HABITAT EXPOSURE NEGATIVELY LINKED TO WILDLIFE ACTIVITY ON PURCHASE COLLEGE CAMPUS

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ABSTRACT

One of the resources required by wildlife in habitat selection is concealment from predation risks; and fragmented habitats with limited plant coverage may threaten that necessity. I studied the relationship between forest habitat exposure and wildlife abundance at Purchase College via two physical "exposure" characteristics: trail width and vegetation coverage. A correlation was found between thinner trails and wildlife abundance (particularly among prey species), and greater vegetation coverage and abundance -- although the former to a greater extent. These correlations seem to underscore the importance of vegetation and habitat contiguity for wildlife populations on campus and beyond.

Keywords: habitat exposure, mammals, trail width, vegetation coverage

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INTRODUCTION

Habitat fragmentation -- human development segmenting of natural areas -- is shown to have negative effects on wildlife populations (Harrison and Bruna 1999). There is evidence of wildlife avoidance of areas associated with human activity, and which may be perceived as exposed to higher predation risk (Flores-Morales et al. 2018, Frid and Dill 2002, Parsons et al. 2016). It has been noted that the presence of fragmenting roads has a negative impact on wildlife populations (Underhill and Angold 1999, McGregor et al. 2008). And although small forest fragments can serve as habitat corridors, their quality may suffer from edge effects and/or increased threat of predation (Harrison and Bruna 1999, Soulé et al. 1992).

Purchase College contains a number of forest sites with varying degrees of fragmentation and habitat disturbance, as a result of their physical characteristics and land management. While variations in vegetation coverage and walking trail width are visually evident among forest fragment sites, it is useful to obtain quantitative figures reflecting their structure, as well as their qualities' effects on the activity of wildlife populations.

My objective in this study was to determine the effect of vegetation coverage and trail width (two characteristics identified as potentially increasing wildlife exposure to predation) on wildlife abundance. I predicted that greater habitat concealment (greater vegetation coverage, thinner trails), would mean greater rates of wildlife abundance, particularly among prey mammal species.

METHODS

Field locations

Purchase College campus is located in central Westchester County, New York, largely surrounded by residential suburbia, as well as golf courses neighboring to the west and the Westchester County Airport to the north. The campus itself is about 180 hectares, including various expanses of forested areas, clear cut fields, and matrixes of parking lots and developed areas.

We chose six trailed forest fragment sites as locations for research; from north to south: Alumni, Music, Softball, East1, Woods, and Loop (Fig. 1). Sites were chosen based on their accessibility by walking trails, qualitative variety from each other, and their spatial separation from each other. All sites' trails were pervious soil surface and surrounded by vegetation on both sides. The two closest sites (Softball and East1) are 211 meters separated from each other, with all six sites stretching across 1.57 kilometers of campus between the two most distant sites (Alumni and Loop).

The northmost site "Alumni" is about 6.1 hectares of continuous woods in the northeast corner of campus, surrounded by two roads and the Alumni residential buildings. The "Music" site on the northwest of campus is approximately 1.9 hectares, and contained by two roads and the West2 parking lot, as well as the Music academic building to its south. "Softball" -- a 0.75 hectare site to the center-east of campus -- is a small trailed fragment between the softball field and a clear-cut soccer field, south of the Fort Awesome residence hall. The smallest fragment "East1" is a 0.55 hectare patch on the southeast side of campus bordering a practice sports field to the west and the East1 parking lot to the east. The last two sites "Woods" and "Loop" are connected within about 9 hectares of trailed forest on the southeast corner of campus; Woods bordering turf athletic fields to its north, while Loop is located further southwest near the intersection of roads Lincoln Ave and East Loop.

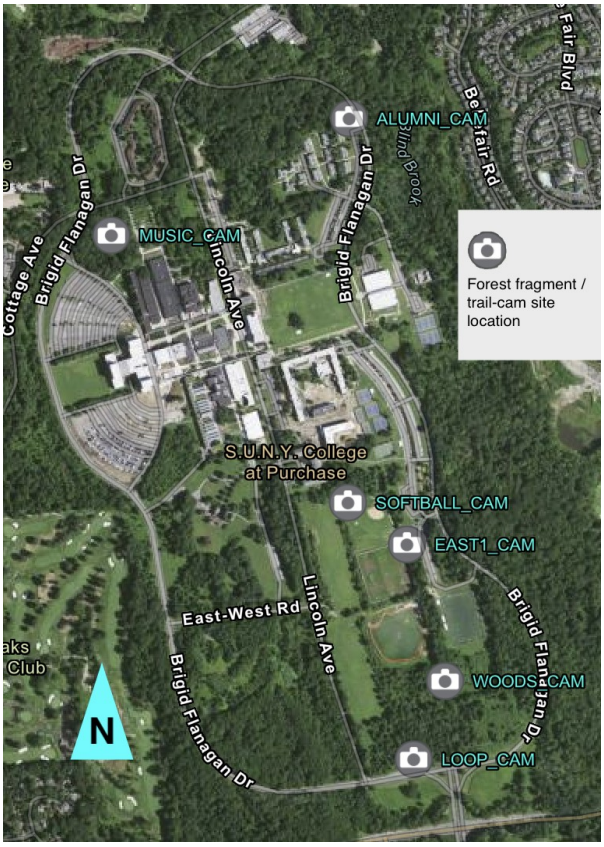

Fig. 1. Site map showing the Purchase College Campus and the 6 forest fragments examined in this study. Camera icons represent the approximate location of a site's trail-camera.

Fig. 2. Diagram of quadrat layout at the "Softball" forest site, generated via GPS plotting. Each 10m x 10m quadrat is separated by 10 meters along the trail, with one quadrat placed on the opposite side of the trail. Camera icon represents the approximate location of the trail-camera, and green squares the approximate locations of the quadrats.

Forest structure sampling

At each forest fragment site, we demarcated two or three 10m x 10m quadrats to collect data within (Fig. 2). The Alumni, East1, and Softball sites each had three quadrats, while the remaining three sites had two quadrats. Quadrats were placed inside the forested areas -- bordering the walking trail on one side but not including it. One quadrat at each site was always centered at the location of the trail-camera, while other quadrats were spaced 10 meters apart from it on either side. There was often an effort to place a site's quadrats on opposite sides of the trail from each other. Each individual quadrat was split into four 5m x 5m squares to aid the data collection process and make quadrats more digestible.

We surveyed each of the forest fragment quadrats for both trail width and vegetation coverage at four strata levels. Data was collected by hand in the field and later transcribed to digital spreadsheets. To quantify the width of the trail, we measured from the center point of each quadrat (on its border with the trail) across perpendicularly to the opposite side. To sample vegetation coverage, we examined vegetation at four individual strata levels (Table 1) and estimated the vegetation coverage of each level in each of the quadrats' four inner squares. Coverage was scored according to the percent of the area covered, using a standardized key to convert percentage estimates to a 1-7 scale (Table 2).

2.3. Wildlife sampling

We recorded movement at each forest fragment site from September 16th to October 21st, 2022 via camera-traps attached to trees adjacent to the walking trails. In some cases, small amounts of vegetation were removed to attach the camera unobscured. Browning "Strike Force" HD cameras were set on trees approximately 0.75 m from the ground and pointed perpendicularly to the path. Camera-traps were set to take one photo at a time, with a 1 second capture delay, and "fast-motion" infrared flash. They were in operation 24 hours/day for all days

deployed (with the exception of a number of technical malfunctions) and were checked on four times during this five-week survey to exchange the memory cards.

2.4. Statistical Analysis

To analyze the five-week trail-cam data collected, we combed through all photos from each of the six sites by hand and recorded the occurrences of nine wild mammal species: chipmunk, squirrel, rabbit, skunk, opossum, raccoon, deer, bobcat, and coyote.

We recorded the contents of all trail-cam images by their day in a digital master spreadsheet. If the same animal or human was present in multiple images captured within the same minute, we recorded one individual for that occurrence, but the lapse of more than one minute between images was scored as separate events. We scored vehicles as such; not counting the number of people operating them. I separated wildlife into three groups: prey (chipmunk, squirrel, rabbit, skunk, opossum, raccoon), predators (bobcat, coyote), and deer, which were given their own group for analysis.

Table 1. Designation of separate forest strata according to vegetation height.

1. Low Strata	<0.5m
2. Moderate Strata	0.5 - 1.5m
3. High Strata	1.5 - 4m
4. Canopy cover	>4m

Table 2. Conversion table used for scoring vegetation coverage from percentages to 1-7 scale.

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

I used Google Sheets to calculate averages among forest quadrats and their squares, and the overall averages for daily observations. I used RStudio and CSV files of the data to program graphs to represent findings.

RESULTS

The six surveyed sites varied somewhat in their recorded trail widths (Fig. 3). The widest trail by a significant margin was at the Music site (7.825 meter average), while Alumni, East1, and Woods measured similarly on the thinner end between 3 - 4 meters wide (with the exception of a low outlier in East1). Loop and Softball measured similarly in the middle range -- both averaging at or above 4 meters wide. Alumni and Music particularly show minimal variance among their different quadrat measurements (with a mere 0.05 meter difference between trail width at the two Music quadrats).

Vegetation coverage within the different strata levels varied between sites and among strata (Fig. 4). Music was consistently the least covered in the first three strata levels, with Alumni often a close second, but the two sites also had the greatest average scores for canopy coverage. All but two sites (East1 and Loop) had the greatest vegetation cover scores in their canopy strata. The median high strata score was least covered compared to other strata at all sites except East1. All sites had somewhat similar average vegetation cover scores in their respective low and moderate strata levels. There was little variation in coverage recorded between quadrats

at the Music site for strata levels 2-4, with just a 0.25 difference between average coverage scores. In contrast, Softball was the site with the most consistently varied coverage scores, with a 3 point difference between its lowest and highest scores for canopy.

Wildlife observations varied among sites, and significantly among wildlife types (Fig. 5). Alumni, Woods, East1, and Softball had somewhat similar averages for total wildlife observations per day, with Loop's total observations slightly lower, and Music with significantly low observations. Alumni saw the greatest numbers of prey species, with East1, Softball, and Woods somewhat comparable in the mid-range, and Loop and Music significantly low. Observations of predators were extremely rare at all sites -- with all average daily observations <0.4 -- but the site with the greatest average daily predators was East1 (~0.306 observations) and lowest was Softball (~0.194 observations). Deer were observed significantly most at Loop, with Softball and Woods comparably behind, and all other sites at or near 0 for average daily observations.

Overall, trail width is negatively correlated with wildlife abundance, particularly among prey mammals (Fig. 6). Additionally, vegetation coverage is somewhat positively correlated with wildlife abundance; moreso among predator species and deer than with prey mammals (Fig. 7).

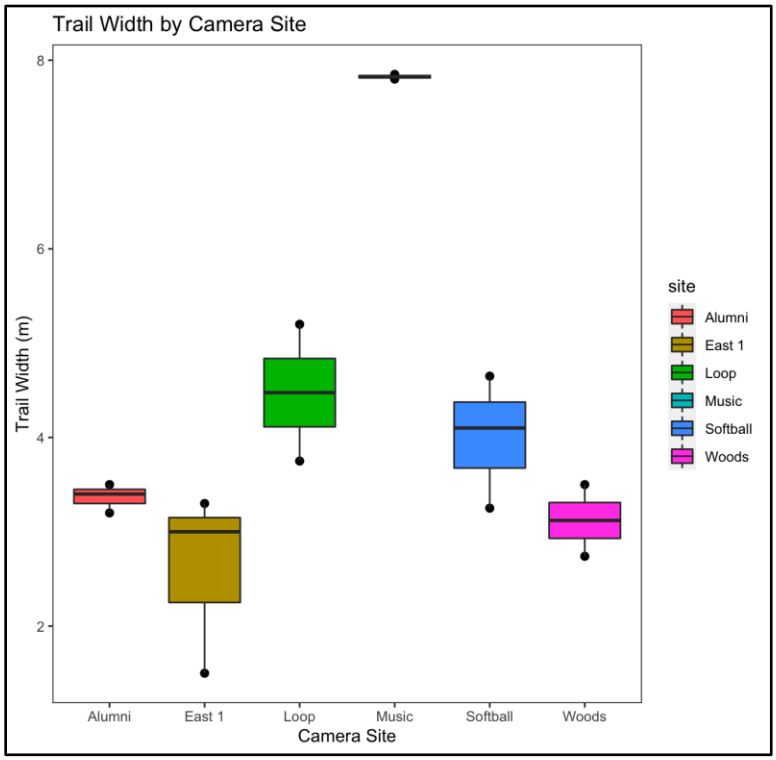

Fig. 3. Width of trails measured at each quadrat in relation to the six forest fragment sites. Fairly comparable results between Alumni, East1, and Woods (with the exception of a low outlier at East1). Trail width at Loop and Softball sites are also comparable to each other. A significant difference in trail width was measured only at the Music site -- considerably wider than others.

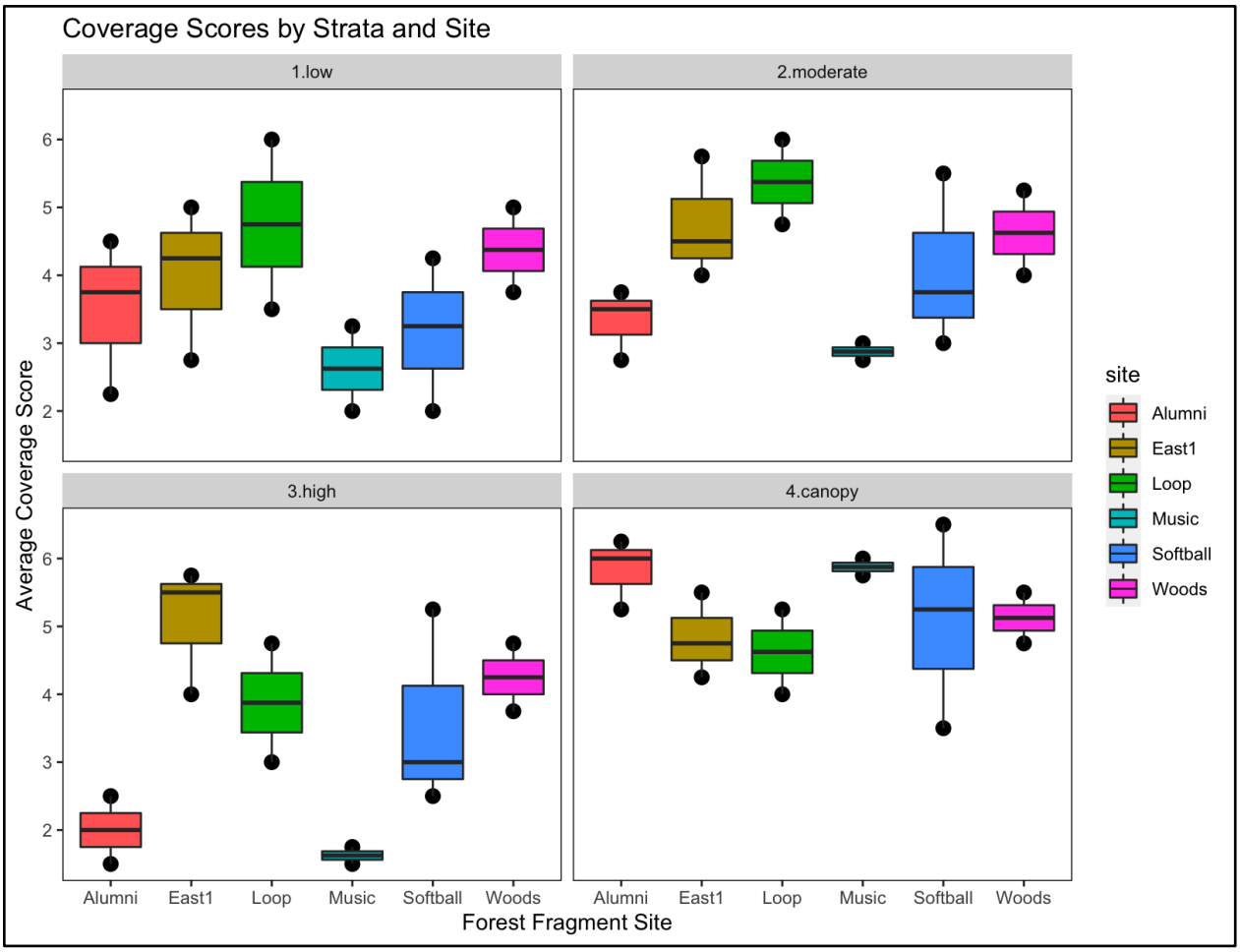

Fig. 4. Average scores for vegetation coverage in four strata levels at six forest fragment sites. Scores for low and moderate strata coverage were similar to each other at all sites. Music was consistently the least covered in strata levels 1-3, with Alumni often a close second; but the two sites also display the greatest average scores for canopy coverage. Coverage was greatest in the canopy level of all sites except East1 and Loop. Compared to coverage of other strata levels, the median score for high strata coverage was lowest at all sites except East1.

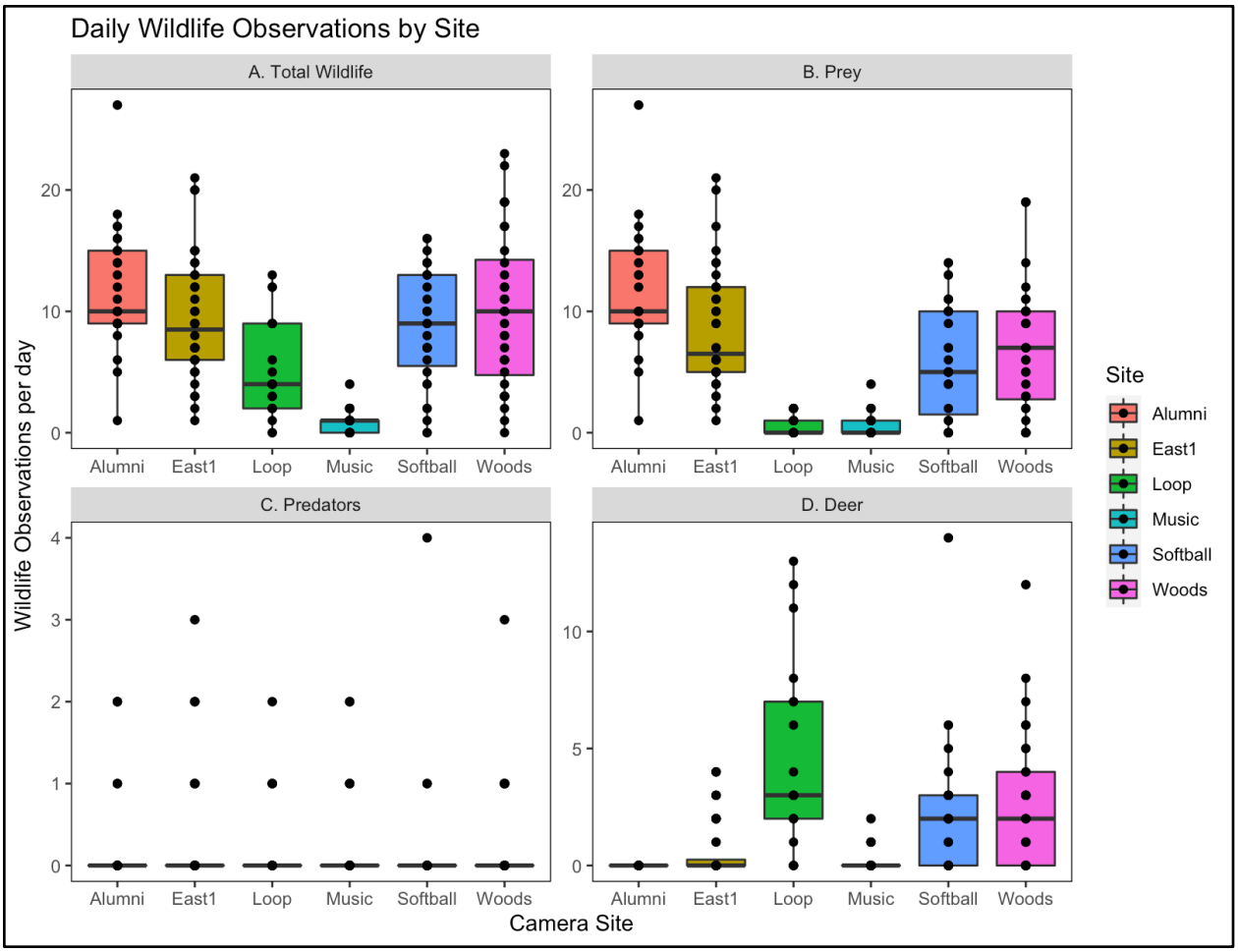

Fig. 5. Daily wildlife observations by wildlife type and forest fragment site. Music observed the lowest total daily numbers of wildlife, largely thanks to low numbers of both prey mammals and deer. Alumni, Woods, East1, and Softball had somewhat similar averages for total wildlife observations, with Loop's total numbers slightly lower as a result of extreme-low prey observations. Predator observations were extremely rare at all sites, but the site with the greatest average daily predators was East1 (~0.306 observations) and lowest was Softball (~0.194 observations). Deer were significantly observed most at Loop, with Softball and Woods behind similarly, and all other sites at or near 0 average observations per day.

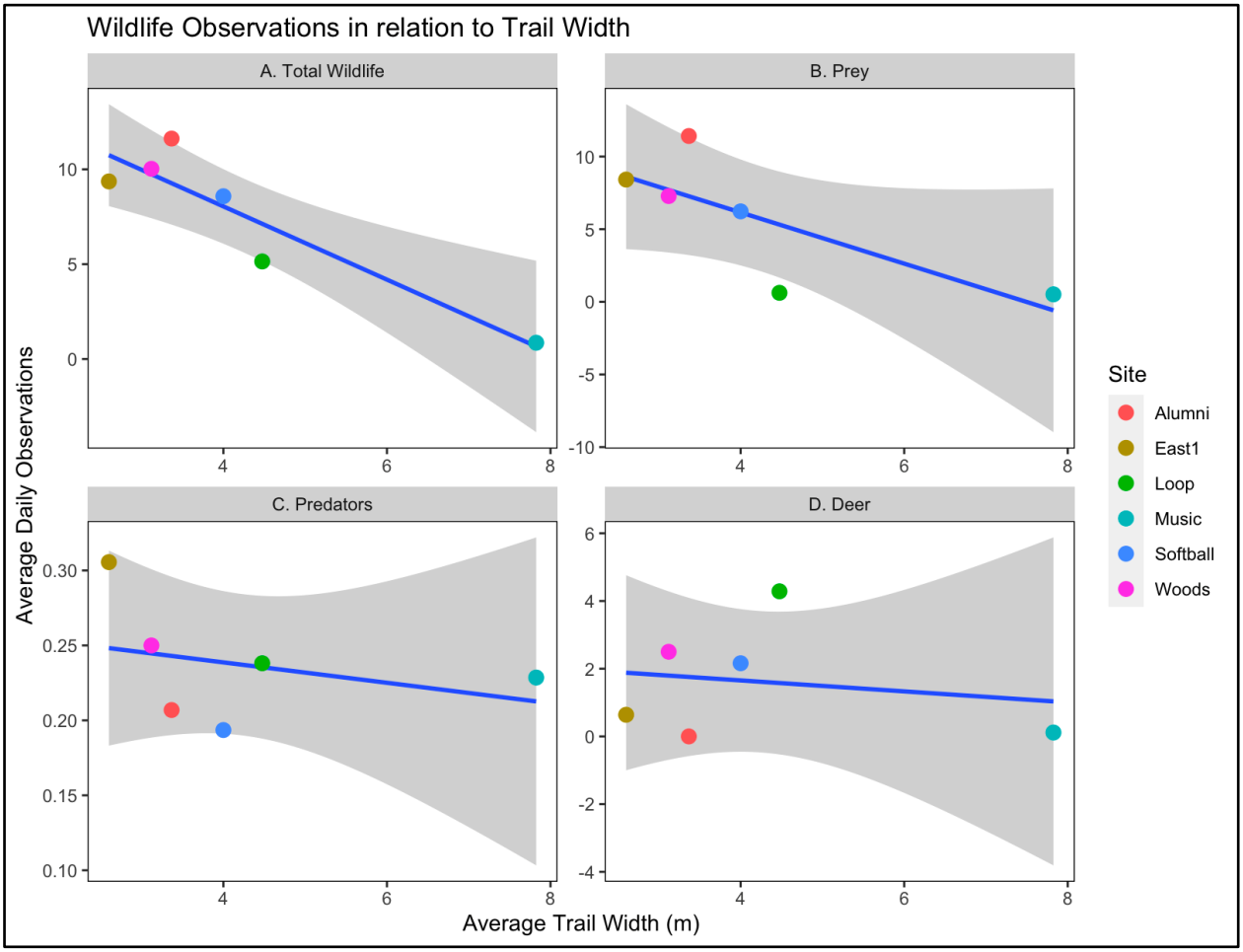

Fig. 6. Average daily observations of total wildlife, as well as three wildlife types, in relation to average trail width at six forest fragment sites. Blue lines represent linear regression models. Trail width is negatively correlated with wildlife abundance, most significantly among prey mammals, but insignificantly among predators and deer.

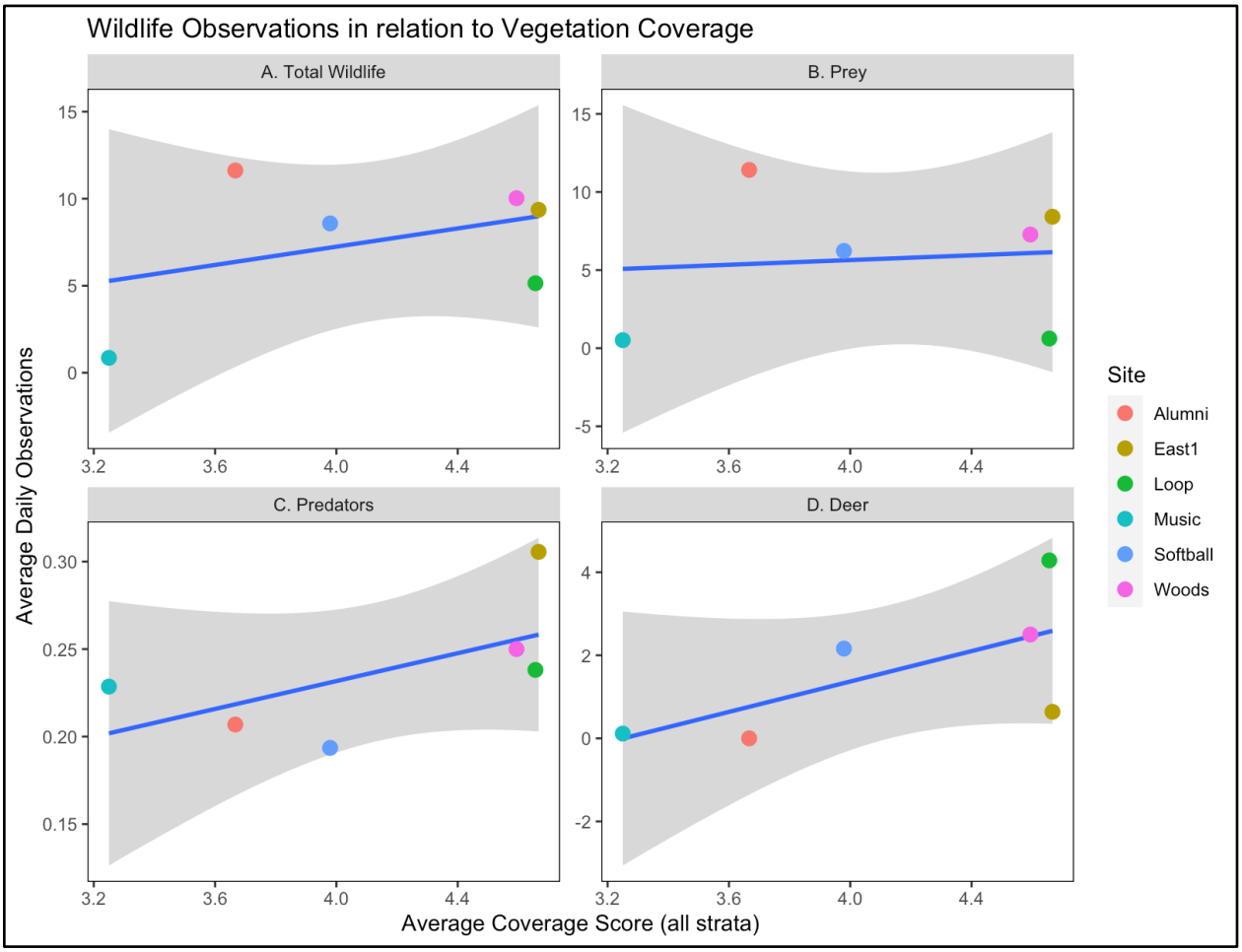

Fig. 7. Average daily observations of total wildlife, as well as three wildlife types, in relation to average vegetation coverage scores at six forest fragment sites. Blue lines represent linear regression models. Vegetation coverage has a slightly positive correlation with wildlife abundance; reflecting patterns with predator species and deer. The prey species surveyed here display an insignificant relationship with vegetation coverage.

DISCUSSION

Based on the data collected for this study, indications of some wildlife habitat preferences are more clear than others. Lack of correlation between prey mammal abundance and vegetation coverage was inconsistent with my initial prediction. Slight preferences among total wildlife for areas of greater vegetation coverage may indicate a reliance on vegetation for a variety of resources, including protection against predation threats (Rantanen et al. 2010, Yarrow 2009). Deer may have particularly preferred areas of high plant coverage because of the predation concealment offered or because of the presence of ample food resources (Pierce et al. 2004).

Avoidance of wider trails may indicate preferences for forested areas with lesser degrees of fragmentation (Soulé et al. 1992). The results may suggest that prey species perceive the

wider clearcut trails as more exposed, and therefore create a heightened sense of vulnerability to predation (Frid and Dill 2002), or as mobility barriers, as seen in previous studies with small mammal species and roads (McGregor et al. 2008).

Further studies should be undertaken to provide a fuller picture as to the habitat and corridor selection preferences of wildlife on Purchase College campus. A shortcoming of this study was the surveyal of only six forest sites and thus further research would be needed to verify the correlational trends found here. While the Music site represents an outlier datapoint for metrics like wildlife abundance and trail width, and has the lowest average vegetation coverage (consequently strengthening the present linear regression modeling), it is largely unclear the degree to which it is representative of similar forest fragments on the larger scale, as opposed to being merely an anomaly. The location of the cameras (only facing the trail) may have resulted in the exclusion of potentially significant observations, particularly in a site like Music in which especially open understory coverage off-trail could offer an easily accessible alternative to trail-use.

Variables not considered in this study that may cause variations in wildlife activity at campus sites are forest fragments' proximity to areas of high human disturbance, such as roads (Prokopenko et al. 2017, Underhill and Angold 1999), as well as forest fragment size (Andrén and Delin 1994) -- both factors requiring further research into their possible influence.

CONCLUSION

While forests with thinner walking trails are seemingly likely to have greater prey wildlife abundances, the broader impact of the sampled forest characteristics, particularly vegetation coverage, is still largely unclear. The findings may broadly indicate the importance of investing in habitat health and contiguity, and it may likely be advised that stewards of natural lands work to minimize the width of throughtrails. It is important to understand the ways that vegetation and land management influence wildlife habitat selection in order to support healthy wildlife populations in an evermore fragmented global landscape.

ACKNOWLEDGEMENTS

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