Spring 2016

Evaluating The Effect Of Water Supplementation On Ring-Necked Pheasant And Mesocarnivore Occupancy In Western Kansas

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Recommended Citation

Calderon, Brandon L., "Evaluating The Effect Of Water Supplementation On Ring-Necked Pheasant And Mesocarnivore Occupancy In Western Kansas" (2016). *Master's Theses*. 30.
https://scholars.fhsu.edu/theses/30

EVALUATING THE EFFECT OF WATER SUPPLEMENTATION ON RING-NECKED PHEASANT AND MESOCARNIVORE OCCUPANCY IN WESTERN KANSAS

being

A Thesis Presented to the Graduate Faculty
of the Fort Hays State University
Partial Fulfillment of the Requirements for
The Degree of Master of Science

by

Brandon L. Calderon
Dual B.S., Kansas State University

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This Thesis for

The Master of Science Degree

by

Brandon L. Calderon

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PREFACE

This thesis is partially written in the style of Journal of Wildlife Management, to which a portion will be submitted for publication.

ABSTRACT

A "guzzler" is any structure that stores and supplements water for wildlife populations. They are often used to target economically influential game species where water is thought to be potentially limiting. Upland game, like the ring-necked pheasant (*Phasianus colchicus*) in the semi-arid landscape of western Kansas, represent such populations as guzzlers have become common practice in wildlife management applications across the region, especially on lands enrolled in the Conservation Reserve Program (CRP). However, little is known about the spatial response, if any, of wildlife populations to guzzlers or the potential increased risk they pose for predation. From June to August of 2011 and 2012 my project used occupancy modeling techniques to identify if guzzlers potentially influenced occupancy by *Phasianus colchicus* and their potential predators (i.e., mesocarnivores) on CRP lands in western Kansas. *Phasianus colchicus* detection was most explained by month of survey (highest in June; $P<0.001$), with occupancy being most influenced by distance from edge and percent forb cover at cameras, and land cover type at sites (camera data aggregated). For mesocarnivores, guzzler was the top performing habitat feature for explaining detection at cameras, but only raccoon (*Procyon lotor*) had guzzler best explain detection across sites as well. This suggested that increased predation near guzzlers, especially from an efficient nest predator like *P. lotor,* might be possible. While controlling for differences in detection, however, guzzlers did not perform well for explaining any target species occupancy. However, future studies are needed to truly evaluate this potential, as well as to assess the capacity for guzzlers to augment local population abundance, even if only during times of drought.

ACKNOWLEDGMENTS

Without the support of many individuals and several organizations, this project would have not been possible. First, I give many thanks to my advisor, Dr. Elmer J. Finck, whose conversations were always productive and insights inspiring. It is to him I give credit for the initiation of this project, as well as support in its full development and completion. Second, I thank my committee, Dr. David Dahlgren, Dr. Richard Packauskas and Dr. Robert Channell, for all of their critiques and feedback. Without the guidance and knowledge of Dr. David Dahlgren, I do not think it would have been possible to implement this project to the degree that was required. I thank Dr. Robert Channell and Dr. Jordana LaFantasie for always having an open door to mentor me in ways that left me motivated as well as challenged, and Dr. Richard Packauskas for stepping in for Dr. LaFantasie on short notice and still providing tremendous feedback.

I give a special thanks to Water for Wildlife©, Pheasants Forever, Inc., DLC Covert Scouting , Inc., and the Kansas Department of Wildlife, Parks, and Tourism (KDWPT). Without the monetary donations from Water for Wildlife ©, and the Greeley County and Ellis County Pheasants Forever, Inc. chapters, acquiring the necessary supplies for this project would not have been possible. The donated and discounted cameras from DLC Covert Scouting, Inc. were instrumental in being able to survey as many sites as I did in this project. I acknowledge the many in-kind donations and seasonal employment by the KDWPT, who made it possible for me to devote the necessary time each field season to this project, while also providing a network of professionals who provided interest and recommendations for meeting the objectives of this project.

I also thank everyone in the Department of Biological Sciences at Fort Hays State University. No doubt my experiences here have not only elevated my academic understanding of the sciences, but also my character; for this I am forever grateful. In intellectually challenging me, the faculty taught me how to evaluate evidence critically while often serving me a dose of humility. This is something that I will carry with me far beyond academics. I also thank my fellow graduate students, especially Brian Gaston, Brian Tanis, Amanda Cheeseman, and Jared Oyster, for their wisdom, understanding, and, sometimes, labor.

To my family, I thank my mother, Belinda Baber, and especially my lovely wife, Kristen Calderon, for bearing my stresses and providing nothing but love and support. As I close this chapter in my life, I extend my gratitude to all those that helped me make this possible and look forward to sharing my next chapter with my family, including my daughter, Aliyah Calderon. It is because of you that I increased my efforts to complete this project.

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INTRODUCTION

At the core of many wildlife management applications is a focus on increasing survivorship and/or reproduction of species of interest (target species), most often in the context of managing limiting factors. As a result, identifying the conditions that limit the ability of a population ability to survive, grow, and/or reproduce is often a focus of research with management implications (Leopold 1933, Cade et al. 1999). Leopold (1933) noted that wildlife populations are limited by complex interactions of environmental factors, specifically between what he called decimating and welfare factors. Decimating factors are essentially anything that limits a population by its presence, whereas welfare factors are anything that limits a population by its absence (Leopold 1933). Welfare factors can be thought of as the least available resources required for resisting the cumulative effects of decimating factors.

Leopold (1933) proposed four general welfare factors that affect populations; food, cover (space), special factors, and water. While food, cover and water are universal needs for all wildlife species, special factors are those that vary among species. Leopold (1933) noted that free-standing water could be considered a special factor as its magnitude of need varies among species. While the need for water in one form or another escapes no currently discovered species, methods in which species meet their water demands is quite diverse. This has become even more apparent since Leopold's paradigm on wildlife management in the 1930's. From diffusion in amphibians (Thorson 1955) to metabolic manufacture and adaptive strategies that minimize loss in arid-adapted rodents (Reaka and Armitage 1976, Mares 1983), canids (Golightly and Ohmart 1984), and ungulates (Warrick and Krausman 1989, Yoakum 1994), wildlife species have proven able to meet water demands without a complete reliance on free-standing water. The necessity of free-standing water for many wildlife species, however, has remained a topic of debate over the past several decades (see Campbell 1960, Broyles 1995, Rosenstock et al. 1999, Krausman et al. 2006). This debate is largely based on the assumption that water is a limiting factor for populations inhabiting arid to semi-arid environments (Roberts 1977, Rosenstock et al. 1999).

Artificial wildlife water developments, or what the Natural Resource Conservation Service (NRCS) denotes as “guzzlers”, are “self-filling, constructed watering facilities that collect, store, and make water available for wildlife” (USDA 2004a). Guzzlers initially were implemented as a means to alleviate the perceived stress of water as a limiting resource for wildlife populations inhabiting arid environments (USDA 2010). While guzzlers were first developed during the 1940’s to supplement water for game species in the arid southwestern United States, specifically for quail (*Callipepla* spp.; Krausman et al. 2006) and desert bighorn sheep (*Ovis canadensis*; Broyles 1995), they have since been used to supplement water for both game and nongame species (Rosenstock et al. 1999) and are often used in areas as far north as Idaho and as far east as Kansas. Early studies suggested that guzzlers fulfilled management goals in benefitting wildlife populations; however, studies contradicting these early findings quickly followed (see Campbell 1960). Echoing the theme of the debate over the importance of water, there is no consensus on the relative influence of guzzlers on wildlife populations (see Broyles 1995, Cutler and Morrison 1998, Broyles and Cutler 1999, Rosenstock et al. 1999, Broyles and Cutler 2001, Rosenstock et al. 2001, Krausman et al. 2006).

In Kansas, guzzlers have been designed with the primary purpose of benefitting upland game birds, such as the ring-necked pheasant (*Phasianus colchicus*), northern bobwhite (*Colinus virginianus*), and prairie-chicken (*Tympanuchus* spp.). Upland game are considered some of the most economically valuable species in the United States, resulting in over $1.8 billion in 2002 related retail sales alone (IAFWA 2002). Hunting of upland game is the most common hunting activity in Kansas, which resulted in over $121 million in total revenue in 2002 alone (IAFWA 2002). During this same year, upland game hunting activities were credited with creating or maintaining over 2,600 jobs in Kansas, and with generating over $2 million and $5.5 million in state and federal taxes, respectively (IAFWA 2002). The economic impact of upland game in Kansas highlights the significance of state interests in managing these populations.

Despite management efforts, however, regional abundances of many upland game species have largely declined over the past several decades (Westemeier et al. 1998, Rodgers 1999, Riley and Riley 1999, Fuhlendorf et al. 2002, Dimmick et al. 2002, Sauer et al. 2008). Habitat fragmentation and land conversion (Fuhlendorf et al. 2002, Dimmick et al. 2002), coupled with local drought and/or harsh winters (Gabbert et al. 1999, Riley and Riley 1999), are thought to have been key drivers behind much of the observed declines. Drought not only reduces free-standing water sources, but negatively affects vegetation (Albertson and Weaver 1942) and arthropods (Frampton et al. 2000), which are core components of upland game diet. Free-standing water is usually not seen as a high priority requirement for *P. colchicus* as moisture-rich arthropods are thought sufficient in meeting water demands, especially during brood rearing (Giudice and Ratti 2001). The benefit of free-standing water opportunities might be increased, however, during times of drought and/or in areas where dew is absent by reducing the quality and/or abundance of moisture-rich food items.

The need for free-standing water varies regionally, where variations in climate and quality of diet establish minimum thresholds. For example, water was the prime limiting factor affecting most southwestern upland game populations, specifically quail (Odontophoridae) (Grinnell 1927). Northern bobwhite quail (*C. virginianus*) nesting is reported as being significantly associated with water in the semi-arid panhandle of Texas (Hiller et al. 2009). While not enough is yet known about the influence of drought on upland game meeting water demands in a semi-arid landscape like western Kansas, possibly guzzlers might benefit local populations by opportunistically storing water from small, short rains during drought. While there are many studies regarding the association between upland game and free-standing water, few have evaluated the influence of guzzlers on these populations (see Campbell 1960, Delehanty et al. 2004, Larsen et al. 2007, Larsen et al. 2011).

Despite little research, guzzlers have become a common occurrence in Conservation Reserve Program (CRP) managed lands across western Kansas. With a primary focus of converting highly erodible land to vegetative cover as “tame or native grasses”, the 1986 Farm Bill created the CRP in an attempt to, among other objectives, increase usable habitat for species such as upland game (USDA 1985, 2011a, 2011b). Whether historically short-grass or mixed-grass prairie, most of the CRP lands in western Kansas were seeded with mixtures of multi-species warm-season, native grasses and did not include forbs until the mid-1990s (Rodgers 1999). Lands enrolled in the CRP are owned privately and are accepted based on their score on the Environmental Benefits

Index (EBI; USDA 2011a). Up until 2011, guzzlers accounted for twenty extra EBI points for every property having one or more on site. However, as little actually is known about their influence on wildlife populations, guzzlers no longer account for EBI points but do qualify for cost sharing incentives (NRCS 2010).

The general assessment regarding impact of CRP on upland game has become increasingly positive over the years. While some early attempts to document the effect of CRP on upland game populations produced doubt (Roseberry and David 1994), successive studies have highlighted how CRP has benefitted wildlife populations, including upland game (King and Savidge 1995, Ryan et al. 1998, Weber et al. 2002, Dimmick et al. 2002, Haroldson et al. 2006, Mathews et al. 2012). Rodgers (1999) suggested that early studies ignored the stabilizing impact CRP might have played on upland game populations, specifically for *P. colchicus*, as ecologically important weedy wheat stubble habitat simultaneously declined while CRP areas increased.

Few studies, however, have examined the effect of CRP on mesocarnivores. A mesocarnivore is a carnivore whose body size is less than 15 kg (Prugh et al. 2009), not at the apex of the trophic hierarchy (Roemer et al. 2009), or whose diet consists of 50-70% meat (Van Valkenburgh 2007). For my project, coyote (*Canis latrans*), American badger (*Taxidea taxus*), raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), opossum (*Didelphis virginiana*), red fox (*Vulpes vulpes*), and bobcat (*Lynx rufus*) are considered mesocarnivores. With the exception of a migrant cougar (*Puma concolor;* KDWPT 2010) or gray wolf (*Canis lupus*; KDWPT 2013), mesocarnivores such as *C. latrans* and *L. rufus* have essentially replaced previous apex predators. However, *C.*

latrans and *L. rufus* are still largely referred to as mesocarnivores based on body size and relatively recent historical placement in most ecosystems (i.e., pre-European settlement).

While large carnivores have been considered focal species for large scale conservation planning (Carroll et al. 2001), they are often met with local intolerance because they prey upon economically important species like upland game (Ray 2000). However, the ecology of carnivores, especially mesocarnivores, is still poorly understood (Roemer et al. 2009). As projected by traditional predator–prey models, occupancy and abundance of carnivores are correlated positively with prey-species (Sih 1998, Thompson and Gese 2007). While one might presume an increased predation risk for prey species when predators are present, not all predators are necessarily equal in their imposed risk. Higher-ordered predators (those that prey upon other predators), such as *C. latrans* in Kansas, potentially suppress smaller, more efficient nest predators of upland game (Thompson and Gese 2007). Rollings and Carroll (2001) suggested that nest predators, such as *Vulpes* spp. and *P. lotor*, might be one of the most influential factors limiting populations of upland game.

Studies have suggested that while arid-adapted carnivores are able to acquire a fraction of their water requirements from prey, they would require significantly more prey to meet water demands than to meet basic energy demands (Golightly and Ohmart 1984). This suggests that carnivores might be inclined to seek out free-standing water sources. Increased densities of carnivores have been observed in areas with guzzlers relative to similar areas without them (DeStefano et al. 2000). This might be a concern for wildlife managers of upland game as guzzlers could serve as potential attractants for predators, potentially increasing predation on species near guzzlers. Yet, as noted above, not all predators represent the same threat of predation. Predator use of guzzlers was exclusively to drink and did not seem to result in guzzler "stalking" (DeStefano et al. 2000). Aside from anecdotal observations, however, predator distributions relative to guzzlers remain unknown in Kansas. Effective monitoring strategies need to be implemented in order to assess both upland game and mesocarnivore distributions relative to guzzlers.

Harvest records and hunter surveys have been the primary methods for monitoring mesocarnivore populations in the Midwest (Lesmeister 2013). Due to the potential unreliability of these records, however, this method of estimating carnivore distributions and population trends might be inaccurate (Gese 2001). In contrast, occupancy-modeling can provide an effective method for monitoring species' distributions and potentially serve as a method for assessing population trends. Because occupancy is considered to be a fundamental function of abundance (Kays and Slauson 2008, Royle and Dorazio 2008), repeat surveys of species occupancy can be used to estimate relative abundances (Royle and Nichols 2003). Furthermore, occupancy modeling based on camera trap data has proven to be a relatively inexpensive and less invasive method for monitoring elusive mammals such as carnivores (Zielinski 1997, O'Connell et al. 2011) and avian species (Olson et al. 2005).

Objectives & Hypotheses

Guzzlers have been constructed in Kansas with the primary purpose of benefitting wildlife (USDA 2004a), with special emphasis on economically important species such as upland game birds. However, few studies have evaluated the impact of guzzlers on wildlife occupancy. Because monitoring is considered an essential step in adaptive management and a requirement for lands enrolled in the CRP Practice CP33-Habitat Buffer for Upland Wildlife program (USDA 2004b; Southeast Quail Study Group 2004), monitoring species use of guzzlers is a necessary tool for meeting many management objectives, especially those that focus on upland game. Additionally, monitoring species use of guzzlers provides insight into how species spatially respond to guzzlers, if at all. My project monitored CRP with and without guzzlers to better understand the effects of supplementary free-standing water on upland game and mesocarnivores in western Kansas.

Many researchers suggest that the ecology of species, along with the potential for negative impacts of guzzlers, should be evaluated prior to the construction and/or during the management of guzzlers (see Broyles 1995, Rosenstock et al. 1999). Critics of guzzlers often refer to the variety of strategies that organisms use in meeting water requirements without consuming free-standing water (see Reaka and Armitage 1976, Mares 1983, Golightly and Ohmart 1984, Warrick and Krausman 1989 among others). While it has been hypothesized that guzzlers increase predation on upland game species (Rosenstock et al. 1999, DeStefano et al. 2000), this has largely remained untested. While my project did not attempt to directly monitor predation, it did examine trends in upland game and mesocarnivores occupancy as it related to guzzlers, which might cautiously be used to gauge risk of predation.

My project is only an initial step for monitoring guzzlers and their associative impacts. Nonetheless, the objectives are to 1) monitor upland game and mesocarnivore use of guzzlers (collectively referred to as “target species”), 2) assess and model the relative influence of guzzlers and other habitat features on target species’ occupancy across CRP in western Kansas, and 3) evaluate potential risk for predation events at guzzlers. Rather than attempting to test a priori hypotheses, I used occupancy modeling to develop and test a posteriori hypotheses (models) about the influence of guzzlers on upland game and mesocarnivore spatial ecology across western Kansas CRP lands, as well as provided a tentative guzzler management recommendation to wildlife managers.

STUDY AREA

My project was conducted in Barton, Russell, Ellis, Trego, Gove, and Logan counties in Kansas (~11,900 km^2, US Census Bureau 2012; Figure 1). These counties were selected based on geographic overlap with known distributions of target species (Figures 2-4), presence of CRP, proximity to Hays, KS, and ability to survey across a gradient of average annual precipitation (Figure 5). Mesocarnivore distribution maps are not provided due to all target species being well-known as occurring throughout Kansas (Schmidt et al. 2015). The study area's elevation ranged from 450 to 900 m, increasing from East to West, and had an average human density of 13.15 persons/km^2 (U.S. Census Bureau 2012). While land cover type varied in relative proportion across each county, a mosaic of non-CRP grassland (including pastures), CRP, and agriculture are the common land cover types throughout the study area, as well as much of Kansas in general (Peterson et al. 2010).

The study area stretched from the Smoky Hills into the High Plains physiographic regions of Kansas (Figure 6), which incorporated both mixed and short grass prairies (Küchler 1974; Tomanek 1995). The mixed grass, also known as the grama-bluestem prairie, typically receives 51-74 centimeters of average annual precipitation, which permits a diverse assemblage of short, mid, and tall grasses. It is characterized by the predominance of blue grama (*Bouteloua gracilis*), sideoats grama (*Bouteloua curtipendula*), little bluestem (*Schizachyrium scoparium*), and big bluestem (*Andropogon gerardii*; Tomanek 1995). The short grass prairie, also known as the grama-buffalo grass prairie, typically receives an average of 38-48 centimeters of annual precipitation, and is characterized by short grasses such as blue grama and buffalograss (*Buchloe dactyloides*).

However, areas of taller mixed grasses occur in localized mesic environments within the region. For example, the chalk flats prairie in Trego and Gove counties is dominated by mid-height grasses such as *B. curtipendula*, *S. scoparium,* and various short grasses (Tomanek 1995).

METHODS

Research Design

Site Selection – CRP field sites with guzzlers (n=36) were selected by stratified random sample from a database acquired by field survey (see Appendix 1). Once I selected a prospective CRP field site with a guzzler I used county plat maps and online directories to acquire landowner contact information. I then contacted landowners to confirm ownership of the property of interest, whether a guzzler was present, and gain permission to survey the property. After permission was granted I collected additional information regarding the enrollment date of CRP, the Conservation Practice (CP-#), age of the guzzler, and the management option and time since last application (i.e., hayed, burned, inter-seeding, etc.). However, other than CRP age and guzzler age, much of this information was incomplete as many landowners were unsure about their CP enrollment and management option.

While I used a similar method for acquiring permission and gathering site information, non-guzzlers sites went through a different selection process as they were selected based on similarity to a paired guzzler site. Indices of similarity included soil classification, distance to guzzler pair site, distance to nearest other water source (ignoring the guzzler at guzzler sites), and apparent dominant vegetation. In evaluating similarity, much of the process incorporated the use of GIS datasets and imagery; all datasets were accessed via the Kansas Data Access and Support Center (KDASC).

The Soil Survey Geographic database (SSURGO) was used for evaluating soil similarity. Soil similarity was a parameter for assessing pair site candidacy due to likely spatial autocorrelation (i.e., less likely to select a site >25 km away), as well as similar soils likely having similar nutrients and water holding capacities. Because of this I expected sites with similar soils to have a higher likelihood for having similar vegetation communities compared to simple random selection. In assessing soil similarity, I used the most updated shapefile of all CRP sites in Kansas available to the KDWPT (acquired from Dr. David Dahlgren) to clip CRP sites against the SSURGO dataset (KARS 2010) in ArcMap 9.3. I then used zonal statistics to summarize each CRP site by proportion of soil type. Relative proportions of soil type were compared by subtracting the proportion of each soil type in the non-guzzler candidate site from that of the paired guzzler site. I summed all differences by absolute value, where the most similar non-guzzler candidate site would have the lowest absolute value. I then compared site acreages where sites that differed by a factor of two or more from the guzzler site acreage were removed from the candidate set. I measured the distance between all candidate non-guzzler sites and the paired guzzler site, and removed any sites that were greater than 25 km or less than1 km. However, I had to violate this condition with one pair of sites as there were no possible pairings within this distance threshold (T07 to T07P, ~35 km).

The National Hydrography Dataset (NHD; USGS 2010) and the National Agriculture Imagery Program (NAIP; FSA 2010) imagery were used in ArcMap 9.3for estimating distance to nearest potential natural water sources (e.g., streams, rivers, etc.) and other water sources (e.g., ponds, guzzlers, stock tanks, etc.), respectively. All measures were based on the estimated center of the CRP site to the nearest edge of the water source. I retained candidate non-guzzler sites that matched closest to the paired guzzler site’s distance to nearest water source. I then visited each non-guzzler candidate site to visually confirm the absence of a guzzler. If one was absent I took digital photos of the field for visual comparison of the vegetation community with the guzzler pair site.

The candidate site having the qualitatively most similar vegetation community and structure was selected as the non-guzzler pair site. The similarity metrics for all paired-sites can be observed in Table 1.

Camera Trap Sampling – Camera trap sampling was done with the consideration that there is a tradeoff between the number of sites surveyed and the duration of the survey for each site (see MacKenzie and Royle 2005, Bailey et al. 2007). The longer the duration of the surveys, the less sites can be surveyed in a given field season with a fixed number of cameras. Design considerations addressing this tradeoff were further complicated due to different detection probabilities likely associated with different target species (MacKenzie et al. 2004, MacKenzie and Royle 2005). For example, a scent-bait station used for increasing detection of mesocarnivores might decrease detection of upland game. For this reason I decided not to use any visual or olfactory bait at any camera.

From Jun. 13 - Aug. 30 and Jun. 11 - Aug. 31 I deployed 215 cameras across 72 legally-defined CRP field sites over the 2011 and 2012 field seasons, respectively. A "site" was statistically defined at two different scales. At the camera scale, I defined a site by individual camera (n=216). At the site scale, the detection histories for the three cameras within a CRP field were aggregated to form a single "site" (n=72; see Figure 1 for distribution of guzzler and non-guzzler sites). Camera level analysis was used primarily to assess the effect of local habitat (patch) features on species occupancy, whereas site level analysis was used to primarily evaluate landscape features (land cover). Throughout this paper the term "site" referred to site level analysis and/or the legally defined CRP fields, while camera level analysis will designate sites as "cameras".

Three motion-sensing cameras were deployed for three weeks within the legal boundaries of each site; however, one camera was stolen, leaving one guzzler site with only two cameras (G49). From setup to takedown, I made one weekly visit to each camera for data collection and maintenance. The entire three weeks of survey statistically represented the "season" for that site or camera, where each week corresponded to a "survey". I opted for a three week season in order to maximize the number of sites and detection of most target species (Moruzzi et al. 2002), while attempting to not violate the assumption of a closed population (Kays and Slauson 2008).

Because this project focused on guzzlers, maximum distances for spacing cameras was a major consideration as cameras spaced too far from a guzzler at a guzzler site may falsely relate a species occupancy to the guzzler. Maximum distance between cameras within a CRP field site was set by evaluating average summer seasonal movements of upland game. For this multispecies project, upland game was the group most likely to exhibit the shortest summer movements and thus served as the upper limit for spacing cameras at a CRP site. *Colinus virginianus* (Dimmick 1992, Brennan 2011), *Tympanuchus spp.* (Patten et al. 2011), and *P. colchicus* (Gates et al. 1974, Giudice and Ratti 2001, Perkins et al. 1997, and Riley et al. 1994) were all reported as having average summer seasonal movements of less than 0.4 km. I was conscious about spacing cameras below this threshold as I did not want to space cameras out so far at a site that they likely were beyond the limits of these movements. However, I did not want to space them so close that they also violated an assumption of independence for any target species. Following methodology from other mesocarnivore camera trap studies, I decided to use a minimum distance of 250 m to promote survey independence while maintaining maximum area coverage between cameras (Kays and Slauson 2008, Lesmeister 2013). When CRP fields were so small and/or their shape made these thresholds impossible, optimal distances between cameras was attained by maximizing distance while attempting to reduce oversampling of edge (move a camera more interior).

At guzzler sites, a camera was first placed at the guzzler itself, facing the drinking trough. At non-guzzler sites, I used ArcMap to randomly select a point in the CRP field to designate the first camera placement; however, I gave myself a 30 meter buffer for selection discretion. For both sites the second camera was placed by following a heading from the second hand of my wristwatch for at least 250 m, then looking for an optimal camera placement along the same heading. From the second camera I repeated this same procedure for the placement of the third and final camera. While random headings sometimes made for spacing all three cameras in a straight line, I tried to avoid this by resampling a different heading for the third camera. However, if the shape of the site only permitted this configuration due to being narrowly linear, I did the best I could for meeting the camera spacing limits ($250 \text{ m} \leq x \leq 400 \text{ m}$). Where necessary, I preferred to slightly violate spacing limits evenly across all cameras, rather than for only one camera (i.e., all cameras spaced out at 175 m versus one at 125 m).

At each site I placed at least one camera along game trails and ridges in order to maximize mesocarnivore detection (Wemmer et al. 1996). I used a two meter by three meter mowed patch directly in front of each camera to reduce false camera triggers caused by wind-blown vegetation, and maximize detection of upland game by increasing biologically important edge and usable space (Guthery and Bingham 1992, Guthery 1997). I assumed that this small-scale habitat manipulation did not alter occupancy of target species at the site, but did potentially increase the detection probability at cameras for individuals already present. Each camera was mounted to a post by using zip ties or a supplied camera strap, and was angled to the North to reduce interference with the sun (Kays and Slauson 2008). To deter raptors from perching on the posts and scaring off upland game, I added a string of roofing nails to the top of the posts, points facing up.

Detection Covariate Sampling – Detection covariates are variables that change between surveys, therefore possibly influencing detection, but not necessarily occupancy, between surveys (MacKenzie et al. 2006). Meteorological variables were the primary covariates meeting this condition, and thus make up the majority of the covariates used in modeling detection. As there were three surveys for each site, there were also three samples for each detection covariate at each site or camera. Meteorological covariates included total precipitation for the weekly survey (Precipitation), total precipitation for the previous week (Previous Precipitation), precipitation difference from previous week (Precipitation Difference), average daily maximum temperature of survey (Temperature), difference in average daily maximum temperature from previous week (Temperature Difference), and average variance in maximum and minimum temperature of survey (Temperature Variance). Meteorological data was taken from weather stations accessed via the National Oceanic and Atmospheric Association's (NOAA) National Climactic Data Center (NCDC). Only the closest weather stations were used for each site; however, I averaged multiple stations when they were equidistant from a site (Table 2). Methodology for calculating all climate covariates used in modeling detection can be found in Appendix B.

The presence/absence of a guzzler (Guzzler) at a camera and the month of survey (Month; *P. colchicus* only) make up the remaining detection covariates. While guzzle presence does not change between surveys, it was used in modeling detection as it seemed reasonable it might influence species detection due to potentially attracting species for water, cover, or curiosity. Additionally, detections were thought to be variable at guzzlers based on available water and magnitude of temperature. Because changes in biological season often result in changes in behavior, Month was thought to be potentially correlated to changes in species behavior and activity; therefore, it was used as a detection covariate. However, I only used Month as a detection covariate for target species that typically experience a transition in biological season during the summer field season (i.e., June to August). Thus, Month was only used as a covariate in modeling detection of *P. colchicus* as the transition between the nesting and brood-rearing seasons typically occurs between late-June and early-July (Taylor 1980, Berthelsen and George 1990, Runia 2011). *Tympanuchus spp.* and *C. virginianus*, however, were not assessed regarding biological season as they were not used in occupancy modeling due to small sample size of detection. The whelping-pup rearing season and parturition-young rearing season for *C. latrans* and the other mesocarnivores, respectively, typically occurs from May – August (Gese et al. 1988, Carnivore Ecology Research Project 2011). Because a single biological season spanned all survey months (June – August), there was no reason to include Month as a detection covariate for mesocarnivores.

Occupancy Covariate Sampling - Occupancy covariates were classified as site-specific variables that do not significantly change between surveys; thus, they are not likely to influence detection between surveys. Covariates thought to potentially influence occupancy include, but are not limited to, duration of enrollment in CRP (CRP Age), presence of a guzzler (Guzzler), age of guzzler (Guzzler Age), average visual obstruction reading of vegetation (VOR) and associated Shannon-Weiner diversity (*H'*) and evenness metrics (*E*), and percent aerial cover (%Grass, %Forb, %Legume, %Tree/Shrub, %Litter, and %Bare) as well as its associated Shannon-Weiner metrics (*H'* and *E*). Multiple distance and land cover metrics also were used in modeling species occupancy. Guzzler was used for modeling occupancy as well as modeling detection at both the site only as it was highly correlated with distance from water (Water Distance; see below). If a model incorporated Guzzler at both the detection and occupancy phases of modeling, it would be strong support for guzzlers influencing occupancy (i.e., accounting for detection variance) and evidence that guzzlers are influencing species distributions to some degree across the landscape.

Visual Obstruction Reading (VOR) was the height class that vegetation impeded vision at a 1 meter height from 3 meters away, and is used as an index of vegetation biomass (Robel et al. 1970). Visual Obstruction Reading sampling followed the methodology as described by Robel et al. (1970). Percent aerial cover of vegetation (%) was calculated by using the line-intercept method (Salo et al. 2008). Only measurements taken at each camera were used for camera level analysis of VOR and % (n=32 and n=88, respectively). For site level analysis, all measurements taken at each camera at a CRP field site were aggregated to represent site measurements of VOR and % (n=96 and n=264, respectively). VOR Diversity (*H'*) and Evenness (*E*) was calculated by using the Shannon-Weiner Diversity Index where obstruction classes were treated as “species”.

Further details on the VOR sampling protocol and calculation can be found in Appendix C.

Distance metrics included distance to nearest human dwelling (Human Distance), woodland (Woodland Distance), edge (Edge Distance), water source (Water Distance), and nearest other water source (NOWS). Definitions and sampling protocols for these covariates can be found in Appendix C. All distances were measured in meters by using ArcMap 9.3/10.0, and all but distance to edge was ground-truthed. All distance metrics except for NOWS (site only) and Edge Distance (camera only) were recorded at both the camera and site scales. Camera distance measures were taken from the location of the camera to the nearest covariate location, whereas site distance measures were taken from the center point of the CRP field site polygon. Water Distance at the camera scale included the guzzler, if present, in its calculation. NOWS, however, was only used at the site scale and did not include the guzzler if it was present. Because there was a strong association between Guzzler and Water Distance at the camera scale, the latter was only used in modeling occupancy while the former was only used in modeling detection as this seemed the most biologically logical (i.e., guzzlers directly impacting detection, and distance to water being the potential factor for occupancy).

Land-cover metrics were calculated by using the software FRAGSTATS V4 (McGarigal *et al.* 2012), and were used in modeling occupancy only at the site scale because metrics would be highly autocorrelated at the camera scale due to large overlap of the sampling grid (see Appendix D). Metrics included percent land cover by class (%CRP, %Ag, %Pasture, %Fallow, and %Other), connectedness (Connect), interspersion and juxtaposition index (IJI), total number of patches by class (NP-CRP, NP-Ag, etc.)

and in the landscape (NP), and edge density (ED) in the landscape. While class referred to the specific type of land cover or land use, landscape corresponds to the entire land cover grid for the site, being either ~2 km^2 or ~28 km^2 depending on target species. Complete methodology for creating and assigning the land cover grid by species, as well as definitions of FRAGSTAT land cover metrics can be found in Appendix D.

Statistical Analyses

Detection Histories – Detection history referred to the modelable series of detections and/or non-detections for a particular species at a site over the season. Each site's detection history had three intervals of detection that correspond to the three surveys in the season. Detection data were coded in binary, where "1" represents the detection of a species during the survey, and "0" represents non-detection. For example, a detection history of "111" meant that a species was detected over all three surveys in the season, and a "010" signifies detection only during the second survey. Modelable detection histories did not account for the total number of picture detections over the survey. The maximum number of possible modelable detections for any species was the number of cameras or sites ($n_{camera} = 214$, $n_{site} = 72$) multiplied by the number of surveys per site ($n_{camera} = 635$, $n_{site} = 216$); two cameras (G49C & G71PC) and seven surveys (B03PA-3, B03PB-3, G30PC-3, G53C-3, L03B-1, L03B-3, and R01PC-3) were not used in analyses as the camera was either stolen or suspected of malfunctioning over the survey. Target species with less than 20 modelable detections were not used in occupancy modeling or pre-modeling analysis due to insufficient statistical power.

A Pearson's Chi-squared test was used to determine if target species detection was statistically different ($P<0.05$) between guzzler and non-guzzler sites and cameras. I also used the Pearson's Chi-squared test to determine whether species detection varied based on average annual precipitation class (See Figures 1 and 5). In order to determine if there was spatial autocorrelation between detections, a Mantel test for autocorrelation was used for all modeled species across sites and cameras. Only the first detection of a species at a site was used in detection analysis as repeat detections, like those expected at guzzler cameras and sites, might inflate detection covariate relationships. When expected values were less than five, I used the Fisher's Exact Test for Count Data.

Detection Covariates –All continuous detection covariates were assessed for multicollinearity by using the package "stats" in the statistical analysis program R (R Core Team 2013) before being included in modeling. Covariate pairs having a Pearson's coefficient of correlation (r) greater than or equal to 0.8 were evaluated for covariate removal. A Friedman rank sum test of independence was used to test whether detection covariates were significantly different ($P<0.05$) between repeated surveys before being included in modeling. If they were not different, there would be little reason to include them as potentially influencing detection between repeated surveys. A Kruskal-Wallis test of significance was used to identify whether climate covariates were statistically independent ($P<0.05$) across seasons for modeling detection of *P. colchicus*. If independence was statistically supported, multiple comparisons tests using the package "kruskalmc" in R were ran to identify potentially confounding trends between climate covariates and Month before use in modeling (i.e., consistent with change in biological season from June to July).

Occupancy Covariates – As with detection covariates, all pairs of continuous occupancy covariates were evaluated for multicollinearity; however, Fragstats metrics were evaluated for multicollinearity independent of non-Fragstats covariates due to the large difference in spatial scales. All continuous occupancy covariates were evaluated for normality by using the Shapiro-Wilk test for normality in R (package "mvtnorm"). Continuous occupancy covariates at guzzler and non-guzzler sites were assessed by means of a Welch's two sample t-test for samples with unequal variances (Ruxton 2006). Covariates exhibiting non-normality ($P<0.05$) were ranked by their standard scores prior to performing the Welch's t-test. Covariates whose central tendencies significantly differed between guzzler and non-guzzler sites ($P<0.05$) were examined prior to running *s*pecies occupancy models in order to determine whether any covariate should be removed to reduce potential confounding influence on the model.

Occupancy Modeling Techniques – I used occupancy modeling techniques (MacKenzie et al. 2002, Bailey et al. 2004, and Mackenzie and Royle 2005), and used the program PRESENCE for analysis (PRESENCE Version 5.7, http://www.mbr-pwrc.usgs.gov/software/presence.html, accessed February 2013). Occupancy modeling relies on logistic regression and maximum likelihood estimation (MLE) to estimate parameters (covariate coefficients, β) that maximize the likelihood function (L) of the probability of occupancy (ψ) or detection (p) of a model (MacKenzie et al. 2006). Logistic regression is used due to the response variable being categorical (detection/non-detection). Maximum likelihood estimation is an iterative process that calculates a probability distribution as a function of the βs by selecting random parameters for each β (μ, σ) until convergence is reached. This probability distribution represents L, being a function of the βs given the observed data (MacKenzie et al. 2006). The β value with the highest probability, or the one that maximized L, is the one selected as being most likely and used in the model. The model itself is represented as an additive combination of all covariate βs, including the intercept (β_0), equal to the logit-link function of the parameter of interest ($\theta = \psi$ or p). The logit-link function is a log-odds transformation of the model parameter probability (ψ or p) as a function of the covariates.

$$\text{logit}(\theta_i) = \beta_0 + \beta_1\chi_{i1} + \beta_2\chi_{i2} + \dots + \beta_n\chi_{in}$$

Species detection histories with covariates were entered into PRESENCE's data input spreadsheet. I used modeling techniques that used a two-stage approach that first identified covariates most likely to impact species detection (Lesmeister 2013). Where applicable, these covariates were used as potentially impacting detection in occupancy models. Thus, covariates that were suggested as influencing a species' detection were first identified, and then used in all subsequent models of covariates that were thought to influence species occupancy. I ran all species occupancy models as a single-season model, which assumed a closed population.

Model support was evaluated by using Akaike's Information Criterion for small sample sizes (AICc). The Akaike Information Criterion (AIC) is a statistical measure used for comparing multiple models. AIC is calculated by adding twice the log-likelihood to twice the sum of covariate and intercept parameters (k) in the statistical model (i.e., $\text{AIC} = 2\ln(L) + 2k$). Relatively speaking, the lower the AIC value the better the model does at explaining the observed data (least loss of information) while also promoting parsimony (i.e., penalizing added covariates in models). While AIC is a measure that allows the user to compare a suite of models, it does not imply that the best performing model in the suite was the most indicative for that species.

Nevertheless, occupancy models are capable of being evaluated for model fit by using the parametric bootstrapping method for goodness of fit in PRESENCE. If the most general model (most parameters) in the suite of models exhibited poor fit, then the Quasi Akaike's Information Criterion for small samples (QAICc) was used for ranking models. QAICc adjusts the model selection procedures and inflates the standard errors based on the overdispersion parameter ($\hat{c}$). The overdispersion parameter ($\hat{c}$) is calculated by dividing the observed chi-square goodness of fit statistic of the most general model by its degrees of freedom. This promoted a conservative approach to assessing model support as it further penalized increased complexity in models.

Coefficients of covariates (β) represent the log of the odds ratio (ln-OR) for probability of success (p or ψ) between groups or per unit increase for categorical and continuous covariates, respectively. Because continuous covariates were standardized to a mean of zero and standard deviation of one (Z scores), a unit increase corresponds to one standard deviation increase (s). Negative coefficients indicated a negative relationship between the covariate and the probability of success; positive values indicated a positive relationship. All top-model βs were further evaluated based on magnitude of effect size and significance. Odds ratios (OR) were used over ln-OR for assessing effect size as the former is easier to interpret. The OR was calculated by exponentiation of β (e^{β}), where a value greater than one indicated the percentage of change (%Δ) in odds of success ($\%\Delta = [e^{\beta}-1]*100$). For example, if β equaled 1.56, then the OR would be 4.76 ($OR = e^{\beta} = e^{1.56} = 4.76$), which can be interpreted as a 376% increase in the odds of success.

Statistical significance of βs was evaluated by a Wald Test, which divides the coefficient by its standard error (SE) to calculate a Z score; the p-value can be calculated from the Z statistic by using a Z table at the 0.05 alpha level ($P(-1.96 > Z > 1.96) = 0.05$). Ninety-five percent confidence intervals (95% CI) were calculated by adding and subtracting the product of the standard error by the Z score, or 1.96. The 95% CI would span zero for coefficients that were not statistically significant ($P>0.05$).

All top-model probabilities of occupancy (ψ) and detection (p) were calculated by converting the logits (log-odds) of the models. Where the model is represented below, ψ or p is represented as θ, and the ln-OR for the respective covariate is the coefficient, β.

$$\text{logit}(\theta) = \beta_0 + \beta_1 * \text{Variable } 1 + \ldots + \beta_N * \text{Variable N}$$

Being that the logits are the log-odds of success, probability (θ) can be calculated by the following:

$$\theta = e^{\text{logit}(\theta)}/(1 + e^{\text{logit}(\theta)}), \text{ where } \text{logit}(\theta) = \log(\theta/(1-\theta))$$

I used model averaging techniques when there were multiple competing top occupancy models ($\Delta\text{AICc} \leq 3$ and $w \geq 0.10$, or $\Delta\text{AICc} \leq 2$) to create a composite model with weighted averages of all coefficients in the competing models.

$$\hat{\bar{\theta}} = \sum_{i=1}^{R} w_i \hat{\theta}_i$$

In the above, $\hat{\bar{\theta}}$ is the model averaged estimate of the coefficient, w_i is the Akaike weight computed from AICc values for each of R candidate models containing the respective covariate, and $\hat{\theta}$ is the estimate of the covariate coefficient in model i (MacKenzie *et al.* 2006). Unconditional standard error estimates for model-averaged coefficients (Burnham and Anderson 2002) were calculated as:

$$SE(\hat{\bar{\theta}}) = \sqrt{\widehat{\text{var}}(\hat{\bar{\theta}})}$$

where,

$$\widehat{\text{var}}(\hat{\bar{\theta}}) = \left[\sum w_i \sqrt{\widehat{\text{var}}(\hat{\theta}_i) + (\hat{\theta}_i - \hat{\bar{\theta}})^2}\right]^2$$

To begin modeling, I used only one covariate at a time to see how each compared to the null model. Covariates that did not result in a model that performed better than the null were not used in additive combinations with any other covariates unless there was biological pertinence to do so. For example, if nearest other water source (NOWS) did not outperform the null model on its own, I would not combine it with most other covariates. However, I might combine it with Guzzler as the magnitude of NOWS might influence the degree to which a species visits guzzlers. Such combinations were rare and only used when an interactive combination was recognized as being potentially greater than any one covariate on its own.

Species Richness – Species richness was compared between guzzler and non-guzzler sites by using the Chao species richness estimator for incidence data (Chao2). I calculated Chao2 by using the package ‘fossil’ in R (Vavrek 2011), and compared the species richness estimates between guzzler and non-guzzler sites using a Welch’s two sample t-test. While this project’s objectives were to assess the diversity of species that use guzzlers, it was not designed to sample species richness as influenced by guzzlers. Therefore, species richness should be interpreted cautiously.

RESULTS

Pre-modeling Analysis

Detection History Assessment – Only modelable detections of *P. colchicus*, *C. latrans*, *T. taxus, P. lotor,* and *M. mephitis* were sufficient to attempt modeling ($\geq$20; Table 3). The Pearson's Chi-squared test suggested that the frequency of modelable detections for *C. latrans* (P_{site}=0.47, P_{camera}=0.63), *T. taxus* (P_{site}=0.79, P_{camera}=0.39), and *M. mephitis* (P_{site}=0.30, P_{camera}=0.48) was not significantly different between guzzler and non-guzzlers sites or cameras (Table 4). While *P. colchicus* did not exhibit differences in the frequency of modelable detections between guzzler and non-guzzler sites (P=0.31), there was support for differences between guzzler and non-guzzler cameras (P=0.02). Only *P. lotor* exhibited significant differences in frequency of modelable detections between guzzler and non-guzzler sites (P=0.01) and cameras (P<0.001).

Geographic distribution of *P. colchicus* detection appears to be relatively free of geographical influence; however, there appears to be separation between detections and non-detections corresponding to Hwy 281 near the Russell and Barton county boundary (Figure 7). *Canis latrans* appeared to be relatively free of geographical influence (Figure 8), whereas *T. taxus* (Figure 9) and *P. lotor* (Figure 10) were not detected in the southwestern region of the study area. *Mephitis mephitis* mostly was detected in Barton and Russell counties, going undetected in most western sites (Figure 11). A Pearson's Chi-Squared test suggested that there was no difference in detection of *P. colchicus* (χ^2 = 0.71, df = 2, P = 0.70), *C. latrans* (χ^2 = 1.24, df = 2, P = 0.54), and *P. lotor* (χ^2 = 3.42, df = 2, P = 0.18) between precipitation gradient classes in the study area (Figure 5). *Taxidea taxus* (χ^2 = 10.46, df = 2, P < 0.01) was detected least often at sites receiving 45-53 cm of annual precipitation from 1971-2000, while *M. mephitis* (χ^2 = 10.43, df = 2, P < 0.01) was detected most often at sites receiving 61-69 cm over the same period (Table 5). Considering only guzzler sites, again, *T. taxus* ($\chi^2 = 8.00$, df = 2, $P = 0.02$) and *M. mephitis* (P=0.04) were the only target species to exhibit any difference in detection between sites at different precipitation classes (Table 6). Fisher's Exact Test for Count Data was used for *M. mephitis* due to expected values being less than five.

A Mantel test suggested there was no statistically significant spatial autocorrelation (P>0.05) among detection of *P. colchicus*, *C. latrans*, or *P. lotor* (P>0.05; Figures 12-14). *Taxidea taxus* exhibited a low degree of positive spatial autocorrelation across cameras ($r = 0.057$, *df.* = 39, $P = 0.02$; Figure 15), whereas *M. mephitis* detection was positively auto-correlated across both sites (r=0.103, *df*=16, P=0.01) and cameras (r=0.068, *df*=21, $P = 0.004$; Figure 16).

Assessment of Detection Covariates – All pairs of continuous detection covariates were evaluated for multicollinearity (Table 7). Only Precipitation and Precipitation Difference (r=0.76) exhibited correlation near the threshold for removal (r =0.80). While both were retained for use in modeling, they were further examined if additively present in top performing models. The Friedman Rank Sum test suggested that Temperature (P=0.003), Temperature Difference (P=0.006), Precipitation (P=0.01), Precipitation Difference (P<0.001), and Previous Precipitation (P=0.003) significantly differed between weekly surveys (Table 8); Temperature Variance exhibited only moderate differences between surveys (P=0.07). The Kruskal-Wallis test of significance suggested that all detection covariates except Previous Precipitation (P=0.06) and Precipitation Difference (P=0.86) significantly differed between Month categories (Table 9). Multiple comparisons tests showed that differences were spread between all months for

Temperature (Table 10) and Temperature Difference (Table 11), with June and July not showing differences in Temperature Variance (Table 12). Precipitation, however, showed no significant difference between Month categories when evaluated by multiple comparisons (Table 13).

Assessment of Occupancy Covariates – All pairs of non-Fragstats continuous occupancy covariates were evaluated for multicollinearity at the site (Table 14) and cameras scale (Table 15). Only Veg Diversity and Veg Evenness had a correlation coefficient greater than 0.80 across sites (r=0.84) and cameras (r=0.81). Because Veg Evenness is the most easily interpretable metric, Veg Diversity was removed from modeling. VOR and Veg Structure Diversity approached the threshold for removal (r_{site}=0.74; r_{camera}=0.65); however, both were retained for modeling but would be further examined if additively present in top performing models. Distances to Woodland and Human Dwelling experienced some degree of positive collinearity among cameras (r=0.64), but were retained and would be further examined if placed in top models as well.

With the exception of Water Distance at cameras (P<0.001), continuous occupancy covariates did not differ (P>0.05) between guzzler and non-guzzler sites (Table 16) or cameras (Table 17). Veg Evenness, however, exhibited moderate differences between guzzler and non-guzzler sites (P=0.06). Nonetheless, all occupancy covariates were included in modeling at both scales, with Water Distance and Guzzler not being additively used during the same phase of modeling at the camera scale. I retained Guzzlers for modeling detection and Water Distance for modeling species' occupancy because guzzlers and proximity to water, no matter the source, are at the core of this project's objectives. Veg Evenness would be further assessed if suggested as a top performing covariate in modeling.

Among Fragstats metrics, Number of Patches and Edge Density exceeded the threshold for removal at ~2 km^2 (r=0.90, Table 18) and ~28 km^2 (r=0.94, Table 19). Number of Patches was not included in further analysis as Edge Density seemed the most biologically interpretable. Landscape IJI and CRP IJI also exceeded the threshold for removal at ~28 km^2 (r=0.81). Landscape IJI was not included due to characteristics of CRP on species occupancy being a key objective of this project. The Number of Total Patches (NP) and CRP Patches (NP-CRP) in the ~28 km^2 landscape approached the threshold for removal (r=0.78), as did %Ag and %Pasture (r=0.77). None of the Fragstats metrics at the ~2 km^2 (Table 20) or ~28 km^2 (Table 21) radius exhibited differences between guzzler and non-guzzler sites.

Occupancy Modeling – Camera Level Analysis

Phasianus colchicus Models- The top model for *P. colchicus* detection at cameras included Month (i.e., June, July, and August) and Temperature Variance (w = 0.58, K = 5, -2L = 462.12; Table 22). The top model's coefficients for Intercept (P<0.001) and June (P<0.001) suggested predictable changes in probability of detection between June and August (Table 24); however, the coefficient for July (P=0.96) did not. Because I used two dichotomous dummy variables for the three categories of Month ($\text{logit}(\theta) = \beta_0 + \beta_1{*}\text{June} + \beta_2{*}\text{July}$), the Intercept coefficient also corresponds to the coefficient for August survey month. The second most supported model included both covariates in addition to Guzzler. While Temperature Variance (AIC_c = 507.42, w=0.00) and Guzzler (AIC_c = 508.39, w=0.00) did perform slightly better than the null (AIC_c = 510.22, *w*=0.00) as individual covariates, they performed rather poorly compared to Month (AIC_c = 475.43, *w*=0.11). Month performed better than all other models when additive combinations were removed (ΔAIC_c=0.00, *w*=1.00; Table 23). The model with only Month was retained for the occupancy phase of modeling as the combination of Month and Temperature Variance potentially biased the model due to the confounding nature of the covariates relationship (Table 12). The Model with month also was the most parsimonious out of the two, and exhibited adequate model fit ($\chi^2 = 15.07$, $P = 0.19$, $\hat{c} = 1.48$).

For comparison, I used model averaging techniques to develop a composite model with weighted averages of the covariates in the top two additive models (Table 24). The composite model included Month ($\beta_{June} = 2.43 \pm 0.42$; $\beta_{July} = 0.38 \pm 0.45$), Temperature Variance ($\beta = -0.38 \pm 0.23$), and Guzzler ($\beta = 0.07 \pm 0.42$). The coefficient for the model averaged Intercept was statistically significant ($P<0.001$), as was the June coefficient for Month ($P<0.001$); detections in June was significantly different from August. The coefficients for July ($P=0.41$) and Guzzler ($P=0.55$) were not statistically significant, while Temperature Variance approached significance ($P=0.06$). The relative predicted probability of *P. colchicus* detection across survey months suggested that detection of *P. colchicus* was highest during June, regardless of guzzler presence (Figure 17) or temperature variance (Figure 18). Probabilities of detection decreased with increasing Temperature Variance, but did not significantly vary between guzzler and non-guzzler cameras (Figure 19).

The top performing model for *P. colchicus* occupancy at cameras included Edge Distance ($\beta = -0.56 \pm 0.22$) and %Forb ($\beta = 0.59 \pm 0.32$) as being the most influential covariates (*w* = 0.39, K = 7, -2L = 450.39; Table 25). Both the top (χ^2 = 11.78, *P* = 0.16, ĉ = 1.36) and most general model (χ^2 = 11.96, *P* = 0.18, ĉ = 1.37) exhibited adequate model fit. However, only Edge Distance resulted in significantly different occupancy probabilities (*P*=0.01), with %Forb exhibiting only moderate differences (*P*=0.07; Table 26). The next four most supported models all included Edge Distance and %Forb, as well as an addition or combination of VOR, Water Distance, and Contiguous CRP (Table 25). Because each of these model's AIC$_c$ deviated from the top model by less than two (ΔAIC$_c$ = 0.26, 1.49, 1.52, and 1.81, respectively) I developed a composite model with weighted averages of the covariates in the top three models (Table 26). The composite model included Edge Distance (β = -0.51 ± 0.32), %Forb (β = 0.55 ± 0.32), VOR (β = 0.01 ± 0.08), Water Distance (β = -0.02 ± 0.04), and Contiguous CRP (β = -0.16 ± 0.15, *P*=0.85). All covariates did not significantly differ between Month (*P*>0.05), thus, suggesting low potential for confounding relationships between the detection and occupancy covariates (Table 27). Only predicted probabilities of *P. colchicus* occupancy for Edge Distance (*P*=0.02, Figure 20) and %Forb (*P*=0.09, Figure 21) were presented graphically due to other covariate' statistical insignificance (*P*>0.30) and low effect size (OR= 0.85-1.01).

Canis latrans Models- The top model (*w* = 0.52, K = 3, -2L = 348.46) for *C. latrans* detection at cameras included only Guzzler (β = 0.99 ± 0.03; Tables 28-29), and exhibited adequate model fit (χ^2 = 13.71, *P* = 0.28, ĉ = 1.13); there was no general model in the candidate suite. The top model's coefficients for Intercept (*P*<0.001) and Guzzler (*P*=0.03) were statistically significant (Table 29). The predicted probabilities of *C.*

latrans suggested significantly higher probabilities of detection at guzzler cameras compared to non-guzzler cameras (Figure 22).

The top model for *C. latrans* occupancy at cameras included VOR Diversity (β = 0.50 ± 0.26) as being most influential (*w* = 0.33, K = 4, -2L = 343.91; Tables 30-31), and exhibited adequate model fit (χ^2 = 10.83, *P* = 0.35, ĉ = 1.10); there was no general model in the candidate suite. The top model's Intercept(*P*=0.38) was not statistically significant, while the coefficient for VOR Diversity (*P*=0.05) approached significance (Table 31). The predicted probabilities of *C. latrans* occupancy as affected by VOR Diversity can be observed in Figure 23**.**

Taxidea taxus Models- The top model for detection of *T. taxus* at cameras included Guzzler (β = 0.89 ± 0.37) and Precipitation (β = -0.54 ± 0.20) as being the most influential covariates (*w* = 0.50, K = 4, -2L = 409.11; Tables 32-33). Both the top-performing (χ^2 = 6.29, *P* = 0.64, ĉ = 0.69) and most general models (χ^2 = 6.52, *P* = 0.57, ĉ = 0.70) exhibited adequate model fit. The coefficients for the top model's Intercept (*P*<0.001), Guzzler (P=0.02), and Precipitation (*P*=0.01) were all statistically significant. The second most supported model included Precipitation Difference, in addition to Precipitation and Guzzler, and deviated from the top model by less than two (ΔAIC_c = 1.07). Thus, model averaging techniques were used to develop a composite model with weighted averages of the coefficients in the top two models (Table 33). The composite model suggested that decreasing Precipitation (β = -0.60 ± 0.24, *P*=0.01) and Guzzler presence (β = 0.89 ± 0.37, *P*=0.02) resulted in higher detection probabilities, while Precipitation Difference (β = 0.08 ± 0.11, *P*=0.46) did not. Relative probabilities of *T. taxus* detection were only slightly higher at guzzler cameras compared to non-guzzler cameras, but reduced with increasing precipitation at both (Figure 24). Precipitation Difference was not graphed due to statistical insignificance (P=0.46) and low effect size (OR=1.08).

The top model for occupancy of *T. taxus* at cameras included Edge Distance (β = -1.09 ± 0.47), Human Distance (β = -0.85 ± 0.42), and %Tree (β = -1.49 ± 1.05) as being the most influential covariates (w = 0.34, K = 7, -2L = 387.47; Tables 34-35). The most general model exhibited adequate model fit (χ^2 = 6.79, P = 0.56, $\hat{c}$ = 0.74), as did the top model (χ^2 = 6.29, P = 0.68, $\hat{c}$ = 0.62). The top model's coefficients for the Intercept (P=0.44) and %Tree (P=0.16) were not statistically significant, but Edge Distance (P=0.02) and Human Distance (P=0.04) were. The second most supported model included %Forb, Edge Distance, Human Distance, and %Tree as covariates potentially influencing *T. taxus* occupancy. The third most supported model included only Edge Distance and Human Distance. Because the second and third most supported models deviated from the top model by less than three (ΔAIC_c = 1.45 and 2.30, respectively) and had a weighted value greater than 0.10 (w=0.17 and 0.11, respectively), model averaging was used to develop a composite model (Table 35). The composite model included increasing Human Distance (β = -0.82 ± 0.42, P=0.05; Figure 25) and Edge Distance (β = -1.06 ± 0.47, P=0.02; Figure 26) as increasing predicted probability, while %Tree (β = -1.19 ± 0.88, P=0.18) and %Forb (β = -0.08 ± 0.11, P=0.50) did not result in significant changes to predicted probabilities.

Procyon lotor Models- The top model for *P. lotor* detection at cameras included Guzzler (β = 2.54 ± 0.42) as the most influential covariate (w = 1.00, K = 3, -2L = 275.23; Tables 36-37). The top model in the full suite of models exhibited adequate model fit (χ^2 = 7.43, P = 0.38, ĉ = 0.76); there was no most general model in the candidate suite. The top model's coefficient for the Intercept (P<0.001) and Guzzler (P<0.001) suggested that detections at guzzler and non-guzzler cameras were significantly different (Table 37), with relative predicted probabilities of detection being higher at guzzler cameras compared to non-guzzler cameras (Figure 27).

The top model for occupancy of *P. lotor* at cameras included Human Distance (β = -1.17 $\pm$ 0.42) and %Grass (β = -0.78 $\pm$ 0.42) as being the most influential covariates (w = 0.19, K = 5, -2L = 258.81; Tables 38-39). The top model (χ^2 = 8.12, P = 0.29, ĉ = 1.00) and most general model (χ^2 = 8.05, P = 0.31, ĉ = 0.98) in the full suite of models for *P. lotor* occupancy both exhibited adequate model. The top model's Intercept (P=0.57) was not statistically significant, but the coefficients for Human Distance (P=0.01) and %Grass (P=0.06) suggested they had significant to moderate influence on predicted occupancy. The second to seventh most supported models all included Human Distance with all but one having some combination of %Grass, Edge Distance, and/or %Tree (see Table 38). As the second to seventh most supported models' AIC_c deviated from the top model by less than two ($\Delta AIC_c < 2$), model averaging techniques were used to develop a composite model (Table 39). The eighth most supported model deviated from the top model by less than three ($\Delta AIC_c < 3$), but its model weight was less than 0.10 so it was not used in model averaging. The composite model included Human Distance (β = -1.08 $\pm$ 0.46, P=0.02), %Grass (β = -0.43 $\pm$ 0.30, P=0.16), Edge Distance (β = -0.26 $\pm$ 0.22, P=0.24), and %Tree (β = 0.25 $\pm$ 0.43, P=0.57). Relative probabilities of *P. lotor* occupancy are predicted to decrease with increasing Human Distance; however, considering confidence intervals, decreases are not really evident until after distances of 2 km from a human dwelling (Figure 28). Edge Distance, %Grass, and %Tree were not graphed as each did not significantly influence predicted probabilities ($P>0.05$).

Mephitis mephitis Models- The top model for *M. mephitis* detection at the cameras included only Guzzler as a covariate ($\beta = 1.50 \pm 0.5$; $w = 0.74$, K = 3, -2L = 199.92; Tables 40-41), and exhibited adequate model fit ($\chi^2 = 5.16$, $P = 0.61$, $\hat{c} = 0.55$); there was no general model in the candidate suite. The Intercept ($P<0.001$) and Guzzler ($P=0.01$) suggested significant differences in probability of detection between guzzler and non-guzzler cameras (Table 41). Relative probabilities of detection for *M. mephitis* were predicted to be highest at guzzler cameras compared to non-guzzler cameras (Figure 29).

The top model for predicted occupancy of *M. mephitis* at the camera scale included Veg Evenness ($\beta = 0.75 \pm 0.45$), %Legume ($\beta = 1.83 \pm 0.71$), and %Tree ($\beta = 4.86 \pm 7.87$) as being the most influential covariates ($w = 0.37$, K = 6, -2L = 174.38; Tables 42-43). The most general model in the full suite of models exhibited adequate model fit ($\chi^2 = 5.22$, $P = 0.55$, $\hat{c} = 0.75$), as did the top model ($\chi^2 = 5.24$, $P = 0.62$, $\hat{c} = 0.46$). The coefficients for Intercept ($P=0.73$), Veg Eve ($P=0.09$) and %Tree ($P=0.54$) were not statistically significant, but %Legume ($P=0.01$) was significant for influencing predicted occupancy of *M. mephitis*. The second and third most supported models also included %Legume and %Tree, with the third including Veg Evenness and %Forb (see Table 42). Because their AIC_c values deviated from the top model's by less than three ($\Delta AIC_c < 3$), and they had model weights greater than 0.10, model averaging techniques were used to develop a composite model (Table 43). The fourth supported model deviated from the top model by less than three ($\Delta AIC_c < 3$), but had a model weight less than 0.10. The composite model included %Tree ($\beta = 25.63 \pm 107.81$, $P=0.81$), Veg Evenness ($\beta = 0.47 \pm 0.34$, $P=0.16$) and %Forb ($\beta = -0.01 \pm 0.14$, $P=0.95$), but only %Legume ($\beta = 1.83 \pm 0.70$, $P=0.01$) significantly influenced predicted occupancy probabilities (Table 43). The relative probabilities of *M. mephitis* occupancy was predicted to increase with increasing %Legume, with increasing confidence as legume cover passes 10% (Figure 30).

Occupancy Modeling – Site Level Analysis

Phasianus colchicus Models – The top model for *P. colchicus* detection at sites included Month ($\beta_{June} = 2.29 \pm 0.51$, $\beta_{July} = 0.15 \pm 0.49$; $w = 1.00$, K = 4, -2L = 227.98; Table 45), and exhibited adequate model fit ($\chi^2 = 5.06$, $P = 0.44$, $\hat{c} = 0.96$); there was no general model. The top model's coefficients for Intercept ($P=0.01$) and June ($P<0.001$) suggested predictable changes in probability of detection between June and August (Table 45); however, the coefficient for July ($P=0.76$) did not. Predicted probability of *P. colchicus* detection was highest in June, with July and August exhibiting low probability (Figure 31).

The top model for predicted occupancy of *P. colchicus* at sites included %CRP ($\beta = -0.98 \pm 0.62$) and %Fallow ($\beta = 0.0002 \pm 0.0005$; $w = 0.14$, K = 6, -2L = 217.95; Tables 46-47). The top model ($\chi^2 = 4.54$, $P = 0.63$, $\hat{c} = 0.73$) and most general model both exhibited adequate model fit ($\chi^2 = 4.80$, $P = 0.43$, $\hat{c} = 0.92$). The top model's Intercept ($P<0.01$) was statistically significant, but the coefficients for %CRP ($P=0.11$) and %Fallow ($P=0.69$) were not. The second most supported model included %CRP only as influencing *P. colchicus* occupancy, while the third to seventh most supported models also included %CRP with Veg Eve, %Ag, %Fallow and Edge Density in various additive combinations (see Table 46). The second to seventh most supported models' AIC_c deviated from the top model by less than two ($\Delta AIC_c < 2$) and were retained for developing a model averaged composite model (Table 47). The composite model included %CRP ($\beta = -1.33 \pm 0.96$, P=0.16), %Fallow ($\beta = 9.0e-4 \pm 3.3e-4$, P=0.79), %Ag ($\beta = 0.39 \pm 0.45$, P=0.38), Veg Eve ($\beta = 0.39 \pm 0.34$, P=0.24), and Edge Density ($\beta = 0.07 \pm 0.13$, P=0.59). All covariates did not differ by Month, suggesting low potential for confounding relationships between the detection and occupancy covariates (Table 27). No coefficient, including the Intercept, influenced the model enough to cause significant changes in predicted probabilities (P>0.05; Table 47). However, because %CRP had a relatively high effect size with the most degree of change in predicted probability (OR=0.38, P=0.11); it was the only covariate graphed to visualize its influence on predicted occupancy (Figure 32).

Canis latrans Models - The top model for *C. latrans* detection at sites was the null model (w = 0.24, K = 2, -2L = 221.56; Table 48), and it did not exhibit adequate model fit ($\chi^2 = 12.67$, $P = 0.03$, $\hat{c} = 2.33$); there was no general model in the candidate suite. Therefore, $QAIC_c$ values were used for model selection. The intercept was statistically significant (P=0.02; Table 49).

The top model for predicted occupancy of *C. latrans* at sites was also the null model (w = 0.13, K = 2, -2L = 221.56; Table 50), which did not exhibit adequate fit ($\chi^2 = 12.67$, $P = 0.03$, $\hat{c} = 2.33$). The Intercept (P=0.04) was statistically significant (Table 51). While other models' $QAIC_c$ differed by less than two ($\Delta QAIC<2$) and had comparable weighted values to the top model in both the detection and occupancy phases of modeling, model averaging was not used due to no single covariate being shown as benefitting the model over that of the null. Additive combinations of the top performing covariates (e.g., %Ag, %CRP, etc.) resulted in even poorer performing models, beyond the scope of consideration.

Taxidea taxus Models - The top model for *T. taxus* detection at sites only included Precipitation (β = -0.53 ± 0.21; *w* = 0.61, K = 3, -2L = 240.48; Tables 52-53). Both the top (χ^2 = 3.59, *P* = 0.66, ĉ = 0.70) and most general model (χ^2 = 0.52, *P* = 0.91, ĉ = 0.17) exhibited adequate model fit. The top model's Intercept was marginally significant (*P*=0.05), with the coefficient for Precipitation being statistically significant (*P*=0.01). The second most supported model included Precipitation and Precipitation Difference as covariates potentially influencing *T. taxus* detection. Because this model's AIC_c deviated from the top model by less than two (ΔAIC_c =1.93), model averaging techniques were used to develop a composite model (Table 53). The composite model included Precipitation (β = -0.57 ± 0.35, *P*=0.10) and Precipitation Difference (β = 0.05 ± 0.13, *P*=0.70), with neither suggested as significantly influencing probability of detection. Because Precipitation and Precipitation Difference had marginally high collinearity (r=0.76), this composite model carried less weight compared to others without potential confounding effects. The relative probability of *T. taxus* detection is predicted to decrease with increasing Precipitation (Figure 33).

The top model for *T. taxus* at sites included CRP IJI (β = -3.98 ± 1.94), %Bare (β = 1.91 ± 1.07), and %CRP (β = 1.91 ± 1.02; *w* = 0.43, K = 6, -2L = 217.97; Tables 54-55). The top (χ^2 = 4.16, *P* = 0.56, ĉ = 0.78) and most general model (χ^2 = 3.29, *P* = 0.76, ĉ = 0.55) exhibited adequate model fit. The top model's Intercept (*P*=0.03) and coefficient for CRP IJI (*P*=0.04) were both statistically significant. However, the coefficients for %CRP (*P*=0.07) and %Bare (*P*=0.06) were only moderately significant. The next three most supported models included some combination of %Bare, %CRP, %Ag and/or CRP IJI as covariates potentially influencing *T. taxus* detection (Table 54). Because the second, third and fourth most supported models deviated from the top model by less than three (ΔAIC_c = 2.16, 2.43 and 2.44, respectively) and had weighted values greater than 0.10 (*w*=0.15, 0.13 and 0.13, respectively), they were retained in developing a composite model (Table 55). The fifth most supported model deviated from the top model by less than three (ΔAIC_c = 2.94) and had a model weight of 0.10; however, because of abnormally large coefficients (>600) and indistinguishable standard errors (-1.#IND00), it was not used in model averaging. The composite model included %CRP (β = 0.39 ± 0.34, *P*=0.08), %Bare (β = 1.65 ± 0.98, *P*=0.09), %Grass (β = 1.58 ± 0.91, *P*=0.62), and %Ag (β = 0.17 ± 0.19, *P*=0.38), with only the Intercept (β = 3.88 ± 2.01, *P*=0.03) and CRP IJI (β = -4.10 ± 2.02, *P*=0.04) being statistically significant. The predicted probability of *T. taxus* occupancy is predicted to decrease with increasing CRP IJI (Figure 34) and %CRP (Figure 35), and increase with increasing %Bare (Figure 36); %Bare and %CRP were graphically assessed due to exhibiting moderate differences in predicted probability of occupancy.

Procyon lotor Models - The top model for *P. lotor* detection at sites included Guzzler (β = 1.36 ± 0.52; *w* = 0.66, K = 3, -2L = 188.66; Tables 56-57). The top model exhibited adequate model fit (χ^2 = 7.71, *P* = 0.18, $\hat{c}$ = 1.54); there was no most general model. The Intercept (*P*=0.01) and coefficient for Guzzler (*P*=0.01) were both statistically significant (Table 57). Probability of detection was predicted to be significantly higher at guzzler sites compared to non-guzzler sites (Figure 37).

The top model for *P. lotor* occupancy at sites included %Tree ($\beta = 3.84 \pm 2.86$) and Human Distance ($\beta = -0.77 \pm 0.41$) as being the most influential covariates (*w* = 0.35, K = 5, -2L = 174.24; Tables 58-59). The top ($\chi^2 = 7.80$, *P* = 0.14, ĉ = 1.52) and most general model both exhibited adequate model fit ($\chi^2 = 7.69$, *P* = 0.26, ĉ = 1.20). The top model's Intercept (*P*=0.49) and coefficient for %Tree (*P*=0.18) were not statistically significant, though the coefficient for Human Distance (*P*=0.06) was moderately significant (Table 59). The next three most supported models all included %Tree, with all but one having some combination of Human Distance and/or Woodland Distance as covariates potentially influencing *P. lotor* detection (see Table 56). Because the second, third and fourth most supported models' AIC_c deviated from the top model by less than three ($\Delta AIC_c = 0.67$, 2.10 and 2.20, respectively) and each had a weighted value greater than 0.10 (*w*=0.25, 0.12 and 0.12, respectively), model averaging techniques were used to develop a composite model (Table 59). The composite model included %Tree ($\beta = 5.39 \pm 3.69$, *P*=0.14), Human Distance ($\beta = -0.40 \pm 0.30$, *P*=0.16) and Woodland Distance ($\beta = -0.31 \pm 0.29$, *P*=0.24), with none reaching statistical significance regarding influence on predicted probability of occupancy. The probability of occupancy is predicted to increase with increasing %Tree, but only at levels greater than 4% are any differences observed (Figure 38). Probability of occupancy somewhat decreased with increasing Human Distance (Figure 39) and Woodland Distance (Figure 40); however, as evidenced by the wide 95% confidence intervals, the predicted differences were not significantly different.

Mephitis mephitis Models - The top model for *M. mephitis* detection at sites included Temperature Difference ($\beta = -0.71 \pm 0.35$) and Precipitation ($\beta = -0.77 \pm 0.40$;

w = 0.24, K = 4, -2L = 128.68; Tables 60-61). The top (χ^2 = 4.90, P = 0.45, ĉ = 0.96) and most general model (χ^2 = 4.47, P = 0.51, ĉ = 0.89) exhibited adequate model fit. The top model's Intercept (P=0.61) was not statistically significant; however, the coefficients for Temperature Difference was (P=0.04), while Precipitation (P=0.05) was marginally significant (Table 61). The second and third most supported models all included Precipitation Difference with the second adding Temperature Difference as influencing *M. mephitis* detection (see Table 60). Because these models' AIC_c deviated from the top model by less than two (ΔAIC_c = 0.28 and 1.63, respectively), model averaging techniques were used to develop a composite model using the top three models (Table 61). The fourth most supported model deviated from the top model by less than three (ΔAIC_c = 2.11), but its model weight was less than 0.10 (w = 0.08) so it was not used in model averaging. The composite model included Temperature Difference (β = -0.37 ± 0.25, P=0.14), Precipitation (β = -0.23 ± 0.20, P=0.25) and Precipitation Difference (β = -0.21 ± 0.17, P=0.79), though none were statistically significant. The probabilities of *M. mephitis* detection were predicted to decrease with increasing Temperature Difference (Figure 41) and Precipitation (Figure 42**).** Precipitation Difference was not graphed due to high statistical insignificance (P=0.79) combined with a low effect size (OR=0.81).

The top model for *M. mephitis* occupancy at sites included Woodland Distance (β = -1.59 ± 0.69) as being the most influential covariate (w = 0.39, K = 5, -2L = 118.85; Tables 62-63). The top (χ^2 = 4.66, P = 0.40, ĉ = 0.98) and most general model (χ^2 = 4.66, P = 0.49 ĉ = 0.90) exhibited adequate model fit. The top model's Intercept (P<0.01) and coefficient for Woodland Distance (P=0.02) were statistically significant (Table 63). Both the second and third most supported models included Woodland Distance, with the second adding Connectance, and the third adding Human Distance (see Table 62). Because the second and third most supported models' AIC_c deviated from the top model by less than two ($\Delta AIC_c = 0.81$ and 2.17, respectively), they were used to develop a composite model (Table 63). The fourth most supported model deviated from the top model by three ($\Delta AIC_c = 3.00$), but its model weight was less than 0.10 ($w = 0.09$) so it was not used in model averaging. The composite model included Woodland Distance ($\beta = -1.52 \pm 0.71$, P=0.03), Connectance ($\beta = -0.22 \pm 0.24$, P=0.34) and Human Distance ($\beta = -0.06 \pm 0.13$, P=0.65), but only Woodland Distance was statistically significant. The relative probabilities of occupancy for *M. mephitis* were predicted to decrease with increasing Woodland Distance, with increasing confidence passing 1,000 meters (Figure 43). Connectance and Human Distance were not graphed due to statistical insignificance and low effect size (0.81<OR>0.94).

Species Richness

The average Chao2 estimate for species richness was 13.37 for guzzler sites, and 12.05 for non-guzzler sites. The Welch's two sample t-test (Table 64) suggested that the difference in the Chao2 species richness estimator between guzzler and non-guzzler sites was not statistically significant (t = 0.75, df = 68.55, p-value = 0.46). I did not analyze subsets of species richness (carnivores, herbivore, avian, etc.) because the total species richness being similar between guzzler and non-guzzler site suggested little practical need to further assess for the purposes of this project's objectives.

DISCUSSION

Data from this project suggested that many species might use guzzlers, but few, if any, were likely to alter occupancy in response to them. Considering that this project was carried out over the course of drought (KSU 2014) and that the primary purpose of guzzlers is to provide water, the influence of guzzlers on species occupancy should have been stronger over the course of my project compared to non-drought years. Because the influence of guzzlers was not overly apparent when controlling for variations in detection, guzzlers probably play a minor role, if any at all, in the occupancy of target species across CRP in western Kansas. However, due to not evaluating demographics in conjunction with detection, my project was unable to assess the influence of guzzlers on local population abundances. Thus, I am unable to determine the effects of guzzlers on potentially augmenting local populations compared to populations in areas without guzzlers. As a result, I recommend future studies consider evaluating local population abundance by marking individuals in conjunction with a camera trap design in order to provide a more complete evaluation of the potential effects of guzzlers on wildlife ecology.

All target species were detected at least once at guzzlers (Table 2). With the exception of *P. lotor,* target species exhibited some degree of balance between detections at guzzler and non-guzzler sites (Table 3); however, both *P. lotor* and *P. colchicus* were detected significantly more often at guzzler cameras (Table 4). Nonetheless, guzzler presence did not best explain *P. colchicus* detection across cameras. Though guzzler presence was factored into the composite model, its odds ratio indicated only an insignificant 7% increase in the odds of *P. colchicus* detection at guzzler cameras

(OR=1.07, Table 26). Compare that to *P. lotor*, where guzzler presence indicated a significant 1,168% and 290% increase in odds of detection across cameras and sites, respectively (OR=12.68, Table 37; OR=3.90, Table 59). In addition to *P. lotor*, guzzler presence also best explained the detection of *C. latrans*, *T. taxus,* and *M. mephitis* across cameras; suggesting significant increases in odds of detection by 169%, 143%, and 348%, respectively (OR=2.69, Table 29; OR=2.43, Table 33; OR=4.48, Table 41).

While many target and non-target species were often observed drinking or seeking water from guzzlers (i.e., looking directly into trough), several species were commonly observed using guzzlers as a multifaceted resource. It was not uncommon for mule deer (*Odocoileus hemionus*), white-tailed deer (*Odocoileus virginianus*), mourning dove (*Zenaida macroura*), and/or *P. colchicus* to remain stationary underneath guzzlers for long periods of time. Most often this was during high temperatures (>32°C) where individuals were observed panting or gular fluttering. Dusting behavior by *Z. macroura* and *P. colchicus* also was observed in the loose, dry soil underneath and surrounding guzzlers. These observations suggest guzzlers serve as a resource for more than free-standing water, attracting some species more than others.

Because guzzlers might attract wildlife, guzzlers were first evaluated at the detection phase of modeling for cameras and sites. Strong evidence supporting guzzler influence on species occupancy would have been distance to water source performing well in the occupancy phase with guzzler presence being accounted for as influencing detection. Distance from water source at cameras did perform moderately well in the occupancy phase of *P. colchicus* while also accounting for guzzlers at the detection phase (Table 25). The odds ratio, however, suggested that a unit increase in distance from a water source (*s* = 431 m) only resulted in an insignificant 2% decrease in odds of *P. colchicus* occupancy (OR=1.02, Table 26). I expected that *P. colchicus* spatial affinity for water, if any, would have been most evident during this project given that it occurred over the course of two subsequent summer and spring seasons that averaged 25% and 40% less precipitation than the 1981-2010 average (KSU 2014). Assuming that the distance to water metrics were representative to that perceived by *P. colchicus*, data from this project suggested that guzzler sources of free-standing water have a minor but insignificant influence on *P. colchicus* summer CRP occupancy in western Kansas.

Month of survey performed best for explaining *P. colchicus* detection, thus, suggesting that the odds of detection in June were 767% (Table 24) and 887% (Table 45) higher compared to August for cameras and sites, respectively. June is typically the peak month in the *P. colchicus* nesting season, with July and August corresponding to the brood rearing season for most hens (KDWPT 2015, Runia 2011). Given that renesting attempts can occur throughout June (KDWPT 2015), it was possible that higher detections were in part due to displaying males that might be less active by early July. Alternatively, by July most hens that have successfully nested have moved their chicks to areas rich in forbs and appropriate cover (Runia 2011). Brood rearing hens have been observed as reducing their core home range, or area of frequent use (Kuck et al. 1970; Whiteside and Guthery 1983; Smith 1994; Smith et al. 1999), which might help explain reduced detections after June as hens constrict brood movements to optimal habitat. While reductions in core home range across nesting and brood rearing seasons was not observed in northwestern Kansas populations (Applegate et al. 2002), variations in *P.*

colchicus nesting and brooding core home ranges should still be considered in future research as it has the potential to identify *P. colchicus'* perceived optimal habitat.

Possibly, hen and chick mortality played a role in reduced detection of *P. colchicus* after June. In South Dakota, up to 33% of chicks die due to predation, extreme weather, and interactions with farm equipment during the July and August months (Runia 2011). Hens faced up to a 30% reduction in body mass by August, where hen survival has been shown to be occasionally lower than that in winter months (Runia 2011). Also being an agriculture-dominated landscape interspersed with grassland, Kansas' hens and chicks might face similar pressures. Additionally, emergency grazing operations were permitted during the month of July across all Kansas counties surveyed during the 2011 and 2012 seasons (USDA 2011c, 2012). While grazing operations might negatively affect ground nesting avian species due to nest trampling (Koerth et al. 1983), a reduction in vegetative cover (Beck and Mitchell 2000) and/or physical disturbance (Lupis et al. 2006), only 2 out of the 72 sites were surveyed during or following grazing operations. Whether due to roosters being less active, hens and chicks constricting their movements or experiencing high mortality, or some combination of, the exact nature of the observed differences in monthly detection cannot be answered from my project. My project does, however, recognize a potential shift in *P. colchicus* spatial ecology and/or survivorship between the nesting and brood rearing seasons in western Kansas. Post-hoc multiple state occupancy modeling techniques to signify between chick, hen, and rooster detections are recommended to determine whether detections were sex or age biased.

Phasianus colchicus are often associated with areas high in forbs throughout the summer season due to the availability of high quality food resources (seed and arthropods) and open understory that enables easier movement through the grassland (Doxon and Carroll 2008; Mankin et al. 2005; Riley 1999; Runia 2011). Areas rich in forbs have been shown to have significantly higher abundances of arthropods in Kansas (Hickman et al. 2006). *Phasianus colchicus* preference for areas rich in forbs was reflected across cameras in my project, where increasing percent aerial cover of forbs was positively associated with *P. colchicus* occupancy (Figure 22). Every unit increase in forb cover (s = 9.5%) increased the odds of *P. colchicus* occupancy by 85% (OR=1.85, P=0.06), suggesting *P. colchicus* occupancy was most associated with forb-rich habitats. Given certain CRP practices, increasing forb seed in seed mixes might function to increase *P. colchicus* occupancy.

In addition to favoring forb-rich habitats, *P. colchicus* is also considered an edge adapted species (Warner 1994) where management plans often recommend increasing certain types of edge (Fleming and Giuliano 1998; Riley 1999). *P. colchicus* occupancy was associated negatively with increasing distance from edge (Figure 21), suggesting a 43% decrease in odds of occupancy for every unit increase in distance from edge ($s \approx$ 98.5 m; OR=1.43, Table 26). Vegetation species evenness and edge density also factored into some of the top models at the site scale, increasing the odds of *P. colchicus* occupancy by 48% and 7% per unit increase ($s \approx$ 0.10 and $s \approx$ 6.44 m/ha), respectively (Table 47). Increased vegetation species evenness and edge might influence foraging opportunities, movement, and/or cover. While research examining the degree of this relationship is recommended, possibly the use of strip-disk fireguards might increase *P. colchicus* occupancy by influencing both vegetation diversity (related toe evenness) and edge (Rodgers 1999).

Previous studies have shown a positive relationship between *P. colchicus* occupancy and CRP area (Nielsen et al. 2006). Thus, it was unexpected to see *P. colchicus* occupancy, albeit insignificant, negatively associated with increasing CRP. Affinity of *P. colchicus* for edge, however, might help to explain this observation. Cameras placed in large patches of contiguous CRP were shown to be farther from edge than those placed in smaller patches ($t = 5.74$, $df=212$, $P \leq 0.001$); the same is true at sites with higher percent CRP in the landscape ($t=4.03$, $df=70$, $P \leq 0.001$). Therefore, the seemingly surprising inverse relationship between *P. colchicus* occupancy and increasing area of CRP might be an artifact of the biased sampling design with respect to edge.

Phasianus colchicus home range in high density CRP areas in northwestern Kansas has been reported as being half that of those in low density areas, further suggesting that CRP potentially met the resource requirements more efficiently than non-CRP areas (Applegate et al. 2002). However, that study classified an area with 25% CRP as being high density (Applegate et al. 2002), whereas my model implies a real drop in occupancy only around 38%, the observed average. To add, 79% of all sampled sites were less than 50% CRP, where predicted probability of occupancy ranged from 82% to 99%. Only two sites, both in Trego County, were below 10% CRP and one detected *P. colchicus*. Of the five sites greater than 70% CRP, only one in Gove County detected *P. colchicus*. Rather than saying *P. colchicus* occupancy is associated negatively with increased area of CRP, I think it is more prudent to suggest that there potentially existed a limit to increasing *P. colchicus* occupancy by increasing large tracts of CRP without also managing other factors (e.g., degree of edge).

One study recommended a minimum of 15 hectares (40 acres) of undisturbed grassland, such as CRP, for nesting *P. colchicus* (Clark et al. 1999). They further noted that *P. colchicus* showed the highest nest success in areas of greater than 65 hectares (160 acres). For my project, the median legally defined field size was 40.5 ha (100 ac); the median contiguous CRP was 85 ha (210 ac). This suggested that the average site surveyed met and possibly exceeded their recommended CRP patch sizes for nesting hens. Additionally, that project was able to assess the influence of CRP area on *P. colchicus* by identification of active nests, and evaluated the landscape at a 485 m radius from nests with a 4 x 4 m spatial resolution (Clark et al. 1999), whereas my project, however, used an 800 m radius from the center of CRP field sites, did not survey for *P. colchicus* nests, and lacked such a fine spatial resolution (400 x 400 m). As a result, my project lacked the capability to precisely define the landscape from a likely central location of nesting hens. Thus, by incorporating potentially large areas of land cover not in *P. colchicus* home range, likely my project inaccurately estimated the relationship of land cover type with *P. colchicus* occupancy.

Nonetheless, *Phasianus colchicus* occupancy was most explained by positive associations with fallow and agricultural percent land cover at sites. I expected that percent fallow field would be positively associated with *P. colchicus* occupancy as they are commonly observed in fallow fields in Kansas, where populations might even depend on weedy fallow fields (Rodgers 1983). However, the effect size of fallow field predicted no change in odds of occupancy based on fallow area (OR=1.00; Table 47). Given all of the threats from machinery and a reduction in arthropods diversity and abundance on agricultural lands (Doxon and Carroll 2008), it was a bit surprising to see percent agriculture positively associated with *P. colchicus* occupancy. The composite model suggested that the odds of occupancy insignificantly increased by 48% for each unit increase in agriculture ($s \approx 20.5\%$; P=0.38). However, this insignificance could be due to the sampling distribution of percent agriculture, which was heavily right-skewed with 62% of all sites being less than or equal to the average percent agriculture in the landscape (24.4%).

Conversion and intensification of agriculture has been shown to decrease abundance and diversity of soil macro-biota (Postma-Blaauw et al. 2010), arachnids (Hogg and Daane 2011) and carabids (Holland and Luff 2000), while CRP can provide necessary abundances of arthropod prey for grassland birds (McIntyre and Thompson 2003). Therefore, large percentages of agriculture might function to create ecological islands out of isolated CRP fields, possibly acting as a refuge, even if intermittently, for arthropods evading agricultural management practices. In such conditions, CRP would serve as resource rich areas for *P. colchicus* seeking arthropods and sufficient summer cover. If accurate, *P. colchicus* should be more easily detectable in smaller fields due to potentially higher use rates in a reduced spatial area. Seemingly contradictory to this, previous research has suggested that nest success of *P. colchicus* was highest in diverse agricultural landscapes (>50% of landscape) with large blocks of CRP (~25%), compared to areas dominated by monoculture agriculture (~70%) and only a few small blocks of CRP (~10%) (Clark et al. 1999). However, given that the average percent of agriculture and CRP in the landscape were 27% and 38%, respectively, most sites in my project would probably be closer to the former, ideal proportions of CRP and agriculture. Nevertheless, my project did not assess agricultural diversity or landscape configuration in modeling analysis, which might be critical for understanding the inter-relationship of agriculture and CRP on *P. colchicus* occupancy (Clark et al. 1999; Riley 1999).

Canis latrans occupancy was most associated with vegetation structural diversity across cameras, where a unit increase in the Shannon-Weiner diversity index ($s \approx 0.25$) resulted in a significant 65% increase in predicted occupancy (OR=1.65, P=0.05). The increased detection in structurally diverse patches within CRP fields could be attributed to cover and optimal foraging. *Canis latrans* is associated with habitats of increased vegetation cover, in part being due to concealment from humans (Kamler et al. 2005). Diversity, however, might function in optimal foraging by increasing the potential habitats for small mammals and arthropods. Small mammal abundances have been shown to be higher in more structurally heterogeneous environments in Kansas (Sietman et al. 1994), and while it is arguable that it might not be the primary factor (Schaffers et al. 2008), the positive association between structural diversity and arthropod diversity has been well established (Lawton et al. 1998; Wettstein and Schmid 1999; Morris 2000). Structurally diverse patches might work to provide both cover and optimal foraging habitat for *C. latrans* in the western Kansas landscape.

Taxidea taxus detection was best explained by decreasing precipitation and the presence of a guzzler. Every one unit decrease in precipitation (s = 20.8 mm) resulted in, on average, a 72% and 69% increase in the odds of detection at cameras and sites, respectively (OR= 0.58, Table 33; OR=0.59, Table 53). This relationship is most likely due to *T. taxus* not needing to visit guzzlers as drinking water would be more widely available elsewhere. Aside from the occasional dust bath, *T. taxus* rarely did anything more than quickly drink or check for water at guzzlers. Additionally, small mammal activity has been shown to increase during increased precipitation (Gentry et al. 1966; Vickery and Bider 1981). If accurate in western Kansas, precipitation might increase hunting opportunities for predators of small mammals, like *T. taxus*. Therefore, increased precipitation might not only reduce the need to visit guzzlers for access to water, but also work to focus small mammal predator activity to areas where hunting is optimal.

Taxidea taxus occupancy, however, was best explained by decreasing distance from edge, distance from human dwelling, and percent tree cover at the camera scale. At the site scale, interspersion and juxtaposition of CRP, percent CRP, and percent bare cover best explained *T. taxus* occupancy. Cameras analysis suggested that *T. taxus,* not surprisingly, tends to occupy patches near edge and human dwellings, while also avoiding areas with woody cover. Given the fossorial nature of *T. taxus*, necessary cover incorporates soil conditions suitable for digging, which would not favor woody cover. *Taxidea taxus* tended to occupy sites with lower percentages of CRP in the landscape and/or low interspersion and juxtaposition of CRP (i.e., clumped and biased in adjacency to other land cover type), while favoring sites with higher percentages of exposed soil. However, like with *P. colchicus*, the effect of percent CRP in the landscape could be the result of high collinearity with distance from edge. Data from my project suggested that *T. taxus* most occupied areas of low cover, near edge and human dwellings, and typically in poorly interspersed, or clustered, CRP. It is important to note, however, that low cover might be a result of decreased probabilities of detection in higher cover due to the short stature of *T. taxus*.

Proximity to human dwelling also best explained *P. lotor* occupancy. This is not surprising as generalists, *P. lotor* have adapted well to human-altered landscapes (Gehrt

2003, Prange et al. 2003, Beasley et al. 2011, Beasley and Rhodes 2012). In fact, some populations in Kansas have shown to be more reproductively successful in heavily human altered areas, offsetting any increased mortality as a result (Robel and Barnes 1990). *Procyon lotor* is known to use human dwelling as intermittent shelter and den sites in addition to natural ground dens and those in trees (Lotze and Anderson 1979). While percent tree cover was insignificantly associated with *P. lotor* occupancy at cameras (OR=1.28, *P*=0.57, Table 39), it was highly associated with occupancy across sites with a 4,553% increase in odds of occupancy (OR=46.53, *P*=0.18, Table 59). Although this relationship was statistically insignificant (*P*=0.18), the effect size should not be ignored, especially given that tree cavities are used as prime den sites for *P. lotor* and potential optimal foraging in wooded areas due to high quality hard mast being produced by *Quercus* spp., *Carya* spp. *and Fagus* spp. in the Fall (Robb et al. 1996, Chamberlain et al. 2007).

An affinity for tree cover and proximity to human dwelling also were observed in *M. mephitis.* Percent tree cover was associated positively with *M. mephitis* occupancy across cameras, with distance from woodland being the most influential covariate for occupancy across sites (Table 62). Distance from human dwelling suggested an insignificant 6% decrease in predicted probability of occupancy at sites (OR=0.94, Table 63), while distance from woodland suggested an 80% decrease in *M. mephitis* occupancy for every unit increase (s ≈ 581 m; OR=0.20, *P*=0.02). While statistically insignificant, the effect size suggested a 1,119% increase in odds of occupancy per unit increase in percent tree cover (s ≈ 2%) across cameras (OR=12.19, Table 43). Although *M. mephitis* are known to den in abandoned subterranean burrows, they will also use hollowed logs, areas below trees, as well as aboveground human structures for denning (Doty and Dowler 2006). Denning habitat and the potential for foraging of hard mast might explain *M. mephitis* association with tree cover.

Among remaining covariates at cameras and sites, only percent aerial cover of legumes at cameras resulted in significant differences in predicted probability of *M. mephitis* occupancy, suggesting a 523% increase in the odds of occupancy for every unit increase in legume aerial cover at cameras ($s \approx 4\%$; OR=6.23, Table 43). Legumes are known to not only be beneficial to mammalian and avian herbivores by supplying limited nitrogen, but they have also been shown to be positively associated with arthropod abundances (Caballero-López et al. 2010). Therefore, areas with higher legume cover could provide optimal foraging for omnivorous generalist species, like *M. mephitis*, selecting high quality plant matter in combination with preying upon arthropods, avian ground nests, and small mammals. Vegetation evenness was also in the top model for explaining *M. mephitis* occupancy at cameras, albeit only moderately influencing predicted occupancy probabilities (P=0.09). The odds of *M. mephitis* occupancy increased by 112% for every unit increase in vegetation species evenness ($s \approx 0.10$; OR=2.12, Table 43). While *M. mephitis* is a well-known generalist species, occupancy toward high vegetation evenness and percent legume warrants further research in potential optimal foraging strategies of *M. mephitis*.

Again, data from this project suggested that while guzzlers will be used by a diversity of species when present, they probably do not influence occupancy, or species richness (P=0.46, Table 64), across the western Kansas landscape. Of all upland game species, only *P. colchicus* was detected frequently enough to evaluate occupancy, which might have a weak association, if any, with water during times of drought, which is probably only within already occupied sites that have been selected based on other factors. *Phasianus colchicus* did not occupy guzzler sites more than non-guzzler sites, or show any spatial bias regarding proximity to guzzlers or any other potential water source across CRP sites in western Kansas. Edge, percent aerial cover of forbs, and land cover type seemed to be the most influential habitat features for explaining *P. colchicus* occupancy.

Regarding mesocarnivores, all were detected more at guzzler cameras than non-guzzler cameras, but only *P. lotor* was detected more often at guzzler sites as well. However, the presence of a guzzler was not among the most influential habitat features regarding occupancy for any mesocarnivore species. This suggested that while many mesocarnivores will use guzzlers, the influence of guzzlers on mesocarnivore spatial distributions across the landscape is probably low. Species like *P. lotor*, however, probably use guzzlers more frequently than other species due to an affinity for water when present (Robb et al. 1996, Chamberlain et al. 2007). While future research is needed, this affinity for water does not mean that *P. lotor* alters its spatial distribution in response to guzzlers. However, t *P. lotor* will heavily use guzzlers when present. Habitat features that best explained mesocarnivore occupancies included distance from edge, human dwelling, and/or woodland, as well as vegetation structural diversity, percent aerial cover (i.e., tree, legume, bare and forb), and land cover metrics (i.e., %CRP, and CRP IJI).

MANAGEMENT IMPLICATIONS

Given that many wildlife species use guzzlers, especially economically valuable games species, their continual usage in the landscape might be justified. However, it is important to remember that the exact effect of guzzlers on local populations of both mesocarnivores and *P. colchicus* is still unknown. While it might seem innocuous to assume that guzzlers are at best augmenting wildlife populations during drought and intense heat, at worst they have the potential to increase local predation on upland game species or act as a reservoir for disease. Based on my project, guzzlers were unlikely to recruit local predator populations across western Kansas, but I am unable to address their role in spreading disease. Given that guzzler presence did increase the detection of mesocarnivores, however, it is reasonable to presume that increased visitation would increase the chances of random predator-prey encounters.

To reduce the potential to be visited by mesocarnivores, I recommend the installation of guzzlers as far away as possible from human dwellings and tree cover to decrease the potential for visitation by *P. lotor* and *M. mephitis*. Even though *P. colchicus* is associated with forbs and edge, consider that potential predators share a similar propensity. It might be prudent to not place guzzlers in optimal *P. colchicus* nesting and brooding habitat in order to reduce chance encounters. At guzzlers, vegetation structure should be considered in an attempt to provide adequate cover for concealment while also providing open areas for spotting predators and reducing ambush events. I suggest that vegetation around guzzlers should have low forb aerial cover in order to dissuade *P. colchicus* from foraging near guzzlers, and be structurally diverse to balance cover, escape, and vigilance. While structurally diverse areas might promote *C.*

latrans occupancy, a potential predator to *P. colchicus*, the occurrence of *C. latrans* might actually function to suppress smaller, more efficient nest predators such as *Vulpes* spp. and *P. lotor*.

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Table 1. Similarity table for all surveyed CRP field sites. Selection data included percent soil similarity, distance (km) to nearest other water source (NOWS), water source type, and legally defined acreage. Soil similarity is based on the SSURGO GIS data by using proportion of unique soil identifiers for each CRP field site; unique identifiers include slope as well as soil type

Paired Sites	Soil Similarity	NOWS (Guzzler / Non-Guzzler)	NOWS Type (Guzzler / Non-Guzzler)	Acreage (Guzzler / Non-Guzzler)
B01 - B01P	0.67	0.4 / 0.6	Pond / Reservoir	150 / 167
B02 - B02P	0.87	0.6 / 0.7	Pond	18 / 17
B03 - B03P	0.83	0.5 / 1.3	Creek / Reservoir	80 / 61
B05 - B05P	0.88	0.3 / 0.4	Creek / Pond	58 /75
B06 - B06P	0.75	0.6 / 0.4	Reservoir / Pond	156 / 63
B07 - B07P	0.74	1.2 / 0.8	Pond	140 / 83
B09 - B09P	0.83	2.0 / 0.8	Pond	80 / 62
E03 - E03P	1.00	0.5 / 0.6	Pond	150 / 150
G27 - G27P	0.85	1.3 / 1.3	Pond / Reservoir	160 / 150
G28 - G28P	0.71	0.9 / 1.2	Reservoir	145 / 161
G03 - G30P	0.79	0.9 / 0.8	Pond / Creek	159 / 300
G31 - G31P	0.71	1.2 / 0.5	Creek / Pond	80 / 118
G41 - G41P	0.69	1.0 / 0.5	Stocktank / Reservoir	100 / 110
G49 - G49P	0.61	1.8 / 1.2	Pond	10 / 14
G53 - G53P	0.74	1.2 / 1.4	Pond	37 / 30
G64 - G64P	0.79	1.4 / 1.0	Pond	185 / 215
G71 - G71P	0.89	0.4 / 0.5	Stream	300 / 300
G76 - G76P	0.95	0.9 / 1.6	Creek / Stocktank	65 / 100
G78 - G78P	0.38	0.7 / 0.9	Reservoir	75 / 245

Table 1 (Cont.). Similarity table for all surveyed CRP field sites. Selection data included percent soil similarity, distance (km) to nearest other water source (NOWS), water source type, and legally defined acreage. Soil similarity is based on the SSURGO GIS data by using proportion of unique soil identifiers for each CRP field site; unique identifiers include slope as well as soil type

Paired Sites	Soil Similarity	NOWS (Guzzler / Non-Guzzler)	NOWS Type (Guzzler / Non-Guzzler)	Acreage (Guzzler / Non-Guzzler)
L01 - L01P	0.89	125 / 240	Creek / Pond	125 / 210
L02 - L02P	0.72	1.4 / 1.2	Stocktank	80 / 166
L03 - L03P	0.94	1.59 / 1.64	Pond / Creek	65 / 135
L04 - L04P	0.58	1.3 / 0.99	Stocktank / Creek	28 / 10
R01 - R01P	0.46	0.76 / 0.75	Pond	80 / 80
R02 - R02P	0.84	1.65 / 1.38	Creek	160 / 135
R03 - R03P	0.88	0.58 / 0.41	Stocktank / Pond	40 / 60
R04 - R04P	0.90	0.65 / 0.77	Pond	160 / 80
R05 - R05P	0.82	0.97 / 0.94	Pond	40 / 30
T02 - T02P	0.86	1.0 / 0.9	Creek / Reservoir	32 / 35
T03 - T03P	0.85	0.41 / 0.60	Stocktank / Pond	55 / 30
T05 -T05P	0.74	1.47 / 0.69	Pond	160 / 65
T07 - T07P	0.91	1.7 / 0.7	Creek / Pond	40 / 66
T13 - T13P	1.00	0.60 / 0.63	Pond	300 / 300
T17 - T17P	0.95	1.34 / 1.15	Creek / Pond	154 / 270
T18 - T18P	0.50	0.5 / 1.4	Stocktank / Reservoir	75 / 47
T21 - T21P	0.72	0.7 / 0.9	Reservoir	300 / 151

Table 2. National Oceanic and Atmospheric Administration weather stations used for acquiring climate data during the 2011 and 2012 seasons (June – August). Some sites were represented by multiple weather stations; data from all stations were averaged.

Weather Station ID	CRP Field Site
Cedar Bluff Dam	T13, T13P, T21, T18P, T21P, T03P
Great Bend River 1S	B05P , B06, B06P, B07, B07P, R04, R04P
Hays 1S	E03, E03P
Healy KS US	G27, G27P, G28, G28P, G30P, G31, G64, G64P, G71, G71P, G76,
Larned 2	B02, B02P, B09, B09P
Ness City	T17, T17P
Oakley 19 SSW	L02, L02P, L03P, L04, L04P, G78, G78P, L01P, L01, G27P, G53, G53P, G76P, G30
Quinter KS US	G28P, G30P, G31, G31P, G41, G41P, G49, G49P, T17, T17P, T18
Russell 7E	R04, R04P, B05P, B06 , B06P
Russell Muni AP	B01, B01P, B02, B02P, B03P, B03, B05, B05P, B06, B06P, R01, R01P, R02, R02P, R03, R03P, R04, R04P, R05, R05P
Wakeeney	T02, T02P, T03, T05, T05P, T07, T07P, T18
Wallace	L03, L03P, L04

Table 3. Target species detection histories at cameras (n=215) and sites (n=72). Sites are the combined detections by all cameras (3) simultaneously placed within a legally define CRP field site during the 2011 and 2012 seasons (June – August). Detection histories are partitioned into total detections (total pictures) and modelable detections (survey presence/absence). Because there was a maximum of three surveys per site, maximum modelable detection was 3 per site. While the total number of surveys was equal between guzzler and non-guzzler sites (n=108, or 3 surveys per site), there were 2 surveys for non-guzzler cameras to every 1 for guzzler cameras (n_{guzzler} = 216, $n_{\text{non-guzzler}}$ = 419).

	Modelable Detections					
	Sites			Cameras		
Species	Guzzler	Non-Guzzler	Total	Guzzler	Non-Guzzler	Total
*Phasianus colchicus**	43	34	77	24	81	105
Tympanuchus spp.	1	4	5	1	4	5
Colinus virginianus	2	3	5	2	3	5
*Canis latrans**	26	21	47	16	37	53
*Procyon lotor**	30	12	42	33	13	46
*Taxidea taxus**	28	30	58	19	48	67
*Mephitis mephitis**	14	9	23	10	15	25
Vulpes spp.	3	3	6	3	3	6
Lynx rufus	5	2	7	5	2	7
Didelphis virginiana	5	3	8	3	7	10

* Retained for modeling (≥ 20 detections)

Table 4. Pearson's Chi-squared test of target species' modelable detections at guzzler and non-guzzler sites and cameras. Detection data were acquired from western Kansas counties during the 2011 and 2012 seasons (June - August). Camera treats each camera as the sampling unit, whereas Site aggregates all cameras (3) per legally defined CRP field.

	Site			Camera		
Species	χ^2	df	P	χ^2	df	P
Phasianus colchicus	1.05	1	0.31	5.19	1	0.02
Canis latrans	0.53	1	0.47	0.24	1	0.63
Procyon lotor	7.45	1	0.01	30.55	1	<0.001
Taxidea taxus	0.07	1	0.79	0.74	1	0.39
Mephitis mephitis	1.09	1	0.30	0.5	1	0.48

Table 5. Pearson's Chi-squared test of target species site detections across 1971-2000 Kansas Department of Agriculture defined precipitation gradient classes in study area. Site detection represents the first identifiable detection of species at a site. Therefore, repeat detections at a site were not considered, and the maximum number of detections per site was 1. The Chi-square test suggested striped skunk (*Mephitis mephitis*) and American badger (*Taxidea* taxus) were detected differently across precipitation gradients ($P<0.01$).

Species	Site Detections	Precipitation (45-53 cm)	Precipitation (53-61 cm)	Precipitation (61-69 cm)	χ^2	df	*P*
Phasianus colchicus	64	20	20	24	0.71	2	0.70
Canis latrans	42	15	16	11	1.24	2	0.54
Procyon lotor	34	9	16	9	3.42	2	0.18
Taxidea taxus	56	9	25	22	10.46	2	<0.01
Mephitis mephitis	22	5	3	14	10.43	2	<0.01

Table 6. Pearson's Chi-squared and Fisher's Exact tests of target species guzzler site detections across 1971-2000 Kansas Department of Agriculture defined precipitation gradient classes in study area. Guzzler site detection represents the first identifiable detection of species at site having guzzlers. Therefore, repeat detections at a site were not considered, and the maximum number of detections per site was 1. The Chi-squared and Fisher's Exact tests suggested striped skunk (*Mephitis mephitis*) and American badger (*Taxidea* taxus) were detected differently across precipitation gradients (*P*<0.01), respectively.

Species	Guzzle Site Detections	Precipitation (45-53 cm)	Precipitation (53-61 cm)	Precipitation (61-69 cm)	χ^2	df	*P*
Phasianus colchicus	33	11	10	12	0.26	2	0.88
Canis latrans	25	11	9	5	2.91	2	0.23
*Procyon lotor**	22	4	11	7	4.22	2	0.12
*Taxidea taxus**	27	3	12	12	8.00	2	0.02
*Mephitis mephitis**	12	1	3	8	-	-	0.04

*Fisher's Exact Test for Count Data was used instead of Pearson's Chi-squared Test due to expected values being less than 5 in each category.

Table 7. Multicollinearity matrix for all survey specific variables, or those potentially influencing detection between surveys during the 2011 and 2012 seasons (June – August). All data were taken from site level analysis only. No pair of variables had a Pearson's correlation coefficient (r) greater than 0.80; all were retained for modeling.

	Previous Precipitation	Precipitation	Precipitation Difference	Temperature	Temperature Difference	Temperature Variance
Previous Precipitation	1	-	-	-	-	-
Precipitation	-0.003	1	-	-	-	-
Precipitation Difference	-0.61	0.76	1	-	-	-
Temperature	-0.14	-0.32	-0.20	1	-	-
Temperature Difference	-0.08	-0.16	-0.11	0.55	1	-
Temperature Variance	-0.13	-0.27	-0.15	0.28	0.40	1

Table 8. Friedman Rank Sum test of significance for survey-specific meteorological variables across weekly surveys (n=3) during the 2011 and 2012 seasons (June – August). Data were taken from site level analysis only. Except for Temperature Variance, which exhibited moderate differences, all variables exhibited significant differences across weekly surveys ($P<0.05$); all were retained for use in modeling.

Detection Covariate	Weekly Survey		
	X^2	df	*P*
Previous Precipitation	11.73	2	0.003
Precipitation	9.36	2	0.01
Precipitation Difference	25.53	2	<0.001
Temperature	11.58	2	0.003
Temperature Difference	10.33	2	0.006
Temperature Variance	5.36	2	0.07

Table 9. Kruskal-Wallis test of significance for all survey-specific meteorological variables across month of survey (June, July, and August) during 2011 and 2012. Data were taken from site level analysis only. Only Precipitation Difference did not exhibit any reasonable difference between month of survey (*P*=0.86).

Detection Covariate	Survey Season		
	χ^2	df	*P*
Previous Precipitation	5.71	2	0.06
Precipitation	7.99	2	0.02
Precipitation Difference	0.30	2	0.86
Temperature	80.39	2	< 0.001
Temperature Difference	21.21	2	< 0.001
Temperature Variance	23.59	2	< 0.001

Table 10. Multiple comparison test after Kruskal-Wallis test of Temperature across monthly survey seasons (June – August) in 2011 and 2012. All observed values were compared at α = 0.05, where TRUE indicates a difference between months, and FALSE indicates no difference.

Survey Season	June	July	August
June	-		
July	TRUE Crit. Diff.: 25.02 Obs. Diff.: 32.36	-	
August	TRUE Crit. Diff.: 25.50 Obs. Diff.: 58.37	TRUE Crit. Diff.: 24.45 Obs. Diff.: 90.73	-

Table 11. Multiple comparison test after Kruskal-Wallis test of Temperature Difference across monthly survey seasons (June – August) in 2011 and 2012. All observed values were compared at $\alpha = 0.05$, where TRUE indicates a difference between months, and FALSE indicates no difference.

Survey Season	June	July	August
June	-		
July	TRUE Crit. Diff.: 25.02 Obs. Diff.: 25.38	-	
August	TRUE Crit. Diff.: 25.50 Obs. Diff.: 51.74	TRUE Crit. Diff.: 24.45 Obs. Diff.: 26.36	-

Table 12. Multiple comparison test after Kruskal-Wallis test of Temperature Variance across monthly survey seasons (June – August) in 2011 and 2012. All observed values were compared at α = 0.05, where True indicates a difference between months, and False indicates no difference.

Survey Season	June	July	August
June	-		
July	False Crit. Diff.: 25.02 Obs. Diff.: 12.00	-	
August	True Crit. Diff.: 25.50 Obs. Diff.: 33.76	True Crit. Diff.: 24.45 Obs. Diff.: 45.76	-

Table 13. Multiple comparison test after Kruskal-Wallis test of Precipitation across monthly survey seasons (June – August) in 2011 and 2012. All observed values were compared at α = 0.05, where TRUE indicates a difference between months, and FALSE indicates no difference.

Survey Season	June	July	August
June	-		
July	FALSE Crit. Diff.: 25.02 Obs. Diff.: 24.74	-	
August	FALSE Crit. Diff.: 25.50 Obs. Diff.: 5.29	FALSE Crit. Diff.: 24.45 Obs. Diff.: 19.44	-

Table 14. Correlation matrix for covariates used in modeling site occupancy over the 2011 and 2012 seasons (June – August). Distance from edge was not used at this level of analysis and therefore not included in the matrix. Because Veg Diversity and Veg Evenness had a correlation coefficient of 0.8, Veg Diversity was not used in modeling. See Appendix C for covariate definitions.

	VOR	VOR Diversity	VOR Evenness	% Grass	% Forb	% Bare Ground	% Legume	% Litter	%Tree
VOR	1	-	-	-	-	-	-	-	-
Veg Structure Diversity	0.74	1	-	-	-	-	-	-	-
Veg Structure Evenness	0.51	0.64	1	-	-	-	-	-	-
% Grass	0.17	-0.01	-0.12	1	-	-	-	-	-
% Forb	0.35	0.38	0.28	-0.30	1	-	-	-	-
% Bare Ground	-0.39	-0.20	-0.01	-0.40	-0.09	1	-	-	-
% Legume	0.03	-0.02	-0.03	0.08	0.45	-0.24	1	-	-
% Litter	0.08	-0.01	0.07	-0.11	-0.20	-0.13	-0.13	1	-
%Tree	0.27	0.31	0.26	-0.43	0.36	0.20	-0.10	-0.21	1

Table 14 (Cont.). Correlation matrix for covariates used in modeling site occupancy over the 2011 and 2012 seasons (June – August). Distance from edge was not used at this level of analysis and therefore not included in the matrix. Because Veg Diversity and Veg Evenness had a correlation coefficient of 0.8, Veg Diversity was not used in modeling. See Appendix C for covariate definitions.

	VOR	Veg Structure Diversity	Veg Structure Evenness	% Grass	% Forb	% Bare Ground	% Legume	% Litter	%Tree
Veg Evenness	0.30	0.27	0.36	-0.22	0.37	0.05	0.20	-0.01	0.23
Distance to Woodland	-0.27	-0.20	-0.11	-0.06	-0.06	0.08	-0.14	0.08	-0.18
Distance to Human Dwelling	-0.07	-0.09	-0.01	0.15	-0.02	-0.14	0.02	0.09	-0.16
Distance to NOWS	-0.03	0.06	-0.04	-0.19	-0.02	0.06	-0.22	0.08	0.19
CRP Age	0.10	0.01	-0.17	0.05	-0.24	-0.14	0.04	0.15	0.06
Contiguous CRP Acreage	-0.07	0.004	-0.03	-0.05	0.06	0.04	-0.08	0.01	-0.08
Veg Diversity	0.25	0.34	0.33	-0.20	0.46	-0.08	0.36	-0.01	0.11

Table 14 (Cont.). Correlation matrix for covariates used in modeling site occupancy over the 2011 and 2012 seasons (June – August). Distance from edge was not used at this level of analysis and therefore not included in the matrix. Because Veg Diversity and Veg Evenness had a correlation coefficient of 0.8, Veg Diversity was not used in modeling. See Appendix C for covariate definitions.

	Veg Diversity	Veg Evenness	Distance to Human Dwelling	Distance to Woodland	Distance to NOWS	CRP Age
Veg Diversity	1	-	-	-	-	-
Veg Evenness	0.84	1	-	-	-	-
Distance to Human Dwelling	-0.58	-0.48	1	-	-	-
Distance to Woodland	-0.46	-0.43	0.64	1	-	-
Distance to NOWS	-0.36	-0.31	0.39	0.47	1	-
CRP Age	0.04	0.22	-0.06	-0.10	-0.20	1
Contiguous CRP	0.003	-0.07	0.19	0.21	0.24	-0.28

Table 15. Correlation matrix for covariates used in modeling camera occupancy over the 2011 and 2012 seasons (June – August). Because Veg Diversity and Veg Evenness had a correlation coefficient of 0.81, Veg Diversity was not used in modeling. See Appendix C for covariate definitions.

	VOR	VOR Diversity	VOR Evenness	% Grass	% Forb	% Bare Ground	% Legume	% Litter	%Tree
VOR	1	-	-	-	-	-	-	-	-
Veg Structure Diversity	0.65	1	-	-	-	-	-	-	-
Veg Structure Evenness	0.29	0.54	1	-	-	-	-	-	-
% Grass	0.17	-0.07	-0.02	1	-	-	-	-	-
% Forb	0.30	0.32	0.19	-0.42	1	-	-	-	-
% Bare Ground	-0.03	-0.15	-0.07	-0.64	-0.03	1	-	-	-
% Legume	-0.42	0.01	0.05	-0.02	0.39	-0.15	1	-	-
% Litter	0.16	0.04	-0.02	0.05	-0.14	-0.38	0.003	1	-
%Tree	0.22	-0.05	0.09	-0.31	0.17	0.16	0.006	-0.14	1
Veg Diversity	0.12	0.16	0.04	0.06	0.23	-0.12	0.22	0.01	-0.05

Table 15 (Cont.). Correlation matrix for covariates used in modeling camera occupancy over the 2011 and 2012 seasons (June – August). Because Veg Diversity and Veg Evenness had a correlation coefficient of 0.81, Veg Diversity was not used in modeling. See Appendix C for covariate definitions.

	VOR	Veg Structure Diversity	Veg Structure Evenness	% Grass	% Forb	% Bare Ground	% Legume	% Litter	%Tree
Veg Evenness	0.15	0.13	0.08	0.02	0.12	-0.02	0.12	-0.04	0.09
Distance to Woodland	-0.16	0.01	0.08	-0.06	-0.04	0.12	-0.07	0.06	-0.12
Distance to Human Dwelling	-0.05	0.02	-0.002	0.06	0.003	-0.06	0.01	0.07	-0.09
Distance to NOWS	-0.05	0.13	0.05	-0.20	-0.01	0.11	-0.13	0.06	0.11
Distance to Water	-0.05	-0.05	0.06	0.10	-.0.18	-0.03	-0.09	0.02	0.03
Distance to Edge	-0.10	-0.09	0.01	0.03	-0.08	-0.07	-0.13	0.17	-0.12
CRP Age	0.07	-0.06	-0.15	0.04	-0.17	-0.08	0.03	0.12	0.03
Contiguous CRP Acreage	0.02	0.03	0.01	0.08	-0.11	-0.05	-0.07	0.05	-0.06

Table 15 (Cont.). Correlation matrix for covariates used in modeling camera occupancy over the 2011 and 2012 seasons (June – August). Because Veg Diversity and Veg Evenness had a correlation coefficient of 0.81, Veg Diversity was not used in modeling. See Appendix C for covariate definitions.

	Veg Diversity	Veg Evenness	Human Distance	Woodland Distance	NOWS	Distance to Water	Distance to Edge	CRP Age	Contig. CRP
Veg Diversity	1	-	-	-	-	-	-	-	-
Veg Evenness	0.81	1	-	-	-	-	-	-	-
Distance to Human Dwelling	-0.37	-0.28	1	-	-	-	-	-	-
Distance to Woodland	-0.30	-0.27	0.64	1	-	-	-	-	-
Distance to NOWS	-0.29	-0.18	0.40	0.47	1	-	-	-	-
Distance to Water	-0.08	0.02	0.06	0.06	0.26	1	-	-	-
Distance to Edge	-0.10	-0.13	0.30	0.34	0.20	0.11	1	-	-
CRP Age	-0.04	0.05	-0.07	-0.10	-0.20	0.01	-0.12	1	-
Contiguous CRP	-0.10	0.000	0.38	0.32	0.29	0.15	0.37	-0.06	1

Table 16. Welch's two sample t-test for all continuous occupancy covariates across guzzler and non-guzzler sites during the 2011 and 2012 seasons (June – August). Data was taken from site level analysis only. Only Veg Evenness exhibited moderate differences (*P*=0.06) between guzzler and non-guzzler sites.

Occupancy Covariate	t	df	*P*
VOR	-0.746	68.19	0.46
VOR Diversity	-0.736	69.92	0.46
V OR Evenness	-0.761	69.93	0.45
% Grass	1.367	61.15	0.18
% Forb	-0.519	67.43	0.61
% Bare Ground	-1.417	59.16	0.16
% Legume	0.622	69.18	0.54
% Litter	0.323	69.99	0.75
Veg Diversity	1.363	68.76	0.18
Veg Evenness	1.919	67.05	0.06
Distance to Woodland	-0.810	58.10	0.42
Distance to Human Dwelling	-0.909	64.51	0.37
Distance to NOWS	-1.559	68.61	0.13
CRP Age	0.900	69.75	0.97
Contiguous CRP Acreage	-0.841	66.35	0.40
CRP Acre	0.322	69.75	0.75

Table 17. Welch's two sample t-test for all continuous occupancy covariates across guzzler and non-guzzler cameras during the 2011 and 2012 seasons (June – August). Data was taken from camera level analysis only. Only Distance to Water exhibited significant differences (*P*<0.001) between guzzler and non-guzzler sites.

Occupancy Covariate	T	df	*P*
VOR	0.635	49.66	0.53
VOR Diversity	0.571	49.97	0.57
VOR Evenness	0.870	48.98	0.39
% Grass	0.572	52.64	0.57
% Forb	0.464	55.76	0.64
% Bare Ground	-0.950	46.55	0.35
% Legume	1.416	91.19	0.16
% Litter	0.612	48.79	0.54
Veg Diversity	1.15	48.59	0.26
Veg Evenness	1.037	47.40	0.31
Distance to Woodland	-0.450	45.15	0.65
Distance to Edge	-1.407	45.99	0.17
Distance to Human Dwelling	-0.468	45.37	0.64
Distance to Water	15.833	210.26	< 0.001
Distance to NOWS	-1.193	47.96	0.24
CRP Age	0.880	48.83	0.38
Contiguous CRP Acreage	-0.699	56.10	0.49
CRP Acre	0.232	50.62	0.82

Table 18. Multicollinearity matrix for all 0.8 km radius Fragstats landscape covariates used in modeling species' occupancy during the 2011 and 2012 seasons (June – August). NP refers to the number of patches of land cover, % is the percent area of the land cover in the landscape, and IJI is the interspersion and juxtaposition index. For full definitions see Appendix E. Edge Density exhibited high collinearity with NP (r=0.94) and was removed from modeling.

	NP Landscape	Landscape Connectedness	Landscape Diversity	Landscape IJI	NP CRP	% CRP
NP - Landscape	1	-	-	-	-	-
Landscape Connectedness	0.15	1	-	-	-	-
Landscape Diversity	0.57	0.01	1	-	-	-
Landscape IJI	0.13	-0.03	0.37	1	-	-
NP CRP	0.57	0.02	0.11	-0.19	1	-
% CRP	-0.18	<0.001	-0.36	-0.13	-0.13	1
CRP IJI	-0.06	-0.02	0.29	0.56	-0.24	0.03
NP Ag.	0.53	-0.08	0.42	0.27	0.05	-0.03
Edge Density	0.90	0.20	0.69	0.09	0.50	-0.45
% Ag.	-0.14	-0.06	-0.09	<0.001	-0.10	-0.03
% Pasture	0.02	-0.01	-0.03	0.06	0.21	-0.05
% Fallow	0.01	0.02	0.20	0.12	0.02	-0.05
% Other	-0.10	-0.04	-0.05	0.08	-0.04	0.03

Table 18 (Cont.). Multicollinearity matrix for all 0.8 km radius Fragstats landscape covariates used in modeling species' occupancy during the 2011 and 2012 seasons (June – August). NP refers to the number of patches of land cover, % is the percent area of the land cover in the landscape, and IJI is the interspersion and juxtaposition index. For full definitions see Appendix E. Edge Density exhibited high collinearity with NP (r=0.94) and was removed from modeling.

	CRP IJI	Edge Density	NP Ag.	% Ag.	% Pasture	% Fallow
CRP IJI	1		-	-	-	-
Edge Density	-0.12	1				
NP Ag.	0.09	0.45	1	-	-	-
% Ag.	-0.40	0.01	0.19	1	-	-
% Pasture	-0.03	0.07	-0.27	-0.38	1	-
% Fallow	0.21	0.06	0.08	-0.05	-0.36	1
% Other	-0.02	-0.09	-0.14	0.03	-0.002	-0.22

Table 19. Multicollinearity matrix for all 3.0 km radius Fragstats landscape covariates used in modeling species' occupancy during the 2011 and 2012 seasons (June – August). NP refers to the number of patches of land cover, % is the percent area of the land cover in the landscape, and IJI is the interspersion and juxtaposition index. For full definitions see Appendix E. Edge Density exhibited high collinearity with NP (r=0.94) and was removed from modeling.

	NP - Landscape	Landscape Diversity	Landscape IJI	NP CRP	% CRP	CRP IJI
NP - Landscape	1	-	-	-	-	
Landscape Diversity	0.40	1	-	-	-	
Landscape IJI	0.008	0.53	1	-	-	
NP CRP	0.78	0.28	0.11	-1	-	
% CRP	-0.05	0.36	0.38	0.15	-1	
CRP IJI	0.08	0.64	0.81	0.09	0.32	1
Edge Density	0.94	0.48	-0.08	0.69	-0.07	0.07
NP Ag.	0.78	0.38	0.11	0.48	0.48	0.17
% Ag.	0.26	0.12	-0.25	-0.01	-0.55	-0.10
% Pasture	-0.38	-0.53	-0.06	-0.16	0.02	-0.21
% Fallow	0.28	0.43	0.12	0.12	-0.31	0.25
% Other	0.26	0.19	0.34	0.17	0.30	0.20

Table 19 (Cont.). Multicollinearity matrix for all 3.0 km radius Fragstats landscape covariates used in modeling species' occupancy during the 2011 and 2012 seasons (June – August). NP refers to the number of patches of land cover, % is the percent area of the land cover in the landscape, and IJI is the interspersion and juxtaposition index. For full definitions see Appendix E. Edge Density exhibited high collinearity with NP (r=0.94) and was removed from modeling.

	Edge Density	NP Ag.	% Ag.	% Pasture	% Fallow
Edge Density	1				
NP Ag.	0.74	1	-	-	-
% Ag.	0.35	0.01	1	-	-
% Pasture	-0.48	-0.13	-0.77	1	-
% Fallow	0.38	0.16	0.42	-0.63	1
% Other	0.15	0.17	-0.16	-0.08	-0.13

Table 20. Welch's two sample t-test for all 0.8 km radius Fragstats metrics across guzzler and non-guzzler sites during the 2011 and 2012 season (June – August). All covariates were retained for modeling species' site occupancy.

Fragstats Occupancy Covariate	T	df	*P*
NP - Landscape	1.073	69.75	0.29
Landscape Connectedness	0.914	69.48	0.36
Landscape Diversity	-0.052	69.86	0.96
Landscape IJI	-0.074	68.85	0.94
NP CRP	1.866	55.85	0.07
% CRP	0.192	69.80	0.85
CRP IJI	-0.370	69.81	0.71
NP Ag.	0.000	68.617	1.00
% Ag.	-0.666	69.99	0.51
% Pasture	1.262	68.92	0.21
% Fallow	-0.293	68.86	0.77
% Other	1.128	61.83	0.26

Table 21. Welch's two sample t-test for all 3.0 km radius Fragstats metrics across guzzler and non-guzzler sites during the 2011 and 2012 season (June – August). All covariates were retained for modeling species' site occupancy.

Fragstats Occupancy Covariate	T	df	*P*
NP - Landscape	0.518	69.41	0.61
Landscape Diversity	0.388	61.44	0.70
Landscape IJI	0.216	69.96	0.83
NP CRP	0.394	35	0.70
% CRP	-0.347	35	0.73
CRP IJI	-0.702	69.40	0.49
NP Ag.	0.408	68.99	0.68
% Ag.	0.098	35	0.92
% Pasture	0.243	66.56	0.81
% Fallow	0.133	69.99	0.89
% Other	-0.840	48.93	0.41

Table 22. Models for detection of ring-necked pheasant (*Phasianus colchicus*) at cameras during the 2011 and 2012 seasons (Junes – August). Model ranking was based on the Akaike Information Criterion for small sample sizes (AIC_c; n=214). Models are ordered based on difference relative to the top model (ΔAIC_c), and relative support for each model (w). Also presented is the number of model parameters (K), and twice the negative log-likelihood value (-2L). Definitions for model covariates can be observed in Appendix B.

Model	AIC_c	ΔAIC_c	w	K	-2L
p(Month + Temperature Variance)	472.12	0.00	0.58	5	462.12
p(Month + Guzzler + Temperature Variance)	473.68	1.56	0.26	6	461.68
p(Month)	475.43	3.31	0.11	4	467.43
p(Month + Guzzler)	477.10	4.98	0.05	5	467.10
p(Temperature Variance + Guzzler)	505.67	33.55	0.00	4	497.67
p(Temperature Variance)	507.42	35.30	0.00	3	501.42
p(Guzzler)	508.39	36.27	0.00	3	502.39
p(.)	510.22	38.10	0.00	2	506.22
p(Temperature Difference)	510.26	38.14	0.00	3	504.26
p(Temperature)	511.42	39.30	0.00	3	505.42
p(Precipitation Difference)	511.92	39.80	0.00	3	505.92
p(Precipitation)	512.01	39.89	0.00	3	506.01
p(Previous Precipitation)	512.06	39.94	0.00	3	506.06

Table 23. Non-additive models for detection of ring-necked pheasant (*Phasianus colchicus*) at cameras during the 2011 and 2012 seasons (Junes – August). Model ranking was based on the Akaike Information Criterion for small sample sizes (AIC_c; n=214). Models are ordered based on difference relative to the top model (ΔAIC_c), and relative support for each model (w). Also presented is the number of model parameters (K), and twice the negative log-likelihood value (-2L). Definitions for model covariates can be observed in Appendix B.

Model	AIC_c	ΔAIC_c	w	K	-2L
p(Month)	475.62	0.00	1.00	4	467.43
p(Temperature Variance)	507.53	31.91	0.00	3	501.42
p(Guzzler)	508.50	32.88	0.00	3	502.39
p(.)	510.28	34.66	0.00	2	506.22
p(Temperature Difference)	510.37	34.75	0.00	3	504.26
p(Temperature)	511.53	35.91	0.00	3	505.42
p(Precipitation Difference)	512.03	36.41	0.00	3	505.92
p(Precipitation)	512.12	36.50	0.00	3	506.01
p(Previous Precipitation)	512.17	36.55	0.00	3	506.06

Table 24. Comparison of coefficients (β) in the top and composite models for ring-necked pheasant (*Phasianus colchicus*) detection at cameras during the 2011 and 2012 seasons (June – August). Statistical significance (α=0.05) of coefficients was assessed by two-tailed Z test (/Z/ > 1). OR represents the odds ratio and is a reflection of the increase (>1) or decrease (<1) in odds of detection of either presence-to-absence (categorical) or per one unit increase (continuous) of covariates. 95% Confidence Intervals (CI) were calculated for OR; intervals spanning a value of one are not statistically significant as one suggests no difference in odd.

							95% CI - OR	
Model	Covariate	β	SE	Z	P	OR	Lower	Upper
Month	Intercept*	-1.67	0.33	-5.06	<0.001	0.19	0.10	0.36
	June	2.16	0.39	5.54	<0.001	8.67	4.04	18.62
	July	0.02	0.42	0.05	0.96	1.02	0.45	2.32
Top (Additive)	Intercept*	-1.87	0.35	-5.37	<0.001	0.15	0.08	0.30
	June	2.44	0.42	5.79	<0.001	11.36	4.99	25.87
	July	0.37	0.45	0.84	0.41	1.46	0.61	3.53
	Temperature Variance	-0.44	0.23	-1.91	0.06	0.64	0.41	1.01
Composite (Additive)	Intercept*	-1.88	0.35	-5.32	<0.001	0.15	0.08	0.30
	June	2.43	0.42	5.79	<0.001	11.37	4.99	25.92
	July	0.38	0.45	0.83	0.41	1.46	0.60	3.52
	Temperature Variance	-0.38	0.23	-1.59	0.11	0.64	0.43	1.09
	Guzzler	0.07	0.12	0.60	0.55	1.07	0.85	1.36

*Functioned as the coefficient for August, which served as the comparison group for Month.

Table 25. Occupancy probability (ψ) models of ring-necked pheasant (*Phasianus colchicus*) at cameras during the 2011 and 2012 seasons (June – August). Model ranking was based on the Akaike Information Criterion for small sample sizes (AIC_c; n=214). Models are ordered based on difference relative to the top model (ΔAIC_c), and relative support for each model (w). Also presented is the number of model parameters (K), and twice the negative log-likelihood value (-2L). Detection probabilities were allowed to vary based on month of survey. Definitions for model covariates can be observed in Appendix C.

Model	AIC_c	ΔAIC_c	w^a	K^b	-2L
ψ(Edge Distance + %Forb)	468.65	0.00	0.19	6	456.24
ψ(Edge Distance + %Forb + Contig. CRP)	468.91	0.26	0.17	7	454.37
ψ(Edge Distance + %Forb + VOR)	470.14	1.49	0.09	7	455.60
ψ(Edge Distance + %Forb + Water Distance)	471.17	1.52	0.09	7	455.63
ψ(Edge Distance + %Forb + Water Distance + Contig. CRP)	470.46	1.81	0.08	8	451.76
ψ(Edge Distance + %Forb + VOR + Contig. CRP)	470.72	2.07	0.07	8	454.02
ψ(Edge Distance + Contig. CRP)	471.23	2.58	0.05	6	458.82
ψ(Edge Distance)	471.31	2.66	0.05	5	461.02
ψ(%Forb + Contig. CRP)	471.35	2.70	0.05	6	458.94
ψ(Edge Distance + %Forb + Water Distance + VOR)	471.67	3.02	0.04	8	454.97
ψ(Edge Distance + %Forb + Water Distance + VOR + Contig. CRP)	472.29	3.64	0.03	9	453.41
ψ(Contig. CRP)	473.22	4.57	0.02	5	462.93
ψ(%Forb)	473.63	4.98	0.02	5	463.34
ψ(Water Distance + VOR + Contig. CRP)	473.72	5.07	0.02	7	459.18
ψ(Water Distance)	475.20	6.55	0.01	5	464.91

Table 26. Comparison of coefficients (β) in the top and composite models for ring-necked pheasant (*Phasianus colchicus*) occupancy at cameras during the 2011 and 2012 seasons (June – August). Statistical significance (α=0.05) of coefficients was assessed by two-tailed Z test (/Z/ > 1). OR represents the odds ratio and is a reflection of the increase (>1) or decrease (<1) in odds of detection of either presence-to-absence (categorical) or per one unit increase (continuous) of covariates. 95% Confidence Intervals (CI) were calculated for OR; intervals spanning a value of one are not statistically significant as one suggests no difference in odds.

							95% CI	
Model	Covariate	β	SE	Z	P	OR	Lower	Upper
Top	Intercept	0.21	0.28	0.75	0.45	1.23	0.71	2.14
	Edge Distance	-0.56	0.22	-2.55	0.01	0.57	0.37	0.88
	%Forb	0.59	0.32	1.84	0.07	1.80	0.96	3.38
Composite	Intercept	0.19	0.28	0.66	0.51	1.20	0.69	2.09
	Edge Distance	-0.51	0.23	-2.25	0.02	0.60	0.38	0.94
	%Forb	0.55	0.32	1.70	0.09	1.73	0.92	3.24
	VOR	0.01	0.08	0.12	0.90	1.01	0.86	1.18
	Water Distance	-0.02	0.04	-0.67	0.50	0.98	0.91	1.05
	Contiguous CRP	-0.16	0.15	-1.04	0.30	0.85	0.63	1.15

Table 27. Kruskal-Wallis Rank Sum Test comparing the top performing covariates in ring-necked pheasant (*Phasianus colchicus*) occupancy models at both sites and cameras across month of survey. None of the covariates were shown to significantly differ by month of survey.

	Occupancy Covariate	Month of Survey		
		χ^2	df	*P*
Camera	%Forb	2.17	2	0.34
	Edge Distance	0.35	2	0.84
	Contiguous CRP	0.80	2	0.67
	Water Distance	0.69	2	0.71
	VOR	2.18	2	0.34
Site	%CRP	0.18	2	0.91
	%Fallow	0.30	2	0.86
	%Ag	3.51	2	0.17
	Veg Evenness	2.30	2	0.32
	Edge Density	0.11	2	0.95

Table 28. Detection probability (*p*) models for coyote (*Canis latrans*) at cameras during the 2011 and 2012 seasons (Junes – August). Model ranking was based on the Akaike Information Criterion for small sample sizes (AIC_c; n=214). Models are ordered based on difference relative to the top model (ΔAIC_c), and relative support for each model (w). Also presented is the number of model parameters (K), and twice the negative log-likelihood value (-2L). Definitions for model covariates can be observed in Appendix B.

Model	AIC_c	ΔAIC_c	w^a	K^b	-2L
p(Guzzler)	354.46	0.00	0.52	3	348.46
p(.)	357.39	2.93	0.12	2	353.39
p(Previous Precipitation)	358.21	3.75	0.08	3	351.21
p(Temperature Variance)	358.96	4.45	0.05	3	352.96
p(Precipitation Difference)	358.98	4.52	0.05	3	352.98
p(Temperature Difference)	359.32	4.86	0.04	3	353.32
p(Temperature)	359.35	4.89	0.04	3	353.35
p(Precipitation)	359.39	4.93	0.04	3	353.39
p(Survey)	359.62	5.16	0.04	4	351.62

Table 29. Comparison of coefficients (β) in the top and composite models for coyote (*Canis latrans*) detection at cameras during the 2011 and 2012 seasons (June – August). Statistical significance (α=0.05) of coefficients was assessed by two-tailed Z test (/Z/ > 1). OR represents the odds ratio and is a reflection of the increase (>1) or decrease (<1) in odds of detection of either presence-to-absence (categorical) or per one unit increase (continuous) of covariates. 95% Confidence Intervals (CI) were calculated for OR; intervals spanning a value of one are not statistically significant as one suggests no difference in odds.

Model	Covariate	β	SE	Z	P	OR	95% CI Lower	95% CI Upper
Top	Intercept	-1.57	0.33	-4.77	<0.001	0.21	0.11	0.40
	Guzzler	0.99	0.45	2.20	0.03	2.69	1.11	6.50

Table 30. Occupancy probability (ψ) models of coyote (*Canis latrans*) at cameras during the 2011 and 2012 seasons (June – August). Model ranking was based on the Akaike Information Criterion for small sample sizes (AIC_c; n=214). Models are ordered based on difference relative to the top model (ΔAIC_c), and relative support for each model (w). Also presented is the number of model parameters (K), and twice the negative log-likelihood value (-2L). Detection probabilities were allowed to vary based on month of survey. Definitions for model covariates can be observed in Appendix C.

Model	AIC_c	ΔAIC_c	w	K	-2L
ψ(VOR Diversity)	351.91	0.00	0.33	4	343.91
ψ(.)	354.46	2.55	0.09	3	348.46
ψ(VOR Evenness)	355.04	3.13	0.07	4	347.04
ψ(%Forb)	355.22	3.31	0.06	4	347.22
ψ(Water Distance)	355.35	3.44	0.06	4	347.35
ψ(VOR)	355.45	3.54	0.06	4	347.45
ψ(Woodland Distance)	356.00	4.09	0.04	4	348.00
ψ(CRP Age)	356.14	4.23	0.04	4	348.14
ψ(Edge Distance)	356.35	4.44	0.04	4	348.35
ψ(%Bare)	356.38	4.47	0.04	4	348.38
ψ(Human Distance)	356.41	4.50	0.04	4	348.41
ψ(%Grass)	356.43	4.52	0.03	4	348.43
ψ(Veg Evenness)	356.46	4.55	0.03	4	348.46
ψ(%Litter)	356.46	4.55	0.03	4	348.46

Table 31. Comparison of coefficients (β) in the top and composite models for coyote (*Canis latrans*) occupancy at cameras during the 2011 and 2012 seasons (June – August). Statistical significance (α=0.05) of coefficients was assessed by two-tailed Z test (/Z/ > 1). OR represents the odds ratio and is a reflection of the increase (>1) or decrease (<1) in odds of detection of either presence-to-absence (categorical) or per one unit increase (continuous) of covariates. 95% Confidence Intervals (CI) were calculated for OR; intervals spanning a value of one are not statistically significant as one suggests no difference in odds.

Model	Covariate	β	SE	Z	P	OR	95% CI Lower	95% CI Upper
Top	Intercept	-0.35	0.40	-0.88	0.38	0.70	0.32	1.54
	VOR Diversity	0.50	0.26	1.92	0.05	1.65	0.99	7.74

Table 32. Detection probability (*p*) models for American badger (*Taxidea taxus*) at cameras during the 2011 and 2012 seasons (Junes – August). Model ranking was based on the Akaike Information Criterion for small sample sizes (AIC_c; n=214). Models are ordered based on difference relative to the top model (ΔAIC_c), and relative support for each model (w). Also presented is the number of model parameters (K), and twice the negative log-likelihood value (-2L). Definitions for model covariates can be observed in Appendix B.

Model	AIC_c	ΔAIC_c	w	K	-2L
p(Precipitation + Guzzler)	417.11	0.00	0.50	4	409.11
p(Precipitation + Guzzler + Precipitation Difference)	418.18	1.07	0.29	5	408.18
p(Precipitation)	420.88	3.77	0.08	3	414.88
p(Precipitation + Survey)	421.36	4.25	0.06	5	411.36
p(Precipitation + Precipitation Difference)	421.87	4.76	0.05	4	413.87
p(Guzzler + Precipitation Difference)	424.19	7.08	0.01	4	416.19
p(Guzzler)	425.11	8.00	0.01	3	419.11
p(Precipitation Difference)	427.98	10.87	0.00	3	421.98
p(Survey)	428.28	11.17	0.00	4	420.28
p(.)	428.59	11.48	0.00	2	424.59
p(Temperature Variance)	428.98	11.86	0.00	3	422.97
p(Previous Precipitation)	429.73	12.62	0.00	3	423.73

Table 33. Comparison of coefficients (β) in the top and composite models for American badger (*Taxidea taxus*) detection at cameras during the 2011 and 2012 seasons (June – August). Statistical significance (α=0.05) of coefficients was assessed by two-tailed Z test (/Z/ > 1). OR represents the odds ratio and is a reflection of the increase (>1) or decrease (<1) in odds of detection of either presence-to-absence (categorical) or per one unit increase (continuous) of covariates. 95% Confidence Intervals (CI) were calculated for OR; intervals spanning a value of one are not statistically significant as one suggests no difference in odds.

Model	Covariate	β	SE	Z	P	OR	95% CI Lower	95% CI Upper
Top	Intercept	-1.87	0.31	-6.03	< 0.001	0.15	0.08	0.28
	Precipitation	-0.54	0.20	-2.70	0.01	0.58	0.39	0.86
	Guzzler	0.89	0.37	2.41	0.02	2.43	1.18	5.03
Composite	Intercept	-1.87	0.31	-6.04	< 0.001	0.15	0.08	0.28
	Precipitation	-0.60	0.24	-2.52	0.01	0.55	0.34	0.88
	Guzzler	0.89	0.37	2.42	0.02	2.43	1.18	4.97
	Precipitation Difference	0.08	0.11	0.74	0.46	1.08	0.88	1.34

Table 34. Occupancy probability (ψ) models of American badger (*Taxidea taxus*) at cameras during the 2011 and 2012 seasons (June – August). Model ranking was based on the Akaike Information Criterion for small sample sizes (AIC_c; n=214). Models are ordered based on difference relative to the top model (ΔAIC_c), and relative support for each model (w). Also presented is the number of model parameters (K), and twice the negative log-likelihood value (-2L). Detection probabilities were allowed to vary based on month of survey. Definitions for model covariates can be observed in Appendix C.

Model	AIC_c	ΔAIC_c	w	K	-2L
ψ(Edge Distance + Human Distance + %Tree)	401.47	0.00	0.34	7	387.47
ψ(Edge Distance + Human Distance + %Tree + %Forb)	402.92	1.45	0.17	8	386.92
ψ(Edge Distance + Human Distance)	403.77	2.30	0.11	6	391.77
ψ(Edge Distance + Human Distance + %Tree + %Forb + Contiguous CRP)	404.63	3.16	0.07	9	386.63
ψ(Edge Distance + Human Distance + %Forb)	404.85	3.38	0.06	7	390.85
ψ(Edge Distance + %Tree + %Forb + Contiguous CRP)	405.25	3.78	0.05	8	389.25
ψ(Edge Distance + Human Distance + Contiguous CRP)	405.39	3.92	0.05	7	391.39
ψ(Edge Distance + Human Distance + Woodland Distance)	405.71	4.24	0.04	7	381.71
ψ(Edge Distance + Contiguous CRP)	406.21	4.74	0.03	6	394.21
ψ(Edge Distance + Human Distance + %Tree + %Forb + Contiguous CRP + Woodland Distance)	406.50	5.03	0.03	10	386.50
ψ(Edge Distance)	406.81	5.34	0.02	5	396.81
ψ(Contiguous CRP + Human Distance)	409.73	8.26	0.01	6	397.73
ψ(Human Distance)	409.92	8.45	0.01	5	399.92

Table 35. Comparison of coefficients (β) in the top and composite models for American badger (*Taxidea taxus*) occupancy at cameras during the 2011 and 2012 seasons (June – August). Statistical significance (α=0.05) of coefficients was assessed by two-tailed Z test (/Z/ > 1). OR represents the odds ratio and is a reflection of the increase (>1) or decrease (<1) in odds of detection of either presence-to-absence (categorical) or per one unit increase (continuous) of covariates. 95% Confidence Intervals (CI) were calculated for OR; intervals spanning a value of one are not statistically significant as one suggests no difference in odds.

Model	Covariate	β	SE	Z	P	OR	95% CI	
							Lower	Upper
Top	Intercept	0.53	0.68	0.78	0.44	1.70	0.45	6.44
	Edge Distance	-1.09	0.47	-2.32	0.02	0.34	0.13	0.84
	Human Distance	-0.85	0.42	-2.02	0.04	0.43	0.19	0.97
	%Tree	-1.49	1.05	-1.42	0.16	0.23	0.03	1.76
Composite	Intercept	0.54	.69	.78	0.44	1.72	0.44	6.68
	Edge Distance	-1.06	.47	-2.28	0.02	0.35	0.14	0.86
	Human Distance	-0.82	.42	-1.97	0.05	0.44	0.19	1.00
	%Tree	-1.19	.88	-1.35	0.18	0.30	0.05	1.71
	%Forb	-0.08	0.11	-0.68	0.50	0.93	0.75	1.15

Table 36. Detection probability (*p*) models for raccoon (*Procyon lotor*) at cameras during the 2011 and 2012 seasons (Junes – August). Model ranking was based on the Akaike Information Criterion for small sample sizes (AIC_c; n=214). Models are ordered based on difference relative to the top model (ΔAIC_c), and relative support for each model (w). Also presented is the number of model parameters (K), and twice the negative log-likelihood value (-2L). Definitions for model covariates can be observed in Appendix B

Model	AIC_c	ΔAIC_c	w	K	-2L
p(Guzzler)	281.23	0.00	1.00	3	275.23
p(.)	312.87	31.64	0.00	2	308.87
p(Survey)	314.00	32.77	0.00	4	306.00
p(Temperature)	314.13	33.90	0.00	3	308.64
p(Precipitation)	314.64	33.41	0.00	3	308.78
p(Previous Precipitation)	314.73	33.50	0.00	3	308.80
p(Precipitation Difference)	314.86	33.63	0.00	3	308.81
p(Temperature Variance)	314.87	33.64	0.00	3	308.87

Table 37. Comparison of coefficients (β) in the top and composite models for raccoon (*Procyon lotor*) detection at cameras during the 2011 and 2012 seasons (June – August). Statistical significance (α=0.05) of coefficients was assessed by two-tailed Z test (/Z/ > 1). OR represents the odds ratio and is a reflection of the increase (>1) or decrease (<1) in odds of detection of either presence-to-absence (categorical) or per one unit increase (continuous) of covariates. 95% Confidence Intervals (CI) were calculated for OR; intervals spanning a value of one are not statistically significant as one suggests no difference in odds.

Model	Covariate	β	SE	Z	P	OR	95% CI Lower	95% CI Upper
Top	Intercept	-2.60	0.32	-8.13	<0.001	0.07	0.04	0.14
	Guzzler	2.54	0.42	6.05	<0.001	12.68	5.57	28.88

Table 38. Occupancy probability (ψ) models of raccoon (*Procyon lotor*) at cameras during the 2011 and 2012 seasons (June – August). Model ranking was based on the Akaike Information Criterion for small sample sizes (AIC_c; n=214). Models are ordered based on difference relative to the top model (ΔAIC_c), and relative support for each model (w). Also presented is the number of model parameters (K), and twice the negative log-likelihood value (-2L). Detection probabilities were allowed to vary based on month of survey. Definitions for model covariates can be observed in Appendix C.

Model	AIC_c	ΔAIC_c	w	K	-2L
ψ(Human Distance + %Grass)	268.81	0.00	0.19	5	258.81
ψ(Human Distance + Edge Distance + %Grass)	268.90	0.09	0.19	6	256.90
ψ(Human Distance + Edge Distance + %Grass + %Tree)	269.92	1.11	0.11	7	255.92
ψ(Human Distance + Edge Distance)	270.07	1.26	0.10	5	260.07
ψ(Human Distance + %Tree)	270.58	1.77	0.08	5	260.58
ψ(Human Distance + Edge Distance + %Tree)	270.61	1.80	0.08	6	258.63
ψ(Human Distance)	270.67	1.86	0.08	4	262.68
ψ(Human Distance + Woodland Distance + %Grass + %Tree)	271.45	2.64	0.05	7	257.45
ψ(Human Distance + Woodland Distance + Edge Distance + %Grass + %Tree)	271.83	3.02	0.04	8	255.83
ψ(Human Distance + Woodland Distance)	281.66	3.85	0.03	5	262.66
ψ(Woodland Distance + %Grass)	281.94	4.13	0.02	5	262.94
ψ(Woodland Distance + Edge Distance)	275.70	6.89	0.01	5	265.70

Table 39 Comparison of coefficients (β) in the top and composite models for raccoon (*Procyon lotor*) occupancy at cameras during the 2011 and 2012 seasons (June – August). Statistical significance (α=0.05) of coefficients was assessed by two-tailed Z test (/Z/ > 1). OR represents the odds ratio and is a reflection of the increase (>1) or decrease (<1) in odds of detection of either presence-to-absence (categorical) or per one unit increase (continuous) of covariates. 95% Confidence Intervals (CI) were calculated for OR; intervals spanning a value of one are not statistically significant as one suggests no difference in odds.

							95% CI	
Model	Covariate	β	SE	Z	P	OR	Lower	Upper
Top	Intercept	-0.25	0.44	-0.57	0.57	0.78	0.33	1.84
	Human Distance	-1.17	0.42	-2.79	0.01	0.31	0.14	0.71
	%Grass	-0.78	0.42	-1.86	0.06	0.46	0.20	1.04
Composite	Intercept	-0.17	0.48	-0.36	0.72	0.84	0.33	2.16
	Human Distance	-1.08	0.46	-2.36	0.02	0.34	0.14	0.83
	%Grass	-0.43	0.3	-1.41	0.16	0.65	0.36	1.18
	Edge Distance	-0.26	0.22	-1.18	0.24	0.77	0.50	1.19
	%Tree	0.25	0.43	0.57	0.57	1.28	0.55	2.99

Table 40. Detection probability (*p*) models for striped skunk (*Mephitis mephitis*) at cameras during the 2011 and 2012 seasons (Junes – August). Model ranking was based on the Akaike Information Criterion for small sample sizes (AIC_c; n=214). Models are ordered based on difference relative to the top model (ΔAIC_c), and relative support for each model (w). Also presented is the number of model parameters (K), and twice the negative log-likelihood value (-2L). Definitions for model covariates can be observed in Appendix B.

Model	AIC_c	ΔAIC_c	w	K	-2L
p(Guzzler)	206.03	0.00	0.74	3	199.92
p(.)	211.50	5.47	0.05	2	207.44
p(Previous Precipitation)	211.52	5.49	0.05	3	205.41
p(Precipitation Difference)	211.67	5.64	0.04	3	205.56
p(Temperature Difference)	211.71	5.68	0.04	3	205.60
p(Temperature)	212.48	6.45	0.03	3	206.37
p(Precipitation)	213.10	7.07	0.02	3	206.99
p(Temperature Variance)	213.55	7.52	0.02	3	207.44
p(Survey)	214.99	8.96	0.01	4	206.80

Table 41. Comparison of coefficients (β) in the top and composite models for striped skunk (*Mephitis mephitis*) detection at cameras during the 2011 and 2012 seasons (June – August). Statistical significance (α=0.05) of coefficients was assessed by two-tailed Z test (/Z/ > 1). OR represents the odds ratio and is a reflection of the increase (>1) or decrease (<1) in odds of detection of either presence-to-absence (categorical) or per one unit increase (continuous) of covariates. 95% Confidence Intervals (CI) were calculated for OR; intervals spanning a value of one are not statistically significant as one suggests no difference in odds.

Model	Covariate	β	SE	Z	P	OR	95% CI	
							Lower	Upper
Top	Intercept	-2.05	0.53	-3.87	<0.001	0.13	0.05	0.36
	Guzzler	1.50	0.56	2.68	0.01	4.48	1.50	13.43

Table 42. Occupancy probability (ψ) models of striped skunk (*Mephitis mephitis*) at cameras during the 2011 and 2012 seasons (June – August). Model ranking was based on the Akaike Information Criterion for small sample sizes (AIC_c; n=214). Models are ordered based on difference relative to the top model (ΔAIC_c), and relative support for each model (w). Also presented is the number of model parameters (K), and twice the negative log-likelihood value (-2L). Detection probabilities were allowed to vary based on month of survey. Definitions for model covariates can be observed in Appendix C.

Model	AIC_c	ΔAIC_c	w	K	-2L
ψ(%Legume + Vegetation Evenness + %Tree)	186.79	0.00	0.37	6	174.38
ψ(%Legume + %Tree)	187.72	0.93	0.23	5	177.43
ψ(%Legume + Vegetation Evenness + %Tree + %Forb)	188.80	2.01	0.14	7	174.26
ψ(%Legume + %Tree + %Forb)	189.71	2.92	0.09	6	177.30
ψ(%Legume + Vegetation Evenness)	190.21	3.42	0.07	5	179.92
ψ(%Legume + Vegetation Evenness + %Tree + %Forb + Guzzler)	190.90	4.11	0.05	8	174.20
ψ(%Legume + Vegetation Evenness + Guzzler)	192.01	5.22	0.03	6	179.60
ψ(%Legume + Vegetation Evenness + %Forb)	192.31	5.52	0.02	6	179.90
ψ(%Legume)	194.21	7.42	0.01	4	186.02
ψ(%Legume + Guzzler)	196.31	9.52	0.00	5	186.02
ψ(Vegetation Evenness + %Tree + %Forb)	198.95	12.16	0.00	6	186.54
ψ(Vegetation Evenness)	200.59	13.90	0.00	4	192.40
ψ(%Tree)	201.39	14.60	0.00	4	193.20
ψ(%Forb)	201.57	14.78	0.00	4	193.38
ψ(.)	206.03	19.24	0.00	3	199.92

Table 43. Comparison of coefficients (β) in the top and composite models for striped skunk (*Mephitis mephitis*) occupancy at cameras during the 2011 and 2012 seasons (June – August). Statistical significance (α=0.05) of coefficients was assessed by two-tailed Z test (/Z/ > 1). OR represents the odds ratio and is a reflection of the increase (>1) or decrease (<1) in odds of detection of either presence-to-absence (categorical) or per one unit increase (continuous) of covariates. 95% Confidence Intervals (CI) were calculated for OR; intervals spanning a value of one are not statistically significant as one suggests no difference in odds.

Model	Covariate	β	SE	Z	P	OR	95% CI Lower	95% CI Upper
Top	Intercept	-0.50	1.43	-0.35	0.73	0.61	0.04	10.00
	%Legume	1.83	0.71	2.58	0.01	6.23	1.55	25.07
	%Tree	4.86	7.87	0.62	0.54	129.02	0.00	6.45e8
	Veg Evenness	0.75	0.45	1.67	0.09	2.12	0.88	5.11
Composite	Intercept	3.08	8.09	0.38	0.70	21.81	0.00	1.68e8
	%Legume	1.83	0.70	2.59	0.01	6.22	1.56	24.71
	%Tree	25.63	107.08	0.24	0.81	1.35e11	0.00	1.89e102
	Veg Evenness	0.47	0.34	1.39	0.16	1.60	0.83	3.09
	%Forb	-0.01	0.14	-0.06	0.95	0.99	0.75	1.31

Table 44. Detection probability (*p*) models for ring-necked pheasant (*Phasianus colchicus*) at sites during the 2011 and 2012 seasons (Junes – August). Model ranking was based on the Akaike Information Criterion for small sample sizes (AIC_c; n=72). Models are ordered based on difference relative to the top model (ΔAIC_c), and relative support for each model (w). Also presented is the number of model parameters (K), and twice the negative log-likelihood value (-2L). Definitions for model covariates can be observed in Appendix B.

Model	AIC_c	ΔAIC_c	w	K	-2L
p(Month)	236.17	0.00	1.00	3	227.98
p(.)	255.16	18.99	0.00	2	251.10
p(Temperature Variance)	255.37	19.20	0.00	3	249.26
p(Guzzler)	255.76	19.59	0.00	3	249.65
p(Temperature)	255.93	19.76	0.00	3	249.82
p(Temperature Difference)	256.24	20.07	0.00	3	250.13
p(Precipitation Difference)	256.69	20.52	0.00	3	250.58
p(Precipitation)	256.70	20.53	0.00	3	250.59
p(Previous Precipitation)	257.07	20.90	0.00	3	250.96
p(Survey)	257.44	21.27	0.00	4	249.25

Table 45. Comparison of coefficients (β) in the top and composite models for ring-necked pheasant (*Phasianus colchicus*) detection at sites during the 2011 and 2012 seasons (June – August). Statistical significance (α=0.05) of coefficients was assessed by two-tailed Z test (/Z/ > 1). OR represents the odds ratio and is a reflection of the increase (>1) or decrease (<1) in odds of detection of either presence-to-absence (categorical) or per one unit increase (continuous) of covariates. 95% Confidence Intervals (CI) were calculated for OR; intervals spanning a value of one are not statistically significant as one suggests no difference in odds.

Model	Covariate	β	SE	Z	P	OR	95% CI Lower	95% CI Upper
Top	Intercept	-1.04	0.40	-2.60	0.01	0.35	0.16	0.77
	June	2.29	0.51	4.49	<0.001	9.87	3.63	26.83
	July	0.15	0.49	0.31	0.76	1.16	0.44	3.04

Table 46. Occupancy probability (ψ) models of ring-necked pheasant (*Phasianus colchicus*) at sites during the 2011 and 2012 seasons (June – August). Model ranking was based on the Akaike Information Criterion for small sample sizes (AIC_c; n=72). Models are ordered based on difference relative to the top model (ΔAIC_c), and relative support for each model (w). Also presented is the number of model parameters (K), and twice the negative log-likelihood value (-2L). Detection probabilities were allowed to vary based on month of survey. Definitions for model covariates can be observed in Appendix C.

Model	AIC_c	ΔAIC_c	w	K	-2L
ψ(%CRP + %Fallow)	230.36	0.00	0.14	6	217.95
ψ(%CRP)	230.44	0.08	0.13	5	220.15
ψ(%CRP + %Ag. + Vegetation Evenness)	231.23	0.87	0.09	7	216.69
ψ(%CRP + %Fallow + Vegetation Evenness)	231.31	0.95	0.09	7	216.99
ψ(%CRP + %Ag. + Vegetation Evenness + %Fallow)	231.44	1.08	0.08	8	214.74
ψ(%CRP + Edge Density)	231.96	1.60	0.06	6	219.55
ψ(%CRP + %Ag)	232.05	1.69	0.06	6	219.64
ψ(%CRP + %Fallow + Edge Density)	232.37	2.01	0.05	7	217.83
ψ(%CRP + Vegetation Evenness + Edge Density)	232.73	2.37	0.04	7	218.19
ψ (%CRP + %Fallow + Vegetation Evenness + CRP IJI + %Ag	232.93	2.57	0.04	9	214.05
ψ(%Fallow)	233.24	2.88	0.03	5	222.95
ψ(%CRP + %Fallow + Vegetation Evenness + Edge Density)	233.30	2.94	0.03	8	216.60
ψ(%Ag + %Fallow + Edge Density)	233.34	2.98	0.03	7	218.80
ψ(%CRP + %Ag + Vegetation Evenness + Edge Density)	233.39	3.03	0.03	8	216.69

Table 47. Comparison of coefficients (β) in the top and composite models for ring-necked pheasant (*Phasianus colchicus*) occupancy at sites during the 2011 and 2012 seasons (June – August). Statistical significance (α=0.05) of coefficients was assessed by two-tailed Z test (/Z/ > 1). OR represents the odds ratio and is a reflection of the increase (>1) or decrease (<1) in odds of detection of either presence-to-absence (categorical) or per one unit increase (continuous) of covariates. 95% Confidence Intervals (CI) were calculated for OR; intervals spanning a value of one are not statistically significant as one suggests no difference in odds.

Model	Covariate	B	SE	Z	P	OR	95% CI Lower	95% CI Upper
Top	Intercept	2.02	0.69	2.91	<0.01	7.46	1.93	28.86
	%CRP	-0.98	0.62	-1.58	0.11	0.38	0.11	1.27
	%Fallow	0.0002	0.0005	0.40	0.69	1.00	0.99	1.00
Composite	Intercept	2.39	1.47	1.62	0.11	10.90	0.61	195.36
	%CRP	-1.33	0.96	-1.39	0.16	0.26	0.04	1.72
	%Fallow	9.00e-4	3.28e-4	0.27	0.79	1.00	0.99	1.00
	%Ag	0.39	0.45	0.88	0.38	1.48	0.62	3.54
	Veg Evenness	0.39	0.34	1.17	0.24	1.48	0.77	2.86
	Edge Density	0.07	0.13	0.54	0.59	1.07	0.84	1.37

Table 48. Detection probability (*p*) models for coyote (*Canis latrans*) at sites during the 2011 and 2012 seasons (Junes – August). Model ranking was based on the Akaike Information Criterion for small sample sizes (AIC_c; n=72). Models are ordered based on difference relative to the top model (ΔAIC_c), and relative support for each model (w). Also presented is the number of model parameters (K), and twice the negative log-likelihood value (-2L). Definitions for model covariates can be observed in Appendix B.

Model	$QAIC_c$	$\Delta QAIC_c$	w	K	-2L
p(.)	104.77	0.00	0.24	2	221.56
p(Temperature Variance)	105.74	0.97	0.15	3	219.18
p(Previous Precipitation)	106.30	1.53	0.11	3	220.40
p(Guzzler)	106.44	1.67	0.10	3	220.71
p(Precipitation)	106.64	1.87	0.09	3	221.16
p(Temperature)	106.78	2.01	0.09	3	221.46
p(Temperature Difference)	106.79	2.02	0.09	3	221.49
p(Precipitation Difference)	106.81	2.04	0.09	3	221.54
p(Survey)	108.34	3.57	0.04	4	220.33

Table 49. Comparison of coefficients (β) in the top and composite models for coyote (*Canis latrans*) detection at sites during the 2011 and 2012 seasons (June – August). Statistical significance (α=0.05) of coefficients was assessed by two-tailed Z test (/Z/ > 1). OR represents the odds ratio and is a reflection of the increase (>1) or decrease (<1) in odds of detection of either presence-to-absence (categorical) or per one unit increase (continuous) of covariates. 95% Confidence Intervals (CI) were calculated for OR; intervals spanning a value of one are not statistically significant as one suggests no difference in odds.

Model	Covariate	B	SE	Z	P	OR	95% CI	
							Lower	Upper
Top	Intercept	-0.68	0.29	-2.34	0.02	0.51	0.29	0.89

Table 50. Occupancy probability (ψ) models of coyote (*Canis latrans*) at sites during the 2011 and 2012 seasons (June – August). Model ranking was based on the Akaike Information Criterion for small sample sizes (AIC_c; n=72). Models are ordered based on difference relative to the top model (ΔAIC_c), and relative support for each model (w). Also presented is the number of model parameters (K), and twice the negative log-likelihood value (-2L). Detection probabilities were allowed to vary based on month of survey. Definitions for model covariates can be observed in Appendix C.

Model	$QAIC_c$	$\Delta QAIC_c$	w	K	-2L
ψ(.)	87.66	0.00	0.13	2	221.56
ψ(%Ag)	88.93	1.27	0.07	3	219.45
ψ(%CRP)	89.25	1.59	0.06	3	220.31
ψ(Number of CRP Patches)	89.26	1.60	0.06	3	220.33
ψ(Edge Density)	89.35	1.69	0.06	3	220.58
ψ (CRP IJI)	89.42	1.76	0.05	3	220.77
ψ(CRP Age)	89.46	1.80	0.05	3	220.86
ψ(VOR Diversity)	89.47	1.83	0.05	3	220.90
ψ(NOWS)	89.49	1.83	0.05	3	220.95
ψ(%Litter)	89.53	1.87	0.05	3	221.06
ψ(Contiguous CRP)	89.54	1.88	0.05	3	221.07
ψ(Landscape Diversity)	89.55	1.89	0.05	3	221.10
ψ(%Fallow)	89.59	1.93	0.05	3	221.21
ψ(%Tree/Shrub)	89.60	1.94	0.05	3	221.24
ψ(Human Distance)	89.62	1.96	0.05	3	221.29
ψ(Connectance)	89.64	1.98	0.05	3	221.33

Table 51. Comparison of coefficients (β) in the top and composite models for coyote (*Canis latrans*) occupancy at sites during the 2011 and 2012 seasons (June – August). Statistical significance (α=0.05) of coefficients was assessed by two-tailed Z test (/Z/ > 1). OR represents the odds ratio and is a reflection of the increase (>1) or decrease (<1) in odds of detection of either presence-to-absence (categorical) or per one unit increase (continuous) of covariates. 95% Confidence Intervals (CI) were calculated for OR; intervals spanning a value of one are not statistically significant as one suggests no difference in odds.

							95% CI	
Model	Covariate	B	SE	Z	P	OR	Lower	Upper
Top	Intercept	0.61	0.51	2.10	0.04	1.84	1.11	3.06

Table 52. Detection probability (*p*) models for American badger (*Taxidea taxus*) at sites during the 2011 and 2012 seasons (Junes – August). Model ranking was based on the Akaike Information Criterion for small sample sizes (AIC_c; n=72). Models are ordered based on difference relative to the top model (ΔAIC_c), and relative support for each model (w). Also presented is the number of model parameters (K), and twice the negative log-likelihood value (-2L). Definitions for model covariates can be observed in Appendix B.

Model	AIC_c	ΔAIC_c	w	K	-2L
p(Precipitation)	246.83	0.00	0.61	3	240.48
p(Precipitation + Precipitation Difference)	248.76	1.93	0.23	4	240.16
p(Precipitation Difference)	251.47	4.64	0.06	3	245.12
p(.)	252.60	5.77	0.03	2	248.43
p(Temperature Variance)	253.69	6.86	0.02	3	247.34
p(Temperature)	254.32	7.49	0.01	3	247.97
p(Previous Precipitation)	254.61	7.78	0.01	3	248.26
p(Temperature Difference)	254.76	7.93	0.01	3	248.41
p(Guzzler)	254.76	7.96	0.01	3	248.41

Table 53. Comparison of coefficients (β) in the top and composite models for American badger (*Taxidea taxus*) detection at sites during the 2011 and 2012 seasons (June – August). Statistical significance (α=0.05) of coefficients was assessed by two-tailed Z test (/Z/ > 1). OR represents the odds ratio and is a reflection of the increase (>1) or decrease (<1) in odds of detection of either presence-to-absence (categorical) or per one unit increase (continuous) of covariates. 95% Confidence Intervals (CI) were calculated for OR; intervals spanning a value of one are not statistically significant as one suggests no difference in odds.

							95% CI	
Model	Covariate	B	SE	Z	P	OR	Lower	Upper
Top	Intercept	1.14	0.59	1.93	0.05	3.13	0.98	9.94
	Precipitation	-0.53	0.21	-2.52	0.01	0.59	0.39	0.89
Composite	Intercept	1.15	0.84	1.36	0.17	3.15	0.60	16.47
	Precipitation	-057	0.35	-1.63	0.10	0.57	0.29	1.12
	Precipitation Difference	0.05	0.13	0.38	0.70	1.05	0.81	1.36

Table 54. Occupancy probability (ψ) models of American badger (*Taxidea taxus*) at sites during the 2011 and 2012 seasons (June – August). Model ranking was based on the Akaike Information Criterion for small sample sizes (AIC_c; n=72). Models are ordered based on difference relative to the top model (ΔAIC_c), and relative support for each model (w). Also presented is the number of model parameters (K), and twice the negative log-likelihood value (-2L). Detection probabilities were allowed to vary based on month of survey. Definitions for model covariates can be observed in Appendix C.

Model	AIC_c	ΔAIC_c	w	K	-2L
ψ(CRP IJI + %Bare + %CRP)	231.26	0.00	0.43	6	217.97
ψ(CRP IJI + %Bare + %CRP + %Grass)	233.42	2.16	0.15	7	217.67
ψ(CRP IJI)	233.69	2.43	0.13	4	225.09
ψ(CRP IJI + %Bare + %CRP + %Ag)	233.70	2.44	0.13	7	217.95
ψ(CRP IJI + %Bare + %CRP + %Grass + %Ag + VOR Evenness + Veg Evenness)	234.20	2.94	0.10	12	204.91
ψ(CRP IJI + %Bare + %CRP + %Ag + %Grass)	235.96	4.70	0.05	8	217.67
ψ(CRP IJI + %Bare + %CRP + %Grass + %Ag + VOR Evenness + Veg Evenness + Contiguous CRP)	237.19	5.93	0.02	13	204.91
ψ(%Bare + %CRP)	239.46	8.20	0.01	5	228.55
ψ(%Bare + %CRP + %Grass + %Ag + VOR Evenness + Veg Evenness)	242.80	11.54	0.00	11	216.40
ψ(%Bare)	243.79	12.53	0.00	4	235.19
ψ(%CRP)	244.21	12.95	0.00	4	235.61

Table 55. Comparison of coefficients (β) in the top and composite models for American badger (*Taxidea taxus*) occupancy at sites during the 2011 and 2012 seasons (June – August). Statistical significance (α=0.05) of coefficients was assessed by two-tailed Z test (/Z/ > 1). OR represents the odds ratio and is a reflection of the increase (>1) or decrease (<1) in odds of detection of either presence-to-absence (categorical) or per one unit increase (continuous) of covariates. 95% Confidence Intervals (CI) were calculated for OR; intervals spanning a value of one are not statistically significant as one suggests no difference in odds.

							95% CI	
Model	Covariate	B	SE	Z	P	OR	Lower	Upper
Top	Intercept	3.92	1.84	2.13	0.03	50.40	1.37	1.86e3
	CRP IJI	-3.98	1.94	-2.05	0.04	0.02	0.00	0.84
	%Bare	1.91	1.07	1.79	0.07	6.75	0.83	54.99
	%CRP	-1.91	1.02	-1.89	0.06	0.15	0.02	1.07
Composite	Intercept	3.88	2.01	1.93	0.05	48.63	0.94	2.52e3
	CRP IJI	-4.10	2.02	-2.03	0.04	0.02	0.00	0.87
	%Bare	1.65	0.98	1.68	0.09	5.20	0.76	35.60
	%CRP	-1.58	0.91	-1.74	0.08	0.21	0.03	1.22
	%Grass	0.07	0.15	0.50	0.62	1.07	0.81	1.43
	%Ag	0.17	0.19	0.88	0.38	1.18	0.82	1.71

Table 56. Detection probability (*p*) models for raccoon (*Procyon lotor*) at sites during the 2011 and 2012 seasons (Junes – August). Model ranking was based on the Akaike Information Criterion for small sample sizes (AIC_c; n=72). Models are ordered based on difference relative to the top model (ΔAIC_c), and relative support for each model (w). Also presented is the number of model parameters (K), and twice the negative log-likelihood value (-2L). Definitions for model covariates can be observed in Appendix B.

Model	AIC_c	ΔAIC_c	w	K	-2L
p(Guzzler)	195.01	0.00	0.66	3	188.66
p(.)	199.01	4.00	0.09	2	194.84
p(Temperature)	199.37	4.36	0.07	3	193.02
p(Precipitation)	200.42	5.41	0.04	3	194.07
p(Precipitation Difference)	200.70	5.69	0.04	3	194.35
p(Temperature Difference)	200.99	5.98	0.03	3	194.64
p(Temperature Variance)	201.01	6.00	0.03	3	194.66
p(Previous Precipitation)	201.08	6.07	0.03	3	194.73

Table 57. Comparison of coefficients (β) in the top and composite models for raccoon (*Procyon lotor*) detection at sites during the 2011 and 2012 seasons (June – August). Statistical significance (α=0.05) of coefficients was assessed by two-tailed Z test (/Z/ > 1). OR represents the odds ratio and is a reflection of the increase (>1) or decrease (<1) in odds of detection of either presence-to-absence (categorical) or per one unit increase (continuous) of covariates. 95% Confidence Intervals (CI) were calculated for OR; intervals spanning a value of one are not statistically significant as one suggests no difference in odds.

Model	Covariate	B	SE	Z	P	OR	95% CI Lower	95% CI Upper
Top	Intercept	-1.24	0.45	2.76	0.01	0.29	0.12	0.70
	Guzzler	1.36	0.52	2.62	0.01	3.90	1.41	10.80

Table 58. Occupancy probability (ψ) models of raccoon (*Procyon lotor*) at sites during the 2011 and 2012 seasons (June – August). Model ranking was based on the Akaike Information Criterion for small sample sizes (AIC_c; n=72). Models are ordered based on difference relative to the top model (ΔAIC_c), and relative support for each model (w). Also presented is the number of model parameters (K), and twice the negative log-likelihood value (-2L). Detection probabilities were allowed to vary based on month of survey. Definitions for model covariates can be observed in Appendix C.

Model	AIC_c	ΔAIC_c	w	K	-2L
ψ(%Tree + Human Distance)	185.15	0.00	0.35	5	174.24
ψ(%Tree + Woodland Distance)	185.82	0.67	0.25	5	174.91
ψ(%Tree + Human Distance + Woodland Distance)	187.25	2.10	0.12	6	173.96
ψ(%Tree)	187.35	2.20	0.12	4	178.75
ψ(%Tree + Human Distance + Woodland Distance + %Grass)	189.41	4.26	0.04	7	173.66
ψ(%Tree + Human Distance + Woodland Distance + Vegetation Evenness)	189.54	4.39	0.04	7	173.79
ψ(Human Distance)	190.24	5.09	0.03	4	181.64
ψ(%Tree + Human Distance + Woodland Distance + %Grass + Vegetation Evenness)	191.88	6.73	0.01	8	173.59
ψ(Human Distance + Woodland Distance)	192.50	7.35	0.01	5	181.59
ψ(Woodland Distance)	193.11	7.96	0.01	4	184.51
ψ(Vegetation Evenness)	194.01	8.86	0.00	4	185.41
ψ(%Grass)	194.95	9.80	0.00	4	186.35
ψ(.)	195.01	9.86	0.00	3	188.66

Table 59. Comparison of coefficients (β) in the top and composite models for raccoon (*Procyon lotor*) occupancy at sites during the 2011 and 2012 seasons (June – August). Statistical significance (α=0.05) of coefficients was assessed by two-tailed Z test (/Z/ > 1). OR represents the odds ratio and is a reflection of the increase (>1) or decrease (<1) in odds of detection of either presence-to-absence (categorical) or per one unit increase (continuous) of covariates. 95% Confidence Intervals (CI) were calculated for OR; intervals spanning a value of one are not statistically significant as one suggests no difference in odds.

Model	Covariate	B	SE	Z	P	OR	95% CI Lower	95% CI Upper
Top	Intercept	0.56	0.81	0.69	0.49	1.75	0.36	8.56
	%Tree	3.84	2.86	1.34	0.18	46.53	0.17	1.27e4
	Human Distance	-0.77	0.41	1.88	0.06	0.46	0.21	1.03
Composite	Intercept	1.01	1.03	0.98	0.72	2.74	0.37	20.48
	%Tree	5.39	3.69	1.46	0.14	220.02	0.16	3.07e5
	Human Distance	-0.40	0.30	-1.34	0.16	0.67	0.38	1.20
	Woodland Distance	-0.31	0.29	-1.08	0.24	0.73	0.42	1.29

Table 60. Detection probability (*p*) models for striped skunks (*Mephitis mephitis*) at sites during the 2011 and 2012 seasons (Junes – August). Model ranking was based on the Akaike Information Criterion for small sample sizes (AIC_c; n=72). Models are ordered based on difference relative to the top model (ΔAIC_c), and relative support for each model (w). Also presented is the number of model parameters (K), and twice the negative log-likelihood value (-2L). Definitions for model covariates can be observed in Appendix B.

Model	AIC_c	ΔAIC_c	w^a	K^b	-2L
p(Temperature Difference + Precipitation)	137.28	0.00	0.24	4	128.68
p(Temperature Difference + Precipitation Difference)	137.56	0.28	0.21	4	128.96
p(Precipitation Difference)	138.91	1.63	0.11	3	132.56
p(Temperature Difference + Precipitation Difference + Precipitation)	139.39	2.11	0.08	5	128.48
p(Temperature Difference)	139.51	2.23	0.08	3	133.16
p(Precipitation)	139.69	2.41	0.07	3	133.34
p(.)	140.00	2.72	0.06	2	135.83
p(Previous Precipitation)	140.07	2.79	0.06	3	133.72
p(Temperature)	141.11	3.83	0.04	3	134.76
p(Precipitation Difference + Precipitation)	141.15	3.87	0.03	4	132.55
p(Guzzler)	141.95	4.67	0.02	3	135.60

Table 61. Comparison of coefficients (β) in the top and composite models for striped skunks (*Mephitis mephitis*) detection at sites during the 2011 and 2012 seasons (June – August). Statistical significance (α=0.05) of coefficients was assessed by two-tailed Z test (/Z/ > 1). OR represents the odds ratio and is a reflection of the increase (>1) or decrease (<1) in odds of detection of either presence-to-absence (categorical) or per one unit increase (continuous) of covariates. 95% Confidence Intervals (CI) were calculated for OR; intervals spanning a value of one are not statistically significant as one suggests no difference in odds.

Model	Covariate	B	SE	Z	P	OR	95% CI Lower	95% CI Upper
Top	Intercept	-0.22	0.43	-0.51	0.61	0.80	0.35	1.86
	Temperature Difference	-0.71	0.35	-2.03	0.04	0.49	0.25	0.98
	Precipitation	-0.77	0.4	-1.93	0.05	0.46	0.21	1.01
Composite	Intercept	-0.24	0.32	-0.76	0.45	0.78	0.42	1.47
	Temperature Difference	-0.37	0.25	-1.47	0.14	0.69	0.42	1.13
	Precipitation	-0.23	0.20	-1.15	0.25	0.79	0.53	1.18
	Precipitation Difference	-0.21	0.17	-1.24	0.79	0.81	0.58	1.13

Table 62. Occupancy probability (ψ) models of striped skunks (*Mephitis mephitis*) at sites during the 2011 and 2012 seasons (June – August). Model ranking was based on the Akaike Information Criterion for small sample sizes (AIC_c; n=72). Models are ordered based on difference relative to the top model (ΔAIC_c), and relative support for each model (w). Also presented is the number of model parameters (K), and twice the negative log-likelihood value (-2L). Detection probabilities were allowed to vary based on month of survey. Definitions for model covariates can be observed in Appendix C.

Model	AIC_c	ΔAIC_c	w	K	-2L
ψ(Woodland Distance)	129.76	0.00	0.39	5	118.85
ψ(Woodland Distance + Connectance)	130.57	0.81	0.26	6	117.28
ψ(Woodland Distance + Human Distance)	131.93	2.17	0.13	6	118.64
ψ(Woodland Distance+ Human Distance + Connectance)	132.76	3.00	0.09	7	117.01
ψ(Human Distance + Connectance)	134.99	5.23	0.03	6	121.70
ψ(Human Distance)	135.32	5.56	0.02	5	124.41
ψ(Connectance)	136.25	6.49	0.02	5	125.34
ψ(.)	137.28	7.52	0.01	4	128.68
ψ(%Tree)	137.29	7.53	0.01	5	126.38
ψ(%Legume)	137.36	7.60	0.01	5	126.45
ψ(%Bare)	137.51	7.75	0.01	5	126.60
ψ(CRP Age)	137.77	8.01	0.01	5	126.86
ψ(Vegetation Evenness)	137.87	8.11	0.01	5	126.96
ψ(%Forb)	137.93	8.17	0.01	5	127.02
ψ(%Grass)	137.94	8.18	0.01	5	127.03
ψ(Guzzler)	138.31	8.55	0.01	5	127.40

Table 63. Comparison of coefficients (β) in the top and composite models for striped skunks (*Mephitis mephitis*) occupancy at sites during the 2011 and 2012 seasons (June – August). Statistical significance (α=0.05) of coefficients was assessed by two-tailed Z test (/Z/ > 1). OR represents the odds ratio and is a reflection of the increase (>1) or decrease (<1) in odds of detection of either presence-to-absence (categorical) or per one unit increase (continuous) of covariates. 95% Confidence Intervals (CI) were calculated for OR; intervals spanning a value of one are not statistically significant as one suggests no difference in odds.

Model	Covariate	B	SE	Z	P	OR	95% CI	
							Lower	Upper
Top	Intercept	-1.49	0.46	-3.24	<0.01	0.23	0.09	0.56
	Woodland Distance	-1.59	0.69	2.30	0.02	0.20	0.05	0.79
Composite	Intercept	-1.52	0.47	-3.24	<0.01	0.22	0.09	0.55
	Woodland Distance	-1.52	0.71	-2.14	0.03	0.22	0.05	0.88
	Connectance	-0.22	0.24	-0.95	0.34	0.80	0.50	1.27
	Human Distance	-0.06	0.13	-0.45	0.65	0.94	0.73	1.21

Table 64. Welch's two sample t-test comparing total species richness (Chao2) across guzzler ($\bar{x}_{G}$) and non-guzzler sites ($\bar{x}_{NG}$). There is no significant difference between guzzler and non-guzzler site's total species richness (P=0.45; $\bar{x}_{G}$=12.05, $\bar{x}_{NG}$=13.40).

	$\bar{x}_{G}$	$\bar{x}_{NG}$	t	df	*P*
Chao2 Species Richness (Incidence)	13.37	12.05	0.75	68.55	0.46

Figure 1. Map of western Kansas counties representing the study area. Dots represents guzzler and non-guzzler sites surveyed over the 2011 and 2012 survey season (June-August). Map was generated using ArcMap 10.1; Projection in USA Contiguous Albers Equal Area Conic (USGS Version).

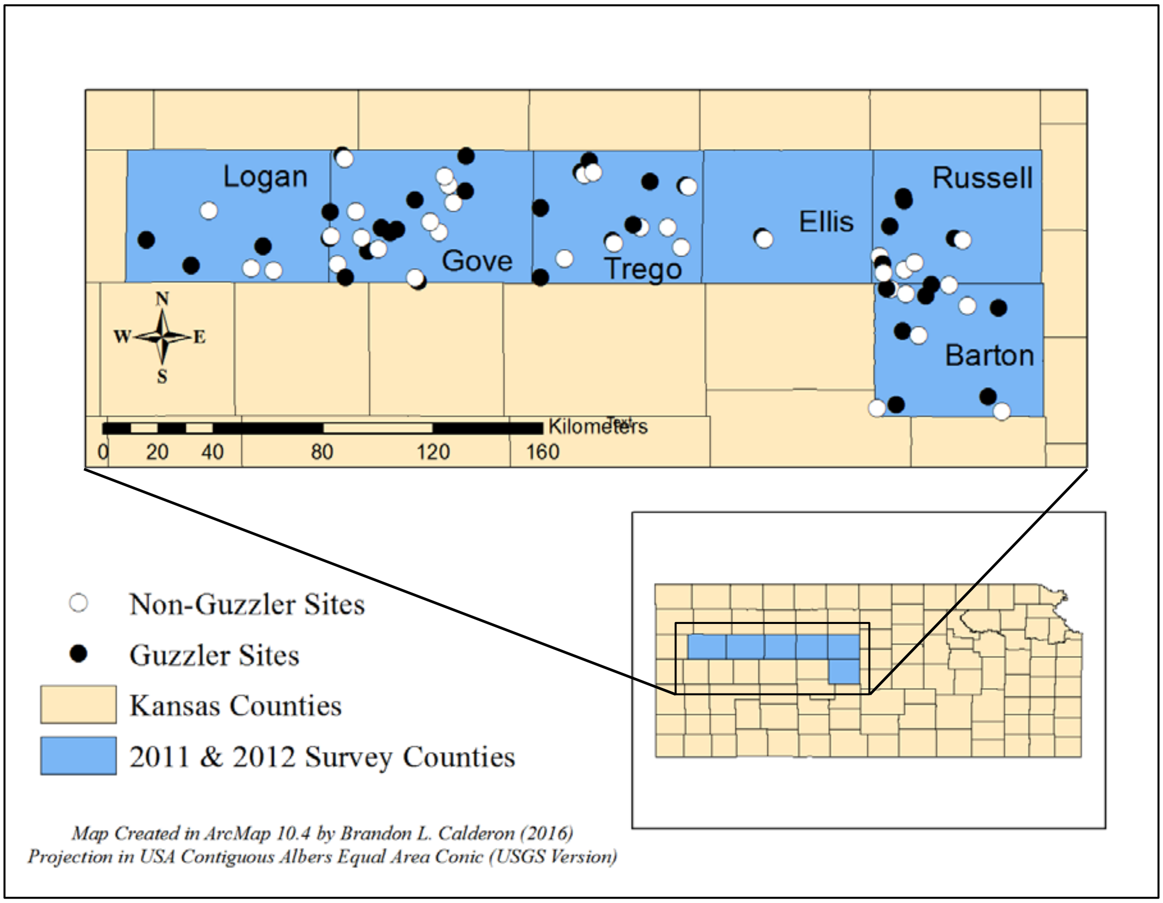


Figure 2. Range of prairie-chicken (*Tympanuchus* spp.) across western Kansas counties. Distribution overlaps all surveyed counties with the exception of Barton County. Dataset was provided by the Kansas Department of Wildlife, Parks, and Tourism, and Kansas Biological Survey. Data accessed via the Kansas GIS Data Access and Support Catalog (KDASC). Map was generated using ArcMap 9.3; Projection in USA Contiguous Albers Equal Area Conic (USGS Version).

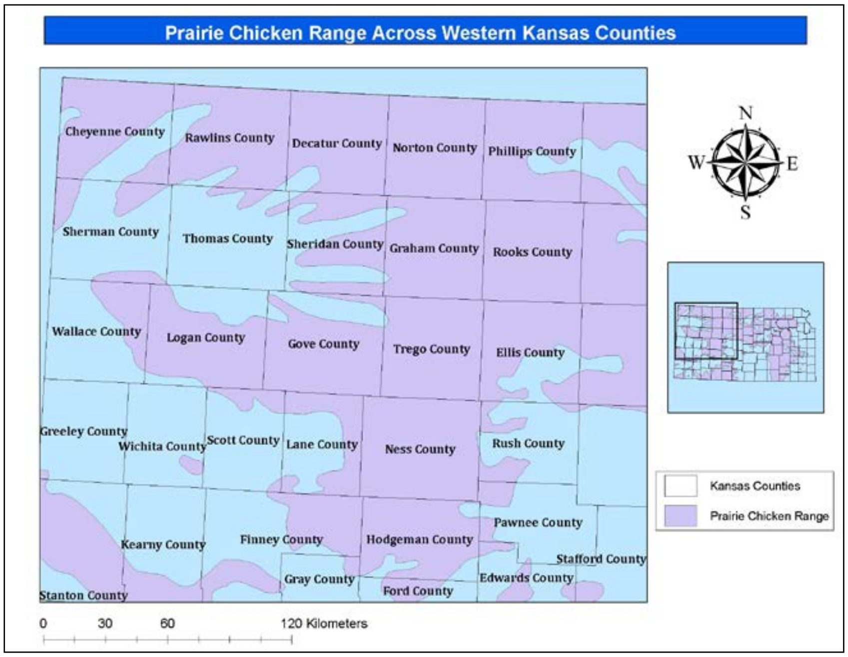


Figure 3. Distribution of ring-necked pheasant (*Phasianus colchicus*) during the 1966-2007 summer months. Ring-necked pheasant distribution appears to overlap all surveyed areas. Figure taken from: Sauer, J. R., J. E. Hines, and J. Fallon. 2008. *The North American Breeding Bird Survey, Results and Analysis 1966 - 2007.* Version 5.15.2008. USGS Patuxent Wildlife Research Center, Laurel, MD. Accessed March 2011: http://www.mbr-pwrc.usgs.gov/bbs/htm96/map617/ra3091.html

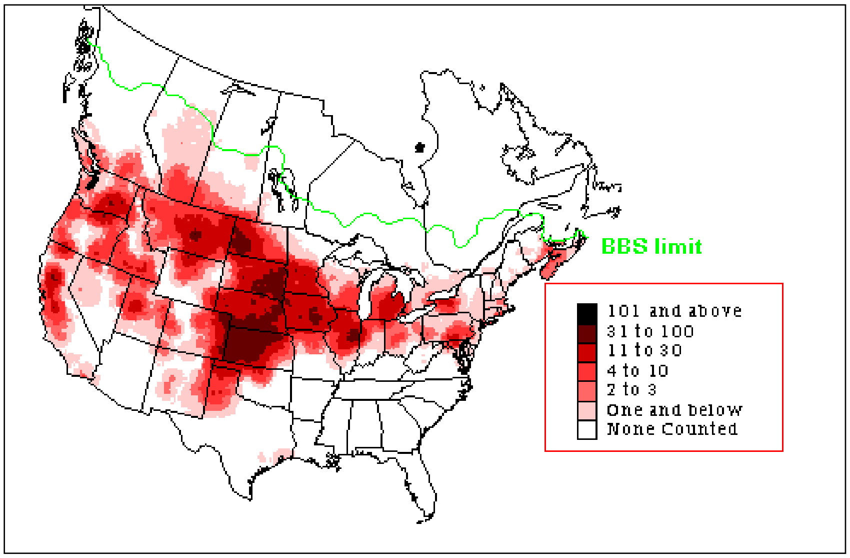


Figure 4. Distribution of northern bobwhite (*Colinus virginianus*) during the summer months from 1994 - 2003. Northern bobwhite distributions appear to overlap all surveyed areas. Figure taken from: Sauer, J. R., J. E. Hines, and J. Fallon. 2008. *The North American Breeding Bird Survey, Results and Analysis 1966 - 2007.* Version 5.15.2008. USGS Patuxent Wildlife Research Center, Laurel, MD. Accessed March 2011: http://www.mbr-pwrc.usgs.gov/bbs/htm03/ra2003_red/ra02890.htm

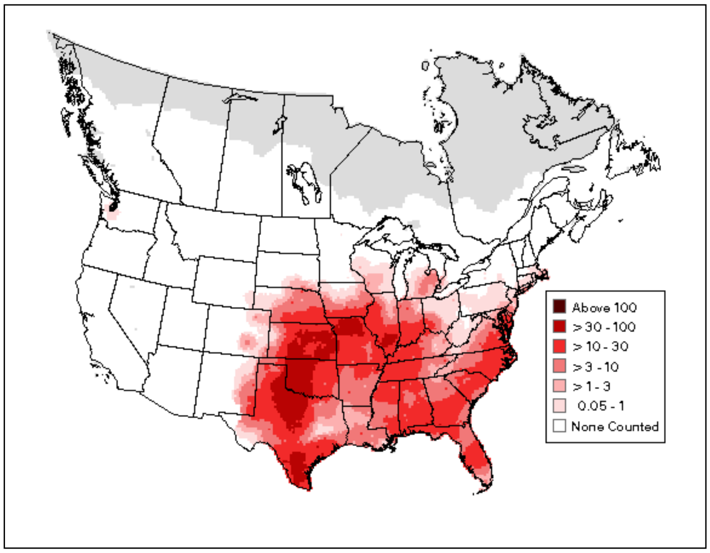


Figure 5. Annual normal precipitation map of Kansas from 1971-2000 showing the longitudinal gradient of precipitation decreasing East to West in Kansas. Precipitation ranges from an average low of 18 inches to a high of 27 inches over the study area. Figure taken from: Kansas Department of Agriculture. 2009. Annual Normal Precipitation 1971-2000. GIS Administrative Services. Accessed 20 March 2011: http://www.ksda.gov/dwr/content/364

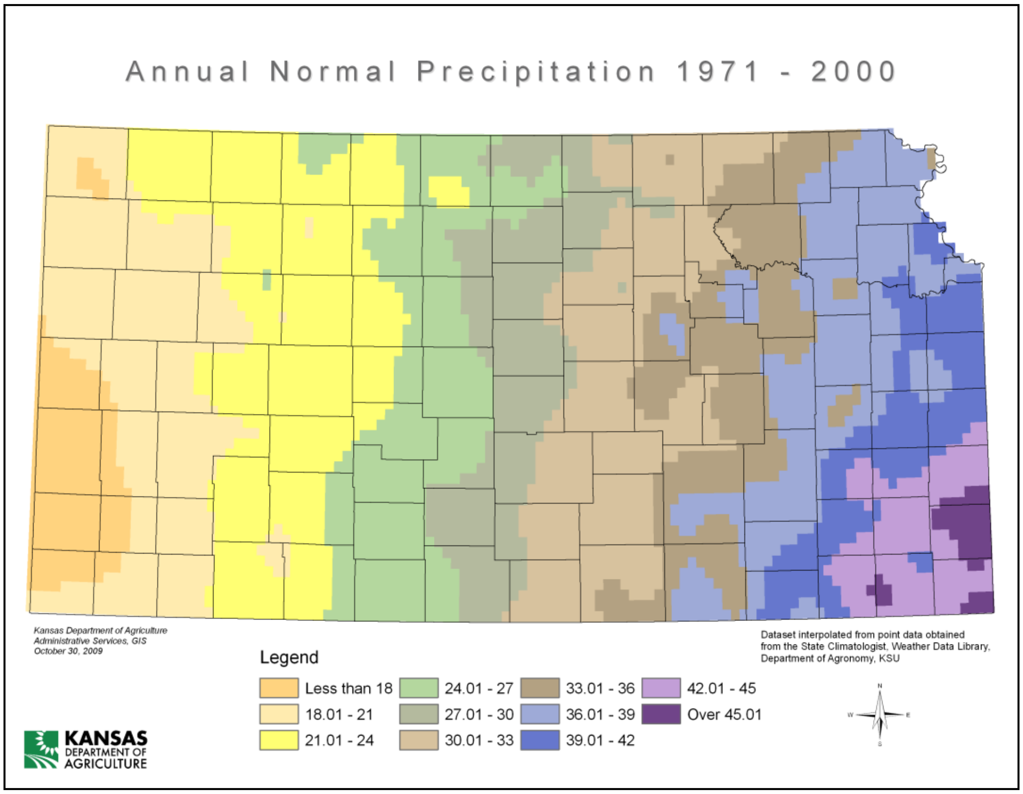


Figure 6. Physiographic map of Kansas showing that the study area runs between the High Plains and Smoky Hills areas. Figure taken from: Kansas Geological Survey. 1997. Generalized physiographic map of Kansas. University of Kansas. Lawrence, KS, USA. Accessed 14 March 2011: http://www.kgs.ku.edu/Physio/physio.html.

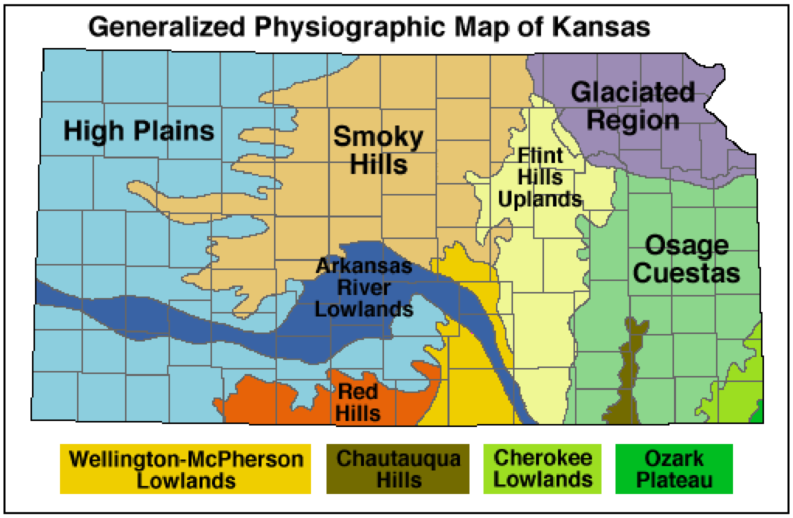
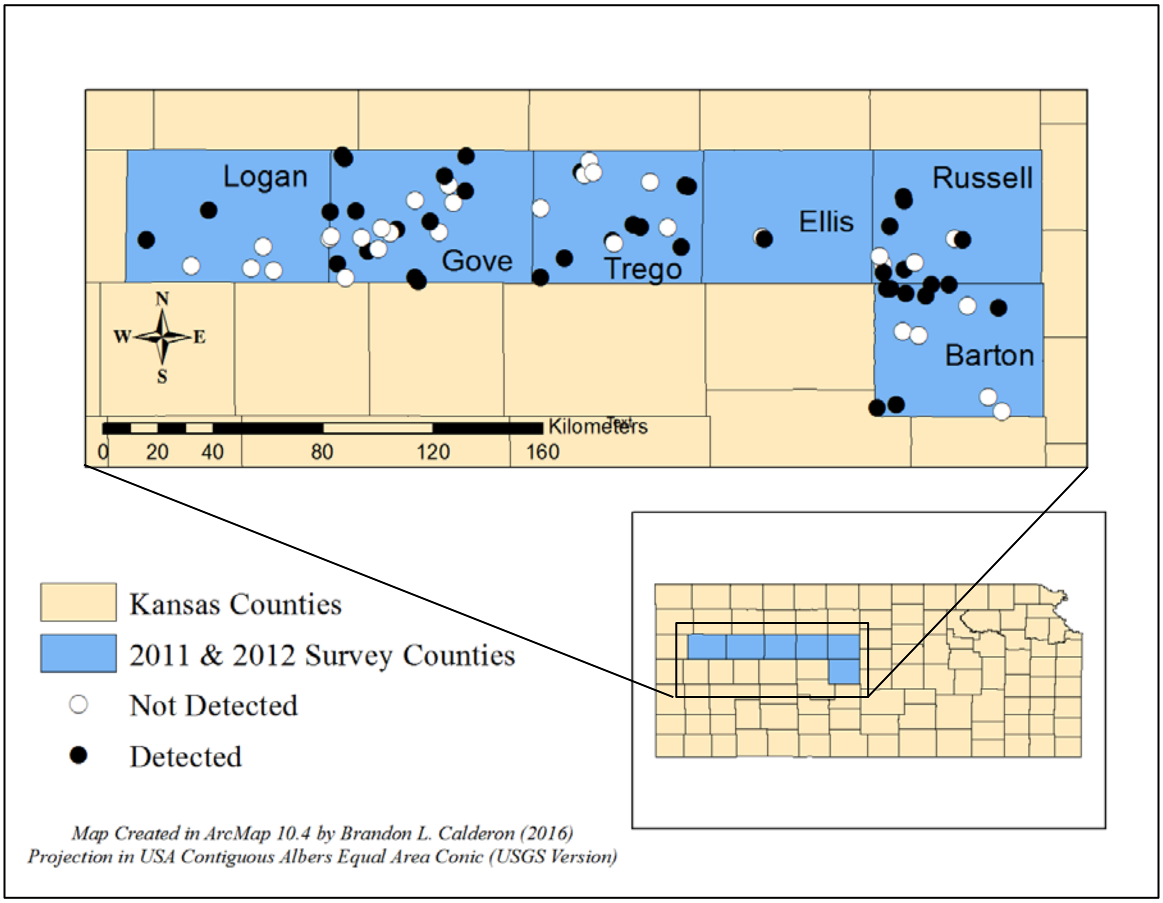


Figure 7. Relative spatial distribution of ring-necked pheasant *(Phasianus colchicus*) detections and non-detections across all surveyed sites (n=72) over the 2011 and 2012 seasons (June – August). Sites represented by a darkened dot indicate the detection of ring-necked pheasant on at least one sampling occasion, and hollow dots represent non-detection.



Map Created in ArcMap 10.4 by Brandon L. Calderon (2016)
Projection in USA Contiguous Albers Equal Area Conic (USGS Version)

Figure 8. Relative spatial distribution of coyote *(Canis latrans*) detections and non-detections across all surveyed sites (n=72) over the 2011 and 2012 seasons (June – August). Sites represented by a darkened dot indicate the detection of coyotes on at least one sampling occasion, and hollow dots represent non-detection.

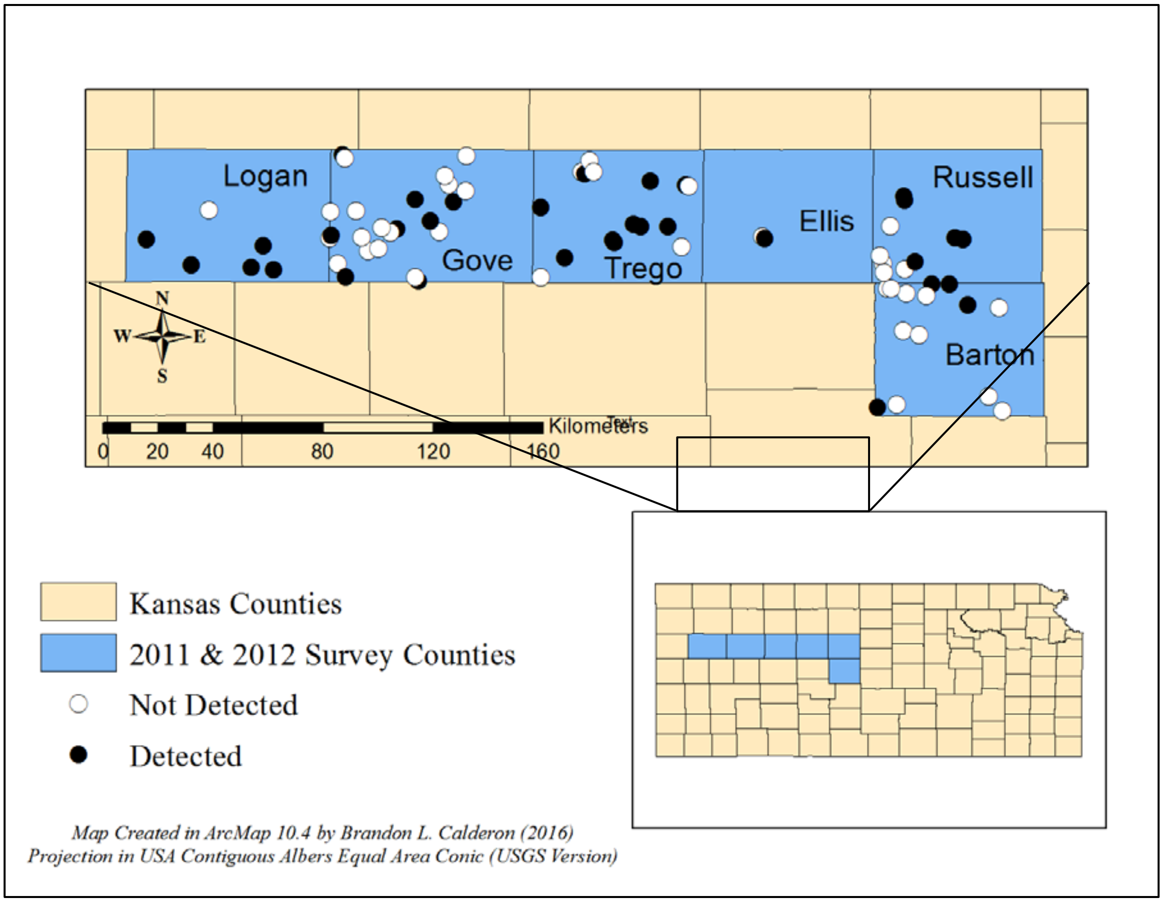


Figure 9. Relative spatial distribution of American badger *(Taxidea taxus*) detections and non-detections across all surveyed sites (n=72) over the 2011 and 2012 seasons (June – August). Sites represented by a darkened dot indicate the detection of badgers on at least one sampling occasion, and hollow dots represent non-detection.

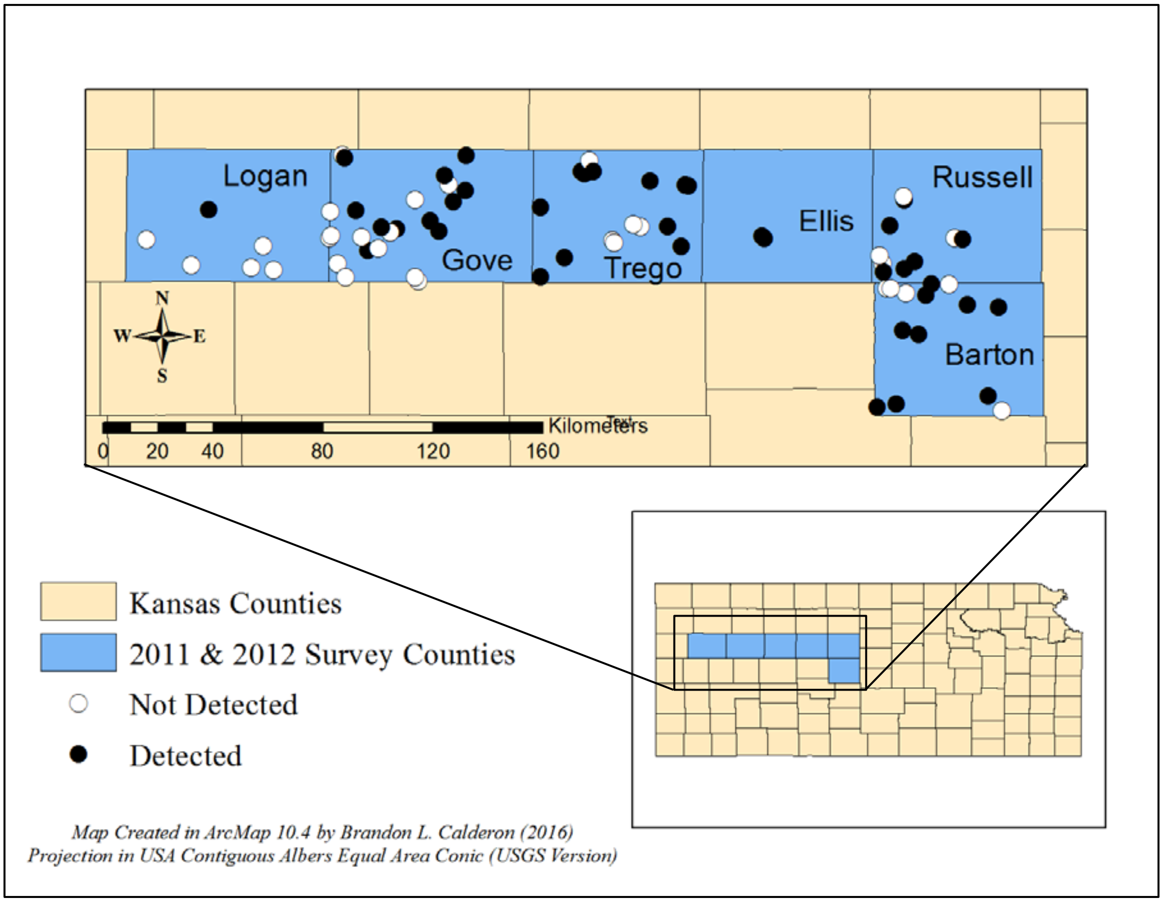


Figure 10. Relative spatial distribution of raccoon *(Procyon lotor*) detections and non-detections across all surveyed sites (n=72) over the 2011 and 2012 seasons (June – August). Sites represented by a darkened dot indicate the detection of raccoons on at least one sampling occasion, and hollow dots represent non-detection).

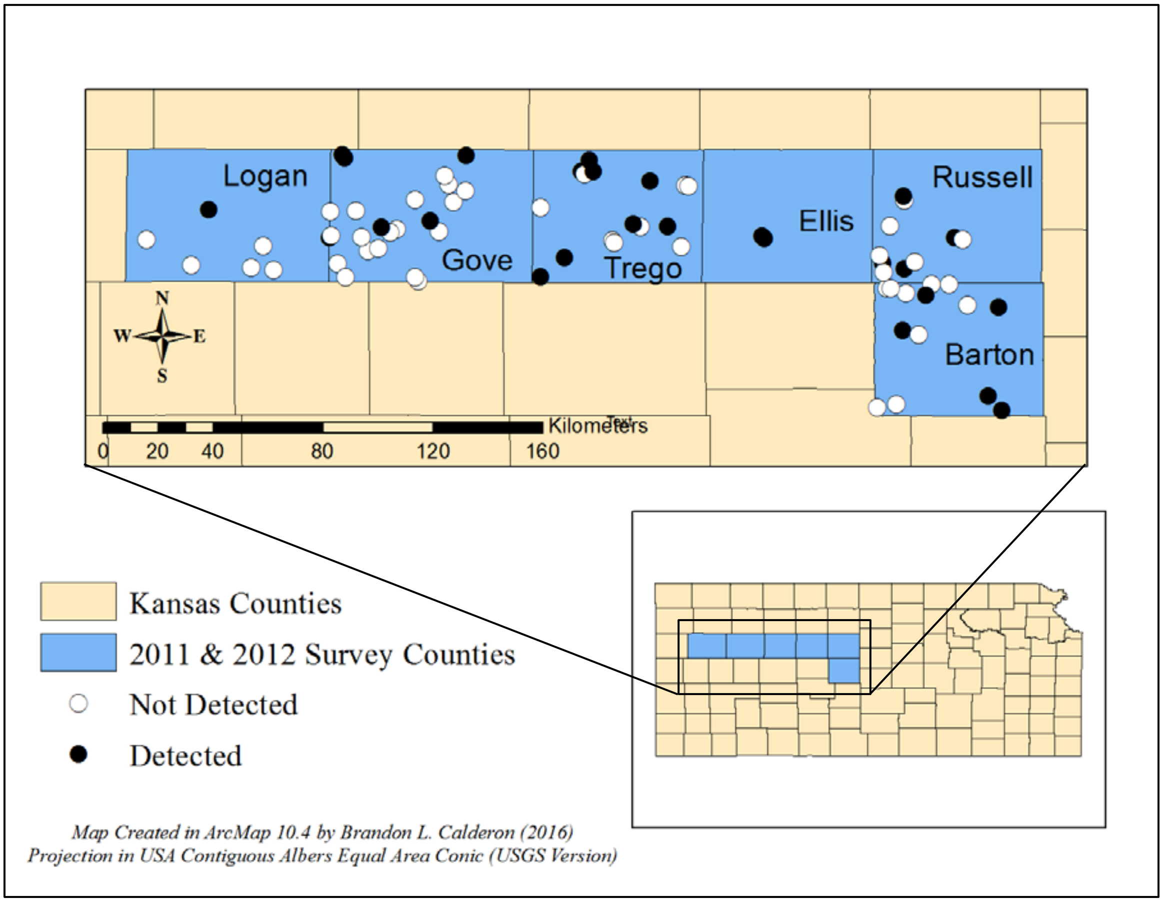
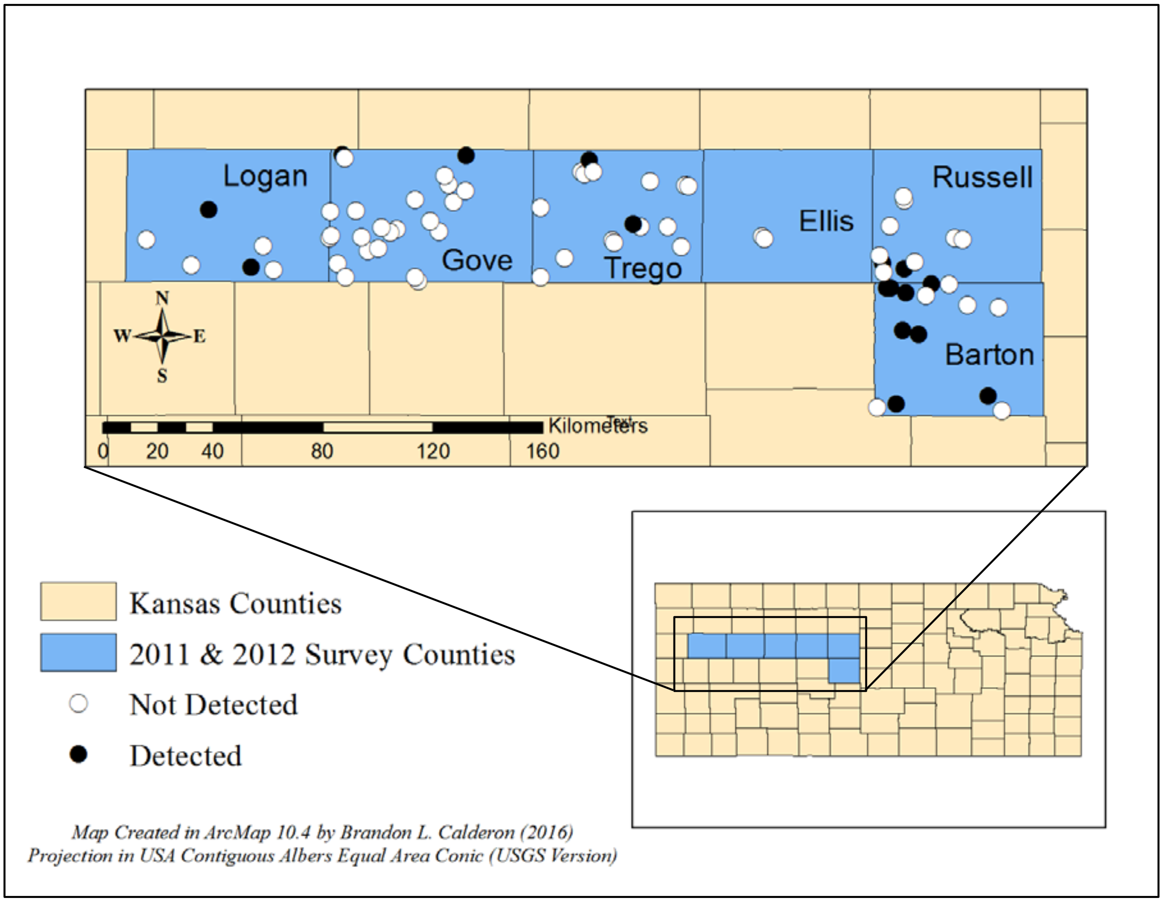


Figure 11. Relative spatial distribution of striped-skunk (*Mephitis mephitis*) detections and non-detections across all surveyed sites (n=72) over the 2011 and 2012 seasons (June – August). Sites represented by a darkened dot indicate the detection of striped-skunk on at least one sampling occasion, and hollow dots represent non-detection.



Map Created in ArcMap 10.4 by Brandon L. Calderon (2016)
Projection in USA Contiguous Albers Equal Area Conic (USGS Version)

Figure 12. Mantel test for spatial autocorrelation among modelable detections of ring-necked pheasants (*Phasianus colchicus*) at cameras (*r* = 0.004, *df.* = 63, *P* = 0.38) and sites (*r* =0.001 = , *df.*= 39 = , *P* = 0.39). Detection data acquired from western Kansas counties during the 2011 and 2012 field seasons (June - August). Camera scale is treating each camera as the sampling unit, whereas site scale aggregates all three cameras per CRP field as a sampling unit.

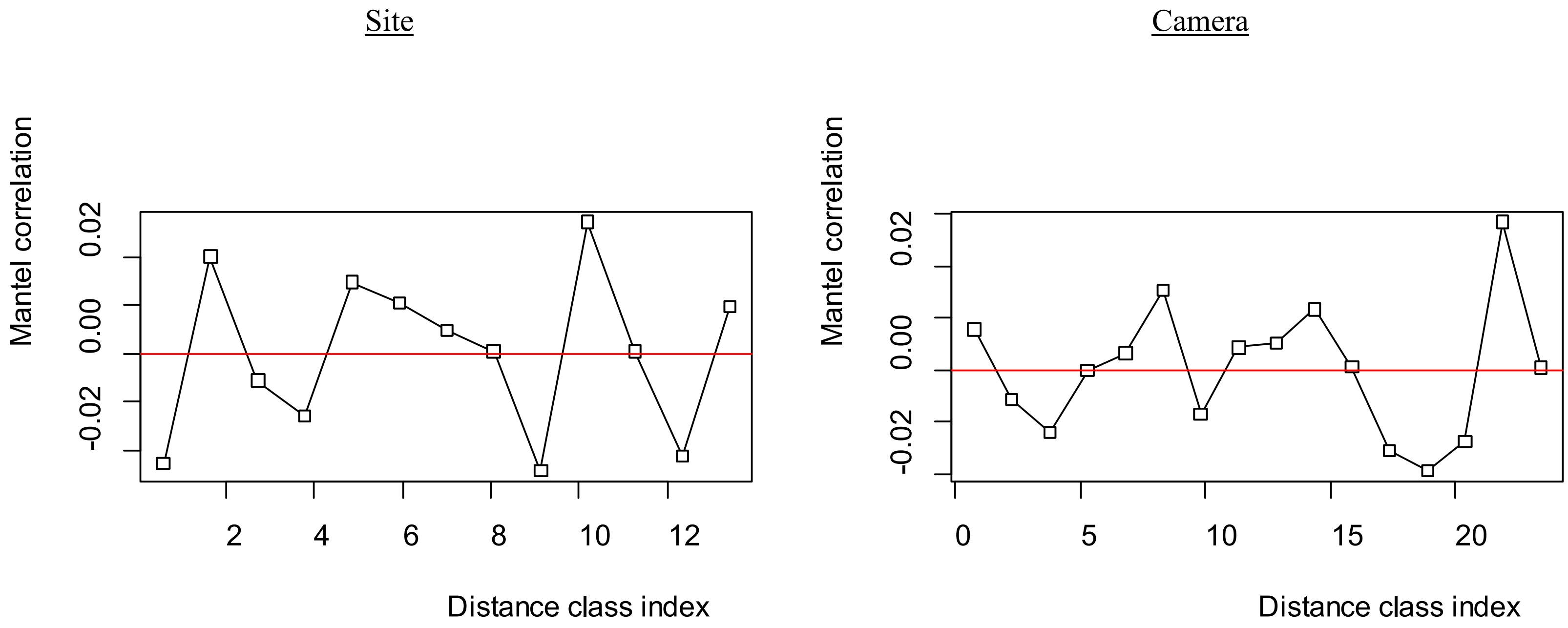


Figure 13. Mantel test for spatial autocorrelation among modelable detections of coyotes (*Canis latrans*) at cameras ($r = 0.01$, *df.* $= 41$, $P = 0.30$) and sites ($r = -0.005$, *df.* $= 32$, $P = 0.48$). Detection data acquired from western Kansas counties during the 2011 and 2012 field seasons (June - August). Camera scale is treating each camera as the sampling unit, whereas site scale aggregates all three cameras per CRP field as a sampling unit.

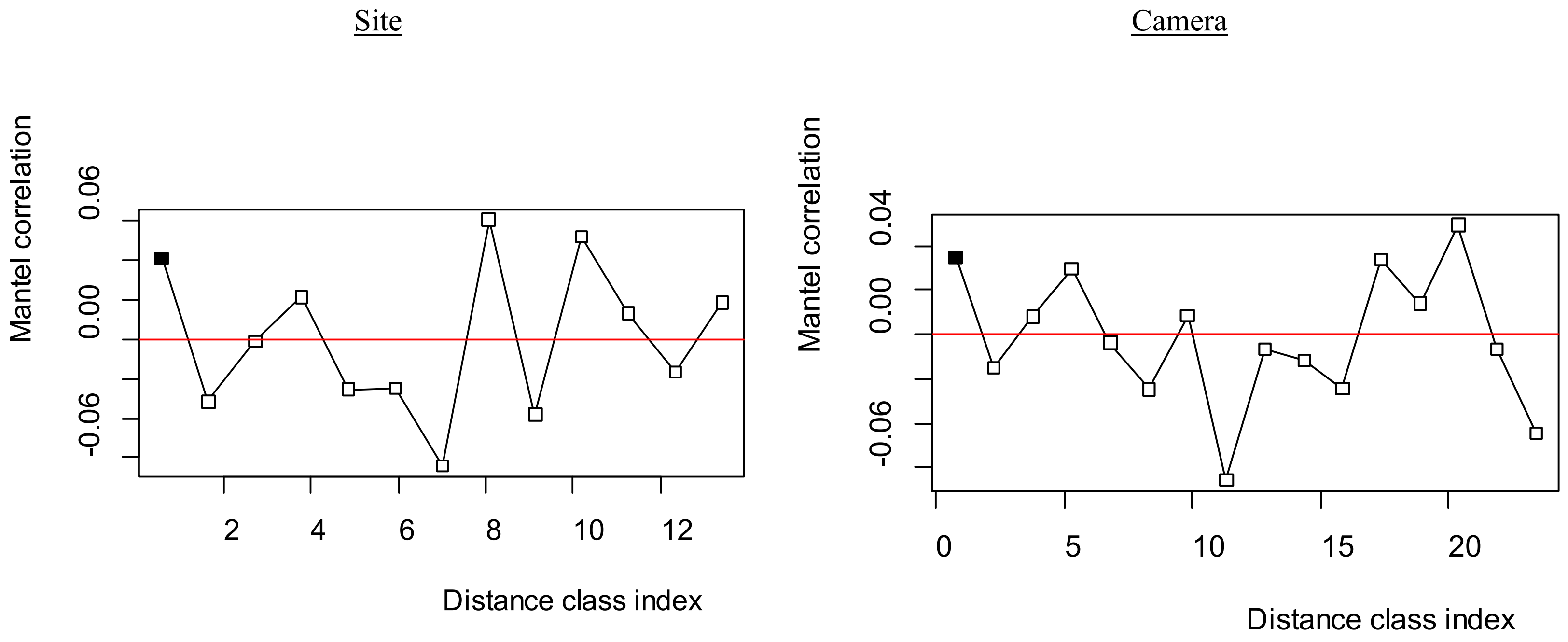
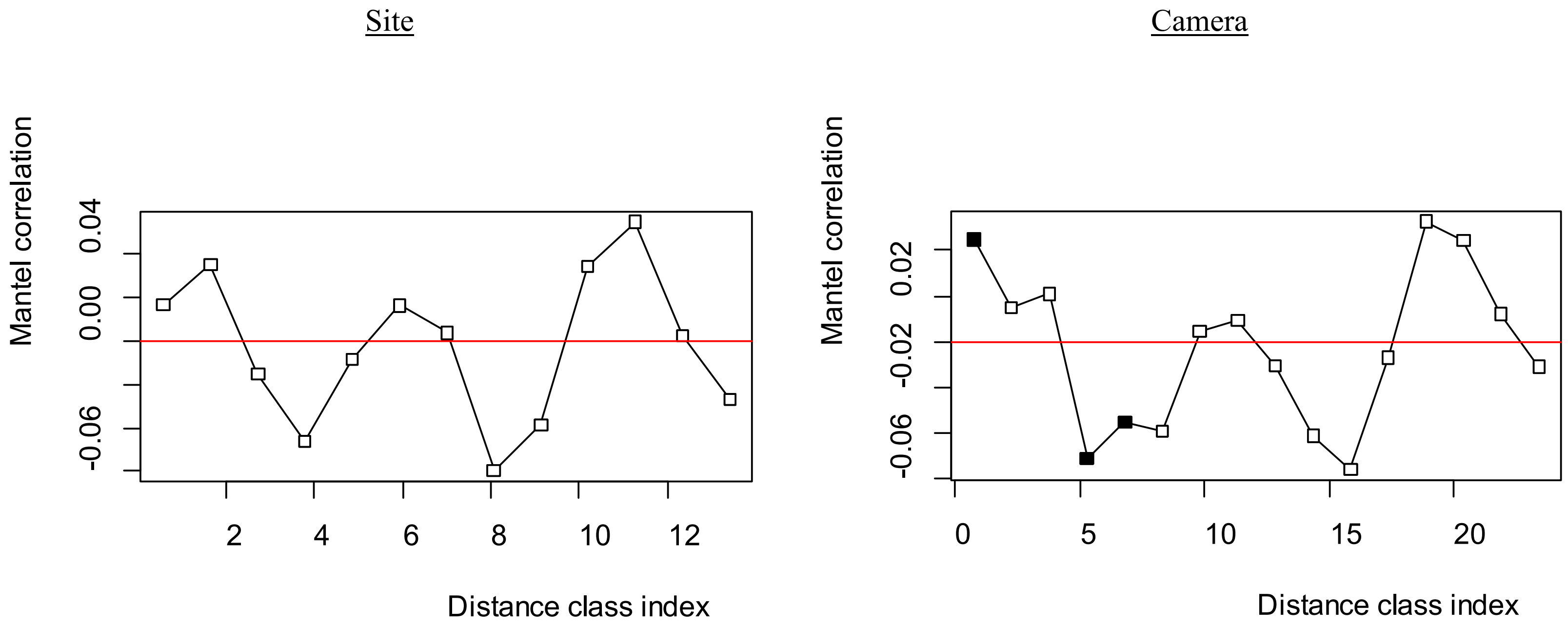


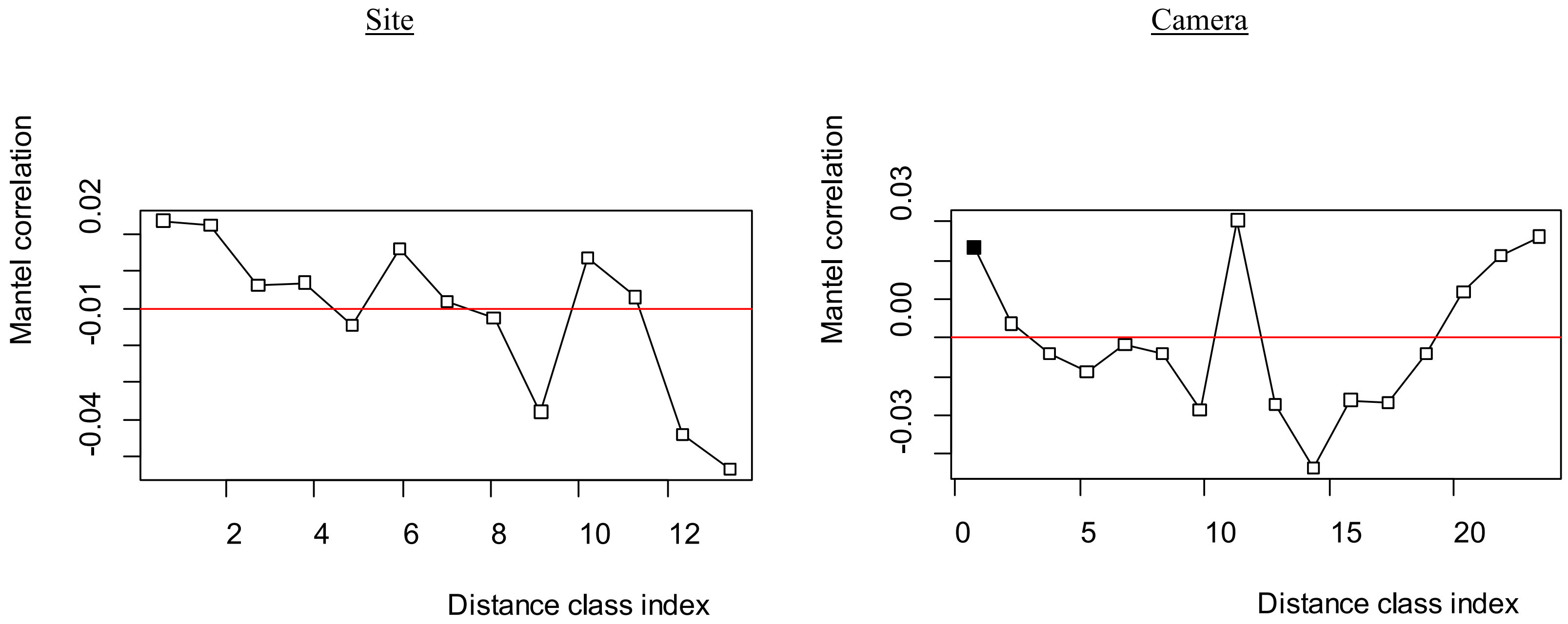
Figure 14. Mantel test for spatial autocorrelation among modelable detections of *Procyon lotor* at cameras (r = -0.004, *df.* = 33, P = 0.56) and sites (r = 0.005, *df.* = 25, P = 0.36). Detection data acquired from western Kansas counties during the 2011 and 2012 field seasons (June - August). Camera scale is treating each camera as the sampling unit, whereas site scale aggregates all three cameras per CRP field as a sampling unit.



Site

Camera

Figure 15. Mantel test of spatial autocorrelation among modelable detections of *Taxidea taxus* at cameras (r = -0.004, *df.* = 55, P = 0.58) scale and sites (r = 0.057, *df.* = 39, P = 0.02). Detection data acquired from western Kansas counties during the 2011 and 2012 field seasons (June - August). Camera scale is treating each camera as the sampling unit, whereas site scale aggregates all three cameras per CRP field as a sampling unit.



Site

Camera

Figure 16. Mantel test of spatial autocorrelation among modelable detections of *Mephitis mephitis* at cameras (r = 0.068, *df.* = 21, P =0.004) and sites (r = 0.103, *df.* = 16, P = 0.01). Detection data acquired from western Kansas counties during the 2011 and 2012 field seasons (June - August). Camera scale is treating each camera as the sampling unit, whereas site scale aggregates all three cameras per CRP field as a sampling unit.

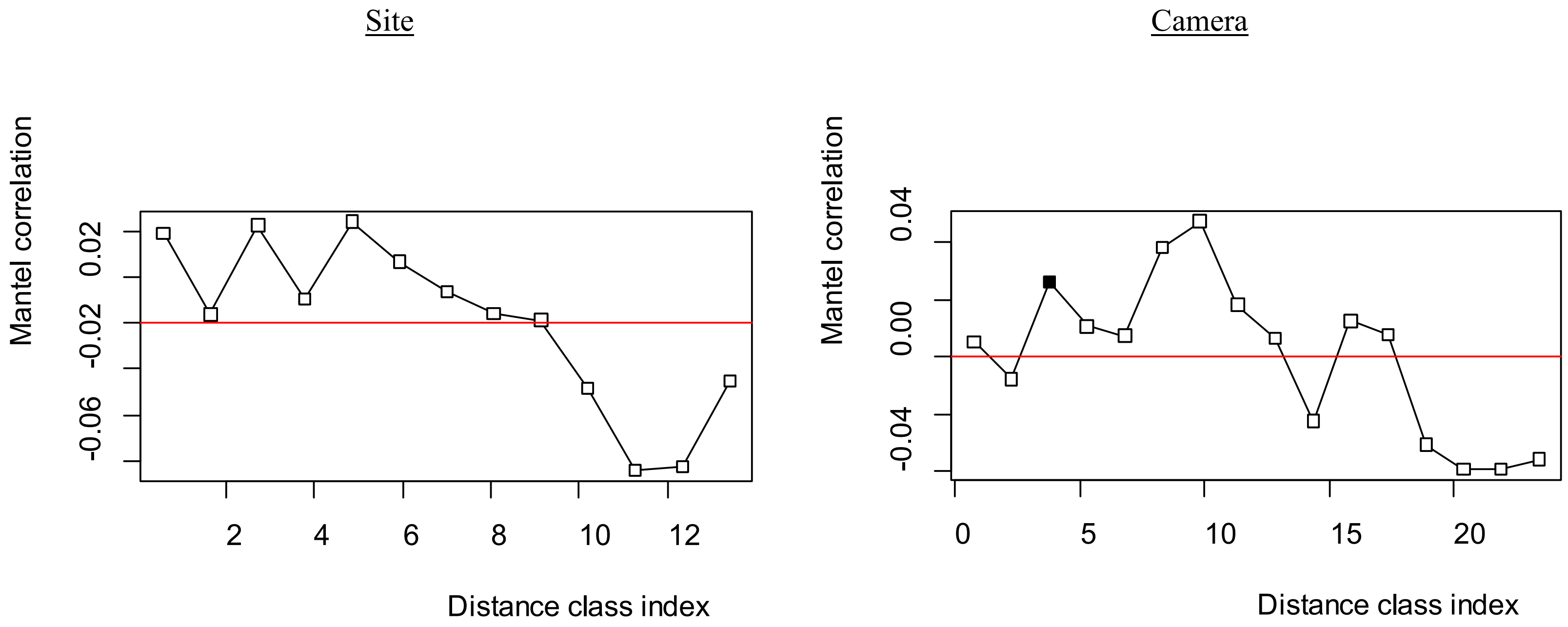


Figure 17. Relative predicted detection probabilities (*p*) for ring-necked pheasant (*Phasianus colchicus*) at guzzler and non-guzzler cameras across month of survey. Dashed lines represent 95% CI for *p* as a result of the interaction between Guzzler and Month coefficients; they do not signify the significance of individual covariates in the composite model.

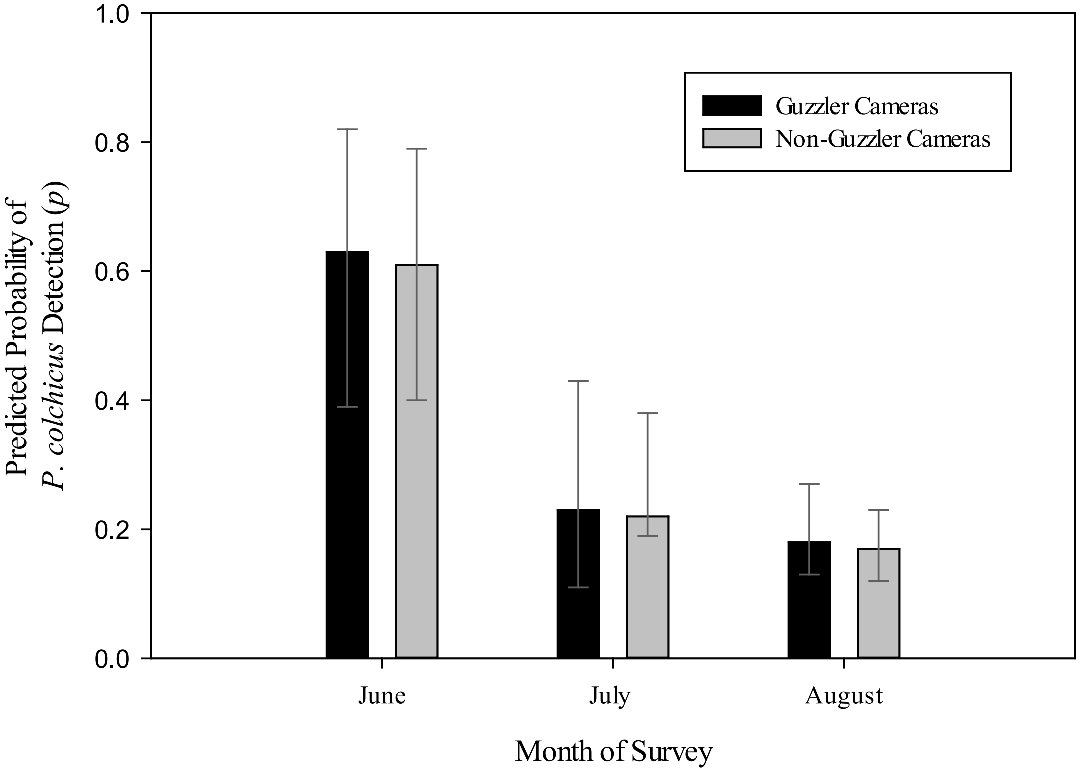


Figure 18. Relative predicted detection probabilities (*p*) for ring-necked pheasant (*Phasianus. colchicus*) in western Kansas across temperature variance at cameras during the 2011 and 2012 seasons (June – August). Dashed lines represent 95% CI for *p* as a result of the interaction between Month and Temperature Variance coefficients; they do not signify the significance of individual covariates in the composite model.

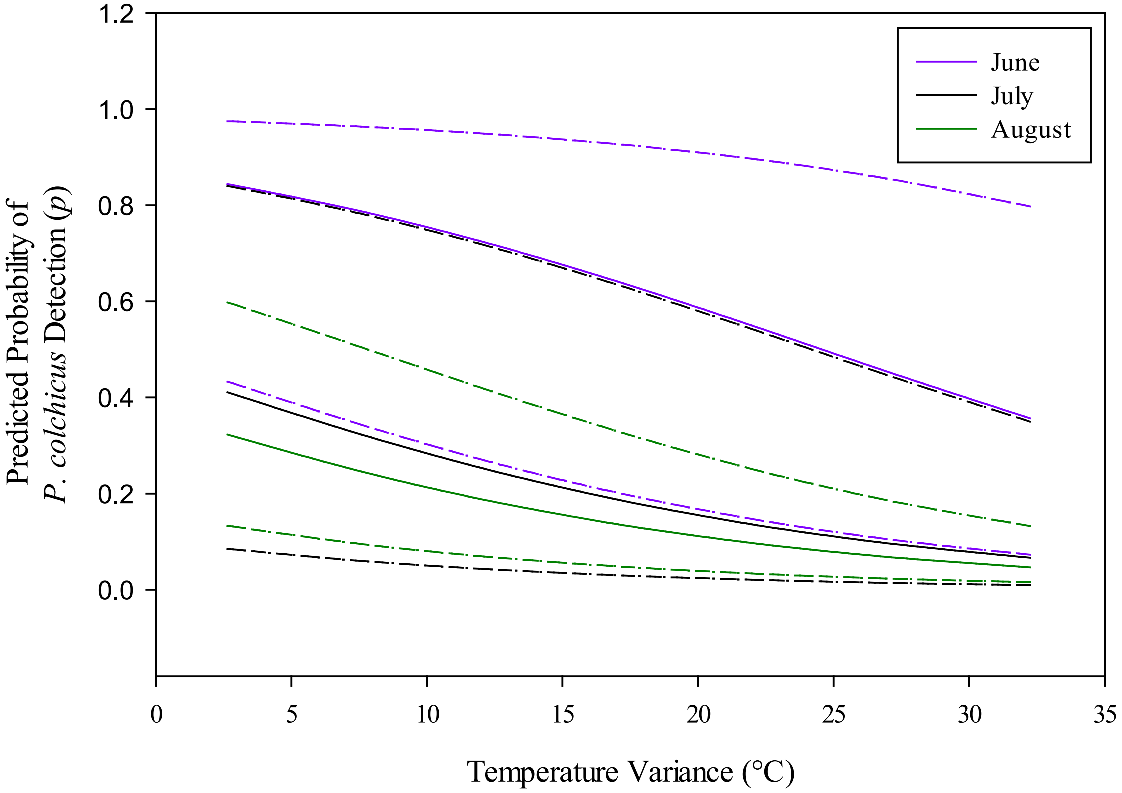


Figure 19. Relative predicted detection probabilities (*p*) for ring-necked pheasant (*Phasianus colchicus*) at differing temperature variances across guzzler and non-guzzler cameras during the 2011 and 2012 season (June - August). Dashed lines represent 95% CI for *p* as a result of the interaction between the Guzzler and Temperature Variance coefficients; they do not signify the significance of individual covariates in the composite model.

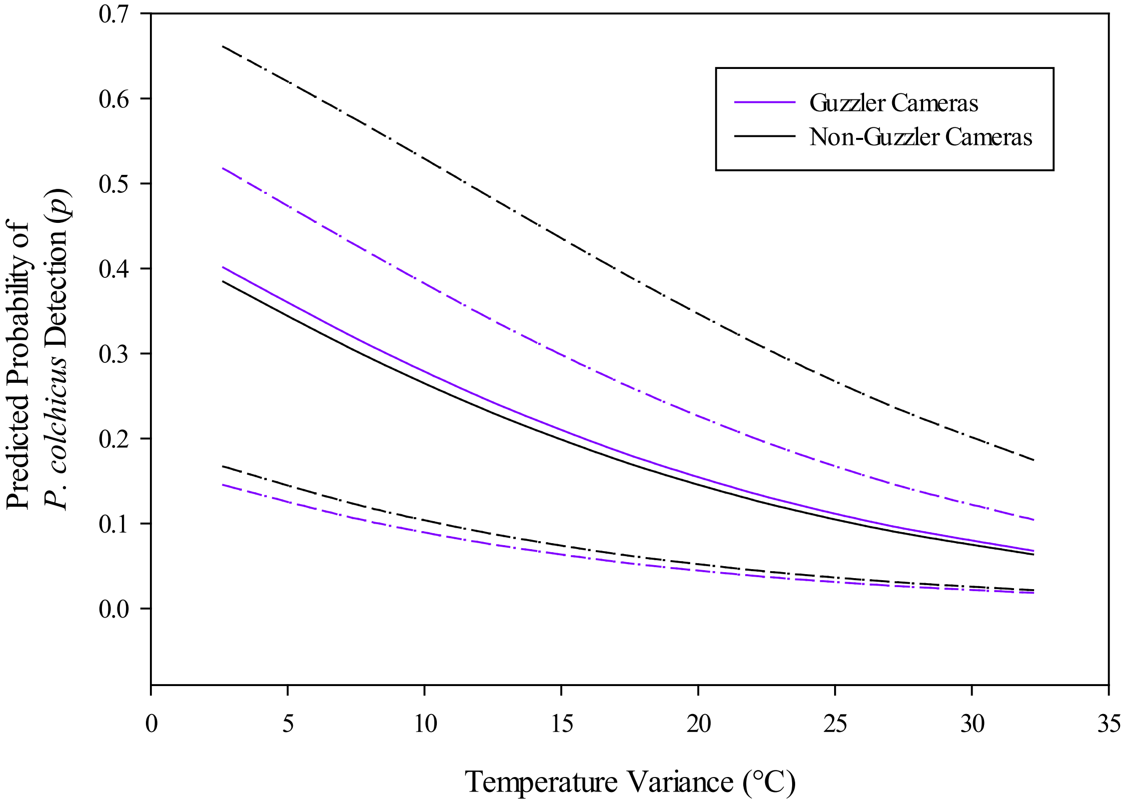


Figure 20. Relative occupancy probabilities (psi) for ring-necked pheasant (*Phasianus colchicus*) as predicted by camera distance from edge during the 2011 and 2012 seasons (June – August). Dashed lines represent 95% confidence intervals.

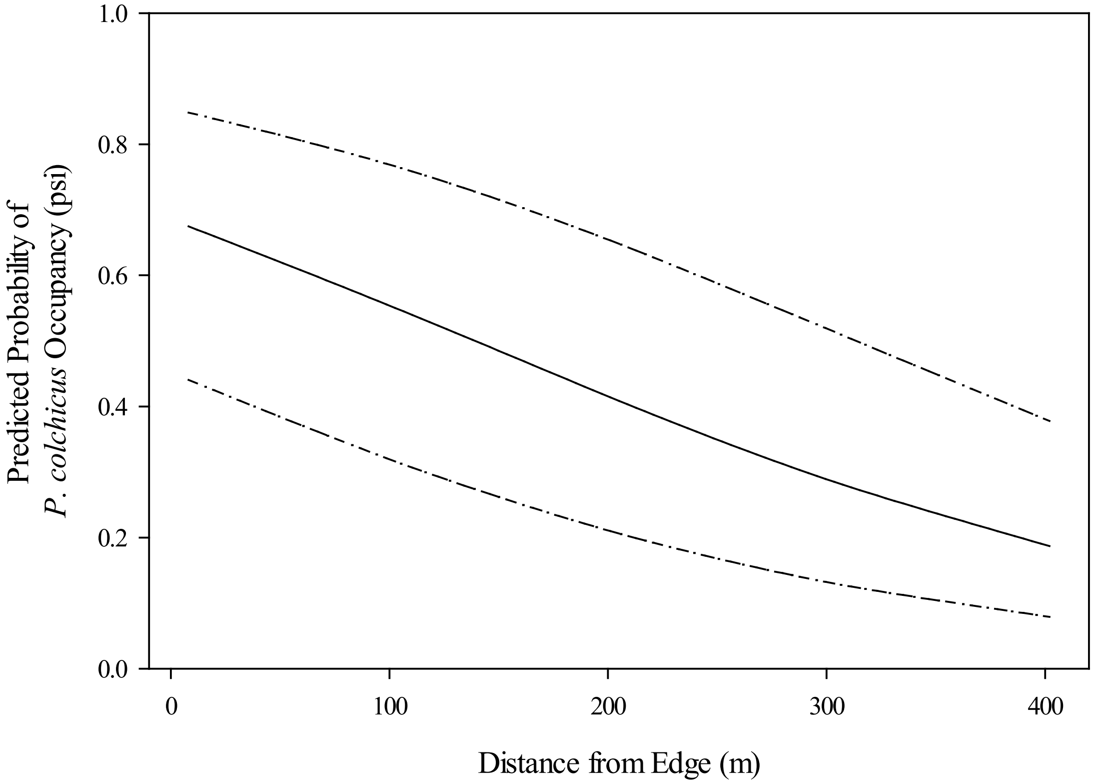


Figure 21. Relative occupancy probabilities (*p*) for ring-necked pheasant (*Phasianus colchicus*) as predicted by percent of forb cover at cameras during the 2011 and 2012 seasons (June – August). Dashed lines represent 95% confidence intervals.

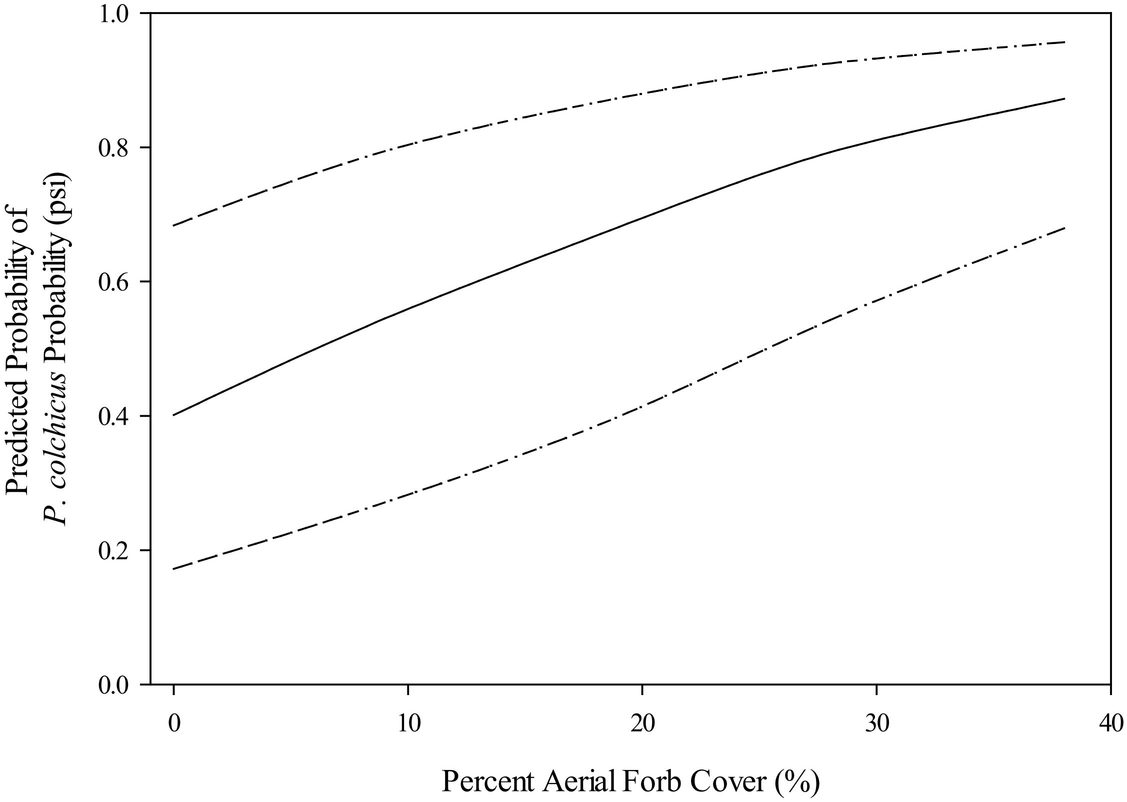


Figure 22. Relative predicted detection probabilities (*p*) for coyote (*Canis latrans*) across guzzler and non-guzzler cameras during the 2011 and 2012 seasons (June – August). Error bars represent 95% confidence intervals.

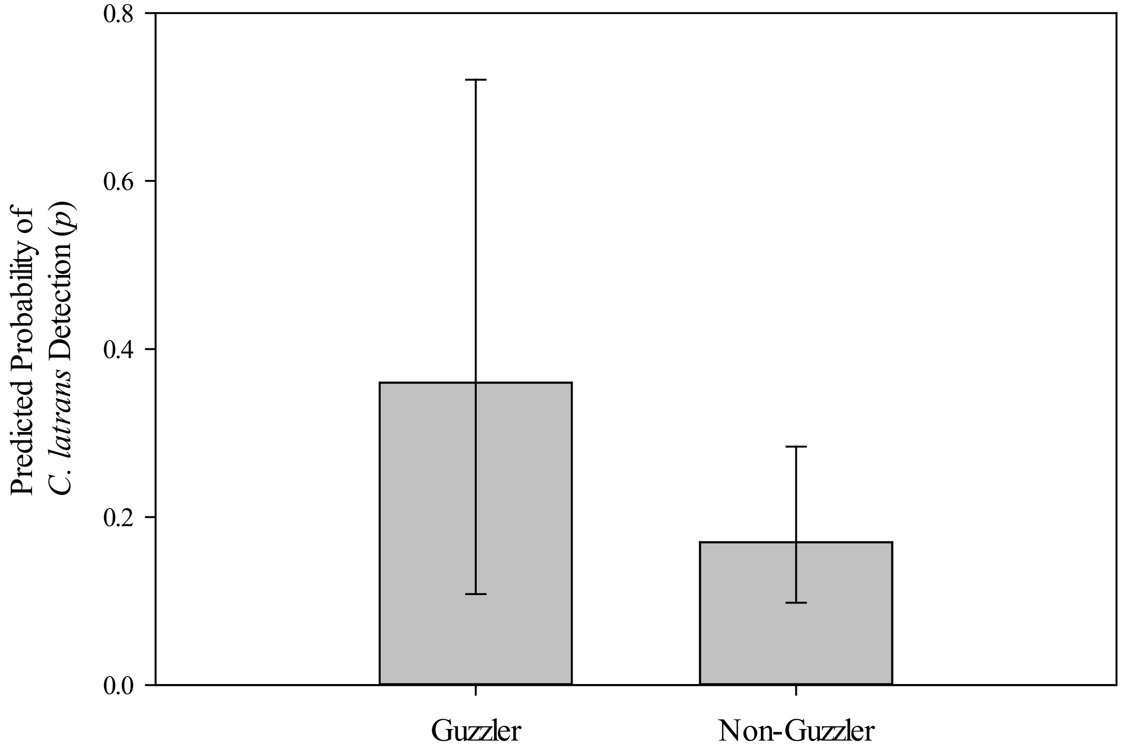


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Figure 23. Relative occupancy probabilities (*psi*) for coyote (*Canis latrans*) as predicted by vegetation structural diversity (VOR Diversity) at cameras during the 2011 and 2012 seasons (June – August). Dashed lines represent 95% confidence intervals.

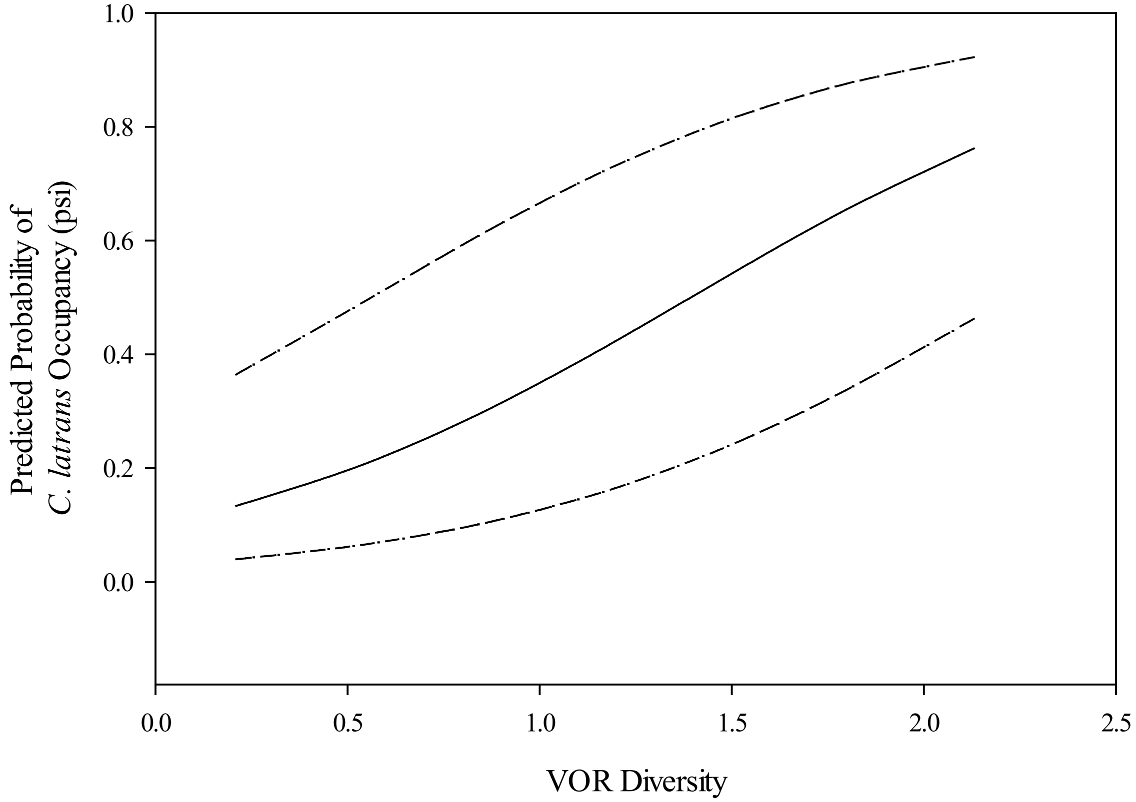


Figure 24. Relative detection probabilities (p) for American badger (*Taxidea taxus*) as predicted by total weekly precipitation across guzzler and non-guzzler cameras during the 2011 and 2012 seasons (June - August). Dashed lines represent 95% confidence intervals for predicted probability of detection as a result of the interaction between Guzzler and Precipitation.

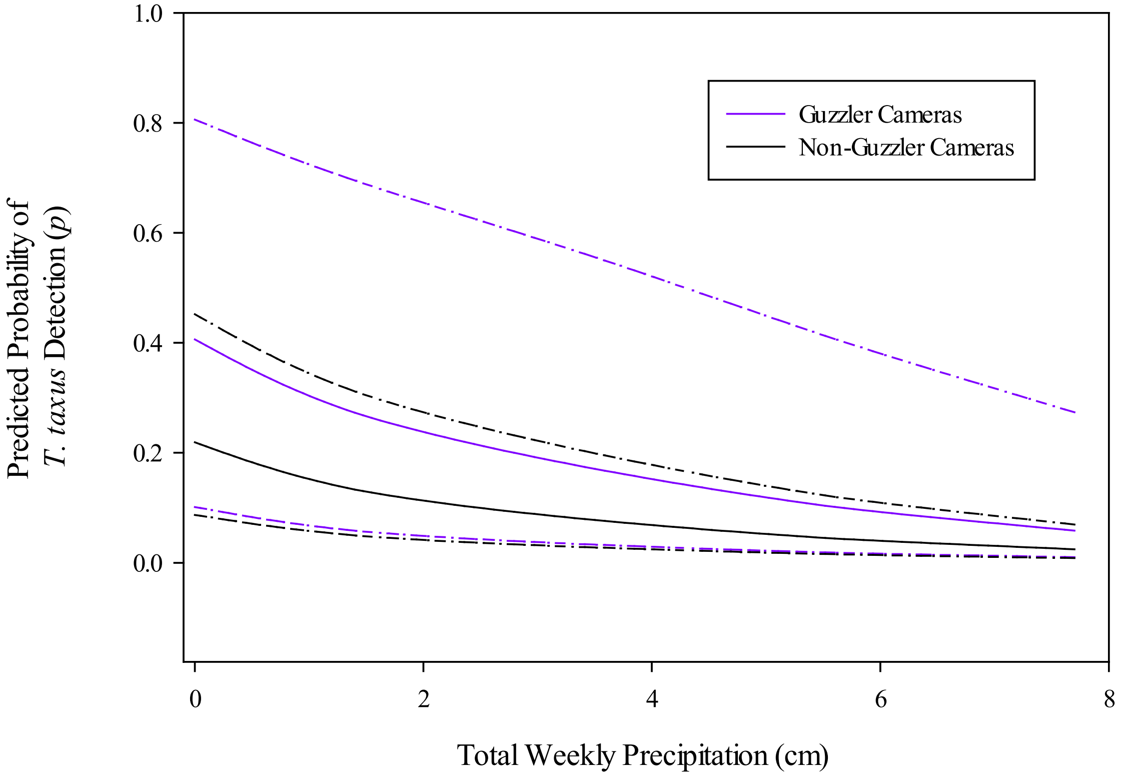


Figure 25. Relative occupancy (psi) for American badger (*Taxidea taxus*) as predicted by camera distance from human dwelling (Human Distance) during the 2011 and 2012 seasons (June – August). Dashed lines represent 95% confidence intervals.

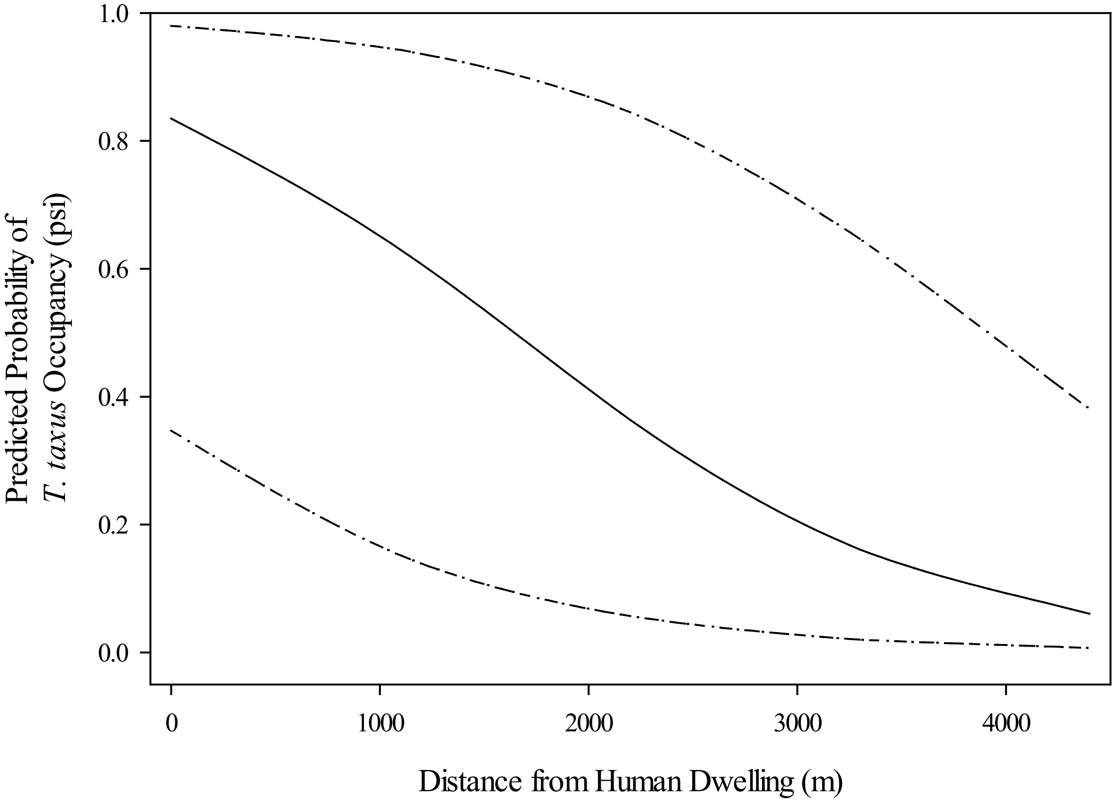


Figure 26. Relative detection occupancy (psi) for American badger (*Taxidea taxus*) as predicted by camera distance from edge (Edge Distance). Dashed lines represent 95% confidence intervals for predicted probability of detection; the coefficient for Edge Distance was statistically significant (*P*=0.02).

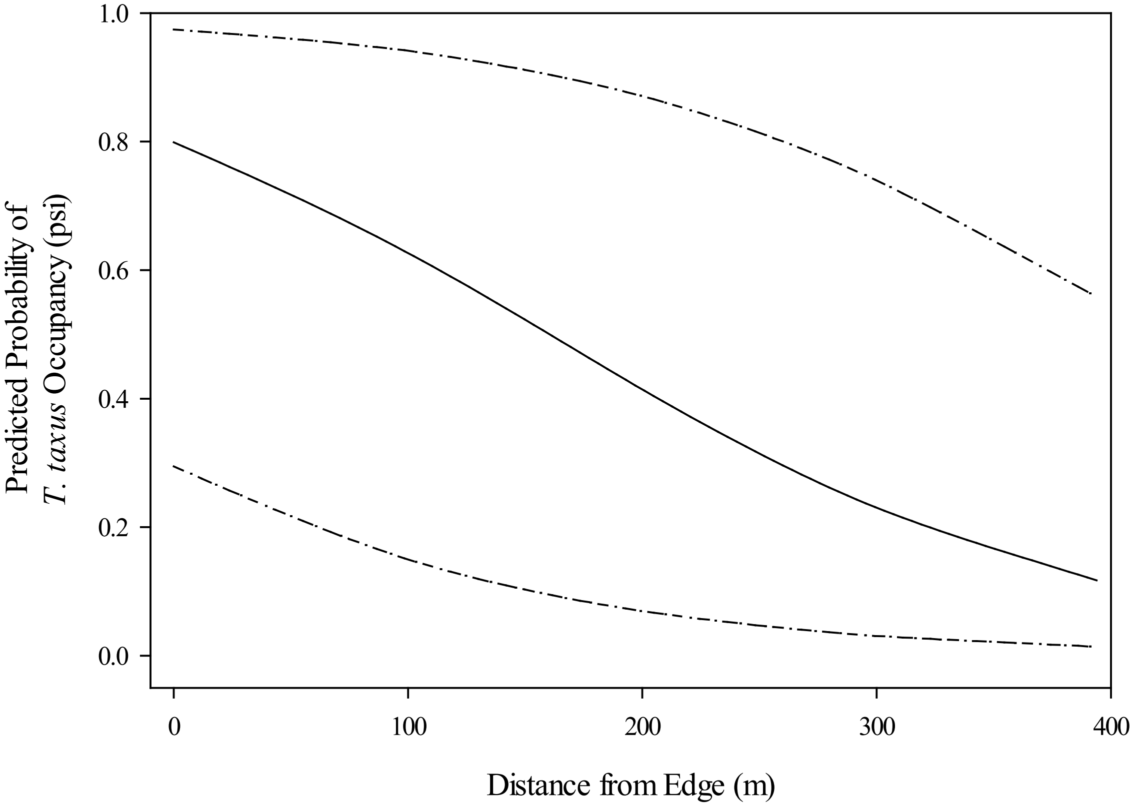


Figure 27. Relative predicted probability of detection (*p*) for raccoon (*Procyon lotor*) for cameras both at guzzlers (Guzzler) not at guzzlers (Non-Guzzler) during the 2011 and 2012 seasons (June – August). Dashed lines represent 95% confidence intervals.

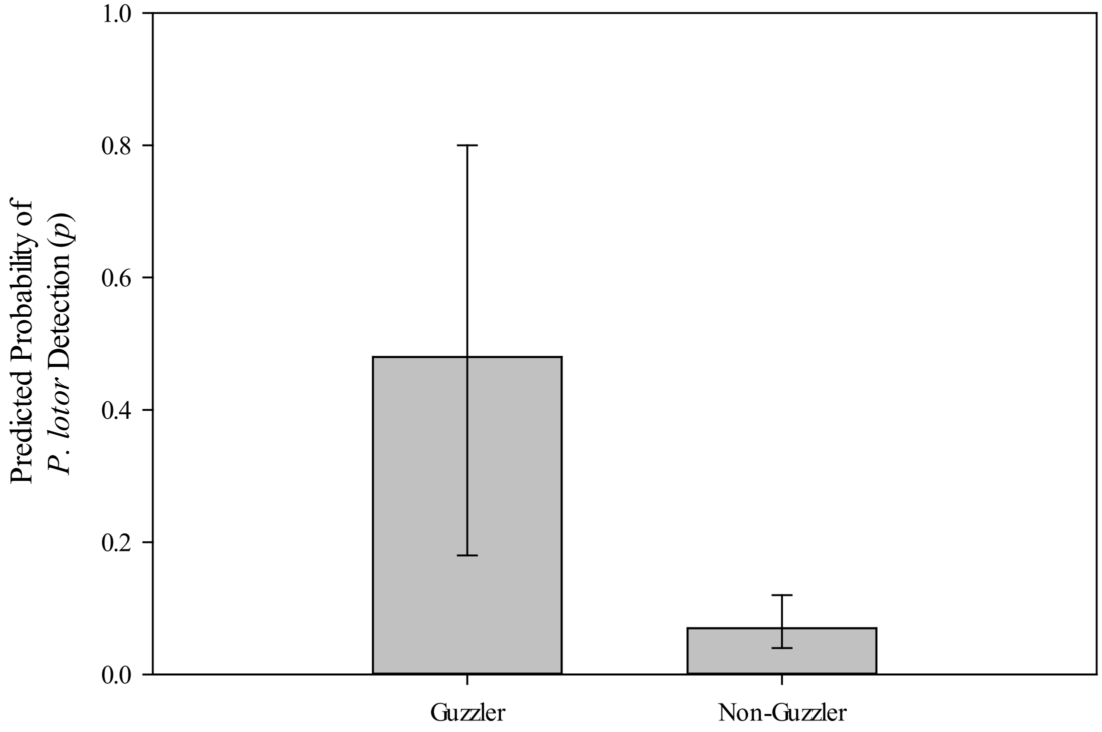


Figure 28. Relative occupancy (psi) for raccoon (*Procyon lotor*) predicted by camera distance from human dwelling (Human Distance) during the 2011and 2012 seasons (June – August). Dashed lines represent 95% confidence intervals.

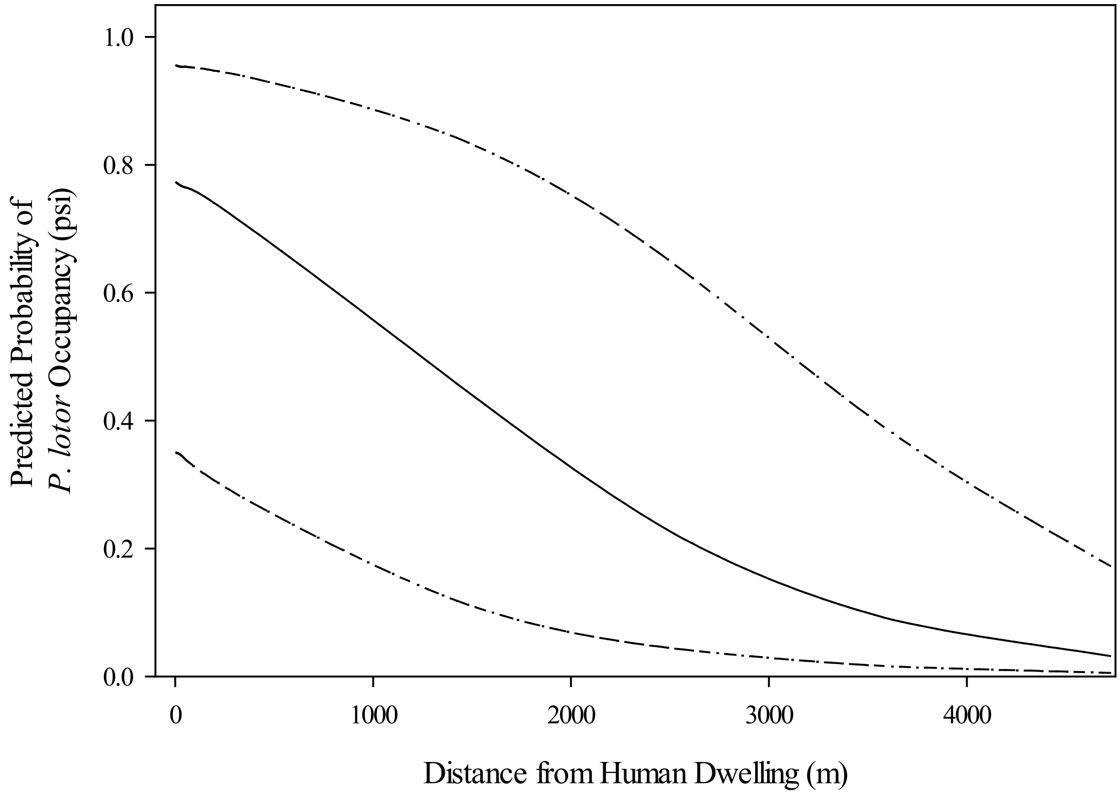


Figure 29. Relative probability of detection (*p*) for striped skunk (*Mephitis mephitis*) as predicted as guzzler and non-guzzler cameras during the 2011 and 2012 seasons (June – August). Error bars represent 95% confidence intervals for predicted probability of detection.

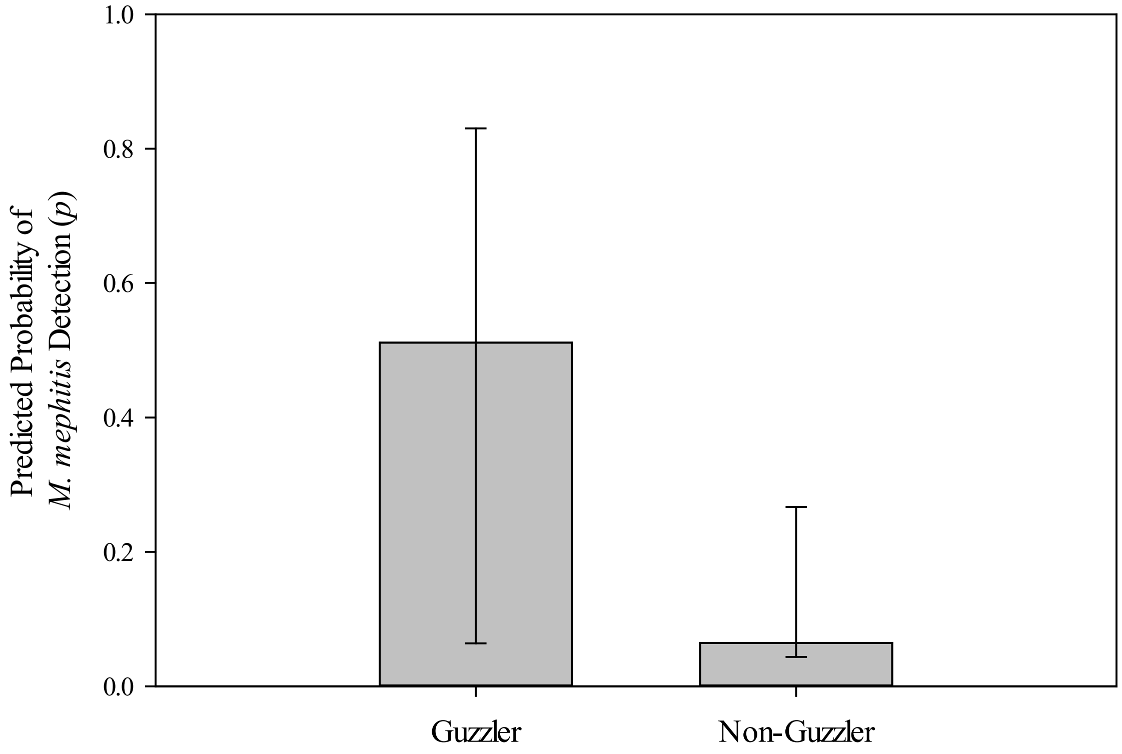


Figure 30. Relative probability of occupancy (psi) for striped skunk (*Mephitis mephitis*) as predicted by percent aerial cover of legumes (%Legume). Dashed lines represent 95% confidence intervals.

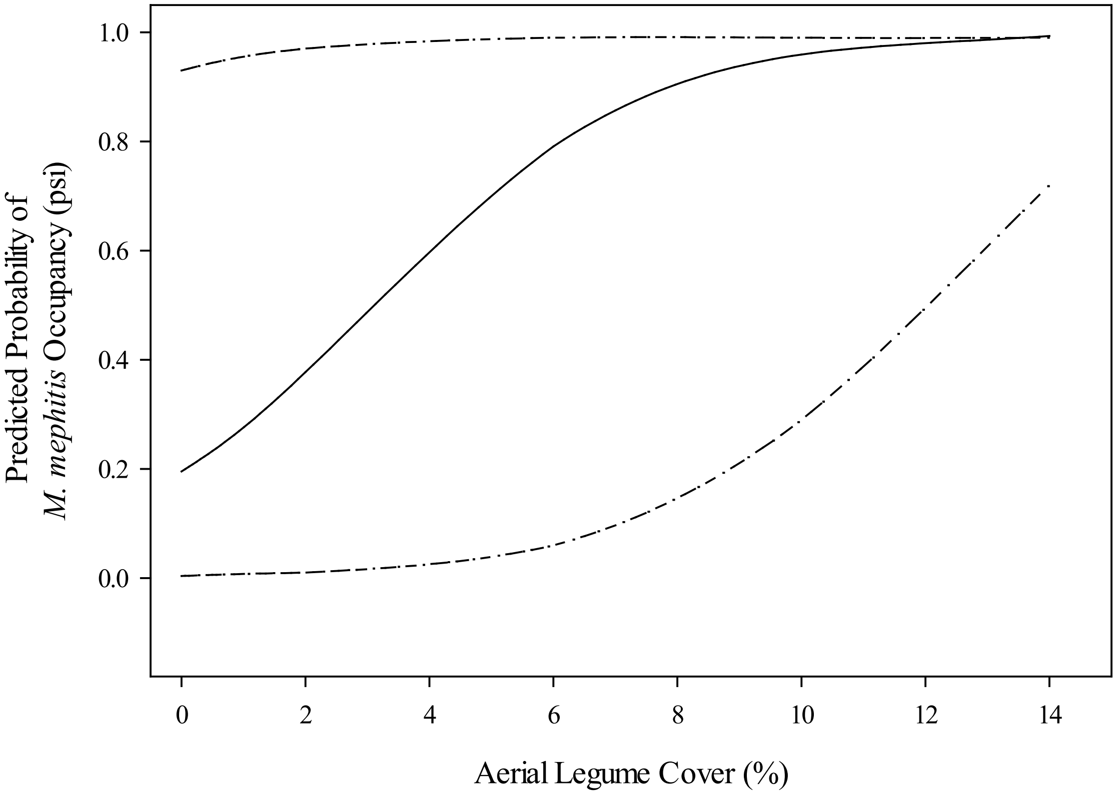


Figure 31. Site detection probabilities (*p*) for ring-necked pheasant (*Phasianus colchicus*) as predicted by month of survey during the 2011 and 2012 seasons (June – August). Error bars represent 95% confidence intervals.

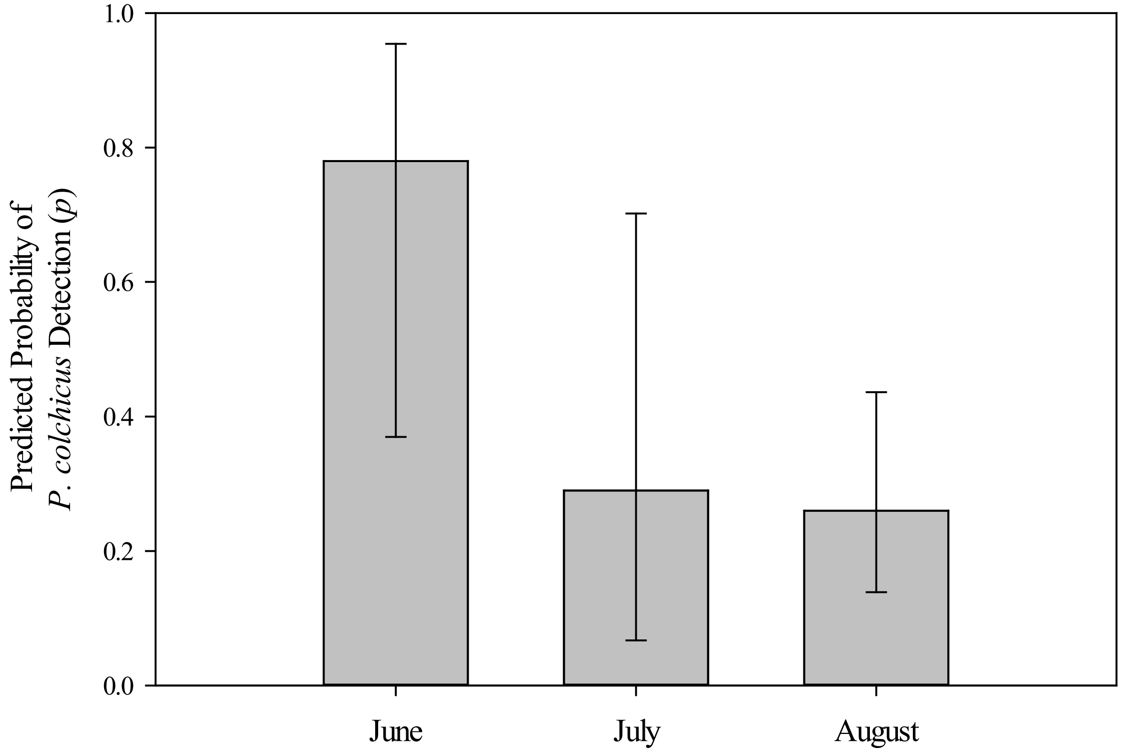


Figure 32. Relative occupancy probabilities (*p*) for ring-necked pheasant (*Phasianus colchicus*) as predicted by percent of CRP in the landscape (%CRP) during the 2011 and 2012 seasons (June – August). Landscape was circularly defined by using a 0.8 km radius from center of site (~2 km^2). Dashed lines represent 95% confidence intervals.

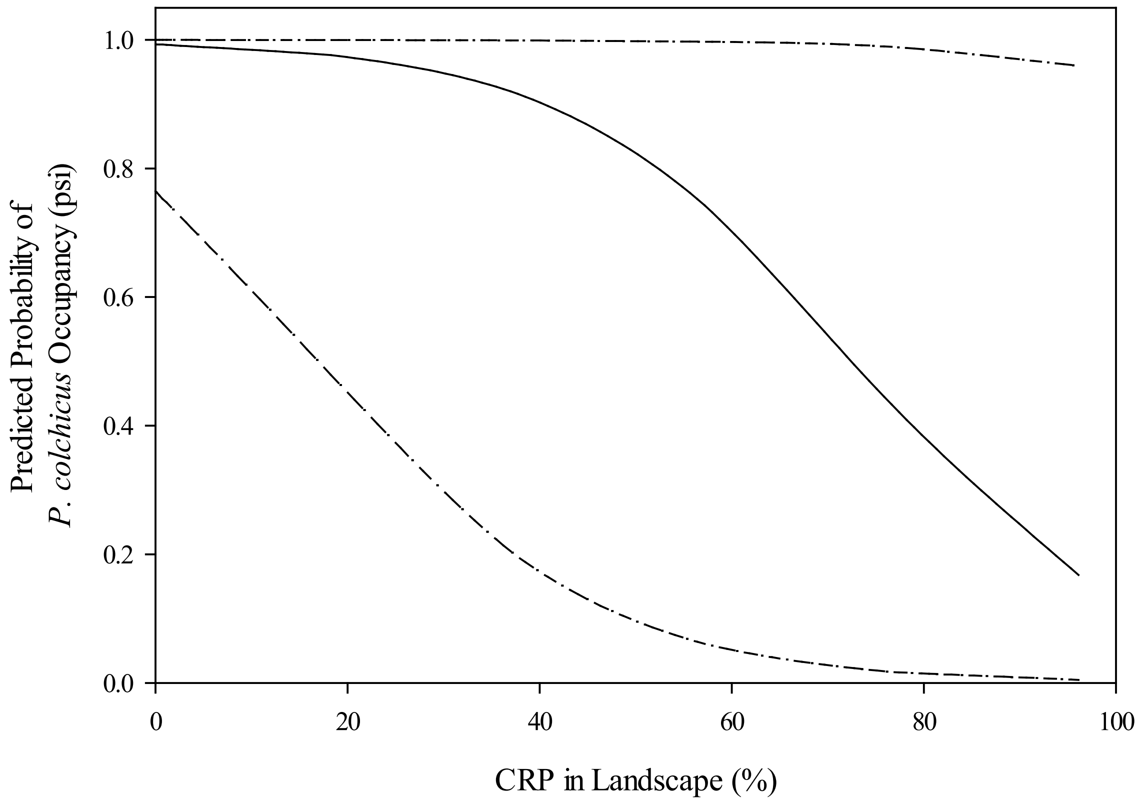


Figure 33. Relative detection probabilities (*p*) for American badger (*Taxidea taxus*) as predicted by total weekly precipitation (Precipitation) during the 2011 and 2012 seasons (June – August). Dashed lines represent 95% confidence intervals.

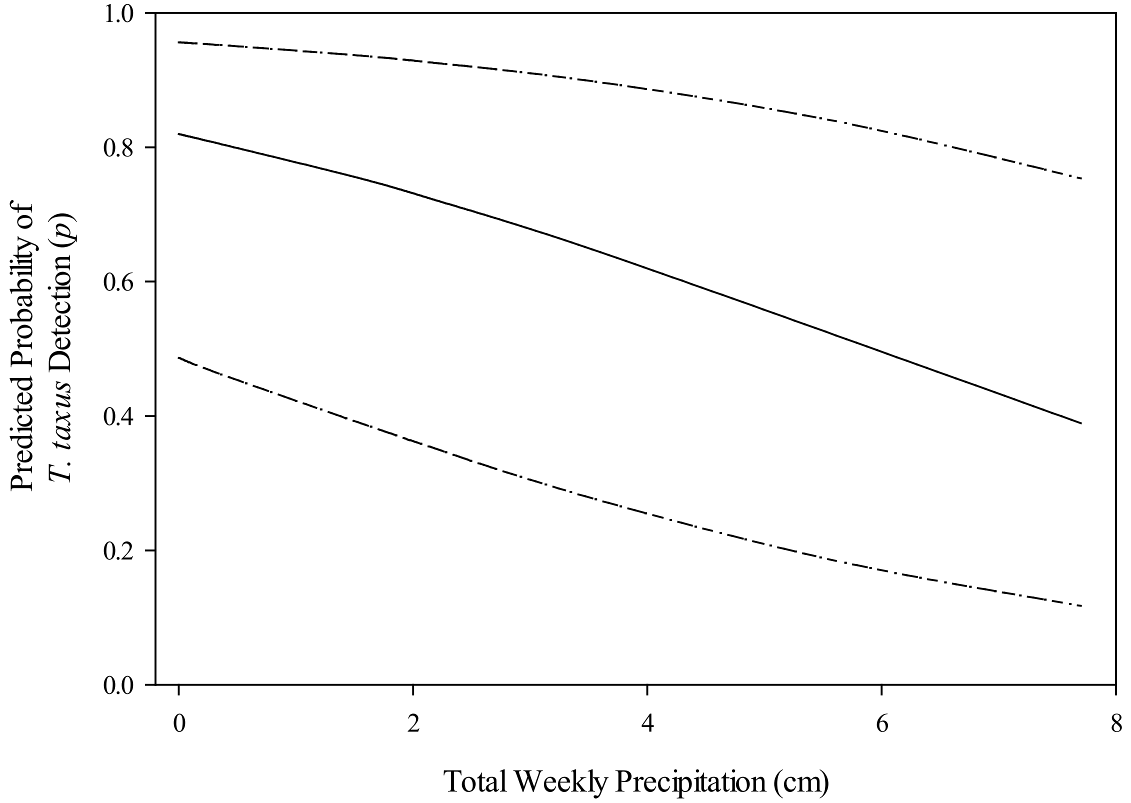


Figure 34. Relative occupancy probabilities (*psi*) for American badger (*Taxidea taxus*) as predicted by percent of interspersion of juxtaposition of CRP (CRP IJI) during the 2011 and 2012 seasons (June – August). Landscape was circularly defined by using a 0.8 km radius from center of site (~2 km^2). Dashed lines represent 95% confidence intervals.

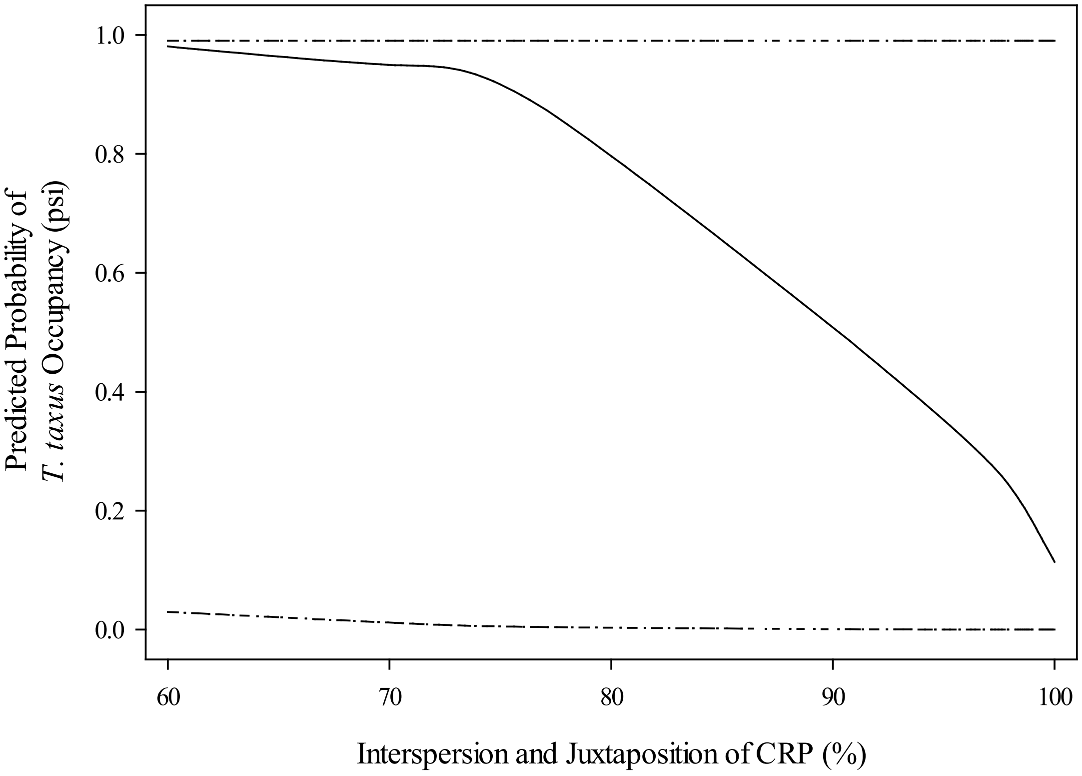


Figure 35. Relative occupancy probabilities (*psi*) for American badger (*Taxidea taxus*) as predicted by percent CRP in the landscape (%CRP) during the 2011 and 2012 seasons (June – August). Landscape was circularly defined by using a 0.8 km radius from center of site (~2 km^2). Dashed lines represent 95% confidence intervals.

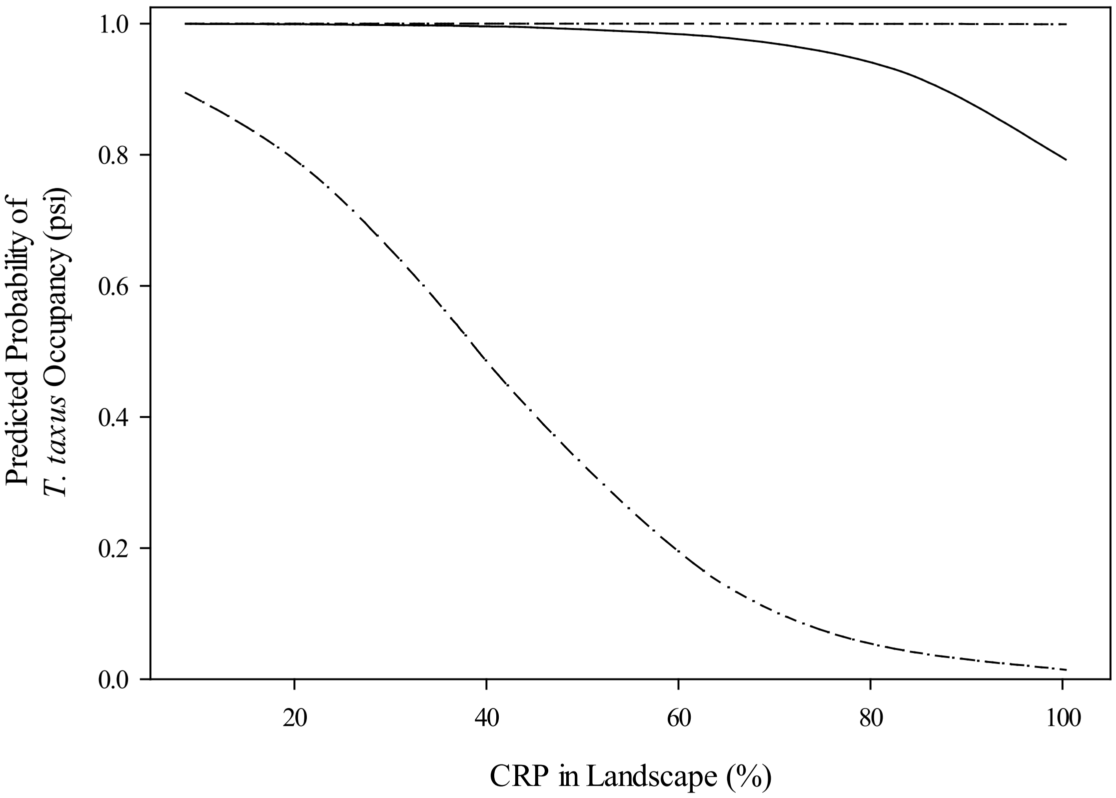


Figure 36. Relative occupancy probabilities (*psi*) for American badger (*Taxidea taxus*) as predicted by percent of no aerial cover, or bare soils (%Bare) during the 2011 and 2012 seasons (June – August). Landscape was circularly defined by using a 0.8 km radius from center of site (~2 km^2). Dashed lines represent 95% confidence intervals.

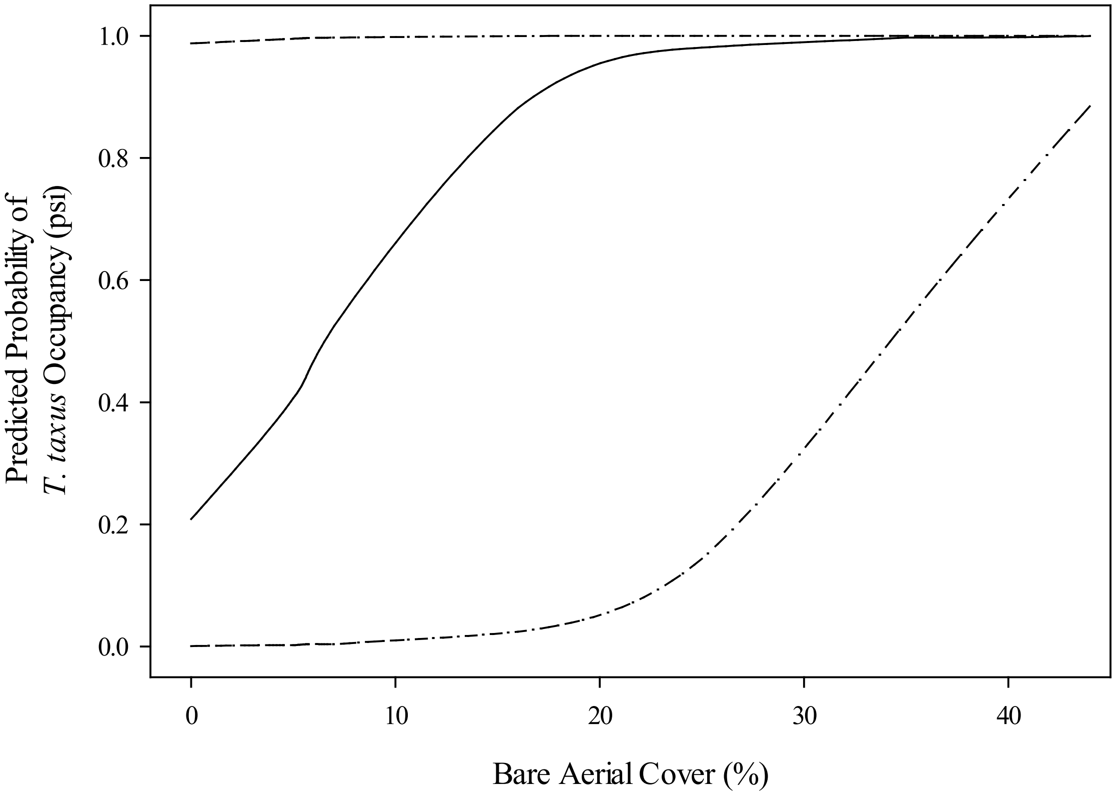


Figure 37. Relative predicted detection probabilities (*p*) for raccoon (*Procyon lotor*) across guzzler and non-guzzler cameras during the 2011 and 2012 seasons (June – August). Error bars represent 95% confidence intervals.

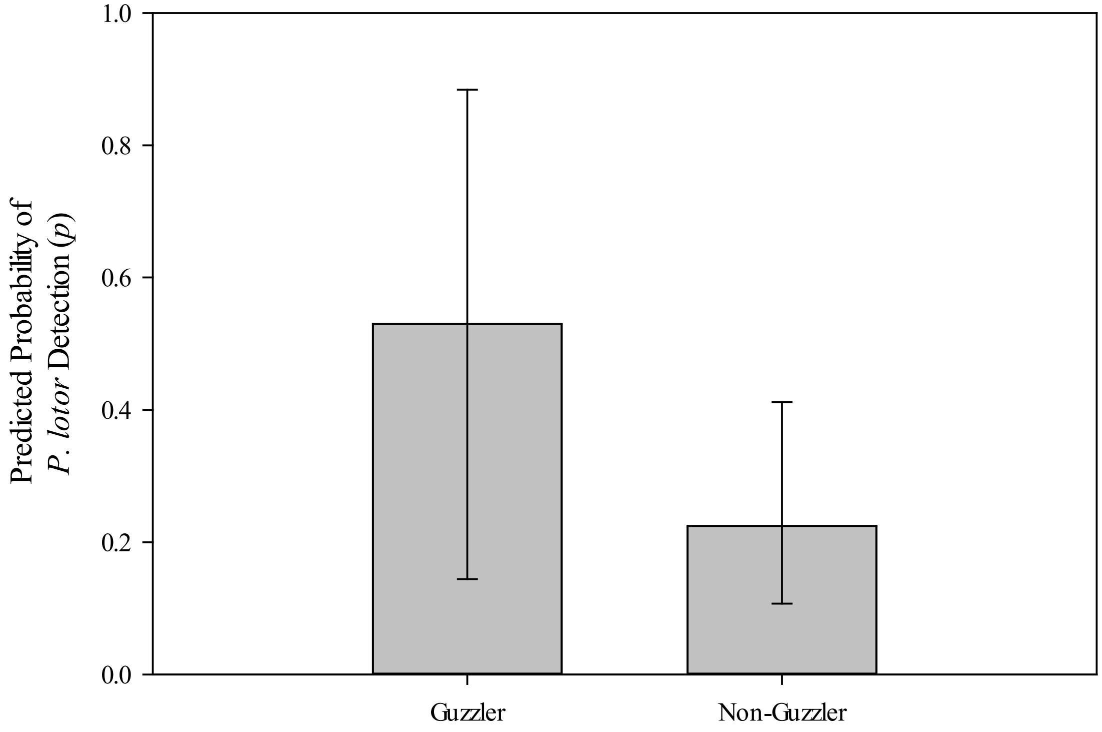


Figure 38. Relative occupancy probabilities (*p*) for raccoons (*Procyon lotor*) as predicted by percent of aerial tree cover at sites (%Tree) during the 2011 and 2012 seasons (June – August). Dashed lines represent 95% confidence intervals.

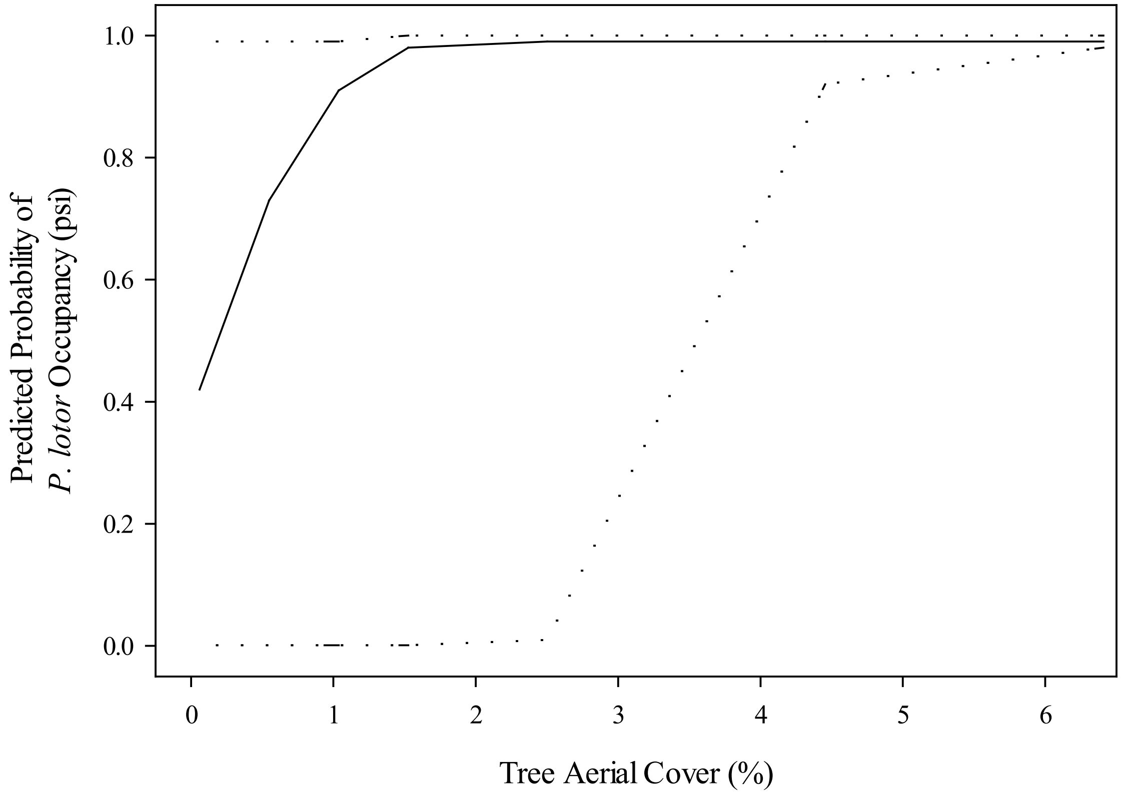


Figure 39. Relative occupancy probabilities (*p*) for raccoon (*Procyon lotor*) as predicted by distance to nearest human dwelling (Human Distance) during the 2011 and 2012 seasons (June – August). Dashed lines represent 95% confidence intervals.

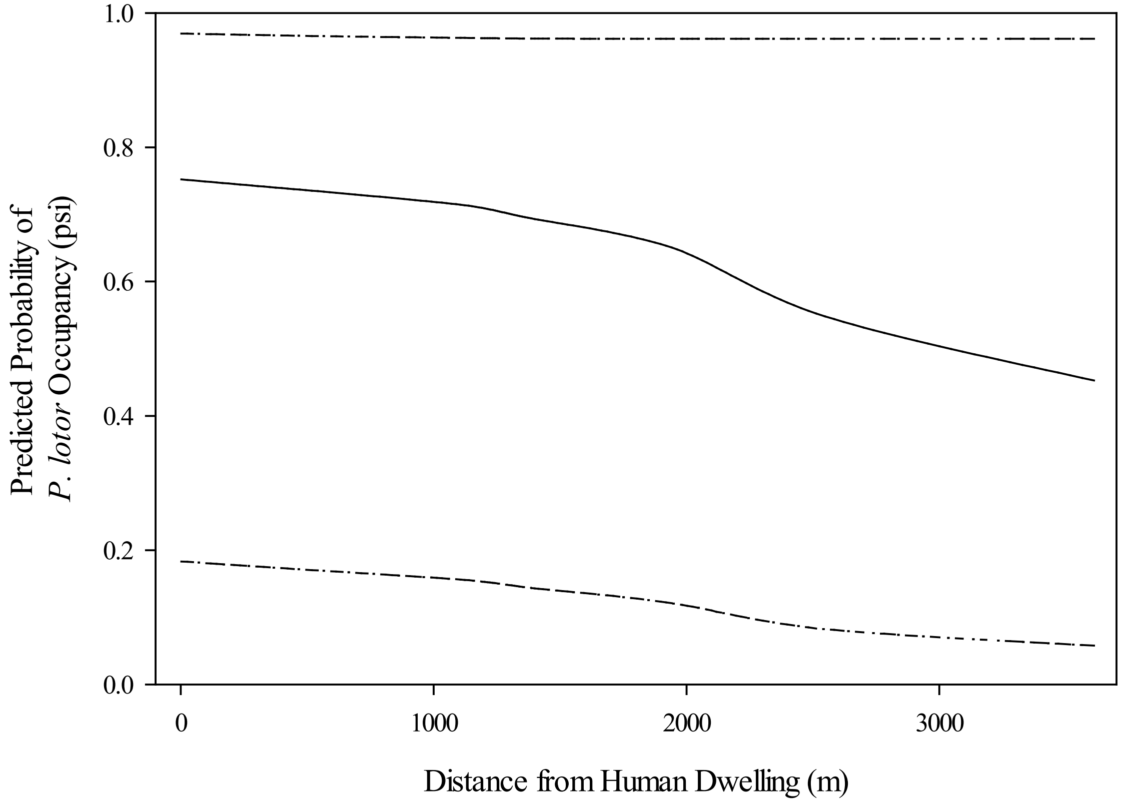


Figure 40. Relative occupancy probabilities (*p*) for raccoon (*Procyon lotor*) as predicted by distance to nearest woodland (Woodland Distance) during the 2011 and 2012 seasons (June – August). Dashed lines represent 95% confidence intervals.

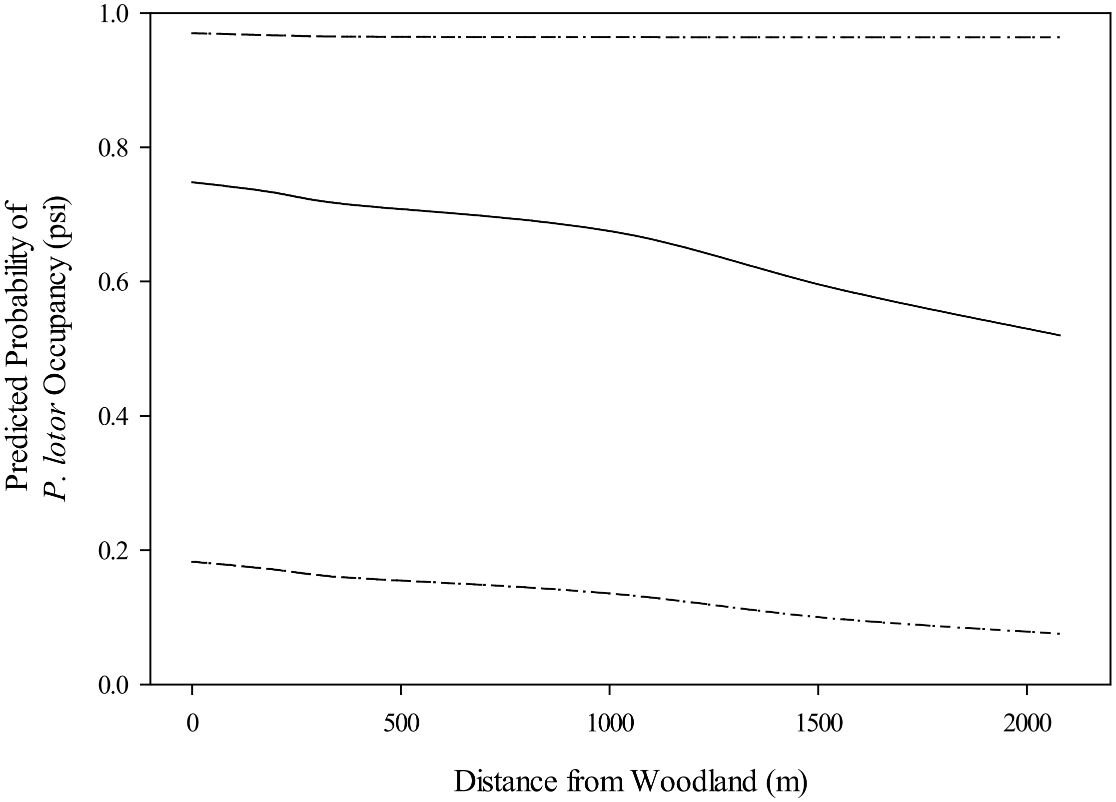


Figure 41. Relative detection probabilities (*p*) for striped skunk (*Mephitis mephitis*) as predicted by temperature difference from previous week (Temperature Difference) during the 2011 and 2012 seasons (June – August). Dashed lines represent 95% confidence intervals.

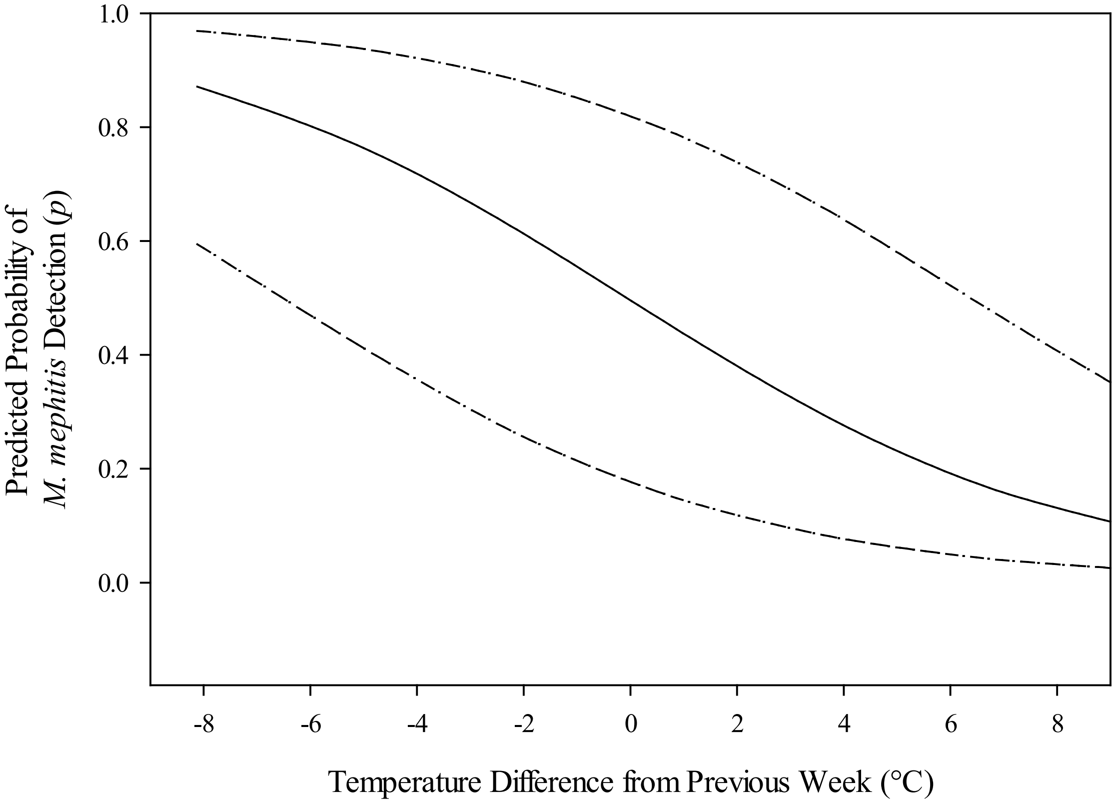


Figure 42. Relative detection probabilities (*p*) for striped skunk (*Mephitis mephitis*) as predicted by total weekly precipitation (Precipitation) during the 2011 and 2012 seasons (June – August). Dashed lines represent 95% confidence intervals.

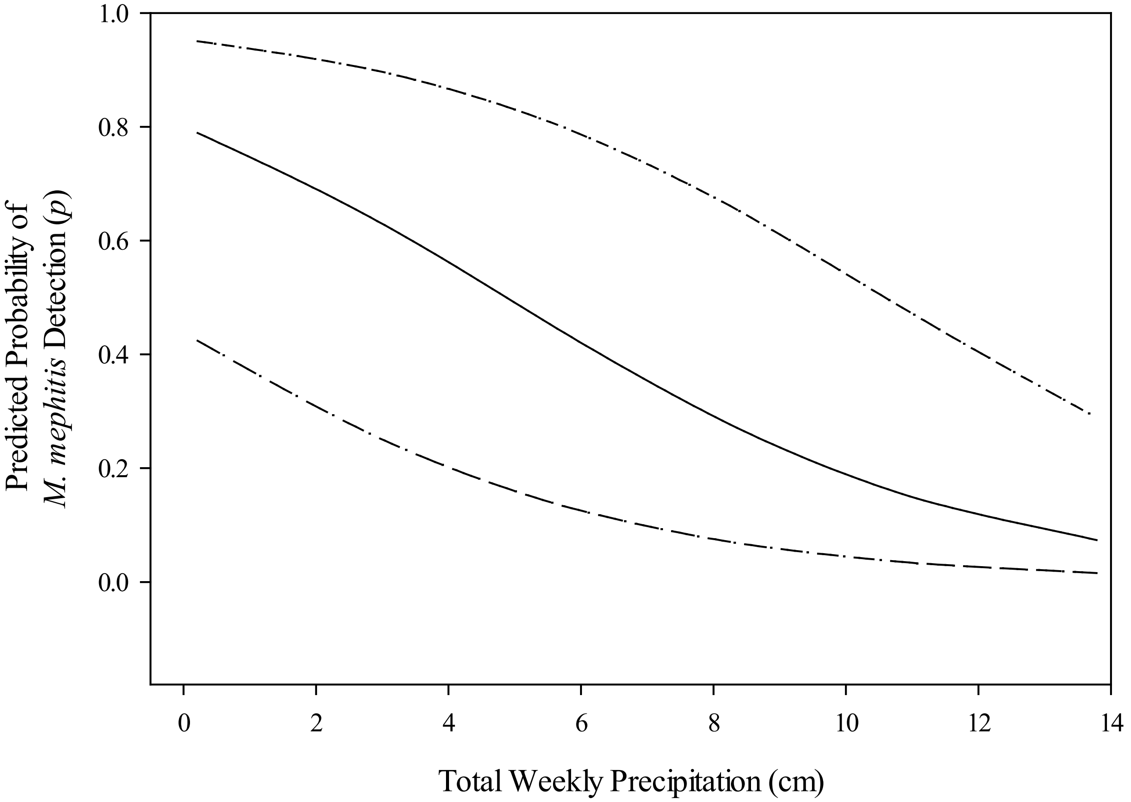


Figure 43. Relative occupancy probabilities (*p*) for striped skunk (*Mephitis mephitis*) as predicted by distance from woodland (Woodland Distance) during the 2011 and 2012 seasons (June – August). Dashed lines represent 95% confidence intervals.

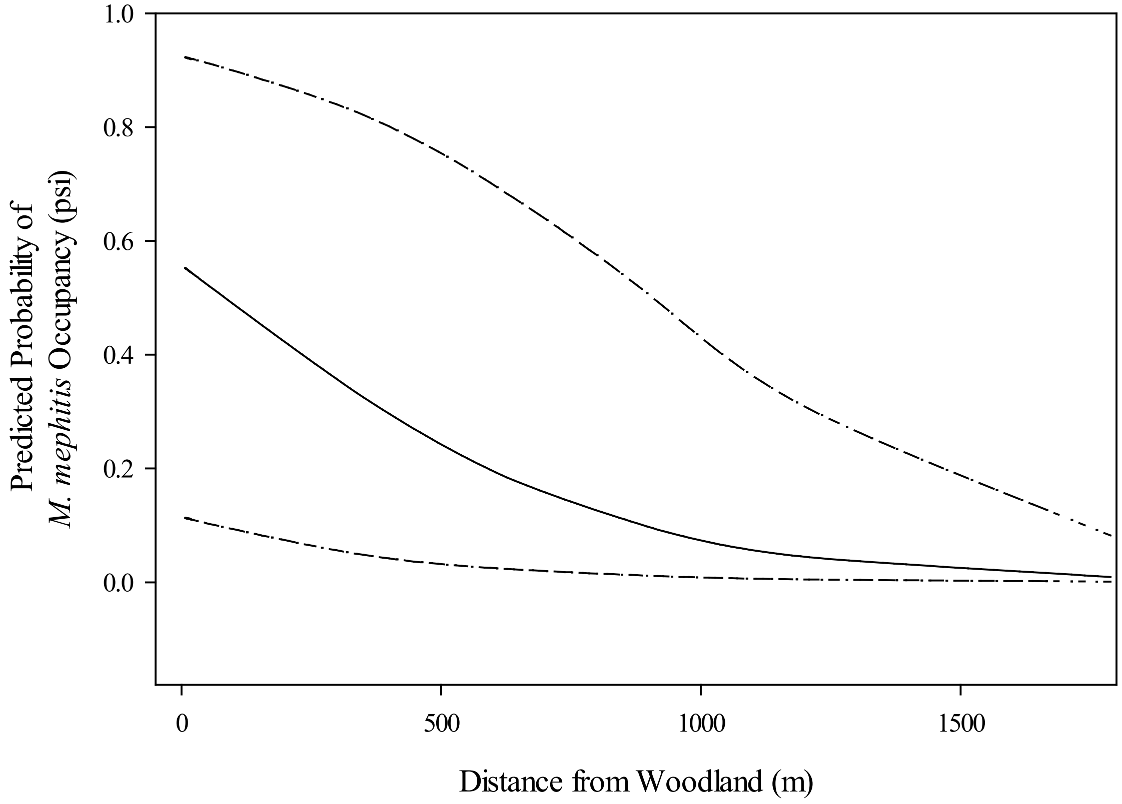
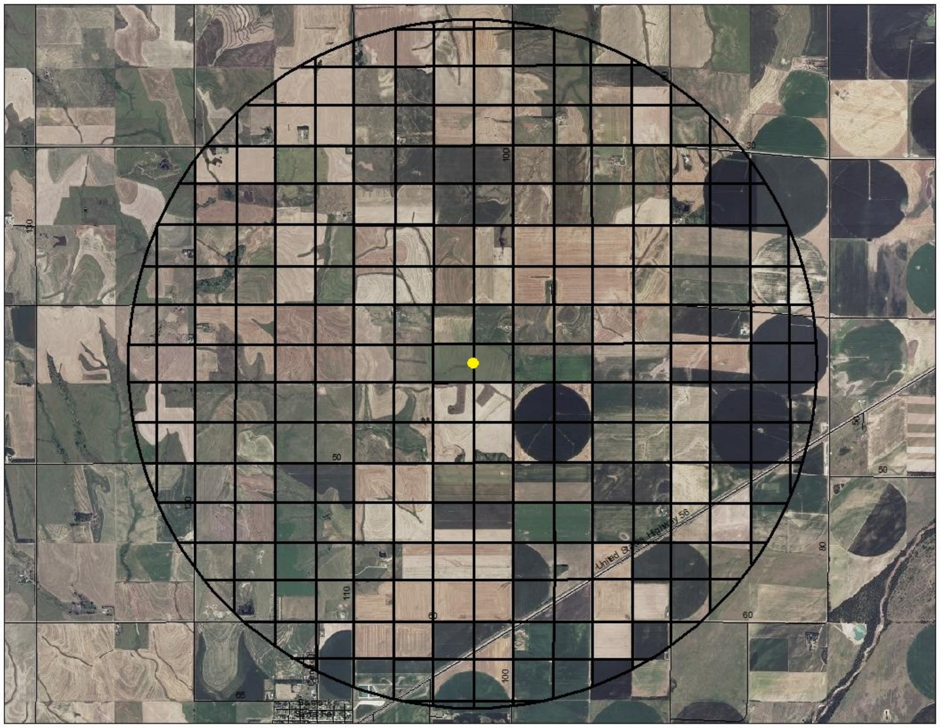


Figure 44. Typical sampling grid (3.5 km radius) for surveying land cover type at western Kansas field sites. Surveys for both the 2011 and 2012 field seasons (June-August) were performed only during the 2012 season.



APPENDIX

A *Instructions for Guzzler Site Survey* - I used Hawth's Tools in ArcMap to randomly select a point within each county. From this point I systematically surveyed for guzzlers by driving on roads in a serpentine pattern with an initial heading of West. I moved north once I reached the east/west boundaries of the county and proceeded east/west at the next available road; often 1 mile due to the county road system. Once all areas to the north of starting point were covered, I proceeded to the southeast corner of the county and I continued this systematic method until I covered the entire county by reaching my starting point. Using a handheld GPS device (Garmin eTrex Vista® H), I marked located guzzlers via waypoints.

B *Definitions for Survey Specific Variables (Climate)* - An *a priori* list of climate variables deemed biologically pertinent to species activity included mean daily maximum temperature (Temperature), mean daily temperature difference from previous week (Temperature Difference), mean daily temperature variation (temperature variance), total weekly precipitation (precipitation), and total weekly precipitation difference from previous week (precipitation difference). Temperature was measured in in tenths of C°, where the maximum daily temperature was averaged over a survey period (one week). Temperature Difference was the average difference between two consecutive survey period's mean temperatures, and Temperature Variance was the daily difference in maximum and minimum temperature averaged over the weekly survey. All calculations subtracted the prior survey period's mean temperature from the current survey period's mean temperature so positive numbers indicated an increase in mean temperature in reference to the week before (i.e., $T_{\text{Difference}} = T_{n+1} - T_n$).

Precipitation was the summed precipitation in tenths of mm over an entire survey period. Precipitation Difference was the total difference between two consecutive survey period's total precipitation. As with temperature difference, all calculations subtract the prior survey period's mean temperature from the current survey period's mean temperature so as to aid future interpretation (i.e., $P_{\text{Difference}} = P_{n+1} - P_n$). Month and Guzzler both served as detection covariates, even though neither varied between surveys. Month refers to the month during which the survey was carried out (June, July, or August), but was only biologically pertinent to *P. colchicus* detection. Guzzler refers to the presence or absence of a guzzler at either the camera or site, depending on scale of modeling, and was used for modeling detection of all species.

C *Definitions for Occupancy Covariates* - CRP age was the number of years the site has been enrolled in the Conservation Reserve Program. Data were acquired via Freedom of Information Act Request (# 2012-FSA-03497-F). Distance measures were made by using the ruler tool on 2010 NAIP imagery in ArcMap 9.3/10.0. Human dwellings were classified as any structure that suggested it was visited regularly by human occupants/visitors. Woodland was classified as any continuous grouping of trees that provided at least 50 m^2 of cover (i.e., single trees in a field were not considered "woody cover"). Edge was defined as any point where land cover type transitioned from one type to another. For input into the model, I used the shortest distance between distance to land cover edge and distance to road as the metric for "distance to edge". Water Distance at the camera scale consisted of distance to the nearest water source in meters, and included the guzzler within the site where applicable. At the site scale, Water Distance ignored the guzzler within the site and only focused on potential water sources outside the site. All distance measures of human structures, water sources, woody cover, etc. were all ground truthed to verify their existence and proximate location as suggested by NAIP imagery.

Vegetation structure was measured by using the Robel visual obstruction (VOR) method at a height of one meter and a distance of four meters from the Robel pole (Robel et al. 1970). The Robel pole I used consisted of ten visual obstruction classes, with each class representing 1 decimeter. The Robel pole was placed at 8 points along the cardinal and intercardinal directions at each camera (i.e., N, NW, W, SW, etc.). Each VOR measure was sampled from facing the four cardinal directions at 11 meters from the camera; resulting in 32 measurements per camera. The lowest class obstructed by vegetation was recorded for VOR ($1 \leq x \geq 10$). I also sampled VOR along 4 100 m transects across the legally defined CRP field site. Observation points occurred every 5 m along transects, and only from a northward facing; resulting in 20 measurements per transect, 80 measurements for the 4 transects combines, and a total of 176 measurements taken per site including the camera measurements; G49 had 32 less measurements due to theft of a camera. Site transects were based on random points generated via Hawth's Tools in ArcMap 9.3. The transect heading corresponded to the second hand direction on my wrist watch at the point of arrival. If the original heading was aimed out of the site boundary, I used the opposite heading or resampled the second hand as necessary.

I measured percent (%) vegetation cover via the line-point intercept method (Salo et al. 2008). At each camera eight transects were placed along the same directional headings as used for vegetation structure (i.e., N, NW, S, SW, etc.). I sampled plant cover every one meter for 11 m starting at the 3rd m from the camera (total of 88 points per camera; 264 per site). I chose to start at the 3rd meter because I mowed an approximately 3 m long patch just north of each camera, which would have impeded plant species identification and affected percent cover. I kept this same starting point for all eight transects at each camera in order to promote consistency. Only camera transects were used for percent cover (i.e., there were no site transects). As with vegetation structure, measurements taken at the camera were used for camera level analysis, whereas all points taken from all cameras over the entire site were used for site level analysis. While vegetation was identified to the species level, I ended up grouping all measurements into five groups; forbs, grass, legumes, litter, and bare ground. Each group was summarized as a percentage and used as a variable in modeling. Additionally, percent (%) cover diversity/evenness was calculated by using the Shannon-Weiner

Diversity Index based on species level identification for each camera/site.

D *Instructions for FRAGSTATS Land cover Grid* – Land cover grids for each CRP site were defined by circular boundaries with the center point being the center of the legally defined CRP field site. The initial grid was made by using a radius of 3.5 km in order to encompass the home ranges of all target species. In an attempt to best match landscape cover with target species home range, smaller 0.8 km radius area (~2.0 km^2) was clipped from the initial grid order to best match summer home range estimates for *P. colchicus* (<2 km^2; Whiteside and Guthery 1983; Smith et al. 1999; Riley et al. 1998; Leif 2005), *T. taxus* (2-7 km^2; Lindzey 1978; Messick and Hornocker 1981; Collins et al. 2012), *P. lotor* (0.5-2 km^2; Beasley et al. 2007; Barding and Nelson 2008) and *M. mephitis* (~5-10 km^2; Lariviére and Messier 1998; Frey and Conover 2007), whereas *C. latrans* (10-40 km^2; Gese et al. 1988; Andelt and Gipson 1979; Holzman et al. 1992; Schrecengost et al. 2009) was assigned a clipped 3 km radius area (~28 km^2). I used ArcMap 10.0 to create a shapefile of the 3.5 km radius over each field site. I then used this shapefile to clip the corresponding area from the county wide NAIP image file. From the circular shapefile with a 3.5 km radius I also created a network of 400 m x 400 m grid cells by using the Grids and Graticules Wizard in ArcMap 10.0.

The grid was then laid over the clipped imagery file and printed to create a grid with aerial imagery of land cover (KARS 2006) for referencing during the current land cover survey (Figure 44); this was repeated for every CRP field site (n=72). Using the grid with aerial imagery, I then proceeded to visually survey the entire 3.5 km radius area from my vehicle, assigning each grid cell to one of 5 categories based on majority of area coverage at the time of survey; CRP/Grassland, Agriculture (with crop), Pasture, Fallow Field, and Other (woodland/urban). It is important to note that while the camera-trap survey spanned the 2011 and 2012 summer seasons, this land cover survey only occurred in the 2012 summer season. While I expect most of the land cover categories to experience little change, crop type for agriculture might have changed.

Thus, while I did collect the information on crop type, I grouped all crops into one group (Ag.) during FRAGSTAT analysis to account for this while also reducing the number of parameters for use in modeling. Following the survey I created a raster file on ArcMap 10.0 from the clipped NAIP imagery having the same geographic extent, but with a resampled resolution of 400 m^2. Thus, each pixel corresponded nearly perfectly to each grid cell, and was edited in the attribute table of the raster to match that of the surveyed grid cells. Once complete, I made a copy of the 3 km radius raster with edited attribute table from which I clipped a smaller 800 m radius circle for all modeled target species with a home range comparable to this smaller extent (~2.0 km^2), thereby creating raster files at two different spatial extents for each site. All edited raster files were batched by spatial extent and imported into FRAGSTATS v4 as EsriGrid files for land cover analysis at the landscape and class scales.

E *Definitions for FRAGSTAT Metrics* - Landscape metrics are those that use the entire extent of the grid for computing a single value for each variable at a site. Class metrics are those that summarize information based on the land cover class, or type (e.g., CRP, Ag., etc.), and will compute a single value for each class at a site relative to the variable of interest. For example, the number of patches variable (NP) at the landscape scale will return the total number of patches, say 8 for example, in the entire site grid irrespective of class. However, at the class scale, NP will return a value for each different class observed in the site grid, where there may be three patches of CRP, two of Ag. and three of Fallow, for example.

Landscape variables used in modeling included Simpson's diversity index (SIDI), edge density (ED), and Connectance (Connect). Number of patches (NP) at the site scale was not used in occupancy modeling due to high correlation with edge density ($r > 0.80$) at both the 2.01 km^2 and 28.27 km^2 land cover area. Connect was used at the landscape in lieu of Cohesion because the latter, while more easily interpretable, has not yet been evaluated at the landscape scale (McGarigal et al. 2012). According to McGarigal et al. 2012, Connect is defined "on the number of functional joinings between patches of the corresponding patch type". A functional joining between a pair of patches is based on a user defined distance criteria, which I set as the average distance between cameras (285 m). Essentially, Connect equals 0 when either the landscape consists of only 1 patch, every class consists of 1 patch, or no patches in the landscape are within 285 m. Connect equals 100 when every patch in the landscape is within the 285 m criteria. SIDI is expressed as a probability that any 2 grid cells selected at random would be from a different land cover class. Because SIDI was highly correlated with the Contagion and Largest Patch Index ($r > 0.80$), and that it is the easiest to interpret of the three, SIDI was the only 1 of the 2 retained in occupancy modeling. ED reports the total edge length (m) divided by the total area of the landscape (Ha); thus calculating edge on a per unit area basis (m/Ha).

Class variables used in modeling included NP, interspersion and juxtaposition index (IJI; CRP only), and percentage of the landscape (%CRP, %Ag, %Pasture, %Fallow, and %Other). NP is simply the number of patches in the landscape of the corresponding patch type. The default, 8 neighbor rule in FRAGSTATS was used for classifying patches. IJI calculates CRP patch adjacency to patches of differing classes. The higher the IJI value (%) the more equally adjacent, or intermixed CRP is to all other patch classes; the value decreases as CRP reduced in adjacency to a subset of the available classes, 0 meaning adjacency to only 1 class type. PLAND is a measure that calculates the proportion of total area (m^2) for each class in the landscape. As the name implies, it is a percentage of the landscape area for the corresponding class type.