Exploring Scavenging Behavior of Bobcats, *Lynx rufus,* in Middle Tennessee and its Forensic Implications

By

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Dedication

To my mom and dad, thank you both for all you have given me in life. You two are the best parents anyone could ask for, and it is only with the consistent love and support from both of you that I have made it this far. I will forever be grateful for you two, and I can only hope to share back as much love with you two as you two have provided me with in my life. I will never forget the many lessons taught, and the many memories shared.

To Jasmine, thank you for the wonderful, exciting journey we live through every day. The time spent with you keeps me going, even in the hardest of times. Without your constant motivation and positivity, I could not imagine how different my years in college and life would have been. You have contributed so much to this paper not with words, but with love and encouragement. I will never forget the many dark nights you have lit up with your glowing personality, and the many days you have turned into treasures.

To my grandfather and grandmother, thank you both for having such large roles in my life. Not everyone gets the opportunity that I have had to bond with their grandparents and reach such a special connection. Grandad, you are the man everyone loves, and your strength, kindness, and endurance throughout life has always served as an inspiration. You are my role model, and my hero. Grandmom, I am dearly sorry you could not see the thesis come to fruition, but you are still here, in my heart. You were such a great person. You always believed in me, and did whatever you could to bring me joy. Thank you for being such a considerate ray of sunshine, I hope I made you proud. I miss you, and I love you.

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Abstract

Although bobcats (*Lynx rufus*) are known as hunters, their scavenging activities have been reported, which could be vital to forensic research (Ubelaker & DeGaglia, 2020). Knowledge about scavengers is required to determine if any trauma observed on a victim was inflicted by animals or humans (Rippley et al., 2012). Fain and Jeong confirm that bobcats are among the scavengers active in Middle Tennessee (2023). The goal of this study is to examine the scavenging patterns and effects of bobcats. Experiments occurred at the MTSU Outdoor Forensic Facility in Murfreesboro, TN. Bobcats' visits to 7 deer specimens were examined for the time, weather conditions, and behaviors observed on camera. Bobcats were observed scavenging in this study. The results will provide forensic investigators with knowledge about bobcat scavenging activities in Middle Tennessee, helping them distinguish bobcat-associated evidence from human-induced trauma. Future studies should further observe bobcats to explore effects of their scavenging.

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Introduction

Bobcats, *Lynx rufus*, are North American wild cats who are known for their bobbed tail and excellent hunting skills. They are the smallest in their genus, *Lynx*, and share this genus with the Iberian lynx (*Lynx pardinus*), the Canadian lynx (*Lynx canadensis*), and the Eurasian lynx (*Lynx lynx*). Within this species, there are two recognized subspecies, *Lynx rufus rufus* in the east of the Great Plains and *Lynx rufus fasciatus* in the west (Kitchener et al., 2017). Bobcats display sexual dimorphism, with males averaging 10% longer and 25-80% heavier than females (Larivière & Walton, 1997). Bobcat's diet generally consists of birds, rodents, white-tailed deer, rabbits, hares, and occasionally, raccoons, opossums, skunks, and foxes (Tewes et al., 2002). They primarily hunt at dusk and dawn. They stalk their prey and then take it down by severing its spinal cord through its neck. Bobcats are known to scent-mark the area where they leave larger prey, presumably to deter others while they are away. They will then return to feed more (Rippley et al., 2012).

Even though bobcats are well known as hunters, recent studies have found evidence of bobcats behaving as scavengers. For example, bobcats have been documented scavenging human cadavers (Moss, 2012; Rippley et al., 2012) as well as ruffed grouse carcasses (Bumann & Stauffer, 2002). In another observation, the stomach content of a road-killed bobcat was analyzed and the remains of a grey squirrel which contained blowfly eggs were found. This indicates that the squirrel was already deceased by the time the bobcat fed (Platt et al., 2010). Younger bobcats

may scavenge more frequently because they are less skilled hunters (Rippley et al., 2012), but observations of scavenging by adult bobcats are mounting. Bobcats are also known to feed on roadkill and wounded animals, but were reported to stop once the tissue starts to spoil (Rippley et al., 2012). Also, when scavenging, they were reported to strongly prefer fresh meat (King et al., 2015).

Scavengers are a vital component of every ecosystem. Their role is to feed on carrion, and remove detritus from the environment. With the constant removal of decaying organisms, there is a lower risk of disease for both wild and domestic animals, including diseases such as rabies, canine parvovirus, canine distemper virus, the bubonic plague, and *Leptospira* spp. bacteria (Ogada et al., 2011). Scavenging contributes to nutrient cycling between soil, air, and water. Importantly, scavenging transfers energy between trophic levels of food webs (Devault et al., 2003; Wilson & Wolkovich, 2011). It also eliminates the unmistakable odors of putrescine and cadaverine, two similar chemical compounds synthesized during the putrefaction process of decomposition. Both organic compounds are diamines (butane-1,4-diamine & pentane-1,5-diamine), and are synthesized when the amino acids in an organism's body naturally break down into smaller components (Heidari & Gobato, 2018). Despite putrescine being a solid substance, unlike its liquid counterpart cadaverine, its vapor pressure increases to such a high amount that the odor becomes noticeable. When this occurs, this series of chemical reactions produces the commonly known "smell of death".

The importance of scavengers has also been well appreciated in the forensic context. Dead bodies in an outdoor setting are susceptible to animal scavenging. When trauma or damage is noticed on a victim recovered from a crime scene, forensic investigators must determine if it

was due to human activities or animal scavenging. Knowledge about scavengers in a region and understanding the species-specific activities is required to make this determination (Dirkmaat & Cabo, 2016). Traditionally-known vertebrate scavengers in Tennessee include vultures (*Cathartes* & *Coragyps* genera), coyotes (*Canis latrans*), opossums (*Didelphis virginiana*) and racoons (*Procyon lotor*) (Fain and Jeong, 2022, 2023). If bobcats are added to the list, forensic workers need better information about their behavior at carcasses and the evidence they leave behind.

Bobcats' scavenging activity in middle Tennessee was first reported by Fain and Jeong (2022, 2023). To survey scavengers in Murfreesboro, TN, the authors placed three carcasses (two goats and one deer) in a field and found that bobcats were one of the scavengers that significantly affected the decomposition of carcasses. However, no further details of bobcat behavior were provided in their study because bobcats were observed for only one day during their experiment period.

In this experiment, the behavior of bobcats near carrion will be recorded and analyzed. Field plots provisioned with road-killed deer carcasses will lure scavengers into the view of multiple trail cameras. Besides bobcats, other common scavengers that cameras are expected to record include black vultures, turkey vultures, opossums, and coyotes. Each appearance of a bobcat will be scored for behaviors observed, time of day/year, weather conditions and the presence of carrion insects. This research will allow for a deeper understanding of this behavior and will be useful to ecological and forensic research fields.

Thesis Statement

The primary purpose of this research is to observe and gain insight into the scavenging behavior of bobcats from a forensic and ecological perspective. They are traditionally understood as predators who hunt small game. However, over the last two decades, there has been evidence suggesting that bobcats also act as scavengers and feed on carrion. This finding is important for forensic workers, researchers, and many others to understand the markings they leave on bodies. The results of this research will (1) help forensic workers identify bobcat-induced markings found on human remains, (2) assist taphonomy researchers in understanding how bobcats affect decomposition, and (3) inform ecologists of bobcats' additional role in food webs and nutrient cycling. Ultimately, this research aims to expand on the observations that have been collected to date and contribute to the scientific community's understanding of this scavenging behavior.

Methods

Seven white-tailed deer (*Odocoileus virginianus)* carcasses were collected as roadkill in Murfreesboro to serve as the carrion for the native scavengers in this observational experiment, with a key focus on the scavenging behavior of bobcats. Carcasses were found on local roadways and collected within 48 hours of death. Each carcass was then wrapped into a tarp and transported to the Murfreesboro Outdoor Forensic Facility (MOFF) in Murfreesboro, TN, an outdoor decomposition research facility administered by the MTSU Forensic Science Program.

Each plot was 238.76 cm long, and 170.18 cm wide. The top of the structures reached 172.72 cm at all sides, with an apex of 220.98 cm meeting in the center (Figure 1). The fence at the bottom was 76.2 cm tall and had some flexibility which allowed digging predators access to the carcass. The taphonomy of these specimens and the activity of scavengers was recorded by motion detection trail cameras (Vikeri, model# A1), in various positions around the carcass. One camera was fastened directly above the specimens, wrapped around the apex of the fencing. A second was fastened around a corner of the fencing, positioned diagonally to the specimens (Figure 1). There was a third camera positioned about 60 cm away from the plot, to capture activity in or around the plot that the first two cameras could not. Cameras were set to record a burst of 10 photos every 5 seconds when motion is detected. This burst would continue until the source of motion was not visible to the camera anymore.

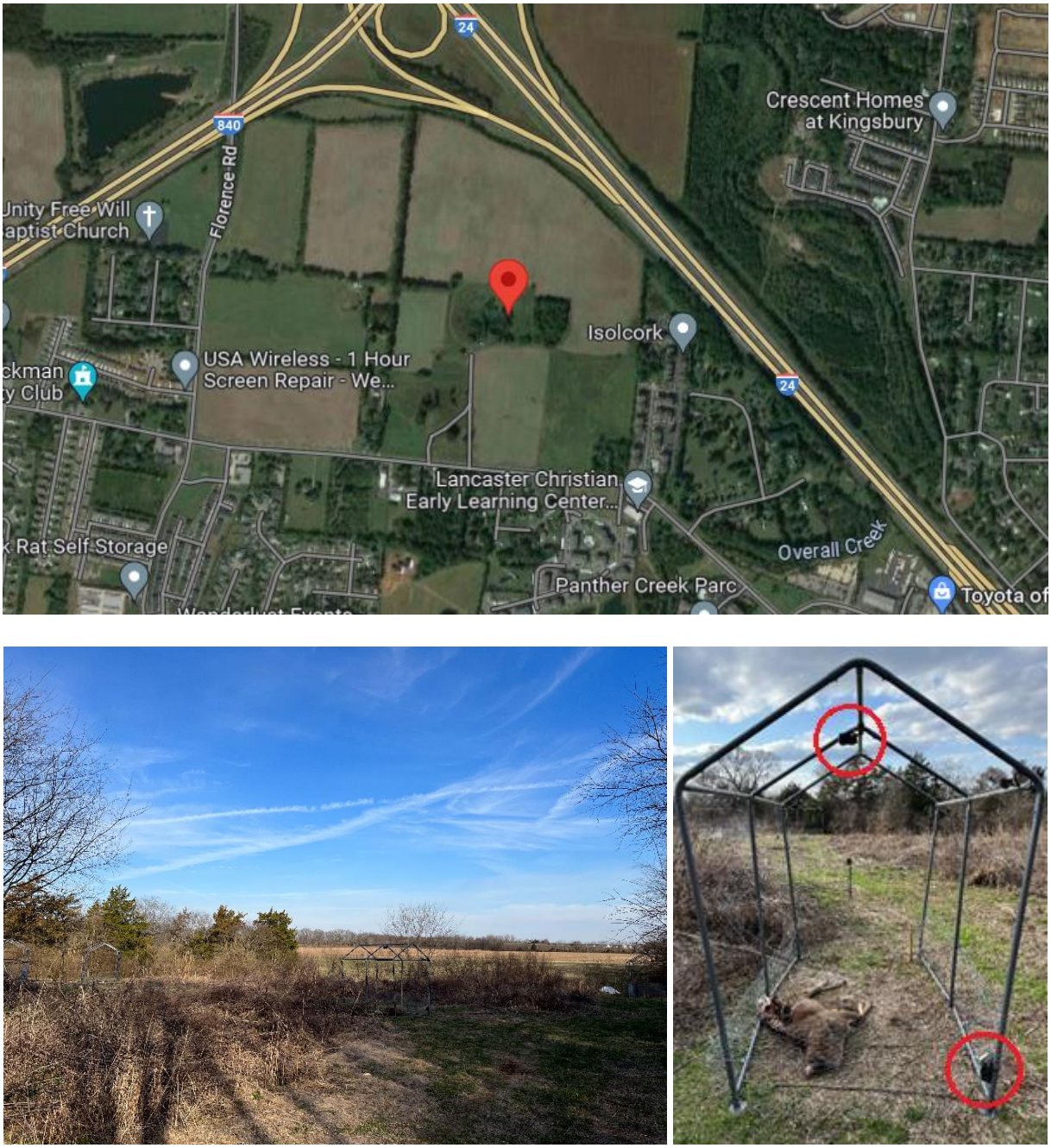


Figure 1. The location where the experiment was conducted (top and bottom left) and the design of a plot which encases a specimen (bottom right). Red circles in the bottom right picture indicate the locations of two motion detection trail cameras.

At the research site, an AcuRite® weather station (AcuRite®, model#01528MCB) measured humidity, temperature, rainfall, and wind speed every 12 minutes. This data was downloaded and matched with the time stamps of bobcats' appearances on camera. Camera cards were collected weekly. Photos were copied to a laptop for viewing, and date/time stamps of bobcat appearances were recorded into an Excel spreadsheet along with weather station data. Any photo series or video of bobcats was categorized into 5 categories following Rippley et al. (2012): feeding, covering/scent-marking, resting, appearing with no activity, and unknown. Further, each behavior was recorded as occurring during peak hours (PH) or non-peak hours (non-PH) to test for the validity of the peak hours (04:00-10:00 and 18:00-24:00) and non-peak hours (0:00-03:59 and 10:01-17:59) proposed by Rippley and colleagues (2012). Once all of the data was collected, a descriptive statistical analysis was performed in order to determine the frequency of each activity. The frequency of each activity was organized into a table, also categorized by these time frames.

Specimen #1 was placed on January 8, 2022 (Figure 2). Its initial condition was good, with its body being fully intact and nearly unscathed from what may have ended its life. All limbs were present, as well as its full skin (not broken), eyes, ears, and tail. This specimen was placed during bobcat breeding season in Tennessee, which was reported by the Tennessee Wildlife Resources Agency to occur between December and early summer, peaking in March (2023). This gives the implication that there might be more bobcat appearances for this specimen, as bobcats only give up a solitary lifestyle in order to mate and raise their young through their first winter (Virchow & Hogeland, 1994). Outside of that, bobcats are territorial

and will prevent any other from entering their marked territory, which they mark with feces, urine, and a pasty, white/yellow substance from their anal glands (Allen et al., 2015;Virchow & Hogeland, 1994). Each night it snowed for the first few nights after placement of the specimen, and the temperatures were low.

Figure 2. Salvage of Specimen #1.

Specimen #2 was placed on September 25, 2022 (Figure 3). It was more contorted and broken than the first specimen, and its neck was turned backwards, causing its head to face in the backwards direction. It had short, needle-like antlers covered in velvet, showing that it was either a young buck, or a buck which had recently shed its antlers over the winter, as deer perform annually (Fergus & Shope, 2010). It also appeared that its spine was broken around the lumbar section, which caused a knot right where the hindlimb meets the torso. It had all of its limbs, as well as both of its ears. The left forelimb had already decomposed some upon placement.

Figure 3. Salvage of Specimen #2.

Specimen #3 was placed on November 4, 2022 (Figure 4). It had short antlers, and a fit body. The body was not noticeably lacerated anywhere, and the structure of the body segments had not been altered or contorted in any way. It had all of its limbs, as well as both of its antlers and ears. Bugs had already began feeding on it soon after placement.

Figure 4. Salvage of Specimen #3.

Specimen #4 was placed on December 2, 2022 (Figure 5). It had very short antlers, which were not covered in velvet. Instead, they just stuck out as sharp, skinny protrusions. This specimen had all of its limbs, however, the right hindlimb was broken in half. The lower half of the limb had been twisted up, with most of the bone sticking out. The body's quality was mostly adequate, with one exception. The lower intestines of the specimen had come out through the rear, exposing them to the outer environment.

Figure 5. Salvage of Specimen #4.

Specimen #5 was placed on January 3, 2023 (Figure 6). Its body was not in good condition. The body had been twisted in two pieces separating around the middle section of the spine. This caused there to be a large hump in the upper back of this specimen. The fur in the posterior region was also heavily disturbed. The specimen had all of its limbs, but it appeared that the limbs were damaged some as well.

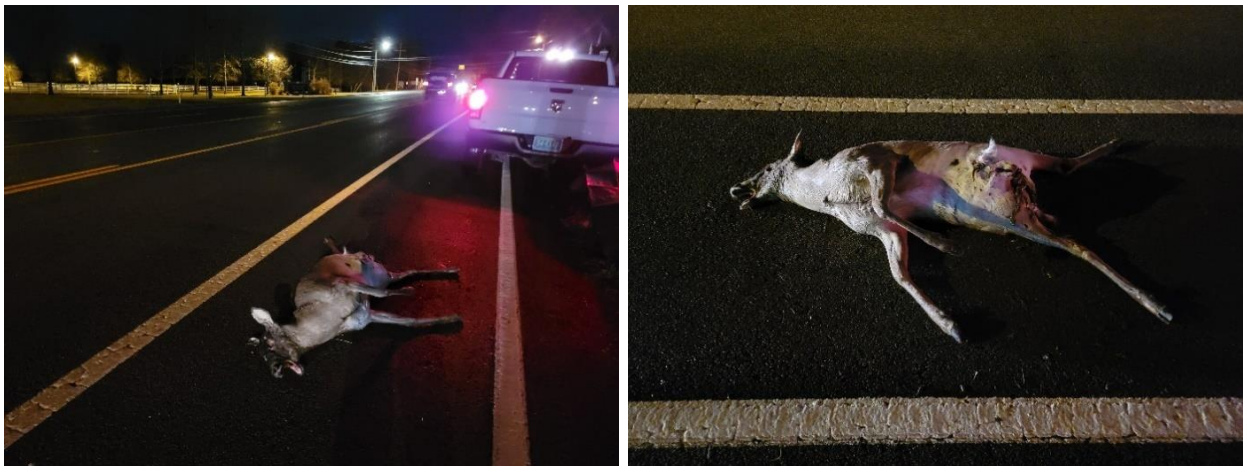


Figure 6. Salvage of Specimen #5.

Specimen #6 was placed on January 21, 2023 (Figure 7). This specimen had been decapitated prior to possession, assumedly from the accident took its life. It had a clean cut right at the base of its neck, with a flat surface where the head of the specimen would be. It had all of its limbs intact, appearing not to be broken. It also still had its tail. The overall quality of the body appeared to be good, and the body itself was meaty.

Figure 7. Salvage of Specimen #6.

Specimen #7 was the last in this study. It was placed on April 9, 2023 (Figure 8). It had all of its limbs, as well as its ears, tongue, and tail. The fur was already quite matted, most noticeably on the face of the specimen. Its tongue hung out to its left, and the fur on its head had an almost greasy appearance. The body itself did not appear to be contorted or improper in any significant way, it was only the outer cosmetics that appeared abnormal compared to the previous specimens.

Figure 8. Salvage of Specimen #7.

Results

The results of this study will be described in two parts. To begin, there will be a section elaborating on what happened to each specimen. The significant events that occurred within each specimen's placement in the field will be detailed, and a description of bobcat appearances for the specific specimen will be given. Following this, there will be a second section which provides the summarized findings. In that section, the bobcat appearances from each specimen will be brought together and analyzed.

Specimen #1.

Specimen #1 was placed on January 8, 2022. On January 16, 8 days after placement, the first bobcat appearance began at 19:56:50. It snowed that morning from cold rain the night before, causing the specimen to remain covered in a layer of snow throughout the day. This occurrence lasted for approximately 30 minutes. The bobcat uncovered the specimen from the snow, and fed on its central abdomen and hindlimb for a while before disappearing (Figure 9).

Figure 9. A capture from the first bobcat appearance for Specimen #1. The bobcat can be seen uncovering the specimen, in order to feed from its central abdomen.

Later that night, at 00:59:36, an interesting observation was noted. Two bobcats approach the specimen at the same time, for the first of only two times throughout the duration of this study (Figure 10). The primary bobcat begins to feed while the secondary bobcat rests and looks in from outside of the fencing. After observing the primary for a brief period, the secondary bobcat temporarily joins, and they feed in unison on the central abdomen and hindlimb. However, for a significant portion of this double appearance, it is only the primary bobcat which feeds. They both leave approximately an hour and a half after appearing, but return that same morning.

Figure 10. A capture depicting the primary bobcat feeding from the central abdomen of Specimen #1, while the secondary bobcat rests and observes (right upper corner).

They come back at 07:44:02. This marks the only other time two bobcats appeared at once, and it is believed to be the same duo. This time, the primary bobcat feeds on the specimen the whole time (Figure 11), while the secondary bobcat can be seen moving around in the background. It alternates between being in the camera's range and not, showing little interest in the specimen itself. Meanwhile, the primary bobcat feeds on three body segments (torso,

forelimb, & hindlimb). Eventually, the secondary bobcat departs, with the primary bobcat following.

Figure 11. The primary bobcat biting at the ends of the forelimbs of Specimen #1 the next morning.

Only once more was a bobcat observed feeding on this specimen, around 24 hours after the aforementioned morning. It was a brief appearance of only 5 minutes, and interestingly, this bobcat decides to feed from the neck of the specimen. Outside of these feedings, a bobcat appeared but performed none of the documented activities on 6 occasions. In most of these, the

bobcat simply smelled the specimen and left. There was also one of the three unknown activities in this study observed with Specimen #1, as the cameras simply caught a bobcat sprinting away from the center of the specimen. In total, there were 11 bobcat appearances for this specimen. A bobcat (or two) fed on this specimen in 4 of the 11 appearances, and otherwise spent a majority of this specimen's time in the field investigating it. The final bobcat feeding occurred on January 18, 2022, only 2 days after the first feeding. The final bobcat investigation into the specimen occurred on January 30, 2022, and the last bobcat appearance at all was on February 6, where it completely disregarded the specimen (Figure 12). Specimen #1 went through a full decomposition process, and was then removed.

Figure 12. A capture of Specimen #1 the morning after the final bobcat appearance, displaying its condition at that time.

Specimen #2.

Specimen #2 was placed on September 25, 2022. This specimen was one of two unique cases where no bobcats were observed visiting (Figure 13). Through all of the footage captured during the time of its placement, there are no bobcats which approach the camera's range, and therefore, the specimen itself. Other animals still scavenged as expected, showing that there was nothing different about the specimen's quality itself.

Figure 13. A capture of Specimen #2 in the post-bloating stage of decomposition.

This specimen's time in the field was cut short by coyotes (*C. latrans*), which removed the specimen from its enclosure between 06:36:55 and 06:43:28 during a scavenging session in the early morning of October 25 (Figure 14). Specimen #2 spent exactly one month in the field before its premature conclusion.

Figure 14. A capture of the coyote minutes before it removes Specimen #2 from the enclosure (red circle).

Specimen #3.

Specimen #3 was placed on November 4, 2022. Its first bobcat appearance was 4 days later, on November 8 (Figure 15). At 17:47:31, the bobcat appears outside of the fencing. It stays there for approximately 40 minutes before deciding to enter and feed on the specimen. It feeds on the upper hindlimb of the specimen, for only a few seconds, before leaving abruptly. About 24

hours later, a bobcat comes and feeds on the forelimbs and torso, heavily focusing on the left forelimb. This continues for about 1 hour before the bobcat departs.

Figure 15. A capture of the first bobcat scavenging session for Specimen #3, where the bobcat fed on the upper hindlimb for a brief period.

This began a short pattern however, as the rest of the bobcat appearances for this specimen occurred throughout the 3 days afterwards. In these 3 days, there were 11 more feedings which were recorded by the cameras (Figure 16). These feedings were spread throughout the length of each day and night. They were each about an hour or less in duration, and the torso was fed from each of the 11 times. In 8 of these feedings, the forelimb was also fed from. In the last 3 feedings, the neck was fed from for the first time with Specimen #3.

Throughout the 11 feedings, the body decomposed further. The bobcat can be seen working to avoid and eat around the growing mass of insects feeding on nearby parts of the specimen.

Figure 16. A capture of the bobcat scavenging during the daytime, fighting around the bugs to feed from the section of Specimen #3 that it desires.

During the 8th feeding of the 11, the bobcat scent-marks the area after it finishes eating, in order to preserve its territorial status on this source of food (Figure 17). To do this, it spends about 1 minute rubbing its face against the plants next to the specimen. The final feeding was on November 12 at 08:41:59, during revised non-peak hours. The bobcat chose to feed on the neck and upper torso. It is clear that the desirable parts of the specimen had mostly been fed from, as the bobcat moves up the neck searching for better bites to take. Finally, it gives up and leaves the specimen for its last time.

Figure 17. A capture of the bobcat scent-marking on the plants in the corner of the specimen's enclosure (red circle).

Specimen #3 remained placed until it completed a full decomposition and was then removed from the site. The reoccurring bobcat most likely played a large role in the specimen having a relatively quick decomposition in comparison to the others. By November 29, the specimen was already mostly just bone. With this specimen, there were 14 total bobcat appearances. All but one of these were feedings (92.9% of total appearances for this specimen). This appearance happened between the first feeding and its proceeding series of feedings. It was an appearance with no documented activity, at 03:28:46 on November 9, where a bobcat spends approximately 2 minutes investigating the specimen. Another activity observed, as mentioned above, was scent-marking during one of the feedings. This specimen was also the one with the

most variety found in hour of visit. This is likely due to how the bobcat fed during the 3 days, returning to the specimen consistently.

Specimen #4.

Specimen #4 was placed on December 2, 2022 (Figure 18). The first time a bobcat appeared for this specimen was not until 41 days after, on January 12, 2023. At 04:10:41, a bobcat appeared in the background (Figure 19). It briefly looked into the fencing, seeming uninterested in the specimen. This was documented as appearing with no activity.

Figure 18. A capture of Specimen #4 taken right after placement, to show the damaged condition of the specimen.

Figure 19. A capture of the first bobcat appearance for Specimen #4, which shows a completely disinterested bobcat shortly before it walks by and leaves.

After 17 more days had passed (January 29, 2023), a bobcat appeared at 02:24:42. It also walked by, fully ignoring the specimen. 5 days later, a bobcat came near and smelled the fencing. Upon inspection, it leaves. On four more occasions throughout the month of February 2023, a bobcat appears for a few seconds just to show disinterest and continue walking. The final appearance was on February 27, 2023 (Figure 20).

Figure 20. A capture which shows the final bobcat appearance for Specimen #4, where the bobcat simply walks by.

The specimen would complete the decomposition process, and then be removed. This specimen was unique in that it was the only case where every bobcat appeared without performing a documented activity. In each of the 7 sparse bobcat appearances, the bobcat disregarded the specimen, other than smelling the fencing on one occasion.

Specimen #5.

Specimen #5 was placed on January 3, 2023. Unlike the recently placed previous specimen, this one had its first bobcat appearance only a week after placement. At 05:07:22 on

January 10, a bobcat is seen crawling under the same area of fencing that opossums had been using in the previous nights. It works its way from the rear of the specimen to its torso before settling on the upper left forelimb. With intermittent breaks to look around, it eats there for about 15 minutes. It leaves, then returns to continue feeding. It then spends a considerable amount of time and effort covering the specimen, to hide it from other consumers (Figure 21). It continues this until finally leaving at 07:52:37.

Figure 21. A capture of the bobcat covering Specimen #5 in order to hide it from other possible scavengers.

It returned within an hour, but its appearance was with no documented activity. Later that evening, a bobcat appeared and uncovered the upper hindlimb in order to feed (Figure 22). After feeding from the exposed internals of the rear, the bobcat lies down to nap for an hour before

waking up and departing. That night, a bobcat again comes to feed on the upper left hindlimb of the specimen. The morning after, a bobcat uncovers the specimen some, seeming to inspect it before covering it again. It then leaves without feeding on the specimen at all. This non-scavenging inspection from the bobcat supports the possibility that this is the same bobcat that covered the specimen right after its placement in the field.

Figure 22. A capture of the bobcat uncovering different parts of the covered specimen, shortly before recovering it. The bobcat did not scavenge in this appearance, which supports the possibility that this is the same bobcat as before.

That night, a bobcat came to feed on the upper hindlimb and lower torso before lying down and resting in the same area where it fed (Figure 23). A few hours later, once midnight had arrived, a bobcat appeared yet again, feeding on the upper left hindlimb and the gut of the

specimen, which was now protruding. It leaves, and just 7 hours later a bobcat appears. It feeds solely on the protruding gut in this occurrence. The next night, on January 13, 2023, a bobcat enters the fencing to simply rest in the back corner, sitting and looking around. After getting up, it covers the specimen some and then departs. That morning after, a bobcat comes to feed from the upper right hindlimb for approximately 20 minutes. Two days later, a bobcat enters the fencing just to immediately turn and leave. Exactly three weeks after this appearance, a bobcat comes in the early morning to feed one last time on what meat is left of the middle section of the torso. It feeds for 20 minutes.

Figure 23. A capture of the final bobcat scavenging with Specimen #5, showing the bobcat feeding on what little is left (red circle).

The final bobcat appearance for this specimen was that night, at 20:54:18. A bobcat approached and pushed its face against the fencing for a second, before disappearing one last time. Specimen #5 was left to finish decomposition, and was then removed from the site. This specimen had 13 total bobcat appearances. It is unique in having the most diverse set of activities recorded in this study. Out of the 17 recorded activities performed by a bobcat with this specimen, 8 were feedings (47.1%) and 3 were covering (17.6%). There were also 3 moments with no documented activity (17.6%). Lastly, there were 3 occasions where a bobcat rested (17.6%).

Specimen #6.

Specimen #6 was placed on January 21, 2023. The first bobcat appearance this specimen had was the night after placement. A bobcat arrived shortly after midnight, inspecting the specimen before scent-marking around the entire body and the fence behind it (Figure 24). Once this was complete, the bobcat began to feed on the lower gut region of the specimen from between the hindlimbs. It fed in that exact spot for about 2 hours, opening up a sizeable hole to fit viscera through.

Figure 24. A capture of the first bobcat appearance for Specimen #6, showing the bobcat scent-marking in the corner prior to its scavenging session.

After 2 more hours, a bobcat appears and feeds in the same area that was fed on previously, with short breaks spread throughout. That night, the same events take place. The same can be said for the morning after that. However, the specimen then went 5 days without a recorded bobcat appearance. On January 28, 2023, a bobcat appears at night, disturbing an opossum's meal of the specimen. It enters from the opposite side of the fencing, and drags the specimen towards itself while feeding intensely (Figure 25). The opossum watches from the other side, before they both leave shortly after.

Figure 25. A capture taken right after the bobcat drags Specimen #6 towards itself, while the disturbed opossum watches and hides carefully.

Once two hours had passed, the second unknown activity of three in this study occurred (Figure 26). The recordings showed a bobcat approaching from outside of the fencing, but then the cameras did not reactivate for another 30 minutes. Once these 30 minutes had passed, the bobcat was inside of the fencing, on the opposite side. It then leaves shortly after. After another 4 hours had passed in the same night, a bobcat appears with no documented activity, having only walked straight through the fencing towards the other side. A day later, on the night of January 30, 2023, the third of three unknown activities in this study was recorded. A bobcat walks through the fencing in 20 seconds. However, the specimen is noticeably disturbed afterwards. The cameras were not able to capture what happened in these 20 seconds, so it can not be

determined whether this was an appearance with no activity or a feeding. This is why it was marked as an unknown activity.

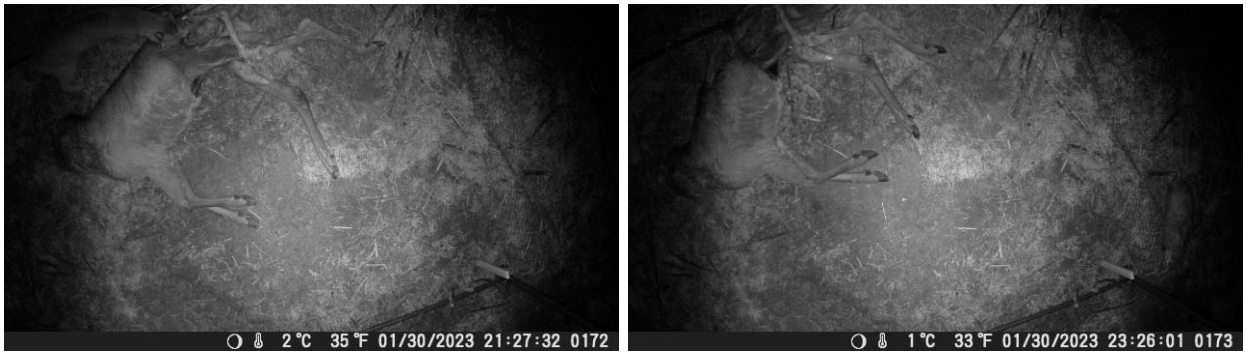


Figure 26. Two captures taken before and after the gap in camera activation. The left capture was the last capture taken for about 2 hours, while the bobcat was inspecting Specimen #6. The cameras were not activated again until two hours after, which is shown in the right capture. Because of this gap, it can not be determined whether the bobcat or another scavenger fed from Specimen #6.

From February 3-6 of 2023, there were 4 bobcat appearances, each with no documented activity. The first three occurred after 18:00, and the last occurred shortly after midnight. Through all 4 of these appearances, the bobcat inspects the specimen and attempts to find any good area to bite into, to no avail. It can be seen examining the region most fed so far, being the lower half of the torso, which had already been exposed down to the bone. It then left abruptly each of the four times. The next time that a bobcat appeared was in the early morning of February 7, 2023. This time, it was finally able to feed again, choosing to move to the upper half

of the torso via the pathway between forelimbs (Figure 27). After feeding on that side of the torso for a brief period, the bobcat then feeds on the forelimbs themselves, dragging the specimen around the enclosure some. It then leaves, after 2 hours of feeding. That night, a bobcat entered the fencing, just to leave shortly after. Two hours later, a bobcat appears and rests in the corner for a couple of minutes before departing. In the following morning, a bobcat appears and feeds in the same region as before, above the ribcage of the specimen. Twice in the night after, a bobcat appeared with no documented activity.

Figure 27. A capture of the bobcat feeding intensely between forelimbs, dragging the specimen around the enclosure in the process.

From February 10-13, a bobcat appeared and fed on the specimen 4 separate times. Each of the four times occurred between 18:00 and midnight. The bobcat fed on the torso in all 4

appearances, including the neck twice as well. During these feedings, the bobcat drags and disturbs the specimen, eating voraciously (Figure 28).

Figure 28. A capture of the bobcat feeding from the region where the head of the specimen belongs, dragging the specimen.

Twice immediately following the last of the four feedings, a bobcat appeared with no documented activity. The bobcat disregards the specimen entirely in both appearances. It returns to feed one more time less than an hour after, appearing to guard the specimen at first. It feeds on the torso for a while, finishes with one of the forelimbs, and leaves. The last bobcat appearance for this specimen was 5 days later, February 18, at around the same time of night. It was also the final time a bobcat fed from this specimen. It feeds on the forelimbs, taking occasional breaks to walk or sit before departing (Figure 29).

Figure 29. A capture of the final bobcat appearance for Specimen #6, where the bobcat attempts to feed on what meat is left on the limbs.

Specimen #6 was removed from the site once it completed decomposition. This specimen was unique in having the highest number of bobcat appearances. A bobcat appeared 26 different times for this specimen, all within the course of a month. Feedings were the dominant activity observed, being a part of 13 appearances (50.0%).

Specimen #7.

The final specimen was placed on April 9, 2023 (Figure 30). This was the second of two specimens where no bobcats were observed. Other animals did scavenge this specimen, similarly to Specimen #2, indicating that the specimen was ordinary. However, for no known reason, no bobcats approached this specimen. Interestingly, there is a separation in the cameras' activation between April 13 and 15, with the body of the specimen being noticeably disturbed afterwards. This was presumably caused by vultures (Figure 31). The specimen remained unapproached by bobcats before and after this event, and was removed after completing the decomposition process.

Figure 30. A capture that was taken of Specimen #7 directly following placement in the field.

Figure 31. Two captures which show the specimen before and after the gap in footage. This massive change could have been caused by vultures.

The results of this research support the idea that bobcats are habitual scavengers in Middle Tennessee. Seven deer carcasses were placed between January 2022 and April 2023, and bobcats were recorded visiting five of the seven in 3 of the 17 months. There were 71 total appearances of bobcats. Of these 71 total appearances, there was a total of 78 behaviors recorded (Table 1; Figure 32). The number of behaviors is higher than the count of appearances due to occurrences of multiple bobcats, or a single bobcat that performed more than one action. In 38 of the appearances, the bobcat fed on the specimen (48.7% of observed behaviors). There were 27 times where a bobcat appeared but did not perform any activity (no interactions with the carcass; 34.6% of observed behaviors). In these appearances the bobcat might peruse the perimeter, inspect the specimen with no physical contact, or simply walk past the camera. There were only 5 times that a bobcat was observed either covering the specimen or scent-marking the area within the fencing (6.4% of observed behaviors). While this is documented in a single category, it must be noted specifically that a bobcat covered the specimen on three occasions (approximately 4%

of observed behaviors), and scent-marked the area on two occasions (approximately 3% of observed behaviors). Further, a bobcat was observed resting within the fencing during 5 appearances (6.4% of observed behaviors). Finally, there were 3 occurrences where the bobcat appeared on camera footage, but it could not be determined what the bobcat was doing (3.8% of observed behaviors). Therefore, these were categorized as "Unknown activity".

Table 1. Frequency of bobcat activities.

Activity	*Frequency*	*%*
Feeding	38	48.7
Covering/scent-marking	5	6.4
Resting	5	6.4
Appearing with no activity	27	34.6
Unknown	3	3.8
Total	78	100

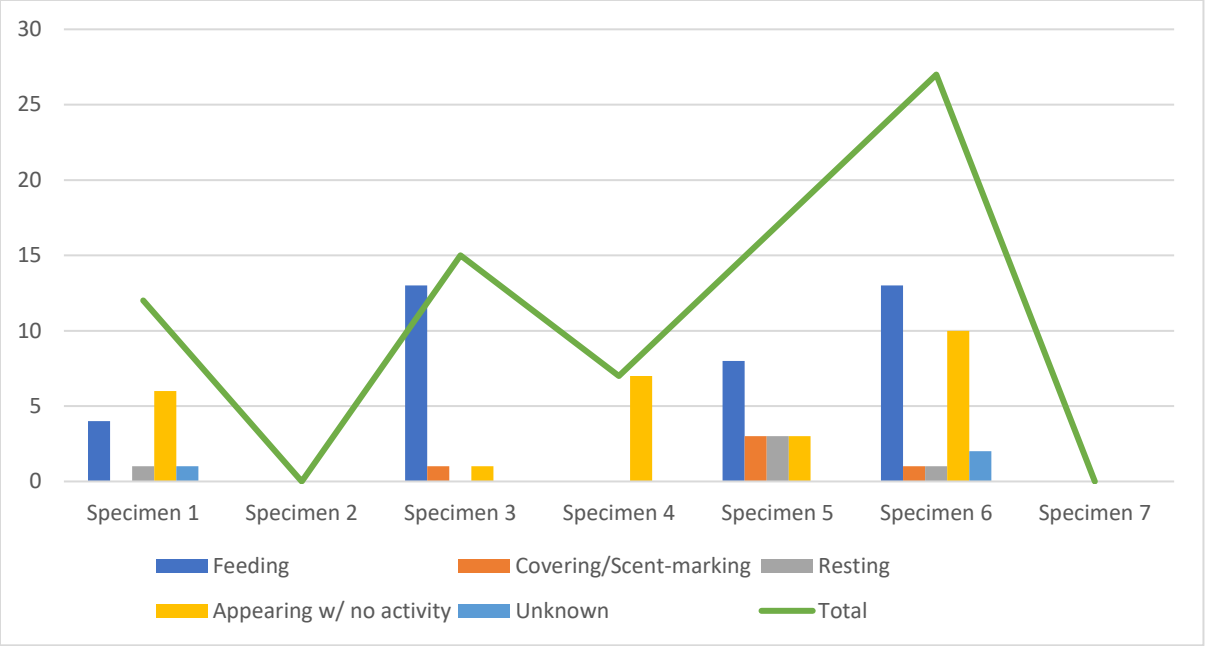


Figure 32. Frequency of bobcat activities.

The results for duration of stay support the idea that bobcats mostly scavenge in brief periods, with 35 of the 71 appearances starting and finishing within 10 minutes (49% of total appearances). Stays that lasted between 30 minutes and an hour were the next most common duration (16 occurrences or 23% of total appearances). The third common length of stay ranged from 1 to 5 hours, occurring 11 times (15% of total appearances). The least common duration for a bobcat visit occurred only 9 times, lasting from 10 to 30 minutes (13% of total appearances) (Figure 33).

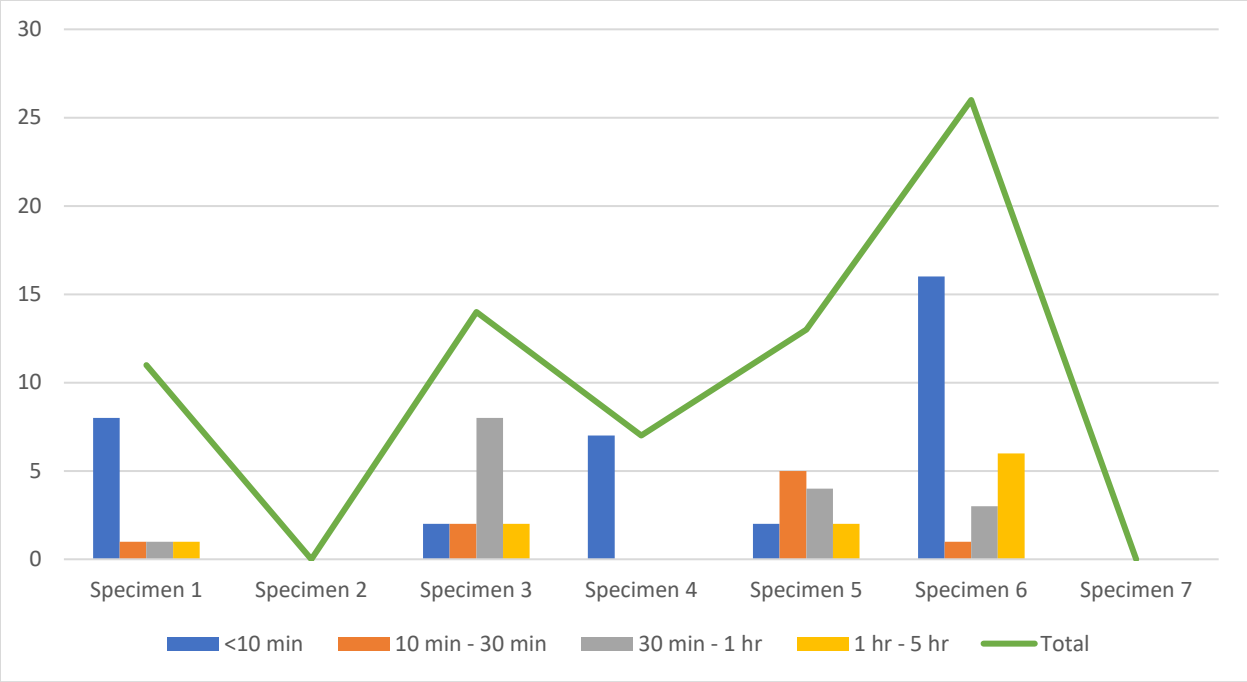


Figure 33. Durations of bobcat visit.

When measuring the occurrences by time of day, it becomes evident that the bobcats recorded in this study prefer to scavenge at night. The most common hour of the day for a bobcat to appear was between 20:00 and 21:00, where 8 bobcat appearances were recorded. The next most common hour for bobcats was tied between 18:00-19:00 and 22:00-23:00, both having 7 bobcat appearances. Beyond this, the number of bobcat appearances scattered across the board, but only occurred as either nocturnal or crepuscular behavior. Aside from two outliers which visited at 11:00-12:00 and 15:00-16:00, every appearance occurred after 17:00 but before 9:00 (Figure 34).

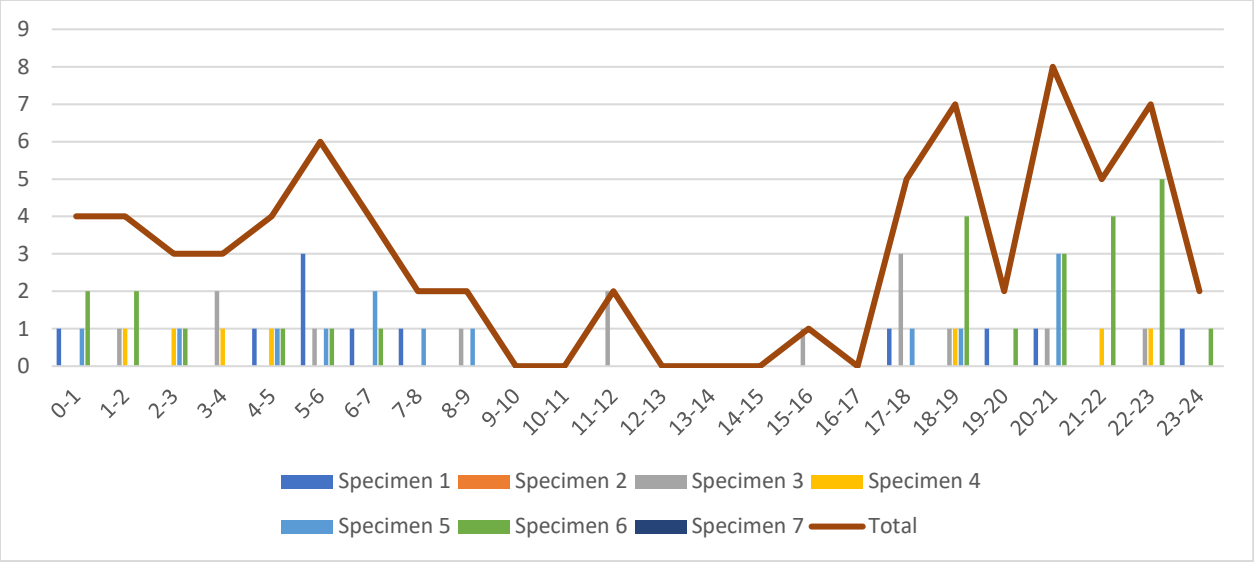


Figure 34. Daily timeline of bobcat activity.

In this experiment, only 49 of the 71 occurrences (69%) happened during the peak hours Rippley and colleagues (2012) proposed (04:00-10:00 and 18:00-24:00). After this was discovered, new peak hours were designed to better reflect the most active hours of bobcats. These revised peak hours range from 17:00-07:00, encompassing 64 of the 71 bobcat appearances (90.1%) (Table 2). There were only 7 appearances that did not occur during the revised peak hours, adding support for the idea of a new structure. Out of all 78 recorded activities performed by bobcats, 70 occurred during the revised peak hours (89.7%). Only 8 recorded activities (10.3%) were observed during the revised non-peak hours.

Table 2. Recorded bobcat activities categorized by revised peak hours.

Activity	*Peak Hours (17:00-07:00)*	*Non-Peak Hours (07:01-16:59)*	*Total*
Feeding	32	6	38
Covering/Scent-marking	4	1	5
Resting	5	0	5
Appearing with no activity	26	1	27
Unknown	3	0	3
Total	70	8	78

A deer specimen was exposed to the environment in the months of January, February, March, April, May, September, October, November, and December. This means that the only months in this study where a specimen was not placed were June, July, and August. Out of these months, the most common month for bobcat occurrences was January, when 31 of the 71 total appearances took place (43.7%) (Figure 35). Following January, the next most common month was February, with a total of 26 bobcat occurrences (36.6%). The only other month where bobcats were recorded was November, which held a total of 14 occurrences (19.7%). This lack of appearance throughout the rest of the year could partially be contributed to the lack of viscera and other meatier elements on the specimens once they had been there for over a month or two. In the month of March, there were no specimens placed that were more than decomposed flesh

and bone. In every other month with a placed specimen, at one point or another, there was a respectable amount of meat on the specimen(s) placed.

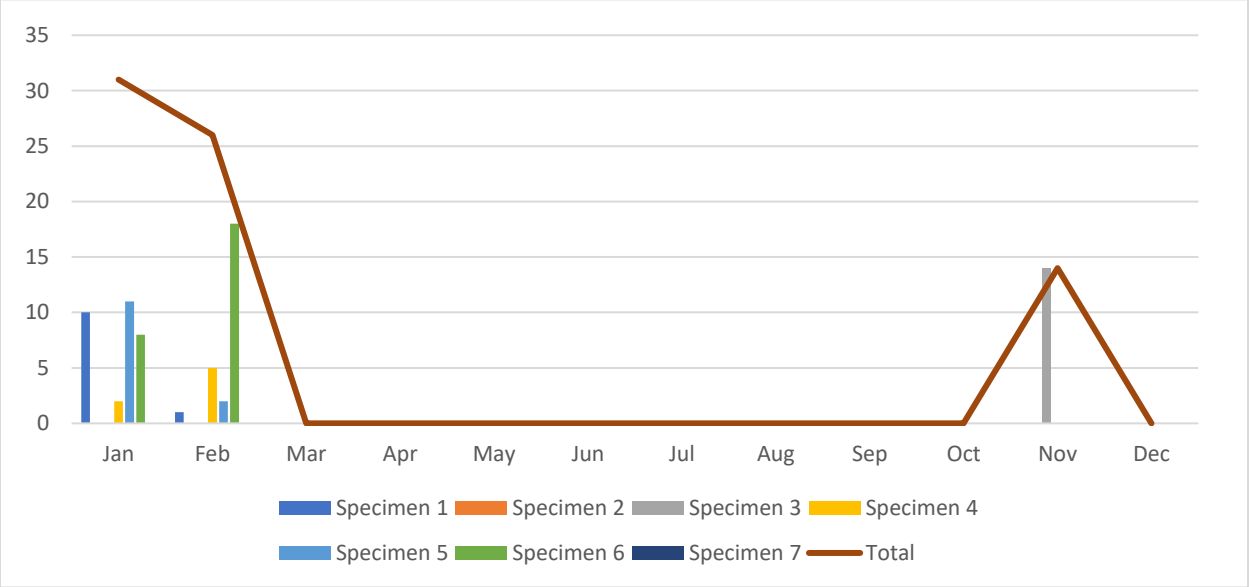
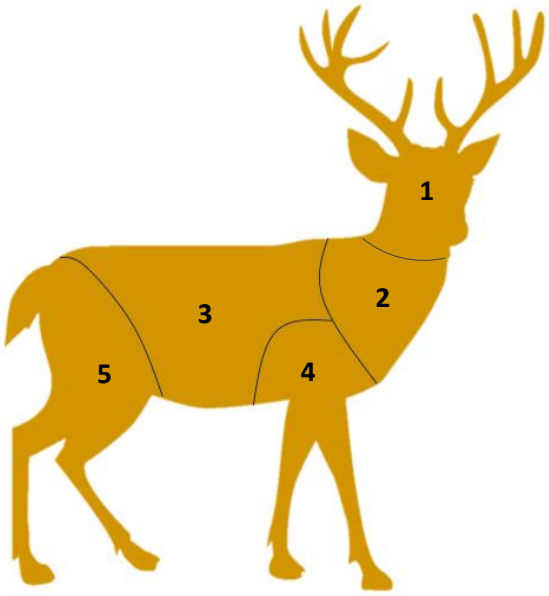


Figure 35. Annual timeline of bobcat activity.

In this study, there were 61 recorded feedings on individual body regions of the 7 specimens. These 61 feedings on various regions of the specimen all occurred within the 38 total feeding visits. The body regions defined in this experiment were head, neck, torso, forelimb, and hindlimb (Figure 36).



Specimen Body Segments Measured:

1. Head

2. Neck

3. Torso

4. Forelimb

5. Hindlimb

Figure 36. The divisions of specimen body segments measured in this study.

For this study, the body of the specimens used were categorized into 5 different sections, in order to measure favoritism towards specific body regions in bobcat scavenging. Each body segment fed on is counted, including occurrences where a bobcat feeds on more than one body segment in one appearance. It is critical to note that the feeding of more than one body segment in an appearance was commonly found. This explains why the number of body segment feedings recorded are much higher than the total number of feedings overall observed. Also, there were no bobcat scavenging attempts observed on the head region of any specimen. The bobcats observed in this study had a feeding preference towards the torso, which held 32 of the 61 total recorded feedings on body regions (Table 3; Figure 37). This means that out of the 38 times a bobcat was recorded feeding on a specimen, there were 32 feedings of the torso (84.2%). However, it must not be ignored that in 21 of these 32 times (65.6%), another body segment was fed on as well.

Although, the torso may have an advantage compared to the other body segments, as it is the segment that connects all of the organism together. It is a section which could easily be transitioned to during a feeding if the bobcat was consuming a part of a body segment in close proximity to the torso. The second preferred body part was the forelimbs, where 14 feedings occurred (36.8% of the 38 total feedings). The next preference after these were hindlimbs, which saw feeding occurrences a total of 9 times (23.7% of total feedings). The least preferred body part was the neck, which was only fed from 6 times (15.8% of total feedings).

Table 3. Frequency of specific body segment preference, out of the total observed body segment feedings. It is important to note that this table focuses on the number of times each body segment was observed being fed from, not the total times a bobcat was recorded feeding. This means that the table includes separate entries for when a bobcat was observed feeding on more than one body segment in an appearance. There were 38 total feedings observed, and in that, 61 different feedings of body segments.

Specimen Body Segment	*Frequency*	***%***
Neck	6	9.8
Torso	32	52.5
Forelimb	14	23.0
Hindlimb	9	14.8
Total	61	100

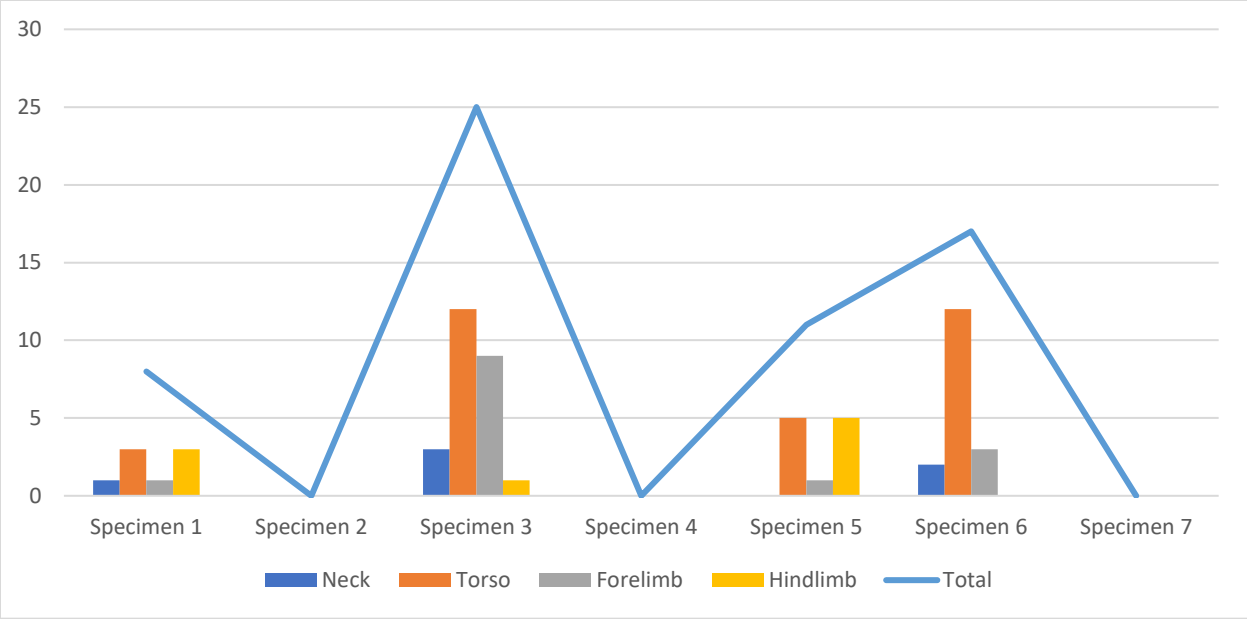


Figure 37. Preference of body region when feeding.

This could be expected, as the torso region is known to house a variety of soft tissues and musculature. This musculature appears to be desirable to the bobcats from the observations made in this experiment. These regions are easier to feed on than more bony regions such as the ends of limbs or a head. Overall, it is a more reliable choice to feed on when time is limited, as there is more likely going to be something to eat that has not already been taken.

Discussion

From this study, it is clear that bobcats of the Middle Tennessee region are willing to scavenge from white-tailed deer carcasses. Out of the 78 total activities recorded, 38 were

feedings. This means that 48.7% of the times that a bobcat neared the specimen, it decided to scavenge. Also, only 34.6% of the time did a bobcat appear and not interact with the specimen in any way. These results also may have been skewed by Specimen #4, if there was some explanation as to why all 7 bobcat appearances included disregarding the specimen entirely. The specimen was in fact of proper quality for scavenging. Many other scavengers were observed feeding from the specimen throughout its placement. Also, with the lower intestines of the specimen being exposed, it could be expected to draw scavengers in even more. This makes the lack of bobcat appearances truly interesting, as there had been appearances of bobcats scavenging from specimens of less quality on several occasions in this study. Despite strange occurrences like that, however, this study was still able to observe, on numerous accounts, a bobcat that came to repeatedly scavenge. As to how many bobcats exactly appeared across these 15 months, it is difficult to fully determine without better identification methods. It can be said that there were at least two separate bobcats observed, due to the appearance of two bobcats at the same time during the placement of Specimen #1. It is also likely that, across this timespan, the territorial zones of bobcats in the local area could have shifted some. This would especially be likely if successful mating was exhibited during the bobcat breeding months between December and early summer. A factor for why the only months with recorded bobcat feedings were January, February, and November could be that bobcats are reported to rely on scavenging more heavily during cold seasons due to the reduction of food sources from hunting and starvation (Platt et al., 2010). Also, while there was a decent amount of meat on the specimens placed throughout most of the 15 months, the meat was not always fresh. If there were more specimens which could have been placed once a month or more, there may have been more frequent bobcat scavenging. There could have also been occurrences of scavenging in the months

where no scavenging was observed, such as the hot summer months when decomposition is at its quickest.

Interestingly, this study found the most common duration of time for a bobcat to stay near the specimen to be ten minutes or less. This duration was observed in thirty-five of the seventy-one appearances (49% of total appearances). This may not be a reliable indicator for how long bobcats specifically scavenge however, as it includes every appearance where a bobcat briefly passes by. This leads to the possibility that, in reality, the bobcats in this study preferred a longer duration when actually scavenging, as there were, for example, sixteen occurrences that lasted between 30 minutes and an hour (23% of total appearances). These were the next most common duration, but could be the most common when examining the scavenging factor specifically, as bobcats in this study were much more likely to scavenge if present for longer than a brief moment. In future studies, it is important to take this into consideration, in order to find a more accurate representation of the common length for bobcats to scavenge. When bobcats fed in this study, they commonly fed from the torso, being observed in 32 of the 38 feedings. This could be contributed to the high amount of musculature found in that body segment, which bobcats in this study favored. In most observations, the bobcats were seen feeding specifically on muscles around the body of the specimens. When they fed on the forelimbs and hindlimbs, they almost never went below the knees of the specimens. Furthermore, they completely ignored the heads of the specimens. All of these findings suggest the preference towards musculature that was observed in this experiment.

The variety of observations in this study support the previous research performed, claiming that bobcats scavenge on a variety of occasions (Bumann & Stauffer, 2002; Rippley et

al., 2012). Knowing this, it should be explored further how they may behave when near carrion. The results of this study can also support the observation in previous research that bobcats have been observed preferring fresher meat compared to that which is in advanced stages of decomposition when they are scavenging (King et al., 2015). Furthermore, the solitary behavior of bobcats has been noted in other studies to extend into all behavior, including their scavenging behavior (Virchow & Hogeland, 1994). This can also be supported by the findings of this experiment. The only time more than one bobcat at a time was observed in this study was on the night of January 16, 2023, when two appeared to scavenge on Specimen #1. There could be two possible explanations as to why this appearance of two bobcats may have occurred. There is a chance that one was the mother of the other. This may explain why only one ate for the majority of the appearance, while the other rested and watched. Their sizes were similar, but this could be explained by the child being born the previous year around March to June, and appearing near the end of the time that the mother will guide the child. This is because mothers will typically keep their children through the first winter that they are alive, before sending them out on their own (King et al., 2015). However, it could also be likely that they were mates, as the breeding season begins in December. They may have been together at the time and in need of sustenance before or after any mating activities that could have occurred. The limitation in this experiment that affects this analysis is that the gender of the bobcats observed were not able to be determined. Genitalia was never observed, and therefore it cannot be known whether the two bobcats observed together were of the same gender or opposite.

There were also findings in this study which did not support previous research. The majority of appearances observed in this study did not agree with the peak hours proposed by

Rippley et al. (2012). When measuring the bobcat appearances recorded in this study according to their peak hours of 04:00-10:00 and 18:00-24:00, only 49 of the total 71 appearances occurred within peak hours. Due to this, a new set of peak hours were devised in this study to more accurately reflect what hours the bobcats were most active and ready to scavenge. These peak hours would last from 17:00-07:00, and would now include 64 of the 71 bobcat appearances.

This study was able to propose what might be a more accurate set of hours to describe peak scavenging activity of bobcats in the southeastern United States. These hours should be tested further in order to ascertain their accuracy. They were devised according to the observations made by these bobcats, and may vary in other locations. This study is also unique in that it serves as one of the few conducted in the middle Tennessee area currently that examines the scavenging patterns of bobcats. This is not a widely understood topic yet, and it requires further research to better understand the local scavenging activities of this animal and how it may affect scavenging ecology and forensic work in areas across this region, such as Murfreesboro and Nashville.

There were several limitations to this experiment that could be eliminated in future research of bobcat scavenging behavior and its effects on forensic taphonomy. Firstly, there were resource limitations in this experiment that could have inhibited its efficiency and reliability. Across 17 months, only 7 deer specimens were able to be found and collected for the study. With more placed across a longer duration than 17 months, the results would be even more valuable and informative. As mentioned above, it would allow for a deeper analysis of behavior and results if there were better identification tools in order to fully differentiate bobcats that had appeared. It also would have been beneficial to put out a control specimen, one that would be

caged, in order to monitor the rate of decomposition when not exposed to vertebrate scavengers. Another limitation in this study was that on two occasions, a specimen was removed by coyotes before complete decomposition had occurred. This premature ending could have affected the results found near the end of those two cycles. Also, this study was only able to utilize deer bodies as opposed to human bodies, in accordance with the facility's rules.

Future research would help to expand on this recently realized scavenging behavior. A few possible suggestions to enhance this research could begin with performing the study in other parts of the country. Bobcats do have two confirmed subspecies across the United States as of now, being *L. r. rufus* and *L. r. fasciatus*. If this study were to be performed in the western half of the country, it could produce entirely different results, which would be important to investigate. Also, the Appalachian Mountains create a large divide in the domain of *L. r. rufus*, causing a possible variation in the behaviors observed from bobcats across the eastern half of the country. This suggests that a bobcat scavenging study performed in states such as New York or Florida could provide insights on the regional bobcat behaviors not shown in other parts of the east. These could then be brought together and defined clearly in order to differentiate patterns between the variety of *L. r. rufus* and learn further about possible variations in scavenging techniques that could affect local forensic activity. Variations may also be found in studies conducted in other settings. This could include performing a study in a more rural location, which may allow a higher frequency of activity to be found in the bobcats, as well as possible different behaviors. Alternatively, studies could be performed on urban bobcats, to determine how their closeness to civilization may affect their scavenging behavior.

This study was able to find that bobcats could affect the forensic field in ways that scientists and other workers must be aware of. Understanding certain possible patterns in bobcat scavenging could prevent errors when determining causes of death, or investigating post-mortem events. Bobcats were observed preferring to scavenge from the torso. They were also particularly interested in the musculature of the specimens. They fed in areas with a lot of meat, as opposed to skinny/bony regions of the body. When they were not satisfied with feeding from the torso, they normally transitioned to the thick upper sections of the forelimbs and hindlimbs. They were rarely observed scavenging on the head or neck of the specimens. When they scavenged, they were observed typically clawing at the specimen a few times, which could leave identifiable scratch marks that could differentiate bobcat scavenging from other possible causes of damage. Bobcats in this study were commonly observed feeding on one place for an extended time, indicating that bobcat scavenging could possibly be identified by large amounts of damage found in a centralized place on bodies. When bobcats fed, they typically fed in shorter bursts, returning to the site at later points to continue, and commonly feeding on the same region of the body as before, until it became bare of meat. They also normally stopped scavenging after the specimens were placed for over one to two months, meaning that any damage found to a body after such time could likely be something other than bobcat scavenging. In the future, this kind of research will be vital to further understand how bobcats scavenging could affect forensic efforts, so that justice can be maintained in criminal cases.

References

Allen, M. L., Wallace, C. F., Wilmers, C. C. (2015). Patterns in bobcat (*Lynx rufus*) scent marking and communication behaviors. *J Ethol.* 33:9-14.

Bumann, G. B., Stauffer, D. F. (2002). Scavenging of ruffed grouse in the Appalachians: Influences and Implications. *Wildlife Soc B.* 30:853-860.

DeVault, T. L., Rhodes, Jr., O. E., Shivik, J. A. (2003). Scavenging by vertebrates: behavioral, ecological, and evolutionary perspectives on an important energy transfer pathway in terrestrial ecosystems. *Oikos*. 102:225-234.

Dirkmaat, D. C., Cabo, L. L. (2016). Forensic Archaeology and Forensic Taphonomy: Basic Considerations on how to Properly Process and Interpret the Outdoor Forensic Scene. *Acad Forensic Pathol. 6*(3):439-454.

Fain, M., Jeong, Y. (2022). Exploring scavengers in Murfreesboro, Tennessee, *MTSU Scholars Week, Murfreesboro, TN.*

Fain, M., Jeong, Y. (2023). Surveying scavengers and their taphonomic effects in Murfreesboro, Tennessee. *American Academy of Forensic Sciences, Orlando, FL.*

Fergus, C., Shope, B. (2010). White-tailed deer. *Bureau of Information and Education, Pennsylvania Game Commission*. 175(28).

Heidari, A., Gobato, R. (2018). Putrescine, Cadaverine, Spermine and Spermidine – Enhanced Precatalyst Preparation Stabilization and Initiation (EPPSI) Nano Molecules. *Parana J Sci Edu*. 4(5):1-14.

King, K. A., Lord, W. D., Ketchum, H. R., O'Brien, R. C. (2015). Facultative Scavenging and Carrion Guild Participation by Lynx Rufus in the Presence of Young. *Southwest Nat.* 60(4):381-385.

Kitchener, A. C., Breitenmoser-Würsten, C., Eizirik, E., Gentry, A., Werdelin, L., Wilting, A., Yamaguchi, N., Abramov, A. V., Christiansen, P., Driscoll, C., Duckworth, J. W., Johnson, W., Luo, S.-J., Meijaard, E., O'Donoghue, P., Sanderson, J., Seymour, K., Bruford, M., Groves, C., Hoffmann, M., Nowell, K., Timmons, Z., Tobe, S. (2017). A revised taxonomy of the Felidae. The final report of the Cat Classification Task Force of the IUCN/ SSC Cat Specialist Group. *Cat News.* 11:80.

Larivière, S., Walton, L. (1997). Mammalian Species Lynx rufus. *American Society of Mammalogists.*

Moss, K. E. (2012). The effects of avian and terrestrial scavenger activity on human remains and decomposition in southeast Texas during an 18 month study. *University of Houston ProQuest Dissertations Publishing.*

Ogada, D. L., Keesing, F., Virani, M. Z. (2012). Dropping dead: causes and consequences of vulture population declines worldwide. *Ann NY Acad Sci.* 1249:57-71.

Platt, S. G., Salmon, G.T., Miller, S.M., Rainwater, T.R. (2010). Scavenging by a Bobcat, Lynx rufus. *Canadian Field-Naturalist.* 124(3):265-267.

Rippley, A., Larison, N. C., Moss, K. E., Kelly, J. D., Bytheway, J. A. (2012). Scavenging Behavior of Lynx rufus on Human Remains During the Winter Months of Southeast Texas. *J Forensic Sci.* 57(3):699-705.

Tennessee Wildlife Resources Agency. (2023). Bobcat, lynx rufus. *Tennessee State Government*. https://www.tn.gov/twra/wildlife/mammals/large/bobcat.html

Tewes, M. E., Mock, J. M., Young, J. H. (2002). Bobcat predation on quail, birds, and mesomammals. *National Quail Symposium Proceedings*.

Ubelaker, D. H., DeGaglia, C. M. (2020). The impact of scavenging: perspective from casework in forensic anthropology. *Forensic Sci Res. 5*(1):32-37.

Virchow, D., Hogeland, D. (1994). Bobcats. Prevention and control of wildlife damage. *University of Nebraska Cooperative Extension*. 35-43.