FREQUENCY OF RACCOON OCCURRENCE AT TWO DUMPSTER SITES ON SUNY PURCHASE COLLEGE CAMPUS

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ABSTRACT

Purchase College campus is a leading example of how urbanization affects mammal abundance and distribution. Raccoons have been spotted around campus by students in large numbers. We conducted a study to further our understanding of raccoon feeding behavior near areas of high human population density. Human impact results in raccoons being able to find a constant food supply, and are able to successfully persist around college campuses and urban/suburban areas. Two dumpster sites with different human usage patterns were observed for raccoon frequency over three nights. Results indicate the steady production of trash contributes to successful raccoon populations in this area.

Keywords. Abundance; Density; Fragmentation; Habitat; Management; Raccoon; Urbanization.

INTRODUCTION

As our population continues to grow at an exponential rate, the development of human altered land follows. The landscape of a once pristine natural world grows smaller with the construction of each new town, neighborhood and individual residence. Urbanization shifts land usage from agricultural to the industrial with more and more commercial and residential fixtures appearing as part of the suburban sprawl. Ecosystem structure and function is heavily impacted by anthropogenic modification, often negatively. These patterns of human expansion have resulted in the change from once prevalent rural land into the rise of the rural-urban gradient (Yunger 2006). Urbanization and habitat fragmentation can both displace local species populations and introduce several alien pest species, potentially devastating existing ecosystems.

Human induced habitat fragmentation often results in the creation of "edge habitats" which are isolated patches of natural habitat. This affects raccoon's geographical range and dispersal capability due to roads and other barriers. Emergence of edge-habitats and increased habitat fragmentation is a direct

result of anthropogenic influenced expansion. Many species prefer habitat-edge areas (i.e. suburbs) that provide a readily abundant food supply, which would otherwise be difficult to find in their natural habitats. Human usage, residential and commercial land use, distance from urban center and road density were the most significant factors relating to species distribution and abundance in urbanized areas (Yunger 2006). Certain species are skilled urban adapters, showing equal preference for wooded edge habitats and human occupied areas. This may reflect their compromise between food and refuge (Houle 2011).

Of all mesopredators, including red fox, possums, coyotes, marmots, stripped skunks, the raccoon (*Procyon lotor)* is of interest, for both its keen urban adaptability and the many problems associated with their presence amongst human populations. Often referred to as an efficient "edge species", raccoons are incredibly effective at exploiting several human-subsidized food sources, specifically vegetative compost and trash (McKinney 2002). Existing "super rich" patches are abundant in human-subsidized food waste and have proven to modify the movements and spatial distribution of raccoons. Even compared to other urbanized mesopredator species such as opossums and skunks, raccoons benefit the most from the effects of urbanization (Ordenana 2010).

Consistency and prevalence of spatially fixed structures (i.e. dumpsters), and the artificial food sources contained within them contribute to increasing human-animal encounters (Prange 2004, Yunger 2006). Several species rely on artificial, concentrated and abundant food sources to maintain a viable population amidst continually changing habitats. In areas with high a human population density, the raccoons only natural predators, the grey/red fox and coyote are less inclined to hunt raccoons a possible reason for raccoon's high survivorship, high reproductive rate and abundance (Ordenana 2010).

Overabundance of raccoons and subsequent raccoon-human interactions can be problematic, and often dangerous. Problems such as reoccurring property damage, interspecies aggression, disease transmission and loss of biodiversity can all be attributed to high raccoon density within urban and suburban areas (Barden 1993). Overabundance in urban-suburban areas results in increased nuisance problems (Prange 2003). Over 40% of North American animal-damage-control jurisdictions deem the raccoon as the primary urban/suburban nuisance animal (Prange 2003). Unwanted animal-human interactions are becoming more frequent in urbanized areas which brings on the risk of attacks and disease transmission (Hirsch 2013). Notorious for hosting an array of deadly zoonotic pathogens (i.e. canine distemper, parvovirus, leptospirosis, rabies), raccoons pose an immediate threat to humans. The frequency of epizootic episodes depends upon host density. Areas with high raccoon population density, such as apartment complexes or restaurants are directly linked to more frequent epizootic episodes (Houle 2011).

Loss of biodiversity, growing extinction rates of local species and increased habitat loss due to anthropogenic influence may increase with continual human development along the urban-rural gradient (McKinney 2002). Several studies address the positive linear relationship between a higher non-native species population density and proximity to a city-center (McKinney 2002). High raccoon density can directly affect other population several native species distribution and abundance.

Present management practices agree that live-baiting, culling, and legal ordinances are the most effective and widely used techniques (Broadfoot 2001, Barden 1993, Lipske 2014). Population reduction through culling can be effective at minimizing potential raccoon-human interactions but the local short-term gains won't translate into long-term wins when applied on a broader scale (Rosatte 2007). This mentality illustrates the problems faced with providing management tools to an ecologically inept public. In response to this issue, several animal control agencies began to halt the publicly misused, reactive catch-and-release practice. A newer, more effective approach was designed to substitute live-trapping with education of the public. Mailing information, pamphlets, public workshops and additional literature was proven to better manage raccoon abundance than more traditional techniques (Barden 1993).

This study investigates the relationship between frequency of raccoon occurrence near dumpster locations at two building sites, and how each site's specific human usage has an effect on local raccoon feeding behavior. We aim to find significant variation of occurrences at each site based on the differing uses of each dumpster site's respective building(s). We predict to find a higher rate of raccoon occurrence at the dumpster site adjacent to "the HUB", a heavily trafficked dining hall compared to "Alumni Village", a moderetly trafficed network of student-used condominiums. Ideally, the findings will be used to develop methods of properly handling local raccoon overpopulation in urban/suburban areas.

METHODS

Study area. – Our study took place at Purchase College in the town of Harrison in Westchester County, New York. Local biota includes various species of oak, tulip, maple, dogwood, willow, grape etc. Mammal species include squirrels, skunks, raccoons, groundhogs, white tailed deer, and birds such as the red-tailed hawk, sparrow, blue-jay and chickadee. The campus's buildings are situated on the interior of Bridget Flannigan Dr., a continuous loop road that surrounds the campus and acts as a barrier between human occupied areas, the surrounding woodlands and the tributaries of "Blind Brook". On the eastern end of campus, a network of three adjacent residential apartments border Bridget Flannigan Dr., including Alumni Village, the Olde and the Quad.

"Alumni Village"- Alumni Village is perhaps the most populated of the three apartment complexes and it's parking lot (E5-E6) houses the largest dumpster cohort on the east side of campus. Between the E5 & E6 parking lots are four large dumpsters lined up side by side inside a 20'x8' fenced in area. The fences are rarely locked, allowing 24/7-hour access for residents of all three apartment complexes. Sufficient lighting was available due to several street lamps hanging above the dumpsters, ensuring we had an accurate view of the study area.

"The HUB"- Situated in arguably the most trafficked area on campus, the HUB serves as the schools main dining hall. Thousands of students and faculty frequent the HUB for several meals a day. The HUB produces tones of human refuse each week, with human-subsidized food waste being the main source of garbage. The HUB's dumpster area is located behind the main building, approximately seven meters away from the loading dock and 30 meters away from the faculty parking lot facing northeast. Many people walk directly past the dumpsters on their way to the apartment buildings many times a day. Compared to the dumpster site at "Alumni Village", the HUB's dumpster area contains only two dumpsters, surrounded by a 12'x7' fence that is almost always locked. Dumpsters are emptied daily, sometimes more than once a day. The fenced in area is inaccessible without granted admittance but a noticeable bend at the top of the fence is indicative of frequent raccoon activity around and inside the HUB's dumpster area.

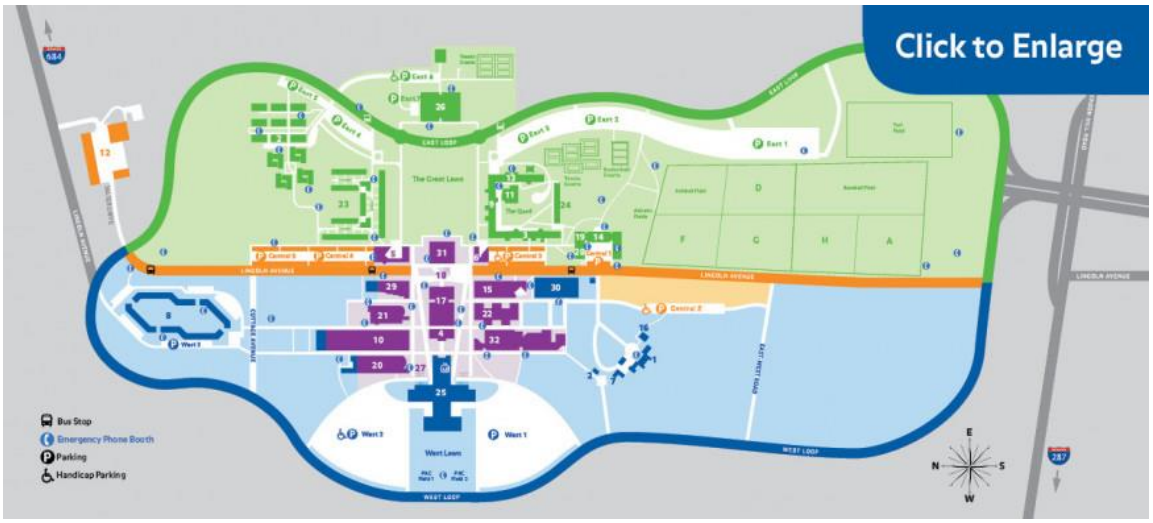

Figure 1: SUNY Purchase College Campus Map. The green shaded area of the map contains the three residence apartments, with Alumni Village being the leftmost, the Olde to the right of Alumni Village and The Quad to the right of the Olde. Also shown in Bridget Flannigan Dr., the entire campus being separated by the road. The grey areas represent the surrounding woodlands, which contain Blind Brooke and are home to dozens of native species. Building #24 represents the HUB and the dark blue square behind it represents the HUB's dumpster site. The Alumni Village dumpster area is between the E5 and E6 parking lots.

Raccoon counts. - Raccoon counts at "Alumni Village" were taken from 32 meters, measured from the nearest dumpster to a patch of grass on the edge of a dark, well-hidden and small wooded area. The observation site at the HUB was situated 17.3 m away on an adjacent, downward sloping walkway leading to the HUB. Observations were conducted from 10:00 pm-12:00am on the nights of 10/20/2017, 10/25/2017 & 11/13/2017. We set our phone alarms at fifteen-minute intervals (i.e. 10:45pm-11:00pm) for two hours and using a tally sheet, we counted each raccoon entering, leaving or walking nearby the dumpster area. The study's aims were completely unrelated to an individual's sex, size and group composition, so these attributes weren't recorded. No account was taken of a raccoon's individual features (i.e. size, stripe patterns, sex, and number of group members and reoccurrence of the same individual).

RESULTS

Observations at both the HUB and Alumni Village locations totaled 53 raccoons for all three nights. Total raccoon count for 10/20/2017 is 17 for Alumni Village and 9 for the HUB. Total raccoon count for 10/25/2017 is 6 for Alumni Village and 15 for the HUB. Total raccoon counts for 11/13/2017 is 1 for Alumni Village and 5 for the HUB. Total raccoon count for Alumni Village is 24 individuals for all three nights. Total raccoon counts for the HUB is 29 individuals for all three nights.

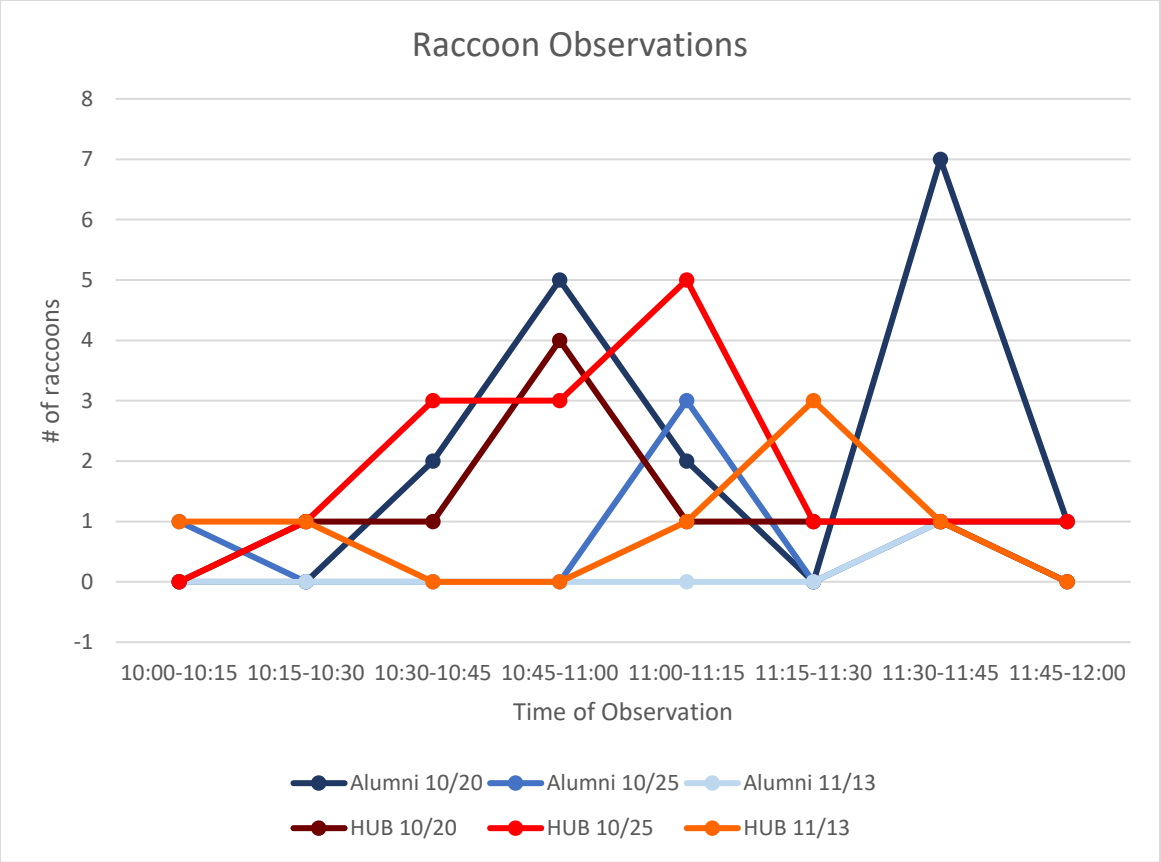

Figure 2. Graph representing the number of raccoons spotted at each time interval on the nights of 10/20/2017, 10/25/2017 & 11/13/2017. The blue shaded lines represent the number of raccoon spotted at the Alumni Village location and red shaded lines represent the raccoons spotted at the HUB location.

Table 1. Raccoon counts at Alumni Village and the HUB on 10/20/2017

10/20/2017	Alumni Village	The HUB
	0	0
	0	1
	2	1
	5	4
	2	1
	0	1
	7	1
	1	0
Total	17	9

Table 2. Raccoon counts at Alumni Village and the HUB on 10/25/2017

10/25/2017	Alumni Village	The HUB
	1	0
	0	1
	0	3
	0	3
	3	5
	0	1
	1	1
	1	1
Total	6	15

Table 3. Raccoon counts at Alumni Village and the HUB on 11/13/2017

11/13/2017	Alumni Village	The HUB
	0	1
	0	1
	0	0
	0	0
	0	1
	0	3
	1	1
	0	0
Total	1	5

DISCUSSION

Results of the study coincide with our original prediction that raccoon occurrence frequency would be highest at the HUB. We assumed this because of the larger daily volume of trash, dumpster contents being mainly composed of human-subsidized food waste and high human foot traffic. We thought because Alumni Village is less trafficked than the HUB, had a lesser volume of trash and a wider variety of trash contents that there would be a significantly lower raccoon count. While Alumni Village had a lesser frequency of raccoon visitation, the difference is so insignificant (Alumni-24 & the HUB-29) that other factors must be considered before coming to any conclusions.

Alumni Village's proximity to an edge of small wooded area may contribute to less raccoon counts. Edge-species, such as the raccoon use these habitat edges to choose between higher food

abundance and the safety of the wooded refuge. Alumni Village's trash contents, which contain a higher variety of refuse compared to the HUB may deter raccoons from visitation compared to the HUB.

Uncertainty of the trash pick-up schedule may have skewed our data. We had no way of knowing when dumpsters were last emptied, how soon they've been emptied or even the specific volume of trash at the times of observation. It may have been random chance and uncertain timing that the HUB had higher raccoon visitation than Alumni Village. The locked fenced area surrounding the HUB dumpsters and unlocked fenced area surrounding the Alumni Village dumpsters seemed to have little effect on raccoon frequency when comparing results.

The study's small sample size and two categories of human usage per site may have contributed to the study's insignificant results between each observation site. Since we only made observations at nighttime between the hours of 10:00pm-12:00am, the fixed time intervals may have been a reason why the data seems so irrelevant. Other possible sampling errors may include raccoons we accidently didn't see, poor choice of observation site and wind speed, which may influence raccoon movement due to olfactory responses to the air's smell.

Through personal experiences, student accounts of aggressive encounters and relevant literature, the often-ignored issue of SUNY Purchase College's overabundant raccoon population needs to be officially addressed. If unresolved, raccoon numbers will continue to grow, as will the risks of disease transmission, biodiversity loss and property damage.

Frequent raccoon occurrences near areas of high human traffic requires further research to understand the feeding behavior of local raccoon populations and its relationship to the specific human uses certain areas of campus have. Site-specific management practices are run completely by Westchester Animal Control, and the school hasn't investigated local raccoon populations and the effect our presence, specifically our refuse has on their behavior, distribution and abundance. There is no specific literature on the current state of SUNY Purchase College's expanding raccoon population. Currently, regional variation of study sites and differences in sampling methods among researchers makes understanding the effects of artificial food sources on the distribution and abundance of species (specifically mammals) uncertain (Baldwin 2006, Wilson 2006). Understanding the spatial relationship to surrounding landscape structure is crucial in determining specific species habitat associations. Presently, most of our knowledge about raccoons' association with their habitat is derived from a series of broad, landscape-level macrohabitats. There is a need for a greater volume of research conducted on raccoon population occurance at the small-scale, local microhabitat level.

CONCLUSIONS

Higher raccoon counts were recorded at the dining hall "the HUB" location, compared to the apartment complex "Alumni Village". Although there's no significant difference in results between each site, a slightly higher count at the HUB can be contributed to larger volume of trash and a higher density of human-subsidized food waste compared to Alumni Village. Insignificant results can be indicative of poor experimental design, small sample size and time constraints, therefore more consideration should be given before committing to similar studies.

Results show that raccoons certainly exploit easily accessible human food waste which may increase overall survivorship and reproductive health of raccoon populations on campus. Variation in human use per area doesn't directly address the issue of overall raccoon overabundance on campus, the implications for student/faculty safety, biodiversity and best management practices for raccoon population control.

ACKNOWLEDGEMENTS

Members of this study would like to thank Dr. Allyson Jackson for the necessary guidance and tools to conduct the study. We also thank former student James Cellum for helping us collect data and Bushnell for providing night vision goggles.

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