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Camera Trap Success Among Carnivores and Prey Animals in Tazewell County, Virginia

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ABSTRACT

Obtaining basic ecological information on occurrence and activity levels in cryptic and elusive species is often difficult. Camera trapping provides a relatively inexpensive opportunity to acquire such data. We used infrared-triggered cameras to assess trap success and activity levels of several species across four consecutive seasons, including: *Ursus americanus* (black bear), *Lynx rufus* (bobcat), *Canis latrans* (coyote), *Vulpes vulpes* (red fox), *Urocyon cinereoargenteus* (gray fox), *Procyon lotor* (raccoon), *Odocoileus virginianus* (white-tailed deer), *Didelphis virginiana* (opossum), *Sciurus carolinensis* (gray squirrel), and *Meleagris gallopavo* (wild turkey). With a total of 396 trap nights (TN) at one station over the span of four consecutive seasons, overall trap success rate was 86.87 captures per 100 TN. Trap success was highest in wild turkeys (31.57/100 TN), followed by raccoons (15.66/100 TN), gray squirrels (10.86/100 TN), gray foxes (8.59/100 TN), white-tailed deer (8.08/100 TN), opossums (5.56/100 TN), coyotes (1.52/100 TN), red foxes (1.26/100 TN), and bobcats (0.76/100 TN). Overall trap success significantly varied across all target species combined (Kruskal Wallis Chi-Square = 349, d.f. = 10, $p < 0.0001$). However, trap success did not vary across all seasons for all target species combined (Kruskal Wallis Chi-Square = 0.99, d.f. = 3, $p = 0.78$). This study is the first to use camera trapping to examine species presence and activity levels in a longitudinal manner for cryptic and elusive species of southwest Virginia.

INTRODUCTION

Camera trapping is an excellent non-invasive tool for identifying cryptic or elusive species (Yasuda, 2004; Rowcliffe et al. 2008). While this approach to elusive species identification is not a recent revelation in ecological methodologies (e.g., Chapman, 1927), camera trap usage has picked up momentum in recent years (Karanth and Nichols, 1998). In fact, published papers utilizing some degree of camera trapping have seen an estimated 50% annual growth over the past decade (Rowcliffe and Carbone,

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2008). Much of this growth can be attributed to increased technological and analytical advances that allow ecologists to determine population densities, dispersal behaviors, and relative abundance – all from a distance (Karanth and Nichols, 2000; Kelly et al. 2012).

Trap success is one common index of activity level that can be obtained using camera trap data. Trap success calculated per species can provide insight into species presence or, at a more interactive scale, potential species interactions among predators/prey (Kelly and Holub, 2008), despite recent debate about its use as an index of abundance (Anderson, 2003; O'Brien et al., 2003). Regardless of debate, it is impractical to ignore the importance of understanding predator/prey dynamics particularly in the wake of increasing anthropogenic disturbances that are altering natural community composition and interactions (Sala et al., 2000; Walker et al., 2005). Thus, the value of camera trapping becomes magnified for elusive species that act as predators and/or prey in their respective systems. Such value is further magnified when camera trapping is employed in highly understudied locations, such as Virginia, in order to elucidate cryptic species interactions.

Our study used camera trapping to survey medium to large-sized mammalian and terrestrial avian species known to occur at our study site. Specifically, we targeted *Ursus americanus* (black bear), *Lynx rufus* (bobcat), *Canis latrans* (coyote), *Vulpes vulpes* (red fox), *Urocyon cinereoargenteus* (gray fox), *Procyon lotor* (raccoon), *Odocoileus virginianus* (white-tailed deer), *Didelphis virginiana* (opossum), *Sciurus carolinensis* (gray squirrel), and *Meleagris gallopavo* (wild turkey). We report overall and seasonal trap success for each target species in the understudied state of Virginia.

MATERIALS AND METHODS

Our study site was located on private property in Tazewell County, near the town of Richlands, Virginia (Fig. 1). The site is situated at approximately 615 m in elevation within a mostly deciduous forest. Trap camera location (one station) was along a fence that bisected a north-facing forested hillside consisting of predominately yellow poplar (*Liriodendron tulipifera*). However, northern red oak (*Quercus rubra*), white oak (*Q. alba*), American ash (*Fraxinus americana*), and eastern red cedar (*Juniperus virginiana*) were also in the adjacent area. Cameras were mounted approximately 80 cm above the ground in a location that would funnel animals in the pathway of the lens that was approximately 3 m away.

Two types of cameras were used throughout the duration of this study: a StealthCam MC2-G and a DeerCam 200, both of which are passive infrared-triggered 35 mm film cameras. These cameras are triggered by heat and motion detectors. The StealthCam MC2-G, programmed with 1 min intervals between each image capture, was used from 1 October 2005 to 25 January 2006. The DeerCam 200, programmed with 15 sec intervals between each image capture, was used from 26 January 2006 until the end of the study. Both cameras, when active separately, were active 24 hours a day. Cameras were routinely checked for basic maintenance and battery and film replacement. No bait or lures were used to attract target species. No camera malfunctions were noted throughout this longitudinal study.

Trap success for each targeted species was calculated as the number of trap events per 100 trap-nights. In order to prevent duplicate counting of images taken over short periods of time (i.e., less than 30 min apart; Kelly, 2003; Silver et al., 2004), date/time

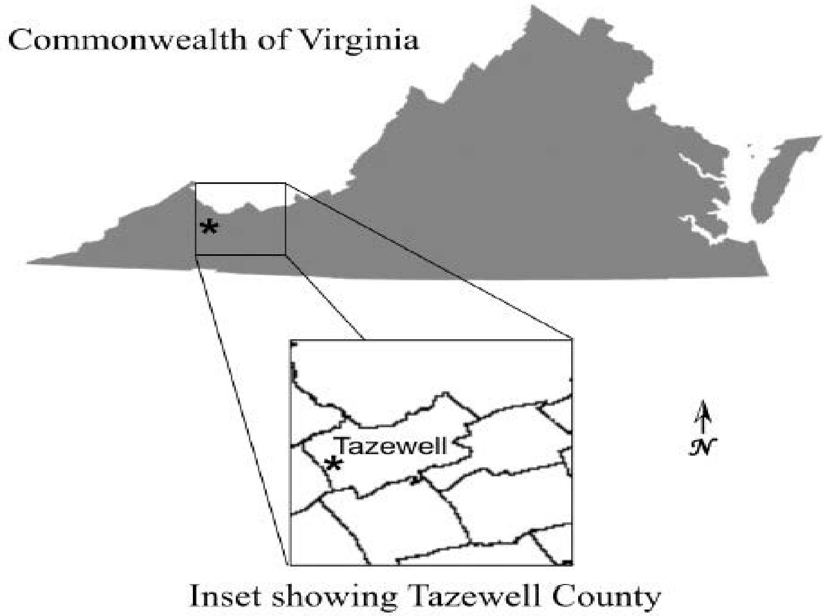

FIGURE 1. Study site location.

stamps on each photograph and individual animal size, position, and markings were examined. Special care was taken to accurately estimate the number of wild turkeys (*M. gallopavo*) for each camera trap event since they periodically appear as a flock that, subsequently, triggered multiple image captures. Because data did not meet assumptions of normality, nonparametric statistical analyses were conducted. Specifically, we used a nonparametric Kruskal-Wallis test to compare overall trap success amongst all targeted species to compare trap success among seasons for each target species. We conducted this study over an entire year, thus all four seasons are represented. Spring season consists of March, April, and May image captures. Summer season reflects image captures from June to August. Fall season includes all image captures from September to November. Finally, winter season includes all image captures from December to February. All statistical analyses were conducting using SAS JMP 9.0 (SAS Institute, Cary, North Carolina).

RESULTS

In total, we photographed nine species (eight mammals and one bird) without the use of lures or baits. Specifically, six (bobcat, coyote, red fox, gray fox, raccoon, and opossum) are considered to be predatory species while the remaining three (white-tailed deer, gray squirrel, and wild turkey) are considered to be prey. We amassed a total of 396 trap nights (TN) and recorded 344 trap events, with a total of 637 target animal photographs (Table 1). Overall trap success for all animals photographed was 86.87 per

TABLE 1. Total number of trap events, number of animals photographed, and overall trap success.

Species (common name)	Total number of trap events	Total number of photographs
Meleagris gallopavo Linnaeus (wild turkey)	125	237
Procyon lotor Storr (raccoon)	62	87
Sciurus carolinensis Gmelin (gray squirrel)	43	57
Urocyon cinereoargenteus Schreber (gray fox)	34	39
Odocoileus virginianus Zimmerman (white-tailed deer)	32	163
DidOverall trap successelphis virginiana Kerr (opossum)	22	22
Canis latrans Say (coyote)	6	8
Vulpes vulpes Linnaeus (red fox)	5	8
Lynx rufus Schreber (bobcat)	3	4
Ursus americanus Pallas (black bear)	0	0
Unknown	12	12
Grand Total	344	637
Total number of trap nights	396	

100 TN (Table 1). In terms of individual species contributing to successful trap events, the majority of raw photographic events were *M. gallopavo* (wild turkey; 36.34%), followed by *P. lotor* (raccoon; 18.02%), *S. carolinensis* (gray squirrel; 12.5%), *U. cinereoargenteus* (gray fox; 9.88%), *O. virginianus* (white-tailed deer; 9.3%), *D. virginiana* (opossum; 6.4%), *C. latrans* (coyote; 1.74%), *V. vulpes* (red fox; 1.45%), and *L. rufus* (bobcat; 0.87%). No *U. americanus* (black bear) were photographed.

Trap success significantly varied across all targeted animals (Kruskal Wallis Chi-Square = 349, d.f. = 10, $p < 0.0001$) (Fig. 2). Trap success was highest in *M. gallopavo* (wild turkey; 31.57/100 TN). *Procyon lotor* (raccoon; 15.66/100 TN) had the second highest trap success, followed by *S. carolinensis* (gray squirrel; 10.86/100 TN), *U. cinereoargenteus* (gray fox; 8.59/100 TN), *O. virginianus* (white-tailed deer; 8.08/100 TN), *D. virginiana* (opossum; 5.56/100 TN), unknown/unidentifiable photographs due to poor quality (3.03/100 TN), *C. latrans* (coyote; 1.52/100 TN), *V. vulpes* (red fox; 1.26/100 TN), and *L. rufus* (bobcat; 0.76/100 TN). Trap success did not significantly vary across seasons for all targeted species combined (Kruskal Wallis Chi-Square = 0.99, d.f. = 3, $p = 0.78$)(Fig. 3.). Unfortunately, rigorous comparisons of seasonal trap success within each individual targeted species were not possible due to low sample sizes among individual seasons.

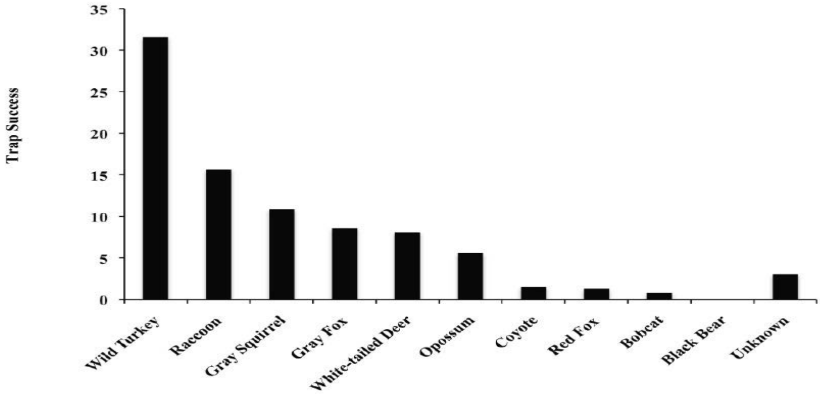

FIGURE 2. Overall trap success for each target species.

DISCUSSION

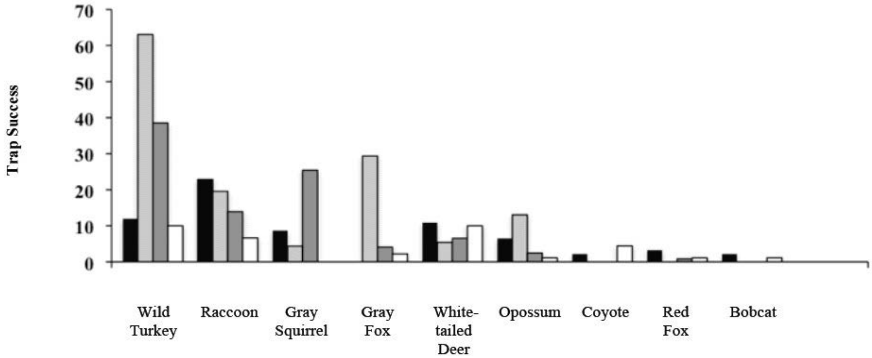

FIGURE 3. Trap success for each target species as a function of season. Spring (black bar) months were March, April, and May. Summer (light gray bar) months were June, July, and August. Fall (dark gray bar) months were Sepetmber, October, and November. Winter (white bar) months were December, January, and February.

While our trap success rates appear low, with most target species having a trap success of less than 10/100 TN, they are reflective of trap success rates reported by other recent studies in North America (Gompper et al., 2006; Kelly and Holub, 2008). Thus, our study adds to the support of utilizing camera traps to address basic ecology questions such as species presence and activity levels.

Interestingly, we did not photograph a single *U. americanus* (black bear). There could be a few possible explanations for this unexpected result. For example, black bears have relatively low reproductive rates, primarily due to their slow reproductive maturation, lengthy reproductive cycle, and small litter sizes (Eiler et al., 1989). Thus, black bear recruitment is a prolonged process even under ideal environmental conditions. This could account for not capturing a black bear on film since our study duration was only one year. However, anthropogenic disturbances, such as hunting and habitat modification, could potentially decrease already relatively low recruitment rates in black bear populations. Another possible explanation for the lack of capturing black bear images was our methodology. Our study did not employ the use of baits at our study site. Baited camera traps have had great success in capturing black bear images (Martorello et al., 2001). Finally, the lack of photographing black bears could be attributed to our number of trap nights. Some studies have suggested that approximately 1000 trap nights are needed to determine whether a species is truly absent from an area (Carbone et al., 2001). Thus, future studies over a larger geographic area could attempt to ascertain the population status of black bears in southwest Virginia.

In summary, our results support the practice of using camera trapping as a means of assessing the ecology of typically cryptic species. While most camera trapping studies have multiple camera stations, they often lack longitudinal breadth since their durations are typically three months or less. Our study is one of the first to utilize camera trapping over the course of an entire year, thus providing interesting and novel species presence and activity level data across seasons in southwest Virginia. With little investment in terms of time and man-power (Srbek-Araujo and Chiarello, 2005), camera trapping can serve as a powerful tool to assess species presence and activity levels. We plan on continual monitoring of our study site over the next decade in order to collect data for comparative analyses. Increasing the number of trap nights and camera stations over multiple years could provide us with a unique opportunity to statistically caste trends concerning species occurrence, abundance, displacement, predator-prey interactions, and/or predator-predator interactions. Such data could prove to be invaluable to ecologists and conservationists alike.

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