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Relative Abundance of Mammalian Nest Predators at Jim Edgar Panther Creek State Fish and Wildlife Area, Cass County, Illinois

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ABSTRACT

We used track stations to document the identity and relative abundance of potential mammalian predators of the nests of northern bobwhite quail and other ground-nesting birds at the Jim Edgar/Panther Creek State Fish and Wildlife Area (JEPC) in Cass County, Illinois. Surveys conducted during the breeding and brood-rearing season for bobwhite in 2000 and 2001 detected 9 species that we considered potential nest predators. Raccoons (*Procyon lotor*) were the most abundant and widespread, and therefore probably the most important nest predators at JEPC, followed by Virginia opossums (*Didelphis virginiana*). The diversity of the predator assemblage and widespread distribution of some species at JEPC suggests that nest predation, and possibly depredation of juvenile and adult bobwhite, may be quite high.

INTRODUCTION

In recent decades, populations of some medium-sized mammals, or mesopredators, have increased dramatically in Illinois (Hoffmeister 1989, Gehrt et al. 2002). Increases in populations of mesopredators have accompanied decreases in many bird populations. High rates of nest predation are considered the most important cause of declines in some bird populations (Ricklefs 1969, Gates and Gysel 1978, Martin 1988, Hanski et al. 1996). Birds, snakes, and mammals are all known to depredate bird nests, but mammals have commonly been identified as the most important predators of ground-nesting birds in the Midwest (Klimstra and Roseberry 1975, Whelan et al. 1994, Donovan et al. 1997). This may be because many species of ground-nesting birds use visual concealment to reduce their risk of nest predation, a strategy that is less effective against mammalian predators that may rely on olfactory cues to locate prey items (Bowman and Harris 1980, Clark and Nudds 1991). To date, considerable effort has been put into documenting patterns of nest predation, but less effort has been put into identifying specific predator species that pose the greatest threats to avian productivity (Heske et al. 2001).

One avian species in particular, the northern bobwhite (*Colinus virginianus*), is currently a focus of attention from wildlife biologists and managers. Despite being one of the most intensely studied and managed of all game species (Church and Taylor 1992), northern bobwhite populations have been declining for decades (Brennan 1991). Population trends derived from Breeding Bird Survey and Christmas Bird Count data show that the northern bobwhite is declining in 24 of the 31 states within its geographic range (Brennan 1991). Biologists at the Illinois Department of Natural Resources (IDNR) have conducted call-counts of northern bobwhite since 1956 (Preno and Labisky 1971). The population index derived from call-count data in 1999 was 30% lower than that in 1998 and the lowest on record since 1975 (David 1999). Bobwhite researchers cite severe habitat loss as the major cause of these declines (Klimstra 1982, Brennan 1991). High quality bobwhite habitat was a by-product of agricultural practices until the 1970s (Klimstra 1982) when revolutions in the agriculture industry caused average field size to increase by an order of magnitude to accommodate new farming equipment (O'Connor and Shrubb 1986). As a result, most of the fencerows and small fields that once provided nesting and brood-rearing habitat for northern bobwhite have been eliminated (Klimstra 1982). A recent evaluation of the landscape in Illinois suggests that only 24% of the state is potentially suitable habitat for bobwhite (Roseberry and Sudkamp 1998). However, bobwhite populations are declining even where suitable habitat is available (Brennan 1991), and other factors that may be contributing to the decline must be assessed. For example, the impact of predators on bobwhite productivity is still poorly understood (Brennan 1991). Mammals such as raccoons, skunks, and opossums have been reported as major nest predators of bobwhite in other regions (Hernandez et al. 1997, Fies and Puckett 2000).

The IDNR manages Jim Edgar/Panther Creek Fish and Wildlife Area (JEPC) for conservation of fish and wildlife. One of its primary objectives is to provide opportunities for sustainable hunting of upland game birds, particularly the northern bobwhite. According to a recent study of landscape variables indicative of the suitability of habitat for bobwhite, most of JEPC offers potentially high quality habitat for quail (Roseberry and Sudkamp 1998).

The goals of our survey were to identify mammalian species present at JEPC that have the potential to exert significant predation pressure on productivity of bobwhite and other ground-nesting species, as well as to describe their relative abundance. Analyses of distributions of predominant species, and habitat composition and structure associated with those distributions, will be the subject of a subsequent paper.

STUDY AREA

JEPC is a 15,574-acre (6,303-ha) site in the Panther-Cox Creek Watershed of Cass County in west-central Illinois. Prior to European settlement, the site consisted of oak-hickory forest, oak savanna, hill prairie and tallgrass prairie. The region was settled and cleared for small farmsteads by the 1860s. In the 1970s, Commonwealth Edison Company purchased the site to build a coal-fired power plant and cooling lake, but those plans were later abandoned. The company leased out the entire acreage for agriculture but maintained a cooperative agreement with the IDNR to allow limited hunting and trapping. Commonwealth Edison sold the property to the State of Illinois in 1993. At present

the site is composed primarily of forest (dominated by osage orange [*Maclura pomifera*], honey locust [*Gleditsia triacanthos*], and oaks [*Quercus* spp.]) and oldfield habitat along the steep riparian corridors and cropland (dominated by corn [*Zea mays*] and soybeans [*Glycine max*]) on the upland plateaus with each habitat type accounting for approximately ⅓ of the overall acreage.

As part of their effort to sustain and increase bobwhite populations, the IDNR has divided the site into three similarly sized management units. The Open Upland Game Hunting Unit features hunting without a special permit, the Controlled Pheasant Hunting Unit features hunting of released pheasant with a fee-special permit, and the Quail Management Unit features limited hunting of quail with a special permit. These management units also serve as the basis for prioritizing habitat restoration efforts designed to benefit bobwhite, including selective planting of retired cropland to warm and cool season grasses and use of prescribed burning to maintain grasslands in a variety of early successional stages.

METHODS

We used track station surveys to determine the identity and relative abundance of potential mammalian nest predators at JEPC. Each track station consisted of a 1-m circular plot cleared of all vegetation and covered with 22.7 kg of fine-grained sand. In the first year of the study (2000), we misted the sand at each station with water and then smoothed out the surface at the start of each survey. Because the sand surface sometimes dried out or crusted over, this method sometimes produced tracks that could not be clearly identified. Therefore, in the second year of the study, we mixed 237 ml of mineral oil with the sand to enhance the consistency of the tracking medium and improve the quality and retention of individual tracks. We added more mineral oil as needed at the start of each survey to maintain desired sand consistency.

To distribute track stations evenly throughout JEPC, we selected survey locations by superimposing a 1-km grid over a habitat map of the site and positioning a track station at each intersection of the grid (Figure 1). However, we were not able to adhere strictly to grid locations because some fell within crop fields, which the site manager asked us to avoid. To maintain consistency, all survey locations were shifted to the closest edge (forest-grassland, forest-cropland, or grassland-cropland) regardless of direction. Locating all track stations in edge habitat had the additional advantage of potentially improving detection rate, as predators sometimes use edges as travel routes (Bider 1968). We eliminated a few track stations around the perimeter of the site so that the total number of track stations was stratified among management units according to their respective acreage. The final distribution of track stations included 25 in the controlled hunting unit, 25 in the quail management unit, and 20 in the open hunting unit. We determined the location of each track station in the field with a GPS Pathfinder Pro XR unit (Trimble Navigation Limited, Sunnyvale, California), or a Garmin III+ unit (Garmin International Incorporated, Olathe, Kansas).

We conducted surveys of predators during the peak breeding and brood-rearing season for northern bobwhite in Illinois in 2000 and 2001. In 2000, we conducted four surveys

starting in mid-April and continuing through the end of June. In 2001, we conducted 3 surveys starting in mid-May because bobwhite at JEPC started breeding later than originally anticipated the previous season. In 2000, we ran each track station for 4 consecutive nights. On Day 0 of each survey, we placed a plywood cubby (61 cm x 61 cm x 81 cm) over each station to prevent rain from damaging tracks. Because we were concerned that some species, particularly canids, may have been inhibited by the cubbies, we removed the cubbies after checking for tracks on Day 1. We then rechecked each station for tracks on Day 4 (i.e., after 3 days without cubbies). In 2001, we checked stations for tracks every day for 3 days during each survey and did not use cubbies. (Despite repeated attempts to collect data on a third day, we were able to collect data for only 2 days at each station during the first survey of 2001 because of a prolonged rainy period.) In 2000, we alternated between using plaster discs pre-soaked in a 15% solution of fatty acid scent (FAS) in mineral oil and using salmon-flavored canned cat food as the attractant. In 2001, we used FAS discs exclusively.

We recorded visits to track stations by all mammalian species considered to be potential predators of bobwhite nests. We identified tracks to the species level whenever possible; however, tracks of red (*Vulpes vulpes*) and gray (*Urocyon cinereo*argenteus) foxes were pooled in the category "fox" because it was often difficult to distinguish between them. For each survey, multiple visits by individuals of the same species to a particular track station counted as one visit.

RESULTS

We recorded 299 visits to track stations by 9 species of mammalian predators. We recorded 162 visits over 1,120 survey nights during the summer of 2000 and 137 visits over 560 survey nights during the summer of 2001. In addition to species we considered important nest predators, squirrels (*Sciurus niger* and *S. carolinensis*), domestic dogs (*Canis familiaris*), house cats (*Felis domesticus*), white-tailed deer (*Odocoileus virginianus*), eastern cottontails (*Sylvilagus floridanus*), unidentified small rodents, wild turkeys (*Meleagris gallopavo*), ring-necked pheasants (*Phasianus colchicus*) and unidentified passerine birds also visited track stations.

Raccoons (*Procyon lotor*) were by far the most frequently recorded species at JEPC, followed by Virginia opossums (*Didelphis virginiana*) and long-tailed weasels (*Mustela frenata*) (Figure 2a). With 145 records, raccoon tracks accounted for 48% of all tracks recorded. Opossum tracks accounted for 17%, and weasel tracks accounted for 14% of all records. Tracks of striped skunks (*Mephitis mephitis*), foxes, and coyotes (*Canis latrans*) each accounted for 5-8% of all records. Badgers (*Taxidea taxus*) and minks (*Mustela vison*) were documented by single records of each during the summer of 2000. Otherwise, the pattern of relative abundance among species was similar between years (Figure 2a).

The number of track stations visited by mammalian predators at JEPC reflected the pattern of relative abundance (Figure 2b). Raccoons, the most commonly encountered species, also were the most widely distributed, visiting 58 of the 70 track stations (83%). Opossums, the second most common species, visited 34 stations (49%). Weasels visited

25 (36%). Skunks, foxes, and coyotes were recorded at 19-26% of track station locations. In total, mammalian predators were recorded at 67 of 70 track stations.

Raccoons were generally abundant throughout JEPC; however, scent stations located in areas heavily dominated by agriculture and/or grasslands were the least likely to be visited by raccoons (Figure 3a). Opossums were distributed relatively evenly throughout JEPC in moderate abundance; however, they rarely visited scent stations in the northwest or central portions of the site (Figure 3b). Visitation by the less common species were too rare to indicate general habitat use by those species at the site (Figures 3c and 3d).

DISCUSSION

We identified 9 mammalian species that would likely depredate bobwhite nests at JEPC. We made no effort to attract small mammals such as mice and shrews to track stations or to identify the tracks of those that did visit track stations. While they can be important predators of ground-nesting passerines (Maxson and Oring 1978, Fenske-Crawford and Niemi 1997, Dion et al. 2000), these species would generally be unable to depredate bobwhite nests due to the large egg size (Roper 1992, Haskell 1995).

Our surveys indicate that raccoons and opossums are probably the most abundant mammalian nest predators at JEPC. Because these species are incidental nest predators (Vickery et al. 1992), they generally depredate nests in proportion to their relative abundance (Chesness 1968, Angelstam 1986). Therefore, raccoons likely exert the greatest predation pressure on bobwhite productivity at JEPC. However, data from track stations must be interpreted with caution. Attractants used in our study were selected for their appeal to a broad range of mammalian species and likely were not equally effective in attracting each species to track stations. Our confidence in the pattern of relative abundance, however, is bolstered by the consistency of our data between years as well as by other studies describing the composition of mammalian predator communities in the Midwest. Heske et al. (1999) reported that raccoons accounted for 66.6% of mammalian predators surveyed at a site similar to JEPC in east-central Illinois, and Donovan et al. (1997) identified raccoons and opossums as the most common predators of ground-nesting birds in highly fragmented areas of Missouri, southern Illinois, and southern Indiana.

Studies of bobwhite nesting success have concluded that predation pressure is high. A study in Illinois reported that 37% of bobwhite nests (n = 863) were lost to predators (Klimstra and Roseberry 1975), and a study in Missouri reported that 68% (n = 157) of nests were lost (Burger et al. 1995). Studies from the southern United States reported even higher nest losses for bobwhite (Lehman 1984, Puckett et al. 1995, Peoples et al. 1996, Hernandez 1999). In studies that recorded predator identity with motion-sensing cameras, mesopredators accounted for the majority of nest losses. For example, a study in Virginia reported that 41% of artificial bobwhite nests were depredated by striped skunks and 37% were depredated by opossums (Fies and Puckett 2000). A study of artificial bobwhite nests in western Texas reported that raccoons accounted for 82% of nest losses (Hernandez et al. 1997). However, the ability of artificial nest studies to accurately estimate predation rates on natural nests has been questioned.

Predation is the primary source of mortality for bobwhite throughout its life cycle (Rollins and Carroll 2001). Several of the mammalian species identified in our study, notably coyotes, red foxes, and raccoons, are capable of capturing and killing juvenile or adult bobwhite. In addition, other species that are not important nest predators, such as bobcats, house cats, and dogs, may be important predators of juveniles and adults. A preliminary study of 69 radio-tagged bobwhite at JEPC found that 27% (10 of 37) of the mortalities detected could be attributed to mammalian predators (J. M. Siegrist, unpublished data); the cause of another 12 mortalities was unclear, and some were likely due to mammalian predators as well. The diversity of the predator assemblage at JEPC suggests that depredation of bobwhite nests, and possibly depredation of juvenile and adult bobwhite as well, may be quite high. Future studies should continue to evaluate the role of predation on population dynamics of bobwhite in conjunction with habitat restoration.

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Figure 1. Map of Jim Edgar/Panther Creek State Fish and Wildlife Area in Cass County, Illinois, showing locations of track stations (black circles) used to survey mammalian predators in 2000 and 2001.

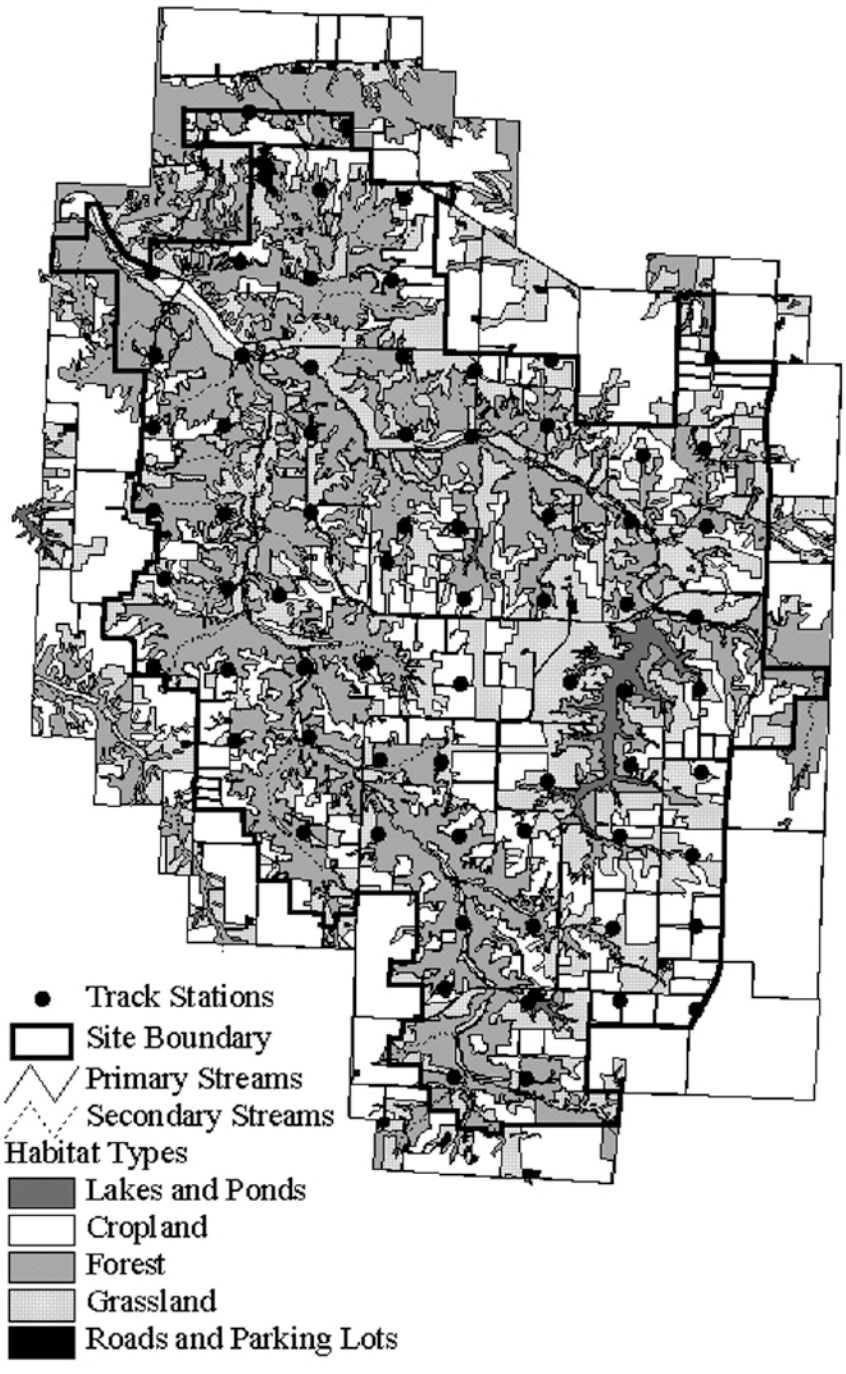

Figure 2. A) Number of visits by mammalian predators to track stations at JEPC in 2000 and 2001. B) Number of track stations visited by mammalian predators at JEPC in 2000 and 2001.

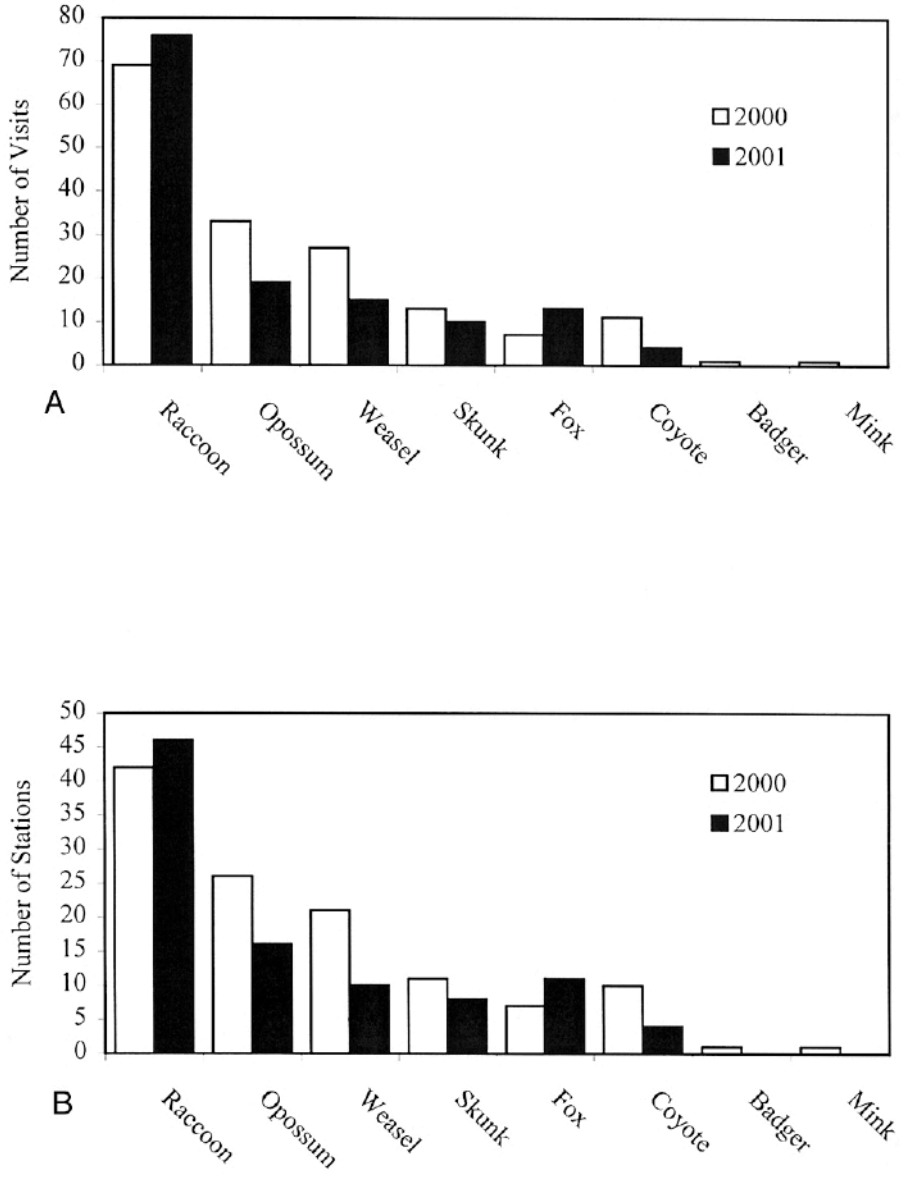

Figure 3. Distribution of records of mammalian nest predators at 70 track stations at JEPC in 2000 and 2001 (years pooled). A) Raccoons. B) Opossums. C) Coyotes and foxes. D) Weasels, skunks, badger, and mink.

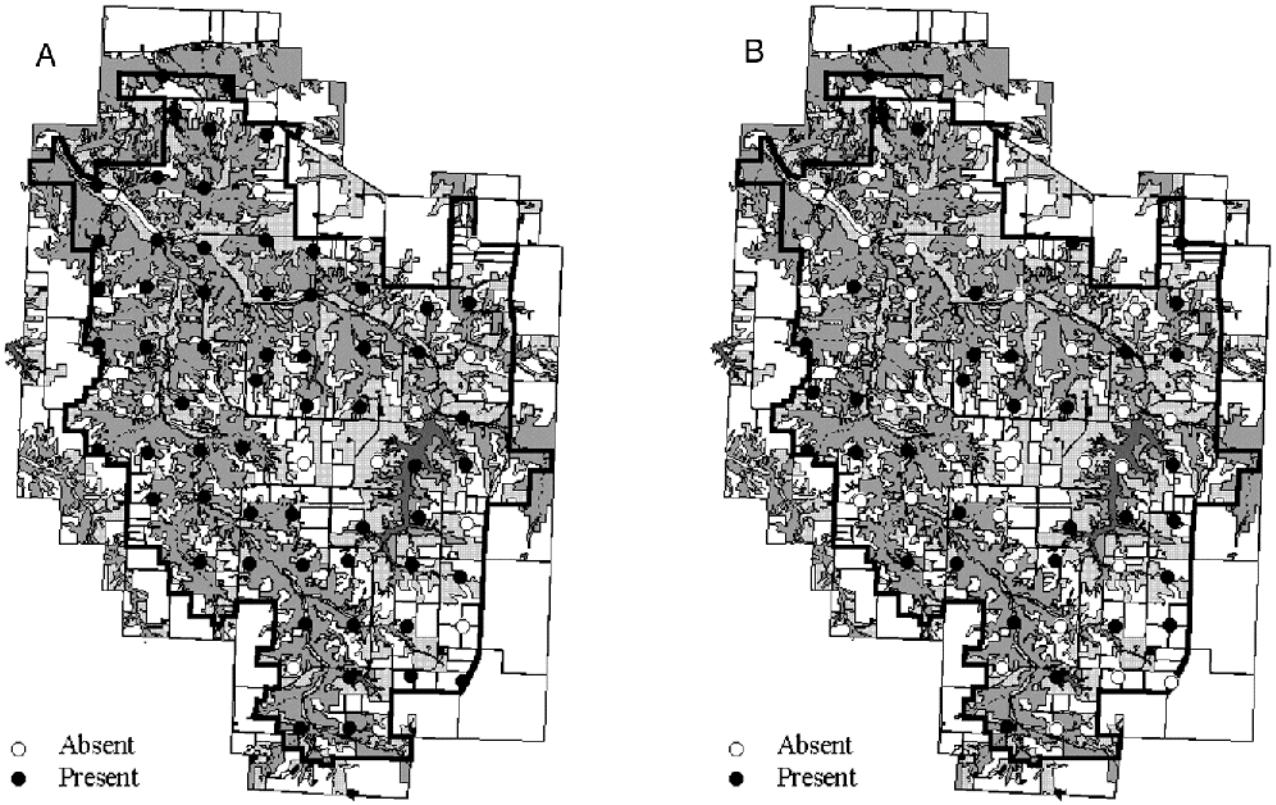

Figure 3. (continued) Distribution of records of mammalian nest predators at 70 track stations at JEPC in 2000 and 2001 (years pooled). A) Raccoons. B) Opossums. C) Coyotes and foxes. D) Weasels, skunks, badger, and mink.