collected by far, and most individuals were collected at sites 1 and 2 by Mill Creek. This tracks with the preferred habitat of pill bugs (*Armadillidiiae)* and sow bugs (*Porcellio)* which made up all of the Isopoda collected. Both of these insects breathe through gills and "…this requirement restricts pillbugs to areas where they can periodically find moist cover." (wci.extension.colostate.edu). Sites 1 and 2 were near areas covered in mulch that were regularly maintained by groundskeepers, thus making them ideal areas for isopods to congregate.

Notably, Orders such as Hemiptera, Orthoptera, and Lepidoptera were collected in small numbers during this study (7, 2, and 6 individuals respectively). Based on field observations while setting out and collecting the traps it is clear these Orders are well represented in the areas tested. This suggests that the traps used were not best for collecting these Orders of insects and that the amount collected does not accurately represent their abundance in the ravine nor Mill Creek.

Despite having significantly fewer insects collected in the 2024 study compared to the 2013 study, insect Order evenness remained largely the same between studies. When comparing the top ten most abundant Orders collected in each study, 9 out 10 Orders were the same between studies.

The first chi-square test conducted compared the number of shared orders between the ravine sites and creek sites for 2024, and it found that there was not a significant difference between sites. The Mill Creek sites were in more open areas and received more foot traffic as two of the sites were next to a walking/biking path and the other two sites were next to the football practice field. Conversely, the ravine sites were more secluded and in areas that received very little foot traffic. The Creek Sites were also closer to a water source than the Ravine sites besides Site B, which was located adjacent to a water runoff area. Despite these differences the shared orders remained similar, suggesting that the insects on campus are not confined to specific areas and move around freely. The one-way ANOVA test that was conducted compared the number of Orders found at all sites and supported the results of the first chi-square test, as it found there was no significant difference between sites as well.

The second chi-square test conducted compared the number of shared and unique orders collected between the 2024 study and 2013 study and found there was a significant difference between studies, as nine orders were collected in 2013 that were not collected in 2024. The two-sample T test also found a significant difference in the number of orders collected in 2013 compared to 2024.

These results show that there were significantly fewer insects collected in the 2024 study, as well as less diversity in Orders compared to the 2013 study. The same kind of traps were used in comparable numbers between studies, and each study ran from April to May. This suggests

that other factors influenced the sharp decline in insects collected from 2013 to 2024. As discussed previously, vegetation cover often plays a large role in how abundant insects will be, but this may not be the sole cause of the decline. In a 1997 study testing the impact of various vegetation treatments, plots were divided based on treatment which included a brushsaw treatment as well as two herbicide treatments. Compared to the control plot which received no treatment, results indicated that "…the vegetation management treatments had little effect on the majority of insects, Coleoptera, Carabidae and non-insectan arthropods tested" (Ward, 1997).

Changes in local weather during the time each study was conducted was likely not a factor. The average high temperature of Arkadelphia, Arkansas throughout April 2013 was 73.7 degrees Fahrenheit, compared to 74.43 in April of 2024. Average precipitation also did not vary significantly. Arkadelphia received 2.37 inches of rain in April 2013 compared to 3.02 in April 2024 (usclimatedata.com and wunderground.com).

Studies have shown that insect populations have been declining for decades, with many anthropogenic stressors such as pollution, insecticides, deforestation, and urbanization described as primary causes for their decline (pnas.org). However, research also suggests that insects are in decline even in areas not affected by human influence. In a 35-year study ran from 1986 to 2020 in a protected meadow in Colorado, insect abundance declined by 61.5% over the course of the study (Dalton *et al*. 2023). While only a decade passed between studies, it is reasonable to assume some degree of insect decline occurred between studies.

With this in mind, it is possible that a combination of factors led to the decline in insects on the OBU campus between studies. Both the clearing of vegetation as well as a general decline in insect abundance may be to blame, but the extent to which either factor influenced the decline cannot be determined.

Citations

"Arkadelphia, AR Weather History" https://www.wunderground.com/history/monthly/us/ar/arkadelphia/KADF/date/2023-2 (Accessed March 29, 2025)

Bassi MIE and Staude IR. "Insects decline with host plants but coextinctions may be limited." Proc. Natl. Acad. Sci. U.S.A. 121 (44) e2417408121, https://doi.org/10.1073/pnas.2417408121 (2024).

Campbell JW, Hanula JL. "Efficiency of Malaise traps and colored pan traps for collecting flower visiting insects from three forested ecosystems." *J Insect Conserv* **11**, 399–408 (2007). https://www.fs.usda.gov/research/treesearch/31451

Cane JH, Minckley RL and Kervin LT. 2000. "Sampling bees (Hymenoptera: Apiformes) for pollinator community studies: pitfalls of pan-trapping." *Journal of the Kansas Entomological Society* 73, 225–231.

"Colorado Crustacean of Interest: Pillbug 'Roly-poly'". https://wci.extension.colostate.edu/wp-content/uploads/sites/14/2017/05/Pillbug.pdf

Dalton RM, Underwood NC, Inouye DW, Soulé ME, Inouye BD. 2023. "Long-Term Declines in Insect Abundance and Biomass in a Subalpine Habitat." *Ecosphere* 14(8): e4620. https://doi.org/10.1002/ecs2.4620

Files, Tyler. Unpublished Data, Jim Taylor's lab, OBU, 2013.

González E, Salvo A, Valladares G. "Insects Moving through Forest- Crop Edges: A Comparison among Sampling Methods." *Journal of Insect Conservation*, vol. 24, no. 2, 2020, pp. 249-258. *ProQuest*, https://obu.idm.oclc.org/login?url=https://www.proquest.com/scholarly-journals/insects-moving-through-forest-crop-edges/docview/2384396990/se-2

Morpurgo J, Huurdeman MA, Oostermeijer JGB, Remme RP. "Vegetation density is the main driver of insect species richness and diversity in small private urban front gardens." *Urban Forestry & Urban Greening*, Volume 101, 2024, 128531, ISSN 1618-8667, https://doi.org/10.1016/j.ufug.2024.128531.

R Core Team (2024). _R: A Language and Environment for Statistical Computing_. R Foundation for Statistical Computing, Vienna, Austria. https://www.R-project.org/.

Saji A, Al Dhaheri S. "Ecological Distribution and Seasonality of Darkling Beetles (Coleoptera: Tenebrionidae) in the Western Region of Abu Dhabi, UAE." *Middle-East Journal of Scientific Research*, 9(6), 2011, 704-710. https://scispace.com/pdf/ecological-distribution-and-seasonality-of-darkling-beetles-bzz7dhuwue.pdf

Saunders M.E. and Luck G.W. “Pan trap catches vary with habitat.” *Australian Journal of Entomology*, 52, 2013, 106-113. https://doi-org.obu.idm.oclc.org/10.1111/aen.12008

Ward J.L. “The Effects of Alternative Vegetation Management Treatments on Epigeal insects, Coleoptera, Carabidae and Non-insectan Arthropods.” Advisor: Dr. Y.H. Prevost, 1997. https://knowledgecommons.lakeheadu.ca/jspui/bitstream/2453/2549/1/WardJ1997m-1b.pdf

“Weather history Arkadelphia – April 2013” https://www.usclimatedata.com/climate/arkadelphia/arkansas/united-states/usar0016 (Accessed March 29, 2025)

Weisner E, "An Inordinate Fondness for Beetles: A Study of Insect Species Diversity and Abundance in Mazumbai Forest Reserve Versus Nearby Agricultural Areas" Independent Study Project (ISP) Collection. 2872, 2018. https://digitalcollections.sit.edu/isp_collection/2872

Kingdom Animalia: The Musing of a Wildlife Enthusiast

Preface

For the past two years my life has been changed for the better, and significantly so, thanks in large part to my discovery of my love to write and the encouragement I have received through the English department at OBU. Becoming a member of "The Bugtruck", as it is so affectionately referred to, has introduced me to a number of fantastic people and opened up opportunities I had never considered possible. "The Bugtruck" is a particularly apt name in my case, as I hope to use the writing skills I have developed in conjunction with my natural sciences background to write about nature (especially bugs) in a way that engages readers that may not already have a science background.

This series of essays serves as a reflective work looking back on experiences that have shaped me into the person I am today and led me to pursuing a wildlife-related career, as well as an exercise in writing about nature in a way that integrates my sciences background with my creative writing interests. I would like to thank Doug and Amy Sonheim, Dr. Utter, Professor Smith, Dr. Wink, Professor Pittman, and the rest of the English department for your continued guidance and encouragement that made this work possible.

Ham on an Ant Mound

It is winter now, at least, winter for Arkansans. It is January 1st and yet the high for today was 47 degrees Fahrenheit. Chilly enough for me. While I do dislike the cold, I most dislike what the cold brings: silence. There are no cicadas humming in the heat of the afternoon or dragonflies

buzzing in a pack at eye level through the yard. Crickets no longer chirp at night and the bullfrogs in the pond down the road are buried in the sediment. I take solace in silence, but not this kind. The silence I crave is not truly even silence, just a reprieve from the busyness of daily life. Give me the moss-covered log in the clearing and let me soak in the sounds of the life around me. That is the silence I wish for right now.

I find myself looking towards the past more and more. A symptom of the cold I suppose. Or because of the creeping and ever-growing feeling that my life will soon be very different. So different that I can never go back to the way things were. In a few short weeks I will begin my final semester of college, and in the blink of an eye I will hopefully be in graduate school. I may find myself living just a few hours away in northern Arkansas, or across the country in Washington, separated from my old life by the Rocky Mountains and many miles.

I try to force myself to be more present. “Savor every moment!” I cry to myself, but it tends to fall on deaf ears. Each day is just passing time. The cold. The cold. 47 degrees of dreadful cold.

One of my closest friends has just graduated college and is now preparing for a job an hour away. He may be moving soon. Not far, sure, but far enough that seeing him will be more of a hassle. And soon enough I will be moving even farther away. I look at him and I see a man, and I am sure he sees a man in me as well. But for just a moment when I am with him he is that little boy I grew up with. Every Sunday after church I would beg my mother profusely to let me go over to his house. I was persistent, and while I never stooped so low as to get on my knees and plead, I suspect I got awfully close at times. We would spend the entire day outside. For some reason, we would only wear boxer briefs while doing so. I never quite knew why, but I went along with him. One of my most vivid memories is the day he and his father tried to teach

me how to ride a bike. I remember hopping on his bike, donning a pair of boxer briefs and nothing else, and riding (if you can call it that) shakily down his driveway. Yet for some reason, this memory has always been in the form of me watching myself as I wobble down the driveway, not through my own eyes.

Most of our time was spent catching bugs. I remember one afternoon we took it upon ourselves to become the benefactors of a towering fire ant colony in his yard. Making it the one colony to rule them all was the goal. And of course, what more does a horde of fire ants need more than food? We set out to catch as many grasshoppers and crickets as we could to satiate their hunger, yet it seemed to not be enough. At some point we took a slab of ham out of his fridge to feed them. I can't recall if his parents gave us permission for that offering, but I suspect not. Despite our heap of blessings upon the mound, for some reason we concluded our quest by peeing on top of the fire ant mound side by side. I laugh even now thinking about it. I don't think there is a better image one could conjure of boyhood in the south than that of peeing on a fire ant mound.

Vacation Spider

For a number of years, each summer meant a new hyper fixation. In truth, not all that much has changed now. I just have too many interests and there is not enough time in the day to become a master at one. I still try to convince myself to keep taking photos, keep writing, keep reading, keep watching films, and perhaps most fervently, keep forcing myself to put all that aside and appreciate the wilderness.

One of the first summers that was marked by a particular interest was over a decade ago. I don't remember how it started, but I became certifiably obsessed with jumping spiders. They are unique from your everyday spider, the ones that spin their webs as the sun sets and lead to

you inevitably walking face first into their webs when night has fallen. Jumping spiders do not create webs, instead they actively hunt for their prey, and secure their meals in a manner you'd be hard pressed to guess: jumping.

I suspect that I may have first become interested in them after seeing some macro photography photos of their faces. At least in my opinion, and the opinion of anyone worth trusting, jumping spiders have the cutest faces of any arachnid. In the macro shots I came upon, the spider's front four eyes are prominent, with the middle pair large and black, full of curiosity not unlike a puppy. Their fangs are often beautifully colored, a bright turquoise or deep maroon, and their pedipalps sit next to them looking like fuzzy caterpillars.

After seeing enough of these photos, I became convinced that I needed one as a pet. I spent hours researching the spiders on my iPad. What they eat, where they're found, and how you care for them. Not long after, I caught a beautiful *Phidippus audax* (commonly referred to as the bold jumper) female. She received a spectacular enclosure and an equally unspectacular name. Charlotte was kept in a repurposed hermit crab cage, filled an inch or two with dirt with a fake plant and plenty of bark and sticks to give her room to leap between and create a hide.

Each day I sprayed her enclosure down with a spray bottle of water to maintain the humidity and give her something to drink. For food, I would usually catch a fly inside or a moth from the front porch. Watching her stalk her meal and eventually make the killing leap never got old. Once I even fed her a honeybee. It was bigger than she was yet she grabbed hold of it and ate it all the same. Now, I regret giving her something that could potentially hurt her, but at that time all I could think was how unbelievably cool that was.

Charlotte the spider became very important to me. So important that when my family went on a short vacation to Branson, Missouri that summer, she and her hermit crab cage had to

come along. Just about the only thing I remember from that trip was waking up in the hotel room in the morning to spray down her enclosure.

As the summer progressed, Charlotte's abdomen continued to grow until it was much larger than the rest of her, and I realized that she must be gravid. Not long after, she retreated into her hide in a corner of the lid. The hide was a tunnel of silk, so thick that you could hardly see through it. On one end was an opening for her to crawl into, and the inside was large enough for her to move around inside. After a few days of non-activity, a number of black specks were visible inside the hide. For a time, the spiders were too young to venture on their own and thus resided inside the hide.

Unfortunately, Charlotte's summer ended the way many a spider's does. A few weeks after her offspring hatched she died, and I opened up the cage and left it outside to let her hatchlings venture off into the world.

Every summer from then on I have kept an eye open specifically for jumping spiders, and each time I see one I fight the urge to keep it. I try to take a more hands-off approach to wildlife now that I have grown older and thus defer to observing them instead. Although, I won't hesitate to stop what I'm doing and catch a meal and bring it to them when I can.

Ant-Induced Insanity

Arkansas weather seems to still keep the invasive fire ants on their toes. It is in the 20s today, cold enough for the colonies littered across the yard to be in diapause, the ant form of hibernation in which their bodies metabolism slows. But just a few days prior it was in the 50s, warm enough to perhaps make the ants believe winter is over and they can return to the upper levels of their nests. I find myself missing their presence. Not so that I can pee on their nests I assure you. I miss them because with the fire ants comes the native ants as well. Big-headed ants,

fungus-cultivators, carpenter ants, and many more are staples of my summers now, all thanks to another summer in my early teenage years marked by a hyper fixation.

Unlike the summer of spiders, I don't remember what started my interest in ants. If I had to guess, it was from spending time crouched down on all fours in the yard as I watched a colony of fungus cultivating ants travel in a line, carrying leaves 3 times the size of their little bodies back to the nest. Their scientific name is *Trachymyrmex septentrionalis,* and they are perhaps the most interesting ants one can find in Arkansas. When an alate ant (a winged, female ant capable of becoming a queen) leaves her home colony to mate with a drone, she brings with her a barely visible, white speck on her abdomen. This speck is a piece of fungus taken from her home colony, which will be cultivated by her future workers and grow into a fist-sized ball of fungus that is the lifeblood of their colony. The ants I observed carrying leaves were bringing them to feed the fungus, which in turn feeds the ants.

Once I became interested in the ants in my yard, I began to watch for nuptial flights after every rainstorm. A nuptial flight is an annual occasion that every ant colony undergoes, in which the aforementioned alate females and fertile drones take flight to breed with other colonies. The males die not long after serving their purpose, and females that were successfully fertilized will shed their wings and search for a place to begin their own kingdom. I remember obsessively keeping up with these flights. Each time I witnessed one, whether that be a *Trachymyrmex* colony or that of another genus such as *Pheidole or Aphaenogaster,* I would take a video of their flight and make an entry in my notes of what species of ant it was, the date they flew, and the GPS coordinates of the colony. Truth be told I have no idea why I did this, but when I become interested in something, I don’t take it lightly.

To supplement my field observations, I of course needed to do the proper research. I spent hours on ant forums online, reading the posts of actual myrmecologists as they identified various species of ants. I also purchased a book which included microscope photos and keys for identifying every single known species of ant in the United States. This book has proved helpful, as I used it once more this past summer for my thesis research.

After reading enough posts online and seeing YouTube videos of people rearing ant colonies, I decided the next natural step was to raise a colony of my own. I began by trying to raise a colony from scratch with only a fertilized queen. The tried-and-true method of raising queens doesn't require much, with the hardest and most important item to acquire being the queen itself. Now that I was a seasoned veteran at tracking their flights, finding the queens was easy. To house them you need a test tube filled ¼ of the way with water. Next, shove a cotton ball down the tube far enough that it becomes saturated, but not so much that it absorbs all the water. Each queen should be housed in her own test tube, in an area that is dark and free of much disturbance. Before long I had myself a number of queens stored in test tubes in my room. However, I quickly realized I was in over my head. Feeding the queens was a challenge. While the queen and her first batch of workers don't require much sustenance, they do need to be fed occasionally. An experienced scientist would make a needle-sized hole in the lid of the tube and feed the ants via a liquid solution in a syringe, but this was not an option for me. I instead tried opening the tubes to quickly place a dead insect inside, but this quickly failed. It stressed the queens too much, and they all died along with their first batch of worker ants.

These failures did not discourage me, instead they only fueled my insanity further. If I couldn't raise a colony from scratch, the natural next step was to acquire an already established one. The first step was to find something to house my future ant empire in. Luckily for me, if you

can imagine it, it definitely exists somewhere on the internet. I quickly found a company online that made quality ant enclosures, and even now I find them unbelievably cool. The enclosure consists of two separate structures connected by a tube. The first is a clear plastic box. The floor was coated with sand and included fake plants and raised areas to give the ants more room to roam. This was to be their foraging area where they were fed and allowed the ants to roam around and search for it. This box was about the size of a hermit crab cage. Connected to that was the "nest". It was a hand-molded collection of tunnels, with the bottom layer of tunnels designed to be the "founding chamber" where the queen resides. In this chamber were two water reserves which could be filled with a syringe. Above this chamber were more layers of chambers to give the ants room to assign chambers for different duties, such as a waste chamber and one for larvae storage. The enclosure itself was called a formicarium, named after the taxonomic family ants belong to - Formicidae.

I convinced my family to buy me one for my birthday, and next came the task of getting a colony. Of course, one could buy a colony online consisting of a queen with a few dozen workers, but I preferred to do it myself. I soon found an abandoned flowerpot in the woods next to the house. It was still filled with potting soil and contained a colony of *Aphaenogaster* ants, which I later determined were of the species *Aphaenogaster tennesseensis* thanks to my ant book. This flowerpot may as well have been a pot of gold, as it was perhaps my only chance of acquiring a colony. One can imagine the difficulty of trying to shovel out a nest in the ground and actually finding the queen, but this was a more confined space. As long as I was careful, the queen had to be somewhere in this pot.

What followed was over two hours of insanity and determination. I sat myself down on the front porch, ant-infested flowerpot in front of me. Beside me was a collection of glass jars, a

trowel, and a pair of soft-grip forceps. Little by little I scooped away the dirt, scattering on the concrete of the porch so the ants inside were easier to see. Then, with quick jabs I picked up every worker ant I could with the forceps and dropped them into a jar. Luckily this colony was far from its maximum size of several thousand workers and was closer to three hundred. Despite its relatively small size, collecting nearly every worker was still a painstaking process. At last, with several jars already teeming with ants and larvae and dirt scattered all over the porch, I caught site of the queen at the bottom of the pot and scooped her up as well.

At last, I had an ant colony of my own and moved them into the formicarium. After a couple of days the colony had seemed to settle in nicely. Above the water tanks lay the queen, hidden beneath a mass of workers whose sole goal in life was to keep her safe. Along with the queen lay all the eggs and larvae of the colony, their future. The most traffic took place on the floor above the water tanks, as it connected to the feeding area. Here there was a constant bustling of movement, as ants carried food, waste, fallen brethren, and larvae around the nest. I quickly discovered the top floor had become the waste area. It may seem surprising, but ants are exceptionally organized creatures, dedicated rooms and tunnels of their nests for specific purposes. One corner of the upper level had become the designated area for food waste, which somehow never became moldy. In the opposite corner was the graveyard, as the ants dumped every worker that reached the end of his life into this mass grave.

I enjoyed watching my hard-earned colony for nearly a month. But then, as I came to check on them one morning, I found the entire formicarium to be empty. There was not a single ant in sight. The cotton balls blocking the extra entrances still seemed secure, but the ants had managed to escape nevertheless. And thus, my summer of obsession with ants ended with having to gently tell my mother that a colony of over 300 ants was loose somewhere in the house.

Torturer Turtles

After a short spell of wintry weather that included freezing rain and temperatures far too low for an Arkansas resident to endure, today was a return to normalcy with temperatures rising to the high 40s. Now that the chill had passed, I decided to check on the turtles this afternoon to see how they fared in the weather. It appears they have thawed out in the water, with just a thin layer of ice remaining in their little pond. They have spent the whole winter in their pond, freezing and unfreezing multiple times now. I suspect they chose to brumate in the water instead of burying in the ground because the temperature underwater varies less. As any Arkansan knows, the weather can be an indecisive fellow. And indecisive weather can be a bothersome thing for a box turtle trying to brumate over winter, as their metabolism slows to a crawl, and they cease to move almost entirely. If the temperature suddenly rises high enough, they may suspect it's time to awaken, only to be driven back underground the next day when temperatures fall. The water lessens this issue, as its temperature adjusts more slowly, allowing the turtles to remain in their slumber until April.

My experience with these box turtles began about 13 years ago. My mother called me outside to look by the hydrangea bush in the front yard, and next to it I found a baby box turtle the size of a gold dollar coin. Of course, being a nine-year-old boy who loved animals, I decided immediately I would be keeping it as a pet. Immediately following this decision was a second: His name would be Mikey, named after the orange bandana wearing and pizza-loving teenage mutant ninja turtle.

Now that I was in possession of one box turtle, word spread to family members, and I quickly found myself with two or three adults as well. Their temporary homes of storage totes

filled with dirt, moss, and a water dish wouldn't do, and before long I had assembled a team of relatives to help build a turtle habitat fit for reptile royalty.

After scouring YouTube for ideas on outdoor turtle habitats, I soon had an idea of how my own turtle paradise should look and set off directing my family's efforts to build it like a seasoned foreman. The enclosure was built outdoors and was made of wood and wire mesh. In each corner were two wooden posts placed diagonally with one another to offer increased support, and they were driven into the ground for stability. We then dug out the ground in between the posts nearly two feet deep, allowing us to connect boards to the posts underground and line the floor of the enclosure with wire mesh and rocks to prevent them from digging out. We then filled the floor with a mix of sand and dirt, lined the sides with more boards working their way up to the lip of the posts, and created a hinged lid with mesh in the middle so you could easily see inside. The enclosure ended up being 6x4 feet and gave them plenty of room to roam. Their swimming area was a large tin water bowl, and we used flowerpots dug halfway underground to act as hides.

My collection of turtles named almost solely after Marvel characters or teenage mutant ninja turtles slowly grew, but not without a handful of hiccups. I can recall one summer afternoon when I went out to check on them to find one turtle mounted on top of another, and naturally my young mind thought they must be fighting. Rather than the birds and the bees, turtles were my introduction to the concept of sex.

I quickly realized that box turtles are not slow at all, and can in fact be blazing fast, especially when they are motivated by an earthworm. Worms became a sacred delicacy to my turtles, as I focused on giving them a balanced diet of veggies while mixing in the occasional fruits and insect treats. When I dropped an earthworm down for them to find, two turtles would

grab it on both ends and promptly speed off in opposite directions, turning one worm into two. Rather than being drawn and quartered, the tortuous turtles opted to bite and halve the poor worms.

The most tenacious of my turtles were two females, April and Gertrude. The latter was named by my mother, although I have no idea where the name came from. While the name's origins may have been ambiguous, it was befitting for her personality that could quickly be summarized as quite bitchy. The two of them would run laps around the enclosure as they chased after the worm in the other's mouth. And when one of them finally managed to take hold of the worm in the other's mouth, rather than going their separate directions and enjoying their halves, the turtle whose worm was split in two would instead chase after their stolen half.

Gertrude's meanness continued mostly harmlessly and provided ample entertainment (besides the time she bit my finger mistaking it for a worm) until the day she got a bit too rude and was evicted from the enclosure. I had fed them a mix of cabbage and some fruit that I can no longer remember, and the turtles formed a circle around the food as they all ate their share. I looked away for a few moments and when I looked back, I saw poor little Mikey with his head nowhere to be seen, replaced by a growing pool of blood. The turtle nearest him was Gertrude, and I quickly surmised that this wicked witch had beheaded him as she reached for some food. I was around 10 or 11 at this time and was probably much too young to witness a turtle lose his head. First inspired by the English and their methods of drawing and quartering, it seems her latest method of execution had come from the French. I picked up poor Mikey, still not much larger than a dollar gold coin, and rushed him inside to wash away the blood and hope his head was not truly gone. Luckily, his head remained intact and largely seemed okay, but it was clear his right eye had been damaged.

Gertrude was kicked out, and Mikey was separated into his own enclosure while he recovered. I kept his eye clean and disinfected with eye drops often, and he largely seemed to recover just fine. He was quickly back to being his spry self. However, once he started eating again, I quickly realized he had not escaped the ordeal unscathed. Despite his eye appearing to heal just fine, it was clear he was now blind in his right eye. Feeding the turtles for the next several years was always a hoot, as I had to move Mikey to his own little corner and drop a worm on the left side of him so he could find it. Mikey lived for nearly a decade, until one winter a few years ago when he never returned to the surface when spring came.

Taking care of hatchlings was also quite a learning curve. In the late summer months, the turtles would breed often and lay their eggs around August. The eggs would hatch just before the turtles buried up for the winter, and thus the hatchlings often didn't have their first meal until Spring. It did not take long for me to realize just how fragile the hatchlings were. When box turtles are young their plastron is not fully developed and lacks the hinge in the front that allows them to fully retract into their shells. Their shells are also much softer in the first few months of life, making them more susceptible to being injured. I discovered this by once again being permanently scarred by my turtle's behavior. Apparently, the adult turtles paid no mind to the hatchlings and walked right over them. Due to their weak shells, this was the equivalent of a bulldozer rolling over a person. After finding a couple of pancake-shaped baby turtles, I began to keep them in a separate enclosure until I released them into the wild to fend for themselves.

Today I have fewer turtles than I once did - eight adults plus the hatchlings that get released each year if they survive the winter. They live in a new enclosure outside which includes a nicely upgraded pond. Rather than a large tin water bowl, they have a full pond made out of pond liner that I cut to fit inside the enclosure. The bottom is lined with rocks, allowing

them to easily climb out while also providing natural nail trimmers. It even includes a small pond filter that runs all summer long, It appears to be a big hit, as almost every turtle overwinters inside. A few toads and bullfrogs have also taken up residence in or near the pond, and I hope to see them soon.

Their future remains a bit uncertain, as I know soon I won't be around to take care of them. My hope is that my parents continue to take care of them until I one day have a house of my own that I can relocate them too. They will live long enough that even my future grandchildren could enjoy them, and I hope that becomes reality.

A New Lens

The days continue to get warmer, and the leaves overhead and the grass underfoot begins to stir more and more. The silence of winter is ending. Soon I can soak up the solitude I've longed for between the trees. A long time ago I realized just how much the forest moves, but you have to be perfectly still yourself to see it. I was walking a trail at a brisk pace, and began to wonder where all the wildlife was. I had hardly seen a thing. So I paused, stood perfectly still and silent, and waited. As each moment passed I began to notice more and more around me. A line of black carpenter ants, *Camponotus pennsylvanicus,* travel up an oak tree beside me. A skink crawls around under the foliage. I can't see it, but the sounds of its moving are unmistakable. Craneflies move between the foliage for as far as I can see, their transparent wings catching in the sunlight.

From then on, every time I walk a trail I will pause a few times during the walk to take count of just how much is around me. I could use one of those moments now. Life has been so busy that I have begun to forget what is around me, instead blazing forward on a trail that has no

end in sight. I need to enjoy the things around me while they're still here, both the people and the insects.

Looking back on past summers and their accompanying fixations on a bug or other animal, I sometimes wonder if I will be able to rediscover that childlike sense of wonder. That drive and fervor to know every single thing I possibly can about something. Somedays I think that I have put my hand into too many metaphorical pots: wildlife, photography, writing, reading, watching and analyzing films, and what have you, that I won't ever be able to fully sink my teeth into a singular interest again. Oh the horrors of daily responsibility and the passage of time. But then I have to convince myself that I don't need to be a master or the greatest at everything I am interested in. Instead, I can utilize my varied interests together, combine them to create something new and transformative. A spider web of interests if you will, all linked together to form my unique skill set to offer the world. I continue to hope that I can use my writing to draw more people outside, to appreciate the things they have left ignored. Mary Oliver, Annie Dillard, and others have inspired me, and I pray that I can do the same for others. I have found that writing poetry has altered the way I view nature myself. The woods is no longer just a place to look for bugs and relax, but a place overflowing with sounds and images that can be used to speak about emotions and experiences everyone feels. So I know that I won't cease to be fascinated by the natural world around me anytime soon, for it is not just a series of hyper fixations for me anymore, it's my avenue to write about the human experience from my own unique lens.