REST SITE SELECTION OF PLAINS SPOTTED SKUNKS (*SPILOGALE PUTORIUS INTERRUPTA*) IN A TEXAS COASTAL PRAIRIE

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KAMREN JEFFERSON

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REST SITE SELECTION OF PLAINS SPOTTED SKUNKS

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by

KAMREN JEFFERSON

APPROVED:

Dr. Robert C. Dowler

Dr. Ben R. Skipper

Dr. Nicholas J. Negovetich

Dr. Steven T. Brewer

May 2021

APPROVED:

Dr. Micheal W. Salisbury
Dean, College of Graduate Studies and Research

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ABSTRACT

The eastern spotted skunk (*Spilogale putorius*) is a species of conservation concern across much of its range and has undergone a population decline since the mid-1900s. The plains subspecies (*S. p. interrupta*) is a potential candidate for listing as an endangered species, and habitat selection for the subspecies is understudied in Texas. Our study investigated the rest site selection of plains spotted skunks occurring on a remnant portion of coastal prairie in Harris County, Texas. From 2019 – 2021, we fitted 30 skunks with GPS radio-collars, tracked them weekly to diurnal rest sites, and compared local habitat characteristics of 426 rest sites to random, paired sites. Our discrete choice analyses indicated plains spotted skunks were selecting rest sites for cover (w_i = 1.000), specifically small-sized brambles of southern dewberry (*Rubus trivialis*) and Macartney rose (*Rosa bracteata*). This may provide plains spotted skunks shelter while retaining potential for foraging between brambles.

TABLE OF CONTENTS

Page

LIST OF TABLES

Page

LIST OF FIGURES

INTRODUCTION

The eastern spotted skunk (*Spilogale putorius*) is a small-bodied (ca. 0.5-1.5 kg), omnivorous mammal within the family Mephitidae (Kinlaw 1995; Crabb 1944). It was once a widely-distributed and relatively common furbearer historically occurring in primarily central and southeastern United States with a northern extension up the Appalachian Mountains. Three subspecies of the eastern spotted skunk are currently recognized: the Florida spotted skunk (*S. p. ambarvalis*) occurs in peninsular Florida; the plains spotted skunk (*S. p. interrupta*) historically occurred north from southeastern Manitoba and southwestern Ontario, Canada, south through the central United States into Tamaulipas, Mexico; and the Appalachian spotted skunk (*S. p. putorius*) historically occurred in primarily the southeastern states and along the Appalachian Mountains into Pennsylvania (Kinlaw 1995; Shaffer et al. 2018).

Eastern spotted skunks have undergone a precipitous range-wide decline since the mid-1900s, and there are several hypothesized contributing factors to the population decline including loss of habitat for foraging and resting, decline in small-scale farms and associate habitat features, increase in pesticide use, altered predator guilds, and disease outbreak (Choate 1974; Gompper and Hackett 2005; Gompper 2017). Many state wildlife agencies in the species' range currently list eastern spotted skunks as endangered, threatened, or a species of concern (Gompper and Hackett 2005), and the conservation status for the species

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Journal of Mammalogy

has been upgraded to the level of "Vulnerable" by the International Union for Conservation of Nature (Gompper and Jachowski 2016).

Diurnal rest sites are essential resources for many carnivores (Rabinowitz and Pelton 1986; Doty and Dowler 2006; Gess et al. 2013), and the availability and quality of these sites may be limiting factors that affect the abundance and distribution of spotted skunks (Crooks 1994). Previous studies on the eastern spotted skunk have investigated the habitat associations of the species' rest sites at the landscape and microhabitat levels, but these studies were focused primarily in forested habitats of mountainous regions (Lesmeister et al. 2008; Thorne et al. 2017; Sprayberry and Edelman 2018; Eng and Jachowski 2019; Higdon and Gompper 2020). Doty and Dowler (2006) provided evidence that the western spotted skunk (*S. gracilis*) in Texas selects for ground sites with dense cover as den or rest sites, but it is unknown whether the plains spotted skunk in Texas shares a similar selection pattern. Harris et al. (2020) studied den site selection of Florida spotted skunks in a dry prairie habitat, similar in some characteristics to Texas coastal prairie, and reported differences in den site selection from studies in more mountainous parts of the range of eastern spotted skunks. This suggests that habitat selection for the species at the microhabitat level is more region-specific.

There is a paucity of research into habitat features that influence the rest site selection of plains spotted skunks in Texas. Bailey (1905) surveyed the mammals of Texas and described the plains spotted skunk as opportunistically finding cover in bushes, tall grass, stream banks, and old buildings. Recently, Perkins (2017) reported multiple detections of plains spotted skunks in Texas, with the Western Gulf Coastal Plains ecoregion in southeastern Texas and the Cross Timbers ecoregion in central Texas having sites with higher localized abundance of the subspecies. Although Perkins (2017) addressed the occurrence of plains spotted skunks in Texas, a direct assessment of fine-scale, habitat selection for the subspecies is still needed. Plains spotted skunks are currently undergoing review for federal listing under the Endangered Species Act by the U.S. Fish and Wildlife Service (USFWS 2012). Additional information on habitat associations of the rest sites of plains spotted skunks may be informative in the species status assessment by the USFWS and biologists, and it may suggest the habitat features that should be targeted when managing and conserving areas for the species' survival and recovery. In this study, our objectives were to (1) investigate the rest site requirements of plains spotted skunks in a remnant, altered coastal prairie of southeastern Texas and (2) to determine any sex or seasonal differences in features selected at rest sites.

MATERIALS AND METHODS

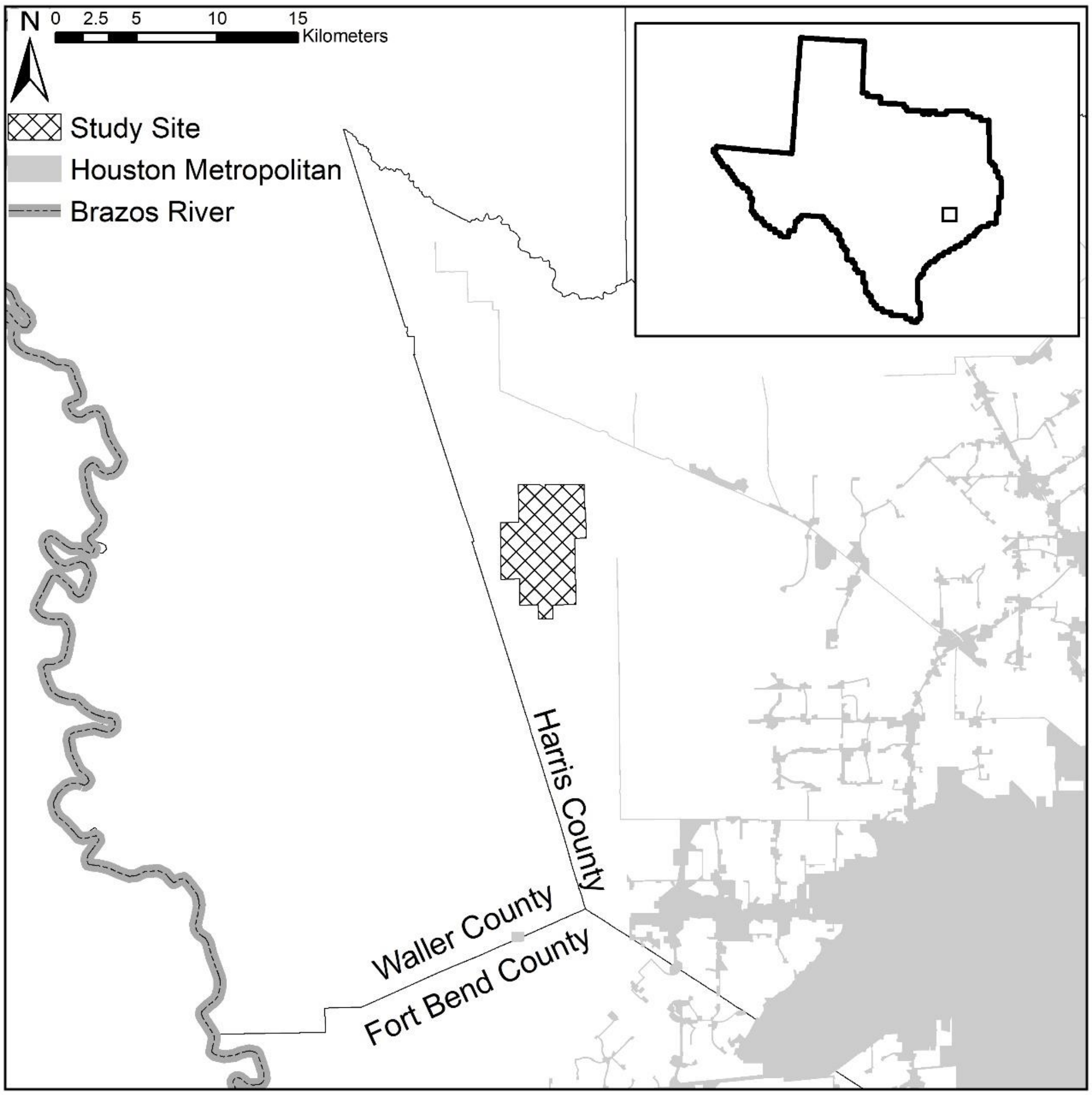
Study area. – We conducted our study within the Katy Prairie of Texas, a coastal prairie that lies within the northern portion of the Western Gulf Coastal Plain (WGCP) ecoregion. The Katy Prairie is bounded by pine forests of the South Central Plains ecoregion on the north, greater Houston on the east, and the Brazos River on the west. The WGCP ecoregion stretches from central Louisiana to southern Texas and lies immediately adjacent to the Gulf of Mexico (Griffith et al. 2007). This ecoregion is characterized by its flat topography, grassland type vegetation, slow drainage, and wet soils (Griffith et al. 2007). The WGCP ecoregion was historically a fire maintained coastal prairie with a grassland community dominated by little bluestem (*Schizachyrium scoparium*), yellow indiangrass (*Sorghastrum nutans*), brownseed paspalum (*Paspalum plicatulum*), gulf muhly (*Muhlenbergia capilaris*), and switchgrass (*Panicum virgatum*; Griffith et al. 2007). Woody vegetation is largely Macartney rose (*Rosa bracteata)*, in association with a mixture of brambles, primarily southern dewberry (*Rubus trivialis*) and pepper vine (*Ampelopsis arborea*), and deciduous shrubs, predominately yaupon holly (*Ilex vomitoria*) and eastern baccharis (*Baccharis halimifolia*; Elliott et al. 2014).

We selected the Katy Prairie for study based on previous trapping in the area (Perkins 2017) that revealed a high probability of occurrence of plains spotted skunks as well as potential anthropogenic threats to habitats inhabited by plains spotted skunks. The Katy Prairie has been heavily altered and fragmented, first by agriculture, and more recently through urbanization of the expanding Houston metropolitan area, reducing the coastal prairie to a remnant portion that has been mostly converted to agricultural fields and grazing lands for cattle. Our study was conducted on Warren Ranch, a 2430-ha active cattle ranch in Harris County, TX co-owned by the Katy Prairie Conservancy (KPC) and the Warren family (Figure 1). Habitats at Warren Ranch undergo prairie restoration management activities, including prescribed burns, invasive species removal, wetland restoration, and rotational grazing of cattle. As a result of these activities, our study site is a mosaic of minimally grazed pastures, hay fields, fallow agriculture fields, and conserved riparian corridors.

Live trapping and animal processing. – We trapped plains spotted skunks from January 2019 through January 2021 using collapsible Tomahawk live traps (Tomahawk Live Trap Co., Hazelhurst, WI, USA). Traps were covered with burlap covers to exclude sunlight and provide protection from inclement weather. We initially conducted casual live trapping surveys based on *a priori* knowledge of recent skunk presence in pastures (Perkins 2017) or in areas with similar habitat characteristics to these pastures. Once our study progressed with several skunks fitted with a radio-collar and the introduction of concurrent camera trap surveys, systematic live trapping surveys were conducted based solely on confirmed detections of plains spotted skunks within the preceding 90 days. Utilizing the National Land Cover Dataset (NLCD 2011), camera trap survey locations were chosen based upon the percentage of habitat type at Warren Ranch. We baited traps with either canned mackerel or a sweet bait mixture composed of chunky peanut butter, grape jelly, molasses, vegetable oil, and marshmallows.

Once captured, skunks were anesthetized with the inhalant isoflurane (Piramal Healthcare Limited, India, distributed by MWI, Boise, ID, USA). Upon showing signs of

Figure 1. – Map of study site in Harris County, TX where we trapped plains spotted skunks and located diurnal rest sites from 2019 to 2021 to evaluate plains spotted skunk rest site selection.



unresponsiveness, skunks were injected intramuscularly with TELAZOL® (Zoetis, Madison, NJ, USA; Larivière and Messier 1996) or a generic equivalent, with the amount given dependent on approximate body weight and intended length of handling time. We recorded morphometric measurements of each skunk, aged them based on body size, tooth wear, and prior capture history (Lesmeister 2009), recorded their sex, and collected samples of ectoparasites, hair, tissue, and feces opportunistically. We ear tagged (National Band & Tag Company, Newport, KY, USA) each skunk and attached a GPS radio-collar (model Litetrack 20; Lotek, Newmarket, ON, Canada). Collar weight did not exceed 5% of each animal's mass (Sikes et al. 2016). All handling procedures were in accordance with the guidelines of the American Society of Mammalogists for the use of wild animals in research (Sikes et al. 2016) and our research protocols were approved by the Angelo State University Institutional Animal Care and Use Committee (IACUC Approval Nos: 18-208; Approval No: 19-202) and the Texas Parks and Wildlife Department (Scientific Research Permit SPR-0390-029).

Tracking. – We used a portable telemetry receiver (R-1000 Receiver, Communication Specialists Inc., Orange, CA, USA) and a 2-element H antenna to track skunks each week (range 1-5 days per week) to a diurnal rest site. Each skunk was tracked weekly until either mortality occurred, the skunk was lost due to depleted battery life of the transmitter, or the individual traveled outside of our study site. We recorded the type of overhead cover directly above the skunk (e.g., Macartney rose) and the material the skunk was directly laying within (e.g. litter). A small portion of sites may be defined as "den sites" where females were rearing young; however, we classified all located sites as "rest sites" for this study.

Rest site habitat characterization. – Within 15 days of recording a rest site location, we measured the local habitat characteristics at each rest site. To evaluate habitat selection relative to what was available to skunks, we identified a random, paired site (henceforth “paired site”) for each rest site. We determined paired sites by using a handheld GPS unit (Garmin, Kansas City, KA, USA) to mark a location 100 m from the located rest site in the direction of a randomly generated azimuth. One-hundred m has been previously reported to be within the range of minimum nightly-traversable distances for an eastern spotted skunk (Eng and Jachowski 2019). If a paired site was located in a wetland, was outside the bounds of the study site, or inaccessible due to management activities, we repeated the process until an appropriate paired site was chosen. If a skunk re-used a rest site after 30 days, we treated it as an independently selected location. We did not record habitat characteristics at a located rest site when the rest site was reused by a skunk within 30 days of its last recorded use, the rest site was inaccessible (e.g. on a privately managed oil drilling pad), the pasture was significantly altered after use (e.g. mowed or plowed), or we were not able to collect data within 15 days of locating the skunk at the rest site.

At each site, we measured habitat characteristics within a 10 m radius plot centered at the site (Table 1). We laid out 4 transect lines leading from the center of the plot to a terminal node in each cardinal direction. Measurements recorded at the nodes were averaged across all 4 nodes and reported as the plot average. Relative saturation of the soil was measured at the center of each plot using a Kelway Soil Acidity and Moisture Tester (Model HB-2, Teaneck, NJ, USA). When a site was flooded, we recorded relative saturation as 100%. Canopy cover measurements were taken using a densitometer (Convex Model A, Forestry Suppliers,

Table 1. – Variable names, abbreviations, and descriptions measured at each plains spotted skunk rest site and random paired site to evaluate plains spotted skunk rest site selection on the Katy Prairie.

Variable	Abbreviation	Description
Overhead cover type	overhead (MR = Macartney rose; DB = southern dewberry; GRASS; FORBS; OTHER)	Classification of the overhead cover at the center of a plot
Tallest height at center	center.ht	Height of tallest vegetation at center of plot (in m)
Tallest height in plot	plot.ht	Height of tallest vegetation in plot (in m)
Soil moisture	moisture	Percent relative saturation of soil at center of plot
Visual obstruction at center of plot	center.rob	Height of visual obstruction at center of plot (in 10-cm increments)
Visual obstruction plot average	plot.rob	Height of visual obstruction averaged in plot (in 10-cm increments)
Canopy cover at center of plot	center.can	Percent cover from canopy vegetation at center of plot
Canopy cover plot average	plot.can	Percent cover from canopy vegetation averaged in plot
Depth of grassland litter at center of plot	center.lit	Depth of grassland litter at center of plot (in cm)
Depth of grassland litter plot average	plot.lit	Depth of grassland litter averaged in plot (in cm)
Number of small Macartney rose	mr.sm	Number of Macartney rose brambles < 1 m tall
Number of medium Macartney rose	mr.med	Number of Macartney rose brambles 1-2.5 m tall
Number of large Macartney rose	mr.lg	Number of Macartney rose brambles > 2.5 m tall
Number of small eastern baccharis	eb.sm	Number of eastern baccharis shrubs < 1 m tall
Number of medium eastern baccharis	eb.med	Number of eastern baccharis shrubs 1-2 m tall

Table 1. – Continued

Variable	Abbreviation	Description
Number of large eastern baccharis	eb.lg	Number of eastern baccharis shrubs > 2 m tall
Number of small Chinese tallow	ct.sm	Number of Chinese tallow trees < 2 m tall
Number of medium Chinese tallow	ct.med	Number of Chinese tallow trees 2-4 m tall
Number of large Chinese tallow	ct.lg	Number of Chinese tallow > 4 m tall
Number of southern dewberry	db.ct	Number of southern dewberry brambles
Number of vines	vine.ct	Number of vine clumps
Number of shrubs	shrub.ct	Number of shrubs
Number of trees	tree.ct	Number of trees
Percent grass	grass	Percent of grass ground cover along transect lines
Percent forbs	forb	Percent of forbs ground cover along transect lines
Percent shrubs	shrub	Percent of shrubs ground cover along transect lines
Percent trees	tree	Percent of trees ground cover along transect lines
Percent grassland litter	litter	Percent of grassland litter ground cover along transect lines
Percent bare ground	bare	Percent of bare ground along transect lines
Percent moist soil vegetation	msv	Percent of moist soil vegetation (rushes and sedges) ground cover along transect lines
Percent deep-rooted sedge	drs	Percent of deep-rooted sedge ground cover along transect lines

Table 1. – Continued

Variable	Abbreviation	Description
Percent Macartney rose	mr	Percent of Macartney rose ground cover along transect lines
Percent southern dewberry	db	Percent of southern dewberry ground cover along transect lines
Percent vines	vine	Percent of vine ground cover along transect lines
Percent anthropogenic debris	debris	Percent of anthropogenic debris ground cover along transect lines
Percent hay	hay	Percent of hay ground cover along transect lines
Percent coarse woody debris	cwd	Percent of coarse woody debris ground cover along transect lines
Percent rocks	rock	Percent of rock ground cover in debris
Percent water	water	Percent of standing, reflective water along transect lines
Distance to riparian corridor	riparian.dist	Distance to nearest riparian corridor (in m)
Distance to ephemeral wetland	ephemeral.dist	Distance to nearest ephemeral wetland (in m)
Distance to permanent wetland	permanent.dist	Distance to nearest permanent wetland (in m)
Distance to primary road	primary.dist	Distance to nearest primary road (in m)
Distance to secondary road	secondary.dist	Distance to nearest secondary road (in m)

Jackson, MS, USA) held level in each cardinal direction and then averaged for the center and for the plot. The depth of grassland litter was measured at the center and at each node using a standard ruler (Bakker et al. 2002).

We measured the height of visual obstruction by placing a 2-m Robel pole (marked in 10 cm increments) at the center and at each node, walking 4 m away from the pole, and bending at a height of 1 m to record the lowest band visible in each cardinal direction (Robel et al. 1970; Toledo et al. 2008). Visual obstruction measurements were averaged across all directions to obtain a center average and a plot average of the measurements taken at the nodes. The height of tallest vegetation at both the center of and within the plot were recorded. We performed a belt-line transect for each transect line and recorded the dominant ground cover in 0.5 m increments (Grant et al. 2004). We recorded the total number of southern dewberry brambles, vines, shrubs, and trees, and classified by height the total number of Chinese tallow, eastern baccharis, and Macartney rose within each plot (Table 1).

We used Geographical Information Systems (GIS) software (ArcGIS 10.7.1, Environmental Systems Research Institute, Redlands, CA) to develop GIS layers for water and road features at our study site. These layers were used to determine distance to water feature and distance to road feature for each rest site and paired site. We categorized water features into three classes: riparian corridors, permanent wetlands, and ephemeral wetlands. We defined riparian corridors as the areas encompassing a stream channel and the immediate proximate banks of the stream. We distinguished wetlands on the basis of water permanence (degree of water retention) and basin size, such that permanent wetlands were identified as basins that sustained water year-round and were more than 0.3 ha in size; conversely, ephemeral wetlands were identified as basins that remained flooded for short periods of time during the year and were 0.3 ha or less in size (Kantrud and Stewart 1977; Dahl 2014). Road features were separated into primary roads, which are heavily-trafficked and caliche, and secondary roads, including mowed grass paths through pastures and plowed firebreaks along the pasture perimeters.

Hypotheses. – We hypothesized that 5 biological factors would affect diurnal rest site selection of plains spotted skunks at our study site (Table 2). First, we hypothesized that rest site selection would be positively associated with the type and amount of cover at a potential rest site. Crabb (1948) established that an appropriate spotted skunk site must exclude sunlight, provide protection and insulation from weather conditions, and provide protection from potential predators. Studies conducted in other regions of the range of spotted skunks have also found cover to be an important influence in site selection (Lesmeister et al. 2008; Sprayberry and Edelman 2018). Second, we hypothesized that specifically protection from predators would have a positive influence on rest site selection. Previous studies have indicated that spotted skunks selected sites that reduce the visibility of skunks to predators and the maneuverability of predators, especially larger mesocarnivores and owls (Lesmeister et al. 2008; Eng and Jachowski 2019; Sprayberry and Edelman 2018).

Third, we hypothesized that rest site selection will be negatively associated with relative saturation of the soil, which will indicate the water content of the soil. The WGCP ecoregion has generally poor drainage due to the clay subsoil and low relief, which can result in heavy flooding for extended durations of the year (Griffith et al. 2007). Alternatively, Eng and Jachowski (2019) indicated that proximity to a water source may serve as an indicator of

Table 2. – Hypotheses and *a priori* models developed to evaluate plains spotted skunk rest site selection at Warren Ranch. A random effect ('id') was added to each model to account for resource selection amongst individual skunks. MR = Macartney rose. DB = southern dewberry. DRS = deep-rooted sedge. EB = eastern baccharis. CT = Chinese tallow.

Hypothesis	Model
Cover	
1. Positive effect of overhead cover type (MR), height of visual obstruction, depth of grassland litter, number of MR brambles, MR %, DB %, grassland litter %, and DRS %; negative effect of grass %, forbs %, bare ground %	$Cover_1$: overhead + center.rob + node.rob + center.lit + node.lit + mr.sm + mr.med + mr.lg + mr + db + litter + drs + grass + forb + bare + id
2. Positive effect of overhead cover	$Cover_2$: overhead + id
3. Positive effect of height of visual obstruction	$Cover_3$: center.rob + node.rob + id
4. Positive effect of MR brambles	$Cover_4$: mr.sm + mr.med + mr.lg + id
5. Positive effect of MR %, DB %, and DRS %	$Cover_5$: mr + db + drs + id
6. Positive effect of grassland litter %	$Cover_6$: litter + id
7. Positive effect of depth of grassland litter	$Cover_7$: center.lit + node.lit + id
8. Negative effect of forbs %, grass %, and bare %	$Cover_8$: forb + grass + bare + id
Predator Avoidance	
9. Positive effect of number of MR small brambles, MR medium brambles, and DB brambles; negative effect of number of MR large brambles, EB large shrubs, CT medium trees, CT large trees, shrubs, and trees	$Predator_1$: mr.sm + mr.med + db.ct + mr.lg + eb.lg + ct.med + ct.lg + shrub.ct + tree.ct + id
10. Positive effect of number of MR small brambles, MR medium brambles, and DB brambles	$Predator_2$: mr.sm + mr.med + db.ct + id
11. Negative effect of MR large brambles	$Predator_3$: mr.lg + id
12. Negative effect of number of EB large brambles, CT medium trees, CT large trees, shrubs, and trees	$Predator_4$: eb.lg + ct.med + ct.lg + shrub.ct + tree.ct + id

Table 2. – Continued

Hypothesis	Model
Forage Availability	
13. Positive effect of grass %, forb %, grassland litter %, DB %, and distance to water; negative effect of DRS % and distance to water	$Forage_1$: grass + forb + litter + db + riparian.dist + ephemeral.dist + permanent.dist + drs + id
14. Positive effect of grass %, forb %, litter %, and DB %	$Forage_2$: grass + forb + litter + db + id
15. Positive effect of distance to water	$Forage_3$: riparian.dist + ephemeral.dist + permanent.dist + id
16. Negative effect of DRS %	$Forage_4$: drs + id
Water Avoidance	
17. Positive effect of distance to water; negative effect of soil moisture content	$Water_1$: riparian.dist + ephemeral.dist + permanent.dist + moisture + id
Road Avoidance	
18. Positive effect of distance to primary road; negative effect of distance to secondary road	$Road_1$: primary.dist + secondary.dist + id
Sub-Global Models	
19. Variables measured within 5 m of the center of the rest site	$Subglobal_1$: overhead + center.ht + center.rob + center.can + center.lit + id
20. Variables measured more than 5 m from the center of the rest site	$Subglobal_2$: plot.ht + node.rob + node.can + node.lit + riparian.dist + ephemeral.dist + permanent.dist + primary.dist + secondary.dist + id
21. Variables measured as percent ground cover	$Subglobal_3$: grass + forb + shrub + tree + litter + bare + msv + drs + mr + db + vine + hay + debris + cwd + rock + water + id
Global Model	
22. All variables measured	Global: overhead + center.ht + plot.ht + moisture + center.rob + node.rob + center.can + node.can + center.lit + node.lit + mr.sm + mr.med + mr.lg + eb.sm + eb.med + eb.lg + ct.sm + ct.med + ct.lg + db.ct + vine.ct + shrub.ct + tree.ct + grass + forb + shrub + tree + litter + bare + msv + drs + mr + db + vine + debris + hay + cwd + rock + water + primary.dist + secondary.dist + riparian.dist + ephemeral.dist + permanent.dist + id

higher quality forage availability and cover, suggesting that plains spotted skunks would select sites closer to water. Fourth, we hypothesized that habitat features that would also support potential prey items would be positively associated with rest site selection. Spotted skunks are generalists with a varied, seasonal diet that includes arthropods, small mammals, amphibians, reptiles, and plant materials (Crabb 1941; McCullough and Fritzell 1984; Kinlaw 1995; Sprayberry and Edelman 2018; Thorne and Waggy 2017; Harris et al. 2020). Fifth, we hypothesized that rest site selection would be negatively associated with heavily-trafficked, caliche primary roads. Previous studies have indicated that roads may serve as a barrier to movement between habitats for wildlife (Oxley et al. 1974; Richardson et al. 1997; Rico et al. 2007; Benítez-López 2010). On the other hand, less-trafficked, secondary roads that are annually mowed or plowed at our study site may serve as a gentler transition for skunks when moving between adjacent areas of vegetation. Thus, we expected rest sites to be located closer to secondary roads.

Model development and validation. – We used the discrete choice modeling approach to fit and evaluate support for each *a priori* model developed for our hypotheses. Discrete choice analysis allows for associations of relevant variables to be tested and for the availability of resources at each rest site to be tested separately, as each rest site is compared to a paired site, while still accounting for temporal and spatial variations in resources (Arthur et al. 1996, Cooper and Millspaugh 1999). When fitting our discrete choice models, each sample consisted of a ‘choice set’ that included data from a rest site and its corresponding paired site (Cooper and Millspaugh 1999). We included a random effect (‘id’) in each model to account for variation in resource selection among individuals (Bodinof et al. 2012).

We developed 22 models to evaluate support for the 5 factors we hypothesized would influence rest site selection of plains spotted skunks (Table 2). We used multinomial logistic regression through the package ‘mlogit’ (Croissant 2020) in the Program R version 4.0.4 (R Development Core Team 2021) to implement our discrete choice modeling. In addition to the models created for each *a priori* hypothesis, we also fit a global model incorporating all variables we measured and 3 sub-global models to evaluate relative support for variables measured within 5 m of the rest sites, variables measured more than 5 m from the center of the rest site, and variables representing percentage of ground cover classes (Table 2). We used Kendall’s correlation coefficients to determine that none of the variables included in a model were colinear ($|r| \geq 0.7$). To increase parsimony in our models we simplified overhead cover to Macartney rose, southern dewberry, grass, forbs, or other (cover types recorded ≤ 1% in our dataset).

To rank our competing models, we used Akaike’s Information Criterion with an adjustment for small sample sizes (AICc) and also calculated distance from lowest AICc (ΔAICc), log-likelihood (L), number of variables (K), and model weights (w_i) to compare model support (Burnham and Anderson 2002; Table 3). We assessed the performance of our top model using 10 iterations of a 10-fold cross validation (Boyce et al. 2002). For each iteration we created a random subset of 80% of our data (maintaining 1:1 choice sets) to act as ‘training sets’ to fit our model and the remaining 20% to act as “test sets” to provide an unbiased evaluation of the trained model. We tested our trained model with the test sets and for each iteration we calculated the relative probability of selection for each rest site and

Table 3. – Output of the 5 top-ranking a priori models developed to predict plains spotted skunk rest site selection at Warren Ranch from 2019-2021.

Model	Log(L)	K	AICc	ΔAICc	w_i
$Cover_1$: overhead + center.rob + center.lit + node.lit + node.rob + mr.sm + mr.med + mr.lg + mr + db + litter + drs + grass + forb + bare + id	-55.66	20	148.13	0.00	1.000
$Subglobal_1$: overhead + center.ht + center.rob + center.can + center.lit + id	-77.41	10	171.00	22.86	0.000
Global: overhead + center.ht + plot.ht + moisture + center.rob + node.rob + center.can + node.can + center.lit + node.lit + mr.sm + mr.med + mr.lg + eb.sm + eb.med + eb.lg + ct.sm + ct.med + ct.lg + db.ct + vine.ct + shrub.ct + tree.ct + grass + forb + shrub + tree + litter + bare + msv + drs + mr + db + vine + debris + hay + cwd + rock + water + primroad.dist + secroad.dist + riparian.dist + ephemeral.dist + permanent.dist + id	-42.50	48	171.26	23.13	<0.001
$Subglobal_3$: grass + forb + shrub + tree + litter + bare + msv + drs + mr + db + vine + debris + hay + cwd + rock + water + id	-104.18	17	230.67	82.53	<0.001
$Cover_5$: mr + db + drs + id	-112.79	4	231.60	83.47	<0.001

paired site in our choice sets (Bodinof et al. 2012). Across our test sets we pooled the proportion of rest sites that were correctly predicted as being selected by our model. If the relative probability of selection across our pooled test sets was greater than 0.5, we determined that the performance of our top model was better than what would be expected at random (Bodinof et al. 2012).

RESULTS

We captured 41 plains spotted skunks between January 2019 and February 2021; however, only 30 skunks (13 females and 17 males) were tracked to rest sites that were included in the data of our study (Appendix A). Eleven captured skunks were excluded from our study because they were too small to affix a radio-collar, slipped their collar soon after being fitted with a collar, relocated to an area outside of the bounds of our study site, were unable to be located, died before rest sites could be located, or were initially captured too near to the end of our study to ensure sufficient data collection. Two skunks were initially captured using casual live trapping surveys and all subsequent skunks were captured by systematic live trapping surveys influenced either by camera trap detections or incidental captures when trapping for recollaring efforts.

We tracked our radio-collared skunks 652 times to a diurnal rest site. We collected data at 426 unique rest sites (207 female and 219 male rest sites; Table 4) and an equal number of paired sites. We observed a 22% (n=143) rate of reuse by our radio-collared skunks. Of the reused sites, 57 were attributed to two skunks (one male and one female) that were successively tracked to two different anthropogenic debris sites (27 tracking events for the female and 32 tracking events for the male). We categorized these anthropogenic debris sites as locations where ranch personnel purposely clustered refuse, such as fence posts, branches and logs, mechanical appliances, and cattle carcasses collected within our study site. Due to safety concerns for ourselves, only the anthropogenic debris site used by the male was surveyed. We collected data at an average number of 14 rest sites (range 1-40) per

Table 4. – Average values, standard errors, and ranges for each variable measured to describe rest sites and paired sites.

Variable	Rest sites			Paired sites		
	x̄	SE	Range	x̄	SE	Range
center.ht	108.49	3.09	10-425	56.696	1.81	10-310
plot.ht	283.21	6.04	60-1212	252.39	8.43	10-1524
moisture	28.49	1.64	0-100	31.22	1.70	0-100
center.rob	95.95	1.69	10-200	43.36	1.54	10-180
plot.rob	56.79	1.28	10-165.63	44.44	1.29	10-177.5
center.can	7.72	0.85	0-96	2.94	0.48	0-96
plot.can	4.46	0.48	0-72	3.67	0.44	0-96
center.lit	2.08	0.20	0-29.5	1.31	0.16	0-32
plot.lit	1.61	0.17	0-43.5	1.18	0.12	0-15.63
mr.sm	3.53	0.20	0-23	2.45	0.16	0-31
mr.med	3.15	0.14	0-21	1.68	0.10	0-10
mr.lg	0.71	0.06	0-9	0.27	0.03	0-4
eb.sm	0.35	0.07	0-16	0.76	0.28	0-88
eb.med	0.76	0.11	0-17	0.61	0.18	0-67
eb.lg	0.72	0.10	0-16	0.83	0.25	0-87
ct.sm	0.04	0.01	0-4	0.05	0.02	0-4
ct.med	0.17	0.04	0-9	0.14	0.04	0-14
ct.lg	0.12	0.03	0-8	0.23	0.06	0-16
db.ct	6.69	0.34	0-44	4.53	0.30	0-44
vine.ct	0.40	0.06	0-10	0.28	0.06	0-11
shrub.ct	1.44	0.28	0-67	1.59	0.35	0-88
tree.ct	0.32	0.10	0-31	0.84	0.57	0-242
grass	27.25	0.96	0-88.75	48.13	1.54	0-100
forb	11.40	0.64	0-71.25	22.93	1.32	0-100
shrub	0.65	0.10	0-18.75	0.54	0.12	0-25
tree	0.08	0.04	0-11.25	0.05	0.02	0-6.25
litter	0.48	0.11	0-32.5	0.92	0.15	0-26.25
bare	0.56	0.15	0-61.25	2.54	0.42	0-85
msv	0.58	0.16	0-40	0.89	0.27	0-68.75
drs	2.44	0.33	0-60	1.97	0.28	0-47.5

Table 4. – Continued

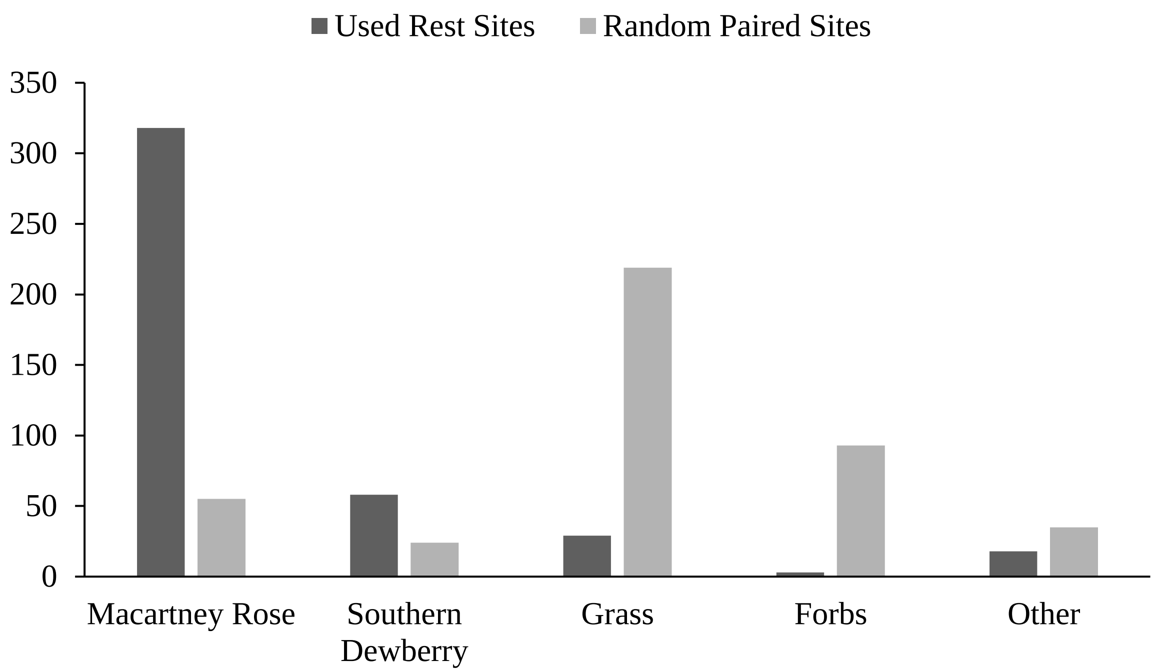
Variable	Rest sites			Paired sites		
	x̄	SE	Range	x̄	SE	Range
mr	43.37	1.06	0-100	14.52	0.91	0-92.5
db	12.54	0.82	0-81.25	7.07	0.60	0-81.25
vine	0.16	0.07	0-23.75	0.12	0.05	0-13.75
debris	0.16	0.12	0-41.25	0	0	0-0
hay	0.15	0.15	0-65	0.06	0.06	0-27.5
cwd	0.01	0.00	0-2.5	0.02	0.01	0-5
rock	0.00	0.00	0-1.25	0.05	0.04	0-15
water	0.16	0.08	0-22.5	0.18	0.07	0-16.25
riparian.dist	310.18	11.16	0-1104.16	312.44	11.14	0-1090.13
ephemeral.dist	337.82	8.67	26.64-1640.89	344.41	9.39	26.64-1665.78
permanent.dist	732.50	23.64	0-2520.10	734.88	23.73	10.11-2619.71
primary.dist	298.95	10.76	5.14-1343.34	291.52	10.84	0.14-1367.87
secondary.dist	131.25	5.71	5.04-563.09	119.89	5.89	0-566.08

individual skunk. We did not observe communal denning, but on rare occasions (n=2) we tracked an individual to a rest site previously used by a different skunk. No individual female skunk contributed more than 10% to rest site data for females and no individual male contributed more than 8% to rest site data for males. We collected data at 127 winter rest sites, 99 spring rest sites, 108 summer rest sites, and 92 fall rest sites (average 106.5 rest sites per season).

Rest site habitat characterization. – Our radio-collared skunks utilized a variety of structures as overhead cover and for bedding at rest sites where habitat characteristics were measured (Figure 2). The vast majority of rest sites were located in Macartney rose brambles (75.4%, n=321; 162 small, 134 medium, and 25 large). We also located rest sites in southern dewberry brambles (14.6%, n=62), bunches of grass (6.1%, n=26), peppervine (0.7%, n=3), forbs (0.7%, n=3), deep-rooted sedge (0.7%, n=3), yaupon holly shrubs (0.7%, n=3), and grassland litter (0.5%, n=2). We also located rest sites in a cattle hay pile (0.2%, n=1), which we defined as a loose mass of hay dispersed on the ground, and anthropogenic debris sites (0.5%, n=2).

Below the overhead cover at rest sites, we located skunks in varying bedding structures. We only recorded the bedding structure or material present at the rest site if either the skunk was visible or we had the strongest signal possible detected from solely our receiver (i.e. antenna disconnected). We did not include bedding structure as a covariate in our models because, at more than half of our rest sites observed (59%, n=251), either the requirements were not met to record the bedding structure or we had not yet begun recording bedding structure in our data. When we were able to record bedding structure, we observed

Figure 2. – Number of structures used as rest sites by plains spotted skunks at Warren Ranch from 2019-2021, compared with paired sites surveyed.



skunks in grass (19.7%, n=84), and of these, 10 sites (2.3%) were classified as a grass nest that appeared purposely constructed likely by a spotted skunk. Skunks were tracked to ground burrows (13.1%, n=56), which we characterized as an underground structure with a tunnel excavated into the ground. We also identified skunks in grassland litter (3.1%, n=13), deep-rooted sedge (0.7%, n=3), and on rare occasions (i.e. <1% of sites, n=1 for each) peppervine, Macartney rose, hay, forbs, coarse woody debris, and bare ground. On one tracking event we located a female skunk resting approximately 2 m off the ground in a yaupon holly shrub.

Of the 426 rest sites located, 15 (3.5%) were denning sites occupied by two females known to be rearing young. Both females were only observed for 1 season, 1 in the summer of 2019 and the other in the spring of 2020. These females showed little rest site fidelity, indicated by a site reuse rate of 11% for a female tracked in summer 2019 and 0% for a female tracked in summer 2020. Of the 15 denning sites located, 75% were under Macartney rose (n=12; small=6, medium=6), 12.5% were under southern dewberry (n=2), and 12.5% were under bunches of grass (n=2). As with the males and females observed without young, we were unable to determine the bedding material or structure at most rest sites (62.5%, n=10). We were able to observe the two maternal females in grass (18.8%, n=3), a grass nest (6.25%, n=1), and ground burrows (12.5%, n=2). We visually confirmed that both females were with pre-dispersal young.

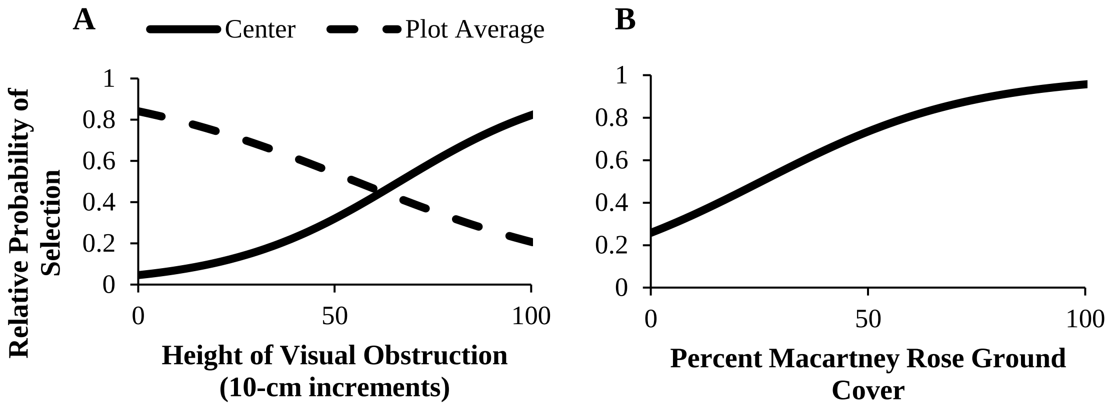
Model selection and validation. – Our cover hypothesis received the most support with the $Cover_1$ model ranking as the top model. Our $Cover_1$ model includes southern dewberry as overhead cover, height of visual obstruction, depth of grassland litter at the center of the rest site, total number of small Macartney rose brambles, and percentage of Macartney rose as ground cover (w_i = 1.000; Table 5). Other variables in our top model had odds ratio 95% confidence intervals that overlapped 1.0, thus we were unable to determine the influence of the effects of these variables on plains spotted skunk rest site selection.

Rest site selection was positively associated with southern dewberry as overhead cover. Relative to Macartney rose, the odds of a skunk selecting for southern dewberry as the overhead cover was approximately 5-fold greater, contrary to the predicted positive influence of Macartney rose overhead cover in our cover hypothesis. Our results showed a positive relationship with the height of visual obstruction at the center of the rest site. Relative probability of a skunk selecting a rest site increased by 6% for every 10-cm increase in the height of visual obstruction at the center of the rest site, providing some support to our Subglobal_1 model of all variables measured within 5 m of the center of the rest site (Figure 3). Contrary to our model, there was a negative relationship with the height of visual obstruction for the plot average. In such cases the relative probability of selection decreased by about 5% for every 10-cm increase in the height of visual obstruction of the plot, lending some support to our Subglobal_2 model of all variables measured more than 5 m from the center of the rest site. For every 10% increase in the percentage of Macartney rose ground cover, the relative probability of selection increased by 7%, thus adding support for our Subglobal_3 model for ground cover classes. We also observed a slight positive influence of depth of grassland litter at the center of the rest site and the total amount of small Macartney rose brambles, providing limited support to our Subglobal_1 model and our predator avoidance hypothesis, respectively. For every 1-unit increase in grassland litter depth or amount of

Table 5. – Estimates, standard errors, and odds ratios and their confidence intervals for the variables included in the top-ranking model for plains spotted skunk rest site selection on the Katy Prairie. *SE* = standard error. *OR* = odds ratio. *CI* = 95% confidence interval. DB = southern dewberry. Selection of overhead cover is relative to the reference category, Macartney rose. * denotes a variable with a *CI* that does not overlap 1.0.

Variable	Estimate	*SE*	*OR*	OR lower *CI*	OR upper *CI*
overhead_DB*	1.564	0.751	4.776	1.095	20.828
overhead_FORBS	-2.141	1.233	0.118	0.010	1.318
overhead_GRASS	-1.073	0.564	0.342	0.113	1.033
overhead_OTHER	1.139	0.957	3.123	0.479	20.379
center.rob*	0.043	0.010	1.044	1.025	1.064
plot.rob*	-0.040	0.011	0.960	0.939	0.982
center.lit	0.193	0.086	1.213	1.024	1.437
node.lit	0.235	0.154	1.265	0.936	1.709
mr.sm*	0.245	0.090	1.277	1.070	1.524
mr.med	-0.011	0.134	0.989	0.760	1.287
mr.lg	-0.257	0.249	0.773	0.474	1.261
mr*	0.081	0.038	1.084	1.005	1.169
db	0.025	0.038	1.025	0.952	1.104
litter	-0.246	0.14	0.782	0.594	1.030
drs	0.014	0.050	1.014	0.921	1.118
grass	0.018	0.036	1.018	0.949	1.092
forb	-0.009	0.037	0.991	0.921	1.066
bare	-0.031	0.073	0.969	0.840	1.119

Figure 3. – Predictive plots illustrating the change in relative probability of plains spotted skunks at Warren Ranch, Harris County, Texas (2019-2021) selecting a rest site with changes in (A) the height of visual obstruction at the center and within a 10 m radius of the center (i.e. plot average) and (B) the percentage of Macartney rose ground cover.



small Macartney rose brambles, there was an equal 1% increase in the relative probability of selection. We found no support for our hypotheses for road avoidance or water avoidance.

When we separated our data by sex we found that rest site selection of female skunks was best explained by our Global model (w_i = 0.9971). For males, we found there was no change in the resulting Cover$_1$ model as the top model (w_i = 1.0000). The influence of variables from the Global model and the Cover$_1$ model on sex differences in rest site selection were undiscernible due to the variables all having odds ratio 95% confidence intervals overlapping with 1.0.

When we separated data by season we found differences in the top models to explain plains spotted skunk rest site selection. Rest site selection in the spring was best explained by our Subglobal$_1$ model (w_i = 0.989), which included all variables measured at the center of the rest site. Height of visual obstruction had a positive influence on spring rest site selection and was the only variable with odds ratio 95% confidence intervals not overlapping 1.0, providing support to our cover hypothesis. Rest site selection in the summer was best explained by our Cover$_5$ model (w_i = 0.608) with the variables for percent of ground cover of Macartney rose, dewberry, and deep-rooted sedge. However, only the percent ground cover of Macartney rose and dewberry had a positive influence that could be interpreted, lending further strength to our cover hypothesis as well as our forage availability hypothesis and Subglobal$_3$ model. For the summer season, the second-ranking model, Cover$_1$, was within 2 AIC scores of our top model (w_i = 0.3094, ΔAIC = 1.4). The influence of variables in the Cover$_1$ model on the summer rest site selection of plains spotted skunks could not be determined because of 95% confidence intervals overlapping 1.0. The top-ranking model to explain rest site selection in the fall and winter was the $Cover_1$ model (w_i = 0.9800 for fall; w_i = 1.000 for winter), however the influence of the variables in this model could not be determined due to 95% confidence intervals overlapping 1.0. Our 10-fold cross validation suggested that our top-ranking $Cover_1$ model to explain plains spotted skunk rest site selection was accurate in predicting use of a rest site approximately 80% of the time.

DISCUSSION

Our results showed that the cover hypothesis was the most successful at explaining rest site selection of plains spotted skunks at our study site. One of the most important factors influencing rest site selection was overhead cover type. We recorded Macartney rose as overhead cover at rest sites at a higher frequency than southern dewberry; yet, discrete choice analyses indicated that skunks selected for southern dewberry over Macartney rose.

Macartney rose, a native species in China and Taiwan, was introduced into the United States in the 1800s as hedge rows for fencing purposes, but has since rapidly spread in the southern United States and become difficult to control (Scifres 1975). In southeast Texas, Macartney rose reduces the foraging ability of livestock by blocking the establishment of forbs and grasses under its canopy and limiting livestock to the areas between Macartney rose brambles to forage. If left unmanaged, eventually individual Macartney rose brambles will merge into a single, large thicket (Scifres 1975; Gordon and Scifres 1977; Enloe 2013).

One explanation for why plains spotted skunks selected southern dewberry over Macartney rose may be that the shape and growth of southern dewberry is more effective in concealing plains spotted skunks from predators and resource competitors. Southern dewberry is a low-growing, trailing shrub native to Texas (Blanchard 1911; Oefinger and Halls 1974). It is typically under 1 m in height at our study site, allowing the dense foliage to cover the entire shrub (KPJ pers. obs.). Macartney rose, conversely, is a climbing and trailing shrub with thorny, arching canes that can extend more than 1 m from the parent bramble to attach to nearby vegetation or back onto itself to increase in size (Scifres 1975; Gordon and Scifres 1977). At our study site, used rest sites with southern dewberry as overhead cover had an average height of 80 cm at its center compared to 120 cm at rest sites with Macartney rose as overhead cover. As Macartney rose grows into tall, dense thickets, the lower portion of the bramble receives less sunlight than the central or upper parts of the bramble, thus the foliage in these areas is less dense. Eng et al. (2018) suggested that vegetative cover may increase the efficacy of the cryptic appearance of eastern spotted skunks to avoid detection by predators. Of the 11 known mortalities of spotted skunks from 2019-2021 at our study site, 7 (64%) were categorized as predation based. The contrasting pattern of white spots and stripes on the black body of a spotted skunk enhances pattern blending against patches of leafy shade and moonlight shadows (Howell 1906; Kinlaw 1995; Caro 2009; Caro et al. 2013). Spotted skunks may have stronger selection for southern dewberry because it enhances their cryptic appearance and for the denser cover it provides to reduce detection by predators.

From the burrows we located and were able to measure, plains spotted skunks used burrows with entrances sized from 5 x 9.5 cm to 14.5 x 20 cm, with an average of 10 x 10.5 cm. Burrows with entrances sizes within this range would likely exclude larger predators. Similar to findings reported by Lesmeister et al. (2008) and Harris et al. (2020) regarding the size of burrow entrances, it may be more difficult for animals larger than plains spotted skunks to enter brambles with small openings. As the lower portion of tall (> 1 m) Macartney rose brambles loses foliage, openings into the bramble become more accessible to entry by wildlife (Dickinson and Arnold 1996; KPJ, pers. obs.) At our study site, we observed coyotes (*Canis lupus*) and great horned owls (*Bubo virginianus*), known predators of spotted skunks, (Kinlaw 1995; Lesmeister et al. 2010), striped skunks (*Mephitis mephitis*) and Virginia opossums (*Didelphis virginiana*), potential resource competitors of spotted skunks (Kinlaw

1995; Doty and Dowler 2006), and other animals (small mammals and raptors) occupying Macartney rose brambles (KPJ, pers. obs.; M. H. Hamilton, pers. comm.). The larger size of these animals leads us to suggest that Macartney rose is more likely to be inhabited or explored than southern dewberry, thus limiting their use by plains spotted skunks.

Crabb (1948) indicated that the 3 site requirements for spotted skunks are cover from predators, exclusion of sunlight, and protection from weather events, all of which the dense cover of southern dewberry can potentially provide. Lesmeister et al. (2008) indicated that thermoregulation has an effect on rest site selection of eastern spotted skunks; however, further research at our study site investigating the ability of southern dewberry to protect plains spotted skunks from both overheating in the summer and freezing in the winter is needed to provide conclusive evidence. For our study, grassland litter at the center of the rest site increased the odds of selection of a used rest site, indicating that it may be useful in thermoregulation.

Another possible explanation for plains spotted skunks selecting for southern dewberry as overhead cover at their rest sites is the historical component. Southern dewberry is native to our study site whereas Macartney rose is an introduced species (Hart et al. 2008). Neither plant species has been specifically mentioned in previous studies conducted in the range of the plains spotted skunk (Bailey 1905; Crabb et al. 1948; Choate 1974). Crabb (1948) mentioned that rose (*Rosa* sp.) and raspberry (*Rubus* sp.) species of shrubs were characteristic of the woodland portion of his study area in Iowa, though they were not considered as habitat for spotted skunks compared to the more abundant tall grass prairie and farmland surrounding the woodland area. Crabb's (1948) findings were based off incidental observations of skunks rather than tracking radio-collared individuals. Our findings indicated that Macartney rose ground cover had a positive influence on rest site selection, suggesting that the plant species is valued more in the surrounding 10 m of the rest site than directly at its center. Combined with the slight positive effects of small Macartney rose brambles and a decreasing height of visual obstruction in the plot, we suggest that plains spotted skunks utilize Macartney rose for cover when its height is low enough to conceal plains spotted skunks and limit the entry of larger wildlife. More research into the habitat selection of the species is needed, especially in parts of Texas where Macartney rose is not present, in order to further understand the importance of southern dewberry to plains spotted skunk rest site selection.

Arthropods, specifically beetles (family Coleoptera), grasshoppers (family Orthoptera), and millipedes (class Diplopoda), have been reported as significant prey items of eastern spotted skunks (Howell 1906; Crabb 1941; McCullough and Fritzell 1984; Kinlaw 1995; Harris 2018). Previous studies have also suggested that ground litter or leaf litter may provide habitat for potential arthropod prey items (McCullough and Fritzell 1984; Eng and Jachowski 2019; Harris et al. 2020). For our study, grassland litter at the center of the rest site increased the odds of selection of a used rest site, although contrary to our cover and forage hypotheses, the percent of litter as ground cover and the average depth of grassland litter at the 4 terminal nodes of the plot had no discernible impact on plains spotted skunk rest site selection. No other variables included under our forage hypothesis, except for percent of southern dewberry ground cover in the summer had any discernible effects on rest site selection. Southern dewberry flowers in the spring and the fruit matures by early summer

(Oefinger and Halls 1974; KPJ, pers. obs.), potentially providing an abundant source of food, either directly for berries or indirectly for insect foraging, to spotted skunks for a limited time in the late spring and summer. We recommend further research directly examining the diet of plains spotted skunks in the Katy Prairie.

Similar to Harris et al. (2018), our findings indicated that the height of visual obstruction had a small influence on rest site selection overall, and more specifically, in the spring. Visual obstruction at the center of the rest site had a positive influence on rest site selection, while visual obstruction averaged from the 4 terminal nodes of the plot had a comparable negative influence on rest site selection. From these findings, in addition to the high importance of dewberry as overhead cover at the center of the rest site, we suggest that plains spotted skunks are valuing cover at the fine-scale (within 5 m of the rest site) over cover at a coarser-scale (more than 5 m from the rest site). In conjunction with our findings of selection for southern dewberry brambles and the high frequency of use of small Macartney rose brambles, we suggest that plains spotted skunks value a heterogenous habitat that provides sources of cover with adjacent areas for foraging.

The top-ranking model for female rest site selection was our global model that included all variables measured. This suggests that the models developed from our hypotheses are absent of the habitat characteristics or combinations of habitat characteristics that females are selecting for, females are acting more as habitat generalists than males when it comes to their rest site selection, or we lacked sufficient sample sizes of female skunks and their rest sites to determine influences on their rest site selection.

Our findings showed a seasonal difference in rest site selection of plains spotted skunks, but there were also shared variables among all 3 models highlighted from our discrete choice analyses. During the spring season, variables measured at the center of the rest site, specifically height of visual obstruction, was important to rest site selection. During the summer, we found that percent ground cover of Macartney rose and southern dewberry had positive influences on rest site selection. Lastly, the fall and winter seasons both shared the Cover1 model as the top-ranking model, same as for the overall dataset. Across all 4 seasons, variables related to the amount of cover at the rest site were included in the top-ranking model.

Consistent with previous studies of eastern spotted skunks (Lesmeister et al. 2008; Sprayberry and Edelman 2018; Eng and Jachowski 2019; Harris et al. 2020), our results indicated that plains spotted skunk at our study site selected rest sites with greater cover availability. Particularly, we found that small-sized brambles of southern dewberry and Macartney rose are important in the rest site selection of plains spotted skunks. Notably, our study was conducted in an altered, prairie habitat, in contrast to other studies conducted in forested or mountainous regions (Lesmeister et al. 2008; Sprayberry and Edelman 2018; Eng and Jachowski 2019). Harris et al. (2020) reported that den type and burrow presence were the most important factors to rest site selection of Florida spotted skunks in a dry prairie habitat. We were unable to include the influence of burrows or the origin of burrows (e.g. armadillos, spotted skunks, pocket gophers, etc.) as a variable in our study, but we similarly found that visual obstruction plays a role in rest site selection and a lack of support of distance to a water feature or road feature to rest site selection.

The strong preference for southern dewberry by plains spotted skunks from our analyses suggests the potential to use management of southern dewberry to improve spotted skunk rest site habitat on the Katy Prairie. Chance et al. (2019) found that after an intermediate disturbance event (e.g. prescribed fire), a high abundance of established native plant species reduced the ability of non-native plant species, even if already established, to invade habitats and displace native species. Although our study was focused on a single site, the similarities of our findings with studies in other parts of the range of the eastern spotted skunk indicate the generality of our findings. The amount and type of cover available to eastern spotted skunks is important in their rest site selection. Because of the unique management of our study site, selection for southern dewberry at the center and Macartney rose in the surrounding area, and the contrasting influence of visual obstruction, we suggest further research into the habitat selection of plains spotted skunks on other portions of the Katy Prairie to determine the area- and site-specificity of our results.

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APPENDICES

Appendix A. – Descriptive data of captured plains spotted skunks, number of rest sites and seasons where habitat characteristics were recorded, and the outcome of the individual at our study site, Warren Ranch, from 2019-2021.

Skunk ID	Sex	Initial Capture Date	Rest Sites	**Seasons**	Outcome
S001	M	03 Feb 2019	12	2	Missing
S002	M	03 Feb 2019	24	4	Active
S003	M	12 Mar 2019	0	0	Missing
S004	M	13 Mar 2019	0	0	Missing
S005	M	27 May 2019	5	2	Missing
S006	M	18 Jun 2019	10	1	Mortality
S007	F	25 Jul 2019	8	1	Mortality
S008	M	26 Jul 2019	5	1	Mortality
S009	F	30 Jul 2019	0	0	Not affixed with collar
S010	F	01 Aug 2019	0	0	Not affixed with collar
S011	F	02 Aug 2019	16	3	Mortality
S012	F	02 Aug 2019	9	2	Missing
S013	M	05 Oct 2019	0	0	Mortality
S014	M	11 Oct 2019	13	3	Active
S015	M	19 Nov 2019	28	4	Missing
S016	F	30 Nov 2019	13	3	Missing
S017	M	04 Jan 2020	0	0	Missing
S018	M	06 Jan 2020	7	1	Missing
S019	F	07 Jan 2020	18	2	Missing
S020	M	19 Feb 2020	23	4	Active
S021	M	26 Feb 2020	13	3	Missing
S022	M	28 Feb 2020	31	4	Missing
S023	M	10 Mar 2020	4	2	Missing
S024	F	12 Mar 2020	40	5	Mortality
S025	F	12 Mar 2020	10	2	Active

Appendix A. – Continued

Skunk ID	Sex	Initial Capture Date	Rest Sites	**Seasons**	Outcome
S026	F	28 May 2020	26	4	Active
S027	M	15 Jun 2020	11	2	Active
S028	M	17 Jun 2020	0	0	Missing
S029	F	18 Jun 2020	7	2	Mortality
S030	F	12 Aug 2020	21	3	Active
S031	M	20 Nov 2020	8	1	Mortality
S032	M	02 Dec 2020	17	2	Active
S033	F	03 Dec 2020	16	2	Active
S034	F	03 Dec 2020	15	2	Active
S035	M	12 Dec 2020	1	1	Mortality
S036	M	16 Dec 2020	8	2	Mortality
S037	M	19 Jan 2021	0	0	Active
S038	M	19 Jan 2021	0	0	Active
S039	M	19 Jan 2021	0	0	Active
S040	F	21 Jan 2021	7	1	Mortality
S041	F	21 Jan 2021	0	0	Active

Appendix B. – IACUC Approval.

ANGELO STATE UNIVERSITY

College of Graduate Studies & Research

Institutional Animal Care & Use Committee

09/27/18

Robert C. Dowler, Ph.D.
Tippett Professor of Biology and
Curator of Mammals, Angelo State Natural History Collections
Angelo State University
ASU Station #10890
San Angelo, TX 76909

Dear Dr. Dowler:

Your proposed project titled, "Spatial Ecology of the Eastern Spotted Skunk" was reviewed by Angelo State University's Institutional Animal Care and Use Committee (IACUC) in accordance with the regulations set forth in the Animal Welfare Act and P.L. 99-158.

This protocol was approved for three years, effective 9-27-2018, and it expires three years from this date; however, an annual review and progress report form (www.angelo.edu/content/files/22583-iacuc-annual-review-progressreport) for this project is due 9-27 of each year. If the study will continue beyond three years, you must submit a request for continuation before the current protocol expires.

The protocol number for your approved project is 18-208. Please include this number in the subject line of in all future communications with the IACUC regarding the protocol.

Sincerely,

Steven T. Brewer, Ph.D.
Assistant Professor,
Director, MS Program in Experimental Psychology
Co-Chair, Institutional Animal Care and Use Committee
Psychology & Sociology
Angelo State University
Member, Texas Tech University System
ASU Station #10907
San Angelo, TX 76909-0907

Appendix C. – IACUC Amendment Approval.

ANGELO STATE UNIVERSITY

College of Graduate Studies & Research

Institutional Animal Care & Use Committee

10-06-2020
Robert C. Dowler, Ph.D.
Tippett Professor of Biology and
Curator of Mammals, Angelo State Natural History Collections
Angelo State University
ASU Station #10890
San Angelo, TX 76909

Dear Dr. Dowler:

Your proposed amendments (increase in number of animal to be studied & adjustment of capture method) for protocol #19-202, "Spatial Ecology of the Eastern Spotted Skunk" was reviewed by Angelo State University's Institutional Animal Care and Use Committee (IACUC) in accordance with the regulations set forth in the Animal Welfare Act and P.L. 99-158.

These amendments were approved, effective 10-05-2020 and retain the proposal number as #19-202. Expiration of this protocol is three years from the original protocol approval date; an annual review and progress report form (www.angelo.edu/content/files/22583-iacuc-annual-review-progressreport) for this project is due no later than 07-18 of each year. If the study will continue beyond three years, you must submit a request for continuation before the current protocol expires.

Please remember to include the protocol number (19-202) in the subject line of all future communications with the IACUC regarding this protocol.

Sincerely,

Steven T. Brewer, Ph.D.
Associate Professor,
Director, MS Program in Experimental Psychology
Co-Chair, Institutional Animal Care and Use Committee
Department of Psychology & Sociology
Angelo State University
Member, Texas Tech University System
ASU Station #10907
San Angelo, TX 76909-0907
Phone: 325-486-6124