Anthropogenic Influences on Raccoon Problem-Solving Characteristics

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Considered generalists, raccoons are extremely adaptable and often regarded as nuisances due to their tendency to scavenge in dumpsters and garbage cans. Because the relationship between humans and raccoons is not unilateral, it is important to study the effect human-dominated environments have on raccoon ecology. In order to better understand these anthropogenic influences, raccoon problem solving characteristics were evaluated in both urban and natural settings. To do this, baited puzzle boxes were provided to the raccoons and motion-activated cameras were set to record any disturbance. The study found that raccoons from the natural site solved the food puzzles in fewer nights, in less time per attempt, and in fewer interactions with the box than raccoons from the urban site, although these results were not statistically significant. This suggests that further research is necessary to determine the mechanism driving this relationship and whether the relationship applies universally to raccoon ecology or whether the results are only an isolated incidence.

Introduction

Raccoons are well-known to many people as bothersome nuisances which scavenge in dumpsters and garbage cans (Clark 1994). For this reason, their behavior and ecology are important to human well-being. Additionally, areas dominated by human beings may alter raccoon ecology in specific ways. For example, food availability and distribution may be concentrated in urban environments such as cities (Prange et al. 2004). In other cases, raccoon travel patterns and territories may be affected. This may be a result of urban structure and organization which limits raccoon movement to certain areas and corridors or may deter them from others, such as those dominated by busy roads (Prange et al. 2004).

Raccoons eat a wide range of foods, including both plants and animals (Bromley et al. 1984). They opportunistically scavenge fish, eggs, crops, insects and much more (Bromley et al. 1984). In areas dominated by humans, many of these food sources are often plentiful as a result of waste and can lead to a variety of changes in raccoon ecology and population structure (Prange et al. 2004). One such change is that raccoons in cities and suburbs are typically more densely packed (i.e. occupy smaller ranges and have increased overlap with other individuals) than those in natural habitats (Bromley et al. 1984). Their home ranges also increase in stability and decrease in size with human presence, likely do to steady food supplies and shelter (Prange et al. 2004). Raccoons naturally den in trees but can inhabit a wide variety of homes (Prange et al. 2004). Although they put on fat and thick fur and den, raccoons do not hibernate in the

winter (Prange et al. 2004). In fact, even during bitter cold, raccoons are active, including breeding between February and March (Managing raccoons, skunks, and opossums).

These are just a few of the ways in which raccoon ecology has been influenced by human presence. While some changes positively affect pest management, others negatively impact it. For example, avoidance of heavily trafficked areas by raccoons, such as roads, is positive because it reduces negative interactions between humans and raccoons. However, high raccoon densities where human densities are also high increase the likelihood of human-raccoon conflicts. I would like to determine whether or not human dominance has increased the degree to which urban raccoons' curiosity and problem-solving abilities have been impacted.
Information about how raccoon behavior has changed with human presence could provide insights into how raccoons function as pests. For example, if the artificial environment created by humans in cities selects for more curious raccoons, then human waste disposal should be adjusted. Investigating the ecology and behavior of pests—particularly in response to human activities—can help to reduce human-raccoon conflict.

Methods

Data Collection

Two locations were sampled: McFarland Park (the natural setting) and Pammel Woods (the urban setting). Both locations were thoroughly scouted and sites with comparable features (cover, hydrology, topography and distance from human trails) were identified. Due to time constraints, only one site at each location was sampled.

In early spring, baited puzzle boxes were deployed at both sites. These boxes were made of wood, had holes drilled in them to help scent spread, were baited with sardines, and were wired to a stake in the ground. There were four types of puzzle boxes and two copies of each type. Three box types had unique latches on them, and one box was latchless (the control). The control was the first puzzle set out and was simpler in that it only had a wooden lid that needed to be lifted in order to access the sardines. This served to accustom the raccoons to receiving a food reward from the box (and lessen any existing foraging biases). Boxes are referred to in the order in which they were deployed (i.e. the first control box is called box 1).

For the first three days that the control box was deployed, the box was left wide open to strengthen the connection between the box and a food reward. After three days, the box was rebaited, and the lid was shut until it was solved and replaced with a new box type. The order of the other three puzzle boxes was based on the estimated difficulty of the latch for raccoons. The experimental boxes were latched and deployed at the sites one at a time. Boxes were deployed at both locations at the same time—i.e. when one

population solved a puzzle type before the other, it had to wait to receive the new type. Deployment dates were recorded and days since deployment tracked. Trail cameras recorded both pictures and videos of the area surrounding the puzzle boxes and were checked every few days. Due to camera malfunction, a second camera was added to the McFarland site (natural) with the deployment of Box 3.

Data Analysis

The following metrics were recorded and analyzed with the aid of the photo and video recordings:

- Number of nights needed to solve box
- Whether attempt was successful or not
- Length of attempt
- Number of interactions needed to solve box (characterized by an attempt to unlock the box)
- Length of time spent interacting with the box's location (i.e. amount of time spent examining, solving, and foraging at the box's site)

Data was analyzed with t-tests comparing the two populations on: the differences between the length of attempt; number of nights to solve the puzzle; the number of interactions; and the length of each interaction.

Results

Although several trends emerged from the data, none of the results were statistically significant due to the small sample size. Raccoons from the natural site tended to have fewer or equal interactions with the puzzle before they were able to solve it than suburban raccoons (Figure 1; p-value= 0.253). On average, raccoons from the natural site interacted with the puzzles fewer times before they were able to solve it than raccoons from the suburban site were able to (Figure 1). Additionally, the McFarland raccoon population required fewer nights to solve the puzzle types than the Pammel population (Figure 5; p-value= 0.207).

Interestingly, raccoons from the suburban site needed less time to solve Box 1 and 2 while raccoons from the natural site solved Box 3 and 4 more quickly than the suburban raccoons (Figure 2; p-value= 0.8995). This trend also appeared in the amount of time spent attempting to solve the box regardless of success (Figure 3; p-value= 0.1949). Furthermore, the amount of time raccoons spent actively engaging with the puzzle box and examining its deployment site varied by box type, but overall raccoons at McFarland spent less time doing this (Figure 4; p-value= 0.5848).

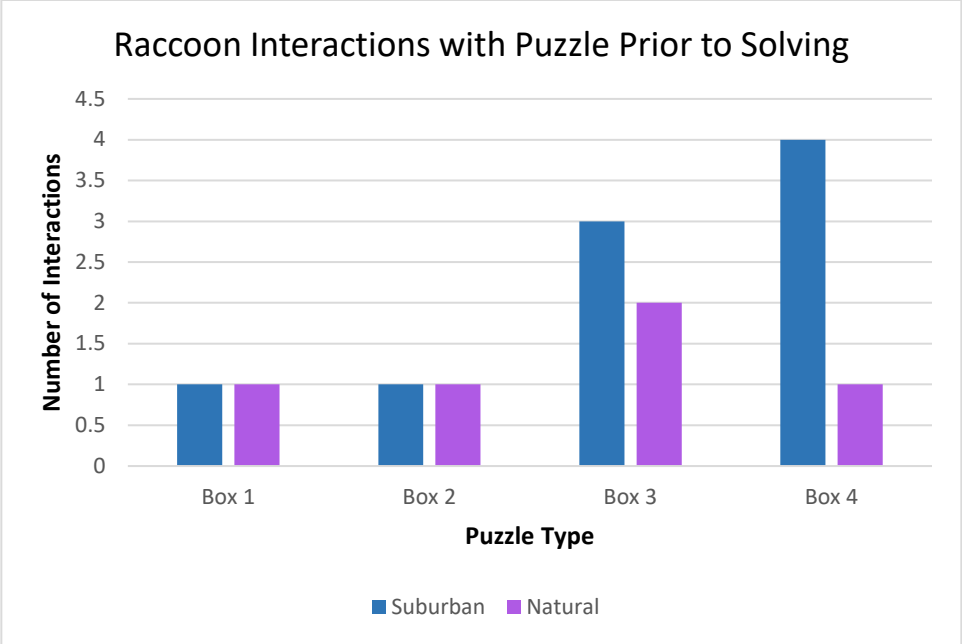

Figure 1 depicts the total number of times that the same raccoon was on camera with the puzzle box before a raccoon managed to solve the box.

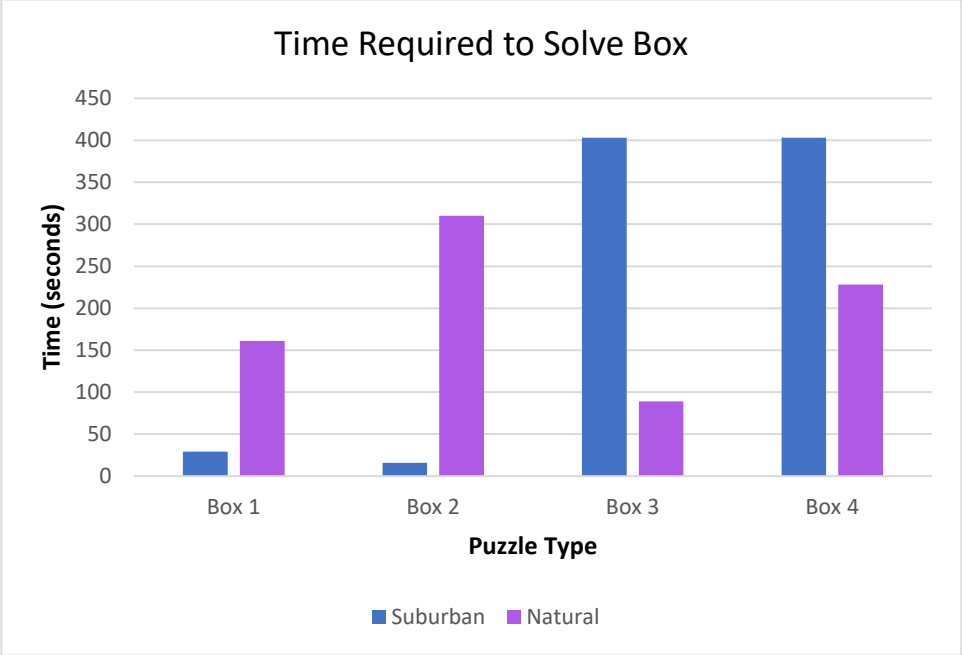

Figure 2 shows the amount of time the successful interaction lasted before the raccoon solved the puzzle box.

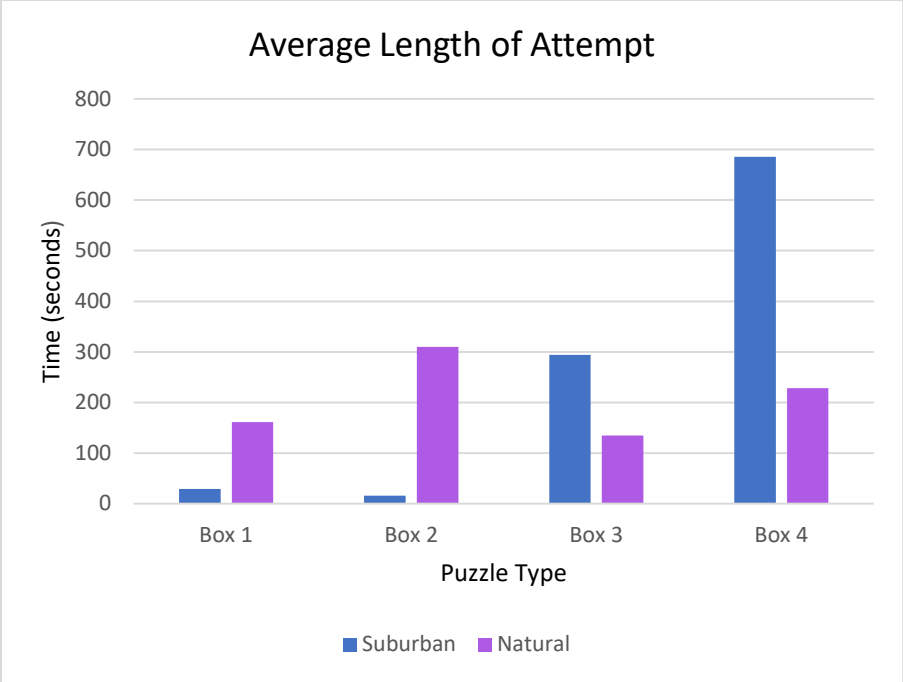

Figure 3 depicts the average length of time in seconds that a raccoon spent trying to solve the puzzle box before successfully opening it or moving on.

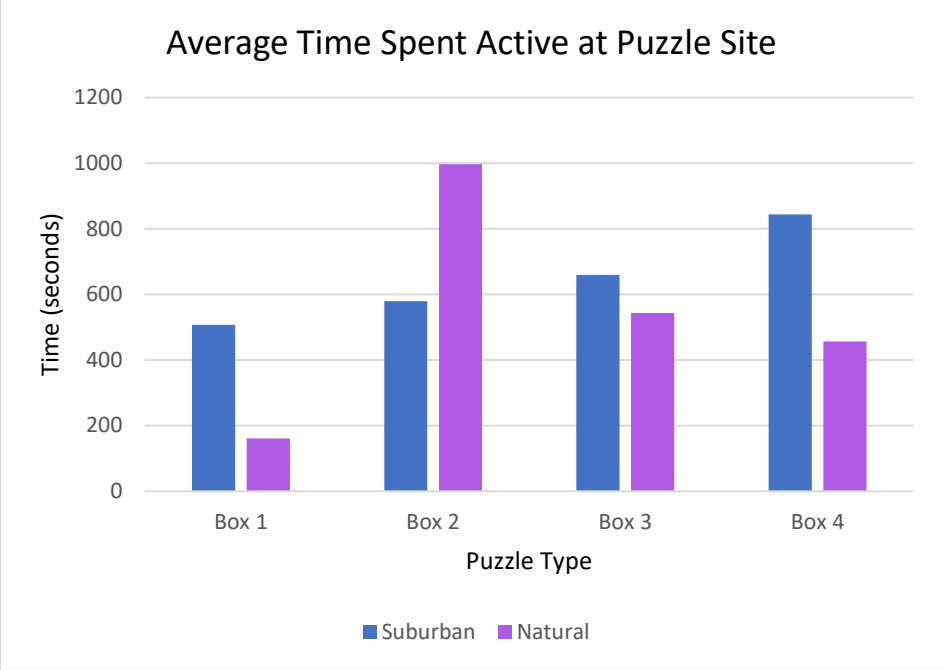

Figure 4 shows the length of time in seconds that raccoons at each site spent engaging with the puzzle box's site. Actively engaging with the site is categorized as examining the area, solving the puzzle, and foraging for the sardine reward.

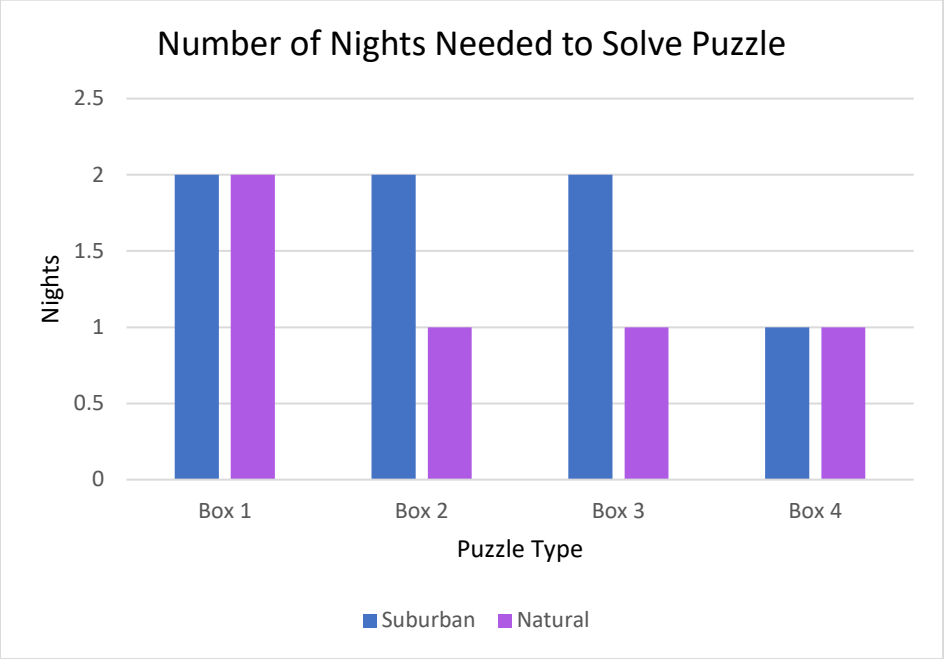

Figure 5 shows the number of nights that the puzzle box was deployed before it was solved by the raccoons at each location.

Discussion

Although none of the data collected was statistically significant, several trends emerged. In general, raccoons from natural sites tended to outperform raccoons from suburban sites in the metrics measured. Overall, natural raccoons interacted with puzzles less (fewer times, shorter durations, fewer nights) than suburban raccoons and were more efficient at acquiring the food reward. This indicates that the natural raccoons may be more apprehensive of the area, possibly due to large predator abundance or increased habituation to disturbance in human-dominated environments.

Alternatively, these results may be due purely to chance and may simply be indicative of a more efficient or intelligent raccoon solving the puzzles. This is especially likely due to the study's small sample size. Furthermore, individual raccoons were not able to be identified, leaving a lack of information regarding disproportionate abilities among raccoons in a population.

Lastly, these findings could be due to suburban raccoons commonly encountering food and having easier access to abundant resources provided by humans. Suburban raccoons may not be as motivated by hunger as natural raccoons and may therefore have been less efficient at solving the puzzles.

There were also various sources of potential error in this study. One major issue was camera malfunctioning in the dark and not recording videos and occasionally pictures. Although there was always enough evidence to confirm that a racoon was the creature that solved the puzzle, other encounters were sometimes only briefly captured. Because there is the possibility that some raccoon activity was not recorded, several metrics are suspect: number of interactions prior to solving the box, amount of time of each attempt, and amount of time spent engaging with site.

Additionally, camera malfunctioning led to the deployment of an additional camera at McFarland Park which was cause of great (and extended) interest from raccoons. Not only did the camera increase the wariness of the raccoons encountering the box site, but it may have also frightened off raccoons before they entered the camera frame.

Future research should focus on increasing sample size and decreasing sources of error. Continuing the experiment in order to increase the sampling size would drastically clarify the relationship between anthropogenic influence and raccoon problem-solving abilities. In areas where pest management is a primary concern, surveys should be used to determine the nuisance level that raccoon foraging causes the public and raccoon problem-solving should be compared with this information in mind.

References

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