FOREST COMPOSITION AFFECTS ACTIVITY LEVELS AND ABUNDANCE OF MAMMALS

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ABSTRACT

Forest composition is affected by both human disturbance and wildlife that graze understory vegetation. Areas experiencing browsed vegetation and human impact affect species richness and diversity. By using a trail camera trap study to observe what species are present and creating 10x10m quadrats to collect data on forest composition in 6 different sites on Purchase Campus we can analyze how differing levels of vegetation affects mammal species present. Forest composition does not influence activity levels of mammals throughout the day, it does however influence the species richness and abundance. There is also a strong correlation between un-browsed natural areas and wildlife diversity.

Key Words – Abundance; Activity Levels; Forest Composition; Mammals; Trail Camera.

INTRODUCTION

Urbanization and development of natural lands increases to accommodate growing populations which results in the fragmentation and loss of habitat for many native species (Dunagan et al. 2019, Forrest and St. Clair 2006). This global problem affects species in every country. As a result, biodiversity is decreasing dramatically across the world due to human interference and destruction of wildlife habitat (Steinbeiser et al. 2019). This rapid human expansion also impacts the spatial distribution of wildlife and therefore affects the daily patterns of wildlife (Gaynor et al. 2018). It is common for wildlife disturbance to drive animals out of their home territories or force them to adapt to their new ones. While many species use avoidance tactics when interacting with humans, it is believed that species who are more tolerant to humans will experience an increase in their populations. With such an increase in human disturbances and presence in nature many mammals, birds, and lizards are becoming more receptive and tolerant of humans approaching (Samia et al. 2015).

When natural areas contain human-modified landscapes or manicured habitats where much of the native vegetation has been removed or replaced, species richness and diversity are at their lowest. Areas with large amounts of mowed habitat contain fewer small mammal species than areas left undisturbed (Mahan and O'Connell 2005). When forested areas become fragmented due to human interference it is much more likely for invasive species to take over the

area. While this provides more cover for small mammal species such as mice, it is ultimately harmful to the environment and biodiversity as a whole.

Deer oftentimes can influence the types of plant species available in an area. With deer present, it is less likely for certain invasive species to be found in an area than when deer are absent. The presence of deer also affects the composition of the understory, with there being much denser shrubs and saplings when there is an absence of deer. (Martin et al. 2010). Deer browsing can dramatically alter young woodland composition and therefore affect the habitat quality for species who are reliant on understory vegetation (Holt et al. 2013). Browsed vegetation and areas that naturally have less undergrowth are more likely to have a lower diversity of mammal species.

To better understand the effects of forest composition and how it affects the activity levels and abundance of mammals we set up a camera trapping study to observe the wildlife as well as set up 10x10m quadrats at each of our sites to study forest composition. I hypothesize that forests and forest fragments with a higher invasive species population and thicker undergrowth will have a higher abundance of wildlife.

METHODS

Study Area

This study was conducted on the SUNY Purchase College Campus in Harrison, NY. Forests and forest fragments for this study were chosen based on where a trail passed through each site. Two of the sites – Alumni and Music – were located on the Northern half of campus and were composed of an old growth forest with little to no invasive species present. The other four sites – East 1, Loop, Softball, and Woods – were located on the Southern half of campus and were forest fragments that were significantly younger with many invasive species present and were much narrower.

Using Google Earth Pro, rough measurements for each site were taken with the Northern sites being much larger than the Southern sites. Alumni was 5.9ha in size while Music was 1.76ha. For the Southern sites, the smallest forest fragments were East 1 and Softball which were both 0.42ha, followed by Woods at 0.66ha, and the largest being Loop with a size of 1.37ha.

Field Sampling

At each site, between 1 and 3 quadrats were constructed. These quadrats were 10x10m and at least 15m apart. Each quadrat was then split into four equal sections. In each sub-quadrat the strata level scores were calculated based on the density of vegetation present at different levels and then given a score (Table 1). At each site the level of invasive species present was also measured using the same scoring method. The GPS location was also taken at the center of each quadrat at each site using the Survey123 App (Figure 1).

Each site was then equipped with a Browning Trail Camera (Model BTC-5HDP). The trail cameras were set at around 0.5m in height facing the trails. For the first week of data collection the camera settings were set to a 1 second capture delay with the multishot rapid fire 5 shot setting with power save mode turned on. After the initial data was collected the camera settings were changed to a 1 second capture delay with multishot turned off, and the flash was changed from IR to fast motion. These were the settings kept for the rest of the survey. The data collection period ran from September 19 to October 21, 2022.

After the initial medium sized mammal study concluded the trail cameras were then moved off trail and deeper into the forest or forest fragment at each site. We chose areas with some underbrush that wasn't overcrowded and set the cameras a few inches off the ground to begin the baited trap survey. After moving the cameras, the same settings were kept as before, and a mixture of meal worms and mixed bird seed were left in front of the cameras to encourage small mammal interaction. This data collection period ran from October 21 to the 22, 2022.

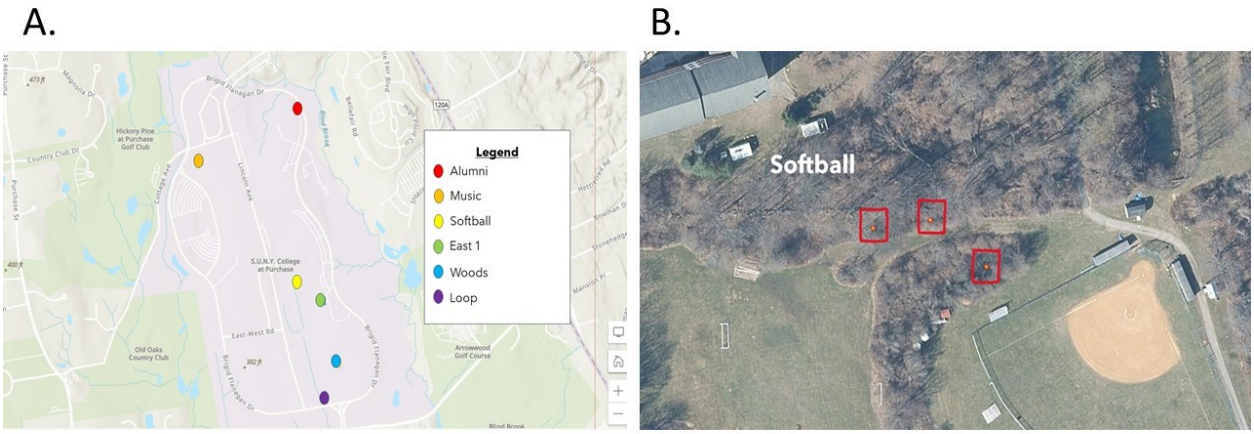

Figure 1. A.) A map of Purchase College showing where GPS measurements were taken for each of the 6 sites. B.) Showing how quadrats were constructed at each site.

Analysis

After conducting the strata level analysis, and level of invasive species present the data was then input into RStudio to create box and whisker plots for each of the study sites. For the medium mammal data, the photos had to first be analyzed. The data was broken down hour by hour throughout each day. Each time an animal disturbance occurred it was counted as an event, and each individual mammal was counted. If an animal was captured within one minute of

exiting the frame and then re-entering it was counted as one event during the hour but counted as two events if the hour changed in between sightings. After analyzing all the photos the results were then put into Microsoft Excel to organize the data. Afterwards RStudio was once again used to create bar graphs to display the activity level of the animals during the study. For the small mammal data, the photos also needed to be looked at individually. We counted each individual photo taken of the mammal for as long as they were in frame. This was done by the day and night cycle and not by the hour – it was considered nighttime when the trail cameras started taking photos with night vision. We also counted the maximum number of the same species present in each photo and used that to track abundance and Shannon diversity.

Table 1. A.) The four different levels of strata measured at each site. B.) The scoring system used when ranking each level of strata.

A.

Number	Strata (m)	Plant Group
1 – Low	<0.5	Grasses, shrubs, seedlings
2 – Moderate	0.5-1	Shrubs, saplings
3 – High	1.5-4	Tall shrubs, small trees
4 – Canopy	>4	Mature trees

B.

Score	Cover
7	95-100%
6	75-95%
5	50-75%
4	25-50%
3	5-25%
2	1-5%
1	<1%

RESULTS

The Northern site locations (Alumni and Music) had the overall lowest number of invasive species present while the Southern sites had the most invasive species present with East 1 having the highest level (Figure 2). Mammal activity was recorded at each site; however, Music had the fewest number of hours during the day with mammal activity whereas Alumni had the highest. Music also had the lowest strata score for the low strata category of any of the sites.

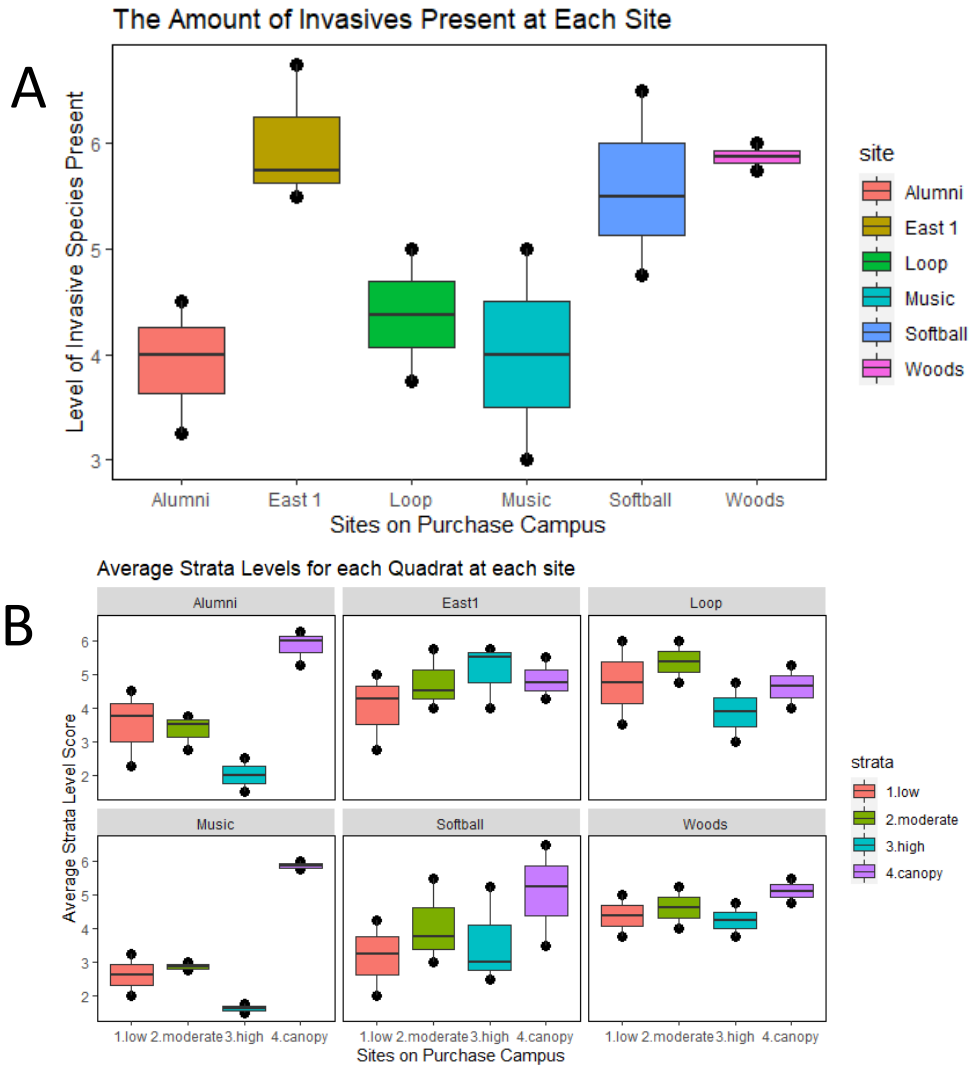

Figure 2. A.) Box and whisker plot showing the level of invasive species present at each site. Alumni and Music have the overall lowest number of invasive species while East 1 and Softball had the highest amount. Woods had about the same level of invasive species present at each quadrat location. B.) Box and whisker plot showing average strata levels for low, moderate, high, and canopy level strata at each site. Loop had the highest score for low strata while Alumni had the lowest.

Most of the sites had the most mammal activity occurring during the middle of the day, apart from Loop which had most of its activity occur at night. The most common species recorded at each site were Gray Squirrels (*Sciurus carolinensis*) apart from Loop where White-tailed deer (*Odocoileus virginianus*) were the most common (Figure 3). However, rarer species such as the Bobcat (*Lynx rufus*), Coyote (*Canis latrans*), Striped Skunk (*Mephitis mephitis*), and Virginia Opossum (*Didelphis virginiana*) were mostly active at night and not found at every site. East 1 had the most activity regarding these 4 species with 6 skunk sightings, 9 coyote, 2 bobcat, and 24 opossum. The Loop had the least activity for these species with only 5 coyote sightings total. Of these 4 species, the most common is the coyote which was observed at every site, while

skunks were the least common and appeared at only 50% of sites (Alumni, East 1, and Music). Overall, East 1 had the most mammal activity and highest strata scores for both strata levels and invasive species levels.

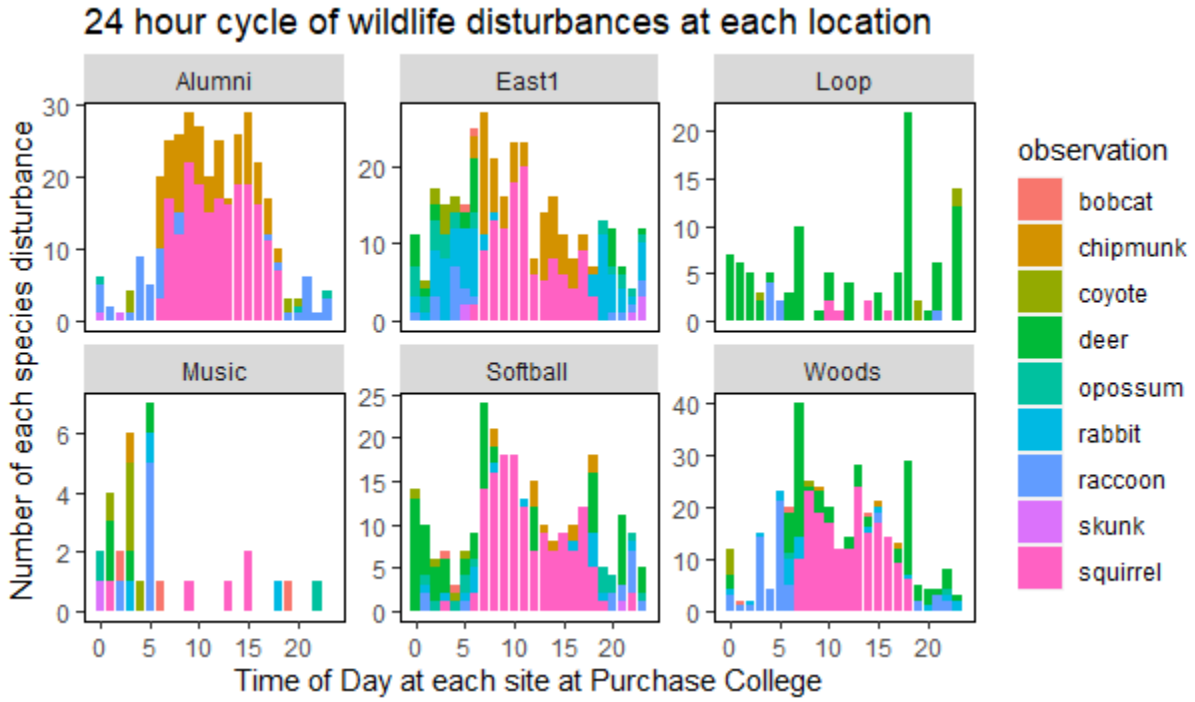

Figure 3. Bar graph showing the breakdown of wildlife disturbances recorded at each site by species during a 24-hour period. The most common species documented at each site was squirrels apart from Loop where deer were most common. Music had the least overall wildlife disturbances. Most sites had the most activity during the middle of the day except for Loop which had the most nighttime activity.

With the small mammal baited data it was found that the area with the lowest species richness and Shannon diversity were Music and Alumni, the two Northern sites with the least number of invasive species and the most open understory. All sites had the lowest amount of richness during the nighttime except for Woods where the richness was the same during the night and day. All the Southern sites had a richness of 3 or 4 during the daytime.

There also was a strong correlation between the level of invasive species present at each site compared to the Shannon diversity calculated. Loop and Alumni had the lowest level of Shannon diversity while the other four sites all had much greater numbers (Figure 4). The site Music however seems to be an outlier due to the fact that its Shannon diversity score is much higher than expected compared to the level of invasive plant species found in that location.

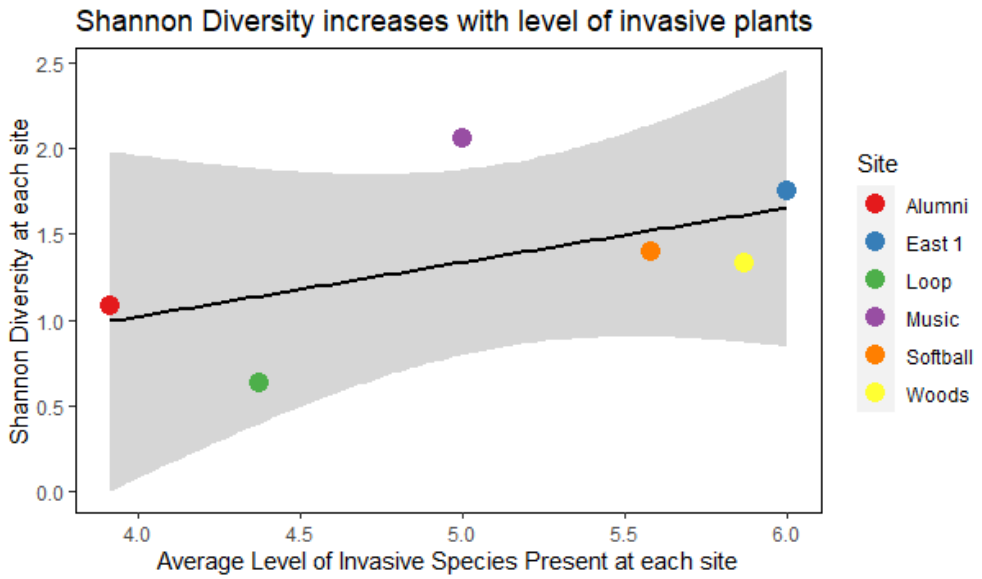

Figure 4. Scatterplot showing the level of Shannon diversity compared to the average level of invasive species present at each site. There is a positive correlation among all sites, with the Loop having the lowest Shannon diversity and Music having the highest. However, East 1 had the highest level of invasive species present while Alumni had the lowest.

DISCUSSION

Due to the limited sampling area that was contained to only the campus of Purchase College, I feel that the findings of this research are still significant. I have concluded that an old growth forest such as that found at the site Alumni offers a significant amount of space and resources necessary for animals to use throughout the entire day. However, due to the lack of understory vegetation found here and the other Northern site Music, it is not that useful to small mammals such as the White-footed mouse (*Peromyscus leucopus*).

From the data collected it was also concluded that forest composition plays less of a role in mammal usage throughout the day. The activity levels found at both Alumni and East 1 were similar throughout the 24-hour cycle, however East 1 is a younger forest fragment with more invasive species present whereas Alumni is older and hosts far less invasive plant species. This further proves that composition doesn't affect mammal usage throughout the day, however it does affect which species find the area useful.

The conclusions drawn from this study agree with the results found by Mahan and O'Connell (2005) in that younger woodland areas tend to have a much higher species richness and diversity than older growth forests do. The conclusions also agree with those found by Markovchick-Nicholls et al.(2008) that generalist species are more often found across different types of forested areas. Although generalists species weren't the main species studied

specifically, nearly all mammals recorded were generalists. However, the conclusions found by Osbourne et al. (2005) found that there was little difference between riparian and upland habitats regarding small mammal diversity and abundance. Although the study sites were all roughly on the same level it should be noted that depending on the study area results can vary.

Some errors that occurred during this study included both battery and trail camera failures. The battery for the camera stationed at Loop during the medium mammal survey died and did not collect data from October 7 to 14. After replacing the battery, the trail camera failed by recording data with the wrong date and time. This occurred on October 15, therefore making all data collected after this day unusable. This also occurred at the site Softball from October 5 to 7 where the wrong date and time was being recorded. Finally, there was a track meet that occurred on campus on October 15 where a young boy altered the camera angle in Alumni, thus making the data after this day unusable. The camera at Loop also had the same issue with the date and time during the small mammal survey, however this was a nonissue because it was only out for 2 days and it was easy to tell the difference between night and day. These issues could be easily remedied by checking the battery percent more frequently as well as by switching out cameras that have the issue with the date.

Another point that should be noted is that the site Music seems to be an outlier. It has an unusually high Shannon diversity while also having very sporadic times of day where activity is recorded. This could be because the trail that ran through this site was significantly larger than the trails at the other sites and therefore the trail camera may have picked up data only sometimes depending on the subjects' distance to the camera. Loop suffers from a similar problem, with there being so many camera failures at this site, it is likely that there was plenty of data that wasn't able to be collected and therefore isn't properly shown in this study.

I believe that the data collected for this study could be used as a starting point for more research into the effects of undergrowth composition on small mammals. This data could also be used to test the effects of invasive species on small mammal usage and whether their presence has a positive or negative affect on their habits.

CONCLUSION

It is significant to understand the effects of forest composition on mammal interactions. It is important to further study whether or not invasive species provide any positive impact on the mammals in a given environment since the number of invasive species has been dramatically increasing over the last several years. Human interference has opened up the ability for invasive species to take root in our fragmented study areas and it is vital to other researchers to study whether or not this can be a positive or negative affect on wildlife.

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