AN ASSESSMENT OF MICROHABITAT VARIABLES AND CAPTURE SUCCESS OF STRIPED SKUNKS (*MEPHITIS MEPHITIS*)

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The association of microhabitat variables and capture (= occurrence) of striped skunks (*Mephitis mephitis*) was assessed at 3 sites in western Tennessee. Sixteen features were included in univariate and stepwise logistic regressions to investigate relationships between occurrence and habitat factors and to construct models predictive of occurrence. Accuracy of models was examined using jackknife procedures, and maps predictive of occurrence were developed through semivariance and kriging analyses. Average height of stand, hardwood snags >35 cm diameter at breast height, number of stems, distance to permanent water sources, and distance to open areas were among the habitat features most frequently found to be related to occurrence. Models derived from logistic regression predicted occurrence of the species at varying levels (56% to 75%). Overall, classification percentages appeared to be at a level useful for predicting the occurrence of *M. mephitis*, and mapping procedures sufficient for illustrating the association between occurrence and habitat.

Key words: generalist, habitat partitioning, kriging, logistic regression, *Mephitis mephitis*, mesopredator, microhabitat, semivariance, striped skunk, western Tennessee

Although striped skunks (*Mephitis mephitis*) have been the subject of numerous biological investigations, most previous studies relating to habitat have been descriptive in nature and focused on larger geographic areas (see Bixler and Gittleman 2000; Larivière and Messier 2000; Rosatte 1987; Verts 1967). Litvaitis et al. (1996) pointed out that habitat selection can occur at a variety of scales, and Gutzwiller and Anderson (1987) noted that analyzing habitat components at different levels results in a more complete understanding of habitat attributes important to species. Recent investigations (e.g., Baldwin 2003; Kolowski and Woolf 2002; Wilson 1996) have demonstrated that microhabitat (habitat on a local scale) variables can be useful in predicting occurrence of mid-sized mammalian predators. However, at present, the association of individual habitat variables with the occurrence of *M. mephitis* and use of statistical models to predict habitats most likely to support the species are lacking. Only Dijak and Thompson

(2000) have attempted to address the influence of local-scale factors on occurrence of striped skunks. However, no statistical examination of the influence of fine-scale variables on occurrence was conducted during their investigation because of insufficient visitation at scent stations. Knowledge of such issues could provide new insight toward understanding ecological factors that limit occurrence of *M. mephitis*.

Pearson (1993) noted that generalist species might select habitat characteristics primarily at a site level because they are able to use different local factors that exist in a variety of landscapes. Because striped skunks have a broad tolerance for habitat and act as generalists (Verts 1967; Wade-Smith and Verts 1982), they make an interesting model for assessing how habitat factors influence occurrence at different geographic scales. Additionally, due to removal of top predators (Crooks and Soulé 1999; Rogers and Caro 1998; Soulé et al. 1988), altered land use (Dijak and Thompson 2000; Donovan et al. 1997; Oehler and Litvaitis 1996), reduced harvest of skunks (Hamilton and Vangilder 1992), and perhaps other factors, populations of mesopredators, such as *M. mephitis*, have increased in abundance in many regions during recent years (Andren 1995; Kuehl and Clark 2002). Such increases in size of mesopredator populations have influenced ecosystems in

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many ways (e.g., increased nest predation on ground nesting birds—Donovan et al. 1997; Vickery et al. 1992; altered flora and fauna structure—Asquith et al. 1997; Levesque 2001; increased potential for the spread of diseases—Rosatte et al. 1986). Given the ecological and economic importance of this species, there is a need to better understand microhabitat factors that are associated with occurrence of the taxon. Therefore, the purpose of this investigation was to assess the association of microhabitat variables and capture success (= occurrence) of *M. mephitis.* Specifically, the following predictions were examined: 1) there is an association between occurrence and selected (individual) habitat variables; 2) selected habitat factors can be used to construct statistical models predictive of the occurrence of the species.

MATERIALS AND METHODS

Study area and habitat characterization.—This study was conducted in temperate deciduous forest in western Tennessee characterized by a fragmented landscape consisting of upland and bottomland forest, early successional and agricultural fields, homeplaces, and road systems at 3 sites. Sites were located at Ames Plantation (Ames, Tennessee), a 7,462-ha tract located approximately 3 miles northwest of Grand Junction in Fayette and Hardeman counties. Ames was owned and operated by Trustees of the Hobart Ames Foundation cooperatively with the University of Tennessee. Site 1 was composed of upland and bottomland forest, cropland, and old-field habitats. The most heterogeneous location was site 2, with numerous fragments of upland and bottomland forest interspersed among cropland and old-field patches, resulting in abundant edge habitat. Site 3 was the most homogenous location composed almost exclusively of upland and bottomland forest. In general, agricultural crops included soybeans (*Glycine max*), corn (*Zea mays*), and cotton (*Gossypium*). Typical upland tree species were loblolly pine (*Pinus taeda*), oak (*Quercus*), and hickory (*Carya*); typical bottomland species included oak, maple (*Acer*), cottonwood (*Populus*), and sweet gum (*Liquidambar stryaciflua*—Gabor 1993). Old-fields included native warm season grasses such as broomsedge (*Andropogon virginicus*), big blue stem (*Andropogon gerardii*), Indian grass (*Sorgastrum nutans*), and switch grass (*Panicum virgatum*) that were maintained by periodic burning. Topography of upland forest sites was characterized by gently rolling slopes, whereas bottomland forest, old-field, and agricultural areas occupied a flatter topography. Ponds and streams were numerous, and drainages were interspersed throughout all sites.

Trapping procedure.—Trapping grids were established at each site. Grids followed an 8 × 8 trap configuration with traps located approximately 230 m apart for a total of 64 traps per grid. Following Kolowski and Woolf (2002), association of microhabitat variables and capture success of striped skunks was assessed during the period that coincided with times when leaves were absent (winter) on most woody and herbaceous vegetation. All sites were trapped for approximately 2,000 trap nights (1 trap night = 1 trap set for 1 night) per site for each year (except for site 3, which was trapped for approximately 4,000 trap nights), and were operated on selected nights from 29 October–31 March during 2000–2002.

Raccoon size Tomahawk (Tomahawk Live Trap Co., Tomahawk, Wisconsin) and Havahart (Woodstream Corporation, Lititz, Pennsylvania) live traps were used. Traps were baited with canned cat food. Upon initial capture, individuals were anesthetized with a mixture of ketamine hydrochloride (Ketaset; Bristol Laboratories, Syracuse, New York) and acepromazine maleate (PromAce; Ayerst Laborato-

ries, New York, New York) at a 10:1 ratio with 0.1 cc of ketamine hydrochloride used per estimated kg of captured animal. Striped skunks were tagged with No. 3 Monel (National Band and Tag Company, Newport, Kentucky) ear tags to determine recaptures. All capture procedures followed guidelines established by the American Society of Mammalogists (Animal Care and Use Committee 1998).

Microhabitat variables.—Sixteen habitat variables were measured to determine the influence of microhabitats on captures of striped skunks. "Slope" represented the average percentage slope for a 32 m radius around the trap site as measured by a clinometer. "Total basal area" represents the amount of area (m²) covered by trees (>5 cm) per ha and was determined through use of a prism sweep (10 basal area factor prism) conducted at the trap site and at 2 additional sites 11.4 m in 2 random cardinal directions. This technique estimates basal area by using an offset image formed by the prism. If the offset image was within the original line of the tree, that tree was counted in the basal area estimation. This procedure was repeated in a 360° circle, with the total number of trees counted, averaged across sites, and multiplied by 10 to estimate basal area. The same technique applied to "basal area of small trees" (5–35 cm diameter at breast height [dbh]) and "basal area of large trees" (>35 cm dbh) except only trees of their respective size classes were included. Heights were recorded for each tree measured during the basal area estimation using a haga altimeter. The mean of these values was determined and recorded as "average height". "Number of fallen logs" ≥10 cm in diameter and "number of total snags" ≥10 cm dbh were counted within a 32 m radius of the trap site. In addition, separate categories were developed for "number of small hardwood snags" (10–35 cm dbh), "number of large hardwood snags" (>35 cm dbh), and "number of pine snags" (≥10 cm dbh) within the same radius of the trap site. "Number of ground dens" represented the total number of potential ground dens within a 32 m radius of the trap site. An opening of ≥5 cm in diameter was required to be considered a potential den. The "number of stems" 1–5 cm in diameter was counted for a 3.2 m radius around the trap site. The procedure was repeated in 2 random cardinal directions 11.4 m from the trap site and the average used. "Distance to potential water" represented the nearest distance to a water source that held water ≥30 days a year. "Distance to permanent water" was the minimum distance to a water source that held water ≥11 months a year. "Distance to road" was measured to the nearest road or man-made vehicular trail, and "distance to open area" represented the nearest distance to a non-forested patch. All distance measurements were in m and were measured using digital orthophoto quarter-quadrangles georeferenced in ArcView software.

Data analysis.—Temple and Wilcox (1986) noted that wildlife habitat models need to consider size, shape, proximity, and spatial arrangement of fragmented landscapes in order to have practical utility in reflecting the immediate habitat requirements of a species. In order to account for this variation in habitat composition across sites, Maurer (1986) proposed an updating strategy that combined sites from various locations in order to construct the most meaningful models. Therefore, in the present investigation, statistical analyses were conducted for each site individually and for combined sites in order to replicate the study and examine results in detail. For analysis, a natural log transformation was applied to all continuous variables, and percentage variables were arcsine transformed to approximate a normal distribution (Zar 1999). Univariate logistic regression was used to assess associations between single habitat variables and striped skunk captures. Significance was indicated at $\alpha = 0.05$. No statistical adjustment to this alpha level was made following suggestions by Moran (2003). However, no variable with a moderate P value (0.025–0.050) was considered significant if no other variables were significant and it was

not shown to be significant across other replicated sites in order to account for spurious results.

For stepwise logistic-regression analysis, a preset $\alpha = 0.15$ was used as a minimum threshold for inclusion into a stepwise logistic-regression function in order to reduce the data set, following Hosmer and Lemeshow (2000). Multicollinearity effects between 2 significant variables were addressed by assessing correlations among habitat variables. If 2 significant variables were correlated at $r \geq 0.70$, only the most significant variable of the pair was included in further analysis in order to reduce use of redundant variables, as suggested by Agresti (1996).

Variables remaining after univariate analysis were included in a backward stepwise logistic-regression function. For variables to be removed from the model, $P > 0.15$ was used. Akaike's Information Criterion has been employed as a model selection criterion in order to determine the most parsimonious model that still maintained a high explanatory value (Burnham and Anderson 1998), and this technique was assessed in the present study. However, models developed using Akaike's Information Criterion often contained a large number of variables. Therefore, for practicality, efficacy, and to simplify management applications, these models were reduced further by forcing exclusion of variables with lowest t ratios, resulting in a minimum variable model that maintained approximate classification percentages. Results from the minimum variable models were similar to Akaike's Information Criterion. Therefore, only the minimum variable models are given in the present study. Results derived from Akaike's Information Criterion models can be found in Baldwin (2003). The t ratio represents the ratio of each regression coefficient to its standard error. Relative importance of variables included in the final models was ascertained through t ratios. The greater the t ratio, the better the variable is for predicting captures (Hacker and Coblentz 1993; Hosmer and Lemeshow 2000; Kolowski and Woolf 2002).

Percentage correct classification of trap sites was determined using logistic regression models. Accuracy of these models was determined using jackknife procedures as a pseudo-validation technique (Kolowski and Woolf 2002; Morrison 1976). This procedure tested classification accuracy by removing 1 trap site at a time and then classified that site based upon the model built from all other sites combined, which results in a less-biased classification percentage (Hacker and Coblentz 1993; Kolowski and Woolf 2002). All statistical procedures were conducted using SYSTAT 10.0 (SPSS 2000).

Following Robertson (1998), semivariance analysis, succeeded by blocked kriging, was used to build interpolation maps representing capture probabilities of all trap sites for each trapping grid. Kriging is an interpolation technique that uses known values associated with X and Y coordinates and estimates values for all locations within the known coordinates. In this study, capture probability was the value interpolated. Capture probabilities were determined using the success probability formula for logistic regression (Agresti 1996). Using models built for each site individually, differences across all sites were assessed. In addition, models were constructed with sites combined to determine their ability to predict occurrence across different but similar sites. This technique utilized X and Y universal transverse Mercator (UTM) coordinates along with capture probabilities for each trap site in order to predict probabilities of capture throughout the entire site. Probabilities of capture were transformed (either log or square root) when needed in order to approximate a normal distribution. Isotropic (all directional) semivariograms were then constructed and the best-fit model (i.e., highest r^2 and lowest residual sum of squares) for each site was used (either spherical, exponential, linear, linear to sill, or Gaussian—Robertson 1998). Maps were developed based upon 2 × 2 blocked kriging interpolations and were

related to digital orthophoto quarter-quadrangles to relate capture probabilities to landscape features (see Nesslage and Porter 2001 for an in-depth discussion of methods for this technique). All statistics and mapping were performed using GS+ software (Robertson 1998).

RESULTS

Trapping effort yielded 130 total captures of 67 individual striped skunks. Captures were obtained at 192 trap stations in winter (site 1 = 30 total captures of 17 individuals; site 2 = 42 total captures of 22 individuals; site 3 = 58 total captures of 28 individuals).

Site 1.—Univariate logistic regression resulted in a significant association among 12 habitat variables and captures (Table 1). The only significant positive association was for distance to potential water. Highest negative t ratios were observed for distance to road and basal area of large trees. Slope and large hardwood snags were the only variables with a P value >0.10. Stepwise logistic regression and model construction yielded 2 significant variables (both negative—basal area of large trees, distance to road) and correctly classified 75% of the sites (Table 2). The semivariance model for site 1 was constructed using the Gaussian function and resulted in an $r^2 = 0.944$ and residual sum of squares = 3.624×10^{-3}. Using the minimum variable model, capture probabilities are shown to be highest in open areas, whereas lowest probability of capture is shown in larger forested fragments (Fig. 1).

Site 2.—One habitat variable (positive—large hardwood snags) was statistically significant with captures of striped skunks based on univariate logistic regression (Table 1). From stepwise regression functions and model construction, large hardwood snags were selected (Table 2). The correct classification percentage was 56%. The Gaussian function was used to construct the semivariance model and resulted in an $r^2 = 0.950$ and residual sum of squares = 2.630×10^{-5}. The largest forested area (northeastern corner) had the greatest capture probability, whereas the lowest probability of capture was found in open areas with few forest fragments present (southeastern corner). See Fig. 2.

Site 3.—Nine habitat variables were significantly associated to captures of striped skunks based on univariate logistic regression. Strongest positive associations were for pine snags and slope, whereas distance to permanent water, distance to open area, and stems expressed strong negative associations (Table 1). In general, variables associated with slope, height of stand, number of logs, snags, stems, and distances to permanent water sources and open areas were associated with striped skunk captures; variables relating to basal area measurements, ground dens, and distance to roads were not. Four significant variables (2 positive—distance to potential water, slope; 2 negative—distance to open area, distance to permanent water) were selected through stepwise procedures with an overall classification percentage of 69% (Table 2). The semivariance model for site 3 was constructed using the exponential function and resulted in an $r^2 = 0.984$ and residual sum of squares = 4.020×10^{-1}. Locations of highest capture probability occurred in areas close to large edge habitats (northwestern and

TABLE 1.—Resulting *t* ratios and *P* values from univariate logistic regression of captures of striped skunk (*Mephitis mephitis*) when compared to habitat variables during winter 2000–2002 at 3 sites in western Tennessee. All variables are considered significant at $P < 0.05$. Basal area measurements are per ha. Height and distance measurements are in m. See text for explanation of variables and sites.

	Site 1 ($n = 4,224$)		Site 2 ($n = 4,352$)		Site 3 ($n = 8,448$)		Combined sites ($n = 17,024$)	
Variable	*t* ratio	*P* value	*t* ratio	*P* value	*t* ratio	*P* value	*t* ratio	*P* value
Slope	−0.932	0.351	−0.369	0.712	3.499	<0.001[a]	1.207	0.227
Total basal area	−3.471	0.001	1.021	0.307	1.415	0.157	−2.059	0.040[a]
Basal area of small trees	−3.258	0.001[a]	0.993	0.321	1.302	0.193	−2.023	0.043
Basal area of large trees	−3.856	<0.001[a]	−0.799	0.424	1.354	0.176	−2.038	0.042[a]
Average height	−3.256	0.001[a]	0.414	0.679	−1.961	0.050[a]	−2.703	0.007[a]
Number of logs	−3.287	0.001[a]	−0.516	0.606	3.070	0.002[a]	−1.802	0.072[a]
Number of small hardwood snags	−2.232	0.026[a]	0.248	0.804	0.884	0.377	−0.197	0.844
Number of large hardwood snags	−1.390	0.164	1.999	0.046[a]	2.039	0.041[a]	2.266	0.023[a]
Number of pine snags	−1.651	0.099[a]	1.301	0.193	3.768	<0.001[a]	2.391	0.017[a]
Number of total snags	−3.026	0.002	0.675	0.500	2.959	0.003[a]	0.644	0.520
Number of ground dens	−1.788	0.074[a]	1.419	0.156	−1.062	0.288	−1.363	0.173
Number of stems	−2.383	0.017[a]	0.895	0.371	−3.201	0.001[a]	−3.017	0.003[a]
Distance to potential water	2.085	0.037[a]	−0.352	0.725	1.820	0.069[a]	1.398	0.162
Distance to permanent water	−2.775	0.006[a]	0.510	0.610	−4.882	<0.001[a]	−4.182	<0.001[a]
Distance to road	−4.059	<0.001[a]	1.760	0.078[a]	−0.532	0.595	−1.923	0.055[a]
Distance to open area	−2.706	0.007	1.746	0.081[a]	−4.703	<0.001[a]	−2.947	0.003[a]

[a] Variable included in stepwise logistic-regression function.

northeastern corners), whereas lowest capture probabilities occurred within interior portions of site 3 (Fig. 3).

Combined sites.—Univariate logistic regression resulted in a significant association among 9 habitat variables and captures. The only significant positive associations existed for pine snags and large hardwood snags, whereas the highest negative *t* ratios were for distance to permanent water, stems, and distance to open area (Table 1). Only 5 variables (slope, small hardwood snags, total snags, ground dens, and distance to potential water) had *P* values >0.10. Four significant variables (1 positive— total basal area; 3 negative—distance to permanent water, aver-

age height, distance to open area) were selected through subsequent stepwise procedures and model construction and correctly classified 65% of the sites (Table 2). For combined sites, Gaussian functions were used to construct semivariance models for sites 1 and 2, whereas exponential functions provided the best fit for site 3. Results of these models for combined sites for each location were as follows: site 1 ($r^2 = 0.268$, residual sum of squares $= 4.291 \times 10^{-3}$); site 2 ($r^2 = 0.651$, residual sum of squares $= 2.446 \times 10^{-3}$); site 3 ($r^2 = 0.949$, residual sum of squares $= 6.252 \times 10^{-4}$). Highest capture probabilities are generally shown around edges of small
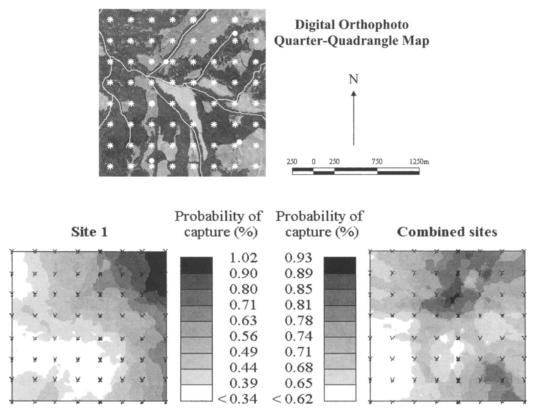
TABLE 2.—Regression coefficients, *t* ratio, and *P* value for striped skunks (*Mephitis mephitis*) derived from logistic-regression functions, as well as % correct classifications using the jackknife procedure. Data included in analyses were from 3 sites located in western Tennessee during the winter seasons of 2000–2002. Number of trap nights for each site: site 1 = 4,224; site 2 = 4,352; site 3 = 8,448; combined sited = 17,024. See text for explanation of sites and variables.

Site	Variable	Logistic regression			Jackknife classification		
		Coefficient	*t* ratio	*P*	No capture[a]	Capture[b]	Combined[c]
1	Constant	−3.219	−8.646	<0.001	78	67	75
	Basal area of large trees	−0.326	−2.692	0.007			
	Distance to road	−0.305	−2.593	0.010			
2	Constant	−4.800	−24.489	<0.001	70	33	56
	Number of large hardwood snags	0.521	1.999	0.046			
3	Constant	0.770	0.626	0.531	67	79	69
	Distance to open area	−0.786	−4.835	<0.001			
	Distance to permanent water	−2.076	−3.500	<0.001			
	Distance to potential water	1.685	2.760	0.006			
	Slope	0.734	2.740	0.006			
Combined	Constant	−2.358	−4.871	<0.001	69	51	65
	Distance to permanent water	−0.349	−4.539	<0.001			
	Average height	−0.883	−3.242	0.001			
	Distance to open area	−0.202	−3.223	0.001			
	Total basal area	0.598	3.058	0.002			

[a] Percent correct classification of sites with no captures.
[b] Percent correct classification of sites with captures.
[c] Percent correct classification of all sites combined.

**Digital Orthophoto
Quarter-Quadrangle Map**

FIG. 1.—Probability of capture of striped skunks (*Mephitis mephitis*) interpolated from logistic regression equations using kriging analysis for habitat variables on site 1. The digital orthophoto quarter-quadrangle map reflects site 1 and provides a reference for available macrohabitats. Dark areas on this map represent forested sites, and light areas signify agricultural and old-field sites. White lines and circles represent streams and ponds, respectively. Trap sites are represented by an asterisk (*) on the digital orthophoto quarter-quadrangle map and an × on the capture probability maps. Site is located in southwestern Tennessee.

forested patches and open areas that are close to permanent water sources; lowest probability of capture occurs in large interior forested areas.
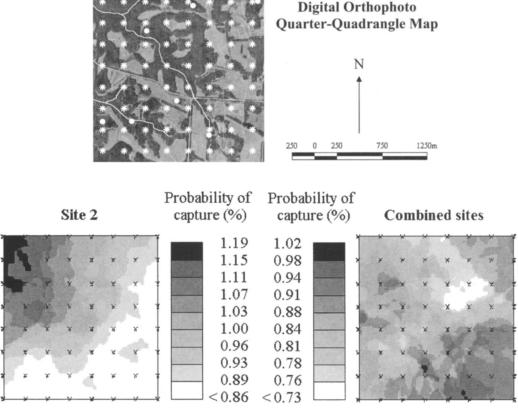
DISCUSSION

Results of univariate analyses indicated that selected microhabitat variables were associated with occurrence of striped skunks, but variation existed across sites in factors significantly correlated with captures of *M. mephitis*. Statistical analyses reflected no microhabitat features significantly associated with occurrence across all sites. However, several variables were significant and expressed the same association (positive or negative) for 2 of 3 sites (e.g., average height, large hardwood snags, stems, distance to permanent water, distance to open area). Previous investigators (Bixler and Gittleman 2000; Kuehl and Clark 2002; Verts 1967) have noted the importance of open areas for daily activity of striped skunks at the macrohabitat level. Greater occurrence of the species at sites with shorter heights of forest stands, fewer stems, and close proximity to open areas in the present study provides support for this contention at the microhabitat scale. These results also reflect a greater importance of open areas to *M. mephitis* at the microhabitat scale than for other mid-sized mammalian predators investigated to date (see Baldwin 2003; Kissell and Kennedy

1992; Kolowski and Woolf 2002). Prior studies have not quantitatively assessed the influence of large snags on the occurrence of striped skunks. However, several investigations have indicated greater occurrence of *M. mephitis* around forest patches (which often contain several to numerous snags—Gehring and Swihart 2003; Larivière and Messier 2001) and water (e.g., Larivière and Messier 1998; Philips et al. 2003) at the macrohabitat level. At the microhabitat scale, close proximity to water and presence of large snags have been reported as significant habitat factors for raccoons (*Procyon lotor*), Virginia opossums (*Didelphis virginiana*—Baldwin 2003; Kissell and Kennedy 1992; Levesque 2001), and bobcats (*Lynx rufus*—Kolowski and Woolf 2002). Use of open areas, aquatic habitats, and forested areas with snags likely are related to foraging behavior. Insects and other invertebrates (aquatic and terrestrial) comprise a large portion of the diet consumed by *M. mephitis* (Greenwood et al. 1999; Llwellyn and Uhler 1952; Verts 1967).

In general, the pattern of association between occurrence and microhabitat factors was similar to that reported for *P. lotor* and *D. virginiana* (Baldwin 2003). Baldwin (2003) suggested that a suite of microhabitat variables are important to generalist predators, but importance varies across sites at a macrohabitat level; this results in varying combinations of important habitat factors, depending upon location. The difference in microhabitat composition across sites is probably best explained by the large
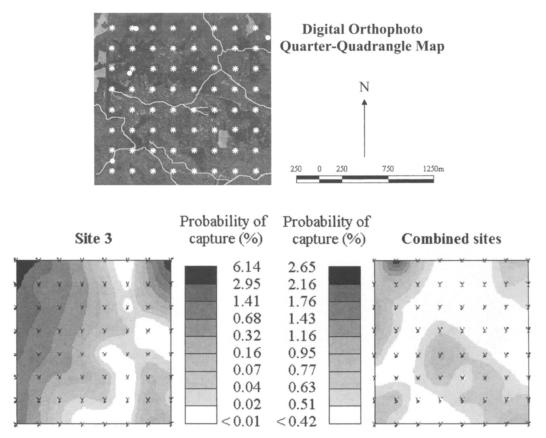
FIG. 2.—Probability of capture of striped skunks (*Mephitis mephitis*) interpolated from logistic regression equations using kriging analysis for habitat variables on site 2. The digital orthophoto quarter-quadrangle map reflects site 2 and provides a reference for available macrohabitats. (For explanation of dark areas, light areas, and symbols, see caption for Fig. 1.) Site is located in southwestern Tennessee.

degree of habitat heterogeneity (especially edge) among sites in the present study; edge habitat was most abundant at site 2, relatively lacking at site 3 (although the NW corner was adjacent to large open spaces), and intermediate at site 1 (see Figs. 1–3). Many species are known to differentially use edge habitats when it is available in varying amounts (see Morris 1987; Oehler and Litvaitis 1996). *M. mephitis* is typically associated with forest-field edge (Bixler and Gittleman 2000; Levesque 2001; Walker 1964; but see Heske 1995). In addition, Gehring and Swihart (2003) noted that in highly fragmented landscapes, striped skunks prefer small forested patches, and skunks were correlated to, among several factors, a greater proportion of grasslands and cropland. These characteristics were all present at site 2, thus providing a possible explanation for the opposite associations observed at this location. In addition, lack of edge at site 3 was a likely factor in concentration of captures of striped skunks around this limited resource. Therefore, significant microhabitat factors for this species appear to vary depending upon landscape composition.

Models resulting from stepwise logistic regression also indicated that captures of *M. mephitis* can be predicted based on microhabitat variables and that significant habitat factors associated with the occurrence of striped skunks varied among sites. Final models for individual sites included such variables as basal area measurements, large snags, slope, and distances to water sources, open areas, and roads. However, no overlap

existed in significant variables across sites, although these variables were generally those associated with captures in univariate analyses of this study. In a related study at these same sites, Baldwin (2003) reported greater overlap of significant habitat variables for raccoons and Virginia opossums. Such results reflect the difference in habitat needs and habitat use demonstrated for these species.

Classification percentages reflecting the association of occurrence and habitat factors derived in the present study (ranging in predictive ability from 56% to 75%) fall within the range reported for other mammalian mesopredators (raccoons, 58–88%—Baldwin 2003; 58–68%—Ladine 1995; 69%—Levesque 2001; 69–74%—Wilson 1996; Virginia opossums, 57–80%—Baldwin 2003; 68%—Levesque 2001; bobcats, 59–70%—Kolowski and Woolf 2002). Additionally, Palma et al. (1999), using sighting data of Iberian lynx (*Lynx pardinus*), reported a classification accuracy of 83%; the occurrence of fishers (*Martes pennanti*) was correctly classified at a 79% rate (Carroll et al. 1999). Models developed for different species are known to predict occurrence at varying rates depending upon their life history traits (e.g., generalist compared to specialist; migratory compared to territorial—Kolowski and Woolf 2002; North and Reynolds 1996; O'Neil and Carey 1986). As expected, more accurate models are typically produced for habitat specialists than for habitat generalists due to the narrow habitat tolerance of specialist species. However, it appears that

FIG. 3.—Probability of capture of striped skunks (*Mephitis mephitis*) interpolated from logistic regression equations using kriging analysis for habitat variables on site 3. See text for explanation of probability of capture, habitat variables, and site. The digital orthophoto quarter-quadrangle map reflects site 3 and provides a reference for available macrohabitats. (For explanation of dark areas, light areas, and symbols, see caption for Fig. 1.) Site is located in southwestern Tennessee.

across studies, predictive models for generalist species fall within a range of 50–80%. Models with such classification rates should be useful in predicting the occurrence and determining habitat needs of mammalian mesopredators.

Anderson and Gutzwiller (1996) pointed out the need to verify models for each set of habitat conditions, and Maurer (1986) and O'Neil et al. (1988) noted that wildlife habitat models perform poorly when they are examined outside the specific conditions in which they were developed. However, as noted by Baldwin (2003), grouped data provide a better representation of significant microhabitat factors for a region than data from individual sites due to spatial variation in habitat variables across sites. For example, percentage of trap locations correctly classified for individual sites ranged from 56–75% for the present investigation (Table 2). In addition, no variables were included in predictive models for more than 1 site. However, the combined model did have 3 general classes of variables in common with individual-site models (basal area of trees, proximity to open areas, and permanent water) and resulted in a classification accuracy that was intermediate to those derived for individual sites. Therefore, classification percentages derived at local sites could be misleading on a larger scale. Many mammalian mesopredators have wide tolerances for habitat features (Schwartz and Schwartz 2001; Sealander and Heidt 1990). Survival and reproduction needs

are met in varying ways depending on the microhabitat factors available at sites.

Results of semivariance and kriging analyses indicated that *M. mephitis* capture probabilities could be represented spatially across sites. These techniques have been used to determine spatial patterns in Iberian lynx sightings (Palma et al. 1999) and in mapping white-tailed deer (*Odocoileus virginianus*) harvest (Nesslage and Porter 2001), and were useful in our investigation as well. Variation in probability of capture occurred at each site. For site 1, capture probabilities were greatest in locations close to or within open areas, whereas lower capture probabilities were in larger forested areas (Fig. 1). The opposite was true for site 2; forested areas were representative of the greatest likelihood of capture, and open areas presented the least chance of occurrence (Fig. 2). For site 3, the greatest probability of capture occurred within areas closely associated to edge habitats (Fig. 3). Therefore, results illustrate the importance of considering landscape composition and edge effects when developing predictive models for *M. mephitis*. Mapping techniques such as these should be beneficial in determining occurrence probabilities for numerous species.

It is important to note that statistical procedures, such as correlations and regressions, do not imply causation of associations between occurrence and habitat factors. However, they do provide initial insight for habitat features that are related to

occurrence. Anderson and Gutzwiller (1996) pointed out that correlations between numbers of individuals and habitat features can be useful for understanding the habitat needs of species. A more complete understanding of the factors influencing the relationship between occurrence and habitat components is needed to better recognize the influence of microhabitat factors on the occurrence of striped skunks. Future investigations that assess use versus availability at different spatial scales should provide valuable insight toward understanding the relationship between mesopredator occurrence and associated habitat factors.

ACKNOWLEDGMENTS

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