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Comparison of Methods to Detect Mesocarnivores in Southern Illinois

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ABSTRACT

We used trapping, track plates, and remote cameras to survey the distribution of gray foxes (*Urocyon cinereoargenteus*), coyotes (*Canis latrans*), and bobcats (*Lynx rufus*) in southern Illinois during 2005-07. Gray fox detection rates were low for all survey techniques when compared to more abundant mesocarnivore species. We captured 9 gray foxes and 21 bobcats in 7,729 trap-nights and 6 coyotes in 1,416 trap-nights. Track plates (n = 883 survey-nights) resulted in the detection of 6 gray foxes, 1 bobcat, and 1 coyote. Cameras (n = 953 survey-nights) resulted in the detection of 4 gray foxes, 5 bobcats, and 4 coyotes. Although the relative effectiveness of detection methods varied by species, our data are generally in agreement with other survey methods that indicate the relative scarcity of gray foxes compared to bobcats and coyotes in southern Illinois.

Key words: bobcat, *Canis latrans*, coyote, gray fox, *Lynx rufus*, remote camera, survey, track plate, southern Illinois, trapping, *Urocyon cinereoargenteus*.

INTRODUCTION

Mesocarnivores often use large home ranges and engage in secretive behavior; these attributes complicate assessments of their abundance and distribution. Three sympatric mesocarnivore species associated with forest cover in southern Illinois are the gray fox (*Urocyon cinereoargenteus*), coyote (*Canis latrans*), and bobcat (*Lynx rufus*), and wildlife biologists have expended many resources monitoring their populations during the past 20 years (e.g., Nielsen and Woolf 2002*a*,*b*). The most reliable estimate of mesocarnivore population trends in Illinois is the Archery Deer Hunter Survey (ADHS), which each year asks hunters to document harvest effort and wildlife sightings. Since its inception in 1991, the ADHS has quantified a 75% decrease in gray fox sightings (Bluett 2007) versus a 15% increase in coyotes and an almost 600% increase in bobcats (Figure 1). Wildlife biologists are unsure why gray fox populations are declining in Illinois, but important limiting factors may include intraguild predation, competition, and mortality from disease (Cypher 2003).

We used traps, track plates (Drennan and Dodd 1998, Olson et al. 2003) and remote cameras (Silveira et al. 2003, York et al. 2003) to survey for gray foxes, coyotes, and bobcats in southern Illinois, and compared detection rates among survey methods and species. In addition to our assessment of survey methods, we also wished to determine whether field survey methods generally supported mesocarnivore trends observed in the ADHS.

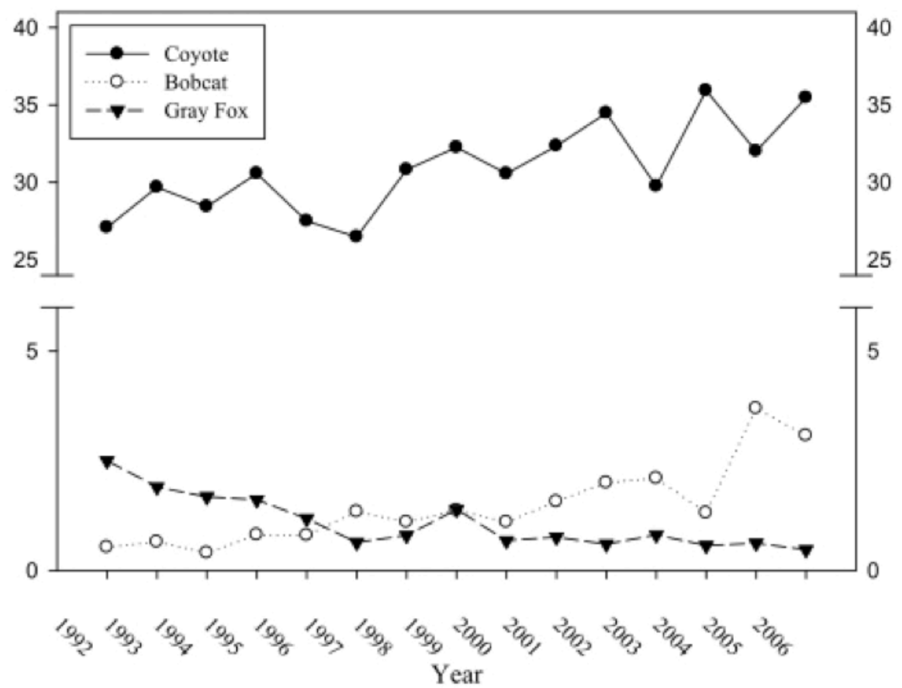

Figure 1. Trends in sighting indices for gray foxes, bobcats, and coyotes based on the Illinois Department of Natural Resource's Archery Deer Hunter Survey, 1996-2006, Illinois, USA.

STUDY AREA

We conducted field research in 5 southern Illinois counties (Jackson, Johnson, Pope, Union, and Williamson) in the Shawnee National Forest, Crab Orchard National Wildlife Refuge, Giant City State Park, Ferne Clyffe State Park, Southern Illinois University Carbondale, City of Carbondale, and on land in private ownership. Elevation in southern Illinois ranges from 91 to 325 m (Netstate 2006) and comprises cropland (39%); upland and bottomland forests (25%) dominated by maples (*Acer* spp.), oaks (*Quercus* spp.), and hickory (*Carya* spp.); and rural grasslands (24%; Luman et al. 1996). Climate in southern Illinois is characterized by 4 distinct seasons with an average annual temperature of 14º C and average annual precipitation of 120 cm (Illinois State Water Survey 2003). Road density (1.4 km/km²) and human population density (21.5 persons/km²) are moderately high in this area (Nielsen and Woolf 2002*a,b*).

METHODS

Trapping

We trapped for gray foxes, coyotes, and bobcats during 3 field seasons: 30 November 2005–18 March 2006, 5 June–4 August 2006, and 9 October 2006–28 February 2007. We used Victor #1.5 padded foothold traps and wire-cage box traps (30 x 30 x 72.5 cm), and also used Woodstream #3 padded foothold traps during winter 2005-06. During the winter seasons, we selected trapping areas based on reported animal sightings, evaluation of suitable habitat, historic occurrence, and incidental captures in other studies (Follman 1973, Cypher 1991; C. Nielsen, unpublished data). We used standard dirt-hole and scent-post sets with the foothold traps, and placed box traps under shrubs and concealed them with vegetation. We used a variety of baits including game meat, fatty acid scent discs, commercial scent lures, peanut butter, jelly, and carnivore urine. We checked all traps every morning and immediately released all non-target animals. We immobilized trapped individuals using Telazol® with a dosage rate of 13 mg/kg, or used physical restraint and a blindfold. All animals were marked with individual ear tags. Capture and handling procedures followed Southern Illinois University Carbondale Animal Care and Use Protocol #05-028.

We estimated capture rates for gray foxes, bobcats, and coyotes. Capture rates for gray foxes and bobcats were the total number of individuals captured/100 trap-nights; however, capture rates for coyotes was based solely on the number of individuals captured in #3.0 footholds/100 trap-nights, as box traps and #1.5 footholds were less likely to capture coyotes.

Track Plates and Remote Cameras

During 5 June–5 September 2006, we surveyed southern Illinois for gray foxes, bobcats, and coyotes using track plates and remote cameras. We divided each county into sections (2.6 km²) and considered sections for surveying if they contained >50% forest and adequate road access. We used forest cover as a criterion for selecting a section based on knowledge of habitat use by gray foxes, bobcats, and coyotes (Anderson and Lovallo 2003, Bekoff and Gese 2003, Cypher 2003). We included only sections with road access across the section to maximize survey efficiency; 117 sections in the 5-county study area met these criteria. From these, we randomly selected approximately 50% of the suitable sections in each county: 19 from Jackson County, 6 from Johnson County, 18 from Pope County, 11 from Union County, and 4 from Williamson County.

We placed 5 stations along the main road of each section (Figure 2). The first station was placed on the road in the middle of the section with 2 additional stations placed in each other direction. Each station was separated by 325 m (Conner et al. 1983), and we placed 1 remotely triggered camera and 1 track plate at each station. We randomly selected the first detection device and placed it 50 m from the road, and then placed the second detection device 25-50 m from the first. Because it is not uncommon to see gray foxes, bobcats, and coyotes on roads or to find their carcasses near roads (Kolowski and Nielsen 2008), we thought selection of sites near roads would not bias the probability of detecting carnivores. We opportunistically placed detection devices near game trails, creeks, and other probable animal travel ways. We conducted surveys for 4 consecutive nights, weather permitting (Roughton and Sweeny 1982, Nottingham et al. 1989, Engeman and Allen 2000). We recorded the location of all detection devices using a global positioning system unit.

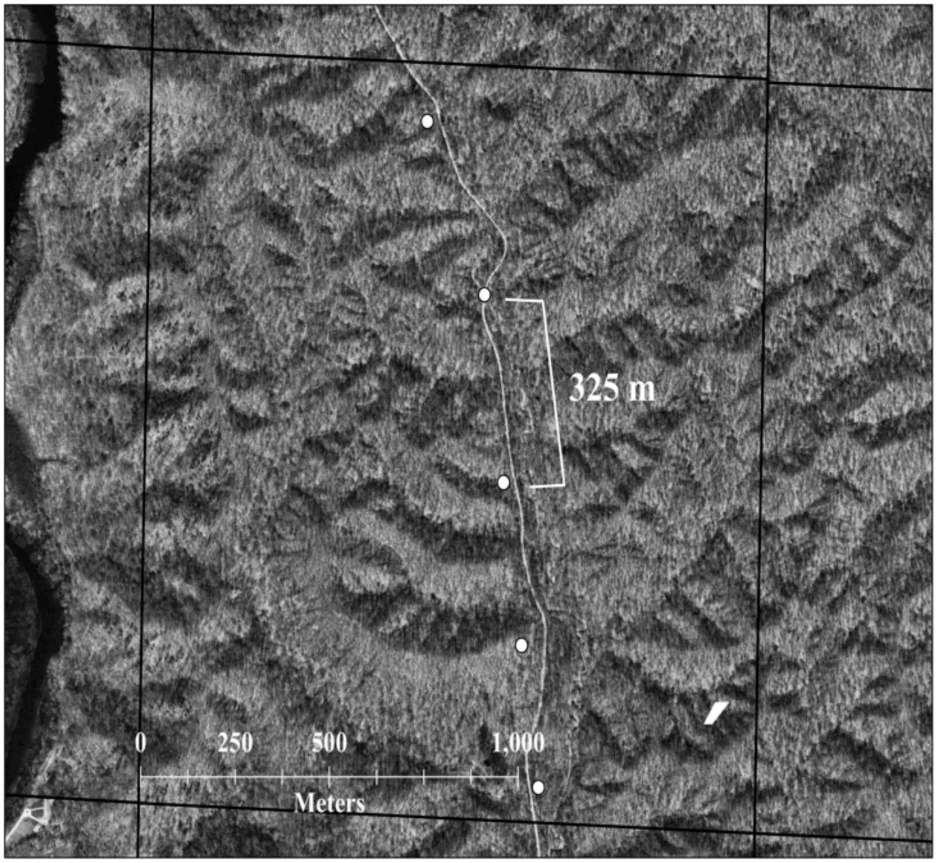

Figure 2. Set up of sections (2.6 km²) for track plate and camera detection surveys ran during June–September 2006, southern Illinois, USA. One camera and 1 track plate were placed at each station marked by the white dot. Stations were separated by 325 m.

At each detection device, we randomly selected a lure that should appeal to all mesocarnivore species potentially present. We used a commercial food-based lure (Lenon's Fox #1 Super All Call), a mixture of fish oil and shellfish oil, or a fatty-acid-scent disc. We replaced lures if they had been obviously removed by animals visiting the site. As an attractant, we also sprayed the area around each detection device with carnivore urine. We used Moultrie® 100v2 Gamespy (2.1 megapixel) and Moultrie® 200 Gamespy (3.1 megapixel) cameras. We set cameras to take 2 pictures/min when triggered and attached the camera approximately 0.5 m above the ground on a tree. We then dug a dirt hole approximately 2 m from the camera in which the lure was placed. We downloaded all images from the cameras and identified species.

Track plates were 0.64-m² treated plywood boards covered with aluminum flashing and sprayed with a 1:4 mixture of dissolved carpenter's chalk and denatured ethyl alcohol (Drennan and Dodd 1998, Olson et al. 2003). We placed a lure in the center of the track plate and identified carnivore tracks to species. We calculated detection rates using cameras and track plates for gray foxes, bobcats, and coyotes based on the number of individuals detected/100 survey-nights.

RESULTS

Trapping

We captured 9 gray foxes and 21 bobcats in 7,729 trap-nights and 6 coyotes in 1,416 trap-nights. Capture rates (individuals/100 trap-nights) were 0.12, 0.27, and 0.42, for gray foxes, bobcats, and coyotes, respectively (Table 1). Other animals captured included Virginia opossums (*Didelphis virginiana*), raccoons (*Procyon lotor*), domestic dogs (*C. familiaris*), striped skunks (*Mephitis mephitis*), eastern cottontails (*Sylvilagus floridanus*), squirrels (*Sciurus* spp.), domestic cats (*Felis catus*), an eastern box turtle (*Terrapene carolina*), and a woodchuck *(Marmota monax*; Table 2).

Table 1. Detection rates (individuals/100 survey-nights) of sympatric carnivores based on trapping, track plate, and camera surveys conducted during December 2005–February 2007, southern Illinois, USA.

Device (# survey-nights)	Gray fox	Bobcat	Coyote
Box trap (2,163)	0.05	0.37	N/A
Foothold (5,566)	0.14	0.23	0.42[a]
Track plate (883)	0.68	0.11	0.11
Camera (953)	0.42	0.53	0.42
Totals (9,565)	0.20	0.28	0.34

[a]Capture rate for coyotes was based on total trap nights using #3.0 foothold traps (*n* = 1,416).

Table 2. Capture totals based on 7,756 trap-nights during December 2005–March 2007, southern Illinois, USA.

Species	Footholds	Box trap	Totals
Virginia opossum	104	108	212
Raccoon	89	65	154
Striped skunk	9	14	23
Bobcat	13	8	21
Domestic dog	13	0	13
Eastern cottontail	9	0	9
Gray fox	8	1	9
Coyote	6[a]	0	6
Squirrel	3	0	3
Domestic cat	2	1	3
Woodchuck	1	0	1
Turtle	1	0	1
Totals	258	197	455

[a]Capture total for coyotes was based on total trap nights using #3.0 foothold traps (*n* = 1,416).

Track Plates and Remote Cameras

Track plates (*n* = 883 survey-nights) resulted in the detection of 6 gray foxes, 1 bobcat, and 1 coyote (Table 1). Cameras (*n* = 953 survey-nights) resulted in the detection of 4 gray foxes, 5 bobcats, and 4 coyotes. Other species detected using these methods included raccoons, opossums, domestic dogs, squirrels, eastern cottontails, striped skunks, turkey vultures (*Cathartes aura*), black vultures (*Coragyps atratus*), a woodchuck, a domestic cat, a wild turkey (*Meleagris gallopavo*), and a nine-banded armadillo (*Dasypus novemcinctus*).

Overall, remote cameras (1.36 detections/100 survey-nights) were more effective for detecting these 3 focal carnivore species than track plates (0.91 detections/100 survey-nights). Both bobcats and coyotes were more effectively detected by cameras than the other devices, but gray foxes appeared to be best detected by track plates (Table 1).

DISCUSSION

Our trapping data are in agreement with the ADHS, which indicates the relative scarcity of gray foxes in Illinois compared to bobcats and coyotes (Bluett 2007). We captured twice as many bobcats as gray foxes and coyotes, but the capture rate for coyotes (0.42) was higher than for both gray foxes (0.11) and bobcats (0.27). We based capture rates for coyotes solely on the #3.0 foothold traps because #1.5 foothold traps and the box traps were too small to effectively catch or hold most coyotes. This bias should not exist for gray foxes and bobcats (Zezulak 1980, Fuller et al. 1995, Gabriel 2006). Using these capture rates as coarse indices of relative abundance, gray foxes are scarcer than bobcats or coyotes. However, the species differ in likelihood of capture. For example, coyotes are wary of novel objects, especially within their core home ranges, making them difficult to trap (Sauvajot et al. 2000, Sequin et al. 2003, Mettler and Shivik 2007), whereas gray foxes and bobcats may not possess this trap shyness (Fritzell and Haroldson 1982). Therefore, capture rates from this study actually may underestimate relative abundance of coyotes in southern Illinois.

The relative effectiveness of detection methods used during this study varied by species. Although remote cameras detected the most bobcats and coyotes, cameras did not appear to detect gray foxes as well as did track plates. Again, differential detectability of gray foxes and coyotes may explain some variation in the number of detections obtained by devices such as track plates or cameras. Coyotes are wary of cameras (Sauvajot et al. 2000, Sequin et al. 2003), and it is likely they would have similar reactions to track plates, as concluded by Heske et al. (2011). Track plate surveys could be improved (e.g., by creating a more natural-looking tracking surface such as sand or soil) to make them more attractive to wary species (Heske et al. 2011).

There are many ways to conduct carnivore surveys (Roughton and Sweeny 1982, Gese 2001, Sargeant et al. 2003, Barea-Azcon et al. 2007). The most efficient surveys would allow researchers to run the fewest number of devices in the smallest area for the fewest nights without risking inefficient sampling (Field et al. 2005, Joseph et al. 2006). Complicating matters is that at different times of the year, animals are more or less likely to visit devices (Gompper et al. 2006). For example, during the breeding and juvenile dispersal seasons, home ranges expand (Follman 1973, Andelt and Gipson 1979, Sawyer and Fendley 1990), whereas home ranges contract during the whelping season (Follman 1973, Sawyer and Fendley 1990). There also may be an increased chance of detection during seasons when food is less plentiful, due to animals roaming more widely in search of food.

Altering survey methods in several ways may have produced higher detection rates of mesocarnivores in southern Illinois. Because coyotes may be more reluctant to visit non-natural devices (Sauvajot et al. 2000, Sequin et al. 2003, Mettler and Shivik 2007), dirt-circle scent stations may seem less out of place than track plates. Remote cameras also may appear suspicious to coyotes (Sauvajot et al. 2000, Sequin et al. 2003). Also, we conducted surveys in the summer, at which time the maximum number of gray foxes should be present due to the birth pulse. Juvenile animals may be less wary of survey devices (Windberg and Knowlton 1990). It is also difficult to determine the number of nights to survey for multiple species that have differently-sized home ranges. Because gray foxes inhabit relatively small home ranges when compared to bobcats and coyotes, they should have been more likely to encounter a detection device within the 2.6-km^2 study sections, whereas a coyote or bobcat may never enter that section in the 4 nights we ran surveys.

Our initial assessment of mesocarnivore distribution in Illinois has refined objectives for continuing research on mesocarnivores in Illinois. Specifically, we are using remote cameras (and not the other techniques discussed in this paper) to conduct occupancy surveys (MacKenzie et al. 2006) of gray foxes and sympatric mesocarnivores at 1,118 sites in 357 2.6-km^2 sections in the 16 southernmost counties of Illinois (C. Nielsen, unpublished data). These surveys will provide a more rigorous assessment of factors affecting occupancy and distribution of gray foxes, coyotes, and bobcats, focusing primarily on species interactions and habitat characteristics.

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