

Identifying individual bobcats (*Lynx rufus*) using camera traps

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Introduction

In 1959, Russell and Burch came up with the 3 R's: replace, reduce, and refine. These principles were proposed to motivate scientists to replace animal use in laboratory research wherever possible, reduce the number of animals used, and refine the methods of experiments to preserve animal welfare. The principles of the 3 R's are continuous is not only laboratory research, but wildlife research as well. Because of this, non-invasive methods have increasingly been used in wildlife research alternative to traditional surveying methods that can endanger animal welfare (Sutherland et al., 2004, Walker et al, 2010). Prior to camera trapping, common methods of conducting population estimates were capturing and marking (Ealey & Dunnet, 1956; White & Shenk, 2001). By moving to non-invasive surveying techniques, the welfare of the animal and the reliability of accurate, true to nature, data is preserved.

Many North American mammals do not have distinctive traits that set individuals apart from one another like caribou and their antlers. Surveys have been done on bobcats in the past, but only on bobcats in the western United States (Helibrun et al., 2006; Larrucea et al. 2007). In the western United States, bobcats have more prominent spots against their coat to identify individuals from a picture. In the east, their spots blend more into their coats which makes it more difficult (Figure 1).

Figure 1. 1A shows an image of a bobcat in Texas. 1B shows an image of a bobcat from Connecticut



1A Lynette & Lynette (2014)



1B Benson (2009)

Methods and Materials

Study Site

Mianus River Gorge Preserve is a nature preserve within the Mianus River Watershed. Mianus protects and manages land in and around Bedford, NY and Stamford, CT along the Mianus River. Within the land managed by Mianus, there are two types of forests: old growth forests, and hardwood forests. Within the preserve, common mammals include black bears (*Ursus americanus*), coyotes (*Canis latrans*), red foxes (*Vulpes vulpes*), white-tailed deer (*Odocoileus virginianus*), and bobcats (*Lynx rufus*). Within Mianus, there are three separate camera sites: South Lockwoods, Rock Hill Way, and Meadows. These three camera sites were predetermined due to sightings of bobcats in previously collected data within the Gorge.

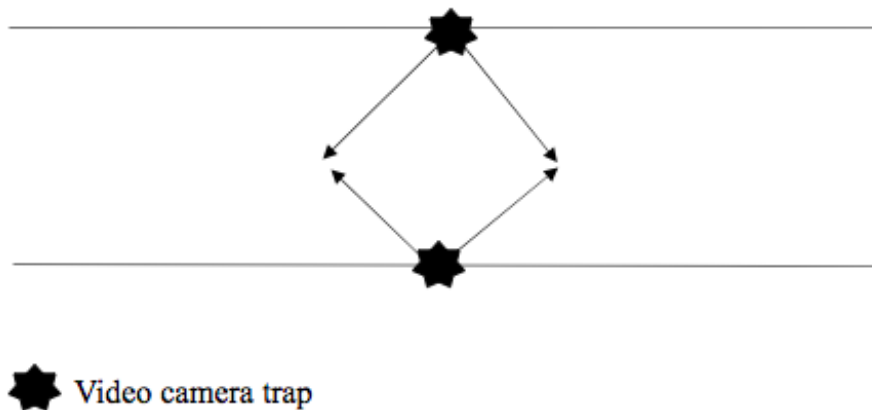
Camera Trapping

Data collected in this study was compared to previous data collected in 2020. In total, there were two field seasons of collecting data: spring 2020 to fall 2020, and spring 2021 to fall 2021. In each season, a different CT configuration was set up.

In the first trial, CT sites were scouted for two adjacent trees along a natural corridor, about 10 feet from each other (Figure 2) in accordance with Hiby et al., 2009. The tree trunks would serve as mounts for the cameras. Two video-capable CTs were secured 1-2 feet above the

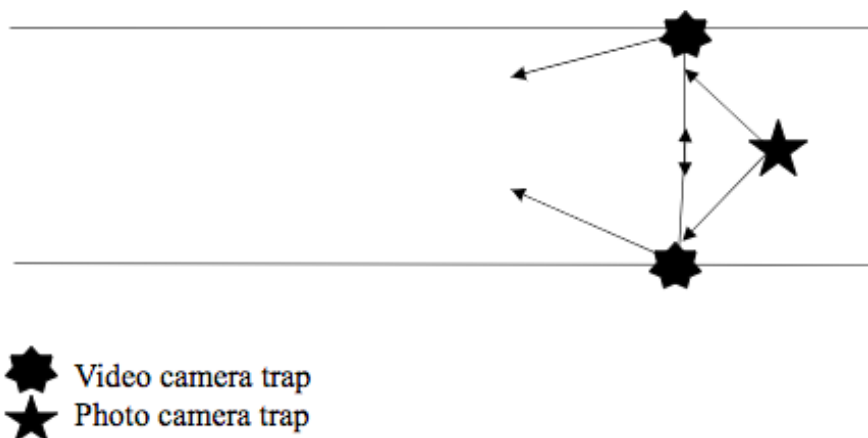
ground, around the trunk of each tree, facing each other. This was labeled an “opposite” configuration. All three camera sites had the same configuration during the first trial.

Figure 2: Diagram of CT set up at Rock Hill Way, South Lockwoods, and Meadows for Trial 1.



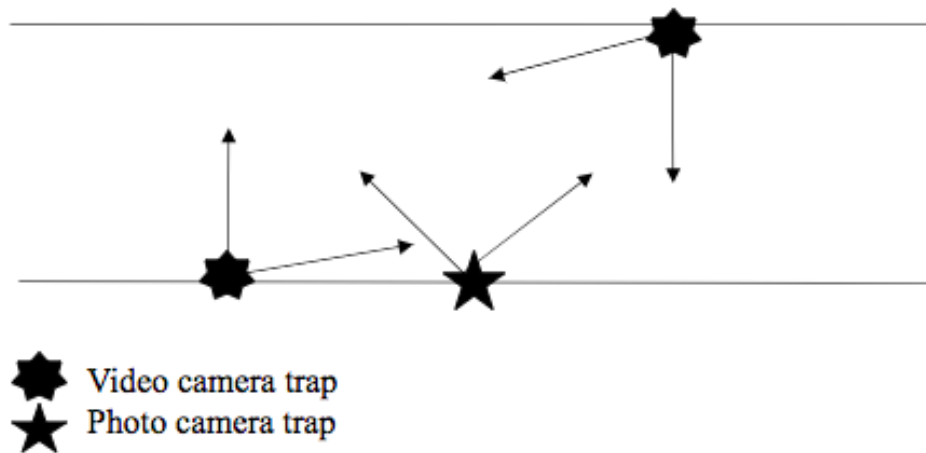
In the second trial, one tree and two stakes were used to mount CTs. In total, 2 video-capable CTs and 1 photographic CT were used. Rock Hill Way and South Lockwoods had the same CT set up, but Meadows did not due to nature of the corridor. At Rock Hill Way and South Lockwoods, each stake was mounted at about a 55° angle from the base of the tree, facing the corridor (Figure 3). On each stake, one video CT was mounted, while the photographic CT was mounted 1-2 feet above the base of the tree.

Figure 3. Diagram of CT set up at Rock Hill Way and South Lockwoods for Trial 2.



At Meadows, the corridor was surrounded by thick vegetation on both sides. To allow for capture of both sides of bobcats, we placed two CTs on one side, and the other CT on the opposite side (Figure 4). The photo CT and one video CT were set on the same side about 4 feet apart. The other video CT was placed on the opposite side of the video CT, across the corridor.

Figure 4. Diagram of CT site set up at Meadows for Trial 2.



Both configurations were called “triangle” due to three cameras being used.

Video CTs were set to take 20-second videos and the photo CTs were set to take a burst of 5 images per trigger. Every 1-3 weeks, camera maintenance checks were conducted to replace memory cards and batteries for each camera. The videos and photos were then downloaded and categorized for images containing bobcats.

Bobcat Identification

Images of bobcats were taken from both videos and photographs from CTs to capture instances of distinct markings. These images were utilized to mark and record instances of unique features. All identifying frames from each encounter were organized onto slides recording the date, site, and the side of the body the frame captured. Slides were created in timeline order. Once the encounters were presented on slides, encounters with shots of both sides were analyzed first, then single-sided encounters. Multiple encounters with identical markings were grouped and those encounters were categorized as an individual bobcat. A separate

document was created to keep track of which distinct markings belonged to which bobcat. Blank slides (slides with bobcat images that have not been identified yet) were analyzed by both mentor and researcher to increase confidence of having identified an individual bobcat.

Results

3 bobcats have encounters with images of both sides. 3 additional individuals were identified despite having only one side recorded. This is due to the right side of each encounter being documented, with each bobcat having differentiating marks in the same places. There were 10 encounters of a possible individual. All these encounters captured only the left side of the bobcat. In total, there are at least 6 individuals that have been captured within Mianus. Of these 6, bobcats 2,3, and 4 have been recorded in both years (Figure 5); and bobcats 2,3,4 and 5 have been captured at a minimum of 2 CT sites (Figure 6).

Figure 5. Number of bobcat encounters per individual from both trials. Bobcats 2, 3, and 4 have at least 1 encounter per trial.

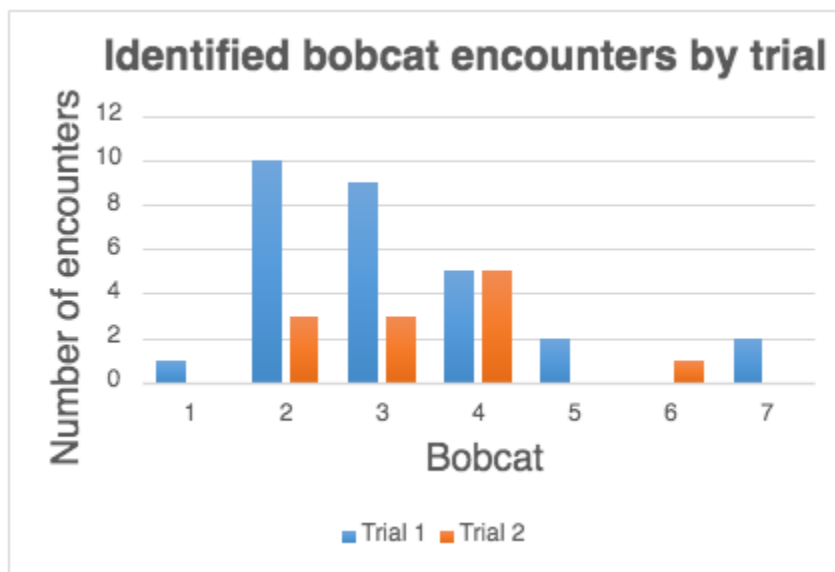
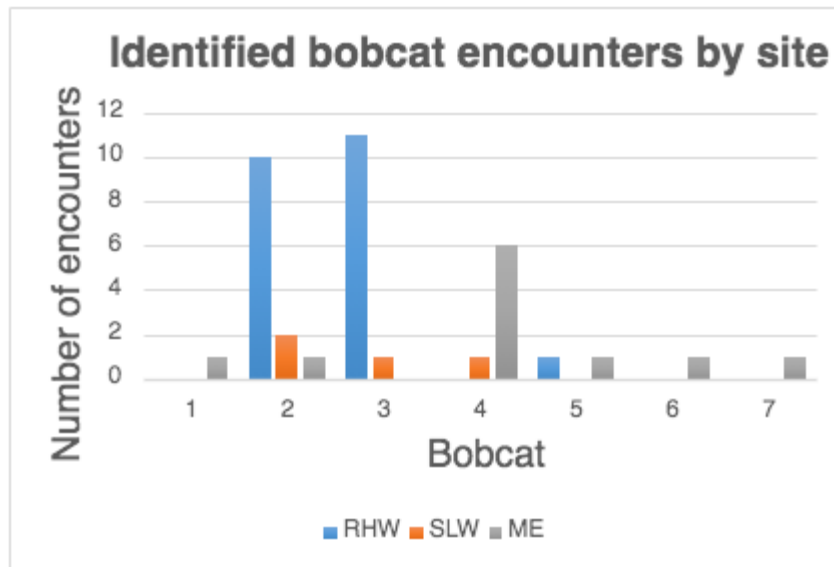


Figure 6. Number of bobcat encounters per individual from each CT site: Rock Hill Way (RHW), South Lockwoods (SLW), and Meadows (ME). Bobcat 2 was the only one spotted at all three CT sites, while bobcats 3 and 4 were spotted at two CT sites.



Of the 50 total encounters, only 9 contained images of both sides. All 9 of these came from the first trial with the opposite configuration. 9 encounters were not utilized due to poor lighting, poor proximity to the camera, or excessive movement. The problem with movement only stemmed from the photo CTs where the image blurred.

Discussion and Conclusion

The biggest issue faced during this study was the setting up of the CT sites. During the first trial, CT sites were set up in an opposite configuration following Hibby et al. 2009. At night, the infrared flash from the opposing cameras would either blind the other one or backlit the bobcat making the markings difficult to see. Occasionally, one camera would trigger as a bobcat passed through, but not the other. So, while there were 9 occasions of double-sided shots, there were 27 single-sided ones. During the second trial, no double-sided encounters were captured and there were still issues of only one or two CTs triggering but not the last.

Deciding where to set up the CT sites was a significant aspect of designing the study. During trial 1, the CT sites at all three study sites were set up along natural pathways. However, at South Lockwoods and Meadows, there were alternate routes surrounding the CT sites that bobcats would occasionally take. In trial 2, we limited the number of alternate routes by either using fallen branches to block them off or angle the CT site where those pathways could be captured.

The most consistent areas where distinct markings were found were on the inside of the limbs. Being able to capture multiple angles of the same marking was very useful because different surrounding spots can be seen at different angles. In one encounter, a marking might seem to be the only one there, but at a different angle, another one might appear.

While neither the triangle nor opposite configuration was perfect, opposite was the better of the two. The advantageous part of the triangle configuration was the use of the photo CT due to its faster trigger speed, but the video CTs had better image quality, and the 20-second videos allowed for scrolling through frames. Until better CTs come out with great trigger speed and quality, it is recommended to use a combination of both.

Future studies can investigate how to configure CT sites to minimize interference from the flash while simultaneously capturing images of both sides of the bobcat. CT studies are cost-effective methods for conducting ecological and wildlife research. Surveying bobcats within Westchester County where there is a combination of exurban, suburban, and urban landscapes will enable conservation groups to better approach their conservation efforts.

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