Ecological Distribution of Shrews in the Cumberland Plateau of Alabama

by

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Abstract

Shrews are small mammals that often occur in sympatry with other species of shrews. This suggests some form of resource partitioning is occurring. I examined eight habitats in Jackson County, Alabama, and detected evidence of habitat partitioning by shrews in pine forests, mixed forests with liana undergrowth, and deciduous riparian zones. Also, I discovered that I was 11 times more likely to capture a shrew on a night with rainfall than on a night with clear skies. Habitat segregation and increased activity on rainy nights should both be considered when researchers attempt to capture shrews in the field.

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ECOLOGICAL DISTRIBUTION OF SHREWS IN THE CUMBERLAND PLATEAU OF ALABAMA

INTRODUCTION

Partitioning of habitats is a method of reducing competition between species that have similar ecological requirements, feeding preferences, or feeding times, and allows coexistence of species (Rychlik 2000). Partitioning of habitats happens in many types of vertebrates from foxes, coyotes, gerbils and lizards to fishes (Shine 1986, Theberge and Wedeles 1989, Zaret and Rand 1971, Ziv et al. 1993). Shrews are small, semi-fossorial mammals in the order Soricomorpha and family Soricidae (Vaughan et al. 2015). Species of shrews rarely occur in allopatry and diverse assemblages of four or more species have been reported in many parts of the world (Kirkland 1991). Most studies of shrews in sympatry have determined that some partitioning of habitats has occurred.

Characteristics of macrohabitats of most species of shrews are well known; however, details of microhabitats occupied need additional assessment (Malmquist 1985, Rychlik 2000). Throughout the Northern Hemisphere, shrews use partitioning of habitats to reduce interspecific competition. Species that are similar in size and foraging mode often will not occur in the same area (McCay et al. 2004). Larger shrews can occur with smaller shrews because larger shrews often have the musculature to be more fossorial, while smaller shrews usually stay in the leaf litter (McCay et al. 2004, Saarikko 1989). Previous studies have compared ecological relationships among species of shrews that share the same geographic area (Brannon 2000). Brannon (2000) discovered that the two species he studied, *Sorex cinereus* and *S. fumeus*, were separated ecologically by differences in microhabitats, such as moisture, depth of litter, and size of body. In the United States, much research has been conducted on the six species of shrews reported from Alabama. Habitat preferences for each of these species have been assessed and researchers seem to agree on the type of habitat each species occupies (Dusi 1959, French 1980*a*, Hamilton 1934, Kaufman et al. 2004, Miller and Getz 1977).

Shrews usually forage for arthropods and annelids in leaf litter (Dusi 1959), but they may burrow to obtain food (Churchfield 1980). Shrews use leaf litter and vegetation as natural cover when foraging for prey or moving to avoid predation (Dusi 1959). Due to their foraging habits, shrews rely primarily on scent and auditory cues rather than sight (Churchfield 1980). Shrews have a high metabolic rate because of their high surface-to-volume ratio. Because of this ratio, they lose heat quickly and must burn many calories to maintain body temperature. Shrews consume foods that total ≥75% of their body weight each day (Pearson 1947).

There is a paucity of research on the impact of weather on activity of shrews. In a study of *S. cinereus*, activity seemed to increase on rainy nights (Doucet and Bider 1974). There has been no previous comparison of weather conditions and activity of shrews in Alabama. However, these species of shrews and the interaction with rainfall have been studied elsewhere (McCay 1996, Brannon 2002, Otto and Roloff 2011). These studies determined that activity of shrews increased on nights with rainfall. However, Whitaker and Feldhamer (2005) suggested that rainfall was not a contributing factor to the activity of shrews and that humidity was the factor that changed activity of shrews. In rodents, there is an increase in nighttime foraging activity when weather is warm and rainy; also, rodents were nocturnal during winter and diurnal in summer (Stokes et al. 2001). This activity pattern is most likely a way to help avoid hot daytime temperatures and predators by foraging on rainy nights (Stokes et al. 2001). Rodents and shrews have the same natural predators, so foraging on rainy nights is most likely true for shrews as well.

Shrews occur throughout most of the world (McCay et al. 2004). Alabama has six species of shrews native to the state (Appendix 1): *Blarina brevicauda* (northern short-tailed shrew), *Blarina carolinensis* (southern short-tailed shrew), *Cryptotis parva* (North American least shrew), *Sorex fumeus* (smoky shrew), *Sorex hoyi* (American pygmy shrew), and *Sorex longirostris* (southeastern shrew; Best and Dusi 2014, Felix et al. 2009, Laerm and Lepardo1996). The primary purposes of my study were to determine 1) habitats occupied by each species, 2) whether partitioning of habitats is occurring, and 3) whether weather, lunar cycles, and other nocturnal conditions affect activity of shrews. My null hypothesis is that there is no significant correlation between distribution of shrews and variation in habitats and that there will be no significant relationship among lunar cycle, weather condition, and number of captures.

Materials and Methods

Jackson County is in northeastern Alabama, and all six species of shrews that occur in the state have been reported there (Best and Dusi 2014); the county is characterized by diverse habitats that range from lowland agricultural fields to high-elevation forested slopes. Based on previous research (Dusi 1959, French 1980*a*, George et al. 1986, Kaufman et al 2004, Long 1974), I chose several habitats with a high probability of being occupied by shrews in the Cumberland Plateau of James D. Martin Skyline Wildlife Management Area, Jackson County, Alabama, and in Horton, Marshall County, Alabama. James. D. Martin Skyline Wildlife Management Area (Skyline) occupies about 163 km^2 in Jackson County (Alabama Cooperative Fish and Wildlife Research Unit http://www.ag.auburn.edu/auxiliary/alcfwru/documents/ALCFWRU%202009.pdf). This area contains a diversity of habitats that were similar to those assessed by previous researchers who sought shrews occurring in sympatry (Dusi 1959, French 1980*a*, George et al. 1986, Kaufman et al 2004, Long 1974). Habitats were evaluated based on predominant vegetation (deciduous, pine, and mixed forests, or more open habitats), by presence or absence of riparian zones within habitats, and by composition of understory (e.g., open, lianas *Parthenocissus*, grasses). Type and composition of understory was measured using a quadrant-sampling square as described by Cottam and Curtis (1956). GPS location, habitat, canopy cover, type of soil, and depth of litter were recorded in a 1-meter-diameter, circular area around each trapping site (Appendix 2). Canopy cover was estimated using a spherical densitometer (model C; Forest Densitometers, Bartlesville, Oklahoma). Depth of litter was measured to the nearest 1 millimeters using a ruler. Soil in each habitat was categorized based on data from the soil survey of Jackson County (United States Department of Agriculture Natural Resources Conservation Service http://websoilsurvey.nrcs.usda.gov/). Types of soil were shallow sandy loam, fine sandy loam, stony fine loam, and sand. Shallow sandy loam is soil that has 0-15-millimeter particles and is usually a dark gray or dark brown with large amounts of rocks. Fine sandy loam is similar to shallow sandy loam, but lacks large amounts of rocks. Stony fine loam has particles <1 millimeter in diameter (Bennett and Griffen 1904). Sand was soil with 0.5-2.0-millimeter particles (Kettler et al. 2001) and usually occurred near a body of water or in riparian zones in my study area.

Pitfall traps are an efficient way to capture shrews (Mengak and Guynn 1987). The trap is usually a can or bucket placed into the ground so the rim is flush with the surface. Depth and diameter of the pitfall trap must be large enough so that the shrew cannot crawl or jump out

(Felix et al. 2009). Pitfall traps range in size from a small cup to an in-ground swimming pool, but the general design is a hole in the ground into which an unwary animal falls (Fisher et al. 2008). Pitfall traps and drift fences were set following the methods of Fisher et al. (2008). Traps were checked each morning, GPS locations of captured individuals was recorded, and shrews were identified to species (Appendix 1). In 2013, 8 traplines of 15-20 pitfall traps consisting of a total of 108 small (0.4-liter) plastic containers were open for 5 nights and closed for 2 nights for a total of 43 nights yielding 4,644 trap nights. Small pitfall traps had a diameter of 8.5 centimeters at the opening. Pitfall traps were placed 3-5 meters apart along an 85-meter-long by 1-meter-high drift fence. Number of habitats sampled at each locality was determined by consulting previous reports on habitat preferences of shrews (Dusi 1959, French 1980*a*, George et al. 1986, Kaufman et al. 2004, Long 1974). In 2014, 37 large (≥3.7-liters) pitfall traps were set during spring and summer. Large pitfall traps had a diameter of 10.5 centimeters at the opening. I followed the method of Whitaker and Cudmore (1986), Clark and Blom (1992), and Whitaker and French (1984) who used 3.7-liter pitfall traps with no drift fence were open for 5 nights and closed for 2 nights for a total of 72 nights yielding 2,664 trap nights, but I placed pitfall traps next to fallen trees, shrubs, brambles, and bases of trees. Shrews use fallen trees, bases of trees, brambles, and shrubs as foraging sites to avoid being attacked by predators (French 1980*a*). In addition, the swimming pool in Marshall County was checked for shrews each day beginning 7 May through 1 August. The pool was in open field with scattered trees and acted as a giant pitfall trap. I examined size of pitfall traps and use of drift fences to increase success in capturing shrews.

Data were analyzed using Poisson and binomial-logistical regression (R statistical program; Real et al. 2006), which are generalized-linear models (Guisan et al. 2002).

Generalized-linear models used in assessments of ecological data do not have as many assumptions as linear models, and because of this, they are less likely to force data into unnatural statistical scales (Guisan et al. 2002). This also allows for more variance in data that would be expected in non-model analyses (Guisan et al. 2002). Because binomial-logistical regression is useful in assessing presence or absence of species (MacKenzie et al. 2005), I used it to assess presence (coded as 1) or absence (coded as 0) based on habitat where each individual shrew was captured, similar to analyses conducted by previous researchers (e.g., Theberge and Wedeles 1989, Zaret and Rand 1971, Ziv et al. 1993). In addition, Compton et al. (2002) examined partitioning of habitats among wood turtles *(Glyptemys*) and determined that binomial-logistical regression was an appropriate assessment technique. To investigate the relationship among weather, lunar cycle, and number of captures of shrews, I also used binomial-logistical regression. I used a pairwise *t*-test to evaluate the relationship between number of shrews captured, percentage illumination of the moon, and number of minutes of overnight illumination (Real et al. 2006).

Rainy nights were characterized as having >0.5 millimeters of rainfall that continued for >30 minutes from 1900 h to 1100 h CDT the next day. Cloudy nights were characterized as having >50% cloud cover that persisted for >1 hour from 1900 h to 1100 h CDT the next day. Clear nights were characterized as having <50% cloud cover that persisted >1 hour from 1900 h to 1100 h CDT the next day. Snowy nights were nights that had snowfall. I evaluated percentage illumination of the moon using records from the United States Naval Observatory (http://www.usno.navy.mil/USNO) and dividing it into five categories based on percentage illumination; 0-19%, 20-39%, 40-59%, 60-79%, and 80-100%.

To be considered statistically significant, I used an 85% confidence interval because this is a robust confidence interval that demonstrates correlation between two or more habitats, weather, lunar cycle, and species of shrews. In previous analyses, there was no statistical difference between the use of an 85% and a 95% confidence interval (Payton et al. 2000). Thus, it was recommended that using an 85% confidence interval reduced the probability of a type 1 error to ≤ 0.05 in ecological assessments (Payton et al. 2000).

RESULTS

In spring and summer of 2013 and 2014, I placed a total of 145 pitfall traps in nine locations representing seven habitats and 7,308 trap nights. I captured 32 shrews representing five species during 115 nights at seven sites (Table 1). At the swimming pool in Marshall County, four shrews (*C. parva*) were collected in 87 nights and two shrews (*C. parva*) were killed by domestic cats in adjacent open field.

A total of four *S. hoyi* was captured; three were in an ephemeral creek-bed and one was next to a stream in deciduous riparian forest with sandy soil. Six *C. parva* were captured in open fields with scattered trees, five in pine forest, and one in mixed forest ($n = 12$, $P = 0.118$; $SE = \pm 1.16$; $z = 1.562$). Association of *C. parva* with pine forest was statistically significant ($P = 0.027$; $z = 2.212$). Five *S. longirostris* were in mixed forest with an understory of lianas and one was in mixed forest without lianas (Table 2). I also captured 5 *B. carolinensis* and 2 *B. brevicauda*, but the samples were too small for statistical analyses.

Deciduous riparian forests revealed a significant relationship between habitat and species of shrew present ($P = 0.139$; $z = 1.478$; Table 3). Mixed forests with an understory of lianas or woody shrubs approached significance ($P = 0.155$; $z = 1.424$), and other habitats exhibited no significant associations with any species of shrew ($P \geq 0.400$; $z \geq 0.700$). Analyses of number of nights in each category of lunar illumination revealed no significant correlation with number of shrews captured (Table 4). When compared, there was a significant relationship between duration of lunar illumination and number of shrews captured. When lunar illumination was 181 to 360 minutes, I was about 4 times less likely to catch a shrew than on nights with more or less lunar illumination ($P = 0.011$; $z = -2.545$; Table 5). A binomial-logistical regression between number of shrews captured and weather each night revealed that captures were 11 times more likely to occur on nights when it rained compared to nights with clear skies ($P = 0.002$; $z = 3.042$; Table 6) for *B. carolinensis*, *C. parva*, *S. hoyi*, and *S. longirostris*. The only two *B. brevicauda* caught were on cloudy nights. Also, captures were 5.8 times as likely on rainy nights compared to nights with cloudy skies ($P = 0.011$; $SE = \pm\text{-}0.7$; $z = 2.546$).

In comparing the two sizes of pitfall traps, there was a difference between them. Large pitfall traps were 18 times more likely to capture shrews than small pitfall traps and this difference was statistically significant ($P < 0.001$; $z = 4.389$).

DISCUSSION

Some species of shrews were more common in pine forests (*B. carolinensis*, *C. parva*), mixed forests with lianas (*S. longirostris*), or deciduous-riparian forests (*S. hoyi*; Appendix 2). I infer that this is evidence of partitioning of habitats among species. It is likely that other habitats (open fields, riparian-mixed, mixed forest, and deciduous forest) would show a significant relationship, but samples of captured shrews were too small in those areas.

The larger species of shrews, *B. brevicauda* and *B. carolinensis*, did not co-occur at any site (Table 2). This could be because the level of competition is greater between larger species than between larger and smaller species of shrews. This could best be explained by differences in prey of larger shrews compared to prey of smaller shrews (Whitaker and French 1984).

Because they have different prey, there is less competition among species of shrews of different sizes. *B. brevicauda* is a large shrew with silver-to-black pelage. Its hair often is tipped with brown and the tail is only 20% as long as the head and body (George et al. 1986). *B. brevicauda* usually occupies microhabitats with >50% vegetation cover (Miller and Getz 1977). I did not capture enough *B. brevicauda* to make comparisons with previous research, but the two I did capture were in a deciduous forest near a riparian area (Table 2). This indicates that they live near sources of water.

Most captures of *B. carolinensis* were in pine forests (Table 2). Two of the *B. carolinensis* that were captured were large, both weighed 12 grams and were captured in the same pitfall trap on two different nights. A large portion of the geographic range of *B. carolinensis* is in non-climax pine forests (Genoways and Choate 1998). This correlates with previous work on the species in Nebraska (Genoways and Choate 1998). *B. carolinensis* is a large shrew common in the southeastern United States (McCay 2001). However, little is known about this species in Alabama (Best 2004). General characteristics of *B. carolinensis* are similar to *B. brevicauda* (McCay 2001), but size is useful in distinguishing the two species in the field as *B. brevicauda* is longer than *B. carolinensis* (Appendix 1; Hall 1981). These species also differ in occiptio-premaxillary length, which on average is 19 millimeters in *B. carolinensis* and 24 millimeters in *B. brevicauda* and cranial breadth, which on average is 10.4 millimeters in *B. carolinensis* and 13.5 millimeters in *B. brevicauda* (Genoways and Choate 1972, Hall 1981). Species of *Blarina* generally inhabit moist woods with well-drained soils and dense ground cover (Kaufman et al. 2004).

Areas where *C. parva* was detected matched the microhabitat requirements of open field with broomsedge (*Andropogon)* and open canopy described by Hamilton (1934) and Whitaker (1974). *C. parva* is the only North American shrew with four unicuspid teeth (Hall 1981, Whitaker 1974). These shrews sometimes nest together to conserve energy (Hamilton 1934, Jackson 1961, Whitaker 1974). *C. parva* occupies brushy fields (Hamilton 1934, Whitaker 1974). Type of soil is believed to play a key role in habitats occupied by this species, but it also needs dense herbaceous ground cover and downed woody debris (Davis and Joeris 1945).

S. hoyi was captured in areas with sandy soils and stream beds. This is additional evidence that this species occupies wet soil as described by Long (1974). Specimens I obtained are new records for Alabama and indicate that this species might occur in adjacent counties.

As in previous research indicating it is a habitat generalist (French *1980a*), I captured *S. longirostris* in a variety of habitats. *S. longirostris* is a reddish-brown shrew with a long-narrow snout and a tail ≥50% as long as the head and body (Kaufman et al. 2004). This shrew is smaller than other species of *Sorex* (French 1980*a*). Of the six species of shrews in Jackson County, this is the most studied in Alabama (French 1980*a*). One was captured and observed making a soft, bird-like chirp that approached a frequency of 22,000 cycles/second (French 1980*a*). It is believed this chirping is used for echolocation (French 1980*b*). This species often is captured in moist areas bordering swamps; however, *S. longirostris* occurs in a variety of habitats from arid grasslands to moist deciduous forests (French 1980*a*). This habitat generalist could have an interesting effect in an area with so many species of shrew coexisting such as Jackson County.

Crypotis parva was captured in a variety of habitats suggesting that it is a habitat generalist as is *S. longirostris*. I could not verify if the habitat generalist, *S. longirostris*, was impacting abundance of shrews in habitats occupied where one or more species of shrews are present. I caught eight *S. longirostris* and, in areas where it was present, I did not catch any other species of *Sorex*. This is likely due to the fact that these smaller species would be in direct competition, whereas larger species, such as *B. brevicauda* and *B. carolinensis*, would be foraging for different foods or in different areas (McCay et al. 2004). Although most of these shrews have different habitat preferences in other areas of North America (Whitaker and French 1984), it is possible that the generalist species *S. longirostris* could be affecting habitat preference of other species of shrews in the area, but I could not verify this. *S. longirostris* lives in a variety of habitats and is the only species to have such a flexible range of habitats (French 1980*a*). This means that *S. longirostris* could displace *S. hoyi* or *C. parva* through either direct competition or even predation in areas that are not optimal habitat for *S. hoyi* and *C. parva*. Shrews are cannibalistic on dead shrews in the lab (Davis and Joeris 1945). This could mean that interspecific predation occurs between species of shrews living in sympatry, but no previous research has made note of this. This may explain why I only caught *C. parva* in open fields and *S. hoyi* in areas of sandy, moist soil. This is where I would expect to catch these species based on research by Hamilton (1934) and Long (1974).

Habitat partitioning and general trends for habitats selected by shrews has been well studied elsewhere (Genoways and Choate 1998, Rychlik 2000), but not in Alabama. More research is needed to compare body size among species of shrews in the same habitat or different habitats. A difference in size could be a product of resource partitioning and researchers might even see character displacement in these situations. *Sorex minutus* has significantly smaller jaws when in sympatry with *Sorex araneus* (Malmquist 1985). Character displacement is likely affecting feeding ecology of these two species to allow them to coexist (Malmquist 1985). Shrews are generalized predators, so the simplest way for two species to coexist would be to have different important prey and an important factor in prey is size of the predator (Whitaker and French 1984).

Shrews did not show a change in activity based on percent lunar illumination. This is most likely because they forage primarily under leaf litter and underground (Churchfield 1980, Dusi 1959). Duration of lunar illumination at 181-360 minutes was correlated with a decrease in activity. This could be because shrews are staying sedentary to help avoid predators until the moon sets (Churchfield 1980); however, due to their high metabolic demand, they cannot stay sedentary on nights with >360 minutes of illumination (Pearson 1947).

My results indicated that rainfall affects success in capturing shrews; *Sorex cinereus* is most active during nights with rains that begin in the afternoon (Doucet and Bider 1974). In my study, number of rainy nights (n = 38) was about equal to cloudy (n = 31) and clear nights (n = 36). Weather and its association with success in capturing shrews is an understudied phenomenon; my results support what Brannon (2002), McCay (1996) and Otto and Roloff (2011) previously suggested about activity of shrews and weather. This relationship between weather and activity may be because earthworms (*Amynthus gracilus*) come to the surface of the soil during rainstorm events (Chuang and Chen 2008). Another possible reason is that shrews move about less while foraging on clear nights. Predators of shrews, such as owls and feral cats, would have an advantage on a clear night. Shrews have relatively poor eyesight, so foraging in darker situations is to their advantage when trying to avoid predators (Churchfield 1980).

The difference in size of pitfall traps is something future researchers should take into consideration. Shrews may have been able to escape the small pitfall traps, so it is better to use larger pitfall traps when attempting to capture shrews.

Habitat diversity shows some relationships with presence of shrews. This must be considered in the future to preserve these truly amazing micropredators. Rainfall promotes activity of shrews and more work is needed to determine the cause of this foraging pattern. Presence of *S. hoyi* in new localities suggests more research on this shrew should be conducted in northern Alabama.

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Table
1.—Trap, date, location, habitat, type of soil, depth of litter, canopy cover, and shrews captured at sites where pitfall traps were set for shrews (Soricidae) in northern Alabama.

Pitfall	Depth of litter (cm)	Latitude, longitude	Canopy cover (%)	Type of soil	Captures	Habitat	Trapping dates
1A	2	34º52.296'N, 86º06.214'W	76	Stony fine sandy loam	None	Pine forest	13 May-6 June 2013
2A	2	34º52.295'N, 86º06.213'W	76	Stony fine sandy loam	None	Pine forest	13 May-6 June 2013
3A	1	34º52.300'N, 86º06.209'W	88	Stony fine sandy loam	1 *Cryptotis parva*	Pine forest	13 May-6 June 2013
4A	2	34º52.303'N, 86º06.209'W	85	Stony fine sandy loam	None	Pine forest	13 May-6 June 2013
5A	3	34º52.303'N, 86º 06.210'W	90	Stony fine sandy loam	None	Pine forest	13 May-6 June 2013
6A	1	34º52.304'N, 86º 06.210'W	74	Stony fine sandy loam	1 *Cryptotis parva*	Pine forest	13 May-6 June 2013
7A	3	34º52.308'N, 86º 06.209'W	92	Stony fine sandy loam	None	Pine forest	13 May-6 June 2013
8A	3	34º 52.311'N, 86º 06.206'W	93	Stony fine sandy loam	None	Pine forest	13 May-6 June 2013
9A	1	34º 52.314'N, 86º 06.210'W	87	Stony fine sandy loam	None	Pine forest	13 May-6 June 2013
10A	0	34º 52.317'N, 86º 06.202'W	91	Stony fine sandy loam	None	Pine forest	13 May-6 June 2013
11A	1	34º 52.319'N, 86º 06.201'W	90	Stony fine sandy loam	None	Pine forest	13 May-6 June 2013
12A	4	34º 52.320'N, 86º 06.201'W	84	Stony fine sandy loam	None	Pine forest	13 May-6 June 2013

Table 1.—Continued.

13A	2	34º 52.321'N, 86º 06.200'W	76	Stony fine sandy loam	None	Pine forest	13 May-6 June 2013
14A	1	34º 52.322'N, 86º 06.200'W	69	Stony fine sandy loam	None	Pine forest	13 May-6 June 2013
15A	2	34º 52.327'N, 86º 06.195'W	85	Stony fine sandy loam	None	Pine forest	13 May-6 June 2013
1B	4	34º 52.274'N, 86º 06.217'W	97	Fine sandy loam	None	Mixed forest	13 May-6 June 2013
2B	1	34º 52.273'N, 86º 06.218'W	95	Fine sandy loam	None	Mixed forest	13 May-6 June 2013
3B	3	34º 52.27'N, 86º 06.221'W	96	Fine sandy loam	None	Mixed forest	13 May-6 June 2013
4B	1	34º 52.269'N, 86º 06.223'W	92	Fine sandy loam	1 *Blarina carolinensis*	Mixed forest	13 May-6 June 2013
5B	2	34º 52.267'N, 86º 06.223'W	90	Fine sandy loam	None	Mixed forest	13 May-6 June 2013
6B	0	34º 52.265'N, 86º 06.225'W	46	Fine sandy loam	None	Mixed forest	13 May-6 June 2013
7B	1	34º 52.262'N, 86º 06.225'W	53	Fine sandy loam	None	Mixed forest	13 May-6 June 2013
8B	1	34º 52.259'N, 86º 06.227'W	43	Fine sandy loam	None	Mixed forest	13 May-6 June 2013

Table 1.—Continued

Pitfall	Depth of litter (cm)	Latitude, longitude	Canopy cover (%)	Type of soil	Captures	Habitat	Trapping dates
9B	2	34º 52.255'N, 86º 06.227'W	61	Fine sandy loam	None	Mixed forest	13 May-6 June 2013
10B	1	34º 52.252'N, 86º 06.228'W	62	Fine sandy loam	None	Mixed forest	13 May-6 June 2013
11B	2	34º 52.25'N, 86º 06.229'W	87	Fine sandy loam	None	Mixed forest	13 May-6 June 2013
12B	1	34º 52.247'N, 86º 06.228'W	55	Fine sandy loam	None	Mixed forest	13 May-6 June 2013

Table

Pitfall	Depth of (%)	Latitude, longitude	Canopy	Type of soil	Captures	Habitat litter (cm)	cover
13B	0	34º 52.244'N, 86º 06.227'W	9	Fine sandy loam	None	Mixed forest	13 May-6 June 2013
14B	0	34º 52.243'N, 86º 06.277'W	9	Fine sandy loam	None	Mixed forest	13 May-6 June 2013
15B	0	34º 52.240'N, 86º 06.277'W	0	Fine sandy loam	None	Mixed forest	13 May-6 June 2013
1C	0	34º 52.276'N, 86º 06.231'W	30	Fine sandy loam	None	Open field with scattered trees	13 May-6 June 2013
2C	0	34º 52.275'N, 86º 06.232'W	22	Fine sandy loam	None	Open field with scattered trees	13 May-6 June 2013
3C	0	34º 52.273'N, 86º 06.232'W	23	Fine sandy loam	None	Open field with scattered trees	13 May-6 June 2013
4C	0	34º 52.270'N, 86º 06.233'W	17	Fine sandy loam	None	Open field with scattered trees	13 May-6 June 2013
5C	0	34º 52.268'N, 86º 06.236'W	4	Fine sandy loam	None	Open field with scattered trees	13 May-6 June 2013
6C	1	34º 52.264'N, 86º 06.238'W	3	Fine sandy loam	None	Open field with scattered trees	13 May-6 June 2013
7C	0	34º 52.263'N, 86º 06.239'W	22	Fine sandy loam	None	Open field with scattered trees	13 May-6 June 2013

Table 1.—Continued

							Trapping dates
8C	0	34º 52.259'N, 86º 06.243'W	13	Fine sandy loam	None	Open field with scattered trees	13 May-6 June 2013

Table 1.—Continued

9C	2	34º 52.257'N, 86º 06.244'W	4	Fine sandy loam	None	Open field with scattered trees	13 May-6 June 2013
10C	2	34º 52.251'N, 86º 06.248'W	26	Fine sandy loam	None	Open field with scattered trees	13 May-6 June 2013
11C	1	34º 52.249'N, 86º 06.249'W	35	Fine sandy loam	None	Open field with scattered trees	13 May-6 June 2013
12C	2	34º 52.248'N, 86º 06.251'W	39	Fine sandy loam	None	Open field with scattered trees	13 May-6 June 2013
13C	2	34º 52.246'N, 86º 06.253'W	44	Fine sandy loam	None	Open field with scattered trees	13 May-6 June 2013
14C	2	34º 52.245'N, 86º 06.253'W	37	Fine sandy loam	None	Open field with scattered trees	13 May-6 June 2013
15C	0	34º 52.243'N, 86º 06.254'W	27	Fine sandy loam	None	Open field with scattered trees	13 May-6 June 2013
1D	0	34º 52.298'N, 86º 06.249'W	100	Shallow sandy loam	None	Mixed forest	13 May-6 June 2013
2D	2	34º 52.297'N, 86º 06.254'W	100	Shallow sandy loam	None	Mixed forest	13 May-6 June 2013
3D	2	34º 52.298'N, 86º 06.254'W	99	Shallow sandy loam	None	Mixed forest	13 May-6 June 2013
4D	1	34º 52.297'N, 86º 06.260'W	97	Shallow sandy loam	None	Mixed forest	13 May-6 June 2013

Table 1.—Continued

Pitfall	Depth of litter (cm)	Latitude, longitude	Canopy cover (%)	Type of soil	Captures	Habitat	Trapping dates
5D	0	34º 52.298'N, 86º 06.264'W	100	Shallow sandy loam	None	Mixed forest	13 May-6 June 2013
6D	0	34º 52.300'N, 86º 06.269'W	99	Shallow sandy loam	None	Mixed forest	13 May-6 June 2013
7D	2	34º 52.303'N, 86º 06.274'W	97	Shallow sandy loam	None	Mixed forest	13 May-6 June 2013

Table 1.—Continued

Pitfall

Pitfall	Depth of	Latitude, longitude	Canopy	Type of soil	Captures	Habitat litter (cm)	
	cover (%)						
8D	1	34º 52.305'N, 86º 06.276'W	98	Shallow sandy loam	None	Mixed forest	13 May-6 June 2013
9D	2	34º 52.308'N, 86º 06.279'W	97	Shallow sandy loam	None	Mixed forest	13 May-6 June 2013
10D	3	34º 52.308'N, 86º 06.281'W	95	Shallow sandy loam	None	Mixed forest	13 May-6 June 2013
11D	2	34º 52.310'N, 86º 06.281'W	97	Shallow sandy loam	None	Mixed forest	13 May-6 June 2013
12D	1	34º 52.310'N, 86º 06.282'W	97	Shallow sandy loam	None	Mixed forest	13 May-6 June 2013
13D	0	34º 52.311'N, 86º 06.284'W	97	Shallow sandy loam	None	Mixed forest	13 May-6 June 2013
14D	2	34º 52.313'N, 86º 06.287'W	95	Shallow sandy loam	None	Mixed forest	13 May-6 June 2013
15D	4	34º 52.314'N, 86º 06.289'W	97	Shallow sandy loam	None	Mixed forest	13 May-6 June 2013
1E	5	34º 51.414'N, 86º 07.914'W	94	Fine sandy loam	None	Deciduous forest	13 May-6 June 2013
2E	4	34º 51.414'N, 86º 07.914'W	95	Fine sandy loam	None	Deciduous forest	13 May-6 June 2013
3E	5	34º 51.435'N, 86º 07.902'W	96	Fine sandy loam	None	Deciduous forest	13 May-6 June 2013
4E	6	34º 51.434'N, 86º 07.909'W	97	Fine sandy loam	None	Deciduous forest	13 May-6 June 2013

Table 1.—Continued

							Trapping dates
5E	8	34º 51.439'N, 86º 07.908'W	94	Fine sandy loam	None	Deciduous forest	13 May-6 June 2013
6E	4	34º 51.446'N, 86º 07.907'W	97	Fine sandy loam	None	Deciduous forest	13 May-6 June 2013
7E	3	34º 51.445'N, 86º 07.909'W	96	Fine sandy loam	None	Deciduous forest	13 May-6 June 2013
	Depth of	Latitude, longitude	Canopy	Type of soil	Captures	Habitat	Trapping dates litter (cm) cover (%)
8E	0	34º 51.449'N, 86º 07.907'W	97	Fine sandy loam	None	Deciduous forest	13 May-6 June 2013
9E	5	34º 51.452'N, 86º 07.907'W	90	Fine sandy loam	None	Deciduous forest	13 May-6 June 2013
10E	7	34º 51.455'N, 86º 07.907'W	94	Fine sandy loam	None	Deciduous forest	13 May-6 June 2013
11E	7	34º 51.459'N, 86º 07.908'W	97	Fine sandy loam	None	Deciduous forest	13 May-6 June 2013
12E	3	34º 51.461'N, 86º 07.906'W	97	Fine sandy loam	None	Deciduous forest	13 May-6 June 2013
13E	7	34º 51.463'N, 86º 07.907'W	94	Fine sandy loam	None	Deciduous forest	13 May-6 June 2013
14E	5	34º 51.464'N, 86º 07.907'W	94	Fine sandy loam	None	Deciduous forest	13 May-6 June 2013
1F	2	34º 50.811'N, 86º 04.396'W	96	Fine sandy loam	None	Deciduous forest	10 June-8 August 2013
2F	2	34º 50.810'N, 86º 04.393'W	93	Fine sandy loam	None	Deciduous forest	10 June-8 August 2013
3F	3	34º 50.810'N, 86º 04.391'W	90	Fine sandy loam	None	Deciduous forest	10 June-8 August 2013
4F	2	34º 50.811'N, 86º 04.388'W	97	Fine sandy loam	1 *Blarina brevicauda*	Deciduous forest	10 June-8 August 2013

Table 1.—Continued

Pitfall							
5F	4	34º 50.809'N, 86º 04.386'W	98	Fine sandy loam	None	Deciduous forest	10 June-8 August 2013
6F	2	34º 50.808'N, 86º 04.385'W	97	Fine sandy loam	None	Deciduous forest	10 June-8 August 2013
7F	2	34º 50.809'N, 86º 04.385'W	91	Fine sandy loam	None	Deciduous forest	10 June-8 August 2013
8F	2	34º 50.811'N, 86º 04.384'W	92	Fine sandy loam	None	Deciduous forest	10 June-8 August 2013

Table 1.—Continued

			Canopy				Trapping dates
Pitfall	Depth of	Latitude, longitude	Type of soil	Captures	Habitat litter (cm)	cover (%)	
9F	3	34º 50.815'N, 86º 04.384'W	89	Fine sandy loam	None	Deciduous forest	10 June-8 August 2013
10F	3	34º 50.816'N, 86º 04.384'W	93	Fine sandy loam	None	Deciduous forest	10 June-8 August 2013
11F	3	34º 50.817'N, 86º 04.383'W	95	Fine sandy loam	None	Deciduous forest	10 June-8 August 2013
12F	2	34º 50.817'N, 86º 04.379'W	97	Fine sandy loam	None	Deciduous forest	10 June-8 August 2013
13F	5	34º 50.816'N, 86º 04.377'W	94	Fine sandy loam	None	Deciduous forest	10 June-8 August 2013
14F	1	34º 50.826'N, 86º 04.374'W	94	Fine sandy loam	None	Deciduous forest	10 June-8 August 2013
15F	1	34º 50.830'N, 86º 04.377'W	98	Fine sandy loam	None	Deciduous forest	10 June-8 August 2013
1G	1	34º 50.953'N, 86º 04.497'W	97	Sand	None	Deciduous-riparian forest	10 June-8 August 2013
2G	2	34º 50.954'N, 86º 04.494'W	93	Sand	1 *Sorex hoyi*	Deciduous-riparian forest	10 June-8 August 2013
3G	1	34º 50.955'N, 86º 04.492'W	83	Sand	1 *Sorex hoyi*	Deciduous-riparian forest	10 June-8 August 2013
1H	1	34º 52.481'N, 86º 06.341'W	62	Sand	None	Deciduous-riparian forest	29 July-8 August 2013
2H	2	34º 52.480'N, 86º 06.34º'W	54	Sand	None	Deciduous-riparian forest	29 July-8 August 2013
3H	4	34º 52.479'N, 86º 06.338'W	97	Sand	None	Deciduous-riparian forest	29 July-8 August 2013

Table 1.—Continued

Pitfall	Captures	Latitude, longitude	Canopy cover (%)	Type of soil	Depth of litter (cm)	Habitat	Trapping dates
4H	5	34º 52.477'N, 86º 06.337'W	97	Sand	None	Deciduous-riparian forest	29 July-8 August 2013
6H	1	34º 52.481'N, 86º 06.333'W	94	Sand	None	Deciduous-riparian forest	29 July-8 August 2013
7H	2	34º 52.484'N, 86º 06.329'W	92	Sand	None	Deciduous-riparian forest	29 July-8 August 2013
8H	0	34º 52.483'N, 86º 06.327'W	91	Sand	None	Deciduous-riparian forest	29 July-8 August 2013
9H	0	34º 52.482'N, 86º 06.326'W	91	Sand	None	Deciduous-riparian forest	29 July-8 August 2013
10H	1	34º 52.482'N, 86º 06.325'W	95	Sand	None	Deciduous-riparian forest	29 July-8 August 2013
11H	3	34º 52.481'N, 86º 06.323'W	96	Sand	None	Deciduous-riparian forest	29 July-8 August 2013
12H	2	34º 52.482'N, 86º 06.321'W	94	Sand	None	Deciduous-riparian forest	29 July-8 August 2013
13H	0	34º 52.482'N, 86º 06.319'W	93	Sand	None	Deciduous-riparian forest	29 July-8 August 2013
14H	1	34º 52.482'N, 86º 06.318'W	92	Sand	None	Deciduous-riparian forest	29 July-8 August 2013
15H	2	34º 52.482'N, 86º 06.317'W	89	Sand	None	Deciduous-riparian forest	29 July-8 August 2013
I1	1	34º 52.477'N, 86º 06.326'W	32	Stony fine sandy loam	None	Pine forest	1 March-28 July 2014
I2	2	34º 52.293'N, 86º 06.218'W	26	Stony fine sandy loam	None	Pine forest	1 March-28 July 2014

Table 1.—Continued

Pitfall	Depth of litter (cm)	Latitude, longitude	Canopy cover (%)	Type of soil	Captures	Habitat	Trapping dates
I3	4	34º 52.293'N, 86º 06.222'W	30	Stony fine sandy loam	1 *Sorex longirostris*	Pine forest	1 March-28 July 2014
I4	3	34º 52.293'N, 86º 06.219'W	46	Stony fine sandy loam	None	Pine forest	1 March-28 July 2014
I5	2	34º 52.296'N, 86º 06.220'W	31	Stony fine sandy loam	2 *Cryptotis parva* 1 *Sorex longirostris*	Pine forest	1 March-28 July 2014
I6	3	34º 52.298'N, 86º 06.218'W	19	Stony fine sandy loam	None	Pine forest	1 March-28 July 2014
I7	6	34º 52.301'N, 86º 06.219'W	23	Stony fine sandy loam	None	Pine forest	1 March-28 July 2014
I8	2	34º 52.302'N, 86º 06.218'W	52	Stony fine sandy loam	None	Pine forest	1 March-28 July 2014
I9	2	34º 52.301'N, 86º 06.226'W	29	Stony fine sandy loam	None	Pine forest	1 March-28 July 2014
I10	2	34º 52.318'N, 86º 06.223'W	40	Stony fine sandy loam	None	Pine forest	1 March-28 July 2014
I11	3	34º 52.313'N, 86º 06.221'W	36	Stony fine sandy loam	1 *Blarina carolinensis*	Pine forest	1 March-28 July 2014
I12	5	34º 52.301'N, 86º 06.225'W	79	Stony fine sandy loam	1 *Cryptotis parva*	Pine forest	1 March-28 July 2014
I13	4	34º 52.300'N, 86º 06.219'W	45	Stony fine sandy loam	2 *Blarina carolinensis*	Pine forest	1 March-28 July 2014
I14	1	34º 52.301'N, 86º 06.217'W	16	Stony fine sandy loam	None	Pine forest	1 March-28 July 2014
I15	1	34º 52.303'N, 86º 06.217'W	34	Stony fine sandy loam	None	Pine forest	1 March-28 July 2014

Table 1.—Continued

Pitfall			Canopy				Trapping dates
J1	2	34º 52.291'N, 86º 06.269'W	62	Shallow sandy loam	None	Mixed forest	1 March-28 July 2014
J2	4	34º 52.291'N, 86º 06.261'W	77	Shallow sandy loam	None	Mixed forest	1 March-28 July 2014
J3	4	34º 52.294'N, 86º 06.265'W	81	Shallow sandy loam	None	Mixed forest	1 March-28 July 2014
J4	1	34º 52.297'N, 86º 06.264'W	83	Shallow sandy loam	None	Mixed forest	1 March-28 July 2014
J5	3	34º 52.299'N, 86º 06.266'W	56	Shallow sandy loam	None	Mixed forest	1 March-28 July 2014

Table 1.—Continued

Pitfall	Depth of litter (cm)	Latitude, longitude	Canopy cover (%)	Type of soil	Captures	Habitat	Trapping dates
J6	3	34º 52.300'N, 86º 06.265'W	76	Shallow sandy loam	1 *Sorex longirostris*	Mixed forest	1 March-28 July 2014
J7	2	34º 52.31'N, 86º 06.267'W	81	Shallow sandy loam	None	Mixed forest	1 March-28 July 2014
J8	3	34º 52.308'N, 86º 06.261'W	74	Shallow sandy loam	None	Mixed forest	1 March-28 July 2014
K1	4	34º 52.473'N, 86º 06.322'W	88	Sand	None	Deciduous-riparian forest	1 March-28 July 2014
K2	4	34º 52.480'N, 86º 06.335'W	63	Sand	1 *Sorex hoyi* 1 *Cryptotis parva*	Deciduous-riparian forest	1 March-28 July 2014
K3	1	34º 52.480'N, 86º 06.327'W	39	Sand	1 *Cryptotis parva*	Deciduous-riparian forest	1 March-28 July 2014
K4	1	34º 52.481'N, 86º 06.326'W	39	Sand	None	Deciduous-riparian forest	1 March-28 July 2014
L1	2	34º 52.271'N, 86º 06.220'W	80	Fine sandy loam	2 *Sorex longirostris*	Mixed forest	7 April-28 July 2014
L2	3	34º 52.270'N, 86º 06.221'W	86	Fine sandy loam	1 *Sorex longirostris*	Mixed forest	7 April-28 July 2014
L3	3	34º 52.270'N, 86º 06.219'W	87	Fine sandy loam	None	Mixed forest	7 April-28 July 2014

Table

Pitfall	Depth of litter (cm)	Latitude, longitude	Canopy cover (%)	Type of soil	Captures	Habitat	Trapping dates
L4	3	34º 52.269'N, 86º 06.220'W	82	Fine sandy loam	2 *Sorex longirostris*	Mixed forest	7 April-28 July 2014
L5	4	34º 52.271'N, 86º 06.221'W	94	Fine sandy loam	None	Mixed forest	7 April-28 July 2014
L6	4	34º 52.272'N, 86º 06.221'W	87	Fine sandy loam	None	Mixed forest	7 April-28 July 2014
M1	0	34º 50.948'N, 86º 04.501'W	22	Sand	2 *Sorex hoyi*	Deciduous-riparian forest	7 April-28 July 2014
M2	1	34º50.949'N, 86º 04.501'W	92	Sand	None	Deciduous-riparian forest	7 April-28 July 2014
M3	2	34º 52.954'N, 86º 04.493'W	79	Sand	None	Deciduous-riparian forest	7 April-28 July 2014
M4	2	34º 50.957'N, 86º 04.492'W	16	Sand	1 *Blarina brevicauda*	Deciduous-riparian forest	7 April-28 July 2014
Pool	0	34º 18.145'N, 86º 34.430'W	0	Fine sandy loam	4 *Cryptotis parva*	Open field with scattered trees	7 April-28 July 2014

2.—Evaluation of the relationship between habitat and success in capturing shrews (Soricidae) in northern Alabama. Asterisks indicate habitats with significant differences in species of shrews present at an 85% confidence interval.

Habitat	*Blarina brevicauda*	*Blarina carolinensis*	*Cryptotis parva*	*Sorex hoyi*	*Sorex longirostris*	Individuals captured	*P*-value	*z*-value
Deciduous forest	1	0	0	0	0	1	0.916	-1.699

Table 1.—Continued

Deciduous	1	0	0	4	0	5	0.139	1.478	riparian forest*
Mixed	0	0	1	0	1	2	0.478	0.709	forest
Mixed	0	1	0	0	5	6	0.155	1.424	forest with lianas*
Open field	0	0	6	0	0	6	0.396	0.849	with scattered trees

Table 2.—Continued

Habitat	*Blarina brevicauda*	*Blarina carolinensis*	*Cryptotis parva*	*Sorex hoyi*	*Sorex longirostris*	Individuals captured	*P*-value	*z*-value
Pine forest*	0	4	5	0	2	11	0.027	2.212
Riparianmixed forest	0	0	0	1	0	1	1.00	0
Total number of individuals per species	2	5	12	5	8	32		

Table

3.—For each habitat, β-estimates and *P*-values based on probability that partitioning of habitats is occurring and species of shrews based on probability that the species is selecting specific habitats derived from logistical-regression analysis conducted using R (Real et al. 2006). Deciduous forest was the intercept.

Habitat and species	β-estimate	*P*-value
Deciduous forest	-1.460	1.000
Deciduous-riparian forest	2.095	0.139
Mixed forest	1.066	0.478
Mixed forest with lianas	1.07	0.155
Open field with scattered trees	1.177	0.396
Pine forest	3.154	0.027
Riparian-mixed forest	<0.001	1.000
Blarina. brevicauda	-2.487	0.916
Blarina. carolinensis	0.549	0.646
Cryptotis parva	1.83	0.118
Sorex hoyi	0.88	0.454
Sorex longirostris	1.59	0.175

4.—Evaluation of the relationship between lunar illumunation and success in capturing shrews (Soricidae) in northern Alabama.

Zero illumination was the reference phase for calculation of β-values. No relationship was significant.

Table

Lunar illumination (%)	Number of nights	Number of captures	Individuals captured	β-value	±1 *SE*	*P*-value
0-19	42	12	4 *Blarina carolinensis* 3 *Cryptotis parva* 2 *Sorex hoyi* 3 *Sorex longirostris*	-1.022	0.389	0.991
20-39	13	1	1 *Cryptotis parva*	-0.482	0.676	0.475
40-59	15	3	1 *Cryptotis parva* 2 *Sorex longirostris*	-0.824	0.733	0.261
60-79	15	4	2 *Blarina brevicauda* 2 *Sorex longirostris*	-0.008	0.650	0.990
80-100	29	10	5 *Cryptotis parva* 3 *Sorex hoyi* 2 *Sorex longirostris*	0.105	0.571	0.854

5.—Date, weather conditions, lunar illumination, time of moonrise and moonset, time of sunset and sunrise, and duration of lunar illumination on each night at sites where pitfall traps were set for shrews (Soricidae) in northern Alabama

Date	Weather conditions	Lunar illumination (%)	Times of moonrise and moonset (CDT)	Time of sunset and sunrise (CDT)	Duration of lunar illumination (minutes)	Captures

Table 5.—Continued

Date	Weather conditions	Lunar illumination (%)	Times of moonrise and moonset (CDT)	Time of sunset and sunrise (CDT)	Duration of lunar illumination	Captures
13 May 2013	Clear	9	0729-2148	1839-0442	187	None
14 May 2013	Clear	16	0821-2228	1839-0441	229	1 *Blarina carolinensis*
15 May 2013	Clear	23	0914-2305	1840-0440	265	None
16 May 2013	Clear	32	1009-2340	1841-0440	299	None
17 May 2013	Rainy	41	1105-0015	1842-0439	333	None
20 May 2013	Cloudy	71	1202-0014	1844-0437	330	None
21 May 2013	Clear	80	1505-0155	1845-0437	370	None
22 May 2013	Rainy	88	1612-0233	1845-0436	468	2 *Cryptotis parva*
27 May 2013	Clear	94	2131-0709	1849-0434	433	None
28 May 2013	Cloudy	86	2218-0817	1850-0433	358	None
29 May 2013	Cloudy	77	2300-0925	1850-0433	333	1 *Blarina brevicauda*
3 June 2013	Cloudy	25	0119-1432	1853-0432	191	None

Table

					(minutes)	
4 June 2013	Clear	17	0153-1529	1854-0431	158	None
5 June 2013	Clear	10	0229-1625	1854-0431	122	None
6 June 2013	Rainy	5	0308-1625	1855-0431	53	None
11 June 2013	Cloudy	2	0615-2028	1857-0431	91	None
12 June 2013	Clear	6	0708-2106	1857-0431	129	None
13 June 2013	Clear	11	0802-2142	1858-0431	164	None
14 June 2013	Rainy	18	0858-2215	1858-0431	196	None
2 July 2013	Cloudy	30	0031-1420	1901-0436	229	None
3 July 2013	Rainy	21	0109-1515	1901-0436	207	None
4 July 2013	Rainy	14	0149-1607	1901-0437	168	1 *Sorex hoyi*
5 July 2013	Rainy	8	0233-1657	1901-0437	124	1 *Sorex hoyi*
8 July 2013	Cloudy	0	0504-1907	1900-0439	7	None
9 July 2013	Cloudy	1	0558-1944	1900-0439	44	None

Table 5.—Continued

Date	Weather conditions	Lunar illumination (%)	Times of moonrise and moonset (CDT)	Time of sunset and sunrise (CDT)	Duration of lunar illumination (minutes)	Captures
16 July 2013	Cloudy	51	1243-2345	1857-0444	288	None
17 July2013	Clear	62	1347-0031	1856-0444	334	None
18 July 2013	Cloudy	73	1453-0031	1856-0445	334	None
19 July 2013	Clear	83	1557-0124	1855-0446	389	None
22 July 2013	Cloudy	99	1843-0440	1854-0448	586	None
23 July 2013	Rainy	99	1927-0551	1853-0449	622	None
24 July 2013	Cloudy	97	2007-0700	1852-0449	522	None
29 July 2013	Clear	55	2309-1212	1848-0453	344	None
30 July 2013	Clear	45	2349-1308	1848-0454	305	None
31 July 2013	Rainy	36	0043-1402	1847-0454	251	None

Table 5.—Continued

Date	Weather conditions	Lunar illumination (%)	Times of moonrise and moonset (CDT)	Time of sunset and sunrise (CDT)	Duration of lunar illumination (minutes)	Captures
1 August 2013	Rainy	27	0031-1453	1846-0455	264	None
2 August 2013	Clear	19	0118-1541	1845-0456	218	None
5 August 2013	Clear	8	0352-1744	1842-0457	65	None
6 August 2013	Cloudy	1	0447-1820	1841-0459	12	None
7 August 2013	Cloudy	0	0543-1853	1840-0500	13	None
8 August 2013	Rainy	2	0639-1926	1839-0500	53	None
22 February 2014	Snow	55	0010-1050	1734-0622	372	None
24 February 2014	Snow	33	0210-1243	1736-0619	249	None
6 April 2014	Clear	40	1033-0046	1809-0523	397	None

Table 5.—Continued

Date	Weather conditions	Lunar illumination (%)	Times of moonrise and moonset (CDT)	Time of sunset and sunrise (CDT)	Duration of lunar illumination (minutes)	Captures
7 April 2014	Rainy	49	1125-0041	1810-0522	391	1 *Sorex longirostris* 1 *Cryptotis parva*
8 April 2014	Cloudy	59	1218-0120	1811-0520	369	1 *Sorex longirostris*
14 April 2014	Clear	99	1754-0444	1815-0512	629	None
28 April 2014	Cloudy	1	0433-1805	1827-0456	23	None
29 April 2014	Rainy	0	0513-1906	1827-0455	39	None
30 April 2014	Cloudy	1	0557-2004	1828-0454	96	1 *Sorex longirostris*
1 May 2014	Clear	4	0643-2059	1829-0453	150	None

Table 5.—Continued

			Lunar			
5 May 2014	Clear	33	1008-2354	1832-0449	322	None
6 May 2014	Clear	42	1101-0048	1833-0448	375	None
7 May 2014	Clear	51	1155-0030	1834-0447	356	None
8 May 2014	Clear	61	1249-0103	1835-0446	388	None
9 May 2014	Rainy	70	1345-0135	1835-0445	420	None
10 May 2014	Rainy	78	1441-0207	1836-0444	452	None
12 May 2014	Cloudy	92	1640-0316	1838-0443	518	None

Table 5.—Continued

Date	Weather conditions	Lunar illumination (%)	Times of moonrise and moonset (CDT)	Time of sunset and sunrise (CDT)	Duration of lunar illumination (minutes)	Captures
13 May 2014	Cloudy	97	1742-0355	1838-0442	557	None
14 May 2014	Rainy	100	1845-0438	1839-0441	593	None
15 May 2014	Rainy	100	1947-0527	1840-0441	534	None
16 May 2014	Cloudy	97	2047-0622	1841-0440	473	None
17 May 2014	Rainy	92	2143-0722	1842-0439	416	None
18 May 2014	Rainy	85	2234-0825	1842-0438	364	1 *Sorex hoyi* 1 *Cryptotis parva* 1 *Sorex longirostris*
19 May 2014	Rainy	75	2319-0931	1843-0438	317	None
20 May 2014	Clear	65	0025-1037	1844-0437	252	None
21 May 2014	Clear	53	0001-1143	1845-0437	276	None
25 May 2014	Rainy	13	0231-1555	1847-0435	124	1 *Sorex*

Table 5.—Continued

Date	Weather conditions	Lunar illumination (%)	Times of moonrise and moonset (CDT)	Time of sunset and sunrise (CDT)	Duration of lunar illumination (minutes)	Captures
						longirostris
26 May 2014	Clear	7	0310-1655	1848-0434	84	None
27 May 2014	Rainy	3	0352-1754	1849-0434	42	1 *Blarina carolinensis* 1 *Sorex longirostris*
28 May 2014	Cloudy	1	0436-1849	1849-0433	0	None
29 May 2014	Cloudy	0	0524-1941	1850-0433	51	None
1 June 2014	Rainy	12	0759-2152	1852-0432	180	1 *Blarina carolinensis*
2 June 2014	Cloudy	18	0852-2229	1853-0432	216	None
8 June 2014	Rainy	73	1423-0112	1856-0431	376	1 *Blarina brevicauda* 2 *Sorex longirostris*

Table 5.—Continued

Date	Weather conditions	Lunar illumination (%)	Times of moonrise and moonset (CDT)	Time of sunset and sunrise (CDT)	Duration of lunar illumination (minutes)	Captures
9 June 2014	Rainy	82	1524-0149	1856-0431	413	None
10 June 2014	Rainy	89	1626-0229	1857-0431	452	None
11 June 2014	Rainy	95	1730-0315	1857-0431	497	None
12 June 2014	Rainy	99	1832-0407	1858-0431	549	1 *Sorex hoyi* 2 *Cryptotis parva*
13 June 2014	Rainy	100	1932-0506	1858-0431	539	None
14 June 2014	Clear	98	2026-0610	1858-0431	485	None

Table 5.—Continued

2014						
15 June 2014	Clear	94	2116-0717	1859-0431	435	None
16 June 2014	Clear	87	2200-0826	1859-0431	331	None
17 June 2014	Clear	78	2241-0933	1859-0431	350	None
18 June 2014	Clear	67	2319-1040	1900-0431	312	None
19 June	Clear	56	2356-1144	1900-0431	265	None

Table 5.—Continued

Date	Weather conditions	Lunar illumination (%)	Times of moonrise and moonset (CDT)	Time of sunset and sunrise (CDT)	Duration of lunar illumination (minutes)	Captures
20 June 2014	Clear	45	0015-1247	1900-0431	256	None
21 June 2014	Clear	34	0033-1348	1900-0432	239	None
22 June 2014	Clear	24	0111-1449	1901-0432	201	None
23 June 2014	Cloudy	16	0151-1547	1901-0432	161	1 *Blarina carolinensis*

Table 5.—Continued

Date	Weather conditions	Lunar illumination (%)	Times of moonrise and moonset (CDT)	Time of sunset and sunrise (CDT)	Duration of lunar illumination (minutes)	Captures
2014						
24 June 2014	Rainy	9	0234-1643	1901-0433	119	None
25 June 2014	Rainy	4	0319-1736	1901-0433	74	1 *Sorex longirostris* 2 *Cryptotis parva*
26 June 2014	Rainy	1	0408-1825	1901-0433	25	None
27 June	Cloudy	0	0459-1910	1901-0434	9	None
28 June 2014	Rainy	1	0551-1951	1901-0434	50	None
29 June	Cloudy	4	0645-2029	1901-0434	78	None

5.—Continued

2014						
30 June 2014	Cloudy	8	0738-2103	1901-0435	122	1 *Cryptotis parva*
6 July 2014	Clear	58	1308-2324	1900-0438	264	None
2014						
7 July 2014	Clear	68	1408-0023	1900-0438	323	None
8 July 2014	Cloudy	77	1510-0105	1900-0439	365	None

Table 5.—Continued

Date	Weather conditions	Lunar illumination (%)	Times of moonrise and moonset (CDT)	Time of sunset and sunrise (CDT)	Duration of lunar illumination (minutes)	Captures
9 July 2014	Rainy	86	1613-0153	1900-0439	413	None
10 July 2014	Cloudy	93	1714-0248	1859-0440	469	None
14 July	Clear	95	2037-0716	1858-0442	485	1 *Sorex hoyi*
15 July 2014	Rainy	89	2118-0825	1857-0443	445	None
16 July 2014	Clear	80	2157-0933	1857-0444	407	None
17 July 2014	Clear	70	2234-1038	1857-0444	370	None
21 July 2014	Rainy	28	0034-1438	1854-0447	254	None
22 July 2014	Rainy	20	0118-1532	1854-0448	210	1 *Cryptotis parva*

5.—Continued

23 July 2014	Clear	12	0205-1622	1853-0448	163	None
24 July 2014	Cloudy	7	0347-1751	1852-0451	64	None
27 July 2014	Clear	0	0533-1905	1850-0451	15	None
28 July 2014	Rainy	2	0626-1938	1849-0452	49	None

Table 6.—Evaluation of the relationship between overnight weather conditions and success in capturing shrews (Soricidae) in northern Alabama.

Overnight weather	Number of nights	Number of captures	β-estimate	*P*-value	*z*-value
Clear	36	2	-2.970	0.999	-4.10
Cloudy	31	3	0.668	0.480	0.707
Rainy	38	24	2.431	0.002	3.042
Snowing	3	0	-13.600	0.992	-0.010

Appendix 1.—Taxonomic key to shrews (Mammalia: Soricomorpha: Soricidae) in Alabama (modified from Hall 1981).

1. Three unicuspid teeth on each side of upper jaw, brown on dorsal side of body,

   paler on venter, tail indistinctly bicolored……..………...*Sorex hoyi*

2. Four unicuspid teeth on each side of upper jaw, total length

   69-135 mm; length of tail 19-52% of length of body, pelage

   brown or black……….……………………………………………*Cryptotis parva*

3. Five unicuspid teeth on each side of upper jaw

   Tail <40% of length of head and body…………………………………...…… 4

   Tail >40% of length of head and body………………………………………..5

4. Color grayish-black, sometimes with silvery or brownish cast.

   Total length ≥110 mm and occipito-premaxillary length

   >20.5 mm……………………………………………………..*Blarina brevicauda*

   Total length <110 mm and cranial breadth <11 mm…………*Blarina carolinensis*

Appendix 1.—Continued

5. Length of tail >40% of length of head and body

Distinctly bicolored tail, length of tail 45-52 mm…………………..*Sorex fumeus*

Length of tail length ≤40 mm, reddish brown or brownish dorsal hair, and paler on the venter……………………………..*Sorex longirostris*

Appendix 2.—Habitat, type of soil, depth of litter, and canopy cover at sites where pitfall traps were set for shrews (Soricidae) in northern Alabama for all habitats sampled in 2013 and 2014. Small pitfall traps (0.4 liters) were used in the 2013 and large pitfall traps (3.7 liters) were used in 2014.

Habitat	Type of soil	Depth of litter (mean; range cm)	Canopy cover (mean; range %)
Deciduous forest	Fine sandy loam	2 (0-8)	94 (90-97)
Deciduous riparian forest	Sand	2 (0-4)	89 (54-96)
Mixed forest with lianas	Fine sandy loam	1 (0-4)	60 (43-97)
Mixed forest	Shallow sandy loam	1 (0-4)	98 (95-100)
Open-grass field	Fine sandy loam	1 (0-2)	23 (3-44)
Pine forest	Stony fine sandy loam	2 (1-4)	84 (75-93)

Riparian mixed forest			
	Sand	1 (1-2)	91 (83-97)